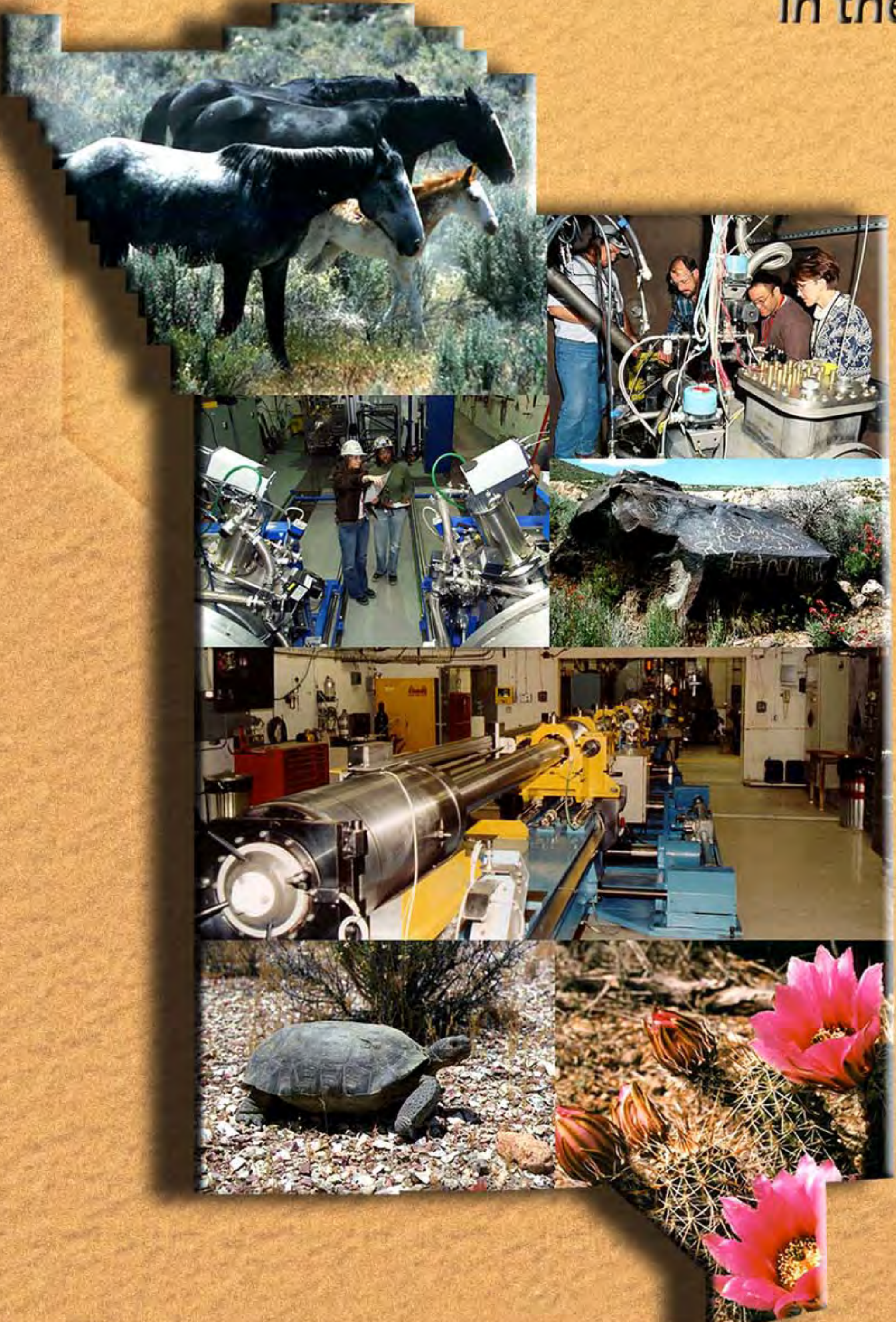
DOE/EIS-0426D

Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada

Summary



U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

AVAILABILITY OF THE DRAFT SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF THE DEPARTMENT OF ENERGY/ NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA NATIONAL SECURITY SITE AND OFF-SITE LOCATIONS IN THE STATE OF NEVADA (NNSS SWEIS)

For further information on this draft SWEIS, or to request a copy of the SWEIS or references, please contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518
Telephone: 702-295-0077
Fax: 702-295-5300
E-mail: nepa@nv.doe.gov

Printed with soy ink on recycled paper

COVER SHEET

Responsible Agency: U.S. Department of Energy/National Nuclear Security Administration

Cooperating Agencies: U.S. Air Force
U.S. Department of the Interior, Bureau of Land Management
Nye County, NV

Title: *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE/EIS-0426D)

Location: Nye and Clark Counties, Nevada

For additional information or for copies of this draft site-wide environmental impact statement (SWEIS), contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518

Telephone: 702-295-0077
Facsimile: 702-295-5300
E-mail: nepa@nv.doe.gov

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Telephone: 202-586-4600, or leave a message at 1-800-472-2756
Facsimile: 202-586-7031
E-mail: askNEPA@hq.doe.gov

Abstract: This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes the potential environmental impacts of proposed alternatives for continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA)-managed sites in Nevada, including the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration areas on the U.S. Air Force Nevada Test and Training Range. The purpose and need for agency action is to provide support for meeting NNSA's core missions established by Congress and the President, and to satisfy the requirements of Executive orders and comply with congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since the October 1992 moratorium on nuclear testing, NNSA's primary mission at the NNSS has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests, if so directed by the President. Resources have been reallocated to introduce and expand other mission activities/programs at the NNSS, RSL, NLVF, and the TTR to support three DOE/NNSA core missions: National Security/Defense, Environmental Management, and Nondefense. The National Security/Defense Mission includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation and Counterterrorism, and Work for Others

Programs. The Work for Others Program supports other DOE programs and Federal agencies such as the U.S. Department of Defense, U.S. Department of Justice, and U.S. Department of Homeland Security. The Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. The Nondefense Mission includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The NNSS, RSL, NLVF, and the TTR support DOE/NNSA's core missions by providing the capabilities to process and dispose of a damaged nuclear weapon or improvised nuclear device and to conduct high-hazard experiments involving special nuclear material and high explosives, non-nuclear experiments, and hydrodynamic testing. Nuclear stockpile stewardship activities at the NNSS include dynamic plutonium experiments that provide technical information to maintain the safety and reliability of the U.S. nuclear weapons stockpile and research and training in areas such as nuclear safeguards, criticality safety, and emergency response. Special Nuclear Materials are also stored at the NNSS. In addition, in accordance with the amended Record of Decision (ROD) (DOE/EIS-0243) for the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS*) , NNSA receives low-level and mixed low-level radioactive waste for disposal at the NNSS.

This *NNSS SWEIS* analyzes the environmental impacts of three reasonable alternatives for continued operations at the NNSS, RSL, NLVF, and the TTR during the 10-year period following the issuance of a ROD. These alternatives include a No Action Alternative and two action alternatives: Expanded Operations and Reduced Operations. The No Action Alternative, which is analyzed as a baseline for evaluating the two action alternatives, would continue implementation of the *1996 NTS EIS* ROD (DOE/EIS-0243) and subsequent amendments (61 FR 65551and 65 FR 10061), as well as other decisions supported by separate NEPA analyses completed since issuance of the final *1996 NTS EIS*. The No Action Alternative reflects activity levels consistent with those seen since 1996. The Expanded Operations Alternative would consider adding reasonably foreseeable new work at the NNSS in the areas of nonproliferation and counterterrorism, high-hazard and other experiments, research and development and testing. Such expanded operations could include developing test beds for concept testing of sensors, mitigation strategies, and weapons effectiveness. The Reduced Operations Alternative would reduce the overall level of operations and close specific buildings and structures. NNSA would also consider allowing the development of solar power generation facilities under each alternative.

Public Comments: DOE issued a Notice of Intent (NOI) in the *Federal Register* (74 FR 36691) on July 24, 2009, to solicit public input on the preparation of this Draft SWEIS. Comments received from the public during the scoping period (July 24, 2009 to October 16, 2009) have been considered in the preparation of this Draft SWEIS. Comments received after the close of the comment period also have been considered. Comments on this Draft SWEIS will be accepted following publication of the U.S. Environmental Protection Agency's Notice of Availability (NOA) in the *Federal Register* for a period of 90 days, and will be considered in the preparation of the Final SWEIS. Any comments received after the comment period will be considered to the extent practicable. Public meetings and locations will be identified at a later date.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

CFR	*Code of Federal Regulations*
CGTO	Consolidated Group of Tribes and Organizations
DOE	U.S. Department of Energy
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
NEPA	National Environmental Policy Act
NLVF	North Las Vegas Facility
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NTS	Nevada Test Site
NSO	Nevada Site Office
PEIS	programmatic environmental impact statement
rem	roentgen equivalent man
ROD	Record of Decision
RSL	Remote Sensing Laboratory
SWEIS	site-wide environmental impact statement
TNT	2,4,6-trinitrotoluene
TTR	Tonopah Test Range
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
WM	Waste Management

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.315	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

SUMMARY

S.1 Introduction and Purpose and Need

S.1.1 Introduction

The U.S. Department of Energy's (DOE's) "National Environmental Policy Act Implementing Procedures" (10 *Code of Federal Regulations* [CFR] 1021.330(c)) require preparation of a site-wide environmental impact statement (SWEIS), a broad-scope document that identifies and assesses the potential individual and cumulative impacts of ongoing and reasonably foreseeable future actions for certain large multiple-facility DOE sites, such as the Nevada National Security Site (NNSS) (formerly the Nevada Test Site). An evaluation of an existing SWEIS is required every 5 years. DOE determines whether an existing SWEIS remains adequate or whether a new SWEIS or supplement to the existing SWEIS is needed.

In 1996, DOE issued the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996) and an associated Record of Decision (ROD) (61 *Federal Register* [FR] 65551). In the ROD, DOE selected the Expanded Use Alternative for most activities, but decided to manage low-level radioactive waste and mixed low-level radioactive waste at levels described under the No Action Alternative, pending decisions resulting from the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS)* (DOE 1997). In the February 2000 *WM PEIS* ROD (65 FR 10061), DOE announced that the NNSS would be one of two regional sites to be used for disposal of low-level radioactive waste and mixed low-level radioactive waste. At the same time, DOE amended the *1996 NTS EIS* ROD to select the Expanded Use Alternative for waste management activities at the NNSS.

Subsequently, as required by DOE regulations (10 CFR 1021.330(d)), the National Nuclear Security Administration (NNSA), a separately organized semiautonomous agency within DOE, conducted the first 5-year review of the *1996 NTS EIS*, as documented in the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002). Based on this review, NNSA concluded there were no substantial changes to the actions proposed in the *1996 NTS EIS* and no significant new circumstances or information relevant to environmental concerns. Thus, NNSA determined that no further National Environmental Policy Act (NEPA) documentation was required.

In 2007, NNSA initiated its second 5-year review of the *1996 NTS EIS* and, in April 2008, issued the *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2008b). Based on consideration of comments received on the draft supplement analysis, potential changes to the NNSS program work scope, and changes to the environmental baseline, NNSA decided to prepare this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* (DOE/EIS-0426D). NNSA has prepared this *NNSS SWEIS* in compliance with Council on Environmental Quality regulations that implement NEPA (40 CFR Parts 1500–1508) and DOE NEPA implementing procedures (10 CFR Part 1021).

The U.S. Air Force, U.S. Bureau of Land Management, and Nye County, Nevada, are cooperating agencies in the preparation of this *NNSS SWEIS*. In addition, the Consolidated Group of Tribes and Organizations, which includes representatives from 17 tribes and organizations, participated in the preparation of the SWEIS; their assessments and recommendations appear in text boxes in this Summary and throughout the SWEIS.

Consolidated Group of Tribes and Organizations

Southern Paiute
- Kaibab Paiute Tribe, Arizona
- Paiute Indian Tribes of Utah
- Moapa Band of Paiutes, Nevada
- Las Vegas Paiute Tribe, Nevada
- Pahrump Paiute Tribe, Nevada
- Chemehuevi Paiute Tribe, California
- Colorado River Indian Tribes, Arizona

Western Shoshone
- Duckwater Shoshone Tribe, Nevada
- Ely Shoshone Tribe, Nevada
- Yomba Shoshone Tribe, Nevada
- Timbisha Shoshone Tribe, California

Owens Valley Paiute and Shoshone
- Benton Paiute Tribe, California
- Bishop Paiute Tribe, California
- Big Pine Paiute Tribe, California
- Lone Pine Paiute Tribe, California
- Fort Independence Paiute Tribe, California

Other Official Native American Organizations
- Las Vegas Indian Center, Nevada

S.1.2 Purpose and Need for Agency Action

The purpose and need for agency action is to support NNSA's core missions established by the Congress and the President. NNSA, through its Nevada Site Office (NNSA/NSO), needs to meet its obligations to ensure a safe and reliable nuclear weapons stockpile, support other national security programs, characterize and remediate areas of the NNSS and offsite locations previously contaminated as a result of the Nation's nuclear weapons testing program, and provide for the disposal of low-level and mixed low-level radioactive waste from across the DOE complex.

NNSA also must meet the mandates of Executive Orders 13212, *Actions to Expedite Energy-Related Projects*, and 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, as well as the *Energy Independence and Security Act of 2007* (Public Law 109-58). Accordingly, NNSA's purpose and need is also to satisfy the requirements of these Executive Orders and comply with Congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

Summary—American Indian Perspective

Since the beginning of time, the area encompassing the Nevada National Security Site (NNSS) and the offsite locations has been essential to the lives of American Indian tribes. These lands contain traditional gathering, ceremonial, and recreational areas for the American Indian people. They contain ecological resources and power places that are crucial for the continuation of American Indian culture, religion, and society.

The Consolidated Group of Tribes and Organizations (CGTO) knows American Indian people are charged by the Creator to interact with the environment and its resources in culturally appropriate ways to maintain balance, regardless of the U.S. Department of Energy's stated purpose and need for agency action. American Indians further believe these lands and their resources contain life-sustaining characteristics that must be properly respected and cared for to ensure harmony. The CGTO does not support harmful land-disturbing activities currently conducted and proposed within the NNSS area and offsite locations.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since October 1992, there has been a moratorium on underground nuclear testing. Thus, NNSA has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests if so directed by the President. NNSA's primary mission at the NNSS is to support nuclear stockpile reliability through subcritical experiments. The limitation on conducting underground nuclear weapons testing also has resulted in resource reallocation and the introduction and expansion of other (nonprimary) mission activities/programs at the NNSS and offsite locations in Nevada. In addition, the NNSS supports DOE waste management activities, including disposal; environmental restoration activities; and research, development, and testing programs related to national security. The NNSS also provides opportunities for various environmental research projects, and the development of commercial-scale solar energy projects, as well as innovative solar and other renewable energy technologies.

S.2 Alternatives

S.2.1 Background

This *NNSS SWEIS* analyzes potential environmental impacts of continued management and operation of the NNSS and other DOE/NNSA-managed sites in Nevada – the Remote Sensing Laboratory (RSL), North Las Vegas Facility (NLVF), and Tonopah Test Range (TTR) (see **Figure S–1**). This *NNSS SWEIS* also analyzes impacts of other DOE programs and those of other Federal agencies, such as the U.S. Department of Defense and U.S. Department of Homeland Security, that occur or are proposed to occur on these NNSA-managed sites.

The NNSS occupies approximately 1,360 square miles of desert and mountain terrain in southern Nevada. About 6,500 square miles of the U.S. Air Force's Nevada Test and Training Range and the Desert National Wildlife Refuge surround the NNSS on the northern, western, and eastern sides. The NNSS is a multi-disciplinary, multi-purpose facility primarily engaged in work that supports national security, homeland security initiatives, waste management, environmental restoration, and defense and nondefense research and development programs for DOE, NNSA, and other government entities.

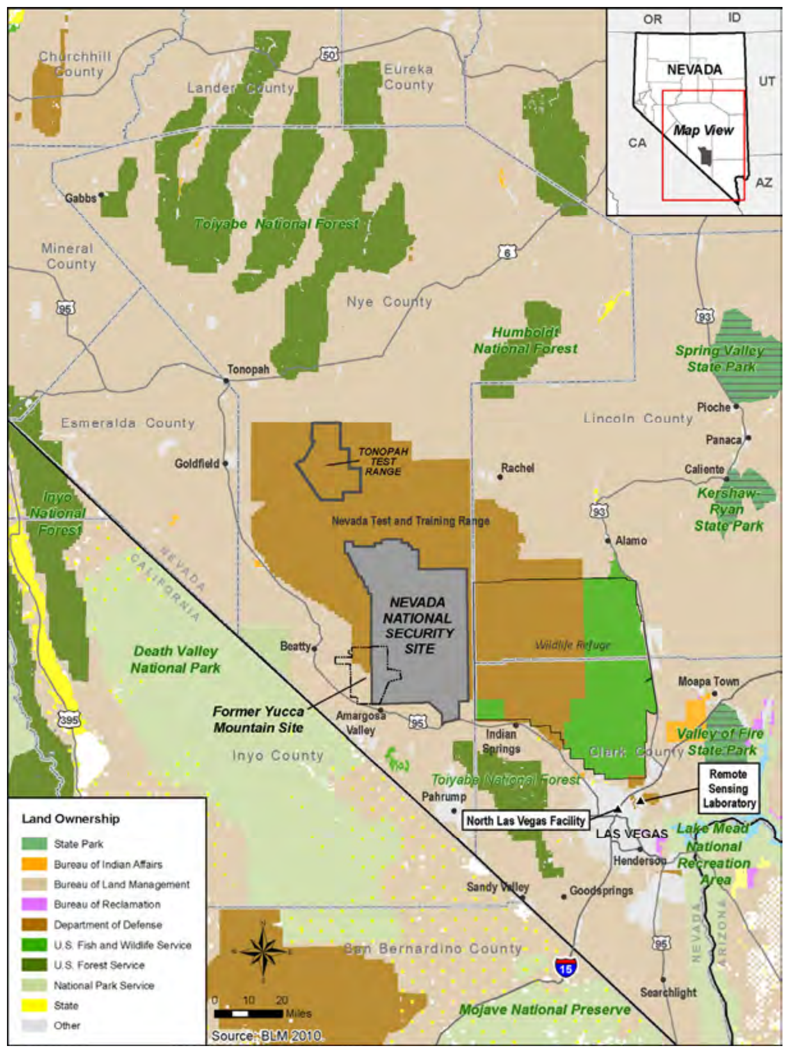


Figure S–1 Location of Nevada National Security Site and Offsite Locations in the State of Nevada

RSL is located on 35 acres at Nellis Air Force Base in North Las Vegas, approximately 59 miles southeast of the nearest NNSS boundary. RSL is adjacent to the Nellis Air Force Base runway and has seven buildings. Radiological emergency response, the Aerial Measuring System, radiological sensor development and testing, Secure Systems Technologies, nuclear nonproliferation capabilities, and information and communication technologies are supported at RSL.

NLVF, located on 78 acres approximately 55 miles southeast of the nearest NNSS boundary in Las Vegas, comprises 29 buildings that support ongoing NNSS missions. The facility includes office buildings, a high bay, machine shop, laboratories, experimental facilities, and various other mission-support facilities. Among the NLVF buildings is the Nevada Support Facility, the location of most of the NNSA/NSO personnel offices.

The TTR, located approximately 12 miles north of the nearest NNSS boundary, is a U.S. Air Force facility. It consists of a 280-square-mile area north of the NNSS on the Nevada Test and Training Range. NNSA operations at the TTR are conducted pursuant to a land use permit from the U.S. Air Force under the direction of Sandia National Laboratories and the NNSA Sandia Site Office (other NNSA sites in Nevada are under the direction of NNSA/NSO). NNSA operations at the TTR include flight-testing of gravity weapons (bombs) and research, development, and evaluation of nuclear weapons components and delivery systems.

In this *NNSS SWEIS*, NNSA analyzes the potential environmental impacts of three alternatives: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. Each alternative comprises current and reasonably foreseeable missions, programs, capabilities, and projects at the NNSS and the three offsite locations during a 10-year period. Alternative descriptions are organized under three missions, each with two or more associated programs.

Terminology Used in this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*

Missions. This term refers to the major responsibilities assigned to the U.S. Department of Energy (DOE) and the National Nuclear Security Administration (NNSA) and comprises the National Security/Defense Mission, Environmental Management Mission, and Nondefense Mission.

Programs. DOE and NNSA are organized into program offices, each of which has primary responsibilities within the set of missions. Funding and direction for activities at DOE facilities are provided through these program offices, and similarly coordinated sets of activities to meet program office responsibilities are often referred to as "programs." Programs are usually long-term efforts with broad goals or requirements.

Capabilities. This term refers to the combination of facilities, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and to implement mission assignments. Capabilities at the Nevada National Security Site and offsite locations have been established over time, principally through mission assignments and activities directed by program offices.

Projects. This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to major (such as a project to construct and start up a new nuclear facility).

Activities. In this site-wide environmental impact statement, activities are those physical actions used to implement missions, programs, capabilities, or projects.

The NNSA missions and associated programs in Nevada are (1) the National Security/Defense Mission, which includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs; (2) the Environmental Management Mission, which includes the Waste Management and Environmental Restoration Programs; and (3) the Nondefense Mission, which includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs. Mission-related capabilities, projects, and activities are identified for each of the alternatives. The three alternatives include similar types of capabilities, projects, and activities, but differ primarily in their levels of operations and facility requirements. The No Action Alternative reflects the use of existing facilities and ongoing projects to maintain operations at levels consistent with those experienced since 1996. The Expanded Operations Alternative differs from the No Action Alternative in that the levels of operations would be enhanced or accelerated, and new facilities would be constructed to support increased levels of operations. In addition, under the Expanded Operations Alternative, NNSA would modify (resize) land use zones at the NNSS to better reflect the kinds of activities that would be undertaken in those zones. Under the Reduced Operations Alternative, NNSA would conduct some activities at a level similar to that of the No Action Alternative, but for other activities, the levels of operations would be reduced or would cease altogether. NNSA also would modify land use zones on the NNSS, and limit most activities in the northwestern portion of the NNSS.

Levels of Operations – An Example

In the 1996 Record of Decision, the U.S. Department of Energy (DOE) selected the Expanded Use Alternative. In this alternative, DOE proposed to undertake as many as 110 annual experiments to improve its knowledge of the properties of plutonium, and assess the performance and safety of nuclear weapons. Since then, however, only about 10 such experiments have occurred annually.

The historic levels of operations form the underlying basis for the No Action Alternative in this site-wide environmental impact statement.

Sections S.2.2 through S.2.4 describe the three alternatives in greater detail. **Table S–1** (at the end of Section S.2.4) summarizes the mission-based programmatic similarities and differences among the three alternatives.

S.2.2 No Action Alternative

The No Action Alternative reflects the use of existing facilities and ongoing projects to maintain the levels of operations (activities) consistent with those experienced in recent years at the NNSS and offsite locations. For each of the three mission areas and their supporting programs, the levels of operations for associated capabilities, projects, and activities were determined by analyzing operational levels realized since 1996.

Under the No Action Alternative, Stockpile Stewardship and Management Program activities would continue at NNSA facilities in Nevada under the conditions of the ongoing nuclear testing moratorium. These activities would include science-based stockpile stewardship tests, experiments, and projects to maintain the safety and reliability of the Nation's nuclear weapons stockpile

Description of Alternatives—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) recommends that the U.S. Department of Energy and the CGTO develop co-management strategies to avert or minimize further impacts before continuing with current or proposed activities. Strategies include:

- Identify those areas that have been disrespected and culturally damaged, so that balance can once again be restored.
- Avoid further harmful ground-disturbing activities.
- Make mitigation of restorable areas a top priority.
- Avert or minimize damage to geological formations important to the cultural and ecological landscape, songscapes, and storyscapes.
- Implement collaborative environmental restoration techniques that require minimal ground-disturbing activities.
- Continue to pursue systematic consultations with American Indians so potentially impacted resources can be readily identified, alternative solutions discussed, and adverse impacts averted.
- Provide American Indian people increased access to culturally significant areas so we can use our knowledge, prayers, and traditions to effectively restore balance to the natural and spiritual harmony of the Nevada National Security Site area and offsite locations.

without underground nuclear testing. By Presidential Decision Directive 15, DOE/NNSA must be able to resume underground nuclear weapons tests within 24 to 36 months if so directed by the President.

In support of the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs, under the No Action Alternative, NNSA would continue to (1) provide support to the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program; (2) undertake Aerial Measuring System activities; (3) provide emergency responder training for emergencies involving weapons of mass destruction; (4) disposition improvised nuclear devices; (5) support NNSA's Emergency Communications Network; and (6) integrate existing activities and facilities to support national efforts to control the spread of weapons of mass destruction.

Under the No Action Alternative, the Work for Others Program hosted by NNSA would entail the shared use of certain facilities, such as the Big Explosives Experimental Facility, Nonproliferation Test and Evaluation Complex, and the T-1 Training Area, by other agencies such as the U.S. Department of Defense, as well as the shared use of resources at the NNSS, RSL, NLVF, and the TTR. NNSA also would continue to host projects of other Federal agencies, such as the U.S. Departments of Defense and Homeland Security, as well as state and local government agencies and nongovernmental organizations.

As part of the Environmental Management Mission, Waste Management Program, the NNSS would continue accepting and disposing wastes, such as low-level radioactive waste and mixed low-level radioactive waste. The Environmental Restoration Program would continue to ensure compliance with the Federal Facility Agreement and Consent Order to characterize, monitor, and, if necessary, remediate contaminated areas, facilities, soils, and groundwater that have sustained adverse environmental impacts (NDEP 1996).

Federal Facility Agreement and Consent Order

The Nevada National Security Site Environmental Restoration Program includes activities to comply with the Federal Facility Agreement and Consent Order, which was entered into in 1996 by the U.S. Department of Energy, the U.S. Department of Defense, and the State of Nevada. The Federal Facility Agreement and Consent Order provides a process for identifying sites having potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.

Under the No Action Alternative, the Nondefense Mission would include those activities that are necessary to support mission-related programs, such as construction and maintenance of facilities, provision of supplies and services, and warehousing. Activities related to supply and conservation of energy, including renewable energy and other research and development projects, would also continue to be conducted under the Nondefense Mission. For example, NNSA would continue to identify and implement energy conservation measures and renewable energy projects related to energy efficiency, renewable energy, water, and transportation/fleet management. NNSA would also support development of a 240-megawatt commercial solar power generation facility and an associated transmission line in the southwest corner of the NNSS. If a commercial solar power generation facility were proposed at the NNSS, additional project-specific NEPA analysis would be required.

At the NNSS, the missions, programs, capabilities, and projects under the No Action Alternative would be undertaken in one or more of seven land use zones. The land use zones, which are used to manage activities at the NNSS and prevent interference among the various projects and activities, are not considered absolute descriptors of the range of activities that may occur in a particular zone. In addition, the NNSS is divided into numbered operational areas to facilitate management; communications; and distribution, use, and control of resources. **Figure S–2** provides the location and size of these zones and operational areas, and the locations of major facilities within these zones and areas.

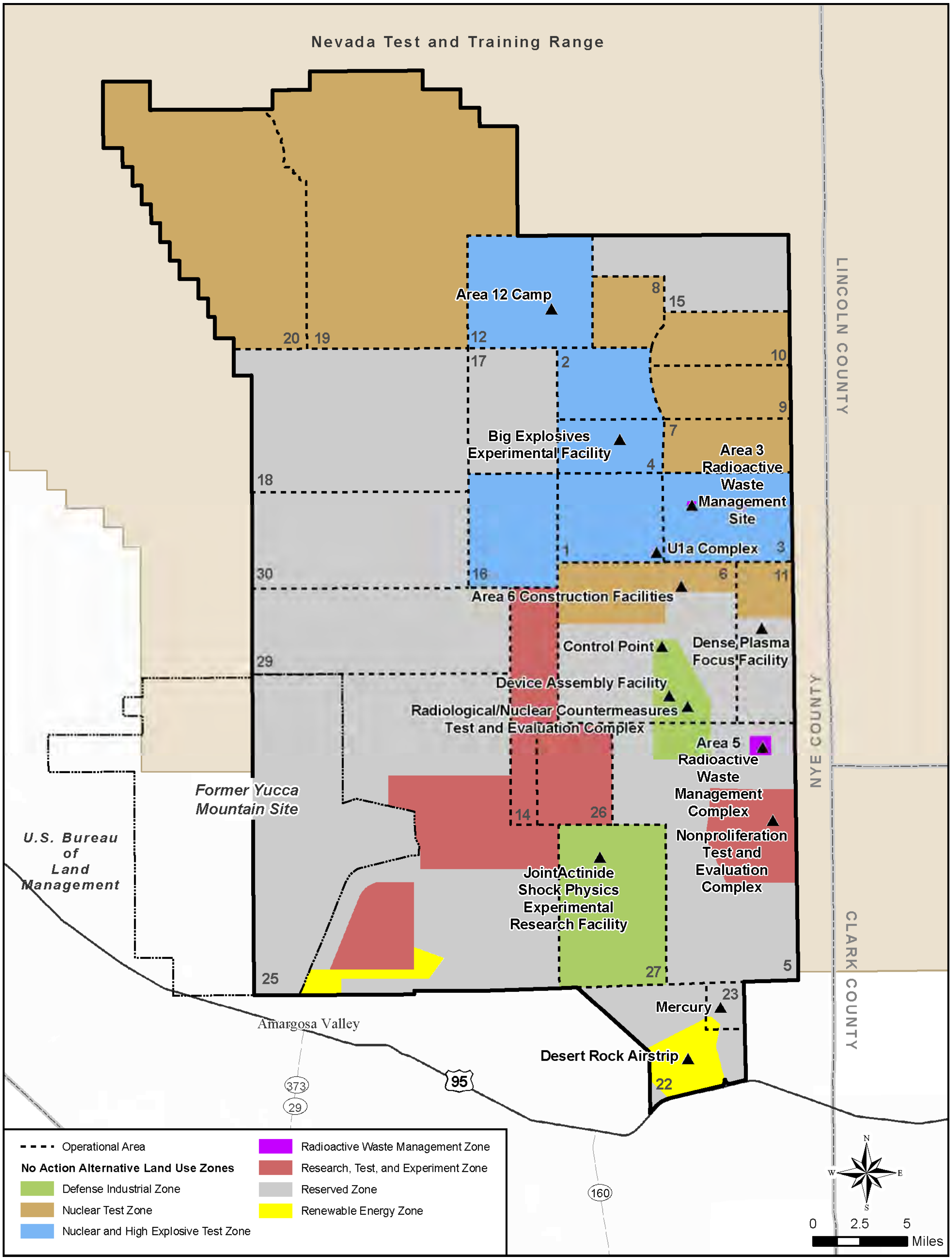


Figure S–2 No Action Alternative Land Use Zones

S.2.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the levels of operations, capabilities, and projects described under the No Action Alternative, as well as additional proposed capabilities and projects. These additional capabilities and projects include modification and/or expansion of existing facilities and construction of new facilities. In addition, some ongoing activities would be conducted more frequently than under the No Action Alternative.

To illustrate, under the Expanded Operations Alternative, the annual number of stockpile stewardship tests and experiments and the yearly number of nuclear weapons that would be dispositioned would increase relative to the No Action Alternative. NNSA would construct new facilities to support enhanced training for the Office of Secure Transportation, to enhance efforts to control the spread of weapons of mass destruction, and to advance counterterrorism training, research, and development. Although the pace of environmental restoration activities would remain unchanged from that under the No Action Alternative, NNSA would accelerate the pace and amount of low-level radioactive waste that would be disposed on the NNSS.

Under the Expanded Operations Alternative, there would be two changes in NNSS land use zones: (1) the designated use for Area 15 would be changed from “Reserved” to “Research, Test, and Experiment,” and (2) approximately 36,900 acres within Area 25 would be designated as a Renewable Energy Zone (an expansion of the 4,100-acre area under the No Action Alternative). In the Renewable Energy Zone, NNSA would support development of several commercial solar power generation facilities with a maximum combined generating capacity of 1,000 megawatts in Area 25. Elsewhere, NNSA would construct a 5-megawatt photovoltaic solar power generation facility (in Area 6), and a geothermal energy demonstration project and research center (location to be determined). The location and size of the land use zones and operational areas, and the locations of major facilities within these zones and areas are shown in **Figure S–3**.

S.2.4 Reduced Operations Alternative

The Reduced Operations Alternative includes all of the types of activities conducted at the NNSS and offsite locations since 1996. The activity level under the Reduced Operations Alternative would vary across programs, but for many programs, the levels of operations would be reduced. Furthermore, under the Reduced Operations Alternative, activities would cease in the northwestern portion of the NNSS (Areas 18, 19, 20, 29, and 30), with the exception of environmental restoration and monitoring, site security operations, military training and exercises, and maintenance of Well 8 and critical communications and electrical transmission systems. Maintenance of roads on Pahute Mesa, Stockade Wash, and Buckboard Mesa would also be terminated, and operation of the Pahute Mesa Airstrip would be limited to those operations necessary to provide access for activities that would continue in these areas. The electrical transmission and distribution system beyond the Echo Peak Substation in Areas 19 and 20 also would be de-energized.

Preferred Alternative

Council on Environmental Quality regulations require an agency to identify its preferred alternative or alternatives, if one or more exists, in the draft environmental impact statement. At this time, the National Nuclear Security Administration (NNSA) has not selected a preferred alternative. NNSA will evaluate the information presented in the *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*, the comments received on this *NNSS SWEIS*, and other factors before selecting a preferred alternative, which will be identified in the *Final NNSS SWEIS*. NNSA may identify an alternative in its entirety, or may identify a “hybrid” preferred alternative comprising various capabilities, projects, and activities selected from among the three alternatives.

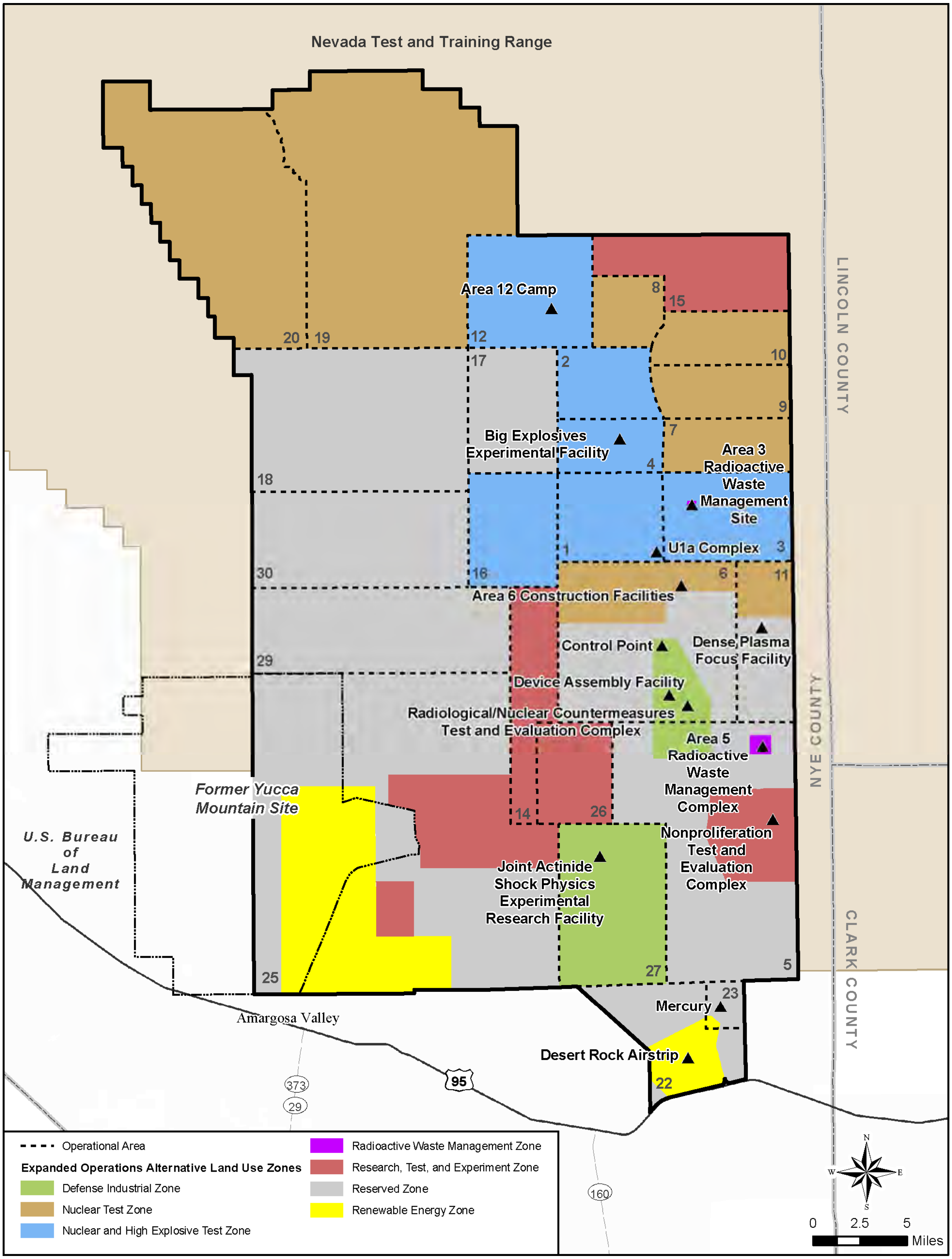


Figure S–3 Expanded Operations Alternative Land Use Zones

The pace of environmental restoration activities and most waste generation and disposal rates would remain unchanged from those of the No Action Alternative. However, the amount of transuranic waste generated, and the amount of sanitary waste generated and disposed of on site would be reduced.

Under the Reduced Operations Alternative, activities related to supply and conservation of energy, including renewable energy and other research and development projects, would continue to be conducted. For example, NNSA would support development of a 100-megawatt commercial solar power generation facility in Area 25.

At the NNSS, the Area 18, 19, 20, 29, and 30 land use designations would change to a Limited Operations Zone. **Figure S–4** provides the location and size of these zones and operational areas, and the locations of major facilities within these zones and areas.

S.2.5 Decisions Resulting from this Site-Wide Environmental Impact Statement

The information, analyses, and potential environmental impacts of this *NNSS SWEIS* will provide the basis, in part, for NNSA to determine the nature of capabilities and projects, as well as their associated levels of operations (activities), over the next 10-year period at the NNSS and offsite locations in Nevada. Accordingly, NNSA may choose to implement, either wholly or in part, any of the three alternatives, or may choose to implement a "hybrid" alternative, comprising various capabilities, projects, and activities selected from among the three alternatives. Implementation of any of the alternatives could result in changes to the name, size, or location of the land use zones, or in the location of ongoing or proposed capabilities and projects within these zones.

Although NNSA has analyzed various radioactive waste shipping routes through and around metropolitan Las Vegas, Nevada, decisions on routing would not be made as part of this NEPA process. NNSA has undertaken this analysis to inform any highway routing-related revisions to its waste acceptance criteria; such revisions are developed in accordance with NNSA's standard practices, which include consultation with the State of Nevada, and, when finalized, become publicly available through publication on the NNSS website. NNSA also would not make any decisions regarding environmental restoration activities that are not consistent with the Federal Facility Agreement and Consent Order unless agreed to by the Nevada Division of Environmental Protection.

DOE's Office of Energy Efficiency and Renewable Energy is proposing to conduct a Concentrating Solar Power Validation Project on the NNSS, the environmental impacts of which are being analyzed in an environmental assessment (DOE/EA-1842). This project would demonstrate the viability of cutting-edge technologies for commercial power production. The intent would be to demonstrate technology advancements that are proven at a prototype level, but have not yet been demonstrated at a scale or for a sufficient period for deployment in a commercial setting. DOE's decision regarding the proposed Concentrating Solar Power Validation Project is independent of the alternatives analyzed in this SWEIS and does not limit the range of alternatives analyzed herein or influence NNSA's decision regarding alternatives analyzed in this SWEIS.

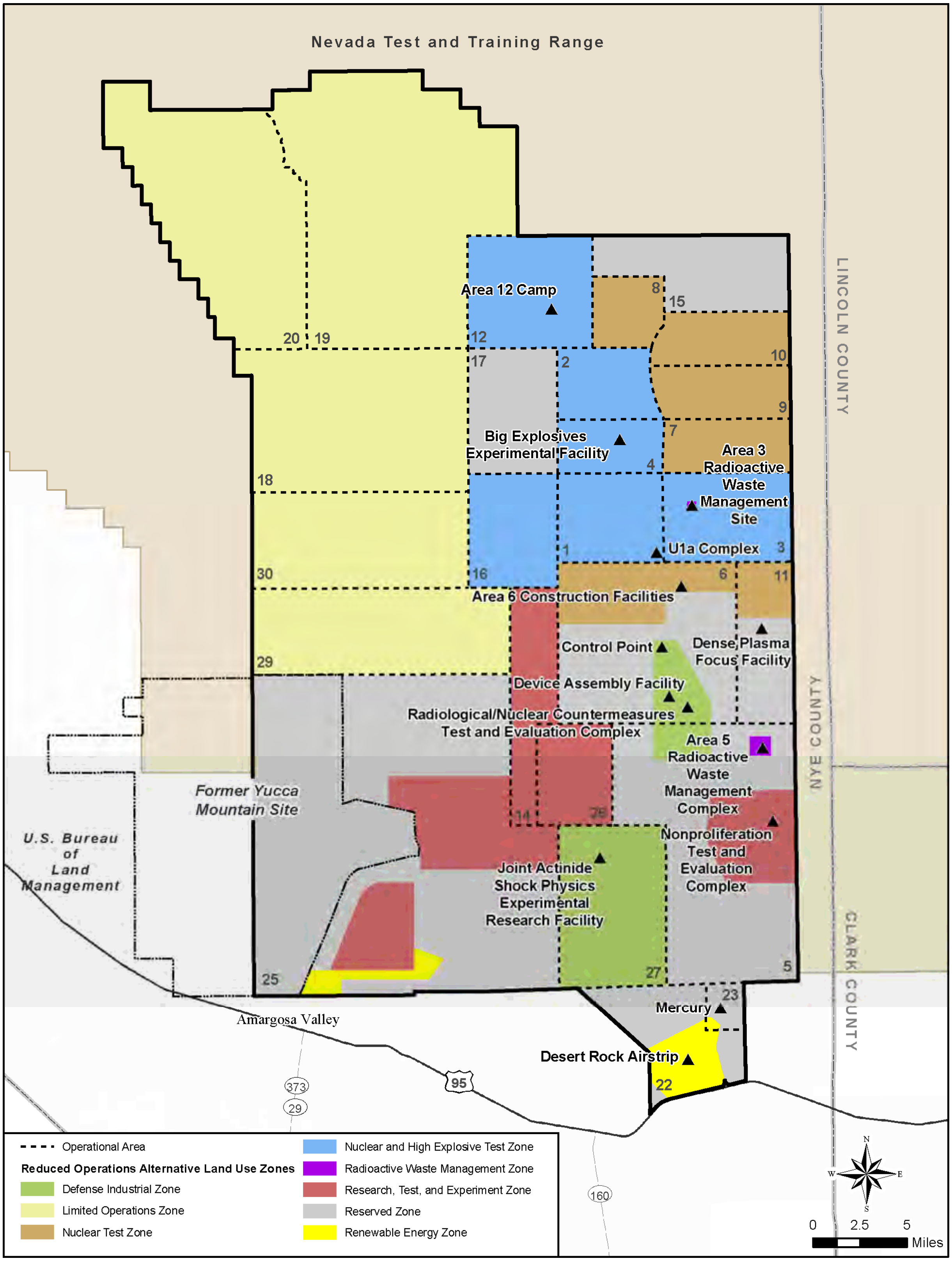


Figure S–4 Reduced Operations Alternative Land Use Zones

Table S–1 Comparison of Mission-Based Program Activities Under the Proposed Alternatives

NO ACTION ALTERNATIVE	***EXPANDED OPERATIONS ALTERNATIVE***	***REDUCED OPERATIONS ALTERNATIVE***
National Security/Defense Mission		
Stockpile Stewardship and Management Program		
Maintain readiness to conduct underground nuclear tests.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct up to 10 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 20 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 6 dynamic experiments per year at the NNSS; no dynamic or dynamic plutonium experiments or hydrodynamic tests would be conducted in Areas 19 or 20.
Conduct up to 20 conventional explosives experiments per year at the Big Explosives Experimental Facility and up to 10 per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 70,000 pounds TNT [2,4,6-trinitrotoluene]-equivalent of explosives charges; would also support Work for Others Program.	• Conduct up to 100 conventional explosives experiments per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 120,000 pounds TNT-equivalent of explosives charges (70,000 pounds at the Big Explosives Experimental Facility); would also support Work for Others Program. • Add second firing table and high-energy x-ray capability at Big Explosives Experimental Facility. • Establish up to three areas at the NNSS for conducting explosive experiments with depleted uranium.	Conduct up to 10 conventional explosives experiments per year at the Big Explosives Experimental Facility using up to 70,000 pounds TNT-equivalent of explosives charges per year to directly support the Stockpile Stewardship and Management Program; no other explosives experiments would be conducted.
Conduct up to 12 shock physics experiments per year at the NNSS using actinide targets at the Joint Actinide Shock Physics Experimental Research Facility in Area 27 and up to 10 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 36 shock physics experiments per year at the NNSS using actinide targets at the Joint Actinide Shock Physics Experimental Research Facility in Area 27 and up to 24 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 6 shock physics experiments per year at the NNSS using actinide targets at the Joint Actinide Shock Physics Experimental Research Facility in Area 27 and up to 8 experiments per year using the Large-Bore Powder Gun in Area 1.
Conduct up to 500 criticality operations, training, and other operations per year at the Criticality Experiment Facility at the Device Assembly Facility in Area 6.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Maintain the Atlas Facility in standby with the capability to conduct up to 12 pulsed-power experiments per year.	Activate the Atlas Facility and conduct up to 24 pulsed-power experiments per year.	Decommission and disposition the Atlas Facility.
Conduct up to 600 plasma physics and fusion experiments each year at NLVF and 50 per year in NNSS Area 11.	Conduct up to 1,000 plasma physics and fusion experiments each year at NLVF and 650 per year in NNSS Area 11, increasing the size and complexity of such experiments.	Conduct up to 350 plasma physics and fusion experiments each year at NLVF and 25 per year in NNSS Area 11.
Conduct five drillback operations at the NNSS over about a 10-year period.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	*EXPANDED OPERATIONS ALTERNATIVE*	*REDUCED OPERATIONS ALTERNATIVE*
Conduct Stockpile Management Program activities in NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20, including:	Same as under the No Action Alternative, plus the following activities:	Same as under the No Action Alternative, except activities would not be conducted in Areas 19 and 20.
• Disposition damaged U.S. nuclear weapons.	• Stage nuclear devices pending dismantlement, modification/maintenance, and/or transportation to another location. • Dismantle up to 100 nuclear weapons per year • Replace limited-life components of up to 360 nuclear devices per year and conduct associated maintenance activities. • Test weapons components for quality assurance under the Limited Life Component Exchange Program.	
• Stage special nuclear material, including nuclear weapon pits.	• Stage special nuclear material, including nuclear weapon pits, and transfer between 4 and 5 metric tons of special nuclear material from other locations in the DOE complex for use in experiments at the NNSS.	
Conduct training for the Office of Secure Transportation up to six times per year at various locations on NNSS roads.	Same as under the No Action Alternative, plus: • Develop facilities in Area 17 and upgrade or construct new facilities in Area 6, 12, or 23 to support training for the Office of Secure Transportation.	Conduct training for the Office of Secure Transportation up to four times per year at various locations on NNSS roads.
Conduct the following stockpile stewardship operations at the TTR: • Conduct tests and experiments, including flight test operations for gravity weapons (i.e., bombs). • Conduct ground/air-launched rocket and missile operations. • Conduct impact testing. • Conduct passive testing of joint test assemblies and conventional weapons. • Conduct fuel-air explosives testing.	Same as under the No Action Alternative.	Same as under the No Action Alternative, except: • Discontinue ground/air launched-rocket and missile operations. • Discontinue fuel-air explosives testing.
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs		
Provide support for the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program (most of this support is provided by RSL).	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct Aerial Measuring System activities from RSL base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	***EXPANDED OPERATIONS ALTERNATIVE***	***REDUCED OPERATIONS ALTERNATIVE***
Conduct weapon of mass destruction emergency responder training at various NNSA/NSO locations.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Support DOE Emergency Communications Network.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Disposition improvised nuclear dispersion devices, deploy the NNSA and Federal Bureau of Investigation Disposition and Disposition Forensics Programs to the NNSS for training and exercises or for an actual event, as needed.	Same as under the No Action Alternative, plus: • Disposition radiological dispersion devices, as needed	Same as under the No Action Alternative.
Integrate existing activities and primarily NNSS facilities to support United States efforts to control the spread of weapons of mass destruction, particularly nuclear weapons of mass destruction, including arms control, nonproliferation activities, nuclear forensics, and counterterrorism capabilities.	Same as under the No Action Alternative, plus: At the NNSS: • Construct laboratory space and other facilities for design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures as part of the Arms Control Treaty Verification Test Bed. [a] • Develop and construct new facilities to support a Nonproliferation Test Bed to simulate chemical and radiological processes that an adversary would clandestinely conduct. [a] • Construct an Urban Warfare Complex to support counterterrorism training. [a]	Same as under the No Action Alternative.
Work for Others Program		
Work for Others Program activities would continue to be conducted in all appropriate zones on the NNSS, and at RSL and NLVF.	Same as under the No Action Alternative, except the NNSS land use zone designation for Area 15 would be changed from "Reserved Zone" to "Research, Test, and Experiment Zone."	Same as under the No Action Alternative, except Work for Others Program activities, with the exception of military training and exercises, would not be conducted in Areas 18, 19, 20, 29, and 30 of the NNSS.
Host treaty verification activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct nonproliferation projects and counterproliferation research and development at the NNSS, including:	Same as under the No Action Alternative.	Same as under the No Action Alternative, except:
• Conduct conventional weapons effects and other explosives experiments within parameters established for conducting conventional high-explosives experiments.		• Discontinue conventional weapons effects and other Work for Others Program high-explosives experiments.
• Support development of capabilities to hold at-risk and defeat military assets in deeply buried hardened targets.		• Discontinue development of capabilities to hold at-risk and defeat military assets in deeply buried hardened targets.

NO ACTION ALTERNATIVE	***EXPANDED OPERATIONS ALTERNATIVE***	***REDUCED OPERATIONS ALTERNATIVE***
• Conduct up to 20 controlled chemical and biological simulant release experiments per year (each experiment would include multiple releases by a variety of means, including explosives). • Support training, research, and development of equipment, specialized munitions, and tactics related to counterterrorism.		• Discontinue projects requiring explosive releases of chemical or biological simulants.
Support the U.S. Department of Defense and other Federal agencies in developing counterterrorism capabilities.	Develop and construct new facilities to support counterterrorism training, research, and development activities.	Same as under the No Action Alternative.
Conduct criticality experiments to support National Aeronautics and Space Administration deep space power source development within the parameters for criticality experiments established under the Stockpile Stewardship and Management Program.	Same as under the No Action Alternative, plus: • Conduct experiments using existing boreholes at the NNSS to sequester emissions such as radionuclides.	Same as under the No Action Alternative.
Host the use of various aerial platforms, such as airplanes and helicopters, at various locations at the NNSS for research and development, training, and exercises.	• Increase use of various aerial platforms, such as airplanes and helicopters, for research and development, training, and exercises, including constructing additional hangars, shops, and buildings at existing airports at the NNSS. • Conduct up to 3 underground and 12 open-air radioactive tracer experiments per year. • Host treaty verification activities, including development of a facility for simulating nuclear fuel cycle-related radionuclide release detection and characterization. [a] • Develop a facility for specialized explosive experiments and simulated manufacture to support high-explosives experiments. [a] • Support increased research and development of active interrogation equipment, methods, and training. • Develop new facilities to support research and development in radio frequency generation and infrasonic observations. [a] • Develop new facilities, including simulated clandestine laboratories, to support chemical and biological simulant experiments. [a]	Same as under the No Action Alternative.
Conduct Work for Others Program activities at the TTR, including robotics testing, smart transportation-related testing, smoke obscuration operations, infrared tests, and rocket development.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	***EXPANDED OPERATIONS ALTERNATIVE***	***REDUCED OPERATIONS ALTERNATIVE***
Environmental Management Mission		
Waste Management Program		
Dispose up to 15 million cubic feet of low-level radioactive waste and 900,000 cubic feet of mixed low-level radioactive waste in the Area 5 Radioactive Waste Management Complex.	Dispose up to 48 million cubic feet of low-level radioactive waste and 4 million cubic feet of mixed low-level radioactive waste at the Area 5 Radioactive Waste Management Complex and Area 3 Radioactive Waste Management Site.	Same as under the No Action Alternative.
Maintain the Area 3 Radioactive Waste Management Site on standby.	Open the Area 3 Radioactive Waste Management Site for disposal of authorized and/or permitted waste.	Same as under the No Action Alternative.
Repackage onsite-generated mixed low-level radioactive waste.	Same as under the No Action Alternative, plus: • Treat mixed low-level radioactive waste received from on- and offsite generators via macroencapsulation and microencapsulation, sorting/segregating, and bench-scale mercury amalgamation, as appropriate, and store at the Area 5 Radioactive Waste Management Complex pending treatment or disposal.	Same as under the No Action Alternative.
Continue to use rail-to-truck transloading facilities outside of Nevada.	Increase rail-to-truck transloading, including use of facilities within Nevada.	Same as under the No Action Alternative.
Store onsite-generated transuranic waste pending offsite disposal.	Same as under the No Action Alternative, except a larger volume of transuranic waste would be generated by increased activities at NNSS facilities, such as the Joint Actinide Shock Physics Experimental Research Facility.	Same as under the No Action Alternative, except a smaller volume of transuranic waste would be generated by increased activities at NNSS facilities, such as the Joint Actinide Shock Physics Experimental Research Facility.
Store onsite-generated hazardous waste as needed at the Area 5 Hazardous Waste Storage Unit pending offsite treatment or disposal.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 11 Explosives Ordnance Disposal Unit.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 6 Hydrocarbon Landfill.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 23 Solid Waste Disposal Site and the U10c Solid Waste Disposal Site.	Same as under the No Action Alternative, except larger volumes of solid sanitary waste would be generated by increased activity levels at the NNSS. Construct new sanitary solid waste disposal facilities as needed in Area 23 and develop a new solid waste disposal site in Area 25 to support environmental restoration activities and potential construction of solar energy projects in Area 25.	Same as under the No Action Alternative, except smaller volumes of solid sanitary waste would be generated by reduced activity levels at the NNSS.

NO ACTION ALTERNATIVE	*EXPANDED OPERATIONS ALTERNATIVE*	*REDUCED OPERATIONS ALTERNATIVE*
Environmental Restoration Program		
Underground Test Area Project – Comply with the Federal Facility Agreement and Consent Order; monitor groundwater from existing wells; drill new characterization and monitoring wells; develop groundwater flow and transport models; and continue to evaluate closure strategies.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Soils Project – Identify and characterize areas with contaminated soils and perform corrective actions in compliance with the Federal Facility Agreement and Consent Order.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Industrial Sites Project – Identify, characterize, and remediate industrial sites under the Federal Facility Agreement and Consent Order and continue decontaminating and decommissioning facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Defense Threat Reduction Agency Sites – In accordance with the Federal Facility Agreement and Consent Order, perform remediation activities at sites that are the responsibility of the Defense Threat Reduction Agency.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Execute the Borehole Management Program.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission		
General Site Support and Infrastructure Program		
Conduct small projects to maintain the present capabilities of NNSA/NSO facilities in all areas of the NNSS and at NLVF, RSL, and the TTR. Maintain existing infrastructure, manage various permits and agreements, and provide security for the former Yucca Mountain site.	Same as under the No Action Alternative, plus: • Construct a new 85,000-square-foot multistory security building in Area 23. • Replace the NNSS 138-kilovolt electrical transmission system. • Expand cellular telecommunication system on the NNSS • Reconfigure Mercury.	Same as under the No Action Alternative, except: No infrastructure projects would be conducted within Areas 18, 19, 20, 29, and 30 of the NNSS beyond maintaining mission-critical existing electrical and communication facilities and Well 8.

NO ACTION ALTERNATIVE	*EXPANDED OPERATIONS ALTERNATIVE*	*REDUCED OPERATIONS ALTERNATIVE*
Conservation and Renewable Energy Program		
• Continue to identify and implement energy conservation measures and renewable energy projects in compliance with applicable Executive Orders and DOE Orders. • Reduce energy intensity by 3 percent annually and a total of 30 percent through the end of fiscal year 2015. • Reduce greenhouse gas emissions by 28 percent by fiscal year 2020. • Install advanced electric metering systems. • Obtain at least 7.5 percent of the NNSS annual electricity and thermal consumption from renewable energy sources. • Support development of a 240-megawatt commercial solar power generation facility in NNSS Area 25. [a] • Reduce water use by 16 percent by 2015. • Maximize use of alternative fuels (e.g., E85 and biodiesel). • Ensure all new construction and renovation projects implement high-performance building goals.	Same as under the No Action Alternative, plus: • Support development of 1,000 megawatts of commercial solar power generation facilities in NNSS Area 25. [a] • Modify NNSS land use zones to establish a 39,600-acre Renewable Energy Zone in Area 25. • Construct a 5-megawatt photovoltaic solar power generation facility near the Area 6 Construction Facilities. • Support a Geothermal Energy demonstration project and Geothermal Research Center at the NNSS. [a]	Same as under the No Action Alternative, except: • Support development of a 100-megawatt commercial solar power generation facility in NNSS Area 25. [a]
Other Research and Development Programs		
Support the DOE National Environmental Research Park Program and other non-DOE/NNSA research and development activities in all areas of the NNSS.	Same as under the No Action Alternative.	Same as under the No Action Alternative, except: Activities would be conducted in all areas of the NNSS, except Areas 18, 19, 20, 29, and 30.

NLVF = North Las Vegas Facility; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NSO = Nevada Site Office; RSL = Remote Sensing Laboratory; TNT = 2,4,6-trinitrotoluene; TTR = Tonopah Test Range.

[a] These potential projects have not reached a point of development that allows full analysis in this *NNSS SWEIS*, and would be subject to additional NEPA analysis before NNSA would make any decision regarding implementation. At this point, NNSA has not received or solicited proposals for any commercial solar power generation projects.

S.3 Summary of Environmental Impacts

S.3.1 Nevada National Security Site

This section summarizes the potential environmental impacts at the NNSS from continuing and proposed projects and capabilities, including their associated levels of operations (activities), under each of three alternatives analyzed in this SWEIS. The text focuses on those resource areas for which the impacts are sufficiently different to permit one to distinguish among the alternatives in a meaningful manner or that may be controversial, i.e., infrastructure and energy, transportation and traffic, socioeconomics, groundwater hydrology, biological resources, air quality, visual and cultural resources, waste management, human health, and cumulative impacts. **Table S–15** (at the end of Section S.3.1.10) summarizes the potential environmental impacts for all 13 resource areas.

S.3.1.1 Energy

NNSA compared projections of utility resource requirements, such as the demand for electricity and liquid fuels, under each alternative to local and regional capabilities to supply these resources. Implementing the Expanded Operations Alternative would result in the highest energy demands of the three alternatives.

Under the Expanded Operations Alternative, continuing and newly proposed projects and capabilities would require an increase of up to 25 percent or about 1.4 million gallons per year of various fuel types, such as unleaded gasoline, ethanol-gasoline blended fuel, and biodiesel fuel. NNSA does not foresee difficulty in obtaining this amount of liquid fuels from regional suppliers. The projected annual demand for most fuel types constitutes a small proportion of current fuel use in Nevada. For example, the estimate of unleaded gasoline needed annually (534,000 gallons) would be approximately 0.05 percent of the total unleaded gasoline used in Nevada (NSOE 2009). However, the NNSS is a major consumer of biodiesel fuel in Nevada, making up approximately 60 percent of the current, annual statewide demand of 575,000 gallons (NSOE 2009); under the Expanded Operations Alternative, NNSA would increase consumption of biodiesel fuel to about 75 percent (429,000 gallons). Although not anticipated, if demand for biodiesel fuel were to exceed regional supply, the NNSS could temporarily switch to petroleum-based diesel fuel for most applications.

Implementing the Expanded Operations Alternative also would result in increased demand for electricity during construction and, later, operation of proposed projects and capabilities. NNSA estimates that the average power demand would increase up to approximately 25 percent (from 22 to 28 megawatts) over current demand, and up to approximately 35 percent (from 30 to 41 megawatts) under peak power demand. Peak demand would exceed existing system capacity (40 megawatts) (NNSA/NSO 2010a), which could result in voltage fluctuations or blackouts. However, as part of implementing the Expanded Operations Alternative, NNSA would upgrade the existing electrical distribution system to accommodate projected electrical demand, increase service reliability, and provide additional capacity to support future growth on the NNSS.

A 35 percent increase over the 2009 average electrical demand of 84,600 megawatt-hours at the NNSS (DOE 2008b) would amount to approximately 105,700 megawatt-hours. During 2009, NV Energy and Valley Electric Association provided about 21,675,000 megawatt-hours collectively to their customers. Under the Expanded Operations Alternative, electricity demand would represent only about 0.49 percent of the regional electrical supply (NSOE 2009). In addition, the construction of commercial solar power generation facilities in Area 25 would increase regional electricity supplies.

S.3.1.2 Transportation and Traffic

Transportation. Radiological and nonradiological impacts on workers and the public would result from the shipment of radioactive waste, such as low-level radioactive waste, and radioactive materials, such as special nuclear material, from locations outside the State of Nevada to the NNSS, and from locations within Nevada, such as the TTR, to the NNSS. Radiological impacts are those associated with the effects of radiation emitted during incident-free transportation (normal operations) and from accidents resulting in a release of radioactive materials; radiological impacts are expressed as additional latent cancer fatalities. Nonradiological impacts are independent of the nature of the cargo being transported and are expressed as fatal traffic accidents.

Special Nuclear Material

Special nuclear material is (1) plutonium, uranium-233, uranium enriched in isotopes of uranium-233 or -235, or any other material that the U.S. Nuclear Regulatory Commission determines to be special nuclear material, or (2) any material artificially enriched by any of these radioactive materials.

Radioactive waste shipments would be by truck, or by a combination of rail and truck. Rail transport to the NNSS is not possible; therefore, rail cargo must be transferred to trucks at a transfer station. Some shipments, such as radioactive materials shipments, would only be by truck. **Table S–2** provides the estimated number of shipments of radioactive waste and radioactive materials to the NNSS under each alternative.

Table S–2 Estimated Number of Shipments of Radioactive Waste and Materials

Mode of Shipment to the Nevada National Security Site	*No Action Alternative*	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Truck			
In-state radioactive waste shipments	2,300	15,400	2,300
Out-of-state radioactive waste shipments	24,700	79,000	24,700
Out-of-state radioactive material shipments	240	10,700	180
Rail-to-Truck			
Out-of-state radioactive waste shipments (rail only)	12,300	38,200	12,300
Out-of-state radioactive waste shipments (rail and truck)	37,000	92,600	37,000

This *NNSS SWEIS* includes analyses of incident-free transportation for two cases: a Constrained Case and an Unconstrained Case. The Constrained Case retains current routing of shipments of low-level and mixed low-level radioactive waste to avoid crossing the Colorado River near Hoover Dam and the interstate system in Las Vegas, Nevada. The Constrained Case was analyzed for all alternatives. The Unconstrained Case, in which shipments of this waste would occur over the bypass bridge near the Hoover Dam and on the interstate system through the greater metropolitan area, was analyzed for the Expanded Operations Alternative.

Under the Constrained Case, truck shipments that would approach the NNSS from the south (via Interstate 40) would use U.S. Route 95 to Nevada State Route 164, to Interstate 15, to Nevada State Route 160, and then to U.S. Route 95. Truck shipments approaching the NNSS from the north (via Interstate 80) would use U.S. Routes 50, 6, and 95 (see **Maps 1** and **2**; all referenced maps are presented at the end of this Summary).

Waste Transportation through the Las Vegas Valley

Historically, the U.S. Department of Energy (DOE) committed to the State of Nevada that it would avoid shipping low-level radioactive waste through the Interstate 15/U.S. 95 interchange in Las Vegas, Nevada. This commitment was made when major highways, such as Interstate 15 and U.S. Route 95, were unable to accommodate increased traffic volumes. The commitment as stated in the waste acceptance criteria for the Nevada National Security Site (NNSS) avoided Hoover Dam and Las Vegas. In compliance with this requirement, commercial carriers of low-level radioactive waste used alternate shipping routes, such as Nevada State Route 160.

Now, the transportation infrastructure throughout metropolitan Las Vegas, such as Interstate 15 and U.S. Route 95, have been expanded and improved. In addition, the 215 Beltway was built to take traffic around the center of Las Vegas. Moreover, highways that continue to be used to transport waste, such as Nevada State Route 160, have experienced increased traffic as the population has grown in that area of the valley.

The National Nuclear Security Administration (NNSA) has analyzed two transportation cases: one that reflects the existing commitment (Constrained Case) and one that permits shipments through the greater metropolitan Las Vegas (Unconstrained Case). This analysis was undertaken to develop a greater understanding of the potential environmental consequences of shipping such waste through and around metropolitan Las Vegas, and to provide information relevant to consideration of potential highway routing-related revisions to NNSS's waste acceptance criteria. Although an analysis of low-level/mixed low-level radioactive waste shipping routes is included in this site-wide environmental impact statement, individual decisions on routing will not be made as part of this National Environmental Policy Act process; such decisions are developed in accordance with NNSA's standard practices, which include consultation with the State of Nevada, and when finalized become publicly available through publication on the NNSS website.

For rail-to-truck shipments, rail shipments would be transferred to trucks at transfer stations in Parker, Arizona, and West Wendover, Nevada (see **Maps 1** and **2**). These transfer stations are those outside of Las Vegas, but nearest to the NNSS, at which such transfers have occurred in the past. From Parker, truck shipments would proceed north on U.S. Route 95 to Nevada State Route 164 to Interstate 15 to Nevada State Route 160 to U.S. Route 95; from West Wendover, truck shipments would proceed south on U.S Routes 93, 6, and 95.

For the Unconstrained Case, NNSA analyzed truck shipments for two primary route segments. The first segment is from regions in the United States (see **Map 3**) to one of three entry points to Las Vegas. These entry points are Henderson, Nevada, at the intersection of Interstate 515 and U.S. Route 95; Apex, Nevada, on Interstate 15 north of Las Vegas; and Arden, Nevada, on Interstate 15 just south of the junction of Interstates 15 and 215 (see **Map 4**). The second segment includes different routes from the entry points to the NNSS (see **Map 4**). Rail shipments also are analyzed by segment. The first segment is rail shipments from each region of the United States to one of five transfer stations at Apex, Arden, and West Wendover, Nevada, and Kingman and Parker, Arizona (see **Maps 5** and **6**). The second segment is from the transfer stations to one of the three entry points to Las Vegas (see **Map 7**). For the second segment, truck transport from West Wendover would proceed to the Apex entry point via U.S. Route 93; truck transport from Parker would proceed to Henderson via U.S. Route 95; and truck transport from Kingman would proceed to Henderson via U.S. Route 93 over the bridge downstream of the Hoover Dam. The final segment is truck travel from one of the three Las Vegas entry points to the NNSS (see **Map 4**).

Incident-Free Transportation (Constrained Case). For incident-free truck transportation, under the No Action Alternative, Expanded Operations Alternative, and Reduced Operations Alternative, NNSA estimated (numerically calculated) that approximately 1 (1.2), 3 (3.1), and 1 (1.2) latent cancer fatalities, respectively, would occur in the population of transportation workers exposed to radiation from shipments of low-level and mixed low-level radioactive waste (**Figure S–5**). Because many workers would be involved, the risk to an individual worker would be small. Similarly, NNSA estimated that less than

1 (0.2, 0.6, and 0.2, respectively) latent cancer fatality would occur among members of the public exposed to these same truck shipments under the three alternatives.

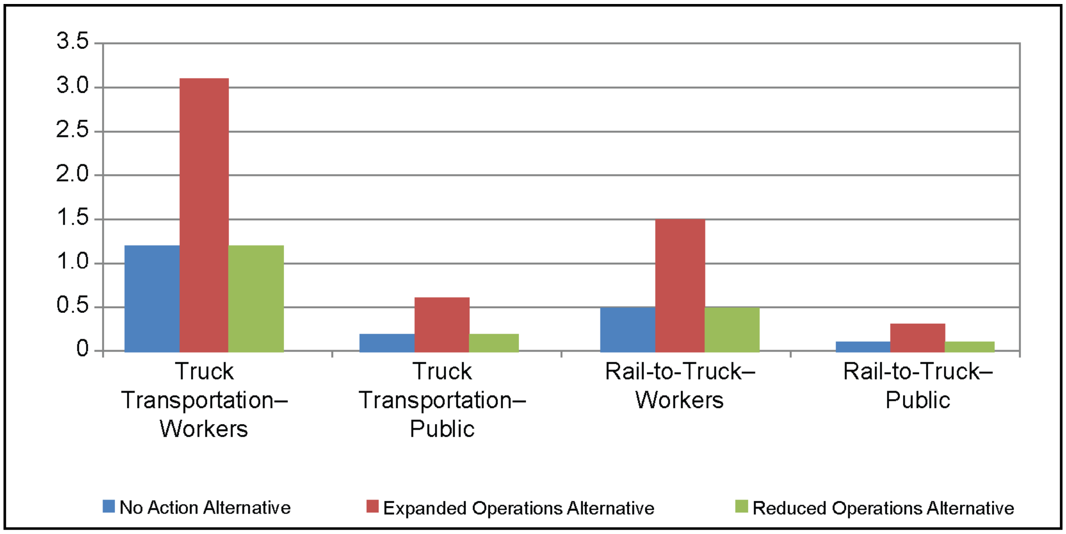


Figure S–5 Latent Cancer Fatalities from Incident-Free Transportation (Constrained Case)

For incident-free rail-to-truck transportation, under the No Action Alternative, Expanded Operations Alternative, and Reduced Operations Alternative, NNSA estimated (numerically calculated) that less than 1 (0.5), 1 (1.5), and less than 1 (0.5) latent cancer fatality, respectively, would occur in the population of transportation workers exposed to radiation from shipments of low-level and mixed low-level radioactive waste. Similarly, NNSA estimated that less than 1 (0.1, 0.63, and 0.1, respectively) latent cancer fatality would occur among members of the public exposed to these same truck and rail shipments under the three alternatives (Figure S–5).

> **What is a Latent Cancer Fatality?**
>
> A latent cancer fatality is a death from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens. This site-wide environmental impact statement focuses on latent cancer fatalities as the primary means of evaluating health risk from radiation exposure. The values reported for latent cancer fatalities are the increased risk of a fatal cancer for a maximally exposed individual or noninvolved worker, or the increased risk of a single fatal cancer occurring in an identified population.

Under the No Action Alternative or Reduced Operations Alternative, if an individual member of the public were exposed to every truck shipment of radioactive waste and materials, an unlikely event, this maximally exposed individual would receive an estimated dose of about 10 millirem, resulting in a risk of contracting a fatal cancer of 5×10^{-5} (1 chance in 200,000). Under the Expanded Operations Alternative, this individual would receive an estimated dose of about 20 millirem, resulting in a risk of contracting a fatal cancer of 1×10^{-5} (1 chance in 100,000). An individual exposed to every rail shipment would receive an estimated dose of about 10 millirem under the No Action and Reduced Operations Alternative, and about 30 millirem under the Expanded Operations Alternative.

Incident-Free Transportation (Unconstrained and Constrained Cases). Table S–3 summarizes the range of impacts for transporting low-level and mixed low-level radioactive waste by truck to the NNSS for the Unconstrained Case, and compares these impacts to those of the Constrained Case. If truck routes were unconstrained, the total incident-free dose to the workforce and population would be lower, albeit slightly, than if routes were constrained.

Table S–3 also summarizes the range of impacts for transporting low-level and mixed low-level radioactive waste by rail to each of the five transfer stations, trucking the waste from each transfer station to Las Vegas, and subsequently traveling through Las Vegas to the NNSS using different routes as shown in **Maps 4** through **6**. NNSA estimates that the dose to the workforce would be highest if a transfer station were located at West Wendover because of the longer distance traveled by truck, as compared to other transfer station locations. The risk to the workforce, however, would be about the same (approximately 1 latent cancer fatality) among all locations. While the incident-free population dose and risk would vary, the differences would be small. For rail-to-truck transport, the radiation dose to workers and the public under the Constrained Case would fall within the range of impacts that would result unconstrained routes were used, recognizing that the overall risk of a latent cancer fatality would essentially be the same, regardless of the route taken.

Units of Radiation

A rem is a unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem is estimated by a formula that accounts for the type of radiation, the total absorbed dose, and the tissues involved. One thousandth of a rem is a millirem. The average dose to an individual in the United States, primarily from natural background sources of radiation, is about 310 millirem per year; the national average including medical sources is about 620 millirem.

A person-rem is a unit of collective dose applied to a population or group of individuals. It is calculated as the sum of the estimated doses, in rem, received by each individual of the specific population. For example, if 1,000 people each received a dose of 1 millirem, the collective dose would be 1 person-rem (1,000 persons × 0.001 rem = 1.0 person-rem).

Table S–3 Health Impacts from Incident-Free Transportation – Expanded Operations Alternative (Unconstrained and Constrained Cases) [a]

Through Point-of-Entry to the NNSS	*Number of Truck Shipments*	*Workforce*		*Population*	
		Dose (person-rem) [b]	*Latent Cancer Fatality*	*Dose (person-rem)*	*Latent Cancer Fatality*
Apex	23,500	960 – 1,000 [b]	0.6	230 – 260	0.1 – 0.2
Arden	3,040	38 – 46	0.2 – 0.3	14 – 17	0.009 – 0.01
Henderson	27,400	3,100 – 3,200	2	510 – 540	0.3
Total Unconstrained	54,000	4,100 – 4,200	2 – 3	760 – 810	0.5
Total Constrained	54,000	4,900	3	830	0.5
Through Transfer Station to the NNSS	*Number of Rail and Truck Shipments*	*Workforce*		*Population*	
		Dose (person-rem)	*Latent Cancer Fatality*	*Dose (person-rem)*	*Latent Cancer Fatality*
Apex	81,000	1,300 – 1,500	0.8 – 0.9	360 – 470	0.2 – 0.3
Arden	81,000	1,300 – 1,400	0.8 – 0.9	390 – 410	0.2
Kingman	81,000	1,400 – 1,600	0.8 – 1	440 – 490	0.3
Parker	81,000	1,700 – 1,900	1	490 – 540	0.3
West Wendover	81,000	1,900 – 2,200	1	430 – 530	0.2 – 0.3
Total Unconstrained	81,000	1,300 – 2,200	0.8 – 1	360 – 540	0.2 – 0.3
Total Constrained	81,000	1,800	1	480	0.3

NNSS = Nevada National Security Site; rem = roentgen equivalent man.

[a] The truck and rail-to-truck shipments shown in Table S–3 are a subset of all such shipments (shown in Table S–2) analyzed in the *NNSS SWEIS*. For instance, of the 79,000 truck shipments shown for the Expanded Operations Alternative in Table S–2, the corresponding 54,000 truck shipments include only low-level and mixed low-level radioactive waste shipments, and the analysis does not consider other types of waste shipments nor shipments of radioactive materials, or other low-level and mixed low-level radioactive waste postulated for disposal at the NNSS but analyzed in other NEPA documents (for example, the environmental impact statement for West Valley decommissioning) (DOE 2010b).

[b] Ranges reflect differences among routes.

Transportation Accidents. The maximum reasonably foreseeable transportation truck accident involving the release of radiation was estimated to occur at an annual frequency of about 3.1×10^{-7} (about 1 chance in 2.6 million) under the No Action and Reduced Operations Alternatives and about 6.1×10^{-7} under the Expanded Operations Alternative. This accident would involve the release of radiation from a truck carrying low-level radioactive waste or mixed low-level radioactive waste that is involved in a severe collision and an ensuing fire. If the accident were to occur in an urban area, NNSA estimates that the population within 50 miles of the accident would receive a collective dose of approximately 180 person-rem, which would result in less than 1 (0.1) additional fatal cancer in that population. The maximally exposed individual, a hypothetical individual assumed to be located downwind of the event and exposed to the entire plume of radioactive release, would receive an estimated dose of 34 millirem, resulting in a risk to that individual of contracting a fatal cancer of 2×10^{-5} (1 chance in 50,000). The corresponding rail accident was estimated to occur at an annual frequency of about 9.8×10^{-8} (about 1 chance in 10 million); this accident was not analyzed because the probability of the event is so remote.

Transportation Accident Risk

In a shipping campaign, risk is defined as the sum of the probability of each accident involving a release of radioactive material multiplied by the consequence of that event (i.e., the product of these two factors summed for all accidents).

Under the No Action and Reduced Operations Alternatives, the total transportation accident risk for all projected accidents involving radioactive waste and radioactive materials would result in an estimated collective dose to the general population of 0.17 (truck) and 0.08 (rail-to-truck) person-rem, resulting in less than 1 (0.001) latent cancer fatality for truck transport and less than 1 (0.00005) latent cancer fatality for rail-to-truck transport. The nonradiological accident risks were estimated to be 2 and 6 fatal traffic accidents in the general population for truck transport and rail-to-truck transport, respectively. Under the Expanded Operations Alternative, the total transportation accident risk for all projected accidents would result in an estimated collective dose to the population of about 17 (truck) and 8 (rail-to-truck) person-rem, resulting in less than 1 (0.01) latent cancer fatality for truck transport, and less than 1 (0.005) latent cancer fatality for rail-to-truck transport. The nonradiological accident risks were estimated to be 6 and 15 fatal traffic accidents in the general population for truck transport and rail-to-truck transport, respectively.

Traffic. Traffic impacts would result from personnel (worker) trips, and trucks transporting radioactive waste and radioactive and nonradioactive materials. Traffic impacts are expressed as the relative change in the number of onsite and offsite daily vehicle trips, and the degree to which traffic on nearby Federal and state highways would be affected, referred to as "level of service." The level of service provides a means to gauge the degree of congestion on transportation networks. The six levels, designated "A" through "F," represent a range of traffic conditions; the best operating conditions are characterized by free flow and little delay (A) and the worst operating conditions, by poor progression and long delays (F) (TRB 2000).

Under the No Action Alternative, traffic on Mercury Highway (onsite traffic) would continue to operate at level of service A during peak traffic hours, as there would be an increase of only 16 daily vehicle trips (relative to a baseline of 1,748 trips) (**Figure S–6**). Implementing the Expanded Operations Alternative would result in additional congestion on Mercury Highway during peak traffic hours (level of service B), as there would be an increase of about 832 daily vehicle trips. Under the Reduced Operations Alternative, traffic on Mercury Highway would continue to flow freely (level of service A), as daily vehicle trips would decrease by about 153.

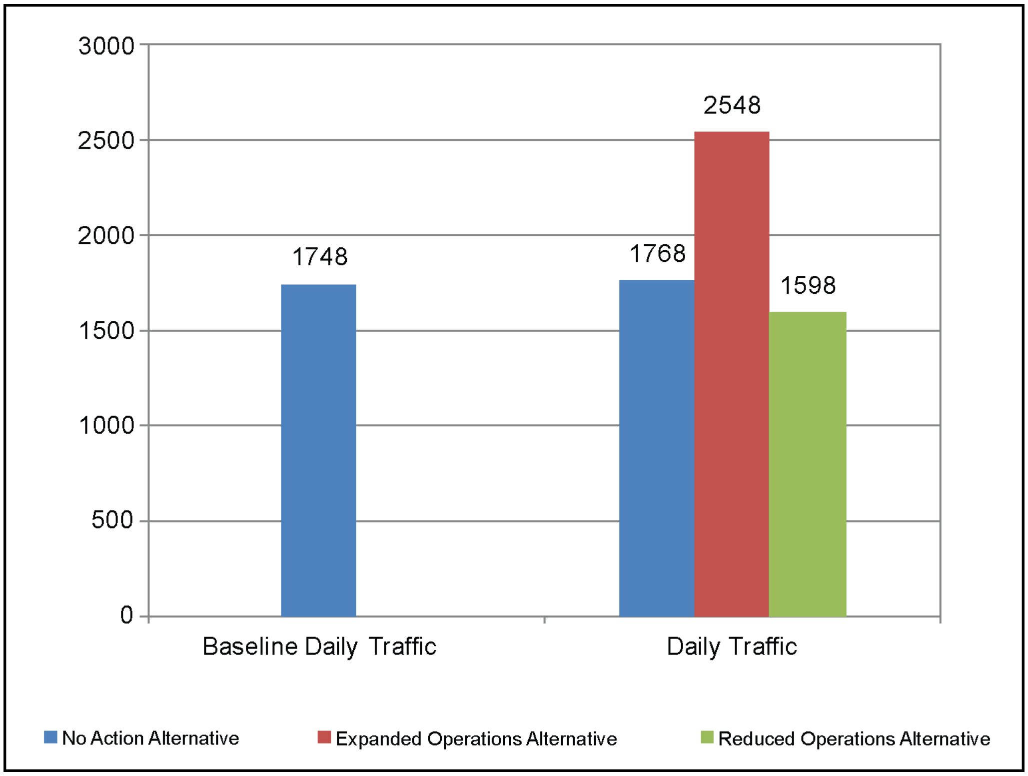


Figure S–6 Daily Vehicle Trips Between U.S. Route 95 and Mercury Highway

Construction of commercial solar power generation facilities in Area 25 would result in increased traffic on Lathrop Wells Road north of U.S. Route 95 and on site (level of service information is unavailable). Under the No Action, Expanded Operations, and Reduced Operations Alternatives, NNSA estimates that average daily vehicle trips (worker vehicles) during peak hours would increase by 250, 375, and 200, respectively. The increase in traffic from workers and construction equipment would require increased road maintenance or fundamental improvements. Although traffic during operations of solar power generation facilities would be less than traffic during construction, road maintenance or fundamental improvements would continue to be needed.

To estimate offsite traffic impacts after complete implementation of the alternatives, NNSA estimated baseline traffic levels and corresponding levels of service for the year 2020 for highways nearby the NNSS. The additional traffic associated with any alternative generally would not change future levels of service; for instance, the levels of service along U.S. Route 95 just west of Nevada State Route 373 in Amargosa Valley would remain at level of service C, and along Nevada State Route 373 south of U.S. Route 95 would remain at level of service A.

Level of Service C

The number of vehicles stopping is significant, although many still pass through the affected intersection without being required to stop.

S.3.1.3 Socioeconomics

The continued operation and proposed projects and capabilities at the NNSS would result in changes to the current (baseline) workforce under each of the three alternatives. Accordingly, NNSA evaluated how these changes in workforce could affect economic activity; population; and the demand on housing, public finance, and public services, such as police and fire protection, in Clark and Nye Counties (the counties in which the principal direct and indirect socioeconomic impacts are likely to occur).

NNSA estimates that implementing the No Action Alternative would result in the creation of up to 1,000 temporary and 150 permanent jobs (direct employment), in addition to the current (baseline) workforce of about 1,700. Most of the additional workforce would be due to the construction and operation of a 240-megawatt commercial solar power generation facility in Area 25, as construction would require an average of approximately 500 individuals during the 35-month construction period (temporary workforce), and operation would require approximately 150 individuals (permanent workforce).

An increase in direct employment under the No Action Alternative also would result in an increase in the demand for goods (for example, fuel for personal vehicles) and services (for example, vehicle repair), which, in turn, would create additional employment opportunities (indirect jobs). NNSA used the Regional Input-Output Modeling System II (RIMS II 2010), which was developed for the U.S. Department of Commerce, to evaluate the indirect economic impact of employment. Based on this analysis, approximately 930 to 1,860 indirect temporary and approximately 394 indirect permanent jobs would be created.

The addition of 544 direct and indirect permanent jobs was estimated to reduce unemployment by 0.3 percent in Clark County and 3.9 percent in Nye County. NNSA estimates there would be adequate housing and public services available for this additional workforce. For example, housing vacancies in Clark and Nye Counties would decrease by only 0.01 percent and 0.1 percent, respectively, and the person-to-hospital-bed ratio would remain unchanged.

Implementing the Expanded Operations Alternative would result in the creation of up to 1,500 temporary and 625 permanent jobs, in addition to the current (baseline) workforce of about 1,700. Most of the additional workforce would be a result of the construction and operation of 1,000 megawatts of commercial solar power generation facilities in Area 25, as construction would require an average of approximately 750 individuals (1,500 workers at peak) during the 42-month construction period (temporary workforce), and operation would require approximately 200 individuals (permanent workforce). NNSA estimates that this workforce would result in approximately 1,866 to 3,256 indirect temporary and approximately 920 direct permanent jobs.

The addition of 1,545 direct and indirect permanent jobs under the Expanded Operations Alternative would reduce unemployment in Clark and Nye Counties by 0.8 and 11.0 percent, respectively. The increased temporary and permanent workforce would not result in undue demand on housing (vacancies would decrease by only 0.02 percent in Clark County and 0.4 percent in Nye County) and most public services, although there could be a need to hire five new teachers (four in Clark County and one in Nye County) to maintain the current student-to-teacher ratio, and a need to expand the medical clinic in Mercury to maintain the person-to-hospital-bed ratio.

Implementing the Reduced Operations Alternative would result in the need for an average of 400 individuals (800 workers at peak) during the 32-month period to construct a 100-megawatt commercial solar power generation facility in Area 25. The permanent workforce needed to operate a solar power generation facility (125 individuals), however, would not offset the loss of employment due to the reduction in the levels of operation at the NNSS; the NNSS workforce would be reduced by approximately 45 percent (1,700 to 1,655 individuals). The longer-term workforce reduction also would reduce the demand for goods and services and thus indirect employment in Clark and Nye Counties. Housing vacancies would increase and demand for public services would decrease because of the reduction in the permanent workforce.

S.3.1.4 Groundwater Hydrology

Groundwater Quality. Drinking water quality is monitored to assess compliance with primary and secondary drinking water standards according to a schedule set in Federal and state laws, and requirements set by the State of Nevada Division of Health. The three public water systems on site and permitted water hauling trucks meet primary and secondary drinking water standards. Implementing any of the three alternatives is not expected to result in a degradation of groundwater quality because projects and activities would be undertaken within confinement barriers, such as tests in the Joint Actinide Shock Physics Experimental Research Facility, or would be above ground, where depth to groundwater is on the order of several hundred feet. In addition, the use of operational controls and other administrative measures would remove and remediate any surface spills well before contaminants could migrate to the water table (the zone beneath the surface that is saturated with water).

Corrective Action

Corrective action unit means one or more corrective action sites grouped geographically, by technical similarity, agency responsibility, or for other appropriate reasons, for purposes of determining corrective actions.

Corrective action site refers to the sites potentially requiring corrective action.

There have been 828 underground nuclear tests at the NNSS. Of these, approximately one-third were detonated near, below, or within the water table. These detonations have contaminated groundwater with 43 radionuclides; tritium (a radioactive form of hydrogen) is the most mobile (NNSA 2008). The Federal Facility Agreement and Consent Order established five corrective action units that delineate and define areas of concern for groundwater contamination. In 2009, NNSA verified the presence of tritium in Well ER-EC-11, located on the Nevada Test and Training Range adjacent to the Western Pahute Mesa region (see **Figure S–7**). This finding supports previous predictive modeling that indicated tritium was migrating in that direction. This well is about 14 miles from the nearest private well and, based on a range of computer model predictions, contamination is not expected to reach the private well for at least 100 years, and may never reach it (the half-life of tritium, the time in which one-half of its atoms disintegrate into helium, is about 12.3 years).

Groundwater Use. In this *NNSS SWEIS*, NNSA examined the extent to which each of the alternatives would have an adverse impact on the capacity of aquifers (sustainable yield) within a hydrographic basin. Potential impacts were estimated by comparing current (baseline) groundwater demand for each basin, modified by the demand from continuing and proposed projects and capabilities under each alternative, to the sustainable yield of each basin. **Figure S–8** shows the basins underlying the NNSS.

Annual water usage at the NNSS from 2005 through 2009 ranged from 530 to 691 acre-feet (NSTec 2010). NNSA has established goals to reduce the use of potable water by 2015 by at least 16 percent from the 2007 level of about 646 acre-feet (NSTec 2008) (potable water accounts for up to 90 percent of the current groundwater use). However, the analysis in this *NNSS SWEIS* does not account for this reduction in demand, and, instead, conservatively assumes a continued annual (baseline) water usage of 691 acre-feet.

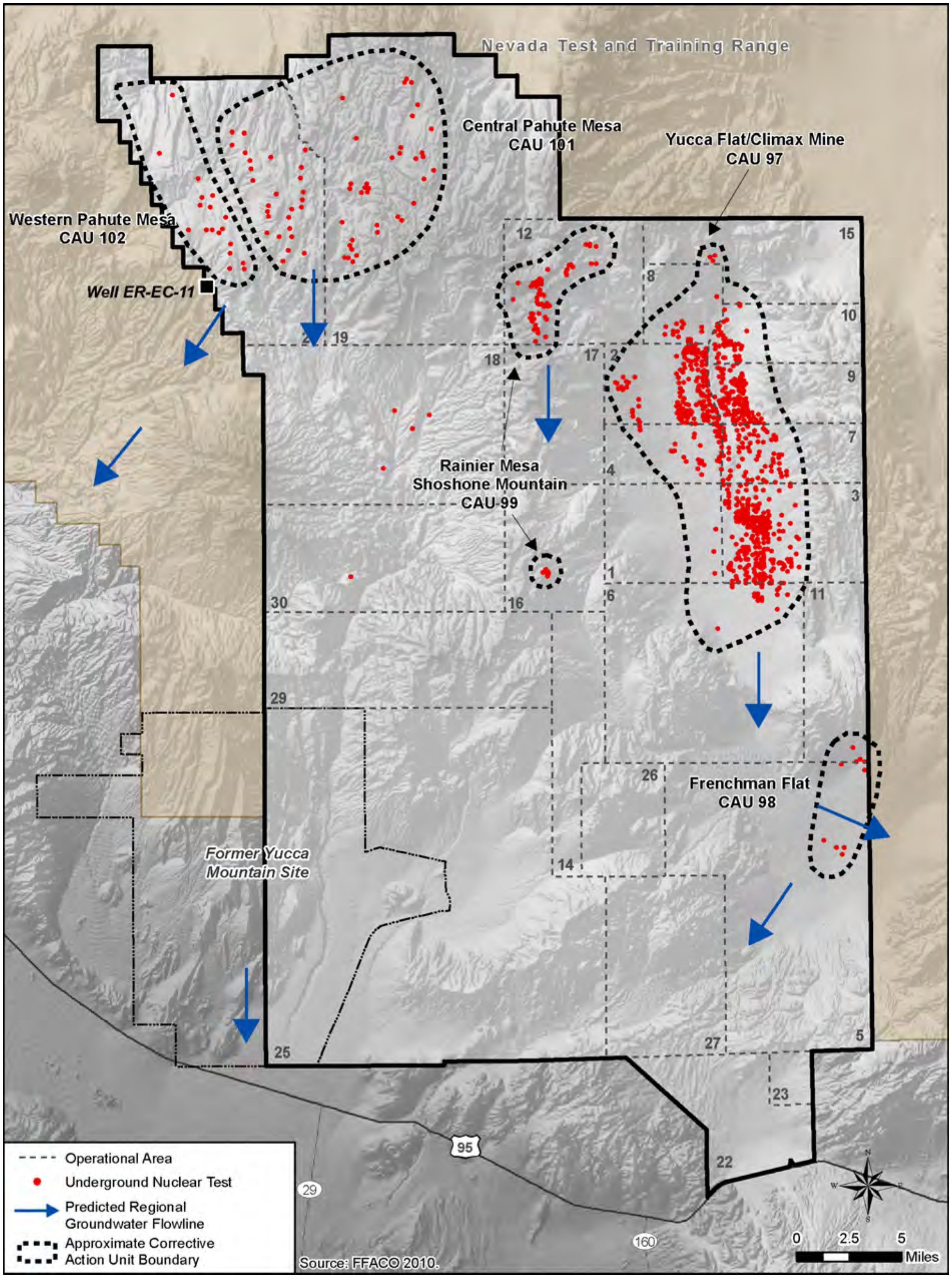


Figure S–7 Corrective Action Units at the Nevada National Security Site

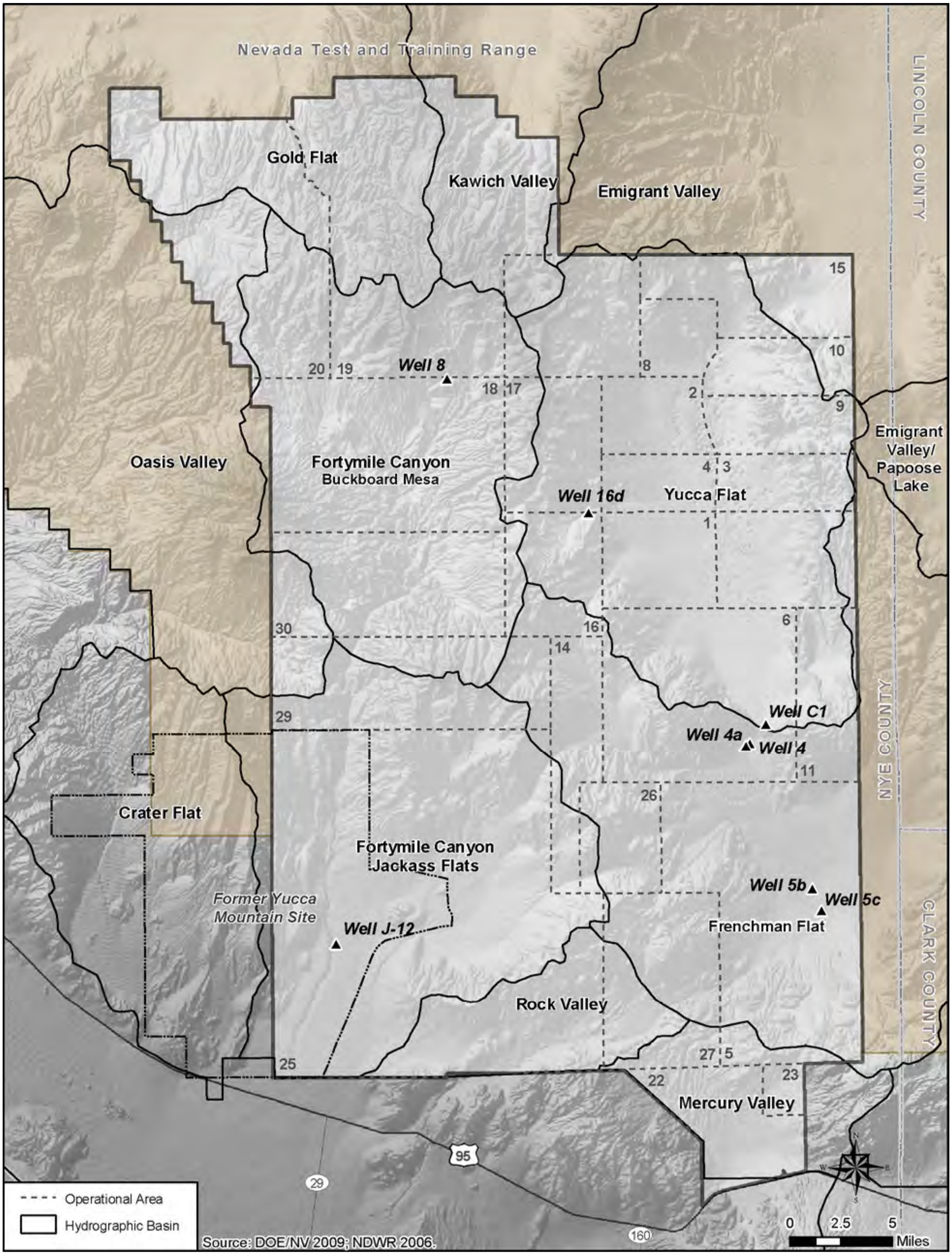


Figure S–8 Hydrographic Basins at the Nevada National Security Site

Groundwater Use Terms

Perennial yield is an estimate of the quantity of groundwater that can be withdrawn from a basin on an annual basis without depleting the basin (Scott et al. 1971).

Sustainable yield is the perennial yield of the basin minus any rights already committed by the Nevada State Engineer to other users.

Hydrographic basins are mapped on the basis of topographic divides and are used by the State of Nevada for the purposes of water appropriation and management.

Tables S–4 through **S–6** illustrate the estimated groundwater demand and the extent to which demand would affect sustainable yield of the affected basins under each alternative. Long-term groundwater demand would increase relative to the baseline by approximately 250, 871, and 106 acre-feet per year under the No Action, Expanded Operations, and Reduced Operations Alternatives, respectively. With the exception of demand on the Jackass Flats basin during construction of commercial solar power generation facilities (only under the Expanded Operations Alternative), water demand would be below the sustainable yield of the basins and no adverse impacts on those basins are expected. Construction and operation of commercial solar power generation facilities, which would have the largest water demand of any single activity or project, would draw water only from the Jackass Flats basin in Area 25. Under the Expanded Operations Alternative, water demand from constructing the facilities, although temporary and lasting about 42 months, was estimated to consume 27 to 129 percent of the basin's sustainable yield; the uncertainty in the sustainable yield reflects the results of multiple studies conducted by DOE (DOE 2008a) and the State of Nevada (NDCNR 2010).

S.3.1.5 Biological Resources

Implementing the alternatives would result in the permanent loss of native and nonnative vegetation of varying types, distribution and abundance, which would adversely impact wildlife that inhabit or otherwise use the NNSS. Vegetation would be lost through actions such as the drilling of new wells, grading and excavation for new facilities, detonations of high explosives, remediation of contaminated soils, and modification or construction of infrastructure such as roads and water lines.

In general, NNSA assessed the impacts on biological resources by considering the amount of land that would be disturbed under each alternative as a means to represent the permanent loss of vegetation and animal habitat. **Table S–7** provides an estimate of the amount of newly disturbed lands, and thus vegetation and habitat that would be lost, under each alternative.

The NNSS occupies approximately 870,000 acres of land, about 790,400 (91 percent) of which are undisturbed (DOE 2008b). Of the undisturbed land, implementing the No Action, Expanded Operations, and Reduced Operations Alternatives would require an additional 4,460 (0.6 percent), 25,877 (3.3 percent), and 2,740 (0.4 percent) acres, respectively.

Vegetation. Under the Expanded Operations Alternative, which would result in the highest land disturbance among the alternatives, the primary vegetation alliances that would be impacted are Creosote Bush/White Bursage Shrubland, Nevada Jointfir Shrubland, Saltbush Shrubland, Blackbrush Shrubland, and Burrobush/Wolfberry Shrubland. In total, these vegetation alliances cover about 483,200 acres, or about 61 percent of the undisturbed lands on the NNSS. Because of the prevalence of these vegetation types on the NNSS as well as regionally, the amount of additional habitat loss (25,877 acres) would not reduce the viability of any of the vegetation alliances or result in substantial adverse impacts on biodiversity. However, some areas of creosote bush/white bursage vegetation in Jackass Flats and Frenchman Flat, and blackbrush vegetation in Yucca Flat, are considered sensitive habitat (BN 1999; DOE/NV 1998a) because soils are particularly vulnerable to wind erosion and require longer periods of time to recover if disturbed. To the extent possible, NNSA would avoid activities that would disturb soils in these areas.

Table S–4 No Action Alternative Impacts on Groundwater Supply

Basin	***Water Demand, excluding solar power generation facility (acre-feet per year)***	***Water Demand, including construction demand from solar power generation facility (acre-feet per year)***	***Water Demand, including operational demand from solar power generation facility (acre-feet per year)***	***Sustainable Yield of Basin (acre-feet per year)***	***Maximum Percentage of Sustainable Yield Consumed during Construction***	***Maximum Percentage of Sustainable Yield Consumed during Operation***
Frenchman Flat (160)	474	474	474	1,070	44%	44%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	42	42	42	3,600	1%	1%
Fortymile Canyon, Jackass Flats Subdivision (227a)	47	397	297	824 – 3,944	10% – 48%	8% – 36%
Yucca Flat (159)	128	128	128	350	37%	37%
Total	691	1,041	941			

Table S–5 Expanded Operations Alternative Impacts on Groundwater Supply

Basin	***Water Demand, excluding solar power generation facility (acre-feet per year)***	***Water Demand, including construction demand from solar power generation facility (acre-feet per year)***	***Water Demand, including operational demand from solar power generation facility (acre-feet per year)***	***Sustainable Yield of Basin (acre-feet per year)***	***Maximum Percentage of Sustainable Yield Consumed during Construction***	***Maximum Percentage of Sustainable Yield Consumed during Operation***
Frenchman Flat (160)	591	591	591	1,070	55%	55%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	53	53	53	3,600	1%	1%
Fortymile Canyon, Jackass Flats Subdivision (227a)	59	1,059	759	824 – 3,944	27% – 129%	19% – 92%
Yucca Flat (159)	159	159	159	350	46%	46%
Total	862	1,862	1,562			

Table S–6 Reduced Operations Alternative Impacts on Groundwater Supply

Basin	***Water Demand, excluding solar power generation facility (acre-feet per year)***	***Water Demand, including construction demand from solar power generation facility (acre-feet per year)***	***Water Demand, including operational demand from solar power generation facility (acre-feet per year)***	***Sustainable Yield of Basin (acre-feet per year)***	***Maximum Percentage of Sustainable Yield Consumed during Construction***	***Maximum Percentage of Sustainable Yield Consumed during Operation***
Frenchman Flat (160)	427	427	427	1,070	40%	40%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	38	38	38	3,600	1%	1%
Fortymile Canyon, Jackass Flats Subdivision (227a)	42	242	217	824 – 3,944	6% – 29%	6% – 26%
Yucca Flat (159)	115	115	115	350	33%	33%
Total	622	822	797			

Table S–7 Land Disturbance

Source of Disturbance	***No Action Alternative (acres)***	***Expanded Operations Alternative (acres)***	***Reduced Operations Alternative (acres)***
Total Land Disturbance	4,460	25,877	2,740
Commercial Solar Power Generation Facilities	2,650	10,300	1,200

Implementing the No Action and Reduced Operations Alternatives would result in lower land disturbance (see Table S–7) in the same vegetation alliances, with the exception of Blackbrush Shrubland, which is not prevalent in the areas that would be affected by these alternatives. NNSA believes that the levels of additional habitat loss under either of these alternatives would not reduce the viability of any of the vegetation alliances or result in substantial adverse impacts on biodiversity because of the prevalence of these vegetation types on the NNSS as well as regionally. However, although less than under the Expanded Operations Alternative, activities under the No Action and Reduced Operations Alternatives would also occur in some areas of Jackass Flats and Frenchman Flat having creosote bush/white bursage vegetation. To the extent possible, NNSA would avoid activities that would disturb soils in these areas.

Sensitive and Protected Species. The desert tortoise, a "threatened" species, is the only plant or animal species on the NNSS that has been determined by the U.S. Fish and Wildlife Service (USFWS) to be threatened or endangered. NNSA focused its analysis of direct and indirect impacts on the desert tortoise because data are available to delineate desert tortoise habitat on the NNSS, and these data allow quantitative estimates of the potential impacts on desert tortoises from ongoing and proposed activities at the NNSS.

On the NNSS, the northern extent of the desert tortoise occurs between elevations of approximately 3,900 and 4,880 feet above mean sea level, and its distribution and population densities are shown in **Figure S–9**. In its 2009 *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada (2009 Biological Opinion*), USFWS concluded that activities on the NNSS would not jeopardize the continued existence of the Mojave population of desert tortoises, and no critical habitat would be destroyed or adversely modified (USFWS 2009). The *2009 Biological Opinion* also identified terms and conditions applicable to activities on the NNSS. Under these terms and conditions, USFWS determined that up to 2,710 acres of land could be disturbed, and up to 216 tortoises could be "taken" incidentally, that is, 22 could be killed or injured, and 194 could be harassed (captured, displaced, relocated, or behavior disrupted) without the need to reinitiate consultation.

Based on the distribution and a density range of 10–45 tortoises per square mile, NNSA estimated the amount of desert tortoise habitat disturbed and the range of the number of tortoises that could be taken under each alternative (**Table S–8**). The take of desert tortoises would be due primarily to harassment, rather than injury or death, because NNSA would implement its Desert Tortoise Compliance Program, which requires, in part, (1) conducting clearance surveys at project sites within 1 day of the start of project construction, (2) ensuring that environmental monitors are on site during heavy equipment operations, and (3) ensuring personnel are trained in the requirements of the *2009 Biological Opinion*.

Implementing any alternative would result in disturbing desert tortoise habitat; however, only the No Action and Expanded Operations Alternatives would result in disturbance in excess of that permitted by USFWS (Table S–8). Under the Expanded Operations Alternative, the estimated number of tortoises taken (163–346) could exceed that permitted by USFWS (216), whereas under the No Action and Reduced Operations Alternatives, the estimated number of tortoises taken (133–213 and 131–181, respectively) would be less than that permitted by USFWS. If either the disturbance of tortoise habitat or take of tortoises were reached and anticipated to be exceeded during implementation of the alternatives, NNSA would reinitiate consultation with USFWS in accordance with the *2009 Biological Opinion*.

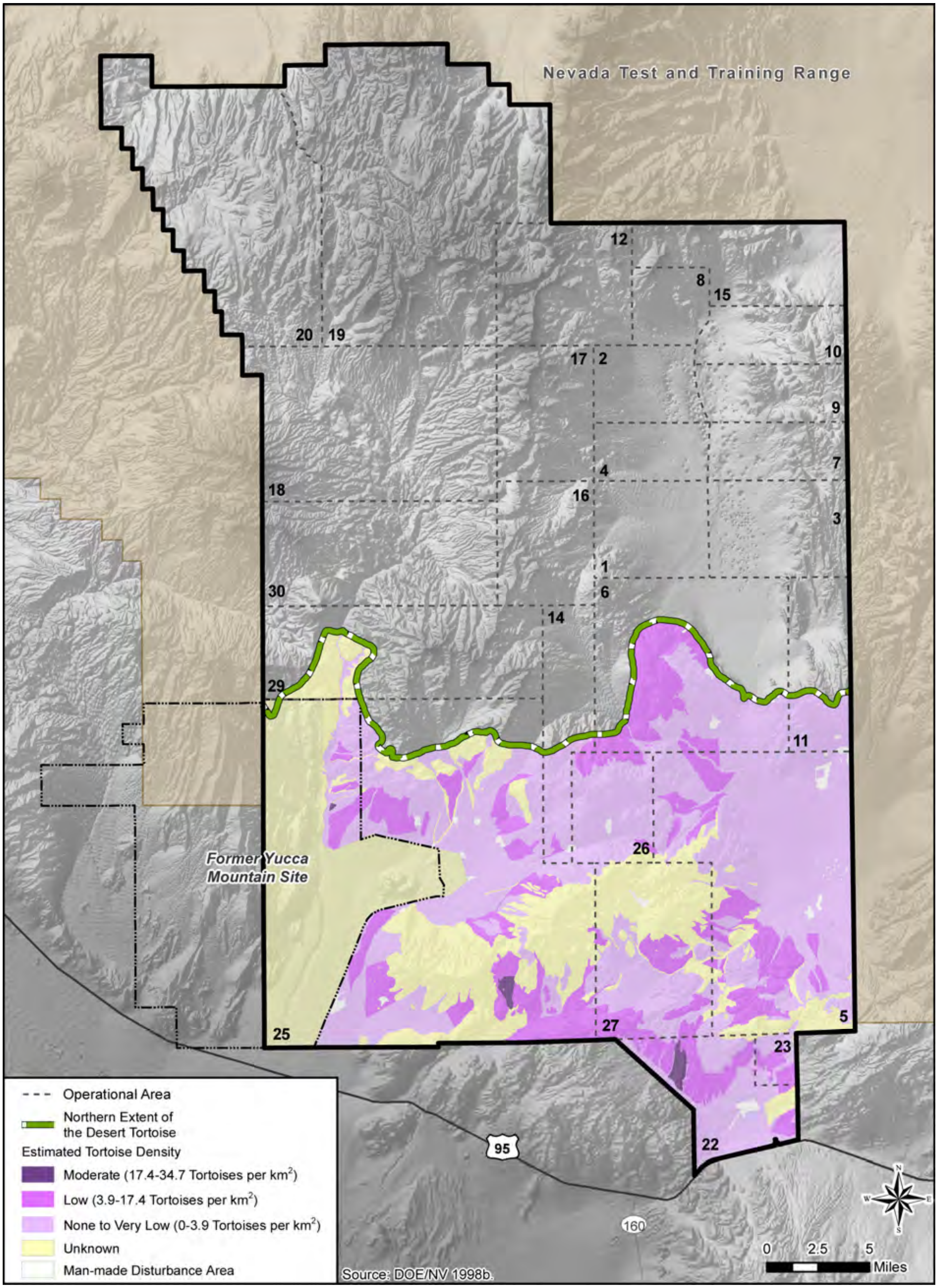


Figure S–9 Desert Tortoise Range and Abundance on the Nevada National Security Site

Table S–8 Potential Impacts on Desert Tortoises at the Nevada National Security Site

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*	*U.S. Fish and Wildlife Service Limit*
Area of Desert Tortoise Habitat Disturbed (acres)				
Total	**3,705**	**13,670**	**2,120**	**2,710**
Commercial Solar Power Generation Facilities	2,650	10,300	1,200	
Number of Desert Tortoises Taken				
Total	**133—213**	**163–346**	**131–181**	**216**
Commercial Solar Power Generation Facilities	0–41	0–161	0–19	

S.3.1.6 Air Quality

Ambient air quality in Clark and Nye Counties would be adversely impacted because of releases of air pollutants from stationary, mobile, and fugitive sources, with the magnitude of the impact variable by alternative. Greenhouse gases, also released from these sources, would contribute to global climate change.

Air quality is determined, in part, by measuring concentrations of certain pollutants (referred to as “criteria pollutants”) in the atmosphere. The U.S. Environmental Protection Agency (EPA) designates an area as “in attainment” for a particular pollutant if ambient air concentrations of that pollutant are below the National Ambient Air Quality Standards. Criteria pollutants regulated under these standards by both EPA and the State of Nevada include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and particulate matter (two different sizes of particulates are regulated).

Air quality also is determined, in part, by estimating emissions of hazardous air pollutants; these pollutants are known or suspected to cause cancer or other serious health effects, such as birth defects. EPA, under the Clean Air Act, established emission standards (the National Emission Standards for Hazardous Air Pollutants) for 188 such pollutants, most of which originate from manmade sources. Benzene, for example, is found in gasoline. In establishing the standards, EPA identified various industries and corresponding emission limits that, if exceeded, would require the use of additional control technologies to reduce such emissions to the maximum extent achievable.

Greenhouse gases are emitted from a wide variety of sources, including energy production, industrial processes, waste, agriculture, and forestry. Carbon dioxide is by far the primary greenhouse gas emitted in the United States (EPA 2009); other gases include methane, nitrous oxide, and a variety of fluorinated gases. Effects of these emissions on the climate involve very complex processes, although recent advances in the state of the science regarding these processes suggest a very high likelihood that greenhouse gases produced by humans are affecting climate in detectable and quantifiable ways (IPCC 2008).

Greenhouse Gases

Greenhouse gases are gaseous constituents of the atmosphere, both natural and anthropogenic (resulting from or produced by human beings), that absorb and emit thermal infrared radiation (heat) emitted by the Earth’s surface, the atmosphere itself, and clouds. Water vapor, carbon dioxide, nitrous oxide, methane, and ozone are the primary greenhouse gases in the Earth’s atmosphere. Greenhouse gases trap heat between the Earth’s surface and the lower part of the atmosphere; this phenomenon is called the greenhouse effect.

For each alternative, NNSA estimated the amount of nonradiological and hazardous air pollutants, and greenhouse gases (expressed as carbon dioxide-equivalents) that would be released during the construction of proposed projects and the operation of ongoing and proposed projects (**Table S–9**).

Table S–9 Emissions of Air Pollutants and Greenhouse Gases (tons per year)

		No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
	Estimated 2008 Emissions	***Annual Average Operational Emissions in 2015***		
Particulate Matter$_{10}$	3.3	6.8	20.1	4.4
Particulate Matter$_{2.5}$	2.7	3.4	8.1	2.6
Carbon Monoxide	181.3	123.3	160.9	109.8
Nitrogen Oxides	64.2	39.7	56.6	36.3
Sulfur Dioxide	0.41	0.55	1.1	0.41
Volatile Organic Compounds	4.0	5.9	11.0	4.8
Lead	0.0024	0.030	~0.010	0.0024
Hazardous Air Pollutants	0.56	0.41	~0.53	0.40
Carbon Dioxide-equivalent	50,478	39,690	49,303	38,045
	Estimated 2008 Emissions	***Peak Year Construction Emissions*** [a]		
Particulate Matter$_{10}$	3.3	20.0	129.1	8.4
Particulate Matter$_{2.5}$	2.7	6.0	35.6	2.6
Carbon Monoxide	181.3	44.8	296.5	24.4
Nitrogen Oxides	64.2	56.0	388.6	24.4
Sulfur Dioxide	0.41	0.14	0.68	0.08
Volatile Organic Compounds	4.0	6.2	41.6	2.8
Lead	0.0024	0.0000089	0.000013	0.0000071
Hazardous Air Pollutants	0.56	0.038	0.058	0.030
Carbon Dioxide-equivalent	50,478	5,686	25,107	2,774

Particulate Matter$_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate Matter$_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

[a] Represents emissions for first year of construction, as construction activity would be linearly distributed over multiple years; however, mobile source emissions would be highest in the first construction year.

In general, emission-generating activities under any alternative would be widely dispersed over the 1,360-square-mile area of the NNSS, as well as along the U.S. Route 95 corridor between Las Vegas and the NNSS. Thus, at the boundaries of the NNSS, ambient air concentrations are expected to be below the National Ambient Air Quality Standards. Nye County would continue to be in attainment for all criteria pollutants, while in Clark County, these emissions would not cause or contribute to any new violations of the standards or increases in the frequency or severity of any violations of the standards. Greenhouse gas emissions, while estimated to decrease relative to baseline levels, would still contribute to global climate change. NNSA also estimates that emissions of hazardous air pollutants would continue to remain low under any alternative, not require additional emission control technologies, and, therefore, would not pose an undue health risk to workers or the public.

More specifically, emissions of carbon monoxide, nitrogen oxides, and greenhouse gases attributable to the levels of operations would decrease relative to existing levels under any alternative. These reductions would be due primarily to the introduction over time of newer NNSA fleet and worker vehicles with improved fuel economy, and improved combustion and emissions treatment efficiencies of electric power generation sources on the NNSS.

In contrast, emissions of volatile organic compounds, sulfur dioxide, and particulate matter would increase relative to existing levels under the No Action and Expanded Operations Alternatives. Increases in volatile organic compounds reflect the increased use of ethanol-blended fuels in vehicles. Sulfur dioxide and particulate matter emissions would increase primarily because of new projects and an increase in the levels of operations on the NNSS. Corresponding emissions under the Reduced Operations Alternative would tend to remain similar to existing emissions levels.

S.3.1.7 Visual Resources

The evaluation of visual impacts requires an understanding and identification of the visual resources (features) of the landscape, an assessment of the character and quality of those resources relative to the overall regional visual character, and a determination of the importance to people, or sensitivity, of views of visual resources in the landscape. NNSA evaluated the impact on visual resources in consideration of scenic quality classes, defined as follows:

- Class A – The visual environment is made up of outstanding natural and manmade physical features.
- Class B – The visual environment is made up of a combination of outstanding natural and manmade physical features and those that are common to the region.
- Class C – The visual environment is made up of natural and manmade physical features that are common to the region.

Under the No Action Alternative, only the construction of a commercial solar power generation facility in Area 25 would affect the existing visual resources of the NNSS. Because of projected traffic volumes along U.S. Route 95 (about 3,000 average daily trips), viewer sensitivity (i.e., the importance of a particular viewshed to the public) would remain moderate. A solar power generation facility and associated transmission line, which would occupy about 2,650 acres, would introduce a source of glare, alter the existing visual character of a landscape that is largely undeveloped, be visible to highly sensitive viewers, and reduce the existing visual quality from Class B to Class C.

Under the Expanded Operations Alternative, new facilities would be constructed or reconfigured, an existing electric transmission line would be upgraded, and geothermal and solar energy projects would be constructed. Because of projected traffic volumes along U.S. Route 95, viewer sensitivity would change from moderate to high near Mercury (approximately 5,310 average daily trips) and near Area 25 (approximately 3,030 average daily trips). For most such facilities, impacts on visual resources would not be adverse. However, the addition of approximately 200,000 square feet of facilities to the Desert Rock Airport would be visible from U.S. Route 95 and would have an adverse visual impact, as would the construction of commercial solar power generation facilities on 10,300 acres in Area 25, which would reduce the existing visual quality from Class B to Class C. The geothermal project could also alter the visual character and reduce visual quality if its facilities are visible from U.S. Route 95.

Under the Reduced Operations Alternative, only the construction of a commercial solar power generation facility in Area 25 would affect existing visual resources. A solar power generation facility, which would occupy about 1,200 acres, would reduce the existing visual quality of this area of Area 25 from Class B to Class C, even though viewer sensitivity would remain moderate (2,980 average daily trips).

S.3.1.8 Cultural Resources

Cultural resources include prehistoric and historic archaeological districts, sites, buildings, structures, or objects created or modified by human activity. Cultural resources also include traditional cultural properties—properties that are eligible for inclusion in the National Register of Historic Places (the Register) because of their association with the cultural practices or beliefs of a living community that are (a) rooted in that

> **National Register of Historic Places**
>
> The National Register of Historic Places is the official list of the Nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources.

community's history and (b) important in maintaining the continuing cultural identity of the community (Parker and King 1998).

An area's potential for containing cultural resources sites is site specific and influenced by factors such as the presence of water, food sources, shelter (e.g., caves or rock alcoves), source of materials for building shelters, and less-tangible but equally important factors such as features that may have spiritual value to a culture. While all areas of the NNSS have the potential to possess cultural resources, the areas with the highest number of recorded cultural resources are Rainier and Pahute Mesas in the northwest, Jackass Flats in the southwest, and Yucca Flat in the east. Although it is not possible to predict with a high degree of certainty the number of cultural resources sites in a given area, the record provided by cultural resources surveys conducted at the NNSS provides a means to estimate site densities and, therefore, the likelihood of encountering a cultural resources site within a given area.

Cultural Resources Management

As part of compliance with Section 106 of the National Historic Preservation Act, the National Nuclear Security Administration (NNSA) conducts cultural resource surveys and identifies cultural resources within the area of potential effect for all proposed projects and activities (undertakings) that may affect cultural resources. If possible, NNSA avoids significant cultural resources impacts by adjusting the location of a proposed undertaking. When avoidance is not practicable, NNSA consults with the Nevada State Historic Preservation Officer, and possibly the Advisory Council on Historic Preservation, to identify measures to mitigate adverse impacts on those resources.

Under the No Action Alternative, the disturbance of approximately 4,460 acres of land would affect an estimated 1,855 cultural resources sites, 575 of which would be eligible for inclusion in the Register. NNSA estimates that implementing the Expanded Operations Alternative would disturb approximately 25,877 acres of land and thereby directly affect about 7,688 cultural resources sites, about 2,447 of which would be eligible for inclusion in the Register. Under the Reduced Operations Alternatives, approximately 2,170 acres of land would be disturbed, directly affecting about 861 cultural resources sites; about 266 of these sites would be eligible for inclusion in the Register.

Commercial solar power generation facilities, including an associated transmission line, would be developed in Area 25. Solar power generation facilities would vary in size; under the No Action, Expanded Operations, or Reduced Operations Alternatives, the facilities would disturb approximately 2,650, 10,300, and 1,200 acres, respectively. **Table S–10** presents the estimated number of cultural resources sites that would be impacted by solar power generation facilities under the three alternatives, including a subset of those eligible for listing in the Register.

Table S–10 Cultural Resource Sites Impacted by Solar Facilities

Alternative	*Cultural Resources Sites*	*National Register of Historic Places – Eligible Sites*
No Action	1,802	557
Expanded Operations	7,004	2,163
Reduced Operations	816	252

S.3.1.9 Waste Management

At the NNSS, NNSA operations, environmental restoration, and decontamination and decommissioning activities would generate low-level radioactive waste; mixed low-level radioactive waste; transuranic waste; hazardous waste; explosive waste; and nonhazardous wastes, including sanitary solid waste, hydrocarbon-contaminated soil and debris, and construction and demolition debris.

NNSA assessed waste management impacts by comparing the projected waste volumes generated or disposed under each alternative to current waste management practices and/or the availability of onsite or offsite waste management capacity. **Table S–11** summarizes the types and volumes of wastes generated and disposed at the NNSS under the three alternatives. The estimates of low-level radioactive waste and mixed low-level radioactive waste volumes to be disposed of at the NNSS under the Expanded Operations Alternative are based upon conservative estimates from waste-generating facilities, and the aggregated totals reflect this conservatism (i.e., likely overestimates quantities). Appendix A, Section A.2.2.1, Table A–6, of this SWEIS provides additional details regarding generators and their associated waste volumes; Chapter 6, Table 6–13, of this SWEIS shows historical and projected disposal volumes.

Table S–11 Waste Generated and Disposed at the Nevada National Security Site

Waste Stream	*Alternatives*		
	No Action (cubic feet)	*Expanded Operations (cubic feet)*	*Reduced Operations (cubic feet)*
Waste Volumes Generated at the Nevada National Security Site			
Low-level radioactive waste	1,200,000	1,300,000	1,200,000
Mixed low-level radioactive waste	520,000	520,000	520,000
Transuranic waste	9,600	19,000	7,100
Hazardous waste	210,000	350,000	190,000
Sanitary solid waste and construction and demolition debris	3,900,000	10,000,000	3,700,000
Waste Volumes Disposed at the Nevada National Security Site			
Low-level radioactive waste	15,000,000	48,000,000	15,000,000
Mixed low-level radioactive waste	900,000	4,000,000	900,000
Sanitary solid waste and construction and demolition debris	3,600,000	9,100,000	3,400,000

Construction and operation of a solar power generation facility in Area 25 at the NNSS under each of the three alternatives also would generate hazardous waste, sanitary solid waste, and construction debris. **Table S–12** describes the estimated volumes of these wastes.

Table S–12 Waste Generated by Construction and Operation of Commercial Solar Power Generation Facilities

Waste Stream	*Alternatives*		
	No Action (cubic feet)	*Expanded Operations (cubic feet)*	*Reduced Operations (cubic feet)*
Waste Volumes Generated During Construction			
Hazardous waste	6,500	27,000	2,700
Sanitary solid waste and construction debris	140,000	600,000	60,000
Waste Volumes Generated During Operations (per year)			
Hazardous waste	42,000	180,000	18,000
Sanitary solid waste and construction and demolition debris	160,000	630,000	77,000

Waste Definitions

Radioactive Waste – Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and is of negligible economic value considering costs of recovery.

Transuranic Waste – Radioactive waste containing alpha particle-emitting radionuclides having an atomic number greater than 92 (the atomic number of uranium) and half-lives greater than 20 years, in concentrations greater than 100 nanocuries per gram.

Low-Level Radioactive Waste – Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent fuel, or byproduct material as defined by Section 11e(2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the concentration of transuranic elements is less than 100 nanocuries per gram.

Hazardous Waste – A category of waste regulated under the Resource Conservation and Recovery Act. To be considered hazardous, a waste must be a solid waste under the Resource Conservation and Recovery Act and must exhibit at least one of four characteristics described in 40 *Code of Federal Regulations* (CFR) 261.20-24 (ignitability, corrosivity, reactivity, and toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

Mixed Waste – Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and the Resource Conservation and Recovery Act, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste, such as mixed low-level radioactive waste and mixed transuranic waste.

Under the No Action and Reduced Operations Alternatives, sufficient capacity would be available at the NNSS to dispose the projected volume of low-level radioactive waste and mixed low-level radioactive waste at the Area 5 Radioactive Waste Management Complex. The Waste Isolation Pilot Plant near Carlsbad, New Mexico, maintains adequate capacity to enable the disposal of transuranic waste generated at the NNSS. In addition, adequate capacity is expected to exist in Nevada and elsewhere in the United States to recycle or treat, store, and dispose hazardous waste generated at the NNSS, including waste generated by a solar power generation facility. For instance, four treatment, storage, and disposal facilities were permitted to receive hazardous waste in Nevada as of 2009 (NDEP 2009). There is also existing capacity at the NNSS to dispose nonhazardous waste (including such waste from a solar power generation facility); as of 2008, NNSA estimated that the three NNSS landfills have the following waste capacities: the Area 6 Hydrocarbon Solid Waste Disposal Site, 2.8 million cubic feet; the Area 9 U10c Solid Waste Disposal Site, 15 million cubic feet; and the Area 23 Solid Waste Disposal Site, 13 million cubic feet.

Under the Expanded Operations Alternative, disposal of low-level radioactive waste and mixed low-level radioactive waste would require all of the disposal capacity at the Area 5 Radioactive Waste Management Complex, as well as activation of the Area 3 Radioactive Waste Management Site. The Waste Isolation Pilot Plant maintains adequate capacity to enable the disposal of transuranic waste generated at the NNSS. In addition, for the reasons described immediately above, adequate capacity is expected to exist in Nevada and elsewhere in the United States to recycle or treat, store, and dispose hazardous waste generated at the NNSS, including the waste from a solar power generation facility, and to dispose nonhazardous solid waste in NNSS or offsite landfills.

S.3.1.10 Human Health

Surface-disturbing activities, tests, and experiments (operations) at various facilities on the NNSS could result in health impacts on workers and the public from exposure to radioactive waste and materials and hazardous chemicals. Workers could also be exposed to hazardous chemicals and would be subject to industrial accidents.

Radiological impacts were estimated (numerically calculated) for two public receptors: the general population living within 50 miles of a location at which radiation is released, and a maximally exposed individual, which is a hypothetical individual assumed to be at the offsite location that would receive the maximum radiological exposure. General population impacts were estimated for a residential scenario whereby people are exposed to radiation emitted from operational facilities, other locations where experiments are to be performed, environmental restoration activities, or legacy weapons testing areas that emit tritium or are contaminated with particulate radioactive materials. Impacts on the maximally exposed individual were estimated for a scenario that includes the same exposure pathways assumed for the general population, but assumes an increased amount of time spent outdoors and a higher rate of contaminated food consumption. NNSA also considered potential impacts on the public from exposure to hazardous chemicals.

Potential radiological and chemical impacts also were considered for two categories of workers: (1) those directly involved in activities associated with assigned missions (involved workers) and (2) nearby, noninvolved workers. An involved worker is defined as a person who is exposed to radioactive or chemical emissions during normal operations. A noninvolved worker is defined as a person who is incidentally exposed to radioactive or chemical emissions, either during normal operations or as a result of an accident.

Radiological impacts were estimated (numerically calculated) for involved workers routinely exposed to radioactive emissions, but were not estimated for these workers under accident conditions. In the event of an accident, although involved workers could receive a radiation dose, the impacts were not estimated because it is recognized that an accident could lead to extensive physical injuries or high radiological exposures and ultimately to worker deaths.

Impacts also were estimated (numerically calculated) for noninvolved workers incidentally exposed to radiological emissions under accident conditions. Noninvolved workers generally were assumed to be 110 yards downwind of the emission source, except in those instances where the presence of a noninvolved worker would not be logical (for example, inside the exclusion zone of a high-explosives experiment).

In addition, NNSA estimated impacts on the entire workforce (involved plus noninvolved) from industrial accidents.

Normal Operations. Under the No Action Alternative, the public and workers would be exposed to radiation primarily from widespread diffuse sources, such as residual radioactive contamination, and from releases from activities associated with the Stockpile Stewardship and Management Program at the Dense Plasma Focus Facility in Area 11 and the Environmental Restoration Program. NNSA estimates that the offsite population would receive 0.50 person-rem, resulting in an estimated risk of 0.0003 latent cancer fatalities to that population (an annual risk of 1 chance in 3,300 of a single latent cancer fatality in the population). The maximally exposed individual would receive an estimated dose of 2.8 millirem, resulting in a risk of 1 chance in 500,000 (0.000002) of contracting a fatal cancer. The involved worker population would receive an estimated collective dose of 5.2 person-rem, resulting in a risk of 0.003 latent cancer fatalities to that population (an annual risk of 1 chance in 330 of a single latent cancer fatality in the population). The estimated latent cancer fatalities to the public and worker populations under the Reduced Operations Alternative would be the same as or less than those under the No Action Alternative.

Under the Expanded Operations Alternative, the public and workers would be exposed to radiation primarily from widespread diffuse sources, such as residual radioactive contamination, and from releases from activities associated with the Stockpile Stewardship and Management Program at the Dense Plasma Focus Facility in Area 11 and the Big Explosives Experimental Facility in Area 4, tracer experiments under the Work for Others Program, and the Environmental Restoration Program. NNSA estimates that the offsite population would receive 0.89 person-rem, resulting in a risk of 0.0005 latent cancer fatalities to that population (an annual risk of 1 chance in 2,000 of a single latent cancer fatality in the population). The maximally exposed individual would receive an estimated dose of 4.8 millirem, resulting in an annual risk of 1 chance in 330,000 (0.000003) of contracting a fatal cancer. The involved worker population would receive an estimated collective dose of 6.6 person-rem, resulting in a risk of 0.004 latent cancer fatalities to that population (an annual risk of 1 chance in 250 of a single latent cancer fatality in the population).

Radiological and Chemical Accidents. NNSA considered a range of potential accidents, including the maximum reasonably foreseeable accident, associated with ongoing and proposed projects and activities at various facilities on the NNSS. The same types of operations involving radioactive waste and materials, and hazardous chemicals would occur at the facilities under each of the alternatives, but the levels of operations would vary by alternative. Nonetheless, the accident scenarios and consequences analyzed are the same for each alternative because the differences in accident frequencies (probabilities of occurrence) due to the levels of operations are within the uncertainty range of the accident frequencies.

Maximum reasonably foreseeable accidents involving a release of radioactivity would involve a severe earthquake at the Device Assembly Facility in Area 6 followed by the release of 5 kilograms of plutonium, or an explosion followed by the release of 1 kilogram of plutonium to the atmosphere. The estimated probabilities of these events occurring are 1×10^{-6} and 8×10^{-4} per year of operation, respectively (1 chance in 1,000,000 and 1 chance in 1,250).

Maximum Reasonably Foreseeable Accident

A maximum reasonably foreseeable accident is an accident with the most severe consequences that can reasonably be expected to occur.

The severe earthquake accident would result in the highest consequences for the public and workers. If it were to occur, the maximally exposed individual would receive an estimated dose of 860 millirem, corresponding to a latent cancer fatality risk of 0.0005 (1 chance in 2,000). The offsite population within 50 miles would receive a collective dose estimated to be 113 person-rem; the calculated number of latent cancer fatalities associated with this dose is 0.07, implying that the most likely outcome would be no additional latent cancer fatalities in the exposed population. An involved worker within the Device Assembly Facility could be fatally injured in the explosion, and a noninvolved worker would receive an estimated dose of 2,800 rem, resulting in a lethal dose.

The above consequences would be reduced by a factor of 1 million when the probability of the accident occurring is taken into account. Because the probability of this accident is 1 chance in 1 million, the Device Assembly Facility accident involving an explosion followed by release of plutonium presents a higher risk (consequence times probability) to the public. The explosion followed by a plutonium release accident represents an estimated latent cancer fatality risk to the maximally exposed individual of 9×10^{-8} (1 chance in 11 million), the risk of a single latent cancer fatality in the population of 1×10^{-5} (1 chance in 100,000), and a latent cancer fatality risk to a noninvolved worker of 3×10^{-6} (1 chance in 300,000).

The maximum reasonably foreseeable accident involving a chemical release would involve an accidental chlorine gas release from a railcar at the Nonproliferation Test and Evaluation Complex. This hypothetical accident is expected to be in the "extremely unlikely" to "beyond extremely unlikely" frequency category, in other words, in the 10^{-4} (1 chance in 10,000) to 10^{-6} (1 chance in 1,000,000) per year or lower frequency range.

NNSA estimates that fatal concentrations of chlorine would extend downwind a few miles under typical daytime conditions and for 5 to 6 miles, or greater under more-stable (reduced windspeeds and limited vertical mixing) nighttime conditions. Chlorine concentrations that could lead to irreversible and long-lasting health effects would extend further downwind. NNSA considers these health impacts to be conservative in that the analysis was based on a 1-hour chlorine release; during actual accidents, however, releases occurred over many hours, which resulted in lower concentrations than estimated here.

Members of the public likely would not be affected by a chlorine release because the remote location of the Nonproliferation Test and Evaluation Complex on the NNSS and the additional buffer provided by the Nevada Test and Training Range would keep members of the public at least 8 miles away.

Industrial Accidents. NNSA estimated the injuries and fatalities that could arise in the workforce from industrial accidents based upon accident rates from DOE and the U.S. Department of Labor (DOE 2010a; DOL 2010a, 2010b). Total recordable cases, as well as those cases that result in lost workdays, restricted duty, or require a transfer, were estimated for construction activities and facility operations (see **Table S–13**). Industrial accidents that could result in fatalities are more likely to occur during construction activities than during facility operations include, for example, electrocution and equipment mishaps. NNSA estimates that less than one fatality would occur during construction activities at the NNSS (see **Table S–14**).

Table S–13 Estimated Incidence of Nonfatal Accidents at the Nevada National Security Site

Location/Activity	*No Action Alternative*		*Expanded Operations Alternative*		*Reduced Operations Alternative*	
	Total Recordable Cases	*Lost Workdays, Restrictions, Transfer*	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*
All Operations (annual total)	32	14	44	20	28	13
Commercial Solar Power Generation Facilities – Operations (annual)	6.2	3.2	8.3	4.2	5.2	2.7
Commercial Solar Power Generation Facilities – Construction	60	31	110	56	44	23

Table S–14 Estimated Incidence of Fatal Construction Accidents at the Nevada National Security Site

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
All Operations Annually (includes commercial solar power generation facilities)	0.019	0.031	0.015
Commercial Solar Power Generation Facilities Construction (during construction)	0.019	0.029	0.015

Table S–15 Summary of Potential Direct and Indirect Impacts at the Nevada National Security Site

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Land Use			
National Security/Defense Mission	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on the NNSS and primary land uses adjacent to the site.	No impacts were identified from the increased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. The Reserved Zone would decrease in area by 5.5 percent; the Research, Test, and Experiment Zone would increase by 21 percent.	No impacts were identified from the decreased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. The Reserved Zone would decrease in area by 71 percent, and Areas 18, 19, 20, and 30 would change from Reserved to Limited Operations, which is a new land use zone designation.
	<u>*Airspace*</u> No new impacts were identified from airspace activities because these activities would be maintained at the current levels of air traffic, navigational aid services, and airspace structure, and would be coordinated and scheduled by the controlling entity responsible for NNSS airspace, the Nellis Air Traffic Control Facility.	<u>*Airspace*</u> Minimal impacts would result from increased usage of aerial platforms and airspace usage, as these activities would continue to be coordinated with the Nellis Air Traffic Control Facility.	<u>*Airspace*</u> Same as under the No Action Alternative.
Environmental Management Mission	No impacts were identified from the continuation of activities at the current levels of operations because activities under this alternative would not change.	No impacts were identified from the increased activities under this alternative as these activities would be compatible with land use designations and primary land uses adjacent to the site.	Same as under the No Action Alternative.
Nondefense Mission	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on the NNSS and primary land uses adjacent to the site. The Solar Enterprise Zone would be renamed the Renewable Energy Zone.	Same as under the No Action Alternative, plus: • Area 15 would be changed from a Reserved Zone to a Research Test and Experiment Zone and the Solar Enterprise Zone would be renamed the Renewable Energy Zone and increase in area by 276 percent.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Infrastructure and Energy			
Infrastructure	Buildings, transportation, water supply, and services are adequate to handle temporary increases in demands during construction and long-term demands during operations. Infrastructure would be maintained as needed to accommodate ongoing activities. In addition, new low-level radioactive waste cells would be developed to accommodate disposal of those waste types. Up to 50 new wells would be developed by the Underground Test Area Project.	Same as under the No Action Alternative, plus: • New buildings (about 479,000 square feet), ranges and training facilities (13,455 acres), water distribution lines, wastewater treatment systems (septic tanks), power lines, and communication systems would be added and improvements would be made to existing infrastructure. In addition, new low-level and mixed low-level radioactive waste cells would be developed to accommodate disposal of increased volumes of those waste types and new sanitary and construction, decontamination and decommissioning waste landfills in Areas 23 and 25. • An upgrade to the NNSS electrical transmission system would increase capacity from 40 to 100 megawatts. • A 5-megawatt photovoltaic solar power generation facility would be developed in Area 6.	Same as under the No Action Alternative, except: • Buildings, transportation, water supply, and services would experience reduced demands. Because most operations in the northwestern portion of the NNSS (within Areas 18, 19, 20, 29, and 30) would be discontinued, non-essential infrastructure in those areas would be shut down or removed.
	A commercial 240-megawatt solar power generation plant would be developed in Area 25 of the NNSS. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or wastewater infrastructure.	Up to 1,000 megawatts of commercial solar power generating capacity would be developed in Area 25 of the NNSS. The commercial facilities would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or wastewater infrastructure.	A commercial 100-megawatt solar power generation plant would be developed in Area 25 of the NNSS. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or wastewater infrastructure.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Energy	Average electric power demand would be 22 megawatts, with a peak demand of 30 megawatts.	Average electrical power demand would be 28 megawatts, with a peak demand of 41 megawatts. As noted under Infrastructure, NNSA would rebuild the 138-kilovolt transmission system on the NNSS to accommodate increased loads.	Average electrical power demand would be 20 megawatts, with a peak demand of 27 megawatts.
	Estimated annual usage of various liquid fuels is as follows: Fuel oil for heating – 66,000 gallons Unleaded gasoline – 427,000 gallons Ethanol/E85 – 217,000 gallons #2 Diesel fuel – 65,000 gallons Biodiesel fuel – 343,000 gallons NNSA would maintain and repair energy infrastructure.	Estimated annual usage of various liquid fuels is as follows: Fuel oil for heating – 83,000 gallons Unleaded gasoline – 534,000 gallons Ethanol/E85 – 271,000 gallons #2 Diesel fuel – 81,000 Biodiesel fuel – 429,000 gallons NNSA would maintain and repair energy infrastructure.	Estimated annual usage of various liquid fuels is as follows: Fuel oil for heating – 59,000 gallons Unleaded gasoline – 384,000 gallons Ethanol/E85 – 195,000 gallons #2 Diesel fuel – 59,000 gallons Biodiesel fuel – 309,000 gallons NNSA would maintain and repair energy infrastructure.
Transportation [a] and Traffic			
Transportation			
Out-of-state Low-Level Radioactive and Mixed Low-Level Radioactive Waste			
Truck transport			
Worker risk (latent cancer fatality)	1 (1.2)	3 (3.1)	1 (1.2)
Population risk (latent cancer fatality)	0 (0.2)	1 (0.6)	0 (0.2)
Radiological accident (latent cancer fatality)	0 (0.0001)	0 (0.01)	0 (0.0001)
Traffic fatality	2	6	2
Rail transport only			
Worker risk (latent cancer fatality)	0 (0.3)	1 (1.1)	0 (0.3)
Population risk (latent cancer fatality)	0 (0.1)	0 (0.3)	0 (0.1)
Radiological accident (latent cancer fatality)	0 (0.00005)	0 (0.005)	0 (0.00005)
Traffic fatality	6	15	6
Combined rail-to-truck transport			
Worker risk (latent cancer fatality)	0 (0.5)	1 (1.5)	0 (0.5)
Population risk (latent cancer fatality)	0 (0.1)	0 (0.3)	0 (0.1)
Radiological accident (latent cancer fatality)	0 (0.00005)	0 (0.005)	0 (0.00005)
Traffic fatality	6	15	6

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Traffic			
Onsite traffic impacts	There would be about 20 additional vehicle trips per day on Mercury Highway, which would operate at a level of service A during peak traffic hours. Construction of a 240-megawatt commercial solar power generation facility would result in 250 (average over the period of construction) and 500 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 800 additional vehicle trips per day on Mercury Highway, which would operate at a level of service B or better during peak traffic hours. Construction of 1,000 megawatts of commercial solar power generation facilities would result in 750 (average over the period of construction) and 1,500 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 150 fewer vehicle trips per day on Mercury Highway, which would operate at a level of service A during peak traffic hours. Construction of a 100-megawatt commercial solar power generation facility would result in 400 (average over the period of construction) and 800 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.
Regional traffic impacts	U.S. Route 95, State Route 160, and State Route 372 would experience the greatest increases in daily traffic volumes in the area around the NNSS; however, these would be relatively minor and would not affect the levels of service on regional roadways. Overall traffic volumes would increase during peak hours because of additional traffic volumes attributable to construction and operation of a solar power generation facility.	Segments of Nevada State Route 372, State Route 160, U.S. Route 95, and State Route 164 would experience moderately high percent increases in daily traffic compared to the No Action Alternative. Most of the increase in daily traffic volumes during the peak hours would be attributable to workers commuting to the NNSS; any detectable changes in traffic volumes would primarily occur during the main commuting hours and at the entry gates of the NNSS (the main entrance gate for regular NNSS employees and Gate 510 for those associated with the construction and operation of the commercial solar power generation facilities in Area 25). However, the levels of service on public roadways in the region would not change.	Although the number of commuter trips for the reduced NNSS workforce would decrease, overall traffic volumes would increase slightly during peak hours because of additional traffic volumes attributable to construction and operation of the solar power generation facility. Impacts on regional traffic under this alternative would, therefore, be slightly less or similar to those described under the No Action Alternative; volume-to-capacity ratios and levels of service would not change.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Socioeconomics			
	Operation of a 240-megawatt commercial solar power generation facility would increase employment by 150 full-time equivalents, of which about 15 solar power generation facility employees would relocate from outside of the region. Sufficient housing exists to support the increased population. A total of 22 new students relocating to Clark County would create a need for 1 additional teacher to maintain the student-to-teacher ratio. An increase of 6 new students in Nye County would not result in a need for additional teachers. Direct jobs would reduce unemployment by 0.07 and 0.99 percent, respectively, in Clark and Nye Counties.	Site employment would increase by 625 full-time equivalents; about 63 employees would relocate from outside of the region. Sufficient housing exists in the area to support the increased population. A total of 92 new students relocating to Clark County would create a need for 4 new teachers to maintain the student-to-teacher ratio. An increase of 27 new students in Nye County would create the need for 1 new teacher to maintain the student-to-teacher ratio. Direct jobs would reduce unemployment by 0.31 and 4.2 percent, respectively, in Clark and Nye Counties.	Site employment would decrease by 45 full-time equivalents, increasing unemployment in Clark County by about 0.03 percent and in Nye County by about 0.39 percent. Additional employees would not relocate to Clark or Nye County and there would be no need for new housing or teachers.
	Approximately 500 full-time equivalents over 35 months, with a peak of 1,000 full-time equivalents, would need to be hired for construction of the solar power generation facility.	Approximately 750 full-time equivalents over 42 months, with a peak of 1,500 full-time equivalents, would need to be hired for construction of the solar power generation facility. Other construction projects at the NNSS would require approximately 250 full-time equivalents over the 10-year period.	Approximately 400 full-time equivalents over 32 months, with a peak of 800 full-time equivalents, would need to be hired for construction of the solar power generation facility.
	Direct jobs, indirect jobs, and construction materials purchases would reduce unemployment and have a beneficial effect on local government revenues.	Direct jobs, indirect jobs, and construction materials purchases would have a beneficial effect on the local economy and government revenues.	Direct construction jobs and indirect jobs would reduce the unemployment rate in the region and would have a beneficial impact on the economy in the region. Job loss would have a small negative impact on the local economy; construction material purchases for the solar power generation facility would have a small positive economic impact, including generating additional revenues for local governments.
	Buildings associated with construction and operation of a solar power generation facility and increased site personnel would create a modest increase in demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a larger solar power generation facility and other facilities on site and the increase in personnel would create a greater demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a solar power generation facility would create a greater demand for onsite security and fire and rescue services.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Geology and Soils			
National Security/Defense Mission	About 700 acres of soil would be disturbed by dynamic experiments in boreholes, explosives experiments, drillback operations, Office of Secure Transportation training and exercises, experiments involving biological stimulants, and counterterrorism training.	About 13,455 acres of soil would be disturbed by the same kinds of activities as under the No Action Alternative, including: Up to 10,000 acres of soil would be disturbed for an Office of Secure Transportation training facility; 120 acres for depleted uranium experiment sites; and 3,335 acres for additional explosives experiments, new test beds and training facilities, drillback operations, and additions to existing aviation facilities at the NNSS.	About 430 acres of soil would be disturbed by many of the same kinds of activities as under the No Action Alternative, except: There would be 50 percent fewer explosive experiments and 33 percent fewer Office of Secure Transportation training and exercises.
Environmental Management Mission	About 190 acres of soil would be disturbed for construction of new waste cells at the Area 5 Radioactive Waste Management Complex. Up to 420 acres of soil would be disturbed as part of the Environmental Restoration Program, Soils Project cleanup. Up to 500 acres of soil would be disturbed for development of Underground Test Area project monitoring wells.	About 600 acres of soil would be disturbed for construction of new waste cells at the Area 5 Radioactive Waste Management Complex. About 35 acres of soil would be disturbed for new sanitary, decontamination, decommissioning, and construction waste landfills in Areas 23 and 25. Environmental Restoration would be the same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission	Construction of a commercial solar power generation facility and associated transmission lines would disturb approximately 2,650 acres.	Construction of 1,000 megawatts of commercial solar power generation facilities and associated transmission lines would disturb up to 10,300 acres. Replacing the existing 138-kilovolt NNSS electrical transmission line would disturb about 467 acres of soil. Construction of a DOE photovoltaic solar power generation facility would disturb about 50 acres of land. Minor soil disturbance is expected from several additional research projects. Development of a geothermal demonstration project would disturb up to 50 acres of soil.	Construction of a commercial solar power generation facility could disturb up to 1,200 acres.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Hydrology			
Surface Water Resources			
National Security/Defense Mission	Disturbance of about 700 acres of land by dynamic experiments in boreholes, explosives experiments, drillback operations, Office of Secure Transportation training and exercises, experiments involving releases of chemicals and biological simulants, and counterterrorism training would cause alterations of natural drainage pathways, contamination of ephemeral surface waters via chemical agents, and sedimentation to ephemeral surface waters.	About 13,455 acres of soil and near-surface geologic media would be disturbed by the same kinds of activities as under the No Action Alternative, plus: • Up to 10,000 acres of disturbance for Office of Secure Transportation training facilities, 120 acres for depleted uranium experiment sites, and 3,335 acres for additional explosives experiments, new test beds and training facilities, drillback operations and additions to existing aviation facilities at the NNSS. This would result in proportionately larger impacts on ephemeral waters compared to the No Action Alternative.	About 430 acres of soil and near-surface geologic media would be disturbed by many of the same kinds of activities as under the No Action Alternative, except: There would be 50 percent fewer explosives experiments and 33 percent less Office of Secure Transportation training and exercises. This would result in proportionately smaller impacts on ephemeral waters compared to the No Action Alternative.
Environmental Management Mission	Disturbance of up to 190 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 Radioactive Waste Management Complex would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.	Same as under the No Action Alternative, except: • Disturbance of up to 600 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 Radioactive Waste Management Complex, plus up to 35 acres of disturbance for new sanitary, decontamination, decommissioning, and construction waste landfills would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.	Same as under the No Action Alternative for both Waste Management and Environmental Restoration.
	The Soils Project would reduce or stabilize legacy contamination in soil and could result in disturbance of up to 420 acres. Soil disturbance on about 500 acres of land from drilling additional wells for the Underground Test Area Project could cause localized erosion, as could decontamination and decommissioning of industrial sites, remediation of Defense Threat Reduction Agency sites, and the Borehole Management Program. These activities would affect ephemeral waters by altering natural drainage pathways and increasing sedimentation. Stabilization and/or removal of contaminated facilities and soils would reduce the potential for contamination of ephemeral waters.	Environmental Restoration impacts would be the same as under the No Action Alternative.	

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Nondefense Mission	No new land disturbances would occur during infrastructure-related activities under the No Action Alternative. Development of a 240-megawatt commercial solar power generation facility and associated transmission lines would alter natural drainage pathways over 2,650 acres in Area 25, though it is expected that larger ephemeral waters (e.g., Fortymile Wash) would be avoided; however, there would be a potential for chemical contamination and sedimentation to ephemeral waters during construction-related land preparation.	Up to 517 acres of land would be disturbed by rebuilding the existing 138-kilovolt transmission line on the NNSS and construction of a 5-megawatt photovoltaic solar power generation facility. These disturbances would result in alterations of natural drainage pathways and increased sedimentation of ephemeral waterways. Development of up to 1,000 megawatts of commercial solar power generation facilities and associated transmission lines would disturb drainage pathways over 10,300 acres and increased erosion and construction/operational activities would potentially increase sedimentation and chemical contamination in ephemeral waterways. Development of a Geothermal Demonstration Project would disturb up to 50 acres and cause sedimentation to ephemeral waters, as well as long-term alteration of natural drainage pathways.	Same as under the No Action Alternative, except: • The land area associated with the solar power generation facility would be 1,200 acres.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Groundwater Resources			
Total water use (excluding solar power facility)	Total water use for DOE/NNSA activities would not exceed 691 acre-feet per year. This water demand would be below the sustainable yield of all affected hydrologic basins.	Total water use for DOE/NNSA activities would increase by 25 percent from the No Action Alternative to 862 acre-feet per year. This water demand would be below the sustainable yield of all affected hydrologic basins.	Total water use for DOE/NNSA activities would decrease by 10 percent from the No Action Alternative to 622 acre-feet per year. This water demand would be below the sustainable yield of all affected hydrologic basins.
National Security/Defense Mission	No new or additional impacts on groundwater resources.	The following would be impacts on groundwater resources, in addition to impacts under the No Action Alternative: • 5.5 acre-feet per year of potable water for construction workers. • Water use for construction of facilities included in the overall 25 percent increase in all water uses.	Same as under the No Action Alternative.
Environmental Management Mission	Through 2020, 30 acre-feet per year of nonpotable water for the drilling of new wells under the Underground Test Area Project. Less than 7 acre-feet of total water use for dust suppression during decontamination and decommissioning of facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission	Positive impact of reducing potable water production 16 percent by 2015 utilizing water conservation measures.	Same as under the No Action Alternative, plus: • A 5-megawatt photovoltaic solar power system near Area 6 would use 0.5 acre-feet per year of nonpotable water. • A one-time nonpotable water demand of 20 acre-feet to prime a geothermal power plant. Once operational, the geothermal power plant would use 50 acre-feet of water per year.	Same as under the No Action Alternative.
Commercial Solar Power Generation Facilities			
Construction	350 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	1,000 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	200 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision
Operation	250 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands would be below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (3,944 acre-feet per year).	700 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands would be below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (3,944 acre-feet per year).	175 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands would be below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (3,944 acre-feet per year).

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Biological Resources			
National Security/Defense Mission	Approximately 295 acres of currently undisturbed desert tortoise habitat would be affected by activities in Frenchman, Yucca, and Jackass Flats; Mercury Valley; and Fortymile Canyon. The estimated number of desert tortoises affected ranges from 4 to 21, all by harassment. Total new disturbed area (about 700 acres) would be 0.09 percent of undisturbed land on the NNSS.	Approximately 1,930 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. The estimated number of desert tortoises affected ranges from 30 to 136, all by harassment. Total new disturbed area (about 13,455 acres) would be 1.70 percent of undisturbed land on the NNSS.	Approximately 160 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. The estimated number of desert tortoises affected ranges from 2 to 11, all by harassment. Total new disturbed area (about 430 acres) would be 0.05 percent of undisturbed land on the NNSS.
Environmental Management Mission	Approximately 760 acres of currently undisturbed desert tortoise habitat would be affected, primarily by environmental restoration activities in Frenchman, Yucca, and Jackass Flats, and Mercury Valley. The estimated number of desert tortoises affected ranges from 4 to 26, all by harassment. Total new disturbed area (about 1,110 acres) would be 0.14 percent of undisturbed land on the NNSS.	Approximately 1,205 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative because of additional waste management activities. The estimated number of desert tortoises affected ranges from 4 to 33, all by harassment. Total new disturbed area (about 1,555 acres) would be 0.2 percent of undisturbed land on the NNSS.	Same as under the No Action Alternative.
Nondefense Mission	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality. Approximately 2,650 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and Frenchman Flat would be affected by DOE/NNSA activities, including a 240-megawatt commercial solar power generation facility in Jackass Flats. The estimated number of desert tortoises affected ranges from 0 to 41, all by harassment. Total new disturbed area (about 2,650 acres) would be 0.34 percent of undisturbed land on the NNSS.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality. Approximately 10,535 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and Frenchman Flat would be affected by DOE/NNSA activities, including 1,000 megawatts of commercial solar power generation facilities in Jackass Flats. The estimated number of desert tortoises affected ranges from 4-178, all by harassment. Total new disturbed area (about 10,867 acres) would be 1.37 percent of undisturbed land on the NNSS.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality. Approximately 1,200 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and Frenchman Flat would be affected by DOE/NNSA activities, including a 100-megawatt commercial solar power generation facility in Jackass Flats. The estimated number of desert tortoises affected ranges from 0 to 19, all by harassment. Total new disturbed area (about 1,200 acres) would be 0.15 percent of undisturbed land on the NNSS.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Air Quality			
Annual Average Operational Emission in 2015 (tons per year)			
Particulate Matter$_{10}$	6.8	20.1	4.4
Particulate Matter$_{2.5}$	3.4	8.1	2.6
Carbon Monoxide	123.3	160.9	109.8
Nitrogen Oxides	39.7	56.6	36.3
Sulfur Dioxide	0.73	1.1	0.43
Volatile Organic Compounds	5.9	11.0	4.8
Lead	0.030	~0.010	0.0024
Hazardous Air Pollutants	0.41	0.53	0.40
Carbon Dioxide-equivalent	39,300	49,700	37,500
Peak Year Construction Emissions (tons per year)			
Particulate Matter$_{10}$	20.0	129.1	8.4
Particulate Matter$_{2.5}$	6.0	35.6	2.6
Carbon Monoxide	44.8	296.5	24.4
Nitrogen Oxides	56.0	388.6	24.4
Sulfur Dioxide	0.14	0.68	0.08
Volatile Organic Compounds	6.2	41.6	2.8
Lead	0.0000089	0.000013	0.0000071
Hazardous Air Pollutants	0.038	0.058	0.030
Carbon Dioxide-equivalent	45,000	74,800	40,300
Radiological Air Quality			
	No activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	Except for depleted uranium and radiotracer experiments, no additional activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	No activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.
Visual Resources			
National Security/Defense Mission	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.
Environmental Management Mission	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.
Nondefense Mission	Construction and operation of a solar power generation facility over 2,400 acres of land would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95.	Construction of approximately 200,000 square feet of additional facilities would be added to Desert Rock Airport that would have an adverse effect on visual resources visible from U.S. Route 95. Construction and operation of commercial solar power generation facilities and associated transmission lines over about 10,300 acres of land would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95. A Geothermal Power Project could alter the visual character and reduce visual quality if facilities are built along U.S. Route 95.	Construction and operation of a commercial solar power generation facility over 1,200 acres of land would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Cultural Resources			
National Security/Defense Mission	Approximately 700 acres of undisturbed land would be affected by activities in Frenchman, Yucca, and Jackass Flats; Mercury Valley; and Fortymile Canyon. An estimated 24 cultural resource sites would be involved, of which an estimated 10 may be eligible for the National Register of Historic Places.	Approximately 13,455 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 624 cultural resource sites would be involved, of which an estimated 265 may be eligible for the National Register of Historic Places.	Approximately 430 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 16 cultural resource sites would be involved, of which an estimated 6 may be eligible for the National Register of Historic Places.
Environmental Management Mission	Approximately 1,110 acres of undisturbed land would be affected, primarily by environmental restoration activities in Frenchman, Yucca, and Jackass Flats; Emigrant and Mercury Valleys; and Fortymile Canyon. An estimated 29 cultural resource sites would be involved, of which an estimated 7 may be eligible for the National Register of Historic Places.	Approximately 1,555 acres of undisturbed land would be affected in the same areas as under the No Action Alternative because of additional waste management activities. An estimated 43 cultural resource sites would be involved, of which an estimated 12 may be eligible for the National Register of Historic Places.	Same as under the No Action Alternative.
Nondefense Mission	No impacts on cultural resources from DOE/NNSA infrastructure and energy conservation activities.	Approximately 517 acres of undisturbed land would be affected by DOE/NNSA infrastructure and renewable energy projects. An estimated 15 cultural resource sites may be involved, of which an estimated 6 would be eligible for the National Register of Historic Places.	Same as under the No Action Alternative for DOE/NNSA activities.
	Approximately 2,650 acres of undisturbed land in the Jackass Flats area would be affected by commercial renewable energy development. An estimated 1,802 cultural resource sites would be involved, of which an estimated 557 would be eligible for the National Register of Historic Places.	Approximately 10,300 acres of undisturbed land would be affected by commercial renewable energy projects. An estimated 7,004 cultural resource sites would be involved, of which an estimated 2,163 would be eligible for the National Register of Historic Places. Approximately 50 acres of undisturbed land would be affected by development of a Geothermal Power Demonstration Project in the Yucca Flat area. An estimated 2 cultural resource sites may be involved, of which 1 would be eligible for the National Register of Historic Places.	Approximately 1,200 acres of undisturbed land in the Jackass Flats area would be affected by commercial renewable energy development. An estimated 816 cultural resource sites would be involved, of which an estimated 252 may be eligible for the National Register of Historic Places.

Waste Management (10-year volumes)			
Low-Level Radioactive Waste	15,000,000 cubic feet of low-level radioactive waste is within the disposal capacity of Area 5 Radioactive Waste Management Complex.	48,000,000 cubic feet of low-level radioactive waste is within the disposal capacity of Area 3 Radioactive Waste Management Site and the Area 5 Radioactive Waste Management Complex.	Same as under the No Action Alternative.
Mixed Low-Level Radioactive Waste	900,000 cubic feet of mixed low-level radioactive waste is within the permitted disposal capacity of Cell 18 in the Area 5 Radioactive Waste Management Complex.	Disposal of 4,000,000 cubic feet of mixed low-level radioactive waste would require additional permitted mixed low-level radioactive waste disposal capacity at the Area 5 Radioactive Waste Management Complex.	Same as under the No Action Alternative.
Transuranic waste	9,600 cubic feet generated by DOE/NNSA activities in Nevada. All transuranic waste would be disposed within available capacity at the Waste Isolation Pilot Plant.	19,000 cubic feet generated by DOE/NNSA activities in Nevada. All transuranic waste would be disposed within available capacity at the Waste Isolation Pilot Plant.	7,100 cubic feet generated by DOE/NNSA activities in Nevada. All transuranic waste would be disposed within available capacity at the Waste Isolation Pilot Plant.
Hazardous waste	Total of 210,000 cubic feet, includes 42,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity.	Total of 340,000 cubic feet, includes 170,000 cubic feet generated by commercial solar power generation facilities. All would be recycled, treated, and/or disposed within available offsite capacity.	Total of 190,000 cubic feet, includes 17,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity.
Solid waste	Total of 3,800,000 cubic feet, includes 3,700,000 cubic feet generated by DOE/NNSA activities in Nevada and 160,000 cubic feet generated by construction and operation of a 240-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 370,000 cubic feet that would be transported off site for recycling within available offsite capacity.	Total of 10,000,000 cubic feet, includes 9,400,000 cubic feet generated by DOE/NNSA activities in Nevada and 630,000 cubic feet generated by construction and operation of 1,000 megawatts of commercial solar power generation facilities. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 970,000 cubic feet that would be transported off site to be recycled within available offsite capacity.	Total of 3,700,000 cubic feet, includes 3,600,000 cubic feet generated by DOE/NNSA activities in Nevada and 77,000 cubic feet generated by construction and operation of a 100-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the available capacity at NNSS landfills. Included in the DOE/NNSA volume are 360,000 cubic feet that would be transported off site to be recycled within available offsite capacity.
	Disposal of waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Disposal of waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Disposal of waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Human Health			
Annual Radiological Impacts of Normal Operations			
Offsite Population *Dose (person-rem)* *Risk (latent cancer fatalities)* Maximally Exposed Individual *Dose (millirem)* *Risk (latent cancer fatalities)* Workers *Collective Dose (person-rem)* *Risk (latent cancer fatalities)*	 0.50 3×10^{-4} 2.8 2×10^{-6} 5.2 3×10^{-3}	 0.89 5×10^{-4} 4.8 3×10^{-6} 6.6 4×10^{-3}	 0.48 3×10^{-4} 2.7 2×10^{-6} 4.8 3×10^{-3}
Noise Impacts			
Workers	Mitigated through worker protection practices.	Same asunder the No Action Alternative.	Same as under the No Action Alternative.
Public	Minimal due to remoteness of site and distance to receptors, but there would be some increases in traffic noise associated with the construction and operation of the solar power generation facilities.	Same as under the No Action Alternative, but there would be some increased traffic noise due to larger workforce, increase in daily truck trips, and vehicles associated with the construction and operation of the solar power generation facilities.	Similar to under the No Action Alternative, but slightly reduced due to smaller workforce; limited to increased traffic noise due to vehicles associated with the construction and operation of the solar power generation facilities.
Facility Accident – Dose Consequence and Annual Risk [b]			
Highest Risk Facility Accident – Device Assembly Facility explosion involving 55 pounds of high explosive and 1 kilogram of plutonium (assumed frequency of 1 chance in 1,250 years)			
Offsite Population			
Dose (person-rem)	23	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Risk (latent cancer fatalities per year)	1×10^{-5}	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Maximally Exposed Individual			
Dose (rem)	0.18	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Risk (latent cancer fatalities per year)	9×10^{-8}	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Noninvolved Workers			
Dose (rem)	6.5	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Risk (latent cancer fatalities per year)	3×10^{-6}	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Environmental Justice			
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected. An increase in construction jobs for the solar power generation facility could provide jobs for unemployed individuals, which would have a beneficial impact on low-income individuals.	Same as under the No Action Alternative, except there would be a larger number of construction jobs created.	Same as under the No Action Alternative, except there would be fewer construction jobs created.

NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; rem = roentgen equivalent man; Particulate $Matter_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate $Matter_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

[a] The reported radiological risks are the projected number of latent cancer fatalities in the population and are, therefore, presented as whole numbers. The calculated value is shown in parentheses.

[b] The risk is the annual increased likelihood of a latent cancer fatality in the maximally exposed individual or the noninvolved worker or the increased likelihood of a single latent cancer fatality occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

S.3.1.11 Cumulative Impacts

Council on Environmental Quality regulations define a cumulative impact as the "impact on the environment which results from the incremental impact of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time." Thus, the cumulative impacts of an action are the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource, no matter which entity is acting.

Most of the land in the vicinity of the NNSS is managed by Federal agencies, including the U.S. Bureau of Land Management, U.S. Air Force, USFWS, U.S. Forest Service, and U.S. National Park Service. In addition, there are lands and facilities under the jurisdiction of agencies of the State of Nevada; Nye, Clark, Esmeralda, and Lincoln Counties in Nevada; the State of California; Inyo County, California; various municipal governments; and private landowners. NNSA identified reasonably foreseeable future actions of others by conducting a review of publicly available documents prepared by these Federal, state, tribal, and local government agencies and organizations. In addition, NNSA requested information regarding potential future actions that may not yet have been addressed in publicly available documents.

For DOE/NNSA contributions to cumulative impacts, the analysis primarily uses the Expanded Operations Alternative, as it tends to result in the highest estimates of potential cumulative impacts associated with alternatives analyzed in this *NNSS SWEIS*. To provide a comparison of the cumulative impacts associated with each of the three alternatives considered in this *NNSS SWEIS*, **Table S–16** summarizes cumulative impacts by alternative.

S.3.2 Remote Sensing Laboratory

No new project or capabilities or changes in the levels of operations (activities) are proposed at RSL. For this reason, among the 13 resource areas, either there would be no impacts or the impacts associated with ongoing operations would continue unchanged from baseline conditions. **Table S–17** provides additional information.

S.3.3 North Las Vegas Facility

This section summarizes the potential environmental impacts at NLVF from continuing and proposed projects and capabilities, including their associated levels of operations (activities), under each of three alternatives. The text focuses on those resource areas for which the impacts would be sufficiently different to permit distinguishing among the alternatives in a meaningful manner or would tend to be controversial, i.e., energy, traffic, socioeconomics, air quality, waste management, and human health. **Table S–20** (at the end of Section S.3.3.6) summarizes the potential environmental impacts for all 13 resource areas.

Table S–16 Potential Cumulative Impacts

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Land Use	In Nye County, approximately 139,000 acres of public land managed by the U.S. Bureau of Land Management would be committed to use for renewable energy facilities or commercial/industrial uses. In Clark County, the U.S. Bureau of Land Management would dispose up to about 36,000 acres of public land. Use of this land would be changed from its current public uses to private and/or municipal uses.	The following land use changes would occur under the noted *NNSS SWEIS* alternatives: **No Action** • There would be no changes to NNSS Land Use Zones. • Construction of a commercial solar power generation facility would affect land use patterns outside of the NNSS due to construction of a 230-kilovolt transmission line. **Expanded Operations** • Area 15 – Change from Reserved Zone to Research, Test and Experiment Zone. • Area 25 – Designate about 39,600 acres as a Renewable Energy Zone. • Construction of a commercial solar power generation facility would affect land use patterns outside of the NNSS due to construction of a 500-kilovolt transmission line. **Reduced Operations** • Areas 19 and 20 – Change from Nuclear Test Zone to Limited Use Zone. • Areas 18, 29, and 30 – Change from Reserved Zone to Limited Use Zone. • Construction of a commercial solar power generation facility would not affect land use patterns outside of the NNSS.	Regardless of the implementation of any alternative in this *NNSS SWEIS*, changes in NNSS land use zone designations or functions are not expected to affect land use patterns in areas outside of the NNSS, except for the potential construction of interconnecting transmission lines for commercial solar power generation facilities under the No Action (250 acres) and Expanded Operations (300 acres) Alternatives. Land uses at RSL, NLVF, and the TTR are expected to remain unchanged and would not affect land uses in other areas. A total of over 185,000 acres of public land managed by the U.S. Bureau of Land Management would be either disposed or withdrawn for non-public uses within Clark and Nye Counties.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Infrastructure and Energy	<u>Infrastructure</u> Construction of new facilities, particularly large projects, would place cumulative demands on goods and services. The proposed renewable energy projects in Amargosa Valley and Area 25 of the NNSS would all have similar needs for large tracts of undeveloped land and water; use earthmoving/grading equipment, cranes, and other construction equipment; require similar materials, such as concrete, steel, wood, wiring and cables, etc.; and require the services of both general and specialized construction workers.	<u>Infrastructure</u> Construction of new facilities at the NNSS, particularly one or more solar power generation facilities with a capacity of 240 megawatts under the No Action Alternative, a combined capacity of 1,000 megawatts under the Expanded Operations Alternative, and 100 megawatts under the Reduced Operations Alternative, would cause a demand for construction materials and skilled labor, in proportion to their size, similar to those of other large construction projects.	<u>Infrastructure</u> Large-scale construction projects, particularly renewable energy facilities in the Jackass Flats area of the NNSS and in Amargosa Valley and construction of new high voltage transmission lines would create an increase in demand for and cumulatively affect availability of construction materials, supplies, and labor. Because of the relative number and/or size of new facility construction considered in this *NNSS SWEIS*, the noted cumulative impact would be substantially greater for the Expanded Operations Alternative than for the No Action Alternative. The Reduced Operations Alternative would create the least demand on construction materials, supplies, and labor and would contribute the least to cumulative impacts.
	<u>Energy</u> In 2009, NV Energy (southern division) and Valley Electric Association provided a total of about 21,670,000 megawatt-hours of electricity to their customers (NSOE 2010). The Nevada Public Utilities Commission forecasts a 1.5 percent growth rate in electricity sales through 2020 (NDEP 2008). Based on that growth rate, by 2020, total electricity sales in southern Nevada would be about 25,500,000 megawatt-hours, an increase of almost 4,000,000 megawatt-hours. There are proposals for renewable energy projects in southern Nevada that would produce a total of about 5,800 megawatts of new generating capacity.	<u>Energy</u> The 2020 projected cumulative annual electrical energy demand for DOE/NNSA activities in Nevada under the No Action Alternative is about 113,000 megawatt-hours; under the Expanded Operations Alternative, about 127,000 megawatt-hours; and under the Reduced Operations Alternative, about 96,000 megawatt-hours. A portion of the electrical energy demand under the Expanded Operations Alternative would be offset by development of a 5-megawatt photovoltaic solar power generation facility in Area 6 of the NNSS.	<u>Energy</u> Cumulatively, the projected increase in electrical energy demand, regardless of the demand under any of the alternatives, would be offset by development of up to 5,800 megawatts of new generating capacity from proposed renewable energy facilities. In addition, construction of new high voltage transmission lines, such as the Solar Express Transmission Line Project and the Transwest Express Transmission Project, would provide a stronger connection with other regions to support electrical demand in southern Nevada.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Transportation and Traffic	Traffic During construction of proposed renewable energy projects in Amargosa Valley and the Yucca Mountain Project Gateway Area development, roads in Nye County could experience increases in daily traffic ranging from a two- to a fivefold increase on primary roads such as U.S. Route 95 and Nevada State Route 160, which could degrade levels of service from A to D during peak commuting hours. Personnel and trucks associated with solar power generation facilities in Area 25 would increase daily vehicle trips on local roadways by 500 to 1,000 through the 35-month construction period. During operations, primary roadways could experience increases in daily traffic, and levels of service could degrade one level during peak commuting hours. The degradation in levels of service caused by increased traffic volumes on these roads could generate the need for additional travel lanes and other improvements.	Traffic Personnel and trucks associated with one or more commercial solar power generation facilities in Area 25 would increase daily vehicle trips on local roadways by 500 to 1,000 through the 36-month construction period under the No Action Alternative; by 750 to 1,500 through the 42-month construction period under the Expanded Operations Alternative; and by 400 to 800 under the Reduced Operations Alternative. The addition of these vehicles and associated construction trucks on a daily basis would increase the rate of pavement deterioration, degrade levels of service, and could require increased road maintenance and upgrades for roads in the project area.	Traffic The cumulative impact of increased traffic on local roadways in southern Nye County, nearby the NNSS, associated with NNSS operations and construction and operation of commercial solar power generation facilities in Area 25 would be a reduction in level of service on U.S. Route 95 from B to C, relative to the 2008 baseline, regardless of the traffic increases resulting from implementation of any of the alternatives. When combined with increased traffic from other large construction projects in Amargosa Valley, the level of service would degrade to D, causing accelerated deterioration and associated increased need for maintenance and repair. Some roadways and traffic control measures would need to be upgraded.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Transportation and Traffic (cont'd)	Radiological Transportation Collective worker dose (1943 to 2073) = 399,000 person-rem, equivalent to 240 latent cancer fatalities over 130 years. Collective general population dose (1943 to 2073) = 373,000 person-rem, equivalent to 224 latent cancer fatalities over 130 years.	Radiological Transportation **No Action Alternative** • Worker dose = 2,100 person-rem, equivalent to 1.2 latent cancer fatalities. • Population dose = 390 person-rem, equivalent to 0.2 latent cancer fatalities. **Expanded Operations Alternative** • Worker dose = 5,500 person-rem, equivalent to 3 latent cancer fatalities. • Population dose = 1,300 person-rem, equivalent to 1 latent cancer fatality. **Reduced Operations Alternative** • Worker dose = 2,100 person-rem, equivalent to 1.2 latent cancer fatalities. • Population dose = 390 person-rem, equivalent to 0.2 latent cancer fatalities.	Radiological Transportation **No Action Alternative** • Worker dose = 401,000 person-rem, equivalent to 241 latent cancer fatalities over 130 years. • Population dose = 374,000 person-rem, equivalent to 224 latent cancer fatalities over 130 years. **Expanded Operations Alternative** • Worker dose = 405, 000 person rem, equivalent to 243 latent cancer fatalities over 130 years. • Population dose = 374,000 person-rem, equivalent to 225 latent cancer fatalities over 130 years. **Reduced Operations Alternative** • Worker dose = 401,000 person-rem, equivalent to 241 latent cancer fatalities over 130 years. • Population dose = 374,000 person-rem, equivalent to 224 latent cancer fatalities over 130 years.

Resource Area	Non-DOE/NNSA Contribution to Cumulative Impacts	DOE/NNSA Contribution to Cumulative Impacts	Cumulative Impacts
Geology and Soils	Within the cumulative impacts region of influence, about 215,000 acres of Clark County and 51,000 acres of Nye County have been disturbed by previous development. A total of about 509,750 acres of additional soil and near-surface geologic media would be affected by reasonably foreseeable land development activities in Nye and Clark Counties. This would result in a total of about 775,750 acres of soil and near-surface geologic media being disturbed.	An unknown but substantial amount of deep subsurface geologic media has been affected by underground nuclear tests conducted on the NNSS. Approximately 80,000 acres of land on the NNSS has been disturbed by previous DOE/NNSA activities. Overall, new disturbance of soils and near-surface geological media resulting from proposed DOE/NNSA actions at the NNSS would be as follows: **No Action**: About 1,800 acres plus an additional 2,650 acres for a commercial solar power generation facility. **Expanded Operations**: About 15,500 acres, plus an additional 10,350 acres for commercial solar power generation facilities and a Geothermal Demonstration Project. **Reduced Operations**: About 1,540 acres plus an additional 1,200 acres for a commercial solar power generation facility.	Previous combined actions within the cumulative impacts region of influence have disturbed about 346,000 acres. Reasonably foreseeable actions would disturb additional soil and near-surface geological media within the region of influence, as follows: **No Action:** About 514,250 acres **Expanded Operations:** About 535,750 acres **Reduced Operations:** About 512,450 The total potential cumulative area of land disturbance would range from about 858,450 to 881,750 acres, which represents about 5.5 to 5.6 percent of the total area of the region of influence (15,737,760 acres).
Hydrology	<u>Surface Water</u> Disturbing about 94,300 acres in Amargosa Valley for constructing solar power generation facilities and developing the Yucca Mountain Project Gateway Area could result in erosion and slightly increase sedimentation in the Amargosa River during the construction period. However, U.S. Bureau of Land Management-prescribed and enforced erosion control measures would reduce the likelihood of such an impact.	<u>Surface Water</u> Within areas that drain off the NNSS, under the No Action, Expanded Operations, and Reduced Operations Alternatives, a total of 2,650, 10,300, and 1,200 acres, respectively, of land could be disturbed for construction of one or more commercial solar power generation facilities and under each alternative 110 acres of land would be disturbed for a Concentrating Solar Power Validation Project. During construction of these facilities, the potential for soil erosion affecting surface waters would be greater due to removal of vegetation and other earth-disturbing activities. If such erosion were to occur it would likely result in increased sediments being transported into Fortymile Wash and eventually into the Amargosa River. However, implementation of erosion control measures would reduce the likelihood of such erosion.	<u>Surface Water</u> Although the potential for increased sedimentation in the Amargosa River drainage is a potential cumulative impact regardless of alternative considered in this *NNSS SWEIS*, implementation of recognized measures to prevent erosion would reduce the likelihood of such impacts occurring.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Hydrology (cont'd)	<u>Groundwater</u> The town of Beatty, Nevada, uses just under 500 acre-feet of water per year obtained from the Oasis Valley Hydrographic Basin. Operational water requirements for the solar power generation facilities proposed in Amargosa Valley would require almost 6,000 acre-feet of groundwater each year, primarily from the Amargosa Desert, Oasis Valley, and Crater Flats Hydrographic Basins. Nevada State Engineer Order 1197 requires that water for new uses in the Amargosa Desert Hydrographic Basin be obtained by acquisition of existing water rights.	<u>Groundwater</u> Past underground nuclear testing has contaminated an unknown volume of groundwater beneath the NNSS. That contamination is not expected to impact publicly available water supplies within the next 100 years. DOE/NNSA proposed activities under this *NNSS SWEIS* would not cause new or additional groundwater contamination. DOE/NNSA activities at the NNSS and the TTR, as well as operation of solar power generation facilities in Area 25 of the NNSS, under all three alternatives addressed in this *NNSS SWEIS*, would require withdrawal of groundwater, as follows: **No Action:** 959 acre-feet **Expanded Operations:** 1,580 acre-feet **Reduced Operations:** 815 acre-feet This volume of groundwater represents about 16 percent, 27 percent, and 14 percent, respectively, of the cumulative sustainable yield for all of the affected hydrographic basins. DOE/NNSA would not withdraw groundwater from the Oasis Valley, Crater Flats, or Amargosa Valley Hydrographic Basins.	<u>Groundwater</u> Regardless of alternative considered in this *NNSS SWEIS*, groundwater monitoring programs conducted by DOE/NNSA and other organizations, such as the U.S. Geological Survey and Desert Research Institute, would ensure that there would be sufficient lead-time for DOE/NNSA to identify and implement appropriate protective and mitigative measures if contamination associated with underground nuclear testing were to affect any water supply located off Federal land. Due to the implementation of Nevada State Engineer Order 1197, there would be no new cumulative impacts associated with groundwater availability resulting from DOE/NNSA proposed actions and reasonably foreseeable projects in the Amargosa Desert Hydrographic Basin.
Biological Resources	Reasonably foreseeable actions by the U.S. Fish and Wildlife Service would result in a total of about 360,000 acres of desert tortoise habitat in Clark County, Nevada, being permitted under the Endangered Species Act for incidental take of desert tortoises (USFWS 2000 and 74 FR 50239). This represents about 9 percent of the estimated 4,000,000 acres of tortoise habitat in Clark County. Within Nye County, desert tortoise habitat would be affected by a number of reasonably foreseeable actions. The development of solar energy projects in Nye County would remove up to about 131,500 acres of desert tortoise habitat; development of the	Currently, approximately 80,000 acres of the NNSS are considered disturbed. Overall, new wildlife habitat disturbed by DOE/NNSA actions would be as follows: **No Action**: About 1,810 acres, plus an additional 2,650 acres for a commercial solar power generation facility. **Expanded Operations**: About 15,500 acres, plus an additional 10,350 acres for commercial solar power generation facilities and a Geothermal Demonstration Project. **Reduced Operations**: About 1,540 acres, plus an additional 1,200 acres for a commercial solar power generation facility.	The development of from about 512,000 (Reduced Operations Alternative) to 535,750 acres (Expanded Operations Alternative) of currently open land in the region would cumulatively affect wildlife and wildlife habitat. The loss of large areas of habitat would reduce the available habitat for native wildlife, including federally listed species and other special status species. Development of undisturbed land would contribute to loss, fragmentation, and degradation of habitat and encourage nonnative invasive species, thereby eliminating or degrading natural plant

Resource Area	Non-DOE/NNSA Contribution to Cumulative Impacts	DOE/NNSA Contribution to Cumulative Impacts	Cumulative Impacts
Biological Resources (cont'd)	Nye County Yucca Mountain Project Gateway Area would remove up to 5,800 acres. The development of over 509,000 acres of open land in the region would cumulatively affect wildlife and wildlife habitat. The loss of large areas of habitat would reduce the available habitat for native wildlife, including federally listed species and other special status species. Development of undisturbed land would contribute to loss, fragmentation, and degradation of habitat and encourage nonnative invasive species, thereby eliminating or degrading natural plant communities on which wildlife depend.	Impacts on the threatened desert tortoise under all alternatives would be the result of harassment. **No Action**: DOE/NNSA activities at the NNSS would affect about 1,055 acres of desert tortoise habitat and impact up to 47 tortoises; a commercial solar power generation facility would affect an additional 2,650 acres of tortoise habitat and up to 41 tortoises. **Expanded Operations**: DOE/NNSA activities at the NNSS would affect about 3,370 acres of desert tortoise habitat and impact up to 60 tortoises; commercial solar power facilities would disturb about 10,300 acres of tortoise habitat and up to 161 desert tortoises. **Reduced Operations**: DOE/NNSA activities at the NNSS would disturb about 920 acres of desert tortoise habitat and impact up to 37 tortoises; a commercial solar power generation facility would affect an additional 1,200 acres of tortoise habitat and up to 19 tortoises. An additional 125 tortoises may experience impacts due to harassment on NNSS roads under all three alternatives. The Concentrating Solar Power Validation Project would disturb an additional 110 acres of desert tortoise habitat, respectively, and impact up to 161 additional tortoises by harassment. Overall, wildlife habitat disturbed by DOE/NNSA actions would total about 26,000 acres.	communities on which wildlife depend. DOE/NNSA proposed actions and reasonably foreseeable actions by others within the cumulative impacts region of influence would result in the loss of over 522,000 acres of tortoise habitat under the Expanded Operations Alternative or about 508,000 acres under the No Action and Reduced Operations Alternatives. However, because a large portion of that habitat loss would be permitted by USFWS under the Endangered Species Act, pursuant to Section 10(a)(1)(B) for non-Federal entities and Section 7 for Federal agencies, this habitat loss would not threaten the continued existence of the desert tortoise.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Air Quality and Climate	<u>Nye County</u> Because Nye County is considered an attainment/nondesignated area for purposes of compliance with National Ambient Air Quality Standards, no countywide air monitoring data are available.	<u>Nye County</u> Annual DOE/NNSA air emissions in Nye County from all sources in 2015: **No Action Alternative:** Particulate Matter$_{10}$ = 9.8 tons Particulate Matter$_{2.5}$ = 6.8 tons Carbon Monoxide = 66 tons Nitrogen Oxides = 40 tons Sulfur Dioxide = 1.3 tons Volatile Organic Compounds = 5.2 tons Lead = 0.04 tons Hazardous Air Pollutants = 1.4 tons **Expanded Operations Alternative:** Particulate Matter$_{10}$ = 22.6 tons Particulate Matter$_{2.5}$ = 11 tons Carbon Monoxide = 82 tons Nitrogen Oxides = 50 tons Sulfur Dioxide = 2 tons Volatile Organic Compounds = 10 tons Lead = 0.2 tons Hazardous Air Pollutants = 1.4 tons **Reduced Operations Alternative:** Particulate Matter$_{10}$ = 7.2 tons Particulate Matter$_{2.5}$ = 5.8 tons Carbon Oxide = 55 tons Nitrogen Oxides = 36 tons Sulfur Oxides = 1.2 tons Volatile Organic Compounds = 4.1 tons Lead = 0.01 tons Hazardous Air Pollutants = 1.3 tons	<u>Nye County</u> Cumulatively, the annual air emissions from Federal and non-Federal activities in Nye County from all sources in 2015, regardless of the level of projected emissions under any of the alternatives considered in this *NNSS SWEIS*, are not expected to cause a nonattainment condition with respect to National Ambient Air Quality Standards.

Resource Area	Non-DOE/NNSA Contribution to Cumulative Impacts	DOE/NNSA Contribution to Cumulative Impacts	Cumulative Impacts
Air Quality and Climate (cont'd)	<u>Clark County</u> Clark County, principally the Las Vegas Valley, is classed as a nonattainment area for some air pollutants, i.e., not in compliance with National Ambient Air Quality Standards. Criteria pollutants for which the Las Vegas Valley have been out of attainment and the projected (2013) annual mobile source emissions are: Particulate $Matter_{10}$ = 28,744 tons Carbon Monoxide = 140,160 tons Nitrogen Oxides = 11,625 tons Volatile Organic Compounds = 12,399	<u>Clark County</u> Estimated annual mobile source emissions related to DOE/NNSA activities in Clark County, including worker commuting, for the criteria pollutants that are in nonattainment in the Las Vegas Valley are: **No Action Alternative:** Particulate $Matter_{10}$ = 1.5 tons Carbon Oxide = 97 tons Nitrogen Oxides = 24 tons Volatile Organic Compounds = 3.1 tons **Expanded Operations Alternative:** Particulate $Matter_{10}$ = 2 tons Carbon Oxide = 119 tons Nitrogen Oxides = 29 tons Volatile Organic Compounds = 3.9 tons **Reduced Operations Alternative:** Particulate $Matter_{10}$ = 2 tons Carbon Oxide = 86 tons Nitrogen Oxides = 22 tons Volatile Organic Compounds = 3 tons	<u>Clark County</u> The estimated 2015 cumulative total of annual mobile source emissions of criteria pollutants that are currently in nonattainment in the Las Vegas Valley are: **No Action Alternative:** Particulate $Matter_{10}$ = 28,746 tons Carbon Oxide = 140,257 tons Nitrogen Oxides = 11,649 tons Volatile Organic Compounds = 12,402 tons **Expanded Operations Alternative:** Particulate $Matter_{10}$ = 28,746 tons Carbon Oxide = 140,279 tons Nitrogen Oxides = 11,654 tons Volatile Organic Compounds = 12,403 tons **Reduced Operations Alternative:** Particulate $Matter_{10}$ = 28,746 tons Carbon Oxide = 140,246 tons Nitrogen Oxides = 11,647 tons Volatile Organic Compounds = 12,402 tons
	<u>Greenhouse Gas Emissions</u> Estimated annual greenhouse gas emissions in Nye, Clark, Lincoln, and Esmeralda Counties in 2015 are projected to be about 54.6 million tons.	<u>Greenhouse Gas Emissions</u> DOE/NNSA activities in Nye and Clark County would annually generate the following estimated amounts of greenhouse gas emissions in 2015: **No Action Alternative:** 60,555 tons **Expanded Operations Alternative:** 88,679 tons **Reduced Operations Alternative:** 53,755 tons	<u>Greenhouse Gas Emissions</u> Estimated annual cumulative greenhouse gas emissions in 2015 would in Nye, Clark, Lincoln, and Esmeralda Counties would be: **No Action:** 54,661,000 tons **Expanded Operations:** 54,689,000 tons **Reduced Operations:** 54,654,000 tons
Visual Resources	In Nye County, in the vicinity of the NNSS, development of solar power generation facilities would substantially alter the visual character along U.S. Route 95 in Amargosa Valley.	Under all three alternatives addressed in this *NNSS SWEIS*, the development of one or more solar power generation facilities with generating capacities ranging from 100 to 1,000 megawatts in Area 25 of the NNSS would reduce the visual quality rating of that viewshed from Class B to Class C due to intrusion of manmade elements. Under the Expanded Operations Alternative, construction of additional facilities at Desert Rock Airport would adversely impact the viewshed along U.S. Route 95 in Mercury Valley.	Regardless of the alternative considered in this *NNSS SWEIS*, development of solar power generation facilities, the Yucca Mountain Gateway Project, and new facilities at Desert Rock Airport (only under the Expanded Operations Alternative) would substantially alter the visual character along U.S. Route 95 in Amargosa and Mercury Valleys, reducing the visual quality rating from Class B to Class C.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Cultural Resources	An estimated 26,000 cultural resources sites would be affected by land-disturbing activities within the cumulative impacts region of influence, with about 13,000 of those sites being considered eligible for inclusion in the National Register of Historic Places.	The estimated number of cultural resources sites potentially affected by DOE/NNSA activities and development of commercial solar power generation facilities under each alternative are as follows: **No Action Alternative:** DOE/NNSA activities would potentially affect up to 53 sites; 18 could be considered eligible for inclusion in the National Register of Historic Places. Development of a 100-megawatt commercial solar power generation facility would potentially affect up to 802 sites; 557 could be considered eligible for inclusion in the National Register of Historic Places. **Expanded Operations Alternative:** DOE/NNSA activities would potentially affect up to 682 sites; 283 could be considered eligible for inclusion in the National Register of Historic Places. Development of up to 1,000 megawatts of commercial solar power generation facilities and a Geothermal Demonstration Project would potentially affect up to 7,006 sites; 2,163 could be considered eligible for inclusion in the National Register of Historic Places. **Reduced Operations Alternative:** DOE/NNSA activities would potentially affect up to 45 sites; 14 could be considered eligible for inclusion in the National Register of Historic Places. Development of a 100-megawatt commercial solar power generation facility would potentially affect up to 816 sites; 252 could be eligible for inclusion in the National Register of Historic Places.	The estimated cumulative total of potentially affected cultural resource sites, including both proposed and reasonably foreseeable activities under each alternative, are as follows: **No Action Alternative:** Total sites—26,855 National Register of Historic Places-eligible sites—13,565 **Expanded Operations Alternative:** Total sites—33,688 National Register of Historic Places-eligible sites—15,446 **Reduced Operations Alternative:** Total sites—26,861 National Register of Historic Places-eligible sites—13,266

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Waste Management	<u>Radioactive Waste</u> The NNSS is the only active disposal facility for low-level radioactive waste and mixed low-level radioactive waste in Nevada. It accepts for disposal only low-level radioactive waste and mixed low-level radioactive waste that meet the NNSS waste acceptance criteria. A commercial low-level radioactive waste disposal facility operated from 1962 to the end of 1992 in Beatty, Nevada, about 45 miles west of Mercury on the NNSS. Because of a lack of a groundwater pathway from NNSS radioactive waste management facilities, the large distances between this facility and DOE/NNSA waste management operations, depth to groundwater, the high evaporation rate in the region, and monitoring by the Nevada Division of Environmental Protection to ensure continued proper function of closure/containment measures, this closed disposal facility is not expected to have any cumulative impacts with DOE/NNSA waste management activities.	<u>Radioactive Waste</u> Historic disposal of low-level and mixed low-level radioactive waste, and some transuranic waste at the NNSS totaled about 40,000,000 cubic feet through 2010. During the next 10 years, the following estimated volumes of radioactive waste would potentially be disposed at the NNSS: **No Action and Reduced Operations Alternatives:** • Low-level radioactive waste = 15,000,000 cubic feet • Mixed low-level radioactive waste = 900,000 cubic feet **Expanded Operations Alternative:** • Low-level radioactive waste = 48,000,000 cubic feet • Mixed low-level radioactive waste = 4,000,000 cubic feet	<u>Radioactive Waste</u> Because the NNSS operates the only low-level radioactive waste/mixed low-level radioactive waste disposal facilities in Nevada, there would be no cumulative impacts from management of such wastes outside of the NNSS.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Waste Management (cont'd)	Nonradioactive Waste There are a number of hazardous waste treatment, storage, and disposal facilities in Nevada and neighboring states that treat and dispose such wastes from many generators.	Nonradioactive waste The following estimated volumes of hazardous waste would be generated by DOE/NNSA activities and commercial solar power generation facilities over the next 10 years: **No Action Alternative:** • DOE/NNSA activities—170,000 cubic feet • Commercial solar facility—42,000 cubic feet **Expanded Operations Alternative:** • DOE/NNSA activities—170,000 cubic feet • Commercial solar facilities—170,000 cubic feet **Reduced Operations Alternative**: • DOE/NNSA activities—170,000 cubic feet • Commercial solar facility—17,000 cubic feet All hazardous waste generated by DOE/NNSA activities would be transported to commercial treatment, storage, and disposal facilities for treatment and/or disposal. Hazardous waste generated by commercial solar facilities would be managed by the operator in accordance with applicable statutes and regulations.	Nonradioactive waste The volume of hazardous waste that DOE/NNSA and commercial solar power generation facilities would dispose at commercial treatment, storage, and disposal facilities would not exceed the capacity of such facilities and would represent a very small portion of the overall volume of such waste disposal, regardless of the alternative considered.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Human Health	<u>Radiological</u> There are no other non-background sources of potential radiological exposure for an offsite member of the public within the cumulative impacts region of influence.	<u>Radiological</u> The dose to the offsite population resulting from DOE/NNSA activities in southern Nevada under each alternative addressed in this *NNSS SWEIS* would be: **No Action Alternative:** • Dose = 5.0 person-rem over 10 years • Consequence = No (0.003) latent cancer fatality **Expanded Operations Alternative:** • Dose = 8.9 person-rem over 10 years • Consequence = No (0.005) latent cancer fatality **Reduced Operations Alternative:** • Dose = 4.8 person-rem over 10 years • Consequences = No (0.003) latent cancer fatality	<u>Radiological</u> Because there is no other source for above-background level of exposure to radioactivity in the cumulative impacts region of influence, DOE/NNSA is the sole contributor to the cumulative dose analyzed in this *NNSS SWEIS*. Cumulatively, the impacts would then be as follows: **No Action Alternative:** • Dose = 5.0 person-rem over 10 years • Consequence = No (0.003) latent cancer fatality **Expanded Operations Alternative:** • Dose = 8.9 person-rem over 10 years • Consequence = No (0.005) latent cancer fatality **Reduced Operations Alternative:** • Dose = 4.8 person-rem over 10 years • Consequences = No (0.003) latent cancer fatality

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Human Health (cont'd)	Nonradiological During construction of proposed renewable energy projects in Amargosa Valley, industrial accidents could result in an estimated fatality to one worker in 750 total recordable cases and 380 days away, restricted, or transferred.	Nonradiological The following estimated nonradiological consequences would occur over a 10-year period from DOE/NNSA activities at the NNSS, RSL, NLVF, and the TTR and construction of commercial solar power facilities at the NNSS under each alternative addressed in this *NNSS SWEIS*: **No Action Alternative:** Operations Total recordable cases = 578 Days away, restricted, or transferred = 253 Construction Total Recordable Cases = 60 Days Away, Restricted, or Transferred = 31 TOTAL for Alternative Total Recordable Cases = 638 Days Away, Restricted, or Transferred = 314 **Expanded Operations Alternative:** Operations Total Recordable Cases = 700 Days Away, Restricted, or Transferred = 314 Construction Total Recordable Cases = 148 Days Away, Restricted, or Transferred = 48 TOTAL for Alternative Total Recordable Cases = 848 Days Away, Restricted, or Transferred = 362 **Reduced Operations Alternative:** Operations Total recordable cases = 508 Days away, restricted, or transferred = 225 Construction Total Recordable Cases = 44 Days Away, Restricted, or Transferred = 23 TOTAL for Alternative Total Recordable Cases = 552 Days Away, Restricted, or Transferred = 248	Nonradiological Industrial accidents from all activities at DOE/NNSA sites over a 10-year period, and construction of renewable energy projects in Amargosa Valley could result in the following total recordable cases and days away, restricted or transferred for each alternative: **No Action Alternative:** Total recordable cases = 1,328 Days away, restricted, or transferred = 633 **Expanded Operations Alternative:** Total recordable cases = 1,598 Days away, restricted, or transferred = 742 **Reduced Operations Alternative:** Total recordable cases = 1,302 Days away, restricted, or transferred = 628

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Environmental Justice	Non-DOE/NNSA actions would account for approximately 509,750 acres of new land disturbances within the cumulative impacts region of influence. Land disturbance of this magnitude would likely have adverse impacts on American Indian traditional cultural properties by destroying places important to the continuation of those cultures.	Potential new land disturbances on the NNSS for both DOE/NNSA activities and development of commercial solar generation facilities would result in new land disturbance on up to about 4,500 acres, 26,000 acres, and 2,700 acres, respectively under the No Action, Expanded Operations, and Reduced Operations Alternatives. Previously undisturbed lands may be important to American Indians. Land disturbances on the NNSS could affect traditional cultural properties of concern for various American Indian tribes with a cultural affiliation with the NNSS.	The potential disturbance of up to 514,250 acres (No Action Alternative), 535,750 acres (Expanded Operations Alternative), or 512,450 acres (Reduced Operations Alternative) of currently undisturbed land within the cumulative impacts region of influence would likely have adverse impacts on American Indian traditional cultural properties by affecting places important to the continuation of those cultures.

DOE/NNSA = U.S. Department of Energy/National Nuclear Security Administration; NAAQS = National Ambient Air Quality Standards; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; Particulate $Matter_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate $Matter_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; rem = roentgen equivalent man; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range.

Table S–17 Summary of Potential Direct and Indirect Impacts at the Remote Sensing Laboratory

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Land Use			
	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Infrastructure and Energy			
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Energy demand is expected to continue at about 4,850 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 33,673 therms per year. There is adequate capacity to serve this demand and the condition of the gas lines is satisfactory. Approximately 11,000 gallons of JP-8 jet fuel are used each year for aircraft operations. An adequate supply of JP-8 fuel is available directly through Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Transportation and Traffic			
Transportation	No radioactive materials transported. Nonradioactive material transports are included in Nevada National Security Site impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Traffic	The number of personnel at the Remote Sensing Laboratory is expected to remain the same, and there are no construction or other projects proposed that would result in increased traffic. There would be no additional impacts on onsite or regional traffic conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Socioeconomics			
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Geology and Soils			
	There would be no impacts on geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Hydrology			
Surface Water Resources	No proposed activities would affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Groundwater Resources	No proposed facilities or activities would adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Biological Resources			
	All activities would occur in previously disturbed, developed areas and would not affect biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Air Quality			
Annual Average Operational Emission in 2015 (tons per year)			
Particulate Matter$_{10}$ *Particulate Matter$_{2.5}$* *Carbon Monoxide* *Nitrogen Oxides* *Sulfur Dioxide* *Volatile Organic Compounds* *Lead* *Hazardous Air Pollutants* *Carbon Dioxide-equivalent*	0.084 0.067 4.1 1.6 0.034 0.3 ~0.01 0.19 3,147	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Visual Resources			
	There would be no impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Cultural Resources			
	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Waste Management			
Hazardous waste	Annually, about 680 cubic feet of hazardous waste would be generated and transported to be recycled, treated, and/or disposed within available offsite capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Solid waste	Annually, about 4,550 cubic feet of solid waste would be generated and transported to be recycled or disposed within available offsite capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Human Health			
Normal Operations	There would be no radiological or hazardous chemical risks.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Noise	Noise from Remote Sensing Laboratory activities and traffic would be minimal compared to ambient traffic noise and aircraft noise at Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Facility Accidents	There would be no radiological or hazardous chemical accident risks.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Justice			
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

Particulate $Matter_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate $Matter_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

S.3.3.1 Energy

NNSA assessed potential impacts on energy resources by comparing projections of utility resource requirements, such as the demand for electricity, natural gas, and liquid fuels at NLVF, to local and regional capabilities to supply these resources. The baseline or current energy demand is the same as that under the No Action Alternative. For instance, recent peak electrical demand was about 3.2 megawatts, and approximately 48,000 therms of natural gas (equivalent to about 495,000 cubic feet) were used for heating and in boilers (NNSA/NSO 2010b). Under the Expanded Operations Alternative, continuing and newly proposed projects and capabilities would require an increase of up to 10 percent in the use of electricity, natural gas, and liquid fuels such as gasoline and diesel fuel. Energy demand under the Reduced Operations Alternative would be no more than that under the No Action Alternative. NNSA does not foresee difficulty in obtaining electricity and fuels from regional suppliers under any alternative.

What is a Therm?

A therm equals 100,000 British thermal units. A British thermal unit is the heat required to raise the temperature of one pound of water by one degree Fahrenheit.

On average, 1,000 cubic feet of natural gas equals 10.31 therms.

S.3.3.2 Traffic

Traffic impacts would result primarily from changes in the workforce. NNSA estimates that the current workforce would not change under the No Action Alternative, would increase by approximately 25 percent (from 1,442 to 1,803) under the Expanded Operations Alternative, and would decrease by about 10 percent (from 1,442 to 1,298) under the Reduced Operations Alternative.

Traffic conditions of roadways near NLVF are represented by Losee Road. Under the No Action and Reduced Operations Alternatives, minimal changes in daily traffic volumes would affect Losee Road as a result of NNSS personnel. NNSA estimates that implementing the Expanded Operations Alternative would result in an approximately 3 percent increase in traffic volumes during the peak hour; the level of service, however, would remain at a level of service C.

Level of Service C

The number of vehicles stopping is significant, although many still pass through the affected intersection without being required to stop.

S.3.3.3 Socioeconomics

The continued operation and proposed activities at NLVF would result in changes to the current (baseline) workforce only under the Expanded Operations and Reduced Operations Alternatives. Accordingly, NNSA evaluated how these workforce changes could affect economic activity; population; housing; public finance; and public services, such as police and fire protection, in Clark and Nye Counties.

Under the Expanded Operations Alternative, the workforce would increase by 361 (from about 1,442 to 1,803). NNSA estimates that approximately 10 percent, or 36 individuals, would relocate to Clark and Nye Counties (the remaining 325 individuals would already live in Clark and Nye Counties). Of the total employment increase, NNSA estimates that 99 percent of the workers would live in Clark County and 1 percent in Nye County.

Under the Expanded Operations Alternative, in Clark County, a total of 322 direct jobs could be added, which would decrease the unemployment rate by about 0.23 percent. In Nye County, up to 3 jobs would be added, decreasing unemployment by about 0.10 percent.

An increase in direct employment also would result in an increase in the demand for goods (for example, fuel for personal vehicles) and services (for example, vehicle repair), which in turn would create additional employment opportunities (indirect jobs). The combined effect of direct (361) and indirect

(699) jobs would result in a decrease in the unemployment rate in Clark County of about 0.5 percent and in Nye County of about 0.22 percent.

The increased workforce due to relocating workers (36 individuals) is not expected to result in undue demand on housing (vacancies would decrease by about 0.2 percent) and most public services. There could be a need, however, to hire three new teachers in Clark County to maintain the current student-to-teacher ratio.

Under the Reduced Operations Alternative, the workforce would decrease by about 144; the unemployment rate in Clark County would, in turn, increase by about 0.10 percent and the rate in Nye County would increase by about 0.03 percent. There would be no impact on housing or public services in either county.

S.3.3.4 Air Quality

For each alternative, NNSA estimated the amount of nonradiological and hazardous air pollutants and greenhouse gases that would be released from activities at NLVF (see **Table S–18**).

Table S–18 Emissions of Air Pollutants and Greenhouse Gases (tons per year)

		No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
	Estimated 2008 Emissions	***Annual Average Operational Emissions in 2015***		
Particulate Matter$_{10}$	0.48	0.36	0.44	0.33
Particulate Matter$_{2.5}$	0.34	0.24	0.28	0.21
Carbon Monoxide	26.6	24.4	30.5	22.0
Nitrogen Oxides	8.8	5.9	7.2	5.4
Sulfur Dioxide	0.090	0.079	0.095	0.072
Volatile Organic Compounds	0.80	0.77	0.96	0.70
Lead	~0.060	Less than 0.01	Less than 0.01	Less than 0.01
Hazardous Air Pollutants	0.076	0.062	0.078	0.056
Carbon Dioxide-equivalent	13,355	8,379	9,031	8,118

Particulate Matter$_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate Matter$_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

Under the No Action and Reduced Operations Alternatives, the NLVF contribution to Clark County emissions of nonradiological (criteria) pollutants would continue to be small and would decrease relative to 2008 emission levels. Most of the emission reductions at NLVF would be associated with the phasing in of newer worker vehicles with emission reduction technology. Thus, neither alternative would contribute to or cause additional violations of the criteria pollutant standards.

Implementing the Expanded Operations Alternative would result in increases (relative to the 2008 baseline) in emissions of carbon monoxide, sulfur dioxide, and volatile organic compounds, principally from mobile sources. Because the increases in emissions would be small and would come from mobile sources dispersed throughout the Las Vegas Valley, the additional pollutant burden would not produce additional violations of pollutant standards.

NNSA estimates that emissions of hazardous air pollutants would continue to remain low under any alternative, not requiring additional emission control technologies, and, therefore, would not pose an undue health risk to workers or the public. Greenhouse gas emissions, although estimated to decrease relative to baseline levels under all alternatives, would continue to contribute to global climate change.

S.3.3.5 Waste Management

At NLVF, NNSA operations would generate low-level radioactive waste, hazardous waste, sanitary solid waste, and demolition debris. Under all alternatives, about 150 cubic feet of low-level radioactive waste and small amounts of water containing tritium would be generated. The low-level radioactive waste would be shipped to the NNSS for disposal where adequate capacity exists; water containing tritium either would be evaporated by introducing it to evaporative coolers at NLVF or by shipping it to the NNSS for evaporation.

About 1,100 cubic feet of hazardous waste would be generated over 10 years under all alternatives. This waste would be transferred off site to permitted facilities to be recycled or treated, stored, and disposed. Adequate capacity is expected to exist in Nevada and elsewhere in the United States to recycle or treat, store, and dispose hazardous waste generated at NLVF. For instance, four treatment, storage, and disposal facilities were permitted to receive hazardous waste in Nevada as of 2009 (NDEP 2009).

About 390,000, 490,000, and 350,000 cubic feet of sanitary solid waste would be generated under the No Action, Expanded Operations, and Reduced Operations Alternatives over 10 years, respectively. NNSA anticipates that the local municipal waste service would have sufficient capacity to accommodate disposal of this waste.

Decommissioning and demolition of certain structures at NLVF were estimated to generate up to about 110,000 cubic feet of demolition debris under each alternative. Sufficient capacity is expected to exist at landfills in Clark County to accommodate disposal of these amounts of demolition debris (otherwise, this waste would be disposed at landfills on the NNSS, which have adequate disposal capacity).

S.3.3.6 Human Health

Tritium is the only radionuclide that could result in an exposure to a noninvolved worker or a member of the public. In 1995, an accident resulted in the release of more than 1 curie of tritium in the basement of Building A-1. The tritium release was cleaned up, but residual tritium continues to emanate from the basement floor. The small amount of tritium released was estimated (numerically calculated) to result in a dose of about 0.00035 millirem per year to the maximally exposed individual member of the public located at the facility boundary or to a noninvolved worker. This dose represents an annual risk of a latent cancer fatality of about 1 chance in 5 billion. Applying this dose to the entire population of approximately 2,390,000 persons within 50 miles of NLVF results in an estimated collective dose of 4.1×10^{-5} person-rem per year, with a corresponding estimate of 2×10^{-8} latent cancer fatalities, implying that the most likely outcome would be no additional latent cancer fatalities in the exposed population. The amount of tritium released, and thus the dose and latent cancer fatalities, would be the same among all alternatives.

NNSA estimated the injuries that could arise in the workforce from industrial accidents based upon accident rates from DOE and the U.S. Department of Labor (DOE 2010a; DOL 2010a, 2010b). Total recordable cases, and those cases that result in lost workdays, restricted duty, or require a transfer are shown in **Table S–19**.

Table S–19 Annual Estimated Incidence of Nonfatal Accidents at the North Las Vegas Facility

	No Action Alternative		*Expanded Operations Alternative*		*Reduced Operations Alternative*	
Activity	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*
Facility Operations	22	9.5	27	12	20	8.6

Table S–20 Summary of Potential Direct and Indirect Impacts at the North Las Vegas Facility

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Land Use			
	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Infrastructure and Energy			
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Electric energy demand is expected to continue at about 15,000 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 48,000 therms per year. There is adequate capacity to serve this demand.	Same as under the No Action Alternative for infrastructure. Electric energy demand would increase by no more than 10 percent. The capacity of the electrical distribution system and the capability of commercial providers are adequate to supply the needed electrical energy.	Same as under the No Action Alternative for infrastructure. Electrical energy demand is expected to be the same as under the No Action Alternative or slightly lower.
Transportation			
Transportation	No radioactive materials were analyzed. Nonradioactive material transports are included in the NNSS impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Traffic	No increase in traffic volume due to NLVF-related traffic compared to the projected baseline; levels of service would remain the same.	Approximately a 3 percent increase in daily traffic volumes during peak hours on local roads, when compared to the projected baseline; levels of service would remain the same.	Less than a 1 percent decrease in daily traffic volumes during peak hours on local roads; levels of service would remain the same.

	No Action Alternative	Expanded Operations Alternative	Reduced Operations Alternative
Socioeconomics			
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Employment would increase by 361 full-time equivalents; about 36 employees would relocate from outside the region. Up to 3 new teaching jobs would need to be filled to maintain the current student-to-teacher ratio. Sufficient housing exists in the region to support the increased population. Direct jobs would reduce unemployment by 0.27 and 0.12 percent in Clark and Nye Counties, respectively. Direct jobs and indirect jobs would have a beneficial effect on the local economy and government revenues. The addition of 361 employees would result in an increase in the number of service calls, but would have a negligible impact on area hospitals and hospital personnel.	Employment would decrease by 45 full-time equivalents, increasing unemployment in Clark County by about 0.12 percent and in Nye County by about 0.04 percent. Additional employees would not relocate to Clark or Nye County and there would be no impact on student-to-teacher ratios. Job loss would have a small negative impact on the local economy and government revenues. There would be no impact on public services.
Geology and Soils			
	Proposed activities would not affect geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Hydrology			
Surface Water Resources	Proposed activities would not affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Groundwater Resources	Proposed activities would not adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Biological Resources			
	All activities would occur in previously disturbed, developed areas and would not affect native biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Air Quality			
Annual Average Operational Emission in 2015 (tons per year)			
Particulate Matter$_{10}$ *Particulate Matter$_{2.5}$* *Carbon Monoxide* *Nitrogen Oxides* *Sulfur Dioxide* *Volatile Organic Compounds* *Lead* *Hazardous Air Pollutants* *Carbon Dioxide-equivalent*	0.36 0.24 24.4 5.9 0.079 0.77 <0.01 0.062 8,378	0.44 0.28 30.5 7.2 0.095 0.96 <0.01 0.078 9,031	0.33 0.21 22.0 5.4 0.072 0.70 <0.01 0.056 8,118
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Visual Resources			
	There would be no impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Cultural Resources			
	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Waste Management			
Low-Level Radioactive Waste [a]	150 cubic feet would be generated over the next 10 years and disposed within available capacity at the NNSS in the Area 5 Radioactive Waste Management Complex.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Hazardous waste	1,100 cubic feet would be generated over the next 10 years and shipped off site to be recycled, treated, and/or disposed within available capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Solid waste	500,000 cubic feet would be generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	590,000 cubic feet would be generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	460,000 cubic feet would be generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Human Health			
Offsite Population		Same as under the No Action Alternative.	Same as under the No Action Alternative.
Dose (person-rem)	4.1×10^{-5}		
Risk (latent cancer fatalities)	2×10^{-3}		
Maximally Exposed Individual or Noninvolved Worker			
Dose (millirem)	3.5×10^{-4}		
Risk (latent cancer fatalities)	2×10^{-10}		
Noise	Noise from NLVF-related activities and traffic would not exceed ambient traffic noise.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Facility Accidents	There would be negligible radiological or hazardous chemical accident risks.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Justice			
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; Particulate $Matter_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate $Matter_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; rem = roentgen equivalent man.

[a] Does not include tritiated liquids shipped from NLVF to the NNSS for treatment.

S.3.4 Tonopah Test Range

This section summarizes the potential environmental impacts at the TTR from continuing and proposed projects and capabilities, including their associated levels of operations (activities), under each of three alternatives. The text focuses on those resource areas for which the impacts would be sufficiently different to permit distinguishing among the alternatives in a meaningful manner or would tend to be controversial, i.e., transportation, socioeconomics, air quality, waste management, and human health. **Table S–23** (at the end of Section S.3.4.5) summarizes the potential environmental impacts for all 13 resource areas.

S.3.4.1 Transportation

Radiological impacts on workers and the public would result from the shipment of low-level radioactive waste from the Nevada Test and Training Range, including the TTR, to the NNSS. This waste would be generated from environmental restoration activities. NNSA estimates there would be approximately 230 truck shipments to the NNSS under the No Action and Reduced Operations Alternatives, and about 13,100 truck shipments under the Expanded Operations Alternative.

For incident-free truck transportation, NNSA estimated that less than 1 latent cancer fatality would occur in the population of transportation workers exposed to radiation from shipments of low-level radioactive waste under the No Action Alternative (9×10^{-6}), Expanded Operations Alternative (0.0005), and Reduced Operations Alternative (9×10^{-6}). Because many workers would be involved, the risk to an individual worker would be small. Similarly, NNSA estimated that less than 1 (1×10^{-6}, 0.0002, and 1×10^{-6}, respectively) latent cancer fatality would occur among members of the public exposed to these same truck shipments under the three alternatives.

S.3.4.2 Socioeconomics

The continued operation and proposed activities at the TTR would result in changes to the current (baseline) workforce only under the Expanded Operations and Reduced Operations Alternatives. Accordingly, NNSA evaluated how this change in workforce would affect economic activity, population, housing, public finance, and public services, such as police and fire protection, in Clark and Nye Counties.

Under the Expanded Operations Alternative, the workforce would decrease from about 106 to 43 (63 employees); the unemployment rate in Clark County would, in turn, increase by about 0.01 percent and the rate in Nye County would increase by about 1.34 percent. There would be no impact on housing or public services in either county.

Implementing the Reduced Operations Alternative would have essentially the same impacts as the Expanded Operations Alternative, as the workforce would decrease by 67 employees.

S.3.4.3 Air Quality

For each alternative, NNSA estimated the amount of nonradiological and hazardous air pollutants and greenhouse gases that would be released from ongoing and proposed activities at the TTR (see **Table S–21**). In general, emission-generating activities under any alternative would be widely dispersed over the 280-square-mile area of the TTR, and mobile sources of emissions would occur mostly outside of the TTR.

Table S–21 Emissions of Air Pollutants and Greenhouse Gases (tons per year)

		No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
	Estimated 2008 Emissions	***Annual Average Operational Emissions in 2015***		
Particulate Matter$_{10}$	Less than 4.5	Less than 4.0	Less than 3.8	Less than 3.8
Particulate Matter$_{2.5}$	Less than 4.4	Less than 4.0	Less than 3.8	Less than 3.8
Carbon Monoxide	Less than 14.3	Less than 10.8	Less than 6.1	Less than 5.8
Nitrogen Oxides	Less than 21.4	Less than 17.1	Less than 14.8	Less than 14.7
Sulfur Dioxide	Less than 0.94	Less than 0.93	Less than 0.92	Less than 0.92
Volatile Organic Compounds	Less than 2.0	Less than 1.4	Less than 1.1	Less than 1.1
Lead	Less than 0.05	Less than 0.010	Less than 0.01	Less than 0.01
Hazardous Air Pollutants	Less than 1.2	Less than 1.1	Less than 1.1	Less than 1.1
Carbon Dioxide-Equivalent	4,166	3,653	1,791	1,671

Particulate Matter$_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate Matter$_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

Under all alternatives, emissions of criteria pollutants (hazardous air pollutants) would decrease relative to baseline (2008) levels, and, therefore, would not contribute to or cause additional violations of the criteria pollutant standards. Nye County would continue to be in attainment for all criteria pollutants, while in Clark County, these emissions would not cause or contribute to any new violations of the standards or increases in the frequency or severity of any existing violation of any standard.

NNSA estimates that emissions of hazardous air pollutants would continue to remain low under any alternative, not requiring additional emission control technologies, and, therefore, would not pose an undue health risk to workers or the public. Greenhouse gas emissions, although also estimated to decrease relative to baseline levels under all alternatives, would continue to contribute to global climate change.

S.3.4.4 Waste Management

At the TTR, NNSA actions would generate low-level radioactive waste, hazardous waste, solid waste, and construction debris. Environmental restoration activities at the Nevada Test and Training Range, including the TTR, also would generate low-level radioactive waste and possibly some transuranic waste.

Under the No Action and Reduced Operations Alternatives, about 2.9 million cubic feet of low-level radioactive waste would be generated over 10 years; this waste would be shipped by truck to the NNSS for disposal at the Area 5 Radioactive Waste Management Complex. Under the Expanded Operations Alternative, environmental restoration would generate about 11 million cubic feet of low-level radioactive waste. Although this waste would be shipped to the NNSS for disposal at the Area 5 Radioactive Waste Management Complex, because of the volume of low-level radioactive waste from the TTR and from other in-state and out-of-state sources (see Section S.3.1.10), NNSA also would need to reactivate the Area 3 Radioactive Waste Management Site to accommodate the disposal of this waste.

About 8 tons of hazardous waste would be generated annually under all alternatives. This waste would be shipped from the TTR to permitted facilities to be recycled or treated, stored, and disposed. Adequate capacity is expected to exist in Nevada and elsewhere in the United States to recycle or treat, store, and dispose hazardous waste generated at the TTR. For instance, four treatment, storage, and disposal facilities were permitted to receive hazardous waste in Nevada as of 2009 (NDEP 2009).

TTR site operations also would generate solid waste, including sanitary waste and construction debris. Under the No Action, Expanded Operations, and Reduced Operations Alternatives, about 9,400; 7,700; and 6,600 cubic feet, respectively, of solid waste would be generated annually. The volume of solid waste would be lower under the Expanded Operations Alternative because the projection for sanitary solid waste was based on the estimated number of employees and there would be a decrease of about 63 employees at the TTR. Sufficient capacity exists for NNSA to dispose this waste in solid waste landfills on the TTR, the solid waste landfills on the NNSS, or in local municipal landfills.

S.3.4.5 Human Health

Normal Operations. Environmental restoration activities on the TTR would result in the resuspension of legacy radioactive materials that are transported in the air. NNSA numerically estimated, for the alternatives, that the annual dose to a maximally exposed individual and the population within 50 miles of the TTR would be 0.024 millirem and much less than 1 person-rem, respectively. The maximally exposed individual would incur an increased risk of contracting a latent cancer fatality of 1×10^{-8} (1 chance in 100 million). The estimated number of latent cancer fatalities associated with the annual population dose is 0.0006, implying that the most likely result would be no additional latent cancer fatalities in the population.

Workers also would be exposed to legacy radioactive materials. Under the No Action Alternative, the estimated collective worker dose would be 1.3 person-rem per year (workforce of 106 workers) resulting in an estimated annual latent cancer fatality risk of 0.0008. The workforces under the Expanded Operations and Reduced Operations Alternatives would decrease to 43 and 39 workers, respectively, and, therefore, the collective dose and risk of contracting a latent cancer fatality would be less than estimated for the No Action Alternative.

Accidents. The maximum reasonably foreseeable accident, which is the same for all alternatives, would involve an aircraft crash and ensuing fire involving multiple low-level radioactive waste containers. The estimated probability of this event occurring was estimated to be 1.7×10^{-6} per year of operation (1 chance in 590,000).

If the accident were to occur, the maximally exposed individual would receive a dose of 0.34 millirem, corresponding to a latent cancer fatality risk of 2×10^{-7} (1 chance in 5,000,000). The offsite population within 50 miles would receive a collective dose estimated to be 0.012 person-rem; the calculated number of latent cancer fatalities associated with this dose is 7×10^{-6}, implying that the most likely outcome would be no additional latent cancer fatalities in the exposed population. A noninvolved worker outside the immediate area of the crash would receive an estimated dose of 1.5 rem, with an associated risk of contracting a fatal cancer of 9×10^{-4} (1 chance in 1,100). When the frequency of this accident was considered, the annual risk of a latent cancer fatality was estimated to be 3×10^{-13} for the maximally exposed individual, 1×10^{-11} for the population, and 2×10^{-9} for the noninvolved worker.

NNSA estimated the injuries that could arise in the workforce from industrial accidents based upon accident rates from DOE and the U.S. Department of Labor (DOE 2010a; DOL 2010a, 2010b). Total recordable cases and those cases that could result in lost workdays, restricted duty, or a transfer are shown in **Table S–22**.

Table S–22 Annual Estimated Incidence of Nonfatal Accidents at the Tonopah Test Range

	No Action Alternative		*Expanded Operations Alternative*		*Reduced Operations Alternative*	
Activity	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*	*Total Recordable Cases*	*Lost Workdays, Restrictions, Transfer*
Tonopah Test Range Industrial – Site Operations	1.6	0.7	0.7	0.3	0.6	0.3

Source: DOE 2010a.

Table S–23 Summary of Potential Direct and Indirect Impacts at the Tonopah Test Range

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Land Use			
	There would be no impact on land use from the continuation of activities at the current levels of operations because activities would continue to be compatible with existing land use designations on the TTR and primary land uses on the Nevada Test and Training Range.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
	Airspace No new impacts were identified for airspace activities because these activities would be maintained at the current levels of air traffic, navigational aid services, and airspace structure, and would continue to be coordinated and scheduled by the Nellis Air Traffic Control Facility.	*Airspace* Same as under the No Action Alternative.	*Airspace* Impacts would be slightly reduced compared to the No Action Alternative because of the discontinuation of fixed rocket and missile launches, cruise missile operations, and detonation of fuel-air explosives at the TTR, which would increase the restricted airspace availability for other military uses as coordinated and scheduled by the Nellis Air Traffic Control Facility.
Infrastructure and Energy			
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Transportation [a] and Traffic			
Low-Level and Mixed Low-Level Radioactive Waste			
Incident-free truck transport			
worker risk (latent cancer fatality)	0 (0.0008)	0 (0.003)	0 (0.0001)
population risk (latent cancer fatality)	0 (0.00004)	0 (0.0002)	0 (0.00001)
Transport accidents			
radiological risk (latent cancer fatality)	0 (3×10^{-9})	0 (1×10^{-8})	0 (1×10^{-7})
nonradiological fatalities	0 (0.03)	0 (0.1)	0 (0.03)
Nonradiological waste transport fatalities	Nonradioactive material transports included in Nevada National Security Site impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Traffic	Up to 4 additional truck trips per day from Environmental Restoration radioactive waste transport; minimal impacts on onsite and regional traffic conditions.	Up to 14 additional truck trips per day from Environmental Restoration radioactive waste transport; minimal impacts on onsite and regional traffic conditions.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Socioeconomics			
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Employment would decrease by 63 full-time equivalents, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.64 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.	Employment would decrease by 67 full-time equivalents, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.76 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.
Geology and Soils			
National Security/Defense Mission	There would be localized impacts on soil and geology from tests using gravity weapons, joint test assemblies, and inert projectiles. Some soil contamination could occur. Work for Others – Some localized soil disturbance from a variety of site activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Management Mission	Environmental Restoration – Possible disturbance of soil from environmental restoration of contaminated sites. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.	Same as under the No Action Alternative, plus: • Up to 11,000,000 cubic feet of soil could be removed during environmental restoration activities at the Clean Slate I, II, and III sites. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.	Same as under the No Action Alternative.
Nondefense Mission	There would be no impacts on geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Hydrology			
Surface Water Resources			
National Security/Defense Mission	Gravity weapons drops and rocket and missile testing could cause alterations of natural drainage pathways and chemical contamination of ephemeral waters. Operation of ground-based remote-control vehicles could cause sedimentation to ephemeral waters.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Management Mission	Environmental restoration projects could cause beneficial restoration of natural drainage pathways and adverse impacts of chemical contamination of and sedimentation to ephemeral waters.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission	No proposed activities would affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Groundwater Resources	Proposed activities would not adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Potable water use would decrease by 50 percent compared to current use because several testing activities would cease.
Biological Resources			
	All work would occur in previously disturbed areas and there would be no additional impacts on biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Air Quality and Climate			
Annual Average Operational Emission in 2015 (tons per year) [b]			
Particulate Matter $_{10}$	<4.0	<3.8	<3.8
Particulate Matter $_{2.5}$	<4.0	<3.8	<3.8
Carbon Monoxide	<10.8	<6.1	<5.8
Nitrogen Oxides	<17.1	<14.8	<14.7
Sulfur Dioxide	<0.93	<0.92	<0.92
Volatile Organic Compounds	<1.4	<1.1	<1.1
Lead	<0.010	<0.010	<0.010
Hazardous Air Pollutants	<1.1	<1.1	<1.1
Carbon dioxide-equivalent	3,652	1,790	1,671
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Remediation activities would likely result in increased suspended particulates and higher radiological air emissions relative to those observed in the 2008 baseline conditions. Monitoring would be performed to assess the potential for offsite impacts and the need for mitigating action.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Visual Resources			
	No impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Cultural Resources			
	All work would occur in previously disturbed areas. DOE/NNSA would consult with the State Historic Preservation Officer prior to environmental restoration of Clean Slate sites I, II, and III because they are considered to be historically significant.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Waste Management			
Low-Level Radioactive Waste	200,000 cubic feet generated by environmental restoration activities would be disposed within available capacity at the NNSS Area 5 Radioactive Waste Management Complex.	11,000,000 cubic feet generated by environmental restoration activities would be disposed within available capacity at the NNSS Area 5 Radioactive Waste Management Complex and Area 3 Radioactive Waste Management Site.	Same as under the No Action Alternative.
Hazardous waste	About 4,600 cubic feet of hazardous waste would be generated over the next 10 years that would be transported to permitted offsite facilities to be recycled, treated, and/or disposed within available capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Solid waste	33,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	16,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	15,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Human Health			
Annual Radiological Impacts of Normal Operations due to Legacy Soil Contamination			
Offsite Population		Same as under the No Action Alternative.	Same as under the No Action Alternative.
Dose (person-rem)	<1		
Risk (latent cancer fatalities)	$<6 \times 10^{-4}$		
Maximally Exposed Individual			
Dose (millirem)	0.024		
Risk (latent cancer fatalities)	1×10^{-8}		
Noise Impacts			
Workers	Mitigated through worker protection practices	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Public	Large noises and traffic noise mitigated due to remoteness of site and distance to receptors	Same as under the No Action Alternative, plus: • Minimal increase from higher level of traffic.	Same as under the No Action Alternative, except: • No large noises – fuel-air explosive experiments would not occur.
Facility Accidents – Dose Consequence and Annual Risk [b] *Highest Risk Accident (Aircraft crash and fire into multiple containers of contaminated soil - estimated frequency 1 in 590,000 per year)*			
Offsite Population		Same as under the No Action Alternative.	Same as under the No Action Alternative.
Dose (person-rem)	0.012		
Risk (latent cancer fatality per year)	1×10^{-11}		
Maximally Exposed Individual			
Dose (rem)	0.00034		
Risk (latent cancer fatality per year)	3×10^{-13}		
Noninvolved Worker			
Dose (rem)	1.5		
Risk (latent cancer fatality per year)	2×10^{-9}		
Environmental Justice			
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.		

NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; Particulate $Matter_{10}$ = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; Particulate $Matter_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; rem = roentgen equivalent man; TTR = Tonopah Test Range.

[a] The reported radiological risks are the projected number of latent cancer fatalities in the population and are, therefore, presented as whole numbers. The calculated value is shown in parentheses.

[b] The emissions under the Expanded Operations Alternative would be less than the levels projected under the No Action Alternative, as the Record of Decision for the *Complex Transformation Supplemental Programmatic Environmental Impact Statement* would occur under this Expanded Operations Alternative, resulting in smaller, more-efficient operations and fewer employees at the TTR.

[c] The risk is the annual increased likelihood of a latent cancer fatality in the maximally exposed individual or the noninvolved worker or the increased likelihood of a single latent cancer fatality occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

S.4 Conclusions

S.4.1 Major Conclusions

NNSA evaluated the potential direct, indirect, and cumulative impacts on 13 environmental resource areas that include features of the natural environment and matters of social, cultural, and economic concern. Each resource area is evaluated under each of three alternatives, and the potential environmental consequences are summarized in Section S.3.

In general, the potential environmental impacts would be greatest under the Expanded Operations Alternative. The continuation and enhancement of current levels of operations, specifically the rate of radioactive waste disposal, quantities of radioactive material used in tests and experiments, and transportation of radioactive wastes and materials at the NNSS, as well as the pace of environmental restoration at the Nevada Test and Training Range, including the TTR, are the primary factors that would contribute to the radiological dose and estimated health impacts on the public and workers. The vast majority of the public dose would be due to transportation of radioactive materials and waste. If all of the transportation activities evaluated under this alternative were to occur, the public would receive a collective dose of 1,400 person-rem, resulting in an estimated 1 (0.8) latent cancer fatality in that population.

Under each alternative, construction and operation of solar power generation facilities at the NNSS would result in the following: an increase in employment relative to the current workforce, loss of desert tortoise habitat and the taking of tortoises, direct impacts on cultural resources, and increases in demand for groundwater. At present, DOE/NNSA has neither sought nor received proposals for specific solar facilities. Prior to authorizing the development of such facilities, NNSA would conduct a project-specific NEPA review, and undertake actions necessary to demonstrate compliance with applicable regulations.

At RSL, NNSA would maintain the current levels of operations, as no new projects or enhanced capabilities are proposed. Among the 13 resource areas, either there would be no impacts or the impacts associated with ongoing operations would remain small and continue unchanged from baseline conditions. Although the levels of operations could increase and proposed projects could be implemented at NLVF and the TTR, NNSA concludes that environmental impacts on all resource areas would remain small.

S.4.2 Areas of Controversy

American Indian tribes and organizations believe that activities at the NNSS and offsite locations, regardless of the magnitude of potential environmental impacts under any of the alternatives, would result in an adverse and unacceptable disturbance of the natural and cultural environment. In recognition of Federal laws and policies, NNSA maintains an ongoing consultation program with the Consolidated Group of Tribes and Organizations to address American Indian concerns about the environment, and, in particular, archaeological sites, plant and animal resources, traditional cultural properties, and sacred sites of cultural value.

The public in general, and Nye County residents in particular, remain concerned about the quality of groundwater from the NNSS, which flows into southern Nye County along multiple flow paths. Groundwater contaminated by past underground nuclear weapons testing has the potential to affect the quality of water available to communities, residents, and commercial enterprises in the future. In 2009, tritium was detected in a well located on the Nevada Test and Training Range adjacent to the Western Pahute Mesa region of the NNSS. This well is about 14 miles from the nearest private well. Based on computer model predictions, NNSA does not expect contamination to reach the private well for at least 100 years, and furthermore, contamination may never reach the well.

Water use and water rights will continue to be a major concern, regardless of the water demands associated with the NNSS. Growth in water demand in Nevada, particularly in Nye County, has been rapid, and water use and Federal water rights at the NNSS remain a controversial issue when considered against the backdrop of regional water transfer plans.

The State of Nevada continues to believe that disparities exist between the original NNSS land withdrawals and DOE/NNSA activities.

The public remains concerned about possible health effects that could occur from the resuspension of radioactively contaminated soils from land-disturbing activities on the NNSS. NNSA continues to monitor the releases of radionuclides to the environment from all sources, such as soils and air, and used these data to estimate the dose to a maximally exposed individual. Since 2004, the dose to this individual is estimated to have ranged from 2.0 to 2.9 millirem per year, a small fraction of the average annual dose of about 310 millirem that a member of the public receives from natural background sources of radiation.

C G T O

Summary of the Consolidated Group of Tribes and Organizations' Areas of Interest

- Increased access to the Nevada National Security Site (NNSS) and Off-Site Locations to conduct traditional ceremonies and activities to promote balance and sustainability to the land.
- Expanded ethnographic studies focusing on traditional and religious use areas culminating in a Traditional Cultural Property nomination on the NNSS.
- Identify and establish co-management strategies with the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) for protection of American Indian cultural resources on the NNSS and Off-Site Locations.
- Expanded studies of impacts derived from the transportation of radioactive waste and materials through ancestral lands and to the overall Indian culture.

The State of Nevada and others continue to promote the current DOE/NNSA commitment of avoiding shipments of low-level and mixed low-level radioactive waste through Las Vegas, Nevada. This commitment, as expressed in the waste acceptance criteria for the NNSS, avoided Hoover Dam and Las Vegas. DOE/NNSA committed to avoid these areas at a time when major highways, specifically Interstate 15 and U.S. Route 95, were unable to accommodate the growing traffic volume. Since then, these highways have been widened and otherwise improved, the Bruce Woodward Beltway (Interstate 215 and Clark County Route 215) around Las Vegas has been expanded, and the bypass bridge has been constructed nearby Hoover Dam. NNSA, in this *NNSS SWEIS*, has analyzed two transportation cases; a Constrained Case and an Unconstrained Case. The Constrained Case retains current routing of shipments of low-level and mixed low-level radioactive waste and avoids crossing the Colorado River near Hoover Dam, and the interstate system in Las Vegas. The Unconstrained Case analyzes shipments on highways through the greater metropolitan area. This analysis was undertaken to develop a greater understanding of the potential environmental consequences of shipping such waste through and around metropolitan Las Vegas, and to inform any potential highway routing-related revisions to NNSA's waste acceptance criteria. Such revisions are developed in accordance with NNSA's standard practices, which include consultation with the State of Nevada and, when finalized, become publicly available through publication on NNSS' website. Based on the analysis, NNSA concludes that the radiation dose to workers and the public under the Constrained Case would fall within the range of impacts that would result if using unconstrained routes.

Maximally Exposed Individual

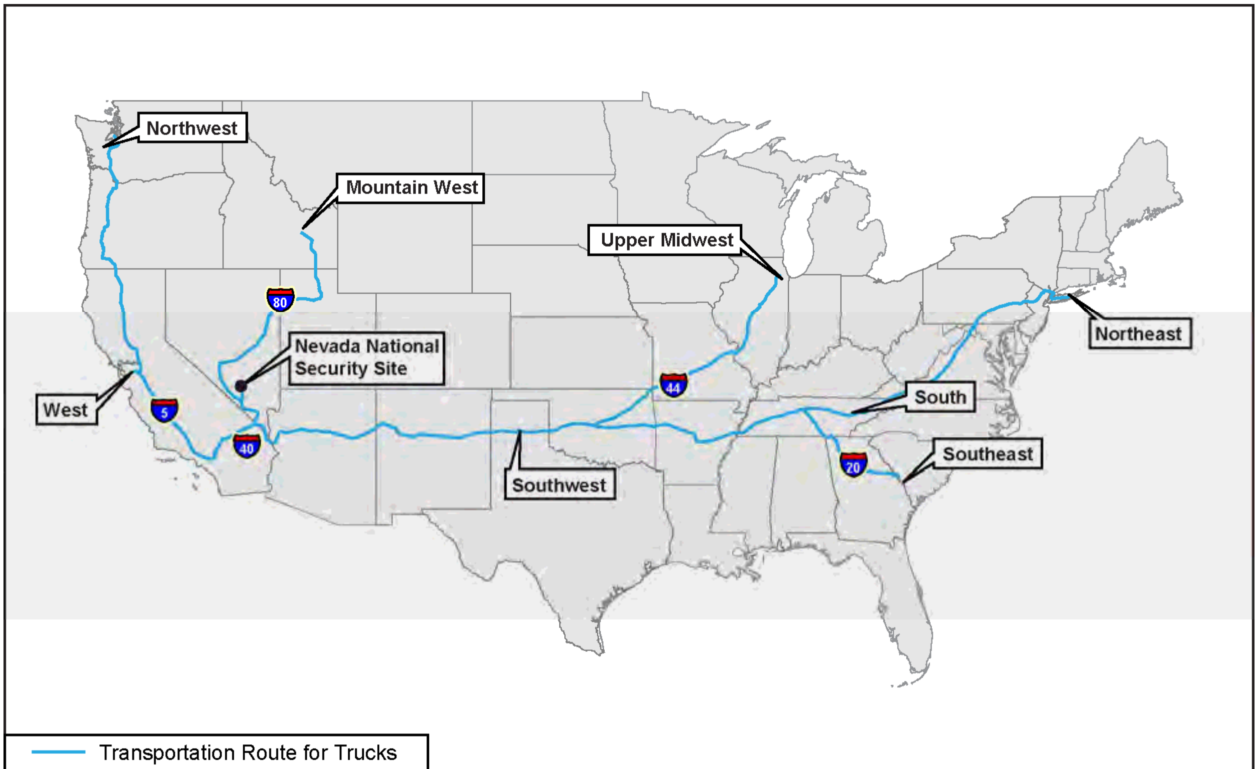
A hypothetical individual whose location and habits result in the highest total radiological exposure, (and thus dose), from a particular source for all relevant exposure routes (e.g., inhalation, ingestion, direct exposure).

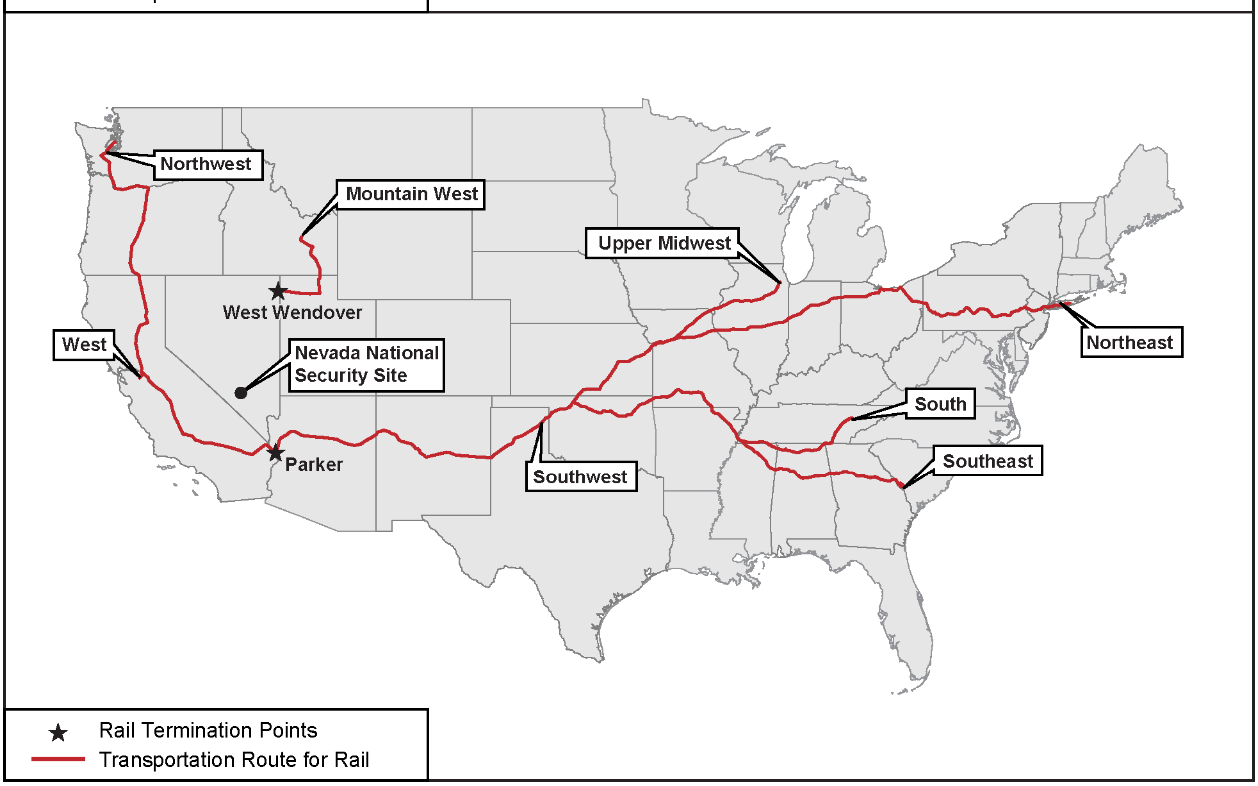
S.4.3 Issues to be Resolved

Implementing any of the alternatives may trigger other regulatory actions that NNSA would need to undertake prior to proceeding, such as reinitiating consultation under Section 7 of the Endangered Species Act with USFWS regarding the desert tortoise, consultations with the Nevada State Historic Preservation Officer under Section 106 of the National Historic Preservation Act, or consultations with the State of Nevada regarding reactivation of the Area 3 Radioactive Waste Management Site. NNSA has in the past undertaken such consultations, and continues to do so. As an example, NNSA, in consultation with USFWS, submitted a biological assessment of projects and activities anticipated to occur on the NNSS, and in 2009, USFWS issued its *2009 Biological Opinion* (USFWS 2009). This SWEIS addresses a range of reasonably foreseeable projects and activities that would be developed or undertaken over the next 10 years, although several such projects and activities are in the early phases of development. For these proposals, conservative assumptions regarding the location and scale of these projects and activities were made to provide a basis for programmatic analysis. Accordingly, when the planning processes for future projects and activities are refined and more-detailed information becomes available, and subsequent to any decisions in a Record of Decision, NNSA would identify regulatory requirements applicable to newly proposed projects and to changes in ongoing operations (activities), and then initiate actions leading to compliance with those requirements.

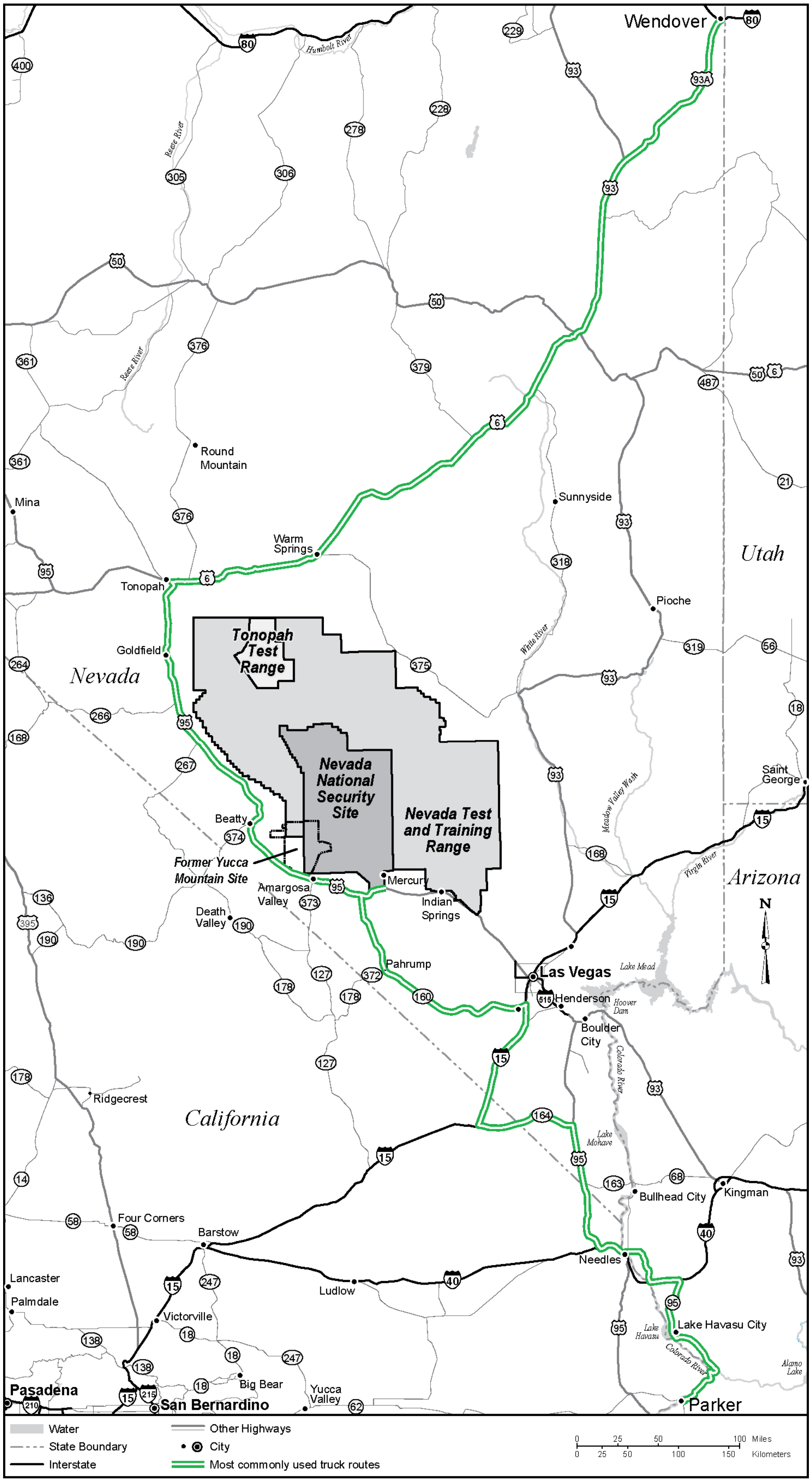
Groundwater contaminated from past weapons testing continues to migrate, and tritium has been found in a well outside the NNSS, but within the secure boundaries of the Nevada Test and Training Range. Developing an improved understanding of where radiological contamination exists in the groundwater, predicting where the contamination is moving, and defining how far it will migrate will require NNSA to continue the development of a regional three-dimensional groundwater computer model. Such a model would also form the basis for developing individualized models for each major area where underground testing was conducted.

NNSA could not proceed with the development of utility-scale solar power generation facilities in Area 25 of the NNSS in the absence of a commercial developer. If a developer were to propose such a facility, additional NEPA analysis would be required to identify and analyze potential project-specific environmental impacts. In addition, NNSA would need to identify and resolve any conflicts between the proposed facility and ongoing operations at the NNSS before the facility could be constructed.

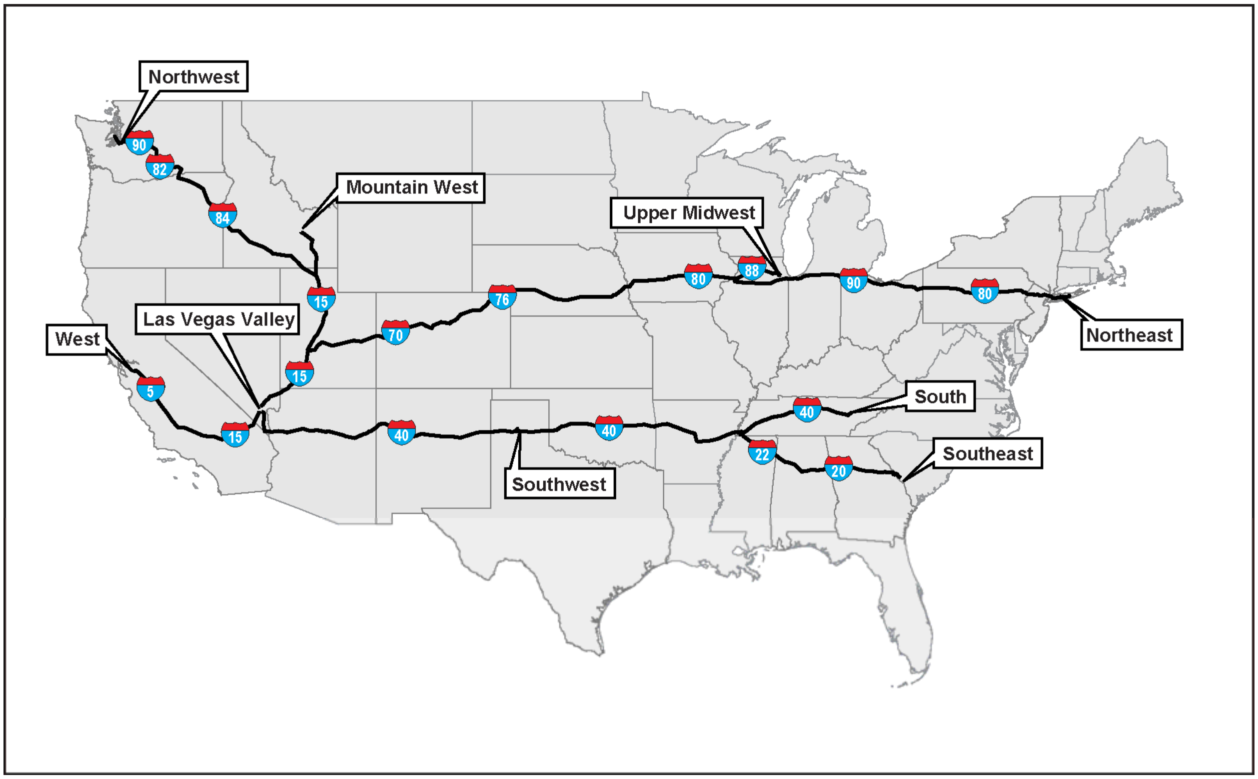




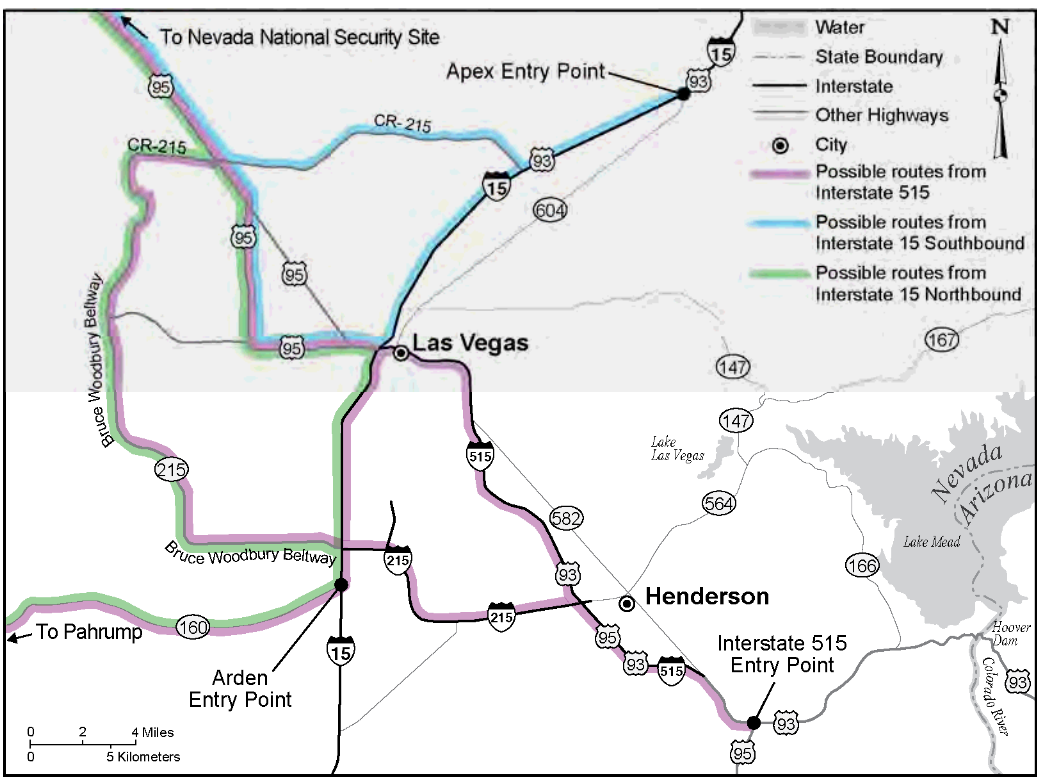
Map 1 Constrained Case – Truck Routes to the Nevada National Security Site and Rail Routes to Transfer Stations in West Wendover, Nevada, and Parker, Arizona



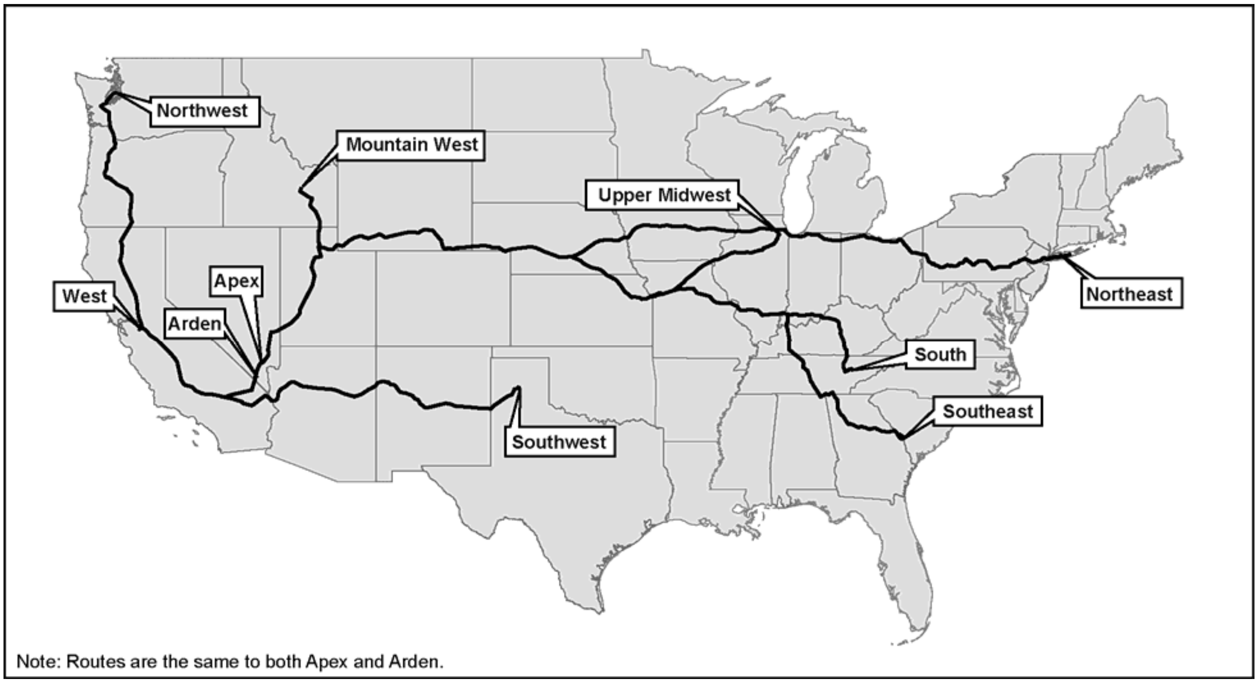
Map 2 Constrained Case – Truck Routes from the Transfer Stations to the Nevada National Security Site



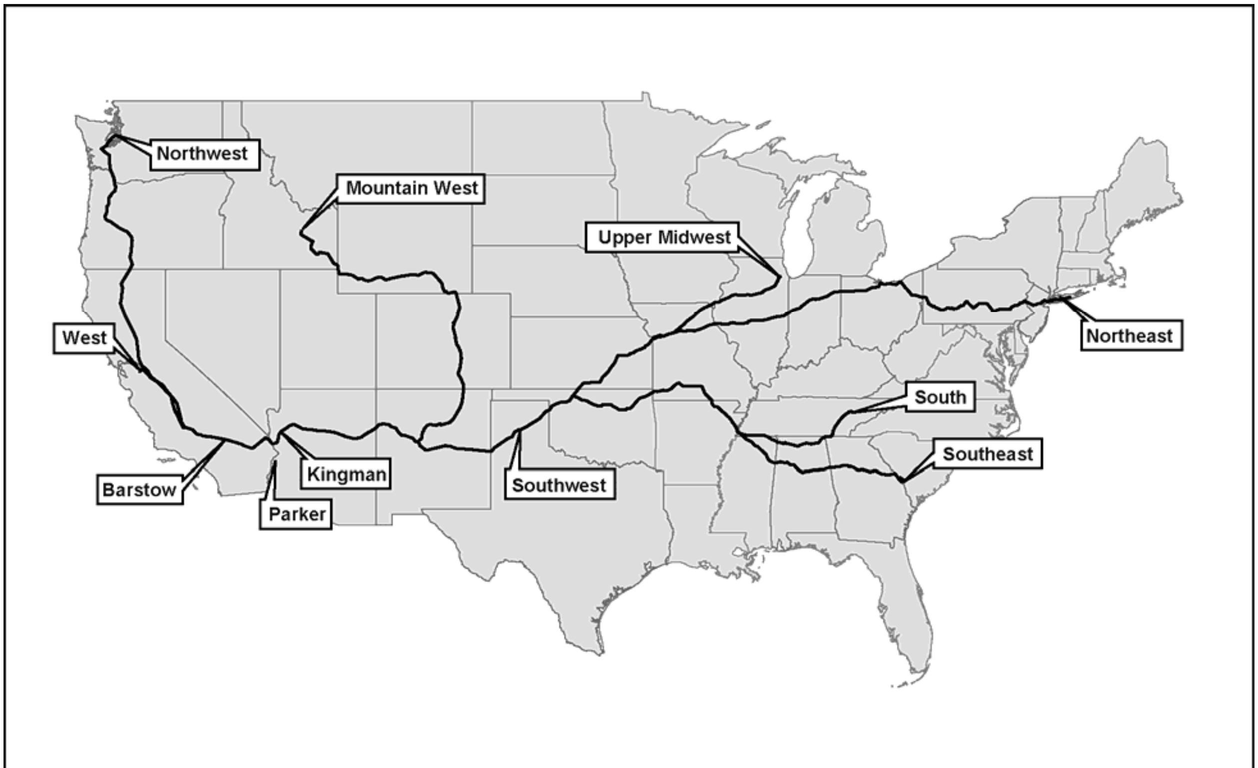
Map 3 Unconstrained Case – Truck Routes to Las Vegas Entry Points

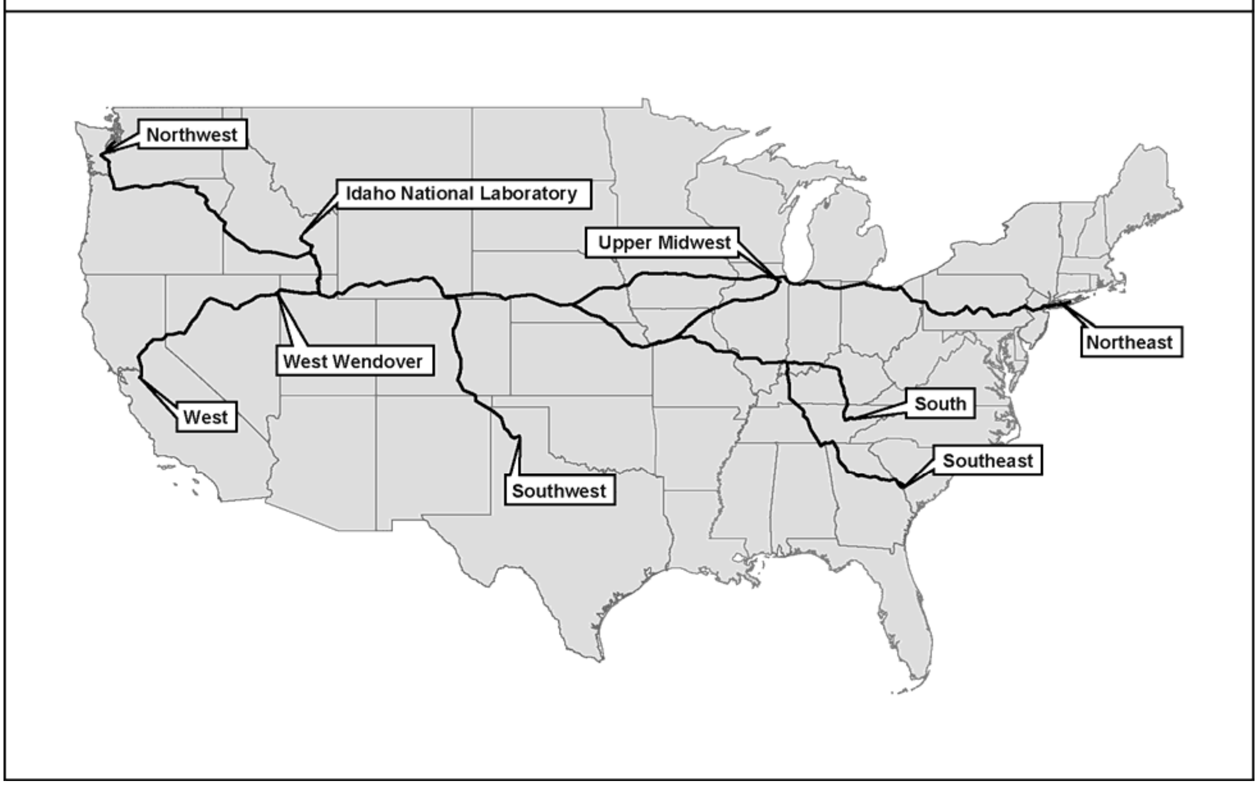


Map 4 Unconstrained Case – Truck Routes From Las Vegas Entry Points to the Nevada National Security Site

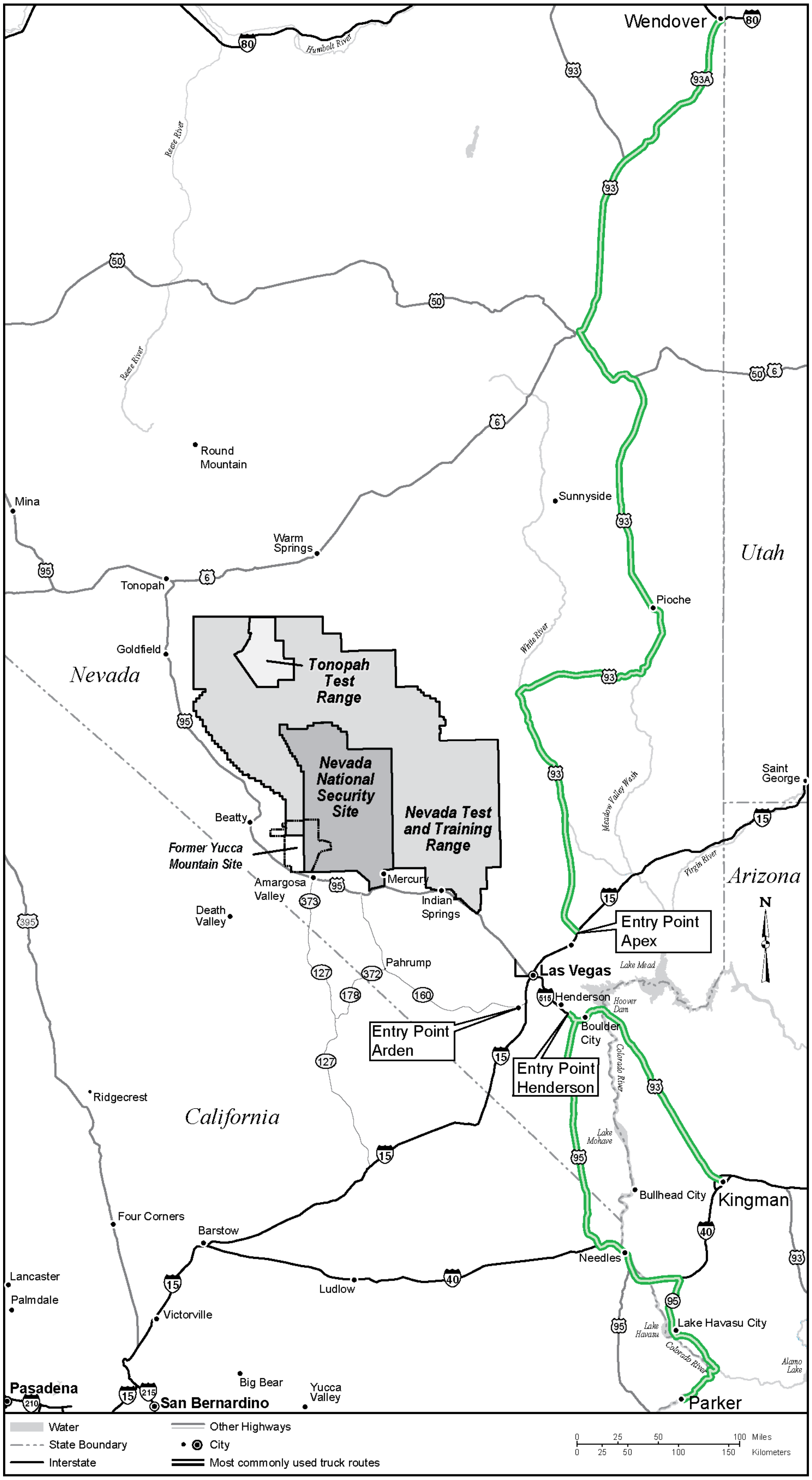


Map 5 Unconstrained Case – Rail Routes to Transfer Stations at Apex and Arden, Nevada





Map 6 Rail Routes to Transfer Stations at Parker and Kingman, Arizona, and West Wendover, Nevada



Map 7 Truck Routes from Transfer Stations to Las Vegas Entry Points

S.5 References

BLM (Bureau of Land Management), 2010, Mapping Sciences, Nevada State Office, Landowner - Digital Data, Nevada.

BN (Bechtel Nevada), 1999, *Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways*, Nevada Test Site, PBS&J 511036.00, North Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1996, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 1997, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200F, May.

DOE (U.S. Department of Energy), 2002, *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243-SA-01, July.

DOE (U.S. Department of Energy), 2008a, *Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada*, Office of Civilian Radioactive Waste Management, DOE/EIS-0369, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008b, *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243-SA-03, National Nuclear Security Administration, Nevada Operations Office, Las Vegas, Nevada, April.

DOE (Department of Energy), 2010a, Computerized Accident/Incident Reporting System," Occupational Injury and Illness Summary Report," Office of Health, Safety and Security (http://www.hss.doe.gov/csa/analysis/cairs/cairs/summary/oipds094/sum.html).

DOE (U.S. Department of Energy), 2010b, *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*, DOE/EIS-0226, Washington, DC, January.

DOE/NV (U.S. Department of Energy, Nevada), 1998a, *Nevada Test Site Resource Management Plan*, DOE/NV-518, Las Vegas, Nevada, December.

DOE/NV (U.S. Department of Energy, Nevada), 1998b, *The Relative Abundance of Desert Tortoises on the Nevada Test Site Within Ecological Landform Units*, DOE/NV/11718-245, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2009, *Nevada Test Site Environmental Report 2008*, DOE/NV/25946-790, Nevada Site Office, Las Vegas, Nevada, September.

DOL (U.S. Department of Labor), 2010a, "Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data," Bureau of Labor Statistics, accessed at http://www.bls.gov/iif/oshcfoi1.htm, April 21.

DOL (U.S. Department of Labor), 2010b, "Workplace Injuries and Illnesses -- 2009," News Release USDL-10-1451, Bureau of Labor Statistics, October 21.

EPA (U.S. Environmental Protection Agency), 2009, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, EPA 430-R-09-004, (accessed August 5, 2009, http://www.epa.gov/climatechange/emissions/usinventoryreport.html), Washington, DC, July 14.

FFACO (Federal Facility Agreement and Consent Order), 2010, Appendix VI, Corrective Action Strategy, Revision No. 3, March.

IPCC (Intergovernmental Panel on Climate Change), 2008, *Climate Change 2007*.

NDEP (Nevada Division of Environmental Protection), 1996, The State of Nevada Department of Conservation and Natural Resources, Division of Environmental Protection and the U.S. Department of Energy and the U.S. Department of Defense in the matter of Federal Facility Agreement and Consent Order, March 15.

NDCNR (Nevada Department of Conservation and Natural Resources, Division of Water Resources), 2010, Hydrographic Basin Summary by Manner of Use, Basin 160 (accessed at http://water.nv.gov/water%20Rights/permitdb/UGactive2.cfm?CFID=777906&CFTOKEN=93208706).

NDEP (Nevada Division of Environmental Protection), 1996, The State of Nevada Department of Conservation and Natural Resources, Division of Environmental Protection and the United States Department of Energy and the United States Department of Defense in the matter of Federal Facility Agreement and Consent Order, March 15.

NDEP (Nevada Division of Environmental Protection), 2008, *Nevada Statewide Greenhouse Gas Emissions Inventory and Projections, 1990-2020*, Carson City, Nevada, December.

NDEP (Nevada Division of Environmental Protection), 2009, Bureau of Waste Management (accessed April 20, 2010, http://ndep.nv.gov/bwm/hazard01.htm), October 13.

NDWR (Nevada Division of Water Resources), 2006, Hydrographic Boundaries – State of Nevada, Nevada.

NNSA (National Nuclear Security Administration), 2008, 2008 NTS 4th Quarter Employment Report.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010a, Personal communication with K. Thornton and G. Babero, Office of the Assistant Manager for Site Operations, Information provided on existing electrical circuit configuration and capacity, email on April 14.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010b, (Parts 1-4), Personal communication with R. A. Reece, Manager at Facility and Infrastructure Planning, Data provided on electrical usage, natural gas, and liquid fuel usage (gallons) by type (red dye, E85, unleaded, biodiesel, #2 diesel, jet fuel) for NTS, RSL, and NLVF.

NSOE (Nevada State Office of Energy), 2009, *2008 Status of Energy in Nevada, Report to Governor Jim Gibbons and Legislature* (accessed January 19, 2011, http://www.leg.state.nv.us/Interim/75th2009/Committee/Studies/Energy/Other/2008StatusofEnergyinNevadaFinalReport.pdf), Carson City, Nevada.

NSOE (Nevada State Office of Energy), 2010, 2009 Status of Energy in Nevada, Report to Governor Jim Gibbons and Legislature, Carson City, Nevada, May.

NSTec (National Security Technologies LLC), 2008, *FY 2009 NNSA/NSO Energy Executable Plan*, December.

NSTec (National Security Technologies LLC.), 2010, Water usage data for NTS active wells and fillstations between 2005 and 2009, Provided by D. D. Rudolph, Senior Scientist, Water and Waste Section, National Security Technologies, Data sent as 2005-2010wellFlowTotals.pdf and Fillstandsall.pdf (data compiled and summarized in Well Water DATA compiled AMW spreadsheets 1-21-10.xls), January 20.

RIMS II, 2010, Regional Input-Output Modeling System II, U.S. Department of Commerce, Bureau of Economic Analysis.

Parker, P. L., and T. F. King, 1998, "Guidelines for Evaluating and Documenting Traditional Cultural Properties," *National Register Bulletin*, U.S. Department of the Interior, National Park Service, National Register, History and Education, and National Register of Historic Places, Washington, DC.

Scott, B. R., T. J. Smales, F. E. Rush, and A. S. Van Denburgh, 1971, *Water for Nevada*, Water Planning Report 3, Nevada Department of Conservation and Natural Resources, Division of Water Resources, State of Nevada, Carson City, Nevada.

TRB (Transportation Research Board), 2000, *Highway Capacity Manual*.

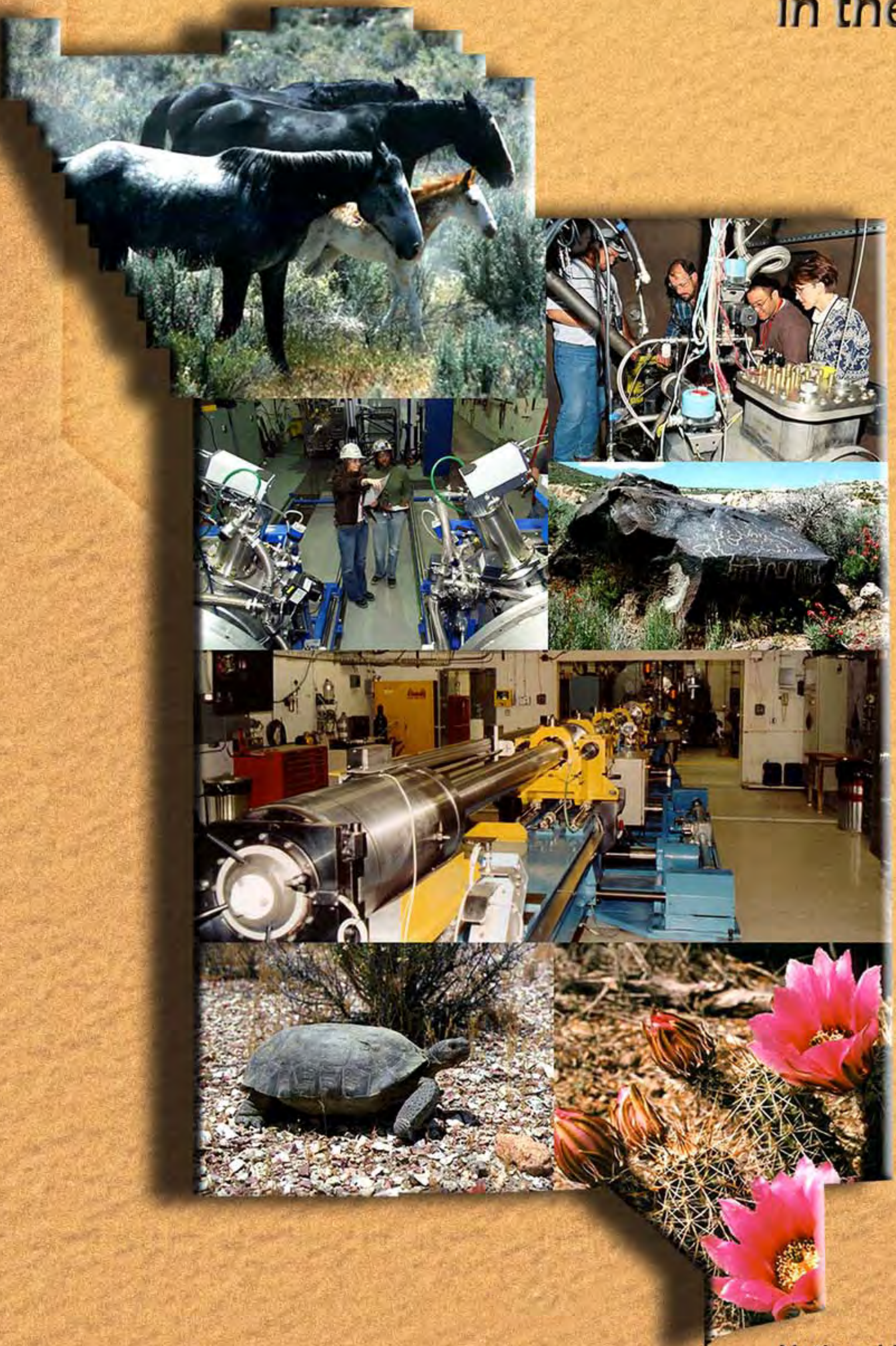
USFWS (U.S. Fish and Wildlife Service), 2000, *Clark County Multi-Species Habitat Conservation Plan Environmental Impact Statement*, U.S. Department of the Interior, Las Vegas, Nevada, September.

USFWS (U.S. Fish and Wildlife Service), 2009, *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada*, (File Nos. 84320-2008-F-0416 and 84320-2008-B-00 15), U.S. Department of the Interior, Nevada Fish and Wildlife Office, Las Vegas, Nevada, February 12.

DOE/EIS-0426D

Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada

Volume 1, Book 1
(Chapters 1 through 4)



U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

Availability of the Draft Site-Wide
Environmental Impact Statement for the
Continued Operation of the Department of Energy/
National Nuclear Security Administration
Nevada National Security Site and Off-Site Locations in
the State of Nevada (NNSS SWEIS)

For further information on this draft SWEIS, or to request a copy of the SWEIS or references, please contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518
Telephone: 702-295-0077
Fax: 702-295-5300
E-mail: nepa@nv.doe.gov

Printed with soy ink on recycled paper

COVER SHEET

Responsible Agency: U.S. Department of Energy/National Nuclear Security Administration

Cooperating Agencies: U.S. Air Force
U.S. Department of the Interior, Bureau of Land Management
Nye County, NV

Title: *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE/EIS-0426D)

Location: Nye and Clark Counties, Nevada

For additional information or for copies of this draft site-wide environmental impact statement (SWEIS), contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518

Telephone: 702-295-0077
Facsimile: 702-295-5300
E-mail: nepa@nv.doe.gov

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Telephone: 202-586-4600, or leave a message at 1-800-472-2756
Facsimile: 202-586-7031
E-mail: askNEPA@hq.doe.gov

Abstract: This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes the potential environmental impacts of proposed alternatives for continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA)-managed sites in Nevada, including the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration areas on the U.S. Air Force Nevada Test and Training Range. The purpose and need for agency action is to provide support for meeting NNSA's core missions established by Congress and the President, and to satisfy the requirements of Executive orders and comply with congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since the October 1992 moratorium on nuclear testing, NNSA's primary mission at the NNSS has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests, if so directed by the President. Resources have been reallocated to introduce and expand other mission activities/programs at the NNSS, RSL, NLVF, and the TTR to support three DOE/NNSA core missions: National Security/Defense, Environmental Management, and Nondefense. The National Security/Defense Mission includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation and Counterterrorism, and Work for Others

Programs. The Work for Others Program supports other DOE programs and Federal agencies such as the U.S. Department of Defense, U.S. Department of Justice, and U.S. Department of Homeland Security. The Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. The Nondefense Mission includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The NNSS, RSL, NLVF, and the TTR support DOE/NNSA's core missions by providing the capabilities to process and dispose of a damaged nuclear weapon or improvised nuclear device and to conduct high-hazard experiments involving special nuclear material and high explosives, non-nuclear experiments, and hydrodynamic testing. Nuclear stockpile stewardship activities at the NNSS include dynamic plutonium experiments that provide technical information to maintain the safety and reliability of the U.S. nuclear weapons stockpile and research and training in areas such as nuclear safeguards, criticality safety, and emergency response. Special Nuclear Materials are also stored at the NNSS. In addition, in accordance with the amended Record of Decision (ROD) (DOE/EIS-0243) for the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS*) , NNSA receives low-level and mixed low-level radioactive waste for disposal at the NNSS.

This *NNSS SWEIS* analyzes the environmental impacts of three reasonable alternatives for continued operations at the NNSS, RSL, NLVF, and the TTR during the 10-year period following the issuance of a ROD. These alternatives include a No Action Alternative and two action alternatives: Expanded Operations and Reduced Operations. The No Action Alternative, which is analyzed as a baseline for evaluating the two action alternatives, would continue implementation of the *1996 NTS EIS* ROD (DOE/EIS-0243) and subsequent amendments (61 FR 65551and 65 FR 10061), as well as other decisions supported by separate NEPA analyses completed since issuance of the final *1996 NTS EIS*. The No Action Alternative reflects activity levels consistent with those seen since 1996. The Expanded Operations Alternative would consider adding reasonably foreseeable new work at the NNSS in the areas of nonproliferation and counterterrorism, high-hazard and other experiments, research and development and testing. Such expanded operations could include developing test beds for concept testing of sensors, mitigation strategies, and weapons effectiveness. The Reduced Operations Alternative would reduce the overall level of operations and close specific buildings and structures. NNSA would also consider allowing the development of solar power generation facilities under each alternative.

Public Comments: DOE issued a Notice of Intent (NOI) in the *Federal Register* (74 FR 36691) on July 24, 2009, to solicit public input on the preparation of this Draft SWEIS. Comments received from the public during the scoping period (July 24, 2009 to October 16, 2009) have been considered in the preparation of this Draft SWEIS. Comments received after the close of the comment period also have been considered. Comments on this Draft SWEIS will be accepted following publication of the U.S. Environmental Protection Agency's Notice of Availability (NOA) in the *Federal Register* for a period of 90 days, and will be considered in the preparation of the Final SWEIS. Any comments received after the comment period will be considered to the extent practicable. Public meetings and locations will be identified at a later date.

TABLE OF CONTENTS

TABLE OF CONTENTS

Volume 1, Book 1
(Chapters 1 through 4)

Chapter 3
Description of Alternatives

Chapter 4
Affected Environments

Chapter 5
Environmental Consequences

Chapter 6
Cumulative Impacts

Chapter 7
Mitigation Measures

Chapter 8
Resource Commitments

Chapter 9
Laws, Regulations, and Permits

LIST OF FIGURES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

LIST OF TABLES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 9

Chapter 10

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACEC	Area of Critical Environmental Concern
AEA	Atomic Energy Act
AFVs	Alternate Fuel Vehicles
AIWS	American Indian Writers Subgroup
ALARA	as low as is reasonably achievable
AMS	Aerial Measuring System
ARG	Accident Response Group
ASSESS	Analytical System and Software for Evaluating Safeguards and Security
ATLAS	Adversary Time-Line Analysis System
BEEF	Big Explosives Experimental Facility
BLM	Bureau of Land Management
BMP	best management practice
BRAC	Base Realignment and Closure
CAA	Clean Air Act
CAPP	Chemical Accident Prevention Program
CARE	Communities Against a Radioactive Environment
CAU	corrective action unit
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CGTO	Consolidated Group of Tribes and Organizations
CSP	Concentrated Solar Power
CY	calendar year
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DAQEM	Department of Air Quality and Environmental Management
DARE	Drug Abuse Resistance Education
DART	days away from work, restricted work, or job transfer
dBA	decibels A-weighted
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/NNSA	U.S. Department of Energy/National Nuclear Security Administration
DOE/NV	DOE Nevada Operations Office
DOT	U.S. Department of Transportation
DTRA	Defense Threat Reduction Agency
DU	depleted uranium
EA	Environmental Assessment
EERE	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
EIS	environmental impact statement
EMAC	Ecological Monitoring and Compliance

E-MAD	Engine Maintenance, Assembly, and Disassembly
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERPG	Emergency Response Planning Guideline
ETDS	E-Tunnel Waste Water Disposal System
ExperRT	Expeditionary Readiness Training
FAA	Federal Aviation Administration
FACE	Free-Air Carbon Dioxide Enrichment
FBI	Federal Bureau of Investigation
FFACO	Federal Facilities Agreement and Consent Order
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FTE	full-time equivalent
FY	fiscal year
GBUAPCD	Great Basin Unified Air pollution Control District
GCD	greater confinement disposal
GHG	greenhouse gas
gpd	gallons per day
GTCC	greater-than-Class C [waste]
GWP	global warming potential
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
HAP	hazardous air pollutant
HAZMAT	hazardous materials
HLW	high-level radioactive waste
INL	Idaho National Laboratory
ISO	International Organization for Standardization
JASPER	Joint Actinide Shock Physics Experimental Research
JCATS	Joint Conflict and Tactical Simulations
KLF	Kistler Launch Facility
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LCF	latent cancer fatality
LLW	low-level radioactive waste
LOS	level of service
LTHMP	Long-Term Hydrological Monitoring Program
M-2	general industrial district in North Las Vegas
MCL	maximum contaminant level
MEI	maximally exposed individual
MGCF	Mojave Global Change Facility
MGD	million gallons per day
MLLW	mixed low-level radioactive waste
MSHCP	Multi-Species Habitat Conservation Plan

NAAQS	National Ambient Air Quality Standards
NAC	*Nevada Administrative Code*
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act of 1969
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NEST	nuclear emergency support team
NHPA	National Historic Preservation Act
NLVF	North Las Vegas Facility
NNSA	National Nuclear Security Administration
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NOI	Notice of Intent
NPDES	National Pollutant discharge Elimination System
NPS	National Park Service
NPTEC	Nonproliferation Test and Evaluation Complex
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NSO	Nevada Site Office
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
NV	Nevada
NWRPO	Nuclear Waste Repository Project Office
Opinion	Biological Opinion
OSHA	Occupational Safety and Health Act
OST	Office of Secure Transportation
P.L.	Public Law
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
pH	a measure of acidity or basicity
PM_n	particulate matter with an aerodynamic diameter less than or equal to $_n$ micrometers
PSD	Prevention of Significant Deterioration
PWS	public water system
QAPP	Quality Assurance Program Plan
rad	radiation absorbed dose
RADTRAN	Radioactive Material Transportation Risk Assessment Code 6
RAP	Radiological Assistance Program
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RIMS II	Regional Input-Output Modeling System II
RISKIND	Risks and Consequences of Radioactive Material Transport computer code
RNCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
ROD	Record of Decision

ROI	region of influence
RREM	Routine Radiological Environmental Monitoring
RSL	Remote Sensing Laboratory
RTG	radioisotope thermoelectric generator
RWAP	Radioactive Waste Acceptance Program
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SA	Supplement Analysis
SARA	Superfund Amendments and Reauthorization Act
SNF	spent nuclear fuel
SNM	special nuclear materials
SNWA	Southern Nevada Water Authority
SPA	Specific Planning Area
SPEIS	supplemental programmatic environmental impact statement
SSO	Sandia Site Office
SWAT	special weapons and tactics
SWEIS	site-wide environmental impact statement
TNT	2,4,6-trinitrotoluene
TRAGIS	Transportation Routing Analysis Geographic Information System
TRC	total recordable cases
TRU	transuranic waste
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TTR	Tonopah Test Range
TRUPACT	Transuranic Package Transporter
TYSP	Ten-Year Site Plan
UGTA	Underground Test Area
UIC	underground injection control
USAF	United States Air Force
U.S.C.	*United States Code*
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant
ZPPR	zero power plutonium reactor
ºC	degrees Centigrade
ºF	degrees Fahrenheit
μS	microsiemens

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.315	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

CHAPTER 1
INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.0 INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.1 Introduction

This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes potential environmental impacts of continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other sites managed by the National Nuclear Security Administration (NNSA) in Nevada. The primary purpose of continuing operation of the NNSS is to provide support for NNSA's nuclear weapons stockpile stewardship missions. NNSA also supports other U.S. Department of Energy (DOE) programs and Federal agencies such as the U.S. Department of Defense (DoD), U.S. Department of Justice, and U.S. Department of Homeland Security. This site-wide environmental impact statement (SWEIS) analyzes the potential environmental impacts of reasonable alternatives for current and reasonably foreseeable missions, programs, capabilities, and projects at the NNSS and offsite locations in Nevada during a 10-year period.

Established by Congress through the National Nuclear Security Administration Act (Title XXXII of the National Defense Authorization Act for Fiscal Year 2000, Public Law [P.L.] 106-65), NNSA is a separately organized, semiautonomous agency within DOE. NNSA operates programs at the NNSS and at offsite locations in Nevada, including the North Las Vegas Facility (NLVF), the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the Tonopah Test Range (TTR), and environmental remediation areas on the U.S. Air Force Nevada Test and Training Range (formerly the Nellis Air Force Range) through the Nevada Site Office in North Las Vegas, Nevada. These facilities and sites are shown in **Figure 1–1**. The NNSS and the TTR are located in Nye County; NLVF and RSL are located in Clark County; and the Nevada Test and Training Range is located in Nye, Lincoln, and Clark Counties in southern Nevada.

DOE's National Environmental Policy Act (NEPA) implementing procedures (10 *Code of Federal Regulations* [CFR] 1021.330(c)) require preparation of a SWEIS, a broad-scope document that identifies and assesses the individual and cumulative impacts of ongoing and reasonably foreseeable future actions for certain large multiple-facility DOE sites such as the NNSS. In accordance with 10 CFR Part 1021, an evaluation of a SWEIS is required every 5 years. NNSA determines whether an existing SWEIS remains adequate or a new SWEIS or supplement to the existing SWEIS is needed. NNSA has prepared this SWEIS to comply with NEPA and Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500–1508) and DOE NEPA implementing procedures (10 CFR Part 1021).

In 1996, DOE issued the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996c) and an associated Record of Decision (ROD) (61 *Federal Register* [FR] 65551). DOE selected the *1996 NTS EIS* Expanded Use Alternative for most activities, but decided to manage low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) at levels described under the No Action Alternative, pending decisions on the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS)* (DOE 1997). In the February 2000 *WM PEIS* ROD (65 FR 10061), DOE announced that the NNSS would be one of two regional sites to be used for LLW and MLLW disposal. At the same time, DOE amended the *1996 NTS EIS* ROD to select the Expanded Use Alternative for waste management activities at the NNSS (65 FR 10061).

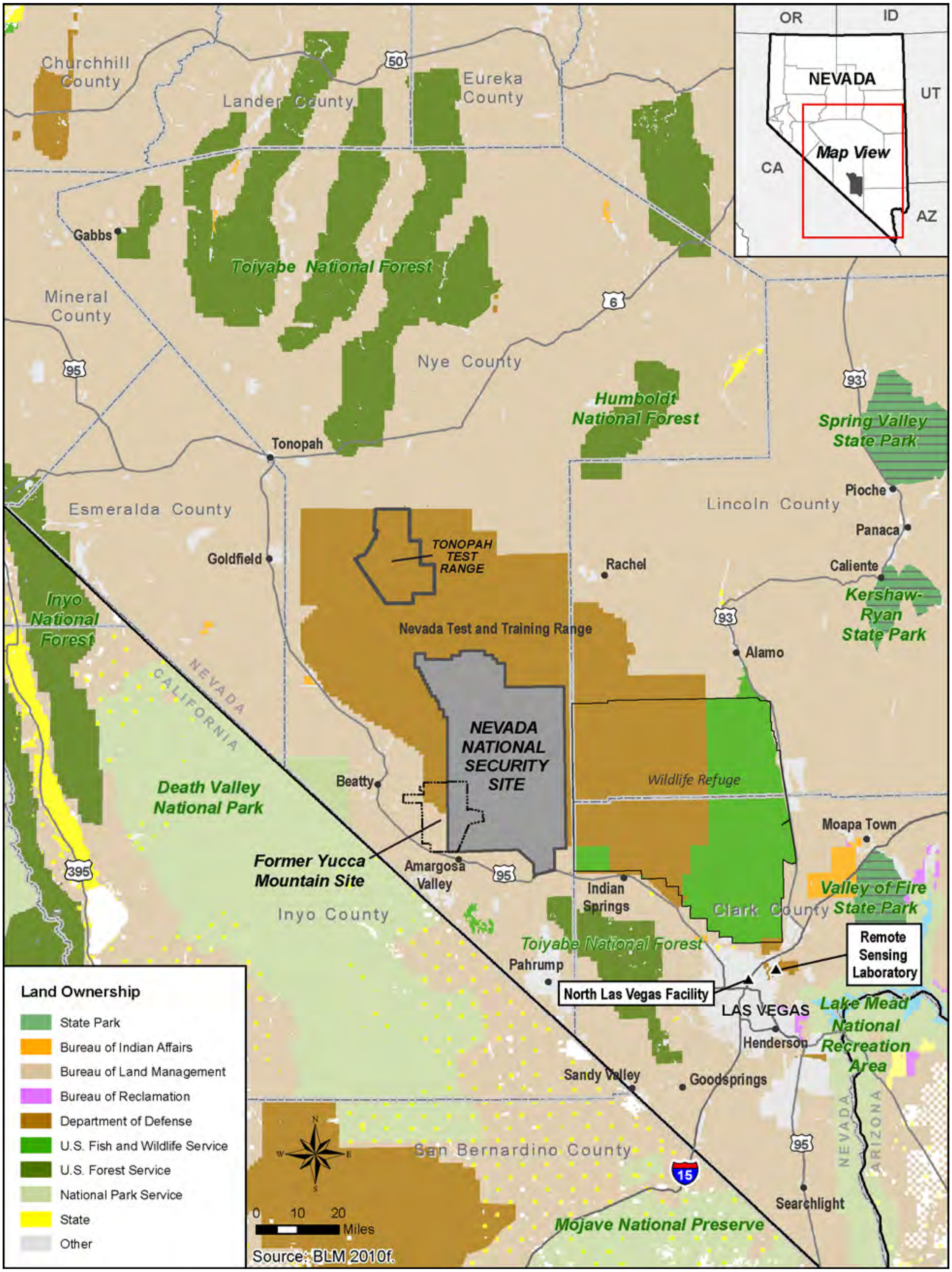


Figure 1–1 Location of the Nevada National Security Site and Offsite Locations

Subsequently, as required by DOE regulations (10 CFR 1021.330(d)), NNSA conducted the first 5-year review of the *1996 NTS EIS*, as documented in the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)* (DOE 2002g). The review found that there were no substantial changes to the actions proposed in the *1996 NTS EIS* and no significant new circumstances or information relevant to environmental concerns. Thus, NNSA determined that no further NEPA documentation was required (i.e., the existing *1996 NTS EIS* remained adequate based on the supplement analysis [SA], in accordance with 10 CFR 1021.330(d)).

In 2007, NNSA initiated its second 5-year review of the *1996 NTS EIS* and, in April 2008, issued the *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2008 Draft NTS SA)* (DOE 2008f). Based on consideration of comments received on the *2008 Draft NTS SA*, potential changes to the NNSS program work scope, and changes to the environmental baseline, NNSA decided to prepare this SWEIS to update its analysis of the NNSS and offsite location operations in Nevada.

This chapter provides information on the purpose and need for agency action and introduces the alternatives analyzed for NNSA operations in Nevada and decisions to be supported through the development of this SWEIS. Also included in this chapter are descriptions of related NEPA analyses and a summary of the public involvement process and stakeholder scoping comments, as well as American Indian perspectives prepared by the American Indian Writers Subgroup (AIWS). The AIWS input is in text boxes identified with a Consolidated Group of Tribes and Organizations (CGTO) feather icon.

Introduction—American Indian Perspective

Since the beginning of time, the area encompassing the Nevada National Security Site (NNSS) and the offsite locations has been essential to the lives of American Indian tribes. These lands contain traditional gathering, ceremonial, and recreational areas for the American Indian people. They contain ecological resources and power places that are crucial for the continuation of American Indian culture, religion, and society.

In consideration of our ties to these lands and their resources, and to comply with U.S. Department of Energy (DOE) Order 144.1 and Executive Order 13127, DOE invited the Consolidated Group of Tribes and Organizations (CGTO) to contribute to the development of this site-wide environmental impact statement (SWEIS). Specifically, DOE provided the CGTO with the opportunity to develop text summarizing our perspective and concerns regarding the resources and alternatives presented in this SWEIS.

The CGTO has had a long-standing relationship with DOE since 1987. We are comprised of 17 tribes and organizations, representing the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people. Each of these groups has substantiated cultural and historic ties to the NNSS and the surrounding areas (Steward 1938; Stoffle and Evans 1988).

Information provided by the CGTO for inclusion in the chapters of this SWEIS is presented in text boxes such as this to distinguish it from DOE text. The full text of American Indian perspective and concerns related to the resources and alternatives evaluated in this SWEIS is presented in Appendix C.

1.2 Purpose and Need for Agency Action

The purpose and need for agency action is to support NNSA's core missions established by Congress and the President. Through its Nevada Site Office, NNSA needs to meet its obligations to ensure a safe and reliable nuclear weapons stockpile, support other national security programs, characterize and/or remediate areas of the NNSS and offsite locations previously contaminated as a result of the Nation's nuclear weapons testing program, and provide for the disposal of LLW and MLLW from across the DOE complex.

NNSA also must meet the mandates of Executive Orders 13212, *Actions to Expedite Energy-Related Projects*, and 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, as well as the Energy Independence and Security Act of 2007 (P.L. 109-58). Accordingly, NNSA's purpose and need also is to satisfy the requirements of these Executive orders and comply with congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since October 1992, there has been a moratorium on underground nuclear testing (a brief description of underground nuclear testing is provided in Appendix H). Thus, NNSA has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests if so directed by the President. NNSA's primary mission at the NNSS is supporting nuclear weapons stockpile reliability through subcritical experiments. The limitation on conducting underground nuclear weapons testing has resulted in resource reallocation and the introduction and expansion of other national security missions, programs, and activities at the NNSS and offsite locations in Nevada. In addition, the NNSS supports DOE waste management activities, including disposal; environmental restoration activities; and research, development, and testing programs related to national security. The NNSS also provides opportunities for various environmental research projects and the development of commercial-scale solar energy projects, as well as innovative solar and other renewable energy technologies.

Purpose and Need for Agency Action—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows American Indian people are charged by the Creator to interact with the environment and its resources in culturally appropriate ways to maintain balance, regardless of the U.S. Department of Energy's (DOE's) stated purpose and need for agency action. American Indians further believe these lands and their resources contain life-sustaining characteristics that must be properly respected and cared for to ensure harmony.

The CGTO does not support harmful land-disturbing activities currently conducted and proposed within the Nevada National Security Site (NNSS) area and offsite locations. These lands are part of the traditional holy lands of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people (Stoffle et al. 1990). Harmful land disturbing activities threaten the health and welfare of Indian people through possible contamination and resource destruction.

As Indian people, we are obligated to manage the land and its resources for seven generations. This means we evaluate and guide our actions in terms of what they could do for or to the next seven generations. The CGTO takes this obligation very seriously and has provided information throughout the site-wide environmental impact statement (SWEIS) so we can continue to fulfill our purpose and need to care for these lands.

See Appendix C for more details.

1.3 Alternatives Analyzed

The proposed action in this SWEIS is the continued operation of the NNSS, other NNSA sites in Nevada, and environmental restoration sites in Nevada. The alternatives in this SWEIS are structured to provide information regarding current and future use of NNSA facilities in Nevada. The following three alternatives are analyzed: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. These alternatives were developed to reflect current operations and reasonably foreseeable future operations and to allow NNSA to analyze and compare the potential environmental effects of a wide range of use options. Chapter 3, Table 3–1, provides a summary of the alternatives analyzed in this SWEIS.

The alternative descriptions are organized under the three NNSS missions. Each mission includes two or more associated programs. The missions and associated programs are (1) the National Security/Defense Mission, which includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs; (2) the Environmental Management Mission, which includes the Waste Management and Environmental Restoration Programs; and (3) the Nondefense Mission, which includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs. More information about the NNSS missions and programs and associated capabilities, projects, and facilities and the levels of operations under each alternative can be found in Chapter 3 of this SWEIS.

Terminology Used in this *NNSS SWEIS*

Missions. In this site-wide environmental impact statement (SWEIS), the term "missions" refers to the major responsibilities assigned to the U.S. Department of Energy (DOE) and National Nuclear Security Administration (NNSA) (described in Section 1.1). DOE and NNSA accomplish these major responsibilities by assigning groups or types of activities to DOE's system of security laboratories, production facilities, and other sites.

Programs. DOE and NNSA are organized into program offices, each of which has primary responsibilities within the set of DOE and NNSA missions. Funding and direction for activities at DOE facilities are provided through these program offices, and similarly coordinated sets of activities to meet program office responsibilities are often referred to as "programs." Programs are usually long-term efforts with broad goals or requirements.

Capabilities. This term refers to the combination of facilities, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and implement mission assignments. Capabilities at the Nevada National Security Site (NNSS) have been established over time, principally through mission assignments and activities directed by program offices.

Projects. This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to major (such as a project to construct and start up a new nuclear facility). Projects are usually relatively short-term efforts and can cross multiple programs and missions, although they are usually "sponsored" by a primary program office. In this SWEIS, "project" is usually used more narrowly to describe construction activities, including facility modifications (such as a project to build a new office building or to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at the NNSS over about a 10-year period are discussed and analyzed in this SWEIS.

Activities. In this SWEIS, activities are those physical actions used to implement missions, programs, capabilities, or projects.

1.3.1 No Action Alternative

As defined in this *NNSS SWEIS*, the No Action Alternative reflects the use of existing facilities and ongoing projects to maintain operations consistent with those experienced in recent years at the NNSS and offsite locations in Nevada. For each of the three mission areas and their supporting programs, the level of operation for associated capabilities, projects, and activities is determined by operational levels actually realized since 1996. Examples include the number of experiments performed at the Joint Actinide Shock Physics Experimental Research Facility (JASPER) or the U1a Complex; reasonable expectations for recently implemented projects, such as the number of shots for the Large-Bore Powder Gun; or the nature and number of activities, such as training undertaken for the Office of Secure Transportation. Accordingly, under the No Action Alternative, Stockpile Stewardship and Management Program activities would continue at NNSA facilities in Nevada under the conditions of the ongoing nuclear testing moratorium. These activities would emphasize U.S. science-based stockpile stewardship tests, experiments, and projects to maintain the safety and reliability of the Nation's nuclear weapons stockpile without underground nuclear testing. By Presidential Decision Directive 15 (November 1993), DOE/NNSA must be able to resume underground nuclear weapons tests within 24 to 36 months if so directed by the President. This capability is maintained at the NNSS.

In support of the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs, under the No Action Alternative, NNSA would continue its responsibilities regarding (1) support for the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program; (2) Aerial Measuring System activities; (3) weapons of mass destruction emergency responder training; (4) disposition of improvised nuclear devices and radiological dispersion devices; (5) support for NNSA's Emergency Communications

Network; and (6) integration of existing activities and facilities to support U.S. efforts to control the spread of weapons of mass destruction.

Under the No Action Alternative, the Work for Others Program, which is hosted by NNSA, would entail the shared use of certain facilities, such as the Big Explosives Experimental Facility (BEEF), the Nonproliferation Test and Evaluation Complex, and the T-1 Training Area, with other agencies, such as DoD, as well as the shared use of resources at the NNSS, RSL, NLVF, and the TTR. NNSA would continue to host the projects of other Federal agencies, such as DoD and the U.S. Department of Homeland Security, as well as state and local government agencies and some nongovernmental organizations.

Under the No Action Alternative, in support of the Environmental Management Mission and Waste Management Program, the NNSS would continue accepting and disposing LLW and MLLW from approved generators as long as such wastes meet the NNSS waste acceptance criteria. The projected LLW volume analyzed is based on the average annual disposal of LLW from 1997 to 2010. The volume of MLLW analyzed is the permitted capacity of the Mixed Waste Disposal Unit (Cell 18) at the Area 5 Radioactive Waste Management Complex. The Environmental Restoration Program would continue to ensure compliance with the Federal Facility Agreement and Consent Order (FFACO) to characterize, monitor, and, if necessary, remediate locations that have sustained adverse environmental impacts from past DOE activities. These impacts include hazardous material and radioactively contaminated areas, facilities, soils, and groundwater.

Under the No Action Alternative, the Nondefense Mission includes those activities that are necessary to support mission-related programs, such as construction and maintenance of facilities, provision of supplies and services, and warehousing. Activities related to supply and conservation of energy, including renewable energy and other research and development projects, are also conducted under the Nondefense Mission. NNSA would continue to identify and implement energy conservation measures and projects related to energy efficiency, renewable energy, water conservation, transportation/fleet management, and high-performance and sustainable buildings.

Federal Facility Agreement and Consent Order

The Nevada National Security Site Environmental Restoration Program includes activities to comply with the Federal Facility Agreement and Consent Order, which was entered into in 1996 by the U.S. Department of Energy, the U.S. Department of Defense, and the State of Nevada. The Federal Facility Agreement and Consent Order provides a process for identifying sites having potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.

1.3.2 Expanded Operations Alternative

The Expanded Operations Alternative includes the level of operations under the No Action Alternative, plus the level of operations associated with additional capabilities at the NNSS and offsite locations in Nevada. The additional level of operations would include modification and/or expansion of existing facilities and construction of new facilities. An example of an additional level of operations would be the increased number of experiments that would be conducted at the NNSS with conventional high explosives under the Expanded Operations Alternative (100 experiments within limited areas of the NNSS) compared with the number that would be conducted under the No Action Alternative (20 experiments in the same areas). An example of facility expansion would be adding a new firing table at BEEF. As with the No Action Alternative, the Expanded Operations Alternative reflects continued implementation of previous NEPA decisions (see Section 1.5) and retains the necessary capabilities from those decisions. The key differences from the No Action Alternative are shown in Chapter 3, Table 3–1, of this SWEIS, and a detailed description of the Expanded Operations Alternative is provided in Chapter 3, Section 3.2.

1.3.3 Reduced Operations Alternative

The Reduced Operations Alternative analyzed in this SWEIS reflects diminished activity levels, as well as decommissioned facilities and areas at the NNSS and other offsite locations in Nevada. The Reduced Operations Alternative includes continued implementation of previous NEPA decisions (see Section 1.5), but may not retain all capabilities from those decisions. No new projects or facilities are proposed under the Reduced Operations Alternative. Operational levels would be reduced relative to the No Action Alternative, and geographical and organizational constraints would be placed upon some activities under the Reduced Operations Alternative. Using the same example used for the Expanded Operations Alternative, the number of conventional high-explosives experiments under the Reduced Operations Alternative would be 10 experiments compared with the 20 experiments proposed under the No Action Alternative. A geographical constraint example would be the cessation of most activities in the northwest portion of the NNSS (although activities such as security, monitoring, environmental restoration, and military exercises would continue). The key differences from the No Action Alternative are shown in Chapter 3, Table 3–1, of this SWEIS, and a detailed description of the Reduced Operations Alternative is provided in Chapter 3, Section 3.3.

1.3.4 Relationship to *1996 NTS EIS*

In 1996, DOE issued the final *NTS EIS* and its associated ROD. The *1996 NTS EIS* (DOE 1996c) evaluated four alternatives: (1) Continue Current Operations (No Action Alternative), (2) Discontinue Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. These alternatives are described below.

- Alternative 1, Continue Current Operations (No Action): DOE and interagency programs, activities, and operations at the NNSS that are associated with the five program areas would continue in the same manner and degree (level of operations) as during the 3 to 5 years previous to 1996. For example, at the NNSS, DOE would continue to undertake nuclear weapons stockpile and stewardship experiments and operations; environmental restoration would continue in the form of characterization and remediation of contaminated areas and facilities; and waste would be disposed at then-current yearly rates or levels.

- Alternative 2, Discontinue Operations: DOE and interagency programs, activities, and operations at the NNSS would be terminated. Facilities would be placed in cold standby after operations cease. Only those environmental monitoring and security functions necessary for human health, safety, and security would be maintained at the NNSS.

- Alternative 3, Expanded Use: DOE and interagency programs, activities, and operations at the NNSS associated with the five program areas would be maintained, but in a manner and level above that of the 3 to 5 years previous to 1996. Defense Program activities associated with stockpile stewardship would increase, as would waste management and environmental restoration activities.

- Alternative 4, Alternate Use of Withdrawn Lands: All defense-related activities and most interagency programs would discontinue at the NNSS.

In its 1996 ROD, DOE selected the Expanded Use Alternative, which provided for increasing the level of operations of most programs, activities, and operations, but decided to manage LLW and MLLW at levels described under the No Action Alternative. However, in a 2000 amendment to the 1996 ROD, DOE selected the Expanded Use Alternative for waste management activities at the NNSS.

For the most part, the level of operations envisioned and analyzed in the *1996 NTS EIS* (DOE 1996c) has not been realized. **Table 1–1** provides a comparison of the *1996 NTS EIS* Expanded Use Alternative and the current *NNSS SWEIS* No Action Alternative. As shown in Table 1–1, under the Expanded Use Alternative, DOE proposed undertaking approximately 110 dynamic experiments (i.e., experiments designed to improve knowledge of plutonium properties and assess performance and safety of nuclear weapons) each year. Since then, however, fewer than 10 such experiments have occurred each year. Also, the Expanded Use Alternative analyzed the transport and disposal of about 37 million cubic feet of LLW and 11 million cubic feet of MLLW at the NNSS. At the end of 2010, however, almost 22 million cubic feet of LLW and 370,000 cubic feet of MLLW had been disposed.

This *NNSS SWEIS* includes three alternatives: (1) No Action, (2) Expanded Operations, and (3) Reduced Operations. The No Action Alternative reflects the NNSA and interagency programs, activities, and operations in the program areas addressed in the *1996 NTS EIS* Expanded Use Alternative, but at the historic or baseline level of operations experienced since 1996. For example, under the No Action Alternative in this *NNSS SWEIS*, NNSA analyzes 10 dynamic experiments per year and the transport and disposal of 15 million cubic feet of LLW and 900,000 cubic feet of MLLW.

The No Action Alternative also includes the level of operations associated with missions, programs, capabilities, and projects analyzed in other NEPA documents. For example, NNSA completed the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE 2002h; DOE/EIS-319) and its ROD (67 FR 79906) and then relocated materials and equipment associated with criticality experiments to the NNSS. Consistent with the baseline level of operations, under the No Action Alternative, the Criticality Experiment Facility is expected to conduct up to 500 criticality operations for training, experiments, and other purposes each year.

As described in Section 1.3.2, the Expanded Operations Alternative includes a higher level of operations than under the No Action Alternative, plus operations associated with proposed additional capabilities, which is a similar concept to the Expanded Use Alternative considered in the *1996 NTS EIS*. The Reduced Operations Alternative reflects diminished levels of operation, as well as geographic restrictions on some activities at the NNSS. There is no clear equivalent to the Reduced Operations Alternative in the *1996 NTS EIS.*

Table 1–1 Comparison of the *1996 NTS EIS* Expanded Use Alternative and the *NNSS SWEIS* No Action Alternative

Mission, Program, Project, or Activity Analyzed	***Analyzed in the* 1996 NTS EIS [a]**	***Analyzed in this* NNSS SWEIS [a]**
General		
Mission/program	Five program areas: Defense, Waste Management, Environmental Restoration, Nondefense Research and Development, and Work for Others	Three mission areas: National Security/Defense Mission, Environmental Management Mission, and Nondefense Mission
NATIONAL SECURITY/DEFENSE MISSION		
Stockpile Stewardship and Management Program		
Maintain readiness to conduct an underground nuclear test	Addressed as overarching mission	Addressed as overarching mission
Conduct dynamic experiments	110 per year	10 per year
Conduct high-explosives tests and experiments	100 per year at BEEF, up to 70,000 pounds of high explosives per detonation, including limited use of certain hazardous materials; no SNM would be used in any experiment	To support Stockpile Stewardship and Management Program: 20 per year at BEEF (70,000 pounds TNT-equivalent maximum per event) and 10 per year at other locations within the Nuclear Test Zone and Nuclear and High Explosives Test Zone; explosives experiments at BEEF may include limited use of certain hazardous materials To support Work for Others Program: 40 experiments using up to 2,000 pounds TNT-equivalent of explosives at various locations on the NNSS
Disposition of damaged U.S. nuclear weapon(s)	Disposition damaged U.S. nuclear weapon(s) on an as-needed basis	Disposition damaged U.S. nuclear weapon(s) on an as-needed basis
Reserve land and infrastructure for a large, heavy-industrial facility and/or next generation nuclear weapons simulators	Consistent with analyses in other NEPA documents that considered the NNSS as an alternative location, such as the *Pantex Plant Site-Wide EIS* and the National Ignition Facility in the *Stockpile Stewardship and Management PEIS*	Not analyzed
Conduct underground nuclear test, if so directed by the President of the United States	Yes	Not analyzed
Reserve land and infrastructure for nuclear weapons assembly/disassembly operations and/or long-term storage and disposition of weapons-usable fissile material	Yes	Not analyzed
Shock physics experiments	Not analyzed [b]	12 per year at JASPER and 10 per year at the U1a Complex
Criticality experiments at DAF	Not analyzed [b]	500 operations per year
Pulsed-power experiments at the Atlas Facility	Not analyzed [b]	Facility maintained on standby with capability to conduct up to 12 experiments per year
Plasma physics and fusion experiments	Not analyzed [b]	Conduct up to 600 per year at NLVF and 50 per year at Area 11 of the NNSS
Conduct drillback operations	Yes, as part of maintaining readiness to conduct or as part of actual conduct of an underground nuclear test	Up to five over the next 10 years as part of maintaining readiness to test
Stage SNM, including nuclear weapons pits	Yes	Yes

Mission, Program, Project, or Activity Analyzed	***Analyzed in the* 1996 NTS EIS** [a]	***Analyzed in this* NNSS SWEIS** [a]
Training for the Office of Secure Transportation	Yes, as part of conducting unspecified exercises and training	Yes, up to six times per year
Conduct stockpile stewardship activities at the TTR, including experiments using SNM, where containment is assured	Yes	Yes, but SNM use not expected
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs		
Support various DOE nuclear emergency response activities, including FRMAC, NEST, ARG, RAP, and AMS	Yes	Yes
Disposition improvised nuclear devices	Not analyzed [a]	Yes
Support U.S. efforts to control the spread of WMDs, including arms control, nonproliferation activities, nuclear forensics, and counterterrorism capabilities	Partial; counterproliferation and nonproliferation activities, treaty verification, and training and exercises were addressed	Yes; counterterrorism activities [b] are also included
Work for Others Program		
Support U.S. Department of Homeland Security testing and evaluation of detection devices for use in transportation-related applications at RNCTEC and other locations on the NNSS	Not analyzed [b]	Yes
Experiments using releases of chemicals and/or biological simulants	Partial; chemical releases at NPTEC (Liquefied Gaseous Fuels Spill Test Facility in the *1996 NTS EIS*) were addressed	Yes; an unspecified number of release experiments at NPTEC and up to 20 experiments using releases of low concentrations of chemicals and biological simulants per year NNSS-wide [a]
Support development of capabilities to detect and defeat assets in deeply buried/hardened targets	Yes	Yes
Host the use of various aerial platforms for tests, experiments, training, and exercise	Yes	Yes
ENVIRONMENTAL MANAGEMENT MISSION		
Waste Management Program		
LLW disposal MLLW disposal	Almost 36,800,000 cubic feet About 10,600,000 cubic feet	15,000,000 cubic feet 900,000 cubic feet [c]
Manage onsite-generated TRU and TRU mixed wastes pending shipment to offsite treatment and disposal facilities	Yes	About 9,600 cubic feet over the next 10 years
Generate and temporarily store hazardous waste pending shipment to a permitted treatment, storage, and disposal facility	Yes	About 190,400 cubic feet over the next 10 years
Operate the Area 11 Explosives Ordnance Disposal Unit	Yes	Yes
Operate the Area 6 hydrocarbon landfill	Yes	Yes
Operate the Area 23 and the U10c Solid Waste Disposal Sites	Yes	About 3,810,000 cubic feet of sanitary solid waste and construction/ decontamination and demolition debris
Environmental Restoration Program		
Underground Test Area Project to characterize, monitor, and remediate, as necessary, groundwater contaminated by underground nuclear testing	Yes	Yes, in accordance with the FFACO; analyze up to 50 additional characterization and/or monitoring wells over the next 10 years

Mission, Program, Project, or Activity Analyzed	***Analyzed in the* 1996 NTS EIS [a]**	***Analyzed in this* NNSS SWEIS [a]**
Soils Project to investigate and characterize soil contamination at non-industrial sites on the NNSS, TTR, and Nevada Test and Training Range and perform corrective actions, as necessary	Yes	Yes, in accordance with the FFACO
Industrial Sites Project to identify, characterize, and remediate, as necessary, industrial sites at the NNSS and TTR	Yes	Yes, in accordance with the FFACO
Conduct environmental restoration activities at Defense Threat Reduction Agency sites on the NNSS	Yes	Yes
Conduct environmental characterization and monitoring at two former offsite underground nuclear weapons test sites: Central Nevada Test Area and Project Shoal	Yes	No; stewardship of both sites has been assumed by the DOE Office of Legacy Management
NONDEFENSE MISSION		
General Site Support and Infrastructure Program		
Infrastructure	Upgrade, renovate, replace, and construct new common site support facilities to support ongoing and additional activities	Maintain, repair, and replace current infrastructure; the only new "infrastructure" would be LLW cells, as needed, and construction of the Underground Test Area Project wells, in consultation with the Nevada Division of Environmental Protection
Conservation and Renewable Energy Program		
Energy conservation	Not addressed	Reduce energy consumption and improve efficiency of energy use
Renewable energy	Up to 1,000 megawatts of solar power generation in one of two Solar Enterprise Zones on the NNSS: Area 22/23 and Area 25 Also considered solar power generation facilities at three non-DOE sites outside of the NNSS	"Solar Enterprise Zone" renamed "Renewable Energy Zone" Allow commercial entity to construct and operate up to 240 megawatts of solar power generation in the Renewable Energy Zone in Area 25
Other Research and Development Program		
Support nondefense research and development	Yes	Yes

AMS = Aerial Measuring System; ARG = Accident Response Group; BEEF = Big Explosives Experimental Facility; DAF = Device Assembly Facility; FFACO = Federal Facility Agreement and Consent Order; FRMAC = Federal Radiological Monitoring and Assessment Center; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NEPA = National Environmental Policy Act; NEST = Nuclear Emergency Support Team; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; NPTEC = Nonproliferation Test and Evaluation Complex; RAP = Radiological Assistance Program; RNCTEC = Radiological/Nuclear Countermeasures Test and Evaluation Complex: SNM = special nuclear material; TNT = 2,4,6 trinitrotoluene; TRU = transuranic; TTR = Tonopah Test Range; WMD = weapon of mass destruction.

[a] Quantitative bases for analyses used in this table were derived from the published *1996 NTS EIS* and assumptions used in this *NNSS SWEIS*. For some activities, such as training and exercises, the bases for impact assessment were not derived from the number of events but from the potential to disturb previously undisturbed land.

[b] Addressed in other NEPA documentation.

[c] Actual permitted capacity of the Mixed Waste Disposal Unit (Cell 18) is 899,996 cubic feet.

1.4 Decisions to be Supported by this Site-Wide Environmental Impact Statement

This SWEIS analyzes and evaluates the potential impacts of existing and proposed capabilities and projects. The results documented in this SWEIS will provide the basis for NNSA to determine the nature of these capabilities, projects, and activities, as well as their associated level of operations, over about a 10-year period at the NNSS and offsite locations in Nevada. Where information is insufficient to support an implementing decision or there are statutory or regulatory uncertainties, a more "programmatic" description is provided; in these cases, implementation would require an appropriate level of additional NEPA analysis.

NNSA may choose to implement any alternative in its entirety or to select a hybrid that incorporates parts of the different proposed alternatives. NNSA may make the following decisions regarding its operations:

- *Implement the No Action Alternative, either wholly or in part.* Under the No Action Alternative, NNSA operations in Nevada would continue in accordance with previous decisions made pursuant to NEPA analyses.
- *Implement the Expanded Operations Alternative, either wholly or in part.* The Expanded Operations Alternative includes planned and proposed capabilities and projects and an overall increase in the level of operations, relative to the No Action Alternative, that could be implemented over about a 10-year period.
- *Implement the Reduced Operations Alternative, either wholly or in part.* The Reduced Operations Alternative involves reductions of operations for many of the activities that would continue under the No Action Alternative. Choosing to implement this alternative in whole or in part would result in reductions of affected capabilities and projects.

The decision on a preferred alternative is based on analysis of how various operations fulfill DOE mission requirements and responsibilities, as well as consideration of economic, environmental, and technical factors.

NNSA capabilities and projects at the NNSS are located in seven land use zones that were developed and designated following decisions made in the *1996 NTS EIS* ROD. Implementation of any of the alternatives analyzed in this SWEIS, either in whole or in part, could result in changes to the name, size, or location of these land use zones, or in the location of proposed capabilities and projects within these zones.

Although an analysis of environmental restoration activities' impacts is included in this SWEIS, environmental restoration activities at the NNSS, the TTR, and sites on the Nevada Test and Training Range are driven by the FFACO. The State of Nevada, through the Nevada Division of Environmental Protection, oversees FFACO compliance and enforces its provisions. Therefore, NNSA would not make any decisions regarding environmental restoration activities that are inconsistent with the FFACO without consultation with the Nevada Division of Environmental Protection.

Although an analysis of LLW/MLLW shipping routes is included in this SWEIS, decisions on routing would not be made as part of this NEPA process. This analysis was undertaken to develop a greater understanding of the potential environmental consequences of shipping such waste through and around metropolitan Las Vegas and to inform any highway routing revisions to NNSA's waste acceptance criteria.

Decisions such as removing mission support assignments from the NNSS or altering the operational level of ongoing capabilities at the NNSS would only be made if the pertinent information has been identified in the alternatives analyzed in this SWEIS. NNSA will not consider shutting down the NNSS because it does not meet the agency's purpose and need. Programmatic changes to the NNSA nuclear weapons complex were addressed in the *Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (NNSA 2008l) (see Section 1.5 of this chapter). As discussed in Section 1.5, decisions made in the *Complex Transformation SPEIS* RODs (73 FR 77644 and 73 FR 77656) will best enable NNSA to meet its statutory missions while minimizing technical risks, risks to mission objectives, costs, and potential environmental impacts.

1.5 Relationship Between this Site-Wide Environmental Impact Statement and Other National Environmental Policy Act Analyses

Decisions made in the *1996 NTS EIS* ROD (61 FR 65551) and various subsequent NEPA documents have defined implementation of proposed projects at the NNSS. These NEPA compliance reviews, which are summarized below, were used to identify operational changes and potential environmental impacts in this SWEIS.

Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS) (DOE/EIS-0243) (DOE 1996c) – As discussed in Section 1.3.4, the *1996 NTS EIS* evaluated four alternatives for the continued operation of the Nevada Test Site (now called the NNSS): (1) Continue Current Operations (No Action Alternative), (2) Discontinue Operations, (3) Expanded Use, and (4) Alternate Use of Withdrawn Lands. Included in the *1996 NTS EIS* was an assessment of reasonable alternatives for flight testing at the TTR. DOE published a ROD on December 13, 1996 (61 FR 65551), selecting the Expanded Use Alternative plus the public education activities from the Alternate Use of Withdrawn Lands Alternative. Under that decision, NNSA continued the multipurpose, multiprogram use of the NNSS and a continuation and diversification of the DOE Nevada Operations Office (the predecessor of the NNSA Nevada Site Office) and interagency programs and operations at the NNSS. The Expanded Use Alternative included support for ongoing DOE Nevada Operations Office program categories defined under the Continue Current Operations (No Action) Alternative and increased the use of the NNSS and its related resources and capabilities. The Expanded Use Alternative also made the NNSS more available to both public and private institutions for demonstration of new technologies.

A subsequent amendment to the *1996 NTS EIS* was included in a February 2000 ROD (65 FR 10061) for the *WM PEIS* (discussed below). This ROD announced DOE's decision to implement LLW and MLLW activities in accordance with the *1996 NTS EIS* Expanded Use Alternative. The new *NNSS SWEIS* and its ROD(s) will supersede the *1996 NTS EIS* and its ROD and amended ROD.

Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS) (DOE/EIS-0200) (DOE 1997) – The *WM PEIS* examined the potential environmental impacts of strategic alternatives for managing five types of radioactive and hazardous wastes resulting from nuclear defense and research activities at DOE sites around the United States. When the *1996 NTS EIS* (DOE 1996c) was issued, the NNSS was under consideration in the *Draft WM PEIS* as a site for centralized or regional management of certain DOE wastes.

DOE published four RODs associated with the *WM PEIS*, three of which are relevant to the NNSS. In its ROD for the treatment and management of transuranic waste, published January 23, 1998 (63 FR 3629), and subsequent revisions to this ROD, published December 9, 2000, July 25, 2001, and September 6, 2002 (65 FR 82985, 66 FR 38646, and 67 FR 56989, respectively), DOE decided (with one exception) that each DOE site that either had or might generate transuranic waste would prepare the waste for disposal and store it on site until it could be shipped to the Waste Isolation Pilot Plant near Carlsbad, New Mexico, for disposal. In the second ROD, published August 5, 1998 (63 FR 41810), DOE decided to continue using offsite facilities for the treatment of major portions of nonwastewater hazardous wastes generated at DOE sites.

In the third ROD, which addressed the management and disposal of LLW and MLLW and was published February 25, 2000 (65 FR 10061), DOE decided to perform minimal treatment of LLW at all sites and to continue, to the extent practicable, onsite disposal of LLW at Idaho National Laboratory, Los Alamos National Laboratory, Oak Ridge Reservation, and the Savannah River Site. DOE decided to establish regional disposal capacity at the Hanford Site and the NNSS. Specifically, in addition to disposing their own LLW, the Hanford Site and the NNSS would dispose LLW generated at other DOE sites, provided the waste met their respective waste acceptance criteria. DOE decided to treat MLLW at the Hanford Site, Idaho National Laboratory, Oak Ridge Reservation, and the Savannah River Site, with disposal at either the Hanford Site or the NNSS.[1]

Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site (DOE/EIS-0359) (DOE 2004d) – This environmental impact statement (EIS), tiered from the *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269) (DOE 1999c), considered the potential environmental impacts of construction, operation, maintenance, and decontamination and decommissioning of a proposed facility for converting depleted uranium hexafluoride to a more-stable chemical form at alternative locations within the Paducah Site. DOE evaluated transportation of the depleted uranium conversion product to a commercial facility or the NNSS for disposal as LLW. The July 27, 2004, ROD (69 FR 44654) stated that DOE planned to decide the specific disposal location(s) after further NEPA review.

Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site (DOE/EIS-0360) (DOE 2004e) – This EIS, tiered from the *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269) (DOE 1999c), considered the potential environmental impacts of construction, operation, maintenance, and decontamination and decommissioning of a proposed facility for converting depleted uranium hexafluoride to a more-stable chemical form at alternative locations within the Portsmouth Site. DOE evaluated transportation of the depleted uranium conversion product to a commercial facility or the NNSS for disposal as LLW. The July 27, 2004, ROD (69 FR 44649) stated that DOE planned to decide the specific disposal location(s) after further NEPA review.

Draft Supplement Analysis for Location(s) to Dispose of Depleted Uranium Oxide Conversion Product Generated from DOE's Inventory of Depleted Uranium Hexafluoride (DOE 2007d) (DOE/EIS-0359-SA1 and DOE/EIS-0360-SA1) – DOE issued a Notice of Availability for this draft SA on April 3, 2007 (72 FR 15869). DOE is proposing to amend the two site-specific RODs (69 FR 44649 and 69 FR 44654) for depleted uranium hexafluoride conversion to decide whether the depleted uranium conversion product would be disposed at the NNSS or at the EnergySolutions (formerly Envirocare of Utah, Inc.) LLW disposal facilities.

Final Environmental Assessment for the Site Launch, Reentry and Recovery Operations at the Kistler Launch Facility, Nevada Test Site (NTS) (FAA 2000) – The Federal Aviation Administration (FAA) prepared an environmental assessment (EA) and issued a Finding of No Significant Impact (FONSI) on May 3, 2002 (67 FR 22479), for the Kistler Launch Facility (KLF); this EA analyzed preflight processing activities, launch/flight operations, and reentry and recovery operations. To conduct operations, Kistler

[1] DOE has established a moratorium on the receipt of offsite waste at the Hanford Site until 2022 or until the Waste Treatment Plant at the Hanford Site is operational. This facility is currently under construction and is designed to treat radioactive waste from the Hanford Site's underground storage tanks.

Aerospace Corporation proposed to construct a base of operations consisting of a private launch site (including a vehicle processing facility); a vehicle reentry, landing, and recovery area; and a payload processing facility. KLF operations and activities were to occur in Area 18 and at an adjacent location in Area 19. The proposed launch site was on the southern slopes of Pahute Mesa, south of Rattlesnake Ridge and north of Stockade Wash, at an elevation of about 5,800 feet. FAA proposed to license Kistler's proposed space launch and reentry activities. FAA issued a FONSI, but the KLF project was subsequently cancelled.

The Nevada Test Site Development Corporation's Desert Rock Sky Park at the Nevada Test Site Environmental Assessment (DOE/EA-1300) (DOE 2000a) – This EA analyzed the potential environmental effects of developing, operating, and maintaining a commercial/industrial park in Area 22 of the NNSS, between Mercury and U.S. Route 95, east of Desert Rock Airport. DOE issued a FONSI in March 2000, but the project was not implemented.

Aerial Operations Facility, Nevada Test Site Environmental Assessment (DOE/EA-1334) (DOE 2001a) – This EA analyzed the potential environmental effects of developing, operating, and maintaining an aerial operations facility for testing and operating aerial vehicles at an existing facility located at the southern end of Yucca Lake in Area 6 of the NNSS. DOE issued a FONSI based on this EA in 2001. The facility is in operation.

Final Environmental Assessment for Aerial Operations Facility Modifications, Nevada Test Site (DOE/EA-1512) (DOE 2004g) – This EA evaluated the potential impacts of constructing a new runway, hangars, and operations buildings and performing infrastructure upgrades to accommodate an increase in Aerial Operations Facility operations and personnel. NNSA issued a FONSI based on this EA in October 2004. The facility is in operation.

Atlas Relocation and Operation at the Nevada Test Site Final Environmental Assessment (DOE/EA-1381) (DOE 2001b) – This EA analyzed the relocation of the Atlas pulsed-power machine from Los Alamos National Laboratory to the NNSS. At the NNSS, the Atlas Facility would be reassembled in a newly constructed building within a designated industrial, research, and support site in Area 6. NNSA issued a FONSI based on this EA in May 2001. The facility was relocated to the NNSS and is currently in a standby status.

Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA) (DOE/EIS-0243-SA-01) (DOE 2002g) – In 2002, NNSA completed the first of three SA processes of the *1996 NTS EIS* (DOE 1996c). The *2002 NTS SA* provided a 5-year review of the *1996 NTS EIS* to determine whether there were sufficient changes to either the NNSS operations or environmental impacts to warrant a new SWEIS, a supplemental EIS, or whether no further NEPA action was warranted. NNSA found that there were no substantial changes to the actions proposed in the *1996 NTS EIS* and no significant new circumstances or information relevant to environmental concerns; thus, no further NEPA documentation was required (i.e., the existing *1996 NTS EIS* remained adequate based on the SA, in accordance with 10 CFR 1021.332(d)).

Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory (DOE/EIS-0319) (DOE 2002h) – This EIS addressed the potential impacts of relocating criticality missions and materials from Technical Area 18 at Los Alamos National Laboratory to several sites, including the NNSS. In a December 31, 2002, ROD (67 FR 79906), NNSA made the decision to relocate Security Category I/II missions and materials to the Device Assembly Facility at the NNSS. The relocation has been completed.

Hazardous Materials Testing at the Hazardous Materials Spill Center, Nevada Test Site Environmental Assessment (DOE/EA-0864) (DOE 2002i) – This EA established potential environmental impacts from planned releases of hazardous and toxic materials at the Hazardous Materials Spill Center (formerly the Liquefied Gaseous Fuels Spill Test Facility and now the Nonproliferation Test and Evaluation Complex). NNSA issued a FONSI based on this EA in September 2002. The facility is in operation.

Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (Yucca Mountain EIS) (DOE/EIS-0250-F) (DOE 2002e) – Published in 2002, the *Yucca Mountain EIS* analyzed a proposed action to construct, operate, monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain in Nye County, Nevada. Following issuance of the *Yucca Mountain EIS* in 2002, DOE modified its approach to repository design and operational plans. In 2008, DOE published the *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250F-S1) (DOE 2008g). This supplemental EIS evaluated the potential environmental impacts of DOE's modified repository design and operational plans. As reflected in the Administration's fiscal year 2010, 2011, and 2012 budget requests, however, the Administration has determined that a repository at Yucca Mountain is not a workable option and has called for all funding and activities related to development of a repository at Yucca Mountain to be eliminated.

Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada to Address the Increase in Activities Associated with the National Center for Combating Terrorism and Counterterrorism Training and Related Activities (DOE/EIS-0243-SA-02) (DOE 2003e) – This second SA to the *1996 NTS EIS* was prepared to determine whether impacts of NNSA operations, which include activities and potential facility and infrastructure improvements proposed for the NNSS related to combating terrorism and performing counterterrorism training, would be within the limits of impacts identified in the *1996 NTS EIS*. NNSA determined that there were no significant new circumstances or information relevant to environmental concerns that would require preparation of a supplemental EIS or a new EIS (i.e., the existing *1996 NTS EIS* remained adequate based on the SA, in accordance with 10 CFR 1021.332(d)).

Final Environmental Assessment for Activities Using Biological Simulants and Releases of Chemicals at the Nevada Test Site (DOE/EA-1494) (DOE 2004c) – This EA analyzed the potential environmental effects of conducting experiments, training, and other similar activities involving controlled releases of biological simulants (noninfectious bacteria, fungi, killed viruses, and similar materials) and low concentrations of various chemicals at the NNSS. NNSA issued a FONSI based on this EA in June 2004. These activities are ongoing at the NNSS.

Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site Final Environmental Assessment (DOE/EA-1499) (DOE 2004f) – This EA evaluated the potential effects of constructing and operating a Radiological/Nuclear Countermeasures Test and Evaluation Complex at the NNSS for post-bench-scale testing and evaluation of radiological and nuclear detection devices that may be used in transportation-related facilities. The new facility would be used by the U.S. Department of Homeland Security. NNSA issued a FONSI based on this EA in September 2004. The facility was constructed and is operational.

Draft Revised Environmental Assessment, Large-Scale, Open-Air Explosive Detonation, DIVINE STRAKE, at the Nevada Test Site (DOE/EA-1550) (DOE 2006e) – This draft revised EA was published in December 2006 to document an analysis of the potential impacts of a proposal by the Defense Threat Reduction Agency, an NNSA customer, to conduct a single large-scale, open-air explosive detonation of up to 700 tons of an ammonium nitrate and fuel oil mixture above an existing tunnel complex in Area 16 at the NNSS. The proposed experiment is known as DIVINE STRAKE. The Defense Threat Reduction Agency cancelled the project.

Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (GTCC EIS) (DOE/EIS-0375-D) – On February 25, 2011, the U.S. Environmental Protection Agency issued a Notice of Availability (76 FR 10583) for this *Draft GTCC EIS* that addressed disposal of LLW generated by activities licensed by the U.S. Nuclear Regulatory Commission or an Agreement State that contains radionuclides in concentrations exceeding Class C limits, as defined in 10 CFR Part 61 (referred to as "greater-than-Class C [GTCC] LLW"), as well as disposal of DOE's GTCC-like waste. Currently, there is no location for disposal of GTCC LLW, although the Federal Government is responsible for such disposal under the Low-Level Radioactive Waste Policy Amendments Act (P.L. 99-240). The NNSS is being considered as one of seven candidate disposal sites in the *Draft GTCC EIS*. DOE is evaluating several disposal technologies in the *Draft GTCC EIS*, including above-grade vaults, intermediate-depth boreholes, and enhanced near-surface disposal facilities.

Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2008 Draft NTS SA) (DOE/EIS-0243-SA-03) (DOE 2008f) – The *2008 Draft NTS SA* is the third SA and 5-year comprehensive review of the *1996 NTS EIS* (DOE 1996c). In preparation of the *2008 Draft NTS SA*, a systematic environmental impacts review was conducted to determine whether there were substantial changes in the actions proposed in the *1996 NTS EIS* or significant new circumstances or information relevant to environmental concerns. Projects and activities introduced since the *1996 NTS EIS* ROD or proposed for the next 5 years were screened. The *2008 Draft NTS SA* was not finalized; instead, NNSA elected to proceed with a new SWEIS (this *NNSS SWEIS*) to provide an updated analysis of NNSA operations in Nevada. All comments from the *2008 Draft NTS SA* were considered in the scoping of this SWEIS.

Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS) (DOE/EIS-0236-S4) (DOE 2008l) – In the *Complex Transformation SPEIS*, alternatives were analyzed for the potential environmental impacts of transforming the nuclear weapons complex into a smaller, more-efficient enterprise that can respond to changing national security challenges and ensure the long-term safety, security, and reliability of the nuclear weapons stockpile. The NNSS was evaluated, but not selected, as a potential location for a consolidated plutonium center or a consolidated nuclear production center, both of which would entail consolidation of Category I/II special nuclear material. The NNSS was also evaluated, but not selected, as a potential site for consolidated hydrotesting, high-explosives research and development, and environmental testing.[2] In addition, existing DoD and NNSA test ranges (such as White Sands Missile Range in New Mexico and the NNSS) were considered as alternatives to continued use of the TTR for NNSA flight test operations. Two RODs were issued on December 19, 2008. In the ROD for Tritium Research and Development, Flight Test Operations, and Major Environmental Test Facilities (December 19, 2008, 73 FR 77656), NNSA decided to continue to conduct flight testing at the TTR in Nevada under a reduced footprint (i.e., 1 square mile) permit using a campaign mode of operations. The "campaign mode of operations" would continue operations at the TTR but reduce permanent staff and conduct tests and experiments by deploying NNSA and national laboratory personnel from other locations, as needed. In the ROD for Operations Involving Plutonium, Uranium, and the Assembly and Disassembly of Nuclear Weapons (December 19, 2008, 73 FR 77644), NNSA decided to transform the plutonium and uranium aspects of the complex into smaller and more-efficient operations while maintaining the capabilities NNSA needs to perform its national security missions.

---

[2] *In this context, "environmental testing" refers to subjecting a test unit to specified, controlled environments such as vibration, shock, or static acceleration.*

Environmental Assessment for a Solar Demonstration Project at the Nevada National Security Site (DOE/EA-1842) – DOE's Office of Energy Efficiency and Renewable Energy is preparing this EA on its proposal to support the demonstration of concentrating solar power (CSP) technologies in Area 25 of the NNSS. The intent would be to demonstrate technology advancements that are proven at a prototype level, but have not yet been demonstrated at a scale or for a sufficient period for deployment in a commercial setting. DOE held scoping meetings on the EA in Las Vegas and Amargosa Valley in November 2010.

DOE expects to issue a Funding Opportunity Announcement in the near future to solicit proposals for CSP demonstration projects (collectively, the "CSP Validation Project"). Applicants may propose projects to be located in Area 25 of the NNSS or at an offsite location. The EA will address potential projects at the NNSS and any proposed offsite locations that are close enough to Area 25 to pose potential cumulative impacts. DOE would provide partial funding for the selected projects. For any project proposed to be located on the NNSS, in addition to the use of land, DOE would offer basic infrastructure, such as power, water, telecommunications, and security, as well as other operation and support facilities. The funding provided by DOE would partially cover the construction, operation, and decommissioning (dismantling and removal) of various solar technology demonstration projects. DOE expects the proposed projects would involve a combined generating capacity of about 20 megawatts. Any projects proposed for the NNSS would be located on approximately 300 acres within Area 25 of the NNSS along its southern border, just east of Lathrop Wells Road.

DOE's decision regarding the proposed CSP Validation Project is independent of the alternatives analyzed in this SWEIS and does not limit the range of alternatives analyzed herein or influence NNSA's decision regarding alternatives analyzed in this SWEIS. The potential environmental impacts of the CSP Validation Project are discussed qualitatively under Cumulative Impacts in Chapter 6, Section 6.2.1.1.

1.6 Cooperating Agencies/Tribal Involvement

DOE/NNSA is the lead agency for this SWEIS. Under CEQ NEPA regulations, other Federal agencies, as well as state and local agencies and American Indian tribes, may request designation as cooperating agencies in the preparation of this SWEIS if they can offer special, relevant expertise or have legal jurisdiction over one of the affected areas being studied (40 CFR 1501.6 and 1508.5). Three government agencies requested cooperating agency status for this SWEIS: the U.S. Bureau of Land Management; the U.S. Air Force; and Nye County, Nevada. DOE/NNSA, as the lead agency, has designated these three organizations as cooperating agencies.

As mentioned in Section 1.1, American Indian groups were invited to participate in the preparation of this SWEIS, in accordance with DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*. As a result of consultation with the CGTO, the AIWS prepared the summary assessments and recommendations that appear in text boxes placed throughout this SWEIS, as well as the text provided in Appendix C, "The American Indian Assessment of Resources and Alternatives Presented in the SWEIS." Appendix C summarizes the beliefs expressed by the CGTO regarding this SWEIS and contains (a) general concerns regarding long-term impacts of NNSA operations on the NNSS and (b) a synopsis of specific comments made by the AIWS for various chapters of this SWEIS. Although the consultation focused specifically on the three alternatives analyzed in this *NNSS SWEIS*, the CGTO responses in the text boxes and Appendix C also integrate relevant recommendations made by American Indian people regarding previous NNSA projects in which American Indians participated.

1.7 Public Involvement Process in this *NNSS SWEIS*

During development of an EIS, there are opportunities for public involvement (see **Figure 1–2**). As an early step in the development of an EIS, the regulations established by CEQ (40 CFR 1501.7) and DOE require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a Proposed Action." The purpose of the scoping process is (1) to inform the public about a proposed action and the alternatives being considered and (2) to identify and clarify issues relevant to the EIS by soliciting public comments.

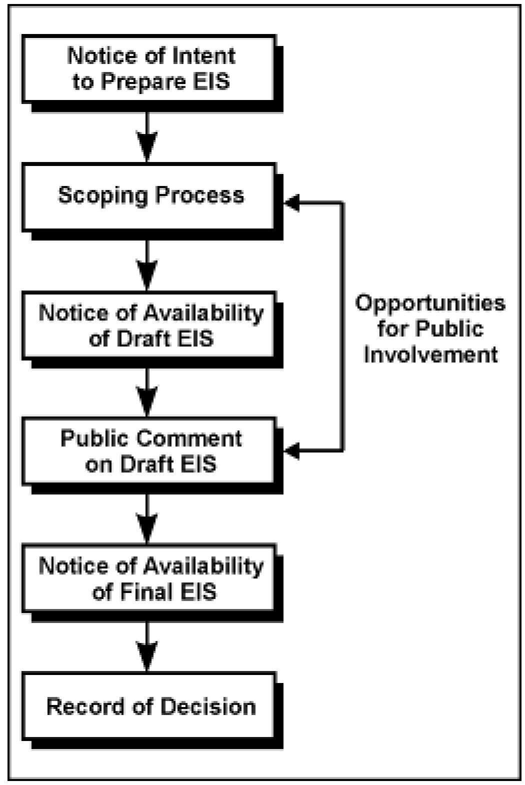


Figure 1–2 The National Environmental Policy Act Process

The *NNSS SWEIS* public scoping process began with issuance of a Notice of Intent (NOI) (74 FR 36691) on July 24, 2009, and concluded on October 16, 2009. In the NOI, NNSA invited public comment on the scope of this SWEIS and described four alternatives (No Action, Expanded Operations, Reduced Operations, and Renewable Energy Operations) and environmental issues to be considered. As discussed in Section 1.7.1, "Summary of Major Scoping Comments and National Nuclear Security Administration Responses," the components of the Renewable Energy Operations Alternative were incorporated as part of the three other alternatives in response to public comments, and Renewable Energy Operations was removed as a separate alternative. Public scoping meetings for this SWEIS were conducted in Las Vegas, Nevada (September 10, 2009); Pahrump, Nevada (September 14, 2009); Tonopah, Nevada (September 16, 2009); and St. George, Utah (September 18, 2009). NNSA received approximately 150 comment documents regarding this *NNSS SWEIS*, submitted by email, fax, U.S. mail, telephone message, written comment forms at public meetings, or transcribed oral statements at public meetings. In addition, comments provided on the *2008 Draft NTS SA* were considered in developing the scope of this SWEIS.

While many of the comment documents were from private individuals, comment documents were also received from government and nongovernmental organizations, including the U.S. Environmental Protection Agency, the State of Nevada (Office of the Attorney General, State Historic Preservation Officer, Commission on Minerals, and Division of State Lands), Nye County, the Western Shoshone National Council, Tri-Valley Communities Against a Radioactive Environment (Tri-Valley CAREs), the Western States Legal Foundation, Citizens for Dixie's Future, and Nuclear Watch New Mexico. Comments on similar or related topics were grouped into common categories as a means of summarizing them. After the issues were identified, they were evaluated to determine whether they were within the scope of this SWEIS. Issues found to be within the scope of this SWEIS are addressed in the appropriate chapters or appendices of this draft SWEIS.

1.7.1 Summary of Major Scoping Comments and National Nuclear Security Administration Responses

Scoping comments are summarized in **Table 1–2**, including NNSA's response and how the comments were incorporated into this SWEIS.

Table 1–2 Summary of Key Scoping Comments on this *NNSS SWEIS*

General Topic	*Issue and Response*
Land Withdrawal	Commenters asked NNSA to identify concrete steps to reconcile the current uses of the NNSS with the uses identified in existing land withdrawals (i.e., to assure that ongoing or proposed activities at the NNSS will be lawful and permitted under existing Federal law). One commenter also recommended that NNSA consider each of its activities within the context of the land withdrawals and make a judgment as to whether it meets the purpose for which the withdrawal was issued. One commenter was concerned about the status of the land withdrawal. ***Response:*** *NNSA believes the land withdrawals are not restrictive with respect to NNSS activities in support of its three missions (National Security/Defense, Environmental Management, and Nondefense). As part of a Settlement Agreement (April 1997) between the State of Nevada and DOE, consultation with the U.S. Department of the Interior was initiated concerning the status of existing land withdrawals with regard to LLW storage and disposal. The consultation process concluded in November 2009, when NNSA accepted custody and control of the approximately 740 acres constituting the NNSS Area 5 Radioactive Waste Management Complex. Land withdrawal is discussed in Chapter 4, Section 4.1.1.3.*
Alternatives	NNSA received several comments related to the range of reasonable alternatives and the recommended scope of those alternatives. One commenter requested that this SWEIS be a programmatic document, given the range of decisions intended to be supported by the proposed EIS. Some commenters favored the cessation of all defense-related activities at the NNSS and the removal of associated infrastructure, with only environmental remediation and monitoring activities allowed to continue. One commenter specifically favored expansion of programs aimed at controlling the illicit use and transportation of nuclear materials. Another commenter provided a detailed recommendation for a “curatorship” approach in lieu of the current Stockpile Stewardship and Management Program. A commenter also requested that NNSA evaluate an alternative whereby the NNSS lands would be withdrawn permanently and NNSA would take responsibility for environmental impacts far into the future. In addition, commenters supported the inclusion of renewable energy development projects under the No Action, Expanded Operations, and Reduced Operations Alternatives, as opposed to under a separate alternative. One commenter stated that the Expanded Operations Alternative and the Renewable Energy Operations Alternative described in the “Alternatives for the SWEIS” section of the *Federal Register* NOI should be combined into a single Expanded Operations Alternative. ***Response:*** *This SWEIS tiers from NNSA and DOE programmatic EISs that have facilitated decisionmaking regarding the assignment of missions to the NNSS, such as supporting stockpile stewardship, maintaining nuclear testing capability, and disposing LLW and MLLW. These NEPA documents and related decisions are described in Section 1.5 of this SWEIS. This* NNSS SWEIS *would not provide the basis for a DOE programmatic decision, but would provide the basis for site-specific implementation of programmatic decisions that have already been made in existing programmatic EISs and other NEPA documents. DOE NEPA regulations (10 CFR 1021.330(c)) require that large, multiple-facility DOE sites, such as the NNSS, prepare SWEISs. This* NNSS SWEIS *addresses the full range of missions, programs, capabilities, projects, and activities under the purview of NNSA in Nevada.* *In response to public comments, conservation and renewable energy projects are addressed under each of the SWEIS alternatives (No Action, Expanded Operations, and Reduced Operations), and the Renewable Energy Operations Alternative was eliminated from consideration as a separate alternative. See Chapter 3, Section 3.5, of this SWEIS for further discussion of these issues.*

General Topic	***Issue and Response***
Alternatives (continued)	A commenter stated that the only actions that should be considered within the No Action Alternative are actions that are currently ongoing or in existence at the NNSS. ***Response:*** *In response to this comment, SWEIS alternatives were restructured. The No Action Alternative now reflects the current missions, programs, capabilities, projects, and activities. It includes reasonably foreseeable actions not yet implemented, but analyzed and approved under previous NEPA decisions.* Commenters showed preferences for particular alternatives. One commenter stated that the Nation's pressing needs in the areas of defense technology testing and counterterrorism preparedness, along with the suitability of the NNSS to support such programs, make the Expanded Operations Alternative the preferred choice. Another commenter favored the Reduced Operations Alternative, with a focus on phasing out unnecessary defense programs in light of changing national policies to focus more on remediation and alternative energy research. ***Response:*** *Regarding the commenters' preferences for specific alternatives, DOE/NNSA has not yet selected a preferred alternative. However, the final SWEIS will identify DOE/NNSA's preferred alternative. Renewable energy projects have been consolidated into the Conservation and Renewable Energy Program under the Nondefense Mission and have been incorporated into each of the three alternatives considered in this NNSS SWEIS: No Action, Expanded Operations, and Reduced Operations.* A commenter stated that this SWEIS should evaluate a potential future scenario in which DOE must maintain sole control of vast areas of the NNSS that must remain perpetually isolated from other uses. This alternative would require DOE to seek congressional legislation to establish a perpetual withdrawal of land and would have significant implications in terms of long-term stewardship, costs, etc. Additionally, a commenter stated that this SWEIS should consider closing the NNSS in its entirety (Discontinued Operations Alternative). ***Response:*** *Closure of the NNSS with or without perpetual control and isolation would not meet the purpose and need for agency action as identified in Section 1.2 of this SWEIS. Should the missions of the NNSS change such that perpetual control and isolation is a valid scenario, either through presidential decision directives or congressional direction, NNSA would revisit this SWEIS and determine through the supplement analysis process whether additional NEPA analysis is warranted.* A commenter stated that this draft SWEIS should describe how each alternative was developed, how it addresses each project objective, and how it would be implemented. ***Response:*** *Chapter 3 of this SWEIS describes how each alternative was developed and presents information on programs supporting the missions, as well as specific information on the implementation of the projects (such as the number of tests, experiments, or training activities; location/facility; and purpose of activity).*

General Topic	***Issue and Response***
Transportation	NNSA received comments regarding how analyses such as transportation of waste and other materials should be addressed. Commenters stated that this SWEIS should evaluate impacts associated with the transportation of wastes on communities along the shipping routes within Nevada and in corridor states. In addition, a commenter asked for assurances that shipments from offsite waste generators would continue to be prohibited from routes through the Las Vegas metropolitan area. One commenter asked that the waste disposal analysis identify waste volumes by specific generator or origin location, as well as specific transportation routes and times. ***Response:*** *This SWEIS presents the potential transportation impacts on communities along shipping routes in Nevada and representative routes in corridor states (see Chapter 5, Section 5.1.3.1, and Appendix E, "Evaluation of Human Health Effects from Transportation"). This SWEIS does evaluate transportation routes through Las Vegas. The NNSA/NSO has historically avoided travelling through the Las Vegas metropolitan area (Interstate 15/U.S. Route 95 interchange, known as the Spaghetti Bowl) with LLW and MLLW shipments based on a verbal commitment from DOE. This informal commitment was made at a time when the major highway infrastructure, specifically Interstate 15 and U.S. Route 95, was not adequate to handle the rapidly expanding volume of traffic. Since the mid-2000s, U.S. Route 95 has been widened and expanded, and overpasses have been built to accommodate traffic much more safely. In addition, Interstate 215 (encompassing approximately three-quarters of the valley) was built at the far edges of Las Vegas to further reduce traffic loads on Interstate 15 and U.S. Route 95. In addition, a bypass bridge has been constructed adjacent to Hoover Dam. This bridge was opened to all traffic in October 2010. Specific LLW/MLLW waste generators tied to specific waste streams are not addressed in the transportation analysis; instead, reference routes were used. Existing waste generators are identified in Appendix A, "Detailed Description of Alternatives." Total estimated waste volumes by waste type were used to calculate transportation impacts.* A commenter stated that this SWEIS should contain an analysis of how intermodal transport (rail-to-truck transfer) would be done (if planned) and a comprehensive evaluation of risks and impacts, regardless of where the intermodal transfer(s) would take place. ***Response:*** *An analysis of rail-to-truck transport is included in the transportation analysis of this SWEIS (see Chapter 5, Section 5.1.3.1).*
Contamination	NNSA received comments requesting that this SWEIS contain the following analyses: • A comprehensive analysis of contamination from all activities that have occurred and are ongoing at the NNSS and offsite locations • An assessment of what has been "cleaned up" since the inception of DOE's Environmental Management Mission and what remains to be assessed and remediated for industrial sites, contaminated soils, and groundwater under the Environmental Management Mission programs at the NNSS and all offsite locations for the foreseeable future • An extensive analysis of groundwater contamination within the NNSS to determine to what extent and where contamination is or could be migrating off site ***Response:*** *Impacts from contamination are analyzed in Chapter 5, "Environmental Consequences," and Chapter 6, "Cumulative Impacts." A description of the Environmental Restoration Program, (including an update on Environmental Restoration Program projects and activities and remaining projects and activities to clean up the NNSS) is included in Chapter 3, Section 3.1.2.2, and in more detail in Appendix A, Section A.1.2.2.*
Nye County Impacts	NNSA received the following comments from Nye County, in summary: (1) Nye County believes that significant adverse impacts and losses of natural resources have occurred that must be mitigated; (2) environmental monitoring will not suffice as a mitigation measure; and (3) this SWEIS must address the legacy of environmental insult that has occurred and define appropriate measures to mitigate the massive loss of natural resources. ***Response:*** *Impacts from previous activities at the NNSS and offsite locations are included in the analysis of cumulative impacts presented in Chapter 6, "Cumulative Impacts," of this SWEIS. Chapter 6 analyses of potential environmental impacts generally encompass the impacts of past, present, and reasonably foreseeable actions. Text provided by Nye County describing its perspective on cumulative impacts of primarily Federal actions has been included in its entirety in Chapter 6.*

General Topic	***Issue and Response***
Waste Disposal	Commenters requested that this SWEIS contain a comprehensive and thorough evaluation of all current and potential waste disposal activities at the NNSS, including LLW, MLLW, transuranic waste, GTCC waste, depleted uranium, and any other existing or foreseeable waste stream. ***Response:*** *The Waste Management Program is part of the Environmental Management Mission performed at the NNSS. Chapter 3 describes the Waste Management Program activities to be performed under each of the alternatives analyzed in this SWEIS. Under all of the alternatives, NNSS would continue to receive LLW and MLLW, including depleted uranium waste streams, for disposal. Transuranic waste would not be disposed at the NNSS, but would be transferred off site for disposal at the Waste Isolation Pilot Plant. DOE has prepared the* Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste *(DOE/EIS-0375) to evaluate the potential environmental impacts of siting and operating a GTCC disposal facility or facilities. The GTCC facility is included in the cumulative impacts analysis in Chapter 6. Chapter 5, Section 5.1.11, of this SWEIS contains a thorough analysis of the capacity of the waste management system to manage all current and potential NNSS waste streams.* Commenters requested that this SWEIS also identify waste volumes by generator/origin location, where such waste would be disposed, the facilities required (existing and new), the transportation requirements for moving various waste streams from generator locations to the NNSS for disposal, the interrelationships of waste disposal activities, and the cumulative impacts associated with all of the current and future NNSS onsite and offsite waste disposal activities. ***Response:*** *Consistent with the* 1996 NTS EIS *and 2000 revised Record of Decision, this SWEIS does not evaluate specific generators tied to specific waste streams because of the variability that can occur both in waste stream characteristics and future waste volumes. Instead, this SWEIS evaluates the potential impacts of transporting and disposing LLW and MLLW that meet the NNSS waste acceptance criteria based on transportation from various regions of the country. The list of waste generators used in the analysis of potential impacts is included in Appendices A and E.* Commenters requested that this SWEIS discuss the following topics and assess their programmatic, environmental, and legal ramifications: disposal of various waste streams; the interrelationships of waste disposal activities; and the cumulative impacts associated with all of the current and future on- and offsite NNSS waste disposal activities, and, in particular, plans to accept new LLW streams, including any that may be of commercial origin. ***Response:*** *Chapter 5, Section 5.1.11, of this SWEIS contains a thorough analysis of all current and potential NNSS waste disposal activities and waste streams. Additionally, cumulative impacts of waste management activities are evaluated in Chapter 6, "Cumulative Impacts." See the next response concerning waste of commercial origin.* A commenter requested that this SWEIS address DOE's proposal for taking LLW from commercial entities, subsequently declaring it to be DOE waste, and disposing it at the NNSS. ***Response:*** *In reference to activities performed by DOE's Office of Global Threat Reduction, the goal of the Offsite Source Recovery Project is to recover excess, unwanted, or abandoned sealed sources that pose a potential risk to health, safety, and national security. DOE/NNSA takes ownership of some sealed sources under its Global Threat Reduction Initiative. If no reuse of these sealed sources is identified, they may be declared waste and be disposed as LLW.*

General Topic	*Issue and Response*
Coordination and Consultation	A commenter stated that this SWEIS should acknowledge Nevada's important role in overseeing aspects of NNSS activities that are of special concern to the state and the importance of the Agreement in Principle framework for cooperative efforts. In addition, commenters stated that this SWEIS should evaluate the potential for more formal state regulatory oversight of LLW activities, such as the application of the state's authority (delegated by the U.S. Nuclear Regulatory Commission) to oversee LLW disposal operations at the NNSS. ***Response:*** *This SWEIS discusses the Agreement in Principle, under which the State of Nevada provides enhanced oversight of DOE's management of MLLW. DOE's authority is vested pursuant to the Atomic Energy Act authority. LLW is managed solely under DOE directives pursuant to DOE's Atomic Energy Act authority. However, DOE and NDEP have an Agreement in Principle whereby NDEP participates in the Low-Level Waste Acceptance Program.* NNSA received several comments addressing outreach and consultations. Commenters urged continued dialogue and collaborative planning efforts with local American Indian groups in the NEPA process. A commenter stressed the need for consultations with the State Historic Preservation Office on this SWEIS and recommended that the alternatives describe the consultation process for key issues, including cultural resources surveys and impact assessments. Commenters stated that the NNSS should pursue more partnerships with local organizations, including the University of Nevada at Las Vegas and Nye County businesses, for future research and testing projects. One commenter stated that NNSA should consider additional opportunities for training local first responder personnel at the NNSS. ***Response:*** *Outreach and consultations are discussed in Section 1.6 and Chapter 10, "Consultation and Coordination." American Indian groups have been invited to participate in the preparation of this SWEIS. Text prepared by the Consolidated Group of Tribes and Organizations' American Indian Writers Subgroup appears in text boxes throughout this SWEIS and as Appendix C. NNSA is carrying out consultations with the State Historic Preservation Office and the U.S. Fish and Wildlife Service, as appropriate, regarding the preparation of this SWEIS. Descriptions of these consultation processes appear in the cultural resources and biological resources impacts sections of this SWEIS. Copies of correspondence with these agencies will appear in an appendix of the final SWEIS. NNSA will consider proposals for research and development projects from academic institutions, other government agencies, and private companies and individuals.* Nye County requested that NNSA consider the benefits of partnering with Nye County for delivery of infrastructure services. ***Response:*** *Although this comment is not within the scope of this SWEIS, NNSA/NSO will take this under consideration.* Nye County suggested that it conduct the groundwater characterization program for NNSA. Nye County offered to provide a fully developed programmatic alternative for review in this SWEIS. ***Response:*** *NNSA/NSO conducts a robust Underground Test Area (UGTA) Monitoring Project. NNSA/NSO will continue to interact with Nye County on this UGTA Project.*
	Nye County suggested that the draft and final SWEIS incorporate text it prepared for inclusion in the discussion of cumulative impacts presenting the Nye County perspective. ***Response:*** *Nye County text has been included in its entirety in the cumulative impacts discussion in Chapter 6.*
Land Use	A comment was made that this SWEIS should address the land transfer and all incidental activities contemplated for this acreage, including closure of Pit 3 and new state-imposed permitting requirements under RCRA. ***Response:*** *In November 2009, 740 acres in Area 5 of the NNSS were transferred for custody and control to the NNSA/NSO. Chapter 5, Section 5.1.11, of this SWEIS contains a thorough analysis of all current and potential NNSS waste disposal activities, including establishment of a new mixed-waste pit under a new RCRA permit.*

General Topic	*Issue and Response*
Yucca Mountain	A commenter stated that this *NNSS SWEIS* must: • Fully evaluate the relationship between the potential repository and NNSS activities • Assess any potential cumulative impacts with respect to the former DOE Yucca Mountain Project • Identify, assess, and address the combined effects of these two facilities and related associated activities ***Response:*** *As indicated in the fiscal year 2010, 2011, and 2012 budget requests, the Administration decided to cease funding and activities related to development of a repository at Yucca Mountain while developing alternative storage and disposal approaches for spent nuclear fuel and high-level radioactive waste. Proposed actions associated with the former Yucca Mountain Project included construction, operation, monitoring, and eventual closure of a geologic repository at Yucca Mountain for disposal of spent nuclear fuel and high-level radioactive waste in storage or projected to be generated at 72 commercial and 5 DOE sites across the United States. In 1994, the DOE/Nevada Operations Office (the predecessor of NNSA/NSO) entered into a management agreement with the DOE Yucca Mountain Site Characterization Office for use of about 58,000 acres of NNSS land for site characterization activities related to the former Yucca Mountain Project. Under the agreement, the former Yucca Mountain Project was responsible for meeting the same environmental requirements that applied to the NNSS independent of, but in coordination with, the NNSS organizations. Until DOE receives appropriations for remediation of the infrastructure and buildings of the former Yucca Mountain Project, NNSA will maintain the infrastructure and buildings and provide security and support to DOE to remain compliant with Federal and state regulations pursuant to existing site permits. Upon receipt of appropriations, DOE will remediate and close the infrastructure and buildings as required by law, regulations, and applicable agreements. At the completion of site closure, DOE will initiate a long-term surveillance program.*
Cumulative Impacts	A commenter stated that the analysis of cumulative impacts in this SWEIS must include the following: • A comprehensive evaluation of the combined impacts of all activities, programs, and projects currently ongoing at the NNSS or reasonably foreseeable in the future • An assessment of impacts from past NNSS activities and an examination of how they interact with impacts from current and future activities • An assessment of the cumulative impacts on groundwater from past activities, in combination with potential additional contamination from current and future NNSS activities ***Response:*** *NNSA concurs with the commenter; Chapter 6, "Cumulative Impacts," contains a comprehensive evaluation of cumulative impacts, including past, present, and reasonably foreseeable activities and cumulative groundwater impacts.*
Project Shoal, Central Nevada Test Area, and the Tonopah Test Range	A commenter stated that this SWEIS should contain an assessment of environmental conditions (surface and subsurface) for Project Shoal and the Central Nevada Test Area to establish environmental baselines against which any future impacts may be measured. ***Response:*** *Remediation of the Project Shoal and Central Nevada Test Area sites was completed and transferred to the DOE Office of Legacy Management for long-term stewardship. These sites are no longer under NNSA control and, by agreement with the DOE Office of Legacy Management, they are not addressed in this* NNSS SWEIS. A commenter stated that this SWEIS should address DOE Environmental Management Mission and NNSA activities at the NNSS and NNSS-related sites and locations. Of particular concern is plutonium contamination on the Tonopah Test Range. ***Response:*** *DOE Environmental Management Mission activities (under the Environmental Restoration Program) at the NNSS, Tonopah Test Range, and Nevada Test and Training Range are evaluated in this SWEIS.*

General Topic	***Issue and Response***
NEPA Implementation	A commenter requested that the period for comments on this draft SWEIS should be no less than 180 days. ***Response:*** *NNSA has lengthened the comment period from 60 days (see NOI) to 90 days, twice the minimum requirement.* A commenter requested that the public hearings be held in locations throughout Nevada and in other states affected by NNSS activities (including, but not limited to, the transportation of radioactive and hazardous materials to and from the NNSS). ***Response:*** *Public hearings will be held in the same locations as the scoping meetings (Las Vegas, Pahrump, and Tonopah in Nevada and St. George in Utah).* A commenter requested that the hearings be structured so as to meaningfully facilitate public comments, i.e., in such a way that permits individuals to make comments for the record in a public forum. ***Response:*** *Comments will be taken and recorded in a public hearing format. In addition, the open-house format will be set up to allow the general public a better forum to ask questions and have one-on-one discussions with the NNSA subject matter experts. This format received positive review in every meeting location during the public scoping period.* A commenter requested that all related EISs, environmental assessments, categorical exclusions, and referenced documents be made publicly available online. ***Response:*** *Many DOE EISs and environmental assessments are available online at the DOE NEPA website (http://nepa.energy.gov). Occasionally, due to national security requirements, some NEPA documents are not available online. The references for this draft SWEIS are available at the public reading rooms listed on the cover page of this SWEIS, and copies also may be obtained by request.* A commenter stated that the purpose and need should be a clear, objective statement of the rationale for the proposed project. ***Response:*** *DOE/NNSA has provided a detailed description of the purpose and need in Section 1.2.*
Terrorism and Sabotage	A commenter requested that this SWEIS evaluate risks and impacts relating to acts of terrorism and sabotage against NNSS-related radioactive materials shipments. ***Response:*** *DOE/NNSA concurs with the commenter. A classified appendix with this information was prepared in conjunction with this SWEIS. Pertinent unclassified data from the appendix are included in Chapter 5, Section 5.1.12.3.*

General Topic	*Issue and Response*
Renewable Energy	Commenters stated that renewable energy should be adopted as a secondary mission. ***Response:*** *Renewable energy research and development, as well as commercial development, are discussed in this SWEIS.* A commenter stated that the environmental consequences associated with reasonable buildout of renewable energy facilities should be evaluated in this SWEIS. ***Response:*** *DOE/NNSA concurs with the commenter and has included renewable energy projects in all alternatives evaluated in this SWEIS.* The U.S. Environmental Protection Agency commented that it supports increasing the development of renewable energy resources. ***Response:*** *DOE/NNSA acknowledges the U.S. Environmental Protection Agency's support for renewable energy.* Commenters asked for clarification of the renewable energy technologies considered in this SWEIS. ***Response:*** *Each of the three alternatives includes renewable energy projects. Each alternative includes a commercial solar power generation facility that varies among the alternatives in terms of electricity-generating capacity, as described in Chapter 3. All the commercial solar projects would be located in Area 25 of the NNSS. In addition, the Expanded Use Alternative includes a project to install a photovoltaic system in Area 6 and a project to demonstrate the feasibility of enhanced geothermal electricity-generating systems in other locations on the NNSS. In the cumulative impacts chapter (Chapter 6), a Concentrating Solar Power Validation Project for solar research and development is also evaluated. This project is intended to demonstrate the viability of cutting-edge technologies for commercial power production. Because there are no proposals for the commercial-scale solar power generation facilities or geothermal electricity generation, additional NEPA review would be required if a specific proposal is considered by NNSA.*
Water Resources	A commenter stated that access limitations to water resources on withdrawn lands constitute a significant, adverse impact on the socioeconomic condition of Nye County. The impact is an indirect result of land access restrictions that have no demonstrated basis and must be recognized and identified as an impact on Nye County in this SWEIS. ***Response:*** *Access restrictions are an integral part of the security of the NNSS. Nye County text concerning lack of access to water resources on withdrawn lands is incorporated in its entirety in Chapter 6, "Cumulative Impacts."*

<table>
<tr><th>General Topic</th><th>Issue and Response</th></tr>
<tr><td>Potential Impacts</td><td>The U.S. Environmental Protection Agency requested that specific discussions and data regarding the following issues related to renewable energy projects be incorporated into this SWEIS:
• Water supply and quality
• Disposal of discharges
• Clean Water Act, Sections 404 and 303(d)
• Biological resources and habitat
• Invasive species
• Indirect and cumulative impacts
• Implementation of adaptive management techniques for mitigation measures
• Climate change
• Air quality
• Coordination with American Indian tribal governments
• Environmental justice
• Hazardous materials/hazardous waste/solid waste
• Mitigation and pollution prevention
• Coordination with land use planning activities
Response: NNSA concurs with the U.S. Environmental Protection Agency comments addressing renewable energy. However, the renewable energy projects in this SWEIS are not sufficiently defined to include this level of detail and would require additional NEPA analysis before being implemented.
A commenter stated that this draft SWEIS should clearly describe the rationale used to determine whether impacts of an alternative are significant and suggested that thresholds of significance consider the context and intensity of an action and its effects.
Response: Wherever possible, impacts are quantified and compared with regulatory standards, system capacities, or other appropriate data. The criteria for determining whether the proposed alternatives impact each resource are identified in each of the Chapter 5 resource impacts sections.
A commenter requested that groundwater contamination from radionuclides or other materials, airborne pollutants, and the full range of other environmental impacts be evaluated in relation to their impacts on people and the environment in communities and areas surrounding the site and along transportation corridors leading to and from the NNSS.
Response: This SWEIS analyzes the potential direct and indirect impacts on people and the environment from groundwater contamination, transportation impacts, airborne pollutants, and all other emissions, as well as impacts on other resources (such as cultural resources and socioeconomic resources). These impacts are presented in Chapter 4, “Affected Environment,” Chapter 5, “Environmental Consequences,” and Chapter 6, “Cumulative Impacts.”
A commenter stated that impacts must be considered in a global context.
Response: Some global impacts are outside the scope of this SWEIS; however, others are analyzed, such as the contribution of greenhouse gas emissions from activities at the NNSS and offsite locations.</td></tr>
<tr><td>Treaty of Ruby Valley</td><td>A commenter was in favor of returning lands to the Western Shoshone.
Response: The U.S. Supreme Court ruled against claims by the Western Shoshone under the Ruby Valley Treaty. NNSA is aware of significant disagreement with the rulings of the U.S. Supreme Court by the Western Shoshone.</td></tr>
</table>

CFR = *Code of Federal Regulations*; CSP = concentrating solar power; EIS = environmental impact statement; GTCC = greater-than-Class C; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NDEP = Nevada Division of Environmental Protection; NEPA = National Environmental Policy Act; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NOI = Notice of Intent; NSO = Nevada Site Office; RCRA = Resource Conservation and Recovery Act; SWEIS = site-wide environmental impact statement.

1.7.2 Next Steps in the Public Involvement Process

DOE/NNSA is soliciting comments on this *Draft NNSS SWEIS* during a 90-day public comment period. During the public comment period, NNSA will hold public hearings to provide interested members of the public with the following opportunities:

- Learn more about the content of this *Draft NNSS SWEIS* from exhibits, fact sheets, and other materials
- Hear NNSA representatives present the results of the impact analyses
- Ask clarifying questions
- Provide oral or written comments

The *NNSS SWEIS* website (http://www.nv.doe.gov/emprograms/impact.aspx) has been established to further inform the public about this *NNSS SWEIS*, public meetings, comment submittal methods, and other pertinent information. Additionally, comment submittal methods and public meeting dates, times, and locations were announced in the *Federal Register*, in local newspapers, and on the *NNSS SWEIS* website.

NNSA will evaluate comments received on this *Draft NNSS SWEIS* in preparing the *Final NNSS SWEIS*. Public comments and responses will be included in the *Final NNSS SWEIS*. NNSA will announce its decision(s) regarding the selected alternative or alternatives in a ROD no sooner than 30 days after the U.S. Environmental Protection Agency Notice of Availability for the *Final NNSS SWEIS* is published. The ROD will be published in the *Federal Register* and will explain all factors, including the potential environmental impacts, considered by NNSA in reaching its decision. The ROD will identify the environmentally preferred alternative or alternatives. If mitigation measures, monitoring, or other conditions are adopted as part of NNSA's decision, these will be summarized in the ROD, as applicable, and will be included in a mitigation action plan that would be prepared following issuance of the ROD. The mitigation action plan would explain how and when mitigation measures would be implemented and how the NNSA would monitor the mitigation measures over time to judge their effectiveness. After NNSA issues its ROD, both the ROD and the mitigation action plan will be posted on DOE's NEPA website (http://nepa.energy.gov), and copies will be placed in the NNSA Reading Room in Las Vegas, Nevada, and in public libraries in southern Nevada and southwestern Utah; they also will be made available to interested parties upon request.

CHAPTER 2
SITE OVERVIEW AND UPDATE

2.0 SITE OVERVIEW AND UPDATE

Among the responsibilities of the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) are continued stewardship of the Nation's nuclear weapons stockpile and maintenance of a nuclear weapons testing capability. Historically, the primary mission at the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) was to conduct nuclear weapons tests. Since the moratorium on nuclear weapons testing in October 1992, the focus at the NNSS has been to support the Stockpile Stewardship and Management Program. However, under a November 1993 Presidential Decision Directive, DOE/NNSA must be able to resume underground nuclear tests within 24 to 36 months if so directed by the President. The NNSA Nevada Site Office (NSO) maintains this test readiness at the NNSS. Because of its favorable environment and infrastructure, the NNSS also supports DOE waste management and disposal; NNSA counterterrorism training, research, and development; nuclear emergency response; nonproliferation; and other research related to national security and nondefense-related research, development, and testing programs.

This chapter of the *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* provides background on the NNSS and its main facilities, as well as other locations used to support NNSA missions. These facilities include the Remote Sensing Laboratory (RSL), the North Las Vegas Facility (NLVF), and the Tonopah Test Range (TTR) (see Chapter 1, Figure 1–1). While many programs and activities take place on the NNSS, several administrative and technical operations occur at other locations. Research, testing, and operations at RSL focus on conducting emergency response procedures and support, remote sensing, counterterrorism, and radiological incident response. RSL houses fabrication laboratories, shops, and advanced scientific equipment. NNSA/NSO's primary administrative offices are located at NLVF and house Federal and contractor personnel. In addition, facilities for engineering, fabrication, assembly, and calibration and laboratories are located at NLVF. Activities at the TTR support the Stockpile Stewardship and Management Program, as well as research and design of new weapons and weapon components. An overview of the changes that have occurred since DOE issued the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996c) is also provided. Some of the site descriptions include American Indian perspectives prepared by the American Indian Writers Subgroup (AIWS); the AIWS input is in text boxes identified with a Consolidated Group of Tribes and Organizations (CGTO) feather icon.

2.1 Nevada National Security Site

The NNSS occupies approximately 1,360 square miles of desert and mountain terrain in southern Nevada at the southern end of the Great Basin. Elevations range from 2,700 feet on Jackass Flats in the southern part of the NNSS to 7,680 feet on Rainier Mesa in the mountainous northern region (DOE/NV 2009d) (see **Figure 2–1**). Sparsely vegetated basins or flats, separated by low mountains, dominate the eastern side and southern end of the NNSS—Jackass Flats in the southwestern quadrant, Frenchman Flat and Mercury Valley in the southeastern quadrant, and Yucca Flat in the northeastern quadrant. Frenchman and Yucca Flats each contain a large playa. The northwestern quadrant of the site comprises mountains with a pinyon-juniper forest and sagebrush shrublands separated by canyons; the dominant topographic features in this area are the Shoshone and Timber Mountains near the center and western border and Rainier Mesa and Pahute Mesas in the northwestern region of the site (DOE 2002f; Wills and Ostler 2001).

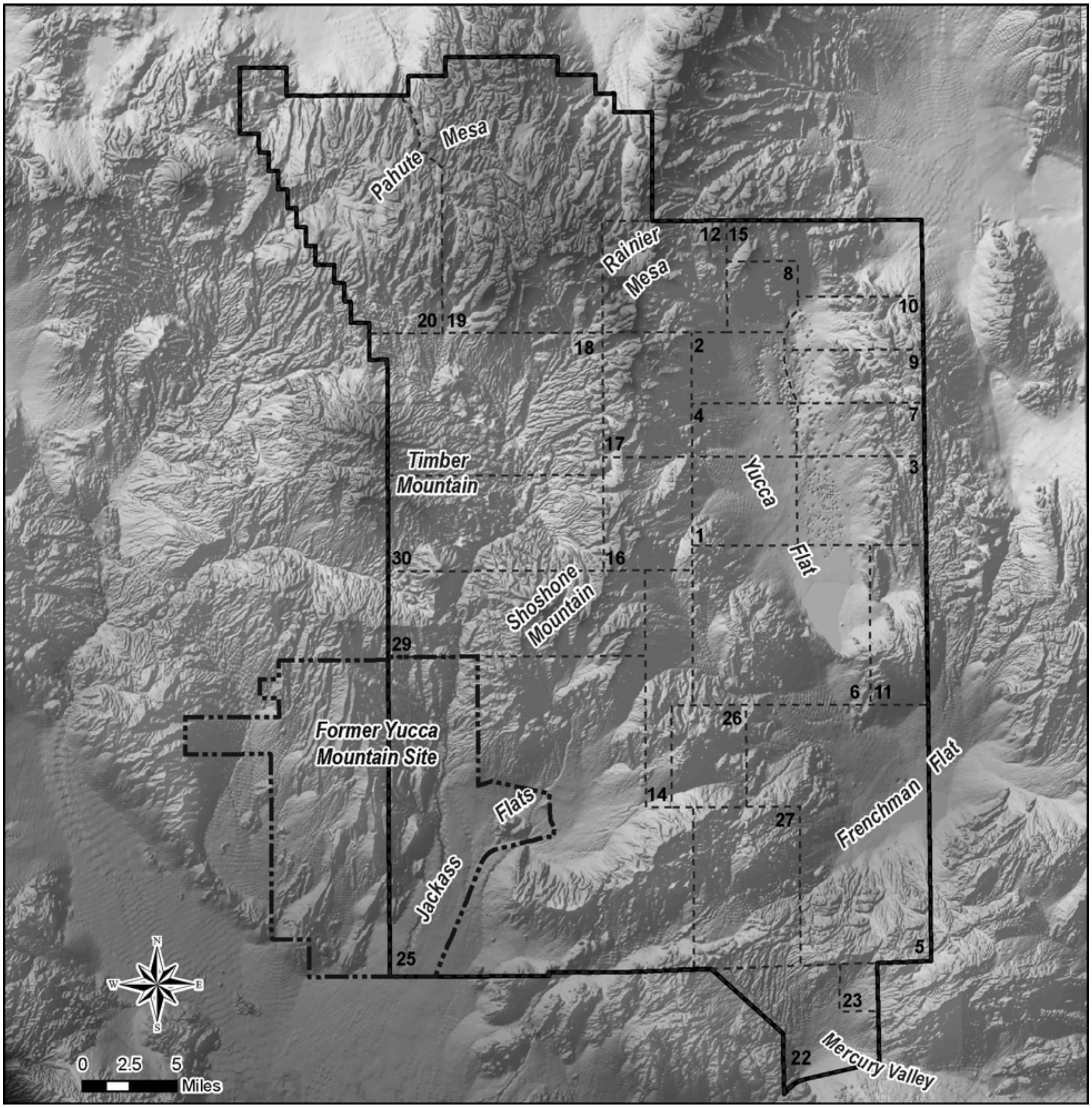


Figure 2–1 Geographic Areas of the Nevada National Security Site

About 6,500 square miles of the U.S. Air Force's (USAF's) Nevada Test and Training Range (formerly the Nellis Air Force Range) and the Desert National Wildlife Refuge surround the NNSS on the northern, western, and eastern sides. Most of the land adjacent to the NNSS is the Nevada Test and Training Range, which is used by the USAF for armament and high-hazard testing; aerial gunnery, rocketry, electronic warfare, and tactical maneuvering training; and equipment and tactics development and training. Public access to this land is restricted, so it serves as an additional buffer between NNSS activities and the general public. The overland distance from the southern edge of the NNSS (Gate 100 near Mercury) to downtown Las Vegas (the intersection of Interstate 15 and U.S. Route 95) is about 57 miles (NNSA 2007).

The NNSS is divided into numbered areas to facilitate management; communications; and the distribution, use, and control of resources (see **Figure 2–2**). The areas are numbered from 1 to 30, although four numbers are missing from the sequence (there are no Areas 13, 21, 24, or 28 on the NNSS). The numbering designations originated when the NNSS was part of the former Nellis Air Force Range (now called the Nevada Test and Training Range). Nellis has since changed the numbers for the Nevada Test and Training Range, but the old numerical designations remain for the NNSS. The missing area numbers previously denoted areas on the range. The approximate size of each area (rounded to whole square miles) and a description of its function are provided in **Table 2–1**.

In addition to dividing the site into administrative areas, NNSA also categorizes the NNSS into land use zones. These zones are discussed in Chapter 4, Section 4.1.1.

American Indian Perspective of the NNSS Area and Offsite Locations

The Nevada National Security Site (NNSS) area and offsite locations are part of the traditional holy lands of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people (Stoffle et al. 1990; Appendix C, Figure C-1). We share this land for medicinal purposes, food, and culturally significant places necessary for traditional narratives and religious ceremonies.

The Consolidated Group of Tribes and Organizations (CGTO) knows these lands contain archaeological remains left by our ancestors. They are home to countless natural resources, such as plants, animals, water, and minerals which are critical to American Indian daily life and religious beliefs. Our ancestral lands contain natural landforms that mark important locations for keeping our history alive and for teaching our children about our culture in detailed Winter Stories. We use traditional sites within these lands to make doctoring tools, stone objects, and ceremonial items. They contain many sites associated with traditional healing ceremonies and power places necessary for our cultural survival. Despite the current physical separation of tribes from our ancestral lands stemming from the actions by the Federal Government, American Indians continue to value and recognize their meaningful role in our culture and continued survival.

Numerous sites have been identified within the NNSS boundaries that are important to American Indian People. For example, Fortymile Canyon is a significant crossroad where trails from distant places such as Owens Valley, Death Valley, and the Avawatz Mountain come together. Black Cone in Crater Flat is an important religious site that is considered an entry to the underworld (AIWS 2005). Prow Pass is a unique ceremonial site and, because of this religious significance, tribal representatives have recommended DOE avoid affecting this area (Stoffle and Evans 1988). Oasis Valley is a known area for trade and doctoring ceremonies. Other locations throughout this area are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and potential burial sites (Stoffle et al. 1990).

See Appendix C for more details.

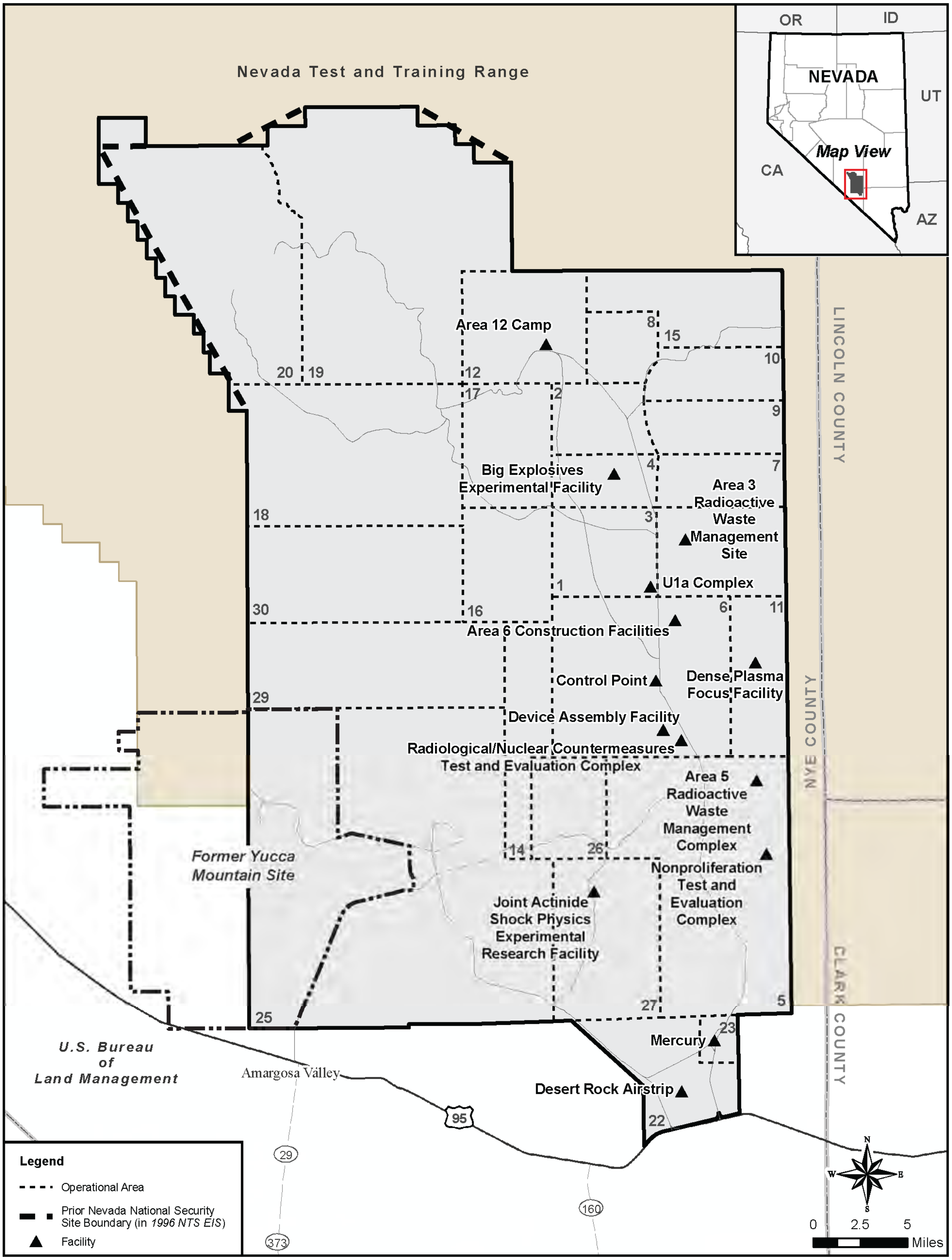


Figure 2–2 Nevada National Security Site Areas and Major Facilities

Table 2–1 Description and Historical Use of Nevada National Security Site Areas

Description of Nevada National Security Site (NNSS) Areas
Area 1—Area 1 occupies approximately 26 square miles of the Yucca Flat basin near the center of the site. The U1a Complex and the Area 1 Industrial Complex are located in Area 1. Area 1 was the site of four atmospheric nuclear tests between 1952 and 1955, and three underground tests (one in 1971 and two in 1990).
Area 2—Area 2 occupies approximately 19 square miles in the northern half of the Yucca Flat basin. The eastern portion of Area 2 was the site of 7 atmospheric nuclear tests conducted between 1952 and 1957. The first of 137 underground nuclear tests in Area 2 took place in late 1962, and tests continued through 1990.
Area 3—Area 3 occupies approximately 32 square miles near the center of the Yucca Flat basin. The Area 3 Radioactive Waste Management Site, which makes use of a group of subsidence craters for low-level radioactive waste disposal, is located in this area. Area 3 was the site of 17 atmospheric tests conducted between 1952 and 1958, and 251 underground nuclear tests from 1958 through 1992.
Area 4—Area 4 occupies approximately 16 square miles near the center of the Yucca Flat basin. The Big Explosives Experimental Facility is located in Area 4. Area 4 was the site of 5 atmospheric nuclear tests conducted between 1952 and 1957. From the mid-1970s through 1991, a total of 35 underground nuclear tests were conducted in Area 4, mainly in the northeastern corner.
Area 5—Area 5 occupies approximately 111 square miles in the southeastern portion of the site and includes the Area 5 Radioactive Waste Management Complex, the Nonproliferation Test and Evaluation Complex, and the Nevada Desert Free Air Carbon Dioxide Enrichment and Mojave Global Change Facility environmental research sites. From 1951 through early 1962, 14 atmospheric tests were conducted at Frenchman Flat. Five underground nuclear weapons tests were conducted at Frenchman Flat between 1965 and 1968.
Area 6—Area 6 occupies approximately 81 square miles from the northern part of Frenchman Flat to the southern part of Yucca Flat, straddling Frenchman Mountain. Facilities in Area 6 include the Control Point Complex, Area 6 Construction Facilities, the Device Assembly Facility, the Radiological/Nuclear Countermeasures Test and Evaluation Complex, the Yucca Lake Aerial Operations Facility, and a Hydrocarbon Contaminated Soils Disposal Site. One atmospheric nuclear test was conducted in Area 6 (in 1957). Between 1968 and 1990, five underground nuclear tests were conducted in this area.
Area 7—Area 7 occupies approximately 19 square miles in the northeastern quadrant of the Yucca Flat basin. Twenty-six atmospheric tests were conducted in this area. From 1964 through 1991, 62 underground nuclear tests were conducted in Area 7.
Area 8—Area 8 occupies approximately 14 square miles in the northern part of the Yucca Flat basin. Area 8 was the site of 3 atmospheric nuclear tests conducted in 1958. From 1966 through 1988, 10 underground nuclear tests were conducted in this area.
Area 9—Area 9 occupies approximately 20 square miles in the northeastern quadrant of the Yucca Flat basin. A construction and demolition debris landfill, using a subsidence crater, operates in Area 9. Area 9 was used extensively for nuclear testing; 17 atmospheric tests were conducted between 1951 and 1958, and 100 underground tests were conducted from 1961 to 1992.
Area 10—Area 10 occupies approximately 20 square miles in the northeastern quadrant of the Yucca Flat basin. Area 10 was the location of the Nation's first nuclear missile system test, an air-to-air rocket, detonated in mid-1957. There were 57 nonatmospheric tests (underground detonations and shallow nuclear testing experiments called cratering) in Area 10 between 1962 and 1991. The Sedan Crater, formed by a thermonuclear device in July 1962 as part of the Plowshare Program, is in Area 10. The Plowshare Program was designed as a research and development activity to explore the technical and economic feasibility of using nuclear explosives for industrial applications. The Sedan Crater is listed in the National Register of Historic Places.
Area 11—Area 11 occupies approximately 26 square miles along the central-eastern border of the NNSS. The Dense Plasma Focus Facility and an explosives ordnance disposal site are located in this area. Because of residual radioactive contamination from historic uses, this area is used intermittently for realistic drills in radiation monitoring and sampling. Four atmospheric safety tests were conducted in the northern portion of Area 11 in 1955 and 1956 in what is now known as Plutonium Valley. In addition to the aboveground safety tests, five underground nuclear weapons effects tests were conducted in Area 11 between 1966 and 1971.
Area 12—Area 12 occupies approximately 40 square miles along the northern boundary of the NNSS on Rainier Mesa. There are a number of tunnel complexes mined into Rainier Mesa that are used for experiments, including E-, G-, N-, P-, and T-Tunnel complexes. The Area 12 Camp was renovated and upgraded and will provide a secure base camp for military units and other government agencies for conducting counterterrorism and other exercises in the northern region of the NNSS. It provides an urban terrain setting utilizing existing commercial, residential, and industrial buildings. The camp includes 200 dormitory rooms, a cafeteria, weapons and munitions storage, and numerous operations and support buildings. The NNSA Office of Secure Transportation currently uses it as a training facility. No atmospheric tests were conducted in Area 12; 61 underground nuclear tests were conducted in Area 12 between 1957 and 1992.

Table 2–1 Description and Historical Use of Nevada National Security Site Areas (continued)

Area 14—Area 14 occupies approximately 26 square miles in the central portion of the NNSS. Various outdoor experiments are conducted in this area. No atmospheric or underground nuclear tests were conducted in Area 14.
Area 15—Area 15 occupies approximately 35 square miles in the northeastern corner of the NNSS. No atmospheric tests were conducted in this area; between 1962 and 1966, three underground nuclear tests were carried out in Area 15. A facility that evaluated the effects of residual radiation on farm animals, called the EPA Farm, previously operated in this area.
Area 16—Area 16 consists of approximately 29 square miles in the central portion of the NNSS. Currently, DoD uses this area for high-explosives research and development in support of programs involving the detonation of conventional or prototype nonnuclear explosives and munitions and for developing tactics to defeat deeply buried and hardened targets. Area 16 was established in 1961 for DoD to conduct nuclear effects experiments. From mid-1962 through mid-1971, six underground nuclear weapons effects tests (all in the U16a Tunnel complex) were conducted in this area.
Area 17—Area 17 occupies approximately 31 square miles in the north-central portion of the NNSS. This area has been used primarily as a buffer between other testing activities. No atmospheric or underground nuclear weapons tests were conducted in Area 17.
Area 18—Area 18 occupies approximately 88 square miles along the western border of the NNSS. The inactive Pahute Airstrip is located in the east-central portion of the area. The airstrip was used for the shipment of supplies and equipment for Pahute Mesa test operations. Area 18 was the site of five nuclear weapons tests from 1962 to 1964, two atmospheric tests, two cratering tests, and one underground test.
Area 19—Area 19 occupies approximately 146 square miles along the northern side of the NNSS. Area 19 was developed for high-yield underground nuclear tests. No atmospheric nuclear tests were conducted in Area 19. From the mid-1960s through 1992, 35 underground nuclear tests were conducted in this area.
Area 20—This area occupies approximately 97 square miles on Pahute Mesa in the northwestern corner of the NNSS. Area 20 was developed in the mid-1960s for high-yield underground nuclear tests. No atmospheric nuclear tests were conducted in Area 20. From the mid-1960s through 1992, a total of 46 underground nuclear weapons tests were conducted in Area 20. In addition, 1 nuclear test detection experiment and 3 Plowshare Program tests were conducted in this area.
Area 22—Area 22 occupies approximately 31 square miles in the southernmost portion of the NNSS and serves as the main entrance (Gate 100) to the NNSS. Before 1958, this area included Camp Desert Rock, a U.S. Army installation used for housing troops taking part in military exercises at the NNSS. After 1958, the camp was removed, with the exception of the Desert Rock Airport. The airport is currently operational, but is only used by those authorized by NNSA.
Area 23—Area 23 occupies approximately 5 square miles near the southeastern corner of the NNSS. It is the location of Mercury, the largest operational support complex on the NNSS. Mercury was established in 1951 and serves as the main administrative and industrial support center at the NNSS. Mercury is located approximately 5 miles from U.S. Route 95. The Area 23 landfill, used to dispose nonhazardous solid waste, is located west of Mercury.
Area 25—Area 25, the largest area on the NNSS, occupies approximately 254 square miles in the southwestern corner of the site and includes an inactive entrance gate to the NNSS. Portions of Area 25 are used by the military for training exercises. The U.S. Army Ballistic Research Laboratory conducts open-air and X-tunnel tests using depleted uranium in Area 25. Research sites within Area 25 include the Treatability Test Facility (inactive) and Bare Reactor Experiment Nevada Tower, a 1,527-foot tower used by a number of organizations for a wide variety of research (e.g., sonic booms, meteorology, gravity drop tests, satellite infrared imaging). Located roughly in the center of Area 25, Jackass Flats was the site of ground experiments for reactors, engines, and rocket stages as part of a program to develop nuclear reactors for use in the Nation's space program.
Area 26—Area 26 occupies approximately 21 square miles in the south-central part of the NNSS. The southern portions of this area were used for nuclear-powered ramjet engine experiments, known as Project Pluto.
Area 27—Area 27 occupies approximately 49 square miles in the south-central portion of the NNSS. The Joint Actinide Shock Physics Experimental Research Facility is located in Area 27. Area 27 was used for weapons assembly and staging.
Area 29—Area 29 occupies approximately 62 square miles on the west-central border of the NNSS and includes portions of Fortymile Canyon. It is used primarily for military training and exercises. No nuclear weapons tests were conducted in Area 29.
Area 30—Area 30 occupies approximately 59 square miles at the center of the western edge of the NNSS. Area 30 has rugged terrain and includes the northern reaches of Fortymile Canyon. It is used primarily for military training and exercises. Area 30 had limited use in support of the Nation's nuclear weapons testing program, but was the site of Project Buggy, an experiment in the Plowshare Program.

DoD = U.S. Department of Defense; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.

Source: DOE 1996c; DOE/NV 2000e.

2.1.1 Major Facilities

The NNSS provides a large area remote from the public at which a broad variety of research, experimentation, and training can be performed. Some of the activities conducted take advantage of the expanses of land at the NNSS. However, a comparatively small part of the NNSS is developed and has facilities that are routinely occupied or visited by NNSS personnel. Following is a list of the more-prominent facilities at the NNSS. The locations of these facilities are shown in Figure 2–2.

U1a Complex – The U1a Complex (formerly called the Lyner Complex) in Area 1 is an underground laboratory used for performing subcritical experiments (see text box) in support of the Stockpile Stewardship and Management Program. **Figure 2–3** shows the aboveground facilities at the U1a Complex. It consists of a series of underground alcoves and test chambers about 960 feet below the ground surface. Three vertical shafts connect to the underground tunnels to provide ventilation, as well as personnel, equipment, instrumentation, and utility access. At the surface are 27 support buildings and a mechanical hoist for accessing the belowground areas. Experiments with high explosives and special nuclear material, including dynamic plutonium experiments (see text box), are conducted in small alcoves mined into the sidewalls or floors of the underground tunnels (DOE/NV 2004b). A Large-Bore Powder Gun for use in conducting shock physics experiments is scheduled to be installed in an alcove of the U1a Complex in 2011.

Area 3 Radioactive Waste Management Site (RWMS) – The Area 3 RWMS consists of five disposal cells that contain waste and two unused disposal cells located in subsidence craters created by previous nuclear weapons tests. The approximately 120-acre site has been used for disposal of bulk and containerized low-level radioactive waste (LLW). The Area 3 RWMS is maintained in a standby condition and could be activated if necessary to dispose nonhazardous solid waste or particular, usually large-volume, LLW streams.

Big Explosives Experimental Facility (BEEF) – BEEF, located in Area 4, is an open-air hydrodynamic experimentation facility (see text box) where high-explosives-driven experiments are performed to provide data to support the Stockpile Stewardship and Management Program (DOE/NV 2005c). The facility consists of two earth-covered bunkers, a control bunker, a camera bunker, a gravel firing table, and other support facilities.

Subcritical Experiments

Subcritical experiments are performed using special nuclear material (for example, plutonium) in a manner that prevents it from achieving a nuclear explosion. Subcritical experiments are designed to improve knowledge of the dynamic properties of new or aged nuclear weapons parts and materials and to assess the effects of new manufacturing techniques on weapon performance. Subcritical experiments can vary any or all factors that influence criticality (mass, density, shape, volume, concentration, moderation, reflection, neutron absorption, enrichment, and interactions). Because there is no nuclear explosion, subcritical experiments are consistent with the U.S. nuclear testing moratorium.

Dynamic Plutonium Experiments

Dynamic plutonium experiments are designed to improve knowledge of plutonium material properties, including equation of state (an equation that expresses the relationship between temperature, pressure, and volume of a substance) and strength, over broad ranges of relevant pressures, temperatures, and time scales. They range from essentially static experiments to increasingly dynamic experiments. None of these experiments reaches nuclear criticality or involves a self-sustaining nuclear reaction.

Hydrodynamic Experiments

Hydrodynamic experiments are high-explosives-driven experiments to assess the performance and safety of nuclear weapons. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term "hydrodynamic." These experiments do not use special nuclear material (plutonium or enriched uranium), but are conducted using test assemblies that are representative of nuclear weapons.

Hydrodynamic experimentation is a central component in maintaining nuclear weapons design and assessment capability. It is coupled with high-performance computer modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear physics package of weapons.

Figure 2–3 Aboveground Facilities of the U1a Complex

Diagnostics equipment used to monitor explosions includes high-speed optics and x-ray radiography. Scientists conduct weapons physics experiments using explosives, pulsed laser power, and shaped charges. BEEF is certified to handle high-explosives loads up to 70,000 pounds. Materials used in explosives experiments may include beryllium and depleted uranium, among others.

Nonproliferation Test and Evaluation Complex (NPTEC) – NPTEC (previously called the Liquefied Gaseous Fuels Spill Test Facility and the Hazardous Materials [HAZMAT] Spill Center) supports experimentation using open-air releases of chemical and biological simulants to create realistic environments for experiments and training (see **Figure 2–4**). The main NPTEC facility has the means of releasing materials from stacks, a wind tunnel, or on spill pads. Experimental data are collected using video cameras, arrays of sensors, and meteorological instrumentation. NPTEC is in Area 5, but experiments using low-concentration chemical or biological simulant releases and portable release systems can be performed at various locations at the NNSS. Public and private users perform experiments at NPTEC to independently analyze and evaluate sensor systems to determine their operational characteristics before their transition from the developmental to the operational phase (DOE/NV 2005e).

Figure 2–4 Large-scale Release Experiment Under Way at the Nonproliferation Test and Evaluation Complex

Area 5 Radioactive Waste Management Complex (RWMC) – The Area 5 RWMC comprises about 740 acres, including about 160 acres of existing and proposed disposal cells for burial of LLW and mixed low-level radioactive waste. The Waste Examination Facility and Transuranic (TRU) Pad and TRU Pad Cover Building are also included in the Area 5 RWMC. Approximately 580 acres of land are available for future radioactive waste management facilities and disposal cells.

Control Point Complex – The Control Point Complex is located in Area 6 on the ridge between Yucca Flat and Frenchman Flat. The Control Point Complex consists of facilities to support testing and experiments in the forward areas of the NNSS (i.e., the experimental areas away from Mercury and areas of daily occupancy). It houses the command center used for nuclear tests and experiments (Control Point 1).

Device Assembly Facility (DAF) – DAF, in Area 6, is a collection of more than 30 heavy-steel-reinforced concrete buildings connected by a common corridor (see **Figure 2–5**). The entire 100,000-square-foot complex is covered by compacted earth. Operational buildings in DAF include five assembly cells, three assembly bays (one with a downdraft table and one with a glovebox), four high bays, and two radiography bays. Support buildings include five bunkers for staging nuclear components or high explosives, two shipping/receiving bays, three small vaults, two decontamination areas, two laboratories, and an administration building (DOE/NV 2004c). Operations at DAF include staging and preparing special nuclear material for transportation and preparation of dynamic plutonium experiments and other unique experiments. DAF is approved for nuclear explosives operations and special nuclear material assemblies. DAF is also the home of the Criticality Experiments Facility, which was transferred from Technical Area 18 at Los Alamos National Laboratory in New Mexico and includes critical assemblies and machines used to conduct criticality experiments and training. In addition, DAF provides nuclear weapons assembly and disassembly capabilities; a damaged nuclear weapon could be sent to DAF for disassembly.

Figure 2–5 Device Assembly Facility at the Nevada National Security Site

Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC) – RNCTEC, in Area 6, is a facility constructed on behalf of the U.S. Department of Homeland Security for analyzing and evaluating countermeasures against potential terrorist attacks using radiological and/or nuclear weapons. The facility consists of several venues that simulate various transportation-related facilities (see **Figure 2–6**) (DOE 2004f).

Area 6 Construction Facilities – The Area 6 Construction Facilities provide craft and logistical support to activities performed in the forward areas of the NNSS (i.e., the experimental areas away from Mercury and areas of daily occupancy). The Area 6 Construction Facilities are also home to the Atlas Facility, a pulsed-power machine used to investigate the properties of nonnuclear materials under extreme conditions. The Atlas Facility can be used to conduct dynamic experiments and produce hydrodynamic data to validate computer models of material response for weapons applications; it was last used for such purposes in 2006. Since 2007, it has been maintained in cold standby, meaning that it can be reactivated, but may require repair and maintenance actions to ready it for use.

Figure 2–6 Radiological/Nuclear Countermeasures Test and Evaluation Complex Provides Capabilities for Evaluating Transportation Monitoring Equipment

Dense Plasma Focus Facility – The Dense Plasma Focus Facility in Area 11 supports research that provides active interrogation (a process that uses an external radiation source to interrogate an unknown object and induce a response) of special nuclear material and calibration of nuclear detection equipment. The focus of this research is enhancement of national security, with the goal of improving capabilities of detecting a smuggled nuclear device or material. The dense plasma focus machines use mixtures of deuterium and tritium.

Area 12 Camp – The Area 12 Camp is generally maintained in a standby condition, but can be reactivated for special projects. Most recently, NNSA activated the Area 12 Camp for use as a training facility by the Office of Secure Transportation. The camp includes 200 dormitory rooms, a full-service cafeteria, weapons and ammunition storage, and support buildings. Office of Secure Transportation training and exercises occur on roadways in Area 12 and throughout the NNSS.

The Area 12 Camp also supports activities at the tunnel complexes in Area 12. NNSA and the Defense Threat Reduction Agency use the various tunnels at the NNSS to conduct experiments and training in support of hard/deeply buried target location and defeat, conventional munitions effects and demilitarization, and other experiments and testing. Additionally, tunnel complexes in the northern area of the NNSS support NNSA programmatic activities, including safe management of improvised nuclear devices, if needed.

Desert Rock Airstrip – Desert Rock Airstrip in Area 22 supports operations of aircraft up to the size of a C-130 (about the length of a Boeing 727-200, but with a much larger wingspan). The airstrip is closed to public carriers, but is used by NNSA and others approved by NNSA for transport of material and personnel to the NNSS.

Mercury – Mercury (formerly called Base Camp Mercury), in Area 23 north of the entrance to the NNSS, is equivalent to a small town. It provides office facilities, dormitories, a cafeteria, classrooms, and various other support facilities for the NNSS. The Homeland Security and Defense Applications Operations and Coordination Center is located in Mercury. This center provides critical information exchange during exercises or real-world events and incidents.

Joint Actinide Shock Physics Experimental Research Facility (JASPER) – JASPER, located in Area 27, houses a two-stage light-gas gun that is designed to propel a projectile into a target at extremely high velocities of up to 8 kilometers per second (see **Figure 2–7**). The JASPER gas gun is specifically designed to conduct research on plutonium and surrogate target materials. JASPER plays an integral role in the certification of the Nation's nuclear weapons stockpile by providing a means of generating and measuring data pertaining to the properties of materials (radioactive chemical elements) at high shock pressures, temperatures, and strain rates. These extreme laboratory conditions approximate those experienced in nuclear weapons. Data from the experiments are used to determine material equations of state (equations that express the relationship among temperature, pressure, and volume of a substance) and to validate computer models of material response for weapons applications. Experiment results are used for code refinement to provide better predictive capability and to ensure confidence in the U.S. nuclear stockpile.

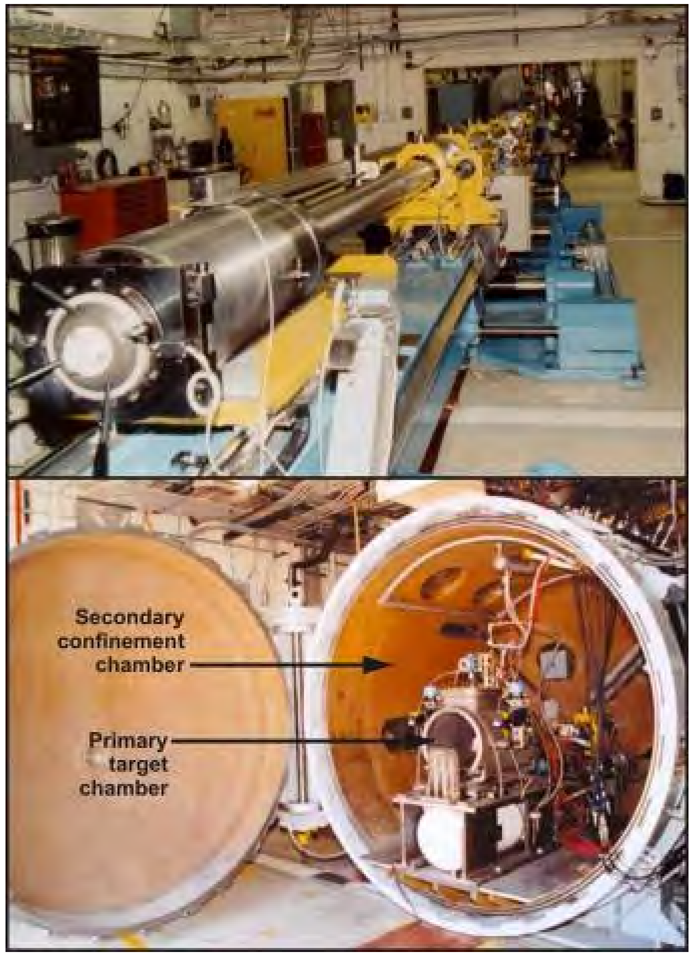


Figure 2–7 The Joint Actinide Shock Physics Experimental Research Facility Two-stage Gas Gun (top) and Target Chamber (bottom)

The nearby Baker Compound supports activities at JASPER, as well as other locations on the NNSS, by providing staging and storage necessary to support high-explosives experiments. The Baker Compound can receive shipments and safely store and transport explosives materials.

2.2 Remote Sensing Laboratory

RSL is located on 35 acres at Nellis Air Force Base in North Las Vegas, approximately 59 miles southeast of the nearest NNSS boundary (60 miles southeast of Gate 100, near Mercury, on the NNSS). RSL is adjacent to the Nellis Air Force Base runway and has seven permanent buildings. Radiological emergency response, the Aerial Measuring System, radiological sensor development and testing, Secure Systems Technologies, nuclear nonproliferation capabilities, and information and communication technologies are maintained at RSL.

2.3 North Las Vegas Facility

NLVF, located approximately 55 miles southeast of the nearest NNSS boundary (56 miles southeast of Gate 100, near Mercury, on the NNSS), comprises 29 buildings that support ongoing NNSS missions. The facility includes office buildings, a high bay, machine shop, laboratories, experimental facilities, and various other mission-support facilities. Among the NLVF buildings is the Nevada Support Facility, the location of most of the NNSA/NSO personnel offices.

2.4 Tonopah Test Range

The TTR, located approximately 12 miles north of the nearest NNSS boundary (73 miles north of Gate 100, near Mercury, on the NNSS), is a USAF facility. It consists of a 280-square-mile area north of the NNSS on the Nevada Test and Training Range. NNSA operations at the TTR are conducted pursuant to a land use permit from the USAF under the direction of Sandia National Laboratories and the NNSA Sandia Site Office. NNSA operations at the TTR include flight-testing of gravity weapons (bombs) and research, development, and evaluation of nuclear weapons components and delivery systems.

In its December 15, 2008, Record of Decision for the *Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (73 FR 77656), NNSA decided to implement a campaign mode of operations at the TTR, reducing its permitted operating area and upgrading its equipment. The "campaign mode of operations" would continue operations at the TTR but reduce permanent staff and conduct tests and experiments by deploying DOE and national laboratory personnel from other locations, as needed. The intent of reducing the footprint for the TTR and instituting a campaign mode of operations was to continue to meet mission and program requirements and reduce costs. After further review, NNSA, in consultation with the USAF, determined that maintaining the current footprint for the TTR would actually be the most cost-effective option. In addition, NNSA is reviewing implications of instituting a campaign mode of operations. The *Complex Transformation SPEIS* addresses operating with the existing TTR footprint in both campaign mode (Campaign Mode Operation of TTR, Option 2 – Campaign under existing Agreement) and in the existing (non-campaign) mode (No Action).

2.5 Overview of Changes Since the *1996 NTS EIS*

The *1996 NTS EIS* analysis of the potential environmental impacts was based on the physical site, facilities, and activities in existence or contemplated by DOE at the time the environmental impact statement was prepared. The primary missions at the NNSS and other sites in the state of Nevada remain unchanged; however, since the *1996 NTS EIS* was prepared, the administration of the sites and its physical boundaries and facilities have changed and there has been an evolution in the programs and activities conducted in support of the NNSA/NSO missions. This section provides an overview of these changes to bridge the gap between the sites, data, and analyses in the *1996 NTS EIS* and this *NNSS SWEIS*.

2.5.1 Administrative Changes

Creation of NNSA – Established by Congress through the National Nuclear Security Administration Act (Title XXXII of the National Defense Authorization Act for Fiscal Year 2000, Public Law [P.L.] 106-65), NNSA is a separately organized, semiautonomous agency within DOE. NNSA is responsible for the management and security of the Nation's nuclear weapons, certain nuclear nonproliferation programs, and naval reactor programs. It also responds to nuclear and radiological emergencies in the United States and abroad. Additionally, NNSA Federal agents provide safe, secure transportation of nuclear weapons and components and special nuclear material, as well as support for other missions related to national security. NNSA administers the NNSS, RSL, and NLVF and is a tenant on the USAF's TTR.

Transfer of Responsibility for Project Shoal and the Central Nevada Test Area – Responsibility for Project Shoal and Central Nevada Test Area environmental restoration sites was transferred to the DOE Office of Legacy Management in 2006. The DOE/NNSA NSO, Office of Environmental Management, completed cleanup at these sites before the transfer; the remaining work is associated with long-term surveillance (groundwater monitoring) and maintenance. These sites are no longer under NNSA control and, by agreement with the DOE Office of Legacy Management, are not further addressed in this *NNSS SWEIS*.

Renaming the Nevada Test Site – In order to better reflect the diversity of nuclear, energy, and homeland security activities conducted at the site, the former Nevada Test Site was renamed the Nevada National Security Site in 2010.

2.5.2 Physical Changes

The NNSS boundary and land withdrawal changes – The *1996 NTS EIS* identified various public land orders and withdrawals, as well as a Memorandum of Understanding between the USAF and the DOE Nevada Operations Office (the predecessor of NNSA/NSO) as the basis for the NNSS. The Military Lands Withdrawal Act of 1999 (P.L. 106-65) revoked Public Land Order 1662 in its entirety and legislatively withdrew the area that makes up the northwestern corner of the NNSS for exclusive DOE use. The Military Lands Withdrawal Act resulted in changes to the border around the northwestern corner of the NNSS, which was historically used for nuclear weapons testing under the Memorandum of Understanding. Figure 2–2 shows both the current NNSS boundary and the boundary as it existed in 1996.

Area 5 Land Transfer – As part of an April 1997 settlement agreement (which resulted in dismissal of *Nevada v. Pena* [CV-5-94-00576-PMP (RLH)] by the U.S. District Court in Nevada) between the State of Nevada and DOE, consultation with the U.S. Department of Interior was initiated concerning the status of existing land withdrawals with regard to LLW waste storage and disposal. This consultation process concluded with NNSA's formal acceptance of custody and control of the approximately 740 acres constituting the Area 5 RWMC in a land transfer action.

Yucca Mountain Management Agreement – As indicated in the fiscal year 2010, 2011, and 2012 budget requests, the Administration decided to cease funding and activities related to the development of a repository at Yucca Mountain, while developing alternative storage and disposal approaches for spent nuclear fuel (SNF) and high-level radioactive waste (HLW). Proposed actions associated with the former Yucca Mountain Project included construction, operation, monitoring, and eventual closure of a geologic repository at Yucca Mountain for disposal of SNF and HLW already in storage or projected to be generated at 72 commercial and 5 DOE sites across the United States. In 1994, the DOE Nevada Operations Office entered into a management agreement with the DOE Yucca Mountain Site Characterization Office for use of about 58,000 acres of the NNSS land for site characterization activities related to the former Yucca Mountain Project. Under the agreement, the Yucca Mountain Project was responsible for meeting the same environmental requirements that applied to the NNSS independent of, but in coordination with, the NNSS organizations. Until DOE receives appropriations for remediation of the infrastructure and buildings of the former Yucca Mountain Project, NNSA will maintain the infrastructure and buildings and provide security and support to DOE to remain compliant with Federal and state regulations pursuant to existing site permits. Upon receipt of appropriations, DOE will remediate lands and close the infrastructure and buildings, as required by law, regulations, and applicable agreements. At the completion of site closure, DOE will initiate a long-term surveillance program.

Notwithstanding the decision to terminate the Yucca Mountain Project, DOE remains committed to meeting its obligations to manage and ultimately dispose SNF and HLW. The Blue Ribbon Commission on America's Nuclear Future was established in March 2010 to conduct a comprehensive review of the back end of the fuel cycle and evaluate alternative approaches for meeting these obligations. The Blue Ribbon Commission will provide the opportunity for a meaningful dialogue on how best to address this issue and will produce a final report by January 2012 that will provide recommendations to Congress for developing a safe, long-term solution to managing the Nation's SNF and HLW. The Blue Ribbon Commission will address both commercial and DOE SNF and HLW (DOE 2010e).

Higher-than-expected growth in Clark and Nye Counties – The *1996 NTS EIS* projected that, in 2005, the populations of Clark and Nye Counties would be 1,380,920 and 38,516 persons, respectively (DOE 1996c). The actual populations in mid-2005 were 1,796,380 and 41,302 persons for Clark and Nye Counties, respectively (NSBDC 2010). These numbers represent an approximate 30 percent increase over projected values for Clark County and a 7 percent increase for Nye County. In Clark County, much of the growth occurred in the northwestern portion of the Las Vegas Valley, projecting toward the NNSS. This growth is potentially relevant to the analysis in this *NNSS SWEIS* because it creates a greater demand for resources and a larger number of people closer to the NNSS. Most recently, however, there has been a small decrease in population for both Clark and Nye Counties. Clark County decreased 0.8 percent from a high of 1,967,716 in mid-2008 to 1,952,040 in mid-2009. Nye County decreased 2.1 percent from a high of 47,370 in mid-2008 to 46,360 in mid-2009. The population used as the baseline for analysis in this *NNSS SWEIS* is provided in Chapter 4, Section 4.1.4. Information on the analysis of socioeconomic impacts is located in Chapter 5, Section 5.1.4.

As the populations in Clark and Nye Counties have increased, concern over water rights and water use has also increased. The Southern Nevada Water Authority has sought to purchase water rights in Lincoln, White Pine, and Nye Counties to meet the growing demand in Clark County. Nye County established the Nye County Water District in 2009 to manage, evaluate, and mitigate groundwater and surface-water resources in Nye County and to develop a long-range sustainability plan (Nye 2010). Water consumption at the NNSS has decreased compared with the 2,975 million gallons per year projected in the *1996 NTS EIS*. While NNSS water use has decreased, solar power generation facilities, described in Chapter 3 of this *NNSS SWEIS*, could increase the demand for water in the southern areas of the NNSS. Further information on NNSS water use and groundwater availability is presented in Chapter 4, "Affected Environment," Section 4.1.2.1 and Section 4.1.6.2. Potential impacts from implementation of alternatives are presented in Chapter 5, "Environmental Consequences," Section 5.1.2.1,and Section 5.1.6.2, and in Chapter 6, "Cumulative Impacts," Section 6.3.6.2.

2.5.3 Program and Activity Changes

A number of changes related to NNSS programs and activities have occurred since the *1996 NTS EIS* after conducting the appropriate level of NEPA review. The most important of these changes are described as follows.

- NNSA relocated its operational capabilities associated with Security Category I and II special nuclear material and the critical assembly machines from Technical Area 18 at Los Alamos National Laboratory in New Mexico to DAF at the NNSS. NNSA conducts nuclear criticality operations at DAF to enable personnel to gain knowledge and expertise in advanced nuclear technologies that support nuclear materials management and criticality safety, emergency response, nonproliferation, safeguards, arms control, and stockpile stewardship science.
- NNSA constructed BEEF, as planned and analyzed in the *1996 NTS EIS*, and subsequently modified it to perform explosives-driven, pulsed-power experiments.
- NNSA completed construction and modifications of JASPER to conduct experiments that provide data on the Nation's nuclear weapons stockpile.

- NNSA relocated the Atlas Facility from Los Alamos National Laboratory to the NNSS. The Atlas Facility was used to conduct pulsed-power experiments until it was placed in standby mode in 2007.
- NNSA identified the U12g Tunnel for the activities of the Improvised Nuclear Device Program. If an improvised nuclear device were to be recovered, the tunnel would be used to stage, assess, and safeguard the weapon.
- A Counterterrorism Support Program was instituted that makes use of site facilities for training and adds activities at NPTEC in Area 5 to address emergency response and counterterrorism training.
- RNCTEC was constructed in Area 6 to provide analysis and evaluation capability for radiological and nuclear detection devices.
- NNSA completed upgrades to the Aerial Operations Facility in Area 6, including construction of a runway and a broad variety of infrastructure improvements.
- A Solar Enterprise Zone was identified at the NNSS, as described in the *1996 NTS EIS*, but a proposed commercial solar facility was cancelled by the project proponent.
- The Nevada Desert Free Air Carbon Dioxide Enrichment Facility and the Mojave Global Change Facility were built in Area 5. These facilities are used to perform controlled manipulative experiments (e.g., analyses of carbon dioxide enrichment, increased precipitation, and evolving soil conditions on natural systems) under controlled conditions.
- The U.S. Military Development and Training in Tactics and Procedures for Counterterrorism Threats and National Security Defense Program was instituted to develop methods for combating adversaries in a desert environment. This activity could occur at any location on the NNSS.
- The Area 5 RWMC resumed acceptance of mixed low-level radioactive waste from approved offsite generators in 2006 after a restriction on the receipt of these wastes was lifted by the Nevada Division of Environmental Protection during the renewal of the interim status permit in December 2005.

Overview of Changes to the American Indian Writing Contributions Since the *1996 NTS EIS*

In 1995, the U.S. Department of Energy (DOE) invited the Consolidated Group of Tribes and Organizations (CGTO) to participate in the development of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*, to represent the American Indian perspective of the actions proposed and analyzed by DOE, and to consider and address the resources impacted. In response, the CGTO developed Appendix G for the *1996 NTS EIS* and provided italicized text for selected sections.

Appendix G and the italicized Final Environmental Impact Statement (EIS) text presented the American Indian perspective and recommended impact mitigation approaches for reducing potential impacts to Indian resources and other heritage values within the analyzed areas. American Indian involvement with the *1996 NTS EIS* and the development of Appendix G followed an American Indian Consultation Model[1] for government-to-government interactions among DOE and culturally affiliated American Indian Tribes. This was considered an innovative approach by Federal agencies at that time.

During the 2009 DOE Annual Tribal Meeting with the CGTO, DOE invited the CGTO to revisit the *1996 NTS EIS* and subsequent National Environmental Policy Act (NEPA) Supplemental Analyses, to review the current and proposed activities presented in this site-wide environmental impact statement (SWEIS), and to develop text that reflects the CGTO's perspective and current concerns. DOE also expanded the CGTO's involvement by providing us with the opportunity to write culturally appropriate text summarizing our perspective and concerns for every section and appendix within the SWEIS, as appropriate, in addition to writing Appendix C, "The American Indian Assesment of Resources and Alternatives Presented in the SWEIS".

See Appendix C for more details.

[1] *The American Indian Consultation Model was based on the Consultation Model produced for the DoD Legacy Project (Deloria and Stoffle 1994), which was modified by the American Indian Writers Subgroup (AIWS) for the CGTO and implemented during the development of the 1996 NTS EIS. This model was again revisited and implemented by the AIWS for the CGTO in the development of the SWEIS, and is presented in Section 10.2.1.*

CHAPTER 3
DESCRIPTION OF ALTERNATIVES

3.0 DESCRIPTION OF ALTERNATIVES

This chapter contains descriptions of the alternatives that are being evaluated by the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) for continued operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site), the Remote Sensing Laboratory (RSL) at Nellis Air Force Base, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration sites located on the Nevada Test and Training Range (formerly the Nellis Air Force Range). Three alternatives are addressed in this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS):* (1) the No Action Alternative, described in Section 3.1; (2) the Expanded Operations Alternative, described in Section 3.2; and (3) the Reduced Operations Alternative, described in Section 3.3. Other sections of this chapter include Section 3.4, Comparison of Potential Consequences of the Alternatives; Section 3.5, Alternatives Eliminated from Detailed Study; and Section 3.6, Identification of the Preferred Alternative. Appendix A of this *NNSS SWEIS* provides a more detailed description of the alternatives. Some of the descriptions include American Indian perspectives prepared by the American Indian Writers Subgroup (AIWS); the AIWS input is in text boxes identified with a Consolidated Group of Tribes and Organizations (CGTO) feather icon.

Descriptions of the alternatives are organized under three mission areas, each with two or more associated programs. These missions and their associated programs are: (1) the National Security/Defense Mission, which includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs; (2) the Environmental Management Mission, which includes the Waste Management and Environmental Restoration Programs; and (3) the Nondefense Mission, which includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The three alternatives include similar types of projects and activities, but differ primarily in operational intensity and facilities requirements. The No Action Alternative generally reflects the use of existing facilities to maintain operations at levels consistent with those experienced since 1996, as well as those anticipated by project-specific National Environmental Policy Act (NEPA) analyses and agency decisions made since 1996 (see Chapter 2, Section 2.5). The Expanded Operations Alternative differs from the No Action Alternative in that, for many activities, the levels of operation would be higher and a number of new facilities would be constructed to support these higher levels of operation. In addition, under the Expanded Operations Alternative, NNSA would modify NNSS land use zones to better reflect the kinds of activities that would be undertaken. Under the Reduced Operations Alternative, NNSA would conduct some activities at levels similar to those under the No Action Alternative, but for other activities, the levels of operations would be lower or would cease. NNSA would also make NNSS land use zone changes under the Reduced Operations Alternative that would limit most activities in the northwestern portion of the NNSS. Mission-related capabilities, projects, and programmatic activities are identified for each of the proposed alternatives in the following sections and **Table 3–1** summarizes the similarities and differences among the three alternatives evaluated in this site-wide environmental impact statement (SWEIS). Detailed descriptions of the activities included under each alternative are provided in Appendix A.

DOE/NNSA has at various times considered the possibility of supporting commercial solar projects at the NNSS. In this *NNSS SWEIS*, DOE/NNSA evaluates potential commercial solar power generation facilities under each of the three alternatives; however, there is no specific proposal for such a project at this time. For this reason, DOE/NNSA cannot be certain regarding the size of any solar power generation facility that might be constructed or whether DOE/NNSA support for such a facility might extend beyond providing access to land and certain infrastructure, such as providing partial funding. However, to ensure consideration of potential environmental impacts in a decision by DOE/NNSA to actively support development of one or more commercial solar power generation facilities at the NNSS, each alternative in this *NNSS SWEIS* addresses commercial-scale projects (the size of the potential facility varies with each alternative). DOE/NNSA selected the potential size of the generation facility under each alternative in terms of megawatts of generating capacity to provide a reasonable range of generating capacities, not to portray any actual project under consideration. If a commercial solar power project were proposed at the NNSS in the future, additional project-specific NEPA analysis would be required.

Detailed Description of Alternatives—American Indian Perspective

CGTO

The Consolidated Group of Tribes and Organizations (CGTO) is concerned about culturally perceived harmful land disturbing U.S. Department of Energy (DOE) actions described in this chapter and Appendix A of this site-wide environmental impact statement (SWEIS). We are concerned because these actions adversely impact the Nevada National Security Site (NNSS) land and offsite locations, which in turn affect the American Indian cultural landscape.

Since 1987, DOE has provided opportunities for representatives of the CGTO to visit portions of the NNSS and identify important places, spiritual trails, and landscapes of traditional and contemporary cultural significance.[1] These actions by DOE are considered positive steps towards fulfilling its trust responsibility through facilitating co-stewardship and land management strategies between DOE and the CGTO; however, this is an ongoing process.

To avert or minimize further impacts, the CGTO recommends DOE and the CGTO develop co-management strategies to help protect the land by implementing the following actions before continuing with these current or proposed activities:

- Identify those areas that have been disrespected and culturally damaged, so that balance can once again be restored.
- Avoid further harmful ground-disturbing activities
- Make mitigation of restorable areas a top priority
- Avert or minimize damage to geological formations important to the cultural and ecological landscape, songscapes and storyscapes
- Implement collaborative environmental restoration techniques that require minimal ground disturbing activities (see CGTO response to Section 3.1.2.2)
- Continue to pursue systematic consultations with American Indians so potentially impacted resources can be readily identified, alternative solutions discussed, and adverse impacts averted
- Provide American Indian people increased access to culturally significant areas so that we can use our knowledge, prayers, and traditions to effectively restore balance to the natural and spiritual harmony of the NNSS area and offsite locations

In addition, the CGTO recommends DOE and the CGTO continue to hold annual meetings to discuss current and proposed actions in greater depth, deliberate potential impacts, and consider and develop mutually acceptable mitigation measures. This is particularly necessary for those actions requiring additional National Environmental Policy Act (NEPA) analysis, including but not limited to solar and geothermal energy development.

In the view of Indian people, the ideal alternative would be to avoid any action that further disturbs the land and resources associated with the NNSS and the offsite locations.

We believe we have been created and placed on these lands. Because of our birth-right and strong ties to our ancestral land, the CGTO believes we have undeniable rights to interact with its precious resources, and a continuous obligation to protect it. The CGTO takes this responsibility very seriously and has developed our input for the alternatives presented throughout Chapter 3 so we may fulfill this obligation.

See Appendix C for more details.

[1] *Because this is a public document, the exact locations of these areas will not be revealed unless determined necessary during government-to-government consultation.*

Table 3–1 Comparison of Mission-Based Program Activities Under the Proposed Alternatives

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
National Security/Defense Mission		
Stockpile Stewardship and Management Program (see Sections 3.1.1.1, 3.2.1.1, and 3.3.1.1 of this chapter for additional information)		
Maintain readiness to conduct underground nuclear tests.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct up to 10 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 20 dynamic experiments per year within NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20.	Conduct up to 6 dynamic experiments per year at the NNSS; no dynamic or dynamic plutonium experiments or hydrodynamic tests would be conducted in Areas 19 or 20.
Conduct up to 20 conventional explosives experiments per year at BEEF and up to 10 per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 70,000 pounds TNT [2,4,6-trinitrotoluene]-equivalent of explosive charges; would also support Work for Others Program.	• Conduct up to 100 conventional explosives experiments per year within NNSS Areas 1, 2, 3, 4, 12, or 16 using up to 120,000 pounds TNT-equivalent of explosive charges (70,000 pounds at BEEF); would also support Work for Others Program. • Add second firing table and high-energy x-ray capability at BEEF. • Establish up to three areas at the NNSS for conducting explosive experiments with depleted uranium.	Conduct up to 10 conventional explosives experiments per year at BEEF using up to 70,000 pounds TNT-equivalent of explosive charges per year to directly support the Stockpile Stewardship and Management Program; no other explosives experiments would be conducted.
Conduct up to 12 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 10 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 36 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 24 experiments per year using the Large-Bore Powder Gun in Area 1.	Conduct up to 6 shock physics experiments per year at the NNSS using actinide targets at JASPER in Area 27 and up to 8 experiments per year using the Large-Bore Powder Gun in Area 1.
Conduct up to 500 criticality operations (experiments, training, and other operations) per year at the Criticality Experiment Facility at DAF in Area 6.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Maintain the Atlas Facility in standby with the capability to conduct up to 12 pulsed-power experiments per year.	Activate the Atlas Facility and conduct up to 24 pulsed-power experiments per year.	Decommission and disposition the Atlas Facility.
Conduct up to 600 plasma physics and fusion experiments each year at NLVF and 50 per year in NNSS Area 11.	Conduct up to 1,000 plasma physics and fusion experiments each year at NLVF and 650 per year in NNSS Area 11, increasing the size and complexity of such experiments.	Conduct up to 350 plasma physics and fusion experiments each year at NLVF and 25 per year in NNSS Area 11.
Conduct five drillback operations at NNSS over about a 10-year period.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Conduct Stockpile Management Program activities in NNSS Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, or 20, including:	Same as under the No Action Alternative, plus the following activities:	Stockpile Stewardship and Management Program activities would be the same as under the No Action Alternative, except activities would not be conducted in Areas 19 and 20 (such activities are not currently conducted in Areas 18, 29, and 30).
– Disposition damaged U.S. nuclear weapons.	– Stage nuclear devices pending dismantlement, modification/maintenance, and/or transportation to another location. – Dismantle up to 100 nuclear weapons per year. – Replace limited-life components of up to 360 nuclear devices and conduct associated maintenance activities. – Test weapons components for quality assurance under the Limited Life Component Exchange Program.	
– Stage special nuclear material, including nuclear weapon pits.	– Stage special nuclear material, including nuclear weapon pits, and transfer between 4 and 5 metric tons of special nuclear material from other parts of the DOE Complex for use in experiments at the NNSS.	
Conduct training for the Office of Secure Transportation up to six times per year at various locations on NNSS roads.	Same as the No Action Alternative, plus: Develop facilities in Area 17 and upgrade or construct new facilities in Area 6, 12, or 23 to support training for the Office of Secure Transportation.	Conduct training for the Office of Secure Transportation up to four times per year at various locations on NNSS roads.
Conduct the following stockpile stewardship operations at the TTR: – Conduct tests and experiments, including flight test operations for gravity weapons (i.e., bombs). – Conduct ground/air-launched rocket and missile operations. – Conduct impact testing. – Conduct passive testing of joint test assemblies and conventional weapons. – Conduct fuel-air explosives testing.	Same as under the No Action Alternative.	Same as under the No Action Alternative, except: – Discontinue ground/air launched-rocket and missile operations. – Discontinue fuel-air explosives testing at the TTR.
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs (see Sections 3.1.1.2, 3.2.1.2, and 3.3.1.3 of this chapter for more information)		
Provide support for the Nuclear Emergency Support Team, the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and Radiological Assistance Program. Most of this support is out of RSL.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct Aerial Measuring System activities from RSL base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct WMD emergency responder training at various NNSA/NSO venues.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Support DOE Emergency Communications Network.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Disposition improvised nuclear devices, deploy the NNSA and FBI Disposition and Disposition Forensic Programs to the NNSS for training and exercises or for an actual event, as needed.	Same as under the No Action Alternative, plus: Disposition radiological dispersion devices, as needed.	Same as under the No Action Alternative.
Integrate existing activities and primarily NNSS facilities to support U.S. efforts to control the spread of WMDs, particularly nuclear WMDs, including arms control, nonproliferation activities, nuclear forensics, and counterterrorism capabilities.	Same as under the No Action Alternative, plus: At the NNSS: • Construct laboratory space and other facilities for design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures as part of the Arms Control Treaty Verification Test Bed.[a] • Develop and construct new facilities to support a Nonproliferation Test Bed to simulate chemical and radiological processes that an adversary would clandestinely conduct.[a] • Construct an Urban Warfare Complex to support counterterrorism training.[a]	Same as under the No Action Alternative.
Work for Others Program (see Sections 3.1.1.3, 3.2.1.3 and 3.3.1.3 of this chapter for more information)		
Continue to conduct Work for Others Program activities in all appropriate zones on the NNSS, and at RSL and NLVF.	Same as under the No Action Alternative, except the NNSS land use zone designation for Area 15 would be changed from “Reserved Zone” to “Research, Test, and Experiment Zone.”	Same as under the No Action Alternative, except Work for Others Program activities, with the exception of military training and exercises, would not be conducted in Areas 18, 19, 20, 29, and 30 at the NNSS.
Host treaty verification activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Conduct nonproliferation projects and counterproliferation research and development at the NNSS, including:	Same as under the No Action Alternative.	Same as under the No Action Alternative, except:
– Conduct conventional weapons effects and other explosives experiments.		Discontinue conventional weapons effects and other Work for Others Program explosives experiments.
– Support development of capabilities to detect and defeat military assets in deeply buried hardened targets.		Discontinue development of capabilities to defeat military assets in deeply buried hardened targets.
– Conduct up to 20 controlled chemical and biological simulant release experiments per year (each experiment would include multiple releases by a variety of means, including explosive).		Discontinue projects requiring explosive releases of chemical or biological simulants.
– Support training, research and development of equipment, specialized munitions, and tactics related to counterterrorism.		Same as under the No Action Alternative.
Support the U.S. Department of Defense and other Federal agencies in developing counterterrorism capabilities.	Develop and construct new facilities to support counterterrorism training and research and development activities.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Conduct criticality experiments to support NASA's deep space power source development within the parameters for criticality experiments established under the Stockpile Stewardship and Management Program.	Same as under the No Action Alternative, plus: Support NASA's deep space power source development, including conducting experiments using existing boreholes at the NNSS to sequester emissions such as radionuclides.[a]	Same as under the No Action Alternative.
Host the use of various aerial platforms, such as airplanes and helicopters, at various locations at the NNSS for research and development, training, and exercises.	• Increase use of various aerial platforms, such as airplanes and helicopters, for research and development, training, and exercises, including constructing additional hangars, shops, and buildings at existing airports at the NNSS. • Conduct up to 3 underground and 12 open-air radioactive tracer experiments per year. • Host treaty verification activities, including development of a facility for simulating nuclear fuel cycle-related radionuclide release detection and characterization.[a] • Develop a facility for specialized explosive experiments and simulated manufacture to support high-explosives experiments.[a] • Support increased research and development of active interrogation equipment, methods, and training. • Develop new facilities to support research and development in radio frequency generation and infrasonic observations.[a] • Develop new facilities, including simulated clandestine laboratories, to support chemical and biological simulant experiments.[a]	Same as under the No Action Alternative.
Conduct Work for Others Program activities at the TTR, including robotics testing, smart transportation-related testing, smoke obscuration operations, infrared tests, and rocket development.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Management Mission		
Waste Management Program (see Sections 3.1.2.1, 3.2.2.1, and 3.3.2.1 of this chapter for more information)		
Dispose up to 15,000,000 cubic feet of LLW and 900,000 cubic feet of MLLW [b] in the Area 5 RWMC.	Dispose up to 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW at the Area 5 RWMC and Area 3 RWMS.	Same as under the No Action Alternative.
Maintain the Area 3 RWMS on standby.	Open the Area 3 RWMS for disposal of authorized and/or permitted waste.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Repackage onsite-generated MLLW.	Same as under the No Action Alternative, plus: Treat MLLW received from on- and offsite generators via macroencapsulation and microencapsulation, sorting/segregating, and bench-scale mercury amalgamation, as appropriate, and store at the Area 5 RWMC pending treatment or disposal.	Same as under the No Action Alternative.
Continue to use rail-to-truck transloading facilities outside of Nevada.	Increase rail-to-truck transloading, including use of facilities within Nevada.	Same as under the No Action Alternative.
Store onsite-generated TRU waste pending offsite disposal.	Same as under the No Action Alternative, except a larger volume of TRU waste would be generated by increased activities at NNSS facilities, such as JASPER.	Same as under the No Action Alternative, except smaller volumes of TRU waste would be generated by reduced operational levels at NNSS facilities, such as JASPER.
Store onsite-generated hazardous waste as needed at the Area 5 Hazardous Waste Storage Unit pending offsite treatment or disposal.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 11 Explosives Ordnance Disposal Unit.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 6 Hydrocarbon Landfill.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Operate the Area 23 Solid Waste Disposal Site and the U10c Solid Waste Disposal Site.	Same as under the No Action Alternative, plus: Larger volumes of solid sanitary waste would be generated by increased activity levels at the NNSS. Construct new sanitary solid waste disposal facilities as needed in Area 23 and develop a new solid waste disposal site in Area 25 to support environmental restoration activities.	Same as under the No Action Alternative, except lower volumes of solid sanitary waste would be generated by reduced activity levels at the NNSS.
Environmental Restoration Program (see Sections 3.1.2.2, 3.2.2.2, and 3.3.2.2 of this chapter for more information)		
Underground Test Area Project – Comply with the FFACO; monitor groundwater from existing wells; drill new characterization and monitoring wells; develop groundwater flow and transport models; and continue to evaluate closure strategies.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Soils Project – Identify and characterize areas with contaminated soils and perform corrective actions in compliance with the FFACO.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Industrial Sites Project – Identify, characterize, and remediate industrial sites under the FFACO and continue decontaminating and decommissioning facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Defense Threat Reduction Agency sites – In accordance with the FFACO, perform remediation activities at sites that are the responsibility of the Defense Threat Reduction Agency.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Execute the Borehole Management Program.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Nondefense Mission		
General Site Support and Infrastructure Program (see Sections 3.1.3.1, 3.2.3.1, and 3.3.3.1 of this chapter for more information)		
Conduct small projects to maintain the present capabilities of NNSA/NSO facilities in all areas of the NNSS and at NLVF, RSL, and the TTR. Maintain existing infrastructure, manage various permits and agreements, and provide security for the former Yucca Mountain site.	Same as under the No Action Alternative, plus: • Construct a new 85,000-square-foot multistory security building in Area 23. • Replace the NNSS 138-kilovolt electrical transmission system. • Expand cellular telecommunication system on the NNSS. • Reconfigure Mercury.	Same as under the No Action Alternative, except: No infrastructure projects would be conducted within Areas 18, 19, 20, 29, and 30 at the NNSS beyond maintaining mission-critical existing electrical and communication facilities and Well 8.
Conservation and Renewable Energy Program (see Sections 3.1.3.2, 3.2.3.2, and 3.3.3.2 of this chapter for more information)		
Continue to identify and implement energy conservation measures and renewable energy projects in compliance with applicable Executive orders and DOE orders.	Same as under the No Action Alternative, plus:	Same as under the No Action Alternative, except:
– Reduce energy intensity by 3 percent annually through the end of fiscal year 2015, for a total 30 percent reduction.		
– Reduce greenhouse gas emissions by 28 percent by fiscal year 2020.		
– Install advanced electric metering systems.		
– Obtain at least 7.5 percent of the NNSS annual electricity and thermal consumption from renewable energy sources.		
– Support development of a 240-megawatt commercial solar power generation facility in Area 25.[a]	• Modify NNSS land use zones to establish a 39,600-acre Renewable Energy Zone in Area 25 and support development of commercial solar power facilities in Area 25 with a maximum combined generating capacity of 1,000 megawatts.[a] • Construct a 5-megawatt photovoltaic solar power facility near the Area 6 Construction Facilities. • Support a Geothermal Energy demonstration project and Geothermal Research Center at the NNSS.[a]	Support development of a 100-megawatt commercial solar power generation facility in Area 25.[a]
– Reduce water use by 16 percent by 2015.		
– Maximize use of alternative fuels (e.g., E85 and biodiesel).		
– Ensure all new construction and renovation projects implement high-performance building goals.		

NO ACTION ALTERNATIVE	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Other Research and Development Programs (see Sections 3.1.3.3, 3.2.3.3, and 3.3.3.3 of this chapter for more information)		
Support the DOE National Environmental Research Park Program and other non-DOE/NNSA research and development activities in all areas of the NNSS.	Same as under the No Action Alternative.	National Environmental Research Park Program and other non–DOE/NNSA research and development activities would be conducted in all areas of the NNSS except Areas 18, 19, 20, 29, and 30.

BEEF = Big Explosives Experimental Facility; DAF = Device Assembly Facility; FBI = Federal Bureau of Investigation; FFACO = Federal Facilities Agreement and Consent Order; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NASA = National Aeronautics and Space Administration; NLVF = North Las Vegas Facility; NNSA = National Nuclear Security Administration; NNSA/NSO = National Nuclear Security Administration Nevada Site Office; NNSS = Nevada National Security Site; RSL = Remote Sensing Laboratory; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; SWEIS = site-wide environmental impact statement; TNT = 2,4,6-trinitrotoluene; TRU = transuranic; TTR = Tonopah Test Range; WMD = weapon of mass destruction.

[a] These potential projects have not reached a point of development to allow full analysis in this *NNSS SWEIS* and would be subject to additional NEPA analysis before NNSA would make any decision regarding implementation. At this point, NNSA has not received or solicited proposals for any commercial solar power generation projects.

[b] The actual permitted capacity of the Mixed Waste Disposal Unit (Cell 18) is 899,996 cubic feet.

3.1 No Action Alternative

As defined in this *NNSS SWEIS*, the No Action Alternative reflects the use of existing facilities and ongoing projects to maintain operations consistent with those experienced in recent years at the NNSS and offsite locations in Nevada. For each mission and its supporting programs, levels of operations for associated capabilities and projects were determined by evaluating historic operational values since 1996, such as the number of experiments performed at the Joint Actinide Shock Physics Experimental Research Facility (JASPER) or the U1a Complex; reasonable expectations for newer projects, such as the number of projected shots for the Large-Bore Powder Gun; or the nature and number of proposed activities, such as training undertaken for the Office of Secure Transportation. For example, in 2004 and 2006, NNSA conducted 8 experiments with plutonium at JASPER; for the No Action Alternative, NNSA is analyzing up to 12 such experiments at JASPER. The operational level for disposal operations of low-level radioactive waste (LLW) in the No Action Alternative is based on the volumes of LLW actually disposed during fiscal years (FY) 1997 through 2010. The No Action Alternative level of operations represents the baseline against which the other alternatives are compared. In the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (*1996 NTS EIS*) (DOE 1996c), NNSA identified land use zones in which certain categories of activities, such as nuclear, dynamic, and hydrodynamic experiments and other compatible defense and nondefense research and development and testing, would be conducted. The land use zones are used to manage activities at the NNSS to prevent interference among the various missions, programs, projects, and activities, but are not considered absolute descriptors of the range of activities that may occur in a particular zone. **Figure 3–1** depicts these land use zones and the major facilities at the NNSS that would continue under the No Action Alternative.

3.1.1 National Security/Defense Mission

Under the No Action Alternative, NNSA would continue to pursue the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

3.1.1.1 Stockpile Stewardship and Management Program

As part of its National Security/Defense Mission, NNSA is tasked with strengthening national security through the military application of nuclear energy and reducing the global threat from terrorism and weapons of mass destruction. The term "stockpile stewardship" refers to core competencies in activities associated with research, design, development, and testing of nuclear weapons components, as well as assessment and certification of their safety and reliability. NNSA's science-based Stockpile Stewardship and Management Program maintains and enhances the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test weapons, to meet national security requirements. Stockpile stewardship and management activities at NNSA facilities in Nevada are conducted via a variety of methods, including experiments involving special nuclear materials (SNM) and high explosives (either in combination or separately), shock physics, nuclear criticality, pulsed power, and plasma physics and nuclear fusion. Under the No Action Alternative, diagnostics and other instrumentation would be developed and used in related tests and experiments. In addition, NNSA would conduct drillback operations; support Office of Secure Transportation training; and, as necessary, disposition damaged U.S. nuclear weapons. Major facilities at the NNSS where stockpile stewardship and management activities would be performed include the Device Assembly Facility (DAF), the U1a Complex, the Big Explosives Experimental Facility (BEEF), and JASPER. NNSA also conducts stockpile stewardship and management activities at the TTR.

Special Nuclear Material (SNM)

SNM is (1) plutonium, uranium-233, uranium enriched in isotopes of uranium-233 or -235, or any other material that the U.S. Nuclear Regulatory Commission determines to be SNM, or (2) any material artificially enriched by any of these radioactive materials.

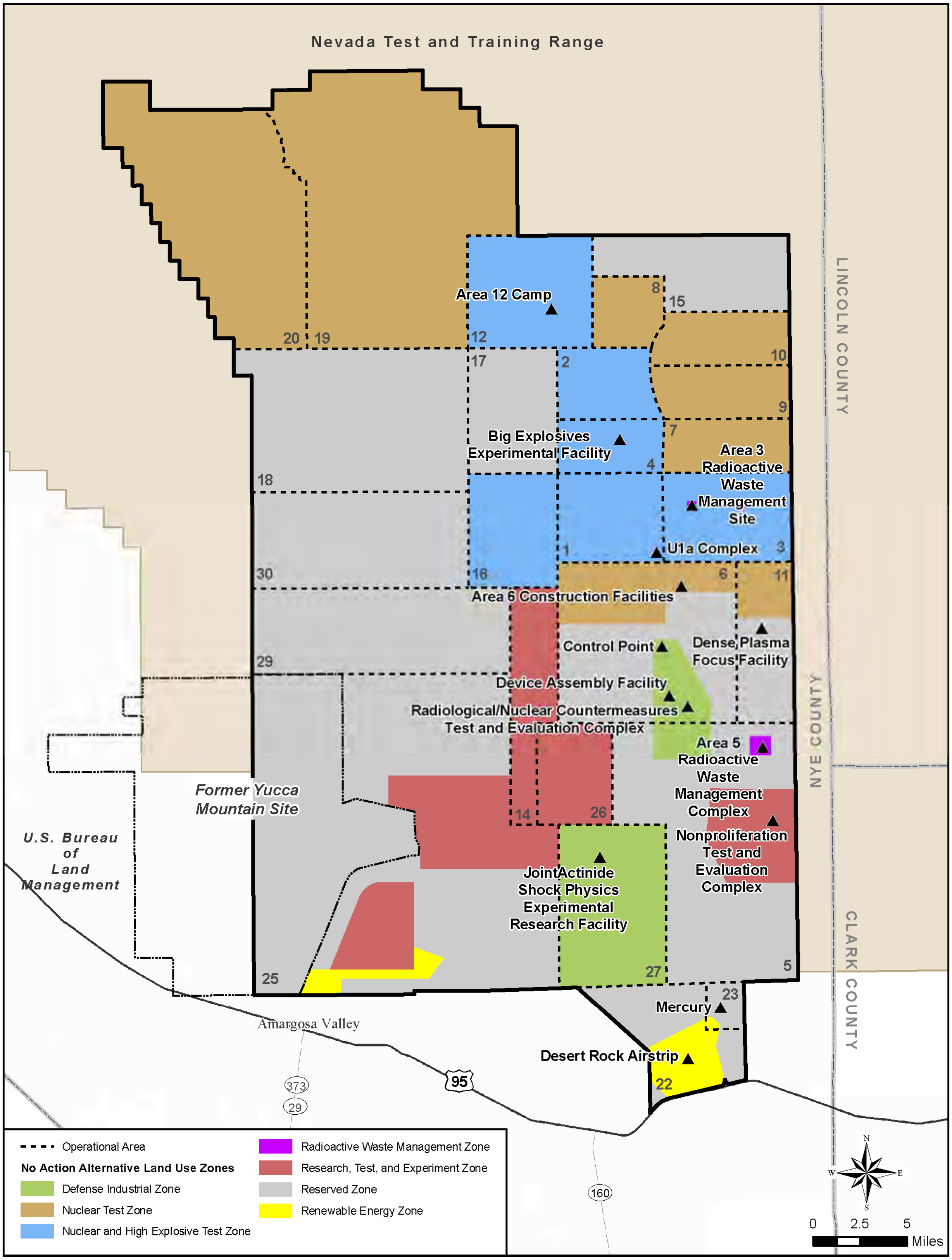


Figure 3–1 Nevada National Security Site Land Use Zones and Major Facilities Under the No Action Alternative

Stockpile stewardship and management activities would continue at NNSA facilities in Nevada under the conditions of the ongoing nuclear testing moratorium. These activities would emphasize science-based stockpile stewardship tests, experiments, and projects to maintain the safety and reliability of the nuclear weapons stockpile without underground nuclear testing. Historically, the primary mission of the NNSS was to conduct nuclear weapons tests. With the moratorium on nuclear testing that began in October 1992, this mission changed to maintaining a readiness to conduct nuclear tests. For this reason, the No Action Alternative includes those activities necessary to maintain the capability to conduct nuclear tests if so directed by the President. Readiness-to-test capabilities include maintaining the necessary infrastructure and, more importantly, exercising the research and engineering disciplines of the U.S. nuclear weapons program through an active science-based Stockpile Stewardship and Management Program at the NNSS to ensure the continued competence of its technical staff. As part of its readiness-to-test activities, NNSA would conduct training and exercises using various kinds of nuclear weapon simulators. A generic description of underground nuclear testing is provided in Appendix H.

In addition to maintaining the capability to conduct nuclear weapon tests and in support of stockpile stewardship and management at the NNSS, NNSA would perform a variety of national security activities under the No Action Alternative, consistent with the program goals and direction provide in Annex D of NNSA's *2011 Biennial Plan and Budget Assessment on the Modernization and Refurbishment of the Nuclear Security Complex* (NNSA 2010) and as summarized in the following descriptions. Detailed descriptions of these activities are included in Appendix A of this *NNSS SWEIS.*

Dynamic experiments – Dynamic experiments, including subcritical and hydrodynamic experiments, would be conducted in alcoves at the U1a Complex, in unused nuclear test vertical emplacement holes, or at other sites within the Nuclear Test and Nuclear and High Explosives Test Zones of the NNSS, which include all or parts of Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, and 20. Under the No Action Alternative, NNSA would conduct up to 10 dynamic tests per year. Over the next 10 years, a total of 5 dynamic experiments would be conducted in emplacement holes and cause new land disturbances.

Dynamic Experiments

Dynamic Plutonium Experiments

Dynamic plutonium experiments are designed to improve knowledge of plutonium material properties, including equation of state (an equation that expresses the relationship between temperature, pressure, and volume of a substance) and strength, over broad ranges of relevant pressures, temperatures, and time scales. They range from essentially static experiments to increasingly dynamic experiments. None of these experiments reaches nuclear criticality or involves a self-sustaining nuclear reaction.

Hydrodynamic Experiments

Hydrodynamic experiments are high-explosives-driven experiments to assess the performance and safety of nuclear weapons. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term "hydrodynamic." These experiments do not use special nuclear material (plutonium or enriched uranium), but are conducted using test assemblies that are representative of nuclear weapons.

Hydrodynamic experimentation is a central component in maintaining nuclear weapons design and assessment capability. It is coupled with high-performance computer modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear physics package of weapons.

Subcritical Experiment

Subcritical experiments are performed with special nuclear material (for example, plutonium) in a manner that prevents it from achieving a nuclear explosion. Subcritical experiments are designed to improve current knowledge of the dynamic properties of new or aged nuclear weapons parts and materials and to assess the effects of new manufacturing techniques on weapon performance. Subcritical experiments can vary any or all factors that influence criticality (mass, density, shape, volume, concentration, moderation, reflection, neutron absorption, enrichment, and interactions). Because there is no nuclear explosion, subcritical experiments are consistent with the U.S. nuclear testing moratorium.

Conventional explosives experiments – Experiments using explosives, including high explosives, would be conducted at BEEF and other locations at the NNSS. Experiments would use up to 70,000 pounds

TNT [2,4,6-trinitrotoluene]-equivalent of explosive charges. Experiments within the BEEF operational area could include potentially hazardous materials such as beryllium, depleted uranium, deuterium, and tritium. Up to 20 conventional explosives experiments would be conducted each year at BEEF and up to 10 per year would be conducted at other locations at the NNSS under the No Action Alternative. The experiments would consist of both open-air and contained (no release to the atmosphere) research and diagnostic experiments using a variety of explosive compounds. These totals do not include the dynamic experiments addressed in the preceding paragraph. Conventional explosives operations supporting other programs at the NNSS are described under those programs. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

Shock physics experiments – Shock physics experiments are a subset of dynamic experiments, but are not included in the dynamic experiments described above. There are two shock physics facilities at the NNSS: JASPER in Area 27, and the Large-Bore Powder Gun at the U1a Complex in Area 1. Up to 12 SNM experiments per year would be conducted at JASPER under the No Action Alternative. The Large-Bore Powder Gun would be operated in an alcove designed for conducting subcritical experiments and would be used to conduct up to 10 subcritical experiments per year using SNM. Additional operations would be conducted without SNM at each of these facilities.

Criticality experiments, training, and other activities – Under the No Action Alternative, NNSA would conduct up to 500 criticality operations within DAF each year for experiments, training, and other purposes in support of Stockpile Stewardship and Management and other programs.

Categories of Special Nuclear Material (SNM)
(Security Categories I, II, III, and IV)

The U.S. Department of Energy (DOE) uses a graded approach to provide SNM safeguards and security. Quantities of SNM stored at each DOE site are categorized into Security Categories I, II, III, and IV, with the greatest quantities included under Security Category I, and lesser quantities included in descending order under Security Categories II through IV.

Pulsed-power experiments – Under the No Action Alternative, the Atlas Facility would be maintained in a standby status with the capability to conduct up to 12 pulsed-power experiments per year.

Plasma physics and fusion experiments – Using the Dense Plasma Focus Machines located in Area 11 of the NNSS and at NLVF, NNSA would conduct plasma physics and fusion experiments to support the Stockpile Stewardship and Management and Work for Others Programs. In the future, fusion experiments at the NNSS and NLVF could support energy production research. Up to 650 plasma physics and fusion experiments would be conducted yearly under the No Action Alternative: 50 in Area 11 of the NNSS and 600 at NLVF.

Drillback operations – NNSA assumes that five drillback operations to obtain samples from former underground nuclear test cavities would take place under the No Action Alternative over the next 10 years. Each drillback operation would be conducted near a former underground nuclear test location and would disturb approximately 5 acres of land.

Stockpile management activities – Stockpile management activities are the hands-on, day-to-day functions and operations involved in maintaining an enduring nuclear weapons stockpile. The following stockpile management activities would be conducted by NNSA at the NNSS under the No Action Alternative:

- Disposition of damaged U.S. nuclear weapons, as needed
- Staging, assembly, and disassembly of nuclear devices "Staging" means to maintain programmatic material, such as nuclear devices, SNM, or other materials, in a safe and

Nuclear Weapon Pit

The pit is the central core of a nuclear weapon containing plutonium-239 and/or highly enriched uranium that undergoes fission when compressed by high explosives. The pit and the high explosive are known as the "primary" of a nuclear weapon.

secure manner until needed for a test, experiment, or other activity. Staging does not include maintaining material with no reasonable expectation of use in the foreseeable future.

- SNM staging, including nuclear weapon pits

Training for the Office of Secure Transportation – The NNSA Office of Secure Transportation would use existing NNSS infrastructure to conduct training and exercises up to six times per year to maintain and improve the skills of its agents to safely and securely transport nuclear weapons, weapons components, and SNM. Training includes practicing convoy activities on existing NNSS roads and adjacent off-road areas.

TTR operations – The primary mission of NNSA at the TTR is to ensure that U.S. nuclear weapons systems meet the highest standards of safety and reliability. In addition, Work for Others Program activities are conducted at the TTR. NNSA activities at the TTR are conducted under the conditions set forth in a land use permit from the U.S. Air Force (USAF) and are the responsibility of the Sandia Site Office, located in Albuquerque, New Mexico. Under the No Action Alternative, in support of stockpile stewardship and management, NNSA would use the TTR for the following activities:

- Tests and experiments, including flight tests for gravity weapons (bombs), would be conducted to ensure the compatibility of the hardware necessary for the interface between weapons and delivery systems and to assess weapon system functions in realistic delivery conditions. NNSA does not expect to use Category I/II SNM in flight tests.
- Impact testing would be conducted to test various parameters of a weapon while in flight or when dropped, including penetration of the ground surface. Weapons tested would include joint test assemblies and conventional and inert projectiles. Joint test assemblies are nuclear weapons with a portion of the nuclear package omitted, making them incapable of achieving the criticality required to produce a nuclear detonation. Impact tests would include the following:
  - Air-drop operations
  - Ground/air-launched rocket operations
  - Ground/air-launched missile operations
  - Compressed-air gun operations
  - Davis Gun operations
  - Fuel-air explosives operations
  - Open-air and underground detonation of explosives
  - Post-test procedures and recovery operations
- Passive tests would be conducted to check the systems in joint test assemblies and conventional weapons. Tests would also be conducted on behalf of nonproliferation research to develop equipment and techniques for determining whether other countries are using or developing nuclear capabilities. Passive tests would include the following:
  - Telemetry, microwave, and photometrics operations
  - Radar operations
  - Laser tracker operations
  - Radiographic operations
  - Electromagnetic radiation testing

Although not listed under the Work for Others description in Section 3.1.1.3, all of these Stockpile Stewardship and Management activities listed for the TTR are similar to activities that may be conducted as Work for Others at the TTR.

3.1.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

NNSA facilities in Nevada provide a broad support base for Nuclear Emergency Response Program activities, including a variety of areas and facilities that may be used for training and exercise activities. Under the No Action Alternative, NNSA would support the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs by conducting the activities summarized in the following discussion. Detailed descriptions of these activities are included in Appendix A of this *NNSS SWEIS.*

- Personnel and logistical support for the Nuclear Emergency Support Team would be provided at RSL. Nuclear Emergency Support Team activities would also occur at the NNSS and other locations.
- Support consequence management, including personnel and early-phase activities management, of the Federal Radiological Monitoring and Assessment Center (FRMAC).
- Fixed-wing and rotary-wing aircraft would be provided for emergency response and aerial mapping activities as part of the Aerial Measuring System. These assets are based at RSL and activities are conducted at various locations around the country.
- Personnel and logistical support would be provided to the Accident Response Group.
- Logistical support would be provided to the Radiological Assistance Program.
- Weapons of mass destruction emergency responder training would be provided.
- Equipment and technical support would be provided for the DOE-dedicated Emergency Communications Network.

Radiological Emergency Response Assets

Nuclear Emergency Support Team (NEST) – NEST provides specialized technical expertise in resolving nuclear or radiological terrorist incidents. The National Nuclear Security Administration (NNSA) assists the Federal Bureau of Investigation or U.S. Department of State with conducting, directing, and coordinating search and recovery operations for nuclear materials, weapons, or devices, and assists in identifying and deactivating an improvised nuclear device or a radiological dispersal device.

Aerial Measuring System (AMS) – AMS provides rapid response to radiological emergencies with helicopters and fixed-wing aircraft equipped to detect and measure radioactive material. In addition, AMS surveys U.S. Department of Energy (DOE) sites, participates in interagency exercises, and performs work for other Federal agencies. AMS can also provide detailed aerial photographs and multi-spectral imagery and analyses.

Radiological Assistance Program (RAP) – RAP is a first-response resource in assessing a radiological emergency, conducting the initial radiological assessment of the area of the emergency and providing assistance to minimize immediate radiation risks. RAP also provides emergency response training to first responders, and is involved in the Weapons of Mass Destruction First Responder Training Program. RAP is implemented on a regional basis, with eight Regional Coordinating Offices in the United States. The National Nuclear Security Administration Nevada Site Office (NNSA/NSO) is part of Region 7, headquartered in Oakland, California.

Federal Radiological Monitoring and Assessment Center (FRMAC) – FRMAC coordinates the efforts of 17 agencies to integrate the Federal response to a radiological emergency within the United States. DOE's responsibility is to set up and initially manage a FRMAC and NNSA provides the Consequence Management Response Team, which draws from NNSA Emergency Response Assets, including the RAP and AMS. The Phase 1 Consequence Management Response Team is deployed from among NNSA/NSO assets.

Accident Response Group (ARG) – ARG develops and maintains readiness to efficiently manage the resolution of accidents or significant incidents involving nuclear weapons that are in DOE's custody and support the U.S. Department of Defense for similar incidents with weapons in its custody. ARG's role in an emergency situation involving a nuclear weapon includes initial onsite assessment; performing evaluations for the safety and health of emergency response personnel, the public, and the environment; weapon recovery; and support for onsite radiological monitoring, analysis, and assessment.

- Disposition improvised nuclear devices as needed, including conducting forensics activities on such a device and its components under the Disposition Forensics Program. Training drills and exercises would be conducted at existing NNSS facilities to maintain a readiness capability for the Disposition and Disposition Forensics Programs.

  The NNSA and Federal Bureau of Investigation Disposition and Forensics Programs would deploy to the NNSS for periodic exercises and training or for an actual incident. All activities would take place in existing facilities at the NNSS.

> **Nuclear Forensics**
>
> Nuclear forensics is the analysis of nuclear materials recovered from either the capture of unused materials or the radioactive debris following a nuclear explosion. Nuclear forensics can contribute significantly to the identification of the sources of the materials and the industrial processes used to obtain them. In the case of an explosion, nuclear forensics can also reconstruct key features of the nuclear device (AAAS 2008).

- Nonproliferation- and counterterrorism-related activities would continue in the areas of arms control (see below), nonproliferation, and counterterrorism. Nonproliferation- and counterterrorism-related activities would provide scientific research and development, technology realization, process and procedure development, equipment testing and certification, and training. The kinds of activities that would be involved in supporting nonproliferation and counterterrorism include use of underground detonations of conventional explosives for seismic studies, releases of biological and chemical simulants, geological studies, and experiments to simulate radio frequencies resulting from various nuclear fuel cycle technologies. These activities are addressed in more detail in Section 3.1.1.3. Some activities supporting U.S. nonproliferation and counterterrorism efforts would occur at RSL and NLVF, but would primarily be conducted at the NNSS.

  Under the No Action Alternative, nonproliferation- and counterterrorism-related activities would integrate existing capabilities (i.e., research and development, training, nonproliferation tests and experiments, counterterrorism training, etc.) under an overall program. There would be no new facilities constructed, although existing buildings and other facilities would be modified to accommodate these activities.

Arms control – A key component of nonproliferation activities would be the use of existing facilities as part of an Arms Control Treaty Verification Test Bed dedicated to supporting U.S. arms control initiatives and commitments. This component would support design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures.

> **Test Bed**
>
> A test bed is an area that includes physical structures or designated terrain where tests and experiments are conducted. Test beds may be permanent facilities or temporary sites.

Nonproliferation – Facilities would be provided for Federal agencies to develop remote sensing equipment, methodologies, and training to support national and international nonproliferation programs. Under the No Action Alternative, NNSA would use existing facilities in Nevada to support research and development in the following areas:

- Safeguarding fissile materials in nations with nuclear weapons or nuclear industries
- Tightening export controls on technology with potential application to weapons of mass destruction
- Improving border protection by installing detectors for radioactive materials
- Inspecting commercial shipments for smuggled nuclear materials

Counterterrorism – NNSA would support research, development, and training associated with detecting and countering various types of improvised explosive devices, including those that are vehicle-borne. These activities would occur at BEEF, the Nonproliferation Test and Evaluation Complex, and other locations at the NNSS. Detonations of high explosives associated with counterterrorism-related activities would be conducted at various existing facilities and other locations on the NNSS. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

3.1.1.3 Work for Others Program

The Work for Others Program, hosted by NNSA, facilitates the use by other agencies and organizations of NNSA facilities and capabilities, such as BEEF, the Nonproliferation Test and Evaluation Complex, T-1 Training Area, and other areas of the NNSS as well as resources at RSL, NLVF, and the TTR. Under the No Action Alternative, NNSA would continue to host the projects of agencies such as the U.S. Department of Defense (DoD) and the U.S. Department of Homeland Security (DHS), as well as other Federal, state, and local government agencies and nongovernmental organizations, by conducting the activities summarized in the following discussion. Detailed descriptions of these activities are included in Appendix A of this *NNSS SWEIS.*

Treaty verification – NNSA would continue to host projects related to verification of compliance under a number of nuclear weapon-related treaties. The projects would range from hosting inspections by other nations to conducting research and development in the area of detecting violations of treaties by others.

Nonproliferation projects and counterproliferation research and development – NNSA would continue to provide support for the following types of activities by other agencies:

- Conventional weapons effects testing, including live drop and static detonations
- Development and demonstration of capabilities and technologies using conventional high explosives and other methods to effectively threaten and defeat military missions protected in tunnels and other deeply buried and hardened facilities
- Explosives experiments and other explosives operations using up to 2,000 pounds of explosives at various locations on the NNSS. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.
- Controlled experiments involving releases (including explosive releases) of biological and chemical simulants. Up to 20 controlled chemical and biological simulant release experiments (each experiment would consist of multiple releases) would be conducted yearly. More-detailed information regarding releases of chemicals and biological simulants is included in Appendix A, Section A.1.1.3.

Counterterrorism – NNSA would continue to support DoD and other Federal agencies in developing methods for engaging or neutralizing an adversary in a variety of topographical environments. In addition to ground-based operations, military operations would be conducted in the restricted air space above the NNSS and the TTR.

DHS and DoD would continue to use facilities at the NNSS to develop technology for homeland security applications. The NNSS would continue to provide land and infrastructure to support testing and evaluation of radiological and nuclear detection devices for use in transportation-related applications. DHS would continue to use the Radiological/Nuclear Countermeasures Test and Evaluation Complex

(RNCTEC), a facility constructed at the NNSS on behalf of DHS, as well as other NNSS land and infrastructure, to conduct its activities.

NNSA's Counterterrorism Operations Support Program would continue to support the Federal Emergency Management Agency's efforts to develop and implement national programs to enhance the capability of state and local agencies to respond to incidents involving weapons of mass destruction through coordinated training, equipment acquisition, technical assistance, and support for state and local exercise planning.

Military Training and Exercises – NNSA would continue to support DoD by providing land, airspace, and infrastructure for use by various branches of the military to conduct training and exercises. These activities range from small-scale, i.e., focused at a specific building or site, to large-scale exercises involving multiple air and/or ground assets with live-fire operations. These activities would include live fire of military munitions, including small arms, hand grenades, rocket-propelled grenades, etc. Military training and exercises may be conducted throughout the NNSS, but would be primarily conducted in the western portions, including Areas 18, 19, 20, 25 (northern portion), 29, and 30 to preclude interference with and from other NNSS activities. Military training and exercises are subject to all applicable regulatory requirements and to NNSA/NSO work authorization processes (NSO O 412.X1E, Real Estate/Operations Permit), which are designed to minimize hazards to workers, the environment, and NNSS physical assets.

Support for the U.S. National Aeronautics and Space Administration (NASA) – NNSA would conduct criticality experiments at DAF in support of NASA's efforts to develop power sources for use in future missions to Mars and similar deep space exploration.

Miscellaneous Work for Others Program activities – Customers would use aerial platforms for various purposes, including research and development, training and exercises, and deployment of sensors for detection of various items. These types of operations would use a variety of manned and unmanned aerial vehicles, including fixed-wing aircraft (airplanes) and helicopters.

Work for Others Program activities at the TTR – These activities would be similar to those addressed under the Stockpile Stewardship and Management Program, with the following additions:

- Robotics testing and development (handling, application, and recovery of hazardous [chemical] material)
- Smart transportation-related testing – preprogrammed/remote-controlled air and ground vehicles
- Smoke obscuration operations
- Infrared tests
- Rocket development, testing, and deployment

National Security/Defense Mission—American Indian Perspective

The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the National Security/Defense Mission are presented in the following text, which summarizes our views and applies to all aspects of this mission, including those pertaining to the Stockpile Stewardship and Management Program; the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program; and the Work for Others Program.

According to tribal elders, *"There is always going to be testing. Areas such as U1a that support underground testing are where the effects are evaluated. There are programs and facilities where stockpile stewardship and management activities are currently performed. The CGTO knows that the U.S. Department of Energy (DOE) maintains and conducts experiments and testing at various locations throughout the NNSS. We continue to be concerned about these activities and their impacts to the cultural landscape. Our involvement is essential to restoring and maintaining the balance to the land and its resources."*

The CGTO understands the National Security Defense Mission includes complying with the nuclear weapons test moratorium of 1992, which precludes new underground nuclear testing. We also understand DOE is required to maintain a state of readiness to resume nuclear tests if so directed by the President. The CGTO continues to be intensely opposed to all nuclear testing. In consideration of our ancestral ties and proximity to the land, the DOE, as a representative of the Federal government, must fulfill its trust responsibility by fully informing the CGTO and culturally affiliated tribal governments prior to any proposed testing activities. This step is vital to protecting the spiritual and physical health of our people by preparing for the desecration of our Holy Land and its resources.

The CGTO understands the fundamental intent of the Nonproliferation and Counterterrorism projects is to promote world peace and reduce the need to use the Nevada National Security Site (NNSS) and its offsite locations for nuclear weapons production, storage, assembly, and testing. However, the CGTO believes these activities may increase the number of weapons stored, disassembled, and disposed. These dangerous conditions may result in the land becoming angry and further contaminated, thereby impeding our ability to access important resources on our ancestral land.

The CGTO knows from past experience, but not formal study, that military training exercises and weaponry tests can adversely impact cultural resources. Military people move across the land on foot and in vehicles without either the time or the purpose to pay attention to delicate plants being disturbed, animals that are being dislocated, or the archaeological material and other important resources underfoot.

Often geographically distinctive power places or culturally sensitive areas are targeted without regard or knowledge of the significance to Indian people. Military exercises involving aircraft disrupt the harmony within the cultural landscape. Cultural resources may be damaged when conventional weapons are fired nearby. The environmental setting is disrupted from the noise and vibrations associated with these military operations and overflights. Noise and vibrations upset the spirituality and solitude of the area, negatively impacting songscapes and storyscapes. When the thoughts and focus are interrupted, the balance and well-being of the community as a whole become affected. Cultural resources are damaged when conventional weapons are fired nearby. Without a formal study, the exact impacts of military training exercises will not be fully understood. Thus, the CGTO again recommends adequate funds and time be provided for the CGTO to develop a guidance document. At a minimum, applicable CGTO representatives must obtain appropriate military clearances and access to pray for (talk to) and prepare the land and its resources prior to these military exercises.

See Appendix C for more details.

3.1.2 Environmental Management Mission

DOE/NNSA's Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Related activities under the No Action Alternative are described in the following sections. A more detailed description of these activities is provided in Appendix A, Section A.1.2.

Environmental Management Mission—American Indian Perspective

The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Environmental Management Mission are presented under the Waste Management Program (Section 3.1.2.1) and the Environmental Restoration Program (Section 3.1.2.2), as appropriate.

See Appendix C for more details.

3.1.2.1 Waste Management Program

The Waste Management Program would continue to store, treat, and/or dispose various wastes at the NNSS. These wastes include LLW, mixed low-level radioactive waste (MLLW), transuranic (TRU) waste, mixed TRU waste, hazardous waste, asbestos and polychlorinated biphenyl (PCB) wastes, hydrocarbon-contaminated soil and debris, and solid wastes such as construction debris or sanitary solid waste. Liquid nonhazardous wastes (such as sewage and other wastewater) are not included under the Waste Management Program, but are addressed in Section 3.1.3.1Infrastructure. All NNSA waste management activities operate in compliance with applicable regulatory requirements and DOE Orders. Waste management activities at NNSA sites in Nevada under the No Action Alternative would include the following:

LLW and MLLW management – LLW and MLLW from approved generators that meet the NNSS waste acceptance criteria would be accepted for disposal. The volume of LLW projected for disposal at the NNSS and analyzed under the No Action Alternative is based on the actual volume of LLW disposed at the NNSS during FY 1997 through FY 2010, and is estimated to total about 15,000,000 cubic feet. The volume of MLLW projected for disposal at the NNSS is based on the disposal capacity of the new Mixed Waste Disposal Unit, Cell 18,[1] and is estimated to total about 900,000 cubic feet.

NNSA would continue to manage onsite-generated MLLW by a combination of several options: (1) repackaging at the TRU Pad in the Area 5 Radioactive Waste Management Complex (RWMC), when appropriate; (2) storage at the TRU Pad or at a new MLLW storage facility, pending certification for disposal; and/or (3) shipment to a permitted facility, such as Energy Solutions in Clive, Utah, or Materials and Energy Corporation in Oak Ridge, Tennessee, for appropriate treatment. Onsite-generated MLLW treated at another location would be returned to the NNSS for disposal or would be disposed at a permitted commercial facility. Under the No Action Alternative, offsite-generated MLLW would not be treated at the NNSS.

Waste Definitions

Radioactive Waste – Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

Transuranic (TRU) Waste – Radioactive waste containing alpha particle-emitting radionuclides having an atomic number greater than 92 (the atomic number of uranium) and half-lives greater than 20 years, in concentrations greater than 100 nanocuries per gram.

Low-Level Radioactive Waste (LLW) – Radioactive waste not classified as high-level radioactive waste, TRU waste, spent fuel, or byproduct material as defined by Section 11e(2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided the concentration of TRU elements is less than 100 nanocuries per gram.

Hazardous Waste – A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 *Code of Federal Regulations* (CFR) 261.20-24 (ignitability, corrosivity, reactivity, and toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

Mixed Waste – Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste, such as mixed low-level radioactive waste (MLLW) and mixed TRU waste.

Waste Generator – An individual, facility, corporation, government agency, or other institution that produces waste material for certification, treatment, storage, or disposal.

Waste Acceptance Criteria – A document that establishes the National Nuclear Security Administration Nevada Site Office waste acceptance criteria. The document provides the requirements, terms, and conditions under which the Nevada National Security Site (NNSS) accepts LLW and MLLW for disposal. It includes requirements for the generator's waste certification program, characterization, traceability, waste form, packaging, and transfer. The criteria apply to radioactive waste received at the NNSS Area 3 Radioactive Waste Management Site and Area 5 Radioactive Waste Management Complex for storage or disposal.

[1] *The actual permitted volume of MLLW that may be disposed in Cell 18 is 899,996 cubic feet.*

Under the No Action Alternative, the Area 5 RWMC would continue to operate within the approximately 740-acre area set aside for waste management purposes. LLW disposal units would be developed, filled, and closed as needed, in compliance with applicable regulatory requirements and DOE Orders. NNSS- and offsite-generated LLW would be disposed within these units. The Nevada Division of Environmental Protection (NDEP) issued a Resource Conservation and Recovery Act (RCRA) Part B permit effective December 1, 2010, for a new MLLW disposal unit, Cell 18, at the Area 5 RWMC. Construction of the new MLLW disposal unit is complete and it began accepting MLLW for disposal in January 2011. Temporary storage operations for MLLW would continue at RCRA-permitted facilities. Support facilities within the Area 5 RWMC would continue to operate.

The Area 3 Radioactive Waste Management Site (RWMS) would be maintained in a standby status under the No Action Alternative.

Small quantities (a few cubic feet over the next 10 years) of LLW may be generated at RSL and NLVF. Normal operations at the TTR are not expected to generate radioactive waste, but environmental restoration activities at the TTR would generate LLW and possibly unknown quantities of TRU waste. These environmental restoration wastes would be disposed at appropriate disposal sites, such as the Area 5 RWMC and/or the Waste Isolation Pilot Plant, as appropriate.

TRU and mixed TRU waste management – TRU waste generated by NNSA operations or by the Environmental Restoration Program (an estimated 9,600 cubic feet over the next 10 years) would be safely stored at the TRU Pad, pending characterization and shipment either to the Waste Isolation Pilot Plant for disposal or to another facility, such Idaho National Laboratory, for processing before being sent to the Waste Isolation Pilot Plant.

TRU and mixed TRU wastes would not be generated at RSL, NLVF, or by NNSA Sandia Site Office activities at the TTR. However, an unknown quantity of TRU waste may be generated by environmental restoration projects at the TTR.

Hazardous waste management – DOE/NNSA activities would generate about 170,000 cubic feet of hazardous waste at the NNSS over the next 10 years under the No Action Alternative. The Hazardous Waste Storage Unit in Area 5 of the NNSS would continue to operate under a RCRA Part B permit issued by NDEP. Onsite-generated hazardous waste would be stored for up to 1 year prior to shipment to offsite treatment and/or disposal facilities.

RSL is a small-quantity generator of hazardous waste. Hazardous waste would continue to be accumulated at RSL for no more than 90 days and transferred off site to a permitted facility for treatment and/or disposal. Waste management field activities at RSL are provided by the USAF as landlord services under a Memorandum of Agreement. USAF personnel pick up and dispose miscellaneous laboratory and process equipment wastes under the terms of Nellis Air Force Base Plan 12 (Hazardous Waste Management Plan, October 2007).

NLVF is a conditionally exempt, small-quantity generator of hazardous waste. Hazardous waste would continue to be accumulated at NLVF and transferred off site to a commercially permitted facility for treatment and/or disposal.

Excess materials that may otherwise be considered hazardous waste would continue to be shipped off site for recycling. Excess materials are those that are no longer needed or are unusable but can be recycled.

The TTR is a small-quantity generator of hazardous waste. Hazardous wastes would continue to be accumulated at the TTR for no more than 180 days before being transferred off site to a permitted treatment, storage, and disposal facility.

Used oil from all NNSA/NSO facilities and the TTR would continue to be collected and sent off site for recycling.

Asbestos and PCB waste management – Friable, nonradioactive asbestos waste would continue to be disposed at the Area 23 Solid Waste Disposal Site and possibly at the U10c Solid Waste Disposal Site, pending permit modification and review. Radioactive asbestos waste would continue to be disposed at the Area 5 RWMC. Nonfriable asbestos waste would continue to be disposed at the U10c Solid Waste Disposal Site. Nonradioactive PCB wastes would be accumulated at the Hazardous Waste Storage Unit in Area 5, pending transfer to a permitted treatment and/or disposal facility. Radioactive PCB-contaminated waste meeting 40 *Code of Federal Regulations* (CFR) Part 761 requirements would continue to be disposed in the MLLW Disposal Unit at the Area 5 RWMC.

NNSA would continue to dispose asbestos and PCB wastes generated at the TTR at a permitted treatment, storage, and disposal facility.

Explosives waste treatment – NNSA would continue to treat old and/or unusable explosives by open-air detonation at the permitted Explosive Ordnance Disposal Unit in Area 11.

Hydrocarbon-contaminated soil and debris management – The Area 6 Hydrocarbon Solid Waste Disposal Site would continue to operate under a permit issued by NDEP and would accept onsite-generated soil and debris contaminated with hydrocarbons. The U10c Solid Waste Disposal Site would also continue to operate under a permit issued by NDEP and would accept limited amounts of onsite-generated soil and debris contaminated with hydrocarbons. Onsite-generated hydrocarbon-contaminated LLW would continue to be disposed in the Area 5 RWMC. During routine activities at RSL and NLVF, no hydrocarbon-contaminated waste would be generated. If an accidental release of hydrocarbon-contaminated waste were generated, it would be disposed at a facility permitted to receive such waste. The TTR would continue to dispose hydrocarbon-contaminated soil and debris at an offsite permitted/approved landfill.

Solid waste management – DOE/NNSA activities would generate about 9,400,000 cubic feet of sanitary solid waste and construction and demolition waste over the next 10 years. Sanitary solid waste would be disposed at existing permitted facilities at the NNSS. NNSA would continue to operate the Area 23 Solid Waste Disposal Site. This permitted facility accepts less than 20 tons of sanitary waste per day. Industrial solid waste and construction and demolition debris would continue to be disposed at the U10c Solid Waste Disposal Site. An estimated 370,000 cubic feet of sanitary solid waste would be sent off site for recycling, rather than landfill disposal during the next 10 years.

At RSL and NLVF, sanitary solid waste would continue to be disposed off site by a municipal waste service.

At the TTR, sanitary solid waste would continue to be disposed at the USAF sanitary waste landfill. Industrial solid waste such as construction or demolition debris would be disposed at a USAF landfill or shipped off site for disposal at the NNSS or a permitted commercial landfill.

Excess materials that are suitable for recycling or reuse, such as scrap metal, would be shipped off site for recycling.

Waste Management Program—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) understands current and proposed waste management activities identified under the Environmental Management Mission include high-hazard experiments involving nuclear material and high explosives, and storing nuclear materials. The CGTO is aware the Nevada National Security Site (NNSS) is used to store hazardous waste, to store and dispose of non-hazardous waste and debris, and to secure and dispose of low-level radioactive waste, low-level mixed radioactive waste (i.e., containing certain hazardous wastes). After many years, the CGTO continues to be greatly concerned with the ongoing storage and disposal of these various waste streams at the NNSS, and the transportation of radioactive waste to the NNSS from locations in Nevada and from other states.

We understand the radioactive and hazardous materials and waste described in this site-wide environmental impact statement (SWEIS) are defined in scientific terms and governed by state and federal regulations. For example, to scientists, radioactive rocks are well understood with specific quantifiable physical properties. Scientists believe if they manage radioactivity in a purely scientifically appropriate manner, they are largely safe for use and disposal at the NNSS, an area often perceived by non-Indian people as a barren wasteland.

Contrary to scientific belief, American Indian people hold complex traditional views of radioactivity, based upon the fundamental knowledge that all resources—including the rocks—are alive. Indian people believe radioactive rocks are very powerful.

We know that radioactive rocks can become "angry rocks" if they are removed without proper ceremony, used in a culturally inappropriate way, disposed of without ceremony, or placed where they do not want to be (Stoffle et al. 1989; Stoffle et al. 1990). The angry rock constitutes a threat that can neither be contained nor controlled by conventional means. It has the power to pollute food, medicine, and places, none of which can be used afterward by Indian people. Spiritual impacts are even more threatening, considering the angry rock would be transported along highways before ultimately being disposed of at the NNSS, affecting animal creation places, access to spiritual beings, and unsung human souls (Stoffle and Arnold 2003).

Indian knowledge and use of radioactive rocks, or minerals, in the western United States goes back for thousands of years. Areas with high concentrations of these minerals are called dead zones. Such areas contain places of power or energy and could only be visited or certain minerals used under the supervision of specially-trained Indian people, who are sometimes referred to in the English language as a shaman or medicine man (Stoffle and Arnold 2003). Therefore, the U.S. Department of Energy would benefit from this knowledge if applied correctly.

Continuing to transport the waste is detrimental to the public and the tribes. We are specifically concerned about the downtown transportation route. According to a tribal elder, "The springs are located there and, if contaminated, can seep into many other water sources and contaminate the people and the environment."

According to tribal elders, *"We are not sure how long Nellis and the NNSS have been designated as these types of facilities, and how much waste has been created, stored, and transported. This information is necessary for the CGTO to fully understand how significant the people and our resources may have been affected, and to prepare ceremonies, prayers, and culturally appropriate mitigation measures to attempt to restore balance. For example, Sunrise Mountain is a very significant mountain. Behind this mountain is an important cave, Gypsum Cave, which some Indian people fear but is highly respected. There are traditional stories surrounding this area. The mountain and the cave are both culturally significant. Caves are supposed to hold much power. They are supposed to interact with your mind. When you leave a cave, you are much more powerful."* Gypsum Cave, which is protected and monitored by culturally affiliated tribes and the Bureau of Land Management (BLM), is awaiting designation as a Traditional Cultural Property that may be impacted by the transportation of the waste.

See Appendix C for more details.

3.1.2.2 Environmental Restoration Program

Under the No Action Alternative, the NNSA Environmental Restoration Program would continue, in compliance with the most recent version of the Federal Facility Agreement and Consent Order (FFACO), to characterize, monitor, and remediate identified contaminated areas, facilities, soils, and groundwater. The Environmental Restoration Program is organized into three projects and supports the Defense Threat Reduction Agency in addressing its environmental restoration sites at the NNSS. The three projects are the Underground Test Area (UGTA) Project, Soils Project (includes contaminated soil sites from the TTR and the Nevada Test and Training Range), and the Industrial Sites Project (includes the Decontamination and Decommissioning Project and facilities to be remediated at the TTR and the NNSS described in the *1996 NTS EIS*). NNSA's Borehole Management Program work is executed by the Environmental Restoration Program. Activities that would be undertaken over the next 10 years by the Environmental

Restoration Program are described in the following discussion. More-detailed descriptions of these activities are provided in Appendix A of this *NNSS SWEIS*.

Underground Test Area – In compliance with the FFACO, the UGTA Project would continue to characterize and monitor groundwater from existing wells, drill new characterization wells, expand groundwater monitoring to include new wells, develop groundwater flow and transport models, and evaluate closure strategies including adaptive monitoring and management. Up to 50 new groundwater characterization and monitoring wells would be developed over the next 10 years. UGTA Project activities would occur on the NNSS, Nevada Test and Training Range, U.S. Bureau of Land Management land, and privately owned land as necessary and as permission is obtained.

Federal Facility Agreement and Consent Order

The Nevada National Security Site Environmental Restoration Program includes activities to comply with the Federal Facility Agreement and Consent Order, which was entered into in 1996 by the U.S. Department of Energy, the U.S. Department of Defense, and the State of Nevada. The Federal Facility Agreement and Consent Order provides a process for identifying sites having potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.

Soils Project – The Soils Project would continue to investigate and characterize soil sites (using in situ monitoring, air monitoring, surface-water contaminant transport studies, and soil sampling) and perform corrective actions, as necessary. The Soils Project would ensure that proper use restrictions are in place to implement site closure so that worker doses are below the applicable regulatory limits and are kept as low as reasonably achievable. The current closure strategy for soil project sites at the NNSS is based on a future industrial land use scenario with a 25-millirem-per-year exposure action level. Soils sites on the Nevada Test and Training Range, including the TTR, are expected to be remediated to an action level that is mutually agreed upon by DOE/NNSA, the USAF, and NDEP. The potential for stricter cleanup levels is addressed under the Expanded Operations Alternative. NNSA anticipates that all identified Soils Project sites will be closed under the FFACO by the end of 2022.

Industrial Sites Project – The Industrial Sites Project would continue its field program to identify, characterize, and remediate industrial sites under the FFACO and to decontaminate and decommission unneeded facilities. The majority of FFACO industrial sites have been closed. Remediation, decontamination, and decommissioning activities are projected to be complete by the end of 2018. Industrial Sites Project activities would continue at present levels, although alternate uses of remediated facilities may require revised cleanup levels.

Defense Threat Reduction Agency sites – The Defense Threat Reduction Agency sites are identified as part of the NNSA Environmental Restoration Program because their site activities are considered environmental remediation on the NNSS. However, the Defense Threat Reduction Agency is responsible for implementing and funding these activities in compliance with applicable agreements with NDEP. Surface-disturbing activities associated with these sites have been completed and environmental monitoring, such as water sampling, would continue.

Borehole Management Program – Under the No Action Alternative, NNSA would continue to plug unneeded boreholes on the NNSS. Based on the current schedule and known inventory of unneeded boreholes on the NNSS that need to be plugged, the Borehole Management Program would be complete by the end of 2013.

Environmental Restoration Program—American Indian Perspective

CGTO According to tribal elders, *"The Creator placed everything—the land, rocks, plants and animals-where they are for a purpose. However, now that the NNSS land is disturbed and has become upset, we must come up with the appropriate prayers and ceremonies to rebalance the land and its resources."*

The Consolidated Group of Tribes and Organizations (CGTO) views environmental restoration activities attributed to the Environmental Management Mission as a positive effort to rebalance the world as everything is connected. Individual restoration projects are insufficient alone but are starting points and should be considered as stages or steps in a comprehensive and complex spiritual and ecological restoration program. The CGTO's view coincides with the principles of holistic ecosystem management subscribed to by the public and many Federal agencies.

A key component to environmental restoration is revegetating the disturbed areas to resemble its original condition. According to tribal elders, *"Prior to re-vegetation efforts, we talk to the land to apologize for what has been done and to let it know what we plan to do. Then we ask the Creator for its help. We choose our seeds from the sweetest and/or best plants, and store them for the winter to dry. When the winter is over, we place the seeds in a moist towel or sock and allow the new plant to sprout. We then plant the sprouts in small containers with soil until they are strong enough to be transplanted into the ground. This is a long and delicate process, requiring patience and traditional ecological knowledge passed down from our ancestors. If the plants are struggling to grow, we tag them and move them to face the same direction as the Sun."*

The U.S. Department of Energy (DOE) would benefit from this unique knowledge to further enhance their re-vegetation efforts of disturbed sites. The CGTO knows DOE struggles with the success rates of the density and diversity of native plants during their re-vegetation efforts. A co-stewardship approach between the CGTO and DOE to collectively manage this land would enable DOE to enhance their re-vegetation efforts, thereby saving time, money, and resources.

In the 1996 *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* and in the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)*, the CGTO continued to express concerns about the removal of contaminated soils and the need for religious leaders to conduct balancing ceremonies and healing prayers at these disturbed locations. The CGTO recommended that tribal representatives provide information about the re-vegetation of a portion of the Double Tracks Site located on the Tonopah Test Range (TTR). The CGTO maintains our involvement is still necessary for the Double Tracks site as well as for the Clean Slates site located at TTR; however, we are awaiting DOE's approval to proceed. Because of the long lapse of time since the last visits, the CGTO believes it is necessary to revisit and reevaluate site conditions.

As stated earlier, the CGTO is supportive of restoring the environment. However, we are concerned about the future plans to decontaminate and decommission (D&D) some buildings that may have asbestos and other contamination, which will be released during the process. Specifically, the CGTO is concerned about potential impacts to the air, water, plants and animals. In addition, nearby tribes may be performing ceremonies and prayers and need to be notified so the D&D process does not negatively impact these important religious and traditional events through elevated noise, vibration levels and the spreading of dead air.[1]

Over the past 14 years, various initiatives have been undertaken to restore animal habitats and reintroducing certain animals, such as the desert big horn sheep near the southern portion of the Nevada National Security Site (NNSS), without participation from the CGTO. Modification of habitat or the restocking of animals is considered a highly sensitive religious act and requires participation from the CGTO. For these activities to be successful and to properly restore environmental balance, it is essential to have tribal representatives involved throughout this process.

In the 2008 *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2008 Draft NTS SA)*, the AIWS presented information regarding the successful reintroduction of a gray wolf in Idaho during the late 1970's, which was a collaborative effort between American Indians and a Federal agency. On the day of release, a Federal liaison unlatched the door of the cage and the animal scrambled out. Waiting for the wolf was an American Indian holy man in traditional regalia, sitting on a horse and watching. The wolf and man gazed at each other and the man spoke words welcoming the wolf back to its natural habitat. The wolf stood for a few more seconds and accepted the holy man's encouragement and blessing. Then the wolf turned and ran into the forest. Everyone present was very moved by the welcoming back ceremony. They knew that was the right thing to do. The CGTO believes collaborative projects such as this underscores the need for American Indian involvement whenever plant or animal species transplanted from other locations are reintroduced to the NNSS area.

We recommend conducting ethnographic studies involving the CGTO to better understand sites such as, but not limited to, Water Bottle Canyon, Timber Mountain, Shoshone Mountain, and other sites identified by the CGTO. Spiritual and ecological restoration assessments and projects require traditional management practices, and the involvement of tribal cultural experts to be successful. These specialists are needed to conduct initial assessments and site inventories, and to make recommendations for the next steps of the restoration effort. This strategy will result in the identification of resources, features, and other site aspects both tangible and intangible, that are in need of healing and restoration using culturally appropriate steps necessary to achieve restoration and balance.

[1] *Refer to Appendix C.2.8, Air Quality and Climate, for additional information regarding dead air.*

Environmental Restoration Program—American Indian Perspective (cont'd)

Clearly, members of the CGTO have unique and extensive experience in collaborative spiritual and ecological restoration. We have many examples of successful collaboration among our tribal members and Federal agencies. For example, the Big Warm Spring near the Duckwater Shoshone Tribe has been used throughout history for spiritual cleansing and healing. Young men are taken there during the "coming of age" to wash and cleanse themselves. In 2005, in collaboration with the U.S. Fish and Wildlife Service, the Duckwater Shoshone Tribe restored the Big Warm Spring to its original size and removed the non-native fish species. In 2007, during the final phase of the project, tribal members reintroduced the Railroad Valley Spring Fish to the Big Warm Spring in a culturally appropriate manner, successfully completing the spiritual and ecological restoration for this collaborative effort.

There are many potential spiritual and ecological restoration projects on the NNSS in need of attention, all with the goal of balancing the spiritual, cultural, and ecological inner-workings of those places. Based on CGTO experience with environmental restoration projects, we encourage DOE to implement a more aggressive collaborative environmental restoration program. Potential projects focusing on the protection of wildlife, plant resources, and geological features, include the following:

Restoration of Water Bottle Canyon

Water Bottle Canyon is a natural water tank area and an exceptional cultural site. Cultural resources include *pohs*, tanks, rock rings, tonal rocks, and traditional-use plants (Stoffle et al. 2006). Any activities impacting the side canyon or Water Bottle Canyon affect the rest of the gully system, which is connected through physical and spiritual flows. Presently, the spiritual aspects of Water Bottle Canyon are out of balance and require cultural interactions to bring the canyon back into balance. The cleaning of the *pohs* and tanks in this canyon system is one of several cultural practices needed to begin spiritual and ecological restoration. This project can reduce drought conditions, and provide spiritual, cultural, and ecological benefits to the area while concurrently fulfilling the primary goal of spiritual and ecological rebalancing. Implementation of this project will require the appropriate cultural experts to identify project sites, inventory and evaluate the conditions, resources, and features of the sites, and develop a compatible restoration plan. The Project would require overnight camping, annual activities, and monitoring of site conditions.

Evaluation of Traditional Cultural Property

During the DOE Annual Tribal Meeting with the CGTO, held September 12, 2009, the CGTO recommended the DOE support the nomination of a Traditional Cultural Property, previously identified as *Wunjikuda*. The CGTO recommended expanding the studies to enhance previously collected ethnographic information, and determining an appropriate title using knowledgeable tribal elders identified by the CGTO. The CGTO also recommended the DOE sponsor overnight camping activities at this site to elicit additional information from knowledgeable tribal representatives for the development and submittal of the nomination to the National Register of Historic Places.

Cleaning Pohs and Tanks

The *pohs* and tanks found throughout the NNSS require traditional attention and cultural management to function effectively. The *pohs* and tanks at Water Bottle Canyon and Ammonia Tanks, for example, are interrelated and tie each location to one another. Both sites are used to store water from the rain needed and used for ceremonial purposes to restore balance. American Indian people have Rain Shaman who have the ability to talk to all of the elements responsible for bringing water or rain to the land, people and animals. According to tribal elders, *"When the water arrives, it is approached with great respect and awakened very carefully when prayed upon. In appreciation and in honor of the water's return, the animals come back, the plants flourish and people will continue to pray and give thanks all ultimately leading to balance and restoration of the area."* Customarily, Indian people cleaned the *pohs* and tanks through the use of songs, stories and prayers. Cleaning of the *pohs* and tanks were followed by the Rain Shaman who called the rain.

By supporting the CGTO's proposed project to clean the *pohs* and tanks, DOE will reduce drought conditions and restore balance to the area. It will provide spiritual, cultural, and ecological benefits to the land and environment, thereby facilitating our obligation of spiritual and ecological rebalancing. Implementation of this project will require the appropriate cultural experts to identify project sites, to inventory and evaluate the conditions, resources, and features of the site, and to develop a culturally compatible restoration plan.

See Appendix C for more details.

3.1.3 Nondefense Mission

The Nondefense Mission generally includes those activities that are necessary to support mission-related programs, such as constructing and maintaining facilities, providing supplies and services, warehousing, and similar activities. Activities related to supply and conservation of energy, including renewable energy and other research and development projects, are included under the Nondefense Mission. Sections 3.1.4.1 and 3.1.4.2 describe Nondefense Mission activities that NNSA would undertake at its facilities in Nevada under the No Action Alternative. A more detailed description of these activities is included in Appendix A of this *NNSS SWEIS*.

3.1.3.1 General Site Support and Infrastructure Program

Like any large facility, the NNSS has a substantial infrastructure that provides all site-support services. Under the No Action Alternative, infrastructure-associated activities would continue, including projects such as repairs and replacements to maintain present facility capabilities. For instance, maintenance and repair projects include: repair Area 23 sewer main, remediate underground storage tanks, replace five roll-up doors, renovate and reactivate several water tanks, replace electric hot water heaters, install water tank security ladders, replace roofs on several buildings, and repair/maintain NNSS roadways.

In addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain site. NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain site.

Nondefense Mission—American Indian Perspective

There are a variety of current and proposed actions considered under the Nondefense Mission. Many of these are related to the Nevada National Security Site (NNSS) Environmental Research Park, which allows universities and other Federal agencies to conduct research. Other projects involve solar and geothermal energy development, and constructing the Nevada Desert Free-Air Carbon Dioxide Enrichment and the Mojave Global Change facilities proposed in Area 5. The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Nondefense Mission, including activities associated with the Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs, are summarized here.

Indian people view each proposed project under the Nondefense Mission as potentially impacting cultural resources. Non-Indian people unfamiliar with the importance of leaving cultural resources untouched may find and collect artifacts or remove plants that are significant to American Indian people. Construction of the proposed solar generating facility in Area 25 involves draining the Sun of its power unnaturally and making it weak. Construction also involves scraping the land, generating dust emissions, facilitating erosion, and impeding visual resources.

All landforms within the NNSS are highly sensitive to American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is central to the spiritual interaction between Indian people and their traditional lands. Visual resources may be negatively impacted if proposed solar and geothermal projects are pursued. The CGTO must be part of any future discussions of these projects due to potential impacts on visual resources that may impede traditional and cultural ceremonies.

Only Indian people know which places are appropriate for visits by non-Indian people and how to manage plants, animals, and soil samples so that these activities do not disrupt the land and its associated spirituality. Because of the potential effects on the environment and its resources from Nondefense Mission projects, the CGTO must become an integral part of site-specific studies and develop culturally appropriate text for future National Environmental Policy Act (NEPA) analyses, including environmental assessments and mitigation plans.

See Appendix C for more details.

Although they are part of NNSA's infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed under the Environmental Management Program, and proposed and potential renewable energy projects are addressed under the Conservation and Renewable Energy Program, rather than the General Site Support and Infrastructure Program.

3.1.3.2 Conservation and Renewable Energy Program

Under the No Action Alternative, NNSA would continue to identify and implement conservation measures and renewable energy projects in the following areas:

- Energy efficiency
- Renewable energy
- Water conservation
- Transportation/fleet management
- High-performance and sustainable buildings

Table 3–2 summarizes the NNSS Conservation and Renewable Energy Program.

Commercial solar power facility – Under the No Action Alternative, NNSA is evaluating a hypothetical 240-megawatt parabolic trough commercial solar power generation facility at the NNSS. NNSA has determined that the southwestern portion of Area 25 would be the only reasonable location on the NNSS for a commercial solar power generation facility. Area 25 includes an extensive area of suitable terrain for solar power generation facilities, has existing vehicular access from Highway 95 via Lathrop Wells Road and an existing 138-kilovolt transmission line, and is removed from national security-related activities on the NNSS that require limited access to uncleared individuals. Although it possesses many of the same attributes as Area 25, Area 22 is not being considered as a potential location for solar power development in this *NNSS SWEIS* because all current solar power technologies require the use of substantial amounts of water for cooling and other purposes and there would be potential impacts on Devil's Hole (see Chapter 5, Section 5.1.6) resulting from construction of any facility built in Area 22 that would draw water from the underlying hydrographic basin. Low-water-use renewable energy projects may be considered for Area 22 in the future.

The solar technologies that are most likely to be deployed at utility scale over the next 20 years are photovoltaic and concentrating solar power, such as parabolic trough, power tower, and dish engine (BLM/DOE 2010). It is unknown what technology would be used in a solar power generation facility at the NNSS, but the analysis in this *NNSS SWEIS* assumes a concentrating solar power parabolic trough facility, based on the prevalence of that technology in other operating, proposed, and potential solar energy projects in southern Nevada (see Table 6-2 in Chapter 6). It is estimated that a concentrating solar power facility using parabolic trough technology would require between 9 and 10 acres of land for each megawatt of generating capacity, based on the proposed Amargosa Farm Road Solar Project (BLM 2010c). This acre per megawatt of generating capacity is about double that used in the *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar Energy PEIS)* (DOE/BLM 2010), but is consistent with proposed parabolic trough solar power facilities currently being considered in southern Nevada. The assumptions used in the *Solar Energy PEIS* are shown in Section A.1.3.2, in Appendix A. Using the ratio scaled from the Amargosa Farm Road Solar Energy Project, the projected amount of power generated from a 2,400-acre Renewable Energy Zone on the NNSS is about 240 megawatts (West 2010). In addition, electrical transmission capacity would be required to integrate the electricity generated by a 240-megawatt facility onto the regional grid system. Approximately 10 miles of new 230-kilovolt transmission line (all of it from off the NNSS) are assumed to be required for purposes of this analysis. Valley Electric Association is in the process of upgrading parts of its 138-kilovolt transmission line system in Amargosa Valley to 230 kilovolts, and other entities are planning/proposing construction of 500-kilovolt transmission lines into Amargosa Valley (see Chapter 6, Section 6.2.4.4). Currently, there are no specific proposals for commercial-scale solar power-generating projects at the NNSS. Therefore, additional NEPA analysis would be required to identify, analyze, and document project-specific impacts if such a commercial-scale solar power generation facility were proposed.

Table 3–2 The National Nuclear Security Administration Conservation and Renewable Energy Program Under the No Action Alternative [a]

Energy Efficiency – The NNSA would improve energy efficiency and reduce greenhouse gas emissions at the NNSS by reducing energy intensity by 3 percent annually or a total of 30 percent through the end of FY 2015, relative to the 2003 baseline. Energy efficiency can be defined for a component or service as the amount of energy required in the production of that component or service; for example, the amount of steel that can be produced with one billion British thermal units of energy. Energy efficiency is improved when a given level of service is provided with reduced amounts of energy inputs, or services or products are increased for a given amount of energy input. Energy intensity is defined as the amount of energy used in producing a given level of output or activity. It is measured by the quantity of energy required to perform a particular activity (service), expressed as energy per unit of output or activity measure of service. Energy intensity measures energy consumption per gross square foot of building space, including industrial and laboratory facilities. Additional activities to improve energy efficiency would include the following: • Installing advanced electric metering systems to the maximum extent practicable at all NNSS buildings and implementing a centralized data collection, reporting, and management system • Using standardized operations and maintenance and measurement and verification protocols coupled with real-time information collection and centralized reporting capabilities to the extent practicable • Expediting improvement in the quality, consistency, and centralization of data collected and reported through the use of commercially available software • Reducing greenhouse gas emissions by 28 percent by FY 2020
Renewable Energy – NNSA would maximize installation of onsite renewable energy projects at the NNSS where technically and economically feasible. The initial goal would be to acquire at least 7.5 percent of the NNSS' annual electricity and thermal consumption from onsite renewable sources. In the event commercial-scale renewable energy projects are implemented at the NNSS (following additional National Environmental Policy Act analysis), NNSA would enter into an agreement with a commercial entity to construct a solar power-generating project at the NNSS with the provision that a portion of the electric power generated would be provided to meet NNSS electrical needs.
Water – In FY 2007, NNSA established a water production baseline (210.6 million gallons) in accordance with EO 13423 (72 FR 3919). Specific water consumption figures are not available by facility because the NNSS does not meter individual buildings. Instead, water production data were used to provide metrics in this area. NNSA sites began saving water through several conservation measures, including installation of WaterSense™ products, xeric landscaping, use of nonpotable water for dust suppression, and 4-day workweeks. NNSA established a goal of reducing potable water production at the NNSS by 2 percent a year, to 177 million gallons per year, by FY 2015. Water production was reduced by 18 percent in FY 2008 compared with the FY 2007 baseline, thereby exceeding the FY 2015 goal of 16 percent water reduction. Water production was reduced by an additional 8 percent in FY 2009. Efforts to identify water-saving projects and obtain funding to complete them are ongoing to ensure that the water production goals that have been met are maintained.
Transportation/Fleet Management – The current NNSA fleet has 540 alternative-fuel vehicles, equal to 96 percent of the covered fleet. NNSA requires that its fleet operate any alternative-fuel vehicles exclusively on alternative fuels to the maximum extent practicable. In FY 2007, NNSA constructed an E85 fuel station in Mercury and implemented a plan to promote the use of E85 fuel (an alcohol–fuel mixture that typically contains a mixture of up to 85 percent denatured fuel ethanol and gasoline or other hydrocarbon by volume). In FY 2007, the total actual usage of E85 was 135,141 gallons; the consumption for FY 2008 was 182,997 gallons, a 35 percent increase in usage. For every gallon of E85 used, 85 percent of the petroleum base fuel is reduced; for every gallon of B-20 Biodiesel used, 20 percent is reduced; and for every gallon of unleaded gasoline used, 10 percent is reduced. Biodiesel fuel is used in all equipment, with the exception of emergency generators and boilers, and is currently at the maximum possible usage level.
High-Performance Sustainable Buildings – NNSA would ensure that (1) all new construction and renovation projects implement design, construction, maintenance, and operation practices in support of the high-performance building goals of EO 13423 (72 FR 3919) and statutory requirements and (2) existing facilities' maintenance and operations practices meet the goals of EO 13423. NNSA/NSO's High-Performance Building Plan would also align with EO 13327 (69 FR 5897) and DOE Order 430.1B, *Real Property Asset Management*. At a minimum, the High-Performance Building Plan would include employment of integrated design principles, optimization of energy efficiency, use of renewable energy, protection and conservation of water, enhancement of indoor environmental quality, and reduction of environmental impacts of materials in accordance with the guiding principles of DOE Order 430.2B, Attachment 1, and construction related to EO 13423.

EO = Executive Order; FR = *Federal Register*; FY = fiscal year; NNSA = National Nuclear Security Administration; NSO = Nevada Site Office; NNSS = Nevada National Security Site.
[a] Goals and information as of December 2009.

3.1.3.3 Other Research and Development Programs

In 1992, the NNSS became the seventh unit of the DOE National Environmental Research Park Program. The NNSS program initially operated under a cooperative agreement between the DOE Nevada Operations Office (now NNSA/NSO); the University of Nevada, Reno; and the University of Nevada, Las Vegas, whereby the DOE Nevada Operations Office's Environmental Management Office provided financial assistance for scientific research projects unique to the Nevada National Environmental Research Park. In addition, scientific research projects conducted by parties other than those in the above-mentioned agreement could be conducted, but would be funded from sources other than NNSA.

Nevada National Security Site (NNSS) Environmental Research Facilities

The Nevada Desert Free-Air Carbon Dioxide Enrichment (FACE) Facility and Mojave Global Change Facility (MGCF) are two environmental research facilities located in Area 5 of the NNSS that conduct long-term environmental research. FACE is a state-of-the-art facility designed to study responses of an undisturbed desert ecosystem to increasing levels of atmospheric carbon dioxide. This facility is in a standby condition due to lack of funding.

MGCF was established in Area 5 of the NNSS to examine the impact of global climate change factors other than increased carbon dioxide (i.e., increasing summer monsoon rains, increased nitrogen deposition, and disturbance or destruction of the desert soil crust) on the Mojave Desert ecosystem.

3.2 Expanded Operations Alternative

The scope of the Expanded Operations Alternative in this SWEIS is defined to include the capabilities and projects described under the No Action Alternative, plus additional newly proposed capabilities and projects. These additional activities would include modification and/or expansion of existing facilities and construction of new facilities. In addition, some ongoing activities would be conducted more frequently than under the No Action Alternative. For each activity addressed in this section, the differences from the No Action Alternative are noted. In addition to changes in activities, under the Expanded Operations Alternative, there would be two changes in NNSS land use zones: (1) the designated use for Area 15 would be changed from "Reserved" to "Research, Test, and Experiment"; and (2) approximately 39,600 acres within Area 25 would be designated as a Renewable Energy Zone. These land use zone changes would clarify the availability of Area 15 as a location for conducting various types of research, tests, and experiments, and the Renewable Energy Zone would designate an area where NNSA/NSO has determined it would be reasonable and feasible to locate commercial renewable energy projects, as explained in Section 3.1.3.2 of this chapter. **Figure 3–2** depicts the land use zones and major facilities at the NNSS under the Expanded Operations Alternative.

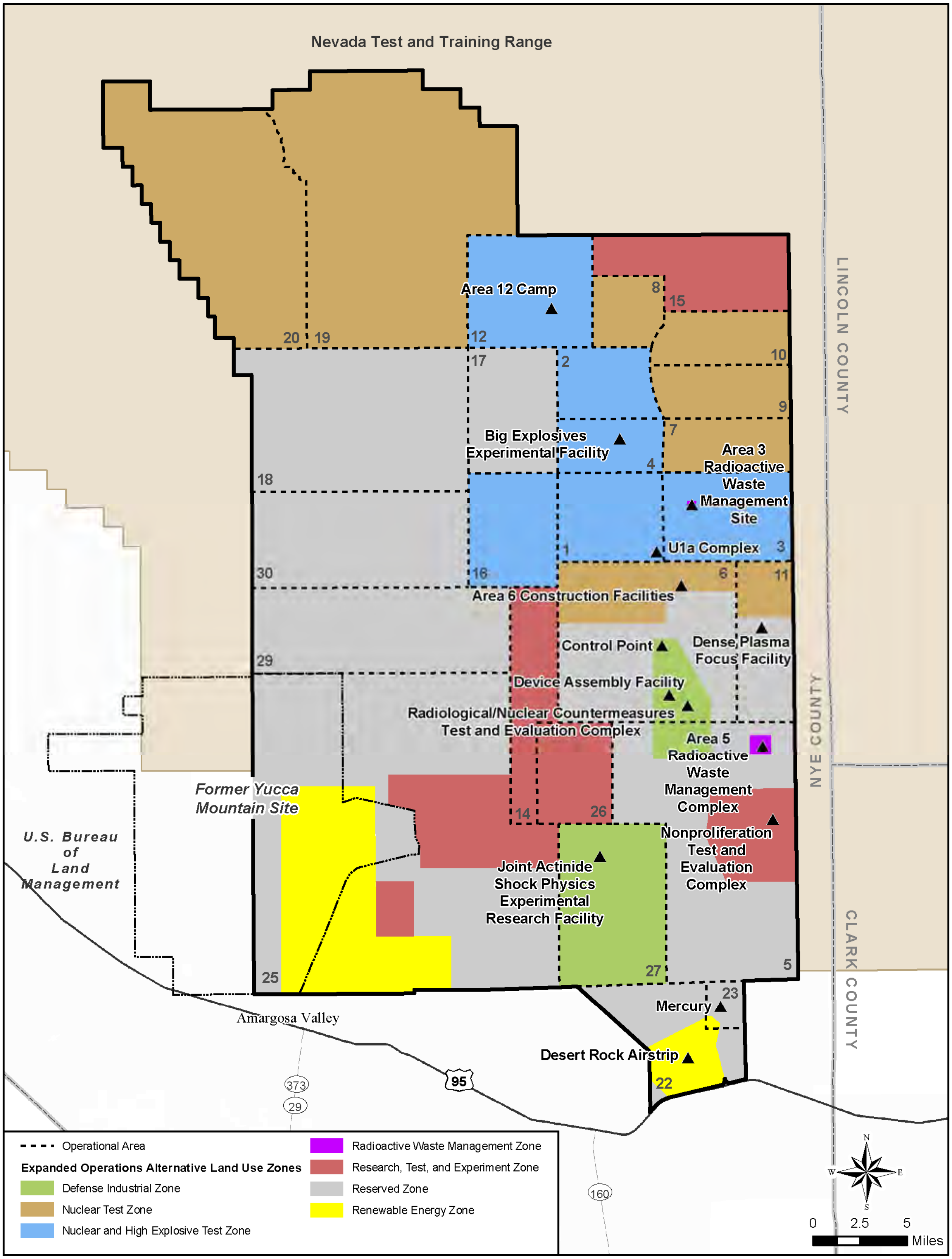


Figure 3–2 Nevada National Security Site Land Use Zones and Major Facilities Under the Expanded Operations Alternative

3.2.1 National Security/Defense Mission

Under the Expanded Operations Alternative, NNSA would pursue additional activities associated with the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

3.2.1.1 Stockpile Stewardship and Management Program

Stockpile Stewardship and Management Program activities are described in more detail in Appendix A of this *NNSS SWEIS*. Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Stockpile Stewardship and Management Program projects and activities:

- Maintenance of readiness to conduct an underground nuclear test (A generic description of underground nuclear testing is provided in Appendix H.)
- Criticality experiments in DAF
- Drillback operations
- Disposition of damaged U.S. nuclear weapons
- Stockpile stewardship and management activities at the TTR

Stockpile stewardship and management activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Dynamic experiments – NNSA would conduct up to 20 dynamic experiments per year. Over the next 10 years, a total of 5 dynamic experiments would be conducted in emplacement holes and cause new land disturbances.

Conventional explosive experiments at BEEF and other locations in the Nuclear and High Explosives Test Zone – NNSA would conduct up to 100 explosives experiments per year. NNSA would add a second firing table and ancillary features within the already developed area at BEEF, and would develop and test for proof-of-concept a high-energy x-ray capability at BEEF. Following successful testing, the new x-ray system would be moved to the U1a Complex for operational use.

In addition to explosives experiments at BEEF (limited to 70,000 pounds TNT-equivalent based on facility design), at the request of the Defense Threat Reduction Agency, NNSA would support experiments using up to 120,000 pounds TNT-equivalent of explosives at various locations other than BEEF within the Nuclear and High Explosives Test Zone at the NNSS. These detonations would be conducted both underground and in the open air. Conventional explosives operations supporting other programs at the NNSS are described under those programs. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

NNSA would establish one or more areas dedicated to conducting explosives experiments with depleted uranium. Up to three depleted uranium experiment areas, each about 40 acres in size, may be established in Areas 2, 4, 12, or 16. An annual maximum of 4,000 pounds of depleted uranium and 12,000 pounds of explosives (TNT-equivalent) would be used to conduct up to 20 of these experiments per year.

Shock physics experiments – NNSA would make the shock physics experimental facilities available for academic and other research on a no-conflict basis and would increase the number of experiments with actinide materials up to 36 per year at JASPER and 24 at the Large-Bore Powder Gun.

Pulsed-power experiments – The Atlas Facility would be activated, and up to 24 pulsed-power experiments per year would be conducted.

Fusion experiments at the NNSS and NLVF – New experimental uses would be pursued for the Dense Plasma Focus Machines that require deuterium-deuterium, deuterium-tritium, and tritium-tritium fusion and pulsed x-ray production. These experiments would require a much larger capacitive energy storage bank than the one currently in use at the Area 11 facility. To facilitate the new uses for the Dense Plasma Focus Machine currently located in Area 11 of the NNSS, it would be relocated to an existing building in Area 6 of the NNSS. Following the relocation, the Area 11 facility would be placed in standby. NNSA would conduct up to 1,650 plasma physics and fusion experiments per year: 1,000 would use the Dense Plasma Focus Machine at NLVF, and 650 would use the machine in Area 11 (or Area 6 if it were moved).

Stockpile management activities – NNSA would conduct nuclear explosives operations at the NNSS in association with conducting an underground nuclear test, if so directed by the President. In addition, under the Expanded Operations Alternative, NNSA would conduct the following activities:

- Stage (i.e., maintain programmatic material, such as SNM, or other materials, in a safe and secure manner until needed in a test, experiment, or other activity; staging does not include maintaining material with no reasonable expectation of use in the foreseeable future) nuclear devices pending disassembly, modification/maintenance, and/or transportation to another location
- Conduct dismantlement of select weapons or weapon systems to aid the United States in meeting its commitment to reduce its nuclear weapons stockpile (weapons shipments to the NNSS under this activity would not exceed 100 per year)
- Modify and maintain nuclear devices at DAF, including replacing limited-life components in selected nuclear weapons systems (weapons shipments to the NNSS under this activity would not exceed 360 per year)
- Test weapons components for quality assurance purposes at DAF

SNM Staging, including pits – NNSA would continue to stage SNM at appropriate facilities on the NNSS. SNM would be relocated from other DOE/NNSA sites. For example, the following materials would be moved to the NNSS: up to 4 metric tons of SNM currently part of the Zero Power Physics Reactor Program at Idaho National Laboratory (for use in criticality experiments); about 200 kilograms of global security SNM currently stored at Lawrence Livermore National Laboratory (for use in detector development and as radiation test objects); 2 kilograms of uranium-233 currently stored at Los Alamos National Laboratory (associated with test readiness); and 500 kilograms of highly enriched uranium, depleted uranium, and uranium stored at Lawrence Livermore National Laboratory (associated with criticality safety). In addition, NNSA would stage weapon pits at DAF, pending their transport to the Pantex Plant in Texas or another appropriate location.

Training for the Office of Secure Transportation – In addition to hosting training and exercises on NNSS roads, NNSA would construct new facilities in Area 17 to support Office of Secure Transportation training programs. The new facilities would occupy approximately 10,000 acres. A total of about 25 miles of roads and fire breaks would be developed surrounding active training areas and between individual training venues. Potable water would be obtained from an existing well approximately 4.5 miles away, requiring construction of a water pipeline. An electrical distribution line would also be constructed to extend electrical service from the vicinity of the well to the new facilities. Main access to the complex would be from the Tippipah Highway.

Facilities would be expanded in the 12 Camp (Area 12), Area 6 Control Point, or Mercury (Area 23), and maintenance and administrative buildings and a dormitory would be constructed to support training operations. These facilities would also be available to other NNSS customers when not in use by the Office of Secure Transportation.

These new and expanded facilities projects are conceptual at this time and would require an appropriate level of NEPA analysis before they could be implemented.

3.2.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program projects and activities are described in detail in Appendix A of this *NNSS SWEIS*. Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program projects and activities:

- Support for the Nuclear Emergency Support Team
- Consequence management support for FRMAC, the Aerial Measuring System, Accident Response Group, and Radiological Assistance Program
- Training for weapons of mass destruction emergency responders
- Equipment provision and technical support for the DOE-dedicated Emergency Communications Network

Nuclear emergency response, nonproliferation, and counterterrorism activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Disposition of improvised nuclear devices on an as-needed basis – In addition to improvised nuclear devices, radiological dispersion devices would be dispositioned on an as-needed basis at the NNSS under the Expanded Operations Alternative.

Nonproliferation- and counterterrorism-related activities – NNSA nonproliferation- and counterterrorism-related activities would include four related areas: arms control, nonproliferation, nuclear forensics, and counterterrorism. Although the purpose of nonproliferation- and counterterrorism-related activities would be the same as that under the No Action Alternative, new nonproliferation and counterterrorism facilities, described below, would be constructed at various locations on the NNSS to undertake enhanced activities. Because the new nonproliferation and counterterrorism facilities (Arms Control Treaty Verification Test Bed, nonproliferation test bed, and Urban Warfare Complex) are still conceptual in nature and their locations are unknown, they are not fully analyzed in this SWEIS, and an appropriate level of NEPA analysis would be required before they could be implemented.

Arms control – The Arms Control Treaty Verification Test Bed would require construction of both indoor and outdoor laboratory space and test areas for design and certification of treaty verification technologies, training of inspectors, and development of arms control-related confidence-building measures. These facilities would be sited at various locations at the NNSS, and construction of new facilities would require a total of about 100 acres of land. A new facility for data fusion, analysis, and visualization would be constructed. The new building would have approximately 10,000 square feet of floor space and would be integrated with a building constructed to house other Arms Control Treaty Verification functions.

Nonproliferation – A Nonproliferation Test Bed would require construction of a new facility for simulations of chemical and radiological processes that could be conducted clandestinely by an adversary.

Counterterrorism – In addition to counterterrorism training at existing facilities, an Urban Warfare Complex would be constructed at the NNSS. This complex would include full-scale, modular replicas of the types of urban areas where terrorists and insurgents typically seek refuge. The Urban Warfare Complex would be constructed on about 100 acres in a remote area on the NNSS.

3.2.1.3 Work for Others Program

Work for Others Program activities are described in more detail in Appendix A of this *NNSS SWEIS*. Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Work for Others Program activities:

- Treaty verification
- Military training and exercises
- Work for Others Program activities at the TTR

Work for Others Program activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Nonproliferation projects and counterproliferation research and development – Support would be provided for development of radiation detection capabilities, additional sensor technologies, and active interrogation programs to detect nuclear material.

Counterterrorism – Counterterrorism activities would include research, development, testing, and evaluation of unmanned aerial vehicles and/or unmanned aircraft systems, as well as integration of training and exercises. Other activities would include development and testing of sensors for detection and defeat of improvised explosive devices, which would require construction of test beds (roads, intersections, small towns, etc.) and support facilities. Construction of these facilities would include new buildings with about 10,000 square feet of new floor space and would disturb about 75 acres of land.

DHS counterterrorism operations support would include construction of new training facilities (about 10,000 square feet of floor space). In addition, RNCTEC would be operated up to the level of a Hazard Category 2 nonreactor nuclear facility, which would allow larger amounts of radioactive material in alternative configurations to be used in tests and experiments. A high-speed road, a short section of full-scale railroad line, a simulated seaport facility, and a mock urban area would also be added to RNCTEC (DOE 2004f), requiring about 125 acres of additional land in Area 6. These new facilities are still conceptual in nature and their potential locations have not been identified. An appropriate level of additional NEPA analysis (beyond this SWEIS) would be required before NNSA makes any decision regarding these facilities.

Support for NASA – NNSA would support NASA nuclear rocket motor development, including using existing boreholes to examine for proof of concept the use of deep alluvial basins for sequestering radionuclides released as part of emissions from tests of a yet-to-be-developed prototype nuclear rocket motor. Over about a 10-year period, NASA would not likely test a nuclear rocket motor, but may conduct proof-of-concept tests using a surrogate, such as spiked xenon, in a borehole to evaluate the effectiveness of the alluvium for this purpose. NNSA would identify and comply with all applicable regulatory requirements for both proof-of-concept experiments and any actual test of a nuclear rocket motor. If NASA proposes to test an actual nuclear rocket motor, additional NEPA analysis would be prepared.

Aviation Work for Others – Activities would include increased research, development, and use of aerial platforms at the NNSS. To support these activities, additional facilities would be required at Desert Rock Airport (hangars, shops, and other buildings occupying approximately 200,000 square feet) and the Area 6 Aerial Operations Facility (a hangar occupying approximately 20,000 square feet). Additional facilities occupying approximately 5,000 square feet may be required at other locations to support air operations, including testing of various types of manned and unmanned aerial vehicles such as small, remote-controlled, fixed-wing airplanes and helicopters. Unmanned aerial vehicles would be tested for potential use carrying sensors for collecting environmental data (e.g., multi- and hyperspectral imagery) to be used in digital environmental model development and for terrain analysis in arid and semiarid regions.

Active interrogation – Active interrogation involves the use of a radiation source to detect nuclear material. Under the Expanded Operations Alternative, Work for Others Program activities would include support for development of active interrogation systems to detect nuclear material and other materials of interest. NNSA would support research and development of active interrogation equipment, including accelerators and other radiation-generating devices and associated radiation detection systems/methods, and training. DHS would conduct active interrogation activities at RNCTEC, but other Federal agencies would require an additional facility, most likely located in Area 12 or 16. In addition to fixed facilities, temporary test beds would be used to provide various terrain, roadway patterns, and other factors to simulate conditions that may be encountered in actual deployment of the active interrogation system. The temporary test beds would be used primarily for testing mobile accelerators and other radiation-generating devices (from man-portable up to units housed in large transportation containers) and detectors. In general, temporary active interrogation test beds would use existing NNSS roads, but could also include some off-road areas. Construction of additional support facilities and temporary test beds would disturb about 100 acres of previously undisturbed land over the next 10 years.

Active interrogation research and development would involve operation of accelerators/radiation-generating devices at energy levels in the range of 10 to 100 million electron volts to irradiate various materials using, for example, electrons, protons, or other types of radiation such as x-rays or neutrons (proton-generating units may attain energy levels of up to 4 billion electron volts). The devices would be used for either radiography or for interrogation of objects to detect and identify such things as fissionable materials, chemicals, or contraband. Other devices may produce gamma rays to be used for the same purposes. Still other systems would include deuterium-deuterium or deuterium-tritium neutron generators (see description of fusion experiments in Sections 3.1.1.1 and 3.2.1.1) that produce from 2.5 to 14 million-electron-volt neutrons.

Test objects would be irradiated using interrogation beams produced by the accelerators/radiation-generating devices. Test objects would consist in part of fissionable materials such as uranium and plutonium. Fissionable material in a test object would be limited to quantities that can be demonstrated to be subcritical under all normal, abnormal, and accident conditions (quantity and nature of process activities must preclude the potential for a nuclear criticality). Test objects that incorporate fissionable material would be used in either shielded or unshielded configurations or surrounded by, for example, naturally occurring radioactive material. The interrogation beams would also be used to irradiate non-fissionable materials, such as chemicals or simulated contraband, to determine signatures produced by the real materials. Test objects would be placed up to 1.25 miles from the beam source and radiation and other detection systems would be placed at various distances away to detect radiation from the test objects.

Radioactive tracer experiments – Radioactive tracer experiments would be conducted to validate sensor technology. These experiments would include both underground releases and open-air releases of radioactive noble gases and nonradioactive gases (i.e., helium and sulfur hexafluoride). The underground experiments would release up to 27 curies of radioactive noble gases with short half-lives (5 to 36 days); nonradioactive releases would include from about 300 gallons of helium to about 2,000 gallons of sulfur hexafluoride. The underground experiments would include explosive gas releases, pressurized releases, explosive radioactive particulate releases, and a baseline survey of contamination from previous activities.

The open-air experiments would release small quantities of radionuclides with short half-lives. Up to 12 experiments involving open-air releases would be conducted each year. NNSA would comply with all relevant regulatory and reporting requirements, including applicable requirements of 10 CFR Part 61, Subpart H, for all experiments that could result in a release of radioactive material to the air. NNSA would ensure that the cumulative annual radiological dose at the boundary of the NNSS resulting from all activities involving radioactive materials would comply with the U.S. Environmental Protection Agency's annual emission standard of 10 millirem (40 CFR 61.92).

New test beds – Additional test beds would be developed to support research and development for sensors, high-power microwaves, and high-power lasers. New test beds (including approximately 50,000 square feet of new building spaces) would be constructed at various locations on the NNSS and would disturb approximately 200 acres of previously undisturbed land. Because there are no specific plans for construction of these new test beds at this time, additional NEPA analysis would be necessary before they could be implemented.

The following new test beds would be developed at the NNSS under the Expanded Operations Alternative:

Nuclear-Fuel-Cycle-Related Radionuclide Release, Diagnostics and Solids Detection, and Characterization Test Bed – In support of the various nuclear nonproliferation treaties in which the United States participates or anticipates participation, NNSA would create test beds for use in developing sensors to support treaty verification and nonproliferation validation. Facilities to support deployment of fixed uranium oxides and controlled amounts of depleted uranium would include static concrete display pads, static target display pans, thermal targets, and ponds and pools of water.

Specialized Explosive Testing and Manufacture Test Bed – Support for DoD and the U.S intelligence community would expand to include development of sensors and techniques for detection and defeat of improvised explosive devices, homemade explosives, conventional military ordnance, and chemical explosives, as well as explosives-driven, shaped-charge development and evaluation.

Radio Frequency Generation Test Bed – Technologies would be developed to detect, sample, characterize, and identify radio frequency signatures and observables. The test bed would be used to develop the ability to generate specific signals, to characterize the radio frequency environment, and to monitor tests.

Infrasonic Observations Test Bed – Technologies would be developed to monitor earthquakes and underground disturbances. This test bed would be used to develop the ability to detect specific signals, characterize the seismic environment, and monitor tests.

Chemical Test Bed – Activities at this test bed would include simulated manufacture and release of illegal drugs by authorized Federal organizations to develop detection and prevention technologies. An existing facility would be used to train personnel and test sensors and procedures for detection of toxic industrial chemicals.

Biological Simulants Test Bed – These operations would include production of biological simulants in an appropriate laboratory by authorized Federal organizations for use in detection technology development. Biological simulant releases to the soil, the air, or an NNSS sewer/septic system would emulate anticipated real-world scenarios. Construction to support these functions would disturb up to 50 acres of land.

3.2.2 Environmental Management Mission

The DOE/NNSA Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Under the Expanded Operations Alternative, the Waste Management Program would accept greater volumes of LLW and MLLW from both offsite and onsite sources. As under the No Action Alternative, the Environmental Restoration Program would continue to meet the requirements of the most recent FFACO.

3.2.2.1 Waste Management Program

In response to increased levels of operations at NNSA facilities in Nevada under the Expanded Operations Alternative, waste management activities associated with some waste types would increase. In particular, up to approximately 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW would be disposed at the NNSS over the next 10 years. Within the existing Area 5 RWMC and the Area 3 RWMS, new disposal units would be constructed, filled, and closed to accommodate these additional waste volumes and types. The basis for these estimated volumes is described in Appendix A, Section A.2.2.1. New MLLW disposal cells would require a new RCRA permit(s) from the Nevada Division of Environmental Protection.

Use of rail-to-truck transloading would increase, including the use of transloading facilities within Nevada, should commercial vendors establish such a facility. DOE/NNSA would not establish or promote establishment of any transloading facilities.

Under the Expanded Operations Alternative, NNSA would treat and store various types of MLLW received from on- and offsite generators. MLLW treatment capacity would be developed within the Area 5 RWMC, including macroencapsulation, stabilization/microencapsulation, sorting/segregating, and bench-scale mercury amalgamation of both onsite- and offsite-generated MLLW. Initially, MLLW storage capacity would be developed on the TRU Pad to accommodate MLLW treatment (for either onsite- or offsite-generated wastes), pending development of MLLW storage capacity in existing or new facilities within the Area 5 RWMC. To handle the increased volumes and more-frequent shipment receipt rates of LLW and/or MLLW, a waste offloading and staging area would be established at the Area 5 RWMC. Appropriate permits would be obtained before expanding MLLW storage capacity or implementing any of these treatment technologies.

In addition, waste management activities at the NNSS under the Expanded Operations Alternative would include the following:

- Because of the projected increased annual number of experiments at JASPER and other national security activities, somewhat larger quantities of TRU waste would be generated annually (about 1,500 cubic feet per year). As with the No Action Alternative, TRU waste generated by DOE/NNSA activities in Nevada would be safely stored at the TRU Pad pending shipment off site for disposition along with other legacy waste (waste or contamination resulting from previous nuclear weapons-related activities) or newly generated environmental restoration waste.
- Continued treatment by evaporation of liquids containing small concentrations of tritium; and continued management of hazardous waste, asbestos and PCB wastes, and hydrocarbon-contaminated soil and debris in compliance with applicable regulations and permits. An estimated 170,000 cubic feet of hazardous waste would be generated by DOE/NNSA activities.
- Continued treatment of explosives at the Explosives Ordnance Disposal Unit in Area 11.

- Continued operation of the Area 23 Class II Solid Waste Disposal Site, the Area 6 Class III Solid Waste Disposal Site (Hydrocarbon Landfill), and the U10c Class III Solid Waste Disposal Site. To accommodate the potential increases in solid wastes (up to about 9,400,000 cubic feet over the next 10 years) that may be generated by various operations at the NNSS under the Expanded Operations Alternative, NNSA would seek permits to construct and operate new solid waste disposal facilities, as needed. A new sanitary waste landfill in Area 23 would require approximately 15 acres of land. To support environmental restoration work in Area 25, NNSA would obtain appropriate permits to construct and operate a construction/demolition debris landfill that would disturb up to 20 acres in Area 25 of the NNSS. Approximately 970,000 cubic feet of the generated sanitary solid waste would be sent off site for recycling during the next 10 years.

3.2.2.2 Environmental Restoration Program

Under the Expanded Operations Alternative, the DOE/NNSA Environmental Restoration Program would continue in compliance with the FFACO in the form of characterization, monitoring, and, if necessary, remediation of identified contaminated areas, facilities, and environmental media. The UGTA and Industrial Sites Projects, remediation of Defense Threat Reduction Agency sites, and Borehole Management Program would all continue as under the No Action Alternative, although the pace of cleanup activities could be accelerated. Cleanup standards for Soils Project sites on lands under the jurisdiction of the USAF are subject to agreement among the USAF, NDEP, and DOE. The No Action Alternative addressed cleanup levels consistent with current land uses; however, if more-stringent cleanup standards are adopted than currently planned or additional sites are included under the FFACO, the volumes of waste requiring transport and disposal would increase. For purposes of analysis under the Expanded Operations Alternative, this SWEIS assumes that a number of contaminated soil sites on the Nevada Test and Training Range and the TTR (i.e., Clean Slate 2, and 3, Project 57, and Small Boy), a total of about 504 acres, would be excavated to a depth of 0.5 feet and the removed soil would be disposed as LLW. The impact of this estimated additional volume of waste that would need to be disposed at the NNSS is analyzed in Chapter 5, Section 5.1.11.

3.2.3 Nondefense Mission

The Nondefense Mission generally includes those activities that are necessary to support mission-related programs, such as construction and maintenance of facilities, provision of supplies and services, warehousing, and similar activities. Activities related to energy supply and conservation, including renewable energy, are considered part of the Nondefense Mission, as are other research and development activities that may occur at NNSA facilities in Nevada, including activities at the Nevada National Environmental Research Park. As described in the following paragraphs, all Nondefense Mission programs would be modified to some extent under the Expanded Operations Alternative.

3.2.3.1 General Site Support and Infrastructure Program

Under the Expanded Operations Alternative, in addition to small projects to maintain the present capabilities of the NNSS, infrastructure-associated activities would include increasing capacities and capabilities or extending the ranges of facilities and/or services to accommodate new operational programs and projects. A detailed description of new activities associated with the General Site Support and Infrastructure Program and the reasons they are proposed under the Expanded Operations Alternative may be found in Appendix A, Section A.2.3.1.

In addition to accommodating operational requirements and constructing the new facilities described in Sections 3.2.1 and 3.2.2, the following infrastructure enhancements would be implemented:

- A security building in Area 23 would be constructed to replace outdated facilities and consolidate security facilities and functions into a new, approximately 85,000-square-foot, two-story facility. The buildings replaced would be evaluated and either demolished or used for another purpose.
- The existing 138-kilovolt electrical transmission system would be replaced between Mercury Switching Center in Area 23 and Valley Substation in Area 2 to increase the capacity of the system from about 40 megawatts to 100 megawatts. The efficiency of the system would be improved, but the system operating voltage would not increase.
- The telecommunication system on the NNSS would be upgraded to better integrate wired and wireless systems.
- Buildings in Mercury are typically 30 to 50 years old. To maintain an efficient and effective operation in support of national security activities, it is necessary to replace most of these facilities and supporting infrastructure due to their lack of energy efficiencies and deteriorating condition. Under the Expanded Operations Alternative, Mercury would be reconfigured to provide the modern facilities and infrastructure necessary to support advanced experimentation and production at the NNSS. Because the reconfiguration of Mercury is conceptual in nature, an appropriate level of NEPA analysis and documentation would be required before it could be implemented.

These projects would contribute to meeting NNSA Strategic Goal 2.1: Transform the Nation's nuclear weapons stockpile and supporting infrastructure to be more responsive to the threats of the twenty-first century.

As under the No Action Alternative, in addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain site. NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain site.

As noted under the No Action Alternative, although considered infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed as part of the Environmental Management Program and proposed and potential renewable energy projects are addressed under the Conservation and Renewable Energy Program, rather than the General Site Support and Infrastructure Program.

3.2.3.2 Conservation and Renewable Energy Program

Under the Expanded Operations Alternative, NNSA would continue to identify and implement energy conservation measures and renewable energy projects as described under the No Action Alternative. In addition, NNSA would pursue renewable energy projects, including geothermal and solar.

NNSS Photovoltaic Power Project – Under the Expanded Operations Alternative, NNSA proposes to build a 5-megawatt photovoltaic solar power system near the Area 6 Construction Facilities. The 5-megawatt photovoltaic system would require about 50 acres of land, based on a similar project at Nellis Air Force Base (USAF 2006c).

Commercial solar power generation – Under the Expanded Operations Alternative, NNSA would allow development of one or more full-scale commercial solar power generation facilities in Area 25 of the

NNSS. As shown in Figure 3–2, the solar power generation facilities would be located within an area of about 39,600 acres in the southwestern part of the NNSS. The reasons for NNSA's consideration of commercial solar power development only in Area 25 and decision to assess the concentrating solar power parabolic trough technology in this *NNSS SWEIS* are addressed in Section 3.1.4.2. The facility(ies) could use a variety of solar power-generating technologies (i.e., parabolic trough, power tower, dish engine, photovoltaic) with a combined generating capability of up to 1,000 megawatts. Approximately 10 miles of new 500-kilovolt electrical transmission line (outside of the NNSS) would be required to integrate the electricity generated into the regional system. The existing regional electrical transmission system does not have sufficient capacity to accommodate an additional 1,000 megawatts of power. Development of the solar power generation facilities in Area 25 would require construction of additional transmission infrastructure in the region. Independent of and unrelated to the commercial solar power generation facilities considered in this *NNSS SWEIS*, NV Energy, a commercial electrical energy company, and Renewable Energy Transmission Company are planning separate new large capacity transmission line projects that would accommodate the additional electrical generation (see Chapter 6, Section 6.2.4.4, for additional information). The analysis in this SWEIS is based on assumptions for a representative commercial solar project (West 2010). Because there is no specific proposal for a commercial solar power-generating project, additional NEPA analysis would be required to evaluate any such proposals in the future.

Geothermal Demonstration Project – There are no proposals to develop a Geothermal Demonstration Project at the NNSS, at this time; however, there has been recent interest in such a project. Under such a project, the NNSS would be evaluated to determine the feasibility of demonstrating an enhanced geothermal electrical generating system. If the initial evaluation were favorable, the location for a Geothermal Demonstration Project on the NNSS would depend on a combination of factors, including the system's potential, land use zone restrictions, and environmental and economic considerations. Approximately 30 to 50 acres of land would be disturbed by construction of a Geothermal Demonstration Project. Several boreholes would be drilled up to 20,000 feet deep. Up to 20 acre-feet of water would be required to initially prime the system. A continuously operating 50-megawatt power plant would require an estimated 50 acre-feet of water per year. As a separate but related project, a geothermal research center, would be established in Mercury using existing facilities. A Geothermal Demonstration Project would be interconnected to the NNSS electrical transmission system, but would not generate sufficient power to exceed the capacity of the rebuilt NNSS 138-kilovolt transmission system addressed in Section 3.2.3.1. Because there are no specific proposals for geothermal exploration or development on the NNSS at this time, additional NEPA analysis would be required before such work could be conducted.

3.2.3.3 Other Research and Development Programs

Under the Expanded Operations Alternative, NNSA would continue to host existing environmental research projects at the NNSS and would actively promote and expand the National Environmental Research Park Program. NNSA would consider new environmental or other proposed research and/or development projects not related to the DOE or NNSA National Security/Defense or Environmental Management missions on a case-by-case basis.

Expanded Use Alternative—American Indian Perspective

The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Expanded Use Alternative include those discussed previously under Sections 3.0, 3.1.1, 3.1.2, 3.1.2.1, 3.1.2.2, and 3.1.3, as well as those summarized here. Under the Expanded Use Alternative, the U.S. Department of Energy (DOE) would pursue geothermal electrical generation in a variety of locations depicted in Figure A.2.3-1, and solar energy systems and facilities in Areas 6 and 25, respectively.

The CGTO understands that DOE is proposing to construct modular geothermal power plants that have a relatively small surface footprint. However, the initial project support activities will reportedly impact 30 to 50 acres. The CGTO also understands that DOE may pursue solar power by constructing a 5 megawatt photovoltaic system, and commercial solar power generating facilities. These proposed solar power electrical generation projects would impact approximately 50 acres and 39,600 acres of land, respectively. The CGTO is particularly concerned with the land and resources potentially impacted by these projects.

Construction of the proposed solar power electrical generation system and facilities, and the geothermal electrical generation facility involves scraping the land, irreparably destroying the land and vegetation. Facility construction will facilitate erosion, impede visual resources, and will emit dust and other potentially hazardous pollutants into the air. This will, in turn, impact the land, water, air, plants, animals, and cultural resources, and will affect the solitude and cultural integrity of the land. Some examples of resources impacted have been highlighted throughout this section.

The CGTO is concerned that DOE's proposed activities unnaturally harnesses the earth's power without understanding the implications of these actions or all that is necessary to begin to prepare the earth and its resources. Numic people have a complex understanding of *power* and believe it is special force that was placed in all things at the time the world was created. It is that spark which keeps the world going and all of its elements thinking, talking, moving, and interacting. This special *power* moves and has the ability to move down hill, often concentrating or pooling in certain places like mineral outcrops, cliffs, and caves. It has characteristics similar to water, and can be understood as having the ability to return to the sky to become like rain and snow, which are called down from the sky by the highest mountains. This special *power* has a rotation of movement similar to the hydrological cycle and has the ability to impact all things (Carroll et al. 2006).

The CGTO is concerned about unnaturally harnessing the power of the Sun. According to tribal elders, *"The Sun is like a big battery. Once you drain its power, will it die? For those of us spiritually connected to the Sun, what will happen to us if it is killed? We know the Sun has only so much energy. If the Sun is drained, how will it be replenished? If the Sun goes away, everything will die. Because of the complexity and potential implications to the environment, cultural landscape, and our own survival, we strongly encourage the DOE to pursue a study that evaluates the cultural implications of pursuing solar energy. The stories and activities of our ancestors are tied greatly to the Sun. Today, our prayers and ceremonies still travel or rely on its strength."*

According to information presented throughout the site-wide environmental impact statement, the proposed geothermal electrical generation facilities would use the power of rocks that are hot. Rocks, or minerals, are culturally important and have significant roles in many aspects of Indian life. For example, the Chalcedony would have made an attractive offering acquired and then left at the vision quest or medicine site located to the north on top of a volcano like Scrugham Peak. In particular, Indian people have observed the presence of the following minerals used as offerings on the Nevada National Security Site (NNSS): (1) Obsidian, (2) Chalcedony, (3) Yellow Chert (otherwise known as Jasper), (4) Black Chert, (5) Pumice, (6) Quartz Crystal, and (7) Rhyolite Tuff.

Obsidian is a glass-like stone produced by volcanoes when they talk. According to information obtained by Dr. Richard Stoffle with the University of Arizona and presented in the report *Black Mountain: Traditional Uses of Volcanic Landscapes* (Carroll et al. 2006), Southern Paiutes use a green volcanic glass during curing ceremonies that involved bleeding the patient. Volcanic glass found below Scrugham Peak was used in the first arrow making lessons for young men. Such lessons were held in small rock shelters found along the base of the basalt flow that constitutes Buckboard Mesa. Obsidian flakes were placed before important rock art panels as offering to the spirits who lived on the other side of the passageway provided by the panel. Small obsidian stones, commonly called *Apache Tears*, cover a depth of 4 inches on the face of Shoshone Mountain in southern Nevada. This massive deposit of obsidian stones is interpreted by Indian people as being provided by the mountain as both a spiritual backdrop and a location for vision quests.

Volcanic rocks are used in a wide range of ceremonial activities. According to a tribal elder, *"Indian women enhance the quality of breast milk by squirting it on heated rocks."* Volcanic rocks are used for medicine society sweat lodge meetings (Zedeño et al. 2001). Indian people call some volcanic rocks "grandfather stones," a designation that reflects reverence as well as wisdom. Such rocks are sought in special places of power and carried over long distances to serve as the heated stones in sweat lodges (Carroll et al. 2006).

Other traditional use minerals are known to exist throughout the NNSS and offsite locations. In order to document the cultural significance of these areas, additional ethnographic mineral studies are needed to fully understand the location and importance of these minerals at the proposed project site locations prior to any surface disturbing activities. The CGTO is particularly apprehensive about the potential impacts or use of these minerals resulting from proposed geothermal activities.

Expanded Use Alternative—American Indian Perspective (cont'd)

Some of the locations proposed for geothermal electrical power plants are recognized as traditionally or spiritually important. In particular, the CGTO is concerned about activities that have the potential to impact Oasis Valley, Amargosa River, Timber Mountain Caldera Complex, Black Mountain, Gold Meadows, Cane Springs, Calico Hills area, Crater Flats, Scrugham Peak, Shoshone Mountain, Devil's Hole, Ash Meadows, and Death Valley. The CGTO is concerned about locating the proposed geothermal project along hydrological basins, whose power is derived from volcanic activity.

We know the forces of power in the world move along channels and combine into specific nodes or places of power. A common set of these channels follows the path of water. From this beginning, the water moves downhill in rivulets, washes, and streams. The water often goes underground where it forms similar networks of channels moving in various directions, corresponding to hydrological basins. Water is often attracted to volcanic activity, thus producing power places like hot mineral springs.

The CGTO is concerned the DOE may impact hot springs in their pursuit of geothermal power. According to information obtained by Dr. Richard Stoffle with the University of Arizona and presented in the report *Black Mountain: Traditional Uses of Volcanic Landscapes* (Carroll et al. 2006), hot springs come from the earth where volcanic activity still occurs even if the magma cannot be seen on the surface. Such springs are a combination of water and volcanoes producing a special place where both ceremonial and medicine activities occur. Indian people from Owens Valley have a single origin story for all of the hot springs in the southern Great Basin and northern Mohave Desert. According to traditional stories, a great ball of fire came from the sky and landed at Coso Hot Springs and then splashed to form at once all of the other hot springs.

Hydrological Impacts

According to information presented in the Site-Wide Environmental Impact Statement, the proposed solar and geothermal projects will require a tremendous amount of water. A modular geothermal power plant alone will require up to 20 acre-feet to initially prime the system.

Indian people believe water is a living being that is fully sentient and willful. Water is already stressed throughout the region. The CGTO is concerned about the use of this very limited and important resource.

Because water is a powerful being it is associated with other powerful beings, such as water babies, a supernatural being that lives in and protects the water. These beings are like the people of the water. They are highly respected by American Indian culture. If water is contaminated and misused, the water babies may cause harm and move to other areas that are not contaminated.

Air Quality and Climate Impacts

Construction of these proposed facilities will impact large areas of land, potentially emitting dust and contaminants. The CGTO knows the air is alive. The Creator puts life into the air, which is shared by all living things. Air can be destroyed, causing pockets of dead air. There is only so much living air that surrounds the world. If it is destroyed, it is gone forever and cannot be restored. Dead air lacks the spirituality and life necessary to support other life forms. The CGTO is concerned about emitting things into the air that are unnatural, and raises the potential health and environmental issues associated with these emissions.

Visual Resource Impacts

All landforms within the NNSS have high sensitivity levels for American Indians. The ability to see the land without obstructions like buildings, towers, cables, roads, and other objects is essential for the spiritual interaction between Indian people and their traditional homelands. Visual resources may be negatively impacted if proposed solar and geothermal projects are pursued. The CGTO must be part of any future discussions as these may impact visual resources and may impede traditional and cultural ceremonies.

Final Thoughts

Only Indian people have traditional ecological knowledge that tells us how and where to interact with plants and animals, water sources, and collect soil samples to minimize impacts to the land while maintaining its spiritual integrity. Because of the potential effects to our ancestral land and its delicate resources, the CGTO must be an integral part of the solar power electrical generation and geothermal electrical generating power projects by conducting systematic ethnographic studies before the ground is disturbed.

The CGTO strongly encourages DOE to evaluate the cultural impacts of pursuing solar and geothermal energy in culturally sensitive areas because of the complexity and potential implications to the environment, cultural landscape, and our survival. The CGTO recommends developing culturally appropriate text for future National Environmental Policy Act (NEPA) analyses, including the environmental assessments and mitigation plans required for these proposed undertakings.

See Appendix C for more details.

3.3 Reduced Operations Alternative

The Reduced Operations Alternative addressed in this SWEIS includes the same types of activities as the No Action Alternative; however, for many programs, the levels of operations would be reduced. Perhaps the most important change from No Action under the Reduced Operations Alternative would be cessation of all activities other than environmental restoration, environmental monitoring, site security operations, military training and exercises, and maintenance of Well 8 and critical communications and electrical transmission systems in the northwestern portion of the NNSS (Areas 18, 19, 20, 29, and 30). Maintenance of Pahute Mesa, Stockade Wash, and Buckboard Mesa Roads would be terminated and operations at Pahute Mesa Airstrip would be limited to those necessary to provide access for the activities that would continue in these areas. The electrical transmission/distribution system beyond the Echo Peak Substation in Areas 19 and 20 would be de-energized. Ceasing all activities other than those mentioned in Areas 18, 19, 20, 29, and 30 would reduce NNSA's maintenance requirements at the NNSS and allow scarce resources to be focused on the more used areas of the NNSS. It may also reduce impacts on some resources, relative to the No Action and Expanded Operations Alternatives. **Figure 3–3** illustrates the configuration of the NNSS under the Reduced Operations Alternative.

Reduced Operations Alternative—American Indian Perspective

CGTO The Consolidated Group of Tribes and Organizations' (CGTO) concerns and perspective regarding the Reduced Operations Alternative include those discussed previously under Sections 3.0, 3.1.1, 3.1.2, 3.1.2.1, 3.1.2.2, and 3.1.3. The CGTO is supportive of a decrease in culturally perceived harmful land-disturbing activities within the Nevada National Security Site (NNSS) area and the offsite locations. To successfully reduce operations and restore environmental balance, it is essential to have tribal representatives involved throughout the process to help guide the U.S. Department of Energy (DOE) in conducting culturally appropriate activities.

See Appendix C for more details.

The following description of the missions, programs, capabilities, projects, and activities that would be conducted under the Reduced Operations Alternative primarily addresses only this alternative's differences from the No Action Alternative; that is, those projects and activities that would be conducted at a lower level of intensity or not at all.

3.3.1 National Security/Defense Mission

Under the Reduced Operations Alternative, NNSA would continue to pursue activities in support of the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

3.3.1.1 Stockpile Stewardship and Management Program

Stockpile stewardship and management operations would continue under the conditions of the ongoing nuclear testing moratorium. As under the No Action Alternative, NNSA would continue to maintain its readiness to conduct an underground nuclear weapon test if so directed by the President. A generic description of underground nuclear testing is provided in Appendix H. Detailed descriptions of Stockpile Stewardship and Management Program activities under the Reduced Operations Alternative are provided in Appendix A, Section A.3.1.1.

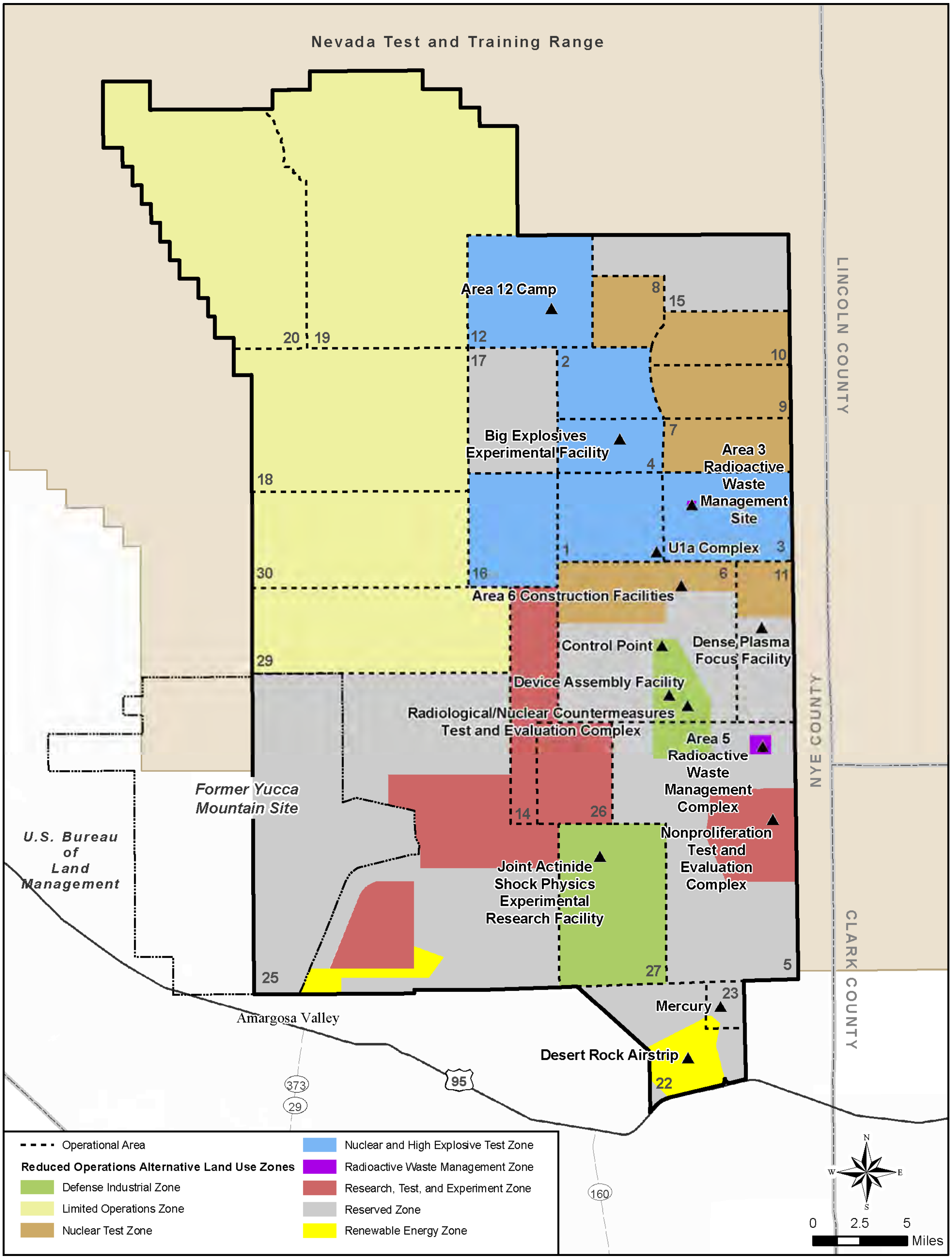


Figure 3–3 Nevada National Security Site Land Use Zones and Major Facilities Under the Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be no change from the No Action Alternative for the following Stockpile Stewardship and Management Program projects and capabilities:

- Shock physics experiments at the Large-Bore Powder Gun
- Criticality experiments at DAF
- Disposition of damaged nuclear weapons
- Storage and staging of nuclear devices
- Staging of SNM, including pits
- Readiness-related training and exercises using various kinds of nuclear weapon simulators

In addition to maintaining these capabilities, under the Reduced Operations Alternative, the following changes in stockpile stewardship and management capabilities at NNSA facilities in Nevada would occur:

Dynamic experiments – NNSA would annually conduct no more than six of these experiments per year. Over the next 10 years, a total of five dynamic experiments would be conducted in emplacement holes and cause land disturbances. No dynamic experiments would occur in Areas 19 or 20 of the NNSS.

Conventional explosives experiments – NNSA would annually conduct up to 10 conventional explosives experiments in the Nuclear and High Explosives Test Zone to directly support the Stockpile Stewardship and Management Program. No other explosives experiments would be conducted.

Shock physics experiments – No more than six shock physics experiments with SNM would be annually conducted at JASPER.

Pulsed Power Experiments at Atlas – The Atlas Facility would be decommissioned and dispositioned.

Fusion experiments at the NNSS and NLVF – NNSA would conduct up to 375 plasma physics and fusion experiments per year: 350 would use the Dense Plasma Focus Machine at NLVF, and 25 would use the machine in Area 11.

Support for Office of Secure Transportation Training – The number of times per year that Office of Secure Transportation training and exercises would be supported would be reduced to four.

Stockpile stewardship and management activities at the TTR – NNSA would not conduct fixed rocket launcher operations, cruise missile operations, or fuel-air explosives operations at the TTR.

3.3.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

There would be no change from the No Action Alternative for Nuclear Emergency Response, Nonproliferation, or Counterterrorism Program activities. See Appendix A, Section A.1.1.2, for a detailed description of these activities.

3.3.1.3 Work for Others Program

Under the Reduced Operations Alternative, NNSA would continue to host the projects of other Federal agencies, state and local governments, and nongovernmental organizations; however, certain activities, such as large-scale explosives tests and experiments, would not be conducted. NNSA also would no longer support the following Work for Others Program activities, which are associated with nonproliferation projects and counterproliferation research and development:

- Conventional weapons effects tests, including live-drop and static high-explosives detonations
- Development and demonstration of capabilities and technologies to attack and defeat military targets protected in tunnels and other deeply buried hardened facilities
- Explosives experiments
- Experiments requiring explosive releases of chemical and biological simulants

No Work for Others Program activities, except military training and exercises, would be conducted in Areas 18, 19, 20, 29, and 30 of the NNSS under the Reduced Operations Alternative. The reason for this exception is that military training and exercises are currently conducted primarily in the western half of the NNSS to ensure adequate separation and avoid interference with other DOE/NNSA activities. This separation would need to be continued for safety and security considerations.

3.3.2 Environmental Management Mission

The NNSA Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Under the Reduced Operations Alternative, both of these programs would be the same as under the No Action Alternative, except that less TRU waste would be generated annually (about 250 cubic feet per year) because of the projected reduced annual number of experiments at JASPER and other national security activities. As with the No Action Alternative, this waste would be safely stored at the TRU Pad pending shipment off site for disposition along with other legacy or newly generated environmental restoration waste. DOE/NNSA activities would generate an estimated 170,000 cubic feet of hazardous waste. Smaller quantities of solid wastes (3,600,000 cubic feet) are also projected (compared to the No Action Alternative) because of reduced employment and construction activities. About 360,000 cubic feet of sanitary solid waste would be sent off site for recycling.

3.3.3 Nondefense Mission

The Nondefense Mission generally includes those projects and capabilities necessary to support NNSA-related programs such as construction and maintenance of facilities, provision of supplies and services, warehousing, and similar activities. Activities related to supply and conservation of energy, including renewable energy and other research and development, are considered part of the Nondefense Mission. Activities under the Reduced Operations Alternative would be the same as the No Action Alternative, including maintenance of the "cold standby" status of the former Yucca Mountain site, but at a lower level of effort, reflective of operational levels and establishment of the "Limited Operations Zone."

3.3.3.1 General Site Support and Infrastructure Program

Under the Reduced Operations Alternative, infrastructure-associated activities would include repairs, replacements, and projects to maintain the reduced capabilities of the NNSS. NNSA would maintain only critical infrastructure within Areas 18, 19, 20, 29, and 30, including the Echo Peak, Motorola, and Shoshone communications facilities; the Echo Peak, Castle Rock, and Stockade Wash Substations; electrical transmission lines interconnecting these substations; and Well 8. Roads within Areas 18, 19, 20, 29, and 30 would be minimally maintained to provide the basic access necessary to maintain the noted infrastructure. As noted under the No Action Alternative, although considered infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed under the Environmental Management Program and proposed and potential renewable energy projects are addressed under the Conservation and Renewable Energy Program, rather than the General Site Support and Infrastructure Program.

3.3.3.2 Conservation and Renewable Energy Program

Commercial Solar Power Generation – Under the Reduced Operations Alternative, NNSA assumes development of a 100-megawatt commercial solar power generation plant in Area 25 of the NNSS. As explained under the No Action Alternative, the southwestern portion of Area 25 is considered the only reasonable location for a commercial solar power generation facility on the NNSS. NNSA estimates 1,200 acres of land would be required for a 100-megawatt parabolic trough solar power generation facility. The existing electrical transmission system has sufficient capacity to transmit the electrical energy produced by a 100-megawatt facility. Minor infrastructure construction and maintenance may be required to support the development of up to 100 megawatts of solar power generation within Area 25. The analysis in this SWEIS is based on assumptions for a representative commercial solar project. Because there are no current proposals for a commercial solar power generation facility on the NNSS, a separate NEPA analysis would be required for any specific proposal

3.3.3.3 Other Research and Development Programs

Under the Reduced Operations Alternative, NNSA would continue to host existing environmental research projects at the NNSS, but would not actively promote the National Environmental Research Park Program. NNSA would consider any new environmental or other proposed research and/or development projects not related to the DOE or NNSA National Security/Defense or Environmental Management Missions in all areas of the NNSS except Areas 18, 19, 20, 28, and 29 on a case-by-case basis.

3.4 Comparison of Potential Consequences of the Alternatives

A summary of the potential impacts of the alternatives evaluated in this SWEIS is provided in this section. **Tables 3–3** through **3–6** present side-by-side comparisons of the impacts under the alternatives at the NNSS, RSL, NLVF, and the TTR, respectively. The information presented in Tables 3–3 through 3–6 is a summary only; for detailed discussion, please refer to the appropriate resource section(s) of Chapter 5.

Table 3–3 Summary of Potential Impacts at the Nevada National Security Site

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Land Use (for details go to Chapter 5, Sections 5.1.1.1, 5.1.1.2, and 5.1.1.3)			
National Security/Defense Mission	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on the NNSS and primary land uses adjacent to the site.	No impacts were identified from the increased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. The Reserved Zone would decrease in area by 5.5 percent; the Research, Test, and Experiment Zone would increase by 21 percent.	No impacts were identified from the decreased activities and change in land use designations under this alternative because activities would be compatible with the proposed land use designations and primary land uses adjacent to the NNSS. The Reserved Zone would decrease in area by 71 percent and Areas 18, 19, 20, and 30 would change from Reserved to Limited Operations, which is a new land use zone designation.
	<u>*Airspace*</u> No new impacts were identified from airspace activities because these activities would be maintained at the current level of air traffic, navigational aid services, and airspace structure, and would be coordinated and scheduled by the controlling entity responsible for NNSS airspace, the Nellis Air Traffic Control Facility.	<u>*Airspace*</u> Minimal impacts would result from increased usage of aerial platforms and airspace usage, as these activities would continue to be coordinated with the Nellis Air Traffic Control Facility.	<u>*Airspace*</u> Same as under the No Action Alternative.
Environmental Management Mission	No impacts were identified from the continuation of activities at the current levels of operations because activities under this alternative would not change.	No impacts were identified from the increased activities under this alternative, as these activities would be compatible with land use designations and primary land uses adjacent to the site.	Same as under the No Action Alternative.
Nondefense Mission	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on the NNSS and primary land uses adjacent to the site. The Solar Enterprise Zone would be renamed the Renewable Energy Zone.	Same as the No Action Alternative, plus: Area 15 would be changed from a Reserved Zone to a Research Test and Experiment Zone and the Solar Enterprise Zone would be renamed the Renewable Energy Zone and increase in area by 276 percent.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Infrastructure and Energy (for details go to Chapter 5, Sections 5.1.2.1 and 5.1.2.2)			
Infrastructure	Buildings, transportation, water supply, and services are adequate to handle temporary increases in demands during construction and long-term demands during operations. Infrastructure would be maintained as needed to accommodate ongoing activities. In addition, new LLW cells would be developed to accommodate disposal of those waste types. Up to 50 new wells would be developed by the UGTA Project.	Same as under the No Action Alternative, plus: New buildings (about 479,000 square feet), ranges and training facilities (13,455 acres), water distribution lines, wastewater treatment systems (septic tanks), power lines, and communication systems would be added and improvements would be made to existing infrastructure. In addition, new LLW/MLLW cells would be developed to accommodate disposal of increased volumes of those waste types and new sanitary and construction/D&D waste landfills in Areas 23 and 25. An upgrade to the NNSS electrical transmission system would increase capacity from 40 to 100 megawatts. A 5-megawatt photovoltaic solar power generation facility would be developed in Area 6.	Same as under the No Action Alternative, except: Buildings, transportation, water supply, and services would experience reduced demands. Because most operations in the northwestern portion of the NNSS (within Areas 18, 19, 20, 29, and 30) would be discontinued, non-essential infrastructure in those areas would be shut down or removed.
	A commercial 240-megawatt solar power generation plant would be developed in Area 25 of the NNSS. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or wastewater infrastructure.	Up to 1,000 megawatts of commercial solar power generating capacity would be developed in Area 25 of the NNSS. The commercial facilities would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or wastewater infrastructure.	A commercial 100-megawatt solar power generation plant would be developed in Area 25 of the NNSS. The commercial facility would provide a portion of the electrical power at the NNSS. Sanitary needs of construction and operational employees would be provided by the commercial entity and are not expected to affect the NNSS solid waste or wastewater infrastructure.
Energy	Average electric power demand would be 22 megawatts, with a peak demand of 30 megawatts.	Average electrical power demand would be 28 megawatts with a peak demand of 41 megawatts. As noted under Infrastructure, NNSA would rebuild the 138-kilovolt transmission system on the NNSS to accommodate increased loads.	Average electrical power demand would be 20 megawatts with a peak demand of 27 megawatts.
	Estimated annual usage of various liquid fuels is estimated, as follows: Fuel oil for heating – 66,000 gallons Unleaded gasoline – 427,000 gallons Ethanol/E85 – 217,000 gallons #2 Diesel – 65,000 gallons Biodiesel – 343,000 gallons	Estimated annual usage of various liquid fuels is estimated as follows: Fuel oil for heating – 83,000 gallons Unleaded gasoline – 534,000 gallons Ethanol/E85 – 271,000 gallons #2 Diesel – 81,000 gallons Biodiesel – 429,000 gallons	Estimated annual usage of various liquid fuels is estimated as follows: Fuel oil for heating – 59,000 gallons Unleaded gasoline – 384,000 gallons Ethanol/E85 – 195,000 gallons #2 Diesel – 59,000 gallons Biodiesel – 309,000 gallons
	NNSA would maintain and repair energy infrastructure.	NNSA would maintain and repair energy infrastructure.	NNSA would maintain and repair energy infrastructure.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Transportation [a] and Traffic (for details go to Chapter 5, Sections 5.1.3.1 and 5.1.3.2 and Appendix E)			
Transportation (for details go to Chapter 5, Sections 5.1.3.1.1, 5.1.3.1.2, and 5.1.3.1.3 and Appendix E)			
Out-of-state LLW/MLLW			
Truck transport			
worker risk (LCF)	1 (1.2)	3 (3.1)	1 (1.2)
population risk (LCF)	0 (0.2)	1 (0.6)	0 (0.2)
Radiological Accident (LCF)	0 (0.0002)	0 (0.01)	0 (0.0002)
Traffic fatality	2	6	2
Rail transport only			
worker risk (LCF)	0 (0.3)	1 (1.1)	0 (0.3)
population risk (LCF)	0 (0.09)	0 (0.3)	0 (0.09)
Radiological Accident (LCF)	0 (0.00004)	0 (0.005)	0 (0.00004)
Traffic fatality	6	15	6
Combined rail-truck transport			
worker risk (LCF)	0 (0.5)	1 (1.5)	0 (0.5)
population risk (LCF)	0 (0.1)	0 (0.3)	0 (0.1)
Radiological Accident (LCF)	0 (0.00006)	0 (0.005)	0 (0.00006)
Traffic fatality	6	16	6

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Traffic (for details go to Chapter 5, Sections 5.1.3.2.1, 5.1.3.2.2, and 5.1.3.2.3)			
Onsite traffic impacts	There would be about 20 additional vehicle trips per day on Mercury Highway, which would operate at a level of service A during peak traffic hours. Construction of a 240-megawatt commercial solar power generation facility would result in 250 (average over the period of construction) and 500 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 800 additional vehicle trips per day on Mercury Highway, which would operate at a level of service B or better during peak traffic hours. Construction of 1,000 megawatts of commercial solar power generation facilities would result in 750 (average over the period of construction) and 1,500 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.	There would be about 150 fewer vehicle trips per day on Mercury Highway, which would operate at a level of service A during peak traffic hours. Construction of a 100-megawatt commercial solar power generation facility would result in 400 (average over the period of construction) and 800 (during the peak of the construction period) additional vehicle trips on a daily basis during the peak commute hours on Lathrop Wells Road; increased roadway maintenance or improvements may be required.
Regional traffic impacts	U.S. Route 95, State Route 160, and State Route 372 would experience the greatest increases in daily traffic volumes in the area around the NNSS; however, these would be relatively minor and would not affect the levels of service on regional roadways. Overall traffic volumes would increase during peak hours because of additional traffic attributable to the construction of a solar power generation facility.	Segments of Nevada State Route 372, State Route 160, U.S. Route 95, and State Route 164 would experience moderately high percent increases in daily traffic compared to the No Action Alternative. Most of the increase in daily traffic volumes during the peak hours would be attributable to workers commuting to the NNSS, any detectable changes in traffic volumes would primarily occur during the main commuting hours and at the entry gates of the NNSS (the main entrance gate for regular NNSS employees and Gate 510 for those associated with the construction and operation of the commercial solar power generation facilities in Area 25). However, the levels of service on public roadways in the region would not change.	Although the number of commuter trips for the reduced NNSS workforce would decrease, overall traffic volumes would increase slightly during peak hours because of additional traffic volumes attributable to construction and operation of the solar power generation facility. Impacts on regional traffic under this alternative would, therefore, be slightly less than or similar to those described under the No Action Alternative; volume-to-capacity ratios and levels of service would not change.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Socioeconomics (for details go to Chapter 5, Sections 5.1.4.1, 5.1.4.2, and 5.1.4.3)			
	Operation of a 240-megawatt commercial solar power facility would increase employment by 150 FTEs, of which about 15 solar power facility employees would relocate from outside of the region. Sufficient housing exists to support the increased population. A total of 22 new students relocating to Clark County would create a need for 1 additional teacher to maintain the student to teacher ratio. An increase of 6 new students in Nye County would not result in a need for additional teachers. Direct jobs would reduce unemployment by 0.07 and 0.99 percent, respectively, in Clark and Nye Counties.	Site employment would increase by 625 FTEs; about 63 employees would relocate from outside of the region. Sufficient housing exists in the area to support the increased population. A total of 92 new students relocating to Clark County would create a need for 4 new teachers to maintain the student to teacher ratio. An increase of 27 new students in Nye County would create the need for 1 new teacher to maintain the student-to-teacher ratio. Direct jobs would reduce unemployment by 0.31 and 4.2 percent, respectively, in Clark and Nye Counties.	Site employment would decrease by 45 FTEs, increasing unemployment in Clark County by about 0.03 percent and in Nye County by about 0.39 percent. Additional employees would not relocate to Clark or Nye County and there would be no need for new housing or teachers.
	Approximately 500 FTEs over 35 months, with a peak of 1,000 FTEs, would need to be hired for construction of the solar power generation facility.	Approximately 750 FTEs over 42 months, with a peak of 1,500 FTEs, would need to be hired for construction of the solar power generation facility. Other construction projects at the NNSS would require approximately 250 FTEs over the 10-year period.	Approximately 400 FTEs over 32 months, with a peak of 800 FTEs, would need to be hired for construction of the solar power generation facility.
	Direct jobs, indirect jobs, and construction materials purchases would reduce unemployment and have a beneficial effect on local government revenues.	Direct jobs, indirect jobs, and construction materials purchases would have a beneficial effect on the local economy and government revenues.	Direct construction jobs and indirect jobs would reduce the unemployment rate in the region and would have a beneficial impact on the economy in the region. Job loss would have a small negative impact on the local economy; construction material purchases for the solar power generation facility would have a small positive economic impact, including generating additional revenues for local governments.
	Buildings associated with construction and operation of a solar power generation facility and increased site personnel would create a modest increase in demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a larger solar power generation facility and other facilities on site and the increase in personnel would create a greater demand for onsite security and fire and rescue services.	Buildings associated with construction and operation of a solar power generation facility would create a greater demand for onsite security and fire and rescue services.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Geology and Soils (for details go to Chapter 5, Sections 5.1.5.1, 5.2.5.2, and 5.1.5.3)			
National Security/Defense Mission	About 700 acres of soil would be disturbed by dynamic experiments in boreholes, explosives experiments, drillback operations, OST training and exercises, experiments involving biological stimulants, and counterterrorism training.	About 13,455 acres of soil would be disturbed by the same kinds of activities as under the No Action Alternative, including: Up to 10,000 acres of soil would be disturbed for an OST training facility, 120 acres for depleted uranium experiment sites, and 3,335 acres for additional explosives experiments, new test beds and training facilities, drillback operations, and additions to existing aviation facilities at the NNSS.	About 430 acres of soil would be disturbed by many of the same kinds of activities as under the No Action Alternative, except: There would be 50 percent fewer explosive experiments and 33 percent less OST training and exercises.
Environmental Management Mission	About 190 acres of soil would be disturbed for construction of new waste cells at the Area 5 RWMC. Up to 420 acres of soil would be disturbed as part of the Environmental Restoration Program, Soils Project cleanup. Up to 500 acres of soil would be disturbed for development of UGTA project monitoring wells.	About 600 acres of soil would be disturbed for construction of new waste cells at the Area 5 RWMC. About 35 acres of soil would be disturbed for new sanitary and D&D/construction waste landfills in Areas 23 and 25. Environmental Restoration would be the same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission	Construction of a commercial solar power generation facility and associated transmission lines would disturb approximately 2,650 acres.	Construction of 1,000 megawatts of commercial solar power generation facilities and associated transmission lines would disturb up to 10,300 acres. Replacing the existing 138-kilovolt NNSS electrical transmission line would disturb about 467 acres of soil. Construction of a DOE photovoltaic solar power generation facility would disturb about 50 acres of land. Minor soil disturbance expected from several additional research projects. Development of a geothermal demonstration project would disturb up to 50 acres of soil.	Construction of a commercial solar power generation facility could disturb up to 1,200 acres.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Hydrology (for details go to Chapter 5, Section 5.1.6)			
Surface Water Resources (for details go to Chapter 5, Sections 5.1.6.1, 5.1.6.1.1, 5.1.6.1.2, and 5.1.6.1.3)			
National Security/Defense Mission	Disturbance of about 700 acres of land by dynamic experiments in boreholes, explosives experiments, drillback operations, OST training and exercises, experiments involving releases of chemicals and biological simulants, and counterterrorism training would cause alterations of natural drainage pathways, contamination of ephemeral surface waters via chemical agents, and sedimentation to ephemeral surface waters.	About 13,455 acres of soil and near surface geologic media would be disturbed by the same kinds of activities as under the No Action Alternative, plus: Up to 10,000 acres of disturbance for OST training facilities, 120 acres for depleted uranium experiment sites, and 3,335 acres for additional explosives experiments, new test beds and training facilities, drillback operations and additions to existing aviation facilities at the NNSS. This would result in proportionately larger impacts on ephemeral waters compared to the No Action Alternative.	About 430 acres of soil and near surface geologic media would be disturbed by many of the same kinds of activities as under the No Action Alternative, except: There would be 50 percent fewer explosives experiments, and 33 percent less OST training and exercises. This would result in proportionately smaller impacts on ephemeral waters compared to the No Action Alternative.
Environmental Management Mission	Disturbance of up to 190 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 RWMC would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.	Same as under the No Action Alternative, except: Disturbance of up to 600 acres of soil to construct, use, cover, and close disposal units within the existing Area 5 RWMC, plus up to 35 acres of disturbance for new sanitary /D&D/ construction waste landfills would result in impacts on ephemeral waters due to alteration of natural drainage pathways, increased erosion, and subsequent sedimentation.	Same as under the No Action Alternative for both Waste Management and Environmental Restoration.
	The Soils Project would reduce or stabilize legacy contamination in soil and could result in disturbance of up to 420 acres. Soil disturbance on about 500 acres of land from drilling additional wells for the UGTA Project could cause localized erosion, as could D&D of industrial sites, remediation of Defense Threat Reduction Agency sites, and the borehole management program. These activities would affect ephemeral waters by altering natural drainage pathways and increasing sedimentation. Stabilization and/or removal of contaminated facilities and soils would reduce the potential for contamination of ephemeral waters.	Environmental Restoration impacts would be the same as under the No Action Alternative.	

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Nondefense Mission	No new land disturbances would occur during infrastructure-related activities under the No Action Alternative.	Up to 517 acres of land would be disturbed by rebuilding the existing 138-kilovolt transmission line on the NNSS and construction of a 5-megawatt photovoltaic solar generating facility. These disturbances would result in alterations of natural drainage pathways and increased sedimentation of ephemeral waterways.	Same as under the No Action Alternative, except: The land area associated with the solar power generation facility would be 1,200 acres.
	Development of a 240-megawatt commercial solar power generation facility and associated transmission lines would alter natural drainage pathways over 2,650 acres in Area 25, though it is expected that larger ephemeral waters (e.g., Fortymile Wash) would be avoided; however, there would be a potential for chemical contamination of and sedimentation to ephemeral waters during construction-related land preparation.	Development of up to 1,000 megawatts of commercial solar power generation facilities and associated transmission lines would disturb drainage pathways over 10,300 acres and increased erosion and construction/operational activities would potentially increase sedimentation to and chemical contamination of ephemeral waterways. Development of a Geothermal Demonstration Project would disturb up to 50 acres and cause sedimentation to ephemeral waters, as well as long-term alteration of natural drainage pathways.	

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Groundwater Resources (for details go to Chapter 5, Sections 5.1.6.2, 5.2.6.2.1, 5.1.6.2.2, and 5.1.6.2.3)			
Total water use (excluding solar power facility)			
	Total water use for DOE/NNSA activities would not exceed 691 acre-feet per year. This water demand would be below the sustainable yield of all affected hydrologic basins.	Total water use for DOE/NNSA activities would increase by 25 percent from the No Action Alternative to 862 acre-feet per year. This water demand would be below the sustainable yield of all affected hydrologic basins.	Total water use for DOE/NNSA activities would decrease by 10 percent from the No Action Alternative to 622 acre-feet per year. This water demand would be below the sustainable yield of all affected hydrologic basins.
National Security/Defense Mission	No new or additional impacts on groundwater resources.	The following would be additional impacts on the groundwater resource, compared to the No Action Alternative: • 5.5 acre-feet per year of potable water for construction workers. • Water use for new construction of facilities included in the overall 25 percent increase in all water uses.	Same as under the No Action Alternative.
Environmental Management Mission	Through 2020, 30 acre-feet per year of nonpotable water for the drilling of new wells under the UGTA Project. Less than 7 acre-feet of total water use for dust suppression during D&D of facilities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission	Positive impact of reducing potable water production 16 percent by 2015 utilizing water conservation measures.	Same as under the No Action Alternative, plus: • A 5-megawatt photovoltaic solar power system near Area 6 would use 0.5 acre-feet per year of nonpotable water. • A one-time nonpotable water demand of 20 acre-feet to prime a geothermal power plant. Once operational, the geothermal power plant would use 50 acre-feet of water per year.	Same as under the No Action Alternative.
Commercial Solar Power Generation Facilities			
Construction	350 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	1,000 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision	200 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision
Operation	250 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (3,944 acre-feet per year).	700 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (3,944 acre-feet per year).	175 acre-feet per year from Fortymile Canyon, Jackass Flats Subdivision These water demands are below the sustainable yield of the Fortymile Canyon, Jackass Flats Subdivision Basin (3,944 acre-feet per year).

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Biological Resources (for details go to Chapter 5, Sections 5.1.7, 5.1.7.1.1, 5.1.7.2, and 5.1.7.3)			
National Security/Defense Mission	Approximately 295 acres of currently undisturbed desert tortoise habitat would be affected by activities in Frenchman, Yucca, and Jackass Flats; Mercury Valley; and Fortymile Canyon. Estimated number of desert tortoises affected ranges from 4 to 21; all by harassment.	Approximately 1,930 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. Estimated number of desert tortoises affected ranges from 30 to 136; all by harassment.	Approximately 160 acres of currently undisturbed desert tortoise habitat would be affected in the same areas as under the No Action Alternative. Estimated number of desert tortoises affected ranges from 2 to 11; all by harassment.
	Total new disturbed area (about 700 acres) would be 0.09 percent of undisturbed land on the NNSS.	Total new disturbed area (about13,455 acres) would be 1.70 percent of undisturbed land on the NNSS.	Total new disturbed area (about 430 acres) would be 0.05 percent of undisturbed land on the NNSS.
Environmental Management Mission	Approximately 760 acres of currently undisturbed desert tortoise habitat would be affected, primarily by environmental restoration activities in Frenchman Flat, Yucca Flat, Jackass Flats, and Mercury Valley. Estimated number of desert tortoises affected ranges from 4 to 26; all by harassment.	Approximately 1,205 acres of currently undisturbed desert tortoise habitat would be affected because of additional waste management activities. Estimated number of desert tortoises affected ranges from 4 to 33; all by harassment.	Same as under the No Action Alternative.
	Total new disturbed area (about 1,110 acres) would be 0.14 percent of undisturbed land on the NNSS.	Total new disturbed area (about 1,555 acres) would be 0.2 percent of undisturbed land on the NNSS.	
Nondefense Mission	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.	Over the next 10 years, up to 125 desert tortoises would be taken on NNSS roadways, due to non-project vehicle travel. Fewer than 20 of these desert tortoises are expected to be taken by injury or mortality.
	Approximately 2,650 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and Frenchman Flats would be affected by DOE/NNSA activities, including a 240-megawatt commercial solar power generation facility in Jackass Flats. Estimated number of desert tortoises affected ranges from 0 to 41; all by harassment.	Approximately 10,535 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and Frenchman Flats would be affected by DOE/NNSA activities, including 1,000 megawatts of commercial solar power generation facilities in Jackass Flats. Estimated number of desert tortoises affected ranges from 4 to 178; all by harassment.	Approximately 1,200 acres of currently undisturbed desert tortoise habitat in Jackass Flats, Mercury Valley, and Frenchman Flats would be affected by DOE/NNSA activities, including a 100-megawatt commercial solar power generation facility in Jackass Flats. Estimated number of desert tortoises affected ranges from 0 to 19; all by harassment.
	Total new disturbed area (about 2,650 acres) would be 0.34 percent of undisturbed land on the NNSS.	Total new disturbed area (about 10,867 acres) would be 1.37 percent of undisturbed land on the NNSS.	Total new disturbed area (about 1,200 acres) would be 0.15 percent of undisturbed land on the NNSS.

	No Action Alternative	Expanded Operations Alternative	Reduced Operations Alternative
Air quality (for details go to Chapter 5, Sections 5.1.8, 5.1.8.1, 5.1.8.2, and 5.1.8.3 and Appendix D)			
Annual Average Operational Emission in 2015 (tons per year)			
PM_{10}	6.8	20.1	4.4
$PM_{2.5}$	3.4	8.1	2.6
CO	123.3	160.9	109.8
NO_x	39.7	56.6	36.3
SO_2	0.73	1.1	0.43
VOC	5.9	11.0	4.8
Lead	0.030	~0.010	0.0024
Hazardous Air Pollutants	0.41	0.53	0.40
CO_2-equivalent	39,300	49,700	37,500
Peak Year Construction Emissions (tons per year)			
PM_{10}	20.0	129.1	8.4
$PM_{2.5}$	6.0	35.6	2.6
CO	44.8	296.5	24.4
NO_x	56.0	388.6	24.4
SO_2	0.14	0.68	0.08
VOC	6.2	41.6	2.8
Lead	0.0000089	0.000013	0.0000071
Hazardous Air Pollutants	0.038	0.058	0.030
CO_2-equiv (tons per year)	45,000	74,800	40,300
Radiological Air Quality			
	No activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	Except for depleted uranium and radiotracer experiments, no additional activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.	No activities are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions.
Visual Resources (for details go to Chapter 5, Sections 5.1.9, 5.1.9.1, 5.1.9.2, and 5.1.9.3)			
National Security/Defense Mission	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.
Environmental Management Mission	No impacts on visual resources.	No impacts on visual resources.	No impacts on visual resources.
Nondefense Mission	Construction and operation of a solar power generation facility over 2,400 acres of land would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95.	Construction of approximately 200,000 square feet of additional facilities would be added to Desert Rock Airport that would have an adverse effect on visual resources visible from U.S. Route 95. Construction and operation of commercial solar power generation facilities and associated transmission lines over about 10,300 acres of land would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95. A Geothermal Power Project could alter the visual character and reduce visual quality if facilities are built along U.S. Route 95.	Construction and operation of a commercial solar power generation facility over 1,200 acres of land may occur; if so, it would reduce the visual quality from a Class B to a Class C rating in portions of Area 25 visible to viewers on U.S. Route 95.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Cultural Resources (for details go to Chapter 5, Section 5.1.10, 5.5.1.10.1, 5.1.10.2, and 5.1.10.3)			
National Security/Defense Mission	Approximately 700 acres of undisturbed land would be affected by activities in Frenchman, Yucca, and Jackass Flats; Mercury Valley; and Fortymile Canyon. An estimated 24 cultural resource sites would be involved, of which an estimated 10 may be NRHP-eligible.	Approximately 13,455 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 624 cultural resource sites would be involved, of which an estimated 265 may be NRHP-eligible.	Approximately 430 acres of undisturbed land would be affected in the same areas as under the No Action Alternative. An estimated 16 cultural resource sites would be involved, of which an estimated 6 may be NRHP-eligible.
Environmental Management Mission	Approximately 1,110 acres of undisturbed land would be affected, primarily by environmental restoration activities in Frenchman, Yucca, and Jackass Flats; Emigrant and Mercury Valleys; and Fortymile Canyon. An estimated 29 cultural resource sites would be involved, of which an estimated 7 may be NRHP-eligible.	Approximately 1,555 acres of undisturbed land would be affected because of additional waste management activities. An estimated 43 cultural resource sites would be involved, of which an estimated 12 may be NRHP-eligible.	Same as under the No Action Alternative.
Nondefense Mission	No impacts on cultural resources for DOE/NNSA infrastructure and energy conservation activities.	Approximately 517 acres of undisturbed land would be affected by DOE/NNSA infrastructure and renewable energy projects. An estimated 15 cultural resource sites may be involved, of which an estimated 6 would be NRHP-eligible.	Same as under the No Action Alternative for DOE/NNSA activities.
	Approximately 2,650 acres of undisturbed land in the Jackass Flats area would be affected by commercial renewable energy development. An estimated 1,802 cultural resource sites would be involved, of which an estimated 557 would be NRHP-eligible.	Approximately 10,300 acres of undisturbed land would be affected by commercial renewable energy projects. An estimated 7,004 cultural resource sites would be involved, of which an estimated 2,163 would be NRHP-eligible. Approximately 50 acres of undisturbed land would be affected by development of a Geothermal Power Demonstration Project in the Yucca Flat area. An estimated 2 cultural resource sites may be involved, of which 1 would be NRHP-eligible	Approximately 1,200 acres of undisturbed land in the Fortymile Canyon–Jackass Flats area would be affected by commercial renewable energy development. An estimated 816 cultural resource sites would be involved, of which an estimated 252 may be NRHP-eligible.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Waste Management (10-year volumes) (for details go to Chapter 5, Sections 5.1.11.1, 5.1.11.2, and 5.1.11.3)			
LLW	15,000,000 cubic feet of LLW is within the disposal capacity of the Area 5 RWMC.	48,000,000 cubic feet of LLW is within the disposal capacity of the Area 3 RWMS and the Area 5 RWMC.	Same as under the No Action Alternative.
MLLW	900,000 cubic feet of MLLW is within the permitted disposal capacity of Cell 18 in the Area 5 RWMC.	Disposal of 4,000,000 cubic feet of MLLW would require additional permitted MLLW disposal capacity at the Area 5 RWMC	Same as under the No Action Alternative.
TRU waste	9,600 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.	19,000 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.	7,100 cubic feet generated by DOE/NNSA activities in Nevada. All TRU waste disposed within available capacity at WIPP.
Hazardous waste	Total of 210,000 cubic feet, includes 42,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity.	Total of 340,000 cubic feet, includes 170,000 cubic feet generated by commercial solar power generation facilities. All would be recycled, treated, and/or disposed within available offsite capacity.	Total of 190,000 cubic feet, includes 17,000 cubic feet generated by a commercial solar power generation facility. All would be recycled, treated, and/or disposed within available offsite capacity.
Solid waste	Total of 3,800,000 cubic feet, includes 3,700,000 cubic feet generated by DOE/NNSA activities in Nevada and 160,000 cubic feet generated by construction and operation of a 240-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 370,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Total of 10,000,000 cubic feet, includes 9,400,000 cubic feet generated by DOE/NNSA activities in Nevada and 630,000 cubic feet generated by construction and operation of 1,000 megawatts of commercial solar power generation facilities. DOE/NNSA solid waste disposed at the NNSS would not exceed the disposal capacity at NNSS landfills. Included in the DOE/NNSA volume are 970,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.	Total of 3,700,000 cubic feet, includes 3,600,000 cubic feet generated by DOE/NNSA activities in Nevada and 77,000 cubic feet generated by construction and operation of a 100-megawatt commercial solar power generation facility. DOE/NNSA solid waste disposed at the NNSS would not exceed the available capacity at NNSS landfills. Included in the DOE/NNSA volume are 360,000 cubic feet that would be transported off site to be recycled within available offsite capacity. Disposal of waste generated by a commercial solar power generation facility would be the responsibility of that project. NNSS disposal capacity would not be impacted under current permit conditions.
Human Health (for details go to Chapter 5, Sections 5.1.12, 5.1.12.1, 5.1.12.2, and 5.1.12.3 and Appendix G)			
Annual Radiological Impacts of Normal Operations (for details go to Chapter 5, Sections 5.1.12.1.1, 5.1.12.1.2, 5.1.12.1.3, and 5.1.12.1.4 and Appendix G)			
Offsite Population			
Dose (person-rem)	0.50	0.89	0.48
Risk (LCFs)	3×10^{-4}	5×10^{-4}	3×10^{-4}
MEI			
Dose (millirem)	2.8	4.8	2.7
Risk (LCFs)	2×10^{-6}	3×10^{-6}	2×10^{-6}
Workers			
Collective Dose (person-rem)	5.2	6.6	4.8
Risk (LCFs)	3×10^{-3}	4×10^{-3}	3×10^{-3}

	No Action Alternative		***Expanded Operations Alternative***		***Reduced Operations Alternative***	
Annual Industrial Accident Incidence Rate (unless noted otherwise)						
	TRC	***DART***	***TRC***	***DART***	***TRC***	***DART***
Nevada National Security Site, including Commercial Solar Power Facility Operations	32	14	44	20	28	13
Commercial Solar Power Facility Operations only	6.2	3.2	8.3	4.2	5.2	2.7
Commercial Solar Power Generation Facility – Construction (per project duration) [d]	60	31	110	56	44	23
Annual Industrial Accident Fatality Rates						
Nevada National Security Site, including Commercial Solar Power Facility Operations (maximum annual incidence)	0.019 [e]		0.031 [f]		0.015 [g]	
Commercial Solar Power Generation Facility Construction (during construction period)	0.019		0.029 [h]		0.015	
Noise Impacts						
Workers	Mitigated through worker protection practices.		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Public	Minimal due to remoteness of site and distance to receptors.		Same as under the No Action Alternative, but there would be some increased traffic noise due to larger workforce and increase in daily truck trips.		Similar to the No Action Alternative, but slightly reduced due to smaller workforce.	
Facility Accident – Dose Consequence and Annual Risk [b] (for details go to Chapter 5, Sections 5.1.12.2.1, 5.1.12.2.2, and 5.1.12.2.3 and Appendix G)						
Highest Risk Facility Accident – DAF explosion involving 55 pounds of high explosive and 1 kilogram of plutonium (assumed frequency 1 in 1,250 years)						
Offsite Population						
Dose (person-rem)	23		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Risk (LCFs per year)	1×10^{-5}		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
MEI						
Dose (rem)	0.18		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Risk (LCFs per year)	9×10^{-8}		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Noninvolved Workers						
Dose (rem)	6.5		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Risk (LCFs per year)	3×10^{-6}		Same as under the No Action Alternative.		Same as under the No Action Alternative.	

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Environmental Justice (for details go to Chapter 5, Sections 5.1.13.1, 5.1.13.2, and 5.1.13.3)			
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected. An increase in construction jobs for the solar power generation facility could provide jobs for unemployed individuals, which would have a beneficial impact on low-income individuals.	Same as under the No Action Alternative, except there would be a larger number of construction jobs created.	Same as under the No Action Alternative, except there would be fewer construction jobs created.

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DAF = Device Assembly Facility; DART = days away, restrictive, or transferred; D&D = decontamination and decommissioning; FTE = full-time equivalent; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; NNSA = National Nuclear Security Administration; NO_x = nitrogen oxides; NRHP = National Register of Historic Places; NNSS = Nevada National Security Site; OST = Office of Secure Transportation; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; rem = roentgen equivalent man; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; SO_2 = sulfur dioxide; TRC = total recordable cases; TRU = transuranic waste; UGTA = Underground Test Area; VOC = volatile organic compound; WIPP = Waste Isolation Pilot Plant.

[a] The reported radiological risks are the projected number of LCFs in the population and are therefore presented as whole numbers. The calculated value is shown in parentheses.

[b] The risk is the annual increased likelihood of an LCF in the MEI or the noninvolved worker or the increased likelihood of a single LCF occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

[c] Increased risk of an LCF to an individual, assuming the accident occurs. The risk value is doubled for individual doses exceeding 20 rem (NCRP 1993).

[d] Based on 500 full-time equivalent workers for a 35-month construction period for the No Action Alternative; 750 full-time equivalent workers for a 42-month construction period for the Expanded Operations Alternative; and 400 full-time equivalent workers for a 32-month construction period for the Reduced Operations Alternative.

[e] Annualized value based on 500 full-time equivalent workers for a 35-month solar power facility construction period.

[f] Annual value includes value from NNSA construction activities and an annualized rate from solar power facility construction (see footnote h).

[g] Annualized value based on 400 full-time equivalent workers for a 32-month solar power facility construction period.

[h] Annualized value based on 750 full-time equivalent workers for a 42-month solar power facility construction period.

Sources: BLS 2010a; DOE 2010i.

Table 3–4 Summary of Potential Impacts at the Remote Sensing Laboratory

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Land Use (for details go to Chapter 5, Section 5.2.1)			
	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations on Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Infrastructure and Energy (for details go to Chapter 5, Sections 5.2.2.1, and 5.2.2.2, and 5.2.2.3)			
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Energy demand is expected to continue at about 4,850 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 33,673 therms per year. There is adequate capacity to serve this demand and the condition of the gas lines is satisfactory. Approximately 11,000 gallons of JP-8 jet fuel are used each year for aircraft operations. An adequate supply of JP-8 is available directly through Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Transportation and Traffic (for details go to Chapter 5, Sections 5.2.3.1, and 5.2.3.2)			
Transportation	No radioactive materials transported. Nonradioactive material transports are included in Nevada National Security Site impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Traffic	The number of personnel at RSL is expected to remain the same and there are no construction or other projects proposed that would result in increased traffic. There would be no additional impacts on onsite or regional traffic	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
	conditions.		
Socioeconomics (for details go to Chapter 5, Section 5.2.4)			
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Geology and Soils (for details go to Chapter 5, Section 5.2.5)			
	There would be no impacts on geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Hydrology (for details go to Chapter 5, Sections 5.2.6.1, 5.2.6.2, and 5.2.6.3)			
Surface Water Resources	No proposed activities would affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Groundwater Resources	No proposed facilities or activities would adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Biological Resources (for details go to Chapter 5, Section 5.2.7)			
	All activities would occur in previously disturbed, developed areas and would not affect biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Air Quality (for details go to Chapter 5, Sections 5.2.8.1.1, 5.2.8.1.2, and 5.2.8.1.3)			
Annual Average Operational Emission in 2015 (tons per year)			
PM_{10}	0.084	Same as under the No Action Alternative.	Same as under the No Action Alternative.
$PM_{2.5}$	0.067		
CO	4.1		
NO_x	1.6		
SO_2	0.034		
VOC	0.3		
Lead	*~0.01*		
Hazardous Air Pollutants	0.19		
CO2-equivalent	3,147		
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Visual Resources (for details go to Chapter 5, Sections 5.2.9.1, 5.2.9.2, and 5.1.9.3)			
	There would be no impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Cultural Resources (for details go to Chapter 5, Section 5.2.10)			
	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Waste Management (for details go to Chapter 5, Section 5.2.11)			
Hazardous waste	Annually, about 680 cubic feet of hazardous waste generated and transported to be recycled, treated, and/or disposed within available offsite capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Solid waste	Annually, about 4,550 cubic feet generated and transported to be recycled or disposed within available offsite capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Human Health (for details go to Chapter 5, Sections 5.2.12, 5.2.12.1, and 5.2.12.2)			
Normal Operations	There would be no radiological or hazardous chemical risks.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Annual Industrial Accident Incidence Rate	***TRC***: 32 ***DART***: 14	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Noise	Noise from Remote Sensing Laboratory activities and traffic would be minimal compared to ambient traffic noise and aircraft noise at Nellis Air Force Base.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Facility Accidents	There would be no radiological or hazardous chemical accident risks.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Justice (for details go to Chapter 5, Section 5.2.13, 5.2.13.1, 5.2.13.2, and 5.2.13.3)			
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DART = days away, restrictive, or transferred; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; TRC = total recordable cases; VOC = volatile organic compound.

Table 3–5 Summary of Potential Impacts at the North Las Vegas Facility

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Land Use (for details go to Chapter 5, Section 5.3.1)			
	No impacts were identified from the continuation of activities at the current levels of operations or foreseeable actions because activities under this alternative would continue to be compatible with existing land use designations.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Infrastructure and Energy (for details go to Chapter 5, Sections 5.3.2.1 and 5.3.2.2)			
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned. Electric energy demand is expected to continue at about 15,000 megawatt-hours per year and the existing electrical distribution is adequate to support this demand. Natural gas use is expected to continue to be about 48,000 therms per year. There is adequate capacity to serve this demand.	Same as under the No Action Alternative for infrastructure, plus. Electric energy demand would increase by no more than 10 percent. The capacity of the electrical distribution system and the capability of commercial providers are adequate to supply the needed electrical energy.	Same as under the No Action Alternative for infrastructure. Electrical energy demand is expected to be the same as under the No Action Alternative or slightly lower.
Transportation (for details go to Chapter 5, Sections 5.3.3.1 and 5.3.3.2)			
Transportation	No radioactive materials analyzed. Nonradioactive material transports are included in NNSS impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Traffic	No increase in traffic volume due to NLVF-related traffic compared to the projected baseline; levels of service would remain the same.	Approximately a 2 percent increase in daily traffic volumes during peak hours on local roads, when compared to the projected baseline; levels of service would remain the same.	Less than 1 percent decrease in daily traffic volumes during peak hours on local roads; levels of service would remain the same.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Socioeconomics (for details go to Chapter 5, Sections 5.3.4.1, 5.3.4.2, and 5.3.4.3)			
	There would be no change in employment; therefore, there would be no change in socioeconomic impacts.	Employment would increase by 361 FTEs; about 36 employees would relocate from outside the region. Up to 3 new teaching jobs would need to be filled to maintain the current student-to-teacher ratio. Sufficient housing exists in the region to support the increased population. Direct jobs would reduce unemployment by 0.27 and 0.12 percent in Clark and Nye Counties, respectively. Direct jobs and indirect jobs would have a beneficial effect on the local economy and government revenues. The addition of 361 employees would result in an increase in the number of service calls, but would have a negligible impact on area hospitals and hospital personnel.	Employment would decrease by 45 FTEs, increasing unemployment in Clark County by about 0.12 percent and in Nye County by about 0.04 percent. Additional employees would not relocate to Clark or Nye County and there would be no impact on student-to-teacher ratios. Job loss would have a small negative impact on the local economy and government revenues. There would be no impact on public services.
Geology and Soils(for details go to Chapter 5, Sections 5.3.5.1, 5.3.5.2, and 5.3.5.3)			
	Proposed activities would not affect geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Hydrology (for details go to Chapter 5, Sections 5.3.6.1, and 5.3.4.2)			
Surface Water Resources	Proposed activities would not affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Groundwater Resources	Proposed activities would not adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Biological Resources (for details go to Chapter 5, Sections 5.3.7)			
	All activities would occur in previously disturbed, developed areas and would not affect native biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	***Expanded Operations Alternative***	***Reduced Operations Alternative***
Air Quality (for details go to Chapter 5, Sections 5.3.8.1, 5.3.8.2, and 5.3.8.3)			
Annual Average Operational Emission in 2015 (tons per year)			
PM_{10}	0.36	0.44	0.33
$PM_{2.5}$	0.24	0.28	0.21
CO	24.4	30.5	22.0
NO_x	5.9	7.2	5.4
SO_2	0.079	0.095	0.072
VOC	0.77	0.96	0.70
Lead	<0.01	<0.01	<0.01
Hazardous Air Pollutants	0.062	0.078	0.056
CO_2-equivalent	8,378	9,031	8,118
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Visual Resources (for details go to Chapter 5, Sections 5.3.9.1, 5.3.9.2, and 5.3.9.3)			
	There would be no impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Cultural Resources (for details go to Chapter 5, Section 5.3.10)			
	All activities would occur in previously disturbed, developed areas and would not affect cultural resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Waste Management [b] (for details go to Chapter 5, Section 5.3.11)			
LLW	150 cubic feet generated over the next 10 years and disposed within available capacity at the NNSS in the Area 5 RWMC.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Hazardous waste	1,100 cubic feet generated over the next 10 years and shipped off site to be recycled, treated, and/or disposed within available capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Solid waste	500,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	590,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.	460,000 cubic feet generated over the next 10 years and shipped off site to be recycled or disposed within available capacity.

	No Action Alternative		***Expanded Operations Alternative***		***Reduced Operations Alternative***	
Human Health (for details go to Chapter 5, Sections 5.3.12.1 and 5.3.12.2)						
Offsite Population Dose (person-rem) Risk (LCFs) MEI or noninvolved worker Dose (millirem) Risk (LCFs)	 4.1×10^{-5} 2×10^{-8} 3.5×10^{-4} 2×10^{-10}		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Annual Industrial Accident Incidence Rate						
	TRC	***DART***	***TRC***	***DART***	***TRC***	***DART***
North Las Vegas Facility – Site Operations	22	9.5	27	12	20	8.6
Noise	Noise from NLVF-related activities and traffic would not exceed ambient traffic noise.		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Facility Accidents	There would be negligible radiological or hazardous chemical accident risks.		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
Environmental Justice (for details go to Chapter 5, Sections 5.3.13.1, 5.3.13.2, and 5.3.13.3)						
	Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.		Same as under the No Action Alternative.		Same as under the No Action Alternative.	

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DART=days away, restrictive, or transferred; FTE = full-time equivalent; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; MLLW = mixed low-level radioactive waste; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; rem = roentgen equivalent man; RWMC = Radioactive Waste Management Complex; SO_2 = sulfur dioxide; TRC=total recordable cases; VOC = volatile organic compound.

[a] Does not include tritiated liquids shipped from NLVF to the NNSS for treatment.

[b] The volumes of LLW generated at NLVF under the three alternatives shown in this table are included in the volumes of LLW to be disposed at the NNSS under the appropriate alternatives in Table 3–3.

Table 3–6 Summary of Potential Impacts at the Tonopah Test Range

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Land Use (for details go to Chapter 5, Section 5.4.1)			
	There would be no impact on land use from the continuation of activities at the current levels of operations because activities would continue to be compatible with existing land use designations on the TTR and primary land uses on the Nevada Test and Training Range.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
	<u>*Airspace*</u> No new impacts were identified for airspace activities because these activities would be maintained at the current level of air traffic, navigational aid services, airspace structure, and coordinated and scheduled by the Nellis Air Traffic Control Facility.	<u>*Airspace*</u> Same as under the No Action Alternative.	<u>*Airspace*</u> Impacts would be slightly reduced compared to the No Action Alternative because of the discontinuation of fixed rocket and missile launches, cruise missile operations, and detonation of fuel-air explosives at the TTR, which would increase the restricted airspace availability for other military uses as coordinated and scheduled by the Nellis Air Traffic Control Facility.
Infrastructure and Energy (for details go to Chapter 5, Sections 5.4.2.1 and 5.3.4.2)			
	Infrastructure would be maintained as needed to accommodate ongoing activities. No new buildings or facilities are planned.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Transportation [a] and Traffic (for details go to Chapter 5, Sections 5.4.3.1 and 5.4.3.2)			
TTR LLW/MLLW			
Incident-free truck transport			
worker risk (LCF)	0 (0.0008)	0 (0.003)	0 (0.0001)
population risk (LCF)	0 (0.00004)	0 (0.0002)	0 (0.00001)
Transport accidents			
radiological risk (LCF)	0 (3×10^{-9})	0 (1×10^{-8})	0 (1×10^{-7})
nonradiological fatalities	0 (0.03)	0 (0.1)	0 (0.03)
Nonradiological waste transport fatalities	Nonradioactive material transports included in Nevada National Security Site impacts.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Traffic	Up to 2 additional truck trips per day from Environmental Restoration radioactive waste transport; minimal impacts on onsite and regional traffic conditions.	Up to 10 additional truck trips per day from Environmental Restoration radioactive waste transport; minimal impacts on onsite and regional traffic conditions.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Socioeconomics (for details go to Chapter 5, Sections 5.4.4.1, 5.4.4.2, and 5.4.4.3)			
	No change in employment; therefore, no change in socioeconomic impacts.	Employment would decrease by 63 FTEs, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.64 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.	Employment would decrease by 67 FTEs, which would increase the unemployment rate by about 0.01 percent in Clark County and about 1.76 percent in Nye County. Local spending would decrease and revenues for Clark and Nye Counties could decrease. This small decrease would have a negligible adverse impact on local economies. There would be no impact on public services.
Geology and Soils (for details go to Chapter 5, Sections 5.4.5.1, 5.4.5.2, and 5.4.5.3)			
National Security/Defense Mission	There would be localized impacts on soil and geology from tests using gravity weapons, joint test assemblies, and inert projectiles. Some soil contamination could occur. Work for Others – Some localized soil disturbance from a variety of site activities.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Management Mission	Environmental restoration – Possible disturbance of soil from environmental restoration of contaminated sites. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.	Same as under the No Action Alternative, plus, Up to 11,000,000 cubic feet of soil could be removed during environmental restoration activities at the Clean Slate I, II, and III sites. Overall, however, environmental restoration would reduce or stabilize the inventory of legacy contamination.	Same as under the No Action Alternative.
Nondefense Mission	There would be no impacts on geological and soil resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Hydrology (for details go to Chapter 5, Sections 5.4.6.1 and 5.4.5.2)			
Surface Water Resources			
National Security/Defense Mission	Gravity weapons drops and rocket and missile testing could cause alterations of natural drainage pathways and chemical contamination of ephemeral waters. Operation of ground-based remote control vehicles could cause sedimentation to ephemeral waters.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Environmental Management Mission	Environmental restoration projects could cause beneficial restoration of natural drainage pathways and adverse impacts of chemical contamination of and sedimentation to ephemeral waters.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Nondefense Mission	No proposed activities would affect surface hydrology.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Groundwater Resources			
	Proposed activities would not adversely affect groundwater quality or supply.	Same as under the No Action Alternative.	Potable water use would decrease by 50 percent compared to current use because several testing activities would cease.
Biological Resources (for details go to Chapter 5, Section 5.4.7.1)			
	All work would occur in previously disturbed areas and there would be no additional impacts on biological resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Air Quality and Climate (for details go to Chapter 5, Sections 5.4.8.1, 5.4.8.2, and 5.4.8.3)			
Annual Average Operational Emission in 2015 (tons per year) [b]			
PM_{10}	<4.0	<3.8	<3.8
$PM_{2.5}$	<4.0	<3.8	<3.8
CO	<10.8	<6.1	<5.8
NO_x	<17.1	<14.8	<14.7
SO_2	<0.93	<0.92	<0.92
VOC	<1.4	<1.1	<1.1
Lead	<0.010	<0.010	<0.010
Hazardous Air Pollutants	<1.1	<1.1	<1.1
CO_2-equivalent	3,652	1,790	1,671
Radiological Air Quality	No activities are expected to produce radiation beyond those documented for 2008 baseline conditions.	Remediation activities would likely result in increased suspended particulates and higher radiological air emissions relative to those observed in the 2008 baseline conditions. Monitoring would be performed to assess the potential for offsite impacts and the need for mitigating action.	Same as under the No Action Alternative.

	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Visual Resources (for details go to Chapter 5, Sections 5.4.9.1, 5.4.9.2, and 5.4.9.3)			
	No impacts on visual resources.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Cultural Resources (for details go to Chapter 5, Section 5.4.10)			
	All work would occur in previously disturbed areas. DOE/NNSA would consult with the State Historic Preservation Officer prior to environmental restoration of Clean Slate sites I, II, and III because they are considered to be historically significant.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Waste Management [e] (for details go to Chapter 5, Section 5.4.11)			
LLW	200,000 cubic feet generated by Environmental Restoration activities would be disposed within available capacity at the NNSS Area 5 RWMC.	11,000,000 cubic feet generated by Environmental Restoration activities would be disposed within available capacity at the NNSS Area 5 RWMC and Area 3 RWMS.	Same as under the No Action Alternative.
Hazardous waste	About 4,500 cubic feet of hazardous waste would be generated over the next 10 years that would be transported to permitted offsite facilities to be recycled, treated, and/or disposed within available capacity.	Same as under the No Action Alternative.	Same as under the No Action Alternative.
Solid waste	33,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	16,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.	15,000 cubic feet disposed at onsite landfills within available capacity. An additional 61,000 cubic feet recycled or disposed at the NNSS or other offsite facilities within available capacity.

		No Action Alternative		Expanded Operations Alternative		Reduced Operations Alternative	
Human Health (for details go to Chapter 5, Sections 5.4.12.1 and, 5.4.5.12.2)							
Annual Radiological Impacts of Normal Operations due to Legacy Soil Contamination							
Offsite Population	Dose (person-rem) Risk (LCFs)	<1 $<6 \times 10^{-4}$		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
MEI	Dose (millirem) Risk (LCFs)	0.024 1.4×10^{-8}					
Annual Industrial Accident Incidence Rate							
Tonopah Test Range Industrial – Site Operations		***TRC***	***DART***	***TRC***	***DART***	***TRC***	***DART***
		1.6	0.7	0.7	0.3	0.6	0.3
Noise Impacts							
	Workers	Mitigated through worker protection practices.		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
	Public	Large noises and traffic noise mitigated due to remoteness of site and distance to receptors.		Same as under the No Action Alternative, plus: Minimal increase from higher level of traffic		Same as under the No Action Alternative, except; No large noises – fuel-air explosive experiments would not occur.	
Facility Accidents – Dose Consequence and Annual Risk [c] *Highest Risk Accident (Aircraft crash and fire into multiple containers of contaminated soil - estimated frequency 1 in 590,000 per year)*							
Offsite Population	Dose (person-rem) Risk (LCFs per year) [c]	0.012 1×10^{-11}		Same as under the No Action Alternative.		Same as under the No Action Alternative.	
MEI	Dose (rem) Risk (LCFs per year) [c]	0.00034 3×10^{-13}					
Noninvolved Worker	Dose (rem) Risk (LCFs per year) [c]	1.5 2×10^{-9}					
Environmental Justice							
		Impacts on low-income and minority populations would be identical to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.					

CO = carbon monoxide; CO_2-equivalent = carbon dioxide-equivalent; DART = days away, restrictive, or transferred; FTE = full-time equivalent; LCF = latent cancer fatality; LLW = low-level radioactive waste; MEI = maximally exposed individual; NNSA = National Nuclear Security Administration; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter of *n* micrometers or less; rem = roentgen equivalent man; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; SO_2 = sulfur dioxide; TRC = total recordable cases; TTR = Tonopah Test Range; VOC = volatile organic compound.

[a] The reported radiological risks are the projected number of LCFs in the population and are therefore presented as whole numbers. The calculated value is shown in parentheses.

[b] The emissions under the Expanded Operations would be less than the levels projected under the No Action Alternative, as the Record of Decision for the *Complex Transformation Supplemental Programmatic Environmental Impact Statement* would occur under this Expanded Operations Alternative, resulting in smaller, more-efficient operations and fewer employees at the TTR.

[c] The risk is the annual increased likelihood of an LCF in the MEI or noninvolved worker or the increased likelihood of a single LCF occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

3.5 Alternatives Eliminated from Detailed Study

A NEPA review specifies the purpose and need for an agency to take action, describes the action that the agency proposes to meet that purpose and need, and identifies reasonable alternatives to meet all or part of the purpose and need. Potential alternatives that would not achieve the purpose and need for an action may be eliminated from detailed consideration. The Council on Environmental Quality's guidance states that reasonable alternatives include those that are practical or feasible from a common sense, technical, and economic standpoint (CEQ 1981). Accordingly, a potential alternative may be eliminated from detailed consideration if it would result in stated objectives not being met within a reasonable timeframe, such that the underlying purpose and need would not be achieved. A potential alternative may also be eliminated from detailed consideration if it would take too long to implement or would be prohibitively expensive or highly speculative in nature. During scoping for this SWEIS, commenters suggested several alternatives that should be considered in the document. NNSA considered those alternatives but did not analyze them in detail in this SWEIS. This section identifies the alternatives that were considered but eliminated from detailed study and provides a brief explanation of the reason for elimination.

3.5.1 Discontinue Operations at the Nevada National Security Site

Ceasing operations at the NNSS would result in a loss of support for a number of missions and other activities that are critical to national security, including Stockpile Stewardship and Management, Nonproliferation and Counterterrorism, and Homeland Security. In addition, as the only U.S. nuclear weapons testing facility, the NNSS must be available to conduct an underground nuclear test if so directed by the President. Because these activities are vital to national security and are among the major components of the missions assigned to the NNSS by NNSA, discontinuing operations at the NNSS would not achieve the purpose and need stated in Chapter 1.

3.5.2 Transfer the Nevada National Security Site to Another Agency

One organization provided a scoping comment that suggested that the NNSS should be transferred "out of NNSA control and, indeed, out of the 'active' nuclear weapons complex altogether." The comment cited statements by the President, United Nations resolutions, the Comprehensive Test Ban Treaty, and U.S. initiatives to strengthen the Nonproliferation Treaty as support for considering such an alternative. Although the United States has not ratified the Comprehensive Test Ban Treaty, since 1992, it has observed a moratorium on underground nuclear testing. However, there have been no new policies or legislative direction to abandon the capability to conduct an underground nuclear test if extraordinary events jeopardize the supreme national interests, which, if the United States were a signatory, would be allowed by Article IX of the Comprehensive Test Ban Treaty. Further, transferring the NNSS from NNSA as part of a larger plan to consolidate the Nuclear Weapons Complex is not being considered. NNSA completed the *Complex Transformation SPEIS* (DOE/EIS-0236-S4) (DOE 2008l) in October 2008 and announced its Record of Decision (ROD) in December 2008. The *Complex Transformation SPEIS* addressed alternatives for consolidating Nuclear Weapons Complex facilities and activities. Closure of the NNSS and/or transfer of responsibility to another organization were not addressed in the *Complex Transformation SPEIS* or in the ROD. A SWEIS is not an appropriate NEPA document to address a portion of a broader programmatic decision that has not been made or is not under active consideration by the agency. This SWEIS updates previous environmental impact statements (EISs) and other NEPA documents that have provided environmental information supporting a number of decisions about operations at the NNSS. In such situations, an alternative that assumes NNSS operations would cease or be transferred from NNSA would not achieve the purpose and need stated in Chapter 1.

3.5.3 Prepare a Programmatic Environmental Impact Statement

In scoping comments for this *NNSS SWEIS*, the Nevada Attorney General expressed that a programmatic EIS should be prepared for the NNSS. DOE defines a site-wide NEPA document as "a broad scope EIS or Environmental Assessment (EA) that is programmatic in nature and identifies and assesses the individual and cumulative impacts of ongoing and reasonably foreseeable future actions at a DOE site." Although this *NNSS SWEIS* is "programmatic in nature" with regard to DOE/NNSA facilities and activities in the state of Nevada, it would not provide the basis for a DOE programmatic decision, but would provide the basis for site-specific implementation of programmatic decisions that have already been made in existing programmatic EISs and other NEPA documents. Those EISs and other NEPA documents include the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996e), the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997), *Complex Transformation SPEIS* (DOE 2008l), *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE 2002h), as well as a number of project-specific environmental assessments. With regard to this *NNSS SWEIS*, DOE NEPA regulations (10 CFR 1021.330(c)) require large, multiple-facility DOE sites, such as the NNSS, to prepare SWEISs. This *NNSS SWEIS* addresses the full range of missions, programs, capabilities, projects, and activities under the purview of NNSA in Nevada. Where project information is sufficiently specific, the analyses are similarly specific and will support implementing decisions by NNSA. Where project information is insufficient to support an implementing decision, or if there are statutory or regulatory uncertainties, a more programmatic description is provided and implementation would require an appropriate level of additional NEPA analysis.

3.5.4 Renewable Energy Alternative

NNSA announced in its Notice of Intent for this SWEIS (74 *Federal Register* [FR] 36691) that it would address a Renewable Energy Alternative. During the scoping meetings, several suggestions were made to include renewable energy in each of the alternatives addressed in this SWEIS. NNSA recognizes the need to incorporate, as appropriate, conservation and renewable energy planning as part of the activities it undertakes at the NNSS. Therefore, the Renewable Energy Alternative was not addressed as a separate alternative, but was made part of each of the alternatives addressed in detail in this SWEIS.

3.5.5 1996 Record of Decision-Based No Action Alternative

As indicated in its Notice of Intent to prepare this SWEIS, dated July 24, 2009 (74 FR 36691), NNSA initially defined the No Action Alternative as "the continued implementation of the *1996 NTS EIS* ROD, and the amendment to the ROD for the *1996 NTS EIS* (65 FR 10061 at 10065) at DOE/NNSA sites in Nevada over the next 10 years." The Notice of Intent also stated that No Action would "include the implementation of other decisions supported by separate NEPA analyses completed since the issuance of the *1996 NTS EIS*" as well as "actions analyzed in eight environmental assessments and their associated Findings of No Significant Impacts, as well as actions categorically excluded from the preparation of either an EA or EIS." The original No Action Alternative considered for analysis in this SWEIS would have addressed significantly higher numbers of many DOE/NNSA activities, based on levels of activities analyzed in the *1996 NTS EIS*. As development of this SWEIS progressed, it became apparent that those potential levels of activities were unrealistically high in some cases. For this reason, DOE/NNSA decided to base the analysis for the No Action Alternative in this SWEIS on actual levels of operations known to have occurred since 1996. For instance, the *1996 NTS EIS* analyzed 1,100 potential dynamic plutonium experiments over a 10-year period. Under the No Action Alternative, this SWEIS considers up to 10 such experiments per year, or 100 over the next 10 years.

3.6 Identification of the Preferred Alternative

Council on Environmental Quality regulations for implementing NEPA (40 CFR 1502.14(e)) require an agency to identify its preferred alternative or alternatives, if one or more exists, in the draft EIS. At this time, NNSA has not selected a preferred alternative. NNSA will evaluate the information presented in this *NNSS SWEIS*, the comments received on the draft SWEIS, and other factors before selecting a preferred alternative, which will be identified in the final SWEIS. NNSA may identify an alternative in its entirety, or may identify a "hybrid" preferred alternative comprising various capabilities, projects and activities selected from among the three alternatives.

CHAPTER 4
AFFECTED ENVIRONMENT

4.0 AFFECTED ENVIRONMENT

This chapter describes the existing environmental conditions of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site), the Remote Sensing Laboratory (RSL) at Nellis Air Force Base, the North Las Vegas Facility (NLVF), and the Tonopah Test Range (TTR). During the preparation of this *Site-Wide Environmental Impact Statement for the Nevada National Security Site and Offsite Locations in the State of Nevada (NNSS SWEIS)*, the most up-to-date and accurate information available was used to describe existing environments, facilities, activities, and projects. This information serves as a baseline from which to identify and evaluate environmental changes resulting from the proposed alternatives. The baseline conditions, for the purpose of analysis, are the conditions that currently exist.

The environmental resources discussed in this chapter include land use, infrastructure and energy, transportation, socioeconomics, geology and soils, hydrology, biological resources, air quality and climate, visual resources, cultural resources, waste management, human health, and environmental justice. For some environmental resource areas, the regions of influence (ROIs) are limited to the areas contained within each U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) jurisdictional boundary. For other environmental resource areas, such as transportation and air quality, the ROIs are larger and include all of southern Nevada, as well as portions of Utah, Arizona, and California.

4.1 Nevada National Security Site

This section describes the existing environmental conditions found at the NNSS, a unique national resource managed by the NNSA Nevada Site Office (NNSA/NSO) that is located approximately 57 overland miles from the intersection of Interstate 15 and U.S. Route 95 in Las Vegas, Nevada. The NNSS covers approximately 1,360 square miles (larger than the state of Rhode Island) and is one of the largest restricted access areas in the United States. The NNSS is surrounded by thousands of additional acres of land withdrawn from the public domain for use as a protected wildlife range and a military gunnery range, creating an unpopulated land area of nearly 6,500 square miles.

NNSA consulted with American Indian tribes and groups that have cultural affiliation with the NNSS to obtain input for this site-wide environmental impact statement (SWEIS). American Indian input regarding natural and cultural resources at the NNSS was provided by the American Indian Writers Subgroup of the Consolidated Group of Tribes and Organizations (CGTO) and may be found in shaded text boxes throughout this chapter identified with a CGTO feather icon.

4.1.1 Land Use

The NNSS is located about 57 miles northwest of downtown Las Vegas in the remote desert and mountainous terrain of southern Nye County, Nevada, at the southern end of the Great Basin. The Federal Government (primarily the U.S. Bureau of Land Management [BLM], the U.S. Department of Defense [DoD], DOE/NNSA, and the U.S. Forest Service [USFS]) manage more than 85 percent of the land in Nevada, and 93 percent in Nye County (DOE 2008g). Approximately 22 percent of the total land area in Nye County, including the NNSS, is designated for federally restricted access for U.S. Government activities.

The NNSS consists of sparsely vegetated basins or flats—Jackass Flats in the southwestern quadrant, Frenchman Flat in the southeastern quadrant, and Yucca Flat in the northwestern quadrant—separated by low mountains that dominate the western and southern sides of the site. Frenchman Flat and Yucca Flat each contain a large playa (the flat-floored bottom of a desert basin that may contain water after a seasonally high runoff). The northeastern quadrant of the site comprises mountains with a pinyon-juniper and sagebrush forest separated by canyons. The dominant mountains in this quadrant are Rainier Mesa near the center of the northern border and Pahute Mesa in the northwestern region of the site (DOE 2002f; Wills and Ostler 2001).

The NNSS is controlled by DOE/NNSA and is the largest and most extensive of NNSA's sites in terms of the complexity of its facilities, buildings, and infrastructure, and its land area. Although the NNSS is under DOE management, DoD and other customers use the site for National Security/Defense and Nondefense Mission-related experiments, training, and research. Chapters 2 and 3 of this SWEIS describe in more detail the missions, levels of operation, and clients that use the NNSS. Numerous offices, laboratories, and support buildings are located throughout the NNSS to assist in these missions.

In 1998, the DOE Nevada Operations Office (now NNSA/NSO) prepared a Resource Management Plan for the NNSS, as specified in the Record of Decision (ROD) (65 *Federal Register* [FR] 10061) for the 1996 *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*. The goals for managing the NNSS resources (both natural and manmade) were developed in consideration of the balance between the primary mission of the NNSS, economic development, and the limits of ecological sustainability. While the principles of the Resource Management Plan have been retained, the primary planning document for new facilities and programs throughout the NNSA complex is the Ten-Year Site Plan. Ten-year site plans are required by DOE Order 430.1B, *Real Property Asset Management* (DOE 2008e), and the NNSS Ten-Year Site Plan is used as an integrated planning tool to help develop an efficient and responsive infrastructure that effectively supports NNSA/NSO's missions.

4.1.1.1 Adjacent Land Use

The lands adjacent to the NNSS include the Nevada Test and Training Range (formerly Nellis Air Force Range), Desert National Wildlife Refuge, and Nye County. The NNSS is located within Nye County, which comprises communities widely separated by distance and which, in 2008, had a population of 43,600 people (USCB 2008b). The nearest community to the NNSS is Amargosa Valley, located about 2 miles south of the NNSS, with a population of 1,400. Additional nearby communities include Indian Springs (about 16 miles southeast of the NNSS, population 1,400); Beatty (about 17 miles west of the NNSS, population 800); Pahrump (about 26 miles south of the NNSS, population 38,200); and Alamo (about 42 miles northeast of the NNSS, population 460). There are other urban and residential land uses outside of and adjacent to the NNSS in the Pahrump Valley (about 22 miles southwest of the NNSS), which is the largest populated area near the NNSS (NV State Demographer's Office 2008). Las Vegas is the closest major metropolitan area (about 57 overland miles southeast of the NNSS, population 564,484) (USCB 2008b).

Nevada Test and Training Range. The Nevada Test and Training Range surrounds the NNSS to the north, east, and west, and is managed by the U.S. Air Force (USAF). It provides a safe and secure remote desert location to test equipment and train military personnel. Testing and training activities occurring on the Nevada Test and Training Range include armament and high-hazard testing (aerial gunnery, rocketry, electronic warfare), tactical maneuvering training, and equipment and tactics development and training. The Nevada Test and Training Range also provides a 3-million-acre security and safety buffer area for activities occurring on the NNSS because it is withdrawn from public use and has limited public access.

Desert Wildlife National Refuge. The Desert National Wildlife Refuge, administered by the U.S. Fish and Wildlife Service (USFWS), is located mostly within the southeastern section of the Nevada Test and Training Range, along the eastern border of the NNSS. The refuge was established in 1936 with the primary objective being the sustainability of the desert bighorn sheep and its habitat. The portion of the refuge that is within the Nevada Test and Training Range is closed to public access. This results in approximately 5,470 acres of additional remote, unpopulated land area surrounding the NNSS, withdrawn from public domain and use (USFWS 2009b).

Bureau of Land Management Land. BLM manages lands adjacent to the NNSS to the south and southwest. BLM is responsible for carrying out numerous programs for the management and conservation of public lands and resources throughout Nevada. Land uses occurring on BLM-managed lands include agriculture, energy and mineral extraction, livestock grazing, and recreation. These lands also provide resources for fish and wildlife habitat (including wild horses and burros); wilderness areas; and archaeological, paleontological, and historic sites. A small portion of the Nevada Wild Horse Range, one of the many herd management areas within Nevada, overlaps the northwestern corner of the NNSS. BLM is responsible for managing the wild horse population under the Wild Free-Roaming Horses and Burros Act of 1971; however, access to the range is coordinated through NNSA.

Nye County. Primary land uses in Nye County occurring in close proximity to the NNSS include mining, grazing, agriculture, and recreation. Section 4.1.5.3 describes soils, including the status of prime farmland soils at the NNSS. **Figure 4–1** depicts land ownership and uses surrounding the NNSS.

BLM has identified seven solar energy study areas in Nevada. The closest study area to the NNSS is in Amargosa Valley, located south and west of the NNSS's southwestern corner, along the U.S. Route 95 corridor between Beatty and Pahrump. Lands identified as solar energy study areas have excellent solar resources and suitable slope, as well as proximity to roads and transmission lines or designated corridors, and include at least 2,000 acres of BLM-administered public lands. Sensitive lands, wilderness, and other high-conservation-value lands, as well as lands with conflicting uses, were excluded from consideration as solar study areas. BLM published a Notice of Intent in the *Federal Register* on July 13, 2009, announcing the development of an environmental impact statement for the Amargosa Farm Road Solar Energy Project. An application for a 4,350-acre right-of-way on public lands was submitted to BLM for two 224-megawatt, dry-cooled solar power generation facilities, as well as thermal storage tanks. This document is expected to be finalized after publication of this SWEIS.

DOE and BLM have initiated preparation of a programmatic environmental impact statement to evaluate utility-scale solar energy development, to develop and implement agency-specific programs that would establish policies and mitigation strategies for solar energy projects, and to amend relevant BLM land use plans with the intent of establishing a new BLM solar energy development program.

4.1.1.2 Historical Nevada National Security Site Development and Current Land Use

Historical Nevada National Security Site Development

Until the mid-1900s, the land on which the NNSS would be established provided traditional, ceremonial, and recreational areas for American Indians. The first European Americans known to traverse what is now the NNSS were emigrants on their way to California in 1849. Short-lived periods of mining and ranching occurred in this region. Military use of the area began in 1940 and, since that time, the NNSS has remained associated with national security and defense activities (DOE 2002f). Section 4.1.10 includes a more detailed description of the history of the NNSS.

There are 19 historic mining districts on the NNSS, as described in the *1996 NTS EIS*. These mining districts would be of interest for economic mining if the NNSS were opened for public access; however, the NNSS has been closed for commercial mineral development since the 1940s (DOE 1996c).

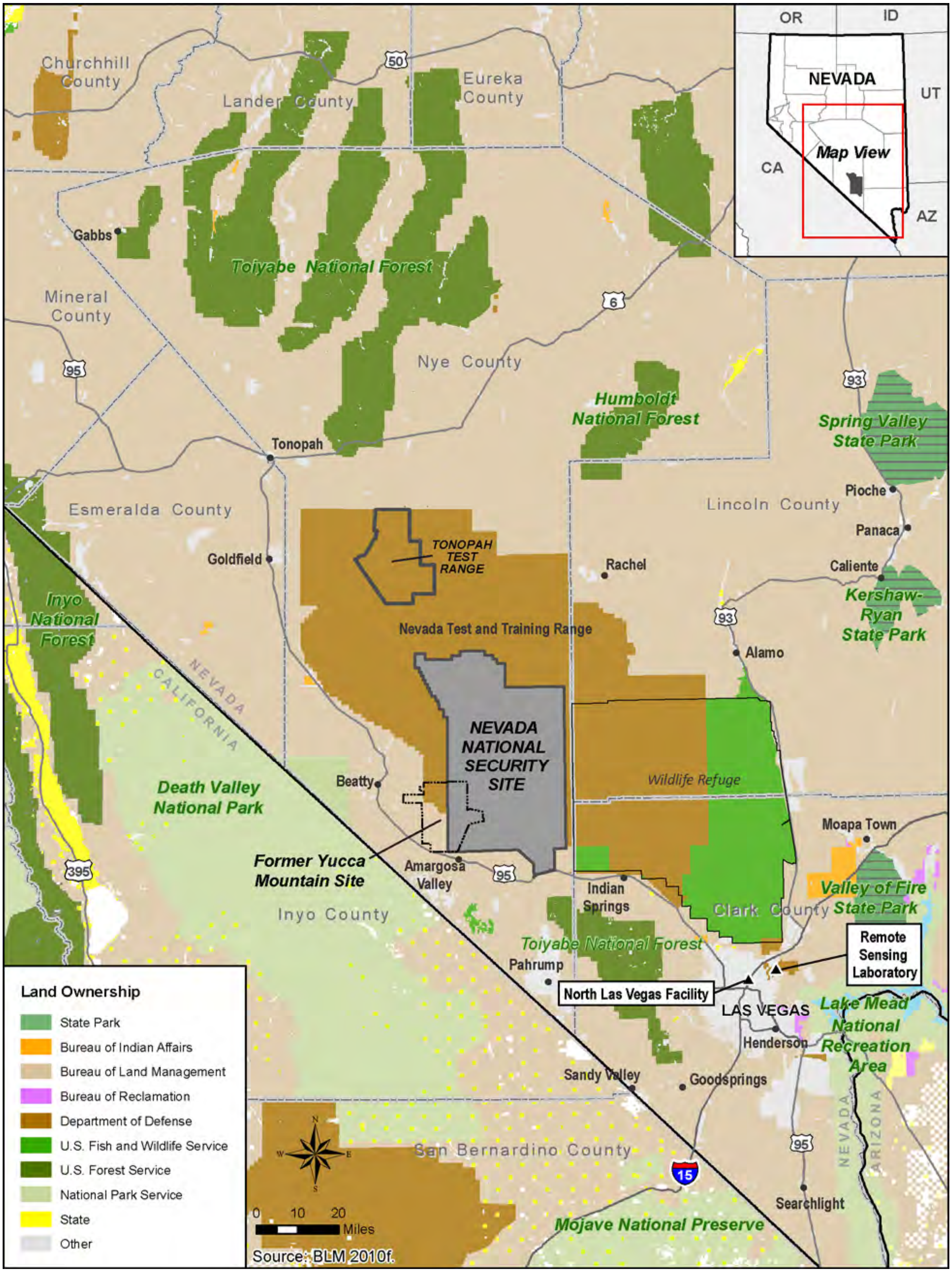


Figure 4–1 Location of Nevada National Security Site and Offsite Locations in the State of Nevada

The first atmospheric nuclear test detonation at the NNSS took place in 1951 on Area 5 of Frenchman Flat. Atmospheric detonations associated with nuclear testing continued through the 1950s until international test ban negotiations culminated in the Limited Test Ban Treaty of 1963, which banned atmospheric testing, but continued to allow underground testing. Nuclear testing occurred at the NNSS for over 40 years until the President declared a moratorium on nuclear weapons testing in October 1992. During the same time that the NNSS was being used for testing nuclear weapons, tests and experiments under the Plowshare Program were conducted there to support and promote peaceful uses of nuclear detonations. Testing and activities associated with these other projects continued until the mid-1970s. These weapons effects experiments have left behind damaged or demolished military hardware, as well as everyday structures and artifacts of domestic life, such as a bank vault, a train trestle, an underground parking garage, and houses built of various materials. Hundreds of saucer-like craters, formed by the subsidence of the ground above an underground test, are located throughout the areas where these detonations occurred.

Plowshare Program

Beginning in 1961, the Plowshare Program was a research development activity, consisting of 35 individual nuclear detonations, established to explore a wide variety of peaceful uses for the inexpensive energy available from nuclear explosions. The majority of detonations that took place at the Nevada National Security Site occurred in the Yucca Flat region.

Peaceful applications utilizing the explosive energy from aboveground detonations that were explored include rock-moving exercises to facilitate the construction of canals, harbors, and dams and aid in the construction of highway and railroad corridors through mountainous areas. Underground engineering applications that were explored include stimulation of natural gas production and formation of underground natural gas and petroleum storage reserves.

Despite great expectations, many projects within the Plowshare Program did not progress past the planning phase. A lack of confidence that projects could be completed at less cost than by conventional means and insufficient public and congressional support led to the program's termination.

Inaccessible to the public, Mercury (formerly called Base Camp Mercury), the "town" located at the entrance to the NNSS, is about 5 miles north of U.S. Route 95. Development of this built-up area increased after 1951, after which it served as a base camp area providing basic facilities for personnel involved with NNSS operations and reached its peak usage by the end of the 1960s. During this time, Mercury served, and continues to serve, as the center of administrative services and activities for the NNSS. It provides a variety of structures and services, including office space, laboratory facilities, fire and medical facilities, and overnight living quarters for personnel (DOE 2007e). Mercury is described in more detail in Chapter 2 of this SWEIS.

The NNSS is divided into numbered operational areas to facilitate management; communications; and distribution, use, and control of resources. Chapter 2, Table 2–1, of this SWEIS describes these operational areas and identifies where atmospheric and underground nuclear testing previously occurred.

Current DOE/NNSA Use. The NNSS currently supports work under three missions: (1) National Security/Defense, (2) Environmental Management, and (3) Nondefense. Further details are included in Chapter 2 of this SWEIS. Since the cessation of nuclear testing in 1992 and the subsequent creation of the Stockpile Stewardship Program, NNSA has consolidated working environments and disposed many excess facilities. As of 2008, the NNSS has 486 buildings, 113 trailers, a 340-mile onsite network of paved roads, and over 300 miles of unpaved roads within its 880,000 acres (DOE 2008i). Most of the experimental facilities and infrastructure are concentrated along the main roadway thoroughfare (Mercury Highway); the majority of maintenance, support, and development activities also are located along this corridor.

Current Military Use. Military organizations use portions of the NNSS for land area exercises and training involving navigation, maneuvering through obstacles, mission rehearsal, and related tactics. The remote areas of the NNSS also provide these organizations with the ability to perform classified exercises**.**

Existing facilities at the NNSS that resemble real-world chemical, water, and nuclear plant facilities are used by DoD for training scenarios and test beds for sensors for both counterproliferation exercises and defensive security force training. The geology, geography, and tunnel complexes of the NNSS provide unique training venues for DoD and other Federal agencies because these features replicate real-world interests.

Public Use. Access to the NNSS is restricted and limited to public bus tours. Tours must be scheduled in advance. Timber Mountain Caldera, a unique volcanic feature listed as a National Natural Landmark by the National Park System, is located on both the NNSS and USAF-managed Nevada Test and Training Range lands. The U.S. National Park Service manages the Timber Mountain Caldera site, except for portions within the NNSS that are managed by NNSA. Access to this site through portions located within the NNSS is coordinated by NNSA.

Under Executive Order 13007, *Indian Sacred Sites*, Federal land agencies are directed, to the extent practical, to allow access to and ceremonial use of American Indian sacred sites by American Indian religious practitioners (DOE 2008f).

Land Use—American Indian Perspective

The Nevada National Security Site (NNSS) area is part of the traditional Holy Lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone peoples. We rely on these lands for medicinal purposes, religious activities and ceremonies, food, recreational use, and integral places described in traditional narratives and religious ceremonies.

Indian people know these lands contain not only archaeological remains left by our ancestors but also natural resources and geologic formations in the region, such as plants, animals, water sources and minerals; natural landforms that mark important locations for keeping our history alive and for teaching our children about our culture. We use traditional sites in the NNSS region to make tools, stone artifacts, and ceremonial objects; many sites are also associated with traditional healing ceremonies and power places.

For many centuries, the NNSS area has been a central place in the lives of American Indian tribes, continuously used by these tribes from antiquity to contemporary times. Until the mid-1900s, traditional festivals involving religious and secular activities attracted American Indian people to the area from as far as San Bernardino, California. Similarly, groups came to the area from a broad region during the hunting season and used animal and plant resources that were crucial for their survival and cultural practices.

Several areas in the NNSS region are recognized as traditionally or spiritually important. For example, Fortymile Canyon is an important crossroad where trails from such distant places as Owens Valley, Death Valley, and the Avawatz Mountain come together. Black Cone, in Crater Flats is an important religious site that is considered to be an entry to the underworld (AIWS 2005). Prow Pass continues to be an important ceremonial site and, because of this religious significance, tribal representatives recommend that the U.S. Department of Energy (DOE) avoid affecting this area (Stoffle et al. 1988). Oasis Valley was historically an important area for trade, and continues to be a place recognized for ceremonial use. Other areas are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and possible burial sites. Despite the current physical separation of tribes from the NNSS and neighboring lands, we continue to recognize the meaningful role of these lands in our culture and continued survival.

The Consolidated Group of Tribes and Organizations (CGTO) maintains we have Creation-based rights to protect, use, and have access to lands of the NNSS and the immediate area. These rights were established at Creation and persist forever. Despite the loss of many traditional lands on the NNSS to pollution and reduced access, Indian people have neither lost our ancestral ties nor have we forgotten our responsibilities in caring for it. As one elder noted, *"Land is to be respected. It sustains us economically, spiritually, and socially."*

During the past decade, representatives of the CGTO have visited portions of the NNSS and have identified places, spiritual trails, and cultural landscapes of traditional and contemporary cultural significance. Because this is a public document, the exact locations of these areas will not be revealed; however, they do include a burial cave, a Native American Graves Protection and Repatriation Act (NAGPRA) reburial area, and a local trail and ceremonial landscape near a large water tank. These actions by DOE are considered positive steps towards facilitating co-stewardship arrangements between DOE and the CGTO to help co-manage important Indian resources of the NNSS and to regain balance.

See Appendix C for more details.

4.1.1.3 Public Land Orders and Withdrawals

The NNSS comprises several separate land transfers from other Federal agencies to DOE/NNSA, as well as land from a legislative withdrawal. The NNSS is federally owned, access-controlled, and withdrawn from public settlement, location, or entry. Withdrawal of land from public use also excludes public mining and mineral leasing.

Public lands may be withdrawn and reserved for military training and testing in support of the Nation's national defense requirements. Lands designated as withdrawn are typically withdrawn from all forms of appropriation under public land laws. The term "withdrawal," as defined by the *Federal Land Policy and Management Act of 1976*, as amended in 2001 (Public Law 92-579), means withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of (1) limiting activities under those laws to maintain other public values in the area; (2) reserving the area for a particular public purpose or program; or (3) transferring jurisdiction of an area of Federal land, other than "property" governed by the Federal Property and Administrative Services Act, as amended (40 *United States Code* [U.S.C.] 472), from one department, bureau, or agency to another department, bureau, or agency.

The following three administrative land withdrawals (public land orders) by the Secretary of the Interior and one legislative withdrawal by Congress, provide the jurisdictional basis for DOE's stewardship and management of the lands constituting the NNSS:

Public Land Order 805. Public Land Order 805, issued on February 12, 1952, reserved approximately 435,000 acres of land for use by the Atomic Energy Commission as a weapons testing site.

Public Land Order 2568. Public Land Order 2568, issued on December 19, 1961, transferred 318,000 acres of land previously reserved for the USAF to the jurisdiction of the Atomic Energy Commission for use in connection with the NNSS for test facilities, roads, and safety distances.

Public Land Order 3759. Public Land Order 3759, issued on August 3, 1965, reserved 21,108 acres of land for placement under the jurisdiction of the Atomic Energy Commission for use in connection with the NNSS.

Military Lands Withdrawal Act of 1999, Public Law 106-65. Enacted on October 5, 1999, this act renewed the withdrawal of lands known as "Pahute Mesa" that are an integral part of the NNSS and provided the site of nuclear weapons testing activities. Pursuant to the act, these lands were transferred from DoD to DOE, thus aligning jurisdictional responsibilities consistent with DOE's retention of environmental, safety and health responsibilities at the NNSS. Use of this area by DOE was previously covered under a Memorandum of Understanding with the USAF.

Figure 4–2 depicts the current NNSS boundary and the boundary prior to 1999.

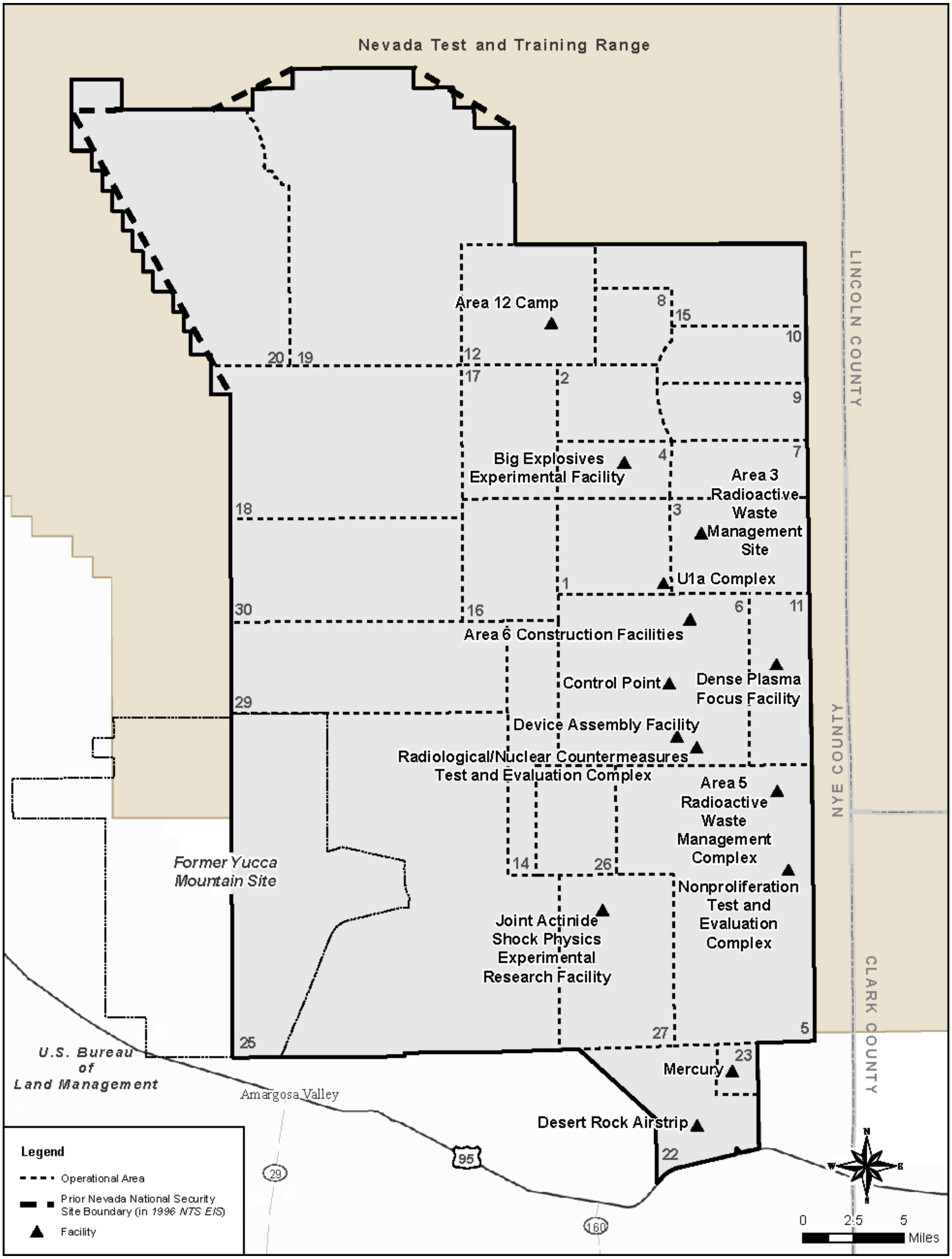


Figure 4–2 Nevada National Security Site Boundary Resulting from the Military Lands Withdrawal Act of 1999 (Public Law 106-65)

Area 5 Land Transfer. As part of an April 1997 settlement agreement between the State of Nevada and DOE, consultation with the U.S. Department of Interior, which oversees BLM, was initiated concerning the status of existing land withdrawals with regard to low-level radioactive waste (LLW) storage and disposal. This consultation process concluded when in November 2009, when DOE/NNSA formally accepted permanent custody of and accountability for the 740-acre Area 5 Radioactive Waste Management Complex (RWMC).

Yucca Project. In 1994, the DOE Nevada Operations Office (now NNSA/NSO) entered into a management agreement with the Yucca Mountain Site Characterization Office for use of about 58,000 acres of NNSS land for site characterization activities related to the Yucca Mountain Project. Under this agreement, the Yucca Mountain Project was responsible for meeting the same environmental requirements that apply to the NNSS independent of, but in coordination with, DOE.

DOE's portion of *The Budget of the United States Government Fiscal Year 2011* states, "The Administration has determined that Yucca Mountain, Nevada, is not a workable option for a nuclear waste repository and will discontinue its program to construct a repository at the mountain in 2010. The Department will carry out its responsibilities under the Nuclear Waste Policy Act within the Office of Nuclear Energy as it develops a new nuclear waste management strategy."

4.1.1.4 Land Use Designations

Existing land use on the NNSS is divided into seven zone designations that support the three NNSS missions: National Security/Defense, Environmental Management, and Nondefense.

These land use zone designations, which are described in **Table 4–1**, include previously disturbed areas, areas with desirable slope and soil conditions for construction, and areas that have mission requirements such as remoteness and space for safety and security reasons. The areas within the land use zones may be sensitive to development for mission, environmental, or cultural reasons, and certain areas are protected from certain uses; however, these zones may host activities not normally associated with the particular zone designation, pending compatibility with existing activities or other factors that would affect collocation of activities, including the health and safety of personnel or avoidance of environmentally sensitive areas.

Most of the experimental facilities are consolidated along a central corridor leading to Mercury Highway (the main thoroughfare on the NNSS). To help simplify the distribution, use, and control of resources, the NNSS is also divided into 26 numbered operational areas. The zone designations generally encompass portions of one or more NNSS areas and are depicted in **Figure 4–3**. Chapter 2, Table 2–1, describes the historical use of the NNSS operational areas, and Chapter 2, Section 2.1.1, describes the major facilities. Section 4.1.2 describes the facilities located within each of the numbered areas, and Section 4.1.11 describes waste management activities and support facilities in detail.

Table 4–1 Description of the Nevada National Security Site Land Use Zone Designations

Zone Designation	*Description of Zone Designation*	*Acres of Zone Designation on the NNSS*	*Operational Area within Zone Designation*
Defense Industrial Zone	Land area designated for stockpile stewardship experiments and operations to maintain confidence in the safety and reliability of the stockpile without underground nuclear testing. Activities include exercises, operations, and experiments (including subcritical experiments involving special nuclear materials). The land area is located around critical assembly areas and is dedicated to defense-related activities.	41,700 acres	Area 27; portions of Areas 6 and 5
Nuclear Test Zone	Land area reserved for underground hydrodynamic tests, dynamic experiments, and underground nuclear weapons and weapons effects tests. This zone includes compatible defense and nondefense research, development, and testing activities. The emplacement hole inventory, underground alcove areas where radioactive materials are tested (designed such that radioactive materials will not reach aboveground environments), is located within this zone.	224,000 acres	Areas 7,8,9,10,19, and 20; portions of Areas 6 and 11
Nuclear and High Explosives Test Zone	Land area designated for additional underground and aboveground high-explosive tests or experiments. This zone includes compatible defense and nondefense research, development, and testing activities.	103,800 acres	Areas 1,2,3,4,12, and 16
Radioactive Waste Management Zone	Land area designated for the shallow land burial of low-level and mixed low-level radioactive wastes.	820 acres	Portions of Areas 3 and 5
Research, Test, and Experiment Zone	Land area designated for small-scale research, development projects, pilot projects, and outdoor tests and experiments related to development, quality assurance, or reliability of materials and equipment under controlled conditions. This zone contains compatible defense and nondefense research, development, and testing projects and activities.	76,200 acres	Areas 14 and 26; portions of Areas 5 and 25
Reserved Zone	Controlled-access land area that provides a buffer between nondefense research, development, and testing activities. The Reserved Zone includes areas and facilities that provide widespread flexible support for diverse short-term nondefense research, testing, and experimentation. This land area is also used for short-duration exercises and training, such as Nuclear Emergency Search Team and Federal Radiological Monitoring and Assessment Center training and land navigation exercises and training.	410,100 acres (includes acreage from the former Yucca Mountain Project Zone)	Areas 15, 17, 18, 29, and 30; portions of Areas 5, 6, 11, 22, 23, and 25
Renewable Energy Zone	Land area and infrastructure reserved for future solar power development, light industrial equipment, and commercial manufacturing capability.	11,900 acres	Portions of Areas 22, 23, and 25

NNSS = Nevada National Security Site.

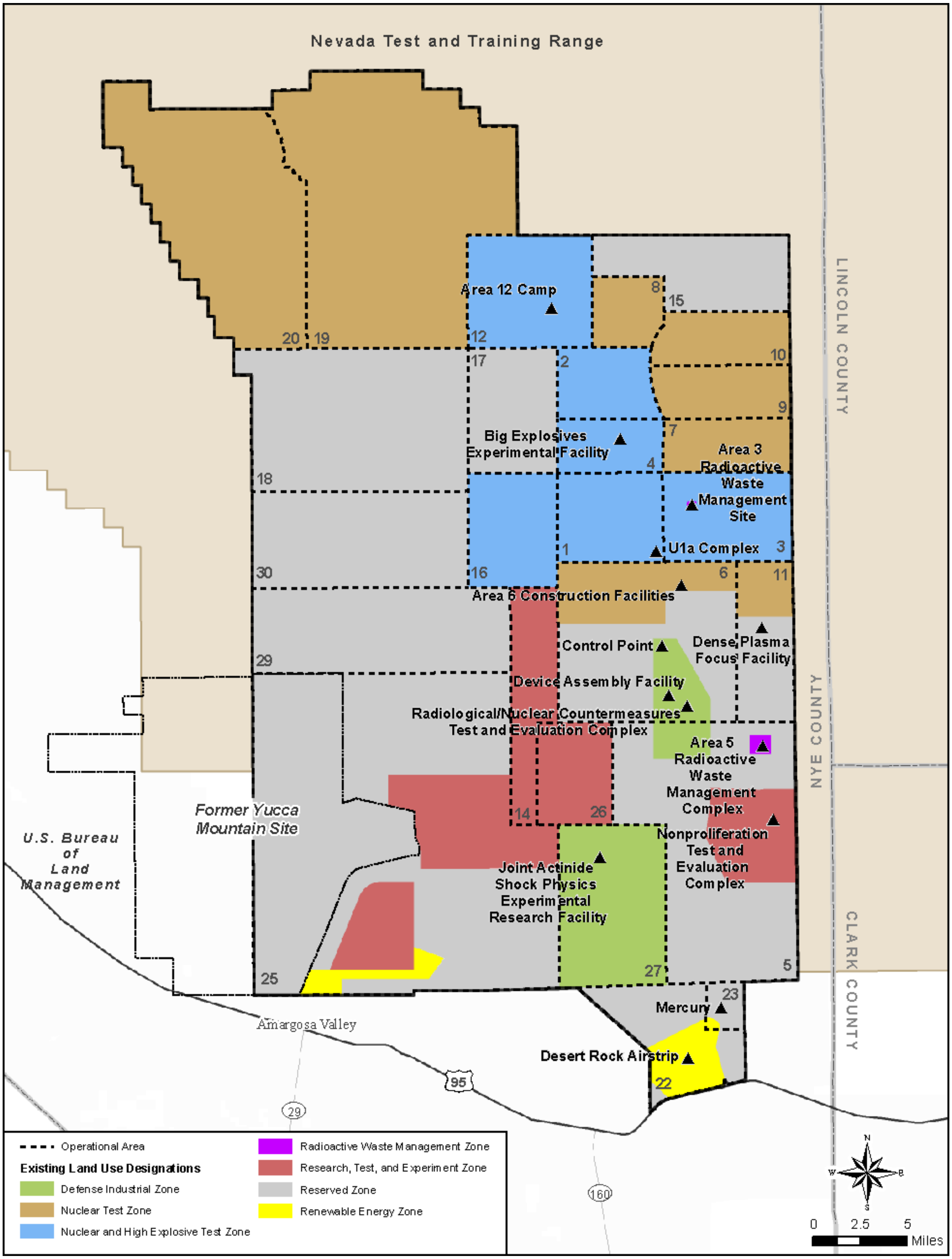


Figure 4–3 Existing Land Use Zones and Major Facilities on the Nevada National Security Site

4.1.1.5 Airspace

Approximately 40 percent of the airspace within Nevada is military "special use" airspace. Airspace in Nevada is managed in a manner that best serves the competing needs of commercial, general, military, and DOE's aviation interests. The Federal Aviation Administration (FAA) is responsible for the overall management of airspace and has established different airspace designations that are designed to protect aircraft flying to or from an airport, transiting between airports, or operating within special use areas identified for defense-related purposes. Flight rules and air traffic control procedures have been established to govern how aircraft must operate within each type of designated airspace.

Special Use Airspace

Airspace where activities must be confined because of their nature or where limitations are imposed upon aircraft operations that are not part of those activities, or both. This airspace includes restricted airspace, military operations areas, and controlled firing areas.

Restricted Airspace

An area of airspace in which the controlling authority has determined that air traffic must be restricted, if not continually prohibited. It denotes the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles.

FAA regulates military operations in the National Airspace System through the implementation of FAA Order JO 7400.2G, *Procedures for Handling Airspace Matters*, and FAA Handbook 7610.4J, *Special Military Operations*. The latter was jointly developed by DoD and FAA to establish policy, criteria, and specific procedures for air traffic control planning, coordination, and services during defense activities and special military operations.

The airspace above the NNSS was withdrawn and designated as Restricted Area 4808, special use airspace, by FAA and DOE. The restricted area within this airspace is used by NNSA, which has established that this parcel of airspace is used by DOE 24 hours a day, 365 days per year, and is not accessible by the public, except under certain conditions. Restricted areas R-4808 (the airspace above the NNSS and the northeastern portions of the Nevada Test and Training Range) and R-4809 (the airspace above the TTR) are managed by DOE and are never authorized for use by civilian aircraft, except under conditions such as flights in direct support of a project at or proposed for the NNSS, meeting minimum security requirements, being scheduled in the airspace by DOE, and other project-dependent conditions. The restricted airspace surrounding the NNSS to the north, east, and west is controlled by the Nevada Test and Training Range (DOE/NV 1998b).

Airspace associated with the NNSS and its vicinity is shown in **Figure 4–4**. The NNSS airspace is part of the Nevada Test and Training Range, which includes four restricted areas, the desert military operating areas/air traffic control assigned airspace, two low-altitude tactical navigation areas, 29 military training routes (established to provide low-altitude and high-speed training, allowing the military to conduct training for combat tactics), and three refueling routes (DOE 1996c). The NNSS contains four airstrips and seven helipads, located in Areas 6, 12, 22, 23, and 25.

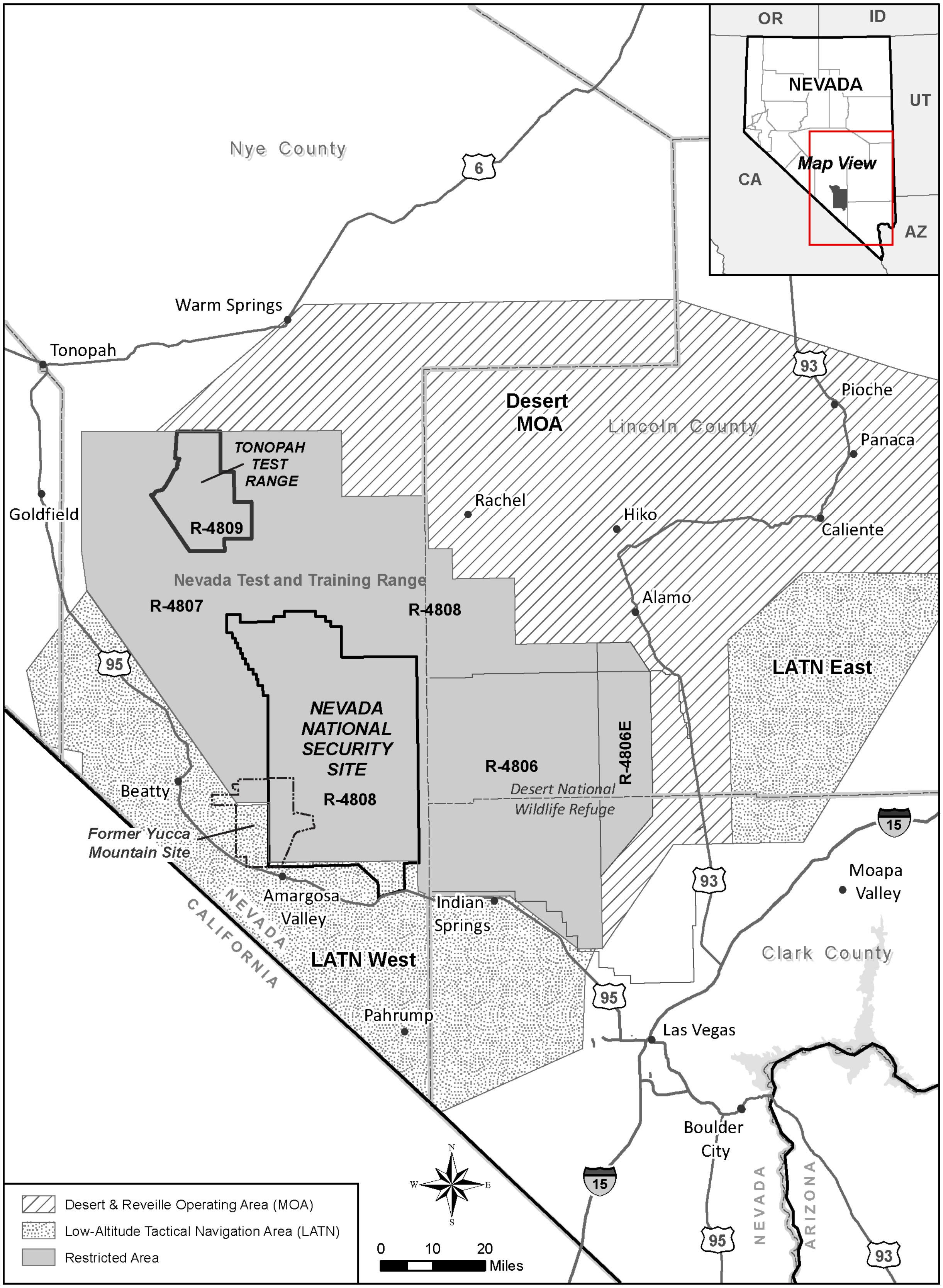


Figure 4–4 Airspace Within the Vicinity of the Nevada National Security Site

4.1.2 Infrastructure and Energy

4.1.2.1 Infrastructure and Utilities

This section discusses the buildings and transportation infrastructure and potable water, wastewater, and communications utilities. Further transportation-related information is discussed in Section 4.1.3, "Transportation and Traffic." Solid waste collection and landfills are discussed in Section 4.1.11, "Waste Management." Energy systems distribution, use, and demand (electricity, natural gas, and liquid fuels) are discussed in Section 4.1.2.2, "Energy." Discussions of NNSS and outside community support services, including law enforcement and security, fire protection, and health care, are presented in Section 4.1.4, "Socioeconomics."

4.1.2.1.1 Infrastructure

Facilities. There are 486 buildings and 113 trailers that support activities at the NNSS. **Table 4–2** presents the building floor space maintained at the NNSS, as well as the building floor space for leased properties off site, delineated by their respective functions, including administration, storage, industrial and production processes, research and development, services, and other uses (e.g., hangars, guard stations, and dormitories). As of November 2009, NNSS floor space totaled 2,231,602 square feet and offsite floor space totaled 214,071 square feet (NNSA/NSO 2009e). Most of these facilities and the supporting infrastructure at the NNSS are 30 to 50 years old and are rapidly deteriorating (NSTec 2008b; DOE 2008f).

NNSA ensures that existing facilities' maintenance and operation practices, as well as all new construction and renovation projects, conform to the requirements of Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (72 FR 3919), and Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (74 FR 52117), signed by President Obama on October 5, 2009, which expands on Executive Order 13423. NNSA will implement design, construction, maintenance, and operation practices in support of the high-performance building goals and statutory requirements of these Executive orders.

Table 4–2 Nevada National Security Site Building Floor Space by Function

Function	*Floor Space (square feet)*	*Offsite Leased Floor Space (square feet)*
Administrative	383,336	117,263
Storage	332,877	1,104
Industrial and Production Processes	359,980	8,253
Research and Development	486,405	87,451
Service Buildings	413,948	0
Other	255,056	0
TOTAL	2,231,602	214,071

Source: NNSA/NSO 2009e.

Transportation Systems. The NNSS is accessible and navigable by vehicles via a network of paved and unpaved roads, accompanied by parking areas. The onsite road network consists of approximately 340 miles of paved roads, including 195 miles considered mission essential, and over 300 miles of unpaved roads.

The primary paved roads in the southern part of the NNSS include Mercury Highway, Jackass Flats Road, Cane Spring Road, and Lathrop Wells Road. The Mercury Highway is the primary access route to the NNSS from U.S. Route 95. Mercury Bypass is well constructed and runs from just north of gate 100 to north of Mercury. This 26-foot-wide road was built to enable the rerouting of all traffic with a forward area destination.

The primary paved roads on the northern part of the NNSS are Pahute Mesa Road, Buckboard Mesa Road, and Tippipah Highway. The areas served by these roads are Pahute Mesa, Buckboard Mesa, and Rainier Mesa, respectively. Pahute Mesa Road from Yucca Flat to the Area 20 camp is typical of hot-mix paved roads on the NNSS. At the higher elevations, the road is winding and crosses rugged terrain that may be hazardous under winter conditions.

Three basic types of road have evolved over the years at the NNSS to support direct mission and mission support requirements: major transport routes, e.g., Mercury Highway, constructed of asphalt concrete suitable for sustained highway loads and speeds; spur roads of shorter length to specific activity locations, e.g., Road 5-01 Radioactive Waste Management Site, generally consisting of multiple applications of oil and chip suitable for use at reduced speeds and loads; and unpaved routes, e.g., Fortymile Canyon Road, graded and passable at low speed suitable for construction or maintenance vehicles.

Determining the level of road serviceability required to meet operational demands on the NNSS is a solid basis for establishing design, construction, maintenance, and safety criteria. The following hierarchy has been established to evaluate existing and proposed roadways:

- *Level I* – Roads that provide safe access to heavily used areas at highway speeds (currently 55 miles per hour); basic emergency response; and critical personnel and material movement routes. Level I roads handle the entire spectrum of vehicular traffic encountered at the NNSS.

- *Level II* – Roads that provide access to more-remote areas and/or complete loop access to most used areas. Highway speed and load capabilities are important. Roads facilitate periodic operations, construction, and maintenance, and provide a bypass during selected operations. Level II roads are primarily program-specific and receive all types of vehicular traffic except for tour buses and heavy construction machinery.

- *Level III* – Roads that maintain established access to specific active programmatic, campaign, or Directed Stockpile Work sites. Level III roads are limited in capacity and serviceability.

- *Level IV* – Unpaved roads that provide more direct and efficient access to selected locations or direct access to established isolated activities. Level IV roads are not routinely used.

Using this hierarchy of roads, **Table 4–3** presents roads assigned to each level.

Table 4–3 Roads Assigned to Each Level of Hierarchy Established on the Nevada National Security Site

Level 1	**Road Segment/Classification [a]**
Mercury Highway	U.S. 95 to BJY Intersection (RA)1
Mercury Bypass	South Turnout to North Turnout (RF)
Rainier Mesa Road	BJY Intersection to Area 12 Camp (RA)
Tippipah Highway	Mercury Highway to Area 12 Camp (RA)
Cane Spring Road	Mercury Highway to 27-01 Road (RC)
5-01 Road	Mercury Highway to Area 5 RWMC site (RC)
3-03 Road	Mercury Highway to Area 3 RWMS site (RC)
Level II	**Road Segment/Classification [a]**
Stockade Wash Road	A-12 Camp to Pahute Mesa Road (RC)
Buckboard Mesa Road	18-03 Road to Pahute Mesa Road North (RF)
Cane Spring Road 27-01	Road to Jackass Flats Road (RC)
Jackass Flats Road (South)	Mercury Bypass to 27-01 Road (RC)
27-01 Road	Cane Spring Road to Jackass Flats Road (RC)
Pahute Mesa Road	Mercury Highway to Stockade Wash Road (RA)
Tweezer Road	Mercury Highway to Construction Area (RF)
18-03 Road/Airport Road	Pahute Mesa Road to Buckboard Mesa Road (RC)
Level III	**Road Segment/Classification [a]**
Jackass Flats Road (North)	27-01 Road to Cane Spring Road (RC)
Pahute Mesa Road	Stockade Wash Road to Buckboard Mesa Road N (RF)
4-04 Road	Rainier Mesa Road to BEEF site (RF)
Level IV	**Road Segment/Classification [a]**
Mercury Highway	Old BJY Intersection to Gate 700 (RA)
Lathrop Wells Road	Cane Spring Road to NNSS boundary (RA) (Gate 510)
Desert Rock Road	Mercury Highway to Desert Rock Airport (RF)
Airport Road (Area 18)	18-03 Road to Pahute Mesa Airport (RF)
5-07 Road	Mercury Highway to 5-01 Road (RF)
5-06 Road	5-01 Road to Spill Test Facility (RF)
Tunnel Access Roads	Multiple spurs (RF)
Other existing paved, gravel or graded roads	

BEEF = Big Explosives Experimental Facility; NNSS = Nevada National Security Site; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site.

[a] Comparison with Nevada state road classifications is shown:
Rural Arterial (RA); Rural Connector (RC); Rural Feeder (RF).

Source: FY 2007 Utility Management Plan, Table 2-1.

With the exception of Mercury Highway, the 340 miles of paved and 300 miles of unpaved roads were not designed or intended for use at the loads and speeds of today's traffic, e.g., 55 miles per hour. While numerous repairs and safety improvements to various segments have allowed continuous operations along most NNSS roadways, portions of the paved road system are currently substandard (DOE 2008i). Approximately 15 miles of roadway (amount usually determined by funding) are oiled and chipped each year to prevent deterioration and provide safe road surfaces. Based on this level of effort, each of the

340 miles of paved road can only be treated every 22 years. However, in 2010, a major Mercury Highway road improvement project was completed on the entire length of the road.

Traffic conditions on NNSS roads are discussed in Section 4.1.3, "Transportation and Traffic."

Parking for government and private vehicles is available at most buildings on the NNSS; and paved parking areas are available for commuter buses at support facilities in Areas 6, 12, 23, and 25. Collectively, the NNSS has approximately 1 square mile of paved land comprising parking areas. A bus fleet operation is used to transport personnel to and from the NNSS and Las Vegas. These buses are operated by a private firm under subcontract to DOE (NNSA/NSO 2009f). There are no operational railroads that access the NNSS.

The NNSS transportation-related infrastructure also includes the following air facilities:

Pahute Airstrip. This airstrip is located in Area 18 and has a paved runway and a secondary support facility. It is currently limited to helicopter use due to a deteriorating runway.

Desert Rock Airport. Located in Area 22, this airport has a paved runway with radio-activated lights, an administrative/control building, aircraft parking areas, and other ancillary features. It is unmanned, but operational, and its use is controlled by NNSA.

Yucca Lake Airstrip. This airstrip is located in Area 6 and has a secondary support facility and an unpaved runway that is subject to flooding following local storms.

Area 6 Aerial Operations Facility. Located in Area 6, this is an Unmanned Aerial Vehicle research and development facility. It has a paved runway, taxiways, and aircraft parking areas, as well as hangars, shops, and administrative buildings.

Helipads. Helipads with windsocks, fire extinguishers, and painted markings are located in seven locations across the NNSS.

All roads, parking areas, and air facilities at the NNSS are maintained for mission-related uses.

4.1.2.1.2 Utilities

The utility systems discussed in this section include the potable water supply, wastewater collection and treatment, and communication systems.

Water Supply. The NNSS water systems provide potable, fire-protection, construction, and wildlife preservation water throughout the expanse of the installation. Water production and distribution systems have been in place at the NNSS for over 50 years, serving work populations of up to 10,000 workers.

Drinking water needs are met by deep-well groundwater draws from two major aquifers (the volcanic and the alluvial aquifers) that are not influenced by surface waters. In addition, groundwater is withdrawn from the carbonate, volcanic, and alluvial aquifers for nonpotable, construction, and fire protection purposes.

The NNSS comprehensive water production and distribution system consists of three permitted public water systems (PWSs), two wildlife preservation reservoirs, and two isolated environmental sampling wells (DOE 2008l).

The three discrete PWSs permitted by the Nevada Division of Environmental Protection (NDEP) to provide potable water to the NNSS are served by six wells (Wells 4 and 4a, Well 5b/5c, Well 8, Well

16D, Well C-1, and Well J-12). The transmission and distribution systems include mains, valves, hydrants, booster pump stations, pump suction tanks, and reservoir storage tanks. Each PWS extends to the point of the service connection. Two tanker trucks used to haul potable water from the permitted wells to remote work sites are also permitted, but are not considered PWSs (NSTec 2010d).

The NNSS water system is spread over four distinct water service areas and consists of eight water systems, two wildlife preservation reservoirs, numerous water storage tanks, fillstands, and construction water open pit reservoirs, as well as approximately 140 miles of pipeline located throughout the site (DOE 2008l). These water service areas are discussed in detail below in relation to their location and the areas they support. The water service areas are also displayed in Figure 4–12.

Water Service Area A: Encompasses Areas 19 and 20. System capabilities within this service area have been abandoned for more than a decade. There are two wells in this area (Wells 19c and 20), both of which are out of service and have monitoring casing to prevent vandalism or contamination (DOE/NV 2008c).

Water Service Area B: Encompasses Areas 2, 4, 7, 8, 9, 10, 12, 15, 17, and 18. PWS NV0004099 serves Area 12. Well 2, within this service area, is out of service and is locked to prevent vandalism or contamination. Well 8 provides water to Area 12 and supplies water to the construction water open pit reservoir system. Water Service Area B also includes one pumping station and two water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area C: Encompasses Areas 1, 3, 5, 6, 11, 22, 23, 26, and 27. PWS NV0000360 serves Areas 5, 6, 22, and 23. Five active wells provide water in this service area (Wells C1, 4, 4a, 5b, and 5c). Fillstand A-6 is used to supply potable water via water trucks to the Joint Actinide Shock Physics Experimental Research Facility (JASPER), Area 12, and the Big Explosives Experimental Facility (BEEF). Water Service Area C also includes five pumping stations and nine water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area D: Encompasses Areas 14, 16, 25, 29, and 30. PWS NV0004098 serves Area 25. It consists of two active wells (Wells J12 and 16d). Water Service Area D also includes three pumping stations and 12 water storage tanks (DOE 2009f; DOE/NV 2008c).

Water is currently hauled into Areas 26 and 27 by truck. There are four elevated tanks in Area 26 that store construction water and one tank in Area 27 that stores fire protection and potable water (DOE/NV 2008c).

The annual maximum production capacity of the site’s potable supply wells (based on equipment capacity) is approximately 2.1 billion gallons per year, although the combined sustainable yield of the groundwater basins is substantially lower, and the sustainable yield of each basin is considered in groundwater withdrawals. Section 4.1.6.2 and Chapter 5, Section 5.1.6.2, provide additional information on groundwater wells, basins, and sustainable yields.

Water Conservation. NNSA is currently implementing programs to maximize compliance with Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and DOE Order 430.2B, *Renewable Energy and Transportation Management Requirements*, while protecting their core missions. One of the goals of these mandates is to reduce the use of energy and water in NNSA facilities by advancing water conservation (NSTec 2008b).

According to NNSA’s Energy Executable Plan of December 2008, the goal is to reduce potable water consumption by no less than 16 percent from the 2007 level by 2015. This reflects an average reduction in water consumption of approximately 2 percent per year. To accomplish this goal, the NNSS began saving water through several water conservation measures and best management practices for water efficiency. Examples include the installation of WaterSense™ products (including toilets and urinals, faucets and showerheads, boiler systems, and other water uses), xeric landscaping, water-efficient irrigation, system audits and leak repairs, use of nonpotable water for dust suppression when possible, and institution of 4-day workweeks (NSTec 2008b). Potable water consumption for the NNSS is presented in **Table 4–4** (see Section 4.1.6.2, "Groundwater," for further information on water usage at the NNSS).

Table 4–4 Potable Water Consumption for the Nevada National Security Site by Year

Year	***Potable Water Consumption (gallons, approximate)***
2005	182,650,000
2006	221,250,000
2007	225,150,000
2008	172,550,000
2009	190,000,000

Source: NSTec 2010c.

Gray water recycling was deemed cost-prohibitive at the NNSS due to the quantity of flow and lack of redistribution means. Gray water is sometimes used for dust control; however, depending on the extent of treatment, there are restrictions on how the water may be used (NSTec 2008b).

Wastewater Collection and Treatment Systems. The NNSS sanitary sewer system consists of approximately 100 linear miles of cast iron or polyvinylchloride mains and service laterals. Domestic and industrial wastewater is treated using either sewage treatment lagoon systems or septic tanks with leach field systems.

In fiscal year (FY) 2003, due to insufficient flow in the lagoons to remain compliant with Nevada regulations, DOE placed 8 of the 10 sewage lagoon systems in inactive status and installed new septic systems that allowed the lagoons to be bypassed. Only the Area 23 (Mercury) and Area 6 (Yucca Lake Complex) lagoon systems remain operative (NSTec 2010g). These two active lagoons operate under NDEP Water Pollution Control General Permit GNEV93001, with design flow capacities of 73,407 gallons per day (Area 23, Mercury) and 10,850 gallons per day (Area 6, Yucca Lake Complex) (NDEP 2005). The current rate of wastewater production for the two operating lagoons is presented in **Table 4–5**.

Sludge removed from the wastewater treatment systems is disposed in the Area 23 sanitary landfill or the Hydrocarbon Disposal site in Area 6, depending on the hydrocarbon content (DOE 2008f).

Installation of new septic tank systems to supplement the NNSS's wastewater treatment capacity enabled the NNSS to meet current site needs and comply with state regulations (DOE 2008f). There are currently 23 permitted septic tank systems at the NNSS (NSTec 2010h). Each septic tank has a capacity for handling 5,000 gallons of wastewater per day. Seven of the septic tanks are maintained by the National Security Technologies, LLC, Department of Water and Waste, and the remaining units are maintained by the individual facilities with which they are connected. Collectively, the 23 septic systems provide a capacity for treating 115,000 gallons of wastewater per day. The currently permitted septic systems at the NNSS and the approximate number of people they serve per workday are presented in **Table 4–6**.

Table 4–5 Wastewater Production for the Mercury and Yucca Lake Lagoons at the Nevada National Security Site by Year

Year	*Wastewater Production (average gallons per day)*		*Total Treated in Lagoon Systems (average gallons per day)*
	Mercury Sewage Lagoon System	*Yucca Lake Sewage Lagoon System*	
2005	44,510	8,229	52,739
2006	42,124	9,219	51,343
2007	42,367	7,427	49,794
2008	32,588	1,084	33,672
2009	26,550	1,049	27,599
Permit Capacity	73,407	10,850	84,257
Percent of lagoon capacity used in 2009	36%	10%	33%

Source: NSTec 2010g.

Table 4–6 Nevada National Security Site Septic Tank Locations and Capacities for 2010

Permit Number	*Location*	*Capacity [a] (gallons)*	*Number of People Served per Workday*
NY-1054	Area 3, Waste Management Office	5,000	10
NY-1069	Area 18	5,000	1
NY-1076	Area 6, Art Hangar	5,000	20
NY-1077	Area 27, Baker	5,000	10
NY-1106	Area 5, NPTEC	5,000	20
NY-1079	Area 12, (U12G)	5,000	1
NY-1080	Area 23, 1103	5,000	20
NY-1081	Area 6, CP-70	5,000	0
NY-1082	Area 22, 22-1	5,000	5
NY-1083	Area 5, RWMC	5,000	20
NY-1084	Area 6, DAF	5,000	40
NY-1085	Area 25, Central Support Area	5,000	0
NY-1086	Area 25, RCP	5,000	0
NY-1087	Area 27, Able	5,000	15
NY-1089	Area 12, Camp	5,000	2
NY-1090	Area 6, LANL Construction	5,000	10
NY-1091	Area 23, Gate 100	5,000	150
NY-1103	Area 22, DRA	5,000	1
NY-1110-HAA-A	Area 12, 12-910	5,000	1
NY-1112	Area 1, U1a	5,000	40
NY-1113	Area 1, 1-121	5,000	1
NY-1124	Commercial individual sewage disposal system NNSS area 6 permit to operate	5,000	–
NY-1128	Commercial individual sewage disposal system NNSS area 6 Yucca Lake Project permit to construct	5,000	–
Total capacity		**115,000**	**367**
Demand	**Assuming 20 gpd per person,[b] total treatment demand**	**7,340**	**6% of collective capacity**

DAF = Device Assembly Facility; gpd = gallons per day; LANL = Los Alamos National Laboratory; NPTEC = Nonproliferation Test and Evaluation Complex; NNSS = Nevada National Security Site; RWMC = Area 5 Radioactive Waste Management Complex.

[a] Source: NSTec 2010h.

[b] Liu and Liptak 1997; CMU 2004.

NNSA assumes that a typical wastewater generation rate for the NNSS would be approximately 20 gallons per day, based on the upper limits of an average flow rate for an office setting (7 to 16 gallons per day) and a school with cafeteria setting (10 to 20 gallons per day) (Liu and Liptak 1997). This estimate is further confirmed by a study done at Carnegie Mellon University that calculated per capita water use in 2004 for the NNSS at 20.81 gallons per day (CMU 2004).

As shown in Table 4–6, the septic tank systems at the NNSS are currently being used at approximately 6 percent of their collective capacity. As shown in **Table 4–7**, the population at the NNSS is currently using approximately 17 percent of the collective total capacity of wastewater treatment at the NNSS (the capacity of the two lagoons and 23 septic tanks).

Table 4–7 Estimated Total Wastewater Treatment Capacity at the Nevada National Security Site

Wastewater Treatment System	*Capacity (gallons per day)*
Lagoons: Mercury and Yucca Lake Systems [a]	84,257
Septic Systems [b]	115,000
Total NNSS Capacity	199,257
Total Wastewater Generation [c]	34,000
Percent of Capacity Used	17%

NNSS = Nevada National Security Site.
[a] Based on NDEP permit design flow capacity.
[b] Based on 23 septic systems at 5,000 gallons per day each.
[c] Based on 20 gallons per day of wastewater per person for the current population of 1,700 persons.

Areas not serviced by a permanent wastewater system are provided with portable sanitary units. The portable sanitary units are serviced regularly, and the wastewater is discharged to a permitted onsite treatment system (DOE 2008f).

Communication Systems. Communication systems cover not only the entire area of the NNSS, but also reach far beyond its boundaries. The NNSS telecommunications/information technology infrastructure is composed of fiber optic and copper cabling and microwave systems. The distribution architecture is composed of approximately 205 miles of fiber optic cabling, thousands of circuit miles of legacy copper telecommunications cabling, and seven major microwave links. The systems include telephone network, data transmission, and storage systems, as well as video, radio, and mail systems. Parts of the NNSS telecommunications/information infrastructure are technologically dated and have been degraded in many locations (DOE 2008f).

4.1.2.2 Energy

Electrical power and liquid fuels are necessary for the continued operations of the NNSS, RSL, NLVF, and the TTR. These sources provide energy to support the buildings, vehicles, and operations at the facilities.

4.1.2.2.1 Electrical Energy

Electrical service at the NNSS is supplied by two power sources: (1) NV Energy (previously Nevada Power) and (2) the Valley Electric Association (DOE 2008f). It is distributed to the compound by an onsite 138-kilovolt transmission loop that supplies eight substations, one switching center, and one 138-kilovolt radial. The power distribution involves an extensive 34.5-kilovolt system, and short 69-kilovolt and 12-kilovolt systems. These voltages are transformed to a 4.16-kilovolt distribution voltage, and then subsequently to 480–208/120-volt working levels. The NNSS is served by approximately 600 miles of transmission and distribution lines (NSTec 2008b).

The electrical capacity at the NNSS is approximately 45 megawatts, and the current load is approximately 20 megawatts. From 2003 through 2006, electrical usage at the NNSS ranged from 57,000 to 95,000 megawatt-hours, averaging 81,000 megawatt-hours with a peak load usage of 27 megawatts (DOE 2008f). Electrical usage at the NNSS during FY 2009 was 84,577 megawatt-hours. Utility use in areas surrounding the NNSS is holding steady; the NNSS capacity should remain at 45 megawatts in the foreseeable future (NNSA/NSO 2010a).

4.1.2.2.2 Natural Gas

There is no infrastructure for natural gas supply at the NNSS.

4.1.2.2.3 Liquid Fuels

The NNSS uses various types of liquid fuel for its energy needs. Red dye fuel oil is used to heat many buildings and facilities (though numerous oil-fired boilers have been replaced with electric boilers). Unleaded gasoline, diesel fuel, and biofuels (such as ethanol/E85 and biodiesel) are used to power its vehicle fleet and equipment. **Table 4–8** presents liquid fuel usage at the NNSS in 2009 by type.

Table 4–8 Fuel Usage in Fiscal Year 2009 at the Nevada National Security Site

Fuel Type	*Quantity*
#2 Red Dye Fuel Oil for Heating	66,433 gallons
Unleaded Gasoline	426,964 gallons
Ethanol/E85	216,616 gallons
#2 Diesel	64,844 gallons
Biodiesel	343,191 gallons

Source: NNSA/NSO 2010b.

The NNSS has two service stations, each with the capacity to store 10,000 gallons of unleaded gasoline and 9,500 gallons of biodiesel. E85 fueling stations are located near these NNSS gasoline/biodiesel service stations. The NNSS currently has a secure source for daily delivery of E85 fuel and currently has no need for a large onsite stored reserve.

The bulk storage tanks in Area 6 are capable of storing approximately 100,000 gallons of biodiesel and 40,000 gallons of unleaded gasoline (DOE 2008l). Both tanks are filled and maintained to 80 percent of their storage capacity. In the event of a fuel shortage, these reserves would be used on a priority basis to keep the fleet running (NSTec 2008b).

The trend over the last several years has been a decline in petroleum-based fuel usage. The majority of the NNSS fleet currently operates on alternative fuels. The NNSS uses E85 fuel for alternative-fuel vehicles and B-20 biodiesel for all diesel vehicles and off-road equipment. As of December 2008, the NNSS had 548 alternative-fuel vehicles that are E85-capable, equal to 94 percent of the NNSS vehicle fleet. The NNSS requires its fleet to operate all alternative-fuel vehicles on alternative fuels to the maximum extent practicable.

4.1.2.2.4 Conservation and Renewable Energy

The Federal Energy Policy Act of 2005 (EPACT 2005, Section 203(a) [42 U.S.C. 15,853 (a)]) requires DOE to reduce the use and cost of energy at its facilities by advancing energy efficiency, water conservation, and renewable energy sources. As a result, DOE has implemented various energy and water conservation practices and is working toward maximizing installation of onsite renewable energy projects at the NNSS where technically and economically feasible.

As of December 2008, there are 395 electrical meters installed in the 423 buildings identified for electrical meter installation at the NNSS, and the remaining 28 facilities have been identified for future installations (NSTec 2008b). The metering will allow NNSA to better track its use of electricity to help improve its ability to identify conservation opportunities.

As part of energy conservation efforts under Energy Saving Performance Contract funding, some NNSS buildings have been retrofitted with low-energy light fixtures and programmable thermostats. Several onsite renewable energy projects have been implemented at the NNSS, including: (1) solar lighting installed for pedestrian footpaths, (2) solar light post in front of the cafeteria lighting, (3) solar-powered monitoring stations, (4) solar-powered low-volume continuous air sampling systems, and (5) solar-powered pedestrian crosswalk lighting (NSTec 2008b).

4.1.3 Transportation and Traffic

This section addresses baseline transportation conditions with respect to onsite and regional traffic, including transportation of materials and wastes. "Onsite traffic" relates to the roadway network within site boundaries; "regional traffic" relates to the roadway network surrounding the site.

4.1.3.1 Onsite Transportation

Access to the NNSS is restricted; guard stations are located at entrances, as well as at other locations throughout the site. The main entrance to the NNSS, Gate 100, is located on Mercury Highway, which originates at U.S. Route 95. Although there are access points at other locations, their use is restricted and they are usually barricaded. Vehicles accessing the NNSS are generally limited to the main entrance. Other existing roadways, some of which are unpaved, provide access or exit routes in cases of emergency or for special purposes.

The NNSS has 640 miles of roadways: 340 miles of paved roads and 300 miles of unpaved roads (DOE 2007c). The paved roads are considered primary roads; most are two-way, two-lane roads with speed limits of 55 miles per hour, unless posted otherwise. The speed limit in developed areas is 20 miles per hour. The maximum speed limit on dirt roads is 35 miles per hour. The majority of the paved roadway network was constructed prior to 1965 and is considered to be in substandard condition, requiring extensive and effective remedial reconstruction, rehabilitation, and resurfacing actions (DOE 2009f). The unpaved portion of the roadway system is composed of graded gravel roads and jeep trails. The NNSS also has numerous unpaved test- or experiment-related roads that are no longer used after a test or experiment is completed.

Figure 4–5 depicts the NNSS's onsite roadway network, which can be considered in terms of a southern network and a northern network. The primary paved roads in the southern part of the NNSS include Mercury Highway, Jackass Flats Road, Cane Spring Road, and Lathrop Wells Road. Mercury Highway is the primary access route to the NNSS from U.S. Route 95. South of Gate 100, Mercury Highway is a two-lane highway. At the gate, it widens to multiple lanes to facilitate entry through the guard station. North of the gate, the highway narrows to a two-lane highway and remains a two-lane highway northward to the transition to Rainier Mesa Road. Most of Mercury Highway is 26 feet wide (13 feet wide per travel lane), but the shoulders vary from 4 to 6 feet wide. Mercury Bypass runs from just north of Gate 100 to north of Mercury. This 26-foot-wide road was built to divert traffic around Mercury to outlying areas of the NNSS.

The primary roads in the northern part of the NNSS include Mercury Highway, Pahute Mesa Road, Buckboard Mesa Road, Stockade Wash Road, Rainier Mesa Road, and Tippipah Highway. The areas served by these roads are Buckboard Mesa, Pahute Mesa, and Rainier Mesa.

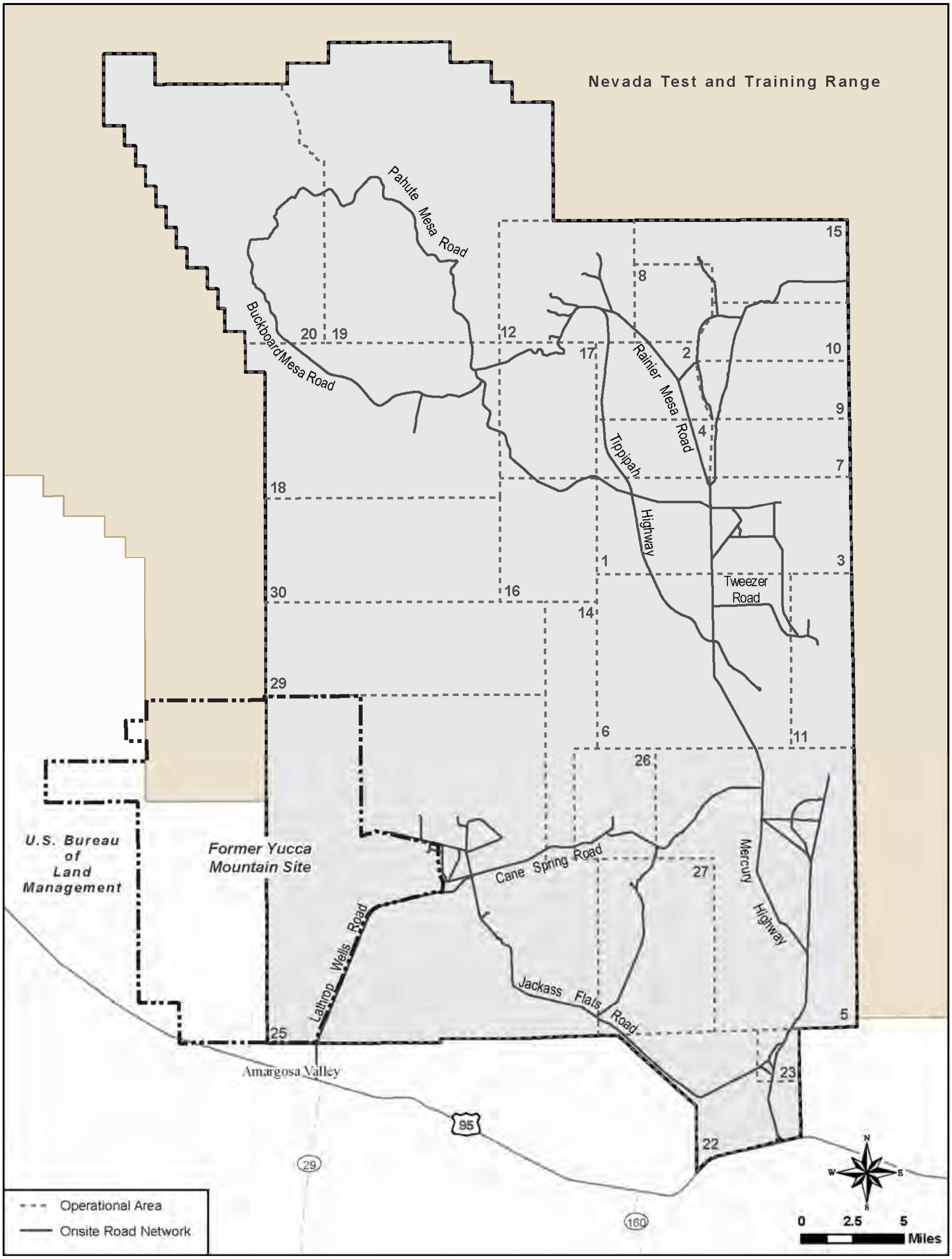


Figure 4–5 Nevada National Security Site Transportation System

Mercury Highway is the main thoroughfare within the NNSS and handles most of the traffic volume at the site. The highway runs approximately 37 miles from the southern border of the NNSS to its intersection with Rainier Mesa Road. A 1999 traffic study estimated that approximately 1,500 vehicle trips were made through the main access gate at the NNSS per day. Peak hours were from 6:00 to 7:00 A.M. and from 5:00 to 6:00 P.M., Monday through Thursday (because most personnel work 4 days per week) (PBS&J 1999). The study also revealed that the mix of vehicles accessing the main gate was approximately 90 percent automobiles, 7 percent trucks, and 3 percent buses. In the northern roadway network, approximately 700 vehicle trips on Mercury Highway occurred per day, of which about 81 percent were automobiles, 15 percent were trucks, and 4 percent were buses. The study determined that the highway was operating at adequate capacity, but that overall surface conditions were suboptimal and could pose traffic safety concerns (PBS&J 1999). In 2010, a major Mercury Highway road improvement project was completed along the entire length of the road. Recent vehicle counts just north of the Mercury interchange at U.S. Route 95 indicate that the total volume of vehicles accessing the NNSS increased 29 percent between 1999 and 2008 (NDOT 2008a, Nye County). NNSS employment data indicate that the number of onsite employees was approximately 1,300 in 1999 and 1,700 in 2008, representing a 31 percent increase over this timeframe (NNSA 2000; DOE/NV 2002c; NNSA 2008). Therefore, because of the similar increases in traffic levels and NNSS personnel, DOE assumed that the number of onsite employees is a reasonable indicator of traffic levels at the NNSS and that current number of onsite vehicle trips per day has also increased by approximately 30 percent since the 1999 traffic study. Major roadway improvements and maintenance work on Mercury Highway and Rainier Mesa Road have occurred over the last decade and are ongoing.

Transportation facilities related to the onsite roadway network include bus parking and commuter-vehicle parking areas. At least 50 percent of NNSS employees commute to the site by bus, but the privately owned vehicles of commuting personnel still contribute to the majority of traffic accessing the NNSS (NSTec 2010a). Commuter buses provide daily passenger service to the NNSS from Las Vegas via U.S. Route 95 and from Pahrump via Nevada State Route 160 and U.S. Route 95. The number of buses entering and exiting the NNSS on a daily basis varies, depending on the onsite activities in progress. Currently, there are 15 buses serving the Las Vegas area and 2 buses serving the town of Pahrump. These buses have dedicated routes to the following locations: Mercury, the Area 6 Device Assembly Facility (DAF), the Control Point in Area 6, the Area 6 Construction Facilities, and Area 5 (when projects are being conducted in the area). Parking for government and private commuter vehicles is available at most buildings on the NNSS.

4.1.3.2 Regional Transportation

4.1.3.2.1 Regional Transportation System

The NNSS is located in a region served by a network of U.S., interstate, and state highways. A significant portion of the commuter and truck traffic associated with the NNSS (approximately 95 percent) arrives via U.S. Route 95 from the Las Vegas area (DOE 2008l). Although the transport of materials and waste includes a nationwide system, the ROI for the regional, nonradiological traffic analysis presented in this SWEIS primarily covers the major roadways within Nye and Clark Counties that are most frequently used by personnel and visitors of the NNSS and by vehicles transporting nonradioactive and radioactive materials and waste to or from the NNSS. **Figure 4–6** presents the major roadways in the southern Nevada region, including those serving RSL, NLVF, and the TTR (discussed in subsequent sections of this chapter), and highlights the major transportation routes for shipments of radioactive materials and waste to and from the NNSS. **Figure 4–7** shows the road network in the vicinity of Las Vegas.

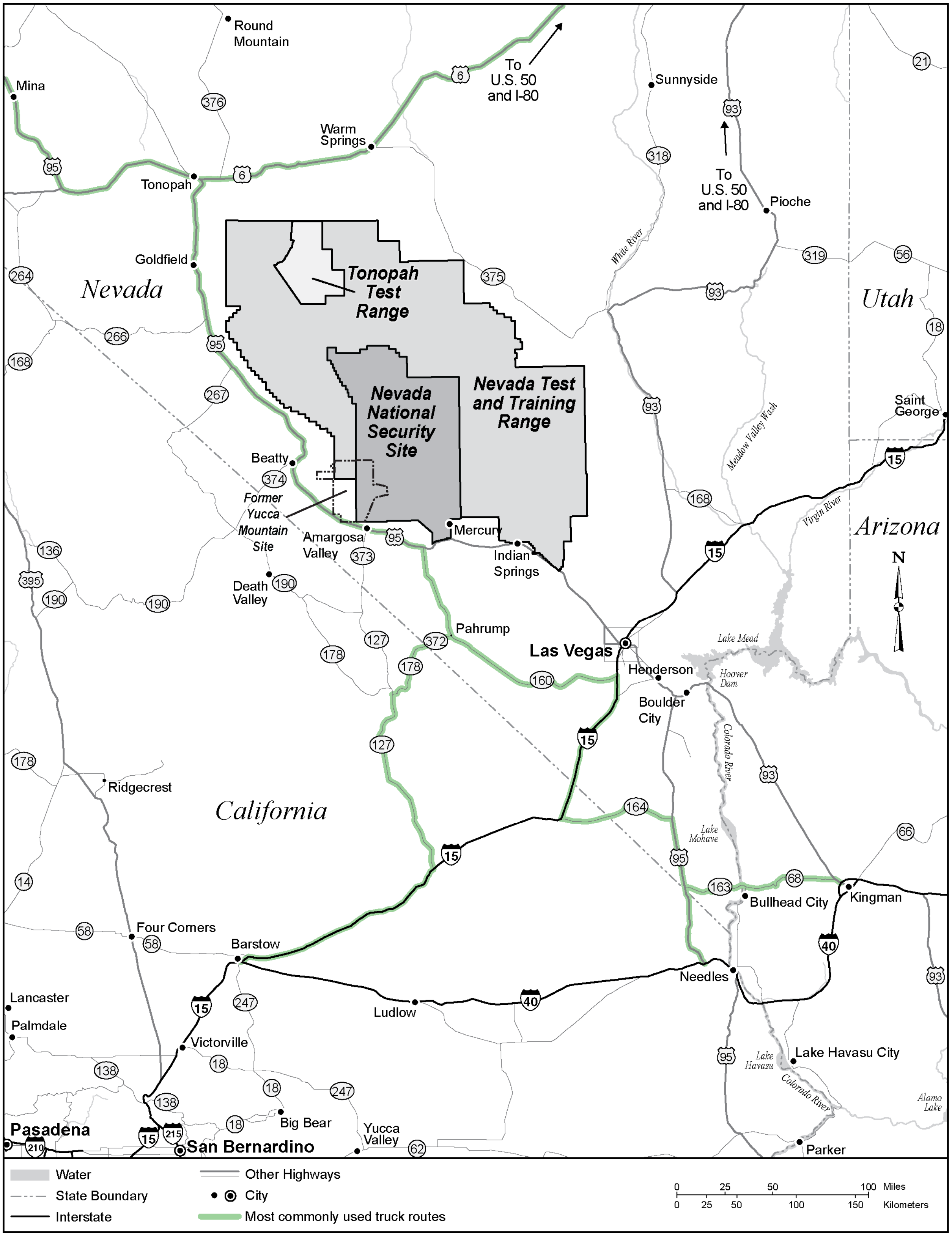


Figure 4–6 Regional Transportation Routes Surrounding the Nevada National Security Site

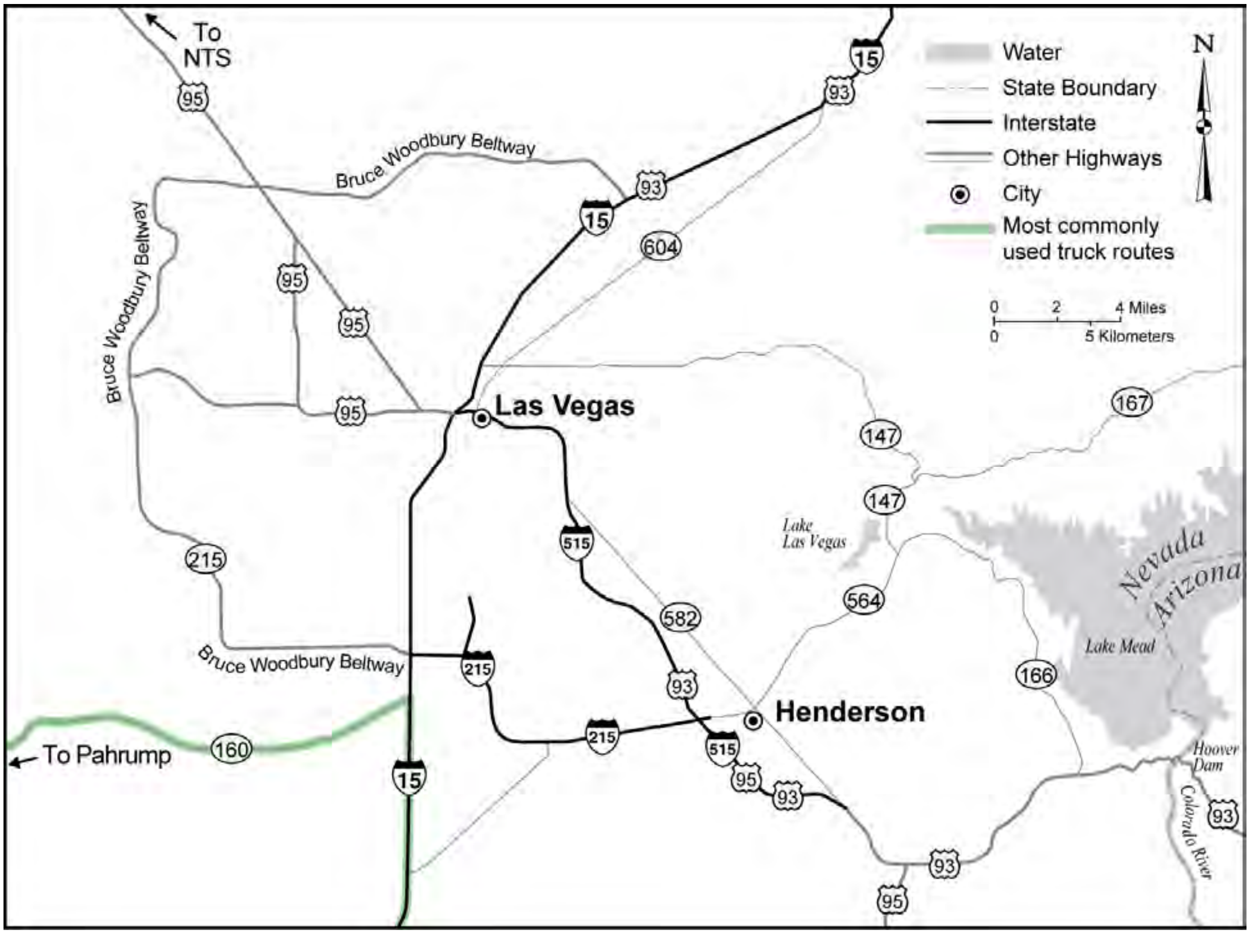


Figure 4–7 Transportation Routes Within the Las Vegas Metropolitan Area

Interstate 15 is the major transportation artery in the Las Vegas area. It is a north–south highway that passes to the south of the NNSS, connecting San Diego, California, to Salt Lake City, Utah, and continuing northward. In southern Nevada, this interstate highway is generally a four-lane divided highway, except in the Las Vegas metropolitan area, where it expands to six lanes. The 53-mile Las Vegas Beltway (also known as Interstate 215 and Clark County Route 215) encircles all but the east side of Las Vegas. Interstate 40 is a major east–west highway approximately 100 miles south of Las Vegas. Interstate 80 and U.S. Route 50 are major east–west highways to the north of the NNSS. Interstate 80 passes about 250 miles north of the NNSS, and U.S. Route 50 passes about 150 miles north.

U.S. Route 95 is a major north–south roadway extending from the Mexican border north to the Canadian border. U.S. Route 95 is a four-lane road between Las Vegas and the interchange with Mercury Highway (the highway leading onto the NNSS) and a two-lane road as it continues north. The interchange of U.S. Route 95 and Interstate 15, also referred to as the "Spaghetti Bowl," has undergone some recent construction to improve traffic flow. U.S. Route 93 is a major north–south, two-lane roadway that enters Nevada south of Lake Mead, and then extends through Las Vegas to the Canadian border, intersecting U.S. Route 50 east of Ely, Nevada, and Interstate 80 near the town of Wells, Nevada. U.S. Route 6 is an east–west, two-lane roadway to the north of the NNSS that links U.S. Routes 93 and 95.

NNSA/NSO has historically avoided shipping LLW and mixed low-level radioactive waste (MLLW) using the Interstate 15/U.S. Route 95 interchange, based on a verbal commitment from DOE. This informal commitment was made at a time when the major highway infrastructure, specifically Interstate 15 and U.S. Route 95, was unable to safely handle the rapidly growing volume of traffic. Since the mid-2000s, U.S. Route 95 has been widened and expanded overpasses have been built to accommodate traffic much more safely. In addition, the Las Vegas Beltway, which extends around approximately three-quarters of the valley, was built at the far edges of Las Vegas to further reduce traffic loads on Interstate 15 and U.S. Route 95. In addition, a bypass bridge has been constructed adjacent to Hoover Dam. This bridge opened to all traffic in October 2010. Therefore, trucks transporting waste on Interstate 15 from the south avoid traveling through Las Vegas by taking Nevada State Route 160 to its intersection with U.S. Route 95. Radioactive waste being transported from points north of Las Vegas avoids Interstate 15 in Nevada by using U.S. Route 50, traveling west to U.S. Route 6 and then south on U.S. Route 95. As a result of DOE's informal commitment, more-circuitous routes are used for the transport of radioactive materials and wastes. The following combinations of routes are most commonly used to ship radioactive materials and wastes to and from the NNSS (NNSA/NSO 2009b):

- From southern California: Interstate 15 to California State Route 127, to California State Route 127, to California State Route 178, to Nevada State Route 372, to Nevada State Route 160, to U.S. Route 95
- From the east via Interstate 40: Interstate 40 to U.S. Route 95, to Nevada State Route 164, to Interstate 15, to Nevada State Route 160, to U.S. Route 95 or Interstate 40, to U.S. Route 93, to Arizona State Route 68, to Nevada State Route 163, to U.S. Route 95, to Nevada State Route 164, to Interstate 15, to Nevada State Route 160, to U.S. Route 95
- From the east via Interstate 80: Interstate 80 to U.S. Route 93 (Alternate), to U.S. Route 93, to U.S. Route 6, to U.S. Route 95
- From the west via Interstate 80: Interstate 80 to U.S. Route 50 (Alternate), to U.S. Route 50, to U.S. Route 95
- From the east via U.S. Route 50: U.S. Route 50 to U.S. Route 6/50, to U.S. Route 6, to U.S. Route 95

There is no direct railroad access at the NNSS. An east–west rail line passes through northern Nevada, roughly paralleling Interstate 80. Another rail line extends northward through Barstow, California, and through Las Vegas and Caliente, Nevada, into Utah. Further south is a rail line through Arizona and California. Any materials or wastes that are destined for the NNSS and are initially transported by rail are offloaded at an intermodal site in Parker, Arizona, and placed onto trucks to complete the trip (NNSA/NSO 2009b).

Nonradioactive materials transported to and from the NNSS include construction materials and equipment that support site operations. Radioactive materials include source, special nuclear material, or other equipment that support research and development activities. Radioactive wastes transported to or from the NNSS include LLW, MLLW, and transuranic (TRU) waste (NNSA/NSO 2009b). NNSA received approximately 20,000 truck shipments of LLW and MLLW from 1997 through 2010. TRU waste is no longer transported to the NNSS; however, it is transported from the NNSS to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, for disposal or to Idaho National Laboratory for processing prior to disposal at WIPP (NNSA/NSO 2007).

4.1.3.2.2 Traffic Volumes and Level of Service Analysis

Population and economic growth in Nevada over the past couple of decades have significantly increased demands on the state's major roads and highways, especially in the Las Vegas metropolitan area. In 2007, Nevada was ranked fourth in the Nation in terms of its share of congested urban interstates and other highways or freeways, with 59 percent of the state's urban highways carrying a level of traffic that is likely to result in significant delays during peak travel hours (TRIP 2009). Between 1991 and 2001, daily vehicle miles traveled increased by 53 percent in Clark County, which experienced the greatest amount of population growth of any metropolitan area in the country over this timeframe (NDOT 2003).

Traffic volumes on Mercury Highway at a location 0.2 miles north of the Mercury interchange are available from the Nevada Department of Transportation and are considered representative of the average daily traffic volumes generated by the NNSS because this highway serves as the main roadway onto the site. **Table 4–9** presents the annual average daily traffic volumes for this location from 1999 through 2008. According to these data, traffic volumes moderately increased (by approximately 30 percent) over this 10-year period.

Table 4–9 Annual Average Daily Traffic Volumes, 1999–2008

Location	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Main Access Road to the Nevada National Security Site	855	1,000	960	960	960	1,250	1,350	1,250	1,100	1,100

Source: NDOT 2008a, Nye County.

The level of service is a measurement typically used by traffic professionals to gauge the adequacy of transportation facilities. All references to levels of service in this section are defined by the *2000 Highway Capacity Manual* published by the Transportation Research Board (TRB 2000). For analysis purposes, the manual defines six categories of level of service that reflect the level of traffic congestion and qualify the operating conditions of an intersection (CMPO 2006). The six levels are given letter designations ranging from "A" to "F," with "A" representing the best operating conditions (free flow, little delay) and "F" the worst (congestion, long delays). For this analysis, the quantitative value that is computed and used to categorize the roadway (based on average daily traffic volumes and roadway characteristics) is the volume-to-capacity ratio. The level-of-service designations for associated ratio values are presented in **Table 4–10**.

Table 4–10 Level-of-Service and Volume-to-Capacity Criteria

Level of Service	*Operating Conditions*	*Criteria (Volume-To-Capacity)*		
		Freeway [a]	*Multilane Highway* [b]	*2-Lane Highway* [c]
A	Very short delays; progression is extremely favorable.	0 – 0.35	0 – 0.33	0 – 0.12
B	Progression, short delay times.	0.36 – 0.54	0.34 – 0.50	0.13 – 0.24
C	Number of vehicles stopping is significant, although many still pass through the intersection without being required to stop.	0.55 – 0.77	0.51 – 0.65	0.25 – 0.39
D	Many vehicles must stop, and the proportion of vehicles not stopping declines.	0.78 – 0.93	0.66 – 0.80	0.40 – 0.62
E	Poor progression, and/or high volume-to-capacity ratios; considered by many agencies to be the limit of acceptable delay.	0.94 – 1.00	0.81 – 1.00	0.63 – 1.00
F	Intersection oversaturation; high volume-to-capacity ratios; poor progression and long delays; considered to be unacceptable to most drivers.	> 1.00	> 1.00	> 1.00

[a] A divided highway with full control of access and two or more lanes for the exclusive use of traffic in each direction.
[b] An undivided highway with four or more lanes (includes both directions); may be divided with medians with two-way left-turn lanes.
[c] A two-lane, undivided highway.

Major roadways in the Las Vegas metropolitan area, including segments of Interstate 15, Nevada State Route 160, and U.S. Route 95, typically experience high levels of traffic congestion (TRIP 2007). Many portions of these roadways within the city are operating at a level of service of E or F because of the heavy traffic volumes, especially during peak commuting hours.

Outside the Las Vegas metropolitan area, traffic within the ROI is generally considered light and free flowing. **Table 4–11** shows the daily traffic volumes and volume-to-capacity ratios during peak hour conditions, with corresponding levels of service, on the key regional and local roadways in the ROI. The NNSS contribution to the existing traffic congestion in the Las Vegas metropolitan area is considered minor compared to the city's existing traffic volumes, as presented in Table 4–11. Daily traffic volumes were projected to the year 2020 to provide a baseline comparison for future traffic conditions in terms of the potential impacts discussed in Chapter 5. These projected volumes take into account population growth (assuming approximately an annual traffic volume of 5 percent) (Nevada State Demographer's Office 2008) and are provided in Table 4–11.

Daily traffic volumes were projected to the year 2020 to provide a baseline comparison for future traffic conditions in terms of the potential impacts discussed in Chapter 5. These projected volumes take into account population growth (assuming an approximate annual traffic volume of 5 percent) (Nevada State Demographer's Office 2008) and are provided in Table 4–11.

Table 4–11 Traffic Volumes and Levels of Service on Key Roads During Peak Hour Conditions

Route	Location	Number of Lanes	2008 (current baseline)			2020 [a] (future baseline)		
			Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour	Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour
Nye County								
U.S. Route 6	0.3 miles east of Warm Springs Road	2	220	0.01	A	358	0.02	A
	200 feet west of Warm Springs Road	2	300	0.02	A	489	0.03	A
	0.2 miles east of Nevada State Route 376 (Tonopah-Austin Road)	2	590	0.03	A	961	0.06	A
	0.2 miles west of Nevada State Route 376	2	1,100	0.06	A	1,792	0.11	A
Nevada State Route 373	0.5 miles south of U.S. Route 95	2	910	0.05	A	1,482	0.09	A
Nevada State Route 372	0.8 miles west of Nevada State Route 160	4	12,000	0.35	B	19,547	0.57	C
	0.1 miles east of Nevada–California state line	2	820	0.05	A	1,336	0.09	A
U.S. Route 95	In Tonopah, 100 feet south of Bryan Ave	4	6,900	0.27	A	11,239	0.43	B
	500 feet north of Cemetery Road, north of Tonopah	2	4,200	0.32	C	6,841	0.53	D
	0.2 miles south of U.S. Route 6 in Tonopah	4	5,400	0.21	A	8,796	0.34	B
	9 miles south of Scotty's Junction (State Route 267)	2	2,300	0.14	B	3,746	0.22	B
	1 mile north of Beatty (State Route 374)	2	2,500	0.15	B	4,072	0.24	B
	0.2 miles west of Amargosa Valley (State Route 373)	2	2,600	0.15	B	4,235	0.25	C
	1.5 miles east of Amargosa (State Route 373)	2	2,900	0.17	B	4,724	0.28	C
	4 miles west of Mercury Interchange	2	2,900	0.17	B	4,724	0.28	C
Mercury Highway	0.2 miles north of Mercury Interchange on U.S. Route 95	2	1,100	0.07	A	1,100	0.07	A

			2008 (current baseline)			***2020 [a] (future baseline)***		
Route	***Location***	***Number of Lanes***	***Annual Average Daily Traffic***	***Volume-to-Capacity Ratio During Peak Hour***	***Level of Service During Peak Hour***	***Annual Average Daily Traffic***	***Volume-to-Capacity Ratio During Peak Hour***	***Level of Service During Peak Hour***
Nevada State Route 160	0.1 miles west of U.S. Route 95	2	1,000	0.06	A	1,629	0.10	A
	7.7 miles east of Nevada State Route 372	2	1,600	0.09	A	2,606	0.15	B
	0.1 miles east of Nevada State Route 372 (near Pahrump)	4	23,000	0.68	D	37,465	1.10	F
	200 feet west of Nevada State Route 372 (near Pahrump)	4	21,000	0.62	C	34,207	1.01	F
	0.6 miles east of the Clark–Nye county line	4	8,900	0.26	A	14,497	0.43	B
Clark County								
Nevada State Route 160	12 miles west of Interstate 15	2	8,100	0.32	C	10,886	0.43	D
	4 miles west of Interstate 15	4	22,000	0.49	B	29,566	0.66	D
	200 feet west of Interstate 15	8	36,000	0.35	B	48,381	0.47	B
U.S. Route 95	9.25 miles north of Indian Springs	4	3,600	0.07	A	4,838	0.09	A
	4 miles east of Indian Springs	4	6,400	0.13	A	8,601	0.17	A
	0.5 miles south of Snow Mountain Interchange (in northwest Las Vegas)	4	9,200	0.18	A	12,364	0.24	A
	0.4 miles north of Ann Road Interchange (in northwest Las Vegas)	6	84,000	1.1	F	112,889	1.48	F
	0.5 miles west of Interstate 15 (between Rancho Drive and Martin Luther King Boulevard)	10	212,000	1.66	F	284,910	2.23	F
	0.5 miles east of Interstate 15 (between Las Vegas Boulevard and Main Street)	8	176,000	1.73	F	236,529	2.32	F
	Between Russell Road and Sunset Road (in southwest Las Vegas)	6	111,000	1.45	F	149,175	1.95	F
	0.8 miles north of Nevada State Route 163 (west of Bullhead City)	2	8,100	0.32	A	10,886	0.43	B
	1 mile south of Nevada State Route 163 (Nevada–California state line)	2	3,200	0.13	B	4,301	0.17	B

Route	Location	Number of Lanes	2008 (current baseline)			2020 [a] (future baseline)		
			Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour	Annual Average Daily Traffic	Volume-to-Capacity Ratio During Peak Hour	Level of Service During Peak Hour
Interstate 215	Between Green Valley Parkway and Valle Verde Drive (in southwest Las Vegas)	8	142,000	1.39	F	190,836	1.87	F
	Between Decatur Boulevard and Interstate 15 (in central-south Las Vegas)	8	151,000	1.48	F	202,931	1.99	F
	0.2 miles north of State Route 159 (in central-west Las Vegas)	4	46,000	0.90	E	61,820	1.21	F
Losee Road	0.3 miles south of Cheyenne Avenue (north of NLVF)	4	15,000	0.38	B	20,159	0.52	C
	0.2 miles south of Carey Avenue (south of NLVF)	4	17,000	0.44	B	22,847	0.59	C
Las Vegas Boulevard	0.3 miles south of Nellis Boulevard (west of RSL)	4	13,000	0.33	A	17,471	0.45	B
Nellis Boulevard	300 feet north of Cheyenne Avenue (west of RSL)	6	27,000	0.46	B	36,286	0.62	C
Nevada State Route 164	1.1 miles west of U.S. Route 95 (west of Searchlight)	4	690	0.03	A	927	0.04	A
Interstate 15	At the Nevada–California state line	4	38,000	0.75	C	51,069	1.00	E
	5 miles north of Interstate 215 (in south-central Las Vegas)	8	263,000	2.58	F	353,450	3.47	F
	1 mile north of Interstate 515 (in central Las Vegas)	10	147,000	1.15	F	197,556	1.55	F
	5 miles north of Interstate 515 (near central Las Vegas)	8	72,000	0.71	C	96,762	0.95	E
	5.5 miles north of Interstate 515 (in north-central Las Vegas)	4	34,000	0.67	C	45,693	0.90	D
	North of West Mesquite Interchange (Nevada–Utah state line)	4	19,000	0.37	B	25,534	0.50	B

NLVF = North Las Vegas Facility, RSL = Remote Sensing Laboratory.

[a] 2008 traffic volumes were projected to the year 2020 (represents future baseline conditions), assuming an annual increase in traffic volumes of 5 percent for Nye County and Clark County (Nevada State Demographer's Office 2008).

Source: NDOT 2008a, Nye County; NDOT 2008b, Clark County; NDOT 2010.

4.1.4 Socioeconomics

4.1.4.1 Region of Influence

The ROI is defined as both the area in which the principal direct and secondary socioeconomic effects of site action are likely to occur and the area expected to be of the most consequence for local jurisdictions. The socioeconomic information presented in this SWEIS discusses current conditions in an ROI comprising Nye and Clark Counties, Nevada. This ROI includes most of the residential distribution of the employees of DOE, its contractor personnel, and supporting government agencies.

Within this ROI, there are also several American Indian reservations, tribal enterprises, tribally controlled schools, tribal police departments, and tribal emergency response units (DOE 1996c). The following reservations are located within the designated ROI: Duckwater Shoshone Tribe, Las Vegas Paiute Tribe, Moapa Paiute Tribe, and Yomba Shoshone Tribe. In addition, there are tribes that are located geographically outside the ROI, but are potentially affected by NNSS activities. One of these tribes, the Timbisha Shoshone Tribe, based in Death Valley, California, is located closer to the NNSS than many towns in northern Nye County. As a consequence of this proximity, the people of the Timbisha Shoshone Tribe are a part of the social and economic ROI of the NNSS. For example, students from the Timbisha Shoshone Tribe attend public school in Beatty, Nevada, whereas many Shoshone students from Tacopa, California, attend school in Pahrump, Nevada. Timbisha tribal members both work and shop in Clark and Nye Counties. The Pahrump Paiute Tribe, located in Pahrump Valley, is composed of American Indian people who have been historically recognized by Federal and state agencies to be both qualified to receive services as American Indian people and a group that is seeking Federal acknowledgment.

4.1.4.2 Economic Activity

Economic activity impacts in the ROI of Clark and Nye Counties were analyzed separately for each county. The differences in size, economies, and contributions would produce a misleading analysis if both were analyzed as one aggregate area. For example, in 2008, Nye County accounted for 1.4 percent of total Nevada employment, contrasted with Clark County, which accounted for 71.6 percent of total Nevada employment (USCB 2008b).

Clark County. Between 2000 and 2008, total employment in Clark County increased an average of 13.3 percent annually (USCB 2008b).

Clark County, which covers an area of 7,927 square miles, is located in southern Nevada and is composed of large expanses of unincorporated land and five incorporated cities (DOE 1996c). These are Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite. By 2008, total employment in Clark County had increased to 890,221, representing an average annual increase of 5.0 percent from the 2000 figure of 637,339 (USCB 2000 and 2008b). Between 2000 and 2008, average annual employment growth in Nevada was 4.1 percent, higher than the United States' average of 1.3 percent.

In 2008, per capita income was $28,138 (USCB 2008b). The unemployment rate in Clark County in 2008 was 6.0 percent, the same as that of the state (6.0 percent) and slightly lower than the national unemployment rate of 6.4 percent. However, as of August 2010, the unemployment rate was 14.7 percent, up 8.7 percent from November 2008.

The largest employment sector in Clark County in 2008 comprised arts, entertainment, recreation, accommodation, and food services (27.5 percent) (USCB 2008b). Educational services, health care, and social assistance accounted for 12.5 percent of employment. Construction; retail trade; professional, scientific, and management; and finance, insurance, and real estate accounted for 11.1 percent, 10.7 percent, 10.7 percent, and 7.5 percent of employment, respectively. The remaining 20 percent was divided among the following sectors: transportation, warehousing, and utilities (4.8 percent); other services (4.0 percent); public administration (3.7); manufacturing (3.5 percent); wholesale trade (2.3 percent); information (1.7 percent); and agricultural, forestry, fishing and hunting, and mining (0.9 percent). Employers of the largest workforces in the region are listed in **Table 4–12**.

Table 4–12 Clark County's Largest Employers

Employer	*City*	*Number of Employees*
Clark County School District	Las Vegas	30,000 – 39,999
Clark County	Las Vegas	10,000 – 19,999
Wynn Las Vegas LLC	Las Vegas	9,000 – 9,499
Bellagio LLC	Las Vegas	8,500 – 8,999
MGM Grand Hotel/Casino	Las Vegas	8,000 – 8,499
Mandalay Bay Resort & Casino	Las Vegas	7,000 – 7,499
Las Vegas Metropolitan Police	Las Vegas	5,500 – 5,999
University of Nevada, Las Vegas	Las Vegas	5,500 – 5,999
Caesars Palace	Las Vegas	5,500 – 5,999
Mirage Casino/Hotel	Las Vegas	5,000 – 5,499
The Venetian Casino Resort	Las Vegas	4,500 – 4,999
University Medical Center of Southern Nevada	Las Vegas	4,000 – 4,499
The Palazzo Casino Resort	Las Vegas	4,000 – 4,499
Rio Suite Hotel & Casino	Las Vegas	3,500 – 3,999
Flamingo Las Vegas	Las Vegas	3,500 – 3,999
Luxor	Las Vegas	3,500 – 3,999
Bally's & Paris Casino/Hotel	Las Vegas	3,000 – 3,499
Harrah's Las Vegas	Las Vegas	3,000 – 3,499
Treasure Island at the Mirage	Las Vegas	3,000 – 3,499

LLC = limited liability corporation.
Source: NV Energy 2010a.

Nye County. Nye County, located northwest of Clark County, covers an area of approximately 18,064 square miles (46,786 square kilometers) (DOE 1996c, 4-54). The Federal Government controls 93 percent of the land area. Mining, Federal installations, tourist and recreation attractions, and grazing allotments all occur largely on public land in Nye County.

Nye County comprises communities that are widely separated by distance, each with a distinct and independent economic base (DOE 1996c, 4-54). The NNSS and the TTR have been operating in Nye County for many decades. Federal facilities have provided employment for Nye County residents and a minor amount of procurement for local business. The economy in each community depends on different private companies and, in some cases, different industries. Because the communities are widely separated by distance, economic links between communities are limited. Metropolitan economies generally absorb a significant portion of business and residential purchases. Rural economies, such as Nye County, however, often leak large portions of both business and residential purchases to larger communities, resulting in economic loss and a different set of economic development needs from those of more-urban areas.

Nye County's strategy to increase economic development opportunities from Federal facilities is to engage the appropriate divisions of DOE in a formal set of interactions (DOE 1996c, 4-54). Nye County has identified the need for a qualified workforce and business base to fulfill Federal requirements. To this end, Nye County has developed programs to inform local businesses of Federal procurement opportunities and continuing formal and informal interaction with appropriate Federal agencies. One example of this proactive approach is Nye County's status as a cooperating agency in the development of this *NNSS SWEIS*.

Between 2000 and 2008, total employment in Nye County increased an average of 4.3 percent annually (USCB 2000 and 2008b). In 2008, per capita income in Nye County was $21,071 (USCB 2008b). The unemployment rate for Nye County in 2008 was 5 percent, lower than the state's (6 percent) and the Nation's (6.4 percent). However, as of August 2010, the unemployment rate was 17.2 percent, up 12.2 percent from 2008.

The largest employment sector in Nye County in 2008 comprised arts, entertainment, recreation, accommodation, and food services (20.8 percent) (USCB 2008b). Construction accounted for 17.9 percent. Educational services, health care, and social assistance accounted for 14.6 percent. Retail trade; agriculture, forestry, fishing and hunting, and mining; and transportation, warehousing, and utilities accounted for 11.0 percent, 7.1 percent, and 5.0 percent, respectively. The remaining 23.6 percent was divided among the following sectors: professional, scientific, and management (4.7 percent); public administration (4.4 percent); finance, insurance, and real estate (4.1 percent); other services (3.4 percent); information (3.2 percent); wholesale trade (2.1 percent); and manufacturing (1.8 percent). Employers of the largest workforces in the region are listed in **Table 4–13**.

Table 4–13 Nye County's Largest Employers

Employer	*City*	*Number of Employees*
National Securities Technologies		1,000 – 1,499
Nye County School District	Tonopah	1,000 – 1,499
Round Mountain Gold Corp.	Round Mountain	700 – 799
Nye County	Tonopah	600 – 699
Wal-Mart Supercenter	Pahrump	300 – 399
Wackenhut Services, Inc.		300 – 399
Pahrump Nugget Hotel & Gambling Hall	Pahrump	300 – 399
Saddle West Casino, ANV LP	Pahrump	200 – 299
Great Basin College [a]		288
Nevada Southern Detention Center	Pahrump	234

[a] Great Basin College 2010.
Source: NV Energy 2010b.

Table 4–14 shows employment numbers for the NNSS, NLVF, RSL, and the TTR.

Table 4–14 Onsite Employment

	NNSS					
	NNSS Only	*Including Contract Employees for Solar Plant*	*NLVF*	*RSL*	*TTR*	*Total*
No Action	1,699	1,849	1,442	132	106	3,379

4.1.4.3 Population

Clark County. In 2008, Clark County's total population was 1,821,359, an increase of 445,594 individuals, or approximately 32.4 percent, from 1,375,765 in 2000 (USCB 2000 and 2008b). This increase was equivalent to an annual average growth of approximately 4.0 percent for the county over the 2000 to 2008 period. By comparison, the average annual growth was approximately 3.4 percent for Nevada and nearly 1 percent for the United States between 2000 and 2008. Most recently, however, there has been a small decrease in population. Clark County decreased 0.8 percent from a high of 1,967,716 in mid-2008 to 1,952,040 in mid-2009 (NSBDC 2010).

The population of the city of Las Vegas totaled 564,484 in 2008, an increase of 18 percent from the 2000 level of 478,434 (USCB 2000 and 2008b). The average annual growth of 2.2 percent for the 2000 to 2008 period was below the county level. In 2000, the city of Las Vegas accounted for 34.8 percent of Clark County's population; in 2008, the city accounted for 31.0 percent of the total population in Clark County.

The population of the city of North Las Vegas was 115,488 in 2008, an increase of 78.9 percent from the 2000 level (USCB 2000 and 2008b). The average annual growth of 9.9 percent for the 2000 to 2008 period was well above the county level. In 2008, the city of North Las Vegas accounted for 11.3 percent of Clark County's population, an increase from 2000, when the city accounted for 8.4 percent of the total population in Clark County. These data indicate a trend toward outward expansion of the Las Vegas metropolitan area.

Nye County. In 2008, the population for Nye County was 43,555, an increase of 11,070, or 34.1 percent, from the 2000 level (USCB 2000 and 2008b). This overall increase is equivalent to an annual average growth for Nye County of about 4.3 percent over the 2000 to 2008 period; the average annual population growth in Nevada was about 3.4 percent, and in the United States, 1 percent. Most recently, however, there has been a small decrease in population. Nye County decreased 2.1 percent from a high of 47,370 in mid-2008 to 46,360 in mid-2009 (NSBDC 2010).

Pahrump is the largest and most rapidly growing community in Nye County. The 2008 population for the town of Pahrump was 36,390, up 47.7 percent from 24,631 in 2000 (USCB 2000 and 2008b). The average annual growth was 6.0 percent for the 2000 to 2008 period. In 2008, Pahrump accounted for 83.5 percent of the population in Nye County.

The 2000 (2008 population data were not available) population in the town of Tonopah was 2,627, down from 3,810 in 1990 (USCB 2000 and 2008b). In 2000, Tonopah accounted for 23.7 percent of the population in Nye County.

The 2000 (2008 population data were not available) population in Beatty was 1,154, down from 1,652 in 1990 (USCB 2000 and 2008b). In 2008, Beatty accounted for only 2.6 percent of the population in Nye County.

4.1.4.4 Housing

Clark County. In 2008, the housing stock in Clark County consisted of 784,892 units, an increase of 234,113 units, or 42.5 percent, over the 2000 total of 550,799 (USCB 2000 and 2008b). Between 2000 and 2008, Clark County housing unit vacancies increased from 47,546 units, or 8.5 percent of the housing stock, in 2000 to 208,275 vacant units, or 13.8 percent of the housing stock, in 2008. According to the Case-Shiller Home Price Index, single-family home prices in Las Vegas were down 28 percent in 2009, and off 46 percent from the peak in August 2006. Prices continue to fall because of an excess supply of housing. According to an April 2009 analysis, the number of excess single-family homes is over 7,000. Multifamily housing, condominiums, and townhouses are also overbuilt, with excess supply topping 7,800 units. Others estimate an excess supply of nearly 35,000 units (UNLV 2009).

An excess supply of residential real estate has caused permitting activity to come to a standstill (UNLV 2009). The number of building permits issued annually in Clark County rose sharply in the mid-2000s, with a peak of 39,015 permits issued in 2005. In 2008, the number of permits dropped, with only 24,596 issued. Monthly permitting from January to October 2009 averaged 508 units per month. Building permits issued in a given year may not represent the actual number of units built; however, they indicate the level of new residential development in the county.

In 2008, the housing stock in the city of Las Vegas consisted of 236,730 units, an increase of 46,006, or 24.1 percent, over the 2000 total of 190,724 (USCB 2000 and 2008b). Between 2000 and 2008, housing unit vacancies in the city of Las Vegas increased from 13,974 units, or 7.3 percent of the housing stock, to 29,005 units, or 12.3 percent of the housing stock.

Nye County. In 2008, the housing stock in Nye County consisted of 16,592 units, an increase of 658 units, or 4.1 percent, over the 2000 total of 15,934 (USCB 2000 and 2008b). Between 2000 and 2008, Nye County housing unit vacancies increased from 2,625 units, or 16.5 percent of the housing stock, to 3,202 units, or 19.3 percent of the housing stock. The vacancy rate does not reflect substandard units or houses held for occasional and recreational use.

4.1.4.5 Public Finance

The financial characteristics of Clark and Nye Counties are presented in this section. For many jurisdictions discussed, ad valorem taxes are a major source of revenue. These are taxes levied on the assessed valuation of real property. "Assessed valuation" is a valuation set upon real estate as a basis for levying taxes. Thirty-five percent of the taxable value placed on real property is used as the basis for levying property taxes in most Nevada jurisdictions.

Nevada has one of the most liberal tax structures in the Nation from a tax planning perspective. Nevada has no personal state income tax, unitary tax, corporate income tax, inventory tax, estate and/or gift tax, franchise tax, or inheritance tax.

Clark County. Clark County, incorporated in 1909, is governed by a Board of County Commissioners and a county manager (DOE 1996c). The seven members of the board are elected by each district to serve staggered four-year terms. Within the county are 5 incorporated cities, including Las Vegas, which is the county seat, and 13 unincorporated towns. County services include the county recorder, assessor, treasurer, social services, airport, hospital, and criminal justice. In addition, the county provides a full range of local services, such as fire, police, road maintenance and construction, animal control, building inspection, and water and sewage systems to county residents living in unincorporated areas.

In Clark County, the sales tax rate is 8.100 percent (NV Energy 2010a). The 2009 to 2010 average countywide property tax rate was 3.1849 percent. The formula for calculating real property tax is as follows:

Taxable Value × .35 = Assessed Value
Assessed Value × Tax Rate = Total Real Property Tax

In 2008, the county's primary revenue sources for government activities were ad valorem taxes ($799,257,814), consolidated taxes ($489,752,501), and sales and use taxes ($265,477,538) (Clark County 2008). These three revenue sources accounted for 25 percent, 15 percent, and 8 percent, respectively, or a total of 48 percent, of government activities revenues. The remaining 52 percent of revenue in Clark County came from interest income, franchise fees, fuel taxes, motor vehicle privilege taxes, room taxes, and other taxes. The county's total expenses were $4,205,515,941. Government activities constituted $2,506,782,626 of total expenses; the largest functional expenses were public safety ($1,082,216,327) and public works ($467,845,743). Business-type activities contributed $1,698,733,315 to total expenses; the largest components were hospital ($589,797,799), water ($431,929,066), and airport ($495,754,402).

Nye County. Nye County is governed by a Board of County Commissioners and a county manager. In Nye County, the sales tax rate is 7.100 percent (NV Energy 2010b). The 2009 to 2010 average countywide property tax rate was 3.1621 percent. The formula for calculating real property tax is the same as that for Clark County.

In 2008, the county's primary revenue sources for government activities were intergovernmental resources ($37,626,930), property taxes ($20,186,445), and miscellaneous ($8,268,727) (Nye County School District 2009). The county's total expenses were $70,843,657. Government activities constituted $20,347,092 of total expenses; the largest functional expenses were public safety ($18,861,475), capital projects ($9,123,301), and public works ($8,287,225).

4.1.4.6 Public Services

The key public services examined in this analysis are public education, police protection, fire protection, and health care. Providers of these services in the ROI are public school districts, police and fire departments, and hospitals and clinics. Existing conditions for each major public service are determined by student-to-teacher ratios at primary and secondary public schools and by the ratio of employees (sworn officers, professional firefighters, and health care personnel) to the serviced population.

4.1.4.6.1 Public Education

Higher Education. The University of Nevada, Las Vegas, was officially established in 1957 (UNLV 2010b). More than 220 undergraduate, masters, and doctoral degree programs are offered to a student body of 28,605. The university has on-campus research facilities, including the Desert Biology Research Center, Center for Business and Economic Research, Nuclear Waste Transportation Research Center, and Parent/Family Wellness Center. The Desert Research Institute, a separate division of the University and Community College System of Nevada, was founded in 1959 as an international center for environmental research. The University of Nevada Medical School trains medical students and resident physicians at the University Medical Center, where the school is located. The Harry Reid Center is an environmental studies organization located on campus and operated by the university.

Clark County School District. The Clark County School District includes all of Clark County, which covers 7,910 square miles and includes the metropolitan Las Vegas area, all outlying communities, and rural areas (Clark County School District 2009). During the 2009–2010 school year, the district operated 350 schools: 212 elementary schools, 58 middle schools, 46 high schools, 25 alternative schools, and 9 special needs schools. The district operates one of the Nation's largest school construction and modernization programs. In fall 2009, the district opened 3 new elementary schools and 3 high schools. The student-to-teacher ratio is 21:1.

Nye County School District. During the 2009–2010 school year, the district operated 18 schools: 7 elementary schools, 3 elementary/middle schools, 1 middle school, 1 middle school/high school, 3 high schools; 1 combined K–12 (kindergarten through 12th grade) school; 1 combined 6th–12th grade school; and one tribally controlled school that is kindergarten through 8th grade (Nye County School District 2009). Some 426 certified personnel were employed by the district in the 2009–2010 school year, and the district had a 2008 enrollment of 6,348 students. The approximate average student-to-teacher ratio for the Nye County School District was 18.6:1.

American Indian Education. Under Federal and tribal law, American Indian children can be educated in tribally controlled, federally certified schools located on American Indian reservations (DOE 1996c). Federal funds are available for the education of American Indian children through the Indian Education Act. Compensation from the Federal Government is provided to any school district that enters into a cooperative agreement with federally recognized tribes regarding a public, private, or tribally controlled school.

In Nye County, there is one tribally controlled elementary school, which is operated by the Duckwater Shoshone Tribe. In 2009, the school had 16 students enrolled from preschool to 8th grade (Nye County School District 2009).

A tribally operated Head Start program is located on the Moapa Paiute Indian reservation (DOE 1996c). The program is open to all eligible preschool students, including both American Indian and non–American Indian students from nearby communities. This program is funded through the Inter-Tribal Council of Nevada, which operates Head Start programs elsewhere in Nevada. American Indian students also attend public schools that are not tribally controlled.

4.1.4.6.2 Police Protection

Police protection in the ROI is provided by the Las Vegas Metropolitan Police Department, the North Las Vegas Police Department, and the Nye County Sheriff's Office, with stations at Tonopah, Pahrump, Beatty, Mercury, and Amargosa Valley. Each station provides law enforcement services in conjunction with other law enforcement agencies, including the Nevada Highway Patrol.

Las Vegas Metropolitan Police Department. The department is headed by the elected sheriff of Clark County. In addition to patrolling the city of Las Vegas, the department provides service for rural areas of the county. The department maintains 3,542 sworn personnel for a level of service of 6.27 personnel per 1,000 people (Castle 2010). There are 15 training personnel and 8 civilian crime prevention specialists, which include community relations, crime prevention, and Drug Abuse Resistance Education (DARE) officers. Some 2,200 vehicles (650 patrol cars), including four-wheel vehicles, motorcycles, and search and rescue vehicles, are used by the department. The holding facility capacity for the Clark County Detention Center is 2,984; the capacity of the Las Vegas Detention Center, operated by the City of Las Vegas, is 1,200.

North Las Vegas Police Department. The North Las Vegas Police Department was founded in 1946 with an original jurisdiction covering almost 4 square miles and approximately 3,000 people (NLVPD 2010). It now services 100.44 square miles and a population of approximately 221,003. The North Las Vegas Police Department, which consists of the police department and the detention center, currently employs a total of 739 employees, including 458 commissioned personnel and 281 civilian personnel. The commissioned staff consists of 310 police personnel and 148 detention personnel. The civilian staff consists of 265 full-time employees and 16 part-time employees, as well as 123 crossing guards employed on a part-time basis (whose numbers are not included in total of civilian personnel). Statistics show that there are 1.33 officers per 1,000 residents.

Nye County Sheriff's Office. The Nye County Sheriff's Office, whose main office is located in Tonopah, serves the entire county and supports substations located in Pahrump, Mercury, Amargosa Valley, Beatty, Smoky Valley, and Gabbs (Becht 2010).

There are 87 total patrol personnel, including administrative staff, 4 DARE/school resource officers, 3 assistant sheriffs, and 1 person specifically assigned to training (Becht 2010). In addition, there are approximately 106 vehicles, including detention transport vehicles and other specialty vehicles (SWAT [special weapons and tactics], Mobile Command Post, etc.)

Based on population estimates, current staffing levels are roughly 1.15 officers per 1,000 members of the population (Becht 2010).

There are 7 sworn detention personnel and 151 bed spaces for prisoners (Becht 2010).

Onsite Law Enforcement. Civilian law enforcement at the NNSS is provided under a contract with the Nye County Sheriff's Department. Officers work out of a substation located in Mercury. Nellis Air Force Base Security Forces respond to RSL when called. The Police Services portion of the current Inter-Service Support Agreement between DOE and Nellis Air Force Base, dated January 2006, reads, "In the event of an emergency, Nellis Security Forces response will be limited to securing the exterior of the facility only." Law enforcement for the TTR is also provided by the Nye County Sheriff's Department, and law enforcement at NLVF is provided by the North Las Vegas Police Department.

Onsite Security. Security enforcement is the responsibility of WSI, a private contractor. The NNSS is a controlled-access area and WSI provides site-wide protective services according to the guidelines established by NNSA/NSO.

4.1.4.6.3 Fire Protection

Fire protection for the ROI is provided by the Clark County Fire Department, Las Vegas Fire Department, and several volunteer fire departments in Nye County (including Tonopah, Pahrump, Beatty, and Amargosa Valley).

Clark County Fire Department. The Clark County Fire Department is divided into two sections: urban and rural (DOE 1996c). The urban fire stations are located in areas that are not cities and do not have their own fire departments. The rural fire stations are manned by volunteer firefighters and are discussed in the subsection on volunteer fire departments below.

In 2008, the Clark County Fire Department provided service to a population of 861,546 in an area covering 7,420 square miles (CCFD 2008). The Clark County Fire Department operates out of 27 paid fire stations and 13 volunteer fire stations. With 650 paid firefighters, 350 volunteer firefighters, 58 inspectors/investigators, and 50 support employees, the department provides a level of service equal to 1.28 firefighters per 1,000 people.

Las Vegas Fire and Rescue. Las Vegas Fire and Rescue has 18 fire stations that protect an area of 133.2 square miles and a population of 607,876 residents (Szymanski 2010). The department uses 19 engines, 6 ladder trucks, 20 emergency medical service rescue units, 3 battalion chief units, 1 heavy rescue unit, 1 hazardous material unit, 1 Chemical-Biological-Radiological-Explosives-Nuclear unit, 1 air/light resource unit, 1 3,000-gallon water tender, and 1 mobile command post. The department has 681 employees, including 12 battalion chiefs, 87 captains, 91 engineers, 126 firefighter/paramedics, and 179 firefighters. Last year, the department responded to nearly 85,000 incidents. Las Vegas Fire and Rescue is both an accredited and an ISO [International Organization for Standardization] Class One department.

City of North Las Vegas Fire Department. The North Las Vegas Fire Department is staffed by 234 uniformed and civilian employees who serve in divisions such as Administration, Fire Operations, Homeland Security and Special Operations, Business and Support Services, Community Life Safety, and Code Enforcement (NLVFD 2010). Personnel provide emergency services response, advanced life support, emergency management, department training and record-keeping, fire prevention, inspection, fire protection enforcement, fire investigations, code compliance, public information, and public education, as well as administrative services. The North Las Vegas Fire Department provides all-hazard 24-hour emergency response service from eight fire stations using seven engines, two trucks, six advanced life-support rescue units, and two battalion chief units. The department provides fire engineering and inspection services, along with a complete public education program. All "first-out" emergency vehicles provide medical services at the advanced-care (paramedic) level.

In 2007, the North Las Vegas Fire Department responded to 23,679 emergency incidents, resulting in 29,009 unit responses, and conducted 3,816 plan reviews, 10,930 fire and business inspections, and 122 fire investigations (NLVFD 2010). Public education activities reached over 62,000 citizens at 226 public events. The Tactical Medic Program started operations on April 18, 2007, and made 68 deployments in 2007 and 54 deployments in the first 4 months of 2008, all in support of the North Las Vegas Police Department. Additionally, 30 members of the North Las Vegas Fire Department are active participants in the Federal Emergency Management Agency's Nevada Urban Search and Rescue Task Force 1. Technical rescue and hazardous material response programs are currently under development.

Volunteer Fire Departments. Nye County's main hub for coordinating volunteer fire protection is Station 51, located in Pahrump, Nevada. Station 51 is the home of a quick response fire/HAZMAT [hazardous materials]/EMS station, and it also functions as the Southern Emergency Operations Center for the southern part of the county. Station 51 consists of 3 paid staff and approximately 20 volunteers. Equipment for Station 51 consists of Engine 51, Engine 52, Brush 51, Rescue 51, HAZMAT 51, Tender 51, Medic 51, Command 51, Command 52, two quads, a trailer containing decontamination supplies, a mass casualty trailer, a mobile command post, and a disaster supplies bus.

Station 11 is located in Tonopah, Nevada, and is the base for the Tonopah Volunteer Fire Department, Tonopah Volunteer Ambulance Service, and Emergency Services Northern Office and serves as the Emergency Operations Center for the northern part of the county. Station 11's volunteer fire department consists of approximately 20 volunteers and no paid staff. Equipment for Station 11 consists of Engine 11, Engine 12, Rescue 11, Ladder 11, Command 11, and a four-by-four utility terrain vehicle with a patient rescue trailer. The Tonopah Volunteer Ambulance Service, an intermediate-level service, has approximately 15 volunteers, and its equipment consists of Medic 11, Medic 12, a mass casualty trailer, and a disaster response trailer. The Emergency Services Department has 2 paid members of staff at this location.

Station 21 is located in Round Mountain/Smoky Valley, Nevada, and is the base for the Round Mountain Volunteer Fire Department. A staff of approximately 14 volunteers and 1 paid member respond to fire and rescue calls from this station. Station 21 is also the home of the Northern HAZMAT Team. Equipment includes Engine 21, Engine 22, HAZMAT 21, Rescue 21, Command 21, and a trailer containing decontamination supplies. The Smoky Valley Volunteer Ambulance Service is an intermediate-level service with approximately 16 volunteers. Equipment includes Medic 21 and Medic 22.

Station 31 is located in Beatty, Nevada, and is the base for the Beatty Volunteer Fire Department and Beatty Volunteer Ambulance Service. Approximately 12 volunteers serve on the fire department and there is 1 paid station superintendent/responder. Equipment includes Engine 31, Engine 32, Rescue 31, Tender 31, Ladder 31, a quad, and Command 31. The Beatty Volunteer Ambulance Service consists of approximately 10 volunteers, who respond at an intermediate level. Equipment includes Medic 31, Medic 32, a mass casualty trailer, and a Point of Distribution trailer.

Station 61 is located in Manhattan, Nevada, and is the base for the Manhattan Volunteer Fire Department. Approximately eight volunteers serve on the department. Equipment includes Engine 61 and Rescue 61.

Station 71 is located in Gabbs, Nevada, and is the base for the Gabbs Volunteer Fire Department and the Gabbs Volunteer Ambulance Service. Approximately six volunteers serve on the fire department. Equipment includes Engine 71 and Rescue 71. The Ambulance Service has approximately eight volunteers and the equipment includes Medic 71 and Medic 72.

Station 81 is located in Belmont, Nevada, and is the base for the Belmont Community Emergency Response Team (CERT). Approximately 10 volunteers serve on the CERT team. Equipment includes CERT 81, CERT 82, and a mobile fire attack trailer.

Station 91 is located in Duckwater/Currant Creek, Nevada, and is the base for the volunteer fire department. Approximately eight volunteers serve on the fire department. Equipment includes Engine 91, Command 91, and a mobile fire attack trailer.

Each station has dedicated mutual aid areas and Station 51 provides mutual aid to Southern Inyo County in California, Clark County, BLM, USFWS, the NNSS, throughout Nye County, and anywhere dispatched, as determined by the director of emergency services. The NNSS Fire/HAZMAT/EMS Team provides mutual aid to Nye County in Crystal, Nevada, and along the transportation corridor leading to Amargosa.

The Pahrump Valley Fire Department is a combination career and volunteer department with 22 career positions (RCI 2005c). According to a 2004 study, 22 volunteers were reported at the time of the assessment (RCI 2005c). Seven career firefighters are on duty each day. Four fire stations are associated with the Pahrump Valley Volunteer Fire Department. Two fire stations are staffed on a 24-hour basis with career personnel; one is manned by a combination of career and volunteer personnel; and one is manned by volunteers and houses reserve equipment.

Equipment consists of one command car, four engines (plus one reserve engine), six medics, three tenders, two brushes, one tower ladder, one rescue unit, two attack units, and one hazardous material response unit.

Onsite Fire Protection. The fire protection capacity of the NNSS is structured to accommodate current mission requirements, and a self-contained firefighting department is responsible for suppression and prevention. Other services include rescue, hazardous material response, training of fire personnel, fire prevention inspection, installation of all fire extinguishers at the NNSS, and fire-prevention awareness programs. NNSS Fire and Rescue operates out of two fire stations; one is in Mercury, and a newly constructed station in Area 6 provides rapid response to emergencies in the forward areas of the NNSS (DOE 2009f).

4.1.4.6.4 Health Care

Health care services within the ROI include 15 full-service hospitals located in Clark and Nye Counties. These facilities provide a wide array of medical services, including physical examinations; treatment of illness; emergency, intensive, and coronary care; internal medicine; x-ray and laboratory; infertility, obstetrics, and gynecology; neonatal intensive care; inpatient and outpatient surgery; pharmaceuticals; optometry; dental; respiratory therapy; and skilled nursing and long-term care. Services provided by three special service hospitals include psychiatric, chemical dependency, and mental health treatment. In addition, the Clark County Health District provides public health services and coordinates the emergency medical services system. The following information pertains to hospitals and medical facilities within the ROI.

Boulder City Hospital is a nonprofit, 20-bed acute-care critical access hospital and a 47-bed skilled nursing facility located in Boulder City, Nevada (Boulder City Hospital 2010). They have a medical staff of nearly 200 physicians, representing nearly 26 specialties.

Centennial Hills Hospital and Medical Center opened in January 2008 and is located in northwest Las Vegas. It provides 171 beds, including a 41-bed Emergency Department, 25-bed Women’s Center, 6-bed Level II Nursery, 32-bed Intensive Care Unit, and 108 medical/surgical beds. It also provides a wide range of medical services and procedures (Centennial Hills Hospital 2011).

Mountainview Hospital is a short-term hospital located in Las Vegas, Nevada (NVEnergy 2010c). It has 235 beds and two specialty units: adult and pediatric (191 beds) and intensive care (36 beds).

Desert Springs Hospital is a 351-bed, acute-care facility located in southeast Las Vegas that has been providing for the healthcare needs of Las Vegas residents since 1971 (NVEnergy 2010c). The hospital provides 24-hour emergency services, including a fast-track area in the emergency room to treat less-acute patients and comprehensive cardiology services. New facilities include a maternity center featuring labor, delivery, recovery, and postpartum suites; a third catheterization laboratory; and a 107,000-square-foot medical office building and outpatient surgery facility.

Lake Mead Hospital Medical Center has served the North Las Vegas Community since 1960 (NVEnergy 2010c). The facility now has 198 licensed beds. The medical staff consists of over 800 specialists and primary care physicians.

Mike O'Callaghan Federal Hospital is a joint venture between the U.S. Department of Veterans Affairs and DoD (99th Medical Group Hospital, Nellis Air Force Base) (NVEnergy 2010c). It is situated on a 49-acre site adjacent to Nellis Air Force Base, approximately 11 miles northeast of downtown Las Vegas. The facility has 114 beds, 52 of which are designated for Department of Veterans Affairs use: 36 for medical/surgical, 14 for psychiatric, and 2 for intensive care/coronary care.

St. Rose Dominican Hospital is a system of three acute-care facilities in southern Nevada: the Rose de Lima Campus in Henderson (opened in 1947), the Siena Campus in Henderson (opened in 2000), and the San Martín Campus in southwest Las Vegas (opened in 2006). Combined, the three campuses offer more than 500 patient beds and have a collective staff of nearly 3,000 employees.

Southern Hills Hospital, located in southwest Las Vegas and opened in 2004, is a full-service hospital. There are a total of 139 beds. Services include an accredited Chest Pain Center, certified Primary Stroke Center, the Nevada Neurosciences Institute, children's services, Emergency Department, and maternity services (Southern Hills Hospital 2011).

Spring Valley Hospital Medical Center opened in October 2003 and is a full-service acute care facility. It has 231 beds, including 105 medical/surgical beds, 22 rehabilitation beds, 18 intensive care beds, 21 intermediate care beds, 12 chest pain observations beds, 28 women's center beds, 9 Level II nursery beds, and 18 Level III Neonatal Intensive Care Unit beds (Spring Valley Hospital 2011).

Summerlin Hospital Medical Center features 169 licensed beds, all of which are private patient rooms (NVEnergy 2010c). The acute-care facility has adjoining facilities for outpatient services such as surgery, a laboratory, and radiology, as well as two medical office buildings.

Sunrise Hospital and Medical Center is located in Las Vegas (Healthgrades 2010). This short-term hospital has 610 beds and three specialty units, including adult and pediatric (436 beds), intensive care (92 beds), and surgical intensive care (10 beds).

University Medical Center, affiliated with the University of Nevada School of Medicine, is the premier teaching hospital in the state. The medical center serves the medical needs of southern Nevada and parts of California, Utah, and Arizona, as well as those of millions of visitors to Las Vegas.

Valley Hospital Medical Center, founded in 1972, is a licensed, 409-bed, full-service acute-care hospital located in the heart of Las Vegas that serves the greater Las Vegas area and the surrounding rural communities of southern Nevada (NVEnergy 2010c).

The Desert View Regional Medical Center, located in Pahrump, Nevada, opened April 27, 2006. It is a short-term acute-care hospital with 24 private rooms, expandable to 50 beds, a 24-hour emergency room, two surgical suites; diagnostic imaging; physical therapy; delivery suites and a nursery; a diagnostic sleep center; and a decontamination room.

Nye Region Medical Center is located in Tonopah (NVEnergy 2010c). It has 44 beds, one physician, and three nurses.

Onsite Health Care. An eight-bed dispensary in Mercury serves as a clinic for the NNSS. Facilities include rooms for emergency care; examination and treatment; and x-ray and associated darkroom equipment, offices, and storage. First-aid stations are located near field activities for quick treatment of personnel.

4.1.5 Geology and Soils

This section presents an analysis of the regional geology and soil environment, including descriptions of the physiography, stratigraphy, structural geology, seismicity, volcanism, and mineralogy of the NNSS and the surrounding region. Although construction, facility operations, and surface and subsurface tests have reworked localized areas of soils and bedrock, the condition of the regional geology and soils remains largely unchanged. This section provides an updated review of the geology and soils in the affected environment as presented in Chapter 4, Section 4.1.4, of the *1996 NTS EIS*.

Beginning in 1951, shortly after the establishment of the NNSS, geologic studies were commissioned for the site. Initially used to support nuclear testing in the 1950s and 1960s, the surface and subsurface geologic surveys were gradually expanded and then compiled into a series of databases now used to create a comprehensive knowledge of the region. Geologic mapping, site-wide geophysical surveys, exploratory drilling and testing, fault mapping, and detailed geotechnical studies have all contributed to the wide-ranging knowledge of the area’s geology. Because of continuous investigations, the NNSS is considered geologically one of the most well-researched regions in the United States (DOE 1996a).

4.1.5.1 Physiography

The NNSS is located in the southern part of the Great Basin, the northernmost subprovince of the Basin and Range Physiographic Province. This region is characterized by north–south-trending, linear mountain ranges that are separated by broad sediment-filled basins. The mountain ranges, formed by tilted, fault-bounded blocks of bedrock, can extend as much as 50 miles in length and 15 miles in width. Extensive fault zones, including the Walker Lane shear zone, its subsidiary, the Las Vegas shear zone, and the southwestern Nevada volcanic field, also affect the area topography. The Walker Lane shear zone transverses the TTR from the north to the southeast and gradually merges with the Las Vegas shear zone, which borders the southern edge of the NNSS (Faulds and Henry 2008). The flat uplands of the northwest NNSS, including the Pahute and Rainier Mesas, are composed of volcanic units of the southwestern Nevada volcanic field. Vertical relief at the NNSS varies from 3,280 feet above sea level at Frenchman Flat and Jackass Flats to 7,216 and 7,675 feet above sea level on Pahute and Rainier Mesas, respectively.

The Great Basin Subprovince is an internally draining basin with no outlet to the Pacific Ocean. Two deserts, the Mojave Desert and the Great Basin Desert, are located within the Great Basin Subprovince and are characterized by their arid conditions and landforms formed by wind and water. The northern section of the NNSS is located in the Great Basin Desert; the southern third is located in the Mojave Desert, with transitional valleys in between. The topography of the region includes rugged mountain and mesas with steep sides. Eroded material from the ranges collects on alluvial fans that extend into the valley floors. The sediments in the alluvial fans and valleys are typically composed of coarse to fine alluvial debris (boulders, cobbles, sand, silt, and clay).

Yucca Flat and Frenchman Flat are topographically closed valleys. In the lowest portions of these valleys, water from snowmelt and other runoff from higher elevations collects during wet seasons. The collected water contains fine sediments and dissolved solids, including salts. As the water evaporates, these fine sediments and evaporite salts are left behind to form a playa. Jackass Flats is topographically open and drains via Fortymile Wash to the south off the NNSS.

Past actions by DOE, particularly underground nuclear testing, have significantly altered the topography at the NNSS. Yucca Flat, and to a much lesser extent, Pahute and Rainier Mesas, is pockmarked with craters from surface explosions and collapsed test cavities. Buckboard Mesa, Shoshone Mountain, Dome Mountain, and Frenchman Flat also exhibit evidence of past tests. Other excavations on the NNSS include blasting for road construction, excavation of aggregate material (e.g., sand and gravel), flood and drainage control, and historical mining tunnels and shafts.

4.1.5.2 Regional Geology

The NNSS is located in a region of complex stratigraphic and structural elements that combines volcanic uplands and calderas, Basin-and-Range faulted bedrock, Mesozoic thrust faults, and modern alluvial basins. All of these features overlay a basement complex of highly deformed Proterozoic- and Paleozoic-age sedimentary and metasedimentary rocks. Approximately 40 percent of the NNSS surface is alluvium-filled basins; 40 percent is Tertiary-age volcanic rocks; and 20 percent is Paleozoic- and Precambrian-age sedimentary rocks (DOE/NV 2009d). **Figure 4–8** presents a simplified map of the geologic units expressed at the surface. **Table 4–15** presents a description and age of the geologic units found at the NNSS. A detailed compilation of the rock units at the NNSS can be found in Slate et al. (1999).

The regional tectonic history is very complex, as the stratigraphy presents a record of faulting, uplift, volcanism erosion, and deposition for millions of years. During the late Paleozoic era, the region was a stable continental shelf, periodically covered by shallow seas that gradually deepened westward. Thick layers of limestone, dolomite, shale, and sandstone deposited in the Cambrian through the early Devonian periods are present on the NNSS. In the late Devonian era, uplift west and north of the NNSS resulted in the seas retreating, erosion, and deposition of Mississippian sandstones and shales in a foreland basin (Poole and Sandberg 1991).

Major east–west compression and deformation occurred during an event called the Sevier orogeny, which produced regional thrusts, folds, and strike-slip faults. The faulting occurred periodically in the Great Basin between 350 million and 65 million years ago. As a result of the thrust faulting, sheets of older Paleozoic sedimentary rocks were thrust over younger rocks. Toward the end of the Sevier orogeny, extensional forces may have caused normal faulting, which allowed volcanic intrusion and the formation of granitic rocks. Erosion on the mountain ranges continued through the early Tertiary period, where extension restarted, forming north–south-trending, high-angle, normal faults, as well as strike-slip faults. Crustal extension in this region continued for the last 20 million years, creating the current Basin and Range Physiographic Province (DOE 1996c). Blocks bounded by normal faults dropped to create basins, which exposed Paleozoic and Mesozoic bedrock on mountainsides. The valleys subsequently filled with coarse gravels and sands eroded from the mountain ranges, which are layered with finer grains that were reworked by wind and water. Volcanic activity in the region caused by continuing crustal extension deposited Tertiary ash in massive layers with younger basaltic lava flows. Crustal extension is continuing today, as evidenced by earthquakes, fault traces in alluvial deposits, and heat flow in the bedrock.

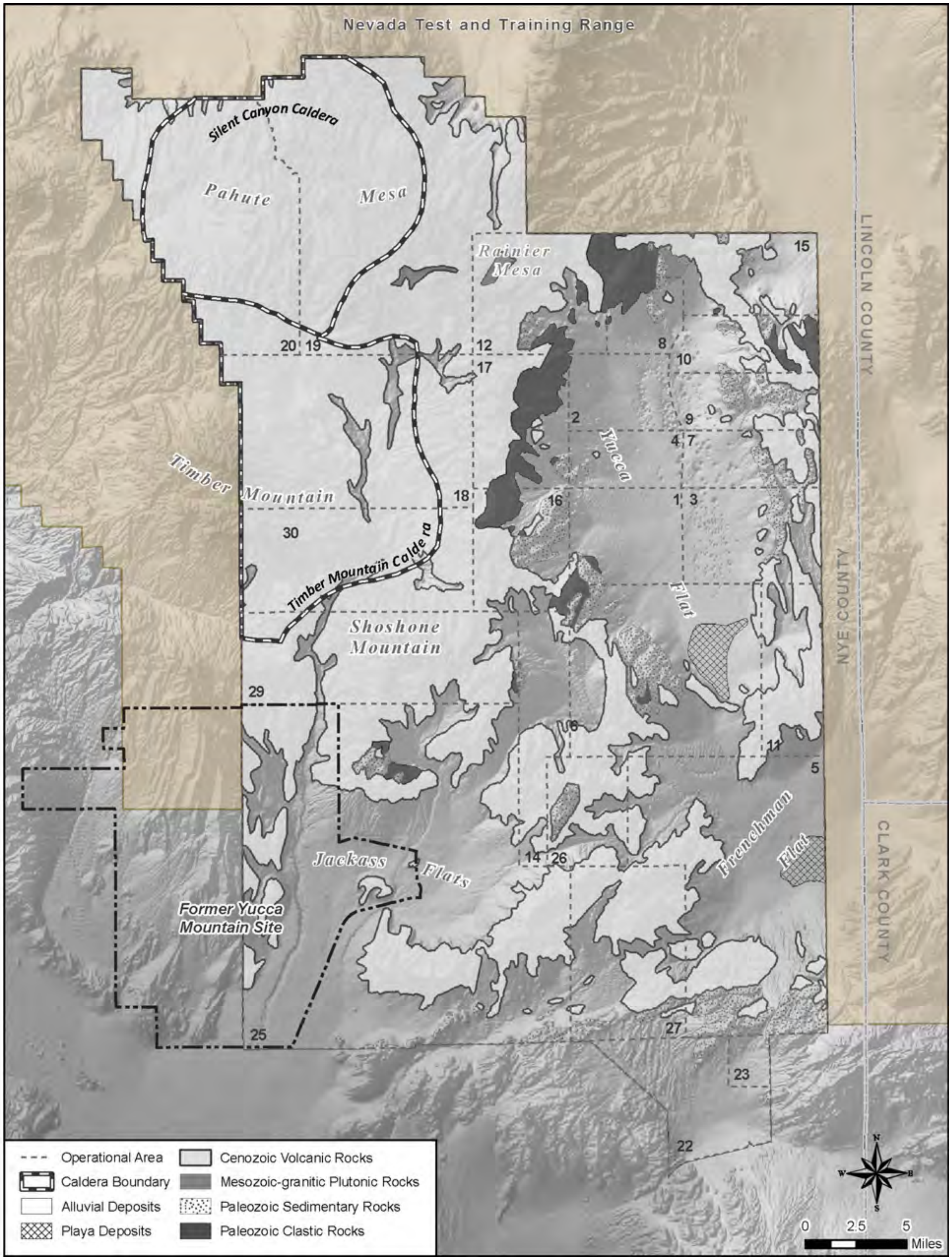


Figure 4–8 Simplified Map of the Geologic Units

Table 4–15 Summary Stratigraphy of the Nevada National Security Site

Era	*Period*	*Series*	*Group*	*Map Units*	*Description*	*Thickness*	*Example Location*
Cenozoic	Quaternary	Holocene – Present Day	Surficial & Volcanic Deposits	Young alluvial deposits	Intermixed gravel, sand, and silt, unconsolidated to poorly consolidated, poorly to moderately well-sorted, locally cross-bedded.	32.8 feet	Fortymile Wash
				Playa	Silt, fine sand and clay, poorly to moderately well-consolidated, calcareous, moderately well-sorted. Ocasionally saline.	65.6 feet	Yucca Flat, Frenchman Flat
		Early Holocene/ Pleistocene		Intermediate Alluvial Deposits	Intermixed and interbedded gravel, sand, and silt. Clasts are light and pinkish gray, with variable sorting and cross-beds. Moderately to densely packed pavement.	Up to 98.4 feet	
		Pleistocene		Youngest Basalt	Isolated black and reddish-brown cinder cones, lava flows, feeder.	Variable	Oasis Valley
		Middle to early Pleistocene/ Pliocene		Old Alluvial deposits	Intermixed and interbedded gravel, sand and silt, light brownish gray to light gray. Generally poorly sorted and moderately cemented with carbonate.	Greater than 131 feet	
	Tertiary (Miocene)	Miocene	Thirsty Canyon Group	Gold Flat Tuff, Pahute Mesa and Rocket Wash Tuffs, Basalt of Thirsty Mountain, Stonewall Flat Tuff	Ash-flow tuff, basalt lava flows and nonwelded tuff from the Black Mountain caldera. Multiple sequences of tuff formations from sequential volcanic eruptions. High-alkali feldspar and low-plagioclase minerals present in tuff.	Greater than 1,640 feet	Buckboard Mesa
			Timber Mountain Group	Ammonia Tanks Tuff, Rainier Mesa Tuff	Rhyolite ash-flow tuff, subordinate rhyolite lava flows and volcanic domes, with related intracaldera breccias. Volcanic rocks erupted from the Timber Mountain caldera complex. Contains an abundance of quartz phenocrysts in rhyolite and iron-magnetic minerals in upper layers. Also contains some thin basaltic lava flows.	Greater than 1,640 feet	Timber Mountain Caldera Complex, Pahute Mesa
			Paintbrush Group	Wahmonie Formation	Alkali rhyolite nonwelded tuff and lava flows erupted form Claim Canyon caldera. Biotite, hornblende, and some clinopyroxene present in sequence through the group. Rhyolite lava flows and related nonwelded tuff.	3,608 feet	North of Frenchman Flat and Shoshone Mountaine
			Crater Flat Group	Prow Pass Tuff, Bullfrog Tuff	Assemblage of ash-flow tuff and related lava flows and airfall tuffs.	Variable	South of Timber Mountain

Era	*Period*	*Series*	*Group*	*Map Units*	*Description*	*Thickness*	*Example Location*
			Belted Range Group	Grouse Canyon Tuff, Tunnel Formation, Comedites of Quartet Dome and Split Range	Voluminous assemblage of peralkine ash-flow tuff and related lava flows and air fall tuff. The source calderas were buried under later eruptions.	Greater than 1,640 feet	Pahute Mesa and Belted Range
		Oligocene/ Cretaceous		Gabbro dikes	Dark-green hornblende gabbro and diorite dikes that cut pre-Tertiary rocks. Medium-grained texture, with plagioclase, hornblende, clinopyroxene, and biotite as the component minerals.	Variable	Northern margin of Yucca Flats
		Upper		Granitic intrusion	Medium-grained intrusive rocks, hornblende-biotite granodiorite, quartz monzonite. Includes Climax stock.	Variable	Northern edge of Yucca Flat
Mesozoic	Cretaceous	Lower		Tippipah Limestone	Light to medium gray and light brown well-bedded marine limestone, calcareous mudstone, and minor chert pebble conglomerate. Forms ledges easily.	4,101 feet	West of Yucca Flat
Paleozoic	Permian	–		Eleana Formation	Chert-rich sandstone and pebble conglomerate, siliceous siltstone.		
	Penn.	–					
	Miss.	Upper and Middle		Guilmette Formation	Thick-bedded finely to coarsely crystalline marine limestone. Contains sandy limestone and thick beds of quartz sandstone; quartzite beds are brecciated.	1,148 feet	Shoshone Mountain
	Devonian	Upper, Middle, Lower		Slope-facies carbonate	Dark gray limestone, dolomite, silty carbonate rocks, well-bedded, locally laminated, debris-flow deposits. Locally fossiliferous.	Variable	Eastern Rainier Mesa
		Middle		Simonson Dolomite	Bedded dolomite and lcoal sandy dolomite. Includes silty and cherty dolomite at base. Fossils present.	984 feet	
		Lower		Sevy Dolomite and Laketown Dolomite	Thick-bedded dolomite, beds of quartz, commonly brecciated. Base is well-bedded, locally cherty, with fossils present.	3,166 feet	West of Yucca Flat
		Lower Devonian/ Upper Silurian		Lone Mountain Dolomite	Varying color dolomite with increased bedding at base. Sparse fossils.	1,607 feet	Yucca Mountain
	Silurian	Upper		Lone Mountain Dolomite Ely Springs Dolomite	Varying color dolomite with increased bedding at base. Sparse fossils. Two major units: Upper is gray dolostone with silty and clay-rich dolostone, and a thin sandy zone. Lower is fine-grained, cherty dolomite.	Upper: 1,607 feet Lower: 164 to 492 feet	Yucca Mountain
	Ordovician	Middle		Eureka Quartzite	Two major parts. Upper is white, very fine medium-grained sandstone and quartzite. Lower is varicolored, medium-grained quartzite interval with thin limestone and dolomite.	246 to 475 feet	

Era	***Period***	***Series***	***Group***	***Map Units***	***Description***	***Thickness***	***Example Location***
		Middle to Lower	Pogonip Group	Antelope Valley Limestone, Ninemile Formation	Medium, well-bedded silty limestone, dolomite, with chert and siltstone.Various invertebrate fossils present.	3,444 feet	
	Cambrian	Upper		Nopah Formation	Poorly to well-bedded carbonates with shale and siltstones. Includes Dunderberg Shale Member. Invertebrate fossils present.	2,362 feet	
		Upper to Middle		Bonanza King Formation	Well-bedded dolomite and limestone with a banded appearance.	4,199 feet	East of Yucca Flat
		Middle to Lower		Carrara Formation	Heterogeneous sequence of shales, siltstone, sandstone, limestone and silty limestone. Clastic rocks at base, silty limestone beds at top. Stromatolith, trilobite fossils present.	1,148 to 1,541 feet	
		Lower		Zabriskie Quartzite	Resistant, massive, white quartz, pink quartz, and red quartz sandstone.	98.4 to 1,148 feet	
		Late		Wood Canyon Formation	Quartz sandstone, mica and quartz sandstone, clay-rich sandstones, and magnesium carbonates; may be slightly metamorphosed. Includes Stirling Quartzite.	2,296 to 3,772 feet	North of Rainier Mesa
				Stirling Quartzite	Medium to thick-bedded, commonly laminated, fine-grained quartz sandstone, mica quartz sandstone, interbedded with pebbly sandstone. Also limestone and dolostone. Locally metamorphosed.	4,921 feet	
Proterozoic	Precambrian	–		Johnnie Formation	Thick-bedded, few cross-beds, locally pebbly quartz sandstone, with laminated mica siltstone, limestone, and calcareous siltstone.	2,952 to 6,561 feet	
				Metamorphic and intrusive rocks	Light-gray and brown biotite schist, biotite-hornblende schist, and biotite-epidote schist intruded by gneissic monzogranite. Some aplite and pegmatite dikes, quartzofeldspathic gneiss and buiotite schist, minor metaconglomerate, and marble also present.	Bedrock	Gold Flat, Funeral Mountains

Source: Slate et al. 1999.

Most of the uplands along the western edge of the NNSS and the TTR are covered by middle Tertiary-age volcanic rocks that are part of the southwestern Nevada volcanic field. This volcanic field includes a broad volcanic plateau underlain by tuffs and lavas that erupted from multiple vents in the area. Its history is a complex sequence of volcanism and deformation. At least 17 ash-flow tuff sequences have been associated with eruptions from seven major, overlapping caldera complexes (Byers et al. 1989; DOE/NV 2009d; DOE 1996c). Most of the calderas were formed from massive eruptions approximately

16 to 7.5 million years ago, while the youngest caldera-forming events most likely occurred about 7.5 million years ago, forming the Stonewall Caldera (DOE 1996c). These eruptions deposited silica-rich ash, tuffs, and lava flows and reworked existing deposits. The layers of zoned ash-flow tuffs, and lava flows are represented in the complex Tertiary volcanic sequences seen today. Approximately 1 million years ago, volcanic activity in the area transitioned to low-volume, mild eruptions and basaltic flows. Evidence of these eruptions is located in basaltic cinder cones and sequences of lava flows at Crater Flat, west of the NNSS. Since the last major eruptions about 7.5 million years ago, only scattered, short-duration volcanic activity has occurred in Nevada (DOE 1996c). There is no indication that the re-eruption of a large-scale volcanic field or an increase in the volcanic rate will occur (DOE 1996c).

There are over 300 described Tertiary volcanic units at the NNSS (DOE/NV 2009d; Warren et al. 2000, 2003), although limited units are often grouped into larger, more-extensive units. Due to the large number of volcanic units and multiple caldera locations, the volcanic stratigraphy has been subsequently revised with additional research. Byers et al. (1989) presents a detailed review of the past studies and the evolution of concepts on calderas of the southwestern Nevada volcanic field from 1960 to 1988. The revised stratigraphy was used to generate complex hydrogeologic models for use in analyzing the movement of groundwater near testing locations in support of the Underground Test Area (UGTA) Project.

Soils form in the youngest geologic material at the NNSS, the late Tertiary and Quaternary alluvial, colluvial, spring, lake, playa, and eolian (windblown) deposits. The unconsolidated sediments erode Paleozoic and Tertiary volcanic materials from the surrounding ranges and collect in the alluvial fans and at the base of the valleys. The alluvial fans consist of interbedded gravel, sand, and silt that vary in their cementation. Valleys that only have internal drainage often collect shallow water after seasonal storms and snowmelt in the spring. As the water evaporates, it leaves stratified lakebed sediments and precipitated salts. The resulting playa sediments are typically bedded sand, silt, or clay. The playa typically looks like a dry lakebed that may contain water after a seasonally high runoff. Sand and silt from the playas can be eroded, transported by wind, and subsequently reworked by moving water. However, most sediments remain stable as long as they are not disturbed.

4.1.5.2.1 Site-Specific Geology

The oldest bedrock at the NNSS is the Paleozoic and Proterozoic sedimentary rock, which includes dolomite, limestone, quartzite, and mudstones (see Table 4–15). These sedimentary rocks often form the primary regional aquifer and a "basement" for the Great Basin's hydrology (DOE/NV 2009d). The Paleozoic and Precambrian rocks have been subjected to a lot of faulting, as described in Section 4.1.5.2.2. The rocks were formed from marine sediments and have a thickness of up to 32,800 feet (DOE/NV 2009d).

The oldest formations of the Proterozoic basement consist of approximately 9,800 feet of lower Cambrian and Proterozoic quartzite and siltstones (DOE 1996c). Above these formations is approximately 15,100 feet of Cambrian through Devonian dolomite, interbedded limestone, and thin but persistent shale and quartzite layers. The youngest of the basement rocks is the Missippippian Eleana formation, which outcrops along the western edge of the Yucca Flat basins, and the Pennsylvanian limestone, which overlies the Eleana formation. In western Yucca Flat, east of the Eleana Range, the Paleozoic-age carbonate rocks have been thrust over the Eleana formation. More information on the basement formations at the NNSS is presented in several publications (Cole 1997; Cole and Cashman 1999; Trexler et al. 2003; Slate et al. 1999).

There are two outcroppings of Mesozoic intrusive rocks at the NNSS; both are granitic masses. The Gold Meadows Stock crops out north of Rainier Mesa, and the Climax Stock is located at the extreme north end of Yucca Flat (DOE/NV 2009d). Three underground tests were performed within the Climax Stock. The stock is a granitic (quartz monzonite and granodiorite) intrusion of Late Cretaceous age into Paleozoic sediments. The Climax Stock also occurs at the intersection of two geologic structures: (1) the Tippipa fault and (2) the Halfpint anticline.

Pahute and Rainier Mesas are high volcanic plateaus dissected by young drainages. The mesas are located in the eastern portion of the southwestern Nevada volcanic field. Their Tertiary tuffs were derived from the Timber Mountain–Oasis Valley caldera complex and the Silent Canyon and Black Mountain calderas. Pahute Mesa was formed from an overlapping complex of fault-controlled calderas, while the laterally extensive tabular outflow sheets of welded tuff covered the surrounding area. During faulting and uplift, the softer pre-Tertiary material was exposed, while the welded tuffs and lava flows resisted erosion. The result was flat-topped mesas with steep sides adjacent to down-dropped valleys. The Timber Mountain caldera, located to the southwest of Pahute and Rainier Mesas, is listed as a national natural landmark by the National Park Service (DOE 1996c).

There are two buried calderas at Pahute Mesa; drill hole and geophysical data indicate that their morphology may be largely controlled by the Basin and Range faults (Warren et al. 2000). All of the tests at Pahute and Rainier Mesas were underground tests that occurred within the Tertiary volcanic rocks and did not penetrate the pre-Tertiary bedrock.

Other historical testing locations are located at Buckboard Mesa, Dome Mountain, and Shoshone Mountain. Buckboard Mesa is located along the northeastern edge of Timber Mountain, while Dome Mountain is a foothill to the southeast. These two sites within the Timber Mountain caldera complex have similar geologic characteristics, including a thick sequence of volcanic rocks that also includes rhyolitic lavas and ash-flow tuffs; volcanic-derived sediments, including sandstone and conglomerate; and basalts. Radial fracturing and faulting typical of a caldera are present at both of these sites. Shoshone Mountain is located southeast of Timber Mountain. The mountain is capped by a unit called rhyolite of Shoshone Mountain, and lithic ridge tuff. North of Shoshone Mountain, the Paleozoic sandstone and conglomerate of Eleana formation and carbonates of the Tippipah limestone are exposed. Quarzite of the Guilmette formation is also present in the area.

Yucca Flat and Frenchman Flat are alluvium- and tuff-filled valleys bounded by mountain ranges with Paleozoic sedimentary and Tertiary volcanic rocks. Thick layers of sand and gravel have collected at the base of these valleys. At Yucca Flat, subsurface gravity surveys using isostatic gravity data from surface stations have estimated the thickness of the alluvial deposits to be up to 8,200 feet (Phelps et al. 1999). From the edge of the mountain ranges, coarse-grained deposits in alluvial fans grade laterally to clay deposits at playas in the lowest part of the valleys. Some windblown sand and silt may also collect at the basin troughs.

Underground nuclear tests at Yucca Flat and Frenchman Flat were detonated primarily in alluvium or in the volcanic rocks. A few tests were detonated in the underlying carbonate rocks beneath the northern Yucca Flat during the early years of the testing program (DOE 1996c; OTA 1989). Testing near or below the water table was common in both the Yucca Flat weapons test basin and Frenchman Flat test area.

4.1.5.2.2 Structural History

As a result of the depositional periods interrupted by tectonic upheaval, the structural record in the region is complex. Geologic structures, such as faults and folds, strongly affect the regional hydrology. Groundwater predominantly travels through cooling joints and fractures, often enhanced proximal to faults. Other structures such as caldera faults or normal faults modify surface drainage and erosion patterns.

Five types of structural features occur in the region around the NNSS: (1) thrust faults (e.g., Belted Range thrusts); (2) normal faults (e.g., the Yucca and West Greeley faults); (3) transverse faults and structural zones (e.g., the Rock Valley fault, Walker Lane shear zone); (4) calderas (e.g., the Timber Mountain and Silent Canyon caldera complexes); and (5) detachment faults (e.g., the Fluorspar Canyon–Bullfrog Hills detachment fault).

The Belted Range thrust fault is the principal pre-Tertiary structure in the NNSS region and, therefore, only affects the pre-Tertiary rocks in the area. The fault can be traced or inferred from Bare Mountain, just south of the southwest corner of the NNSS, to the northern Belted Range north of the NNSS, a distance of more than 81 miles (DOE/NV 2009d). The Belted Range thrust fault is an eastward thrust, which generally places late Proterozoic–early Cambrian rocks over rocks as young as the Mississippian Period. Several overlapping thrust faults occur east of the main thrust fault. Deformation related to the Belted Range thrust fault occurred sometime between 100 and 250 million years ago.

Normal faults associated with the formation of the Basin and Range mountain sequence are the most recent structural elements. The high-angle faults cut across Paleozoic volcanic, Precambrian sedimentary rocks, and early Cenozoic volcanic formations. Most of the faults in the region are northwest–northeast-striking and high angle (DOE/NV 2009d). Good examples of normal faults at the NNSS are found at Yucca and Frenchman Flats. In Yucca Flat, the faults generally trend north–south; in Frenchman Flat, the faults generally strike west–southwest in the south, curving northward in the northern portion of the valley. Evidence of normal faulting is also visible in the Tertiary tuffs of Pahute and Rainier Mesas (e.g., the West Greeley fault) (DOE/NV 2009d). Shoshone Mountain has normal faults that also have a strike-slip component, which is representative of the greater physiographic province.

The Walker Lane shear zone trends northwest to southeast of the TTR along the western edge of the NNSS (DOE 1996c). The Walker Lane shear zone is a major strike-slip fault zone that extends several hundred miles to merge with the Las Vegas shear zone. To the west of the Walker Lane shear zone and northwest of the NNSS is a series of volcanic craters, including Goldfield, Cactus Range, Stonewall Mountain, and Mount Helen (DOE 1996c).

4.1.5.2.3 Faulting and Seismic Activity

As seismic activity still occurs in the Basin and Range Physiographic Province, there have been earthquakes in the recent past around the NNSS. In addition, historical nuclear testing has generated ground motion that could be felt miles away from the testing sites. Seismic activity in the Great Basin tends to be concentrated towards the west and, to a lesser extent, the east (USGS 2010a). Seismic activity in the NNSS region was described by Vortman (1991). The analysis determined that, from 1868 to 1991, 11,988 seismic events were recorded within 120 miles of the NNSS. Of these events, 8,161 were naturally occurring and 3,827 were induced by humans (DOE 1996c). This is a minimum count of events because placement of seismic instruments capable of detecting low-magnitude events in the region began after testing in 1951.

The southern Great Basin contains many Quaternary fault traces, but few indications of movement in the last 10,000 years. Quaternary faults are identified by the presence of discontinuous scarps in volcanic material or in the alluvial sediment in valleys. The Spotted Range–Mine Mountain structural zone appears to be the only currently active fault system in the area. The Spotted Range–Mine Mountain structural zone is the revised name for the Cane Spring and Rock Valley fault zones that were described in the *1996 NTS EIS*. These faults are located in southwestern Frenchman Flat and have a generally northeast strike and a left-lateral slip (Anderson 1998a). The Mine Mountain fault is also associated with the Spotted Range–Mine Mountain structural zone and trends northeast–southwest, but is located along the southwestern edge of Yucca Flat, east of Shoshone Mountain (Anderson 1998b).

Small earthquakes have occurred at or near the Spotted Range–Mine Mountain structural zone; although no surface displacements were associated with them (Carr 1974; DOE 1996c). The last earthquake with a magnitude over 5.0 was near Little Skull Mountain in 1992. The shallow 5.6-magnitude earthquake was associated with the Spotted Range–Mine Mountain structural zone and was potentially caused by a 7.5-magnitude earthquake near Landers, California (DOE 1996c). This earthquake was notable because it damaged several of the NNSS facilities that were built prior to revised building codes. Since 1992, several smaller earthquakes ranging between magnitudes of 3.0 to 4.0 have occurred near Little Skull Mountain, Frenchman Flat, and Calico Hills, all in the southern portions of the NNSS. The largest of these earthquakes had a magnitude of 4.0 in 1997, south of Calico Hills; earthquakes with magnitudes of 4.5 and 4.8 occurred in January 1999 in Frenchman Flat; and a 4.6-magnitude earthquake occurred southwest of Skull Mountain in 2002 (USGS 2010b data).

Sandia National Laboratories developed a program for recording surface and subsurface motions resulting from underground nuclear explosions (DOE 1996c). Test-induced ground motion is affected by several factors: (1) the yield of the device; (2) ground-coupling at the source of the explosion, which is a function of the test design, depth of the device, local geology, and stratigraphy; (3) geological complexity along the ground wave path; and (4) the topography and geology at the location receiving ground motion (DOE 1996c). There is always some variation or unknown associated with estimating these factors; however, because of the long history of conducting nuclear weapon tests, ground motion predictions for tests at the NNSS have become increasingly accurate.

Yucca Flat is bisected by a fault scarp called Yucca Fault, which stretches approximately north–south. Several investigations of the scarp height and sediment ages indicate that most of the recent movement occurred between 10,000 and 130,000 years ago. There is also evidence that southern sections of the fault were displaced by testing activities (Anderson 1998c). Testing in Yucca Flat during the 1970s and 1980s generated manmade earthquakes with magnitudes between 4.0 and 6.0 (Rodgers et al. 2005).

DOE policy is to design, construct, and operate DOE facilities so that workers, the general public, and the environment are protected from the impacts of natural phenomena hazards (including seismic events) on DOE facilities. Executive Order 12699, "Safety of Federal and Federally Assisted or Regulated New Building Construction," required new buildings owned by the Federal government to be designed and constructed in accord with appropriate seismic design and construction standards. DOE Order 420.1B, "Facility Safety," and DOE G-420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, require that structures, systems, and components at DOE facilities be designed to withstand the effects of natural phenomena hazards using a graded approach. The graded approach is implemented by five performance categories requiring natural phenomena hazard protection, with Performance Category 0 for those structures, systems and components requiring no natural phenomena hazard protection and Performance Category 4 for those structures, systems and components requiring protection from the release of hazardous material similar to that provided by commercial nuclear power plants. For each performance category, DOE-STD-1020-2002, *DOE Standard Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, provides natural phenomena hazard design, evaluation and construction requirements. DOE-STD-1023-95, *DOE Standard Natural Hazards Assessment Criteria*, provides general and detailed criteria for establishing adequate design-basis load levels for DOE structure, systems and components. DOE seismic design criteria also meet the requirements of the International Building Code (ICC 2009).

Seismic waves from nuclear explosions are believed to relieve tectonic stress, as seen by the aftershocks and movement along some Quaternary faults around the testing zones (DOE 1996c; Rogers et al. 1991). The Yucca Fault and Carpetbag Fault, in Yucca Flat, showed indications of reactivation (Frizzell and Shulters 1990) by vertical and lateral displacement as a result of past nuclear detonations in Yucca Flat, though most of this movement is believed to be due to differential compaction of the porous alluvium over the existing buried fault scarp.

As a result of the ongoing moratorium on nuclear testing, the last underground nuclear tests at the NNSS occurred in 1992. The only architectural damage in surrounding communities resulting from underground nuclear testing occurred with test yields over 100 kilotons (DOE 1996c). For the period of time between the enactment of the Threshold Test Ban Treaty and the last underground nuclear test, only a few reports of very minor test-related damage were received (DOE 1996c). For communities farther than 30 miles from the test location, only multiple-story buildings would be affected by the larger tests, should testing resume (DOE 1996c).

4.1.5.2.4 Geotechnical Hazards

There are several geotechnical hazards at the NNSS and the TTR that may present a small risk to structures and roads. The main hazards include slope, soil, and ground instability. Areas near rugged topography and cliffs, combined with ground motion from earthquakes or nuclear tests (should testing resume), present an increased risk for slope stability hazards. However, most existing structures at the NNSS were built in locations with a lower potential for geotechnical hazards.

Many soils in Nevada contain clay minerals (e.g., montmorillonite) that swell when wet (DOE 1996c). Soils with a volume change of 3 percent or less when wet have low limitations when used for construction. Soils that swell from 3 to 6 percent of their volume have moderate limitations, while soils that swell greater than 6 percent of their dry volume have high limitations. Soils with moderate to high limitations due to shrink-swell properties could affect the stability of structures.

In general, ground stability is adversely affected by the presence of weathered or fractured bedrock, a high percentage of void space in the soil, lack of vegetation, freeze-thaw sequences, soil erosion from wind or flowing water, or ground motion. Knowledge of the subsurface activities is also important, as underground nuclear tests may have rubble chimneys that did not reach the surface, but would pose a hazard for any construction or other activity; these areas on the NNSS are known and are fenced and controlled.

Some soil processes enhance ground stability. Development of a pebble pavement as soil is stripped away by erosion, as well as accumulation of calcium carbonate minerals in subsurface horizons, can provide additional stability to certain structures. These areas are also less likely to be reworked by surface flow, so the soil column would be more comprehensive (Friesen 1992).

4.1.5.2.5 Geologic Resources

Potential geologic resources around the NNSS include mineral mining, aggregate, oil and natural gas, and geothermal resources. The availability of the resources has not changed significantly since the publication of the *1996 NTS EIS*.

For more than 100 years, sections of the southern Great Basin have produced amounts of base and precious metals, particularly gold, silver, copper, lead, zinc, tungsten, and uranium (Kral 1951). At the NNSS, there are four historic mining districts (SAIC/DRI 1991). These mining districts would be of interest for economic mining if the NNSS were open for public access. However, the NNSS has been closed to commercial mineral development since the 1940s (SAIC/DRI 1991).

Gold, silver, copper, lead, zinc, and mercury are present in the region around the NNSS. Gold and silver deposits are mined in the Goldfield mining district to the northwest of the Nevada Test and Training Range. Silver may still be present in the Oak Spring District, located at the north end of Yucca Flat; a significant amount of silver has been taken from the Groom mine (BLM 1979) located on the Nevada Test and Training Range, northeast of the NNSS. Economic quantities of copper, lead, and zinc have also been extracted from the Groom mine (SAIC/DRI 1991). On NNSS property, gold or silver deposits may be present in the Wahmonie District, located on the south-central NNSS, although prospecting in the 1930s found few ore deposits (SAIC/DRI 1991; NPS 2000).

In the 1950s and 1960s, commercial tungsten mining occurred at the Oak Spring District, which indicates that the NNSS has a moderate potential for economic tungsten deposits (SAIC/DRI 1991). Iron, in the form of magnetite, is also present in the region; however, there is a low potential for its commercial ores at the NNSS (Sherlock et al. 1996). Aggregate materials are typically mined from alluvial fans that border the region's mountain ranges. There are sufficient aggregate resources in the region to support foreseeable future demand from construction (DOE 1996c).

Uranium resources may be present in the northwestern part of the Nevada Test and Training Range (BLM 1979). Zeolitized rocks are common in the NNSS region. The widespread occurrence of zeolite deposits in the region suggests a low-to-moderate potential for development (SAIC/DRI 1991). Barite is known to occur in the Mine Mountain district, specifically in veins associated with quartz and mercury, antimony, and lead mineralization. However, barite veins at the NNSS are small and impure and do not represent a potential barite resource (SAIC/DRI 1991). Fluorite was reported to be present in the Calico Hills area, although little is known about the occurrence of fluorite, and its resource potential is assumed to be low to moderate (SAIC/DRI 1991).

The northeastern and southwestern portions of the NNSS and the Nevada Test and Training Range have a theoretical potential for hydrocarbon resources, as the rock type, age, and thermal maturity all contribute to a potential for pockets of oil or gas reserves (Grow et al. 1994). The northeastern and southern sections of the NNSS and Nevada Test and Training Range have potential for oil and gas, while the southern portion of the NNSS and southeastern portion of the Nevada Test and Training Range have a potential for gas. Large-scale hydrocarbon resources would be very unlikely; however, as there are few laterally extensive carbon-bearing formations, the thermal maturity of the region is just within acceptability, and the large fault complexes throughout the NNSS are likely to have broken through cap rocks. Other investigations (SAIC/DRI 1991; Garside et al. 1988) used these mitigating factors to determine that the overall potential for the NNSS would be low. No surface occurrences of oil, gas, coal, tar, sand, or oil shale at the NNSS have been reported (DOE 1996c). There are also no oil or gas wells at the NNSS (Hess and Johnson 1996).

4.1.5.2.6 Geothermal Resources

The extensional forces that create seismicity in the Basin and Range Province have also thinned the crust so that the mantle warms the bedrock. Increased heat flow through aquifer-bearing bedrock creates hot springs that could be amenable for use with a geothermal plant facility. Hot springs are not present at the NNSS; however, several are located west of the NNSS (Coolbaugh et al. 2005). If downhole temperatures near Yucca Mountain are representative (120 degrees Fahrenheit [°F] to 140 °F), groundwater temperatures in the region may be insufficient for some types of commercial power development (DOE 1988). However, a 1994 preliminary assessment of the geothermal potential of the NNSS found good potential for development of a moderate-temperature geothermal resource. This resource potential was judged suitable for development of a binary geothermal power plant (HRCES 1994).

An Enhanced Geothermal System, a type of binary geothermal power-generating technology, would use steam created in bedrock to turn electricity-generating turbines. The bedrock would need to be at least 356 ºF to heat the steam. An open system could use steam from hot-water-bearing bedrock (wet), while a closed system could use heat from bedrock that does not contain an aquifer (dry). In a review of geothermal resources, DOE determined that several locations at the NNSS appear to have the heat potential to support an Enhanced Geothermal System (Brown 2009). Hot-water-bearing bedrock is located outside the NNSS at East Yucca Flat, Wahmonie Volcanic Center, Crater Flat, and Oasis Valley. The hot dry rock areas include Halfpint Range, Climax Mine, Gold Meadows, the Timber Mountain Caldera Complex, and Calico Hills.

4.1.5.3 Soils

There are few soil surveys for the NNSS and surrounding areas because the site was established as a nuclear weapons testing site prior to the nationwide soil survey program. Radioactivity and nuclear testing have also resulted in restricted ready access to some parts of the NNSS. Soil surveys internal to the NNSS have been conducted at locations of interest, particularly those associated with the Yucca Mountain Geologic Repository site, new facility construction sites, and onsite waste disposal sites. However, most of the soil characterization is limited to a series of geotechnical descriptions for a particular construction project, rather than a regional soil analysis. These documents are used for internal uses and permit applications. A great deal of research at the NNSS has been focused on defining areas of contamination at testing locations and the movement of contaminants through the soil column.

Soils at the NNSS are similar to those throughout southern Nevada. Most of the soils form on the alluvial fans and valley floors, with thin soils forming on mesa and mountain surfaces. The most common soils at the NNSS are aridisols and entisols. The amount of development these soils have undergone depends on their age, their parent materials, and particularly their geomorphic position. Entisols generally form on steep mountain slopes where erosion is active. Aridisols tend to be older and form on more-stable fans and terraces (DOE 1996c). Evaporate deposits found in playas tend to develop in aridisols. The parent materials for most of these soils are mixed alluvial sediments that were eroded from the surrounding ranges. The soil texture generally grades from coarse-grained soil close to the mountain fronts to fine-grained sediments in playas at the bottom of valleys. This gradation can be seen in cross sections at Yucca Flat and Frenchman Flat. Overall, most of the soils are reasonably young, with low leaching, and retain their structures from when the parent materials were deposited.

Underlying the surface of more well-developed soils is a layer of caliche, calcium carbonate minerals precipitated from evaporating carbonate-saturated groundwater. The saltiness of the soils increases towards the center of internal drainage basins because snowmelt, rainfall, and groundwater tend to collect, concentrate, and then evaporate. The highest level of soluble salts at the NNSS can be found in the soil horizons at Frenchman Flat (DOE 1996c).

The soils at the NNSS are highly susceptible to erosion by wind and water. Although finer-grained soils on steep slopes are more easily erodible, mineral composition and topography can also affect the movement of topsoil. Because the NNSS has not undergone a comprehensive soil survey review, locations of soils that are easily erodible have not been identified.

Approximately 3,257 acres of the NNSS, the TTR, and the Nevada Test and Training Range contain soils with a radioactivity level high enough to qualify for remediation under the Environmental Restoration Program (i.e., greater than or equal to 200 curies per gram) (DOE 1996c). The soils were contaminated by radioactive isotopes expelled from open air testing at Yucca Flat, Frenchman Flat, Plutonium Valley (Area 11), and other areas around the NNSS, the TTR, and the Nevada Test and Training Range. Section 4.1.5.4.1 provides a more detailed description of the soil contamination and isotopes at the NNSS and the surrounding areas.

Prime Farmland soils have not been identified at the NNSS and surrounding areas. However, agriculture production in Nevada often requires irrigation, so soil suitability for irrigation could be used as a proxy for soils with a potential to be classified as Prime Farmland. Previous maps by the Division of Water Resources show that the lowest elevations of Yucca Flat, Frenchman Flat, and Jackass Flats would be the most suitable at the NNSS for water retention (Rush 1974). Other soils at the NNSS tend to be too thin or too permeable to be effectively irrigated. In Yucca Flat, the cobbly, stony soils have moderately low water-holding capability, while Frenchman Flat and Jackass Flats have severe limitations with low water-holding capabilities. These areas tend to flood and drain, rather than retain groundwater directly below the surface (DOE 1996c).

4.1.5.4 Radiological Sources as a Result of Testing

4.1.5.4.1 Soils

There are approximately 100 sites with radioactively contaminated soils as a direct result of past nuclear weapons testing on and around the NNSS (DOE/NV 2009d). The impacts from radioactive contamination have been considerable and, in some cases, significant. The areas of greatest soil contamination were the locations of atmospheric testing of nuclear weapons, safety tests, and shallow borehole tests. Additional surface contamination occurred from crater tests and deep underground testing. This section describes the results of past tests and the remaining contamination in the soils.

NNSA is managing contaminated sites in accordance with the Federal Facility Agreement and Consent Order (FFACO), in conjunction with the State of Nevada. A variety of corrective actions are used to remediate soil contamination, including soil removal and "closure in place," in which the site is fenced, warnings are posted, and access is restricted (DOE/NV 2009d).

Under the FFACO, the goal of the Environmental Restoration Program is to characterize, monitor, and remediate identified contaminated areas, facilities, soils, and groundwater at the NNSS and its associated facilities. Within the Environmental Restoration Program, the Soils Project is responsible for the corrective action units (CAUs) that consist of surface and shallow subsurface contamination from nuclear experiments or testing on the NNSS, the TTR, and the Nevada Test and Training Range.

The Soils Project creates data baselines for soils, implements air monitoring and radiological surveying of key indicator parameters (plutonium and noble gases), and implements comprehensive remediation and/or monitoring plans. The FFACO identified several types of soil site CAUs based on the types of testing that generated the contamination: atmospheric testing, safety experiments, classified hydronuclear experiments, nuclear rocket engine tests, shallow detonations, and subsurface nuclear tests that vented to the surface (Bechtel Nevada 1998a). The tests that generated radiological soil contamination are described below.

A total of 100 atmospheric tests were conducted from 1951 to 1963, when the Limited Test Ban Treaty was signed (DOE 1996c). The majority of atmospheric tests were conducted at Yucca Flat, Frenchman Flat, and Rainier Mesa. Atmospheric testing included weapons dropped by planes, detonated from towers, suspended from balloons, or detonated on the ground surface (DOE 1996c). Depending on the proximity of the explosion to the ground surface and the size of the yield, surface disturbances from atmospheric testing varied widely.

Based on their location, 94 of the atmospheric tests are grouped into 5 atmospheric test CAUs: South Yucca Flat, North Yucca Flat, Frenchman Flat, Buckboard Mesa, and Small Boy (FFACO 2008). The other six tests of the atmospheric test locations are safety-related experiments.

Radioactivity from atmospheric tests was dispersed by three primary mechanisms: (1) throwout, (2) base surge, and (3) fallout (DOE 1996c). Throwout occurs immediately after the initial detonation, when large volumes of rock and soils are thrown outward. Base surge follows as the throwout laterally expands and begins to settle. Fallout consists of the finest particles that remain suspended and mixed with the radioactive weapon residues before gradually being deposited on the ground surface. Fallout can be transported away from the test location because it can remain suspended for several hours after a test. Soil contaminated with radioactive fallout can also be transported limited distances through resuspension by wind. The extent and distribution of contamination from an atmospheric test is quite variable depending on the height of detonation, the yield and type of device, the nature of the ground surface, the mass of the inert material surrounding the device, and the weather conditions during and after the test (DOE 1988).

Various isotopes, including strontium, cesium, barium, hydrogen-3 (tritium), and iodine, form during a nuclear detonation. Most of these isotopes have short half-lives; however, strontium-90 and cesium-137 have half-lives of 28 and 30 years, respectively, so they are retained longer in the soil (Glasstone and Dolan 1977). Because most of the isotopes released during the atmospheric tests rapidly decayed, most of the radioactivity was reduced within the first 12 hours after detonation (OTA 1989). Americium, plutonium, cobalt, cesium, strontium, and europium are the primary radioactive isotopes still present in the soils from historical atmospheric testing. The surface radiation concentration in soils is concentrated near ground zero in the areas where atmospheric testing occurred (Frenchman Flats, Yucca Flat, and Buckboard Mesa) (DOE 1996c). McArthur estimated that, in Frenchman Flat, 20 curies of radioactivity remain at or near the soil surface (McArthur 1991). In Areas 2 and 4, approximately 11.0 and 10.4 curies of cesium-137 were measured at the Kepler and Shasta ground zero locations, respectively (McArthur and Kordas 1985). In Yucca Flat and Buckboard Mesa, some of the radioactivity in soils may also be attributed to underground testing in the area; however, it is likely that the majority is connected to atmospheric testing (DOE 1996c).

Between 1954 and 1963, aboveground safety tests were conducted on the NNSS and the Nevada Test and Training Range, including the TTR. These safety tests used mixtures of plutonium and uranium that were subjected to detonations of conventional explosives. Safety tests at the NNSS were performed in Yucca Flat (Areas 3, 7, 8, and 9); Frenchman Flat (Area 5); Plutonium Valley (Area 11); and Rainier Mesa (Area 12); and in the Nevada Test and Training Range (including the TTR) to the northeast and northwest of the NNSS. Although most tests had no nuclear yield, the explosion spread mostly plutonium, uranium, and americium. Under the FFACO, the safety experiments were grouped into seven CAUs: Double Tracks; Clean Slate 1, 2 and 3; Project 57; Area 11 Plutonium Valley; and the Area 5 GMX Unit (FFACO 2008).

The GMX project in Area 5 was used for 24 experiments that had little nuclear yield. Project 56, in Area 11, had 4 tests, which resulted in plutonium contamination of approximately 2,200 acres in Plutonium Valley (DOE 1996c). Three safety tests were also conducted on the TTR as part of the Clean Slate experiments. Two safety tests, the Project 57 and Double Tracks tests, were conducted on the Nevada Test and Training Range near the northeastern corner of the NNSS and just west of the TTR, respectively.

Each safety test sequence contaminated different areas with radioactive concentrations, as shown in **Table 4–16**. The contamination concentrations shown in Table 4–16 are approximations and reflect limitations in field sampling of large areas, detection equipment, and laboratory analyses. Several isotopes that make up the remaining radioactive inventory from safety tests are plutonium, uranium, americium, and lesser amounts of cesium, strontium, and europium (DOE 1996c).

Table 4–16 Estimated Radioactive Contamination Resulting from Safety Tests

Test Name(s)	*Location*	*Area Contaminated (acres)*	*Remaining Radioactive Inventory (curies)*
GMX	NNSS	240	1.7 to 2.5
Project 56	NNSS	2,200	34 to 39
Project 57 and Double Tracks	Nevada Test and Training Range	1,000	about 50
Clean Slate I, II, and III	Tonopah Test Range	670	about 65

NNSS = Nevada National Security Site.
Source: DOE 1996c.

These long-lived radioisotopes remain today in the surficial soils in the vicinity of the test areas. The mobility of the isotopes has been extensively researched at the NNSS. Wind can transport soil contaminated with plutonium, uranium, and americium-241 from safety tests and concentrate these contaminants in mounds around desert shrubs or dunes (Friesen 1992). Water from precipitation can also cause plutonium to migrate deeper into the soils with time (DOE 1996c).

In addition to explosive tests, a series of activities were conducted at the Nuclear Rocket Development Station in Areas 25 and 26. From 1959 through 1973, the area was used for a series of experiments involving an open-air nuclear reactor, nuclear engine, and nuclear furnace tests, as well as for the High Energy Neutron Reactions Experiment (DOE 1996c). Equipment and facilities remain from some of these locations. Some limited areas of contaminated soils are also present. The total estimated inventory of isotopes remaining in the soils in this area of the NNSS has been estimated to be about 1 curie (McArthur 1991). The primary soil contaminants in this area are isotopes of strontium, cesium, cobalt, and europium (DOE 1996c). Cleanup of contaminated soils resulting from nuclear rocket and related testing is addressed as part of the Environmental Management Mission under the Environmental Restoration Program (FFACO 2008).

The Soils Project is ongoing under the Environmental Restoration Program. Approximately one-fifth of the corrective action sites initially identified have been closed. As new pockets of contamination are identified, the total number of soil contamination sites may increase.

4.1.5.4.2 Subsurface

A total of 828 underground nuclear tests were conducted at the NNSS. This resulted in pockets of radiological contamination in the bedrock in underground nuclear testing areas at the subsurface and in the near vicinity of the testing locations. Underground testing is broken down into three main categories: (1) shallow borehole tests, (2) deep vertical tests, and (3) tunnel tests. This section presents the condition of the bedrock as a result of the tests.

From 1960 through 1968, shallow borehole tests were used to test a variety of explosives. "Shallow borehole tests" refer to the tests performed within 200 feet of the surface. Some of these tests were related to the safety tests done above ground; others were conducted as part of Project Plowshare. Project Plowshare used nuclear detonations to determine whether the explosions could be used for large-scale excavations, such as creating harbors and canals. As a result, some large ejection craters were created at the NNSS, such as the Sedan Crater in Area 10 at the northern end of Yucca Flat and Buggy in Area 18. The Sedan Crater, a 1,280-foot-diameter crater, was generated from a 104-kiloton nuclear device detonated 635 feet underground. McArthur (McArthur 1991) estimated that the remaining inventory of surficial radioactivity at the Sedan Crater is 344 curies. The total estimate for all releases from shallow borehole tests to the surficial soil horizon at the NNSS is 2,000 curies (DOE 1996c). Sites where shallow borehole tests occurred were grouped into six CAUs to integrate subsurface and surface remediation efforts. The tests were grouped by geographic location and named by the area they were conducted in:

Area 10 Sedan, ESS, and Uncle Unit; Area 30 Buggy Unit; Area 20 Cabriolet/Palanquin; Area 20 Schooner; Area 18 Johnnie Boy; and Area 18 Danny Boy (FFACO 2008).

Deep vertical tests occurred at Frenchman Flat, Yucca Flat, Pahute Mesa, and Rainier Mesa. The tunnel complexes at Rainier Mesa and Shoshone Mountain are also used for horizontal tests. Although the deep tests did not usually create ejecta craters like the shallow borehole or atmospheric tests, subsidence craters were often created by collapsed chimneys. Radiological contamination, disruption of the geologic media, and seismic waves (i.e., ground motion) are other major impacts of underground nuclear testing. Some of the tests generated shock waves equivalent to 5.0-magnitude and 7.0-magnitude earthquakes, which were felt for miles outside of the NNSS with no permanent effects.

Following a deep underground nuclear detonation, a pocket of vaporized bedrock is almost instantaneously formed, which quickly fractures and propels a shock wave out from the test site. As the gases cool, molten rock begins to collect and solidify on the cavity sidewalls and settles in a puddle at the bottom of the cavity. When gas pressure decreases to the point that it can no longer support the overlying rock and soil, the cavity may collapse, forming a chimney upward from the cavity. The collapse of the overburden in the chimney occurs until the vertical stress is equalized or the chimney reaches the surface (DOE 1996c). The result is a saucer-like collapse crater. The collapse crater differs from the shallow borehole tests because the crater collapses inward, with no ejecta striations. The complete process usually occurs within a few hours after detonation.

Yucca Flat is pockmarked with subsidence craters formed by deep vertical underground tests. The crater sizes range in diameter from 200 to 1,500 feet, and in depth from a few feet to 200 feet. The size of the crater depends on the depth of the test, the properties of the geologic units, and the explosive energy yield. The creation of craters is the principal visible consequence from underground nuclear testing. The seismic waves created by underground nuclear detonations also created pressure ridges, small displacement faults that occurred as the detonation created upward pressure initially and then released it. Young faults, such as the Yucca Fault in Yucca Flat, showed some signs of reactivation as a result of the bedrock equalizing to the new stress field around the testing area.

Some cratering occurred on Pahute Mesa due to underground tests; however, the greater competency of the volcanic tuffs and lavas prevented large-scale cratering. Some surface fracturing occurred on Pahute and Rainier Mesas. The amount of fracturing in a given test location is predictable, based on test parameters and the host bedrock. Site selection factors that were essential to both containment and the integrity of the test data ensured that failures within the test areas did not occur.

The fracturing of the rock in the near-test environment may have resulted in some alteration of the natural permeability of the rocks underlying portions of the NNSS. The shock wave and compressive forces from the tests can increase the permeability of the rock by creating more fractures near the test, but can also decrease the permeability by opening and closing fractures at greater distances from the test (DOE 1996c). The bedrock is generally unchanged beyond three cavity radii of the detonation site. At further distances, some fractures may open and then close because of the stress differential as the shock wave passes through. The process of opening and subsequent closing of existing rock fractures could reduce the permeability of the rock by reducing the fracture aperture.

Just as surface and atmospheric tests increased the radioactivity of the soils at the surface, underground nuclear tests created pockets of radioactive contamination around the detonation site. The amount of radiation in these pockets has to be estimated because, unlike surface tests, the detonation site is surrounded by fractured and unfractured bedrock. Immediately after the detonation, the amount of radiation spikes, then reduces as the isotopes with short half-lives decay. Most investigators have concluded that much of the radioactivity released during an underground detonation, exclusive of tritium, remains in the melt glass in the original cavity, especially the refractory isotope species; the more-volatile nuclides tend to condense on the chimney rubble (Borg et al. 1976). Refractory species include plutonium, rare earth elements, zirconium, and alkaline earth elements; volatile species include alkali metals, ruthenium, uranium, antimony, tellurium, and iodine. The most mobile isotopes are the gaseous species, including argon, krypton, tritium, and xenon, which tend to rise through the chimney and may ultimately seep out to the surface (DOE 1996c). The total amount of radioactivity released into the underground environment during a test is called the radionuclide source term. The source term includes both short- and long-half-life isotopes. The estimated radionuclide source term from all deep underground tests reported in the *1996 NTS EIS* was 300 million curies (DOE 1996c). The estimated radionuclide source term has been updated based upon radionuclide decay and is currently 130 million curies (Wilborn 2011).

Geology and Soil—American Indian Perspective

When visiting Area 5 of the Nevada National Security Site (NNSS) in 2009, Indian people observed several traditional use minerals. In particular, Indian people have observed the presence of: (1) Chalcedony, (2) Obsidian, (3) Yellow Chert (otherwise known as Jasper), (4) Black Chert, (5) Pumice, (6) Quartz Crystal, and (7) Rhyolite Tuff. Other traditional use minerals are known to exist in other areas throughout the NNSS.

Minerals are culturally important and have significant roles in many aspects of Indian life. For example, the Chalcedony would have made an attractive offering, which could be acquired here and then left at the vision quest or medicine site located to the north on top of a volcano like Scrugham Peak. Upon return, traditional Indian people would bring offerings back to where we acquired offerings.

Obsidian is a glass-like stone produced by volcanoes. Indian people used a green volcanic glass during curing ceremonies that involved bleeding the patient. Volcanic glass found below Scrugham Peak was used in the first arrow making lessons for young men. Such lessons were held in small rock shelters found along the base of the basalt flow that constitutes Buckboard Mesa. Obsidian flakes were placed before important rock art panels as offering to the spirits that lived on the other side of the passageway provided by the panel. Small obsidian stones, commonly called Apache Tears, have been found on the face of Shoshone Mountain in southern Nevada. This massive deposit of obsidian stones is interpreted by Indian people as being provided by the mountain as both a spiritual backdrop and a location rationale for vision quests (Stoffle et al. 2001).

Volcanic rocks are used in a wide range of ceremonial activities. Indian women enhance the quality of breast milk by squirting it on heated rocks (Stewart 1940; Miller 2004). They are used for medicine society sweat lodge meetings (Zedeno et al. 2001: 146). Indian people call some volcanic rocks "grandfather stones," a designation that reflects reverence as well as wisdom. Such rocks are sought in special places of power and carried over long distances to serve as the heated stones in sweat lodges.

See Appendix C for more details.

4.1.6 Hydrology

4.1.6.1 Surface Water

The NNSS lies within the Basin and Range Physiographic Province and the Great Basin, which is a closed hydrographic basin from which no surface water leaves, except by evaporation. Much of Nevada is contained within the Great Basin, including the NNSS, the TTR, and all but the southern corner of the Nevada Test and Training Range. Consistent with the Great Basin, the internal drainage of regional hydrographic basins is controlled by topography (USAF 1999). The Great Basin comprises numerous smaller hydrographic basins; parts of nine different smaller basins occur within the boundaries of the NNSS. The basins that cover the greatest amount of land area on the NNSS include: (1) Fortymile Canyon (the Buckboard Mesa and Jackass Flats Subdivisions), (2) Yucca Flat, (3) Rock Valley, and (4) Frenchman Flat. Hydrographic basins on the NNSS that are less extensive in land area include portions of Gold Flat, Kawich Valley, Emigrant Valley, Mercury Valley, and Oasis Valley (see **Figure 4–9**).

The similarity of physical environmental attributes throughout the region allows for a general discussion of surface water features and characteristics of the NNSS, the TTR, the Nevada Test and Training Range, and offsite features of importance in close proximity. Thus, the surface-water section begins with a brief discussion of regional conditions before focusing on the NNSS.

Surface Water Features

None of the streams in the region perennially contains water. Thus, streams are ephemeral and are fed by runoff from snowmelt and precipitation during storm events. Storms are most common in winter and occur occasionally in fall and spring; localized thunderstorms often occur in the summer. Much of the runoff quickly infiltrates into rock fractures or into the dry soils. Some runoff is carried down alluvial fans in arroyos, and some drains onto playas where it may stand for weeks as a lake (DOE 1988). These usually dry playas illustrate a perennial water deficit that has been characteristic of southern Nevada since about 1850 (Forester et al. 1999).

The Amargosa River, in the Amargosa Desert, is the main ephemeral stream feature in the region, though it is normally dry, and lies approximately 20 miles southwest of the NNSS at its closest point. The Amargosa River continues to Death Valley, California (DOE 1988).

Springs are the only perennial surface-water sources throughout the region. Most perennial surface discharges from springs occur as pools at some large springs. In most instances, discharged spring water travels only a short distance from the source before evaporating or infiltrating the ground. Springs, seeps, and marsh areas of the region discharge from less than one to several thousand gallons of water per minute. In larger springs, discharges are typically several tens to several hundreds of gallons per minute. The largest discharge is at Crystal Pool in Ash Meadows, approximately 15 miles south of the NNSS southern boundary (DOE 1988). A small lake, locally known as Crystal Reservoir, with a storage capacity of 1,489 acre-feet is present in Ash Meadows. Water for the reservoir is supplied by a flume from Crystal Pool (Giampaoli 1986).

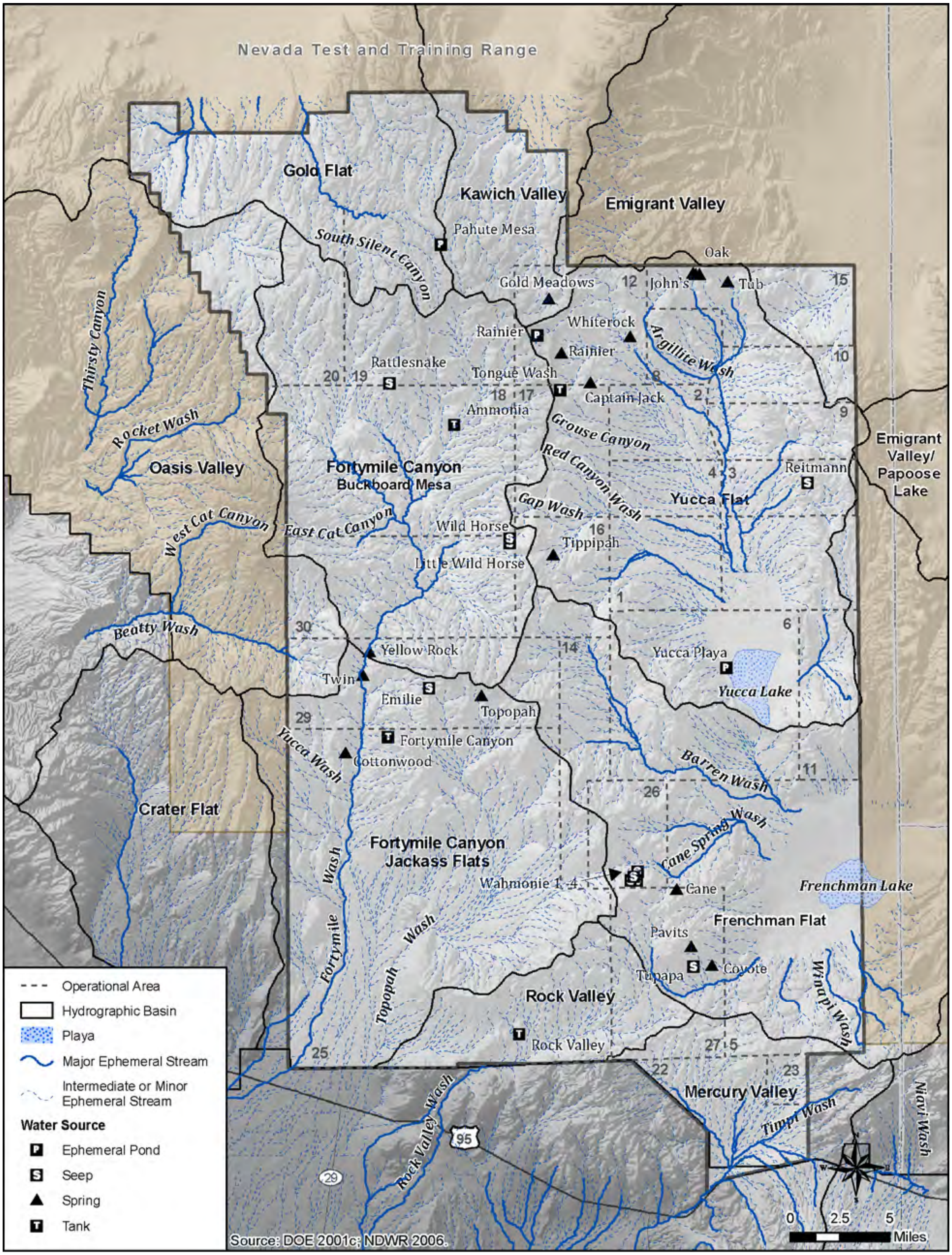


Figure 4–9 Hydrographic Basins and Surface Water Features on the Nevada National Security Site

NNSS-Specific Conditions

There are no important perennial or intermittent streams on the NNSS. During infrequent runoff events, ephemeral channel systems in the western half and southernmost parts of the NNSS carry runoff beyond the NNSS boundaries. Fortymile Canyon is the largest drainage system, draining to the Amargosa River approximately 20 miles southwest of the NNSS boundary. The main tributary in the Fortymile Canyon system is Fortymile Wash. On the NNSS, Fortymile Canyon and its ephemeral tributaries consist of well-defined canyons; however, the canyon splits into several tributaries beyond the NNSS boundary (DOE 1996a).

There are two other major NNSS drainages that discharge to the Amargosa River: (1) Topopah Wash and (2) Rock Valley. Topopah Wash originates in the Jackass Flats Subdivision of Fortymile Canyon in the south central portion of the NNSS and trends southwesterly. Rock Valley drains from the southernmost portion of the NNSS westward (see Figure 4–9). Both of these drainage systems are dry throughout most years (DOE 1996a).

In general, ephemeral surface flows on the NNSS are infrequent, with no flow in some years, while in other years, flows may occur for only a few days (DOE 1996a). For example, stream flows measured in Fortymile Wash near the NNSS boundary (approximately 3 miles northwest of the intersection of Lathrop Wells Road and U.S. Route 95) for the water years of 2002 through 2004 (a water year runs from October 1 through September 30) showed no flow at all in 2002 and 2004 (USGS 2002 and 2004). In 2003, a discharge of less than 0.1 cubic feet per second was recorded as the yearly maximum and the flow was not sufficient to measure a water height (USGS 2003).

There are several “tanks” on the NNSS, which are natural rock depressions that capture surface runoff. There are little data available on the hydrologic characteristics of the tanks. During a study in 1997, the maximum surface areas of individual tanks on site measured approximately 160 square feet with maximum water depths of approximately 3 feet. In addition, there are three ephemeral ponds on the NNSS: (1) Yucca Playa Pond, (2) Pahute Mesa Pond, and (3) Rainier Pond. Yucca Playa Pond occurs in a low spot on the west side of Yucca Lake Playa, where water collects naturally from playa drainage (Hansen et al. 1997). Pahute Mesa Pond occurs in the northern portion of the NNSS near the boundary between Gold Flat and Kawich Valley. Pahute Mesa Pond typically contains water for short periods following summer rain events (DOE/NV 2009d). Rainier Pond was discovered in 2009 (see Figure 4–9).

In areas where underground nuclear tests have occurred, ground surface disturbances and craters have altered natural drainage paths. Some craters have captured nearby drainage and headward erosion of drainage channels has occurred. In some areas of the NNSS, the natural drainage system has been completely altered by the craters (DOE 1996a). The majority of past underground nuclear tests and associated craters are concentrated in the following NNSS locations: Areas 2, 3, 4, 6, 7, 8, 9, 10, and 15. Areas 5, 11, 12, 16, 19, and 20 have been affected as well.

There are 26 known springs and seeps on the NNSS (DOE/NV 1999; Hansen et al. 1997), although some are dry for most of the year (see Figure 4–9). Additionally, 143 manmade impoundments (plastic-lined and earthen sumps) currently exist at the NNSS, but similar to natural water sources, not all of the manmade impoundments contain water year-round.

Records of Wells, Test Holes, and Springs in the Nevada Test Site and Surrounding Area (Moore 1961) provides data on discharges from eight springs on the NNSS and one spring approximately 10 miles north of the NNSS on the Nevada Test and Training Range (i.e., Indian Springs) sampled from 1957 to 1960. The largest two of the nine springs in the study located on the NNSS discharged more than 1 gallon per minute (Cane Spring, 2 to 3 gallons per minute; Whiterock Spring, 1 to 2 gallons per minute); all others discharged less than 1 gallon per minute. *Nevada Test Site Wetlands Assessment* (Hansen et al. 1997, Table 5-1) provides more-recent data (1996 to 1997) on 20 NNSS springs and seeps that indicate a general lowering of discharge rates since the early 1960s. Discharge rates ranged from 0.0 to 0.8 gallons per minute, with the greatest values measured at Cane Spring (0.8 gallons per minute), Tippipah Spring (0.7 gallons per minute), and Whiterock Spring (0.5 gallons per minute). All others discharged less than 0.5 gallons per minute, with several exhibiting no discharge (i.e., Coyote, Gold Meadows, Pavits, and Rainier Springs, as well as Tupapa Seep and Wahmonie Seeps 2 and 3).

The Clean Water Act prohibits the discharge of pollutants (including dredged or fill material) into "waters of the United States," except as authorized by a permit. Joint guidance by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers, issued in response to a June 2006 Supreme Court decision, provides new guidelines for determining whether tributaries and wetlands are waters of the United States and are regulated under the Clean Water Act (EPA and Army 2007). Based on the new guidance, no wetlands at the NNSS are expected to qualify as waters of the United States (DOE/NV 2009d) due to a lack of surface hydrologic connections to navigable waterways or their tributaries, though certain tributaries on the NNSS may qualify (e.g., Fortymile Wash). If an activity is proposed that may affect a tributary or wetland that is potentially a water of the United States, a site-specific evaluation by the U.S. Army Corps of Engineers would be determinative in terms of jurisdictional status.

Surface Water Characteristics

There is no known human consumption of surface water on the NNSS. In fact, no public water supplies are drawn from springs in the Amargosa Valley, which is located downgradient from the NNSS along the primary pathway for surface-water flow. The closest surface-water supply used for public consumption is Lake Mead (NDEP 2010c), which is located approximately 100 miles southwest of the NNSS and supplies a large portion of the water demand of metropolitan Las Vegas.

Few data on the characteristics of water in the region are available because all streams in the region are ephemeral. *Records of Wells, Test Holes, and Springs in the Nevada Test Site and Surrounding Area* (Moore 1961) presented results on chemical analyses for eight springs on the NNSS (**Table 4–17**). More-recent (1996 to 1997), but less extensive data are provided in **Table 4–18**.

Table 4–17 Chemical Analyses of Water from Springs on the Nevada National Security Site (1957 – 1959)

Spring Name	***Cane***	***Cane***	***Topopah***	***Topopah***	***Tippipah***	***Tippipah***	***Rainier***	***Captain Jack***	***White-rock***	***White-rock***	***White-rock***	***White-rock***	***Oak***	***Butte***	***Indian***
Date of Collection	***9/19/57***	***3/24/58***	***9/17/57***	***3/25/58***	***9/17/57***	***3/24/58***	***9/18/57***	***5/1/59***	***4/5/57***	***9/18/57***	***3/21/58***	***5/19/59***	***4/28/58***	***4/30/59***	***5/1/58***
°F	66	64	70	53	53	54	61	56	56	59	48	67	55	52	50
pH	7.9	8.0	6.9	6.9	7.7	7.4	8.3	6.9	6.9	7.1	7.2	8.8	7.5	7.1	7.2
Specific Conductance in Microohms at 25 °C	425	403	291	114	207	192	346	188	215	222	197	219	241	260	358
Silica (ppm)	64	63	71	50	53	50	65	43	80	52	119	48	57	64	61
Aluminum (ppm)	0	0	0.2	0.3	0.6	0	0.2	0.6	1.1	0.1	0.8	0.7	0.1	0.1	0.1
Iron (ppm)	0.1	0	0.08	0.44	0.31	0.23	0.04	0.95	0.62	0.03	0.44	0.3	0	0.13	0.08
Manganese (ppm)	0[a]	0	0	0	0	0	0[a]	0[a]	0	0	0.4 [a]	0	0[a]	0	0
Calcium (ppm)	32	30	20	7.2	4.8	4.8	7.2	3.2	4.8	4.0	6.4	4.8	18	16	42
Magnesium (ppm)	9.2	9.2	3.9	1.0	0.1	0	1.0	0	0	0.2	0	0	4.9	3.9	7.8
Strontium (ppm)	0	<0.1	0	<0.1	0	<0.1	0.2	<0.2	0	0	<0.1	<0.2	<0.1	<0.2	<0.2
Sodium (ppm)	37	36	19	14	40	37	66	47	39	42	35	39	22	31	17
Potassium(ppm)	7.8	7.6	18	6.4	3.0	3.2	4.0	2.2	5.4	5.4	7.4	4.0	6.4	4.0	4.8
Bicarbonate (ppm)	163	152	147	48	88	81	158	95	72	78	66	50	116	118	148
Carbonate (ppm)	0	0	0	0	0	0	2.0	0	0	0	0	13	0	0	0
Sulfate (ppm)	28	30	11	15	16	19	18	25	23	29	32	23	14	14	36
Chloride (ppm)	20	19	6.0	3.0	7.2	6.0	14	4.0	11	8.0	6.0	9.0	9.0	11	12
Fluoride (ppm)	0.5	0.7	0.7	0.3	0.2	0.3	0.6	0.4	0.4	0.4	0.6	0.6	0.3	0.4	0.4
Nitrate (ppm	19	18	0.1	2.0	4.6	4.2	0.6	0	4.9	4.8	4.8	1.9	0	0	0
Phosphate (ppm)	0.25	0	10	0.9	0.45	0.4	2.2	1.2	0.5	0.65	0.45	0.55	0.1	0.21	0
Total Dissolved Solids (sum) [a]	298	288	222	123	172	164	256	172	204	184	243	167	189	202	254
Hardness (as calcium carbonate) – Total (ppm)	118	113	66	22	12	12	22	8.0	12	11	16	12	65	56	137
Hardness (as calcium carbonate) – Non-carbonate (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Percent Sodium	399	399	322	50	84	83	84	90	82	84	75	83	40	52	211

°C = degrees Celsius; °F = degrees Fahrenheit; ppm = parts per million; pH = a measure of acidity or basicity.
[a] In solution at time of analysis.
Source: Moore 1961, Table 5.

Table 4–18 Water Quality Measurements of Natural Water Sources on the Nevada National Security Site (June 1996 – February 1997)

Surface Water Feature	*Date Sampled*	*Location (microhabitat)*	*Water Temperature (°C)*	*Dissolved Oxygen (parts per million)*	*pH*	*Total Dissolved Solids (parts per million)*	*Electrical Conductivity (µS)*
Cane Spring	6/19/96	cave pool	19.4 [a]	6.2 [a]	7.7 [a]	190 [a]	–
	9/09/96	cave pool	17.4	6.0	7.1	207	406
	11/13/96	cave pool	15.7	8.4	7.2	209	424
	6/19/96	flow box	28.0 [a]	0.7 [a]	7.3 [a]	248 [a]	–
	9/09/96	flow box	22.2	2.6	7.0	227	453
	11/13/96	flow box	9.2	6.7	7.3	256	525
Captain Jack Spring	6/19/96	spring pool	19.0 [a]	5.5[a]	7.1 [a]	90 [a]	–
	9/10/96	spring pool	16.8	4.9	7.3	959	193
Cottonwood Spring	1/08/97	spring pool	7.4	3.5	7.1	54	107
Reitmann Seep	6/19/96	spring pool	30.0 [a]	–	9.2 [a]	379 [a]	–
	7/24/96	spring pool	28.4	2.1	7.7	346	–
	9/10/96	spring pool	31.5	8.1	8.8	336	669
	11/22/96	spring pool	12.4	2.7	7.4	287	557
Tippipah Spring	6/18/96	open channel pool	18.6 [a]	1.2	6.8	114	–
	9/03/96	open channel pool	18.5	1.0	6.7	135	267
	11/15/96	open channel pool	13.7	4.6	7.2	119	243
	9/03/96	cave pool	15.3	6.7	7.0	114	227
	11/22/96	cave pool	14.3	7.8	7.1	106	212
Topopah Spring	6/20/96	spring pool	14.9 [a]	3.8	7.5	66	–
	9/09/96	spring pool	20.0	2.7	6.7	69	139
Tub Spring	6/24/96	guzzler can	26.0 [a]	–	7.6	147	–
	9/10/96	guzzler can	26.5	6.0	7.5	146	294
Twin Spring	1/08/97	spring pool	16.8	1.0	7.0	137	271
Wahmonie Seep 1	6/20/96	wash pool	17.8 [a]	1.8	7.5 [a]	259	–
Whiterock Spring	6/18/96	flow box	16.8	8.1 [a]	7.0	124	–
	9/03/96	flow box	18.7	6.6	7.2	139	277
	9/03/96	west cave pool	15.6	5.8	7.4	142	276
Yucca Playa Pond	1/07/97	pond	1.7	13.6	8.1	162	328

°C = degrees Celsius; *µS* = microsiemen; pH = a measure of acidity or basicity.
[a] Values represent single readings. All other values are an average of three readings.
Note: "–" indicates no data collected.
Source: Hansen et al. 1997, Table 5-2.

Prior to 1998, natural springs on the NNSS were tested annually for radiological constituents. In 1998, in accordance with the Routine Radiological Environmental Monitoring (RREM) Plan, this sampling was discontinued because the onsite springs are fed by locally derived or "perched" groundwater (i.e., groundwater in a saturated zone of material separated from other groundwater bodies by a relatively impervious zone) (Hansen et al. 1997; Moore 1961) that is not hydrologically connected to any of the aquifers that may be affected by underground nuclear tests (Bechtel Nevada 1998a, DOE/NV 1999). In 1996 and 1997, seven natural springs on site were sampled because only seven had enough water to provide a sample. The sampled springs were: (1) Rainier Mesa Spring, (2) Oak Spring, (3) Whiterock Spring, (4) Captain Jack Spring, (5) Tippipah Spring, (6) Topopah Spring, and (7) Cane Spring. In 1996, the average gross beta concentration of the sampled springs was 9.2×10^{-9} microcuries per milliliter, and in 1997 it was 9.8×10^{-9} microcuries per milliliter. These average values represent approximately 23 to 25 percent of the EPA Derived Concentration Guide for exposure to the public (based on a strontium-90 value for drinking water of 4 millirem effective dose equivalent). Although these values are much lower than the Derived Concentration Guide, it is important to note that spring water is not used for human consumption on the NNSS (DOE/NV 1997b, Table 5.11; DOE/NV 1998c, Table 5.6). It is also important to note that this radiation is due to elements that naturally exist in the volcanic geologic medium (e.g., uranium and potassium-40).

Flood Hazards

Flash flooding occurs on the NNSS in response to heavy precipitation events, especially during summer thunderstorms. The runoff from these storms is typically of short duration; however, the storms do result in large peak discharge rates. Flood hazards for DOE facilities and activities are most likely associated with flooding in alluvial fans and playas. Throughout the NNSS, there is the potential for sheetflow or channelized flow through arroyos to cause localized flooding. In addition, a rise in any standing water on a playa creates a potential flood hazard. However, because of the size of the NNSS, no comprehensive floodplain analysis has been conducted to delineate the 100- and 500-year floodplains (Cohn 2010).

Playas in the Yucca Flat weapons test basin and Frenchman Flat in the eastern and southeastern parts of the NNSS, respectively, collect and dissipate runoff from their respective hydrographic basins. Control Point and News Knob arroyos (informal names), and Gap Wash, Red Canyon Wash, Tongue Wash, and the Aqueduct arroyos in the Yucca Flat weapons test basin pose a potential flood hazard to existing facilities (DOE 1996a). The Control Point and News Knob arroyos have been assessed for flood hazards (Miller et al. 1994).

Arroyos in Frenchman Flat that pose a potential flood hazard to existing facilities include Barren Wash, Scarp Canyon, Nye Canyon, and Cane Spring (DOE 1996a). There is a 100-year flood hazard area along the southwest corner of the Area 5 RWMC associated with Barren Wash (Schmeltzer et al. 1993). Areas prone to flooding surround Fortymile Wash, a major tributary of Fortymile Canyon. Topopah Wash runs southwesterly across the Jackass Flats Subdivision of Fortymile Canyon from Jackass Divide in the south-central part of the NNSS (DOE 1996a). The 100-year flood-prone areas of Topopah Wash and its tributaries would closely parallel most stream channels with few occurrences of out-of-bank flooding, though 500-year flood events would overtop the banks of all tributaries (not including Topopah Wash itself) and maximum flood events would inundate the entire area (Christensen and Spahr 1980). The Fortymile Canyon hydrographic basin poses a flood hazard to offsite areas (SAIC/DRI 1991). Arroyos trending southward from Red Mountain pose a potential flood hazard to sewage lagoons that service Mercury (DOE 1996a).

Water Discharges and Regulatory Compliance

Industrial discharges on the NNSS are limited to two operating sewage lagoon systems: (1) Area 6 Yucca Lake and (2) Area 23 Mercury (these lagoon systems also receive domestic wastewater). The Area 6 Yucca Lake system consists of two primary lagoons and two secondary lagoons. All lagoons in the Area 6 Yucca Lake system are lined with compacted native soils that meet State of Nevada requirements for hydraulic conductivity (3.937×10^{-8} inches per second). The Area 23 Mercury system consists of one primary lagoon, a secondary lagoon, and an infiltration basin. The primary and secondary lagoons in the Area 23 Mercury system have a geosynthetic clay liner and a high-density polyethylene liner. The lining of the ponds allows the Area 23 lagoons to operate as a fully contained, evaporative, nondischarging system (DOE/NV 2009d).

These Area 6 Yucca Lake and Area 23 Mercury lagoon systems are operated under a State of Nevada Water Pollution Control General Permit (Permit number: GNEV93001). Through 2008, this permit required annual monitoring of gross alpha, gross beta, and tritium radioactivity. The permit was revised on November 20, 2008, and annual monitoring requirements changed; the lagoons are now sampled for gross alpha, gross beta, and tritium radioactivity, as well as 29 organic and inorganic contaminants only in the event of specific or accidental discharges of potential contaminants. Quarterly monitoring of 5-day biochemical oxygen demand, total suspended solids, and pH (a measure of acidity or basicity) continue to be permit requirements (DOE/NV 2009d). **Table 4–19** provides results of 2008 gross alpha, gross beta, and tritium sampling of the active lagoon systems. No concentrations exceeded permit limitations; tritium concentrations did not reach the sample-specific minimum detectable concentration levels.

Table 4–19 Annual Radiological Results for Sewage Lagoon Effluent (2008)

Monitoring Location	***Gross Alpha ± Uncertainty*** [a]	***Gross Beta ± Uncertainty*** [a]	***Tritium ± Uncertainty*** [a]
	(minimum detectable concentration) (picocuries per liter)		
Area 6 Yucca Lake	4.7 ± 1.3 (1.3) [b]	23.8 ± 4.1 (2.0) [b]	136 ± 225 (370)
Area 23 Mercury	3.8 ± 1.3 (1.5) [b]	27.7 ± 5.0 (3.3) [b]	35 ± 222 (370)
Permit Limit	15	50	20,000

[a] ± 2 standard deviations
[b] Results are considered detected (i.e., results greater than the sample-specific minimum detectable concentration).
Note: Samples taken July 8, 2008.
Source: DOE/NV 2009d, Table 4-5.

Table 4–20 provides results of 2008 nonradiological water toxicity sampling of the active lagoon systems. The vast majority of potential contaminants were below the laboratory's detection limits; no exceedances of permit limitations occurred.

Table 4–20 Annual Nonradiological Toxicity Analysis Results of Sewage Lagoon Pond Water (2008)

Contaminant	*Permit Limit (ppm)*	*Area 6 Yucca Lake (ppm)*	*Area 23 Mercury (ppm)*
Benzene	0.5	ND	ND
Carbon Tetrachloride	0.5	ND	ND
Chlorobenzene	100	ND	ND
Chloroform	6.0	ND	ND
Cresol (total)	200	ND	ND
2,4-D	10	ND	ND
1,4-Dichlorobenzene	7.5	ND	ND
1,2-Dichloroethane	0.5	ND	ND
1,1-Dichloroethylene	0.7	ND	ND
2,4-Dinitrotoluene	0.13	ND	ND
Hexachlorobenzene	0.13	ND	ND
Hexachlorobutadiene	0.5	ND	ND
Hexachloroethane	3.0	ND	ND
Methylethyl Ketone	200	ND	ND
Nitrobenzene	2.0	ND	ND
Pentachlorophenol	100	ND	ND
Pyridine	5.0	ND	ND
Trichloroethylene	0.5	ND	ND
2,4,5-Trichlorophenol	400	ND	ND
2,4,6-Trichlorophenol	2.0	ND	ND
Vinyl Chloride	0.2	ND	ND
Arsenic	5.0	ND	ND
Barium	100	0.0411	0.0631
Cadmium	1.0	ND	ND
Chromium	5.0	ND	ND
Lead	5.0	ND	ND
Mercury	0.2	ND	ND
Selenium	1.0	ND	ND
Silver	5.0	0.0060	0.0085

ND = Not detected (results were below the laboratory's minimum detection limits); ppm = parts per million.
Note: Samples taken in July 2008.
Source: DOE/NV 2009d, Table 4-10.

Table 4–21 provides 2009 water-quality analysis results for sewage lagoon influent waters. No exceedances of permit limitations occurred (DOE/NV 2010).

Table 4–21 Annual Water Quality Results for Sewage Lagoon Influent Waters (2009)

Parameter	*Unit*	*Permit Limit*	*Minimum and Maximum Values from Quarterly Samples*	
			Area 6 Yucca Lake	*Area 23 Mercury*
BOD_5	ppm	No Limit	78 – 280	177 – 282
BOD_5 Mean Daily Load	lbs/d	19.09 (Area 6 Yucca Lake) 254.41 (Area 23 Mercury)	0.40 – 2.58	42.79 – 76.72
Total Suspended Solids	ppm	No Limit	114 – 326	91 – 332
pH	S.U.	6.0 – 9.0	7.97 – 8.52	7.95 – 8.44

BOD_5 = 5-day biochemical oxygen demand; lbs/d = pounds per day; pH = a measure of acidity or basicity; ppm = parts per million; S.U. = standard units of pH.
Source: DOE/NV 2010, Table 5-9.

The NNSS manages and operates the E-Tunnel Waste Water Disposal System (ETDS) in Area 12 under a water pollution control permit issued by the NDEP Bureau of Federal Facilities (Permit number: NEV 96021). The permit governs the management of radionuclide-contaminated wastewater that drains from the E-Tunnel portal into a series of holding ponds. **Table 4–22** provides results of 2009 gross alpha, gross beta, and tritium sampling of the ETDS discharge water. Tritium concentrations were about 50 percent of the limit allowed under the permit. The discharge water was also within gross alpha/beta permit limits (DOE/NV 2010). Gross beta values represent radiation from both human-influenced (e.g., tritium) and naturally occurring sources (e.g., radium-228) (DOE/NV 2010).

Table 4–22 Radiological Results for E-Tunnel Waste Water Disposal System Discharge Water Samples (2009)

Radiological Parameter	*Permit Limit (picocuries per liter)*	*Measured Value (picocuries per liter)*
Tritium	1,000,000	477,000 ±72,800
Gross Alpha	35.1	13.6 ± 2.81
Gross Beta	101	38.9 ± 6.51

Note: Samples taken in October 2009.
Source: DOE/NV 2010, Table 5-5.

Table 4–23 shows the results of the 2009 water quality sampling of the ETDS holding ponds for nonradiological parameters that are required to be monitored under the water pollution control permit. No exceedances of permit limitations occurred (DOE/NV 2010).

Table 4–23 Nonradiological Results for E-Tunnel Waste Water Disposal System Discharge Water Samples (2009)

Nonradiological Parameter	*Permit Limit*	*Measured Value*
Cadmium (ppm)	0.045	0.001
Chloride (ppm)	360	9.21
Chromium (ppm)	0.09	0.0011 [a]
Copper (ppm)	1.2	0.003
Fluoride (ppm)	3.6	0.25
Iron (ppm)	5.0	3.34
Lead (ppm)	0.014	0.0029[a]
Magnesium (ppm)	135	1.41
Manganese (ppm)	0.25	0.0348
Mercury (ppm)	0.0018	0.0001
Nitrate nitrogen (ppm)	9	0.29
Selenium (ppm)	0.045	0.005
Sulfate (ppm)	450	17.5
Zinc (ppm)	4.5	0.031
pH (S.U.)	6.0 – 9.0	7.29
Specific conductance (µS/cm)	400 – 500	401.5

pH = a measure of acidity or basicity; ppm = parts per million; S.U. = standard units of pH; µS/cm = microsiemens per centimeter.
[a] Estimated quantity based on the laboratory's minimum detection limit.
Note: Samples taken in October 2009.
Source: DOE/NV 2010, Table 5-10.

4.1.6.2 Groundwater

This section is an overview of the general hydrogeologic setting and characteristics of groundwater underlying the NNSS. Water-resource features, including supply wells and monitoring wells used for access to groundwater, are described in relation to the hydrographic areas in which they lie.

Important characteristics of groundwater systems include recharge zones (areas where water infiltrates from the surface and reaches the saturated zone), discharge points (locations where groundwater reaches the surface), unsaturated zones (the portion of the groundwater system above the water table), saturated zones (the portion of the groundwater system below the water table), aquitards (confining units), and aquifers (water-bearing layers of rock that provide water in usable quantities). In combination, these characteristics define the quantity and quality of the available groundwater.

Hydrogeologic Setting

The NNSS is located within the southern portion of the Great Basin, occupying approximately 0.7 percent of the Great Basin. The Great Basin is a closed hydrographic province (a basin with no external drainage, from which water is lost only by evapotranspiration) with no outlet to the Pacific Ocean. It comprises many hydrographic basins (areas in which surface runoff collects and from which it is carried by a drainage system, such as a river and its tributaries). Hydrographic basins are mapped on the basis of topographic divides and are used by the State of Nevada for the purposes of water appropriation and management. The NNSS lies within a portion of 10 hydrographic basins (Mercury Valley, Rock Valley, Yucca Flat, Frenchman Flat, Buckboard Mesa, Jackass Flats, Oasis Valley, Gold Flat, Kawich Valley, and Emigrant Valley; see **Figure 4–10**).

The perennial yield for the 10 hydrographic basins partly or wholly located within the NNSS, as shown in **Table 4–24**, is estimated at between 30,900 and 34,020 acre-feet per year. The perennial yield is an estimate of the quantity of groundwater that can be withdrawn from a basin on an annual basis without depleting the reservoir (Scott et al. 1971). The perennial yield values used by the Nevada State Engineer were applied for purposes of analysis to all basins with the exception of Frenchman Flat (Basin 160) and the Fortymile Canyon Jackass Flats Subdivision (Basin 227a). The values used by the Nevada State Engineer for most basins are conservative estimates (considering only recharge through precipitation in a basin), and are based upon a series of reports dating to 1970 and earlier.

> **Acre-foot**: The volume of water that will cover an area of 1 acre to a depth of 1 foot; 1 acre-foot is equivalent to 325,851 gallons.

For Frenchman Flat, the Nevada State Engineer has previously estimated a perennial yield of only 100 acre-feet per year (Nevada Department of Conservation and Natural Resources, Division of Water Resources 2010a). However, this yield is based upon previous assumptions that little or no groundwater recharge from precipitation occurred in Basin 160. More recent studies suggest that in-basin recharge does occur in Basin 160, and that perennial yield values are much higher than 100 acre-feet per year. NNSA has extensively studied the groundwater recharge in Frenchman Flat, using a model from the UGTA program (SNJV 2004), two U.S. Geological Survey (USGS) models (Hevesi et al. 2003), and two Desert Research Institute models (Russel and Minor 2002). All of these models provide revised estimates of precipitation-driven recharge (and thus perennial yield) of Frenchman Flat using more-rigorous analytical methods and more-recent data. For purposes of analysis in this SWEIS, NNSA has selected the UGTA model (yielding an estimate of 1,070 acre-feet per year) for Frenchman Flat, as it is the most conservative of these new models. USGS and the Desert Research Institute models provide perennial yield estimates of 1,830 and 1,920 acre-feet per year, respectively.

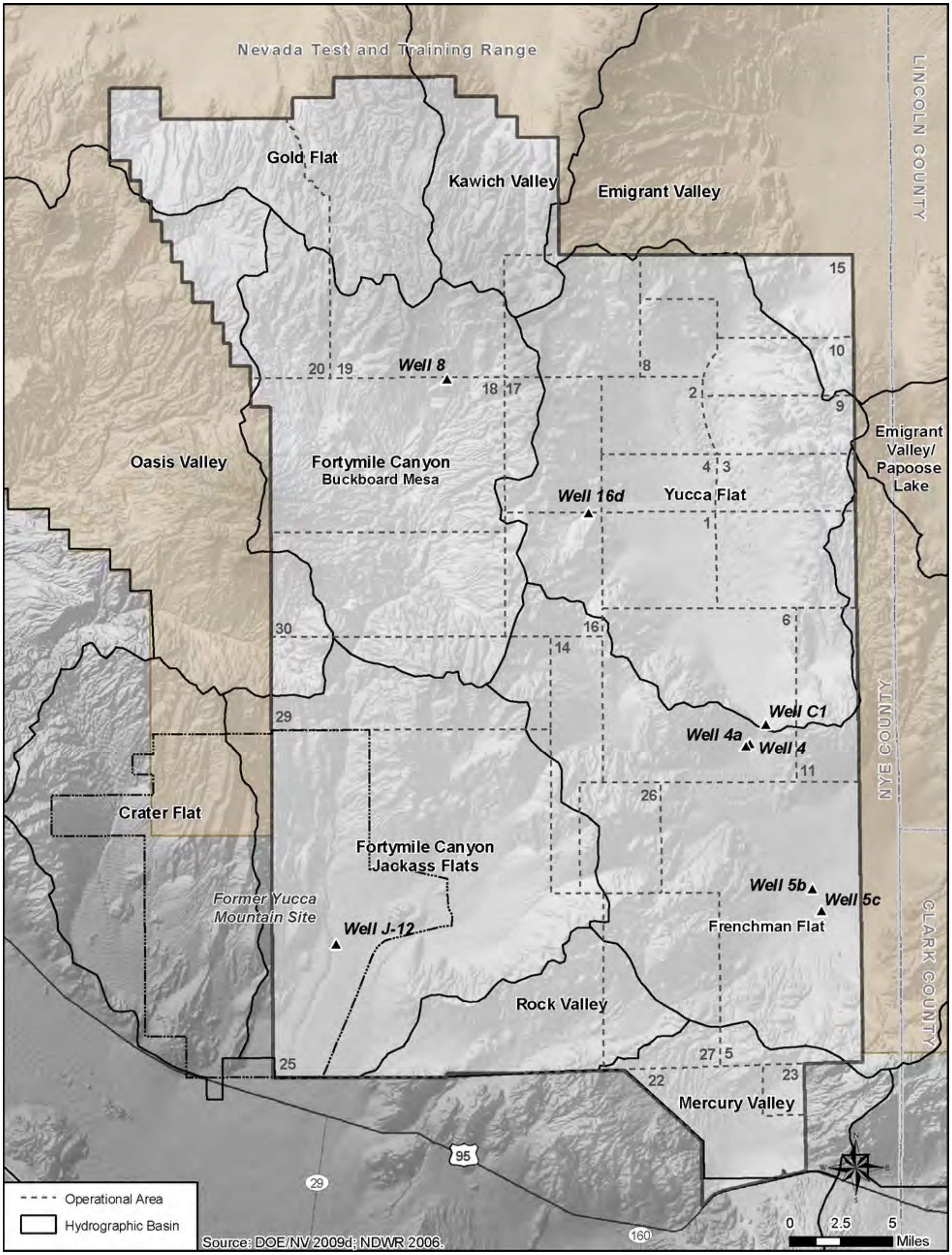


Figure 4–10 Hydrographic Basins at the Nevada National Security Site

Table 4–24 Perennial Yield of Hydrographic Basins at the Nevada National Security Site

Hydrographic Basin	Hydrographic Basin Number	Perennial Yield (acre-feet per year) [a]	Total Committed Groundwater Resources (acre-feet per year) [a, b]	Remaining Yield for Other Withdrawals (acre-feet per year)
Mercury Valley	225	8,000	0	8,000
Rock Valley	226	8,000	0	8,000
Yucca Flat	159	350	0	350
Frenchman Flat	160	1,070 [c]	0	1,070
Fortymile Canyon, Buckboard Mesa Subdivision	227 [b]	3,600	0	3,600
Fortymile Canyon, Jackass Flats Subdivision	227 [a]	880–4,000 [d]	56	824–3,944 [d]
Oasis Valley	228	2,000	1,727	273
Gold Flat	147	1,900	95	1,805
Kawich Valley	157	2,200	8	2,192
Emigrant Valley	158	2,900	12	2,888
Total	N/A	34,020	1,898	32,122

[a] Source: NDWR 2010a.
[b] Represents water rights appropriated to non-National Nuclear Security Administration users off the NNSS.
[c] Revised value based on SNJV 2004.
[d] While the Nevada Department of Conservation and Natural Resources, Division of Water Resources, lists the perennial yield as 4,000 acre-feet per year, studies conducted by DOE show a range of values as low as 880 acre-feet per year (DOE 2008d).

While the Nevada State Engineer lists the perennial yield of the Fortymile Canyon Jackass Flats Subdivision (Basin 227a) as 4,000 acre-feet per year, this value actually represents an aggregation of yield values for several basins adjacent to Basin 227a (i.e., a regional yield value). Studies conducted by DOE show a range of values as low as 880 acre-feet per year for Basin 227a (DOE 2008d). Therefore, a range of 880 to 4,000 acre-feet per year is used for purposes of analysis in this SWEIS.

The eight water supply wells currently used at the NNSS are located within the Fortymile Canyon Buckboard Mesa and Jackass Flats Subdivisions, Yucca Flat, and Frenchman Flat. These four hydrographic basins have a combined perennial yield ranging from 5,900 to 9,020 acre-feet per year. Total water withdrawals at the NNSS between 2005 and 2009 ranged from 530 to 691 acre-feet per year, as shown later in this section in Table 4–27.

Groundwater beneath the NNSS exists within three groundwater subbasins (a subbasin is defined as the area that contributes water to a major surface discharge area), as shown in **Figure 4–11**. The eastern half of the NNSS is located within the Ash Meadows subbasin, which flows toward the Ash Meadows discharge area downgradient of the NNSS. The Ash Meadows discharge area contains the sensitive Ash Meadows National Wildlife Refuge. Within the northeast corner of this refuge lies Devils Hole, which is home to the Devils Hole pupfish, an endangered species (see Section 4.1.7, "Biological Resources," for more information regarding Devils Hole). In 1976, the Supreme Court ruled that the Devils Hole pupfish had prior water rights and that a minimum level of water must be preserved in the hole to ensure its protection (United States v Cappaert. 426 U.S. 128 [1976]). This decision resulted in the prohibition of any development that could lower the water level in Devils Hole. The western half of the site lies largely within the Alkali Flat Furnace Creek Ranch subbasin, which flows toward the Alkali Flat Furnace Creek Ranch discharge area, and a small section of the northwest corner of the site is located within the Pahute Mesa Oasis Valley subbasin, which flows toward the Pahute Mesa Oasis Valley discharge area. As displayed above, these three subbasins are named for their downgradient discharge areas. As all three discharge areas are located off site, any activity that may affect groundwater on the NNSS has the potential to affect groundwater off the NNSS.

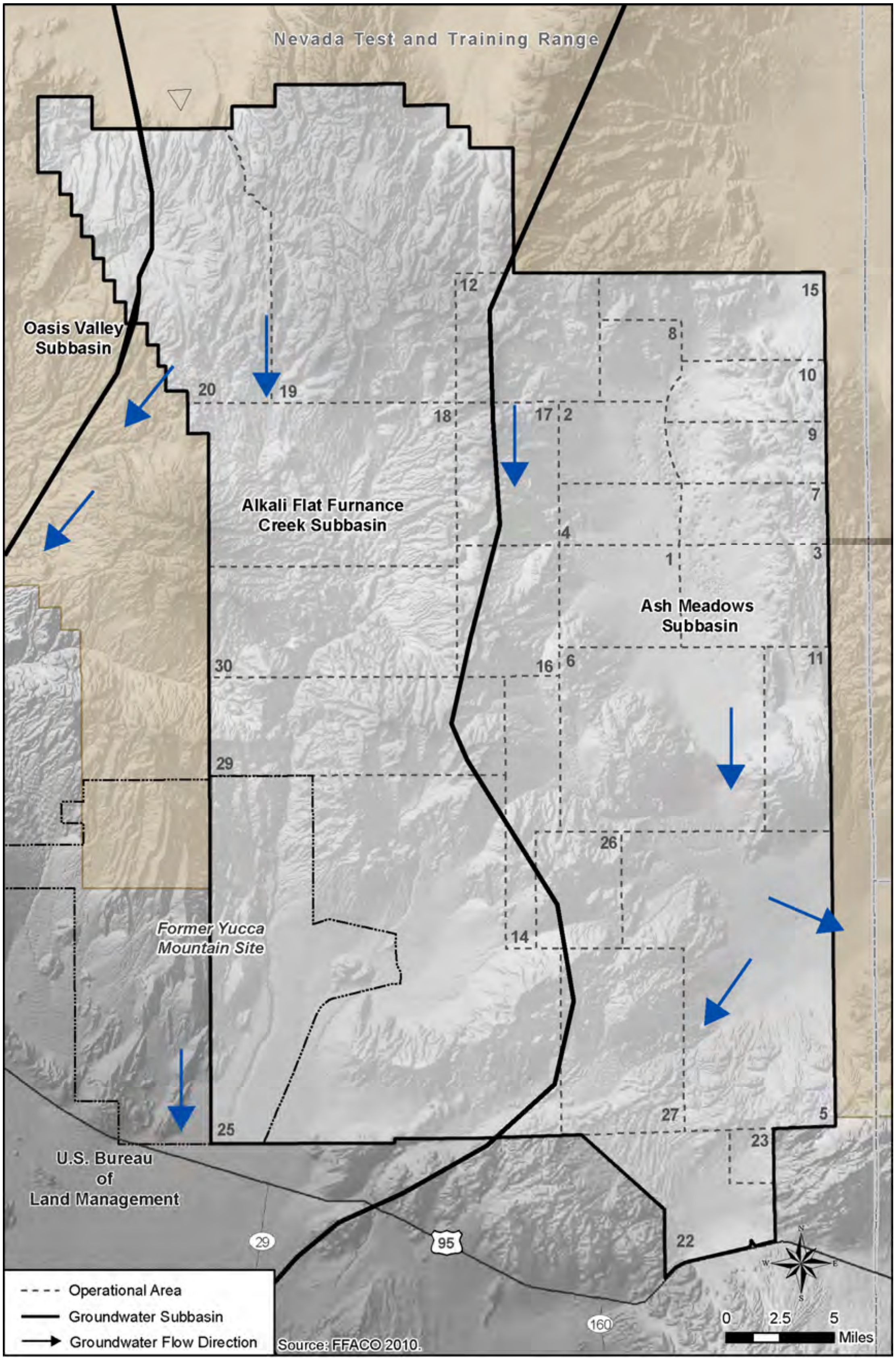


Figure 4–11 Groundwater Subbasins and Flow at the Nevada National Security Site

The NNSS is located within the Death Valley regional groundwater flow system extending from central Nevada north of the NNSS to Death Valley. The Death Valley system encompasses approximately 16,000 square miles of the Great Basin (Harrill et al. 1988). It is very complex, involving many aquifers and aquitards, which vary in their characteristics and presence over distance.

The principal hydrogeologic water-bearing units of the Death Valley regional groundwater flow system are grouped into three types of aquifers: (1) basin-fill alluvium (or alluvial aquifers), (2) volcanic aquifers, and (3) carbonate aquifers. An alluvial aquifer is in a permeable body of sand, silt, gravel, or other detrital material deposited primarily by running water. Volcanic and carbonate aquifers are permeable units of volcanic rocks and marine carbonate (limestone or dolomite) rock, respectively. The mountainous area that makes up the north-central portion of the NNSS is upheld by volcanic rocks associated with the Timber Mountain caldera complex and includes multiple volcanic aquifers associated with areas of fractured rock. The valley or basin areas in the region contain alluvial aquifers. Together, these volcanic and alluvial aquifers are referred to as "Cenozoic aquifers" because the rocks and sediments in which they occur are of Cenozoic geologic age. The rocks containing the carbonate aquifers are older (Paleozoic age) and regionally extensive, generally occurring at large depths below the Cenozoic aquifers. The major aquifers beneath the NNSS are the Lower Carbonate aquifer system and the Cenozoic aquifer system.

Hydrogeologic Terms

Aquifer: A permeable water-bearing unit of rock or sediment that yields water in a usable quantity to a well or spring.

Artesian: Where water in a lower aquifer is under pressure in relation to an overlying confining unit; when intersected by a well, the water will rise in the borehole to a level above the top of the aquifer.

Saturated zone: The area below the water table where all spaces (fractures and rock pores) are completely filled with water.

Aquitard (or confining unit): A rock or sediment unit of relatively low permeability that retards the movement of water in or out of adjacent aquifers.

Caldera: A near-circular volcanic feature formed by the collapse of rocks overlying a magma chamber from rapid emptying of the chamber during large-volume eruptions.

The Lower Carbonate aquifer system is found primarily in the eastern and southern part of the NNSS and is not present in all areas. The Cenozoic aquifer system is found beneath the main valleys, such as Yucca and Frenchman Flats, and caldera areas, including Pahute Mesa and Timber Mountain.

There is hydraulic connection between groundwater in the Lower Carbonate aquifer system and the Cenozoic aquifers (alluvial and volcanic) in many areas, controlled by the location and properties of low-permeability aquitards (see Section 4.1.5 for a discussion of geology and soils). **Table 4–25** shows the hydraulic parameters of the major aquifers found beneath the NNSS. Hydraulic conductivity is a measure of the ability of the hydrogeologic unit to transmit water and effective porosity is that portion of the void space within a geologic unit through which groundwater moves (DOE/NV 1997a). The product of hydraulic conductivity and aquifer thickness is transmissivity. Transmissivity is the rate at which groundwater flows through a unit width of an aquifer under a unit hydraulic gradient. As displayed below, the Lower Carbonate aquifer is the most transmissive aquifer below the NNSS; therefore, it controls regional groundwater flow and the possible transport of contaminants. The hydraulic conductivity of the alluvial aquifer is smaller than the Lower Carbonate but greater than the volcanic. Their ability to transmit water is lower than that of the Lower Carbonate aquifer. Alluvial and volcanic aquifers are highly variable throughout the region and are assumed to be discontinuous. In most instances, the alluvial aquifer is confined to the basin in which it resides by surrounding mountain ranges. In general, these two aquifers only influence regional flow in localized areas.

Table 4–25 Hydraulic Parameters of the Major Aquifers Below the Nevada National Security Site

Aquifer	Hydraulic Conductivity		Effective Porosity Range (percent)
	Mean (meters per day)	Range (meters per day)	
Alluvial Aquifer	8.44	0.00005–83	31–35
Volcanic Aquifer	1.18	0.0003–12	0.00001–0.006
Carbonate Aquifer	31.71	0.0008–1570	0.0006–10

Source: DOE/NV 1997a.

Groundwater flow at the NNSS is complex due to the discontinuous nature of the volcanic aquifers (discussed above) and due to major high-angle Basin and Range faults and other features such as caldera structural margins. Groundwater flow through these units is largely controlled by faults and fractures. Groundwater flows generally south and southwest on the NNSS. The flow system extends from the water table to a depth that may exceed 4,900 feet where the transmissivity of the rocks becomes much smaller (DOE 1996a). The rates of groundwater flow through the hydrogeologic units are highly variable. The current understanding of groundwater flow at the NNSS is derived from work by Winogard and Thordarson (1975), which was summarized and updated by Laczniak et al. (1996), and continues to be further developed by the UGTA Project hydrogeologic modeling team. In general, average flow rates over broad areas were estimated by Winogard and Thordarson (1975) to range from 7 to 660 feet per year, but rates can be much higher or lower over short distances in certain geologic settings.

Depth to Groundwater

The depth to groundwater at the NNSS varies from approximately 30 feet at Fortymile Wash to more than 700 feet in Frenchman Flat, to greater than 1,500 feet in portions of Yucca Flat, to finally more than 2,000 feet under the upland portions of Pahute Mesa. Perched groundwater (isolated lenses of water lying above the regional groundwater level) is known to occur in some parts of the NNSS, mainly in the volcanic rocks of Rainier Mesa. The greatest depth to water at the NNSS was measured near Tippipah Point in the central part of the NNSS at 4,093 feet (DOE 2008l; DOE/NV 1997a).

Groundwater Recharge and Discharge

The Death Valley groundwater flow system is recharged by underflow from upgradient areas as well as precipitation in the higher elevations of the northern and eastern mountain ranges, while discharge areas such as Death Valley and the Amargosa Valley occur primarily in the south and southwest low-lying valleys.

Groundwater recharge includes the water contribution from precipitation and from interbasin underflow from upgradient areas. There are various processes that inhibit recharge of the groundwater from precipitation in arid areas. Therefore, depending on the type of soil, amount of vegetation, evaporation, and subsurface geology, only a fraction of precipitation contributes to recharge. The majority of precipitation recharge on the NNSS is limited to higher elevations where precipitation is greatest and originates over upland areas of Pahute Mesa, Timber Mountain, and the Belted Range (see Section 4.1.8, "Air Quality and Climate," for more information regarding precipitation and evaporation at the NNSS). However, total recharge at the NNSS is dominated by subsurface, lateral regional flow, or interbasin flow. The estimated underflow onto the NNSS from adjacent areas ranges from 38,000 acre-feet per year to 44,000 acre-feet per year. Total recharge for the NNSS regional groundwater flow system from both precipitation and lateral interbasin flow has been estimated at 69,097 acre-feet per year (DOE/NNSA/NSO 2008).

Groundwater discharge within the NNSS is minor, consisting of natural discharge at small springs found in mountainous regions that drain perched water within near-surface volcanic rocks and withdrawals at water supply wells. No discharge from the regional groundwater flow system occurs on the NNSS. Springs at the NNSS are located well above the regional water table level and have very low discharge rates, ranging from 0.22 to 35 gallons per minute (see Section 4.1.6.1, "Surface Water," for more information regarding the location of springs) (DOE/NNSA/NSO 2008). Discharge to these onsite springs is small when compared to the discharge of groundwater from the NNSS to Rock Valley and the Amargosa Desert, which totals an estimated 42,000 acre-feet per year (DOE 1996a).

Groundwater Supply

Groundwater is the only local source of potable water on the NNSS. Drinking water needs, as well as water required for nonpotable, construction, and fire protection purposes are met by groundwater drawn from deep wells installed in the carbonate, volcanic, and alluvial aquifers.

Water production and distribution systems have been in place at the NNSS for over 50 years. Currently, the NNSS has three permitted PWSs served by six wells (Well 4/4a, Well 5b/5c, Well 8, Well 16D, Well C-1, and Well J-12) (NSTec 2010d). Two of the PWSs are non-transient, non-community PWSs (NV0004099 and NV0000360) that operate under permit numbers NY-0360-12NTNC and NY-4099-12NC, respectively. The third PWS is a transient system (NV0004098) and operates under permit number NY-4098-12NC. See **Table 4–26** for a list of these wells and their associated characteristics (e.g., depth and pumping rate). All three systems are regulated under the Safe Drinking Water Act (DOE/NV 2008c). The transmission and distribution systems include mains, valves, hydrants, booster pump stations, pump suction tanks, and reservoir storage tanks. Potable water is hauled to support facilities not connected to the potable water system in two permitted water-hauling trucks; however, these are not considered part of the PWS (NSTec 2010d). The NNSS drinking water systems currently meet all applicable regulatory standards.

Water System Terms

Public Water System: A system that provides water for human consumption that has at least 15 service connections or serves at least 25 individuals daily at least 60 days out of the year. Public water systems are further categorized into three different types: community, non-transient non-community, and transient non-community.

Community Water System: A public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

Non-Transient Non-Community Water System: A public water system that regularly serves at least 25 of the same nonresident persons per day for more than 6 months per year. Examples of such systems are those serving the same individuals (industrial workers, school children) on a daily basis even though those individuals do not reside at that location.

Transient Non-Community Water System: A non-community public water system that does not serve 25 of the same nonresident persons per day for more than 6 months per year. Examples of such systems include a restaurant or convenience store with fewer than 25 permanent nonresident staff, but the number of people served exceeds 25.

The NNSS water system is spread over four distinct water service areas and consists of eight water systems, two wildlife preservation reservoirs, numerous water storage tanks, fillstands, and construction water open pit reservoirs, as well as approximately 140 miles of pipeline located throughout the site (DOE 2008l). These water service areas are discussed in detail below in relation to their location and the areas they support. The water service areas are also displayed in **Figure 4–12**.

Water Service Area A: Encompasses Areas 19 and 20. System capabilities within this service area have been abandoned for more than a decade. There are two wells in this area (Wells 19c and 20), both of which are out of service and have monitoring casings to prevent vandalism or contamination (DOE/NV 2008c).

Table 4–26 Nevada National Security Site Supply Well Characteristics [a]

Well Name	*Aquifer*	*Years Active*	*Depth to Water (feet)*	*Well Depth (feet)*	*Hydrographic Basin*	*Pumping Rate (millions of gallons per year)*	
						Maximum	*Average*
Well 4	Volcanic	1983–Present	837	1,479	Frenchman Flat (160)	192	36
Well 4a	Volcanic	1993–Present	838	–	Frenchman Flat (160)	72	54
Well 5b	Alluvial	1951–Present	687	900	Frenchman Flat (160)	88	31
Well 5c	Alluvial	1954–Present	702	1,187	Frenchman Flat (160)	73	37
Well 8	Volcanic	1963–Present	1,087	5,490	Fortymile Canyon, Buckboard Mesa Subdivision (227b)	121	34
Well J-12	Volcanic	1957–Present	740	1,139	Fortymile Canyon, Jackass Flats Subdivision (227a)	61	21
Well 16d	Carbonate	1981–Present	752	3,000	Yucca Flat (159)	52	30
Well C1	Carbonate	1962–Present	1,544	1,707	Yucca Flat (159)	76	25

Source: DOE/NNSA/NSO 2008.

Water Service Area B: Encompasses Areas 2, 4, 7, 8, 9, 10, 12, 15, 17, and 18. PWS NV0004099 serves Area 12. Well 2 within this service area is out of service and has a monitoring casing to prevent vandalism or contamination. Well 8 provides water to Area 12 and supplies water to the construction water open pit reservoir system. Water Service Area B also includes one pumping station and two water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area C: Encompasses Areas 1, 3, 5, 6, 11, 22, 23, 26, and 27. PWS NV0000360 serves Areas 5, 6, 22, and 23. Five active wells provide water in this service area (Wells C1, 4, 4a, 5b, and 5c). Fillstand A-6 is used to supply potable water via water trucks to JASPER, Area 12, and BEEF. Water Service Area C also includes five pumping stations and nine water storage tanks (DOE 2009f; DOE/NV 2008c).

Water Service Area D: Encompasses Areas 14, 16, 25, 29, and 30. PWS NV0004098 serves Area 25. It consists of two active wells (Wells J12 and 16d). Water Service Area D also includes three pumping stations and 12 water storage tanks (DOE 2009f; DOE/NV 2008c).

Water is currently hauled into Areas 26 and 27 by truck. There are four elevated tanks in Area 26 that store construction water and one tank in Area 27 that stores fire protection and potable water (DOE/NV 2008c).

Since the 1992 moratorium on underground nuclear testing, there has been a significant reduction in personnel and operational activities at the NNSS, and the amount of water consumed at the NNSS has dropped significantly. In 2005, the NNSS installed water volume meters on the active water wells that contribute to the water distribution system; in 2009, the NNSS installed meters on the fillstand locations.

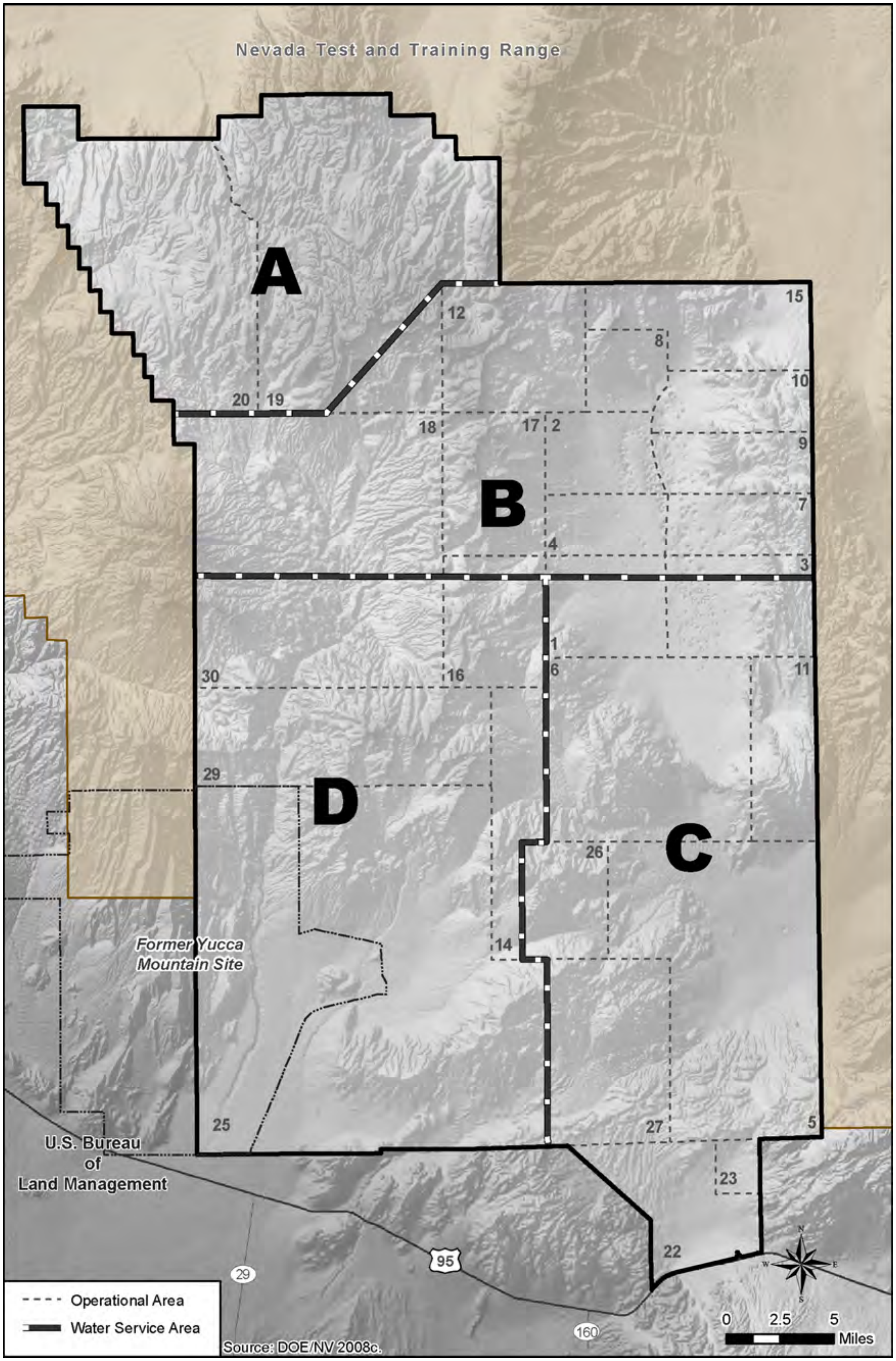


Figure 4–12 Water Service Areas at the Nevada National Security Site

Between 2005 and 2009, total annual water usage from active wells ranged from approximately 173 million to 225 million gallons (from 531 to 690 acre-feet, see **Table 4–27**) (NSTec 2010c), which is significantly less than the peak usage of 3,375 acre-feet per year in 1989 (DOE 1996a). In general, water usage at the NNSS has declined since 1989 and the volume of water produced from characterization wells is minor, totaling typically less than 2 acre-feet per well (DOE/NNSA/NSO 2008).

Table 4–27 Nevada National Security Site Well Withdrawal Totals (2005 through 2009)

Well Name	*2005 Use (gallons)*	*2006 Use (gallons)*	*2007 Use (gallons)*	*2008 Use (gallons)*	*2009 Use (gallons)*	*Total Use (gallons)*	*Percent of 2005–2009 Total Use*
Well 4	38,512,000	52,398,000	40,391,000	26,288,000	22,727,000	180,316,000	18.2
Well 4a	52,325,000	66,257,000	60,990,000	34,434,000	49,633,000	264,639,000	26.7
Well 5b	25,600,000	35,608,000	37,968,000	47,348,000	39,315,000	185,839,000	18.7
Well 5c	10,339,000	8,951,000	4,597,000	14,104,000	11,918,000	49,909,000	5.0
Well 8	11,432,000	8,575,000	15,132,000	12,056,000	13,285,000	60,480,000	6.1
Well J-12	13,919,000	14,440,000	23,403,000	10,004,000	5,651,000	67,417,000	6.8
Well 16d	22,818,000	26,505,000	21,393,000	5,800,000	26,104,000	102,620,000	10.3
Well C1	7,707,000	8,515,000	21,268,000	22,508,000	21,375,000	81,373,000	8.2
Total use in gallons	182,652,000	221,249,000	225,142,000	172,542,000	190,008,000	992,593,000	
Total use in acre-feet	561	679	691	530	583	3,046	

Source: NSTec 2010c.

The measured annual water usage from the active wells includes fillstand water withdrawals, which are used for nonpotable purposes such as dust suppression (NSTec 2010d). As meters were not installed on the fillstand locations until 2009, detailed information on the division of potable and nonpotable water use is only available for one calendar year. See **Table 4–28** for a list of fillstands and corresponding water withdrawals for 2009 and **Table 4–29** for a breakdown of potable and nonpotable water use at the NNSS for 2009.

Table 4–28 Nevada National Security Site Nonpotable Fillstand Flow Totals for 2009

Fillstand Name	*Use*	*Months Used in 2009*	*Total Use (gallons)*	*Total Use (acre-feet)*
FS 5B	Nonpotable	January–December	6,261,100	19.2
FS A-12	Nonpotable	March–December	1,424,200	4.4
FS A-17	Nonpotable	April–December	3,393,100	10.4
FS A-25	Nonpotable	July–December	491,410	1.5
FS A-6 #1 and #2	Nonpotable	May–June	890,400	2.7
FS Birdwell	Nonpotable	March–December	4,917,800	15.1
FS C-1	Nonpotable	February–December	3,666,600	11.3
FS ETS	Nonpotable	February–March	1,277	0.004
FS J-13	Nonpotable	February–March	188,800	0.6
FS Mercury	Nonpotable	February–December	8,037,000	24.7
FS Wet and Wild	Nonpotable	February–December	864,700	2.7
Total Water Withdrawn From Fillstands in 2009			30,136,387	92.5

Source: NSTec 2010c.

Table 4–29 Potable and Nonpotable Water Use at the Nevada National Security Site for 2009

	Gallons	*Acre-Feet*
Total Nonpotable Water Use in 2009	30,136,387	93
Total Potable Water Use in 2009	159,871,613	491
Total Water Use in 2009	190,008,000	583

Source: NSTec 2010c.

Table 4–30 provides a summary of historic water withdrawals from affected hydrographic basins at the NNSS from 2005 through 2009. Over 68 percent of the NNSS water withdrawals in this timeframe occurred in Frenchman Flat (Basin 160), with lesser contributions coming from Yucca Flat (Basin 159) and the Jackass Flats and Buckboard Mesa Subdivisions of Fortymile Canyon (Basins 227b and 227a). In terms of use of sustainable yield (perennial yield minus any rights already committed by the State Engineer to other users), Frenchman Flat was the most heavily used during this timeframe (35 to 47 percent of perennial yield used in any year), followed by Yucca Flat (25 to 42 percent in any year). The Jackass Flats and Buckboard Mesa Subdivisions of Fortymile Canyon showed very light use during this timeframe, never exceeding 8 percent of sustainable yield in any year.

Table 4–30 Summary of Water Withdrawals from Hydrographic Basins

Hydrographic Basin	*Sustainable Yield of the Basin (acre-feet per year)*	*NNSS Operational Water Wells by Basin*	*Percentage of Basin's Average Contribution to NNSS Water Supply 2005–2009*	*Range of Total Withdrawals, 2005–2009 (acre-feet per year)*	*Percentage of Perennial Yield Used 2005–2009*
Frenchman Flat (160)	1,070	4, 4a, 5b, 5c	68.6%	375–501	35–47%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	3,600	8	6.1%	26–46	0.7–1.3%
Fortymile Canyon, Jackass Flats Subdivision (227a)	824–3,944	J-12	6.8%	17–72	0.4–7.8%
Yucca Flat (159)	350	C-1, 16d	18.5%	87–146	25–42%

NNSS = Nevada National Security Site.
Source: Derived from Tables 4–24, 4–26, 4–27.

Groundwater Monitoring and Quality

Water use in Nevada is regulated by the Nevada Department of Conservation and Natural Resources, Division of Water Resources, through an appropriations process. Water availability is monitored through the measurement of groundwater levels in wells and the quantity of water produced. USGS conducts the monitoring, maintains the databases, and reports the results annually in a statewide water resource summary. Over the long term, existing and new regional groundwater modeling will improve the understanding of water availability and planning. The groundwater at the NNSS is classified as Class II groundwater according to the EPA groundwater classification system, which means that it is currently or potentially a source of drinking water.

Water chemistry (see **Table 4–31**) varies from a sodium-potassium-bicarbonate type associated with volcanic aquifers, to a calcium-magnesium-bicarbonate type associated with carbonate aquifers, to a calcium-magnesium-sodium-bicarbonate type, which is a mixed type and may represent alluvial aquifers or the mixing of groundwater entering the Lower Carbonate aquifer from overlying volcanic units (DOE/NNSA/NSO 2008). Drinking water quality on the NNSS is monitored to assess compliance with primary and secondary drinking water standards according to the schedule set in applicable Federal and state laws, monitoring waivers, and variances issued by the State of Nevada Division of Health. The three PWSs and permitted water hauling trucks at the NNSS meet all of the primary and secondary drinking water standards (DOE/NV 2009d). The trucks that are permitted to haul water to the PWSs are permitted by NDEP's Bureau of Safe Drinking Water and the water they carry is subject to water quality standards for coliform bacteria (DOE/NV 2009d).

The Safe Drinking Water Act Arsenic Rule amendment approved in 2001 lowered the allowable maximum level of arsenic in drinking water to 10 parts per billion for PWSs (Congressional Research Service 2007) (note that the water chemistry data displayed in Table 4–31 were collected in 1993, before the Arsenic Rule amendment). Groundwater drawn from two wells serving the PWSs in Area 25 currently exceeds this limit. To maintain compliance with the Safe Drinking Water Act, the pumped groundwater is treated in a reverse osmosis system or a point-of-use treatment to remove the excess arsenic before being distributed for consumption (DOE 2007c).

There have been 828 underground nuclear tests conducted at the NNSS. Approximately one-third of these tests were detonated near or below the water table. Most of the NNSS underground nuclear detonations were conducted at Yucca Flat, Pahute Mesa, and Rainier Mesa. This legacy of nuclear testing has resulted in groundwater contamination in some areas. Detonations conducted at or below the water table have contaminated groundwater near underground nuclear test cavities with 43 identified radionuclides, with tritium being the most prevalent radionuclide (DOE 2008l). The FFACO established five CAUs that delineated and defined areas of concern for groundwater contamination on the NNSS. **Figure 4–13** shows the locations of underground nuclear tests and established CAU areas of potential groundwater contamination (DOE 2008l). This figure also illustrates the predicted groundwater flow from the CAUs.

Several groups regularly test water at and surrounding the NNSS. There are approximately 120 active groundwater monitoring wells (see **Table 4–32** for a complete list of these wells used under the NNSS Environmental Restoration Program). NNSA/NSO's RREM Program samples more than 80 locations, which include wells, springs, and surface-water sites, to make sure radionuclide levels do not exceed Safe Drinking Water Act standards. The UGTA Project samples a network of deep wells to help determine where contaminants are present in groundwater, what direction these contaminants are moving, and how quickly. UGTA wells that are not designated as source-term characterization wells are made available for monitoring under the RREM Program (DOE/NV 2009d). Tritium was the radioactive species created in the greatest quantities and is widely believed to be the most mobile. Therefore, tritium is the primary target analyte; every groundwater sample is analyzed for this radionuclide (DOE/NV 2009d).

In addition to the RREM Program and the UGTA Project sampling efforts, the Community Environmental Monitoring Program (CEMP) performs independent, annual monitoring of 29 springs and water supplies in communities surrounding the NNSS (DOE/NNSA/NSO 2010). In 2008, CEMP offsite water sampling locations included 21 wells, 3 surface water supply systems, and 4 springs. All water samples had levels of tritium either below laboratory background levels or at very low detectable levels (less than 25 picocuries per liter). This very low detectable level represents residual tritium that originated from global atmospheric nuclear testing (DOE/NV 2009d).

Table 4–31 Potable Groundwater Chemistry Data on the Nevada National Security Site

Well Name	*Calcium (mg/L)*	*Magnesium (mg/L)*	*Potassium (mg/L)*	*Sodium (mg/L)*	*Bicarbonate (mg/L)*	*Carbonate (mg/L)*	*Chloride (mg/L)*	*Fluoride (mg/L)*	*Nitrate (mg/L)*	*Sulfate (mg/L)*	*Alkalinity (mg/L)*	*Hardness* [a] *(mg/L)*	*pH*	*TDS (mg/L)*
Well 4	24	8	5	48	149	7	12	0.8	6.8	42	134	93	8.26	288
Well 4a	22	6	6	55	159	5	9	0.81	N/A	35	138	80	8.22	283
Well 5b	8	2	11	93	161	10	23	0.85	2.7	58	148	28	8.6	338
Well 5c	2	1	7	134	278	24	10	1.04	1.5	33	264	9	8.93	396
Well 8	8	1	3	30	71	5	7	0.81	1.3	14	66	24	8.28	149
Well J-12	15	2	5	41	120	0	8	1.8	2	25	98	46	8.15	209
Well 16d	79	24	7	30	356	0	11	0.56	0.6	58	292	296	7.89	401
Well C1	73	28	13	121	578	0	34	1.14	0.6	66	474	298	7.47	639

mg/L = milligrams per liter; N/A = not applicable; pH = a measure of acidity or basicity; TDS = total dissolved solids.

[a] Hardness is expressed as calcium carbonate.

Note: The following elements are present in trace quantities below Safe Drinking Water Act limits: arsenic, boron, chromium, iron, manganese, selenium, silver, barium, cadmium, copper, lead, mercury, silica, and zinc. All data were collected in 1993.

Source: REECo 1992.

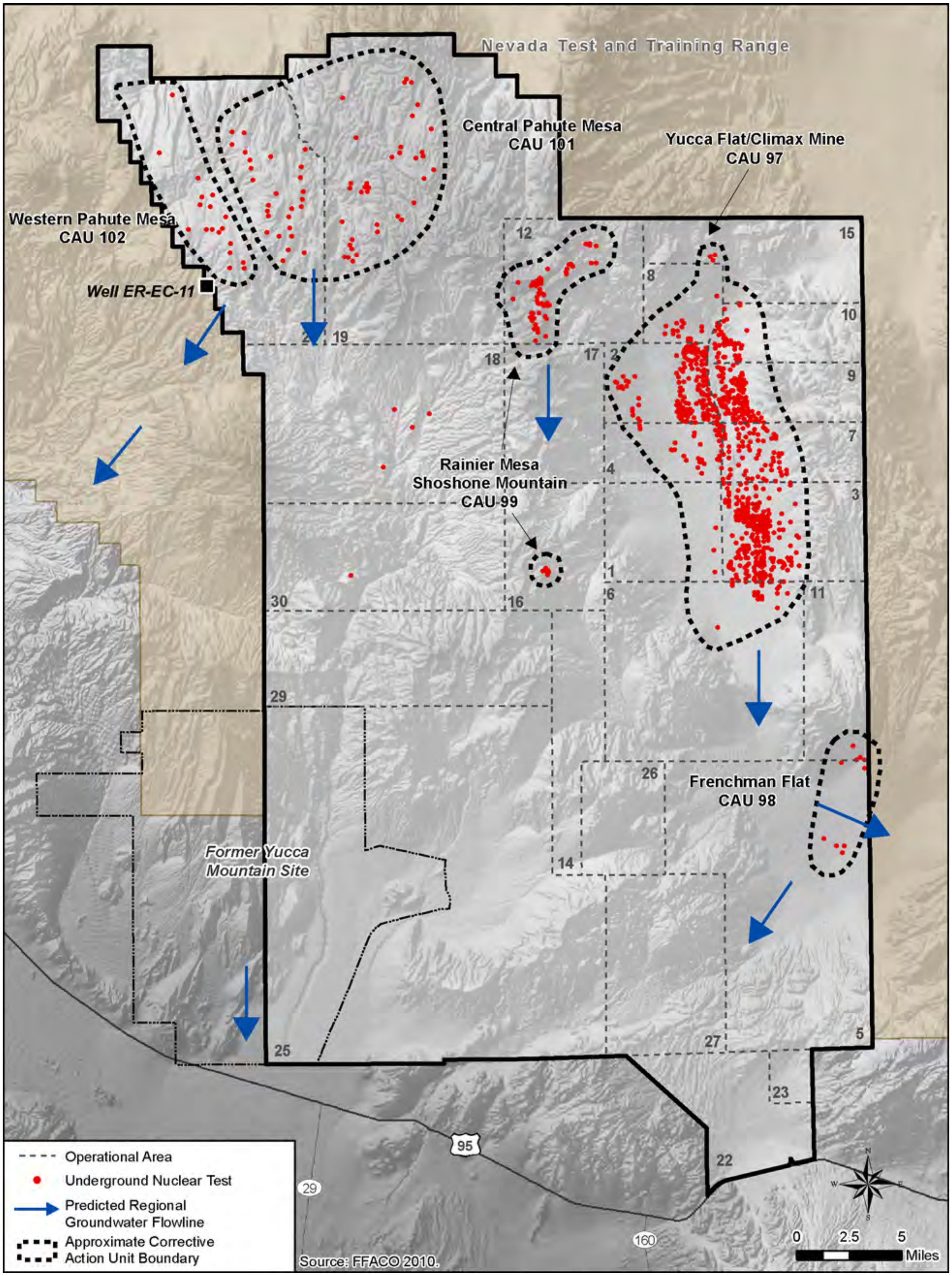


Figure 4–13 Corrective Action Units Site Locations at the Nevada National Security Site

Table 4–32 The Nevada National Security Site Environmental Restoration Program Wells

NNSS Area	Well Name	Status	Depth (feet)	Primary Use	Primary Aquifer	Aquifer Type
Area 20	ER-20-7	Active	3,500	O	Tiva Canyon Tuff	Confined single aquifer
	ER-EC-11	Active	3,500	O	Tiva Canyon Tuff	Confined single aquifer
	ER-20-8	Active	3,500	O	Tiva Canyon Tuff	Confined single aquifer
	ER-20-8 #2	Active	3,500	O	Tiva Canyon Tuff	Confined single aquifer
	ER-20-1	Active	2,065	O	Tiva Canyon Tuff	Confined single aquifer
	ER-20-1-1	Active	2,494	O	Volcanic rocks	Unconfined multiple aquifers
	ER-20-6-1	Active	2,390	O	Volcanic rocks	Confined single aquifer
	ER-20-6-2	Active	2,933	O	Volcanic rocks	Confined single aquifer
	ER-20-6-3	Active	2,790	O	Volcanic rocks	Confined single aquifer
	PM-1	Active	7,731	O	Volcanic rocks	-----
	PM-2	Active	8,788	O	Volcanic rocks	-----
	U-20 WW	Active	3,268	W	Volcanic rocks	Confined multiple aquifers
	U-20ax	Inactive	2,138	U	Volcanic rocks	-----
	U-20bg	Active	2,200	O	Volcanic rocks	-----
	U-20n	Inactive	3,025	Z	Volcanic rocks	-----
	UE-20bh 1	Active	2,810	O	Volcanic rocks	-----
	UE-20n 1	Inactive	2,834	O	Volcanic rocks	-----
Area 19	ER-19-1-1	Active	3,577	O	Clastic sedimentary rocks	Confined single aquifer
	ER-19-1-2	Active	2,720	O	Volcanic rocks	Confined single aquifer
	ER-19-1-3	Active	1,380	O	Volcanic rocks	Confined single aquifer
	U-19bh	Active	2,107	O	Volcanic rocks	-----
	U-19bj	Active	2,149	O	Volcanic rocks	-----
	U-19bk	Active	2,192	O	Volcanic rocks	-----
	UE-19cWW	Active	2,493	W	Volcanic rocks	-----
	UE-19h	Active	2,288	O	Volcanic rocks	Unconfined single aquifer
Area 12	ER-12-1	Active	3,434	O	Simonson Dolomite	Confined single aquifer
	ER-12-2 main lz	Active	6,883	O	Eleana Formation	Confined single aquifer
	ER-12-2 main uz	Active	5,203	O	Eleana Formation	Confined single aquifer
	ER-12-2 piezometer	Active	579	O	Volcanic rocks	Unconfined single aquifer
	ER-12-3 main	Active	4,880	O	Carbonate rocks	Unconfined single aquifer
	ER-12-3 piezometer	Active	1,532	O	Volcanic rocks	Unconfined single aquifer
	ER-12-4 main	Active	3,713	O	Carbonate rocks	Unconfined single aquifer
	ER-12-4 piezometer	Active	1,968	O	Volcanic rocks	Unconfined single aquifer
	U-12s	Active	1,467	O	Granitic rocks	-----
	UE-12t 6	Active	1,461	O	Volcanic rocks	-----
Area 8	ER-8-1	Active	2,567	T	Granitic rocks	-----
	UE-10j	Active	2,532	O	Carbonate rocks	-----
Area 15	U-15k	Active	857	O	Granitic rocks	Unconfined single aquifer
Area 10	-----	-----	-----	-----	-----	-----
Area 18	ER-18-2	Active	2,143	O	Volcanic rocks	Confined single aquifer
	UE-18r	Active	2,183	O	Volcanic rocks	-----
	UE-18t	Active	2,600	O	Volcanic rocks	-----
	WW-8	Inactive	1,862	W	Volcanic rocks	-----

NNSS Area	*Well Name*	*Status*	*Depth (feet)*	*Primary Use*	*Primary Aquifer*	*Aquifer Type*
Area 17	TW-1	Active	3,694	O	Volcanic rocks	-----
	UE-17a	Active	1,207	O	Eleana Formation	Mixed (confined & unconfined multiple aquifers)
Area 2	ER-2-1 main	Active	2,079	O	Volcanic rocks	Unconfined single aquifer
	ER-2-1 piezometer	Active	2,559	O	Volcanic rocks	Confined single aquifer
	U-2gg PS E3A	Inactive	2,060	T	Volcanic rocks	-----
	U-2gk	Active	1,802	O	Valley fill deposits	-----
	UE	Active	1,505	O	Carbonate rocks	Unconfined single aquifer
	WW-2	Active	3,422	W	Pogonip group	Confined single aquifer
Area 9	-----	-----	-----	-----	-----	-----
Area 4	TW-D	Active	1,950	O	Carbonate rocks	Mixed (confined & unconfined multiple aquifers)
Area 7	ER-7-1	Active	2,500	O	Carbonate rocks	Unconfined single aquifer
	U-4u PS 2A	Inactive	2,280	T	Volcanic rocks	-----
	U-7ba PS 1AS	Inactive	1,993	T	Volcanic rocks	-----
	U-7cd	Active	1,523	O	Volcanic rocks	-----
	U-7cd 1	Inactive	1,700	Z	Volcanic rocks	-----
	UE-4t 1	Active	1,993	O	Volcanic rocks	-----
	UE-4t 2	Active	1,724	O	Volcanic rocks	-----
	UE-7nS	Active	2,022	O	Carbonate rocks	Unconfined single aquifer
Area 30	ER-30-1-1	Inactive	786	T	Volcanic rocks	Confined single aquifer
	ER-30-1-2	Inactive	628	T	Volcanic rocks	Confined single aquifer
Area 16	ER-16-1	Active	4,532	O	Guilmette Formation	-----
	UE-16f	Active	1,409	O	Eleana Formation	-----
Area 1	UE-1a	Active	562	O	Eleana Formation	-----
	UE-1b	Active	701	O	Eleana Formation	-----
	UE-1c	Active	1,772	O	Carbonate rocks	Mixed (confined & unconfined multiple aquifers)
	UE-1h	Active	3,228	O	Carbonate rocks	-----
	UE-1L	Active	2,284	O	Eleana Formation	Mixed (confined & unconfined multiple aquifers)
	UE-1q	Active	2,600	O	Carbonate rocks	-----
Area 3	ER-3-1-1	Inactive	2,602	T	Carbonate rocks	Confined single aquifer
	ER-3-1-2	Active	2,310	O	Carbonate rocks	Confined single aquifer
	ER-3-2-1	Inactive	2,938	T	Volcanic rocks	Confined single aquifer
	ER-3-2-2	Active	2,655	O	Valley fill	Unconfined single aquifer
	ER-3-2-3	Inactive	1,779	T	Valley fill	Unconfined single aquifer
	TW-7	Active	2,239	O	Volcanic rocks	Mixed (confined & unconfined multiple aquifers)
	TW-E	Inactive	2,610	Z	Carbonate rocks	Mixed (confined & unconfined multiple aquifers)
	U-3cn 5	Active	2,830	O	Carbonate rocks	Mixed (confined & unconfined multiple aquifers)

NNSS Area	Well Name	Status	Depth (feet)	Primary Use	Primary Aquifer	Aquifer Type
	U-3mi	Active	1,651	O	Volcanic rocks	Mixed (confined & unconfined multiple aquifers)
	UE-3e 4-1	Inactive	2,181	O	Crater Flat Tuff	-----
	UE-3e 4-2	Active	1,919	O	Volcanic rocks	-----
	UE-3e-4-3	Inactive	1,661	O	Rainier Mesa Tuff	-----
	WW-A	Active	1,870	W	Valley fill deposits	Unconfined single aquifer
Area 29	-----	-----	-----	-----	-----	-----
Area 14	UE-14b	Active	3,680	O	Volcanic rocks	Mixed (confined & unconfined multiple aquifers)
Area 6	ER-6-1 main	Active	3,159	O	Carbonate rocks	Confined single aquifer
	ER-6-1 piezometer	Active	1,790	O	Volcanic rocks	Confined single aquifer
	ER-6-1-1	Active	1,940	O	Carbonate rocks	Confined single aquifer
	ER-6-1-2 main	Active	3,045	T	Carbonate rocks	Confined single aquifer
	ER-6-1-2 piezometer	Active	1,587	T	Volcanic rocks	-----
	ER-6-2	Active	3,408	O	Bonanza King Formation	
	TW-B	Active	1,670	O	Volcanic rocks	Mixed (confined & unconfined multiple aquifers)
	UE-6d	Active	3,864	O	Valley fill deposits	Mixed (confined & unconfined multiple aquifers)
	UE-6e	Active	2,230	O	Paintbrush Tuff	-----
	WW-3	Active	1,800	W	Valley fill deposits	Unconfined single aquifer
	WW-4	Active	1,438	W	Volcanic rocks	Mixed (confined & unconfined multiple aquifers)
	WW-4A	Active	1,502	W	Volcanic rocks	Mixed (confined & unconfined multiple aquifers)
Area 11	UE-11a	Active	1,130	O	Volcanic rocks	-----
Area 25	J-11WW	Active	1,325	O	Volcanic rocks	-----
	J-12WW	Active	1,019	W	Volcanic rocks	-----
	J-13WW	Active	3,385	W	Volcanic rocks	-----
	JF-3 Well	Active	1,138	O	Volcanic rocks	-----
	UE-25 WT 13	Active	1,160	T	Topopah Spring Tuff	-----
	UE-25 WT 15	Active	1,360	T	Topopah Spring Tuff	-----
	UE-25p 1 PTH	Active	5,923	-----	Carbonate rocks	-----
Area 26	Pluto 4	Active	261	T	Volcanic rocks	Unconfined single aquifer
	Pluto 5	Active	322	T	Volcanic rocks	Unconfined single aquifer
	Pluto 12	Active	601	T	Volcanic rocks	Unconfined single aquifer
	Pluto 15	Active	252	T	Volcanic rocks	-----
Area 27	TW-F	Active	3,392	O	Carbonate rocks	-----
Area 5	ER-5-3 deep	Active	2,212	O	Valley fill deposits	Mixed (confined & unconfined multiple aquifers)
	ER-5-3 main	Active	1,890	O	Valley fill deposits	-----

NNSS Area	***Well Name***	***Status***	***Depth (feet)***	***Primary Use***	***Primary Aquifer***	***Aquifer Type***
	ER-5-3 shallow	Active	1,237	O	Valley fill deposits	Mixed (confined & unconfined multiple aquifers)
	ER-5-3-2	Active	4,908	O	Carbonate rocks	Confined single aquifer
	ER-5-3-3	Active	1,745	O	Valley fill deposits	Unconfined single aquifer
	ER-5-4 main	Active	3,438	O	Valley fill deposits	Confined single aquifer
	ER-5-4 piezometer	Active	814	O	Valley fill deposits	Unconfined single aquifer
	ER-5-4-2	Active	6,658	O	Volcanic rocks	Confined single aquifer
	RNM-1	Active	999	O	-----	Unconfined single aquifer
	RNM-2	Active	825	O	Valley fill deposits	Unconfined single aquifer
	RNM-2S	Active	1,120	O	Valley fill deposits	-----
	UE-5 PW-1	Inactive	822	T	Valley fill deposits	-----
	UE-5 PW-2	Inactive	890	T	Valley fill deposits	-----
	UE-5 PW-3	Inactive	938	T	Volcanic rocks	-----
	UE-5n	Active	1,523	O	Valley fill deposits	-----
	WW-5A	Active	910	W	Consolidated deposits	Confined single aquifer
	WW-5B	Active	900	W	Valley fill deposits	-----
	WW-5C	Inactive	1,200	W	Valley fill deposits	-----
Area 22	Army 1 WW	Active	1,931	W	Carbonate rocks	-----
	SM-23-1	Active	1,332	O	Carbonate rocks	-----
Area 23	-----	-----	-----	-----	-----	-----

NNSS = Nevada National Security Site; O = Observation; U = Unused; W = Withdrawal of water; T = Test; Z = Destroyed.
Source: USGS 2009; NNSA/EM 2009.

Underground Test Area Project: The CAUs are investigated and monitored under the UGTA Project, which is the largest component of the NNSS Environmental Restoration Program, with the oversight of NDEP as part of the FFACO (DOE/NV 2010). The UGTA Project started in 1989 and is scheduled to be completed in 2027. This project evaluates the extent of radionuclide groundwater contamination due to past underground nuclear testing through hydrogeologic investigation and characterization, groundwater flow and transport modeling, and groundwater sampling and monitoring. The final product for each of the CAUs will be a transport model that evaluates an ensemble forecast of contaminant boundaries, which will provide the primary basis for negotiation of a compliance boundary with NDEP. A long-term-closure monitoring well network will be designed and installed for each CAU and used for monitoring to ensure public health and safety (DOE/NV 2009d).

A regional three-dimensional computer groundwater model has been developed to identify risks to the public, workers, and the environment and to provide a basis for developing individualized models for each major area where underground testing was conducted on the NNSS. Individualized models are needed due to the complexity of geologic/hydrologic conditions within each area. These site-specific groundwater models will be used to identify contaminant boundaries based on the maximum extent of contaminant migration over a 1,000-year time period. Results of the site-specific groundwater models will be used to develop a monitoring network, which augments current monitoring both on and off the NNSS. To ensure public health and safety, groundwater monitoring is expected to continue in perpetuity.

A new well-drilling campaign, initiated in the summer of 2009, identified the construction of nine additional wells over the next 3 years to gather further data for the establishment of a long-term monitoring system (DOE/NV 2010). Three of the nine wells were drilled in 2009 (ER-EC-11, ER-20-8, and ER-20-7) in Pahute Mesa along the northwestern boundary of the NNSS and the remaining six will also be located on or near Pahute Mesa. ER-EC-11 is located off site on USAF land and ER-20-48 and ER-20-7 are within the NNSS boundary. For the first time in October 2009, tritium was detected off site in monitoring well ER-EC-11, located less than half a mile off the northwestern boundary of the NNSS and approximately 14 miles from the nearest public water source. The tritium level was found to be approximately 12,500 picocuries per liter, which is below the EPA Safe Drinking Water Act standard of 20,000 picocuries per liter. The sample results were verified by a certified independent laboratory and reported to NDEP (NNSA/EM 2009). Current groundwater models in the February 2009 Phase 1 Central and Western Pahute Mesa Transport Model and Western Pahute Mesa Corrective Action Plan display transport in this direction near Pahute Mesa.

The UGTA Project has been routinely collecting groundwater samples from an average of six wells a year since 2000. The wells include new construction wells, existing on- and offsite monitoring wells (which may also be used under the RREM Program, along with post-shot/cavity wells). The post-shot/cavity wells are sampled as a part of the "hot well" sampling effort under the UGTA Project. Groundwater samples collected during the construction of new wells, as well as samples collected from existing on- and offsite monitoring wells generally did not display concentrations of tritium above the Safe Drinking Water Act standard of 20,000 picocuries per liter between 2000 and 2008. However, the samples taken under the hot well program consistently display tritium concentrations above the Safe Drinking Water Act standard. The hot well sampling effort supports NNSA's continuing effort to create a long-term monitoring program for wells in or near underground nuclear test cavities. The program's objectives are to characterize the hydrologic source term and evaluate the effects of decay and potential migration of radionuclides through monitoring at or near the source (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d). **Table 4–33** shows a summary of the hot well sampling effort and the associated tritium findings from 2003 to 2008. No post-shot/cavity well samples were taken between 2000 and 2003, nor were well samples taken between 2006 and 2008.

Table 4–33 "Hot Well" Tritium Analysis Summary Table (2003 to 2008)

Year Samples Taken	*Total Number of Samples Analyzed*	*Associated Underground Nuclear Test Cavity*	*Range of Results (picocuries per liter)*
2003	4	Gascon, Camembert, Almendro, and Cheshire	200,000 to 160,000,000
2004	4	Bilby, Chancellor, and Tybo	113,000 to 38,000,000
2005	1	Cheshire	37,000,000
2006–2008	0	–	–

Source: DOE/NV 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d.

Routine Radiological Environmental Monitoring Plan: The RREM Plan was developed in 1998. The Long-Term Hydrological Monitoring Program was the RREM Plan's predecessor and had been in existence since 1972. Before 1972, groundwater was monitored by the U.S. Public Health Service, USGS, and the U.S. Atomic Energy Commission's contractor organizations. In 1999, there was a final transition from the Long-Term Hydrological Monitoring Program to the RREM Plan to have a single, integrated, and comprehensive monitoring program (DOE/NV 2000c). In 2002, the RREM Plan environmental surveillance system was revised in an effort to make the program more efficient. The purpose of the RREM Plan is to determine whether concentrations of radionuclides in groundwater and surface water at the NNSS pose a threat to public health or the environment. The RREM Plan includes a groundwater monitoring well network of 78 wells located on and off the NNSS, which are sampled at frequencies ranging from once every 3 months to once every 3 years. Ten additional wells have been added to the network and are sampled opportunistically. Of these 88 wells, 72 have been sampled since 1999. These 72 wells include 33 offsite monitoring wells, 29 onsite monitoring wells, and 10 onsite water supply wells. The remaining 16 wells identified by the RREM Plan, but not sampled since 1999, comprise 15 onsite monitoring wells and 1 offsite well. These 16 wells have not been sampled for one or more of the following reasons: they are not accessible, are used for other purposes, are blocked, provide water samples that are of poor quality or are contaminated (disqualifying them from monitoring), or contain waters with known high levels of radiological contamination that are not expected to change (DOE/NV 2009d).

Sampling of the NNSS potable supply wells continues to indicate that nuclear testing has not affected the NNSS water supply network. Gross alpha and gross beta radioactivity have been detected in supply wells at concentrations commensurate with background levels of naturally occurring radionuclides and not above the EPA maximum contaminant level (MCL) of 15 picocuries per liter. Tritium has not been detected above the Safe Drinking Water Act standard of 20,000 picocuries per liter in any of the potable supply wells (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d). **Table 4–34** is a summary of the samples taken on site and off site, including potable and monitoring wells and the results from 2000 through 2008. The summary table dates back to 2000, as the Long-Term Hydrological Monitoring Program was transitioned over to the RREM Plan the previous year. The tritium analysis was conducted after the samples were enriched. The enrichment process concentrates tritium in a sample to provide very low minimum detectable concentrations (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d). None of the samples taken within this timeframe under the RREM Plan has displayed concentrations of tritium greater than 10.7 percent of the Safe Drinking Water Act standard of 20,000 picocuries per liter.

Table 4–34 Routine Radiological Environmental Monitoring Plan Tritium Analysis Summary Table (2000 to 2008)

Year Samples Taken	*Total Number of Samples Analyzed* [a]	*Range of Results Minimum Detectable Concentration (picocuries per liter)*	*Percent of Safe Drinking Water Act Maximum Contaminant Level (20,000 picocuries per liter)*
2000	61	8 to 2130	0.04 to 10.7
2001	60	10 to 32	0.05 to 0.16
2002	54	12 to 260	0.06 to 1.3
2003	45	18 to 28	0.09 to 0.14
2004	36	17 to 26	0.09 to 0.13
2005	55	13 to 35	0.07 to 0.18
2006	41	11 to 37	0.06 to 0.19
2007	39	17 to 28	0.09 to 0.14
2008	33	18 to 34	0.09 to 0.17

[a] Includes on- and offsite monitoring wells.
Source: DOE/NV 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d.

Only four onsite monitoring wells (PM-1, U-19BH, UE-7NS, and WW A) located within 0.6 miles of a historical underground nuclear test are known to have detectable concentrations of tritium above their respective minimum detectable concentrations; however, the concentrations are well below the Safe Drinking Water Act drinking water limit of 20,000 picocuries per liter (see **Table 4–35** for the 2008 sampling results). All have consistently had detectable levels of tritium in past years, and no trend of rising tritium concentrations has been observed in these wells since 2000.

Wells PM-1 and U-19BH are located in the Central Pahute Mesa CAU 101 (see Figure 4–13 for CAU locations within the NNSS). PM-1 is located in Area 20 of the NNSS and has a history of tritium concentrations near 200 picocuries per liter over the last 10 years. Well U-19BH has a history of tritium concentrations and in 2002 measured with concentrations at approximately 48 picocuries per liter. The tritium concentrations measured at Well U-19BH since 1999 show a downward trend. Wells UE-7NS and WW A are located within the Yucca Flat CAU 97 (see Figure 4–13 for CAU locations within the NNSS). Well UE-7NS was routinely sampled from 1978 to 1987, with the resumption of sampling in

1991. In 2003, tritium concentrations ranged between 133 and 156 picocuries per liter, consistent with the trend of decreasing concentrations observed in recent years. Well WW A has had measureable tritium since the late 1980s. There was an increase in tritium concentrations between 1985 and 1999, which has been followed by a slight downward trend in concentrations since 2000 (DOE/NV 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d).

Table 4–35 Tritium Analysis Results for the Nevada National Security Site Monitoring Wells (2008)

Underground Test Area Well	*Date Sampled*	*^{3}H±Uncertainty [a] (minimum detectable concentration) (picocuries per liter)*
PM-1	4-23-08	127 ± 25 (23)
U-19BH	3-17-08	31 ± 13 (19)
UE-7NS	2-27-08	90 ± 24 (30)
WW A	2-12-08	356 ± 59 (28)

^{3}H = tritium (hydrogen-3).
[a] ±2 standard deviations.
Source: DOE/NV 2009d.

No adverse impacts on potable groundwater quality have resulted from operations since 1996 (DOE/NV 2002c). Due to the distance between existing water supply wells at the NNSS and the underground tests, DOE believes that groundwater use at the NNSS has little or no effect on the migration or spread of contamination from underground nuclear testing. Groundwater at the NNSS is deep and slow moving, which affords protection to adjacent areas (DOE/NV 2010). Groundwater modeling is used to evaluate the effect of water use on potential radionuclide migration and assist in the selection of optimum water-production wells and monitoring wells. As studies are completed, monitoring plans are negotiated and approved for each of the underground test areas. Maintenance of the quality of waters that are currently clean is managed through the implementation of the Groundwater Protection Management Plan, required by DOE Order 5400.1.

Offsite water use is far removed from the NNSS testing areas. The closest significant offsite withdrawals are in Oasis Valley, approximately 18.6 miles (30 kilometers) from the nearest underground test, and these withdrawals are not thought to affect contaminant migration.

The NNSS has implemented a Borehole Management Plan to protect groundwater from contamination via infiltration of contaminants at the wellhead. Over 4,000 boreholes were drilled on and off the NNSS in support of nuclear testing. Many of the boreholes are no longer used and are not candidates for future use. These boreholes could serve as a pathway for surface contamination to reach subsurface strata (DOE/NV 2002c). The NNSS has implemented the Borehole Management Plan, which identifies boreholes that should be plugged to avoid any potential contamination of groundwater. As of January 2009, the Borehole Management Program has plugged 617 of the 871 boreholes identified as needing closure. Of the boreholes requiring closure, 151 are believed to penetrate groundwater and underground nuclear test cavities and 93 of these boreholes have been plugged as of January 2009 (DOE/NV 2009d).

Water Resources—American Indian Perspective

Indian people believe water is a living organism that is fully sentient and willful. The forces of power in the world move along channels and combine into specific nodes or places of power. A common set of these channels follows the path of water. These paths begin at the tops of mountains, especially the highest peaks. Snow and rain falls on these highlands and peaks after being called down by the mountain itself. From this beginning, the water moves downhill in rivulets, washes, and streams. The water often goes underground where it forms similar networks of channels moving in various directions, only somewhat corresponding to what non-native people call hydrologic basins. Water is often attracted to volcanic activity, thus producing significant power places like hot mineral springs.

According to tribal elders, *"Water is life. Water is needed by the plants and animals. Indian people bless themselves with it. It purifies the body. Water is medicine and must be respected. American Indians need it to conduct religious ceremonies. It cleans the earth. It has a vast connection to the underground. Water shouldn't be contaminated or it will die and lose its spirit."*

Each of the discreet underground water basins, or hydrological basins, has its own origin story. One tribal story tells of a discreet underground water network created by Ocean Woman and where she placed her feet. According to this traditional story, there are points where the water emerges at the surface in springs and seeps. It was here that Ocean Woman placed her medicine staff into the ground and water emerged.

At other points, the surface water in low playa lakes meets the underground water channels. These points are like doorways between the surface world and the underworld.

Rain calling is a basic aspect of American Indian life and culture. Rain ceremonies from the spiritual world help facilitate rain production, and were led by rain callers, often called rain shamans or rain doctors in the English language. The rain caller calls upon the rain by singing songs, and is aided by his spirit helper, which is usually in the form of a mountain sheep. The mountains also had important roles in this activity, and were called up to interact with the clouds and the sky to call down the rain.

Even today, individual traditional Indian people can bring rain. One way this is done is by turning a stinkbug on his back. The rain will come, provided the stinkbug allows a person to tickle his belly with a small stick. As this person prays for rain, he tells the stinkbug why he is asking for rain.

If too much rain fell, certain precautions are taken. For example, the children are not allowed to shake willows that will be used for weaving or to kill frogs as this brings more rain. Hummingbirds were not killed for many reasons, but if they are killed, there will be flooding and lightning storms, with lightning killing the person who killed the hummingbird.

The Snow Ceremony was performed to ensure a good winter with heavy snow fall. The spiritual leader, often called a weather doctor in the English language, would call the people together and meet at a special place in the mountains, sometimes near a pine nut gathering area. The spiritual leader would sing songs and offer prayers. According to Indian tradition, the Snow Ceremony is performed during the late fall when the weather becomes cold. A part of this ceremony involves calling on the Snow Fleas. They represent a special category of American Indian environmental knowledge because they are almost invisible and live at the highest elevations on the mountains. The Snow Fleas are the ones that make the snow wet and absorb into the mountain. Without them, the snow is dry and evaporates quickly, and there is less water for the mountains and the valleys below. The Snow Ceremony is conducted in relationship with ceremony of the seeds where young girls dance with seeds in winnowing trays and a spiritual person sings songs to bring whirlwinds, which surround the dancers and scatter the seeds as a gesture of fertilizing the earth. Water is called upon to nourish the soil and the seeds to make them fertile.

Because water is a powerful being it is associated with other powerful beings, such as water babies. Water babies are like the people of the water. They are highly respected by American Indian culture. If water is contaminated, the water babies will move to other areas that are not contaminated. Proof of their existence has been depicted in historic rock drawings throughout Nevada, including one pecked at the volcanic butte at Black Canyon, Pahranagat Valley.

According to a tribal elder, *"Water babies are important to our culture. They are supernatural. They connect everything and you don't want to disrespect them. The springs are all connected and they follow the water flow. Water babies are supernatural beings and are the guardians of the water. They can make sounds like a baby, and you don't want to startle them because they can disturb life. We are taking their native environment away when we drill and contaminate the water. It angers them. When they get mad, there are adverse impacts to wildlife as they can drain you spiritually and physically."*

Water Resources—American Indian Perspective (cont'd)

Playas

The CGTO knows playas occupy a special place in American Indian culture. Playas are often viewed as empty and meaningless places by western scientists, but to Indian people, playas have a role and often contain special resources that do not occur anywhere else.

The CGTO knows that playas were used in traveling or moving to places where work, hunting, pine cutting, or gathering of other important foods and medicine could be done. One elder remembers crossing over dry lake beds and traveling around but near the edges, and how provisions were left there and at nearby springs by previous travelers at camping spots.

According to tribal elders, who were interviewed during previous NNSS evaluations, *"Indian people left caches in playa areas for people who crossed valleys when water and food was scarce. Frenchman playa is such a place. Indian people took advantage of traveling through this playa as mountains completely surround this area. The CGTO knows that most dry lakes are not known to be completely dry. An example is Soda Lake near Barstow, California. The Mohave River flows into this dry lake and most of the year it looks dry but it actually flows underground. Although some people continue to view Frenchman playa [and other playas] as a wasteland, the CGTO knows it is not."*

See Appendix C for more details.

4.1.7 Biological Resources

The NNSS is located within the Basin and Range physiographic province and along the transition zone between the Mojave Desert and Great Basin ecoregions in south-central Nevada (Beatley 1975, 1976; DOE/NV 2000d) (see Figure 4–9). As a result, this site has a diverse and complex mosaic of plant and animal communities that are representative of both ecosystems, as well as some communities common only in the transition zone. This transition zone extends to the east and west far beyond the NNSS. Thus, the range of almost all species found on the NNSS also extends beyond the site, and there are few rare or endemic species found within the NNSS (DOE 1996c).

Elevation is an important factor affecting the distribution of plant and animal communities on the NNSS. Elevations generally increase from south to north, from a low of 2,688 feet in Jackass Flats to a high of 7,679 feet on Rainier Mesa. Climate and elevation result in a progression from Mojave Desert communities in the south to Great Basin communities in the north.

The biological diversity within the NNSS is also a result of topography. The valleys in the southern and western parts of the NNSS (e.g., Jackass Flats, Rock Valley, and Mercury Valley) have hydrologic connections to drainages outside the NNSS. In contrast, the two large valleys on the eastern side of the NNSS (Frenchman Flat and Yucca Flat) are closed basins. The lack of surface-water drainage out of these closed basins contributes to soil conditions, temperatures, and biotic communities that differ from those found at similar elevations in the open basins (Beatley 1975, 1976; DOE/NV 2000d).

To ensure compliance with laws, regulations, orders, and policies designed to protect plants and animals, NNSA/NSO has developed an Ecological Monitoring and Compliance (EMAC) Program. Over time, as requirements have progressed, the EMAC Program has become an integral part of the NNSA/NSO Environmental Management Plan specified in DOE Order 450.1A, *Environmental Protection Program*. The EMAC Program consists of several sub-programs and procedures tailored to monitor and protect the flora and fauna of the NNSS and incorporate protection of biological resources into project planning and the day-to-day activities of the NNSS, including the Desert Tortoise Compliance Program, the Sensitive Plant Monitoring Program, the Sensitive and Protected/Regulated Animal Monitoring Program, the Habitat Restoration Program, pre-activity biological surveys, surveys to assess the potential for wildland fires, and monitoring of other relevant aspects of the NNSS flora and fauna. The following is a brief description of the various aspects of the EMAC Program.

Desert Tortoise Compliance Program – In August 1989, the desert tortoise was emergency listed under the Endangered Species Act and the Mojave population of the desert tortoise was listed as threatened in April 1990. In October 1989, the manager of the DOE Nevada Operations Office (now NNSA/NSO) issued direction to all employees and contractors to protect tortoises on the NNSS, in part by suspending all off-road driving in tortoise habitat; forbade injuring or handling of tortoises; and strengthened existing environmental review requirements. The NNSA/NSO Desert Tortoise Compliance Program was developed in 1992, with the issuance by USFWS of the first Biological Opinion for the NNSS. Since that time, new NNSS Biological Opinions were issued by USFWS in 1996 and 2009. The Desert Tortoise Compliance Program serves to implement the terms and conditions of the Biological Opinion for the NNSS, to document compliance actions taken, and to assist NNSA/NSO with USFWS consultations. Some of the activities of the Desert Tortoise Compliance Program include (1) reviewing proposed activities at the NNSS to determine if they may be located in tortoise habitat and if clearance surveys and/or monitoring are required, (2) conducting clearance surveys at project sites within 1 day of the start of project construction, (3) ensuring that environmental monitors are on site during heavy equipment operations, (4) developing training modules and ensuring that all personnel working on the NNSS are trained in the requirements of the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada* (*2009 Biological Opinion*), and (5) preparing annual compliance reports for submittal to USFWS. By implementing the Desert Tortoise Compliance Program, NNSA/NSO would ensure that most, if not all, impacts on desert tortoises addressed in this analysis would involve harassment, rather than injury or mortality.

Sensitive Plant Monitoring Program – Under the NNSS Sensitive Plant Monitoring Program, the status or ranking of sensitive plant species known to occur on the NNSS is evaluated annually to ensure such plants are afforded the appropriate protection under Federal and state laws. Sensitive plant species populations on the NNSS are routinely monitored to assess plant density and plant vigor to identify any threats or impacts on the species.

Sensitive and Protected/Regulated Animal Monitoring Program – As part of the Sensitive and Protected/Regulated Animal Monitoring Program, to ensure such animal species are afforded the appropriate protection under Federal and state laws, NNSA/NSO currently monitors 18 animal species on the NNSS. NNSA/NSO also monitors raptorial bird species, including the western burrowing owl (*Athene cunicularia hypugaea*). In addition, NNSA/NSO conducts monitoring and other studies to evaluate species that may be added to the list of sensitive species to determine their abundance and distribution on the NNSS and shares the findings with USFWS and state wildlife agencies to help inform their decisions regarding those species.

Habitat Restoration Program – The Habitat Restoration Program involves the revegetation of disturbed land and evaluation of previous revegetation efforts. These activities are conducted at both the NNSS and the TTR.

Biological Surveys – Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species, their associated habitat, and other important biological resources. Survey reports document species and resources found and provide mitigation recommendations.

Wildland Fire Surveys – In 2004, NNSA/NSO began annual surveys each spring to assess wildland fire hazards on the NNSS. NNSS ecologists conduct these wildland fire surveys in coordination with NNSS Fire and Rescue.

Additional Monitoring – Additional monitoring is conducted for such things as natural wetlands to characterize seasonal baselines and trends in physical and biological parameters; West Nile virus to help the Southern Nevada Health District ascertain the presence and/or prevalence of the virus in the NNSS mosquito population; and constructed water sources to assess their use by wildlife and to develop and implement mitigation measures to prevent them from causing significant harm to wildlife.

4.1.7.1 Flora

Based on an analysis of field data collected from ecological landform units, 10 vegetation alliances and 20 associations have been recognized on the NNSS (DOE/NV 2000d) (see **Table 4–36**). **Figure 4–14** shows the 10 vegetation alliances. Each vegetation alliance and association was named for the dominant tree or shrub species, based on relative abundance and the conventions of the Federal Data Committee and Ecological Society of America (DOE/NV 2000d). In terms of total area, the Great Basin Desert occupies approximately 40 percent of the NNSS, followed by the transition zone, which occupies 37 percent. The Mojave Desert occupies the southern 22 percent of the NNSS (DOE/NV 2000d).

Table 4–36 Vegetation Alliances and Associations on the Nevada National Security Site

Ecoregion	***Alliance***	***Association***
Mojave Desert	*Lycium* sp. (Shrubland Alliance)	*Lycium shockleyi–Lycium pallidum* (Shrubland)
	Larrea tridentata/Ambrosia dumosa (Shrubland Alliance)	*Larrea tridentata/Ambrosia dumosa* (Shrubland)
	Atriplex confertifolia–Ambrosia dumosa (Shrubland Alliance)	*Atriplex confertifolia–Ambrosia dumosa* (Shrubland)
Transition Zone	*Hymenoclea-Lycium* (Shrubland Alliance)	*Lycium andersonii–Hymenoclea salsola* (Shrubland)
		Hymenoclea salsola–Ephedra nevadensis (Shrubland)
	Ephedra nevadensis (Shrubland Alliance)	*Menodora spinescens–Ephedra nevadensis* (Shrubland)
		Eriogonum fasciculatum–Ephedra nevadensis (Shrubland)
		Krascheninnikovia lanata–Ephedra nevadensis (Shrubland)
		Ephedra nevadensis–Grayia spinosa (Shrubland)
	Coleogyne ramosissima (Shrubland Alliance)	*Coleogyne ramosissima–Ephedra nevadensis* (Shrubland)
Great Basin Desert	*Atriplex* sp. (Shrubland Alliance)	*Atriplex confertifolia–Kochia americana* (Shrubland)
		Atriplex canescens–Krascheninnikovia lanata (Shrubland)
	Chrysothamnus–Ericameria (Shrubland Alliance)	*Chrysothamnus viscidiflorus–Ephedra nevadensis* (Shrubland)
		Ericameria nauseosa–Ephedra nevadensis (Shrubland)
	Artemisia sp. (Shrubland Alliance)	*Ephedra viridis–Artemisia tridentata* (Shrubland)
		Artemisia tridentata–Chrysothamnus viscidiflorus (Shrubland)
		Artemisia nova–Chrysothamnus viscidiflorus (Shrubland)
		Artemisia nova–Artemisia tridentata (Shrubland)
	Pinus monophylla/Artemisia sp. (Woodland Alliance)	*Pinus monophylla/Artemisia nova* (Woodland)
		Pinus monophylla–Artemisia tridentata (Woodland)

Source: DOE/NV 2000d.

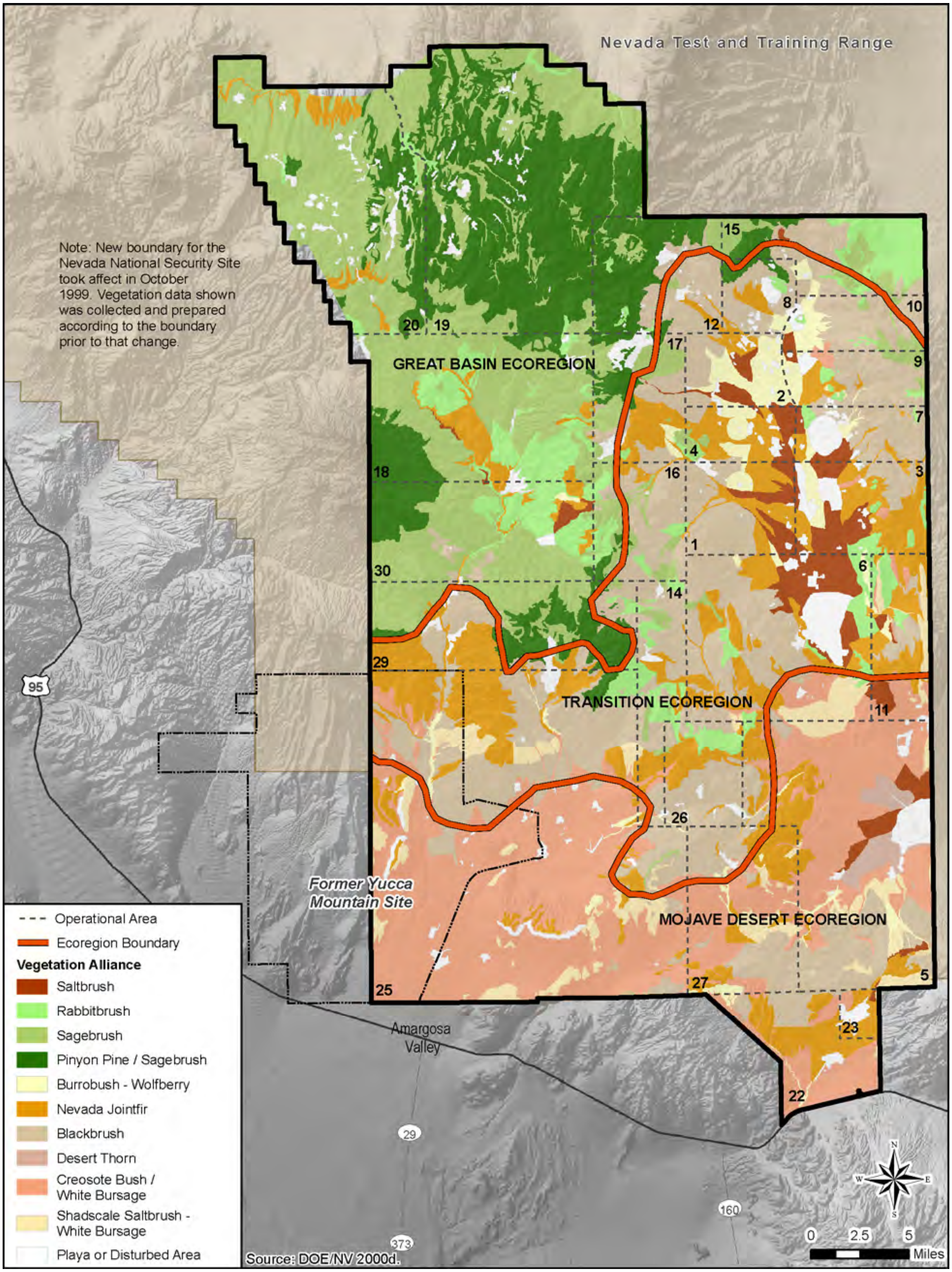


Figure 4–14 Nevada National Security Site Soil Alliances

The flora of the NNSS has been studied extensively and over 750 plant taxa have been collected (DOE/NV 2010). A list of plants found on the NNSS is presented in Appendix F, Tables F–2 and F–3. Appendix F, Table F–1, contains a list of sensitive plant species known to occur on or adjacent to the NNSS.

4.1.7.1.1 Mojave Desert

Mojave Desert plant communities are found at elevations below approximately 4,000 feet. These communities occur on the alluvial fans and valley bottoms of Jackass Flats, Rock Valley, and Mercury Valley and on the alluvial fans of Frenchman Flat. Creosote bush *(Larrea tridentata)* is the dominant shrub within these areas. The soil type and elevation are also contributing factors to the community composition. Shadscale saltbush *(Atriplex confertifolia)* is co-dominant with creosote bush on most alluvial fans where desert pavement is common. On deep, loose soil, such as exists on southern Jackass Flats and northeastern Frenchman Flat, creosote bush is co-dominant with white bursage *(Ambrosia dumosa)* and includes species such as winterfat *(Kraschenínnikovia lanata)* and Indian ricegrass *(Achnatherum hymenoides)*. Range ratany *(Krameria parvifolia)*, Nevada jointfir *(Ephedra nevadensis)*, and Fremont indigo bush *(Psorothamnus fremontii)* are common in both communities. At roughly an elevation of 3,500 to 4,000 feet along the northern and eastern slopes of Jackass Flats and the western half of Frenchman Flat, creosote bush, hopsage *(Grayia spinosa)*, and wolfberry *(Lycium andersonii, L. pallidum, and L. shockleyi)* are the dominant shrub species.

4.1.7.1.2 Transition Zone

Two plant communities are unique to the transition zone between the Mojave Desert and Great Basin Desert ecoregions. The first is best developed at elevations from 4,000 to 5,000 feet on alluvial fans and valley floors. The dominant shrub in this community is blackbrush *(Coleogyne ramosissima)*, which occurs in mixed stands with creosote bush on the northern alluvial fans of Jackass and Frenchman Flats below about 4,500 feet. At higher elevations (e.g., on the valley floor of Tonopah and Mid Valleys and on the western slopes of Yucca Flat), blackbrush occurs in large, nearly monotypic stands. The second unique transition community occurs in the bottom of the enclosed Frenchman Flat and Yucca Flat basins, where the trapped winter air lowers temperatures below those typical of the Mojave Desert (Beatley 1976). The most abundant shrubs in these areas are hopsage and three species of wolfberry. Winterfat is also common in silty soils. Shadscale saltbush, four-winged saltbush *(Atriplex canescens)*, and horsebrush *(Tetradymia glabrata)* can also be found in enclosed basins. Little or no vegetation grows on the playas in these basins.

4.1.7.1.3 Great Basin Desert

Plant communities typical of the desert occur in the Great Basin at elevations generally above 5,000 feet in the northern third of the NNSS. Most of the basin floor is covered with shadscale, and winterfat is also common. On deep, loose soils at middle elevations (4,500 to 5,500 feet), the plant community is dominated by four-winged saltbush. Sagebrush (*Artemisia* sp.) begins to appear at 5,000 feet and is the dominant plant on large parts of Pahute Mesa and Rainier Mesa, as well as elsewhere in the northwestern part of the NNSS. Big sagebrush *(Artemisia tridentata)* is the most abundant shrub on sites with deep soils in this area, and black sagebrush *(Artemisia nova)* is most abundant on the shallow soils of slopes and uplands. Pinyon pine *(Pinus monophylla)* and Utah juniper *(Juniperus osteosperma)* are co-dominant with sagebrush above 6,000 feet and form open shrub woodland. Sites on the NNSS with vegetation or soil modified by nuclear test activities, construction, or other disturbances usually have plant communities that are different from adjacent undisturbed areas. Some of the species that colonize disturbed areas (e.g., cheesebush *[Hymenoclea salsola]* and punctate rabbitbrush *[Chrysothamnus paniculatus])* are native plants that usually occur in washes. However, most species found on disturbed sites are introduced plants such as red brome *(Bromus rubens)*, cheatgrass *(Bromus tectorum)*, Russian thistle *(Salsola tragus)*, and red-stemmed filaree *(Erodium cicutarium)*.

Natural succession of disturbed areas on the NNSS is generally a slow process. Studies of natural succession in the Mojave Desert have shown that several decades, or even centuries, may be required to establish similar plant cover and productivity (Angerer et al. 1994). Because of the increased and more-consistent precipitation, succession rates in the Great Basin Desert are generally quicker than those in the Mojave Desert. Active revegetation of sites can greatly enhance secondary succession. Variables that have been determined to be important in revegetation success are (1) adequate moisture during seed germination and establishment; (2) favorable soil conditions, including depth, texture, fertility, and reduced compaction; and (3) use of species adapted or native to the site.

The only biological communities on and around the NNSS that are not widespread are those associated with springs or other permanent sources of water. There are 16 springs, 10 seeps, 4 tank sites (natural rock depressions that catch and hold surface runoff), and 2 ephemeral ponds on the NNSS (Bechtel Nevada 1998b, 1999; Hansen et al. 1997). Most natural springs are on the mesas and mountains in the northern part of the NNSS (see Figure 4–14); most reservoirs are scattered through the valley bottom to the east and south. There are no springs in the valley bottom areas. Groundwater under the NNSS flows primarily to the south and west and discharges from springs in Ash Meadows, Oasis Valley, and Death Valley (see Section 4.1.5). Most of the springs at the NNSS support wetland (hydrophytic) vegetation, such as cattail, sedges, and rushes, which likely constitute wetlands, as defined by the U.S. Army Corps of Engineers and EPA (33 *Code of Federal Regulations* [CFR] 328.3(b) and 40 CFR 230.3(t), respectively).

4.1.7.1.4 Important Habitats

In 1998, DOE/NNSA evaluated selected biotic and abiotic data collected from ecological landform units to identify areas of the NNSS that may warrant active protection from land-disturbing activities (Bechtel Nevada 1999). Four habitat types on the NNSS were identified as "important habitats": (1) Pristine habitat includes areas that have few manmade disturbances; (2) unique habitat contains uncommon biological resources, such as a natural wetland; (3) sensitive habitat includes areas in which vegetation recovers very slowly from direct disturbance (e.g., areas with high susceptibility to wind erosion); and (4) diverse habitat has high plant species diversity (DOE/NV 1998d). Important habitats are shown in **Figure 4–15**. NNSA believes that the long-term protection of these important habitats is one method by which overall cumulative impacts on biological resources may be minimized. During siting for new projects, these important habitats are avoided whenever possible. Important habitats on the NNSS are not based on regulatory requirements, but were developed as management tools.

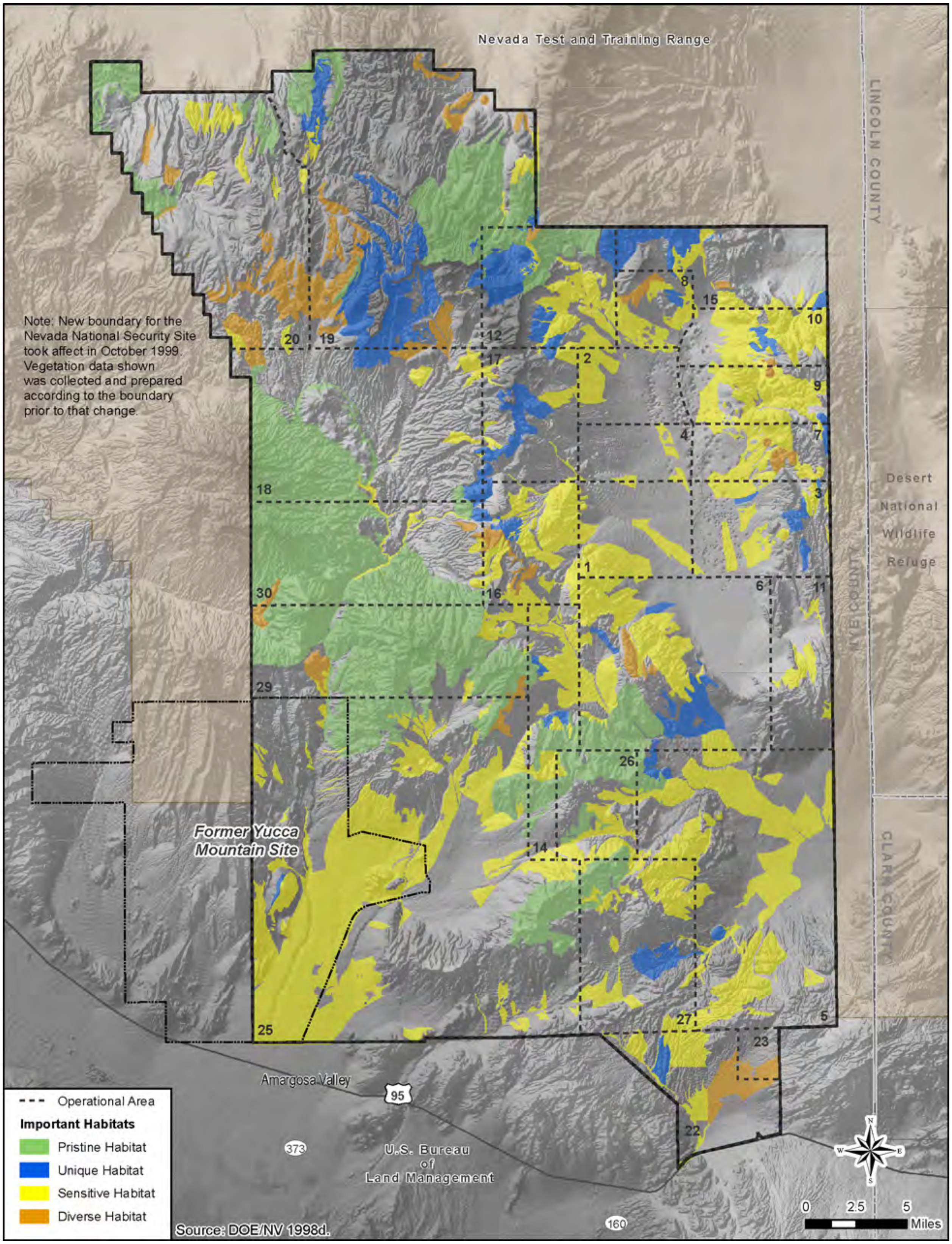


Figure 4–15 Important Habitats on the Nevada National Security Site

4.1.7.2 Fauna

At least 1,163 taxa of invertebrates within the phylum Arthropoda (animals that have an exoskeleton, a segmented body, and jointed appendages) have been identified on the NNSS. Of the known arthropods, 78 percent are insects (DOE/NV 2010). Ants, termites, and ground-dwelling beetles are probably the most important groups of insects on the NNSS in regard to distribution, abundance, and functional roles.

Approximately 300 vertebrate species have been observed on the NNSS, including 60 species of mammals, 239 species of birds, 34 species of reptiles, and 3 species of introduced fish (Wills and Ostler 2001). Approximately 80 percent of the bird species on the NNSS are migrants or seasonal residents (Wills and Ostler 2001). As of 2010, 26 bird species, including 9 raptor species (birds of prey), are known to breed on the NNSS. Raptors that breed on the NNSS include the golden eagle (*Aquila chrysaetos*), long-eared owl (*Asio otus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), western burrowing owl (*Athene cunicularia hypugaea*), barn owl (*Tyto alba*), and great-horned owl (*Bubo virginianus*) (DOE 2002j). A list of animals that have been sighted on the NNSS is presented in Appendix F, Tables F–4 and F–5. See Appendix F, Table F–1, for a list of sensitive animal species known to occur on or adjacent to the NNSS. Many of the predators and scavengers in this region are widespread and utilize a variety of habitat types. These include coyote *(Canis latrans)*, bobcat *(Lynx rufus)*, common raven *(Corvus corax)*, red-tailed hawk, loggerhead shrike *(Lanius ludovicianus)*, speckled rattlesnake *(Crotalus mitchellii)*, and gopher snake *(Pituophis catenifer)*. Other common species are the long-tailed pocket mouse *(Chaetodipus formosus)*, desert woodrat *(Neotoma lepida)*, white-tailed antelope squirrel *(Ammospermophilus leucurus)*, black-tailed jackrabbit *(Lepus californicus)*, black-throated sparrow *(Amphispiza bilineata)*, horned lark *(Eremophila alpestris)*, Say's phoebe *(Sayornis saya)*, and western kingbird *(Tyrannus verticalis)*. The side-blotched lizard *(Uta stansburiana)*, western whiptail *(Cnemidophorus tigris)*, and desert horned lizard *(Phrynosoma platyrhinos)* are the most abundant lizards on the NNSS (Wills and Ostler 2001). The nonnative bullfrog (*Rana catesbeiana*) is the only amphibian that is known to occur on the NNSS (DOE/NV 2010).

Many animal species on the NNSS are common only in the Mojave Desert habitats to the south or the Great Basin Desert habitats to the north. Typical Mojave Desert species found on the NNSS include kit fox *(Vulpes macrotis)*, Merriam's kangaroo rat *(Dipodomys merriami)*, desert tortoise *(Gopherus agassizii)*, chuckwalla *(Sauromalus obesus)*, western shovelnose snake *(Chionactis occipitalis)*, and sidewinder snake *(Crotalus cerastes)*. Typical Great Basin species in this region include cliff chipmunk *(Eutamias dorsalis)*, Great Basin pocket mouse *(Perognathus parvus)*, mule deer *(Odocoileus hemionus)*, northern flicker *(Colaptes auratus)*, western scrub-jay *(Aphelocoma californica)*, Brewer's sparrow *(Spizella breweri)*, western fence lizard *(Sceloporus occidentalis)*, and striped whipsnake *(Masticophis taeniatus)*. About 36 adult wild horses (*Equus caballus*) (not including foals) live on the northern part of the NNSS, usually on or near Rainier Mesa (NSTec 2010).

Some animal species on the NNSS have more-specific habitat requirements and are less widespread. Desert kangaroo rats *(Dipodomys deserti)* are associated with loose, sandy soils at lower elevations. Dark kangaroo mice *(Microdipodops megacephalus)* are restricted to fine, gravelly soils at higher elevations. Chuckwallas occur primarily in rocky outcrops. Desert night lizards *(Xantusia vigilis)* are usually found in stands of yuccas. Many of the birds on the NNSS, including almost all of the waterfowl and shorebirds, use the playas in Frenchman Flat and Yucca Flat, artificial ponds at springs, and sewage lagoons during their migration and/or during winter (Hayward et al. 1963). Bats often seek food over these water sources.

A total of 138 species of animals have been documented at NNSS wetland sites (Wills and Ostler 2001). The largest group of vertebrates using NNSS wetlands is birds (100 species). Passerine birds constitute the majority of birds recorded (80 species). Cane Spring and Yucca Playa Pond are the only natural NNSS locations that are known to attract migratory waterfowl. Many freshwater invertebrates occur in NNSS wetland sites, including an undescribed fairy shrimp. Scat of the desert tortoise has been found at the Rock Valley Tank site.

Wild horses occur in the northern half of the NNSS; their distribution may be related to the location of manmade ponds. Camp 17 Pond in the northwestern corner of Area 18 and Gold Meadows Spring in Area 12 (a natural water source) are heavily used by horses. Camp 17 Pond was used less frequently in 2008 compared with 2007 because 2008 had a wetter spring than 2007, which reduced the water needs of the wild horses (NSTec 2009a). Mule deer use these ponds as well.

An annual horse census is conducted by driving selected NNSS roads and using cameras to record individual markings of animals. Total numbers have dropped from 42 in 2007 to 35 in 2008 (see **Table 4–37**). A similar number of horses were observed in 2009 as in 2008 (i.e., 36 adults, 1 yearling, and 6 foals) (NSTec 2010j). Their estimated range of 222 square kilometers in 2009 is very similar in size to the horse range in 2007 and 2008 (NSTec 2010j). Camp 17 Pond and Gold Meadows Spring continue to be important summer water sources for horses.

Table 4–37 Number of Individual Horses Observed on the Nevada National Security Site by Age Class, Sex, and Year

Age Class	***Year***							
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Foals	11	5	6	5	5	8	8	9
Yearlings	2	0	9	9 [a]	6	8	1	0
Sex [b]	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**	**M / F**
2-Year-Olds	2/2	0/2	0/0	4/4	5/4	3/3	2/3	0/0
3-Year-Olds	0/0	2/2	0/2	0/0	4/4	4/4	1/3	1/1
Older than 3 Years Old	11/20	8/19	8/20	6/21	5/21	7/24	5/27	6/27
Total	37	33	38	44	49	53	42	35

M = male; F = female.
[a] One of the nine was found dead.
[b] Excludes foals and dead horses.
Source: NSTec 2009a.

As described in Section 4.1.5.2, surface runoff periodically ponds on the playas in Yucca and Frenchman Flats. The length of time that water remains on playas and the extent to which playas are used by migratory shorebirds are not routinely monitored. However, water has been observed on the playas for periods of days to months following rainstorms. Occasionally, migratory shorebirds have been observed when the playas are inundated during the spring or fall migratory season.

Several species of state-designated game animals occur in the NNSS, including 412 mule deer (NSTec 2009a) and an unknown number of mountain lions *(Puma concolor)*, desert and Nuttall's cottontails *(Sylvilagus nuttallii)*, chukar *(Alectoris chukar)*, Gambel's quail *(Callipepla gambelii)*, mourning dove *(Zenaida macroura)*, and several species of waterfowl. Pronghorn *(Antilocapra americana)* can be seen year-round on the NNSS, particularly in Yucca Flat and in Frenchman Flat in small numbers. Another game animal, the desert bighorn sheep *(Ovis canadensis* ssp. *nelsoni)*, is a rare visitor on the NNSS, with only eight recorded observations of its presence on or near the NNSS since 1963. In the past, the species was observed in Mercury and on Rainier Mesa (Wills and Ostler 2001). During 2009, desert bighorn sheep were photographed by motion-activated cameras at Topopah Spring in Area 29 and on Skull Mountain in Area 25, and a ram was documented in Area 18. There is an established population of desert bighorns in the Specter Range south of the NNSS and other populations north and west of the NNSS. The NNSS may provide a suitable corridor for movement between these populations. Further field studies will be needed to determine if the observed desert bighorn sheep are transients or if they are, or will become, residents on the NNSS (NSTec 2010j). Bobcats (*Lynx rufus*), ray foxes (*Urocyn cinereoargenteus*), and kit foxes (*Vulpes macrotis*) are the only state-designated fur-bearing animals on the NNSS. No hunting or trapping is allowed on the NNSS.

4.1.7.3 Threatened and Endangered Species

The only species that has been listed by USFWS as threatened or endangered that occurs on the NNSS is the Mojave Desert population of the desert tortoise. The desert tortoise was listed as threatened by USFWS in 1990. The State of Nevada classifies the desert tortoise as a threatened species, and it is protected under *Nevada Revised Statutes*, Chapter 501.

In 1996, USFWS issued a Biological Opinion (*1996 Biological Opinion*) (USFWS 1996) to NNSA/NSO, covering activities occurring within desert tortoise habitat on the NNSS. The *1996 Biological Opinion* authorized the incidental "take" (accidental killing, injury, harassment, etc.) of desert tortoises that may occur during NNSS activities. In July 2008, NNSA/NSO provided USFWS with a biological assessment of activities anticipated to occur on the NNSS over the following 10 years and entered into formal consultation with USFWS to obtain a new Biological Opinion. In February 2009, USFWS issued the *2009 Biological Opinion* (USFWS 2009a) to NNSA/NSO. Both the *1996 Biological Opinion* and the *2009 Biological Opinion* concluded that activities anticipated to occur on the NNSS would not jeopardize the continued existence of the Mojave population of desert tortoises and no critical habitat would be destroyed or adversely modified. Under the *2009 Biological Opinion*, before implementing any new activity in desert tortoise habitat, NNSA provides specified information and consults with USFWS to determine if the anticipated incidental take for each action, at the project level, complies with the programmatic *2009 Biological Opinion*. If a proposed activity or group of activities would result in an exceedance of the *2009 Biological Opinion*, NNSA would consult with USFWS, in accordance with Section 7 of the Endangered Species Act.

Desert tortoises generally occur throughout the southern third of the NNSS (Rautenstrauch et al. 1994). They are found more commonly in bajadas and lower slopes of southern mountains and are rare or absent from the lower basins, particularly in Frenchman Flat. The northern boundary of the desert tortoise range on the NNSS is shown in **Figure 4–16**. The total area of the NNSS (including the portion that is shown as Yucca Mountain Project Biological Opinion Area in Figure 4–16) that is within the range of the desert tortoise is about 328,400 acres. Overall, approximately 7,350 acres, or 2 percent, of NNSS land within desert tortoise range has been disturbed in the past by construction of facilities and infrastructure and other activities. The net area of desert tortoise habitat at the NNSS is about 321,050 acres. The population density of desert tortoises on the NNSS is considered to be "very low" (USFWS 2009a). Within the NNSS, the northern extent of the desert tortoise occurs between elevations of approximately 3,900 and 4,880 feet. The vegetation in the boundary region is dominated by blackbrush, creosote bush, white bursage, spiny hopsage, and Anderson wolfberry (Beatley 1976; DOE/NV 2000d).

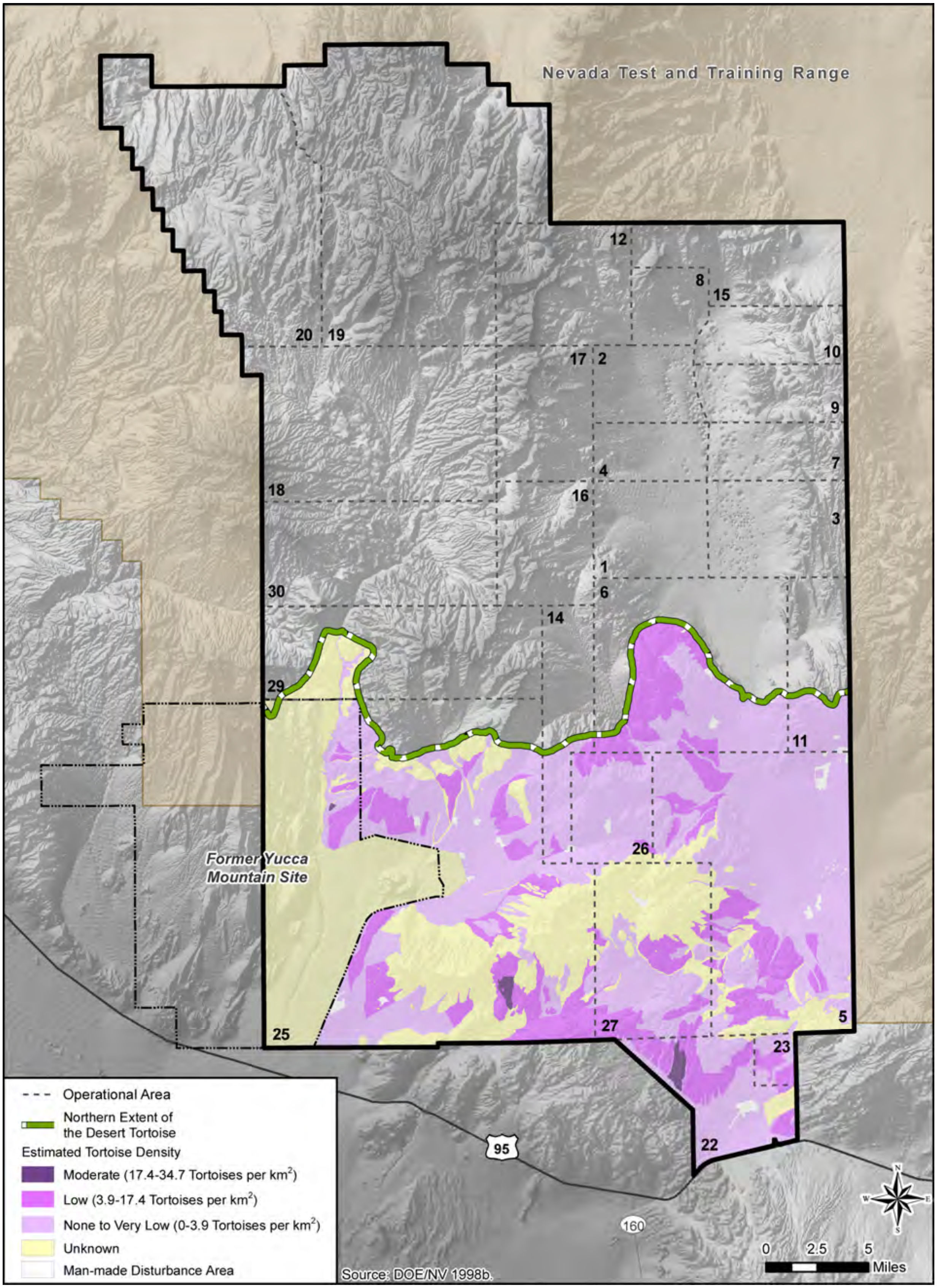


Figure 4–16 Northern Boundary of the Desert Tortoise Range on the Nevada National Security Site

Based on 1996 studies, the relative abundance of the desert tortoise on the NNSS ranges from very low or none (0–3.9 tortoises per square kilometer) to moderate (17.4–34.7 tortoises per square kilometer) (DOE/NV 1998b). Overall, the relative abundance of the desert tortoise on the NNSS is low to very low relative to other areas within the tortoise's range (EG&G 1991). The NNSS contains less than 1 percent of the total habitat of the overall desert tortoise population. A cumulative total of approximately 311 acres of desert tortoise habitat on the NNSS has been disturbed since the desert tortoise was listed in 1992 (NSTec 2009a). Critical habitat for the desert tortoise has not been designated on the NNSS, nor is the NNSS within any Desert Wildlife Management Area delineated in the *Desert Tortoise (Mojave Population) Recovery Plan* (USFWS 1994).

No federally listed threatened or endangered plants are known to occur on the NNSS (NSTec 2010j). However, 18 species of vascular plants and 1 non-vascular plant on the NNSS are considered to be sensitive by the Nevada Natural Heritage Program. Appendix F, Table F–1, includes a list of sensitive plant species known to occur on or near the NNSS. Also in Appendix F is a map showing the known locations of sensitive plant species on the NNSS.

The delisted peregrine falcon (*Falco peregrinus*) and delisted bald eagle *(Haliaeetus leucocephalus)* have also been reported on the NNSS. These species are rare migrants in this region and each has only been sighted once on the NNSS (Greger and Romney 1994). The peregrine falcon was removed from the threatened and endangered species list in 1999 (64 FR 46542), while the bald eagle was removed in 2007 (72 FR 37346). USFWS will monitor the bald eagle population status for a minimum of 5 years after delisting, as required by the Endangered Species Act. The bald eagle will continue to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The State of Nevada lists this species as endangered.

4.1.7.4 Other Species of Concern

There are 88 sensitive and protected/regulated species known to occur on or adjacent to the NNSS (NSTec 2010j): 1 moss, 22 flowering plants (including 3 species of yucca, 1 of agave, and 18 cacti), 1 mollusk, 2 reptiles (including the desert tortoise), 15 birds, and 27 mammals. Two of the bird species, chukar (*Alectois chukar*) and Gambel's quail (*Callipepla gambelii*), are regulated as game species and 7 mammals are regulated as game species, as follows: pronghorn antelope (*Antilocarpra americana*), Rocky Mountain elk (*Cervus elaphus*), desert bighorn sheep (*Ovis canadensis nelsoni*), mule deer (*Odocoileus hemionus*), mountain lion (*Puma concolor*), Audubon's cottontail (*Sylvilagus audubonii*), and Nuttall's cottontail (*Sylvilagus nuttallii*). Three species are regulated as furbearers: bobcat, gray fox, and kit fox. Protected and sensitive species of plants and animals are listed in Appendix F, Table F–1. NNSA reviews the list of sensitive and protected/regulated species each year and conducts ongoing biological surveys to ascertain the presence of sensitive plant and animal species at the NNSS as part of its Ecological Monitoring and Compliance Program.

As discussed above, the Ecological Monitoring and Compliance Program monitors the ecosystem of the NNSS and ensures compliance with laws and regulations pertaining to NNSS biota. An annual report is prepared that summarizes program activities.

As noted above, there are a large number of sensitive wildlife species on the NNSS. One species of potentially sensitive reptiles is present, the western red-tailed skink (*Eumeces gilberti rubricaudatus*). NNSS-wide population numbers are unknown; however, eight red-tailed skinks were captured at 4 of 31 survey sites in 2008 (NSTec 2009a). Western red-tailed skinks have been found primarily in the western and northern portions of the NNSS (NSTec 2010j).

The western burrowing owl (*Athene cunicularia hypugaea)* is the main bird species that may be affected by activities on the NNSS. This species is ground-dwelling and uses burrows found in dry, open areas with flat to gradually sloping terrain. It can be found in most of the major valleys in the eastern and southern portions of the NNSS. Western burrowing owl monitoring, including trapping, has been ongoing on the NNSS for a number of years. A total of 26 breeding pairs and 122 young were detected over a 3-year period from 1999 to 2001 (Hall et al. 2003). There were 7, 8, and 11 breeding pairs and 24, 43, and 55 young detected during 1999, 2000, and 2001, respectively (Hall et al. 2003).

Eight bat species of concern that are known to occur on the NNSS include the spotted bat *(Euderma maculatum),* Townsend's big-eared bat (*Corynorhinus townsendii),* big free-tailed bat (*Nyctinomops macrotis),* long-eared myotis (*Myotis evotis),* small-footed myotis (*M. ciliolabrum),* fringed myotis (*M. thysanodes*), long-legged myotis (*M. volans),* and Yuma myotis (*M. yumaensis)* (Wills and Ostler 2001). Bat monitoring in 2008 included passive acoustic monitoring, preclosure monitoring at tunnels, and removing bats from buildings (NSTec 2009a).

Although not listed as sensitive, all bird species that occur on the NNSS, except chukar (*Alectois chukar*), Gambel's quail (*Callipepla gambelii*), English house sparrow (*Passer domesticus*), rock dove (*Columba livia*), and European starling (*Sturnus vulgaris*), are protected under the Migratory Bird Treaty Act (the noted bird species are not migratory and, therefore, are not covered by the Migratory Bird Treaty Act). As part of pre-activity planning on the NNSS, biological surveys are conducted to ensure protection of sensitive and otherwise protected species. Active nests of migratory birds are protected until the young fledge by avoiding activities that would cause direct harm, such as damaging or destroying a nest, or indirect harm, such as causing disturbance that would cause parent birds to abandon their eggs or young. For example, in 2009, three nests with chicks were protected from harm, including one Say's phoebe nest with four chicks and two nests of unknown species, each with chicks. NNSS activities that may have caused harm to these nests were postponed until the chicks fledged and the nests were empty (DOE/NV 2010).

4.1.7.5 Effects of Past Radiological Tests and Project Activities

A number of studies were conducted to document the types and extent of disturbances of the biological resources that may have resulted from past projects. Much of the focus was on determining the fate and effects of radionuclides, especially TRU radionuclides (Dunaway and White 1974; Gilbert et al. 1988; Howard and Fuller 1987; Howard et al. 1985; White and Dunaway 1975, 1976, 1978; White et al. 1977a, 1977b). Long-term impacts resulting from nuclear tests and nonradiological causes were also investigated (Hunter 1992, 1994a, 1994b, 1994c, 1995).

In areas where atmospheric tests, safety tests, or cratering experiments were conducted, there were measurable changes in the species composition and abundance of plants and animals. Immediately following some tests that deposited fallout containing beta-emitters, shrubs that were more radiosensitive, such as sagebrush, were killed, and a grass disclimax was established. The projects also involved nonradiological physical and mechanical disturbances that altered the characteristics of the soils and usually resulted in the removal of the shrubs, which are a key component of the structure and functioning of these desert ecosystems. The ecological changes observed were similar to effects associated with other human activities that disturb desert habitats, and few could be attributed solely to radiological impacts.

A herd of cattle was allowed to graze the northwestern part of the NNSS for 25 years (Smith and Black 1984). Periodically, tissues of cattle, deer, and bighorn sheep were analyzed for concentrations of radionuclides. Results of this program suggested that, since 1956, no significant amounts of biologically available radionuclides were contributed by activities on the NNSS. Except for periods immediately following the deposition of close-in fallout, tissue concentrations of cesium-137 and strontium-90 reflected the deposition of worldwide fallout. Concentrations of tritium were within the ranges present in the general environment, except in tissues of animals that had access to point sources of tritium, such as the Sedan Crater or the containment ponds in Area 12.

Hypothetical dose commitments for daily ingestion of NNSS beef over varying lengths of time were less than 2 percent of the Federal Radiation Council or the International Commission on Radiological Protection guidelines. Both the calving rate of the herd, which exceeded 85 percent annually, and the 180-day weaning weight, usually greater than 400 pounds, were above average. Routine necropsy and histopathological examinations revealed no harmful health effects that could be attributed to ionizing radiation in herbivores maintained for a lifetime on the NNSS.

Concentrations of radionuclides in soils, plants, and animals in the vicinity of some past tests were above general background levels. Concentrations usually decreased by a factor of 10 between soils and plants and between plants and animals. This is likely due to the fact that plants do not take up all of the contaminants available in the soil and animals, being mobile, may obtain their food from both contaminated and uncontaminated areas. In addition, some contaminants may not be absorbed by the animals, moving through the digestive tract of the animal and being excreted. Chromosomal aberrations were observed in cells of spiny sagebrush collected from Area 11, but the yields may not have been greater than what would be observed in the population naturally, and whether they were valuable or detrimental to the population was undetermined. Depressed levels of circulating lymphocytes and total leukocyte counts were found in kangaroo rats collected in areas contaminated with plutonium, but they were considered to be physiologically inconsequential. Gross pathological changes in native mammals appeared to be minimal and nonspecific. Reproduction in and recruitment to mammalian populations inhabiting contaminated areas were determined to occur largely in response to changes in the food supply of winter annual plants rather than in response to levels of radiation.

The long-term consequences of past DOE activities were studied at past ground zero locations above which atmospheric tests were conducted, within subsidence craters formed following underground tests, in burned areas, on compacted drill pads and scrapes, and along roadsides. One of the major findings was that ecological impacts resulting from DOE programs on the NNSS did not differ in type or magnitude from those resulting from other human activities that disturb desert ecosystems. Changes in the vegetation resulted from changes in patterns and amounts of precipitation. Changes in the species composition of vertebrates appeared to be linked to the structure of the vegetation associations, and changes in abundance were in response to altered food supplies, which were linked to vegetation.

Changes to the structure and function of ecosystems were restricted to the immediate vicinity of project sites, and few long-term effects could be attributed to radiological impacts. Concentrations of radionuclides did not produce genetic or cytological abnormalities that appeared to be detrimental to species or populations either in the short or long term. Restoration of disturbed sites will likely follow the routes and rates of succession observed in comparable, manipulated desert ecosystems.

Public access to the NNSS is restricted and precludes the harvest of plants for direct consumption by humans. However, animals may consume contaminated vegetation or water on the NNSS and become contaminated. Because animals may travel off the NNSS, the ingestion of game animals is the primary potential biotic pathway of radiological exposure to the public. The annual radiological monitoring program for the NNSS includes sampling plants and animals at sites with the highest known concentrations of radionuclides. Sampling includes both plants and small game animals and, when available, larger animals that have been found dead on the NNSS (DOE/NV 2003a).

4.1.7.6 Plant and Animal Monitoring for Radioactivity

Historical atmospheric nuclear weapons testing, outfalls from underground nuclear tests, and radioactive waste disposal sites provide sources of potential radiation contamination and exposure to NNSS plants and animals. DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, requires, in part, that all DOE sites monitor to determine if the radiological dose to aquatic and terrestrial plants and animals on site exceeds DOE-established limits expressed in "rad" (radiation absorbed dose). NNSA annually samples plants and game animals to measure the potential for radionuclide transfer through the food chain and determine if NNSS biota are exposed to radiation levels harmful to their own populations. This monitoring includes sampling plants, burrowing animals, and soils at the Area 3 Radioactive Waste Management Site (RWMS) and the Area 5 RWMC as a measure of the integrity of waste disposal cells.

The goal for vegetation monitoring is to sample the most contaminated plants within the NNSS environment. These plants are generally found inside demarcated radiological areas near the "ground zero" locations of historical aboveground nuclear tests. The species selected for sampling represent the most dominant plants, such as trees, shrubs, herbs, or grasses at these sites.

The goal of sampling animals for the purpose of determining potential dose to biota is to select species that are most exposed and most sensitive to effects from radiation. In general, mammals and birds are more sensitive to radiation than fish, amphibians, or invertebrates (DOE 2002a). In addition, animals are sampled to determine potential dose to the public from ingesting their meat. For these reasons, and because no native fish or amphibians are found on the NNSS, the game animals listed in **Table 4–38** are monitored. The sampling strategy used to assess the integrity of radioactive waste containment includes sampling plants, animals, and soil excavated by ants or small mammals on top of waste covers. The animals monitored for assessing the integrity of radioactive waste containment are listed in Table 4–38.

Table 4–38 Nevada National Security Site Animals Monitored for Radionuclides

Game Animals Monitored for Dose Assessments		
Small Mammals	***Large Mammals***	***Birds***
Cottontail rabbit (*Sylvilagus audubonii*) Jackrabbit (*Lepus californicus*)	Mule deer (*Odocoileus hemionus*) Pronghorn antelope (*Antelocarpa americana*)	Mourning dove (*Zenaida macroura*) Chukar (*Alectoris chukar*) Gambel's quail (*Callipepla gambelii*)
Animals Monitored for Integrity of Radioactive Waste Containment or as Game Animal Analogs		
Kangaroo rat (*Dipodomys* sp.) Mice (*Peromyscus* sp.) Antelope ground squirrel (*Ammospermophilius leucurus*) Desert woodrat (*Neotoma lepida*)		

Source: DOE/NV 2010.

The results of this ongoing monitoring program have consistently demonstrated that, while plants and animals that inhabit radiological sites or radioactive waste containment covers may have elevated concentrations of radionuclides in their bodies, the concentrations are below levels considered harmful to the health of the plants or animals.

Biological Resources—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows the Nevada National Security Site (NNSS) contains an ancient playa, surrounded by mountain ranges. The runoff from these ranges serves to maintain a healthy desert floor and environment. Animals frequent the area, and there are numerous animal trails. Animals and the places where they live play a significant part in Indian history and lifestyle. The CGTO knows Indian people have lived on these lands since Creation value all plants and animals, yet some of these occupy more cultural significance in our lives. It is widely known that many Indian people still collect and use plants and animals that are found within the NNSS region. We describe these plants, animals, and insects in this section in an effort to demonstrate their importance to our well-being and survival, and their role in maintaining ecological balance to our Holy Land.

The CGTO knows, based on previous U.S. Department of Energy (DOE)-sponsored ethnobotany studies, that there are at least 364 American Indian traditional use plants on the NNSS (see Table C-1). Plants are still used for medicine, food, basketry, tools, homes, clothing, fire, and ceremony – both social and healing. Sage is used for spiritual ceremonies, smudging[1] and medicine. Indian rice grass and wheat grass are used for breads and puddings. Joshua tree is important for hair dye, basketry, foot ware, and rope. Globe mallow had traditional medicine uses, but in recent times is also used for curing European contagious diseases.

In order to convey the American Indian meaning of these plants, a series of ethnobotany studies were conducted and the findings used to establish a set of criteria for assessing the cultural importance of each plant and of places where plant communities exist. The CGTO provided these cultural guidelines so that National Environmental Poicy Act analyses and other agency decisions could be assessed from an American Indian perspective.

The CGTO knows, based on previous DOE-sponsored ethnofauna studies, there are at least 170 Indian use animals on the NNSS (see Table C-2). All are culturally important to Indian people.

The CGTO knows if they care for the earth and its resources, the Creator will always provide for them. The NNSS area was among the tribes' places to hunt and trap a variety of animals. It is known that special leaders within each tribe would organize large hunts where many Indian people participated. The Indian people would use these animals for many purposes, including food, bones for tool making, fur for warm blankets, ceremonial purposes, and described in traditional winter stories.

Indian people refrain from eating coyote, wolves, and some birds because these animals are fundamental to stories and songs that teach us life lessons to heal, to build character, and to become better people.

The relationships between the animals, the Earth, and Indian people are represented by the respectful roles they play in the stories of our lives then and now. For example, the NNSS contains a valley where an important spiritual journey occurred. It involved Wolf (*Tavats* in Southern Paiute, *Bia esha* in Western Shoshone, *Wi gi no ki* in Owens Valley Paiute) and is considered a Creation story. Out of respect to our traditional teachings, only parts of this story are presented here. When Wolf and Coyote had a battle over who was more powerful, Coyote killed Wolf and felt glorious. Everyone asked Coyote what happened to his brother Wolf. Coyote felt extremely guilty and tried to run and hide but to no avail. Meanwhile, the Creator took Wolf and made him into a beautiful Rainbow (*Paro wa tsu wu nutuvi* in Southern Paiute, *Oh ah podo* in Western Shoshone, *Paduguna* in Owens Valley Paiute). When Coyote saw this special privilege he cried to the Creator in remorse and he too wanted to be a Rainbow. Because Coyote was bad, the Creator put Coyote as a fine, white mist at the bottom of the Rainbow's arch. This story and the spiritual trails discussed in the full version are connected to the Spring Mountains and the large sacred cave in the Pintwater Range as well as to lands now called the NNSS. These areas comprise the home of Wolf, whose spirit is still present and watches over Indian people and our Holy Land.

Stink bugs, willows, frogs, hummingbirds, and snow fleas are all important to Indian people and our respect to rain and snow. (For additional information on these plants and animals, please see text box for Hydrological Resources, Section 4.5.)

The desert bighorn sheep and the desert tortoise are both culturally sensitive animals to Indian people. Among their many special qualities, when used ceremonially, they have the ability to bring rain and reduce drought impacts.

The desert tortoise has further significance to Indian people because of its healing powers, longevity, and wisdom. It is integral to our traditional stories, well-being and perpetuation of our native culture.

See Appendix C for more details.

[1] *Smudging is a spiritual cleansing involving the use of smoke from certain plants during prayers and ceremonies.*

4.1.8 Air Quality and Climate

4.1.8.1 Meteorology

Overview of NNSS Climate

The NNSS is located mostly in the southwestern corner of the Great Basin Desert, with the southern third of the NNSS located in the Mojave Desert (Warner 2004). The NNSS is located in the rain shadow (lee) of the southern Sierra Nevada mountain range and has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation throughout the year and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The normally dry desert climate specific to the NNSS can occasionally be interrupted by the southwestern monsoon and convective thunderstorms during the summer months, as well as Eastern Pacific tropical storm remnants in the late summer and fall. The climate conditions can be further modified from time to time during strong *El Niño* cycles, which generally bring more rainfall to the area.

Significant climate differences within the NNSS stem largely from differences in elevation. The NNSS generally slopes downward from north to south (from about 7,700 to 2,700 feet). There is considerable variability in terrain due to the number of mountain ranges (which are generally oriented north–south), mesas, basins, and flats. Local topographical features play an important role in defining local wind flow effects on both diurnal and seasonal time scales. Higher elevations within the NNSS generally experience cooler temperatures and more precipitation, while generally warmer temperatures and less precipitation occur in the basins.

Figure 4–17 shows the Meteorological Data Acquisition stations that monitor meteorological conditions across the NNSS. The NNSS areas are also labeled, and some geographic areas (e.g., Pahute Mesa, Frenchman Flat) are labeled and individually shaded. The following three major NNSS complexes that have historically released radiological and nonradiological hazardous air pollutants are labeled: BEEF, the Nonproliferation Test and Evaluation Complex (NPTEC), and Test Cell C. The Amargosa Valley CEMP station is shown, as is the Desert Rock hourly upper-air and Automated Surface Observing System. Terrain gradients are also shown.

Temperature

Average maximum temperatures range from 90 to 100 °F in the summer and from 50 to 60 °F in the winter. Average minimum temperatures range from 55 to 70 °F in the summer and 20 to 35 °F in the winter. At higher elevations, which are mostly in the northern NNSS, temperatures tend to be 10 to 15 °F cooler (NOAA 2006). For more information regarding temperature trends at the NNSS, please see Appendix D, Section D.1.1.1, of this SWEIS.

Precipitation

Higher elevations, mostly in the northern NNSS, receive an average of about 13 inches of precipitation per year, while locations in the southeastern NNSS near Frenchman Flat receive an average of about 5 inches per year, the lowest average amount (SORD Overview). Precipitation falls most often during winter and early spring (during Pacific storm passage) and during mid- to late-summer (during convective thunderstorms, monsoons, and occasional tropical storm remnants) (NOAA 2006). Nevada has had statewide drought conditions for most of the last decade, with precipitation amounts far below normal. For more information regarding precipitation patterns at the NNSS, including tornado statistics and snowfall and thunderstorm trends, please see Appendix D, Section D.1.1.1.

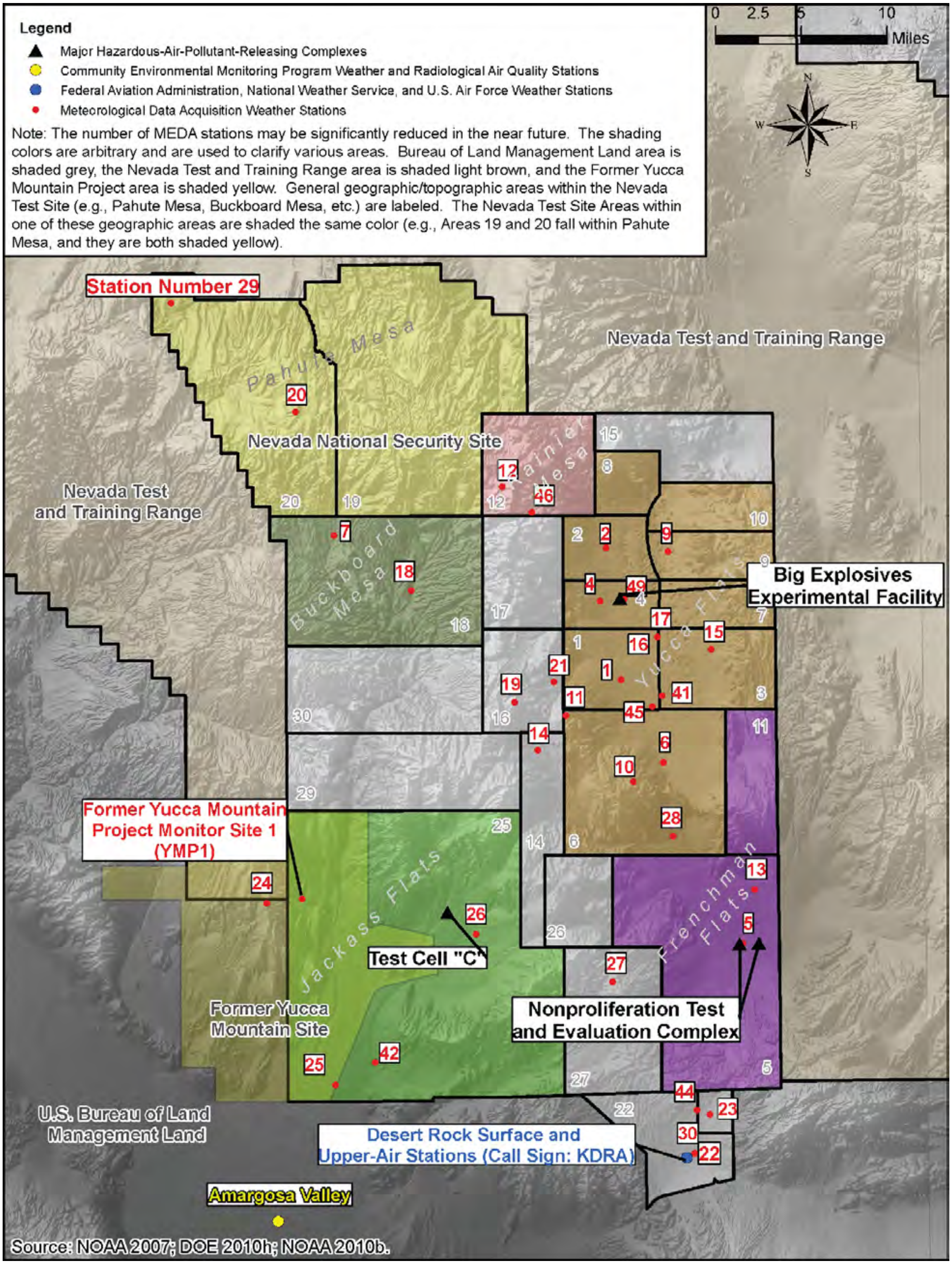


Figure 4–17 Meteorological Data Acquisition System Stations Across the Nevada National Security Site, as of 2010

Wind Flow

Wind conditions affecting the NNSS are perhaps the most complex of the site's meteorological conditions.

The surface winds show strong diurnal variations with distinct nighttime drainage winds in the basins and mountain slopes. Because the terrain tends to slope down in elevation from north to south, these nighttime drainage winds tend to be from the north. Localized terrain gradients that are not north-to-south modify this nighttime wind flow, as do rare low overcast conditions or conditions with extensive nighttime vertical mixing. **Figure 4–18** illustrates the localized wind patterns for the Meteorological Data Acquisition stations nearest the three NNSS sites that have historically, as well as recently, been permitted to release radiological and nonradiological hazardous air pollutants (i.e., BEEF, NPTEC, and Test Cell C). For more information regarding wind flow patterns at the NNSS, please see Appendix D, Section D.1.1.1.

Stability Overview

Cloud cover measurements used to estimate atmospheric stability are available from the Desert Rock site located in the southeastern corner of the NNSS. Based on data recorded from 1978 through 2004 at Desert Rock, stable conditions dominate at night, though stronger windspeeds will tend to mix in the atmosphere, leading to neutral conditions. Nighttimes tend to be more stable during the summer and fall months because of lighter winds at night, relative to the winter and spring periods. Because greater solar radiation leads to greater instability, unstable conditions dominate the daytime hours and the months with highest solar radiation (summer). These stability patterns would be slightly modified within the NNSS based primarily on windspeed differences and potentially on differences in local cloud cover and topology relative to what occurs at Desert Rock (NOAA 2006)

4.1.8.2 Ambient Air Quality

4.1.8.2.1 Region of Influence

The ROI for air quality and climate for the NNSS operations comprises southern Nye County, western Lincoln County, and northern Clark County, with prevailing downwind impacts extending into western Lincoln County. Historic data on pollutant emissions inventories and the compliance status for the State of Nevada are calculated at the county level, and these data provide a basis for determining both existing air quality in the ROI and a metric for emission comparison assessments.

4.1.8.2.2 Existing Air Quality

Current Ambient Air Quality Standards

Air quality is determined by measuring concentrations of certain pollutants in the atmosphere. EPA designates an area as "in attainment" for a particular pollutant if ambient air concentrations of that pollutant are below the National Ambient Air Quality Standards (NAAQS). Pollutants regulated under both the State of Nevada Ambient Air Quality Standards and NAAQS include the following:

- ozone
- carbon monoxide
- nitrogen dioxide
- sulfur dioxide
- lead
- particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10})
- particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$)

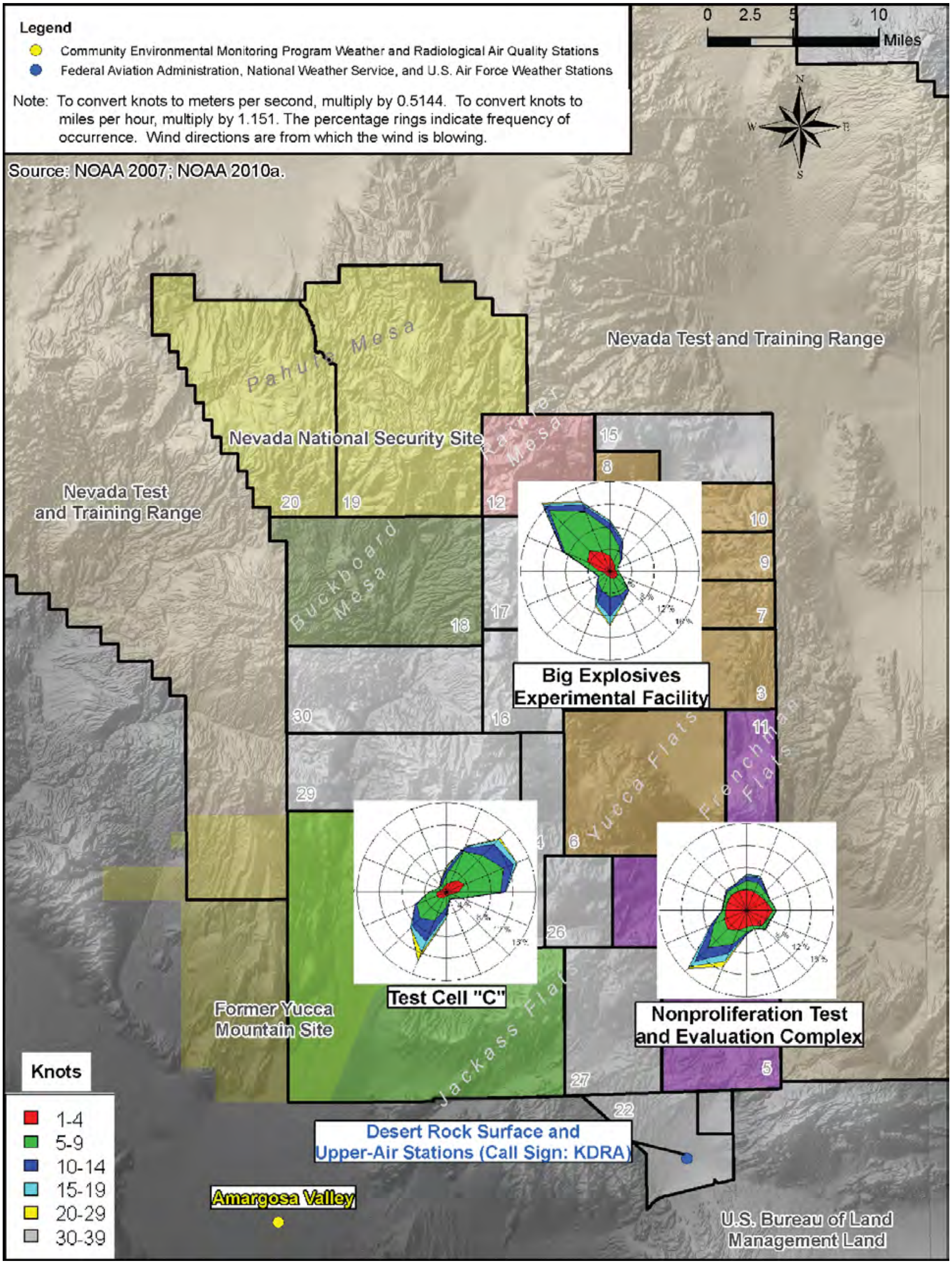


Figure 4–18 Annual Average Wind Roses for Meteorological Data Acquisition Stations near NPTEC, Test Cell C, and BEEF, 2004–2008

Collectively, these NAAQS pollutants are referred to as “criteria pollutants.” **Table 4–39** lists NAAQS for both the primary public health standard and the secondary public welfare standard, which includes protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Table 4–39 also lists the State of Nevada Ambient Air Quality Standards.

Table 4–39 State of Nevada and National Ambient Air Quality Standards

Pollutant	*Averaging Time Over Which Pollutant is Measured*	*Nevada Standard*	*National Primary Standard*	*National Secondary Standard*	*Notes Regarding the Air Quality Standard*
Ozone [a]	1 hour	0.12 ppm	None	None	The 1-hour ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.
	8 hours	None	0.075 ppm	Same as primary	The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed this standard.
Carbon monoxide	8 hours	9 ppm (10,500 $\mu g/m^3$) elevations < 5,000 feet	9 ppm (10 mg/m^3) at any elevation	None	Not to be exceeded more than once per year.
		6 ppm (7,000 $\mu g/m^3$) elevations > 5,000 feet			
Carbon monoxide (at any elevation)	1 hour	35 ppm (40,500 $\mu g/m^3$)	35 ppm (40 mg/m^3)		
Nitrogen dioxide	Annual arithmetic mean	0.053 ppm (100 $\mu g/m^3$)	0.053 ppm (100 $\mu g/m^3$)	Same as primary	Not to be exceeded.
	1 hour	None	0.100 ppm (189 $\mu g/m^3$)	None	The 3-year average of the 98th percentile of the annual distribution of the daily maximum 1-hour average at each monitor within an area must not exceed this standard.
Sulfur dioxide [b]	Annual arithmetic mean	0.03 ppm (80 $\mu g/m^3$)	0.03 ppm (80 $\mu g/m^3$)	None	Not to be exceeded.
	24 hours	0.14 ppm (365 $\mu g/m^3$)	0.14 ppm (365 $\mu g/m^3$)		Not to be exceeded more than once per year.
	3 hours	0.5 ppm (1,300 $\mu g/m^3$)	None	0.5 ppm (1,300 $\mu g/m^3$)	
	1 hour	None	0.075 ppm	None	The 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentration at each monitor within an area must not exceed this standard.
Lead	Quarterly arithmetic mean	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	Same as primary	Not to be exceeded.
	3-month rolling average	None	0.15 $\mu g/m^3$	Same as primary	
Hydrogen sulfide	1 hour	0.08 ppm (112 $\mu g/m^3$)	None	None	Not to be exceeded.

<table>
<tr><th>Pollutant</th><th>Averaging Time Over Which Pollutant is Measured</th><th>Nevada Standard</th><th>National Primary Standard</th><th>National Secondary Standard</th><th>Notes Regarding the Air Quality Standard</th></tr>
<tr><td rowspan="2">PM_{10}</td><td>Annual arithmetic mean</td><td>50 $\mu g/m^3$</td><td>None</td><td>None</td><td>The 3-year average of the weighted annual mean concentration from a single or multiple community-oriented monitors must not exceed this standard.</td></tr>
<tr><td>24 hours</td><td>150 $\mu g/m^3$</td><td>150 $\mu g/m^3$</td><td>Same as primary</td><td>Not to be exceeded more than once per year on average over 3 years.</td></tr>
<tr><td rowspan="2">$PM_{2.5}$</td><td>Annual arithmetic mean</td><td rowspan="2">None</td><td>15 $\mu g/m^3$</td><td>Same as primary</td><td>The 3-year average of the weighted annual mean concentration from a single or multiple community-oriented monitors must not exceed this standard.</td></tr>
<tr><td>24 hours</td><td>35 $\mu g/m^3$</td><td>Same as primary</td><td>The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed this standard.</td></tr>
</table>

$\mu g/m^3$ = micrograms per cubic meter; mg/m^3 = milligrams per cubic meter; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; ppm = part(s) per million.

[a] EPA proposed a new standard of between 0.06 and 0.07 ppm in January 2010.

[b] On June 2, 2010, EPA revised the primary sulfur dioxide standard to 75 parts per billion over 1 hour and revoked both the 24-hour and annual standard.

Source: 40 CFR Part 50; NAC 445B.22097.

Air Quality Status

The NNSS is within Nevada Intrastate Air Quality Region 147. Nye County contains all of the NNSS, but has insufficient available data to determine the attainment status. Thus, it is designated as unclassified/attainment because EPA treats an unclassified area as if it is in attainment for regulatory purposes.

As of early 2010, the closest nonattainment areas to the NNSS are Inyo County, California (about 65 miles from the western border of the NNSS), and the Las Vegas Valley Area nonattainment area, located in Clark County (the closest distance is about 25 miles from the southeastern corner of the NNSS). Inyo County is in serious[1] nonattainment for PM_{10}, and the Las Vegas Valley Area of Clark County is in nonattainment for 8-hour ozone,[2] and serious nonattainment for both 8-hour carbon monoxide standards[3] and 24-hour PM_{10}[4] (EPA 2010c).

Prevention of Significant Deterioration (PSD) is a regulation incorporated into the Clean Air Act (CAA) that limits increases of certain pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. CAA has three classes of areas with different

[1] *EPA designates areas that do not obtain the NAAQS with respect to a particular air pollutant as nonattainment. Within that designation, classification categories have been established in the Clean Air Act based on the severity of the air pollution problem. Ozone has the broadest number of classification categories, including extreme, severe, serious, moderate, and marginal.*

[2] *Classification for 8-hour ozone under Subpart 2 as marginal with a nonattainment area that includes those portions of Clark County that lie in Hydrographic Areas 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218, but excludes the Moapa River Indian Reservation and the Fort Mojave Indian Reservation.*

[3] *Still designated as serious nonattainment for carbon monoxide, but has not had any violations of the carbon monoxide NAAQS since 1999. Clark County Department of Air Quality and Environmental Management submitted a request to EPA in September 2008 for a redesignation to attainment for carbon monoxide. The nonattainment area covers Hydrographic Area 212.*

[4] *Still designated as serious nonattainment for PM_{10}, but has not had any violations of the 24-hour or annual PM_{10} NAAQS since 2004. The nonattainment area covers Hydrographic Area 212.*

increments. The smallest increments allowed are Class I areas, which are areas of special value (natural, scenic, recreational, or historic). Any degradation of existing air quality in these areas should be minimized. The closest PSD Class I areas to the NNSS are Grand Canyon National Park (about 130 miles to the southeast) and Sequoia National Park (about 105 miles to the west). The NNSS has no sources of pollution large enough to be subject to PSD requirements.

Calculations of Emissions on and near the NNSS

Table 4–40 shows the 2008 estimated air emissions for the criteria pollutants and hazardous air pollutants associated with various NNSS activities. PM_{10} and $PM_{2.5}$ emissions from diesel-fueled vehicles are included in the total PM_{10} and $PM_{2.5}$ emissions. Actions on efforts to mitigate diesel emissions are discussed in Chapter 7, Section 7.8. See Appendix D, Section D.1.1.2.1, for more information on how these emissions were determined and further partitioning by source type and vehicle type for the mobile sources.

Measurements of Ambient Air Concentrations on and Near the NNSS

There are no regularly operating ambient air quality monitors for criteria pollutants and hazardous air pollutants within the NNSS. The most comprehensive source of representative data on ambient concentrations of criteria pollutants and hazardous air pollutants for the area surrounding the NNSS is a special study conducted in the southwest portion of the NNSS from October 1991 through September 1995 (see **Figure 4–19** for the locations of the monitors used in the study). During this period, the YMP1 station monitored carbon monoxide, nitrogen dioxide, PM_{10}, ozone, and sulfur dioxide. The YMP1 station was about 1 mile inside the western NNSS border in northwestern Area 25, and it is the only location on the NNSS where criteria pollutants other than PM_{10} have been measured for an extended period of time. Three additional sites monitored PM_{10} (DOE 1999a): YMP5 (about 6 miles southeast of YMP1 in Area 25, from April 1989 until 2002), YMP6 (about 4 miles northeast of YMP1 in extreme northwestern Area 25, from October 1992 until September 1999), and YMP9 (about 12 miles south-southeast of YMP1 in southwestern Area 25, from October 1992 until 2008). An earlier limited 1-month (August 15 – September 15, 1990) air quality monitoring study was done on the NNSS in Areas 6, 12, and 23 for carbon monoxide, sulfur dioxide, and PM_{10}; however, these results are not considered representative of today's ambient air quality concentrations, as overall activity levels at the NNSS have been substantially reduced since the 1992 nuclear testing moratorium. However, the monitored values were all well below the NAAQS and state ambient air quality standards.

The 1991 through 1995 ambient concentrations measured at the YMP1 station are conservative estimates of current concentrations at the NNSS for two reasons. First, the measured PM_{10} ambient concentrations among the four YMP monitors from 1989 through 2005 show a slight downward trend (see **Table 4–41**), and the NNSS onsite stationary emissions of criteria pollutants (see Appendix D, Section D.1.1.2) also trended downward from 1998 through 2008 (see Table 4–40). Second, the principal source of air pollutants is from population activity (vehicle trips and construction) and can be used as a surrogate for increases in PM emissions in the absence of new industrial activity. While Nye County's population increased by about 80 percent between 1990 and 2000, most of that growth occurred at the extreme southern tip of the county in the city of Pahrump, which is about 25 miles south-southeast of the extreme southern tip of the NNSS. Furthermore, the population directly bordering the Yucca Mountain Site to its southwest (Amargosa Valley) grew by only about 16 percent, and the two counties in the prevailing upwind direction of the NNSS (Esmeralda County, Nevada, and Inyo County, California) had population decreases of up to almost 30 percent (USCB 2008b). Industrial activity has not changed over this period; thus, it is estimated that the criteria pollutant emissions near the NNSS have in general only decreased since the early 1990s.

Table 4–40 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to Nevada National Security Site-Related Activities

	Annual Air Emissions (tons per year)														
	Stationary Sources	***Government-Owned Vehicles***	***NNSS Commuters***			***Commercial Vendors***			***Radiological Waste Trucks***			***Total***			
	Nye County	***Nye County***		***Nye County***			***Nye County***			***Nye County***			***Nye County***		
Pollutant	***On-NNSS***	***On-NNSS***	***Clark County***	***On-NNSS***	***Off-NNSS***	***Clark County***	***On-NNSS***	***Off-NNSS***	***Clark County***	***On-NNSS***	***Off-NNSS***	***Clark County***	***On-NNSS***	***Off-NNSS***	***Total***
PM_{10}	0.22	0.82	0.83	0.14	0.19	0.24	0.11	0.032	0.17	0.0046	0.51	*1.2*	*1.3*	*0.73*	*3.3*
$PM_{2.5}$	0.22	0.66	0.56	0.11	0.11	0.22	0.1	0.029	0.16	0.0042	0.48	*0.94*	*1.1*	*0.62*	*2.7*
CO	0.94	39.6	97.0	18.5	21.0	0.98	0.46	0.13	0.67	0.018	2.0	*98.7*	*59.5*	*23.1*	*181.3*
NO_x	3.4	13.9	24.0	4.6	5.3	2.2	0.97	0.277494	2.3	0.064	7.2	*28.5*	*22.9*	*12.8*	*64.2*
SO_2	0.060	0.076	0.19	0.019	0.047	0.0041	0.0018	0.00051	0.0033	0.000088	0.010	*0.20*	*0.16*	*0.058*	*0.41*
VOCs	0.60	0.80	1.2	0.12	0.35	0.32	0.15	0.042	0.11	0.0029	0.33	*1.6*	*1.7*	*0.72*	*4.0*
Lead	0.0023	0.000022	0.000048	0.0000031	0.000013	0.0000038	0.0000018	0.00000052	0.0000022	0.000000017	0.0000019	*0.000054*	*0.0023*	*0.000015*	*0.0024*
Criteria Pollutant Total	*5.2*	*55.2*	*123.2*	*23.4*	*26.9*	*3.7*	*0.48*	*1.7*	*0.014*	*0.09*	*10.1*	*126.9*	*84.4*	*38.7*	*250.0*
HAPs	0.090	0.058	0.095	0.010	0.030	0.042	0.02	0.0056	0.17	0.00038	0.044	*0.31*	*0.18*	*0.080*	*0.56*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

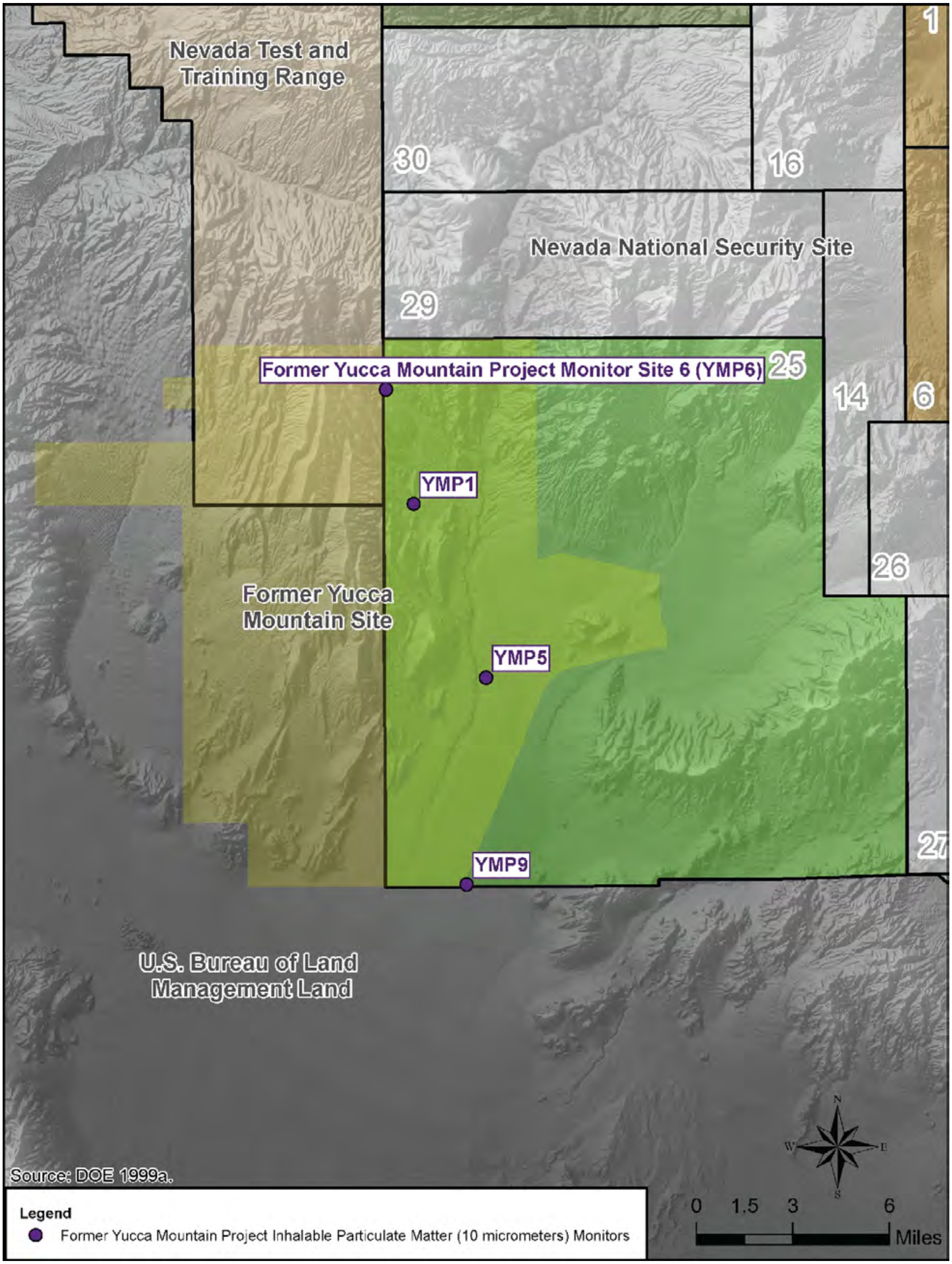


Figure 4–19 Locations of the Four Historical PM_{10} Monitors at the Former Yucca Mountain Site

Table 4–41 YMP1 Station Maximum Observed Ambient Air Quality Concentrations, October 1991 through September 1995, Compared with State of Nevada or National Ambient Air Quality Standards in Place at the Time of Monitoring

Pollutant	*Measuring Time Increment*	*Ambient Air Concentration (parts per million)*				
		2009 Nevada or NAAQS, Whichever is Lower	*Year 1 (October 1991 to September 1992)*	*Year 2 (October 1992 to September 1993)*	*Year 3 (October 1993 to September 1994)*	*Year 4 (October 1994 to September 1995)*
Carbon monoxide	1 hour [a]	35	**0.2**	**0.2**	**0.2**	**0.2**
	8 hours [a]	9 (elevations in Nevada under 5,000 feet above mean sea level)	**0.2**	**0.2**	**0.2**	**0.2**
Nitrogen dioxide	Annual [b]	0.053	0.00201	0.00208	**0.00214**	0.00209
Ozone [c]	1 hour [a]	0.12	**0.096**	0.093	0.081	0.083
	8 hours [d]	0.075	–	–	–	–
Sulfur dioxide	3 hours [a]	0.5	**0.002**	**0.002**	**0.002**	**0.002**
	24 hours [a]	0.14	**0.002**	**0.002**	**0.002**	**0.002**
	Annual [b]	0.03	**0.002**	**0.002**	**0.002**	**0.002**

NAAQS = National Ambient Air Quality Standards.
[a] Not to be exceeded more than once per year.
[b] Annual NAAQS are defined as a calendar year.
[c] The 1-hour Federal ozone standard of 0.12 parts per million, in place during the listed years, was phased out in 2005 and replaced with an 8-hour Federal ozone standard of 0.075 parts per million. The State of Nevada still retains the 1-hour ozone standard of 0.12 parts per million.
[d] The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitoring station within an area over each year must not exceed this standard.
Note: The highest measured concentration in each row is shown in bold font.

As shown in Tables 4–41 and **4–42**, and further discussed in Appendix D, Section D.1.1.2, the Yucca Mountain Site has been well within the attainment status of the applicable ambient air quality standards since at least the early 1990s. Given that the 1991 through 1995 ambient concentration measurements from the YMP1 station are still likely representative of the current concentrations on the NNSS as described above, it remains very likely that the ambient air quality on the NNSS is well within all applicable ambient air quality standards.

4.1.8.3 Radiological Air Quality

National Emission Standards for Hazardous Air Pollutants (NESHAPs) are established under Title I of CAA to limit ambient levels of some hazardous air pollutants. The radionuclide inhalation NESHAP for Federal facilities is set at the emissions total (cumulative across all radionuclides) that would cause a member of the public to receive an effective dose equivalent of 10 millirem in a year (DOE/NV 2009d). To put the dose of 10 millirem per year in perspective: a person would receive a dose of about 3 millirem from a single 5-hour jet flight, a dose of about 8 millirem from a single chest x-ray, and a dose of about 200 millirem per year from natural radon (DOE/NV 2009d). The average natural background radiation exposure, excluding that from radon, for persons residing in select U.S. cities is provided in **Table 4–43**.

Table 4–42 Summary of PM_{10} Concentrations, 1989 through 2005, for Four Monitoring Stations in Area 25

Monitoring Station	*Measuring Time Increment*	*Ambient Air Concentration (micrograms per cubic meter)*																	
		Current (2009) NAAQS	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
YMP1	24-hour highest	150 [a]	41	**62**	33	30	30	39	21	60	31	30	18	38	23	52	33	24	32
	Annual average	50 [b]	**12**	**12**	10	**12**	10	10	10	10	9	8	8	11	8	10	8	8	9
YMP5	24-hour highest	150 [a]	40	51	45	49	21	42	**67**	57	26	26	24	45	27	N/A	N/A	N/A	N/A
	Annual average	50 [b]	**13**	10	10	12	9	9	10	10	9	7	8	12	10	N/A	N/A	N/A	N/A
YMP6	24-hour highest	150 [a]	N/A	N/A	N/A	N/A	21	25	14	32	**59**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Annual average	50 [b]	N/A	N/A	N/A	N/A	**9**	7	7	**9**	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
YMP9	24-hour highest	150 [a]	N/A	N/A	N/A	31	21	39	15	**57**	29	22	18	36	22	43	39	27	26
	Annual average	50 [b]	N/A	N/A	N/A	N/A	9	8	7	10	8	6	8	**11**	9	10	**11**	9	9

N/A = not available; NAAQS = National Ambient Air Quality Standards; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.

[a] Not to be exceeded more than once per year on average over 3 years.

[b] The 3-year average of the weighted annual mean concentration from a single or multiple community-oriented monitors must not exceed this standard.

Note: The highest measured concentration in each row is shown in **bold** font. N/A indicates that the monitor was either not operating or the data are not available.

Source: CRWMS M&O 1997, 1999; DOE 2002d, 2003b, 2004b, 2005a, 2006b; SAIC 1992a, 1992b.

Table 4–43 Average Natural Background Radiation Exposure, Excluding That from Radon, for Select U.S. Cities

City	*Radiation Exposure (millirem per year)*
Denver, Colorado	164.6
Wheeling, West Virginia	111.9
Rochester, New York	88.1
St. Louis, Missouri	87.9
Portland, Oregon	86.7
Los Angeles, California	73.6
Las Vegas, Nevada	69.5
Fort Worth, Texas	68.7
Richmond, Virginia	64.1
Tampa, Florida	63.7
New Orleans, Louisiana	63.7

Source: DOE 1990.

Table 4–44 indicates the NESHAPs concentration levels for environmental compliance for isotopes of americium, cesium, hydrogen, and plutonium. Because analytical methods cannot readily distinguish between plutonium-239 and plutonium-240, the NESHAPs concentration level for plutonium-239 is used for both isotopes. Uranium is not shown because any uranium detected on the NNSS in recent years has been determined to be naturally occurring rather than enriched or depleted (DOE/NV 2009d). Note, however, that 0.06 curies of depleted uranium were estimated to have been released in 2008 from activities at BEEF, in Area 4 (DOE/NV 2009d). A curie is a common measurement of radioactivity and is defined as 3.7×10^{10} disintegrations per second, which is the approximate decay rate of 1 gram of radium (radium-226).

Table 4–44 The Concentration Levels for Five Radionuclides Corresponding to the NESHAPs' Effective Dose Equivalent of 10 Millirem per Year in One Year

Radionuclide	*NESHAPs Annual Average Concentration Levels for Environmental Compliance ($\times 10^{-15}$ micrograms per milliliter)*
Americium-241	1.9
Cesium-137	19
Hydrogen-3 (Tritium)	1,500,000
Plutonium-238	2.1
Plutonium-239	2

NESHAPs = National Emission Standards for Hazardous Air Pollutants.
Source: DOE/NV 2009d.

To demonstrate that total radioactivity is in compliance with NESHAPs, the following steps are performed: (1) divide the concentration level of each detected manmade radionuclide by its NESHAP concentration level (concentration ÷ NESHAP concentration level); (2) sum those fractions for all radionuclides; and (3) confirm that the sum is less than 1.0 at each monitoring station used for monitoring NESHAPs compliance. The NNSS has been in compliance with NESHAPs since the *1996 NTS EIS* (DOE 1996c).

The locations of the ambient radiological monitors on and surrounding the NNSS are discussed in Section 4.1.8.3.1. The locations of potential radiation emissions on the NNSS and the types of activities that might produce them are discussed in Section 4.1.8.3.2. The recent radiation concentrations and exposure levels are discussed in Section 4.1.8.3.3.

4.1.8.3.1 Ambient Radiological Monitoring on and near the Nevada National Security Site

On the NNSS, 6 of the 16 sites established by DOE that monitor ambient tritium levels are considered "critical receptors." These "critical receptors" are approved to monitor levels of various radionuclides for NESHAPs compliance. Most of these 16 ambient monitors are placed at or near locations of historical nuclear testing or current radiological operations (DOE/NV 2009d). The locations of the 16 tritium monitors, with notations for the 6 that are critical receptors, are shown in **Figure 4–20**. The monitoring data from the 6 "critical receptors" demonstrate that the NNSS has been in compliance with the NESHAPs since the *1996 NTS EIS*. Further details on the NNSS ambient radiological monitoring can be found in Appendix D, Sections D.1.1.3.1 and D.1.1.3.

The Desert Research Institute of the Nevada System of Higher Education runs CEMP, which constitutes an offsite nonregulatory network of environmental monitors across southern Nevada, southeastern California, and southwestern Utah. CEMP is a public information and outreach program that monitors for radionuclides that might be released from the NNSS. As of 2008, there were 29 CEMP monitors; the 22 monitors near the Nevada Test and Training Range and Las Vegas area are shown in **Figure 4–21**. Since CEMP was upgraded in 1999 (DOE/DRI 2009a), the CEMP monitors have not detected radiation that can be definitively attributed to NNSS activities, and the monitored radiation levels have been well within the background levels observed in other parts of the country (DOE/NV 2009d). More details about the radiation detected at CEMP locations are provided in Appendix D, Sections D.1.1.3.1 and D.1.1.3.3.

4.1.8.3.2 Sources of Radiation on the Nevada National Security Site

Between 1951 and 1992, 100 atmospheric and 828 underground nuclear tests were conducted on the NNSS (DOE/NV 2009d). Nuclear testing ended in 1992, and since then the NNSS radiation monitoring has focused on detecting airborne radionuclides from historically contaminated soils. Due to occasional high winds, some contaminated soil becomes airborne. Results from the air samplers in these areas indicate that americium-241 and plutonium-230+240 are routinely detected, but only in concentrations slightly above the minimum detectable concentrations. The total emissions (in curies) produced each year from all known legacy sites on the NNSS are estimated with a mathematical resuspension model. For 2008, total annual emissions from legacy sites were estimated as follows: americium-241– 0.047 curies, plutonium-238 – 0.050 curies, and plutonium-239+240 – 0.29 curies (DOE 2009d). The methods used to estimate all NNSS radiological emissions (both point sources and fugitive dust from the legacy sites) include the use of annual field and water monitoring data, historical soil inventory data, and accepted soil resuspension and air transport models (DOE 2009d). Additional detail on radiological emissions and how they are determined is in Appendix D, Section D.1.1.2.2, "Radiological Air Quality." In 1990, most areas within the NNSS had measureable amounts of americium-241 and plutonium-238, -239, and -240 in the first 2 inches of soil (McArthur 1991). Over time the measurable airborne quantities of radionuclides have decreased as a result of radioactive decay, radionuclide immobilization in soil, and decreases in NNSS activities that would resuspend radionuclides from the soil to the air. According to a 1994 aerial survey, the largest areas of soil contamination correspond to the places where the bulk of nuclear testing occurred—especially the northeastern quarter of the NNSS (on Yucca Flat; locations north and east of Areas 1 and 17), but with notable locations in eastern Frenchman Flat (in Area 5), in northwestern Pahute Mesa (in Area 20), in central Buckboard Mesa (in Area 18), and near Dome Mountain (in Area 30). Evaporation and evapotranspiration can also resuspend tritium from contaminated soil, plants, and ponds such as the ones in Area 12 that receive tritium-contaminated water from East Tunnel. For more information regarding the sources of radiation at the NNSS, please see Appendix D, Section D.1.1.3.2.

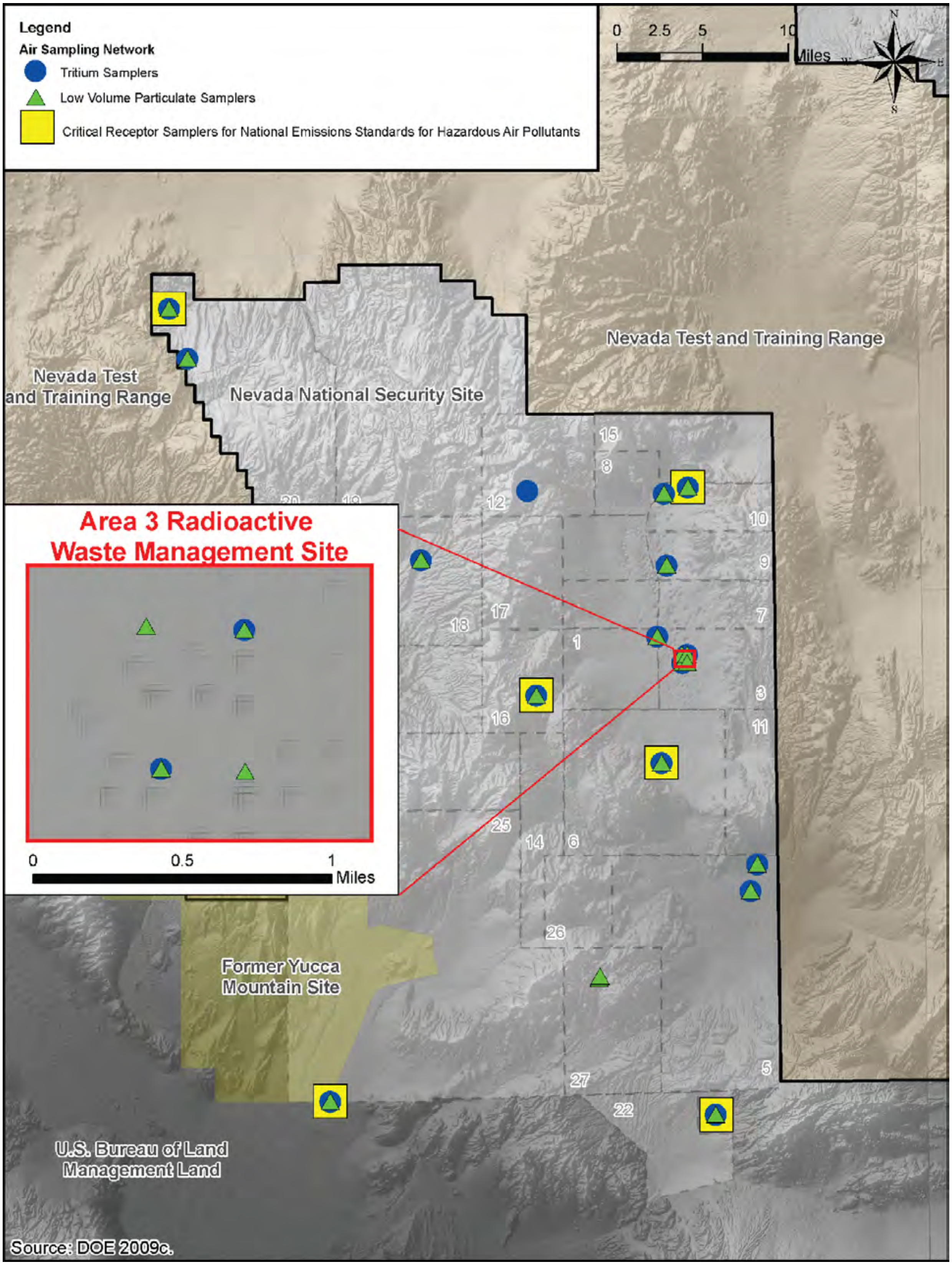


Figure 4–20 Ambient Radiological Monitoring and Critical Receptor Sampling Locations for Air Particulates and Tritium

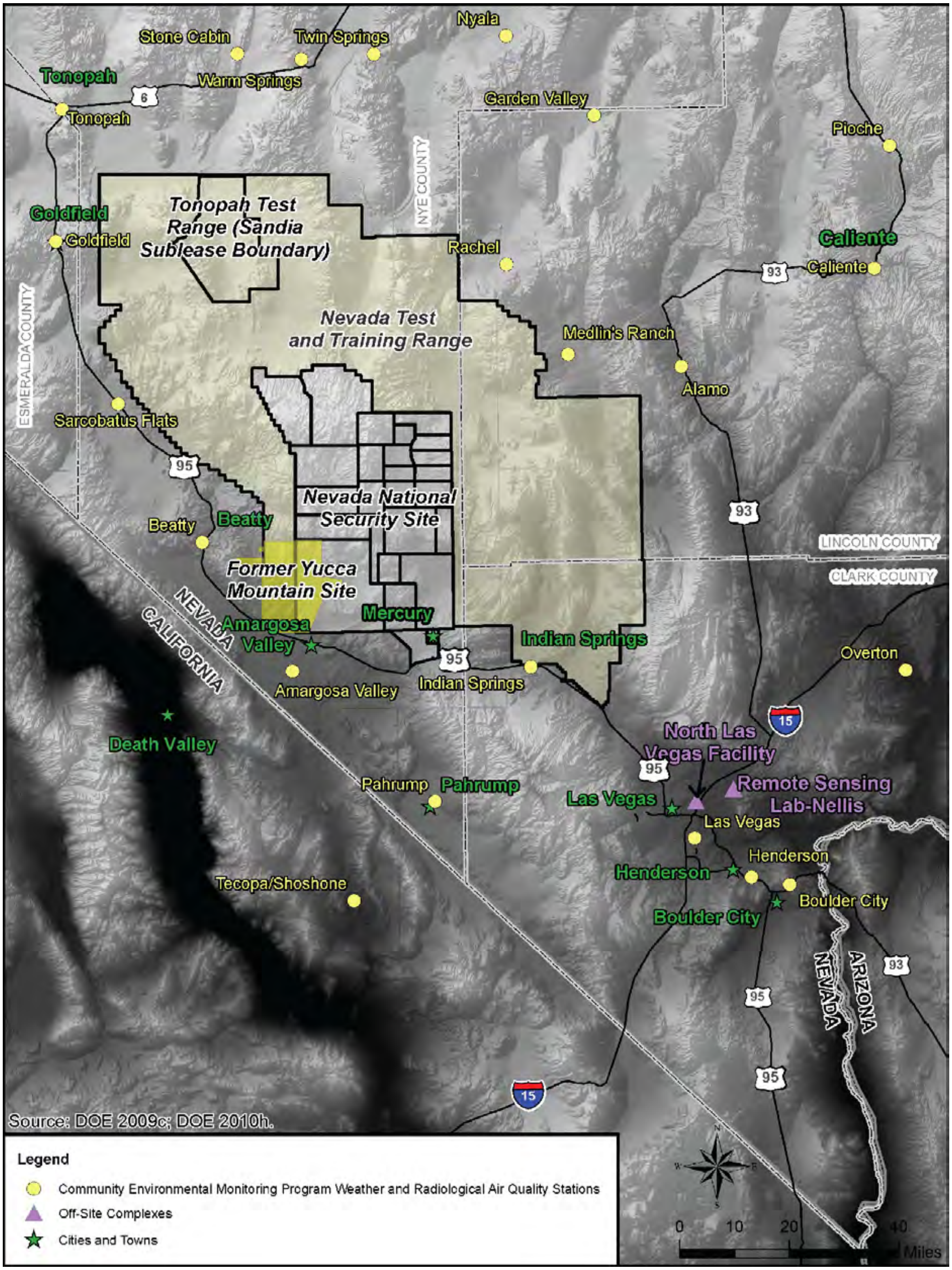


Figure 4–21 Community Environmental Monitoring Program Air Surveillance Network Locations Near the Nevada Test and Training Range and Las Vegas, 2008

4.1.8.3.3 Radiation Levels on and near the Nevada National Security Site

The NNSS has been in compliance with the NESHAPs since the *1996 NTS EIS* (DOE 1996c). The maximum annual average radiation at critical receptor locations was from tritium over the most recent years, 2002 through 2008, with a measured concentration of 434×10^{-12} microcuries per milliliter, which is 29 percent of the NESHAPs concentration level. The radiological monitoring network overall indicates that levels of americium-241; plutonium-238, -239, and -240; cesium-137; and tritium on the NNSS have been well below the NESHAPs concentration levels since the *1996 NTS EIS*. In addition, offsite CEMP stations continue to show radiation levels that are well within natural background radiation levels (DOE/NV 2009d). For more information regarding the radiation levels on and near the NNSS, please see Appendix D, Section D.1.1.2.2.3.

4.1.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions on the climate involve very complex processes and interact with natural cycles, complicating the measurement and detection of changes. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that it is very likely (greater than 90 percent probability) that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways (IPCC 2007).

This section begins with a discussion of emissions and then turns to climate. Both discussions start with a description of conditions in the United States, followed by a description of conditions on the NNSS.

4.1.8.4.1 Greenhouse Gas Emissions

Greenhouse gas emissions in the United States in 2007[5] were estimated at 7,150.1 million carbon-dioxide-equivalent[6] metric tons of (EPA 2009b), which is about 18 percent of total global emissions[7] (WRI 2009). Annual national emissions, which have increased 17 percent since 1990 and typically increase each year, are heavily influenced by "general economic conditions, energy prices, weather, and the availability of non-fossil alternatives" (EPA 2009b). Carbon dioxide is by far the primary greenhouse gas emitted in the United States, representing almost 85.4 percent of all U.S. greenhouse gas emissions in 2007 (EPA 2009b). The other gases include methane, nitrous oxide, and a variety of fluorinated gases, including hydrofluorocarbons, perfluorinated carbons, and sulfur hexafluoride. The fluorinated gases are collectively referred to as "high global warming potential" (GWP) gases. Methane accounts for 8.2 percent of the remaining greenhouse gases on a GWP-weighted basis, followed by nitrous oxide (4.4 percent) and high-GWP gases (2.1 percent) (EPA 2009b).

Greenhouse gases are emitted from a wide variety of sectors, including energy, industrial processes, waste, agriculture, and forestry. Most U.S. greenhouse gas emissions are from the energy sector, largely due to carbon dioxide emissions from the combustion of fossil fuels, which alone account for 80 percent of total U.S. greenhouse gas emissions (EPA 2009b). Fossil fuel combustion contributes 97 percent of national total carbon dioxide emissions. As stated, carbon dioxide emissions from fossil fuel combustion are dominated by electricity generation, which contributes 42 percent of the total carbon dioxide emissions; the transportation sector contributes 33 percent; the industrial sector, 15 percent; the residential sector, 6 percent; and the commercial sector, 4 percent (EPA 2009b).

---

5 *Most recent year for which an official EPA estimate is available.*

6 *Each greenhouse gas has a different level of radiative forcing—that is, the ability to trap heat. To compare their relative contributions, gases are converted to a carbon-dioxide equivalent using their unique global warming potential.*

7 *Based on 2005 data and excludes carbon sinks from forestry and agriculture.*

4.1.8.4.2 Greenhouse Gas Emissions Due to Nevada National Security Site-Related Activities

Table 4–45 provides greenhouse gas emissions due to NNSS-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is an indicator for when a quantitative assessment may be warranted (CEQ 2010).

Power generation (electrical energy generation) is by far the largest single source of greenhouse gas emissions related to NNSS activities. Overall, NNSS-related activities created about 50,478 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, about 83 percent over the reference level.

Table 4–45 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases by Activities Related to the Nevada National Security Site in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year* [a]
STATIONARY SOURCES		
Power generation	28,517	1.03
Natural gas heating	0	0
Other stationary sources, except air conditioning/refrigeration and natural gas heating	747	0.03
Sulfur hexafluoride from refrigeration/air conditioning	690	0.03
Hydrofluorocarbons from refrigeration/air conditioning	326	0.01
All Stationary Sources	*30,280*	*1.10*
MOBILE SOURCES		
Onsite government vehicles	4,920	0.18
Commuting	13,201	0.48
Hazardous waste transport (nongovernment)	837	0.03
Commercial Vendors	1,240	0.05
All Mobile Sources	*20,198*	*0.73*
Total	***50,478***	***1.83***

Note: Fractional amount may not match the shown emission rate due to rounding.

4.1.8.4.3 Current Changes in Climate

This section describes observed historical and current climate change impacts on the United States and, in particular, on the desert southwest. Much of the material that follows is drawn from the following sources, including the citations therein: *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act* (EPA 2009d) and the *Scientific Assessment of the Effects of Global Change on the United States* (NSTC 2008).

The past decade has been the warmest in more than a century of direct observations; average temperatures for the contiguous United States have risen at a rate near 0.58 °F per decade in the past few decades. In the southwest, the average annual temperature has increased by 1.4 °F over the 1960 to 1978 baseline (Karl et al. 2009). The annual average temperature across the region is projected to rise approximately

4 to 10 °F over the 1960 to 1978 baseline by the end of the century, depending upon how much greenhouse gas emissions increase (Karl et al. 2009).

Higher temperatures cause higher rates of evaporation and plant transpiration, meaning that more water vapor is available in the atmosphere for precipitation events. Depending on atmospheric conditions, increased evaporation means that some areas experience increases in precipitation events, while other areas are left more susceptible to droughts. For the southwest, a severe drought prevailed from 1999 to 2008 (NSTC 2008). Most climate models project a decrease in precipitation for many areas in the southwestern United States throughout the twenty-first century (EPA 2009d; NSTC 2008).

Air Quality and Climate—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows that the air is alive. The Creator puts life into the air, which is shared by all living things. When a child is born, he pulls in the air to begin its life. The mother watches carefully to make sure that the first breath is natural and that there is no obstruction in the throat. It is believed if the day of birth is a windy day, it is a good day and the child will have a good life.

According to tribal elders' perspectives from Area 5 Nevada National Security Site activities, *"…You can listen to the wind. The wind talks to you. Things happen in nature. Our people had weather watchers, who are kinds of people who will know when crops and things should be done. They watch the different elements in nature and pray to ask the winds to come and talk about these things. Sometimes you ask the north wind to come down and cool the weather. The north wind is asked to blow away the footsteps of the people who have passed on to the afterlife. That kind of wind helps people, it is positive. The wind also brings you songs and messages. Sometimes the messages are about healing people, a sign that the sickness is gone now from the person, or that it is coming to get that sickness to take it away, or it is coming to bring you the strength that you will need to deal with the illness."*

See Appendix C for more details.

Melting snow and ice, increased evaporation, and changes in precipitation patterns all affect surface water. Stream flow decreased about 2 percent per decade over the past century in the central Rocky Mountain region (NSTC 2008). Annual peak stream flow (dominated by snowmelt) in western mountains occurs at least a week earlier than in the middle of the twentieth century. Changes in temperature and precipitation also affect frozen surface water. Spring and summer snow cover has decreased in the west. In mountainous regions of the western United States, the April snow water equivalent has declined 15 to 30 percent since 1950, particularly at lower elevations and primarily due to warming (NSTC 2008). This decrease in stream flow will likely reduce the groundwater recharge throughout the southwestern United States (NSTC 2008).

4.1.9 Visual Resources

Identifying an area's visual resources and conditions involves three steps: (1) objective identification of the visual features (visual resources) of the landscape; (2) assessment of the character and quality of those resources relative to overall regional visual character; and (3) determination of the importance to people, or *sensitivity*, of views of visual resources in the landscape.

The aesthetic value of an area is a measure of its visual character and quality, combined with the viewer response to the area (FHA 1988). Scenic quality can best be described as the overall impression that an individual viewer retains after driving through, walking through, or flying over an area (BLM 1980). Viewer response is a combination of viewer exposure and viewer sensitivity. Viewer exposure is a function of the number of viewers, number of views seen, distance of the viewers from key observation points to what is being viewed, and viewing duration. Viewer sensitivity relates to the extent of the public's concern for a particular viewshed. These terms and criteria are described in greater detail in the following sections.

Visual Character

Natural and artificial landscape features contribute to the visual character of an area or view. Visual character is influenced by geologic, hydrologic, botanical, wildlife, recreational, and urban features. Urban features include those associated with landscape settlements and development, including roads, utilities, structures, earthworks, and the results of other human activities. The perception of visual character can vary significantly seasonally, even hourly, as weather, light, shadow, and elements that compose the viewshed change. The basic components used to describe visual character for most visual assessments are the elements of form, line, color, and texture of the landscape features (BLM 1980; USFS 1995; FHA 1988). The appearance of the landscape is described in terms of the dominance of each of these components.

Scenic Quality

Scenic quality was evaluated using the scenic quality classes established in the *1996 NTS EIS* and includes the following:

- Class A – The visual environment is made up of outstanding natural and manmade physical features.
- Class B – The visual environment is made up of a combination of outstanding natural and manmade physical features and those that are common to the region.
- Class C – The visual environment is made up of natural and manmade physical features that are common to the region.

Visual Exposure and Sensitivity

The measure of the quality of a view must be tempered by the overall sensitivity of the viewer. Viewer sensitivity or concern is based on the visibility of resources in the landscape, proximity of viewers to the visual resource, elevation of viewers relative to the visual resource, frequency and duration of views, number of viewers, and type and expectations of individuals and viewer groups.

Public roadways, mostly highways, provide the only public vantage points of the NNSS. Commuters and nonrecreational travelers have generally fleeting views and tend to focus on commute traffic, not on surrounding scenery; therefore, they are generally considered to have low visual sensitivity. Highways pass by the NNSS in areas that are largely undeveloped, and views of the sites are fleeting at standard highway speeds. Because roadways provide the majority of views and the viewer sensitivity of roadway users is generally low, the number of viewers that pass by and have views of the NNSS and other NNSA-managed offsite locations was used to determine the level of sensitivity and to analyze effects on visual resources (see Chapter 5, Section 5.1.9). The 2008 *Annual Traffic Report* (NDOT 2008c) was used to determine traffic volumes on public roadways with views of the NNSS and other NNSA-managed offsite locations. **Figure 4–22** shows the sensitivity levels assigned to roadways near the NNSS and other NNSA-managed offsite locations based on traffic volumes and are as follows:

- High Visual Sensitivity – 3,000 or more average annual daily viewers
- Moderate Visual Sensitivity – 1,000 to 2,999 average annual daily viewers
- Low Visual Sensitivity – 0 to 999 average annual daily viewers

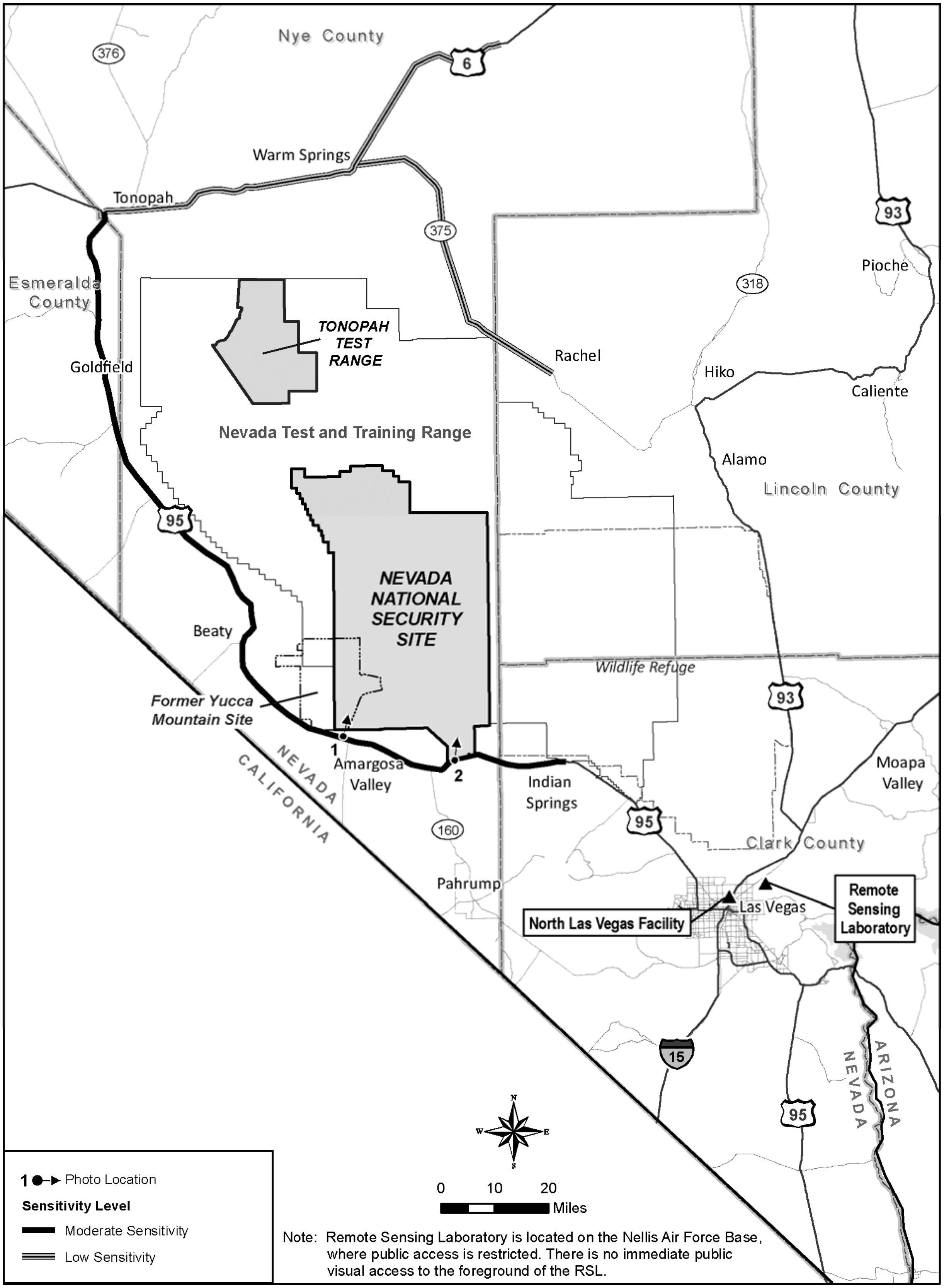


Figure 4–22 Photograph Locations and Sensitivity Levels at the Nevada National Security Site and Other Nevada Locations Managed by the National Nuclear Security Administration

The importance of a view is related in part to the position of the viewer to the resource; therefore, visibility and visual dominance of landscape elements depend on their location within the viewshed. A viewshed is defined as all of the surface area visible from a particular location (e.g., an overlook) or sequence of locations (e.g., a roadway or trail) (FHA 1988). To identify the importance of views of a resource, a viewshed must be broken into distance zones of foreground, middle ground, and background. Generally, the closer a resource is to the viewer, the more dominant it is and the greater its importance to the viewer. Although distance zones in a viewshed may vary between different geographic regions or types of terrain, the standard foreground zone is up to 0.5 miles from the viewer, the middle ground zone is 0.5 miles to 4 miles from the viewer, and the background zone is 4 miles and beyond (USFS 1995).

Visual Resources—American Indian Perspective

All landforms within the Nevada National Security Site (NNSS) have high sensitivity levels for American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is essential for the spiritual interaction between Indian people and our traditional lands.

Views from places are an important cultural resource that contributes to the location and performance of American Indian ceremonialism. Views combine with other cultural resources to produce special places where power is sought for medicine and other types of ceremony. Views can be of any landscape, but more central viewscapes are experienced from high places, which are often the tops of mountains and the edges of mesas. Indian viewscapes tend to be panoramic and are made special when they contain highly diverse topography. The viewscape panorama is further enhanced by the presence of volcanic cones and lava flows.

Viewscapes are tied with songscapes and storyscapes especially when the vantage point has a panorama composed of multiple locations described by traditional songs or stories. Our traditional songscapes and storyscapes can be compromised if projects like geothermal energy development are pursued. If geothermal resources are altered, our songs and stories will be impacted and will no longer accurately reflect key traditional aspects of the viewscape.

The Consolidated Group of Tribes and Organizations (CGTO) recognizes the cultural significance of viewscapes and have identified a number of these on the NNSS. The Timber Mountain Caldera contains a number of significant vantage points with different panoramas including but not limited to Scrugham Peak, Shoshone Mountain, and Buckboard and Pahute Mesa. The CGTO feels revisiting sites within the viewscapes are essential to Indian people to interact with the land, communicate with the spirits who watch over the land, conduct religious ceremonies with prayers and songs, and monitor each site's condition. Special considerations should be given to tribal elders and youth to provide an educational experience and reinforce positive connections with our culture.

See Appendix C for more details.

Visual sensitivity depends on the number and type of viewers and the frequency and duration of views. Visual sensitivity also varies with differences in viewer activity, awareness, and visual expectations in relation to the number of viewers and viewing duration. For example, visual sensitivity is generally higher for views seen by people who are driving for pleasure; people engaging in recreational activities such as hiking, biking, or camping; and homeowners. Sensitivity tends to be lower for views seen by people driving to and from work or as part of their work (USFS 1995; FHA 1988; U.S. Soil Conservation Service 1978). As described above, commuters and nonrecreational travelers have low visual sensitivity. Residential viewers typically have extended viewing periods and are concerned about changes in the views from their homes; therefore, they are generally considered to have high visual sensitivity. Recreational viewers (e.g., those using recreation trails and areas, scenic highways, and scenic overlooks) are usually assessed under the assumption that they have high visual sensitivity.

Nevada National Security Site Vicinity

The NNSS landscape is typical of the Basin and Range Physiographic Province. Key visual features include the Mercury Valley, on either side of U.S. Route 95, gently sloping upward toward the mountains, mesas, and hills enclosing the valley. Representative locations where photographs were taken and sensitivity levels of the roadways in the area are shown in Figure 4–22. Lower elevations in the valley are vegetated with creosote bush and white bursage shrubland, transitioning to spiny menodora, Nevada jointfir, and white bursage shrubland at higher elevations (DOE/NV 2000d). While this vegetation looks rougher in the foreground, it appears smoother as it recedes into the distance. The coarse, angular terrain of the mountain, mesa, and hill slopes provides visual interest during different times of the day, providing simple-to-complex light and shade patterns (see **Figure 4–23**). These patterns provide visual contrast to the smooth valley floor that does not cast visually dynamic shadows. Light and shade also affect the perceived color of the terrain by saturating or dulling the color hues present in the landscape. Development is limited to the Mercury and Amargosa Valleys. While both of these developed areas are small in scale, the use of light-colored building materials makes these areas more visually apparent against the darker natural landscape (see **Figure 4–24**).

Most of Areas 22 and 23 and portions of Area 25 are the only areas of the NNSS that are visible to the public from U.S. Route 95 and the Amargosa Valley. All other public visual access to the interior of the NNSS is limited by terrain. Portions of the study area visible from U.S. Route 95 are considered to have a Class B scenic quality rating due to the lack of visual intrusions and picturesque views of the natural landscape that vary throughout the day and seasonally, combined with commonality of these views to the region.

Figure 4–23 Landscape Photographs – Visual Interest of Terrain near the Nevada National Security Site

Figure 4–24 Landscape Photographs – Developed Areas near the Nevada National Security Site

4.1.10 Cultural Resources

This section discusses the known prehistoric, ethnographic, and historic cultural resources within the boundaries of the NNSS. Unless otherwise noted, the information in this section is derived from the *1996 NTS EIS* (DOE 1996c). Additional information regarding cultural resources on the NNSS was obtained from the Desert Research Institute, which provides cultural resources program support to NNSA/NSO (DOE 2010a). Information sources provided by the Desert Research Institute include the *Cultural Resources Management Plan for the Nevada Test Site* update (DOE 2010a); short report summaries; lists of recorded sites on the NNSS and their National Register of Historic Places (NRHP) eligibility status; and excerpts from major archaeological, ethnographic, and historical studies conducted on the NNSS for NNSA/NSO.

Cultural resources include prehistoric and historic archaeological districts, sites, buildings, structures, or objects created or modified by human activity. Cultural resources also include traditional cultural properties, locations of American Indian significance that are important to a community's practices and beliefs and maintain a community's cultural identity. Under Federal regulation, a significant cultural resource, designated as a "historic property," warrants consideration with regard to potential adverse impacts resulting from proposed Federal actions (DOE 2002e). A cultural resource is a historic property if its attributes make it eligible for listing in the NRHP. Federal agencies also are required to consider the effects of their actions on sites, locations, and other resources, such as plants, that are of cultural or religious significance to American Indians, as established under the American Indian Religious Freedom Act (42 U.S.C. 1996, 1996a). American Indian graves, associated funerary objects, and objects of cultural patrimony are protected by the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 et seq.).

The area of influence for cultural resources is the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of influence for the NNSS is defined as all ground areas that would be disturbed by construction, maintenance, or operations of program facilities and activities occurring on site. Based on current knowledge of cultural resources on the NNSS, all areas have the potential to contain cultural resources. Therefore, the area of influence for this SWEIS comprises the entire NNSS.

The NNSS lies within the Southern Great Basin physiographic region and possesses a long history of American Indian occupation and more-recent European-American settlement and American military use. The following is a brief outline of prehistoric, ethnographic, and historic cultural chronologies.

Archaeological research has documented 12,000 years of human occupation on the NNSS. Numerous prehistoric chronological sequences have been developed for the Southern Great Basin (Lyneis 1982; Pippin 1995 and 1998a; Warren and Crabtree 1986). The chronological periods are defined primarily by major changes in patterns of artifact assemblage composition, subsistence, settlement, and land use characterizing each period. The chronology developed by Pippin is most applicable to the NNSS (Pippin 1998a). These chronologies of cultural adaptations generally fall into periods occurring during the late Pleistocene (12,000–10,000 BP [years before present]); early Holocene (10,000–7,500 BP); middle Holocene (7,500–4,500 BP); and late Holocene (4,500–150 BP) (DOE 2010a).

At the time of historic contact during the mid-nineteenth century, the region in which the NNSS is situated was occupied by Numic-speaking hunter-gatherer groups now known as the Western Shoshone and the Southern Paiute, whose territories were defined by ethnicity, political affiliation, and subsistence and settlement patterns (Drollinger et al. 2009; Pippin 1998b).

The first European Americans known to traverse what is now the NNSS were emigrants on their way to California in 1849 (DOE 2010a). The area remained sparsely populated and served primarily as a transportation corridor. However, short-lived periods of mining and ranching occurred in the region as well. Military use of the area began in 1940; since that time, the NNSS has remained associated with national security missions, military research and training, and nuclear weapons testing.

4.1.10.1 Recorded Cultural Resources

Current knowledge of cultural resources on the NNSS results from numerous cultural resources studies completed over the last 30 years. Many of these studies were completed prior to NNSS activities, but most were completed within the framework of the NNSS Cultural Resources Management Program. Over 600 cultural resources studies have been conducted on the NNSS and almost 2,000 cultural resources sites have been recorded (see **Table 4–46**). Approximately 4 percent of the NNSS has been surveyed for cultural resources. Surveys are generally completed as part of Section 110 inventory requirements or Section 106 compliance for NNSS projects. In the past, projects were frequently conducted at the higher elevations in the northern end of the NNSS; therefore, the amount of acreage surveyed in these areas, along with the number of identified cultural resources, is greater in the north relative to other portions of the NNSS. However, over the past 10 years, most projects and their associated cultural resources studies have occurred at lower elevations. While all areas of the NNSS have the potential to possess cultural resources, the areas with higher numbers of recorded cultural resources are Rainier and Pahute Mesas in the northwest, followed by Jackass Flats in the southwest, and Yucca Flat in the east (DOE 2010a).

Table 4–46 Nevada National Security Site Cultural Resources Sites by Site Type and Hydrographic Basin

	Prehistoric Site Types							*Historic Site Types*		*Untyped Sites*		
Hydrographic Basin	RB	TC	EL	PL	LO	CA	STA	HI	NT	UT	***Total Sites***	***NRHP-Eligible***
Mercury Valley	0	0	0	0	3	0	0	1	2	0	6	2
Rock Valley	0	1	1	1	15	0	0	0	1	0	19	4
Fortymile Canyon–Jackass Flats	1	36	17	62	243	7	1	8	8	9	392	120
Fortymile Canyon–Buckboard Mesa	0	111	7	109	211	6	1	3	0	54	502	346
Oasis Valley	0	14	1	20	90	0	0	1	0	2	128	49
Gold Flat	0	25	1	97	131	10	0	2	1	1	268	169
Kawich Valley	0	9	1	25	37	0	0	2	0	8	82	58
Emigrant Valley/Groom Lake Valley	0	0	0	0	5	0	0	0	0	0	5	0
Yucca Flat	4	68	10	37	132	57	1	44	25	17	395	176
Frenchman Flat	1	3	2	43	60	0	0	11	34	0	154	58
Total Sites	**6**	**267**	**40**	**394**	**927**	**80**	**3**	**72**	**71**	**91**	**1,951**	**982**

CA = cache; EL = extractive locality; HI = historic site; LO = locality; NRHP = National Register of Historic Places; NT = nuclear testing; PL = processing locality; RB = residential base; STA = station; TC = temporary camp; UT = untyped.
Note: This table does not include isolated artifacts or features. This table does include sites recorded within environmental restoration sites in the Nevada Test and Training Range adjacent to the NNSS.

Prehistoric archaeological sites make up 90 percent of recorded cultural resources. The remaining 10 percent are historic archaeological sites and structures, more-recent facilities and locations associated with scientific research, or sites of unknown age (DOE 2010a). Numerous evaluations of nuclear weapons testing facilities have been conducted since the *1996 NTS EIS* was completed, resulting in 38 sites and historic districts associated with NNSS activities becoming eligible for listing in the NRHP.

The types of cultural resources found on the NNSS include prehistoric and historic sites, features, and artifacts. These resources provide a range of information about past human activity. The terminology used to describe these resources is derived from site type definitions used by the Desert Research Institute (DOE 2010a) and adapted from the *1996 NTS EIS* (DOE 1996c). Prehistoric sites consist of residential bases, temporary camps, extractive localities, processing localities, uncategorized localities, caches, and stations. Historic site types are presented here in two categories: historic sites reflecting mining, ranching, communications, or transportation activities, and those sites and features associated with nuclear weapons testing of the Cold War era. Untyped sites lack enough information to assign a more specific category. Isolated artifacts consist of single prehistoric or historic artifacts or features that lack context and provide limited information about past human activity.

Residential bases are locations of extended occupation of prehistoric people. Temporary camps are occasional operational centers of prehistoric populations or task-oriented groups. These sites served as bases for resource collection and processing, tool manufacture and maintenance, and living activities. The wide range of artifact categories and features at these sites provides important data reflecting the diverse activities conducted by prehistoric populations. Extractive localities are sites where resources were procured. These sites may consist of quarries, water sources, plant-gathering areas, and hunting blinds. Processing localities are areas where groups brought procured resources, such as plant and animal resources or toolstone material, for processing or manufacture. Uncategorized localities lack sufficient information to determine what type of activity is represented. These three locality site types are areas of focused activity that lack the diverse artifact assemblages that residential bases or temporary camps possess. Caches are places used for storing tools or plant and animal resources. Stations are areas where information about game movement, travel routes, or ritual activity was shared and may consist of cairns marking travel routes, geoglyphs, rock art, and observation points.

Historic sites reflect broad categories of activities that occurred after European Americans arrived in the area. These activities are reflected in material remains at mining sites and ranching sites, and on transportation and communication routes.

Documents providing further information used to assess cultural resources located on the NNSS include prehistoric overviews (Pippin et al. 1986; Pippin 1995; DuBarton and Drollinger 1996; Drollinger et al. 2000; Jones et al. 2001), ethnographic and historical studies (DuBarton and Drollinger 1996; Pippin 1998a; Johnson et al. 1999; Zedeno et al. 1999; Drollinger and Nials 1996; Jones et al. 2001; Drollinger 2003), and studies associated with nuclear testing (Beck et al. 1996; Johnson and Edwards 2000; Johnson et al. 2000; Jones et al. 2005; Drollinger et al. 2009; and others). The following discussion presents a brief description of known cultural resources on the NNSS, most documented as a result of cultural resource compliance studies associated with DOE activities. Because the NNSS covers a large geographic area, cultural resources are grouped by the 10 hydrographic basins located within the NNSS boundary (NDWR 2010a) (see Figure 4–9 and Table 4–46). The cultural resources described below consist of archaeological sites and historic NNSS facilities; isolated artifacts and features are not discussed.

4.1.10.1.1 Mercury Valley

Mercury Valley is bounded by the Spotted Range and the Specter Range. Twenty-six cultural resources studies have been conducted within the portion of Mercury Valley that lies within the NNSS. Approximately 338 acres have been surveyed for cultural resources. Only six sites have been recorded as a result of these surveys. Of these, three are prehistoric localities and one is a historic site, none of which is eligible for listing in the NRHP. One historic district associated with nuclear testing, the Camp Desert Rock Historic District, was recorded, evaluated, and determined to be eligible for listing in the NRHP. The Camp Desert Rock Historic District contains building foundations and features associated with the administration and housing of troops who participated in the Desert Rock atmospheric exercises (Edwards 1997).

4.1.10.1.2 Rock Valley

Rock Valley is bounded by the Specter Range to the south and Skull and Little Skull Mountains to the north. The majority of Rock Valley lies within the NNSS boundary. Eleven archaeological reconnaissance surveys have been conducted within Rock Valley and approximately 445 acres have been surveyed for cultural resources. A total of 19 sites have been recorded as a result of these studies, including 1 temporary camp, 1 extractive locality, 1 processing locality, 15 uncategorized localities, and 1 event associated with nuclear testing. Of these 19 sites, 4 are eligible for listing in the NRHP, 1 of which exhibits occupation from the prehistoric, ethnographic, and historic periods (Jones et al. 2003).

4.1.10.1.3 Fortymile Canyon–Jackass Flats

The Fortymile Canyon–Jackass Flats hydrographic basin is bounded by Skull and Little Skull Mountains to the south and the Shoshone Mountains to the north. Almost the entire basin falls within the NNSS boundary. A total of 167 cultural resources studies have been conducted within this area, covering approximately 575 acres. The number of cultural resources identified in this basin is high, reflecting the extensive cultural resources studies associated with NNSS activities in the area. A total of 392 cultural resources sites have been recorded as a result of these studies. This number includes 1 residential base, 36 temporary camps, 17 extractive localities, 62 processing localities, 243 uncategorized localities, 7 caches, 1 station, 9 untyped sites, 8 historic sites, and 8 sites related to nuclear testing. To date, 120 sites are eligible for listing in the NRHP.

4.1.10.1.4 Fortymile Canyon–Buckboard Mesa

This hydrographic basin includes Buckboard Mesa and a portion of Pahute Mesa. It is bounded by the Shoshone Mountains to the west and the Eleana Range to the east. A total of 69 cultural resources studies have been conducted within the portion of Buckboard Mesa that lies within the NNSS boundary. Approximately 6,138 acres have been surveyed for cultural resources. Buckboard Mesa possesses the highest number of recorded archaeological sites on the NNSS. To date, 502 sites have been recorded in the Fortymile Canyon–Buckboard Mesa hydrographic basin. This total includes 111 temporary camps, 7 extractive localities, 109 processing localities, 211 uncategorized localities, 6 caches, 1 station, 3 ranching sites, and 54 untyped archaeological sites. Of these resources, 346 sites are eligible for listing in the NRHP. The large number of prehistoric sites, particularly localities and temporary camps, suggests that this region was intensively used by prehistoric hunter-gatherers.

4.1.10.1.5 Oasis Valley

The eastern portion of the Oasis Valley hydrographic basin lies within the NNSS boundary and includes portions of Pahute Mesa. A total of 32 cultural resources investigations have been conducted within the portion of Oasis Valley that lies within the NNSS boundary, and 10 studies have been conducted on environmental restoration sites within the Nevada Test and Training Range adjacent to the NNSS. Approximately 3,477 acres have been surveyed for cultural resources. To date, 128 cultural resources have been recorded in this portion of Oasis Valley. These include 14 temporary camps, 1 extractive locality, 20 processing localities, 90 uncategorized localities, 1 historic period site, and 2 untyped sites. Of these, 49 sites are eligible for listing in the NRHP.

4.1.10.1.6 Gold Flat

The southern portion of the Gold Flat hydrographic basin lies within the NNSS boundary and includes part of Pahute Mesa. A total of 52 cultural resources studies have been conducted in the portion of Gold Flat that lies within the NNSS. Approximately 6,371 acres have been surveyed for cultural resources. To date, 268 sites have been recorded as a result of these studies. These sites include 25 temporary camps, 1 extractive locality, 97 processing localities, 131 uncategorized localities, 10 caches, 2 historic sites, 1 site associated with a nuclear testing event, and 1 untyped site. Of these, 169 prehistoric sites are eligible for listing in the NRHP.

4.1.10.1.7 Kawich Valley

The southern part of Kawich Valley lies within the NNSS boundary and includes a portion of Pahute Mesa. A total of 22 cultural resources studies have been conducted in the portion of this basin that lies within the NNSS boundary. Approximately 2,635 acres have been surveyed for cultural resources. To date, 82 sites have been recorded as a result of cultural resources studies. These sites include 9 temporary camps, 1 extractive locality, 25 processing localities, 37 uncategorized localities, 2 historic sites, and 8 untyped sites. Of these sites, 58 are eligible for listing in the NRHP.

4.1.10.1.8 Emigrant Valley

A very small portion of the Emigrant Valley hydrographic basin lies within the NNSS boundary. This basin includes a portion of the Belted Range. Two cultural resources surveys have been conducted in the portion of the basin that lies within the NNSS boundary and one study has been conducted on an environmental restoration site on the Nevada Test and Training Range just northeast of the NNSS. Approximately 60 acres have been surveyed for cultural resources. Five prehistoric localities have been recorded in this area, none of which is eligible for listing in the NRHP.

4.1.10.1.9 Yucca Flat

Most of the Yucca Flat hydrographic basin lies within the NNSS boundary and is bounded by the Eleana Hills to the west and the Halfpint Range to the east. Yucca Dry Lake lies at the southern end of the basin. To date, 150 cultural resources studies have been conducted in Yucca Flat. Approximately 9,030 acres have been surveyed for cultural resources. To date, 395 sites have been recorded within Yucca Flat. These sites consist of 4 residential bases, 68 temporary camps, 10 extractive localities, 37 processing localities, 132 uncategorized localities, 57 caches, 1 station, 44 historic sites, 25 sites associated with nuclear testing, and 17 untyped sites. Currently, 176 sites are eligible for listing in the NRHP, 18 of which are associated with nuclear testing. One site, Sedan Crater, is already listed in the NRHP. Numerous structures associated with atmospheric nuclear testing are eligible for listing in the NRHP, such as the Yucca Flat Historic District (Jones et al. 2005; Johnson and Edwards 2000; Drollinger et al. 2009).

4.1.10.1.10 Frenchman Flat

Frenchman Flat is bounded by the Spotted Range to the east; Mine Mountain and Massachusetts Mountain to the north; the Shoshone Mountains, Lookout Peak, and the Skull Mountains to the west; and the Ranger Mountains to the south. The western half of the Frenchman Flat hydrographic basin lies within the NNSS boundary. A total of 63 cultural resources studies have been completed for the portion of Frenchman Flat that lies within the NNSS boundary. Approximately 9,047 acres have been surveyed for cultural resources. To date, 154 sites have been recorded as a result of these studies. These sites consist of 1 residential base, 3 temporary camps, 2 extractive localities, 43 processing localities, 60 uncategorized localities, 11 historic sites, and 34 sites associated with nuclear testing and research. Of these, 58 sites are eligible for listing in the NRHP, 8 of which are associated with nuclear testing. One of these is the Frenchman Flat Historic District; it includes buildings, structures, and features associated with nuclear atmospheric testing (Johnson et al. 2000).

4.1.10.2 Sites of American Indian Significance

In compliance with Federal laws and DOE policy, NNSA/NSO conducts an ongoing American Indian consultation program to address American Indian concerns about archaeological sites, plant and animal resources, traditional cultural properties, and sacred sites on the NNSS that hold great cultural value. This program has been in place since 1987 and recognizes the government-to-government relationship between NNSA/NSO and American Indians. NNSA/NSO consults with representatives of 16 tribal groups and 1 American Indian organization representing 3 ethnic groups (Western Shoshone, Southern Paiute, and Owens Valley Paiute) who have cultural and historic ties to the NNSS area. These American Indian groups are collectively known as the Consolidated Group of Tribes and Organizations (CGTO). Representatives express their respective tribal concerns and perspectives to DOE and provide input regarding the protection and management of sites and resources that hold important cultural values for CGTO (DOE 2010a).

Ongoing consultation with CGTO, consisting of meetings, interviews, and site visits, has resulted in several studies that identify sites and locations throughout the NNSS that possess cultural significance for contemporary American Indians (Stoffle et al. 1989a, 1989b, 1994). These sites and locations consist of numerous ethnoarchaeological, ethnobotanical, and ethnozoological sites; rock art sites; and sites of spiritual significance (DOE 2010a). These consultation efforts have resulted in a better understanding of the cultural significance these sites and locations possess in relation to traditional cultural landscapes (Zedeno et al. 1999; Stoffle et al. 1996; Stoffle et al. 2001).

4.1.10.3 American Indian Cultural Resources

As a part of consultation efforts conducted for this SWEIS, the CGTO American Indian Writers Subgroup documented American Indian perspectives on cultural resources on the NNSS, in relation to the proposed undertaking. This information is presented in the following sections.

Cultural Resources—American Indian Perspective

American Indians consider cultural resources to include not only archaeological remains left by their ancestors but also natural resources and geologic formations in the region, such as plants, animals, water sources, minerals, and natural landforms that mark important locations for keeping their history alive and for teaching their children about their culture. The Consolidated Group of Tribes and Organizations (CGTO) knows, based upon its collective knowledge of Indian culture and past American Indian studies, that American Indian people view cultural resources as being interconnected.

The Nevada National Security Site (NNSS) area and nearby lands were significant to the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people. The lands were central in the lives of these people and were mutually shared for religious ceremony, resource use, and social events (Stoffle et al., 1990a and b). When Europeans encroached on these lands, the numbers of Indian people, their relations with one another, and the condition of their traditional lands began to change. European diseases killed many Indian people; European animals replaced Indian animals and disrupted fields of natural plants; Europeans were guided to and then assumed control over Indian minerals; and Europeans took Indian agricultural areas. Indian people believe that the natural state of their traditional lands was what existed before European contact, when Indian people were fully responsible for the continued use and management of these lands.

The withdrawal of Nevada's lands for military purposes in the 1940's, followed by use of the land by the U.S. Department of Energy (DOE) continued the process of Euroamerican encroachment on Indian lands. Land-disturbing activities followed, thus causing some places to become unusable again for Indian people. On the other hand, many places were protected by this land withdrawal because "pothunters" were kept from stealing artifacts from rock shelters and European animals were kept from grazing on Indian plants. The forced removal of Indian people from the land was combined with their involuntary registration and removal to distant reservations in the early 1940s. Indian people were thus removed from lands that had been central to their lives for thousands of years.

DOE has supported several cultural resource studies at the NNSS, most occurring as a result of recommendations made by the CGTO in the 1996 NTS FEIS and commitments made by DOE in the subsequent Record of Decision. Many of these studies are cited throughout Appendix C of the SWEIS. These studies were also designed to comply with various federal laws and executive orders, including the American Indian Religious Freedom Act, Native American Grave Protection and Repatriation Act, and Executive Order 13007, *Indian Sacred Sites*.

Through these studies, the CGTO confirmed that American Indians used traditional sites in the NNSS area to make tools, stone artifacts, and ceremonial objects; many sites are also associated with traditional healing ceremonies and power places. Several areas in the NNSS region are recognized as traditionally or spiritually important. For example, Fortymile Canyon was an important crossroad where trails from such distant places as Owens Valley, Death Valley, and the Avawatz Mountain came together. Black Cone, in Crater Flat, is an important religious site that is considered to be an entry to the underworld. Alice Hill, (refine location with acceptable language) is also regarded as a culturally important place (AIWS 2005). Prow Pass was an important ceremonial site and, because of this religious significance, tribal representatives have recommended that DOE avoid affecting this area (Stoffle et al. 1988). Oasis Valley was another important area for trade and ceremonies. In 1993, tribal members visited a rockshelter site containing perishable basketry and crookneck staff on the NNSS, and recommended that the items be left in place, with annual monitoring to assess their condition. Gold Meadows is also extremely important to the Indian people. Other areas are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and possible burial sites.

See Appendix C for more details.

4.1.11 Waste Management

Introduction

Radioactive and nonradioactive wastes are generated and managed at the NNSS as part of operations in support of National Security/Defense and Nondefense Mission programs; decontamination and demolition of unneeded structures and facilities; and the Environmental Restoration Program, including remediation of soil sites and industrial facilities and, to a small extent, the UGTA Project.[8] Radioactive wastes generated and/or managed at the NNSS include LLW and MLLW, and TRU waste. The Waste Management Program also manages nonradioactive hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.), wastes containing asbestos or polychlorinated byphenyls (PCBs) regulated under the Toxic Substances Control Act (TSCA) (15 U.S.C. 2601 et seq.), explosive wastes; and nonhazardous wastes, including sanitary solid waste, construction and demolition debris, and hydrocarbon-contaminated soil and debris. These wastes are defined in Chapter 12, "Glossary."

> **Nevada National Security Site (NNSS) Low-Level and Mixed Low-Level Radioactive Waste Management Programs**
>
> The NNSS low-level radioactive waste (LLW) management program addresses waste containing radioactive constituents (LLW as defined in Chapter 12, "Glossary") as well as LLW containing regulated (friable) asbestos, polychlorinated biphenyls (PCBs) in low concentrations (e.g., radioactive PCB bulk product waste containing PCBs in concentrations less than 50 parts per million), or hydrocarbon-contaminated soil and debris. The NNSS mixed low-level radioactive waste (MLLW) program addresses waste containing both radioactive and hazardous constituents (MLLW as defined in Chapter 12, "Glossary"), as well as radioactive waste containing PCBs in sufficient concentrations (e.g., radioactive PCB remediation waste containing PCBs in large capacitors or fluorescent light ballasts).

LLW and MLLW managed at the NNSS include wastes generated by activities within the NNSS or other in-state locations such as the TTR, as well as wastes received from authorized out-of-state DOE and DoD generators, including classified wastes.[9] Wastes thus generated or received may be disposed within authorized and/or permitted disposal units located at the NNSS Area 5 RWMC and the Area 3 RWMS. (The Area 3 RWMS has been in standby mode since July 1, 2006.)

MLLW received from authorized out-of-state generators must be treated in accordance with EPA land disposal restriction requirements before delivery to the NNSS. MLLW, however, generated at the NNSS or by other authorized in-state generators may be repackaged at the Area 5 RWMC before disposal, provided the waste meets the acceptance criteria for disposal. In-state-generated MLLW that does not meet the NNSS acceptance criteria for treatment is transferred to offsite treatment, storage, or disposal units.[10] In-state-generated LLW containing regulated PCBs in sufficient concentrations, asbestos, or hydrocarbon-contaminated soil and debris may be disposed at the NNSS in state-permitted disposal units, provided the waste meets the NNSS waste acceptance criteria for disposal.[11]

TRU waste generated as part of ongoing NNSS operations or from in-state environmental restoration programs is sent to the Area 5 RWMC for temporary storage before shipment off site for further characterization and/or final disposition.

---

[8] *The NNSS Environmental Restoration Program includes compliance with the FFACO, which was entered into in 1996 by DOE, DoD, and the State of Nevada (NDEP 1996). The FFACO provides a process for identifying sites that have potential historic contamination, implementing state-approved corrective actions, and instituting closure actions for remediated sites.*

[9] *Some LLW or MLLW consists of classified material that has not been sanitized, demilitarized, or declassified. In addition, the NNSS is designated as a Classified Waste Disposal Facility and accepts low-level classified waste (with or without hazardous constituents) for disposal without sanitization.*

[10] *MLLW treated at offsite facilities may be disposed off site or returned to NNSS for disposal.*

[11] *Hydrocarbon-contaminated LLW received from out-of-state generators may be disposed in any LLW disposal unit.*

Tritiated liquids generated by environmental restoration or other in-state DOE activities are managed by evaporation.

Hazardous waste (and waste regulated under the TSCA or other statutes) generated at the NNSS may be sent directly from the point of generation to permitted offsite treatment, storage, or disposal facilities. If packaged, however, the waste may be temporarily stored in the Area 5 RWMC and consolidated, pending shipment to offsite treatment, storage, or disposal facilities. The waste may also be sent off site for recycle or reuse as part of the NNSS Pollution Prevention and Waste Minimization Program.

Small quantities of explosives or wastes containing explosives may be disposed in Area 11 of the NNSS in accordance with a RCRA permit.

Nonhazardous waste generated at the NNSS or by other in-state generators may be recycled, reused, or disposed in permitted landfills such as those operating in Areas 6, 9, and 23 of the NNSS.

Waste management construction, storage, treatment, and disposal activities at the NNSS are summarized in **Table 4–47** and discussed in this section. The status column in the table relates the current status of the listed activity with respect to its analyses in the *1996 NTS EIS* (DOE 1996c) and the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002g).

Table 4–47 Current Nevada National Security Site Waste Management Activities

Activity	*Status* [a]	*Remarks*
Area 3 Radioactive Waste Management Site		
Disposal		
NNSA/NSO-generated LLW Other LLW	On standby	The Area 3 RWMS would be used for specific waste streams for which it would be economically or environmentally advantageous to dispose waste at that facility.
Closure		
Disposal Crater Complex U3ax/bl	Complete	Facility closure as a RCRA-regulated MLLW disposal unit was completed in 1999.
Disposal Craters U3ah/at and U3bh	On standby	Additional crater disposal is possible pending final closure in accordance with an integrated closure and monitoring plan.
Construction		
Future LLW disposal units	Not developed	Additional existing subsidence craters would be developed as needed if the Area 3 RWMS is re-opened.
Expanded support facility	Not constructed	This project to double the size of an existing support building by adding a prefabricated structure was not implemented. It may be needed in the future if the Area 3 RWMS is re-opened.
Truck decontamination facility	Not constructed	This facility was not constructed but may be needed in the future if the Area 3 RWMS is re-opened.
Area 5 Radioactive Waste Management Complex		
Disposal		
NNSA/NSO-generated LLW LLW received from other authorized generators	Ongoing	Disposal is expected to continue for as long as needed by the U.S. Department of Energy complex in a variety of types of disposal units constructed with consideration of the radiological and chemical characteristics of the wastes to be disposed (e.g., deeper disposal for high-activity wastes).
MLLW	Ongoing	Disposal of in-state- and out-of-state-generated MLLW would continue in the Area 5 RWMC in the new NDEP-permitted disposal unit, Cell 18 [b]. Previously used Pit 3 ceased acceptance of MLLW on November 30, 2010, and is undergoing formal closure.
Greater confinement disposal	Complete	No new waste will be disposed in existing greater confinement disposal boreholes; the performance assessment for these boreholes has been completed. These boreholes are being closed as part of the 92-acre closure.

Activity	***Status*** [a]	***Remarks***
Regulated asbestos LLW	Ongoing	LLW containing regulated asbestos (also called asbestiform waste) is accepted for disposal in Pit 6; disposal of this waste is expected to continue in a new disposal unit after Pit 6 is closed as part of closure of the existing 92-Acre Area.
Storage		
Mixed waste	Ongoing	NNSA/NSO received a RCRA permit for storage of in-state and out-of-state MLLW.
TRU waste	Ongoing	Except for two TRU spheres, all stored legacy TRU wastes were shipped off site for characterization at INL and/or disposal at WIPP. The TRU spheres will be stored pending offsite shipment. Experiments at JASPER generate small annual quantities of TRU waste. Environmental restoration activities may also generate TRU waste. All TRU wastes will be safely stored pending offsite shipment for characterization at INL and/or disposal at WIPP.
Hazardous waste	Ongoing	Temporary storage before shipment to offsite treatment, storage, or disposal facilities.
Treatment		
Repackaging	Ongoing	Repackaging is currently performed on debris generated by in-state environmental restoration programs to meet disposal requirements such as RCRA land disposal restrictions. Repackaging occurs at the TRU Waste Storage Pad.
Facility Construction Activities		
Real-Time Radiography	Complete	A real-time radiography unit is operational for nondestructive examination of LLW and MLLW.
TRU Waste Certification Facility TRU Waste Handling and Loading Facility	Complete	Also known as the Waste Examination Facility. Within the Waste Examination Facility, modifications were made to the Visual Examination and Repackaging Building to support repackaging of TRU waste for offsite shipment, which has been completed. Available for future use for waste treatment projects.
LLW disposal units	Ongoing	New disposal units are typically constructed as needed, based on waste forecasts and baseline operating budgets. The current threshold for new disposal unit construction is when remaining total capacity falls below 3.5 million cubic feet.
MLLW disposal units	Ongoing	NNSA received an NDEP-issued RCRA permit in December 2010 for a new MLLW disposal unit (Cell 18). Cell 18 is currently in operation.
Hazardous waste storage unit (expansion)	Not constructed	If needed in the future, increase to 0.138 acres, with a capacity of 55,000 gallons.
Maintenance building	Not constructed	This 3,200-square-foot storage facility for equipment and machinery was not constructed, but may be needed in the future.
LLW Storage Facility	Not constructed	This 3,000-square-foot curbed concrete pad was not constructed, but may be needed in the future.
Closure Activities		
Close LLW disposal units Close MLLW disposal units	Ongoing	Individual disposal units are operationally closed as they are filled to capacity with waste. Preparations for final closure of the existing 92-Acre Area have begun, as noted below; interim closure is expected to be completed in fiscal year 2011 under the approved 92-Acre Area closure plan.
Close greater confinement disposal units	Ongoing	All existing disposal units have been operationally closed. These disposal units are being filled to grade in preparation for interim closure of the existing 92-Acre Area in fiscal year 2011.
Area 6		
Storage Activities		
PCB-contaminated waste	Discontinued	The Area 6 facility operated temporarily as part of an NNSS program to collect and dispose PCB-contaminated waste. Currently, in-state-generated PCB-contaminated waste may be stored at the Hazardous Waste Storage Unit in the Area 5 RWMC before offsite shipment for disposal. LLW and MLLW containing regulated PCBs in concentrations greater than or equal to 50 parts per million are disposed in the Mixed Waste Disposal Unit (Cell 18).

Activity	*Status* [a]	*Remarks*
Disposal Activities		
Hydrocarbon landfill	Ongoing	Hydrocarbon-contaminated soils and materials generated at the NNSS are disposed at this NDEP-permitted facility. Small quantities of hydrocarbon waste may also be disposed at the U10c landfill in Area 9. Hydrocarbon-contaminated LLW is disposed at the Area 5 RWMC.
Area 9		
Disposal Activities		
U10c Landfill	Ongoing	Accepts inert debris and small quantities of hydrocarbon-contaminated soil and debris.
Area 11		
Treatment Activities		
Explosives Ordnance Disposal Unit	Ongoing	This RCRA-permitted treatment unit may detonate up to 100 pounds of approved waste per hour, and up to 4,100 pounds in a year.
Area 23		
Disposal Activities		
Landfill	Ongoing	Accepts less than 20 tons daily of sanitary solid waste.

INL = Idaho National Laboratory; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NDEP = Nevada Division of Environmental Protection; NNSA/NSO = National Nuclear Security Administration Nevada Site Office; NNSS = Nevada National Security Site; PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] Status relative to the analysis performed for these activities in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996c) and the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002g).

[b] Waste disposed in the Mixed Waste Disposal Unit (Cell 18) includes classified MLLW and LLW, including LLW containing regulated PCBs in concentrations greater than or equal to 50 parts per million and LLW containing regulated asbestos.

Source: Clark et al. 2005; Di Sanza and Carilli 2006; DOE 1996c, 2002g; Gordon 2009b.

4.1.11.1 Radioactive Waste Management

This section addresses NNSS management of LLW and MLLW, and TRU waste.

4.1.11.1.1 Low-Level and Mixed Low-Level Radioactive Waste Management and Disposal

LLW management and disposal currently occurs within the Area 5 RWMC. The Area 5 RWMC is also used for management and disposal of MLLW, and for management of TRU and hazardous wastes. The Area 3 RWMS has been used for disposal of LLW, but is currently in standby mode.

The NNSS receives for disposal LLW and MLLW generated within the DOE complex from numerous DOE sites across the United States, including the NNSS, as well as from DoD sites that carry a national security classification[12] (DOE/NV 2009d). In DOE's December 1996 ROD (61 FR 65551) for the *1996 NTS EIS*, DOE selected the Expanded Use Alternative for most activities, but selected the Continue Current Operations (No Action) Alternative for LLW and MLLW management (61 FR 65551) pending a decision reached through the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (WM PEIS)* (DOE 1997). On February 25, 2000 (65 FR 10061), in the fourth ROD for the *WM PEIS*, DOE established the NNSS as one of two regional LLW and MLLW disposal sites for the DOE complex. This 2002 ROD also modified DOE's December 1996 ROD (61 FR 65551) for the *1996 NTS EIS* by selecting the Expanded Use Alternative for management of LLW and MLLW (see Chapter 1, Section 1.4).

[12] *A security classification is a category to which national security information and material is assigned to denote the degree of damage that unauthorized disclosure would cause to national defense or foreign relations of the United States and to denote the degree of protection required.*

4.1.11.1.1.1 Area 3 Radioactive Waste Management Site

The Area 3 RWMS is located in the northwestern quadrant of Area 3 (see **Figure 4–25**). It covers about 120 acres and includes two support buildings (an office trailer and a change area), as well as land dedicated to waste disposal. It is an access-controlled facility surrounded by a wire fence and earthen berms to mitigate potential flooding (DOE/NV 2007c). The Area 3 RWMS includes five disposal units configured from seven subsidence craters caused by underground weapons testing (see **Table 4–48**). Opened in the late 1960s, it was used for disposal of bulk and containerized LLW, such as contaminated soil and debris, but is currently in standby (Di Sanza and Carilli 2006, DOE/NV 2009d).

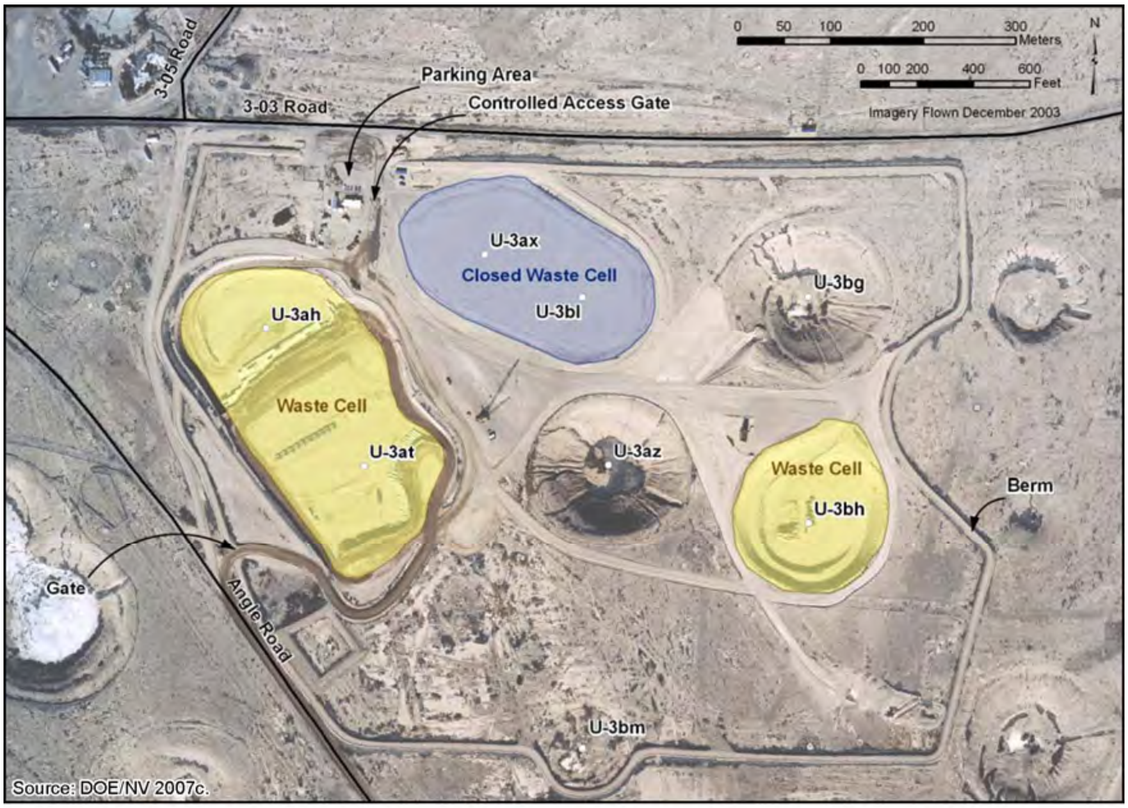


Figure 4–25 Area 3 Radioactive Waste Management Site

Table 4–48 Area 3 Radioactive Waste Management Site Disposal Units

Available Disposal Units [a]	*Closed Disposal Units*	*Undeveloped Disposal Units*
U-3ah/at [b] U-3bh	U-3ax/bl [b]	U-3az U-3bg

[a] As of July 1, 2006, these two disposal units were placed into inactive status.
[b] These disposal units were configured from two subsidence craters.
Source: DOE/NV 2009d.

In FY 2001, the U-3ax/bl disposal unit, which contains hazardous constituents regulated under RCRA (CAU 110), was closed in accordance with a closure plan approved by NDEP. In FY 2001, a lysimeter, which measures water content in soil, was constructed at the Area 3 RWMS to gain data to be used to design final closure covers for NNSS disposal areas. As of early 2006, several million cubic feet of disposal capacity remained in developed and undeveloped subsidence craters. But, because forecasted disposal volumes were lower than expected, on July 1, 2006, the Area 3 RWMS was placed on standby pending a future need (Di Sanza and Carilli 2006; DOE/NV 2007c, 2009d). Final closure of the Area 3 RWMS will occur in accordance with an integrated closure and monitoring plan (see Section 4.1.11.1.1.3).

4.1.11.1.1.2 Area 5 Radioactive Waste Management Complex

In 1961, an area northwest of Frenchman Lake was reserved as an LLW disposal site under regulatory provisions derived from the Atomic Energy Act of 1954, as amended. In 1977, the area was designated the Area 5 Radioactive Waste Management Site (DOE 1996c). Since then, activities at the area have been expanded to include management or disposal of other types of waste. The entire complex of waste treatment, storage, management, disposal, and support capacity is termed the Area 5 RWMC (see **Figure 4–26**). Current operations at the Area 5 RWMC include LLW and MLLW examination and disposal; temporary hazardous and MLLW storage; repackaging of some MLLW before disposal; and temporary storage of in-state-generated TRU waste pending offsite shipment.

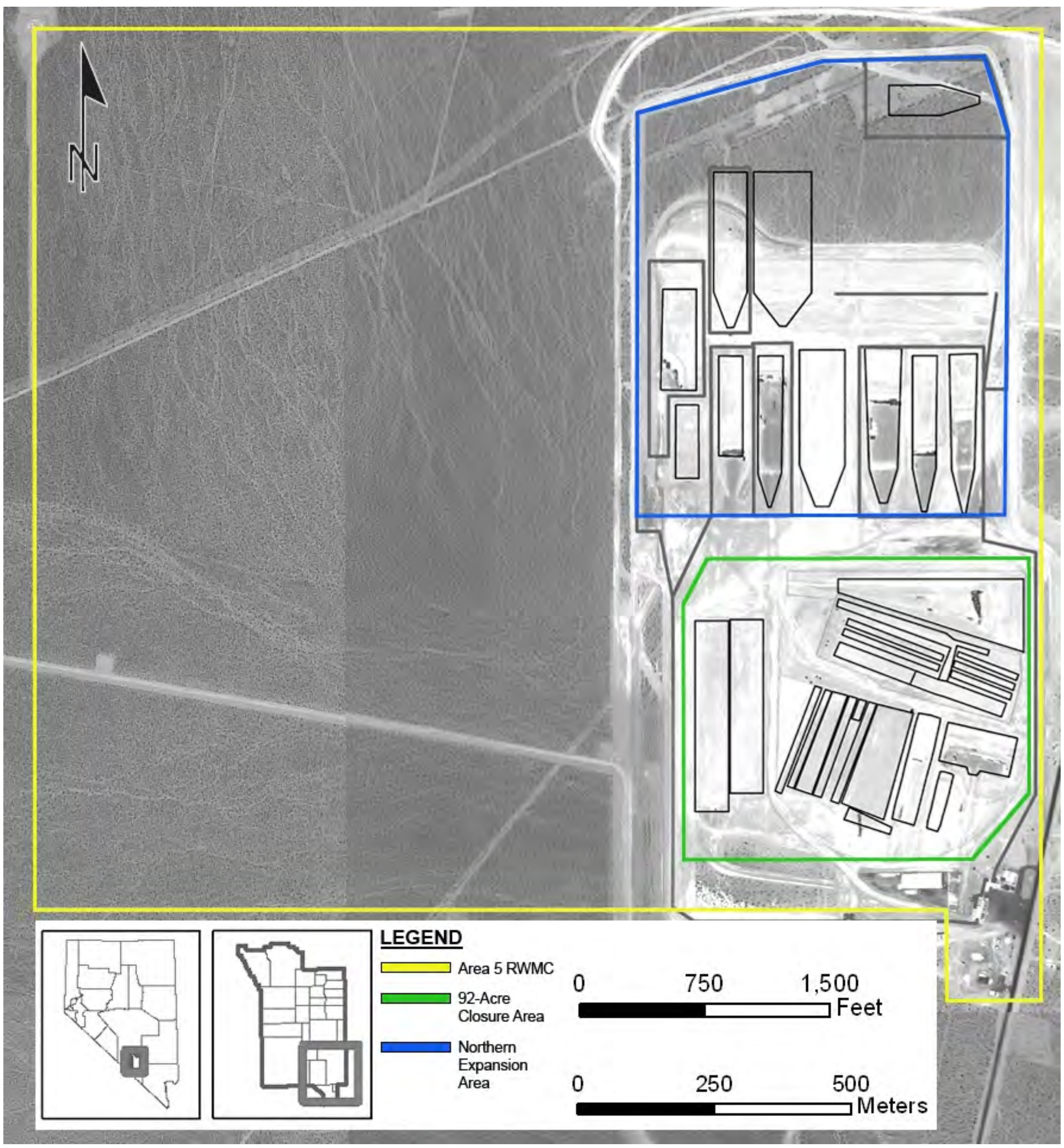


Figure 4–26 Area 5 Radioactive Waste Management Complex

Past and current waste disposal operations are summarized in this section. Additional information about activities at the Area 5 RWMC is provided in the following sections:

- Section 4.1.11.1.1.3, "Waste Disposal Support Activities"
- Section 4.1.11.1.2, "Mixed Low-Level Radioactive Waste Management"
- Section 4.1.11.1.3, "Transuranic Waste Management"
- Section 4.1.11.2.1, "Hazardous Waste Management"

The Area 5 RWMC covers about 740 acres of DOE-owned land[13] and is surrounded by a 1,000-foot-wide buffer zone. The Area 5 RWMC includes several equipment storage yards, as well as structures that are used for offices, laboratories, utilities, and routine operations. Support facilities include:

- Real-Time Radiography Facility (used for verification of MLLW using x-ray technology)
- TRU Waste Storage Pad and Pad Cover Building (used for storage of TRU waste)
- Waste Examination Facility (used to examine and repackage TRU waste for offsite shipment)
- Mixed Waste Storage Units
- Visual Examination and Repackaging Building (located within the Waste Examination Facility)
- Area 5 Hazardous Waste Storage Unit

In addition, a lysimeter facility located southwest of the Area 5 RWMC has been in operation since 1994; data from this facility will be used along with data recorded at the Area 3 RWMS lysimeter to design final disposal covers for NNSS disposal areas.

Waste disposal within the Area 5 RWMC started within a 92-acre area in the southern portion of the site (the "92-Acre Area"), but disposal operations have expanded to the north of this area. The total area used to date for waste disposal, including operational disposal units, covers about 200 acres. The 92-Acre Area consists of 25 pits and trenches and 13 greater confinement disposal (GCD) boreholes, while 10 additional pits have been constructed in the northern expansion area (see **Table 4–49**). The 92-Acre Area is being closed under an NDEP-approved Corrective Action Decision Document and Corrective Action Plan that addresses all waste disposed in the 92-Acre Area (see Section 4.1.11.1.1.3). The GCD boreholes are being filled to grade as part of closure. It is expected that closure activities would be largely completed by mid-2011 except for revegetation, which is scheduled for the fall of 2011.

New disposal units will continue to be constructed to the north and west of the 92-Acre Area. It is estimated that the currently unused portion of the Area 5 RWMC could accommodate disposal of several million cubic yards of waste. Disposal services are expected to continue at the Area 5 RWMC for as long as the DOE complex requires them (Di Sanza and Carilli 2006; DOE 2008f; DOE/NV 2008b, 2009d).

---

[13] *In November 2009, permanent custody of and accountability for the land encompassing the Area 5 RWMC was transferred from BLM to DOE (see Section 4.1.1.3).*

Table 4–49 Area 5 Radioactive Waste Management Complex Disposal Units [a]

Pits and Trenches	*GCD Boreholes*
Active	
7 pits authorized for LLW 1 pit permitted for MLLW (the Mixed Waste Disposal Unit [Cell 18])	Not applicable
Inactive	
	4 boreholes containing no waste
Operationally Closed	
11 LLW pits 12 LLW and MLLW pits 1 asbestiform LLW pit (Pit 7) 1 pit permitted for asbestiform LLW (Pit 6)	4 boreholes containing TRU waste 5 boreholes containing LLW

GCD = greater confinement disposal; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; TRU = transuranic.
[a] As of September 2009.
Source: DOE/NV 2009d.

Seven disposal units are currently active for LLW, one disposal unit is active for disposal of LLW containing regulated asbestos (also called asbestiform LLW),[14] and one disposal unit is active for disposal of MLLW (Cell 18) and LLW containing regulated PCBs in concentrations greater than or equal to 50 parts per million.[15] Twenty-four pits and trenches and all GCD boreholes are operationally closed. That is, the disposal units have been covered with a temporary earthen cap before construction of a final closure cover (see Section 4.1.11.1.1.3).

Of the 24 inactive pits and trenches, 12 pits and trenches contain LLW that also contain constituents that are regulated under RCRA or TSCA. One operationally closed pit contains LLW with regulated asbestos. Eleven pits and trenches contain LLW that does not include constituents regulated under RCRA or TSCA. One of the trenches, however, is a classified materials trench that contains TRU waste that was inadvertently disposed in 1986. This inadvertent disposal involved two waste shipments containing approximately 102 55-gallon drums (about 1,100 cubic feet) of classified waste originally thought to be LLW (DOE/NV 2006e).

Thirteen GCD boreholes were constructed in the 1980s as an experimental concept for disposal of wastes that were not considered appropriate for near-surface disposal. Of these, nine boreholes were used to dispose TRU waste and some high-activity LLW, and the remaining four boreholes were never used. The boreholes were constructed to depths of about 120 feet. After waste placement, the boreholes containing about 10,350 cubic feet of combined waste were backfilled with at least 60 feet of fill (DOE 1996c, DOE/NV 2001a).

Under current operations, LLW received at the Area 5 RWMC is disposed without further treatment. Some onsite-generated MLLW, however, is repackaged and/or treated at the Area 5 RWMC before disposal (see Section 4.1.11.1.2).

Disposal units are excavated, used, and operationally closed as needed, and are used for disposal of waste typically delivered to the site in drums, soft-sided containers, large cargo containers, and boxes. Currently, one to two new LLW disposal units are excavated each year, as needed. The designs of the

[14] Pit P06 is actually two pits: one on top of the other. The lower portion contains thorium-contaminated waste, while the upper portion is for LLW containing regulated asbestos.
[15] LLW containing non-regulated PCBs in concentrations less than 50 parts per million can be disposed in any active LLW disposal unit.

waste disposal units vary depending on waste characteristics, as do operational procedures. Some wastes may require special handling or disposal because of size or weight, or because of radiological or chemical characteristics. For example, cover material over wastes in some disposal units may be thicker. In other instances, the disposal unit may be designed for easy offloading of physically large or long wastes, or to safely accommodate high-activity or high-exposure-rate waste packages (e.g., trenches dug within disposal units). Operational practices, such as remote waste placement using large cranes, or placement of waste containers into prepared pockets nested within a dedicated disposal unit, have also been used. Some disposal units may be dedicated for particular types of waste. Examples include Pit 6, used for disposal of LLW containing regulated asbestos; Cell 18, used for disposal of MLLW; and pits and trenches used for disposal or management of classified waste or material (Clark et al. 2005; Di Sanza and Carilli 2006).

All LLW and MLLW disposed at the NNSS must meet the NNSS waste acceptance criteria for disposal. In addition, all MLLW must meet applicable RCRA land disposal restrictions.[16] The most recent version of the NNSS waste acceptance criteria was issued in January 2011 and requires generators to provide specific information about the characteristics of the wastes, including volume, radionuclide content and quantity, treatment history, and waste form (DOE/NV 2009b). Candidate waste forms for NNSS disposal include (but are not limited to) those listed in the following text box, which illustrates the large variety of different forms in which LLW and MLLW may exist. Some of the listed waste forms (e.g., aqueous liquid) must be processed (e.g., solidified) or specially packaged before receipt and acceptance at the NNSS for disposal. Specific processing and packaging requirements are provided in the NNSS waste acceptance criteria.

Examples of Low-Level and Mixed Low-Level Radioactive Waste Forms Accepted for Nevada National Security Site Disposal[1]

Charcoal	Cation exchange media	Compactable trash
Incinerator ash	Anion exchange media	Noncompactable trash
Soil	Mixed bed ion-exchange media	Animal carcasses
Gas	Contaminated equipment	Biological material (except animal carcasses)
Oil	Organic liquid (except oil)	Activated material (except activated metal)
Aqueous liquid	Glassware or labware	Activated metal
Filter media	Sealed source or device	Other
Mechanical filter	Paint or plating	
EPA hazardous	Evaporator bottoms, sludges, or concentrates	
Demolition rubble		

[1] This list does not include all radioactive waste forms accepted for disposal at the NNSS but provides examples for informational purposes only.
Source: DOE/NV 2009b.

As of 1996, DOE was operating under RCRA interim-status conditions for disposal of MLLW generated by DOE within the state of Nevada (DOE 1996c). By 2002, DOE had applied for an RCRA Part B permit for disposal of MLLW from DOE generators from inside and outside the state of Nevada (DOE 2002g). In December 2005, NDEP reissued the interim-status permit (NEV HW0021) and lifted the prohibition on accepting MLLW from outside Nevada. Pursuant to the permit, the NNSS could accept no more than 20,000 cubic meters (about 710,000 cubic feet) of MLLW from outside the state of

[16] *Wastes containing radionuclides and regulated TSCA constituents must also meet any applicable treatment requirements before NNSS disposal.*

Nevada and had to permanently close the interim status mixed waste disposal unit (Pit 3) by December 2010 (DOE/NV 2006a).

Waste was received for disposal at Pit 3 under the interim permit through November 30, 2010. Because not all disposal space would have been used by that time, NNSA/NSO also disposed of LLW, as well as MLLW, in Pit 3. After disposal operations in Pit 3 ceased, remaining disposal space was filled with native soil and the disposal unit will be closed in FY 2011 as part of final closure of the 92-Acre Area. Postclosure monitoring will start in the same year (DOE/NV 2008b).

On September 29, 2009, DOE submitted an application to NDEP for a new RCRA Part B permit for a new disposal unit for MLLW, including LLW containing PCBs in concentrations greater than or equal to 50 parts per million. NNSA/NSO received final permit approval from the state in December 2010. The capacity of Cell 18, the new disposal unit, is approximately 25,000 cubic meters (883,000 cubic feet).

The *1996 NTS EIS* projected disposal of about 40,310,000 cubic feet (1,141,422 cubic meters) of LLW and about 10,600,000 cubic feet (300,500 cubic meters) of MLLW over a period of 10 years (DOE 1996c). However, from 1996 through 2008, the NNSS actually disposed about 21,400,000 cubic feet of LLW and about 225,000 cubic feet of MLLW. About 60 percent of this waste was disposed at the Area 5 RWMC and the rest at the Area 3 RWMS. Over these 13 years, annual LLW disposal volumes ranged from about 400,000 cubic feet in 1998 to 3,740,000 cubic feet in 2004, and averaged about 1,540,000 cubic feet; annual MLLW disposal volumes ranged from zero in 1997, 2001, 2003, 2004, and 2005, to about 154,000 cubic feet in 2007, and averaged about 17,300 cubic feet. Since July 1, 2006, all LLW and MLLW disposal has occurred in the Area 5 RWMC. From 2004 through 2008, annual LLW volumes ranged from about 919,000 to 3,630,000 cubic feet, and averaged about 1,698,000 cubic feet; annual MLLW volumes ranged from zero to about 154,000 cubic feet, and averaged about 41,600 cubic feet (Gordon 2009b).

4.1.11.1.1.3 Waste Disposal Support Activities

Management and disposal of LLW is regulated by DOE through its authority under the Atomic Energy Act of 1954, as amended. Management and disposal of MLLW containing hazardous constituents is regulated by DOE under the Atomic Energy Act and by EPA and the State of Nevada under RCRA. Management and disposal of LLW containing regulated PCBs in sufficient concentrations, asbestos, or hydrocarbon-contaminated soil and debris is regulated by DOE under the Atomic Energy Act and by EPA and the state under statutes such as TSCA. Safe disposal is assured through operational procedures; compliance with the NNSS waste acceptance criteria; the Radioactive Waste Acceptance Program; risk assessments; air, groundwater, and soil monitoring; and disposal unit closure.

Waste Acceptance

Approval to ship waste to the NNSS for disposal may be granted only after a waste generator demonstrates that it has a waste characterization and certification program that meets the requirements stated in the NNSS waste acceptance criteria. These criteria include specific requirements for waste form, characterization, packaging, and transportation. RWAP personnel provide assistance, interpretation, guidance, and technical expertise on the waste acceptance criteria. Through onsite facility evaluations, RWAP personnel are also responsible for verifying that a waste generator has an established program that complies with regulations regarding the characterization, management, and transportation of radioactive waste. Waste is not accepted at the NNSS until the generator meets the prescribed approval process and a specific waste profile has been reviewed and approved by RWAP personnel (Gordon 2009a).

The waste disposal process begins when a generator (e.g., DOE or DoD) site proposes a specific waste stream for disposal. If initial discussions with NNSA/NSO indicate that the proposed waste stream may meet NNSS eligibility and waste acceptance criteria, RWAP personnel conduct an evaluation to ensure that the generator has implemented a waste certification program that is compliant with the NNSS waste acceptance criteria. During this evaluation, RWAP personnel complete an onsite examination of the waste generator's processes and procedures through all stages of waste management, including waste generation, characterization, packaging, and shipment. Potential waste generators must also provide documentation demonstrating the implementation of the NNSS waste acceptance criteria in their program. If issues are identified during the facility evaluations, corrective actions must be approved and implemented prior to waste certification program approval and eventual waste shipment and disposal (Gordon 2009a).

Radioactive Waste Acceptance Program

The National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Radioactive Waste Acceptance Program (RWAP) ensures that low-level and mixed low-level radioactive wastes (LLW and MLLW) disposed at the Nevada National Security Site (NNSS) meets the NNSS Waste Acceptance Criteria, which includes requirements set forth by the U.S. Department of Energy, the U.S. Department of Transportation, the Resource Conservation and Recovery Act, and other appropriate Federal laws and regulations. The RWAP process consists of two parts: A waste generator evaluation and a waste acceptance process.

Once a generator has been authorized as an approved generator, it is required to maintain a Quality Assurance Program Plan (QAPP) demonstrating compliance with the current revision of the NNSS waste acceptance criteria; DOE Order 435.1, "Radioactive Waste Management"; DOE Order 414.1, "Quality Assurance"; and/or 10 CFR 830.122, "Quality Assurance." Generators are required to submit their current revision of the QAPP to the RWAP manager. Generators must also prepare and submit an NNSS Waste Acceptance Criteria Implementation Crosswalk to the RWAP manager each year. This document references the applicable procedures, processes, or methods affecting quality and personnel directly responsible for implementation of the generator's program. In addition, the generator must submit a written list that identifies key site personnel who certify that the waste meets the NNSS waste acceptance criteria and is safely packaged, marked, and labeled in accordance with U.S. Department of Transportation regulations. RWAP personnel verify the qualifications of these key personnel through the review of training records during the facility evaluations.

Approved waste generators are required to submit documentation (waste profiles) to validate that each proposed waste stream is in compliance with the NNSS waste acceptance criteria. These waste profiles must be in the format prescribed by NNSA/NSO and include information on waste origin, quantity, composition, and packaging, and the analytical and preparatory methods used to characterize the waste. Waste Acceptance Review Panel personnel review these profiles to ensure that established waste form criteria are met. Copies of the waste profiles are routed to NDEP for concurrent evaluation (Gordon 2009a).

Upon arrival of an LLW or MLLW shipment at the NNSS, the shipment documentation is reviewed to ensure consistency with the pre-approved waste stream profile(s). While this document verification is being conducted, the trucks and trailers carrying the waste are monitored to determine whether external radiation and surface contamination levels are below required limits. As a trailer is unloaded, inspectors verify the physical integrity of the waste packages and check to ensure that container marking and labeling meet NNSS waste acceptance criteria requirements. In addition, onsite real-time radiography (x-ray technology) may be used to visually verify waste package contents.

MLLW requiring treatment prior to disposal is subject to independent waste verification (real-time radiography examination, visual verification at the generating facility) and chemical screening conducted by RWAP personnel, as determined by the Waste Acceptance Review Panel during the waste profile approval process.[17] At the discretion of the Waste Acceptance Review Panel, LLW may also undergo examination by real-time radiography. These waste verification activities ensure that the waste form listed on shipment documentation is consistent with the waste form received for disposal. In the unlikely[18] event that any actual waste shipment is deemed not compliant with the NNSS waste acceptance criteria, it is returned to the waste generator for corrective action, consistent with DOE policy (Gordon 2009a).

Disposal Authorization and Performance Assessment

Waste disposal occurs in accordance with authorizations issued by DOE and with permits for MLLW issued by external regulatory agencies. The authorization and permit approval processes are based on formal, quantitative analyses of worker and public health and safety during construction, operation, and closure, as well as consideration of possible long-term (thousands of years) impacts on the public and the environment after the disposal facilities are closed. The results of the analyses must determine that disposal activities would comply with all applicable regulatory requirements.

These analyses include performance assessments and composite analyses prepared in compliance with DOE Order 435.1. The Area 3 RWMS performance assessment and composite analysis were issued in October 2000 (DOE/NV 2000b); the Area 5 RWMC performance assessment, in 1998 (DOE/NV 1998a); and the Area 5 RWMC composite analysis, in September 2001 (DOE/NV 2001a). An addendum to the Area 5 RWMC composite analysis was also issued in November 2001 (DOE/NV 2001d). The scenarios and waste acceptance criteria for the Area 5 RWMC were updated through an April 2000 addendum to the 1998 performance assessment (DOE/NV 2000a). A second addendum to the Area 5 RWMC performance assessment was issued in 2006 and was reviewed by DOE's Low-Level Radioactive Waste Federal Review Group. This review group recommended, without conditions, DOE's approval of the performance assessment, which confirms that it meets the requirements of DOE Order 435.1 (Carilli and Krenzien 2007).

DOE has also conducted analyses of TRU waste disposal to assess compliance with EPA's TRU waste disposal requirements in 40 CFR Part 191. In 2003, DOE approved an analysis addressing disposal of TRU and other waste in the GCD boreholes, concluding that the long-term performance of the boreholes would comply with 40 CFR Part 191 (Colarusso et al. 2003). An additional analysis also concluded compliance with 40 CFR Part 191 as well as with all applicable requirements in DOE Manual 435.1-1 for TRU waste that had been inadvertently disposed in an Area 5 RWMC trench (Colarusso et al. 2003; Shott, Yucel, and Desotell 2008). DOE will close the TRU waste in place along with the other waste in the 92-Acre Area (see below).

The performance assessments and composite analyses support the continued operation of the disposal facilities. DOE requires that performance assessments and composite analyses be maintained after their preparation. The maintenance process includes performing annual reviews, carrying out special analyses, and revising the performance assessments and composite analyses as necessary. A maintenance plan for the Area 3 and 5 performance assessments and composite analyses has been issued (DOE/NV 2002a).

Decision Support System

A decision support system has been implemented that allows rapid assessment and documentation of the consequences of waste management decisions using current site characterization information, the radionuclide inventory, and a conceptual model. The core of the decision support system is a

[17] NDEP participates on the Waste Acceptance Review Panel.

[18] For example, during FYs 2004 through 2008, only two shipments were returned to the waste generators (DOE/NV 2005b, 2005g, 2007a, 2007e, 2009d).

probabilistic inventory and performance assessment model that supports multiple graphic capabilities for documentation of data sources, conceptual model, mathematical implementation, and results. The combined models can be used to estimate disposal site inventory, contaminant concentrations in environmental media, and radiological doses to hypothetical members of the public at various locations. The model is routinely used to provide annual updates of site performance, evaluate the consequences of disposal of new waste streams, develop waste concentration limits, optimize the design of new disposal units, and assess the adequacy of environmental monitoring programs (Shott, Yucel, and Carilli 2006).

The decision support system maintains a database of the inventories of specific radionuclides on both an actual and a projected basis. Generators proposing to dispose waste at the NNSS must submit a waste profile setting forth projected waste volumes and radionuclide distributions. This information is checked through screening analyses, and more-detailed analyses as needed, to enable a determination that proposed disposal of the waste would not result in impacts that would exceed any of the performance objectives or other numerical criteria for the disposal facility.[19] Waste inventory data are routinely updated in the site database as disposal occurs and as new projections of waste inventories are received.

The performance assessment model is updated annually with the latest inventory estimates, and new estimates of the performance measures are calculated. In this way, NNSA/NSO ensures that final closure of the site when it is filled to capacity will be in compliance with applicable disposal requirements.

Area 3 and 5 Monitoring

DOE's environmental monitoring program for the Area 3 and Area 5 disposal sites includes monitoring of radiation exposure, air, groundwater, meteorology, vadose zone, subsidence, and biota. Monitoring data for calendar year (CY) 2008 indicated that the Area 3 and Area 5 disposal sites were performing within the expectations of the model and parameter assumptions for the facility performance assessments (DOE/NV 2009c).

Closure

Final closure of the Area 3 RWMS and Area 5 RWMC will occur in accordance with integrated closure and monitoring plans that are intended to ensure that closure will be in compliance with all applicable standards, including DOE Order 435.1, DOE Manual 435.1-1, 40 CFR Part 191, 40 CFR Part 265, *Nevada Administrative Code* (NAC) 444.743, and RCRA requirements as incorporated into NAC 444.9632. Many disposal units at the Area 5 RWMC have been operationally closed, and final closure has occurred at the U3ax/bl disposal unit in Area 3. Final closure of the 92-Acre Area at the Area 5 RWMC will occur in 2011.

Closure plans have been developed and updated over several years, considering schedules, waste inventories, NNSS and facility characterization data, and final cover designs. An integrated closure and monitoring plan for the Area 3 RWMS and Area 5 RWMC was issued in 2001 (DOE/NV 2001b) and updated in 2005 (DOE/NV 2005d). A closure strategy for the Area 5 RWMC was issued in 2007 (DOE/NV 2007b), and updated closure plans for the Area 3 RWMS and Area 5 RWMC were issued in 2007 (DOE/NV 2007c) and 2008 (DOE/NV 2008b), respectively.

The closure plan for the Area 3 RWMS specifically addresses closure of the U-3ah/at and U-3bh disposal units. (A final closure cover has already been placed over unit U-3ax/bl [CAU 110].) The final cover will consist of a monolayer evapotranspiration layer expected to be somewhat less than 10 feet thick. The

[19] Pursuant to DOE Order 435.1, DOE disposal sites must be operated so that disposal would be in compliance with a number of performance objectives. For example, there are limits on the radiation dose that may be received by a potential future member of the public as determined by performance assessment modeling.

requirements of postclosure maintenance and monitoring will be determined in the final closure plan, which will address the applicable monitoring requirements prescribed by DOE directives and other Federal regulations and NDEP (DOE/NV 2007c).

The closure plan for the Area 5 RWMC addresses closure of the 92-Acre Area, as well as the remainder of the Area 5 RWMC. Final closure of the 92-Acre Area has begun and is scheduled to be completed in 2011 (see Section 4.1.11.1.1.2). Closure of the 92-Acre Area will address the 24 inactive pits and trenches and all GCD boreholes referenced in Table 4–49, as well as Pits 3 and 6.

Within the 92-Acre Area, all of the historical pits and trenches are covered with operational covers made of native soil approximately 8 feet thick. The closure cover for the 92-Acre Area will consist of three monolayer evapotranspiration caps covering separate groups of pits, trenches, and boreholes. The design includes a minimum closure cover thickness of about 10 feet, including the thicknesses of the operational covers. The balance of the Area 5 RWMC used for waste disposal will be closed with covers in a fashion similar to the 92-Acre Area, and adjacent areas between the cover systems will be graded for proper drainage. Following final closure of the entire Area 5 RWMC, institutional controls—including control of public access, cover maintenance, and monitoring—will continue thereafter in accordance with applicable Federal and state requirements. Long-term monitoring provisions for the Area 5 RWMC will be developed as part of its final closure plan (DOE/NV 2008b).

4.1.11.1.2 Mixed Low-Level Radioactive Waste Management

MLLW generated at the NNSS may be stored at the Area 5 RWMC. In November 2010, NNSA/NSO received an NDEP permit for temporary storage of MLLW (Area 5 RWMC) from authorized out-of-state generators.

Onsite repackaging of in-state-generated MLLW may occur at the Area 5 RWMC. The repackaged waste is then disposed in the Area 5 RWMC (Gordon 2009b). The NNSA/NSO expects to submit an application to NDEP for a permit to treat MLLW received from authorized out-of-state generators.

Disposal of MLLW at the NNSS is described in Section 4.1.11.1.1.2.

4.1.11.1.3 Transuranic Waste Management

For several years, the NNSS stored legacy TRU waste received from Lawrence Livermore National Laboratory, Rocky Flats Environmental Technology Site, Lawrence Berkeley Laboratory, and EG&G, and from environmental restoration at the NNSS and the TTR. In recent years, however, DOE completed a program to repackage, characterize, and ship this legacy waste to WIPP, near Carlsbad, New Mexico, for disposal. Most waste was shipped directly to WIPP, and some waste was shipped to Idaho National Laboratory for final characterization before transfer to WIPP.

Remaining TRU waste consists of two 3-foot-diameter steel spheres that were used in subcritical experiments. The spheres cannot be shipped in their current configuration in Transuranic Package Transporter Model 2 (TRUPACT-II) casks because their fissile-gram-equivalent content exceeds the TRUPACT-II limit of 325 grams. The spheres are being stored pending the availability of the TRUPACT-III cask (Gordon 2009c).

Currently, small quantities of TRU waste are generated annually from experiments at JASPER and temporarily stored pending offsite shipment. As of December 2010, 25 standard waste boxes (about 1,660 cubic feet) containing this waste were in storage. Environmental restoration at the NNSS or other in-state locations is also expected to occasionally generate small quantities of TRU waste.

The legacy spheres and accumulated TRU waste from JASPER are temporarily stored at the Area 5 RWMC. Most TRU waste at the Area 5 RWMC is stored in a steel-framed, fabric-covered structure known as the TRU Pad Cover Building. This structure rests on a 2.1-acre asphalt pad containing a protective waterproof layer, plus an 8-inch curb to prevent run-on and runoff (DOE/NV 2006c). Classified TRU material is stored in a separate storage building.

4.1.11.1.4 Tritium Waste Disposal by Evaporation

Liquids containing tritium continue to be disposed at the NNSS by evaporation into the air from ponds and open tanks. The sources of the tritium include tritium-containing water removed from tunnels in Area 12 and from onsite wells that were contaminated from past nuclear tests. In recent years, tritiated water to be evaporated has included air conditioning condensate removed from a sump in the basement of a building at NLVF. Some of this tritiated water is evaporated at NLVF, and the remainder is transported to the NNSS for disposal in NNSS sewage lagoons. The tritium inventory for all sources discharged for evaporation at the NNSS ranged from about 9.5 to 130 curies per year from 1996 through 2008, and averaged about 42 curies per year. From 2004 through 2008, the tritium inventory ranged from about 9.5 to 35 curies per year, averaging about 17 curies (DOE/NV 1997b, 1998c, 1999, 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d).

4.1.11.2 Nonradioactive Waste Management

Nonradioactive wastes include hazardous waste, nonhazardous waste, and explosive waste.

4.1.11.2.1 Hazardous Waste Management

Hazardous and toxic materials used or stored at the NNSS are controlled and managed through the use of a Hazardous Substance Inventory database, which facilitates compliance with the operational and reporting requirements of TSCA; the Federal Insecticide, Fungicide, and Rodenticide Act; the Emergency Planning and Community Right-to-Know Act; and the Nevada Chemical Catastrophe Act. Chemicals to be purchased are subject to a requisition compliance review process.

Hazardous waste (and certain PCB wastes regulated under TSCA as discussed below) generated through NNSS activities may be sent to offsite treatment, storage, or disposal facilities; recycled; or reused. Much of these wastes derives from environmental restoration activities (DOE/NV 2009d). Waste shipped to offsite treatment, storage, or disposal facilities is addressed below; recycle and reuse is addressed in Section 4.1.11.3.

Non-bulk (packaged) hazardous waste generated at the NNSS may be stored temporarily in the RCRA-permitted Hazardous Waste Storage Unit located in proximity to the Area 5 RWMC.[20] NNSS-generated waste containing only PCBs in sufficient amounts, or PCBs mixed with hazardous constituents regulated under RCRA, may also be stored in the Hazardous Waste Storage Unit pending shipment off site for treatment and disposal. PCB-contaminated waste is not routinely generated during operations at the NNSS, but is sometimes generated during environmental restoration and decontamination and decommissioning activities at the NNSS or other in-state locations, and may be received mixed with LLW. Nonradioactive waste containing PCBs in concentrations less than 50 parts per million may generally be disposed as nonhazardous solid waste in a permitted NNSS landfill. Waste quantities shipped off site for treatment and disposal from 2004 through 2008 ranged from 10.8 to 399 tons per year, averaging 111 tons per year (DOE/NV 2005f, 2006a, 2007d, 2008a, 2009d).

[20] *Much of the environmental restoration waste is delivered directly as bulk shipments (dump trucks, roll-off boxes) to offsite treatment, storage, or disposal facilities. The Hazardous Waste Storage Unit only manages packaged (non-bulk) hazardous waste.*

4.1.11.2.2 Explosive Ordnance Disposal

Nonradioactive explosive ordnance generated at the NNSS from tunnel operations, the NNSS Security firing range, the resident national laboratories, and other DOE activities may be treated by open detonation at the Explosives Ordnance Disposal Unit in Area 11.[21] The Explosives Ordnance Disposal Unit is a detonation pit permitted under RCRA (NEV HW0101) and surrounded by an earthen pad with dimensions of about 25 feet by 100 feet. It includes ancillary equipment such as a bunker, electric shot box, and electric wire. DOE is permitted to detonate a maximum of 100 pounds of approved waste at a time, not to exceed one detonation event per hour. The maximum annual treatment capacity is 4,100 pounds.

Annual quantities treated have been much smaller than permitted levels. From 2004 through 2008, the maximum quantity treated was 4.9 pounds in 2004; no wastes were treated in other years (DOE/NV 2004d, 2005f, 2006a, 2007d, 2008a, 2009d).

4.1.11.2.3 Nonhazardous Waste Management

Nonhazardous wastes annually generated through NNSS activities may be sent to NNSS landfills to be disposed, recycled, or reused. NNSS disposal is addressed below; recycle and reuse is addressed in Section 4.1.11.3.

The NNSS operates three permitted landfills for disposal of nonhazardous wastes: the Area 6 Hydrocarbon Disposal Site (Permit SW 13 097 02), Area 9 U10c Landfill (Permit SW 13 097 03), and Area 23 Landfill (Permit SW 13 097 04).[22] Soils and sludge contaminated with hydrocarbons are disposed in the Area 6 Hydrocarbon Disposal Site, while inert debris, such as construction waste and demolition debris, is disposed in the Area 9 U10c Landfill. The Area 9 U10c Landfill can also accept small quantities of hydrocarbon-contaminated waste, as well as nonfriable asbestos waste. The Area 23 Landfill can accept less than 20 tons daily (based on an annual average) of sanitary solid waste, including friable, nonradioactive asbestos waste. All landfills only accept waste from the NNSS and offsite Nevada locations under NNSA/NSO control (DOE 2002g).

From 2004 through 2008, the Area 6 Hydrocarbon Disposal Site received 19 to 1,166 tons of waste for disposal per year, averaging 548 tons per year. Over this time period, the Area 9 U10c Landfill received 4,569 to 15,446 tons of waste for disposal per year, averaging 8,200 tons per year. The Area 23 Landfill received 573 to 1,819 tons of waste for disposal per year, averaging 963 tons per year (DOE/NV 2005f, 2006a, 2007d, 2008a, 2009d). According to a 2008 survey of remaining landfill capacity, the estimated remaining waste capacities for the landfills are as follows: Area 6 Hydrocarbon Disposal Site, 2.8 million cubic feet; Area 9 U10c Landfill, 15 million cubic feet; and Area 23 Landfill, 13 million cubic feet (Gordon 2009b).

4.1.11.3 Pollution Prevention and Waste Minimization

DOE's pollution prevention and waste minimization initiatives entail processes to reduce the volume and toxicity of waste generated at the NNSS and its satellite facilities. The processes also ensure that proposed methods of treatment, storage, and disposal minimize potential threats to human health and the environment. These initiatives address the requirements of several Federal and state regulations applicable to operations at the NNSS. The goals are to minimize the generation, release, and disposal of

[21] *Explosive waste is not accepted for treatment from offsite sources. Any explosive waste generated at the TTR, for example, is treated at the TTR under Emergency Treatment Permits obtained from NDEP.*

[22] *An additional permit (SW-13-097-02) is for landfill disposal of LLW containing regulated asbestos in Pit P06UA in the Area 5 RWMC.*

pollutants to the environment by implementing cost-effective pollution protection technologies, practices, and policies. Pollution prevention and waste minimization components include source reduction, recycling, reuse, affirmative procurement, and employee and public awareness. Impetus was given to these initiatives by the October 5, 2009, Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*.

The accomplishments of the Pollution Prevention and Waste Minimization Program at the NNSS and satellite facilities are documented in the annual NNSS environmental reports. **Table 4–50** illustrates the types and quantities of hazardous and nonhazardous wastes that were managed by other means than disposal for the years 2006 through 2008.

Table 4–50 Waste Reduction Activities, Calendar Years 2006–2008

	Calendar Year Quantities (tons)		
Activity	***2006***	***2007***	***2008***
Hazardous Waste [a]			
Bulk used oil sent to an offsite vendor for recycling	108.2	84.4	84.2
Lead acid batteries shipped to an offsite vendor for recycling	38.0	53.2	196.8
Computer equipment returned to vendor to be refurbished and resold	6.4	42.1	13.3
Spent fluorescent light bulbs and mercury, metal hydride, and sodium lamps sent to an offsite vendor for recycling	3.4	2.3	1.4
Rechargeable batteries sent to an offsite vendor for recycling	1.8	0.3	0.2
Lead scrap metal sold for reuse/recycle	5.7	0.9	b
Lead tire weights reused instead of being disposed as hazardous waste	0.8	0.8	b
Hazardous chemicals relocated to new users through the Material Exchange Program, diverting them from disposal	0.3	b	b
Total:	**164.7**	**184.1**	**296.0**
Nonhazardous Waste			
Scrap ferrous metal sold to a vendor for recycling	593.8	872.8	92.8
Mixed paper and cardboard sent off site for recycling	170.2	668.2	177.5
Food waste from cafeterias sent off site to be reused as pig feed	73.9	52.4	49.2
Shipping materials, including pallets, Styrofoam, bubble wrap, and shipping containers, that were reused	22.8	17.6	9.5
Scrap nonferrous metal sold to a vendor for recycling	19.2	256.1	6.6
Spent toner cartridges sent off site for recycling	2.9	3.2	3.0
Nonhazardous chemicals, equipment, and supplies relocated to new users through the Material Exchange Program, diverting them from disposal	2.0	1.2	3.7
Aluminum cans sent off site for recycling	0.4	0.8	0.8
Total:	**885.1**	**1,872.3**	**343.0**

[a] In accordance with regulations issued pursuant to the Resource Conservation and Recovery Act, the Toxic Substances Control Act, or other applicable Federal or state statutes.
[b] Not reported for this year.
Source: DOE/NV 2007d, 2008a, 2009d.

4.1.12 Human Health and Safety

The health and safety of the general public and site workers are discussed in this section. Environmental health risks from NNSS activities include the effects of environmental noise and acute and chronic exposures to ionizing radiation and hazardous chemicals. Regular programs are administered to monitor releases and evaluate associated potential health impacts. Additionally, studies have been conducted to assess the exposure pathways and potential risks of radionuclide and toxic chemical releases during past NNSS operations. These studies focused on the impacts of releases in terms of health risks to site workers and the general public. Results of current assessments and historic studies indicate (1) there is little risk of enhanced carcinogenesis (the production or manifestation of cancer) due to radionuclide and chemical releases during site operations; (2) doses from site radionuclide releases tend to be far lower than those from natural background radiation; and (3) chemical exposures are well within established guidelines. To optimally protect vulnerable populations, DOE maintains a Comprehensive Emergency Management Program that features hazard-specific plans, procedures, and controls (DOE Order 151.1C).

4.1.12.1 Public Radiation Exposure and Safety

4.1.12.1.1 General Site Description

Major sources of background radiation and average doses from background radiation exposure to individuals in the NNSS vicinity are shown in **Table 4–51**.[23] The average annual dose from background radiation is approximately 670 millirem. About half of the annual dose is from ubiquitous, natural background sources (355 millirem) that can vary depending on geographic location, individual buildings in a geographic area, and age, but are all essentially from space or naturally occurring in the Earth. About half of the dose is from medical exposure to radiation (300 millirem), including computed tomography, interventional fluoroscopy, x-rays and conventional fluoroscopy, and nuclear medicine (use of unsealed radionuclides for diagnosis and treatment). Another approximately 14 millirem per year are from consumer products and other sources (nuclear power, security, research, and occupational exposure) (NCRP 2009). Average background radiation doses from these sources are expected to remain fairly constant over the period of the proposed actions. Background radiation doses identified in Table 4–51 are unrelated to NNSS operations.

Table 4–51 Sources of Radiation Exposure of Individuals Unrelated to Nevada National Security Site Operations [a]

Source	*Effective Dose (millirem per year)* [a]
Natural Background Radiation	
Cosmic and external terrestrial radiation [b]	98
Internal radiation	29
Radon in homes (inhaled)	228
Other Background Radiation	
Diagnostic x-rays and nuclear medicine	300
Consumer products	13
Industrial, Security, Medical, Educational, and Research	0.3
Occupational	0.5
Total (rounded)	670

[a] Except for cosmic and external terrestrial radiation, values are averages for an individual in the United States.
[b] The dose from cosmic and external terrestrial radiation is based on field readings using a pressurized ion chamber (DOE/NV/25946-790).
Source: DOE/NV 2009d; NCRP 2009.

Releases of radionuclides to the environment from NNSS operations provide another potential source of radiation exposure to individuals in the vicinity of the NNSS. Types and estimated quantities of radionuclides released from NNSS operations in 2008 are listed in the *Nevada Test Site Environmental Report, 2008* (DOE/NV 2009d). Estimated doses to the public resulting from these releases are presented in **Table 4–52**. The reported total dose to the maximally exposed individual (MEI) is a conservative estimate. It is based on the concentration of radionuclides at a location on the NNSS (referred to as a “critical receptor station”) where a member of the public could not live and includes the assumed

[23] *Average doses from cosmic and terrestrial sources of background radiation are measured by pressurized ion chamber in the vicinity of the NNSS. Other background doses are assumed to approximate the average dose to an individual in the U.S. population.*

consumption of game animals collected on the NNSS (not at offsite locations). MEI doses estimated in a similar manner for the years 2004 through 2008 range from 2 to 2.9 millirem per year. These doses fall within the limits invoked by DOE Order 458.1 and are much lower than those due to background radiation.

Table 4–52 Radiation Doses to the Public from Nevada National Security Site Operations in 2008 (Total Effective Dose Equivalent)

Receptor	*Atmospheric Releases* [a]	*Liquid Releases* [b]	*Game Animals*	*Total* [c]
Maximally exposed individual (millirem)	1.9	0	0.5	2.4 [d]
Population within 50 miles (person-rem) [e]	< 1 (0.47)	0	(d)	< 1 (0.47)
Average individual within 50 miles (millirem) [f]	< 0.02	0	(d)	< 0.02

rem = roentgen equivalent man.

[a] DOE Order 458.1 invokes the Clean Air Act regulations in 40 CFR Part 61, Subpart H, which establish a compliance limit of 10 millirem per year to a maximally exposed individual.

[b] There is no dose to the public from surface-water or groundwater pathways.

[c] DOE Order 458.1 establishes a dose limit of 100 millirem per year to individual members of the public exposed through all pathways.

[d] The dose from the ingestion of contaminated game (cottontail rabbit or doves) is applicable to the maximally exposed individual only.

[e] In 2008, site reports did not present a calculated population dose; however, a population dose exceeding 1 person-rem is very unlikely (DOE/NV/25946-483). In 2004, the last year that a specific population dose was reported, the estimated dose to a population of 42,871 living within 50 miles of the Area 6 Control Point was 0.47 person-rem (DOE/NV/11718-1065).

[f] The average dose to an individual was obtained by dividing the population dose by the number of people living within 50 miles of the site.

Source: DOE/NV/25946-790; DOE/NV/11718-1065; DOE/NV/25946-483; Warren 2011.

Using a risk coefficient of 600 cancer deaths per 1 million person-rem (or 0.0006 latent cancer fatalities [LCFs] per rem) (DOE 2003c), the risk of an LCF to the MEI due to radionuclide releases from NNSS operations in 2008 was estimated to be 1.4×10^{-6}. That is, the probability of this person dying of cancer at some time in the future as a result of a radiation dose associated with emissions from 1 year of NNSS operations is about 1 chance in 710,000. The hypothetical MEI is a person whose place of residence and lifestyle make it unlikely that any other member of the public would receive a higher radiation dose from NNSS releases. This person was assumed to be exposed to radionuclides in the air and on the ground from NNSS emissions at the Schooner critical receptor station, a location in the far northwestern corner of the NNSS.

Using the same risk coefficient, the calculated LCF risk to the estimated population for 2004 (the last year in which a population dose was estimated) was 0.00028 (DOE/NV/11718-1065). This low calculated risk implies that no LCFs are expected as a result of radioactive emissions. For comparison, the annual risk of a cancer in the U.S. population in the year 2000 was about 200 deaths per 100,000 people, or 0.2 percent per year (Weir et al. 2003). At that rate, expected fatalities from all cancers in the population living within 50 miles of the NNSS would be 86.

No members of the public receive direct gamma radiation exposure that is above background levels as a result of past or present NNSS operations. Gamma radiation exposure rates measured at areas accessible to the public are comparable to natural background rates from cosmic and terrestrial radiation. Radioactively contaminated areas on the NNSS are isolated from members of the general public, given the considerable distances between these areas and the site boundary, so members of the public are not exposed to any measurably contaminated soil, either directly or through resuspension (DOE/NV/25946-790).

Radiation Basics

What is radiation? Radiation is energy emitted from unstable (radioactive) atoms in the form of atomic particles or electromagnetic waves. This type of radiation is also known as ionizing radiation because it can produce charged particles (ions) in matter.

What is radioactivity? Radioactivity is produced by the process of unstable (radioactive) atoms trying to become stable. Radiation is emitted in the process. In the United States, radioactivity is measured in units of curies (Ci). Smaller fractions of the curie are the millicurie (1 mCi = 1/1,000 Ci), the microcurie (1 µCi = 1/1,000,000 Ci), and the picocurie (1 pCi = 1/1,000,000 µCi).

What is radioactive material? Radioactive material is any material containing unstable atoms that emits radiation.

What are the four basic types of ionizing radiation?

Alpha (α) – Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface.

Beta (β) – Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma (γ) – Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it.

Neutrons (n) – A neutron is an atomic particle that has about one-quarter the weight of an alpha particle. Like gamma radiation, it can easily travel several hundred feet in air. Neutron radiation is most effectively stopped by materials with high hydrogen content, such as water or plastic.

What are the sources of radiation?

Natural sources of radiation – (1) Cosmic radiation from the sun and outer space; (2) natural radioactive elements in the Earth's crust; (3) natural radioactive elements in the human body; and (4) radon gas from the radioactive decay of uranium naturally present in the soil.

Manmade sources of radiation – Medical radiation (x-rays, medical isotopes), consumer products (TVs, luminous dial watches, smoke detectors), nuclear technology (nuclear power plants, industrial x-ray machines), and fallout from past worldwide nuclear weapons tests or accidents (Chernobyl).

What is radiation dose? Radiation dose is the amount of energy of ionizing radiation absorbed per unit mass of any material. For people, radiation dose is the amount of energy absorbed in human tissue. In the United States, radiation dose is measured in units of rad or rem. Smaller fractions of the rem are the millirem (1 millirem = 1/1,000 rem) and the microrem (1 µrem = 1/1,000,000 rem).

Regarding groundwater monitoring programs, annual monitoring has detected tritium-contaminated groundwater in a well beyond the NNSS boundary. The well is a monitoring well that is on federally controlled land (the Nevada Test and Training Range), and there are no indications that contaminated groundwater has migrated to any wells that supply water to members of the public. Consequently, there is no radiation dose incurred by the public from the groundwater pathway. Groundwater monitoring programs are discussed in more detail in Section 4.1.6.2.

Radioactive airborne emissions at the NNSS are monitored on site to ensure compliance with NESHAPs under CAA. A network of 19 air sampling stations and a network of 109 thermoluminescent dosimeters are located throughout the NNSS, primarily within operational areas where historic nuclear testing has occurred or where current radiological operations occur. Air sampling stations monitor tritium, manmade radionuclides, and gross alpha and beta activity in airborne particulates that result either from current site operations or from activities such as environmental restoration that resuspend material at legacy testing locations. Thermoluminescent dosimeters monitor direct gamma radiation exposure.

The total amounts of manmade radionuclides that were emitted to the air from all sources on the NNSS in 2008 were estimated to be 440 curies of tritium, 0.047 curies of americium-241, 0.050 curies of plutonium-238, 0.29 curies of plutonium-239 and -240, and 0.60 curies of depleted uranium. Since the cessation of atmospheric nuclear testing, the annual releases into the air have ranged from 48 to 2,200 curies for tritium, 0.0018 to 0.40 curies for plutonium, and 0.039 to 0.049 curies for americium. These emissions cannot be distinguished from the background airborne radiation measured in communities surrounding the NNSS. Potential radioactive emissions are monitored at stations in selected towns and communities within 240 miles of the NNSS by the independent CEMP. Its purpose is to provide monitoring for radionuclides that may be released beyond the confines of the NNSS boundary. A network of 29 CEMP stations is in use; these stations monitor gross alpha and beta activity, gamma radiation, and meteorological parameters (see Section 4.2.8.3) (DOE/NV/25946-790).

4.1.12.2 Occupational Radiation Exposure and Safety

NNSS workers receive the same dose as the general public from background radiation, but they receive an additional dose from working in and near facilities or areas with radioactive material. The average dose to the individual worker and the cumulative dose to all workers at the NNSS from operations in 2008 are presented in **Table 4–53**. Using a risk coefficient of 0.0006 LCFs per person-rem, the projected LCF risk among NNSS workers from normal operations in 2008 was 0.0033. The largest dose received by a worker in 2008 was 451 millirem (Enyeart 2009); the increased risk of an LCF from this dose was 0.00027.

The average dose of 70 millirem in 2008 is comparable to the average doses over the prior 5-year period (2003–2007) of 46 to 81 millirem (DOE 2006a, 2009n).

Table 4–53 Radiation Doses to Workers from Nevada National Security Site Normal Operations in 2008 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Workers	***Standard*** [a]	***Actual***
Maximally exposed worker (millirem)	5,000	451
Average radiation worker (millirem)	None	70
Total of all radiation workers (person-rem) [b]	None	5.2

rem = roentgen equivalent man.
[a] No standard is specified for an "average radiation worker"; however, the maximum dose to a worker is limited as follows: The dose limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, DOE's goal is to maintain radiation exposure as low as is reasonably achievable (ALARA). DOE has, therefore, established the Administrative Control Level of 2,000 millirem per year; the site contractor sets facility administrative control levels below the DOE level, with 500 millirem per year considered a reasonable goal for trained radiation workers.
[b] There were 75 workers with measurable doses in 2008.
Note: Total radiation worker dose presented in the table slightly differs from that calculated from data shown due to rounding.
Source: 10 CFR 835.202; DOE Standard 1098-99; DOE 2009n; Enyeart 2009.

Worker occupational risks are generally associated with activities such as waste handling, construction, environmental restoration, and decontamination and decommissioning. DOE's Computerized Accident/Incident Reporting System provides statistics on worker injury and illness information, including accidents involving government-owned vehicles. Although the total number of hours worked showed an upward trend between 1996 and 2005, the rate of total recorded cases per 200,000 hours worked remained fairly stable, as did the rates of accident cases causing days away from work, restricted work, or job transfer (DART cases). These accident statistics are comparable to those for the DOE complex as a whole. In 2006, the total recorded accident/incident case rate at the NNSS was 2.3, and the DART case rate was 0.9; the comparative rates for 2006 over the entire DOE complex were 1.6 and 0.7, respectively. From 1996 through 2004, accident rates for government vehicles at the NNSS averaged 0.5 accidents per million vehicle miles, while the overall DOE accident rates over this period averaged 1.7 accidents per million vehicle miles. In addition, it is noteworthy to mention that a key Lessons

Learned (2002-NV-NTSBN-035) implemented in 2002, the conduct of weekly roundtable discussions focused on safety between managers and staff, was responsible for eliminating injury incidents for the better part of the following annual period. This implementation focused on the induction of regular weekly roundtable discussions between managers and workers during scheduled safety meetings. It is these types of programs and recognition that are regularly set in place at the NNSS in an effort to keep an accident goal of "zero accidents/incidents" with "zero work-days lost" (DOE/EIS-0243-SA-03; OE Summary 2009-07).

4.1.12.3 Chemical Exposure and Risk

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media, through which people may come in contact with hazardous chemicals. Hazardous chemicals can cause cancer and non-cancer-related health effects.

Because of the NNSS's remote location and large size, there is no risk of chemical exposure to the surrounding public population resulting from normal site operations. Nevertheless, monitoring efforts and baseline studies are regularly performed. However, certain workers at the NNSS are at risk of chemical exposure depending on their job function and proximity to various sources.

Of key concern at the NNSS is exposure to beryllium. Beryllium can cause acute respiratory disease (for which a workplace air concentration limit has long been in place) and chronic beryllium exposure can cause lung disease. In December 1999, DOE promulgated the Chronic Beryllium Disease Prevention Program (64 FR 68853), and in February 2006, DOE included the program in worker safety and health regulations established to govern contractor activities at DOE sites (71 FR 6857). NNSA has implemented the program at the NNSS to reduce the number of workers potentially exposed to beryllium and establish a medical surveillance program for early detection of the disease. DOE sponsors and funds a screening program for former DOE workers who may have been exposed to beryllium at the NNSS and other DOE sites.

As discussed in Section 4.1.8, common sources of chemical air pollutants at the NNSS include various particulate matter from construction activities, aggregate production, surface disturbances, fuel-burning equipment, state-authorized open burning, fuel storage facilities, and chemical release tests conducted at NPTEC. An estimated 6.05 tons of criteria air pollutants were released on the NNSS in 2008. The majority of the emissions comprised nitrogen oxides from diesel generators. Total air emissions of lead were 4.56 pounds, and the total quantity of hazardous air pollutants released in 2008 was 0.09 tons. Other emitters included carbon monoxide, sulfur dioxide, and volatile organic compounds, all in quantities well below emission criteria limits (DOE/NV/25946-790).

As for monitoring potential chemicals released to drinking water and wastewater systems at the NNSS, six permitted wells on the NNSS serve the drinking water needs of NNSS workers and visitors. The wells are regularly monitored for potability and purity. In 2008, water samples from these wells (in addition to potable-water hauling trucks) met all national primary and secondary drinking water standards. In addition, site operating lagoon systems are tested for biochemical oxygen demand, pH, total suspended solids, and a suite of toxic chemicals; all lagoon water measurements were found to be within permit limits in 2008. Discharge water at the site is also tested for a host of potential contaminants. In 2008, no contaminants were detected at levels that exceeded permit limits (DOE/NV/25946-790).

Regarding risks from handling toxic or hazardous chemicals, worker safety programs at the NNSS are enforced via required adherence to Federal and state laws; DOE orders; Occupational Safety and Health Administration requirements; EPA guidelines; and plans and procedures for performing work, including training, monitoring, use of personal protective equipment, and administrative controls. Although chemical inventories have varied to a limited extent over recent years, administrative controls continually ensure that quantities do not approach levels that pose undue risk due to storage, concentration, bulk quantity, or logistical factors. Any amounts that potentially exceed threshold planning quantities require reporting under Federal regulations (40 CFR Part 355; 40 CFR Part 370).

4.1.12.4 Health Effects Studies

There have been numerous studies conducted over the years examining the potential health effects that U.S. populations may have incurred from exposure to fallout associated with the NNSS atmospheric nuclear tests. Most notable are those discussed below.

A 1979 study reported in the *New England Journal of Medicine* concluded that a significant excess of leukemia deaths occurred in children up to 14 years of age living in Utah between 1959 and 1967. This excess was concentrated in the cohort of children born between 1951 and 1958, and was most pronounced in those residing in Utah counties receiving high fallout. Mortality increased by 2.44 times (95 percent confidence, 1.18 to 5.02) to just slightly above that of the United States in the high-exposure cohort residing in the high-fallout counties, and was greatest in 10- to 14-year-old children. For other childhood cancers, no consistent pattern was found in relation to fallout exposure (NEJM 1979).

In 1994, DOE published a report entitled *Development of the Town Data Base: Estimates of Exposure Rates and Times of Fallout Arrival Near the Nevada Test Site* in an effort to model public radiation exposure rates in populated areas of Nevada, California, Arizona, and Utah at the time of fallout arrival and at 12 hour intervals thereafter. This report only focused on empirical exposure rate data (e.g., intensity isopleths across land areas) and did not convey interpretations on associated resulting health effects on potentially affected populations (DOE/NV-374). In a 1997 report by the National Cancer Institute, it was determined that 90 atmospheric tests at the NNSS deposited high levels of iodine-131 (149 million curies) across a large portion of the contiguous United States during the 1950s and 1960s, especially in the years 1952, 1953, 1955, and 1957; the resulting doses were large enough to produce 10,000 to 75,000 cases of thyroid cancer and had the potential of being the causational link for up to 212,000 cases. Results of the study show that, depending on their age at the time of the tests, where they lived, and what foods they consumed, particularly milk, Americans were exposed to varying levels of iodine-131 (which accumulates in the thyroid gland) for about 2 months following each of the 90 tests, after which the isotope decayed to essentially harmless levels. Rain, wind, and the food supply spread iodine-131 from these tests across the United States, with the largest deposits immediately downwind of the NNSS and the lowest on the west coast, upwind of the NNSS. The average cumulative thyroid dose to approximately 160 million people who lived in the United States during the testing era was about 2 rad, about five times the radiation dose emitted by a mammogram. Americans were exposed to varying levels depending on their residence, age, and food consumption. People who lived in the western states to the north and east of the NNSS, such as Colorado, Idaho, Montana, South Dakota, and Utah, had the highest per capita thyroid doses, ranging from 9 to 16 rad. Children between 3 months and 5 years old in these high-fallout areas probably received three to seven times the average dose for the population in their county because they had smaller thyroids and tended to drink more milk than adults (NCI 1997).

Milk was a major exposure vehicle because iodine-131 was deposited on pasture grasses and then consumed by cows. However, an estimated 20,000 people who drank goats' milk during the testing years were at an even greater risk because the iodine-131 was more concentrated in goats' milk than cows' milk. Thyroid doses to the individuals who drank goats' milk could be 10 to 20 times greater than those to residents of the same county, who were the same age and gender, and drank an equal amount of cows' milk. Other pathways included inhaling contaminated air or ingesting tainted leafy vegetables, cottage cheese, and eggs. However, the relationship between iodine-131 and thyroid cancer still is not fully known. It makes up less than 1 percent of cancer cases nationwide each year, and cancer registries do not indicate that fallout has caused an epidemic, although record-keeping did not start until the early 1970s (NCI 1997).

A Centers for Disease Control and Prevention report states that fallout from the NNSS, combined with nuclear tests conducted overseas by the United States and other countries, could ultimately be responsible for an additional 17,000 cancer deaths (CDC/NCI 2001).

In regard to potential health effects on onsite military and DoD civilian participants during the testing years, the Nuclear Test Personnel Review Program, administered by the U.S. Defense Threat Reduction Agency, was implemented to (1) confirm veteran participation in U.S. atmospheric nuclear tests from 1945 to 1962 and (2) upon confirmation, provide either an actual or estimated radiation dose received by the veteran, leading to potential financial dispensation (via the U.S. Department of Veterans Affairs) associated with a presumptive adverse health condition resulting from this dose. Each dose assessment, thousands of which have been conducted since the program's inception in 1978, can be interpreted as an independent radiation exposure health effects study. Outside of the Nuclear Test Personnel Review Program, there have been numerous other financial claims independently submitted against the Federal Government by employees at the NNSS, alleging similar adverse health effect manifestations resulting from their involvement or presence during the testing era.

There are no studies that indicate adverse health effects in populations near the NNSS as a result of activities or operations supporting the current NNSS missions.

4.1.12.5 Accident History

Nuclear testing began at the NNSS in 1951. There were 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in 1963. Nuclear tests were conducted underground until October 1992, when the nuclear testing moratorium was implemented. Since 1970, there have been 126 nuclear tests that released approximately 54,000 curies of radioactivity to the atmosphere. Of this amount, 11,500 curies were accidental due to containment failure (massive releases or seeps) and late-time seeps (small releases after a test, when gases diffuse through pore spaces of overlying rock). The remaining 42,500 curies were operational releases. From the perspective of human health risk, if the same person had been standing at the boundary of the NNSS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure, or the equivalent of one-thousandth of a single chest x-ray (OTA-ISC-414).

Other noteworthy incidents since 1980 include the following (ORPS 2009):

- Twelve site workers were injured when their instrumentation trailers dropped several feet downward due to collapsing ground, following an underground test (February 1984).
- A fatality occurred at P-Tunnel as the result of a rigging failure during the cutting and removal of a section of line-of-sight pipe (October 1989).
- A DOE security helicopter crashed within the NNSS boundary during a routine training mission, killing all five people aboard (July 1991).
- Three workers were injured by an explosive blowback at N-Tunnel during the re-entry phase of a high-explosives test. The blowback was caused by the ignition of hydrogen gas that was released while opening a containment valve (October 1992).
- In P-Tunnel, during mucking operations, five muck cars became uncoupled from their locomotive and subsequently rolled 20 feet down the track. The cars ran off the end of the track and struck

two barrels of contaminated material. The impact resulted in the release of approximately 30 gallons of contaminated water. No workers were injured or contaminated as a result of this incident (November 1992).

- An energized 4,160-volt power cable was inadvertently cut while linemen were in the process of rolling up de-energized and disconnected power cables in Area 2; no injuries resulted (May 1994).
- A 2,000-gallon diesel fuel tank in Area 2 tipped over as a result of inclement weather (high winds). Roughly 500 gallons of diesel fuel were spilled as a result (February 1995).
- Five personnel were accidentally exposed to the chemical agent orthochlorobenzalmalononitrile during a training exercise. First-aid treatment was required in response to these exposures (December 1999).
- High winds on the NNSS caused structural damage to a variety of buildings, trailers, vehicles, and utility poles. Maximum gusts of 80 miles per hour were reported (April 2002).
- A major brush fire occurred at the NNSS near EGG Point in Area 12. The fire covered an area of 50 acres, with flames reaching 20 feet in height (August 2002).
- A lightning strike near the U1h Shaft injured a site employee (October 2002).

4.1.12.6 Emergency Preparedness

Each DOE site has established an Emergency Management Program, developed in accordance with DOE Order 151.1C, *Comprehensive Emergency Management System*, that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for postulated accident conditions and to provide response efforts for accidents not specifically considered. The Emergency Management Program incorporates activities associated with emergency planning, preparedness, and response. The NNSA/NSO Consolidated Emergency Plan is designed to document all aspects of the site's emergency management program, including provisions to effectively and efficiently respond to an operational emergency, and minimize the consequences of an emergency event for the health and safety of workers, responders, the public, and the environment. The plan integrates all emergency planning into a single entity to minimize overlap and duplication and to ensure proper responses to emergencies not covered by a plan or directive. The NNSA/NSO Site Manager has the responsibility to respond, manage, and recover from an emergency occurring at the NNSS.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. NNSA receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current NNSA vulnerability assessments, resources, and capabilities regarding emergency preparedness.

4.1.12.7 Environmental Noise

The acoustic environment in areas adjacent to the NNSS is characteristic of uninhabited desert areas or small rural communities where natural phenomena, such as wind and rain, account for most of the background noise. Manmade noise in some areas of the ROI is caused by vehicles traveling along public highways and an occasional military aircraft. The Creech Air Force Base and the Desert Rock Airstrip are located near the southern border of the NNSS and generate intermittent increases in noise levels in the surrounding area. Although no ambient noise data are available, monitoring measurements from communities with similar environmental settings show that day–night average noise levels from such communities typically range from 45 to 65 decibels, A-weighted[24] (DOE 2008d).

[24] *A decibel is a unit for expressing the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.*

Major sources of noise at the NNSS include equipment and machines, blasting and explosives experiments, aircraft operations, and vehicles. Explosives at BEEF and other areas in the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, and 16), Areas 5 and 26, and the Explosives Ordnance Disposal Unit in Area 11 occasionally result in increased acute noise levels (less than 10 times per year at each site) (Morris 2009). Because of the NNSS' remote location, large size, access restrictions, and lack of a nearby population, the general public has little to no exposure to noise generated within the NNSS. The closest sensitive receptors to the site boundary are residences located approximately 1 mile to the south, in Amargosa Valley. At the NNSS boundary, away from most facilities, noise from most sources within the NNSS is barely distinguishable above background noise levels. Traffic generated by personnel commuting to and from work and occasional aircraft operations are the main NNSS-related contributors to increased noise levels in nearby communities.

Section 4 of the Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.), directs Federal agencies to carry out programs in their jurisdictions "to the fullest extent within their authority" and in a manner that furthers a national policy of promoting an environment free from noise that jeopardizes health and welfare. The Occupational Safety and Health Administration regulations (Occupational Noise Exposure; Hearing Conservation Amendment, 29 CFR 1910.95) require hearing conservation and protection for all employees potentially exposed to criteria noise levels as would be generated by the project. Standards issued under the authority of the *DOE Explosives Safety Manual* establish safety requirements applicable to operations involving the development, testing, handling, and processing of explosives, including noise protection guidelines during the detonation of explosives (DOE 2006f). High-explosives experiments must be conducted in accordance with this directive. Except for the prohibition of nuisance noise, neither the State of Nevada nor local governments have established specific environmental noise standards. Occupational noise exposure is regulated to the extent required by law.

4.1.13 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental impacts of Federal programs, policies, and activities on minority and low-income populations.

This section presents a summary of the demographic analysis prepared to analyze the potential impacts on low-income and minority populations affected by the programs discussed in this SWEIS. Demographic analysis is the first step in determining disproportionately high and adverse human health or environmental effects on low-income and minority populations. This analysis sets the stage for the impacts analysis presented in Chapter 5. Demographic analysis includes defining the ROI, census block groups, low-income populations, and minority communities.

The ROI for analyzing environmental justice in this SWEIS comprises Nye and Clark Counties, Nevada. DOE did not consider areas outside Clark and Nye Counties because any impacts extending beyond this area would impact the population equally and would not have a disproportionately adverse impact on low-income or minority communities.

The CGTO has also identified areas and nearby lands as culturally important to American Indian peoples. Although many of the American Indian groups live outside Clark and Nye Counties, American Indian peoples continue to value and recognize traditional ties to the NNSS and surrounding area. In recognition of these traditional ties, DOE has established a relationship with CGTO. Specific aspects of the participation of the group in DOE cultural resources management projects are discussed in Section 4.1.10.2. CGTO has also presented additional viewpoints on environmental justice in Chapters 4, 5 and Appendix C of this SWEIS.

4.1.13.1 Methodology

DOE used the Council on Environmental Quality definition of low-income and the annual statistical poverty thresholds from the U.S. Census Bureau. A low-income community exists when the percentage of low-income people in the area of interest is meaningfully greater than the corresponding percentage in the general population. For purposes of the analysis, DOE used the state-wide average of 11.2 percent to define the percentage of low-income people in the general population. To identify low-income populations, DOE used Census Bureau data for census block groups (USCB 2000, USCB 2008b) where the percentage of low-income people exceeded the state average (sorted into ranges of 11-20, 21-30, and greater than 30 percent). The census block group, which typically consists of between 600 and 3,000 people, with an optimal size of 1,500 people, is the smallest census unit for which the Census Bureau releases income data (to protect confidentiality).

DOE followed the Council on Environmental Quality guidance which considers a minority population to exist where either (1) minority individuals in the affected area exceed 50 percent of the population or (2) the percentage of minority individuals in the affected area is meaningfully greater than the corresponding percentage in the general population or other appropriate unit of geographic analysis. The state-wide percentage of minority individuals (used to represent the general population) is 38.2 percent. For purposes of analysis, DOE identified census block groups where the percentage of minority individuals was greater than 50 percent.

4.1.13.2 Low-Income Populations

Poverty thresholds are dollar amounts the Census Bureau uses to determine poverty status. In 2008, the weighted average threshold for households with two people was $14,051; that for households with three people was $17,163.

In 2008, the average household size for Clark County was 2.66; that for Nye County was 3.22. For the purposes of this analysis, DOE rounded the average household size for the counties within the ROI—an average household size of 3 was used for Clark and Nye Counties.

Census data were available for the number of households with an income less than $15,000 and those with an income between $15,000 and $24,999. DOE used the combined number of households with incomes less than $24,999 as the poverty threshold for Clark and Nye Counties.

Analysis of the data (see **Figure 4–27**) illustrates that there are numerous census block groups with low-income populations between 11 and 20 percent (that is, at or above the state-wide average) distributed throughout the ROI, including large (but sparsely populated) block groups adjacent to the NNSS. Block groups with low-income populations in the 21-30 and greater-than-30 percent ranges are found further to the east in the Las Vegas metropolitan area, closer to the RSL and NLVF facilities (see Sections 4.2.13 and 4.3.13).

4.1.13.3 Minority Populations

There are no block groups in Nye County (the county the NNSS is located within) with minority populations greater than 50 percent. Within the ROI, the closest block group to the NNSS with a minority population greater than 50 percent is Census Tract 5818, Block Group 1, in Clark County; approximately 2 miles east of the southeastern corner of the NNSS (see **Figure 4–28**). Additional block groups with minority populations greater than 50 percent are found further to the east in the Las Vegas metropolitan area, closer to the RSL and NLVF facilities (see Sections 4.2.13 and 4.3.13).

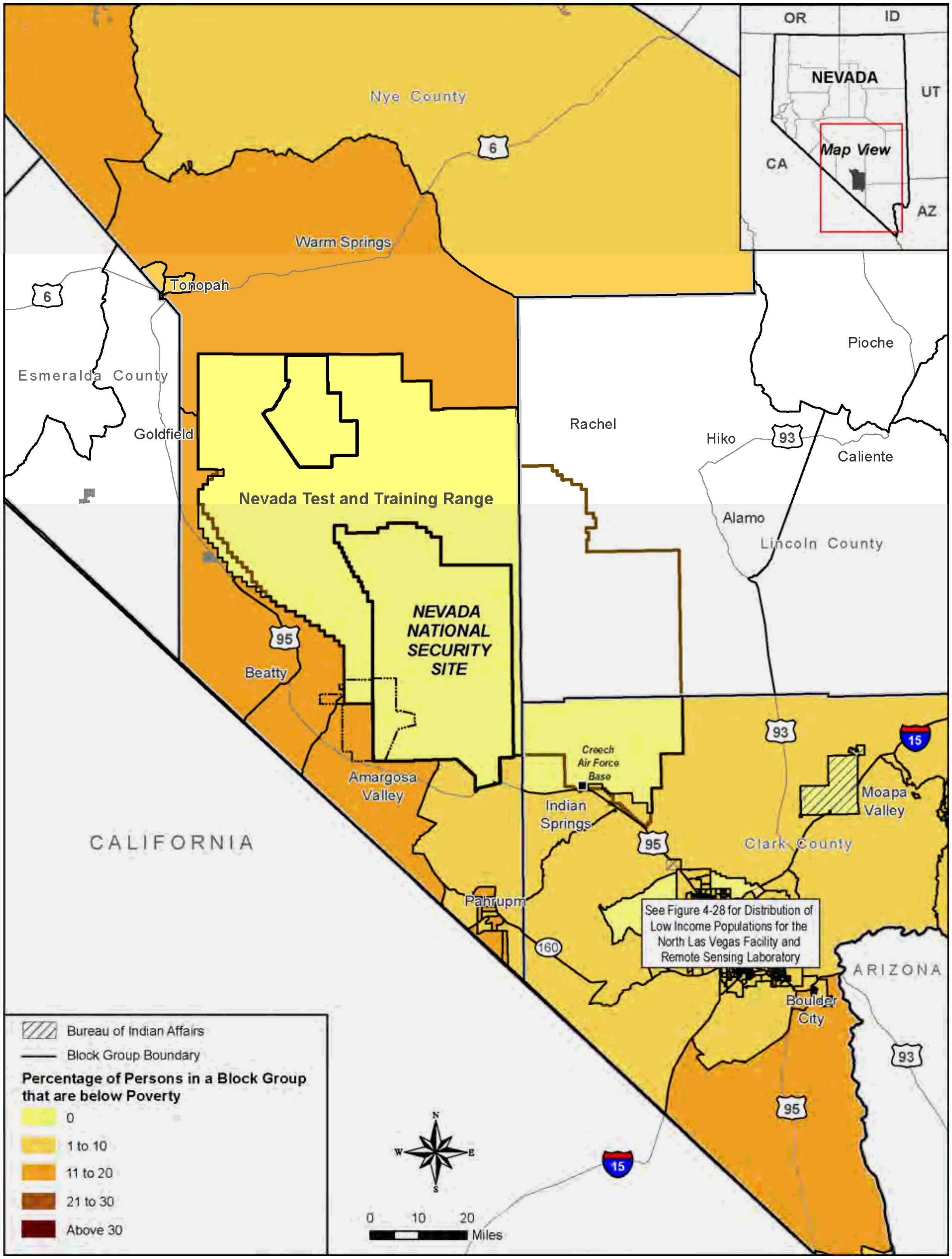


Figure 4–27 Distributions of Low-Income Populations for the Nevada National Security Site and the Tonopah Test Range

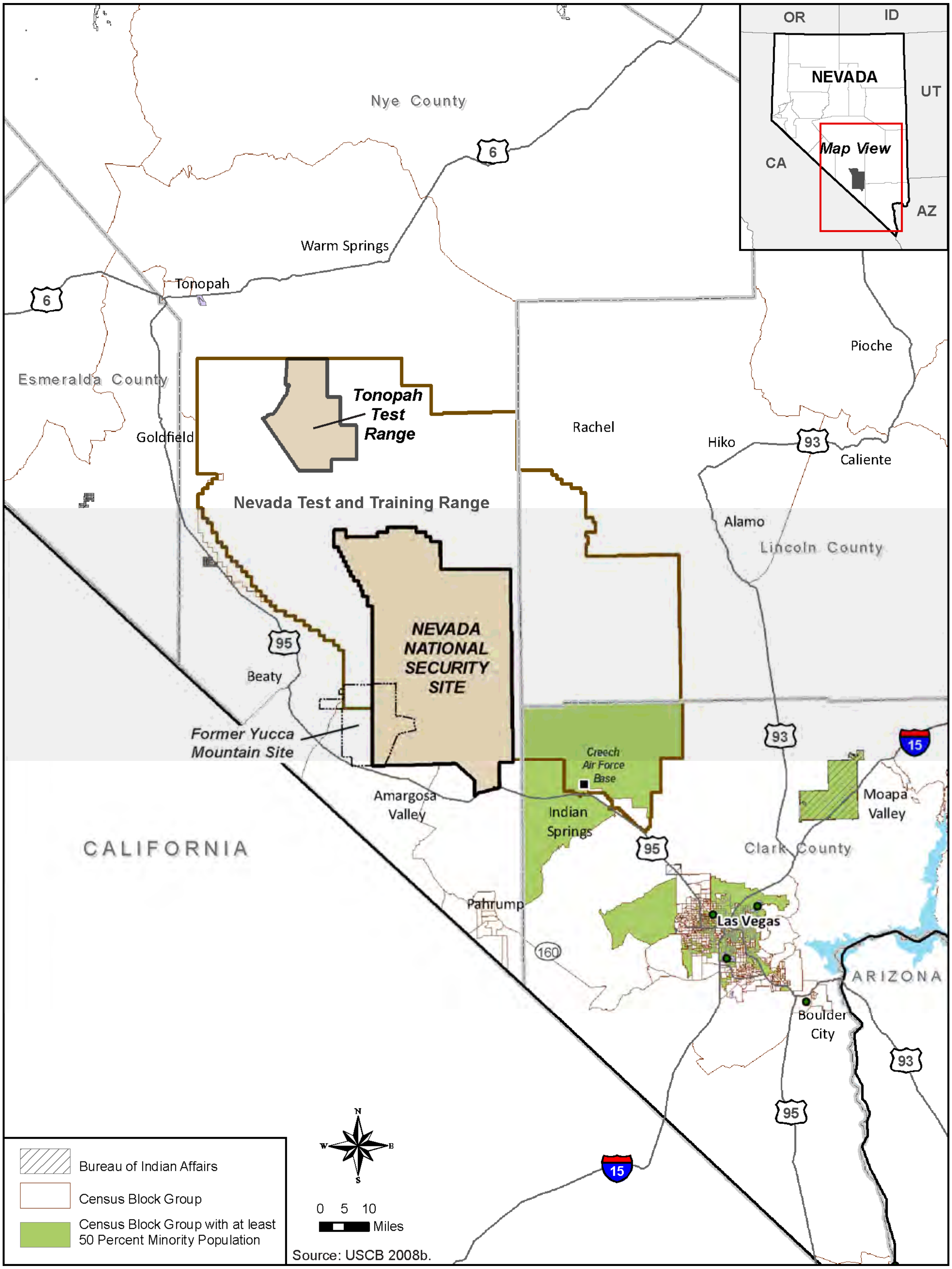


Figure 4–28 Nevada National Security Site and Tonopah Test Range Distributions of Minority Populations Greater than 50 Percent

4.2 Remote Sensing Laboratory

This section describes the existing environmental conditions at RSL. RSL is located adjacent to the main runway on Nellis Air Force Base, in North Las Vegas, Nevada. RSL provides emergency response resources for incidents involving weapons of mass destruction through the development and customization of state-of-the-art instruments and remote sensing technologies.

4.2.1 Land Use

RSL, located on the Nellis Air Force Base, is approximately 8.5 miles northeast of the center of Las Vegas. This land is federally owned and withdrawn from the public for military use. Nellis Air Force Base is located adjacent to the city of North Las Vegas to the north and west, the city of Las Vegas to the south and west, and public lands managed by BLM to the east and south. In accordance with a Memorandum of Agreement with the USAF, NNSA leases the land under a 25-year lease (starting in 1989), with an option for two term extensions (DOC 2009f). The facility, initially occupied in 1989, is located on approximately 35 secured acres and comprises seven buildings used for research, testing, and fabrication laboratories and shops. RSL totals 168,012 gross square feet (DOE 2008f; 2008i). There is no public access to RSL.

Federal regulations and the *Integrated Natural Resource Plan* for Nellis Air Force Base and the Nevada Test and Training Range, developed in May 2007, restrict land use on Nellis Air Force Base. This resource plan was developed to provide guidance for the conservation of natural resources on the installation. The guidelines have been developed within the context of the military mission at Nellis Air Force Base. Private development on the base is not allowed under this mission. Through the guidelines and recommendations in the resource plan, land conservation and natural resource protection is imposed; however, mission needs take precedent (USAF 2007c).

4.2.1.1 Adjacent Land Use

Nellis Air Force Base entirely surrounds RSL. Nellis Air Force Base is a secured military installation and is currently used for aircraft operations and maintenance, weapons storage, rock quarrying, and housing and offices. A large portion of the installation is undeveloped.

The 11,300-acre Nellis Air Force Base is divided into three major functional areas. RSL is within Nellis Air Force Base Area III, which is located just east of Las Vegas Boulevard and adjacent to Nellis Air Force Base Area I. Area III contains housing, a hospital, a runway, and open space (USAF 2010c). The surrounding land to the east and portions to the north of Nellis Air Force Base are managed by BLM's Southern Nevada District Office.

4.2.2 Infrastructure and Energy

4.2.2.1 Infrastructure and Utilities

This section discusses the RSL buildings and transportation infrastructure; potable water, wastewater, and communications utilities; and support services, including law enforcement and security, fire protection, and health care. Further transportation-related information is discussed in Section 4.2.3, "Transportation." Solid waste collection is discussed in Section 4.2.11, "Waste Management." Energy systems (electricity, natural gas, and liquid fuels) are discussed in Section 4.2.2.2, "Energy."

4.2.2.1.1 Infrastructure

Facilities. As stated above, RSL comprises seven NNSA buildings, all leased from the USAF. The total floor space at RSL is approximately 161,528 square feet, as shown in **Table 4–54**, presented according to building function.

Table 4–54 Remote Sensing Laboratory Building Floor Space by Function

Function	*Floor Space (square feet)*
Administrative	0
Storage	16,454
Industrial/Production/Process	0
Research and Development	144,059
Service Buildings	0
Other	1,015
TOTAL	161,528

Source: NNSA/NSO 2009e.

Transportation Systems. RSL is located on Nellis Air Force Base, adjacent to the runway. There are no railroads at RSL. According to an agreement with the USAF, RSL has access to and use of the runway for mission purposes.

4.2.2.1.2 Utilities

Water Supply. Potable water sources at Nellis Air Force Base include five active government-owned and -operated wells (three wells located off base and two wells located on base) and water purchased from the Southern Nevada Water Authority via bulk-supply pipelines from Lake Mead (NAFB 2005). The base also purchases a small quantity from the City of North Las Vegas Water District. The existing water supply at Nellis Air Force Base is considered adequate.

The water system at RSL suffers from low pressure and limited supply capability. NNSA is working with Nellis Air Force Base officials to address these issues (DOE 2008f). See Section 4.2.6, “Hydrology,” for more information on the water supply.

Wastewater Collection and Treatment Systems. RSL wastewater is discharged to existing municipal sewage systems. RSL holds an Industrial Wastewater Discharge Permit (Permit Number CCWRD-080) from the Clark County Water Reclamation District (DOE/NV 2009d).

Communication Systems. RSL has standard communications services (e.g., telephone, internet). RSL has recently undergone extensive fiber optic communications and LAN systems upgrades, bringing the facility up to technological standards, so that it is currently able to function at peak efficiency.

4.2.2.2 Energy

4.2.2.2.1 Electrical Energy

Electrical energy at RSL is supplied by three sources as follows: 65 percent by NV Energy; 10 percent by Western Area Power Administration (Hydropower); and 25 percent by Solar Star Inc. (the Nellis Air Force Base Solar photovoltaic project). In FY 2009, RSL’s electrical usage was 4,850 megawatt-hours (NNSA/NSO 2010b). The existing electrical distribution system at RSL is capable of supporting present demands (DOE 2008f). According to the *FY 2009 NNSA/NSO Ten-Year Site Plan*, the RSL electrical distribution system is slated for improvements in 2014 (DOE 2008i).

As part of energy conservation efforts under Energy Saving Performance Contract funding, buildings at RSL have been retrofitted with low-energy light fixtures (NSTec 2008b).

4.2.2.2.2 Natural Gas

Natural gas at RSL is provided by the Southwest Gas Corporation via 2-inch-high pressure gas lines. Natural gas is regulated to low pressure at three locations. In FY 2009, RSL used 33,673 therms of natural gas (NNSA/NSO 2010b). There is adequate capacity to serve current demands, and the condition of the gas lines is satisfactory (NSTec 2010i).

4.2.2.2.3 Liquid Fuels

RSL maintains liquid-fueled boilers, water heaters, and emergency generators. The underground storage tank program at RSL/Nellis Air Force Base consists of two active permitted tanks (one 550-gallon gasoline tank and one 550-gallon diesel fuel tank), one inactive tank (empty used oil tank), one deferred tank (as per 40 CFR 280.10(d)) for emergency power generation, and three unregulated tanks. The permitted and deferred tanks are located at Building 2211 (DOE/NV 2009d). The two permitted tanks supply RSL with fuel used for the various forklifts, generators, and other onsite needs.

RSL maintains five aircraft that carry out remote sensing operations. These aircraft use approximately 111,030 gallons of JP-8 jet fuel annually (NNSA/NSO 2010b). Nellis Air Force Base provides all JP-8 jet fuel for RSL assets (NSTec 2010i). RSL currently does not use any alternative form of fuel (e.g., E85).

4.2.3 Transportation

4.2.3.1 Onsite Transportation

RSL is located within the Nellis Air Force Base, which has several access gates. RSL can be accessed by most of the gates at the base. Hollywood Gate is the gate closest to RSL and may be used by authorized personnel to access the base during designated morning and afternoon hours. As shown in **Figure 4–29**, Access Road provides traffic circulation around RSL facilities and parking areas.

4.2.3.2 Regional Transportation

The primary access points are the Main Gate and North Gate, which are both located on North Las Vegas Boulevard (see Figure 4–29). The Main Gate is open 24 hours daily, and the North Gate is open from 5:00 A.M. to 5:00 P.M. daily. Access to RSL is provided by Perimeter Road, near Nellis Boulevard (also known as Nevada State Route 612) in the eastern portion of the North Las Vegas region. Traffic volumes and levels of service on roadways in the Las Vegas metropolitan area are discussed in Section 4.1.3.2.2. Traffic volumes near RSL are represented by Las Vegas Boulevard and Nellis Boulevard, presented in Table 4–11; these roadways experience moderate-to-high daily traffic volumes and are operating at levels of service A and B, respectively.

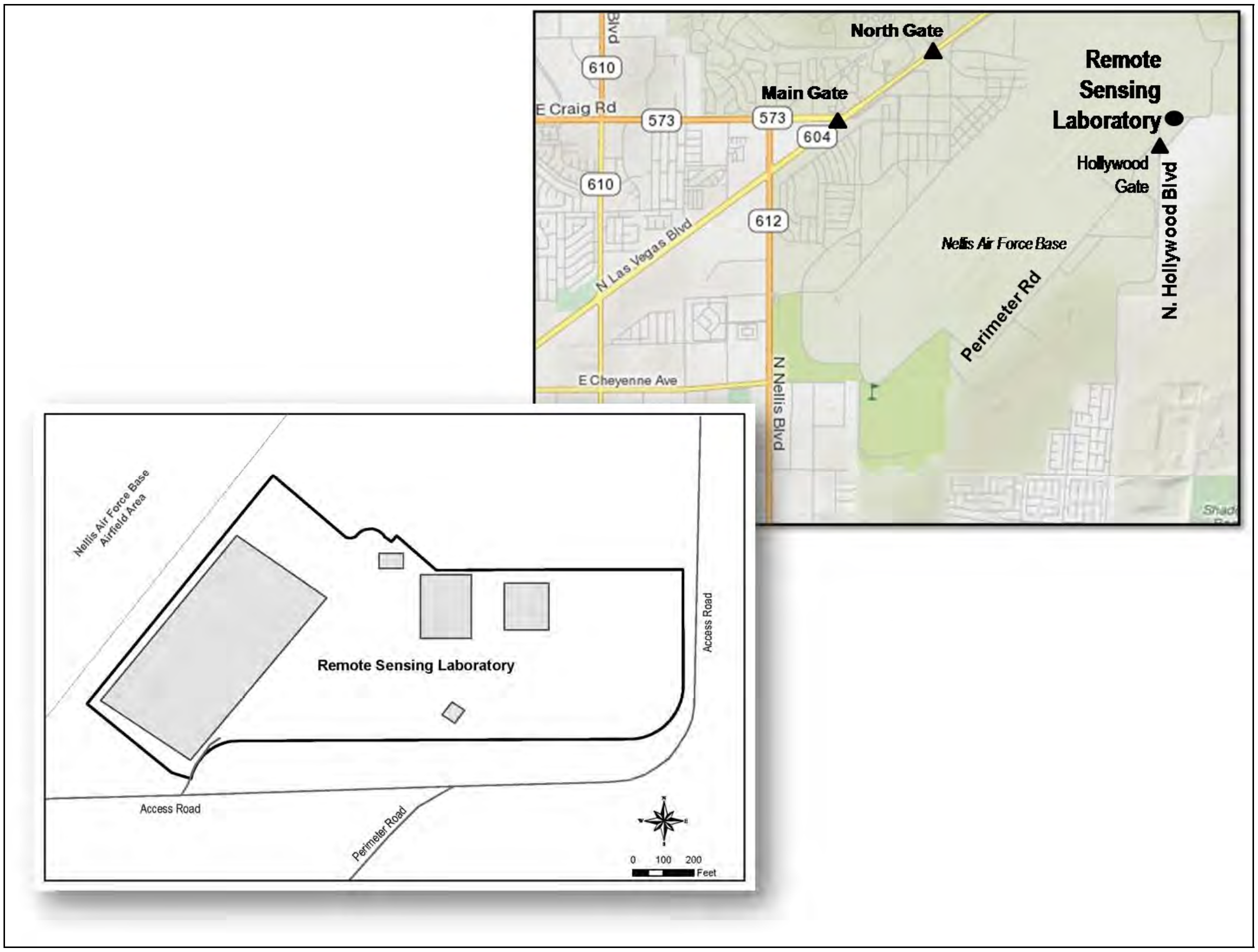


Figure 4–29 Remote Sensing Laboratory Roadways

4.2.4 Socioeconomics

General existing socioeconomic conditions within the ROI of RSL (Clark County) are presented in Section 4.1.4.

Police Protection. The USAF provides security services on the wider Nellis Air Force Base, but WSI, a private contractor, provides security services at RSL, following guidelines established by NNSA/NSO Safeguards and Security. Nellis Air Force Base Security Forces respond to RSL when called. The Police Services portion of the current Inter-Service Support Agreement between DOE and Nellis Air Force Base, dated January 2006, reads, "In the event of an emergency, Nellis Security Forces response will be limited to securing the exterior of the facility only."

Fire Protection. Fire protection is provided by Nellis Air Force Base.

Health Care. RSL does not have a medical facility. In the event of a medical emergency at RSL, Nellis Air Force Base would dispatch an ambulance from the base hospital (99th Medical Group).

The 99th Medical Group provides medical care for the military community to ensure maximum wartime readiness and combat capability. The group's functions include flight medicine, surgical services, maternal and child care, pharmacy, laboratory, radiology, dental care, medical benefits and information, and diagnostic and therapeutic services.

Emergency calls (9-1-1) reach the Base Fire Department emergency dispatch station directly. Depending on the nature of the emergency, the appropriate response organization is dispatched (e.g., fire department, ambulance).

4.2.5 Geology and Soils

4.2.5.1 Physiography

RSL is located in the northeastern section of the city of Las Vegas on Nellis Air Force Base. Las Vegas is situated in the Las Vegas Valley, a broad northwest–southeast trending basin in the Basin and Range Physiographic Province. The valley was formed during the extensional tectonics and gradually filled with sedimentary deposits that eroded from the surrounding mountain ranges. The deepest sediments are Tertiary in age, and gradually become younger, up to the Quaternary lake bed and stream deposits. The Las Vegas Valley is bounded by the Las Vegas shear zone to the north, by Frenchman Mountain to the east, by the Spring Mountains to the west, and by the McCollough and Bird Spring Ranges to the south (Rodgers et al. 2005).

Nellis Air Force Base is located northwest of Sunrise and Frenchman Mountains, which form the eastern border of the city of Las Vegas. The topography is generally flat at Nellis Air Force Base, although there is a gradual slope to the south. RSL is located approximately 1,850 feet above sea level.

4.2.5.2 Geology

The geologic history for the Las Vegas Valley is described in Section 4.1.5.2. Nellis Air Force Base is located on a series of alluvial fans formed from eroded sediments from the Sunrise, Las Vegas, and Dry Lake Mountain Ranges. The surrounding mountain ranges are primarily composed of Permian-age limestone, mixed with sandstone, shale, dolomite, and gypsum interbedded with quartzite. Gravity and seismic tests have estimated the maximum thickness of the alluvial deposits in Las Vegas Valley to be up to 3.1 miles thick (Rodgers et al. 2005). The alluvium is approximately 1.86 miles deep beneath RSL (Rodgers et al. 2005).

The alluvial fans around Nellis Air Force Base overlap and are carved by numerous drainage channels. The grain size is largest and poorly sorted closer to the source bedrock, and becomes increasingly finer and well sorted at a farther distance from the mountain range. The deposits found in the alluvium at RSL are pink to pale-brown sand and pebble to cobble conglomerate.

4.2.5.2.1 Structural History

The Las Vegas Valley is bounded to the north by the Las Vegas Valley shear zone, which is a subsidiary zone in the larger Walker Lane shear zone, described in Section 4.1.5.1. The mountain ranges that bound the valley to the east, west, and south are all bounded by normal faults from the extensional tectonics described in Section 4.1.5.2.

The closest normal fault sequence to RSL is the Frenchman Mountain Fault, which creates a structural boundary between Frenchman Mountain and the Las Vegas Valley. The Frenchman Mountain Fault stretches from the northwest to southeast, and gradually curves to the east. The normal fault is typical of the Basin and Range sequence of faults that forms the basin topography. Scarps in the Quaternary-aged alluvium suggest that there has been movement within the last 130,000 years (Anderson 1999b).

In addition to the normal faults at the edge of the Las Vegas Valley, there are several scarp sequences that trend north–south through metropolitan Las Vegas. The scarps can be up to 98.4 feet high and 16.8 miles long. It is unclear if the scarps are related to past tectonic activity or internal basin features

(Anderson 1999a). Most of the scarps have been modified by the development of Las Vegas. One prominent scarp in the northwestern section of the Las Vegas Valley is named the Eglington Fault, and may be related to faults within the basin bedrock (Anderson 1999c).

4.2.5.2.2 Faulting and Seismic Activity

An earthquake database search was performed for the area within 30 miles of the center of Las Vegas from 1973 to the present. Because the NNSS is outside of this 30-mile radius, the seismic tests from nuclear testing were not included in the database search. There have been 44 seismic events recorded around Las Vegas since 1973 (USGS 2010c). None of the earthquakes had a magnitude larger than 3.9, and approximately half of the earthquakes had a magnitude of less than 3. Section 4.1.5.2.3 presents a history of the seismic activity in the NNSS area and the greater Basin and Range region, which includes the Las Vegas Valley. Seismic design requirements are discussed in Section 4.1.5.2.3, "Faulting and Seismic Activity."

Due to the proximity of Las Vegas to the NNSS, seismic effects from nuclear testing have been a concern. Starting in the 1960s, a series of seismic stations were distributed throughout the Las Vegas Valley to measure the shockwaves from earthquakes and nuclear testing at the NNSS. Recordings were taken from 1968 through 1989, when the greatest number of tests occurred at the NNSS. The amount of ground motion recorded at the seismic station network correlated with the size of the nuclear test. The largest explosions at the NNSS (Boxcar, Handley, Muenster, and Fontina) generated the greatest ground motion in Las Vegas. These largest explosions were typically felt as IV or less on the Modified Mercalli Intensity Scale, which is used to measure the felt intensity of an earthquake (Rodgers et al. 2005). At that point, shaking is felt on the ground, but there is generally little to no damage to structures. The Modified Mercalli Intensity IV rating is roughly equivalent to a Richter magnitude of 4.0 (Rodgers et al. 2005). Smaller tests (e.g., Bambwell) generated minimal ground motion in the Las Vegas Valley; typically below 20 square centimeters per second (approximately 2 percent of the coefficient of gravity), which would be felt as weak motion with a low potential for structural damage (Rodgers 2008).

4.2.5.2.3 Geotechnical Hazards

RSL is located on the flat portion of the alluvial fans that fill the Las Vegas Valley. Sunrise Mountain is approximately 1.5 miles to the southeast of the facility. Runoff from Sunrise Mountain and Nellis Air Force Base collects in gullies to the south of RSL, which indicates that RSL would not be affected by landslides.

Section 4.1.5.2.4 describes how soils with shrink-swell properties could affect construction. RSL is located on Glencarb silt loam, which contains moderate amounts of clays and has a moderate shrink-swell potential (USDA 1985).

4.2.5.2.4 Geologic Resources

RSL is located on thick alluvial fans in the Las Vegas Valley. Gravel from alluvial deposits is the only geologic resource in the immediate vicinity of the facility.

4.2.5.3 Soils

The soils at Nellis Air Force Base and RSL have been labeled as Glencarb silt loam by the Natural Resources Conservation Service soil survey. The soil forms on the alluvial deposits from the surrounding mountain ranges and is often eroded and reworked by water. The soil is well drained, with a light, sandy loam with gravel and clay-rich sand in the upper layer. Up to 60 inches beneath the surface is a layer of caliche, which restricts root growth (USDA 1985). Due to the high percentage of clay, the soil does have some shrink-swell properties; however, this does not prevent construction of small commercial buildings. The topsoil is very susceptible to erosion by wind, as the fine-grained silt can be easily stripped from the coarser deposits. This soil is not classified as a prime farmland soil by the U.S. Department of Agriculture.

4.2.5.4 Radiological Sources as a Result of Testing

There has been no nuclear testing at Nellis Air Force Base or RSL; therefore, the soils are not contaminated with radioactive materials.

4.2.6 Hydrology

4.2.6.1 Surface Hydrology

RSL is located on Nellis Air Force Base in the northern portion of the Las Vegas Valley, which extends in a northwest-to-southeast direction and drains through the Las Vegas Wash into Lake Mead (USAF 2007c).

Surface-Water Features. No natural perennial streams, lakes, or springs are found on Nellis Air Force Base due to low precipitation, high evaporation rates, and low humidity. Water erosion is rare in the Las Vegas Valley, but can be somewhat prominent along alluvial fans. Nellis Air Force Base contains several ephemeral streams or washes that eventually flow into the Las Vegas Wash. One ephemeral stream originates near the northeastern corner of the RSL site (USAF 2007c).

Flood Hazards. The Federal Emergency Management Agency Flood Insurance Rate Map covering RSL (Map Number 32003C2200 E) indicates that the facility is located within Zone X. Zone X indicates an area of minimal flood hazard, which is determined to be above the 500-year flood level (FEMA 2002b).

Water Discharges and Regulatory Compliance. RSL holds an Industrial Wastewater Discharge Permit (Permit Number CCWRD-080) from the Clark County Water Reclamation District. The permit includes water chemistry limits and requires quarterly monitoring and reporting (DOE/NV 2010). In 2009, no permit limits were exceeded (see **Table 4–55**).

4.2.6.2 Groundwater

Hydrogeologic Setting. RSL is located on Area 1 of Nellis Air Force Base and is under lease to NNSA. Nellis Air Force Base is located on the eastern side of the Las Vegas Valley hydrographic basin, an intermountain basin within the Basin and Range Physiographic Province of the United States within the Colorado River Basin. The Las Vegas Valley hydrographic basin is approximately 1,600 square miles, with an estimated perennial yield of 25,000 acre-feet per year (NDWR 2010b). Groundwater flow within the Las Vegas Valley hydrographic basin is generally from west to east (USAF 2007c).

The little precipitation that is captured on site is drawn into the valley's principal basin-fill aquifer, shallow aquifers, and the Colorado River. Nellis Air Force Base is underlain by carbonate rock aquifers of the Colorado aquifer system, which is hydrologically connected to shallower alluvial aquifer systems composed of sand and gravels. The principal aquifer in the Las Vegas Valley hydrographic basin is naturally recharged by 30,000 to 35,000 acre-feet per year mostly from the Spring Mountains on the west valley boundary. Recharge of the shallow aquifers also occurs, primarily as a result of irrigation water percolating into the ground (USAF 2008c).

Table 4–55 Water Quality Results for Remote Sensing Laboratory Industrial Wastewater Discharges in 2008

Contaminant	*Permit Limit*	*Outfall*
Ammonia (ppm)	No limit listed	12.5
Cadmium (ppm)	0.35	0.00046
Chromium (total) (ppm)	1.7	0.0012
Copper (ppm)	3.36	0.234
Cyanide (total) (ppm)	1	<0.00521
Lead (ppm)	0.99	0.0022
Nickel (ppm)	10.08	0.0037
Phosphorus (ppm)	No limit listed	5.1
Silver (ppm)	6.3	0.0042
Total Dissolved Solids (ppm)	No limit listed	1,123
Total Suspended Solids (ppm)	No limit listed	304
Zinc (ppm)	23.06	0.43
pH (Standard Units)	5.0–11.0	8.13
Temperature (degrees Fahrenheit)	140	75.6

pH = a measure of acidity or basicity; ppm = parts per million.
Note: Permit limits are set forth in Clark County Water Reclamation District Industrial Wastewater Discharge Permit (Permit Number CCWRD-080).
Source: DOE/NV 2010, Table A-7.

Groundwater Supply. Sources of groundwater are available from the principal alluvial-fill aquifer underlying the Las Vegas Valley. Approximately 29 percent of the Nellis Air Force Base water supply comes from groundwater, and the base is allotted 7.1 million gallons per day of surface water and groundwater (USAF Air Combat Command 2008). Potable water sources at Nellis Air Force Base include five active government-owned and -operated wells (three wells located off base and two wells located on base) and water purchased from Southern Nevada Water Authority via bulk-supply pipelines from Lake Mead. Virtually all of the water in Lake Mead begins as snowmelt in the Rocky Mountains and arrives via the Colorado River. All the water drawn from Lake Mead is sent to the Alfred Merritt Smith or River Mountains water treatment facilities.

The water supplied by the Southern Nevada Water Authority is supplemented by a small percentage of groundwater from wells located on the base and near the base within the northeastern part of the valley. This groundwater comes from the Las Vegas Valley Aquifer (NAFB 2005). The base also purchases a small quantity from the City of North Las Vegas Water District. The existing water supply at Nellis Air Force Base is considered adequate.

The raw water from base wells is chlorinated and then mixed with the Southern Nevada Water Authority water prior to use as drinking water. The two on-base wells have arsenic concentrations that exceed the MCL, but, when blended with the Southern Nevada Water Authority water and off-base well water, the resultant arsenic concentration is below the current arsenic MCL of 10 parts per billion. The revised arsenic MCL regulation became effective in January 2006 (NAFB 2005).

The water system supplying RSL, located on Nellis Air Force Base, suffers from low pressure and limited supply capability. NNSA is working with Nellis Air Force Base officials to address these issues (DOE 2008f). No expansion or addition of water-consuming facilities can be made at RSL until a new water source can be installed.

Nellis Air Force Base announced a water loop project in 2008, which is to take place within 5 years, and invited NNSA to participate. In the interim, Nellis Air Force Base has offered to allow NNSA to obtain water from the water line running to Area 2 and to extend the line approximately 4,000 feet from

Perimeter Road to the compound. Eventually, this interim line could be capped and the same connection used on the new loop that would be adjacent to the property. The most economical new source for the Nellis Air Force Base is approximately 1 mile east of the compound and belongs to the Southern Nevada Water Authority (DOE 2007c).

Groundwater Monitoring and Quality. Technicians collect and analyze water samples monthly from Nellis Air Force Base's drinking water and water treatment facilities. The water is tested more frequently and extensively than the Safe Drinking Water Act and the *Nevada Administrative Code* require (NAFB 2005).

Nellis Air Force Base had two regulatory compliance violations in 2005 (June and September). In June 2005, two samples tested positive for total coliform and one tested positive for *Escherichia coli* bacteria. In September 2005, two samples tested positive for total coliform. Public notifications were issued after both instances, and all subsequent test results were negative for total coliform and *E. coli* bacteria (NAFB 2005).

4.2.7 Biological Resources

RSL is in the Southern Basin and Range Ecoregion. This facility is located in an urban setting that includes buildings, pavement, and landscaping. No original undisturbed native vegetation remains on the site; current vegetation on the site consists of urban landscape. Few wildlife species exist at the site because it is located in an urban area and contains little vegetation.

4.2.7.1 Flora

This facility is located in an urban setting; no native vegetation within a natural setting occurs at this site.

4.2.7.2 Fauna

This facility is located in an urban setting; only urban-adapted wildlife occur at this site. The only species that exist in this habitat include those that are adapted to urban habitats, which may include small mammals such as the house mouse *(Mus musculus)* and Norway rat *(Rattus norvegicus)*, as well as ubiquitous bird species such as the northern mockingbird *(Mimus polyglottos)*, European starling *(Sturnus vulgaris)*, house finch *(Carpodacus mexicanus)*, house sparrow *(Passer domesticus)*, ruby-crowned kinglet *(Regulus calendula)*, mourning dove *(Zenaida macroura)*, and rock dove *(Columba livia)*.

4.2.7.3 Threatened and Endangered Species

This facility is located in an urban setting; no threatened, endangered, or rare species are expected to occur at this site. No designated critical habitats for federally listed species exist at RSL. The urban areas of Clark County are not considered tortoise habitat.

4.2.7.4 Other Species of Concern

No other species of concern inhabit RSL.

4.2.7.5 Effects of Past Radiological Tests and Project Activities

This facility is located in an urban setting; no past radiological tests or project activities are anticipated to affect wildlife or vegetation at this site.

4.2.8 Air Quality and Climate

4.2.8.1 Meteorology

Downtown Las Vegas is located in Clark County, Nevada, about 56 miles southeast of the southeastern edge of the NNSS. RSL, at Nellis Air Force Base, is about 14 miles northeast of downtown. RSL is located in the Las Vegas Valley, which is situated in the northeastern corner of the Mojave Desert and in the rain shadow (lee) of the southern Sierra Nevada mountain range.

The Las Vegas Valley has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation throughout the year and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The generally dry, desert conditions specific to the area can occasionally be modified by the southwestern monsoon and convective thunderstorms during the summer months and Eastern Pacific tropical storm remnants in the late summer and fall. The dry conditions also tend to be moderated during strong *El Niño* cycles, which generally bring more rainfall to the area.

The average maximum temperatures range from about 95 to 105 °F in the summer and from about 55 to 65 °F in the winter. The average minimum temperatures range from about 70 to 80 °F in the summer and from about 35 to 45 °F in the winter, based on average temperatures recorded from 1971 through 2000 at the Las Vegas Weather Service Office Airport (NCDC 2009).

The Las Vegas Valley ranges in elevation from about 2,300 to 2,620 feet above mean sea level and is bounded by mountains to the north, south, and especially to the west, where the Spring Mountains peak above about 6,560 feet. This terrain causes wind flows in the Las Vegas Valley to be dominated by up-slope and down-slope conditions. The Clark County Department of Air Quality and Environmental Management (DAQEM) maintains an ambient air monitoring site (the J.D. Smith monitor, at 1301 East Tonopah Road) near RSL. **Figure 4–30** shows the wind roses for the J.D. Smith and E. Craig Road (at 4701 Mitchell Street) Clark County DAQEM sites for 2004 through 2008 (Clark County 2010) and the average wind direction and speed data surrounding both RSL and NVLF for the same time period. For additional information regarding the meteorological characteristics of RSL, see Appendix D, Section D.1.2.1.

The nearest upper-air measurements, used in estimating atmospheric stability, are available from the National Weather Service Desert Rock site located in the southern end of the NNSS about 58 miles northwest of downtown Las Vegas. Based on data recorded from 1978 through 2004 at Desert Rock, stable conditions dominate at night, though stronger windspeeds will tend to mix in the atmosphere, leading to neutral conditions. Since greater solar radiation leads to greater instability, unstable conditions dominate the daytime hours and the months with the highest solar radiation (summer). These stability patterns are slightly modified within the Las Vegas Valley because of the lower elevation and slightly higher temperatures, windspeed differences, and potential differences in local cloud cover relative to what occurs at Desert Rock (Soulé 2006). A limited comparison study between Desert Rock and Las Vegas upper-air measurements suggests that differences above the first few tens of meters are minimal (Lehrman et al. 2006).

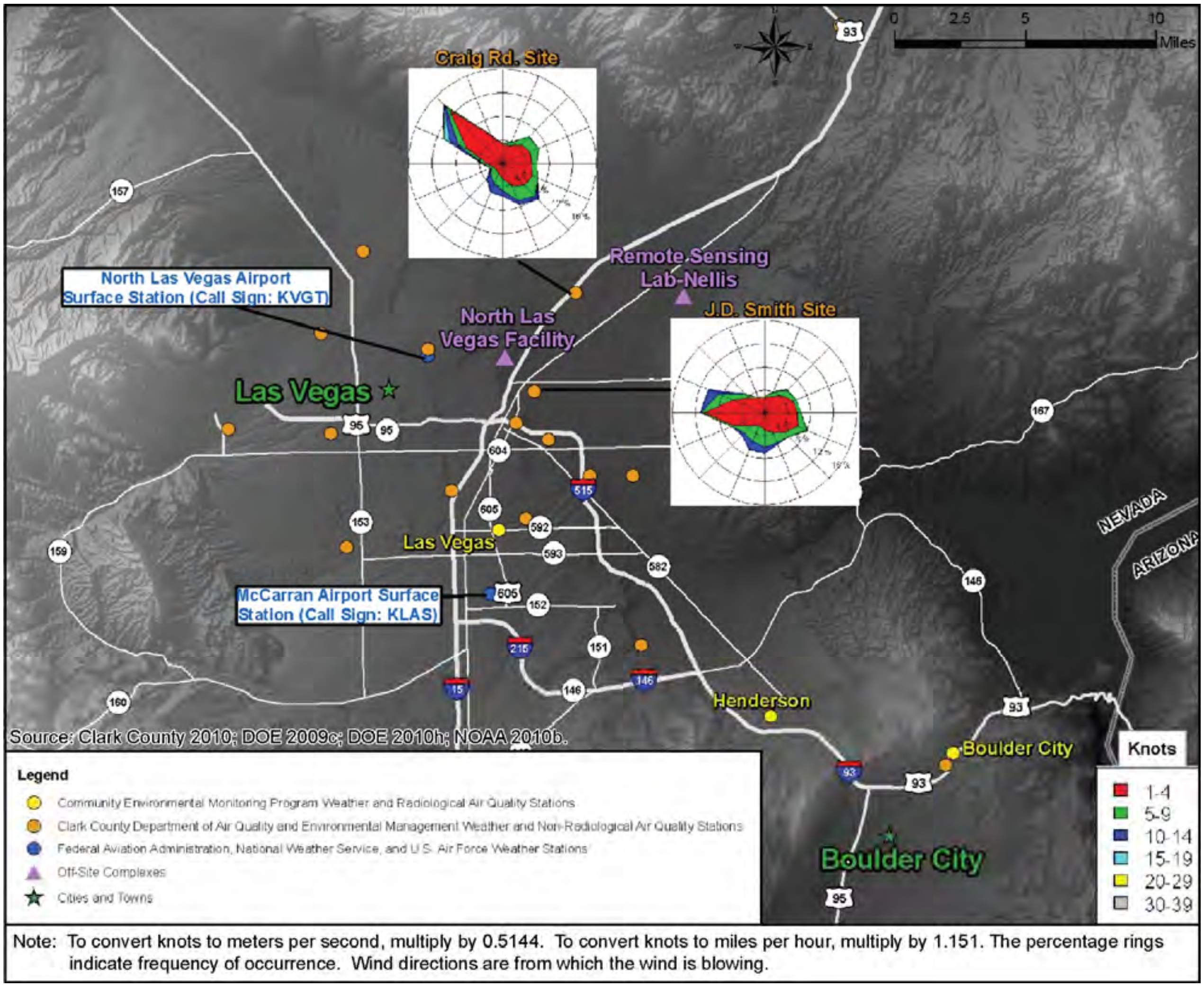


Figure 4–30 Wind Roses for J. D. Smith and E. Craig Road Clark County DAQEM Sites, 2004–2008

4.2.8.2 Ambient Air Quality

4.2.8.2.1 Region of Influence

RSL is located about 60 miles southeast of the southern border of the NNSS. The ROI for air quality and climate for RSL operations comprises northern Clark County. Historic data on pollutant emission inventories and compliance status for the State of Nevada are calculated at the resolution of county or hydrographic areas; these data provide a basis for determining existing air quality in the ROI and a metric for emission comparison assessments.

4.2.8.2.2 Existing Air Quality

Current Ambient Air Quality Standards. See Section 4.1.8.2.2 for a discussion on the current national and Nevada ambient air quality standards.

Air Quality Status. RSL is within Hydrographic Area 212. Clark County is in nonattainment for 8-hour ozone[25] and serious nonattainment for 8-hour carbon monoxide[26] and 24-hour $PM_{10.}$[27] All other pollutants are in attainment.

PSD is a regulation incorporated into CAA that limits increases of certain pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. CAA has three classes of areas with different increments. The smallest increments allowed are Class I areas, which are areas of special value (natural, scenic, recreational, or historic). Any degradation of existing air quality in these areas should be minimized. The closest PSD Class I areas are the Grand Canyon National Park (about 65 miles to the east) and the Sequoia National Park (about 165 miles to the west). RSL currently has no sources of pollution large enough to be subject to PSD requirements. However, because RSL is located in a nonattainment area, it could potentially be subject to nonattainment new source review if the emissions were of sufficient strength; however, they have been determined not to meet the threshold for new source review. Nonattainment new source review requirements are customized for the classification and type of air pollutant nonattainment area.

Emissions Due to RSL Operations. Title V of CAA gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At RSL, a Facility 348 Authority to Construct/Operating Permit regulates emissions from sources such as boilers, water heaters, cooling towers, emergency generators, a spray paint booth, and a vapor degreaser. Except for 1.3 tons of nitrogen oxides emitted in 2004, emissions of carbon monoxide, nitrogen oxides, PM_{10}, sulfur dioxide, volatile organic compounds, and hazardous air pollutants were each less than 1 ton annually from 2003 through 2008. Total emissions of these pollutants over this 6-year period are about 6 tons (DOE 2004b; DOE 2005b; DOE 2006a; DOE 2007b; DOE 2008j; DOE 2009c).

Table 4–56 shows the onsite emissions due to stationary sources and aircraft-related sources, as well as Clark County emissions due to RSL commuters and commercial vendors. The onsite stationary sources include both permitted sources and natural gas combustion used principally for heating. See Appendix D, Section D.1.2.2.2, for further details and a discussion of the methodology used to determine the stationary source emissions, aircraft emissions, commuter vehicle emissions, and commercial vendor emissions.

---

[25] *Proposed (74 FR 2936) classification for 8-hour ozone under Subpart 2 as marginal with a nonattainment area that includes those portions of Clark County that lie in Hydrographic Areas 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218, but excludes the Moapa River Indian Reservation and the Fort Mojave Indian Reservation. Final designation is expected in March 2011.*

[26] *Still designated as serious nonattainment for carbon monoxide; however, since 1999, there have been no violations of the carbon monoxide NAAQS. Clark County DAQEM submitted a request to EPA in September 2008 for a redesignation to attainment for carbon monoxide. The nonattainment area covers Hydrographic Area 212.*

[27] *Designated as serious nonattainment for $PM_{10.}$ The nonattainment area covers Hydrographic Area 212.*

Table 4–56 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to Remote Sensing Laboratory Activities

Pollutant	Annual Air Emissions (tons per year)						
	Stationary Sources	Aircraft-Related Sources	RSL Commuters	Commercial Vendors	Total		
	Clark County						
	On-RSL	On-RSL	Off-RSL	Off-RSL	On-RSL	Off-RSL	Total
PM_{10}	0.038	0.00040	0.030	0.043	*0.038*	*0.073*	***0.11***
$PM_{2.5}$	0.038	0.00037	0.016	0.04	*0.038*	*0.056*	***0.094***
CO	0.36	0.88	3.1	0.18	*1.2*	*3.3*	***4.5***
NO_x	0.9	0.045	0.76	0.4	*0.95*	*1.2*	***2.1***
SO_2	0.01	0.016	0.0084	0.00074	*0.026*	*0.0091*	***0.035***
VOCs	0.032	>0.17	0.062	0.058	*~0.2*	*0.12*	***~0.32***
Lead	<0.01	0.00040	0.0000020	0.00000068	*~0.01*	*0.0000027*	***~0.010***
Criteria Pollutant Total	*1.4*	*~1.1*	*4.0*	*0.68*	*~2.4*	*4.7*	***~7.2***
HAPs	0.0071	~0.17	0.0048	0.0076	*~0.18*	*0.012*	***~0.19***

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Measurements of Ambient Air Concentrations On and Near RSL. The Clark County DAQEM maintains an air quality monitoring network. The E. Craig Road monitor (at 4701 Mitchell Street) is about 3 miles west of RSL. It monitors hourly ozone and PM_{10} levels. **Table 4–57** shows (1) maximum 8-hour average concentrations of ozone and (2) maximum 24-hour average and annual average concentrations of PM_{10} measured at the E. Craig Road monitor from 2006 through 2008. Sulfur dioxide, carbon monoxide, and $PM_{2.5}$ values shown are the highest concentrations measured in the Las Vegas Valley. For ozone and PM_{10}, about 25 percent of the 2008 observations were missing, so the maximum concentration numbers for that year could potentially be higher than what is shown; however, the maximum concentration over the past 3 years is likely representative of the current conditions. The ambient air quality standards are also shown in the table. See Table 4–39 for more information on the standards. Note that the E. Craig Road monitor may be moved about 7 miles south in 2010; if that happens, the closest Clark County DAQEM monitor to RSL would be the J.D. Smith monitor (1301 East Tonopah Road), about 5 miles southwest of RSL.

Ozone measurements at the E. Craig Road monitor (at 4701 Mitchell Street) exceeded the 8-hour ozone NAAQS in 2006 and 2007. The largest 8-hour ozone concentration was 0.084 parts per million (ppm) (in 2006), which is 0.009 ppm larger than the current NAAQS (0.075 ppm). Maximum ambient ozone concentration levels have generally remained constant at this and other nearby monitors since at least 1998 (DAQEM 2009). The second-highest 24-hour average PM_{10} concentration at the E. Craig Road monitor (at 4701 Mitchell Street) was 168 micrograms per cubic meter (in 2008), which is 18 micrograms higher than the NAAQS of 150 micrograms per cubic meter. The largest annual average PM_{10} concentration was 35 micrograms per cubic meter (in 2006), well below the Nevada ambient air quality standard of 50 micrograms per cubic meter (there is no national PM_{10} annual average standard). This monitor typically observes the largest PM_{10} concentrations of all the PM_{10} monitors in the Las Vegas Valley.

All other criteria pollutants are well below NAAQS. No lead monitoring data are available in the Las Vegas Valley.

Table 4–57 Ambient Air Quality Monitoring Data in the Vicinity of the Remote Sensing Laboratory, 2006–2008

Year	*2nd Max 1-hour CO (ppm)*	*2nd Max 8-hour CO (ppm)*	*Annual Mean NO_2 (ppm)*	*2nd Max 1-hour NO_2 (ppm)*	*4th Max 8-hour O_3 (ppm)*	*2nd Max 1-hour SO_2 (ppm)*	*2nd Max 24-hour SO_2 (ppm)*	*Annual Mean SO_2 (ppm)*	*98th percentile $PM_{2.5}$ (µg/m^3)*	*Annual Mean $PM_{2.5}$ (µg/m^3)*	*2nd Max 24-hour PM_{10} (µg/m^3)*	*Annual Mean PM_{10} (µg/m^3)*
2006	6.3	5	0.021	0.080	**0.084**	0.015	0.007	0.002	24.3	9.4	124	35
2007	4.6	3.8	0.020	0.066	**0.081**	0.007	0.003	0.001	22.6	10.3	120	34
2008	4.7	3.7	0.016	0.062	**0.080**	0.006	0.001	0.001	22.5	9.1	**168**	33
NAAQS	35.0	9.0	0.053	0.100	0.075	0.075	0.030	0.140	35.0	15.0	150	None

µg/m^3 = micrograms per cubic meter; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; O_3 = ozone; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide.

Note: Monitored values are from the E. Craig Road monitor (at 4701 Mitchell Street) for O_3 and PM_{10}; other values are the highest monitored values in the Las Vegas Valley. All exceedances of the NAAQS are shown in bold font.

Source: EPA 2010a.

4.2.8.3 Radiological Air Quality

Radiation sources currently used at RSL at Nellis Air Force Base are sealed in locations that prevent the release of radionuclides or any elevated gamma radiation from reaching the public. Therefore, radiation monitoring for public health is not performed (DOE 2009e), and exposure levels are at natural background levels. See Section 4.1.8.3 for more information on radiation sources and radiation monitoring on and near the NNSS.

4.2.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions on the climate involve very complex processes and interact with natural cycles, complicating the measurement and detection of change. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways.

For information on greenhouse gas emissions in the United States, please see Section 4.1.8.4.1. Greenhouse gas emissions at RSL are discussed in the next section. Details on the methodology used to determine these emissions are discussed in Appendix D, Section D.2.2.1.1.

4.2.8.4.1 Greenhouse Gas Emissions

Table 4–58 provides greenhouse gas emissions due to RSL-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is the threshold for which a quantitative assessment may be meaningful (CEQ 2010).

Table 4–58 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases from Remote Sensing Laboratory Activities in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons* [a]
STATIONARY SOURCES		
Power generation	2,046	0.07
Natural gas heating	203	0.01
All stationary sources, except air conditioning/refrigeration and natural gas heating	11	0.01
All Stationary Sources	*2,260*	*0.08*
MOBILE SOURCES		
Aircraft and ground support equipment	1,184	0.04
Commuting	473	0.02
Commercial vendors	138	0.01
All Mobile Sources	*1,795*	*0.07*
Total	***4,055***	***0.15***

[a] 25,000 metric tons are equal to about 27,558 short tons.

Electricity consumption is by far the largest single source of greenhouse gas emissions related to RSL activities, emitting approximately 2,046 carbon-dioxide-equivalent tons of greenhouse gases, or 50 percent of the RSL-related greenhouse gas emissions total. Stationary sources altogether emitted about 2,260 carbon-dioxide-equivalent tons of greenhouse gases. Mobile sources emitted about 1,795 carbon-dioxide-equivalent tons. Overall, RSL-related activities created about 4,055 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, which in itself is well below the threshold reporting level.

4.2.8.4.2 Current Changes in Climate

For a discussion of climate change impacts in the region, please see Section 4.1.8.4.2.

4.2.9 Visual Resources

RSL is located at Nellis Air Force Base, to the east of the northern end of the runways. This area is primarily developed, with the RSL facilities, adjacent runways, and infrastructure such as roadways, fences, and utility lines. The immediate surrounding land is undeveloped desert shrubland of the lower Mojave Desert (USAF 2006c). Public access to the airfield and RSL is restricted.

The area surrounding RSL is Nellis Air Force Base land. Public, middle ground views exist from Las Vegas Boulevard North, located over a mile north of RSL, but development along the roadway and infrastructure associated with the airfield are more readily visible. RSL blends with this visual environment. Visible portions of RSL are considered to have a Class C scenic quality rating (see Section 4.1.9 for information on the visual impact rating system) due to the developed nature of the landscape, combined with high intrusion of manmade elements and lack of elements that help to improve aesthetics, such as landscaping. There is no immediate public visual access to the foreground of RSL.

4.2.10 Cultural Resources

For introductory information regarding cultural resources, see Section 4.1.10. Unless otherwise noted, the information in this section is derived from the *1996 NTS EIS* (DOE 1996c).

RSL is situated in the northern Las Vegas Valley, within the center region of the Las Vegas Valley hydrographic basin, an intermountain basin within the Basin and Range Physiographic Province of the United States (NDWR 2010a). RSL is located in Area III of Nellis Air Force Base, adjacent to the northern end of the Nellis Air Force Base runway. The facility is constructed in a highly built military setting that includes operations buildings, maintenance structures, paved runways, and ornamental landscaping. There is no original undisturbed ground surface on RSL.

The area of influence for cultural resources includes all areas where facilities, operations, and maintenance of DOE programs would take place. For the purposes of this SWEIS, the area of influence includes the entire 35-acre RSL facility.

4.2.10.1 Recorded Cultural Resources

There are no recorded cultural resources within the boundary of RSL.

4.2.10.2 Sites of American Indian Significance

There are no known sites of American Indian significance within the boundary of RSL. As part of the preparation of this SWEIS, DOE consulted with CGTO to determine whether any sites of American Indian significance exist within RSL.

4.2.11 Waste Management

RSL is a small-quantity generator of hazardous waste that also generates sanitary solid waste and recyclable materials. Hazardous wastes are stored on site at RSL for no more than 90 days before being transferred as needed to an offsite facility. As the landlord for RSL, the USAF provides waste management services, including removal and disposal of miscellaneous laboratory and process equipment wastes. Sanitary solid waste is collected and disposed by a municipal waste service. DOE occasionally ships scrap metal to the NNSS to be combined with other accumulated scrap metal at the NNSS and recycled under the NNSS Pollution Prevention and Waste Minimization Program (see Section 4.1.11.3).

4.2.12 Human Health and Safety

No human health impacts on the public or workers are associated with the regular operation of RSL. Because RSL is located within the Nellis Air Force Base, the greatest contributors to background noise conditions are aircraft operations and vehicular traffic. No environmental noise data are available at RSL; however, because of the surrounding land uses, it is assumed that background noise levels are those typical of an industrial land use area, ranging from 50 to 65 decibels, A-weighted (EPA 1974).

4.2.13 Environmental Justice

As seen in **Figure 4–31**, Nellis Air Force Base (the host installation for the RSL) directly borders several block groups where the low-income population is between 11 and 20 percent, and additional block groups in the 21-30 and greater-than-30 percent range are located further to the southwest. RSL is located in an area where the majority of block groups have minority populations exceeding 50 percent (see **Figure 4–32**).

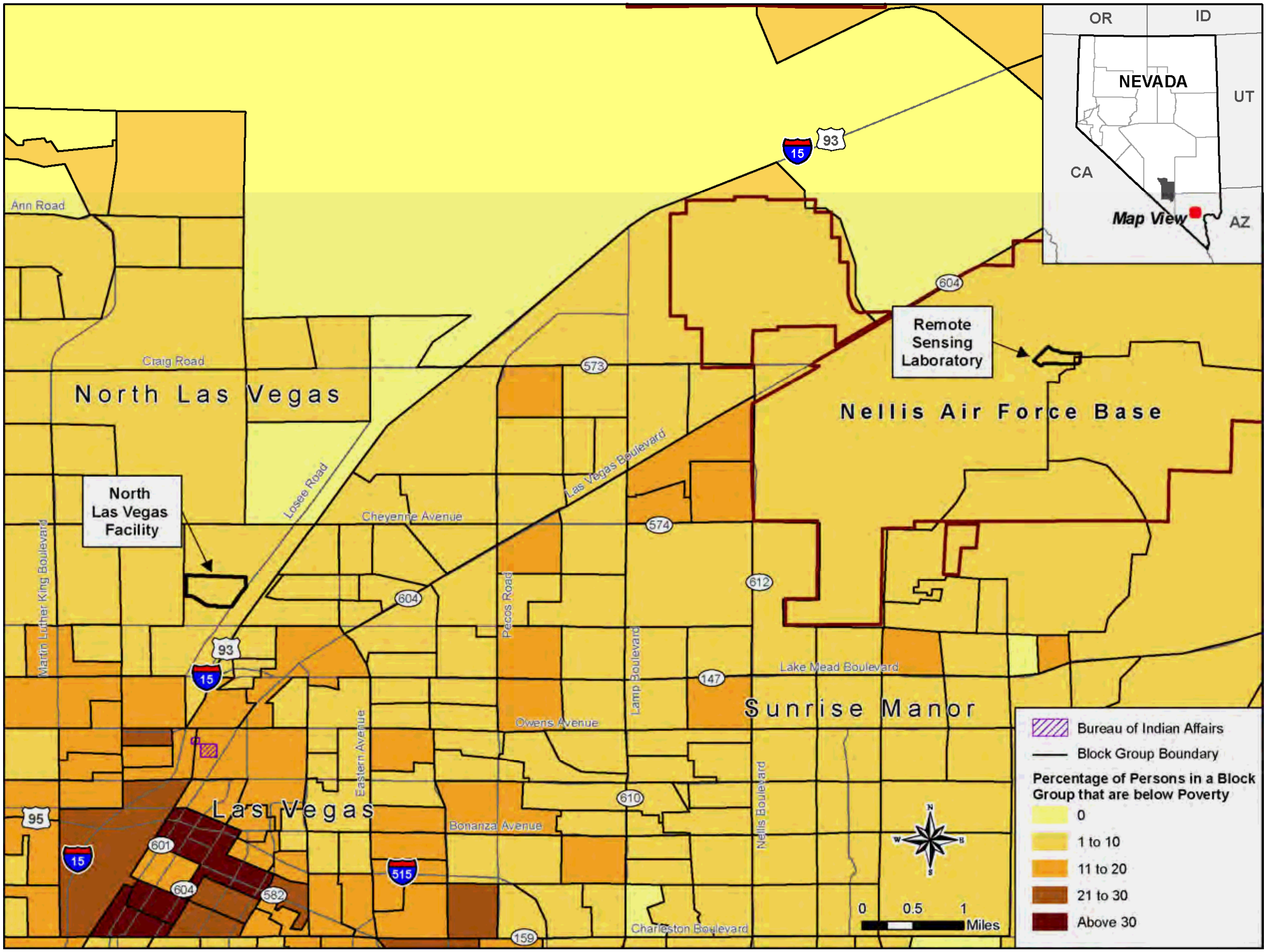


Figure 4–31 Distributions of Low-Income Populations for the North Las Vegas Facility and Remote Sensing Laboratory

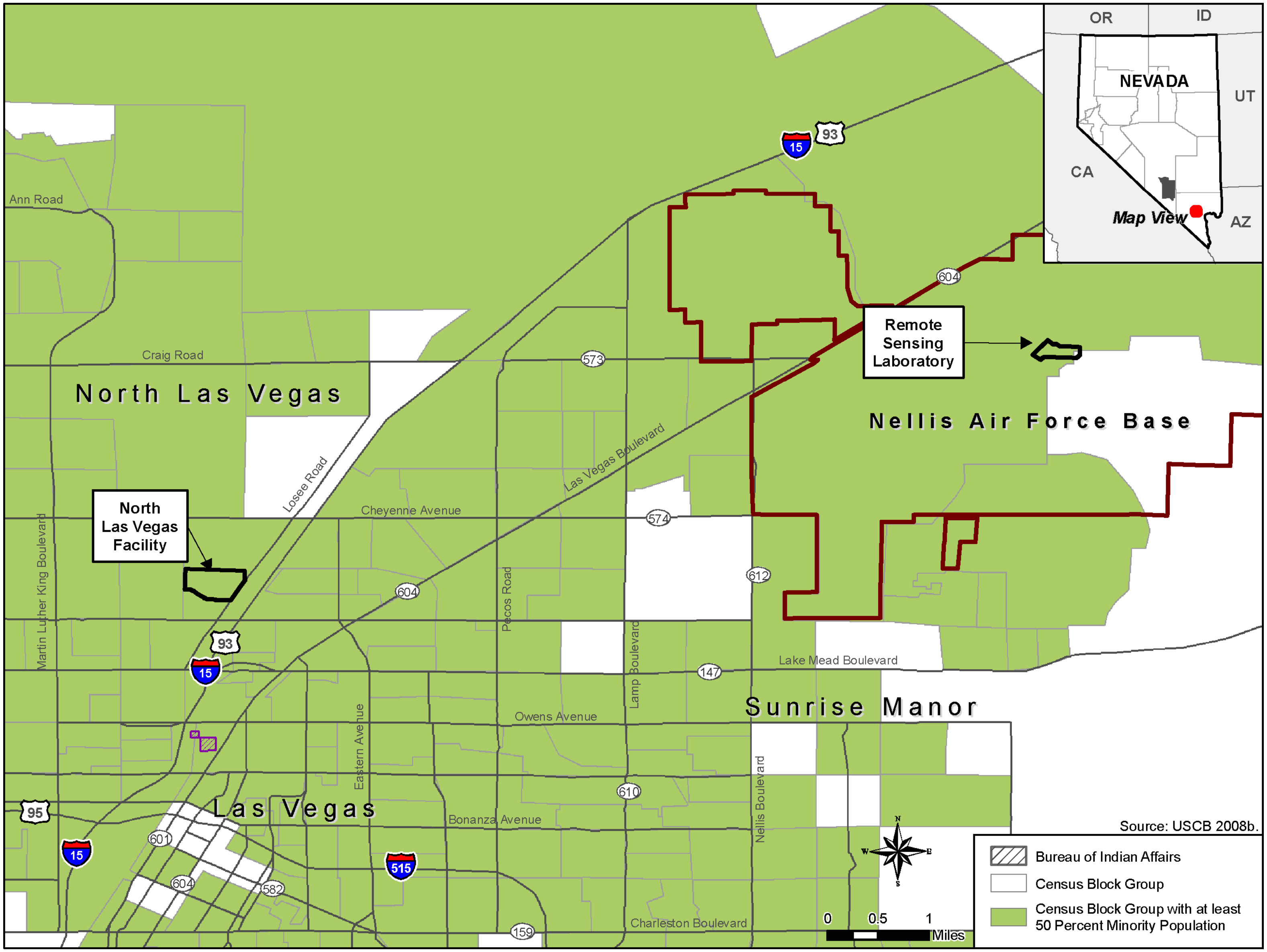


Figure 4–32 Distributions of Minority Populations Greater than 50 Percent for the North Las Vegas Facility and the Remote Sensing Laboratory

4.3 North Las Vegas Facility

This section describes the existing environmental conditions at NLVF. NLVF is located in North Las Vegas, Nevada, and occupies 80 acres along Losee Road, about 0.2 miles west of Interstate 15 (Las Vegas Freeway) and a railroad corridor. Many of the NNSS project management, diagnostic development and testing, designing, engineering, procurement, and environmental compliance activities take place at NLVF. The NNSA/NSO support facility is also located within NLVF. Public access to NLVF is restricted (DOE 2008i).

4.3.1 Land Use

NLVF consists of 30 buildings, parking lots or paved surfaces, and one trailer within the fenced complex. The existing structures account for 665,988 gross square feet of developed space. Buildings A-1 and C-3 provide space for communications, test fabrication and assembly, radiography, and other diagnostics. Building A-1 houses machine shops and overhead cranes that would be essential if nuclear tests were conducted in the future. Building C-3 houses a laboratory, stockpile stewardship experimental facilities, and readiness assets (DOE 2009f). The property is located within a heavy industrial land use area, and the property is zoned for general industry.

4.3.1.1 Adjacent Land Use

The primary land uses adjacent to NLVF are industrial and include manufacturing, processing, warehousing, storage, shipping, and other uses similar in function or intensity. Secondary uses include office uses and commercial uses supporting industrial development.

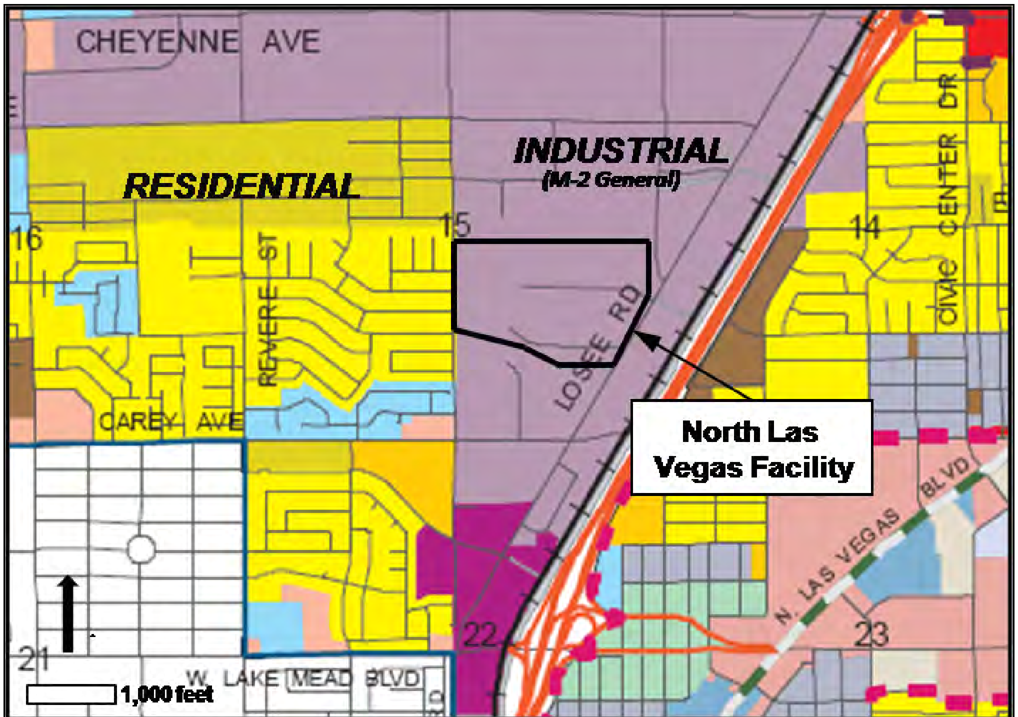
With the exception of the residential area just west of the NLVF western boundary, across North Commerce Street, the land uses adjacent to NLVF consist primarily of businesses in the manufacturing and distribution sectors, with warehouse and office buildings occupying the properties. Products manufactured in this area include automobile engines and transmissions, electrical equipment, and component parts.

The City of North Las Vegas manages land use. Regulations are imposed on the city through the North Las Vegas *2006 Comprehensive Plan*, adopted in 2006. This plan establishes policy and guiding principles for the city for the next 20 years, including a balanced land use mix, a diverse economic base, and thriving and attractive commercial and business centers. Leaders use this plan to help them make decisions about development, programs, and investments in the city. This plan identifies three Specific Planning Areas (SPAs) to help implement and achieve goals of the City of North Las Vegas. The three types of SPAs are as follows (NLV 2006):

- Residential neighborhoods – includes older neighborhoods, areas still under construction and areas yet to be developed
- Activity centers – includes areas planned for mixed-use development, which will serve as key areas of social, commercial, and employment activity for the community
- Employment districts – includes the industrial and primary employment corridors within the city of North Las Vegas and the lands planned for these uses in the future

NLVF is zoned for a general industrial district (M-2) and is within the Employment District SPA, and specifically, within the Industrial District. The M-2 designation provides an area for the development of uses that would not be compatible with those in most other zoning districts because of the nature of the operations, appearance, traffic generation, or emissions associated with industrial activities. These activities are necessary and desirable to the city and are typically located in close proximity to each other (NLV 2010).

Figure 4–33 depicts NLVF and zoning in the city of North Las Vegas.



Source: NLV 2006.

Figure 4–33 Zoning in the City of North Las Vegas and the North Las Vegas Facility

4.3.2 Infrastructure and Energy

4.3.2.1 Infrastructure and Utilities

NLVF facilities are divided into three distinct areas. The first area covers 20 acres and supports the Lawrence Livermore National Laboratory test program. The second area covers 20 acres and supports the Los Alamos National Laboratory test program. The third area covers 38.3 acres and supports a computer center and administrative and engineering support facilities.

4.3.2.1.1 Infrastructure

This section discusses the NLVF buildings and transportation infrastructure; potable water, wastewater, and communications utilities; and support services, including law enforcement and security, fire protection, and health care. Further transportation-related information is discussed in Section 4.3.3, "Transportation." Solid waste collection is discussed in Section 4.3.11, "Waste Management." Energy systems (electricity, natural gas, and liquid fuels) are discussed in Section 4.3.2.2, "Energy."

Facilities. NLVF is a fenced complex composed of 30 buildings (including one trailer), with a total of 665,988 square feet of floor space, as shown in **Table 4–59**, presented according to building function.

Table 4–59 North Las Vegas Facility Building Floor Space by Function

Function	*Floor Space (square feet)*
Administrative	444,090
Storage	22,179
Industrial/Production/Process	58,969
Research and Development	136,079
Service Buildings	4,023
Other	648
Total	665,988

Source: NNSA/NSO 2009e.

Transportation Systems. NLVF consists of a network of approximately 4,000 feet of roadway providing access to the buildings and parking lots. These roads and parking lots are in poor condition and will require replacement or rehabilitation in the near future. There are no railroads or aircraft facilities at NLVF.

4.3.2.1.2 Utilities

Water Supply. Potable water at NLVF is adequately supplied from city services by the Las Vegas Valley Water District (DOE 2008f). NLVF conserves water by using only desert landscaping, which requires minimal use of potable water.

Wastewater Collection and Treatment Systems. NLVF wastewater is discharged to existing municipal sewage systems of the City of North Las Vegas. NLVF holds National Pollutant Discharge Elimination System (NPDES) Permit NV0023507 and Class II Wastewater Contribution Permit VEH-112 (DOE/NV 2008d).

Communication Systems. NLVF has standard communications infrastructure, including telephone, internet, data transmission and storage, radio systems, etc. The telephone communication systems equipment was installed over 20 years ago and is functional but less than adequate; however, some upgrades have been recently installed. Projects are currently under way to modernize NLVF data movement needs.

4.3.2.2 Energy

4.3.2.2.1 Electrical Energy

Electrical energy at NLVF is supplied by NV Energy from the Miller Substation. The main switch is 12.47 kilovolts at 1,200 amperes. The power is distributed throughout the site through an underground distribution system to multiple pad-mounted switches and step-down transformers, where it is transformed to usable 480-volt power (NSTec 2010i). In FY 2009, NLVF's electrical usage was 15,447 megawatt-hours (NNSA/NSO 2010b). The peak demand recorded in 2008 and 2009 was approximately 3,200 kilowatts, recorded in August 2008 during on-peak afternoon hours.

As of December 2008, three of the buildings at NLVF have electrical meters. However, Energy Saving Performance Contract funding is slated to install numerous other buildings at NLVF with electrical, gas, and water meters (NSTec 2008b). The metering will allow for better tracking of NLVF's use of electricity, water, and gas, thus improving its ability to identify conservation opportunities.

As part of energy conservation efforts under Energy Saving Performance Contract funding, buildings at NLVF have been retrofitted with low-energy light fixtures. All NLVF buildings are equipped with an energy management system that controls lighting and heating, ventilation, and air conditioning 24 hours a day, 7 days a week (NSTec 2008b).

4.3.2.2.2 Natural Gas

Natural gas at NLVF is provided by Southwest Gas Corporation via 2-inch-high pressure gas lines (NSTec 2010i). In FY 2009, the North Las Vegas Complex used 25,947 therms and the Nevada Site Facility (part of the North Las Vegas Complex) used 22,226 therms, for a total natural gas usage of 48,173 therms at NLVF (NNSA/NSO 2010b). There is adequate capacity to serve current demands, and the condition of the gas lines is satisfactory.

4.3.2.2.3 Liquid Fuels

NLVF maintains liquid-fueled boilers and emergency generators. There are currently two liquid fuel storage tanks at NLVF: a diesel tank (267 gallons) and a gasoline tank (391 gallons) (NSTec 2010i; DOE 2008k).

4.3.3 Transportation

4.3.3.1 Onsite Transportation

As shown in **Figure 4–34**, Atlas Drive and Energy Way provide access from Losee Road to NLVF; security gates are located on these roadways. Energy Way provides the main access point for personnel. Paved roads and parking lots at the facility are deteriorating and require replacement or rehabilitation (DOE 2007c).

4.3.3.2 Regional Transportation

NLVF is located on Losee Road, which is adjacent and parallel to Interstate 15 to the east. Traffic volumes and levels of service on roadways in the Las Vegas metropolitan area are discussed in Section 4.1.3.2.2. Traffic volumes on Losee Road are presented in Table 4–11; this roadway experiences moderate levels of daily traffic volumes and is currently operating at level of service B near NLVF.

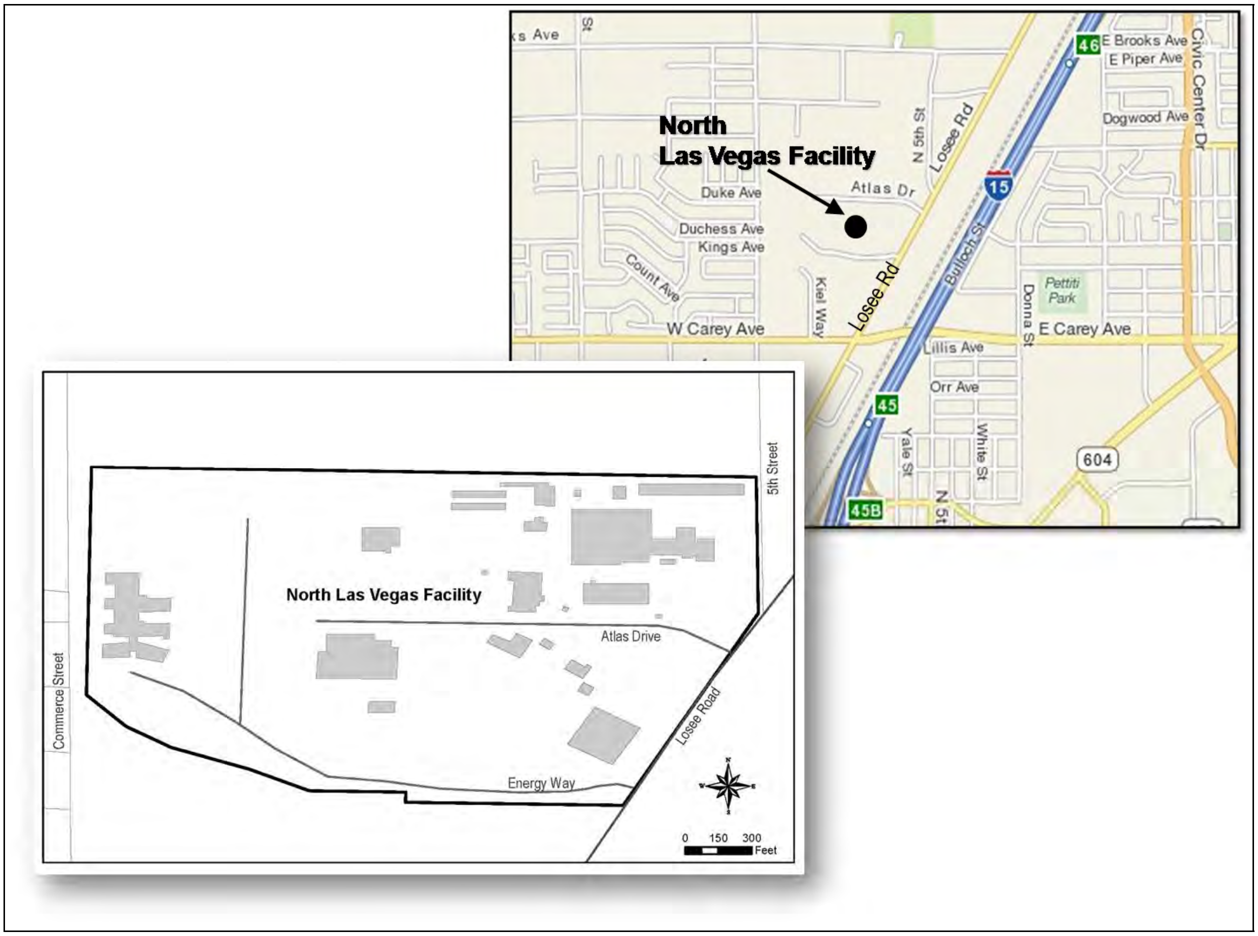


Figure 4–34 North Las Vegas Facility Roadways

4.3.4 Socioeconomics

General existing socioeconomic conditions within the ROI of NLVF (Clark County) are presented in Section 4.1.4.

Police Protection. NLVF is a controlled-access area. WSI, a private contractor, provides security enforcement at NLVF, following guidelines established by NNSA/NSO Safeguards and Security.

Law enforcement at NLVF is provided by the North Las Vegas Police Department.

Fire Protection. Fire protection is provided by the North Las Vegas Fire Department.

Health Care. NLVF has a fully operational occupational medicine center with diagnostic and laboratory support facilities. The center offers a complete array of certification and surveillance exams and has rooms for urgent care, Employee Assistance Program, and ergonomic services. This occupational medicine center can respond to normal and emergency medical situations in North Las Vegas.

4.3.5 Geology and Soils

4.3.5.1 Physiography

NLVF is located in the northern section of the city of Las Vegas. As it is also located in the Las Vegas Valley, the physiography is similar to that described for RSL in Section 4.2.5.1. The facility property has been graded for the construction of its buildings; however, there is a slight grade from west to east. The elevation at the site is approximately 2,000 feet above sea level. The location is surrounded by other urban lands that have also been graded.

4.3.5.2 Geology

NLVF is located on alluvial sediments eroded from the surrounding mountain ranges, as described in Section 4.2.5.2. Although the sediment depth becomes shallower closer to the edges of the valley, the alluvial deposits for most of the valley are at least 0.62 miles deep (Rodgers et al. 2005).

4.3.5.2.1 Structural History

Section 4.2.5.2.1 presents the structural history for the Las Vegas Valley, which includes NLVF. NLVF is located approximately 4.8 miles from the Eglington Fault scarps in northwestern Las Vegas.

4.3.5.2.2 Faulting and Seismic Activity

Section 4.2.5.2.2 presents the faulting and seismic activity for the Las Vegas Valley, which includes NLVF.

4.3.5.2.3 Geotechnical Hazards

The geotechnical hazards would be similar to those discussed in the NNSS and RSL discussions. NLVF is located well within the city boundaries and away from the mountain ranges. Gypsum can generate electrochemical reactions in normal concrete, so foundations for new structures would require concrete resistant to sulfate corrosion (USDA 1985). The presence of several inches of hardpan indicates that heavy machinery would be required for deep excavation.

4.3.5.2.4 Geologic Resources

There are no geologic resources at NLVF.

4.3.5.3 Soils

Soils surveys of the area show that soils at NLVF range from stiff to very stiff, silty and sandy clay, and clay with interbedded medium-dense clayey and silty sand. These soils have been determined acceptable for standard construction (DOE 1996c).

NLVF is located in an urban location, where the soils have previously been disturbed. Two soil associations are found at NLVF. Neither of the soil associations are classified as prime farmland soils. Approximately 60 percent of the site is Las Vegas-McCarran-Grapevine Complex on 0 to 4 percent slopes. The Las Vegas-McCarran-Grapevine Complex is a sandy loam, typically found in basin floor remnants. The soil complex contains three soil associations that are typically too intermingled to define individually. The soil develops in alluvium from limestone, sandstone, and lake bed sediments. The soil profile can be shallow to deep but is generally well drained. The upper section of the soil is typically brown fine, sandy loam that gradually becomes coarser at the bottom. A root-restricting later of hardpan gypsum or lime can be found within approximately 11 inches of the surface (USDA 1985).

The rest of the soils at NLVF constitute Skyhaven very fine sandy loam on 0 to 4 percent slopes. The Skyhaven association is a moderately deep, well-drained soil found on relic alluvial flats. The soil consists of fine, sandy loam over light-brown clay loam that becomes coarser at depth. The soil forms on a variety of rock parent materials, as long as they are rich in lime. A root-constricting layer of lime-cemented materials is found within 15 inches of the surface (USDA 1985).

4.3.5.4 Radiological Sources as a Result of Testing

There has been no nuclear testing at NLVF; therefore, soils are not contaminated with radioactive materials.

4.3.6 Hydrology

4.3.6.1 Surface Hydrology

NLVF is located in the Las Vegas Valley, which has a drainage area of 2,200 square miles in a desert region between sharp, rugged mountain ranges. The lowest point of the valley is the Las Vegas Wash, which drains the area toward Lake Mead (NPS 2001).

Surface-Water Features. There are no surface-water features located at or in close proximity to NLVF.

Flood Hazards. The Federal Emergency Management Agency Flood Insurance Rate Map covering NLVF (Map Number 32003C2160 E) indicates that the facility is located within Zone X. Zone X indicates an area of minimal flood hazard, which is determined to be above the 500-year flood level. There is an area approximately 500 feet north of the facility noted as Zone A, which indicates this location has a 1 percent chance of flooding annually (i.e., a 100-year floodplain) (FEMA 2002a).

Water Discharges and Regulatory Compliance. NLVF has an extensive storm drainage system, consisting of a retention basin, a network of slotted drains, storm drains of reinforced concrete pipe, directed sheetflow, and manmade channels. Stormwater pollution prevention is managed through a variety of measures including, but not limited to, general good housekeeping; spill prevention and response measures (including the implementation of a spill prevention, control, and countermeasures plan); sediment and erosion control measures; and employee training and education (DOE n.d.). NLVF has a "No Exposure Certification" for exclusion from NPDES stormwater permitting, which is afforded to certain facilities where potential contamination sources are protected from exposure to precipitation (Radack 2009).

Wastewater permits for NLVF include a Class II Wastewater Contribution Permit (Permit Number VEH-112) from the City of North Las Vegas for discharges to the city sewer system. This permit specifies concentration limits for contaminants in the wastewater discharges (DOE/NV 2009d). In 2009, no exceedances of permit limits occurred at either of the two outfalls to the city sewer system (see **Table 4–60**).

Table 4–60 Water Quality Results for North Las Vegas Facility Sewer Discharges in 2009

Contaminant	*Permit Limit*	*Outfall A*	*Outfall B*
Ammonia (ppm)	61.0	40.9	12.8
Arsenic (ppm)	2.3	0.0023	0.0026
Barium (ppm)	13.1	0.150	0.209
Beryllium (ppm)	0.02	<0.000125	<0.000125
Cadmium (ppm)	0.15	0.00031	0.00018
Chromium (hexavalent) (ppm)	0.10	<0.02	<0.02
Chromium (total) (ppm)	5.60	0.00157	0.00169
Copper (ppm)	0.60	0.221	0.372
Cyanide (total) (ppm)	19.9	<0.005	<0.005
Lead (ppm)	0.20	0.00217	0.00318
Mercury (ppm)	0.001	<0.0001	<0.0001
Nickel (ppm)	1.10	0.00716	0.00419
Oil and Grease (animal or vegetable) (ppm)	250	1.1	<1.0
Oil and Grease (mineral or petroleum) (ppm)	100	<1.0	<1.0
Organophosphorous or Carbamate Compounds (ppm)	1.0	<0.01	<0.01
pH (Standard Units)	5.0–11.0	8.43	8.18
Phenols (ppm)	33.6	0.0417	0.0775
Phosphorus (total) (ppm)	0.50	3.64	1.9
Selenium (ppm)	2.70	0.00297	0.00309
Silver (ppm)	8.20	<0.000375	<0.000375
Zinc (ppm)	13.1	0.353	0.776

< = less than; pH = a measure of acidity or basicity; ppm = part(s) per million.
Note: Permit limits set forth in City of North Las Vegas Class II Wastewater Contribution Permit (Permit Number VEH-112).
Source: DOE/NV 2010, Table A-2.

NLVF also operates under an NPDES permit (Permit Number NV0023507) issued by EPA, which is used for dewatering operations to control rising groundwater levels that surround the facility. Four dewatering wells pump groundwater into a storage tank. The permit allows for the discharge of water from the storage tank to groundwater via percolation, when used for landscape irrigation and dust suppression, and into the Las Vegas Wash via direct discharge into the City of North Las Vegas stormwater drainage system. In accordance with permit requirements, water chemistry analyses are performed quarterly, annually, and biennially for samples collected from the storage tank. In 2009, no permit limits were exceeded (see **Table 4–61**) (DOE/NV 2010).

Table 4–61 Water Quality Results for North Las Vegas Facility Dewatering Operations Measured at Water Storage Tank in 2009

Parameter	*Sample Frequency*	*Permit Limit*	*First Quarter*	*Second Quarter*	*Third Quarter*	*Fourth Quarter*
Daily Maximum Flow (MGD)	Continuous	0.005184	0.002398	0.002119	0.002652	0.002391
Total Petroleum Hydrocarbons (ppm)	Annually (4th Quarter)	1.0	NS	NS	NS	ND
Total Suspended Solids (ppm)	Quarterly	135	ND	ND	ND	ND
Total Dissolved Solids (ppm)	Quarterly	1,900	872	848	1,080	1,180
Total Inorganic Nitrogen as N (ppm)	Quarterly	20.0	1.3	0.84	0.84	1.25
pH	Quarterly	6.5-9.0	7.92	7.86	7.84	7.66
Tritium (pCi/L)	Annually (4th Quarter)	MR	NS	NS	NS	ND

MGD = million gallons per day; MR = monitor and report; ND = not detected; NS = sample not required that quarter; pCi/L = picocuries per liter; pH = a measure of acidity or basicity; ppm = part(s) per million.
Note: Permit limits set forth in U.S. Environmental Protection Agency National Pollutant Discharge Elimination System permit (Permit Number NV0023507).
Source: DOE/NV 2010, Table A-3.

4.3.6.2 Groundwater

Hydrogeologic Setting. NLVF is located within the center region of the Las Vegas Valley hydrographic basin, an intermountain basin within the Basin and Range Physiographic Province. The Las Vegas Valley hydrographic basin is approximately 1,600 square miles, with an estimated perennial yield of 25,000 acre-feet per year (NDWR 2010b). The basin is bordered by Spring Mountains (west), Frenchman Mountains (east), the McCullough Range (south), and the Sheep Range (north). Groundwater flow within the Las Vegas Valley is generally from west to east (USAF 2007c).

Groundwater Supply. All of the utility service lines at the NLVF complex (i.e., power, water, sewage, and natural gas) are owned by NNSA. NLVF receives its potable water from the Las Vegas Valley Water District, which is a member agency of the Southern Nevada Water Authority (SNWA). Southern Nevada gets nearly 90 percent of its water from the Colorado River. The other 10 percent comes from groundwater that is obtained from production wells in Clark County (LVVWD 2010b). Groundwater comes from three major aquifer zones (underground rock or sediment that is permeable and can conduct water) of the Las Vegas Valley aquifer, generally situated from 300 to 1,500 feet below land surface. Groundwater in the Las Vegas Valley aquifer is naturally recharged from precipitation in the Spring Mountains and the Sheep Range. This drinking water supply is protected from surface contamination by a layer of clay and fine-grained sediments throughout most of the Las Vegas Valley (LVVWD 2010a).

Groundwater Monitoring and Quality. EPA sets national standards for drinking water to protect public health. SNWA requires public drinking water systems to meet these health-based water standards and send customers an annual water quality report. While EPA requires water systems to monitor for approximately 90 regulated contaminants, the Las Vegas Valley Water District monitors for these contaminants as well as about 30 additional unregulated contaminants. Water delivered by the Las Vegas Valley Water District meets or surpasses all Federal and state drinking water standards (LVVWD 2009).

The water table at NLVF occurs at shallow depths ranging from approximately 13 to 50 feet from ground surface. In 1995, a release of tritium occurred in the basement of Building A-1, resulting in the contamination of groundwater that was not discovered until 1999 (Radack 2010b). Remediation was initiated in 2001, when a sump well was installed in the basement of Building A-1. The sump well was used to capture contaminated groundwater until 2002, when remedial operations were completed. All contaminated groundwater was disposed at the NNSS Area 5 sewage lagoon. In early 2003, the sump well was again used intermittently to support NLVF's Dewatering Program. The Dewatering Program was established to control encroaching groundwater beneath Building A-1 (DOE/NV 2009d). Although the levels of tritium are now one-tenth of the SNWA limit, water that is pumped from the sump well is disposed at the NNSS Area 5 sewage lagoon in the winter months and is evaporated through swamp coolers located at NLVF during the summer months (DOE/NV 2009d; Radack 2010a).

Under the NLVF Dewatering Program, water table elevation monitoring is conducted at 12 monitoring wells, and water levels are monitored continuously at the sump well in Building A-1. In addition, the total volume of groundwater discharged and groundwater chemistry are monitored in accordance with the NPDES permit (NV0023507) (DOE/NV 2009d; Radack 2010a).

Groundwater Control. In 1999, groundwater intruded into the elevator pit of Building A-1 (DOE/NV 2008a). As a result of this groundwater intrusion, NNSA initiated groundwater studies and eventually instituted a Dewatering Program to control rising groundwater levels surrounding the facility. Groundwater studies conducted in 2002 and 2003 revealed a complex hydrogeologic setting. Borehole data from the studies indicate that fine-grained sediments represent a low-energy, mid-valley alluvial and fluvial environment. Individual lithologic units are complexly interbedded, and several normal faults have been mapped in the vicinity.

The hydrogeologic setting suggests that the source of the rising groundwater is water flowing upward along local faults from deeper confined aquifers. This condition is considered a long-term adjustment that can be attributed to a combination of causes, including a seasonal water injection program conducted by SNWA and shifting of regional pumping centers away from the vicinity of NLVF (Bechtel Nevada 2005).

The Dewatering Program at NLVF is regulated under an NPDES permit (NV0023507), which establishes contaminant and discharge limitations. Dewatering wells (NLVF-13, 15, 16, and 17) pump groundwater into a 10,500-gallon storage tank. The permit allows for the discharge of water from the storage tank to groundwater via percolation, when used for landscape irrigation and dust suppression, and into the Las Vegas Wash via direct discharge into the City of North Las Vegas stormwater drainage system (see Section 4.3.2.1.2 for more information regarding discharges). In accordance with the permit, sampling and analyses of discharge water are performed quarterly, annually, and biennially (DOE/NV 2009d).

Discharge rates have not exceeded NPDES permit limits. In 2008, the four dewatering wells produced a total of 2,553 gallons per day (average daily flow) that were directed into the storage tank. The pumping rates varied from 0.72 to 0.24 gallons per minute. The average combined discharge from all four wells was about 78,000 gallons per month (DOE/NV 2009d).

4.3.7 Biological Resources

NLVF is in the Southern Basin and Range Ecoregion. It was built on cleared, previously disturbed land that now consists of an urban setting that includes buildings, pavement, and landscaping. No original undisturbed native vegetation remains on the site. Current vegetation at NLVF consists of urban landscape. Few wildlife species exist at NLVF because it is located in an urban area and contains little vegetation.

4.3.7.1 Flora

This facility is located in an urban setting; no native vegetation within a natural setting occurs at this site.

4.3.7.2 Fauna

This facility is located in an urban setting; only urban-adapted wildlife occur at this site. Wildlife species would be similar to those described in Section 4.2.7.2 for RSL.

4.3.7.3 Threatened and Endangered Species

NLVF is located in urban Las Vegas, Nevada, on previously disturbed land within a fenced site. No threatened, endangered, or rare species are expected to exist at this site. No designated critical habitats for federally listed species exist at NLVF. The urban areas of Clark County are not considered tortoise habitat.

4.3.7.4 Other Species of Concern

No other species of concern inhabit NLVF.

4.3.7.5 Effects of Past Radiological Tests and Project Activities

This facility is located in an urban setting; no past radiological tests or project activities are anticipated to affect wildlife or vegetation at this site.

4.3.8 Air Quality and Climate

4.3.8.1 Meteorology

Downtown Las Vegas is located in Clark County, Nevada, about 56 miles southeast of the southeastern edge of the NNSS. NLVF is about 10 miles northeast of downtown. The facility is located in the Las Vegas Valley, which is situated in the northeastern corner of the Mojave Desert and in the rain shadow (lee) of the southern Sierra Nevada mountain range.

The Las Vegas Valley has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation throughout the year and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The generally dry desert conditions specific to the area can occasionally be modified by the southwestern monsoon and convective thunderstorms during the summer months and Eastern Pacific tropical storm remnants in the late summer and fall. The dry conditions can also be moderated by strong *El Niño* cycles, which generally bring more rainfall to the area.

The Las Vegas Valley ranges in elevation from about 2,300 to 2,620 feet above mean sea level and is bounded by mountains to the north, south, and especially to the west, where the Spring Mountains peak above about 6,560 feet. This terrain causes wind flows in the Las Vegas Valley to be dominated by up-slope and down-slope conditions. The Clark County DAQEM maintains an ambient monitoring site (the J.D. Smith monitor, at 1301 East Tonopah Road) near the North Las Vegas Campus. For more information regarding the meteorological characteristics of NLVF, see Appendix D, Section D.1.2.1.

4.3.8.2 Ambient Air Quality

4.3.8.2.1 Region of Influence

NLVF is located about 55 miles southeast of the NNSS. The ROI for air quality and climate for NLVF operations comprises northern Clark County. Historic data on pollutant emissions inventories and compliance status for the State of Nevada are calculated at the resolution of county or hydrographic areas. These data provide a basis for determining existing air quality in the ROI and a metric for emission comparison assessments.

4.3.8.2.2 Existing Air Quality

Ambient Air Quality Standards. See Section 4.1.8.2.2 for a discussion on the current national and Nevada ambient air quality standards.

Air Quality Status. NLVF is within Hydrographic Area 212. Clark County is in nonattainment for 8-hour ozone[28] and serious nonattainment for 8-hour carbon monoxide[29] and 24-hour $PM_{10.}$[30] All other pollutants are in attainment.

PSD is a regulation incorporated into CAA that limits increases of certain pollutants in clean air areas (attainment areas) to certain increments even though ambient air quality standards are being met. CAA has three classes of areas with different increments. The smallest increments allowed are Class I areas, which are areas of special value (natural, scenic, recreational, or historic). Any degradation of existing air quality in these areas should be minimized. The closest PSD Class I areas are the Grand Canyon National Park (about 65 miles to the east) and the Sequoia National Park (about 165 miles to the west). NLVF currently has no sources of pollution large enough to be subject to PSD requirements. However, because NLVF is located in a nonattainment area, it could potentially be subject to nonattainment new source review if the emissions were of sufficient strength; however, they have been determined not to meet the threshold for new source review. Nonattainment new source review requirements are customized for the classification and type of air pollutant nonattainment area.

Emissions Due to NLVF Operations. Title V of CAA gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At NLVF, a Source 657 Authority to Construct/Operating Permit regulates emissions from sources such as an aluminum sander, an abrasive blaster, emergency generators, boilers, cooling towers, and a spray paint booth. The emissions of carbon monoxide, nitrogen oxides, PM_{10}, sulfur dioxide, volatile organic compounds, and hazardous air

[28] *Proposed (74 FR 2936) classification for 8-hour ozone under Subpart 2 as marginal with a nonattainment area that includes those portions of Clark County that lie in Hydrographic Areas 164A, 164B, 165, 166, 167, 212, 213, 214, 216, 217, and 218, but excludes the Moapa River Indian Reservation and the Fort Mojave Indian Reservation. A final designation is expected in March 2011.*

[29] *Still designated as serious nonattainment for carbon dioxide, but has not had any violations of the carbon monoxide NAAQS since 1999. Clark County DAQEM submitted a request to EPA in September 2008 for a redesignation to attainment for carbon monoxide. The nonattainment area covers Hydrographic Area 212.*

[30] *Designated as serious nonattainment for $PM_{10.}$ The nonattainment area covers Hydrographic Area 212.*

pollutants were each less than 1 ton annually from 2003 through 2008 for these permitted facilities. Total emissions of these pollutants over this 6-year period are about 4.4 tons (DOE 2004b; DOE 2005b; DOE 2006a; DOE 2007b; DOE 2008j; DOE 2009c).

Table 4–62 shows the onsite emissions due to stationary sources, as well as emissions due to NLVF commuters, commercial vendors, and radioactive waste trucks in Clark County and in Nye County both on the NNSS and off the NNSS, where appropriate. The onsite stationary sources include both permitted sources and natural gas combustion for heating. See Appendix D, Section D.3.2.1, for more information on mobile and stationary source emission methodology.

Measurements of Ambient Air Concentrations On and Near NLVF. The Clark County DAQEM maintains an air quality monitoring network throughout Clark County. The J.D. Smith monitor (at 1301 East Tonopah Road) is located about 1 mile northwest of NLVF. It monitors hourly ozone, carbon monoxide, and nitrogen dioxide levels and daily PM_{10}, and $PM_{2.5}$ levels. **Table 4–63** shows these results along with the highest sulfur dioxide value monitored in the Las Vegas Valley. Note that at least 25 percent of the 2008 observations were missing, so the maximum concentrations could potentially be higher than what is shown for that year. The ambient air quality standards are also shown in the table. See Table 4–39 for more information on the standards.

Ozone measurements at the J. D. Smith monitor (at 1301 East Tonopah Road) exceeded the 8-hour ozone NAAQS in 2006 and 2007. The largest 8-hour ozone concentration was 0.081 ppm (in 2006), which is 0.006 ppm larger than the current NAAQS of 0.075 ppm. Maximum ambient ozone concentration levels have generally remained constant at this level and other nearby monitors since at least 1998 (DAQEM 2009).

PM_{10} measurements at the J.D. Smith monitor (at 1301 East Tonopah Road) indicated that the second-highest 24-hour average PM_{10} concentration was 136 micrograms per cubic meter (in 2006), which is 14 micrograms lower than the NAAQS of 150 micrograms per cubic meter. Although this 24-hour PM_{10} concentration is below the NAAQS, other monitoring locations within the Las Vegas Valley exceed the standard and the entire valley has been designated as nonattainment for PM_{10}. The largest annual average PM_{10} concentration was 33 micrograms per cubic meter (in 2006), which is well below the Nevada ambient air quality standard of 50 micrograms per cubic meter (there is no national PM_{10} annual average standard).

All other criteria pollutants are well below NAAQS. No lead monitoring data are available for the Las Vegas Valley.

Table 4–62 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to North Las Vegas Facility Activities

	Annual Air Emissions (tons/year)												
	Stationary Sources	***NLVF Commuters***		***Commercial Vendors***	***Radiological Waste Trucks***			***Total***					
	Clark County	***Clark County***	***Nye County***	***Clark County***	***Clark County***	***Nye County***		***Clark County***		***Nye County***			
Pollutant	***On-NLVF***	***Off-NLVF***	***Off-NNSS***	***Off-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***On-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***Total***
PM_{10}	0.037	0.25	0.0015	0.19	0.0051	0.00032	0.00048	*0.037*	*0.45*	*0.00032*	*0.0020*	***0.48***
$PM_{2.5}$	0.037	0.13	0.00086	0.17	0.0048	0.0003	0.00045	*0.037*	*0.30*	*0.00030*	*0.0013*	***0.34***
CO	0.19	25.5	0.16	0.76	0.02	0.0013	0.0019	*0.19*	*26.3*	*0.0013*	*0.16*	***26.6***
NO_x	0.73	6.2	0.042	1.7	0.069	0.0045	0.0068	*0.73*	*8.0*	*0.0045*	*0.049*	***8.8***
SO_2	0.017	0.069	0.00039	0.0032	0.000098	0.0000062	0.0000094	*0.017*	*0.072*	*0.0000062*	*0.00040*	***0.090***
VOCs	0.028	0.51	0.0032	0.25	0.0033	0.00021	0.00032	*0.028*	*0.76*	*0.00021*	*0.0035*	***0.80***
Lead	<0.01	<0.01	<0.01	0.0000029	<0.01	<0.01	<0.01	*<0.01*	*~0.020*	*<0.01*	*<0.01*	***~0.060***
Criteria Pollutant Total	1.0	32.5	0.21	0.76	0.097	0.0064	0.0096	*1.0*	*33.4*	*0.0064*	*0.22*	***34.6***
HAPs	0.0026	0.04	0.00026	0.033	0.00043	0.000028	0.000042	*0.0026*	*0.073*	*0.000028*	*0.00030*	***0.076***

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 4–63 Ambient Air Quality Monitoring in the Vicinity of the North Las Vegas Facility, 2006–2008

Year	*2nd Max 1-hour CO (ppm)*	*2nd Max 8-hour CO (ppm)*	*Annual Mean NO_2 (ppm)*	*2nd Max 1-hour NO_2 (ppm)*	*4th Max 8-hour O_3 (ppm)*	*Max 1-hour SO_2 (ppm)*	*2nd Max 24-hour SO_2 (ppm)*	*Annual Mean SO_2 (ppm)*	*98th Percentile $PM_{2.5}$ (µg/m^3)*	*Annual Mean $PM_{2.5}$ (µg/m^3)*	*2nd Max 24-hour PM_{10} (µg/m^3)*	*Annual Mean PM_{10} (µg/m^3)*
2006	4.8	3.7	0.021	0.072	**0.081**	0.015	0.007	0.002	22.1	8.2	136	33
2007	4.5	2.8	0.020	0.066	**0.080**	0.007	0.003	0.001	19.7	8.8	110	32
2008	3.6	2.4	0.016	0.062	0.068	0.006	0.001	0.001	18.8	8.9	109	31
NAAQS	35.0	9.0	0.053	0.100	0.075	0.075	0.030	0.140	35.0	15.0	150	None

µg/m^3 = micrograms per cubic meter; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; O_3 = ozone; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; ppm = part(s) per million; SO_2 = sulfur dioxide.

Note: Monitored values are from the J.D. Smith monitor (at 1301 East Tonopah Road), except for SO_2, which was the highest monitored value in the Las Vegas Valley.

All exceedances of the NAAQS are shown in bold font.

Source: EPA 2010a.

4.3.8.3 Radiological Air Quality

Direct radiation monitoring is conducted near Buildings A-1 (Source Range Laboratory) and C-3 (High Intensity Source) at NLVF. These are the two locations at NLVF that currently use radioactive sources or are where radiation-producing operations are conducted. These and other historical radiation measurements show that radiological doses to the public from NLVF activities are indistinguishable from background radiation (DOE 2009e). **Table 4–64** presents the total estimated radionuclide emissions from NLVF in 2007 and 2008. Based on the 2008 emission rate of 0.011 curies, the estimated radiation dose to the nearest offsite public access point to NLVF was 0.00006 millirem per year. This is well below the NESHAPs dose limit for the general public of no greater than 10 millirem per year. **Table 4–65** presents statistics on radiation exposure measurements taken once per quarter at the NLVF boundary and control locations. These results both include and are indistinguishable from doses from natural background radiation near NLVF.

Table 4–64 Estimated Annual Air Releases of Radionuclides at the North Las Vegas Facility

	Estimated Annual Emissions (curies)	
	2007	***2008***
Tritium	0.012	0.011
Reference	DOE 2008c	DOE 2009c

Note that parts of the Building A-1 basement were contaminated with tritium in 1995. The release led to a very small potential exposure (less than 0.001 millirem per year) to an offsite person; the NESHAPs dose limit for exposure of the public is 10 millirem per year (40 CFR Part 61, Subpart H). Tritium continues to be emitted at low levels (e.g., 5.3×10^{-4} curies in 2009 [NSTec 2010b]) from the parts of the building that were exposed to the initial release (DOE 2009d).

An accidental release also occurred at NLVF in 2004; this release involved the improper disposal of tritium-contaminated water into a public sewer system. These levels were also well below the level of concern. However, in response to this incident, NNSA/NSO has developed several procedures to prevent this type of accidental discharge in the future (DOE 2005b).

4.3.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions on the climate involve very complex processes and interact with natural cycles, complicating the measurement and detection of change. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways.

For information on greenhouse gas emissions in the United States, please see Section 4.1.8.4.1. Greenhouse gas emissions at NLVF are discussed in the next section. Details on the methodology used to determine these emissions are discussed in Appendix D, Sections D.2.3.1.1, D.2.3.2.1, and D.2.3.3.1.

Table 4–65 Average Annual Average and Maximum Annual Average Radiation Levels Among the North Las Vegas Facility Boundary Monitors and Control Monitors Operating in a Given Year

	Radiation Level (millirem per year)											
	1997	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
Maximum annual average	0.0808	0.0624	0.0619	0 (no data)	0 (no data)	0 (no data)	0.0640	0.0700	0.0740	0.0700	0.0740	0.0920
Annual average for all monitors	0.0610	0.0500	0.0536				0.0635	0.0653	0.0690	0.0660	0.0697	0.0917
Reference	DOE/NV 1998d, pp. 4-32 and 4-33	DOE/NV 1999, p. 4-32	DOE/NV 2000c, p. 4-31	DOE/NV 2001c, p. 1-11	DOE/NV 2002b, p. 1-11	DOE/NV 2003a, p. 1-10	DOE/NV 2004d, p. B-11	DOE/NV 2005f, p. B-11	DOE/NV 2006a, p. A-11	DOE/NV 2007d, p. A-10	DOE/NV 2008a, p. A-9	DOE/NV 2009d, p. A-8

Note: These radiation measurements are taken once per quarter year (DOE 2009e).

4.3.8.4.1 Greenhouse Gas Emissions

Table 4–66 provides greenhouse gas emissions due to NLVF-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is the threshold for which a quantitative assessment may be meaningful (CEQ 2010).

Electricity consumption is by far the largest single source of greenhouse gas emissions related to NLVF activities, emitting approximately 8,392 carbon-dioxide-equivalent tons of greenhouse gases, or 63 percent of the NLVF-related greenhouse gas emissions total. Stationary sources altogether emitted about 8,563 carbon-dioxide-equivalent tons of greenhouse gases. Mobile sources emitted about 4,792 tons, so that overall, NLVF-related activities created about 13,355 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, which is about 52 percent below the threshold reporting level.

Table 4–66 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases from North Las Vegas Facility Activities in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons* [a]
STATIONARY SOURCES		
Power generation	8,392	0.30
Natural gas heating	157	0.01
All stationary sources, except air conditioning/refrigeration and natural gas heating	15	0.00
All Stationary Sources	*8,563*	*0.31*
MOBILE SOURCES		
Commuting	3,896	0.14
Hazardous waste transport (nongoverment)	7	<0.01
Commercial vendors	889	0.03
All Mobile Sources	*4,792*	*0.17*
Total	***13,355***	***0.48***

[a] 25,000 metric tons are equal to about 27,558 short tons.

4.3.8.4.2 Current Changes in Climate

For a discussion of climate change impacts in the region, please see Section 4.1.8.4.2.

4.3.9 Visual Resources

The area around NLVF is highly developed, primarily with commercial and warehouse facilities. The visual environment comprises infrastructure, such as buildings, roadways, and utilities. **Figure 4–35** shows the locations from which photographs of the area around NLVF were taken and the sensitivity levels of the roadways in the area (see Section 4.1.9). Vegetation in the area is limited to street landscaping, such as palm and evergreen trees and various shrubs (see **Figure 4–36**, View 1).

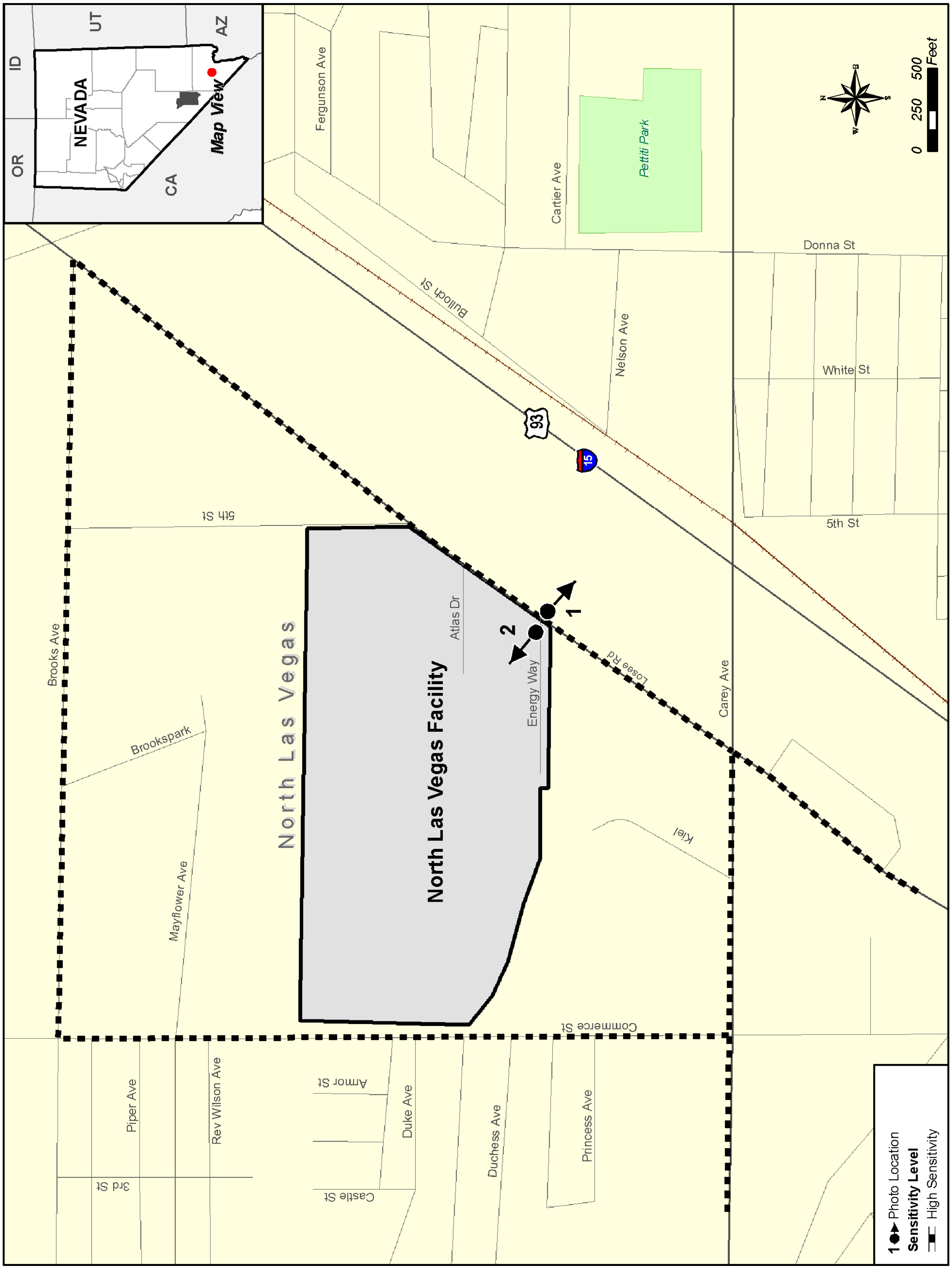


Figure 4–35 Photograph Locations and Sensitivity Levels Near the North Las Vegas Facility

View 1

View 2

Figure 4–36 Landscape Photographs Near North Las Vegas Facility

The areas surrounding NLVF are developed, with warehouse and commercial facilities; visual access to these areas is limited to views from public roadways and sidewalks in the area. On local streets, such as near NLVF, speed limits are lower, yet surrounding development is dense and there is much more traffic. These elements combine so views are not focused on a specific facility that is visually similar to its surroundings, but on driving and views immediate to the road corridor. There is no public visual access to the interior of NLVF (see Figure 4–36, View 2). The area is primarily visible from Losee Road and may have limited views from Commerce Street, Brooks Avenue, and 5th Street. Visible portions of the area are considered to have a Class C scenic quality rating (see Section 4.1.9 for information on the visual impact rating system) due to the developed nature of the landscape, as described above, combined with high intrusion of manmade elements and lack of elements that help to improve aesthetics, such as landscaping.

4.3.10 Cultural Resources

For introductory information regarding cultural resources, see Section 4.1.10.

NLVF is located in northern Las Vegas Valley, within the center region of the Las Vegas Valley hydrographic basin, an intermountain basin within the Basin and Range Physiographic Province of the United States (NDWR 2010). NLVF consists of an 80-acre complex of 30 buildings and 1 trailer located in a highly developed area zoned for generalized industrial activity. It was built on cleared, previously disturbed land that now consists of an urban setting comprising buildings, pavement, and ornamental landscaping. The area of influence at NLVF includes the entire footprint of the facility.

4.3.10.1 Recorded Cultural Resources

There are no recorded cultural resources within the boundary of NLVF.

4.3.10.2 Sites of American Indian Significance

No sites of American Indian significance have been identified within the boundary of NLVF. As part of the preparation of this SWEIS, DOE consulted with CGTO to determine whether sites of American Indian significance exist within NLVF.

4.3.11 Waste Management

DOE operations do not generate LLW, MLLW, or TRU waste at NLVF. DOE does generate, however, water that is slightly contaminated with tritium and collected as air conditioning condensate from the basement sump of one of the buildings. The water is either disposed by evaporation at NLVF or transported in tanker trucks to the NNSS for disposal by evaporation in NNSS sewage lagoons (DOE/NV 2009; NSTec 2009c).

The quantities of hazardous waste that were generated at NLVF and disposed or recycled during CYs 2005 through 2008 are listed in **Table 4–67** (Duke 2009). This waste includes recycled oil and antifreeze, other hazardous waste, such as universal waste, and waste that is regulated under other regulatory authorities, such as TSCA. Hazardous wastes include universal wastes, i.e., materials such as computer equipment, batteries, and fluorescent lamps. (The Regulated Management Program for universal waste is streamlined compared to that for other hazardous wastes and emphasizes material reuse or recycle.) All hazardous and toxic wastes are disposed or recycled at offsite facilities.

Table 4–67 Annual Hazardous and Toxic Waste Disposal or Recycle Quantities for the North Las Vegas Facility (tons)

Waste	Calendar Year			
	2005	2006	2007	2008
Recycled oil and antifreeze	a	0.21	a	7.4
Other hazardous waste [b]	0.57	0.98	0.34	1.36
Other waste [c]	a	a	a	0.26

[a] Not reported for this year.
[b] Hazardous waste, including universal wastes such as computer equipment, batteries, and fluorescent lamps that are generated in a wide variety of settings; are not solely industrial; are generated by a large community; and are present in significant volumes in nonhazardous management systems. The Regulated Management Program for universal waste is streamlined compared to that for other hazardous wastes and emphasizes material reuse or recycle.
[c] Waste regulated under the Toxic Substances Control Act or statutory authorities other than the Resource Conservation and Recovery Act.
Source: Duke 2009.

Most hazardous waste comes from the machine shop. Routine hazardous waste streams include lead- and solvent-contaminated rags and lead metal shavings and debris. Nonroutine hazardous waste streams include non-empty aerosol cans; lab-packs of unused, out-of-date chemicals from various locations; and wastes from occasional demolition activities. Universal waste, such as light bulbs and batteries, come from facility maintenance and cleanup activities. Recycled materials include used oil and antifreeze. The used oil is typically generated by draining or replacing quenching or cooling oils at the machine shop and is occasionally generated as part of draining equipment or replacing hydraulic fluid, as well as from facility maintenance projects (Duke 2009).

Finally, NLVF generates sanitary solid waste, which is generally collected and disposed by a municipal waste service. For security reasons, however, some solid waste is collected by NNSA/NSO and sent for disposal at the NNSS Area 23 Landfill (see Section 4.1.11.2.3).

In the future, waste may be generated as part of decommissioning unneeded structures.

4.3.12 Human Health and Safety

NLVF provides calibration and other services using specialized radiation fields for a variety of instrument packages in support of NNSS operations. The radiation fields are provided by sealed sources containing cobalt-60, cesium-137, or plutonium-239 that are stored in heavily shielded configurations in the below-grade portion of Building A-1. Because these are sealed sources, they do not release radioactive material that could pose a risk to the workers or the public. There is no direct exposure to the public as a result of the shielding provided by the engineered structure and the location below ground level. Worker exposure is managed by the shielding and administrative controls that limit access to the below-grade area where the sealed sources are stored.

An accident in 1995 resulted in the release of more than 1 curie of tritium into the basement area of Building A-1. The release occurred when a container of tritium-aluminum foils was improperly opened in the Atlas Facility in NLVF. The tritium release was cleaned up, but residual tritium continues to emanate from the basement floor. In 2008, the estimated dose to a hypothetical MEI near NLVF was 0.0006 millirem. Since the accident, the highest annual dose to the MEI was 0.0018 millirem in a year; since 2005, the dose has been less than 0.0001 millirem per year. This dose is magnitudes less than the 10 millirem annual limit under NESHAPs (40 CFR Part 61, Subpart H). A detailed discussion of the radiation environment, including radionuclide releases and associated potential doses to an MEI, is presented in the *Nevada Test Site National Emission Standards for Hazardous Air Pollutants Report, Calendar Year 2008* (DOE/NV/25946-742).

Chemical exposure pathways to NLVF workers during normal operations may include inhaling the workplace atmosphere, drinking NLVF potable water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. NLVF adheres to Occupational Safety and Health Administration and EPA occupational standards (see Chapter 9) that limit atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operational processes, ensures that these standards are not exceeded.

In August 2003, beryllium was found in NLVF Buildings B-1, B-2, and B-3. It was determined that the material was from copper-beryllium alloys milled in Building B-1 during the 1980s. Buildings B-1 and B-2 were demolished in 2004.

The greatest contributor to background noise at NLVF is vehicular traffic, as the facility is located near Interstate 15 (just east of the site) and is buffered on the north, south, and east by general industrial zoning. No environmental noise data are available at NLVF; however, because of its proximity to an interstate and the common occurrence of traffic congestion in the surrounding area, it is estimated that background noise levels range from 60 to 70 decibels, A-weighted (EPA 1974).

4.3.13 Environmental Justice

As seen in Figure 4–31, there are numerous block groups to the south and east of the NLVF where the low-income population is between 11 and 20 percent, and several additional block groups in the 21-30 and greater-than-30 percent range further to the south. The NLVF is located in an area where the majority of block groups have minority populations exceeding 50 percent (see Figure 4–32).

4.4 Tonopah Test Range

This section describes the existing environmental conditions found at the TTR. The TTR comprises approximately 280 square miles (179,200 acres) and is surrounded on three sides by the Nevada Test and Training Range. The Nevada Test and Training Range is located approximately 30 miles from the town of Tonopah, Nevada. The TTR, which is operated by Sandia National Laboratories, offers a unique test bed for DOE and DoD weapons systems. The primary mission of NNSA at the TTR is to ensure that the Nation’s nuclear weapons systems meet the highest standards of safety and reliability.

4.4.1 Land Use

TTR is located in Nye County, Nevada, near the northwestern corner of the Nevada Test and Training Range, approximately 12 miles north of the nearest NNSS boundary. The TTR is 22 miles east of Goldfield and 140 miles north of Las Vegas. The TTR is located in a remote, broad, flat valley with scattered former lake beds between the Cactus Range to the west and Kawich Range to the east.

The main operational area for the TTR is within the Cactus Flat Valley, which has outcrops of low hills in the south and consists of hundreds of buildings, structures, and equipment. Many of these buildings and structures are prefabricated; only a handful are permanent structures or buildings. An airport is located just north of the built-up complex, and an additional airstrip is located just south of the built-up complex. The airport and airstrip are not open for public use.

Adjacent Land Use. The TTR is located within a portion of the 1,302,000-acre Nevada Wild Horse Range, which extends across the northern portions of the Nevada Test and Training Range and southward to the NNSS. The Nevada Test and Training Range is primarily used for weapons development and flight training. BLM manages the wild horses on the Nevada Test and Training Range; management of wild horses is a secondary use of these lands. Visitor access is not permitted due to security reasons.

Sparsely populated public lands north of the TTR boundary are jointly administered by BLM and the U.S. Forest Service and are currently used for cattle grazing, recreation, and other uses. The nearest population to the TTR is approximately 22 miles west of the site, in the town of Goldfield.

Historical Use. The TTR was used extensively between 1956 and 1989. It was one of the primary test facilities during the Cold War era due to its isolation and size. The Atomic Energy Commission began testing weapons systems, research rockets, and artillery on the TTR in 1957. TTR capabilities evolved to include nonnuclear field-testing of nuclear weapons design, stockpile surveillance, and research.

Current Use. Principal NNSA activities at the TTR include stockpile reliability testing; research and development; and support for a variety of testing, including arming, fusing, and firing systems testing. No nuclear devices are tested at the TTR (DOE 2008k).

NNSA activities at the TTR are conducted through the NNSA Sandia Site Office under a land use permit from the USAF. Principal activities are conducted within a smaller area (176,000 acres) known as the "Permitted Premises." Revisions to the TTR boundary and the land use permit area for the Sandia Site Office operations area at the TTR would need to be coordinated with the USAF. The current land use permit granting NNSA use of this portion of the TTR extends through 2019 (USAF 2002).

Characterization and remediation of industrial sites at the TTR are ongoing, and the majority of the industrial sites have been closed (DOE 2008f).

4.4.1.1 Public Land Orders and Withdrawals

The following Memorandum of Understanding and Withdrawal are applicable to the TTR.

Memorandum of Understanding. The Memorandum of Understanding, signed in 1956, designated approximately 370,000 acres to support research related to the weapons development program.

Military Lands Withdrawal Act of 1999, Public Law 106-65. Enacted on October 5, 1999, this act extended the withdrawn lands set aside by previous Public Land Orders (about 3 million acres in total) for defense use as part of the Nevada Test and Training Range, including the TTR, for another 20 years. Although no nuclear devices are tested at the TTR, this land is an integral part of DOE operations within the Nevada Test and Training Range.

Sandia Land Permit. This permit, effective from April 26, 2002, until October 5, 2019, grants NNSA permission for use, operation, and occupancy of a portion of the Nevada Test and Training Range at the TTR. This permit is reevaluated at 5-year intervals to review the requirements that established the need for this permit. This permit does not allow activities that significantly interfere with the Nevada Test and Training Range and requires both entities to work cooperatively to accomplish their respective missions. Activities that occur on this leased land must comply with applicable laws and regulations related to the environment, occupational health and safety, handling and storage of hazardous materials, and disposal of hazardous materials.

4.4.2 Infrastructure and Energy

4.4.2.1 Infrastructure and Utilities

This section discusses the TTR buildings and transportation infrastructure; potable water, wastewater, and communications utilities; and support services, including law enforcement and security, fire protection, and health care. Further transportation-related information is discussed in Section 4.4.3, "Transportation." Solid waste collection is discussed in Section 4.4.11, "Waste Management." Energy systems (electricity, natural gas, and liquid fuels) are discussed in Section 4.4.2.2, "Energy."

4.4.2.1.1 Infrastructure

Facilities. The TTR contains 105 major buildings, providing approximately 161,500 square feet of floor space, and approximately 90 smaller buildings, including towers and small sheds (DOE 1996c).

Transportation Systems. See Section 4.4.3.1 for a discussion of the onsite transportation infrastructure at the TTR.

The USAF maintains an active base and airport on the TTR in support of its missions. This airport building is approximately 10,000 square feet. The existing 12,000-foot runway and navigation aids are open to DOE on an as-needed basis. The Mellan Airstrip is located on the southern portion of the TTR. This airstrip supports DOE and USAF training programs and is used sporadically. There are no support facilities associated with the Mellan Airstrip.

4.4.2.1.2 Utilities

Water Supply. The PWS at the TTR is registered with NDEP as a Nontransient, Noncommunity PWS (see text box in Section 4.1.6.2 for PWS definitions).

The following are three active water wells used by the TTR: (1) Production Well 6, (2) Well 7, and (3) the Roller Coaster Well. The most active are Production Well 6 and the Roller Coaster Well. Production Well 6 supplies drinking water to the TTR Main Compound in Area 3; this well is routinely sampled and analyzed per NDEP requirements to demonstrate conformance with primary drinking water standards. Outlying areas and buildings without potable water service use bottled water (DOE 2009a). Nonpotable wells, particularly the Roller Coaster Well, service the TTR for construction and industrial activities. Some impoundments at the TTR are used to store water during activities. Annual water usage at the TTR is approximately 6 million gallons for the entire range, including water used by the USAF at the TTR (DOE 2008l). See Section 4.4.6, "Hydrology," for more information on the water supply.

Wastewater Collection and Treatment Systems. Industrial (primarily discharge from an oil-water separator) and sanitary wastewater generated at the TTR is collected and pumped to a USAF facultative sewage lagoon treatment unit located approximately 1.5 miles southwest of the main gate. The industrial flows combined with sanitary flows for final treatment using biological processes in two lined aerated ponds, which are permitted by NDEP and operated by the USAF under an NPDES permit (Permit Number NEV20001) (DOE 2009a). Five active septic tank systems are used in remote areas of the TTR for domestic sanitary sewage treatment; there is also one inactive septic tank system in one area (DOE 2009a). Annual wastewater samples are taken at the point where wastewater leaves the TTR property and enters the USAF system (DOE 2009a).

Communication Systems. Communications at the TTR are supported by a regional system. The TTR telecommunication system employs digital telephone switching, fiber optic transmission, microwave, two-way radio, voice privacy, data transmission systems, general- and special-purpose data communications, and teleconferencing services. The TTR also has a ground-to-air communication system that supports all air-to-ground testing programs. The VHF [very-high-frequency] and UHF [ultra-high-frequency] communication capability is reliable within a 200-mile radius of the TTR, depending on the altitude, while high-frequency communication can be reliable for thousands of miles.

4.4.2.2 Electrical Energy

Power to DOE facilities at the TTR is supplied by NV Energy. NV Energy has two supply lines to the TTR: the primary line is 120 kilovolts, and a backup line is 60 kilovolts. NV Energy transformers step the voltage down to 13.8 kilovolts for the DOE distribution system. The remaining power line supplies the USAF facilities. All remote operations are supplied with electrical power by portable generators.

4.4.2.2.1 Natural Gas

There is no infrastructure for natural gas supply at the TTR.

4.4.2.2.2 Liquid Fuels

The TTR uses various types of liquid fuel for its energy needs, including gasoline, diesel, and propane. There are currently no aboveground storage tanks at the TTR requiring registration with the State of Nevada (DOE 2009a); however, there are a number of fuel storage tanks that are listed as non-permit equipment in the TTR NDEP Class II Air Quality Operating Permit (AP8733-0680.02). The Non-Permit Equipment List indicates that the TTR maintains diesel-fired generators, gasoline generators, and propane-fired boilers. The TTR has onsite propane storage tanks, as presented in **Table 4–68**, with a permitted collective storage capacity of 23,563 gallons (NDEP 2007).

Table 4–68 Tonopah Test Range Propane Storage Tank Capacities

Equipment	***Quantity***	***Size***
Propane Storage Tanks	22	1 × 119 gallons 1 × 250 gallons 5 × 495 gallons 2 × 500 gallons 5 × 1,000 gallons 1 × 1,050 gallons 3 × 1,150 gallons 1 × 1,500 gallons 1 × 2,000 gallons 1 × 3,000 gallons 1 × 3,219 gallons

Source: NDEP 2007.

4.4.3 Transportation

4.4.3.1 Onsite Transportation

The TTR's onsite roadway network consists of 118 miles of primary paved roads, 23 miles of secondary paved roads, 113 miles of primary compacted dirt roads, and 39 miles of secondary compacted dirt roads (DOE 1996c). The two primary paved roads on the TTR (one traversing north–south and one east–west) support the majority of the daily traffic, as well as traffic during operations. See **Figure 4–37** for primary paved roads. Traffic within the TTR mainly occurs on Main Road South. Dirt roads are used for secondary daily travel, but are primarily used during experimental activities.

The roadway system on the TTR is jointly maintained by DOE and the USAF. Generally, no privately owned vehicles are permitted on the site; however, privately owned vehicle passes are occasionally issued to offsite personnel and visitors that temporarily reside in the housing area located near the main entrance. Workers either drive government-supplied vehicles from the main entry of the TTR or ride government-supplied bus transportation to the work site. The majority of the onsite traffic is attributed to security support and facility operations (DOE 1996c).

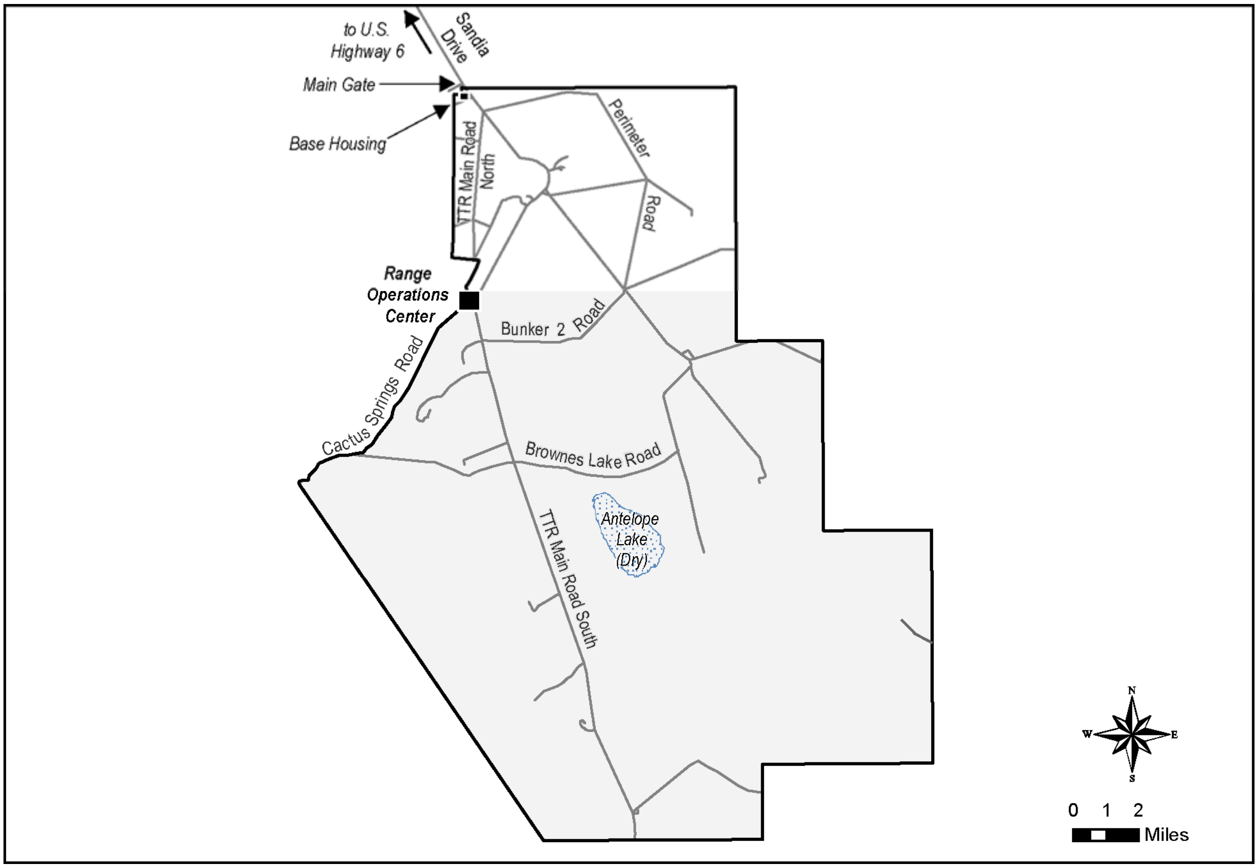


Figure 4–37 Tonopah Test Range Roadways

4.4.3.2 Regional Transportation

The TTR is bounded by the Nevada Test and Training Range on the east, west, and south. Although there are access points to areas of the Nevada Test and Training Range through other gates, access to the site is normally through the Main Gate at the northern boundary. North of the Main Gate, Main Road North becomes Sandia Drive (also known as State Route 504), which connects to U.S. Route 6 about 20 miles to the north. Traffic volumes and levels of service on roadways in Nye County, including those near the TTR, are discussed in Section 4.1.3.2.2. Because the TTR is located in an isolated, rural area, traffic volumes on nearby public roadways are low. Daily traffic volumes on U.S. Route 6 are presented in Table 4–11; this roadway is currently operating at level of service B near the TTR.

4.4.4 Socioeconomics

General existing socioeconomic conditions within the ROI of the TTR (Nye County) are presented in Section 4.1.4.

Police Protection. Law enforcement for the TTR is provided by the Nye County Sheriff's Department. Onsite security is provided by Advanced Security, Inc.

Fire Protection. Fire protection services for the TTR are provided by Sandia National Laboratories and the USAF.

Health Care. Currently Sandia National Laboratories provides the TTR with the following emergency operations (fire, rescue, and medical) personnel: 1 registered nurse, 4 emergency medical technicians (intermediate), and 2 emergency medical technicians (basic). If serious care is required, the patient would be either transferred to the town of Tonopah or airlifted to Las Vegas, depending on the medical needs.

4.4.5 Geology and Soils

4.4.5.1 Physiography

The TTR is also located within the southern section of the Great Basin, as described in Section 4.1.5.1. The TTR is located in the lowest sections of Cactus Flat and Stonewall Flat, which are separated by Cactus Range. The TTR is bounded by Stone Cabin Valley to the north, by the Kawich Range to the east and northeast, by Goldfield Hills to the west, and by Stonewall Mountain to the south. Elevations vary dramatically throughout the TTR, from 8,000 feet above sea level at the top peak of the Kawich Range and 8,275 feet above sea level at Stonewall Mountain to 5,400 feet above sea level at the base of Cactus Flat (DOE 1996c). Other features in the area include Gold Flat, which is separated to the south of Cactus Flat by the hills around Gold Mountain.

Within the basins, the topography is flat to gradually sloping. Cactus Flat is a closed basin, so salts and playa deposits form in the deepest sections of the basin. Stonewall Flat is open, so water flows to the west, although playas may form in depressions as well. Because of the high salt concentration in the playa deposits, little vegetation grows in the valleys.

4.4.5.2 Geology

Geologic deposits at the TTR primarily consist of volcanic rocks and alluvium. Alluvial fans composed of eroded volcanic bedrock and ash from the surrounding mountain ranges fill the flats with unconsolidated deposits. Although the total depth of the alluvial deposits is unknown, exploratory wells have determined that basin sediment thickness is at least 1,000 feet (DOE 1996c).

The mountain ranges are primarily composed of Tertiary volcanic rocks, in a sequence of welded and nonwelded ash-flow tuffs and associated basalts, andesites, dacites, and rhyolites. The southern edge of the TTR comprises the Southwestern Volcanic field described in Section 4.1.5.2. The Cactus Range is an exception to the basic volcanic sequences, as it is a fault block bounded by a sequence of elliptical rings, suggesting that it is the center of a major collapsed volcanic cauldron. Basalt dikes and sills have infiltrated the fractures, which cut through Paleozoic sedimentary rocks, granite intrusions, and other Tertiary rocks. The rocks associated with the eruption sequence are approximately 6 million years old. A sequence of small hills to the south and southeast of the range are made up of lavas and tuff valleys and capped by weathered breccias (DOE 1996c).

4.4.5.2.1 Structural History

The Walker Lane shear zone transects the TTR from the northwest to southeast and eventually connects to the Las Vegas Valley shear zone to the southeast (DOE 1996c). The shear zone is a series of transcurrent faults that connect volcanic centers, such as the Cactus Range and Stonewall Mountain.

The main fault sequences at the TTR include the Cactus Flat, Stonewall Mountain, and Gold Flat Faults and a few unnamed Cactus Faults located between Cactus Flat and Gold Flat. The Cactus Flat Fault strikes mostly north, with west-facing scarps. The fault is estimated to have moved within the last 130,000 years (Anderson 1998d). In addition, there are several scattered and unnamed faults in the western section of Cactus Flat (Anderson 1998e).

The Stonewall Mountain Fault forms the structural border between Stonewall Flat and Stonewall Mountain. These faults appear to connect to a fault block sequence and also may have moved within the Late Quaternary period (Anderson 1998f).

4.4.5.2.2 Faulting and Seismic Activity

The TTR is included within the seismic activity review found in Section 4.1.5.2.3, which identified at least 11,988 seismic events within 120 miles of the NNSS. Most of the earthquakes immediately around the TTR have been in the magnitude 2.0 to 3.0 range. Two earthquakes had magnitudes of 4.2 and 4.5. The closest earthquake with a magnitude over 5.0 was the 1992 earthquake near Little Skull Mountain, which is described in Section 4.1.5.2.3. Seismic design requirements are discussed in Section 4.1.5.2.3, "Faulting and Seismic Activity."

4.4.5.2.3 Geotechnical Hazards

The geologic hazards at the TTR are very similar to those outlined in Section 4.1.5.2.4, specifically surface instability. The geotechnical hazards do not generate extreme constraints on construction in the TTR. In addition, the high concentration of salts in the soils may affect concrete, as discussed in Section 4.3.5.2.3.

4.4.5.2.4 Geologic Resources

Economic geologic resources in and around the TTR include metallic ore and aggregate. Several historic mining districts are located at the TTR, including Silver Bow, Antelope Springs, Cactus Springs, Wilsons, and Mellan (SAIC/DRI 1991). The TTR is also adjacent to a number of other mining districts, most notably the Goldfield Gold Crater, Stonewall, Gold Reed, and Jamestown districts (SAIC/DRI 1991). The Silver Bow district has produced appreciable quantities of silver and gold, while the Antelope Springs district has produced silver and minor amounts of gold. Cactus Springs produced small quantities of silver, although turquoise, gold, and copper are also mined in the area. The Wilsons district produced small quantities of gold and silver in the early 1900s. Minor production of gold and silver came from the Mellan district. Of the mining districts, only the Silver Bow mine is classified as having high potential for economic mineral ores (DOE 1996).

There is low potential for oil, gas reserves, or other petroleum products at the TTR or adjacent areas on the Nevada Test and Training Range (SAIC/DRI 1991). No geothermal resources have been identified at the TTR (SAIC/DRI 1991). Aggregate used for construction is present at the TTR in the form of sand and gravels; however, it can be mined from multiple alluvial fans throughout the Basin and Range area; therefore, the resources at the TTR are not considered unique (SAIC/DRI 1991).

4.4.5.3 Soils

Soils at the TTR form in the alluvial fans, ephemeral washes, valley floors, and dry lake beds. The parent material of the soils is the igneous tuff and sedimentary rocks eroded from the surrounding ranges. A major feature of the soils is a silica-cemented duripan, precipitated from the silica-rich igneous parent materials (DOE 1996c).

In 1977, a high-level soil survey was performed at the TTR. Soils were mapped to the soil series throughout the area. Three main soil orders were found at the TTR: (1) mollisols, (2) aridisols, and (3) entisols (DOE 1996c). Mollisols are found in semiarid environments and have well-developed organic horizons. Aridisols are more typical in arid environments, and have little organic matter. Entisols are younger soils that have little or no development in soil horizons. The soils at the TTR would be categorized into three main categories based on their physiographic position in the local topography: (1) playas in valley bottoms and dry lake beds; (2) alluvial fans, the upper alluvial fans; and (3) mountains and hills. **Table 4–69** presents the soil families that were identified at the TTR during the 1977 soil inventory.

Table 4–69 Soil Families Identified in the Tonopah Test Range

Soil Families	*Example Soil Series*	*Physiographic Position*	*General Description of Soils in Physiographic Position*
Typic Salorhids	Saltair	Valley bottom and dry lake beds	Very deep, poorly drained fine-grained soils with concentrated salts and alkali deposits. Shallow groundwater table. Shrink-swell properties from high percentage of clays. Cement corrosion potential from salt concentration.
Typic Haplaquolls	Hutton	Valley bottom and dry lake beds	
Typic Torriorthents	Fang and Cliffdown	Alluvial fan	Deep to very deep, well-drained, sand to sandy loam/loam and gravelly soils on 2 to 4 percent slopes up to 8 to 15 percent slopes. Soils with higher concentrations of gravel are located in ephemeral washes.
Typic Camborthids	Alcorn and Dun Glen	Alluvial fan	
Calciorthids	Puddle	Alluvial fan	
Xerollic Durothids	Ursine	Upper erosional alluvial fan	Very shallow to moderately deep, moderately to well-drained, very coarse to sandy loam/loam and gravelly soils. Some soils may contain an old, rich concentrated clay horizon. Duripan present below the surface. Slopes range from 4 to 8 percent to 15 to 30 percent.
Xerollic Durargids	Ratto, Olson, Indian Creek, and Deer Lodge	Upper erosional alluvial fan	

Source: DOE 1996c.

The upland mountains and hill primarily consist of exposed rock outcrops, cobble or pebble pavement, or steep slopes with thin layers of alluvial deposits. These soils are typically very thin, young, and have little to no horizon definition.

4.4.5.4 Radiological Sources as a Result of Testing

4.4.5.4.1 Soils

Soils have been contaminated by radioactivity from testing at the TTR. Safety tests were performed at the NNSS and the TTR from 1954 to 1963. Section 4.1.5.4 describes the safety tests and the resulting contamination of the soils. Three safety tests were conducted on the TTR as part of the Clean Slate experiments under Project Roller Coaster. The Clean Slate experiments used open detonation on a concrete pad and detonation in igloo-like structures with varying amounts of earth cover to simulate accidents in open storage and weapon magazines (DOE 1996c). Depleted uranium and plutonium were used as tracers for the tests. Each test location has a concentrated center where the test occurred and a tail of decreasing contamination to the southeast of each test site. As a result of these tests, approximately 670 acres were contaminated, with an estimated plutonium contamination of 65 curies (DOE 1996c). An initial cleanup of each Clean Slate site was conducted shortly after each test (DOE 2009a). Test-related debris was buried at the test ground zero. Each location where radioactive contamination has exceeded 1,000 micrograms per square meter of plutonium has been fenced off and posted as radioactively contaminated. Further studies of the ground contamination were performed to determine the extent of the wind-carried contamination (DOE 2009a). Further remediation of the contaminated soil will be completed under the Soils Project. Section 4.1.5.4.1 describes the Soils Project in more detail.

Soils have been routinely tested for pollutants deposited from air or contaminants transported and deposited from moving water. Nonradiological sampling of the soils at the TTR takes place every 5 years. In 2008, soil samples were collected from 26 offsite, 10 perimeter, and 27 onsite locations. The soil samples were compared to the Target Analyte List metals with no anomalies identified (DOE 2009a).

4.4.6 Hydrology

4.4.6.1 Surface Hydrology

Five hydrographic basins are within the boundaries of the TTR, including most of Cactus Flat and parts of Stone Cabin Valley, Ralston Valley, Stonewall Flat, and Gold Flat (see **Figure 4–38**). In terms of land area, Cactus Flat is the most extensive hydrographic basin within the TTR. These basins are typically internally drained—runoff collects in playas at the low points of valleys (USAF 1999).

Surface-Water Features. No perennial streams exist on the TTR. There are numerous washes that drain upland areas that occasionally convey ephemeral flow. The ephemeral flows pond in playa areas, which collect and dissipate runoff from these basins. Water typically only exists in the playas for periods of hours following summer storms and weeks following winter storms. Little water is recharged to the groundwater system due to a high rate of evaporation (USAF 1999).

There are three small springs within the TTR's boundaries: (1) Cactus Springs, (2) Antelope Springs, and (3) Silverbow Springs. Water from these springs does not travel more than several tens of yards before it dissipates through evaporation and infiltration (DOE 2009a).

Surface-Water Characteristics. No site-specific water quality data are available for surface waters on the TTR. In general, water quality of the ephemeral waters is poor because of naturally high sediment loads and dissolved solids. The water quality of springs and seeps is primarily controlled by the physical and chemical characteristics of the rocks through which the groundwater flows prior to discharge to the surface. Once the water reaches the surface, other environmental factors affect water quality, such as precipitation, evapotranspiration, erosion, and chemical characteristics of the underlying rock or soil (USAF 1999).

In July 2007, 71 wild horses died at the TTR. The horses were from a herd that frequently drank from a manmade depression on a dry lake bed controlled by NNSA through Sandia National Laboratories. Initial sampling and necropsy results indicated that high nitrate levels may have caused the deaths. Subsequently, the Desert Research Institute was commissioned by BLM, the USAF, and DOE to sample water and soil on the TTR to determine the source of the nitrates that may have caused the deaths. This sampling was conducted in February of 2008. The conclusion of the report reinforced the original theory, specifying that the nitrate most likely came from natural sources concentrated by evaporation of the water within the depression during the heat of the summer (DOE/NV 2008a). In July of 2008 BLM gathered the horses within range of the TTR. During 2008 and 2009, NNSA drained the manmade depression and filled it with clean soils (SNL 2010b).

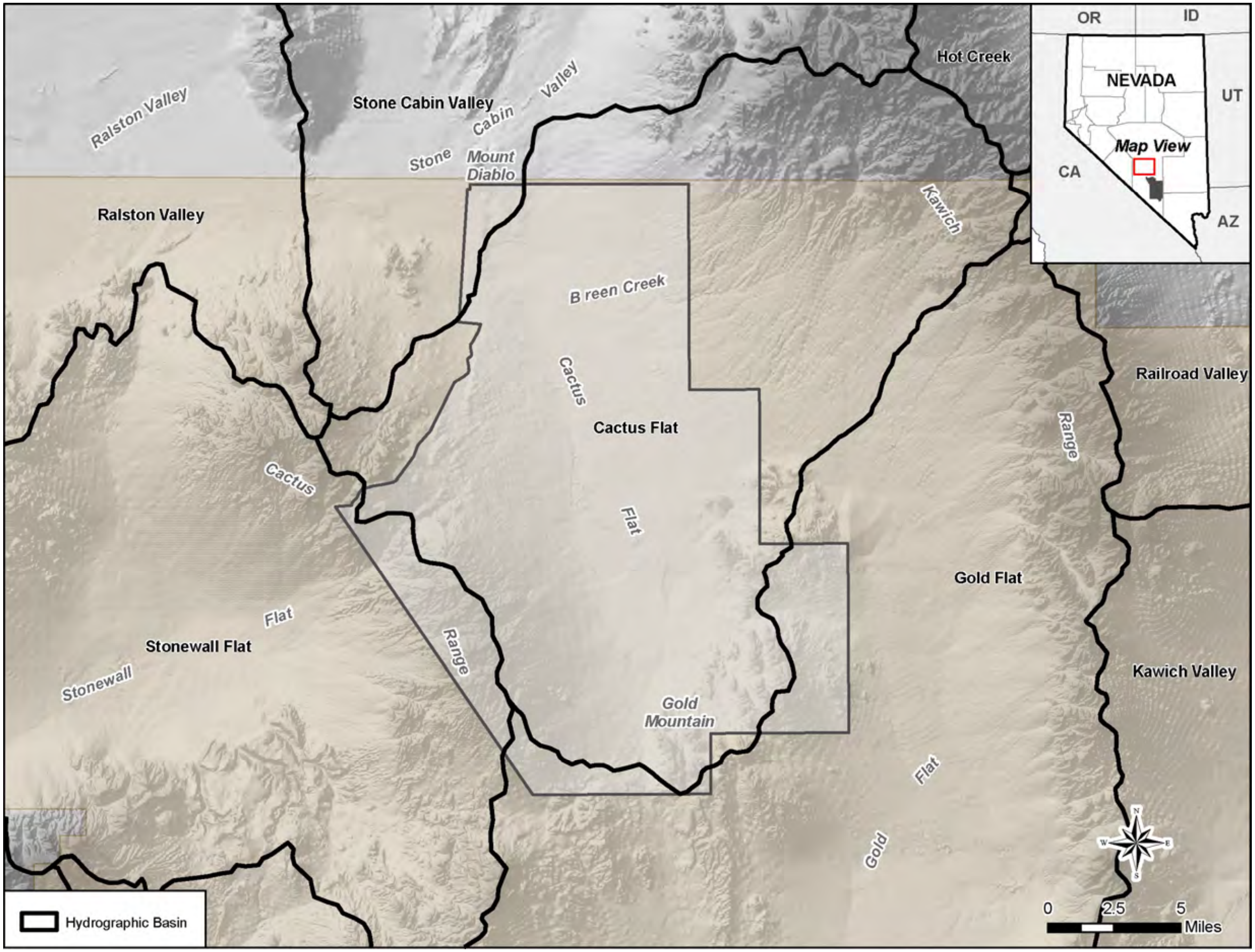


Figure 4–38 Hydrographic Basins on the Tonopah Test Range

Flood Hazards. The USAF has identified and mapped floodplain areas throughout the TTR, thus resulting in the delineation of potential 100-year flood event locations associated with playas, alluvial fans, and valley collectors (i.e., valleys that have relatively large drainage areas or several smaller tributaries that discharge to the main collector). On the TTR, floodplains are associated with two playas near the middle portion of the range (Main Lake and Antelope Lake) and a valley connector running north to south between the two playas, which roughly parallels the main access road on its eastern side. In addition, there are three valley connector floodplains and one alluvial fan floodplain that drain to the Main Lake and Antelope Lake playa system from the east and the south (USAF 1999).

Water Discharges and Regulatory Compliance. Wastewater discharges from TTR activities conducted at facilities in the main compound of Area 3 are conveyed to the USAF facultative sewage lagoon for treatment. The USAF holds an NPDES permit for the facultative sewage lagoon (Permit Number NEV20001) (DOE 2009a). Combined sanitary and pretreated industrial wastewater flows into two lined aerated ponds with treatment by biological processes. This is a zero-discharge treatment facility, by which water is lost through evaporation. For the period from June 2007 through June 2008, effluent water quality was within permitted limits and averaged 33 ppm carbonaceous biochemical oxygen demand, 49 ppm total suspended solids, and 0.4 ppm total petroleum hydrocarbon, and one metal was detected (barium at 0.019 ppm) (Kaminski 2008). All analytical results for wastewater sampled at Area 3 were within regulatory limits throughout 2008 and 2009 (DOE 2009a; SNL 2010b). No NPDES stormwater permitting is required at the TTR due to the lack of significant stormwater runoff discharging into waters of the United States (DOE 2009a).

4.4.6.2 Groundwater

Hydrogeologic Setting. The TTR lies between two Great Basin mountain ranges, the Cactus Range to the west and the Kawich Range to the east. The valley is typical of the high desert of the Basin and Range Physiographic Province. The north–south axis of the valley, known as Cactus Flat, consists of a string of playas at an elevation of approximately 5,300 feet above mean sea level. Cactus Flat is a closed basin; surface runoff following precipitation flows toward the playas, with no discharge off of the TTR (SNL 1992). Stonewall Flat is bounded on the south by Stonewall Mountain and on the west by Goldfield Hills. On the valley floors of both Cactus and Stonewall Flat, the dominant features are a number of small playas and the many washes that drain the upland areas (see Section 4.4.6.1 for more information) (DOE 2006d).

The TTR encompasses portions of five hydrographic basins (Cactus Flat, Gold Flat, Stonewall Flat, Ralston Valley, and Stone Cabin Valley) that make up portions of two regional groundwater systems. Past DOE operations have been concentrated in two areas: Stonewall Flat and the lowland portions of Cactus Flat (DOE 2008l).

Groundwater that originates as precipitation over the Kawich Range flows west and then southwest under the TTR, ultimately discharging in Death Valley through springs and evapotranspiration. Some groundwater may flow northwest off the TTR and into the Southern Marshes flow system, with discharge at Mud Lake, Alkali Flat, and Clayton Valley. The generalized directions of regional groundwater flow are shown in **Figure 4–39**. Groundwater in Cactus Flat is derived from precipitation over the upland areas, and there is no subsurface recharge from neighboring basins. The total recharge has been estimated at only 600 acre-feet per year. Depth to groundwater ranges from 90 to 450 feet below the land surface. Groundwater under Stonewall Flat is derived from recharge over the upland areas and is estimated at 100 acre-feet per year. Depth to groundwater ranges from 100 to 275 feet below the land surface (DOE 1996c).

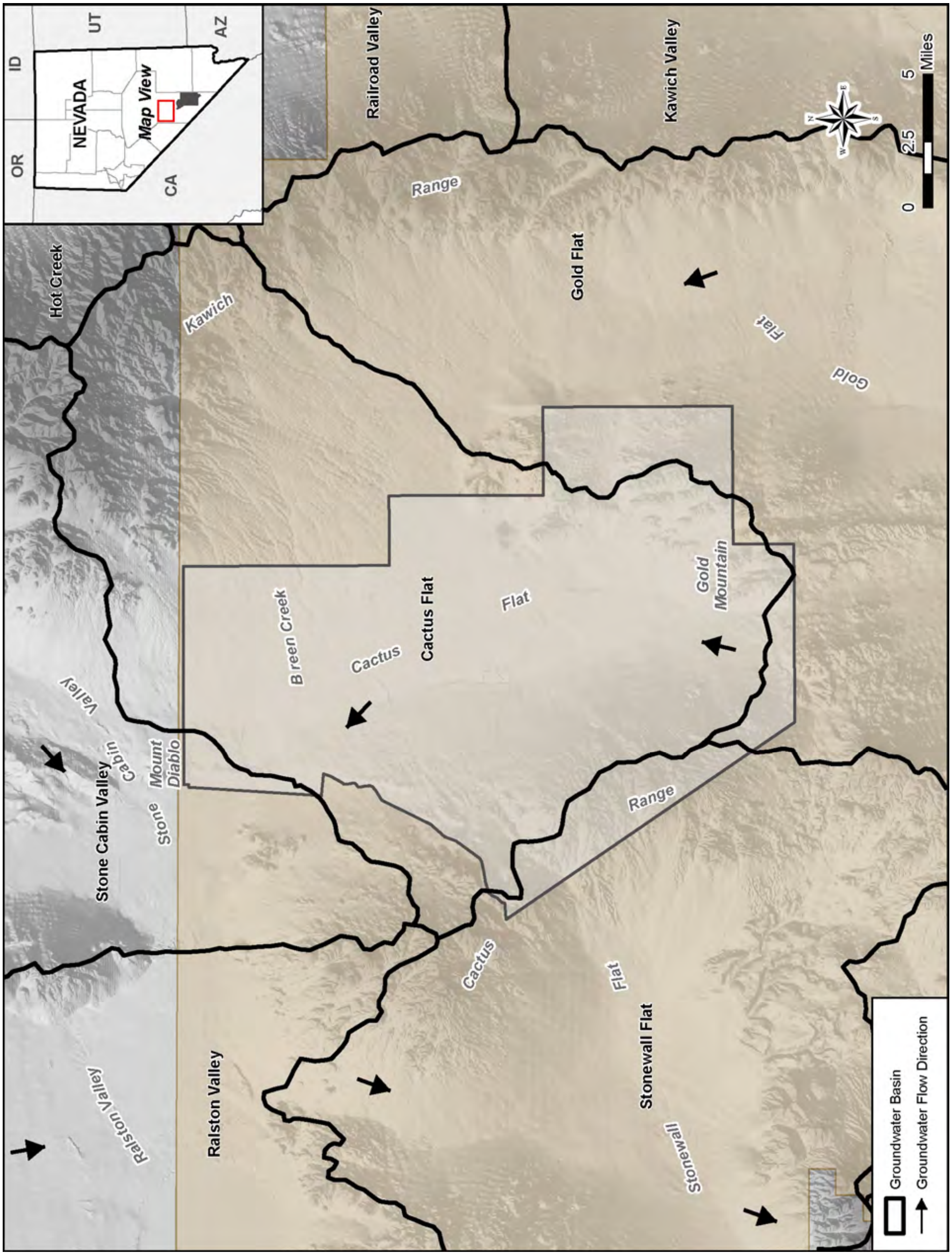


Figure 4–39 Groundwater Basins and Flow at the Tonopah Test Range

Groundwater Supply. Groundwater at the TTR has been used for domestic, industrial, and construction purposes. Groundwater is pumped from a number of wells, depending on the location of range activities and the total demand for water. The following three active wells are used at the TTR: (1) Production Well 6, (2) Production Well 7, and (3) the Roller Coaster Well.

Production Well 6 supplies drinking water and fire water distribution systems at the TTR Main Compound in Area 3 and is the only well that has been sampled for contaminants. It pumps water to an elevated water tank in Area 3 that holds 200,000 gallons (Lacy 2011). In June 2008, a new carbon dioxide (pH) adjusting treatment system for arsenic removal became operational in Area 3 of the TTR (Lacy 2011). Outlying areas and buildings without water service use bottled water. Production Well 7 and Roller Coaster Well are used only for nonpotable purposes (construction and dust suppression), and there is no regulatory sampling requirement. The water use (for the entire TTR, including the USAF) for operations is approximately 6 million gallons per year (DOE 2008l). The static water level at Well 6 is approximately 350 feet (SNL 2010b).

The water conservation plan for the TTR complies with State Water Resources Division regulations requiring a water conservation plan for permitted water systems and major water users in Nevada. An updated Water Conservation Plan for the TTR (SNL 2011) was approved by the Nevada Division of Water Resources in January 2011 (NDWR 2011).

There are about 15,000 acre-feet per year of water rights in the five hydrographic basins associated with the TTR. Approximately 10,300 acre-feet per year of this total are surface-water rights (see Section 4.4.6.1); the remainder (almost 4,700 acre-feet) represents groundwater rights. Currently, defense-related water appropriations total 1,775 acre-feet per year, 148 acre-feet of which are surface-water rights. **Table 4–70** lists the water yield and resources for each of the basins that encompass portions of the TTR.

Water appropriations are limited to two basins: (1) Cactus Flat and (2) Stone Cabin Valley, and total 200 acre-feet (65,170,200 gallons) per year. Both basins are over-appropriated (i.e., the appropriations exceed the perennial yield in each basin). It is unlikely that additional water rights can be obtained in the area without groundwater mining (the removal of groundwater from storage) (DOE 2008l).

Table 4–70 Water Rights Status for Hydrographic Basins at the Tonopah Test Range

Hydrographic Basin	*Hydrographic Basin Number*	*Perennial Yield (acre-feet per year)*	*Total Committed Groundwater Resources (acre-feet per year)*	*TTR water rights/use (acre-feet per year)*
Cactus Flat	148	300	619	Estimated TTR water rights 160
Gold Flat	147	1,900	95	Estimated TTR water rights 40
Stonewall Flat	145	100	12	No TTR water rights
Ralston Valley	141	6,000	1,917	No TTR water rights
Stone Cabin Valley	149	2,000	2,033	Estimated TTR water rights 240

TTR = Tonopah Test Range.
Source: DOE 2008l; NDWR 2010c.

Groundwater Monitoring and Quality. The lithology of the rocks controls the water chemistry observed in the wells. Potential sources of groundwater contamination existing on the TTR include French drains, septic tanks and leach fields, underground storage tanks, landfills, and sewage lagoons (DOE 2008l). The quality of water at the TTR is generally good and is suitable for domestic purposes, livestock, and wildlife use (DOE 1996c). The nuclear safety tests conducted at the Clean Slate sites on the TTR have resulted in surface soil contamination; however, groundwater contamination has not been detected at the TTR (see Section 4.4.5.4.1 for soil contamination). Infiltration is limited by the depth to groundwater (90 to 150 feet), low rainfall, and high evaporation rate. The small quantities of liquid water that may have been disposed or released will, therefore, attenuate in the soil and are unlikely to affect groundwater. Soil was sampled for explosive residues from unexploded ordnance remedial activities; however, no reference can be found for groundwater sampling for perchlorate (DOE 2008l).

Water analyses are conducted at various times at several locations throughout the TTR to characterize water quality. None of the constituents that have been analyzed have exceeded the recommended health standards set by the Nevada Division of Health, with the exception of pH. Although the pH values slightly exceeded the standard, the waters do not pose health problems. The Roller Coaster Well is classified as a sodium-bicarbonate-chloride-type water, while the remaining wells are classified as sodium-bicarbonate-type waters (DOE and U.S. Air Force 1988).

4.4.7 Biological Resources

The following description of vegetation was taken from EG&G Energy Measurements (1995), unless otherwise stated. The scientific names of plants and animals mentioned in this section are given in Section 4.1.7.

The TTR is within the Great Basin Desert. The lowest elevation on the TTR is approximately 5,250 feet; the highest elevation is approximately 7,550 feet.

NNSA/SSO has an ecology program that serves to conserve flora and fauna at the TTR (NNSA/SSO 2010). The primary objectives of the Ecology Program include:

- Collect ecological resource inventory data to support site activities, while preserving ecological resources, and maintaining regulatory compliance
- Collect information on plant and animal species present to further the understanding of ecological resources on site
- Collect biota contaminant data on an as-needed basis in support of site projects and regulatory compliance
- Assist Sandia organizations in complying with regulations and laws
- Provide information to employees regarding ecological resource conservation
- Support Sandia organizations with biological surveys in support of site activities

Enhancement measures that have been utilized in the past include installing artificial nest platforms, boxes, and perches.

In 2010, an Avian Protection Plan was adopted and implemented at the TTR (Lacy 2011). The Avian Protection Plan was developed to describe procedures that would be taken by NNSA at the TTR to address potential impacts of its associated transmission and distribution lines on avian species that are known to occur in the area (NNSA/SSO 2010).

4.4.7.1 Flora

There are four general vegetation types on the TTR, dwarf shrubland, shrubland, woodland, and bare or disturbed areas (**Figure 4–40**). The dominant flora of the valley bottoms on the TTR include shadscale, budsage, winterfat, and galleta grass (*Pleuraphis* Torr.). Less-common plant species are horsebrush, greasewood, desert globemallow *(Sphaeralcea ambigua)*, and desert prince's plume *(Stanleya pinnata)*. Big sagebrush occurs in wash bottoms and near the playa on the southwestern corner of the site. On the bajadas above the valley floor, Nevada jointfir, green rabbitbrush, shadscale, budsage, winterfat, and Indian ricegrass are dominant. At higher elevations, greasewood, wolfberry, hopsage, and desert prince's plume are common. Pinyon-juniper woodlands occur at the highest elevations.

4.4.7.2 Fauna

Animal species on the TTR include all species found in the Great Basin Desert on the NNSS. Some of the most common animal species include side-blotched lizards, desert-horned lizards, horned larks, chisel-toothed kangaroo rats, little pocket mice, and wild horses (Bradley and Moor 1975). State-designated game animals that occur on the TTR include mule deer, bighorn sheep, pronghorn, mountain lions, desert and Nuttall's cottontails, chukar, and mourning dove. The gray fox and bobcat are species known to occur at the TTR that are listed by the state as furbearers (SNL 2010a).

Bird species typically found in the valley floor of the TTR are those associated with the sagebrush community and include sage thrasher (*Oreoscoptes montanus*), sage sparrow (*Amphispiza belli*), horned lark, and common raven. Less-frequently observed species include the green-tailed towhee (*Pipilo chlorurus*), western meadowlark (*Sturnella neglecta*), mourning dove, greater roadrunner (*Geococcyx californianus*), and common nighthawk (*Chordeiles minor*) (NNSA/SSO 2010).

Bird species diversity increases with elevation at the TTR, to include birds such as loggerhead shrike, mourning dove, black-throated sparrow, and juniper titmouse (*Baeolophus ridgwayi*). Scott's orioles (*Icterus spurius*), western kingbirds, and ash-throated flycatchers (*Myiarchus cinerascens*) are occasionally observed nesting in the Joshua trees. In the rocky slopes of the steep terrain, chukars (introduced into the area) and rock wrens (*Salpinctes obsoletus*) are sometimes encountered (NNSA/SSO 2010).

Raptor species are present throughout the TTR and include red-tailed hawk, golden eagle, prairie falcon, American kestrel, common barn owl, great horned owl, Swainson's hawks, and ferruginous hawks (*Buteo regalis)*. Known nesting raptors include red-tailed hawk, golden eagle, and great horned owl (NNSA/SSO 2010).

The Nevada Wild Horse Range and other wild horse land-use areas constitute a significant portion of the Nevada Test and Training Range, including the TTR, with herds common in Cactus and Gold Flats, Kawich Valley, Goldfield Hills, and the Stonewall Mountains (SNL 2010a). The Nevada Wild Horse Range is managed by BLM, but wild horse and burro management does not affect national security activities at the TTR to a great extent, since the USAF mission still has precedence over BLM management (USAF 2007e). The draft *Integrated Resource Management Plan for Nellis Air Force Base and the Nevada Test and Training Range* (USAF 2007e) recommended that BLM continue annual censuses of the wild horse population and to conduct wild horse gathers as necessary to maintain the current appropriate management level for the Nevada Wild Horse Range of 300 to 500 horses. Hundreds of wild horses graze freely throughout the TTR, and activities on site have had little effect on the horse population or their grazing habits. BLM routinely rounds up a portion of the herds for auction through the Wild Horse and Burro Adoption Program (SNL 2010a).

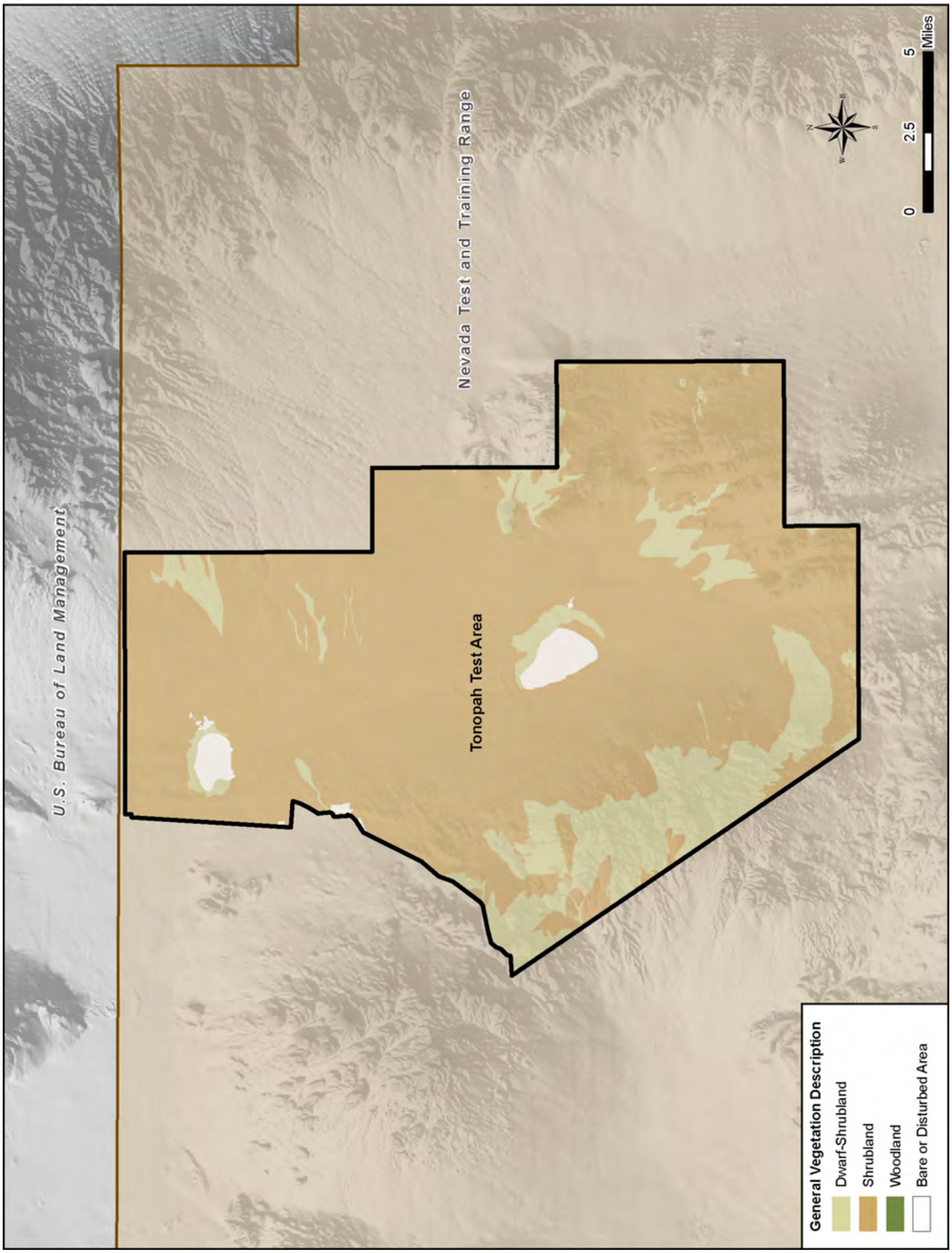


Figure 4–40 Vegetation Types on the Tonopah Test Range

Wild horses have altered the TTR and Nevada Test and Training Range vegetation composition and production where they graze, and compete with native species, such as mule deer, pronghorn, and bighorn sheep, for water and vegetation. An extreme example of the potential negative impacts of wild horse grazing may be seen in the Kawich Valley. Where wild horses are present in this area, the Great Basin scrub vegetation has been uniformly cropped over many acres to less than 8 inches high. It is clear that the closely cropped plants in the Kawich Valley do not represent the condition of the vegetation before the horses were introduced (USAF 2007c). On the TTR, the Clean Slate I, II, and III environmental remediation sites have been fenced for other purposes, but the fences also serve to prevent grazing by wild horses. These excluded areas have regrown with abundant native vegetation, which is not affected by wild horse grazing (USAF 2007c).

4.4.7.3 Threatened and Endangered Species

No current federally listed threatened, endangered, or candidate plant or animal species are known to occur on the TTR.

4.4.7.4 Other Species of Concern

The western burrowing owl, a state-protected bird, is known to occur on this site. No other species of concern are known to inhabit the TTR.

4.4.7.5 Effects of Past Radiological Tests and Project Activities

Vegetation samples were collected on the TTR in 1973 and again in 1990 and 1991 (EG&G/EM 1993b). These studies found that plutonium levels in samples of vegetation ranged from 4.0×10^{-5} to 3.9×10^{-2} nanocuries per gram of dry vegetation, and the plutonium levels had not changed substantially over the past 25 years. Many studies in arid and semiarid environments (Francis 1973; Hakonson 1975; Hanson 1975; Price 1973; Romney and Wallace 1977) have shown that most of the plutonium remains in the soil and is not readily transported. Very little of the contamination is incorporated into the biological components of the ecosystem in similar arid areas (Hakonson and Nyhan 1980). Plutonium contamination of vegetation at the TTR and the NNSS is concentrated mainly on the surface of vegetation and is generally not taken up by the roots and concentrated internally. Small mammals were collected from the TTR for plutonium contamination analyses from 1974 through 1975 (Bradley and Moor 1975) and from other contaminated areas on the NNSS and off site (Gilbert et al. 1988). From these studies, the following general conclusions can be made: very low levels of contamination (from undetectable levels to a few hundred femtocuries [10^{-15} curies] per gram) were found in animals; desert rodents (which represent the primary consumer trophic level) have very low plutonium levels; most of the radioactivity in rodents is associated with the pelt and gastrointestinal tract and not internal organs or carcasses; and the plutonium contamination does not appear to bioaccumulate in the food chain.

4.4.8 Air Quality and Climate

4.4.8.1 Meteorology

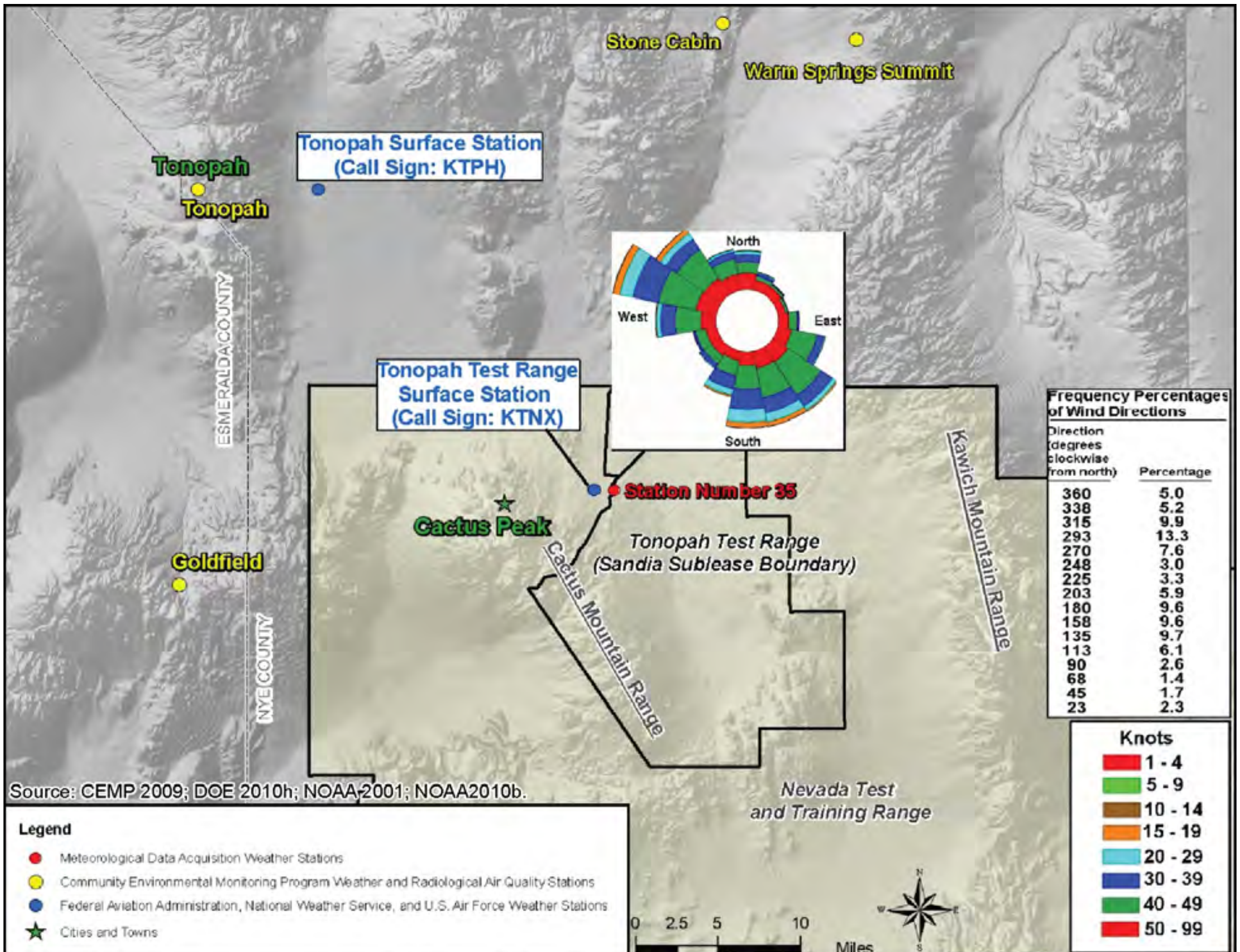
As with the NNSS, the TTR is located in the southwestern corner of the Great Basin and in the rain shadow (lee) of the southern Sierra Nevada mountain range. The TTR has the general climatic characteristics of a mid-latitude desert area, with relatively little precipitation and low humidity, large diurnal and seasonal temperature ranges, and intense solar radiation in the summer. The generally dry desert conditions specific to the TTR are occasionally modified by the southwestern monsoon and convective thunderstorms during the summer months and Eastern Pacific tropical storm remnants in the late summer and fall. The dry conditions can be further modified from time to time during strong *El Niño* cycles, which generally bring more rainfall to the area.

Significant climate differences within the TTR stem largely from differences in elevation. The TTR is generally characterized by a broad, flat valley bordered by two north–south mountain ranges: the Cactus Range to the west and the Kawich Range to the east. Elevations range from 5,347 feet above mean sea level in the valley floor to about 7,484 feet above mean sea level at Cactus Peak (DOE 2009a). Wind flows are strongly affected by the surrounding topographical influences. Temperatures are coolest at the higher elevations and warmest in the valley floor. Precipitation is generally sparse, with about 4 inches of annual average rainfall in the valley floors, though as much as about 12 inches of frozen and liquid precipitation can occur on mountain ridges (SORD 2002).

At the Tonopah Test Range Airport in the north–central portion of the TTR (at an elevation of about 5,548 feet above mean sea level), a long-term meteorological station operates. The average daily maximum temperature typically ranges from about 85 to 90 °F in the summer and from about 40 to 50 °F in the winter; likewise, average minimum temperatures tend to be about 50 to 60 °F in the summer and about 15 to 25 °F in the winter (SORD 2002). The annual average temperature is 52 °F. The Desert Research Institute began operating a meteorological station in July 2008 at the northern edge of the Clean Slate III site.

Precipitation falls most often during the spring period (due to passing East Pacific storms) and during the mid- to late-summer period (due to convective thunderstorms, monsoons, and occasional tropical storms). Nevada on the whole has been in a long-term drought for most of the last 100 years, with precipitation amounts below normal. However, much of the 1980s and 1990s were wetter than normal (DOE 2008j). For more information regarding precipitation patterns at the TTR, please see Appendix D, Section D.1.4.1.

Wind conditions are perhaps the most complex of the meteorological conditions on the TTR. The surface winds show strong diurnal variations with distinct drainage in the valley and mountain slopes. The Cactus Range is to the west of the Tonopah Test Range Airport and is closer to the airport than the Kawich Range, and since the Cactus Range is oriented north-northwest to south-southeast, these nighttime drainage winds tend to be from the northwest at the airport (DOE 2009a). Localized terrain gradients that are not north to south modify this nighttime wind flow, as do occasional low overcast conditions or conditions with extensive nighttime vertical mixing. **Figure 4–41** shows wind direction and speed data for the TTR. For more information regarding the wind patterns at the TTR, please see Appendix D, Section D.1.4.1.



Note: To convert knots to meters per second, multiply by 0.5144. To convert knots to miles per hour, multiply by 1.151. The percentage rings indicate frequency of occurrence. Wind directions are from which the wind is blowing.

Figure 4–41 Wind Rose for Tonopah Test Range Airport Surface Station, 2004–2008

4.4.8.2 Ambient Air Quality

4.4.8.2.1 Region of Influence

The TTR is located about 15 to 40 miles northwest of the NNSS. The ROI for air quality and climate for TTR operations comprises north-central Nye County, with prevailing downwind impacts extending into western Lincoln County. Historic data on pollutant emissions inventories and the compliance status for the State of Nevada are calculated at the county level; these data provide a basis for determining both existing air quality in the ROI and a metric for emission comparison assessments.

4.4.8.2.2 Existing Air Quality

Ambient Air Quality Standards. See Section 4.1.8.2.2 for a discussion on the national and Nevada ambient air quality standards. The TTR is within the Nevada Intrastate Air Quality Region 147. All of the TTR is within Nye County, for which there are insufficient data to determine attainment status, so the TTR is designated as an unclassified area. However, EPA treats unclassified areas as if they are in attainment for regulatory purposes. See Section 4.1.8.2.2 for more information on nearby NAAQS nonattainment areas. No ambient air quality data have been measured on the TTR; however, the ambient air quality characteristics are anticipated to be better than or similar to those of the NNSS, given the lower vehicle and stationary source activity levels.

Emissions Due to TTR Operations. Title V of CAA gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At the TTR, there is one Class II Air Quality Operating Permit. Class II permits are issued for "minor" sources and limit annual emissions in one of the following ways: (1) annual emissions of any one criteria pollutant must not exceed 100 tons; (2) annual emissions of any one hazardous air pollutant must not exceed 10 tons (including lead); or (3) annual emissions of any combination of hazardous air pollutants must not exceed 25 tons (including lead). The emissions limits associated with the TTR's Class II Air Quality Operating Permit are occasionally re-evaluated and reissued—most recently in 2009. The TTR facilities regulated by this permit include screening plants and maintenance shops (including those for painting, welding, and carpentry).

From 2001 through 2008, the TTR reported total annual emissions of less than 1 ton from permitted facilities (DOE 2002a, 2003a, 2004a, 2005a, 2009a; SNL 2007). In 2008, the TTR reported a total of only 0.21 tons of criteria and hazardous air pollutants. As of 2007, when operating at maximum permitted capacity, stationary sources on the TTR are allowed to emit as much as about 21 tons of emissions (comprising 3 tons from permitted facilities and 18 tons from nonpermitted facilities[31]) (NDEP 2007). For more details on how these maximum allowed emissions were determined, see Appendix D, Section D.1.4.2. The Class II permit also requires that the best practical method be used to limit the resuspension of soil dust into the air during construction, repair, demolition, work, or the use of unpaved or untreated areas without applying the measures described in the dust control plan (NDEP 2007).

Table 4–71 shows the onsite emissions due to the stationary sources, as well as emissions due to government-owned vehicles on the TTR, TTR commuters, and commercial vendors servicing the TTR. These emissions are partitioned into Clark County and Nye County (both on the TTR and off the TTR), where appropriate. See Appendix D, Section D.1.4.2, for further detail on the methodology for determining the emissions from commuter and vendor activities.

[31] *A nonpermitted source is a stationary source that, by regulation, does not require an air operating permit. Examples include emergency stationary generators that operate for less than 500 hours per year and propane storage tanks.*

Table 4–71 Estimated 2008 Air Emissions of Criteria Pollutants and Hazardous Air Pollutants Due to Tonopah Test Range Activities

	Annual Air Emissions (tons per year)											
	Stationary Sources	***Government-Owned Vehicles***	***TTR Commuters***			***Commercial Vendors***			***Total***			
	Nye County	***Nye County***		***Nye County***			***Nye County***			***Nye County***		
Pollutant	***On-TTR***	***On-TTR***	***Clark County***	***On-TTR***	***Off-TTR, Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR, Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR, Off-NNSS***	***Total***
PM_{10}	<3.7	0.065	0.0087	0.0010	0.037	0.12	0.0066	0.54	0.13	<3.8	0.58	<4.5
$PM_{2.5}$	<3.7	0.050	0.0048	0.00061	0.021	0.11	0.0061	0.5	0.12	<3.8	0.52	<4.4
CO	<2.9	3.6	0.91	0.047	4.1	0.49	0.027	2.2	1.4	<6.6	6.3	<14.3
NO_x	<13.3	0.97	0.22	0.030	1.0	1.1	0.058	4.7	1.3	<14.4	5.7	<21.4
SO_2	<0.91	0.0071	0.0024	0.00028	0.0095	0.002	0.00011	0.0087	0.0044	<0.92	0.018	<0.94
VOCs	<0.96	0.10	0.018	0.0022	0.075	0.16	0.0088	0.72	0.18	<1.1	0.80	<2.0
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	0.0000019	0.00000011	0.0000089	<0.01	<0.03	<0.01	<0.05
Criteria Pollutant Total	<21.8	4.7	1.2	0.08	1.2	1.9	0.10	8.2	3.1	<26.7	9.4	<39.2
HAPs	<1.1	0.0097	0.0014	0.00019	0.0063	0.021	0.0012	0.095	0.022	<1.1	0.10	<1.2

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

4.4.8.3 Radiological Air Quality

Radiation monitoring from 1996 through 1997 indicated a concentration of 1.6×10^{-18} microcuries per milliliter of plutonium-238, 9.5×10^{-19} microcuries per milliliter of plutonium-239 and -240, and 4.10×10^{-18} microcuries per milliliter of americium-241. These radiation levels would cause an MEI (either on site or off site) to receive an effective dose equivalent of 0.024 millirem per year (DOE/NV 1997a; DOE/NV 1997b; DOE 2009a). This dose level is approximately 400 times less than the EPA NESHAPs standard of 10 millirem per year (DOE 2009d). These results are indistinguishable from the natural background radiation level on or near the TTR.

Ambient air quality radiation monitoring had not been performed at the TTR since 1997 because operations at the TTR do not involve activities that release radioactive emissions into the air from point sources or from diffuse sources such as outdoor testing. However, the Desert Research Institute began monitoring air quality for radioactive contaminants at the TTR in July 2008 (DOE 2009c) to address concerns about fugitive radioactive emissions from the possible resuspension of americium and plutonium present at the Clean Slate environmental restoration sites. One site is located near the Range of Operations Center and the other at the northwestern end of the Clean Slate III site. Since May 2009, neither site has detected any anthropogenic gamma-emitting radionuclides, which would potentially indicate the presence of americium and/or plutonium. Other environmental restoration sites with minor radioactive contamination, such as depleted uranium, do not produce significant air emission sources from resuspension (DOE 2009a).

4.4.8.4 Climate Change

This section describes the affected environment in terms of current and anticipated trends in greenhouse gas emissions and climate. The effects of emissions and the corresponding processes that affect climate involve very complex processes with considerable variability, complicating the measurement and detection of change. Recent advances in the state of the science, however, are contributing to an increasing body of evidence that anthropogenic greenhouse gas emissions affect climate in detectable and quantifiable ways.

For information on greenhouse gas emissions in the United States, please see Section 4.1.8.4.1. Greenhouse gas emissions at the TTR are discussed in the next section. Details on the methodology used to determine these emissions are discussed in Appendix D, Sections D.2.4.1.1, D.2.4.2.1, and D.2.4.3.1.

4.4.8.4.1 Greenhouse Gas Emissions

Table 4–72 provides greenhouse gas emissions due to TTR-related activities for 2008. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions were derived from fuel use, vehicle activity, and power consumption data. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). These emissions were compared with a reference amount of 25,000 metric tons (27,558 tons), which is an indicator for when a quantitative assessment may be warranted (CEQ 2010).

Commercial vendors are by far the largest single source of greenhouse gas emissions related to TTR activities, emitting approximately 2,210 carbon-dioxide-equivalent tons of greenhouse gases, or 53 percent of the TTR-related greenhouse gas emissions total. Mobile sources altogether emitted about 3,396 carbon-dioxide-equivalent tons of greenhouse gases, which is 88 percent less than the threshold reporting level. Overall, TTR-related activities created about 4,166 carbon-dioxide-equivalent tons of greenhouse gas emissions in 2008, an amount well below the threshold level.

Table 4–72 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases Due to Tonopah Test Range Activities in 2008

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons* [a]
STATIONARY SOURCES		
Power consumption	275	0.01
Natural gas heating	0	0.00
All stationary sources, except air conditioning/refrigeration and natural gas heating	495	0.02
All Stationary Sources	*771*	*0.03*
MOBILE SOURCES		
Onsite government vehicles	454	0.02
Commuting	732	0.03
Commercial vendors	2,210	0.08
All Mobile Sources	*3,396*	*0.12*
Total	***4,166***	***0.15***

[a] 25,000 metric tons are equal to about 27,558 short tons.

4.4.8.4.2 Current Changes in Climate

For a discussion of climate change impacts in the region, please see Section 4.1.8.4.2.

4.4.9 Visual Resources

The TTR is visually similar to areas of the NNSS with higher elevations and is only visible from an access road off U.S. Route 6 (DOE 1996c). The portion of the area visible from U.S. Route 6 is considered to have a Class B scenic quality rating (see Section 4.1.9 for information on the visual impact rating system) due to the lack of visual intrusions and picturesque views of the natural landscape that vary throughout the day and seasonally, combined with the commonality of these views to the region.

4.4.10 Cultural Resources

For introductory information regarding cultural resources, see Section 4.1.10. Unless otherwise noted, the information in this section is derived from the *1996 NTS EIS* (DOE 1996c). Additional information regarding cultural resources on the TTR was obtained from the Desert Research Institute (DOE 2010a), which provides Cultural Resources Program support to NNSA/NSO and to the USAF. Information sources provided by the Desert Research Institute include short report summaries, lists of recorded sites on the TTR and their NRHP eligibility status, and excerpts from cultural resources studies conducted on the TTR.

The TTR lies within the Southern Great Basin physiographic region and encompasses portions of five hydrographic basins (Cactus Flat, Gold Flat, Stonewall Flat, Ralston Valley, and Stone Cabin Valley) (NDWR 2010a) (see **Figure 4–42**). The TTR area possesses a long history of American Indian occupation and more-recent European-American settlement and American military use. Archaeological research indicates humans have used the area within the TTR for the last 10,000 years. When European-American explorers first entered this area in the mid-nineteenth century, groups of Western Shoshone occupied the region. Historic period activity consisted of mining and ranching; more-recent activity has focused on military use of the TTR area.

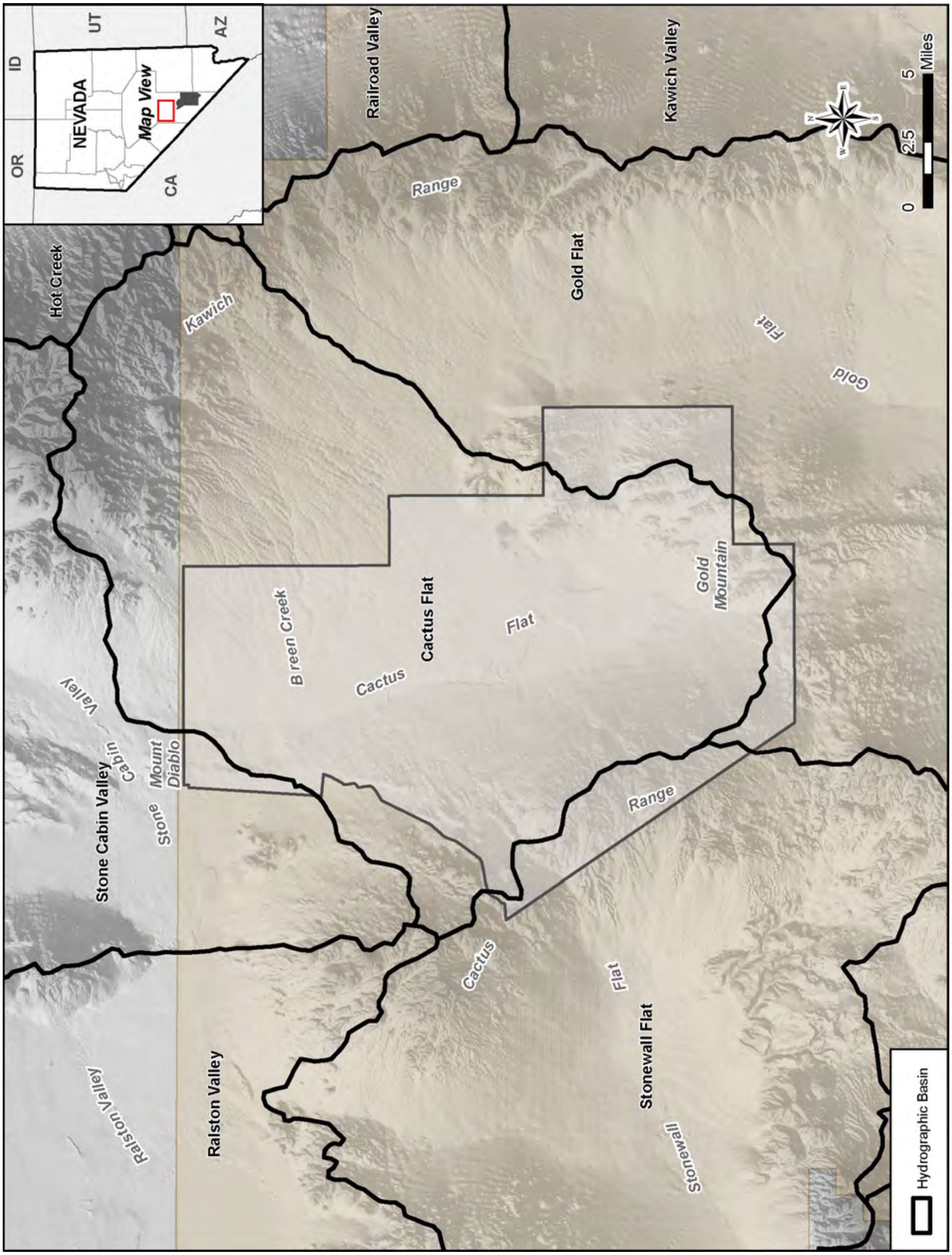


Figure 4–42 Hydrographic Basins Within the Tonopah Test Range Boundary

The area of influence for the TTR is defined as all ground areas that would experience direct or indirect impacts of construction, maintenance, or operations of program facilities and activities occurring on the TTR. Based on current knowledge of cultural resources within the TTR, all areas have the potential to contain cultural resources. Therefore, the area of influence for this SWEIS includes the entire area within the TTR boundary.

4.4.10.1 Recorded Cultural Resources

Current knowledge about cultural resources on the TTR is largely the result of project-specific cultural resources studies completed for DOE activities. Cultural resources studies that included large portions of the TTR include Bergin et al. 1979 and DuBarton and Johnson 1996. Past DOE operations have been concentrated in two areas: (1) the lowland portions of Cactus Flat and (2) Stonewall Flat (DOE 2008l). As a result, these areas of the TTR have been intensively surveyed for cultural resources (Pippin 2005). One area in particular, along the Breen Creek drainage at the southern end of Cactus Flat, is highly sensitive for prehistoric and historic cultural resources (DuBarton and Johnson 1996). Other areas, however, have undergone little or no cultural resources inventory. Consequently, there is no overarching archaeological cultural resources overview for the TTR (Pippin 2005). Cultural resources sites from all chronological periods and site types have been recorded on the TTR. However, the greatest number of recorded sites consists of prehistoric extractive and processing localities, as well as historic mining and ranching sites. One historic building survey resulted in the development of a comprehensive Cold War era historic context and 59 properties recommended for eligibility for the NRHP as a historic district (Ullrich et al. 2005).

Less than 4 percent of the TTR has been surveyed for cultural resources. Seventy-one cultural resources studies have been completed on the TTR, and 330 cultural resources sites have been recorded. Prehistoric archaeological sites make up 87 percent, or 288 sites, of recorded sites on the TTR; the remaining 13 percent, or 42 sites, are historic archaeological sites and structures related to mining and ranching, and 1 site associated with military and scientific research (DOE 2010a). Sixty percent, or 222 sites, are eligible for listing in the NRHP. Cultural resources are grouped by the five hydrographic basins located within the TTR (see **Table 4–73**).

Table 4–73 Tonopah Test Range Cultural Resources Sites by Site Type and Hydrographic Basin

Hydrographic Basin	*Prehistoric Site Types*							*Historic Sites*		*Untyped Sites*	*Total Sites*	*NRHP-Eligible*
	RB	*TC*	*EL*	*PL*	*LO*	*CA*	*STA*	*HI*	*NT*	*UT*		
Gold Flat	0	4	0	0	31	0	0	9	0	0	44	40
Stonewall Flat	0	0	0	0	3	0	1	9	0	0	13	13
Ralston Valley	0	2	0	0	36	0	0	2	0	0	40	38
Cactus Flat	0	19	0	3	93	0	0	18	1	0	134	68
Stone Cabin Valley	0	3	0	6	87	0	0	3	0	0	99	63
Total	**0**	**28**	**0**	**9**	**250**	**0**	**1**	**41**	**1**	**0**	**330**	**222**
Total Sites	**330**											**222**

CA = cache; EL = extractive locality; HI = historic site; LO = locality; NRHP = National Register of Historic Places; NT = nuclear testing; PL = processing locality; RB = residential base; STA = station; TC = temporary camp; UT = untyped.
Note: This table does not include isolated artifacts or features.

4.4.10.1.1 Gold Flat

While most of the Gold Flat hydrographic basin lies south of the TTR, a portion of Gold Flat lies in the southeastern corner of the TTR. Within the TTR, Gold Flat is divided from the Cactus Flat hydrographic basin by the Breen Creek drainage. Seven cultural resources studies have been conducted within the TTR portion of Gold Flat. Approximately 950 acres have been surveyed for cultural resources. To date, 44 cultural resources sites have been recorded, including 4 temporary camps, 31 uncategorized localities, and 9 historic sites associated with mining and ranching. Of these, 40 sites are eligible for listing in the NRHP.

4.4.10.1.2 Stonewall Flat

A small portion of the Stonewall Flat hydrographic basin lies within the southwestern TTR area. Stonewall Flat is separated from Cactus Flat by the Cactus Range. One cultural resources survey covering 215 acres has been completed on the TTR portion of Stonewall Flat. A total of 13 sites have been recorded, including 3 uncategorized localities, 1 station, and 9 historic sites associated with mining and ranching. All 13 sites are eligible for listing in the NRHP.

4.4.10.1.3 Ralston Valley

Only the southeastern corner of the Ralston Valley hydrographic basin falls within the TTR boundary. The Monitor Hills separate Ralston Valley from the Stone Cabin Valley hydrographic basin. One cultural resources survey covering 170 acres has been completed on the TTR portion of Ralston Valley. A total of 40 sites have been recorded, including 2 temporary camps, 36 uncategorized localities, and 2 historic sites. To date, 38 of these sites are eligible for listing in the NRHP.

4.4.10.1.4 Cactus Flat

The majority of the Cactus Flat hydrographic basin lies within the TTR boundary. Cactus Flat is bounded by the Cactus Range to the west, the Kawich Range to the east, Gold Mountain to the south, and Mount Diablo to the north. Cactus Flat is the location of the Tonopah Test Range Airport and support facilities and, therefore, has been intensively surveyed for cultural resources. Fifty-six cultural resources studies have been conducted within Cactus Flat. Approximately 14,057 acres have been surveyed for cultural resources. A total of 134 cultural resources sites have been recorded, including 19 temporary camps, 3 processing localities, 93 uncategorized localities, 18 historic sites associated with mining and ranching, and 1 site associated with nuclear testing. Of these, 68 sites are eligible for listing in the NRHP.

4.4.10.1.5 Stone Cabin Valley

The southern end of Stone Cabin Valley hydrographic basin extends into the northern portion of the TTR. The basin is bounded by the Monitor Hills to the west and the Kawich Range to the east. Six cultural resources surveys have been conducted within the TTR portion of Stone Cabin Valley. Approximately 420 acres have been surveyed for cultural resources. To date, 99 cultural resources sites have been recorded, including 3 temporary camps, 6 processing localities, 87 uncategorized localities, and 3 historic sites. Of these, 63 sites are eligible for listing in the NRHP.

4.4.10.2 Sites of American Indian Significance

For a general description of consultation efforts between DOE and CGTO, see Section 4.1.10.

DOE consultation with CGTO included a site visit to Cactus Flat in 1997 by members of CGTO. The goal of the visit was to provide recommendations for DOE site restoration activities in relation to potential sites of American Indian significance (Stoffle et al. 2001). This and other ongoing consultation efforts have resulted in a better understanding of the cultural significance these sites and locations possess in relation to traditional cultural landscapes *(*Zedeno et al. 1999; Stoffle et al. 2001).

4.4.11 Waste Management

A variety of wastes are generated during TTR operations in support of DOE/NNSA's Weapons Ordnance Program, as well as during environmental restoration activities at the TTR and the Nevada Test and Training Range. Although most wastes so generated are shipped off site for disposal, some sanitary solid waste and construction debris are disposed in onsite landfills.

Waste Generation

Hazardous waste from TTR operations that was disposed or recycled off site during CYs 2006 through 2008 is listed in **Table 4–74** (Schade 2010). Hazardous waste sent off site for disposal includes waste regulated under RCRA; asbestos- and PCB-contaminated waste regulated under TSCA; and waste regulated under other authorities, such as liquids or medical waste. This waste was accumulated and shipped off site for disposal at permitted disposal facilities.[32]

TTR pollution prevention and waste minimization activities include programs to recycle and recover materials such as antifreeze, Freon®, solvents, electronic components, oil, batteries, fluorescent and sodium bulbs, and mercury-containing equipment. Antifreeze is recycled at an onsite unit, while Freon® is recovered at an onsite unit. Other materials were sent off site for recycling, as shown in Table 4–74.

Table 4–74 Tonopah Test Range Operations Hazardous Waste Disposed or Recycled, Calendar Years 2006–2008 (tons)

Waste Type	*Calendar Year*		
	2006	***2007***	***2008***
Hazardous waste	0.354	1.17	0.765
TSCA waste (asbestos/PCBs)	(a)	0.0353	(a)
Non-RCRA- or TSCA-regulated waste [b]	0.864	3.01	2.01
Recycled waste [c]	3.80	0.465	4.35

PCB = polychlorinated biphenyl; RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act.
Note: Data from the cited source were rounded to three significant figures.
[a] Not reported for this year.
[b] Includes liquids, medical wastes, and other toxic solids that are not regulated under RCRA or TSCA.
[c] Includes materials such as batteries, fluorescent lights, or electronic equipment that are regulated under RCRA or other statutory authorities and were shipped off site for recycling.
Source: Schade 2010.

Solid wastes from TTR operations disposed from 2006 through 2008 are summarized in **Table 4–75**. Construction debris and municipal solid waste may be disposed within TTR landfills operated by the USAF (see Table 4–75). Tires and scrap metal waste generated from cleanup of the TTR Salvage Yard were surveyed by radiation control technicians and disposed by shipment to the Apex Landfill near Las Vegas, Nevada. By disposing this waste at a commercial landfill, possible impacts on TTR or NNSS landfill capacity were avoided.

[32] *The TTR is a small-quantity generator of hazardous waste.*

Table 4–75 Tonopah Test Range Operations Solid Wastes Disposed, Calendar Years 2006–2008 (tons)

Waste Type	***Calendar Year***		
	2006	***2007***	***2008***
Tires and scrap metal	63 [a, b]	47.5 [b]	290.2 [b]
Construction debris	21.5	4.87 [c]	1.6 [c]
Sanitary solid waste	25.6	19.9 [c]	23.9 [c]

[a] Measured in cubic yards.
[b] Generated from cleanup of the TTR Salvage Yard. After being surveyed by radiation control technicians and cleared for release, the waste was shipped to the Apex Landfill near Las Vegas, Nevada, for disposal.
[c] The construction debris was disposed at the USAF Construction Landfill at the TTR, while the sanitary landfill waste was disposed at the USAF Sanitary Landfill at the TTR.
Source: DOE 2009a; SNL 2007, 2008.

Table 4–76 presents a summary of the environmental restoration waste generated at the TTR and disposed during CYs 2006 through 2008 (DOE 2009a; SNL 2007, 2008). During these years, TTR environmental restoration activities generated no RCRA- or TSCA-regulated wastes, nor any TRU or mixed wastes. In 2006, the TTR generated a small quantity of solid waste, consisting of personal protective equipment, such as paper and plastic, that was transferred to the NNSS for disposal. In addition, in 2005, closure activities for CAU 489 (World War II unexploded ordnance sites) generated 75.5 tons of scrap metal that in 2006 was transported to and disposed at the NNSS. In 2006 and 2007, the TTR disposed materials consisting of unexploded ordnance and debris from an Honest John M-50 rocket. During these years, depleted uranium recovered from the rocket was disposed at the NNSS as LLW and included debris and soil, personal protective equipment, and some material from the rocket. In 2007, 17 tons of inert unexploded ordnance and metal debris were disposed by the USAF (6 tons of inert unexploded ordnance) or shipped to and disposed at a Nevada Test and Training Range unexploded ordnance pile (11 tons of metal debris). Also in 2007, three metal structures were dismantled, and the metal scrap (10.5 tons) was shipped to the NNSS Area 3 Sandia salvage yard for reuse or recycle.

In 2008, environmental restoration activities were focused on planning activities for CAU 408 (Bomblet Target Area) and a sampling effort on Main Lake. The sampling effort on Main Lake was conducted to support characterization of approximately 40 soil-filled plastic bags that were ultimately disposed as sanitary solid waste. In 2008, however, the TTR generated 24 tons of hydrocarbon-contaminated soil that was shipped off site for disposal at the NNSS hydrocarbon landfill in Area 6.

Table 4–76 Environmental Restoration Wastes Disposed or Recycled, Calendar Years 2006–2008 (tons)

Waste Type	***Calendar Year***		
	2006	***2007***	***2008***
Scrap metal	75.5	(a)	(a)
Inert UXO and metal rocket debris	142	17.0	(a)
Nonradioactive solid waste	0.244 [c]	(a)	(b)
Recycled metal debris	(a)	10.5	(a)
Hydrocarbon-contaminated soil	(a)	(a)	24.0
Low-level radioactive waste (DU-contaminated)	742	407	(a)

DU = depleted uranium; UXO = unexploded ordnance.
[a] Not reported for this year.
[b] This material consisted of approximately 40 bags of soil that were sampled and ultimately disposed as sanitary solid waste.
[c] Consists of nonimpacted personal protective equipment (plastic, paper, Tyvek®, gloves, etc.) transported to the NNSS for disposal.
Source: DOE 2009a; SNL 2007, 2008.

Landfills

At the TTR, the USAF operates a landfill for disposal of construction debris, as well as an expanded Class II sanitary landfill for disposal of municipal solid waste (DOE 2009a). The original sanitary landfill was transferred from DOE to USAF operation in 1992, and was recently expanded. The landfill is authorized to receive no more than 20 tons of municipal solid waste per day, and is projected to have a total license expectancy of 30 years (USAF 2007a).

4.4.12 Human Health and Safety

The health and safety of the general public and workers at the TTR are discussed in this section. Environmental health risks from TTR activities include the effects of environmental noise and acute and chronic exposures to ionizing radiation and hazardous chemicals. Regular programs are administered to monitor releases and evaluate associated potential health impacts. Additionally, studies have been conducted to assess the exposure pathways and potential risks of radionuclide and toxic chemical releases during past TTR operations. These studies focused on the impacts of releases in terms of health risks to the general public and workers at the TTR. Results of current assessments and historic studies indicate (1) there is little risk of enhanced carcinogenesis due to radionuclide and chemical releases during site operations; (2) exposures to site radionuclide releases tend to be far lower than those due to natural background radiation; and (3) chemical exposures are well within established guidelines. In keeping with the goal of optimal protection of vulnerable populations, DOE maintains a Comprehensive Emergency Management Program that features hazard-specific plans, procedures, and controls (DOE Order 151.1C).

4.4.12.1 Public Radiation Exposure and Safety

4.4.12.1.1 General Site Description

Major sources of background radiation and average doses from background radiation exposure to individuals in the TTR vicinity are the same as those for the NNSS (see Table 4–51). The average annual dose from background radiation is approximately 670 millirem. About half of the annual dose is from ubiquitous, natural background sources (355 millirem) that can vary depending on geographic location, individual buildings in a geographic area, and age, but essentially all comes from space or naturally occurring sources in the Earth. About half of the dose is from medical exposure to radiation (300 millirem), including computed tomography, interventional fluoroscopy, x-rays and conventional fluoroscopy, and nuclear medicine (use of unsealed radionuclides for diagnosis and treatment). Another approximately 14 millirem per year are from consumer products and other sources (nuclear power, security, research, and occupational exposure) (NCRP 2009). Average annual background radiation doses to individuals are expected to remain fairly constant over the time period of the proposed actions. Background radiation doses identified in Table 4–51 are unrelated to TTR operations.

Releases of radionuclides to the environment from TTR operations provide another source of radiation exposure to individuals in the vicinity of the TTR. The only sources of radionuclide emissions from the TTR consist of the resuspension of plutonium and americium from past test activities. (SAND2009-4774P). Doses to the public estimated from historic monitoring at the TTR are presented in **Table 4–77**. These doses fall within the limits established in DOE Order 5400.5 and are much lower than those due to background radiation.

Table 4–77 Radiation Doses to the Public from Tonopah Test Range Operations in 2008 (Total Effective Dose Equivalent)

Members of the Public	***Atmospheric Releases*** [a]	***Liquid Releases*** [b]	***Total*** [c]
Maximally exposed individual (millirem)	0.024	0	0.024
Population within 50 miles (person-rem) [d]	<1	0	<1
Average individual within 50 miles (millirem) [e]	<0.024	0	<0.024

rem = roentgen equivalent man.

[a] DOE Order 5400.5 and Clean Air Act regulations in 40 CFR Part 61, Subpart H, establish a compliance limit of 10 millirem per year to a maximally exposed individual.

[b] There is no dose to the public from surface-water or groundwater pathways.

[c] DOE Order 5400.5 establishes a dose limit of 100 millirem per year to individual members of the public exposed through all pathways.

[d] A population dose was not reported in the *Calendar Year 2008 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii* (SAND2009-4774P). The estimated population within 50 miles of the Tonopah Test Range was only about 5,000 in the year 2008; if every member of that population received the same dose as the Tonopah Test Range maximally exposed individual, the population dose would be much less than 1 person-rem.

[e] The dose to the maximally exposed individual was based on an exposure location at the Tonopah Test Range Airport. Members of the population are further away from the sources of airborne radioactive material and are exposed to lower concentrations; therefore, the average dose to an individual of the 50-mile population is significantly lower than that to the maximally exposed individual.

Source: SAND2009-4774P; SANDNESHAP 2008.

Using a risk coefficient of 600 cancer deaths per 1 million person-rem (0.0006 LCFs per person-rem) (DOE 2003c), the risk of an LCF to the MEI due to radionuclide releases from TTR operations in 2008 was estimated to be 1.4×10^{-8}. That is, the probability of this person dying of cancer at some time in the future as a result of a radiation dose associated with emissions from 1 year of TTR operations is about 1 in 70 million. The hypothetical MEI is a person whose place of residence and lifestyle make it unlikely that any other member of the public would receive a higher radiation dose from TTR releases. This person was assumed to be exposed to radionuclides in the air and on the ground from TTR emissions and was assumed to be located at the Tonopah Test Range Airport (SAND2009-4774P).

No members of the public receive direct gamma radiation exposure that is above background levels as a result of past or present TTR operations. Gamma radiation exposure rates measured at areas accessible to the public are comparable to natural background rates from cosmic and terrestrial radiation. Radioactively contaminated areas at the TTR are isolated from members of the public, given the considerable distances between these areas and the TTR boundary.

In regard to groundwater monitoring programs, there is no TTR radiation dose incurred by the public from the groundwater pathway. Annual monitoring indicates that no contaminated groundwater has migrated beyond the TTR boundary into surrounding water supplies used by the public (SAND2009-4774P).

Operations at the TTR do not involve activities that release radioactive emissions from either point sources (stacks/vents) or diffuse sources (outdoor testing). However, diffuse radioactive emissions are produced from the resuspension of americium and plutonium present at sites of previous testing activities. Other locations at the TTR with minor radioactive contamination, such as depleted uranium, are not significant sources of radioactive air emissions from resuspension (SAND2009-4774P).

4.4.12.2 Occupational Radiation Exposure and Safety

Workers at the TTR receive the same dose as the general public from background radiation, but they potentially receive an additional dose from working in or around areas with radioactive material. No worker dose data has been reported since the year 2002, and no workers received a measurable dose between 1998 and 2002. The average annual worker dose measured between 1991 and 2002 was 12 millirem (REMS-112909).

Worker occupational risks at the TTR are generally associated with activities such as waste management, environmental restoration, terrestrial surveillance, and environmental monitoring. DOE's Computerized Accident/Incident Reporting System provides statistics on worker injury and illness information, including accidents involving government-owned vehicles. There were no reportable occurrences in 2008 at the TTR. A reportable occurrence is defined as an unanticipated event that leads to a near-miss, injury, or death of an occupational worker.

4.4.12.3 Chemical Exposure and Risk

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media, through which people may come in contact with hazardous chemicals. Hazardous chemicals can cause cancer and non-cancer-related health effects.

Because of the TTR's remote location and large size, there is no risk of chemical exposure to the surrounding public population resulting from normal site operations. Nevertheless, monitoring efforts and baseline studies are regularly performed. However, certain TTR workers may be at risk to chemical exposure depending upon their job function and proximity to various sources.

Common sources of chemical pollutants and RCRA materials at the TTR include solvents, fuels and oil, pesticides, septic sludge, heavy metals, various munitions materiel, lead-acid batteries, and mercury-containing items. Particulate matter from the TTR portable screen and the TTR maintenance shops (which include painting, welding, and carpentry activities) was released in limited quantities in 2008. The portable screen was operated for 220 hours during 2008 and contributed 0.01 tons of particulate matter emissions. Maintenance shops operated for 282 hours or less in 2008 and contributed less than 0.2 tons of emissions (from particulate matter, hazardous air pollutants, and volatile organic compounds) in total (SAND2009-4774P).

As for monitoring potential chemicals released to TTR drinking water and wastewater systems, a single well (Well 6) supplies the drinking water needs to TTR workers and visitors, and is monitored annually for potability and purity. Water samples from this well continue to meet all national primary and secondary drinking water standards. In addition, the TTR sewage lagoon systems are tested for biochemical oxygen demand, pH, and total suspended solids, as well as for a suite of toxic chemicals. In the two most recent years for which results have been reported, all wastewater measurements were found to be within permit limits (DOE 2009a; SNL 2010b).

To manage risks from handling toxic or hazardous chemicals, TTR worker safety programs are established to comply with Federal and state laws, DOE orders, Occupational Safety and Health Administration requirements, and EPA guidelines. Sandia National Laboratories plans and procedures for performing work ensure worker protection through training, monitoring, use of personal protective equipment, and administrative controls. Although chemical inventories have varied to a limited extent over recent years, administrative controls continually ensure that quantities do not approach levels that pose undue risk due to storage, concentration, bulk quantity, or logistical factors. Any amounts that potentially exceed threshold planning quantities require reporting under Federal regulations.

4.4.12.4 Health Effects Studies

To date, apart from the NNSS-related studies described in Section 4.1.12.4, no studies have analyzed potential epidemiological effects resulting from past TTR operations. There are no studies that indicate adverse health effects in populations near the TTR as a result of activities or operations supporting current TTR missions.

4.4.12.5 Accident History

The only significant incident on record to have occurred at the TTR in recent years is the following: Five USAF personnel were killed when a Beechcraft 1900C crashed at the Tonopah Test Range Airport. It was determined that the incident was due to the pilot undergoing cardiac arrest during landing maneuvers (ASN 2004).

4.4.12.6 Emergency Preparedness

Each DOE site has established an Emergency Management Program, developed in accordance with a DOE order, that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The Emergency Management Program incorporates activities associated with emergency planning, preparedness, and response. The TTR Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public. The plan integrates all emergency planning into a single entity to minimize overlap and duplication and to ensure proper responses to emergencies not covered by a plan or directive. The manager of NNSA has the responsibility to manage, counter, and recover from an emergency occurring at the TTR.

The plan provides for identification and notification of personnel for any emergency that may develop during operational and nonoperational hours. NNSA receives warnings, weather advisories, and any other communications that provide advance warning of a possible emergency. The plan is based upon current NNSA vulnerability assessments, resources, and capabilities regarding emergency preparedness.

4.4.12.7 Environmental Noise

The acoustic environment adjacent to the TTR is similar to that described for land areas adjacent to the NNSS. The nearest residents are located in the towns of Goldfield, approximately 22 miles west of the site boundary, and Tonopah, approximately 30 miles northwest of the site. The main sources of noise at the TTR include air- and ground-launched rockets, gun firing, and explosives experiments. An airbase is located within the TTR in support of Nevada Test and Training Range activities. Because of access restrictions and lack of a nearby population, public exposure to these noise sources is limited to occasional sonic booms produced by supersonic overflights of military aircraft. Principal sources of noise to residents of nearby towns include vehicular traffic on U.S. Routes 6 and 95 and aircraft operations.

4.4.13 Environmental Justice

There are no block groups in Nye County (the county the TTR is located within) with minority populations greater than 50 percent. Within the ROI, the closest block group to the NNSS with a minority population greater than 50 percent is more than 60 miles to the southeast of the TTR, near the southeastern corner of the NNSS (see **Figure 4–28**). Additional block groups with minority populations greater than 50 percent are found further to the southeast in the Las Vegas metropolitan area, closer to the RSL and NLVF facilities (see Sections 4.2.13 and 4.3.13).

4.5 Former Yucca Mountain Site Affected Environment

DOE analyzed a proposed action to construct, operate, monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain in Nye County, Nevada, in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (Yucca Mountain EIS) (DOE/EIS-0250F)* (DOE 2002e), and in the *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250F-S1) (DOE 2008g). The area evaluated for the repository is an approximately 150,000-acre area of land that comprises land administered by DOE (79,000 acres of the NNSS); the USAF (24,000 acres of the Nevada Test and Training Range); and BLM (44,000 acres), as well as private land (a 200-acre Cind-R-Lite Patented Mining Claim). The Nevada Test and Training Range is closed to public access and use. The BLM-administered land outside of the Nevada Test and Training Range is open to public use, with the exception of approximately 4,250 acres. A number of unpatented mining claims are located on the BLM land.

The area evaluated for the repository is in the southern part of the Great Basin, which is characterized by generally north-trending, linear mountain ranges separated by intervening valleys or basins. Within this setting, Yucca Mountain is part of the southwestern Nevada volcanic field, a volcanic plateau that formed between about 14 and 11.5 million years ago. Yucca Mountain is a product of both volcanic activity and faulting. The crest of Yucca Mountain reaches elevations from 4,900 feet to 6,300 feet above sea level. Crater Flat is located on the BLM-administered land to the west of Yucca Mountain and contains four prominent volcanic cinder cones.

Thirty-six species of mammals have been recorded in and around Yucca Mountain. None of these mammals are classified as threatened or endangered by the USFWS. Twenty-seven species of reptiles have been found at and near Yucca Mountain. The desert tortoise (*Gopherus agassizii*) is listed as threatened under the Endangered Species Act. Yucca Mountain is at the northern edge of the range of the desert tortoise. The western chuckwalla (*Sauromalus obesus*) and the western red-tailed skink (*Eumeces gilberti rubricaudatus*) are classified as sensitive species in Nevada by BLM. More than 120 species of birds have been recorded at Yucca Mountain and the surrounding region, including 15 species of raptors. Several bird species are classified as sensitive species in Nevada by BLM. Native plants at Yucca Mountain below an elevation of about 4,000 feet are typical of the Mojave Desert. Above 4,000 feet is a vegetation transition zone between the Mojave Desert and the colder Great Basin Desert. About 30 invasive, nonnative plant species also occur in the Yucca Mountain region.

There are no perennial streams, natural bodies of water, or naturally occurring wetlands in the area evaluated. Solitario Canyon Wash collects drainage from the west side of Yucca Mountain and runs through the Nevada Test and Training Range and BLM-administered lands. Drill Hole Wash and Busted Butte (Dune) Wash collect drainage from the east side of Yucca Mountain and drain into Fortymile Wash on the NNSS. Fortymile Wash drains to the south. The washes only carry water during intense rain and rapid snowmelt. These washes drain into the ephemeral Amargosa River, which terminates in the Badwater Basin in Death Valley.

More than 530 archaeological sites and over 550 isolated artifacts have been discovered at or near Yucca Mountain. Collectively, they indicate that the Yucca Mountain region has been occupied by American Indian populations for at least 12,000 years. According to American Indians, the Yucca Mountain area is part of the holy lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people.

BLM assigns visual resource values to the lands it manages on a scale of Class I to Class IV, with Class IV representative of the lowest visual values. DOE has previously determined that the lands to the west and south of Yucca Mountain, which are visible from portions of U.S. Route 95, are Class III and Class IV lands, which are common to the region.

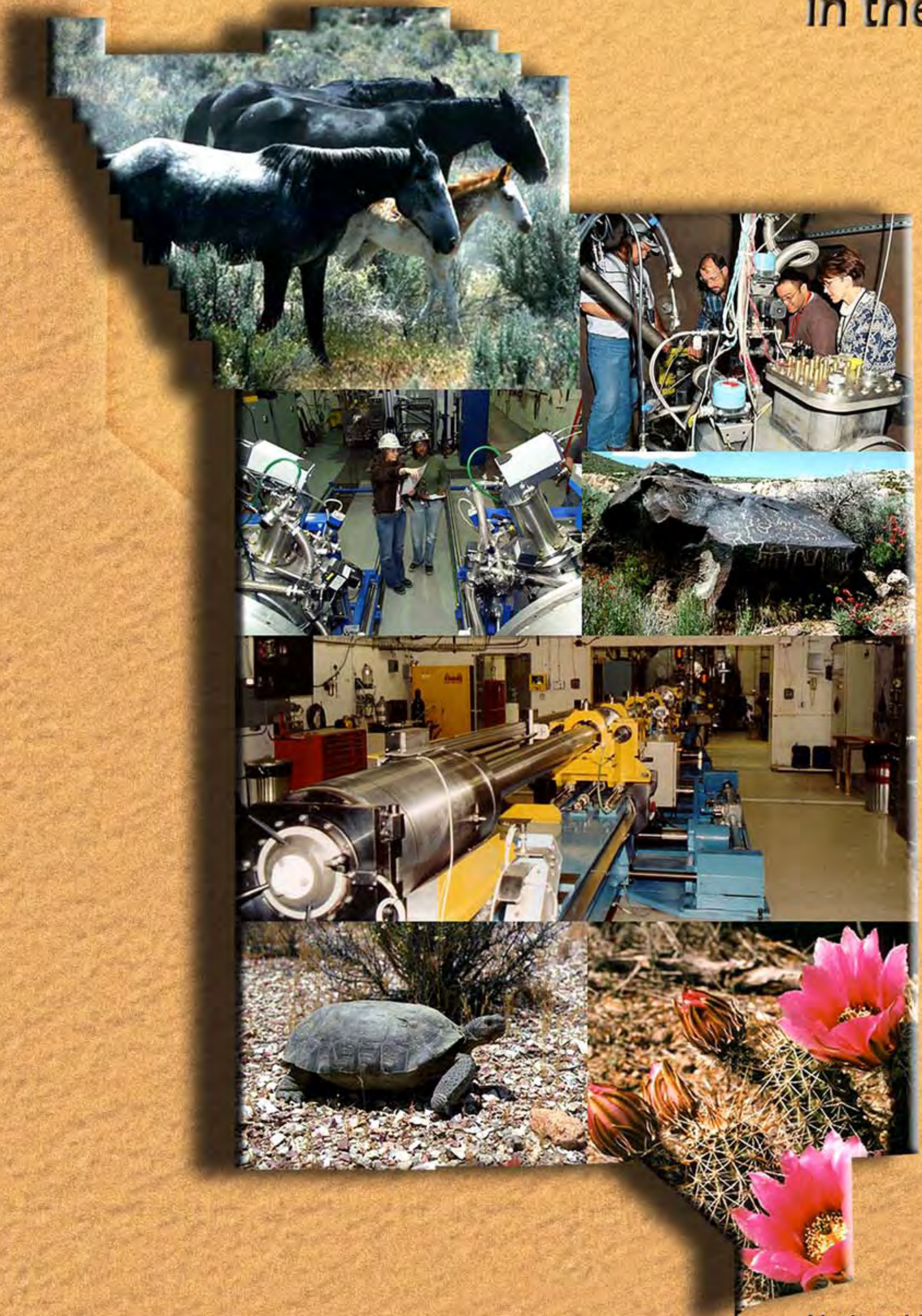
The air quality in the area is characterized as unclassifiable due to limited air quality data. However, data collected by DOE indicate that the air quality is within applicable NAAQS.

DOE/EIS-0426D

Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada

Volume 1, Book 2

(Chapters 5 through 15)



U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

Availability of the Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/ National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)

For further information on this draft SWEIS, or to request a copy of the SWEIS or references, please contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518
Telephone: 702-295-0077
Fax: 702-295-5300
E-mail: nepa@nv.doe.gov

Printed with soy ink on recycled paper

COVER SHEET

Responsible Agency: U.S. Department of Energy/National Nuclear Security Administration

Cooperating Agencies: U.S. Air Force
U.S. Department of the Interior, Bureau of Land Management
Nye County, NV

Title: *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE/EIS-0426D)

Location: Nye and Clark Counties, Nevada

For additional information or for copies of this draft site-wide environmental impact statement (SWEIS), contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518

Telephone: 702-295-0077
Facsimile: 702-295-5300
E-mail: nepa@nv.doe.gov

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Telephone: 202-586-4600, or leave a message at 1-800-472-2756
Facsimile: 202-586-7031
E-mail: askNEPA@hq.doe.gov

Abstract: This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes the potential environmental impacts of proposed alternatives for continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA)-managed sites in Nevada, including the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration areas on the U.S. Air Force Nevada Test and Training Range. The purpose and need for agency action is to provide support for meeting NNSA's core missions established by Congress and the President, and to satisfy the requirements of Executive orders and comply with congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since the October 1992 moratorium on nuclear testing, NNSA's primary mission at the NNSS has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests, if so directed by the President. Resources have been reallocated to introduce and expand other mission activities/programs at the NNSS, RSL, NLVF, and the TTR to support three DOE/NNSA core missions: National Security/Defense, Environmental Management, and Nondefense. The National Security/Defense Mission includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation and Counterterrorism, and Work for Others

Programs. The Work for Others Program supports other DOE programs and Federal agencies such as the U.S. Department of Defense, U.S. Department of Justice, and U.S. Department of Homeland Security. The Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. The Nondefense Mission includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The NNSS, RSL, NLVF, and the TTR support DOE/NNSA's core missions by providing the capabilities to process and dispose of a damaged nuclear weapon or improvised nuclear device and to conduct high-hazard experiments involving special nuclear material and high explosives, non-nuclear experiments, and hydrodynamic testing. Nuclear stockpile stewardship activities at the NNSS include dynamic plutonium experiments that provide technical information to maintain the safety and reliability of the U.S. nuclear weapons stockpile and research and training in areas such as nuclear safeguards, criticality safety, and emergency response. Special Nuclear Materials are also stored at the NNSS. In addition, in accordance with the amended Record of Decision (ROD) (DOE/EIS-0243) for the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS*) , NNSA receives low-level and mixed low-level radioactive waste for disposal at the NNSS.

This *NNSS SWEIS* analyzes the environmental impacts of three reasonable alternatives for continued operations at the NNSS, RSL, NLVF, and the TTR during the 10-year period following the issuance of a ROD. These alternatives include a No Action Alternative and two action alternatives: Expanded Operations and Reduced Operations. The No Action Alternative, which is analyzed as a baseline for evaluating the two action alternatives, would continue implementation of the *1996 NTS EIS* ROD (DOE/EIS-0243) and subsequent amendments (61 FR 65551and 65 FR 10061), as well as other decisions supported by separate NEPA analyses completed since issuance of the final *1996 NTS EIS*. The No Action Alternative reflects activity levels consistent with those seen since 1996. The Expanded Operations Alternative would consider adding reasonably foreseeable new work at the NNSS in the areas of nonproliferation and counterterrorism, high-hazard and other experiments, research and development and testing. Such expanded operations could include developing test beds for concept testing of sensors, mitigation strategies, and weapons effectiveness. The Reduced Operations Alternative would reduce the overall level of operations and close specific buildings and structures. NNSA would also consider allowing the development of solar power generation facilities under each alternative.

Public Comments: DOE issued a Notice of Intent (NOI) in the *Federal Register* (74 FR 36691) on July 24, 2009, to solicit public input on the preparation of this Draft SWEIS. Comments received from the public during the scoping period (July 24, 2009 to October 16, 2009) have been considered in the preparation of this Draft SWEIS. Comments received after the close of the comment period also have been considered. Comments on this Draft SWEIS will be accepted following publication of the U.S. Environmental Protection Agency's Notice of Availability (NOA) in the *Federal Register* for a period of 90 days, and will be considered in the preparation of the Final SWEIS. Any comments received after the comment period will be considered to the extent practicable. Public meetings and locations will be identified at a later date.

TABLE OF CONTENTS

TABLE OF CONTENTS

Volume 1, Book 2
(Chapters 5 through 15)

Chapter 3
Description of Alternatives

Chapter 4
Affected Environments

Chapter 5
Environmental Consequences

Chapter 6
Cumulative Impacts

Chapter 7
Mitigation Measures

Chapter 8
Resource Commitments

Chapter 9
Laws, Regulations, and Permits

LIST OF FIGURES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

LIST OF TABLES

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACEC	Area of Critical Environmental Concern
AEA	Atomic Energy Act
AFVs	Alternate Fuel Vehicles
AIWS	American Indian Writers Subgroup
ALARA	as low as is reasonably achievable
AMS	Aerial Measuring System
ARG	Accident Response Group
ASSESS	Analytical System and Software for Evaluating Safeguards and Security
ATLAS	Adversary Time-Line Analysis System
BEEF	Big Explosives Experimental Facility
BLM	Bureau of Land Management
BMP	best management practice
BRAC	Base Realignment and Closure
CAA	Clean Air Act
CAPP	Chemical Accident Prevention Program
CARE	Communities Against a Radioactive Environment
CAU	corrective action unit
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CGTO	Consolidated Group of Tribes and Organizations
CSP	Concentrated Solar Power
CY	calendar year
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DAQEM	Department of Air Quality and Environmental Management
DARE	Drug Abuse Resistance Education
DART	days away from work, restricted work, or job transfer
dBA	decibels A-weighted
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/NNSA	U.S. Department of Energy/National Nuclear Security Administration
DOE/NV	DOE Nevada Operations Office
DOT	U.S. Department of Transportation
DTRA	Defense Threat Reduction Agency
DU	depleted uranium
EA	Environmental Assessment
EERE	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
EIS	environmental impact statement
EMAC	Ecological Monitoring and Compliance

E-MAD	Engine Maintenance, Assembly, and Disassembly
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERPG	Emergency Response Planning Guideline
ETDS	E-Tunnel Waste Water Disposal System
ExperRT	Expeditionary Readiness Training
FAA	Federal Aviation Administration
FACE	Free-Air Carbon Dioxide Enrichment
FBI	Federal Bureau of Investigation
FFACO	Federal Facilities Agreement and Consent Order
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FTE	full-time equivalent
FY	fiscal year
GBUAPCD	Great Basin Unified Air pollution Control District
GCD	greater confinement disposal
GHG	greenhouse gas
gpd	gallons per day
GTCC	greater-than-Class C [waste]
GWP	global warming potential
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
HAP	hazardous air pollutant
HAZMAT	hazardous materials
HLW	high-level radioactive waste
INL	Idaho National Laboratory
ISO	International Organization for Standardization
JASPER	Joint Actinide Shock Physics Experimental Research
JCATS	Joint Conflict and Tactical Simulations
KLF	Kistler Launch Facility
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LCF	latent cancer fatality
LLW	low-level radioactive waste
LOS	level of service
LTHMP	Long-Term Hydrological Monitoring Program
M-2	general industrial district in North Las Vegas
MCL	maximum contaminant level
MEI	maximally exposed individual
MGCF	Mojave Global Change Facility
MGD	million gallons per day
MLLW	mixed low-level radioactive waste
MSHCP	Multi-Species Habitat Conservation Plan

NAAQS	National Ambient Air Quality Standards
NAC	*Nevada Administrative Code*
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act of 1969
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NEST	nuclear emergency support team
NHPA	National Historic Preservation Act
NLVF	North Las Vegas Facility
NNSA	National Nuclear Security Administration
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NOI	Notice of Intent
NPDES	National Pollutant discharge Elimination System
NPS	National Park Service
NPTEC	Nonproliferation Test and Evaluation Complex
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NSO	Nevada Site Office
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
NV	Nevada
NWRPO	Nuclear Waste Repository Project Office
Opinion	Biological Opinion
OSHA	Occupational Safety and Health Act
OST	Office of Secure Transportation
P.L.	Public Law
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
pH	a measure of acidity or basicity
PM_n	particulate matter with an aerodynamic diameter less than or equal to $_n$ micrometers
PSD	Prevention of Significant Deterioration
PWS	public water system
QAPP	Quality Assurance Program Plan
rad	radiation absorbed dose
RADTRAN	Radioactive Material Transportation Risk Assessment Code 6
RAP	Radiological Assistance Program
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RIMS II	Regional Input-Output Modeling System II
RISKIND	Risks and Consequences of Radioactive Material Transport computer code
RNCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
ROD	Record of Decision

ROI	region of influence
RREM	Routine Radiological Environmental Monitoring
RSL	Remote Sensing Laboratory
RTG	radioisotope thermoelectric generator
RWAP	Radioactive Waste Acceptance Program
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SA	Supplement Analysis
SARA	Superfund Amendments and Reauthorization Act
SNF	spent nuclear fuel
SNM	special nuclear materials
SNWA	Southern Nevada Water Authority
SPA	Specific Planning Area
SPEIS	supplemental programmatic environmental impact statement
SSO	Sandia Site Office
SWAT	special weapons and tactics
SWEIS	site-wide environmental impact statement
TNT	2,4,6-trinitrotoluene
TRAGIS	Transportation Routing Analysis Geographic Information System
TRC	total recordable cases
TRU	transuranic waste
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TTR	Tonopah Test Range
TRUPACT	Transuranic Package Transporter
TYSP	Ten-Year Site Plan
UGTA	Underground Test Area
UIC	underground injection control
USAF	United States Air Force
U.S.C.	*United States Code*
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
WIPP	Waste Isolation Pilot Plant
ZPPR	zero power plutonium reactor
ºC	degrees Centigrade
ºF	degrees Fahrenheit
μS	microsiemens

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.315	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

CHAPTER 5
ENVIRONMENTAL CONSEQUENCES

5.0 ENVIRONMENTAL CONSEQUENCES

This chapter provides the scientific and analytical basis for the comparison of the alternatives identified in this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*. This discussion addresses the potential direct and indirect effects of each of the alternatives. Within this chapter, the analysis is organized based on the following geographic sites covered within this site-wide environmental impact statement (SWEIS): the Nevada National Security Site (NNSS); the Remote Sensing Laboratory (RSL) at Nellis Air Force Base; the North Las Vegas Facility (NLVF); and the Tonopah Test Range (TTR). For each geographic site, potential environmental consequences are then addressed for the following environmental resource areas:

- Land Use
- Infrastructure and Energy
- Transportation
- Socioeconomics
- Geology and Soils
- Hydrology
- Biological Resources
- Air Quality and Climate
- Visual Resources
- Cultural Resources
- Waste Management
- Human Health
- Environmental Justice

Within each environmental resource area, this SWEIS analyzes the potential environmental consequences associated with the three alternatives (No Action, Reduced Operations, and Expanded Operations) identified in Chapter 3 of this SWEIS. Under each alternative, the potential environmental consequences are also described in relation to the three major missions (National Security/Defense, Environmental Management, and Nondefense) described in Chapter 3 of this SWEIS. For some environmental resource areas, additional technical information used to support the analysis is contained in separate appendices. A summary comparison of the mission-based program activities under each of the proposed alternatives is presented in Chapter 3, Table 3–1, of this SWEIS. Section 5.5, Aggregated Environmental Consequences, provides the combined impacts of all four NNSA sites in Nevada for certain resource areas.

Throughout this chapter, the perspectives of American Indian tribes and groups regarding the environmental consequences of U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) activities in Nevada are summarized in shaded and marked text boxes identified with a Consolidated Tribes and Organization (CGTO) feather icon. The full text of American Indian perspectives is contained in Appendix C of this SWEIS, which was prepared by the American Indian Writers Subgroup of the CGTO.

The impact analysis for this SWEIS is based on the best data available, considering current environmental conditions, activities, and facilities. For ongoing activities and existing facilities, DOE/NNSA has applied available data and project parameters to support quantitative analyses. However, this SWEIS also addresses a range of reasonably foreseeable projects and activities that may be developed or undertaken over the next 10 years, although several projects and ensuing activities are in the early phases of proposal development. For these proposals, conservative assumptions regarding the location and scale of future projects and activities were made to provide a basis for programmatic analysis. As the planning processes for future projects are refined, more detailed information will become available to DOE/NNSA. This SWEIS will then serve as a baseline document for the preparation of subsequent, tiered National Environmental Policy Act (NEPA) documents for specific projects.

In this SWEIS, NNSA analyzed potential environmental impacts resulting from proposed activities that are reasonably foreseeable (i.e., the activities that may occur within a 10-year planning window), including long-term as well as short-term effects. The durations of impacts vary for individual resource areas, and are dependent upon whether the impacts are due to construction activities, which typically would last no more than a few years, from the operation of facilities, which would last for many years, or from actions for which impacts could last for hundreds of years or longer. For some resource areas, such as biological and cultural resources, potential impacts are primarily dependent on the amount of newly disturbed land that would occur from changes to ongoing or proposed projects and activities; these impacts would occur "one time" and not change over time. For other resource areas, such as air quality, potential impacts are dependent primarily on the duration of project construction in the short term, and the level of operations in the longer term; such longer term impacts would occur on an annual basis, and continue for as long as these projects and activities continue. Although some activities may eventually cease, such as disposal of low-level radioactive waste (LLW), potential impacts would not appear for many decades, but would then last for hundreds or thousands of years. The presentation of potential environmental impacts in this *NNSS SWEIS* reflects these durations for each resource area, as appropriate.

In 2008, NNSA estimated that approximately 80,000 acres (9 percent) of NNSS land has been disturbed. **Table 5–1** shows the potential amount of additional land disturbance that would result under each of the three alternatives addressed in this SWEIS. Under each alternative in the table, areas of potential land disturbances are noted by mission area, program, and activity. The data used to develop the table were derived from the descriptions in Chapter 3; these data include disturbances associated with ongoing and proposed activities that were used as a basis for an adequate NEPA analysis as well as disturbances associated with potential activities that are less well developed at this time. In addition, all of these potential land disturbances are assumed to affect previously undisturbed land; however, in some cases, lands that are currently disturbed would be used for proposed and potential activities. For these reasons, the land disturbance areas displayed in Table 5–1 provide one of the bases for a conservative analysis of potential impacts.

Table 5–1 Potential Area of Land Disturbance at the Nevada National Security Site for Each Mission Area, Program, and Activity by Alternative [a]

Project or Activity	*Number of "Events" Over 10 Years* [b]	*Disturbance per "Event"* [c] *(acres)*	*Disturbance by Project or Activity* [d] *(acres)*	*Total Disturbance by Program* [e] *(acres)*	*Total Disturbance by Mission and Alternative* [f] *(acres)*
NO ACTION ALTERNATIVE					
NATIONAL SECURITY/DEFENSE MISSION					
Stockpile Stewardship and Management Program					
Dynamic Experiments in Boreholes	5	20	100		
Explosive Experiments	100	5	500		
Drillback Operations	5	5	25		
OST Training and Exercises [g]	60	1	60		
Total Stockpile Stewardship and Management Program				685	
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs					
Releases of Chemicals and Biological Simulants	15	1	15		
Total Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs				15	
Work for Others Program					
Total Work for Others Program				0	
TOTAL NATIONAL SECURITY/DEFENSE MISSION					**700**
ENVIRONMENTAL MANAGEMENT MISSION					
Waste Management Program					
Area 5 RWMC	1	190	190		
Total Waste Management Program				190	
Environmental Restoration Program					
UGTA Characterization and Monitoring Wells [h]	50	10	500		
Soils Projects [i]	1	420	420		
Total Environmental Restoration Program				920	
TOTAL ENVIRONMENTAL MANAGEMENT MISSION					**1,110**

Project or Activity	*Number of "Events" Over 10 Years* [b]	*Disturbance per "Event"* [c] *(acres)*	*Disturbance by Project or Activity* [d] *(acres)*	*Total Disturbance by Program* [e] *(acres)*	*Total Disturbance by Mission and Alternative* [f] *(acres)*
NONDEFENSE MISSION					
General Site Support and Infrastructure Program					
Total General Site Support and Infrastructure Program				0	
Conservation and Renewable Energy Program					
Total Conservation and Renewable Energy Program				0	
TOTAL NONDEFENSE MISSION					**0**
TOTAL NO ACTION: DOE/NNSA					**1,810**
Commercial/Demonstration					
Commercial 240-Megawatt Solar Power Generation Facility [j]	1	2,650	2,650		
Total Commercial/Demonstration				2,650	
TOTAL NO ACTION					**4,460**
EXPANDED OPERATIONS ALTERNATIVE					
NATIONAL SECURITY/DEFENSE MISSION					
Stockpile Stewardship and Management Program					
Dynamic Experiments in Boreholes	5	20	100		
Explosives Experiments	500	5	2,500		
Depleted Uranium Experiment Sites	3	40	120		
Drillback Operations	5	5	25		
OST Training and Exercises [g]	60	1	60		
OST Training Facility	1	10,000	10,000		
Total Stockpile Stewardship and Management Program				12,805	
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs					
Arms Control Treaty Verification Test Bed [k]	1	100	100		
Urban Warfare Complex [k]	1	100	100		
Releases of Chemicals and Biological Simulants	15	1	15		
Total Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs				215	
Work for Others Program					
IED Research and Defeat Facility [k]	1	75	75		
Miscellaneous Aviation Facilities	1	15	15		
Active Interrogation Facilities [k]	1	125	125		
Radioactive Tracer Experiments	1	20	20		

Project or Activity	*Number of "Events" Over 10 Years* [b]	*Disturbance per "Event"* [c] *(acres)*	*Disturbance by Project or Activity* [d] *(acres)*	*Total Disturbance by Program* [e] *(acres)*	*Total Disturbance by Mission and Alternative* [f] *(acres)*
Miscellaneous Test Bed Facilities [k]	1	200	200		
Total Work for Others Program				435	
TOTAL NATIONAL SECURITY/DEFENSE MISSION					**13,455**
ENVIRONMENTAL MANAGEMENT MISSION					
Waste Management Program					
Area 5 RWMC	1	600	600		
Sanitary Landfill Area 23	1	15	15		
Sanitary/D&D/Construction Waste Landfill Area 25	1	20	20		
Total Waste Management Program				635	
Environmental Restoration Programs					
UGTA Characterization and Monitoring Wells [h]	50	10	500		
Soils Project [i]	1	420	420		
Total Environmental Restoration Program				920	
TOTAL ENVIRONMENTAL MANAGEMENT MISSION					**1,555**
NONDEFENSE MISSION					
General Site Support and Infrastructure Program					
138-kilovolt Transmission Line Rebuild [l]	38.5 miles	12	467		
Total General Site Support and Infrastructure Program				467	
Conservation and Renewable Energy Program					
5- Megawatt Photovoltaic Solar Power Generation Facility, Area 6	1	50	50		
Total Conservation and Renewable Energy Program				50	
TOTAL NONDEFENSE MISSION					**517**
TOTAL DOE/NNSA					**15,527**
Commercial/Demonstration					
Commercial 1,000-Megawatt Solar Power Generation Facility(ies) [j]	1	10,300	10,300		
Geothermal Power System Demonstration Project	1	50	50		
Total Commercial/Demonstration				10,350	
TOTAL EXPANDED OPERATIONS					**25,877**

Project or Activity	Number of "Events" Over 10 Years [b]	Disturbance per "Event" [c] (acres)	Disturbance by Project or Activity [d] (acres)	Total Disturbance by Program [e] (acres)	Total Disturbance by Mission and Alternative [f] (acres)
REDUCED OPERATIONS ALTERNATIVE					
NATIONAL SECURITY/DEFENSE MISSION					
Stockpile Stewardship and Management Program					
Dynamic Experiments in Boreholes	5	20	100		
Explosives Experiments	50	5	250		
Drillback Operations	5	5	25		
OST Training and Exercises [g]	40	1	40		
Total Stockpile Stewardship and Management				415	
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs					
Releases of Chemicals and Biological Simulants	15	1	15		
Total Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs				15	
Work for Others Program					
Total Work for Others Program				0	
TOTAL NATIONAL SECURITY/DEFENSE MISSION					**430**
ENVIRONMENTAL MANAGEMENT MISSION					
Waste Management Program					
Area 5 RWMC	1	190	190		
Total Waste Management Program				190	
Environmental Restoration Program					
UGTA Characterization and Monitoring Wells [h]	50	10	500		
Soils Project [i]	1	420	420		
Total Environmental Restoration Program				920	
TOTAL ENVIRONMENTAL MANAGEMENT MISSION					**1,110**
NONDEFENSE MISSION					
General Site Support and Infrastructure Program					
Total General Site Support and Infrastructure Program				0	
Conservation and Renewable Energy Program					
Total Conservation and Renewable Energy Program				0	
TOTAL NONDEFENSE MISSION					**0**
TOTAL DOE/NNSA					**1,540**

Project or Activity	*Number of "Events" Over 10 Years* [b]	*Disturbance per "Event"* [c] *(acres)*	*Disturbance by Project or Activity* [d] *(acres)*	*Total Disturbance by Program* [e] *(acres)*	*Total Disturbance by Mission and Alternative* [f] *(acres)*
Commercial/Demonstration					
Commercial 100-Megawatt Solar Power Generation Facility [j]	1	1,200	1,200		
Total Commercial/Demonstration				1,200	
TOTAL REDUCED OPERATIONS					**2,740**

D&D = decontamination and decommission; IED = Improvised Explosive Device; OST = Office of Secure Transportation; RWMC = Radioactive Waste Management Complex; UGTA = Underground Test Area Project.

[a] This table includes potential projects and activities that could impact previously undisturbed land but excludes those, such as a new Security Building in Area 23 or Reconfiguration of Mercury, that NNSA is certain would be located in previously disturbed areas.

[b] Number of "Events" Over 10 Years is the estimated maximum number of times a proposed or potential project or activity would be conducted over the next 10 years or the number of facilities that would be developed for a type of activity.

[c] Disturbance per "Event" (acres) is the estimated area of land disturbance, in acres, resulting from a single occurrence of a proposed or potential project or activity.

[d] Total Disturbance by Activity equals Disturbance per "Event" × Disturbance per "Event" for a particular proposed project or activity.

[e] Total Disturbance by Program is the aggregated total of acres of potentially disturbed land in the Total Disturbance by Activity column for the specified program.

[f] Total Disturbance by Mission and Alternative is the aggregated total of acres of potentially disturbed land for all programs within a particular mission area and the cumulative total for a specified alternative.

[g] For OST exercises it is conservatively assumed that for each event 1 acre of land immediately adjacent to an existing road would be disturbed by overland vehicle movements

[h] UGTA characterization and monitoring wells would be located on the NNSS, Nevada Test and Training Range, and possibly on Bureau of Land Management (BLM) land and private property.

[i] Soils Project land disturbance includes sites on the NNSS and Nevada Test and Training Range (except for the TTR).

[j] The acres of disturbance for the commercial solar power generation facility(ies)under each alternative include estimated disturbance to construct the necessary electrical transmission lines to interconnect the facilities to the main transmission grid.

[k] These projects are included in the analysis on a "programmatic" level but additional NEPA analysis would be required as specific projects are developed beyond a conceptual stage.

[l] Disturbance for rebuilding the "backbone" electrical transmission line on the NNSS assumes 100 feet of disturbance along the entire 38.5 miles of the project.

5.1 Nevada National Security Site

The following sections describe the potential environmental consequences associated with the proposed alternatives in this SWEIS, as well as ongoing programs at the NNSS.

5.1.1 Land Use

Land use impacts are considered broadly in this SWEIS to include both land and airspace. The criteria used in this analysis of potential impacts on land use and airspace resources resulting from activities of DOE/NNSA in the State of Nevada are:

- Compatibility of proposed activities with existing land use and land use designations both on the NNSS and in the surrounding areas
- Availability of sufficient land within the appropriate land use zone for the proposed activities and facilities
- Compatibility of proposed airspace activities with existing airspace use and airspace classifications with both civilian and military airspace use
- Compatibility of proposed activities at RSL, NLVF, and the TTR with surrounding area land uses (determined by the evaluation of existing and future land use or resource management plans)

Impacts on land use were assessed by comparing the compatibility of proposed land uses with existing land uses, current and potential activities within the land use zone designations developed by the DOE/NNSA, and the assessment of land availability. Land use compatibility is defined here as the ability of two or more land uses to coexist without significant conflict. Examples of significant conflicts include interference of proposed activities with existing activities (including airspace activities); insufficient availability of facilities, infrastructure, and/or resources to safely accommodate a proposed activity; and activities resulting in human health and safety issues due to poor siting. Frequently, compatibility between land uses exists in varying degrees based on the frequency, duration, and intensity of a proposed activity. The land use zone designations preclude proposed activities from being located within a designated zone that would be incompatible with the current or proposed uses. However, an activity could be collocated within a land use zone that it is not normally associated with based on evaluation of its compatibility with nearby activities, including consideration of the availability of facilities and infrastructure, safety of personnel, and sensitive environments. Potential impacts on land use compatibility are based on qualitative assessments and, to the extent possible, quantitative assessments, of the range of activities that could occur under the three missions. Land disturbance within a given land use zone is not considered a land use impact under these criteria unless the disturbance results from a project that is incompatible with the land use designation. Impacts associated with land disturbance that affect resources such as soil, biological resources, and cultural resources, are presented in their respective resource impact sections in Chapter 5 of this SWEIS. The following subsections present analyses of the land use impacts under each alternative by mission and program.

Potential development of commercial solar power generation facilities in Area 25 of the NNSS is addressed at varying levels under all three alternatives in this *NNSS SWEIS*. There is no specific schedule for constructing a solar power generation facility at the NNSS, and the analysis of impacts in this *NNSS SWEIS* is included to enable DOE to make a decision about whether to make land and infrastructure now under DOE control available for another use by a commercial entity.

Impacts on the surrounding land uses near the NNSS, RSL, NLVF, and the TTR were evaluated by assessing existing and future land use and resource management plans to determine whether land uses at these NNSA site locations are compatible with the surrounding land uses. The primary land uses adjacent to the NNSS and the TTR include additional military training and exercises within the Nevada Test and Training Range lands, as well as grazing, mining, and recreation on the Bureau of Land Management (BLM)-managed lands. The assessment showed that NNSS operations would be compatible with surrounding land uses because NNSS activities would occur within appropriately designated land use zones and existing and proposed experiments and activities would be sited to prevent incompatibility with adjacent land uses. Land use at NLVF would be compatible with surrounding land use because no changes are proposed under any of the alternatives and NLVF is located within an area that is suitably zoned for NNSA's activities. As RSL is located on Nellis Air Force Base and any activities occurring at this facility would be compatible with the U.S. Air Force's (USAF) mission and would occur on land withdrawn for the purpose of military training and exercises, no impacts on surrounding land uses would occur. Therefore, discussion of the impacts of each alternative will focus on compatibility with NNSA land use designations.

Land Use—American Indian Perspective

During the evaluation of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*, the Consolidated Group of Tribes and Organizations (CGTO) noted repeated nuclear testing activities had resulted in severe disturbances to the land on large portions of the Nevada National Security Site (NNSS). This seemingly irreparable damage has made certain areas unfit for human use and inaccessible to American Indians who have relied on it for food, medicine, and ceremonies. Sedan Crater, for example, continues to be a dead site; the spirits of the site and resources on it were destroyed in 1962 and the loss can still be felt by members of the CGTO.

One elder from the Moapa Paiute Tribe in Nevada responded to the potential impacts of radioactive contamination of his traditional land as follows: *"You non-Indians can move if you pollute the land on which you live, but we were created for this place, so we must face whatever happens here. We cannot move and continue to be Paiute people – this is our land – we are this land"* (Stoffle and Arnold 2003). This view is shared by other culturally-affiliated tribes within the CGTO. The CGTO maintains we have Creation-based rights to protect, use, and have access to lands of the NNSS and the immediate area.

See Appendix C for more details.

Impacts on airspace were assessed by reviewing the existing airspace classifications and users within the region. Potential impacts on airspace are based on qualitative assessments of the range of potential activities under the three missions that could conflict with existing airspace classifications and existing airspace use. Accordingly, the only activities that would affect airspace would be defense-related. Therefore, only the National Security/Defense Mission is discussed and evaluated in this section for airspace impacts resulting from implementation of the alternatives.

The variety of NNSA programs requiring occasional flights of helicopters and fixed-wing aircraft carrying supplies and personnel would continue to occur under all three alternatives. The NNSS would continue to host the use of aerial platforms (airplanes and helicopters) for research and development, training, and exercises. The inherent constraints of the existing restricted airspace over the NNSS and Nevada Test and Training Range would continue to require nonparticipating civil and military aircraft to be routed around both sites, as necessary. NNSS use of airspace is contingent on joint-use status, operations in progress, and air traffic considerations. NNSA is required to coordinate scheduling of airspace activities through the Nellis Air Traffic Control Facility, which controls the movement of military aircraft in and out of restricted airspace. While the USAF does not own NNSS airspace, NNSS airspace is controlled by Nellis Air Force Base under agreement between NNSA and the USAF.

The current level of air traffic control and radar, radio, and navigational aid services would likely be maintained or improved under normal upgrade programs. Based on past trends and improvements in communication, no increased impacts on civilian air traffic are expected.

5.1.1.1 No Action Alternative

Under the No Action Alternative, current activities and operations would continue and the land use zone designations would remain unchanged, except for the Solar Enterprise Zone, which would be redesignated as the Renewable Energy Zone. **Figure 5–1** depicts the land use zone designations on the NNSS under the No Action Alternative. No proposed changes would occur to affect existing and surrounding land use resources associated with the NNSS. Land use impacts resulting from the development of the Renewable Energy Zone (formerly called the Solar Enterprise Zone) in Area 25 would not be expected because the facility would be within a land use zone designated for solar power development and would not impact surrounding land use resources.

The impacts on land use for the missions under the No Action Alternative are discussed below.

5.1.1.1.1 National Security/Defense Mission

There would be no land use impacts resulting from the continuation of National Security/Defense Mission activities at the current levels of operations under the No Action Alternative because activities under this alternative would not change. This section further discusses the potential impacts of the No Action Alternative on National Security/Defense Mission programs and use of airspace.

Stockpile Stewardship and Management Program. Activities associated with research, design, development, and testing of nuclear weapons components and the assessment and certification of their safety and reliability would continue within the applicable land use zones. The NNSS would maintain readiness to conduct underground nuclear tests, if directed by the President. The continuation of stockpile stewardship management activities would include disposition of damaged U.S. nuclear weapons, staging of nuclear weapons, and disassembly of nuclear weapons. Drillback operations, which were routinely conducted after an underground nuclear test to obtain samples within the explosive cavity region, would continue for the purposes of exercising and maintaining this capability and obtaining data for groundwater studies. Drillback operations would occur near the site of a former underground nuclear test event.

The No Action Alternative assumes the continuation of Stockpile Stewardship and Management Program operations at current levels, consistent with existing NNSS land use designations; therefore, no overall adverse land use impacts are expected.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Because the No Action Alternative assumes the continuation of these programs' current operations and these operations are consistent with existing land use designations, no new impacts on land use are expected.

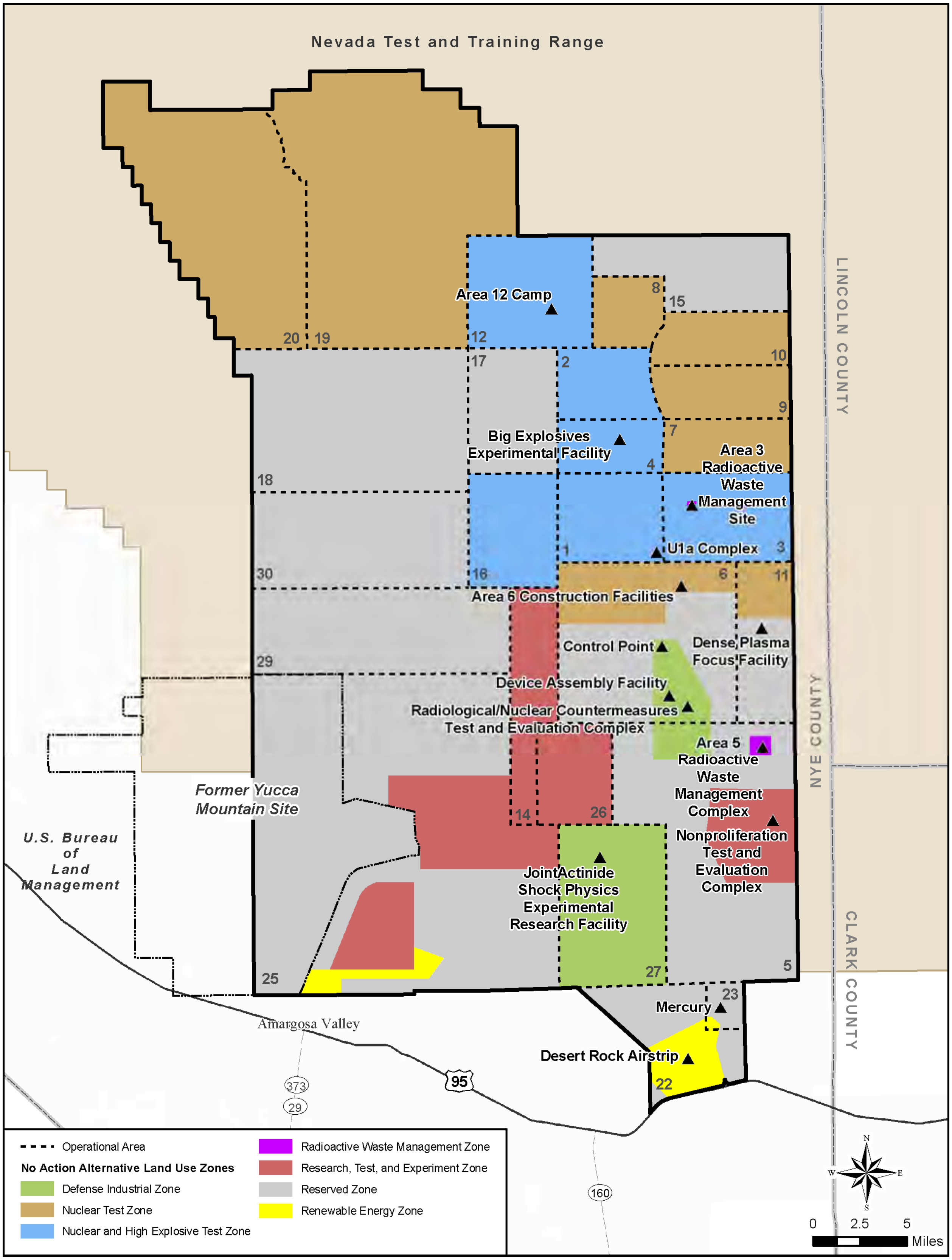


Figure 5–1 Land Use Zones on the Nevada National Security Site Under the No Action Alternative

Work for Others Program. This program is hosted by NNSA and provides other Federal agencies, state and local government agencies, and nongovernmental organizations with the shared use of certain facilities on the NNSS. Because the No Action Alternative assumes the continuation of this program's current operations and these operations are consistent with existing land use designations, no new impacts are expected.

Airspace. Under the No Action Alternative, activities at the NNSS would continue at the level of current operations; therefore, no new impacts are expected from anticipated airspace activities and requirements. NNSA would continue to coordinate the use of airspace with the controlling entity responsible for NNSS airspace, the Nellis Air Traffic Control Facility.

5.1.1.1.2 Environmental Management Mission

There would be no land use impacts resulting from the continuation of Environmental Management Mission activities at the current levels of operations under the No Action Alternative because activities would not change. This section further discusses the potential impacts of the No Action Alternative on Environmental Management Mission activities.

Waste Management Program. Waste management activities would continue at all existing NNSS facilities in accordance with applicable regulatory requirements.

Environmental Restoration Program. Current Environmental Restoration Program activities would continue. These activities include the identification, characterization, and remediation of contaminated soils and facilities. Additional drilling of characterization and monitoring wells also is expected to continue under this program. Underground Test Area (UGTA) activities would occur on the NNSS, the Nevada Test and Training Range, BLM-managed lands, and privately owned land as necessary and as permission is obtained. These activities would not all occur in areas specifically zoned for this type of activity. There could be a temporary impact if restoration activities are carried out in areas that are not consistent with the designated land use identified for that land area; however, coordination with the Nevada Test and Training Range or BLM-managed lands and private landowners prior to the commencement of UGTA activities would reduce the impacts resulting from this activity.

5.1.1.1.3 Nondefense Mission

There would be no land use impacts resulting from the continuation of Nondefense Mission activities at the current levels of operations or foreseeable actions under the No Action Alternative because activities under this alternative would not change. This section further discusses the potential impacts of the No Action Alternative on Nondefense Mission activities.

General Site Support and Infrastructure Program. The substantial infrastructure of the NSSS provides all site support activities. This program includes those activities that are necessary to support mission-related programs, such as the construction and maintenance of facilities and warehousing. The infrastructure necessary to support the mission of the NNSS would continue to be maintained, repaired, and replaced as necessary. General Site Support and Infrastructure Program activities would not result in any changes to land use, so no land use impacts are expected.

Conservation and Renewable Energy Program. Under this program, NNSA would continue to ensure that new construction and renovation projects implement design, construction, maintenance, and operation practices that support high-performance building goals.

Land preparation activities associated with the development of a 240-megawatt commercial solar power generation facility and associated transmission lines within the Renewable Energy Zone in Area 25 would disturb an area of approximately 2,650 acres. Although a portion of Area 22 was identified in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996c) for the Solar Enterprise Zone, (now redesignated as the Renewable Energy Zone), with the currently available renewable energy technology, it is no longer considered a viable location to host a solar power generation facility because of the potential impacts that might result from groundwater withdrawal at Devils Hole, a sensitive environmental area that is downgradient from Area 22. Section 5.1.6.2 discusses impacts on groundwater under each alternative. No impacts on land use resulting from this foreseeable action are expected because a solar power generation facility would be located within a compatible land use zone.

Other Research and Development Programs. The NNSS supports scientific research projects conducted by academic entities and other parties under this program, which is currently inactive. Under the No Action Alternative, the NNSS would continue to support this program and, if activated in the future, these activities would occur in locations consistent with NNSS land use zone designations. Therefore, no impacts on land use are expected.

5.1.1.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, the following two changes would occur in the NNSS land use zone designations:

- The designated use for Area 15 would be changed from “Reserved” to “Research, Test, and Experiment.”
- Approximately 36,900 acres within Area 25 would be designated as a Renewable Energy Zone, a change that would increase the area available for development of a solar power generation facility by about 32,800 acres.

Figure 5–2 depicts land use zones and major facilities at the NNSS under the Expanded Operations Alternative. The proposed revisions to the total acreage of the land use zones under the Expanded Operations Alternative are shown in **Table 5–2**.

Table 5–2 Changes in Land Use Zones Under the Expanded Operations Alternative

Land Use Zone	*Current Acreage*	*Proposed Acreage*	*Percent Change in Acreage*
Reserved Zone	410,100	387,500	-5.5
Research, Test, and Experiment Zone	76,200	92,200	+21
Renewable Energy Zone [a]	11,900	44,700	+276

[a] The Solar Enterprise Zone was expanded and renamed the Renewable Energy Zone.

Although land use zones under the Expanded Operations Alternative would change, this change is not considered an adverse impact. The NNSS developed the land use zones for internal organizational and functional uses and to group similar uses and activities into specific areas based on the support needs of NNSS missions, as determined by previous and anticipated uses. The Renewable Energy Zone would reserve a larger land area under the Expanded Operations Alternative than under the No Action Alternative.

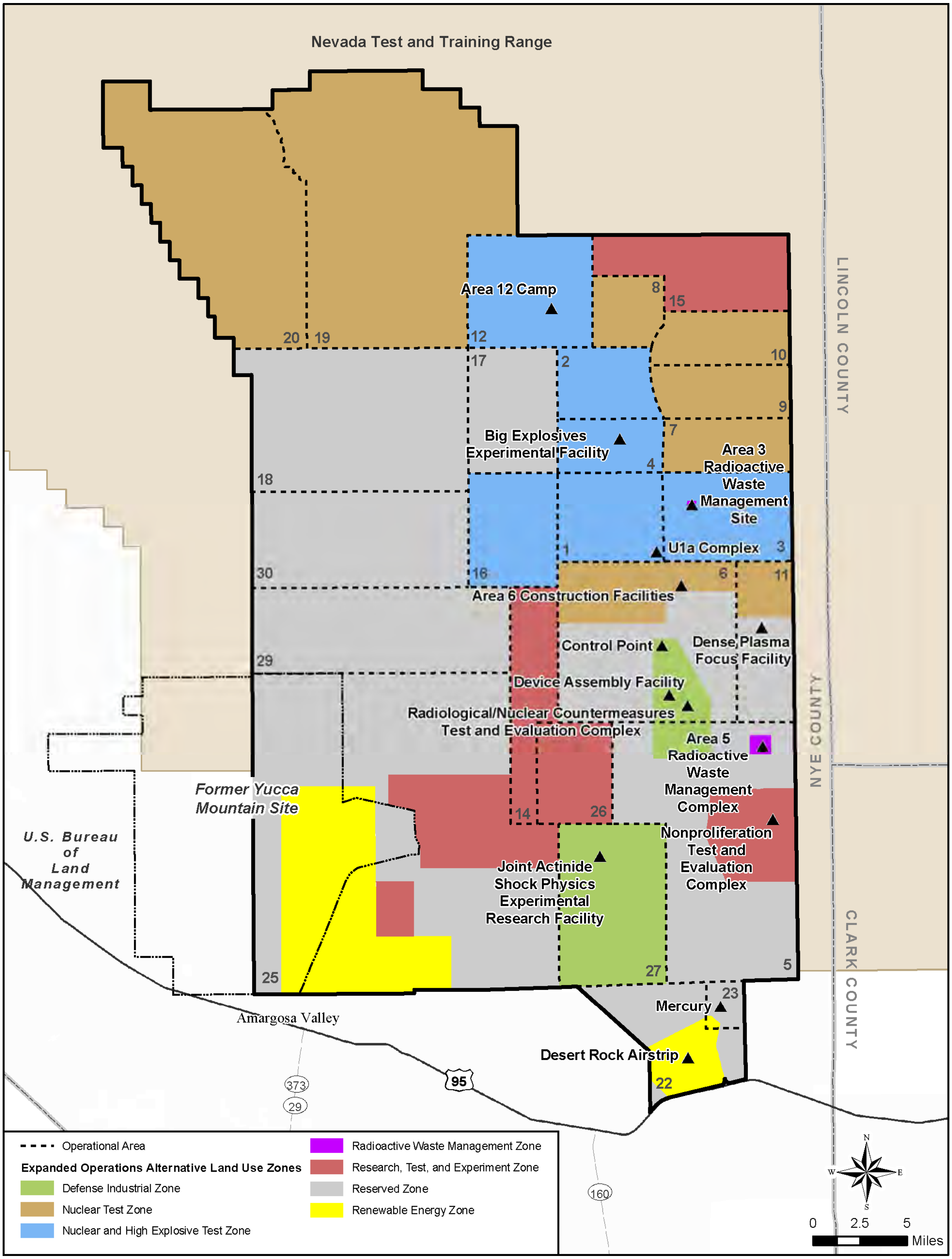


Figure 5–2 Expanded Operations Alternative and Major Facilities

5.1.1.2.1 National Security/Defense Mission

There would be no land use impacts resulting from the increased National Security/Defense Mission activities under the Expanded Operations Alternative because the changes would be compatible with the land use zones. This section discusses the potential impacts of the Expanded Operations Alternative on National Security/Defense Mission programs and use of airspace.

Stockpile Stewardship and Management Program. This section highlights proposed projects for the Expanded Operations Alternative and provides an analysis of whether the projects are compatible with the land use designations.

As part of the Stockpile Stewardship and Management Program, NNSA would add additional equipment and ancillary features within the existing Big Explosives Experimental Facility (BEEF) to support activities occurring in the Nuclear and High Explosives Test Zone. Depleted uranium experiment sites would occupy 40 acres per experiment, with up to three experiments conducted during the period of analysis, while high-explosives experiments would occupy 5 acres per experiment, with up to 500 experiments conducted during the period of analysis. The areas for these experiments would be located in appropriately zoned operational areas on the NNSS; however, reserving these areas for the depleted uranium and high-explosives experiments would prevent other activities or uses from occurring within these reserved areas. Because this activity would occur in an already disturbed area at an active facility zoned for this type of activity, no additional impacts on land use are expected.

Construction activities for new support facilities for the Office of Secure Transportation training would occur in Area 17. The training area would reserve about 16,000 acres of currently undisturbed land for use as an active training area with development of firing ranges and other training facilities and supporting infrastructure. Additionally, the Office of Secure Transportation would expand facilities in one of the following: Area 12 (12 Camp), Area 6 (Control Point Complex), or Area 23 (Mercury). Because these activities would be located in an area zoned for this type of activity, no land use impacts resulting from construction and utilization are expected.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. This section highlights proposed projects for the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs under the Expanded Operations Alternative and provides an analysis of whether the projects are compatible with the land use designations. The NNSA and Federal Bureau of Investigation Disposition and Disposition Forensics Programs would be deployed to the NNSS, as needed for training, exercises, or an actual event. Impacts on land use resulting from disposition activities are not expected because the NNSS already provides facilities for disposition of improvised nuclear devices. Facilities and activities associated with this program would be sited in compatible land use zone designations to minimize land use conflicts.

Additional arms control, nonproliferation, and counterterrorism facilities would be needed to undertake the anticipated enhanced activities. These facilities are still conceptual in nature and their locations are unknown; however, they would be constructed in operational areas within compatible land use zones, which would result in minimal impacts. The land acreage needed for these facilities, to the extent known, are listed below:

- Arms control – Facilities would be sited at various locations at the NNSS and would require approximately 100 acres of land. An additional building encompassing 10,000 square feet (0.2 acres) would be integrated with other buildings.
- Nonproliferation – A new Nonproliferation Test Bed would be developed.

- Counterterrorism – In addition to utilizing existing facilities, an Urban Warfare Complex would be constructed on approximately 100 acres in a remote area on the NNSS.

Work for Others Program. In general, land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1. This section highlights additional Work for Others Program projects that could have impacts under the Expanded Operations Alternative.

Counterterrorism activities would require the development of new test bed facilities (roads, intersections, small towns, etc.). To support this need, the disturbance of approximately 75 acres of land is expected. Construction of these facilities would require new buildings with about 10,000 square feet (0.2 acres) of new floor space, resulting in approximately 25 acres of land disturbance. These facilities would be constructed in operational areas within compatible land use zones; thus, no land use impacts are expected.

NNSA would provide support for the U.S. National Aeronautics and Space Administration (NASA) deep space propulsion system development. This activity would use existing boreholes for testing nuclear rocket motors; however, it is not expected that testing would occur within the 10-year planning period evaluated in this SWEIS. These facilities would be constructed in operational areas within compatible land use zones; thus, no land use impacts are expected.

Anticipated land disturbance resulting from the construction of additional hangars, shops, and buildings would total approximately 200,000 square feet (4.6 acres) at Desert Rock Airport. A 20,000-square-foot (0.5-acre) hangar would be constructed at the Area 6 Operations Facility. Activities and facilities would be sited in appropriately zoned areas and no land use impacts are anticipated.

Because of the increased activities occurring at the Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC) by the U.S. Department of Homeland Security (DHS) under this alternative, other Federal agencies performing activities involving active interrogation to detect nuclear materials would require an additional facility, most likely located in Area 12 or 16. Construction of this new facility would disturb of about 100 acres of previously undisturbed land. No impacts on land use are expected because this facility would be sited in a compatible land use zone.

Approximately 200 acres of land would be used to support additional test bed applications. New buildings would occupy approximately 50,000 square feet (1.1 acres). These facilities would be constructed in operational areas within compatible land use zones; thus, no land use impacts are expected.

Airspace. Under the Expanded Operations Alternative, usage of a variety of aerial platforms, such as airplanes and helicopters, would increase for research and development and training purposes. In addition, airspace use would increase, which could result in conflicts with use of airspace over the NNSS by Nellis Air Force Base. However, impacts resulting from the increased use of NNSS airspace would be minimized through scheduling and coordination with the Nellis Air Traffic Control Facility, which manages airspace activities occurring within Nevada Test and Training Range and NNSS airspace.

5.1.1.2.2 Environmental Management Mission

Overall impacts on Environmental Management Mission activities under the Expanded Operations Alternative would be minimal because such activities would occur in specified areas that are compatible with the land use designations and there is sufficient available land within the designated zones. Additionally, an activity could be collocated within a land use zone that is capable of adequately cohosting the activity. This section further discusses the potential impacts of the Expanded Operations Alternative on Environmental Management Mission activities.

Waste Management Program. In general, potential land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1. This section highlights additional projects anticipated for the Waste Management Program under the Expanded Operations Alternative that could have land use impacts.

Waste disposal activities would increase, including the storage (pending treatment or disposal) of mixed low-level radioactive waste (MLLW) received from authorized generators. New disposal units would be constructed, filled, and closed to accommodate the waste volumes and types. Because all existing waste management facilities on the NNSS are located within areas designated for their specific uses, there would be no impacts on land use from activities at existing facilities. Development of new sanitary landfills in Area 23 and Area 25 would convert a combined total of 35 acres of currently unused land into waste management facilities and preclude that land from other uses.

Environmental Restoration Program. Impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.2.

5.1.1.2.3 Nondefense Mission

No land use impacts were identified resulting from the increased Nondefense Mission activities under the Expanded Operations Alternative because the changes would be compatible with the land use zones. This section further discusses the potential impacts of the Expanded Operations Alternative on Nondefense Mission programs.

General Site Support and Infrastructure Program. In general, land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.3. This section highlights additional infrastructure projects anticipated under the Expanded Operations Alternative that were analyzed for land use impacts. Increasing capacities and capabilities or extending the ranges of facilities and/or services to accommodate new operational programs and projects would result in additional infrastructure enhancements under the Expanded Operations Alternative. The following infrastructure enhancements would likely be implemented:

- Rebuild 38.5 miles of the main 138-kilovolt transmission line between Mercury Switchyard in Area 23 and Valley Substation in Area 2.
- Construct an 85,000-square-foot (1.9-acre), two-story security building in Area 23 to consolidate and replace outdated security facilities built in the 1950s and 1960s. The building would include space for administrative offices, computer infrastructure, training, and emergency response to support NNSS operations.
- Expand the cellular telecommunication system through the addition of cell towers.
- Reconfigure Mercury to provide the necessary modern facilities and infrastructure.

These changes would be compatible with the land use zones.

Conservation and Renewable Energy Program. In general, land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.3. NNSA would pursue renewable energy projects, and provide support for demonstration and/or commercial projects using geothermal and solar energy. Under the Expanded Operations Alternative, NNSA proposes to build a 5-megawatt photovoltaic solar power generation facility, which would require approximately 50 acres of land near the Area 6 Construction Facilities. This solar power generation facility would likely be located within the Nuclear Test Zone and would preclude NNSA from conducting weapons-related testing or other outdoor experiments in close proximity to this new facility. However, locating this facility within this area would not affect NNSA's ability to conduct an underground nuclear test or any other weapons-related tests or experiments in other parts of the Nuclear Test Zone or Nuclear and High Explosives Test Zone. Additionally, NNSA would allow development of one or more commercial solar power generation facilities to be located within the 39,600-acre Renewable Energy Zone, with a maximum combined generating capacity of 1,000 megawatts. These facilities would be constructed in operational areas within compatible land use zones.

A geothermal demonstration project would be developed as a laboratory that would both supply power to the NNSS and conduct research to improve similar systems. The NNSS would evaluate potential locations based on NNSS land use zone compatibility and other factors, including environmental considerations. Approximately 30 to 50 acres of land would be disturbed for construction of the enhanced geothermal power system. No land use impacts are expected because the geothermal power system would be sited in an appropriate land use zone.

5.1.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the following changes to the NNSS land use zone designations would occur: the designated use for Areas 18, 19, 20, 29, and 30 would be changed from "Reserved" to "Limited Operations" for military training and exercise use only.

The proposed revisions to the total acreage of the land use zones under the Reduced Operations Alternative are shown in **Table 5–3**. Although land use zones under the Reduced Operations Alternative would change, these changes are not considered adverse impacts. This is not an adverse impact on land use because the NNSS developed the land use zones for internal organizational and functional uses and to group similar uses and activities into specific areas based on the support needs of the NNSS mission, as determined by previous and anticipated uses.

Table 5–3 Changes in Land Use Zones Under the Reduced Operations Alternative

Land Use Zone	*Current Acreage*	*Proposed Acreage*	*Percent Change in Acreage*
Limited Operations	0	289,800	N/A
Reserved Zone	410,100	120,200	-70.7%

Figure 5–3 depicts the NNSS land use zones and major facilities under the Reduced Operations Alternative.

5.1.1.3.1 National Security/Defense Mission

No land use impacts from National Security/Defense Mission activities under the Reduced Operations Alternative are expected because the activities would be compatible with the land use zones and there is sufficient available land within the designated zones. This section further discusses the potential impacts of the Reduced Operations Alternative on National Security/Defense Mission programs and use of airspace.

Stockpile Stewardship and Management Program. Stockpile stewardship and management activities would not be conducted in Areas 18, 19, 20, 29, and 30. There would be an approximately 10 percent decrease in activities relating to maintaining readiness to conduct underground nuclear tests and underground nuclear weapons experiments. Additionally, the Atlas Facility would be decommissioned and dispositioned. These changes would be compatible with the designated land use zones.

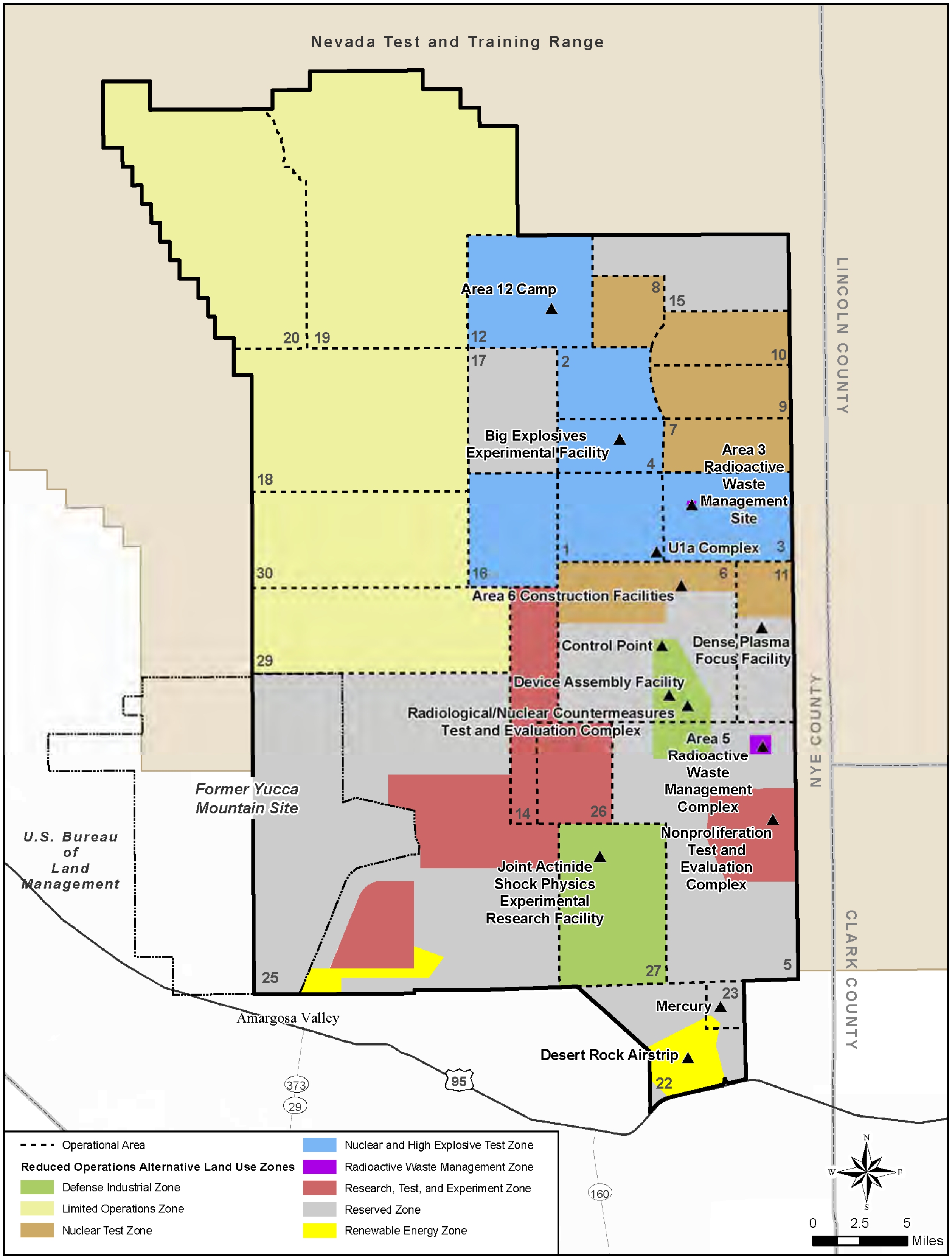


Figure 5–3 Reduced Operations Alternative and Major Facilities

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1; however, no impacts are expected because activities have been curtailed.

Work for Others Program. Land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1; however, no impacts would be expected because activities are curtailed.

Airspace. Land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1.

5.1.1.3.2 Environmental Management Mission

Land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.2 for both the Waste Management Program, and the Environmental Restoration Program.

5.1.1.3.3 Nondefense Mission

In general, land use impacts resulting from decreased Nondefense Mission activities under the Reduced Operations Alternative are not expected because the changes would be compatible with the land use zones. This section further discusses the potential impacts of the Reduced Operations Alternative on Nondefense Mission programs.

General Site Support and Infrastructure Program. Land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1 (i.e., there would be no impacts on land use under the Reduced Operations Alternative).

Conservation and Renewable Energy Program. In general, land use impacts would be similar to those described under the No Action Alternative in Section 5.1.1.1.1. NNSA would continue to support development of a commercial solar power generation facility in Area 25, which would be sited on 2,400 acres of land; however, the net generating capacity under the Reduced Operations Alternative would be 100 megawatts. No impacts on land use are expected because this facility would be sited within a compatible land use designation zone.

5.1.2 Infrastructure and Energy

5.1.2.1 Infrastructure

This subsection presents the proposed new or expanded facilities and infrastructure projects under each alternative and addresses the potential impacts on the NNSS resulting from increases in personnel, as well as facility and project utility needs. Potential impacts are evaluated for transportation systems infrastructure, water supply infrastructure, wastewater treatment systems, and communication systems. Energy-related impacts are discussed in Section 5.1.2.2, "Energy." Activities under an alternative would have an adverse impact on infrastructure and utilities if their implementation would result in any of the following effects:

- Projected increases in onsite vehicular and truck traffic, aircraft use, and parking needs would exceed the design capacity of the roads, airports, and parking lots, requiring them to be substantially expanded and improved. (Impacts on transportation system infrastructure are briefly discussed in this subsection and are analyzed in detail in Section 5.1.3, "Transportation and Traffic," including impacts resulting from increased traffic congestion and delays, road maintenance requirements, and road safety risks.)

- Projected increases in personnel and activities would create a potable water demand exceeding the design capacity of the NNSS water supply system infrastructure, which require substantial unplanned water supply infrastructure improvements. (Impacts on water supply infrastructure are briefly discussed in this subsection and are analyzed in detail in Section 5.1.6, “Hydrology,” including impacts on groundwater aquifers.)

- Projected personnel increases would generate wastewater amounts exceeding the capacity of existing (or proposed) NNSS wastewater treatment systems, which would require substantial unplanned upgrades of sewer mains, treatment lagoons, or septic tank and leach field systems. Potential impacts on wastewater treatment systems were assessed by comparing projections of wastewater generation under each alternative against onsite treatment capacities.

- Communications infrastructure and capabilities become insufficient to support mission needs and would require substantial unplanned upgrades to resume normal functions.

5.1.2.1.1 No Action Alternative

Potential infrastructure impacts from construction and operation under the No Action Alternative are discussed below in regard to facilities, transportation systems, water supply, wastewater treatment systems, and communication systems.

Facilities. Under the No Action Alternative, NNSA would continue to maintain, repair, and replace facilities and infrastructure, as needed and within funding limits, as well as conduct small projects to maintain the present capabilities of the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) facilities. Existing buildings and other facilities would be used and modified as necessary to accommodate the ongoing activities. The only significant new facility considered would be construction and operation of a 240-megawatt solar power generation facility and associated transmission lines by an outside commercial entity. NNSA estimates this facility would utilize approximately 2,000 acres (disturbing approximately 2,650 acres), including the mirror fields.

NNSA/NSO is committed to providing a smaller, safer, more-secure, and less-expensive infrastructure that leverages the scientific and technical capabilities of the workforce and meets national security requirements. To this end, ongoing operations at the NNSS aim to eliminate facility redundancies and dramatically improve efficiencies. This is being accomplished by dispositioning excess buildings that are no longer needed to support NNSA’s missions, programs, or support requirements and by consolidating personnel and programs into enduring buildings, thereby optimizing building use at the NNSS. The *Ten-Year Site Plan,* the *Space Management Plan* (NSTec 2009b), and other NNSA studies delineate recommendation for building disposition and program consolidation. Up to approximately 20 percent of the existing managed building square footage at the NNSA could be dispositioned under the No Action Alternative (NNSA/NSO 2010d).

New or future projects would be reviewed pursuant to requirements in DOE NEPA implementing procedures (10 *Code of Federal Regulations* [CFR] Part 1021) and Council on Environmental Quality NEPA regulations (40 CFR Parts 1500–1508).

Furthermore, NNSA would ensure that existing facilities, as well as all new construction and renovation projects, implement design, construction, maintenance, and operation practices in conformance with the high-performance building goals and statutory requirements of Executive Order 13423 (including those of Executive Order 13514, which expands on Executive Order 13423). The NNSS/North Las Vegas *High Performance and Sustainable Buildings Implementation Plan* (The Plan) would also align with Executive Order 13327 and DOE’s *Real Property Asset Management Plan*. At a minimum, The Plan would include employment of integrated design principles, optimization of energy efficiency, use of renewable energy, protection and conservation of water, enhancement of indoor environmental quality, and reduction of the environmental impacts of materials in accordance with the guiding principles of DOE Order 430.2B, Attachment 1, and construction-related guidance provided in Executive Order 13423.

Transportation Systems. The transportation infrastructure at the NNSS would be maintained for mission-related uses. Under the No Action Alternative, there would be no changes to the transportation infrastructure; therefore, no infrastructure and energy impacts are expected. The existing transportation infrastructure was designed for a considerably larger workforce and truck traffic than are expected under the No Action Alternative; therefore, it is expected to be sufficient for both present and projected future needs (see Chapter 4, Section 4.1.3, "Transportation," for further discussion of transportation issues). Transportation infrastructure maintenance expectations under the No Action Alternative are summarized below:

- Roads – NNSA would continue to maintain mission-essential and other NNSS roadways as resources permit.
- Air facilities – NNSA would continue to maintain mission-essential NNSS air facilities as resources permit.
- Parking lots – The parking infrastructure at the NNSS would be maintained.

Water Supply Infrastructure. Potable water at the NNSS is supplied through groundwater wells and a network of distribution systems, as described in Chapter 4, Section 4.1.2.1.2, "Utilities." Under the No Action Alternative, water system infrastructure may require major recapitalization to meet long-term deterioration issues (DOE 2009). Future system upgrades would be undertaken as needed, in accordance with physical infrastructure project needs; these upgrades would be conducted after appropriate NEPA review.

See Section 5.1.6, "Hydrology," for a discussion of water supply capacity under the No Action Alternative.

The impact of the No Action Alternative on water supply resources would be further reduced due to a concerted water conservation effort (see the discussion on water conservation in Chapter 4, Section 4.1.2), in compliance with Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and DOE Order 430.2B, *Departmental Energy, Renewable Energy and Transportation Management*. The NNSS expects to reduce water consumption by 16 percent from 2007 levels by 2015, an average reduction in water consumption of approximately 2 percent per year.

Under the No Action Alternative, the NNSS would continue installing water-conserving products (toilets, urinals, faucets, showerheads, boiler systems, and other water-using appliances and fixtures) when existing units require replacement. The NNSS also would continue implementing water conservation practices, including xeric landscaping, water-efficient irrigation, system audits, leak repairs, use of nonpotable water for dust suppression when possible, and the institution of 4-day workweeks (NSTec 2008b).

Wastewater Treatment Systems. Under the No Action Alternative, wastewater treatment needs would typically be maintained at current levels, except for the possible construction and operation of the solar power generation facility. The number of construction workers required for the No Action Alternative, predominantly for construction of the solar power generation facility, would average 500 workers over 35 months, with a peak of 1,000 workers. The sanitary needs of construction workers would be addressed through portable toilets and handwashing stations, from which the sanitary waste would be transported off site by contracted septic haulers to a permitted sewage treatment facility. The sanitary needs of construction workers for this solar power generation facility would be managed by the commercial entity responsible for the project; the sanitary waste would be transported and disposed off site in accordance with all applicable regulations.

As discussed in Chapter 4, Section 4.1.2, the wastewater treatment systems at the NNSS (which include two wastewater treatment lagoons and 23 septic systems) are currently utilized collectively at 17 percent capacity. The existing systems have adequate capacity to handle the workers' wastewater treatment needs. Maintenance of the NNSS sanitary system's lagoons and septic systems would continue to ensure effective operation. Future system upgrades would be undertaken as needed, in accordance with physical infrastructure projects conducted after appropriate NEPA review.

The commercial solar power generation facility would include its own wastewater treatment system, for which the design and potential impacts would be defined in a subsequent NEPA analysis, should a project proponent come forward.

Communication Systems. The telecommunications information infrastructure is technologically dated and has been degraded in many locations (DOE 2008f). Under the No Action Alternative, the communications systems at the NNSS would be upgraded within existing utility corridors and facilities (i.e., there would be no new land disturbances) to improve the communications network in order to meet ongoing mission requirements.

5.1.2.1.2 Expanded Operations Alternative

The Expanded Operations Alternative includes the proposed new or expanded infrastructure for program support presented in **Table 5–4**. The modifications and improvements proposed to the existing infrastructure under the Expanded Operations Alternative would be adequate to accommodate the increased demand. Additional information on infrastructure demand and impacts during normal operations for the Expanded Operations Alternative is provided below. Please also see Chapter 3, "Description of Alternatives," and Appendix A, "Detailed Description of Alternatives," for further information on the Expanded Operations Alternative, as well as Section 5.1.2.2, "Energy," for further discussion of energy-related infrastructure improvements. Potential infrastructure and energy impacts from construction and operation under the Expanded Operations Alternative are discussed below in regard to facilities, transportation systems infrastructure, water supply infrastructure, wastewater treatment systems, and communication systems.

In addition to impacts from DOE/NNSA activities under the Expanded Operations Alternative, Section 5.1.2.2, "Energy," discusses how development of one or more commercial solar power generation facilities within the Fortymile Canyon–Jackass Flats Hydrologic Basin, as well as a geothermal power system demonstration project that would be sited at a location to be determined, would impact the infrastructure at the NNSS. There is no specific schedule for constructing a commercial-scale solar facility or project at the NNSS. The potential impacts of these projects are addressed in this *NNSS SWEIS* to enable DOE/NNSA to make a decision about whether to make land and infrastructure that is now under DOE/NNSA control available for another use by a commercial entity.

Table 5–4 Proposed New Infrastructure for Program Support Under the Expanded Operations Alternative

Stockpile Stewardship and Management Program	
Office of Secure Transportation Complex	
Area 17	
Administrative Offices	5,000 square feet
Mock Town	870,000 square feet
Shooting House	8,000–20,000 square feet
Two Modular Training Facilities with Restrooms	4,000 square feet (2,000 square feet each)
Two Butler Buildings	10,000 square feet (5,000 square feet each)
Electrical Substation	100 square feet
Communications Trailer	300 square feet
Potable Water Tank	10,000–20,000 gallons
Septic System with Leach Field	Size not yet determined – additional NEPA analysis would be required
Roads (single-lane dirt roads with shoulders, including up to 4 miles of paved asphalt double-lane roads with shoulders) and Firebreaks	25 miles
Electrical Power Line	4.5 miles (approximate)
Potable Water Pipeline	4.5 miles (approximate) from existing well
Area 6, 12, or 23 (Mercury)	
Maintenance Buildings	20,000 square feet
Administrative Buildings	10,000 square feet
Dormitory	20,000 square feet
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs	
Arms Control Mission	
Indoor and Outdoor Laboratory Space and Test Ranges	100 acres
New Facility for Data Fusion, Analysis, and Visualization	10,000 square feet
Nonproliferation Mission	
New Facility	Size not yet determined – additional NEPA analysis would be required
Counterterrorism Mission	
Urban Warfare Complex (located in remote location on the NNSS)	100 acres (approximate)
Work for Others Program	
Counterterrorism	
Test Ranges to Include Roads, Intersections, Small Towns	75 acres
Buildings	10,000 square feet
Future Training Facilities to support U.S. Department of Homeland Security Counterterrorism Operations Support	125 acres
Buildings	10,000 square feet
Miscellaneous Work for Others	
Additional Facilities at: Desert Rock Airport: Hangars, Shops, Other Buildings	200,000 square feet
Area 6 Aerial Operations Facility: Hangar	20,000 square feet
Pahute Mesa Airstrip Operations Support Building	Size not yet determined – additional NEPA analysis would be required
Other Locations to Support Air Operations	5,000 square feet
Active Interrogation to Detect Nuclear Material: Support Facilities in Area 12 or 16	125 acres
Test Bed Applications	200 acres
New Facilities	50,000 square feet

Waste Management Program [a]	
Radioactive Waste Management Complex in Area 5	600 acres
Sanitary Landfill in Area 23	15 acres
Construction and Demolition Waste Landfill in Area 25	20 acres
Nondefense Mission	
New Security Building in Area 23	85,000 square feet
Photovoltaic Solar Power Generation Facility (5 megawatts) in Area 6	50 acres
Possible Commercial Energy Projects	
Commercial Solar Power Generation Facilities (1,000 megawatts) in Area 25 [b], including associated on- and off-site transmission lines	10,300 acres
Geothermal Energy Demonstration Project	50 acres

NEPA = National Environmental Policy Act; NNSS = Nevada National Security Site
[a] See Section 5.1.11, "Waste Management," for discussion on waste management impacts.
[b] The commercial solar power generation facility and geothermal demonstration project would be developed, if at all, by others. Acreages for energy projects are given for land area potentially disturbed. Actual footprints may be up to 15 percent lower.

Facilities. Under the Expanded Operations Alternative, infrastructure-related activities would include increasing the capacities and capabilities or extending the ranges of facilities and/or services to accommodate new operational programs, projects, and activities, as well as repairs, replacements, and small projects required to maintain the present capabilities of the NNSS (discussed under the No Action Alternative). NNSA would also continue its commitment to eliminating facility redundancies and improving operating efficiencies by dispositioning excess buildings and consolidating personnel and programs into enduring buildings, thereby optimizing building use at the NNSS (NSTec 2009b). Up to approximately 28 percent of the existing managed building square footage at the NNSS could be dispositioned under the Expanded Operations Alternative (NNSA/NSO 2010d, 2010e).

Additional programs, projects, and activities considered under the Expanded Operations Alternative may require modification and/or expansion of existing facilities and construction of new facilities. As discussed in Chapter 3, "Description of Alternatives," and Appendix A, "Detailed Description of Alternatives," the Expanded Operations Alternative would require implementation of the following facility enhancements:

- **Security building construction** – A new security building in Area 23 would be constructed adjacent to existing security facilities. This project would consolidate security facilities (Buildings 1000, 1001, 1002, 114, 701, 1103, 1106, 1107, and 1108 and portions of Control Points 41, 111, and 525) and their functions into a new, approximately 85,000-square-foot, two-story facility. The facility would include space for administrative offices, computer servers for systems supporting NNSS operations, training, emergency response, locker rooms, restrooms, storage, an armory, technology development, electronic security system engineering and maintenance, and classified work areas. The new building would replace outdated facilities, most of which were built in the 1950s and 1960s, and decrease external exposure to critical security facilities. Buildings that are replaced would be evaluated and either demolished or used for another purpose.

- **Mercury reconfiguration** – Mercury would be reconfigured to provide the modern facilities and infrastructure needed to support advanced experimentation and production at the NNSS. Although undefined at this time, this proposed project would (1) demolish facilities that are no longer needed or are not economically salvageable; (2) identify functional zones to facilitate groupings of similar activities; (3) replace obsolete buildings that are needed to support NNSS activities; and (4) improve selected facilities and infrastructure to extend useful life to accommodate existing and future support requirements. Because the reconfiguration of Mercury is conceptual in nature, an appropriate level of NEPA analysis and documentation would be required before it may be implemented.

Transportation Systems. Under the Expanded Operations Alternative, the current transportation infrastructure at the NNSS would be maintained for mission-related uses, and new roads and air facilities would be constructed, expanded, or improved, as discussed below. Higher numbers of personnel and activities at the NNSS would generate increased regional traffic from privately owned vehicles and trucks transporting materials and waste (see Section 5.1.3, "Transportation and Traffic," for a discussion of traffic issues under the Expanded Operations Alternative). Transportation infrastructure maintenance expectations under the Expanded Operations Alternative are summarized below:

- Roads **–** Under the Expanded Operations Alternative, new roadways would be constructed on the NNSS, when necessary, to access newly constructed facilities and accommodate the increased traffic on the roads.

  The proposed training complex for the Office of Secure Transportation would include 25 miles of new road and firebreak construction (as shown in Table 5–4). Most of these roads and firebreaks would be scraped-dirt, single-lane roads with shoulders, with eventually up to 4 miles of paved-asphalt, double-lane roads with shoulders. The main access to the complex would be from Tippipah Highway.

  Overall, the increased traffic at the NNSS under the Expanded Operations Alternative would be acceptably handled within the design capacity of the roadway infrastructure. The existing infrastructure was designed for a much larger workforce and increased program activities. Roads that are currently classified as substandard (DOE 2007c) would require improvements. However, traffic impacts would be mitigated by construction of new roads to the new facilities, as well as maintenance and improvements to the existing roads used most frequently for mission-related purposes. Because the incremental increase in onsite traffic volumes would be moderately high (see Section 5.1.3, "Transportation and Traffic"), the number of repairs and required maintenance on NNSS roadways would increase at a higher rate than currently experienced.

- Air Facilities – Under the Expanded Operations Alternative, various aircraft facilities potentially would be used, expanded, or improved. The following infrastructure projects associated with these aircraft facilities were described previously under "Facilities" and are shown in Table 5–4:

  - Desert Rock Airport expansion
  - Aerial Operations Facility expansion
  - Pahute Mesa Airstrip improvements
  - New Air Operations Facility construction

  These planned expansions and improvements to the air facilities under the Expanded Operations Alternative would improve aviation operations at the NNSS. These actions would be undertaken after appropriate NEPA review.

- Parking lots – Additional parking areas would be provided to accommodate anticipated needs at new facilities or new uses of existing facilities.

Water Supply. Under the Expanded Operations Alternative, the NNSS water supply system would be expanded as necessary to connect to new facilities. Increased potable water demand due to a 25 percent increase in workforce over current levels would affect the existing water supply infrastructure, which is currently in need of repair and upgrade. However, future system upgrades would be undertaken as needed in accordance with physical infrastructure projects conducted after appropriate NEPA review (see Section 5.1.6, "Hydrology," for a discussion of water supply capacity under the Expanded Operations Alternative). NNSA would also continue to implement water conservation efforts under the Expanded Operations Alternative (see the discussion of water conservation in Chapter 4, Section 4.1.2).

Wastewater Treatment Systems. Under the Expanded Operations Alternative, new facilities would be connected to existing permitted wastewater treatment systems when possible, or appropriately sized and permitted wastewater treatment systems would be constructed for the new facilities. The construction phase of the Expanded Operations Alternative would require an average of 750 workers over 42 months, with a peak of 1,500 workers. The sanitary needs of the construction workers would be addressed through portable toilets and handwashing stations, from which the sanitary waste would be transported off site by contracted septic haulers to a permitted sewage treatment facility. Sanitary waste management required for the construction of the commercial solar power generation facility would be managed by the commercial entities responsible for the projects, and the sanitary waste would likely be transported and disposed off site in accordance with all applicable regulations.

During operations under the Expanded Operations Alternative, the workforce at the NNSS would increase by approximately 25 percent to about 2,575 persons, including permanent NNSS personnel, employees for a solar power generation facility, and an additional estimated 250 construction workers to implement the various construction projects proposed under the Expanded Operations Alternative.

As discussed in Chapter 4, Section 4.1.2.1, the wastewater treatment systems at the NNSS include two active sewage lagoon systems (the Mercury lagoon in Area 23 and the Yucca Lake lagoon in Area 6) and 23 currently permitted septic tank systems. These lagoons and septic tank systems have an estimated collective capacity of 199,260 gallons per day. To quantify the impact of the Expanded Operations Alternative, the capacity of each of the two lagoon systems were quantified with a projected 25 percent increase in wastewater inflow. As shown in **Table 5–5**, both sewage lagoon systems have adequate capacity to handle the estimated increase, as the Mercury lagoon would be operating at 45 percent of its capacity and the Yucca Lake lagoon, at 12 percent of its capacity. New facilities proposed under this alternative are located in areas that currently use septic tank systems and would be either served by their own new septic tanks and leach fields or connected to existing septic tank systems with sufficient capacity if they are located in the vicinity.

The commercial solar power generation facility project would include its own wastewater treatment system, for which the design and potential impacts would be defined in a subsequent NEPA analysis, should a project proponent come forward.

Table 5–5 also shows the estimated capacity of the collective site-wide NNSS wastewater treatment systems, based on the projected new workforce population under the Expanded Operations Alternative. Given this site-wide scenario, an employee population of 2,575 workers would result in total wastewater generation of approximately 51,500 gallons per day, which amounts to 26 percent of the capacity of the collective existing wastewater treatment systems at the NNSS. Future system upgrades or installation of additional treatment systems would be undertaken as needed, in accordance with physical infrastructure projects conducted after appropriate NEPA review.

Table 5–5 Wastewater Treatment Capacity at the Nevada National Security Site Under the Expanded Operations Alternative

Sewage Lagoon	*Permit Capacity*	*Current Volume Treated (2009) (gallons per day)*	*Projected Volume Treated (25 percent increase) (gallons per day)*	*Percentage of Capacity Used*
Mercury	73,407	26,550	33,188	45
Yucca Lake	10,850	1,049	1,311	12
Workers	*Wastewater Generation (gallons per day)* [a]	*Capacity of NNSS Wastewater Treatment System (gallons per day)*	*Percentage of Capacity Used*	
2,575	51,500	199,260	26	

NNSS = Nevada National Security Site.

[a] Based on 20 gallons per day per person (see discussion in Chapter 4, Section 4.1.2.1) (CMU 2004, Table 9, p. 58; Lui and Liptak 1997, Tables 7.1.3 and 7.1.4, p. 518).

Communication Systems. Under the Expanded Operations Alternative, the NNSS telecommunication system would be upgraded to replace the existing wired telephone switch with a new one that would seamlessly transition between the older and newer technologies. The wireless elements of the trunked radio infrastructure also would be upgraded to interface with the packet-switched technology. This project would transition the subscriber units (telephones, radios, Blackberrys, and cell phones) in a time-phased replacement program to blend all elements of the wired and wireless systems into an integrated telecommunications hierarchy (NNSA/NSO 2010c). These improvements would benefit the communications network at the NNSS and would have no adverse impact on offsite resources.

5.1.2.1.3 Reduced Operations Alternative

For construction associated with the Reduced Operations Alternative, the facilities, transportation systems infrastructure, water supply infrastructure, wastewater treatment systems, and communication systems are adequate to handle the temporary increased demands. Under the Reduced Operations Alternative the NNSA/NSO workforce would decline, thereby reducing use of infrastructure compared to the No Action Alternative, as discussed below.

Facilities. Under the Reduced Operations Alternative, NNSA would continue to maintain, repair, and modify operating facilities and infrastructure, as needed and within funding limits, and conduct small projects to maintain the present capabilities of NNSA/NSO facilities (described under the No Action Alternative). In addition, under the Reduced Operations Alternative, most activities would cease in the northwestern portion of the NNSS within Areas 18, 19, 20, 29, and 30, with the exception of maintenance and operation of the Echo Peak, Motorola, and Shoshone communications facilities; the Echo Peak, Castle Rock, and Stockade Wash Substations, including electrical transmission lines interconnecting these substations; and Well 8. NNSA would continue environmental restoration, environmental monitoring, site security operations, and military training and exercises within these areas. No infrastructure projects would be conducted in these northwestern areas beyond maintaining the noted mission-essential facilities and critical electrical and communications systems. The only significant new facility considered under the Reduced Operations Alternative would be construction and operation of a 100-megawatt solar power generation facility by an outside commercial entity in Area 25. NNSA estimates this facility would utilize approximately 1,020 acres (disturbing approximately 1,200 acres), including the mirror fields.

Transportation Systems. Under the Reduced Operations Alternative, transportation-related infrastructure at the NNSS would be maintained only for mission-related uses. Only mission-essential roadways would be maintained, and all other roadways on the NNSS would be allowed to deteriorate. This would have a minor adverse impact on the regional transportation infrastructure; however, under this alternative, the roadways would rarely be used (see Section 5.1.3, "Transportation and Traffic," for a discussion of traffic issues under the Reduced Operations Alternative). In addition, under the Reduced Operations Alternative, there would be no change from under the No Action Alternative regarding use of air facilities and parking lots.

Water Supply. Under the Reduced Operations Alternative, the workforce would decrease by approximately 10 percent from current levels. This smaller workforce would reduce the requirement for potable water at the NNSS, which would beneficially impact groundwater resources. The reduced workforce would decrease the requirement for potable water at the NNSS, thus creating an approximate 10 percent reduction in groundwater usage (see Section 5.1.6, "Hydrology," for a discussion of water supply capacity under the Reduced Operations Alternative). There would be no change from under the No Action Alternative regarding water conservation practices.

Wastewater Treatment Systems. The construction phase of the Reduced Operations Alternative would require an average of 400 workers over 32 months, with a peak of 800 workers. The sanitary needs of construction workers would be addressed through portable toilets and handwashing stations, from which the sanitary waste would be transported off site by contracted septic haulers to a permitted sewage treatment facility. The sanitary needs of construction workers for the solar power generation facility would be managed by the commercial entity responsible for the project, and the sanitary waste would be transported and disposed off site in accordance with all applicable regulations.

During operations under the Reduced Operations Alternative, the workforce would decrease by approximately 10 percent from current levels. This smaller workforce would require less wastewater treatment at the NNSS than current levels, so there would be more than adequate capacity. As the workforce is reduced and activities and facility use are curtailed, wastewater treatment systems would be deactivated as demand decreases.

The commercial solar power generation facility would include its own wastewater treatment system, for which the design and potential impacts would be defined in a subsequent NEPA analysis should a project proponent come forward.

Communication Systems. There would be no change in communication systems from under the No Action Alternative within those areas that continue to operate under the Reduced Operations Alternative. All communication operations would cease in the northwestern portion of the NNSS within Areas 18, 19, 20, 29, and 30, including the Echo Peak, Motorola, and Shoshone communications facilities. NNSA would maintain only the critical infrastructure for these facilities.

5.1.2.2 Energy

This subsection addresses potential impacts on the energy resources and distribution systems that serve the NNSS. Activities under an alternative would have an adverse impact on energy resources if their implementation would result in any of the following effects:

- Peak electrical power demands would exceed the supply capacity of local or regional distribution systems, resulting in damage to system components, voltage fluctuations, and/or temporary loss of service at frequencies beyond historical averages.
- Growth in average electrical demand would strain the supply capacity of local or regional distribution systems, resulting in the need for unplanned upgrades or diversion of supply from other planned uses.
- Peak demand for liquid fuels would exceed the capacity of onsite fuel storage systems or planned resupply schedules.

- Long-term demand for liquid fuels would strain the capacity of regional or national supply systems.

Potential impacts on energy resources were assessed by comparing projections of utility resource requirements under each alternative against utility system capacities. While some NNSS facilities do not meter utility use, annual site-wide demands are known and were used to make projections for each of the alternatives considered in this SWEIS. Additional information on policies and programs that would beneficially modify energy use patterns (conservation, energy efficiency, renewable energy development, transportation/fleet management, and high-performance, sustainable buildings) are also provided in this subsection. Unless noted otherwise, these impact criteria and methods of analysis apply to all geographic locations and action alternatives within this SWEIS.

5.1.2.2.1 No Action Alternative

Under the No Action Alternative, activities at the NNSS would primarily continue at frequencies and levels consistent with those experienced since 1996. NNSA would continue to maintain and repair facilities and associated infrastructure as needed to maintain the present capabilities of NNSA facilities. The only significant new facility considered would be construction of a large solar power generation facility by an outside commercial entity. Specific activities and their potential effects are discussed in the following subsections.

Electrical Energy. Electrical service at the NNSS is supplied by two commercial power sources: NV Energy and the Valley Electric Association (DOE 2008f). Previous studies have suggested that the onsite distribution system can support a theoretical load of approximately 72 megawatts based on the thermal limits of the smallest conductor, but outside utilities could only furnish approximately 36 megawatts because of the NNSS system's voltage constraints (DOE 2007c).

While recent estimates suggest that the maximum operating capacity is closer to 40 megawatts (NNSA/NSO 2010a), capacity at the NNSS is also limited by load demands on commercial power suppliers from other users outside the NNSS, and not simply the condition of the NNSS system. Valley Electric Association's line serves additional loads including Pahrump, Lathrop Wells, and Beatty. These outside utility loads have increased at a high rate over the past decade, and the spare capacity of the 138-kilovolt transmission system available for NNSS loads has remained static or effectively decreased, despite reductions in NNSS demand.

From 2003 through 2006, annual electrical energy usage at the NNSS ranged from 57,000 to 95,000 megawatt-hours, averaging 81,000 megawatt-hours (DOE 2008f), while the total electrical usage during fiscal year (FY) 2009 was approximately 84,600 megawatt-hours. Although peak power demand at the NNSS has reached as high as 42 megawatts while nuclear testing programs were active, recent power demand typically averages 20 megawatts, with a peak demand of 27 megawatts (NNSA/NSO 2010a).

Excluding construction and operation of a commercial solar power generation facility (described in subsequent paragraphs), average power demand would likely remain near 20 megawatts, with peak demand of 27 megawatts. However, power demands in any particular year can be affected by unplanned factors, including summer temperatures that would increase power needed for facility air conditioning.

For purposes of analysis, NNSA has estimated that not more than a 10 percent increase in average and peak demand would occur under the No Action Alternative, resulting in average and peak power demands of 22 and 30 megawatts, respectively. Furthermore, a 10 percent increase over NNSA's 2009 average electrical demand of 84,600 megawatt-hours would amount to approximately 93,000 megawatt-hours. During 2009, NV Energy and Valley Electric Association provided about 21,675,000 megawatt-hours, collectively. Under the No Action Alternative, NNSA's use of electricity would represent approximately 0.43 percent of the regional electrical demand (NSOE 2010).

Considering the average and peak power demands (22 and 30 megawatts, respectively) and a total NNSS system capacity of 36 megawatts, the NNSS distribution system would be adequate (with 55 to 75 percent of capacity consumed) to support power needs under the No Action Alternative. However, if future demand from offsite users on the commercial power suppliers were to rapidly increase, then the spare capacity of the NNSS distribution could potentially be reduced, resulting in adverse impacts, including voltage fluctuations and blackouts. Such impacts would limit the NNSS's ability to conduct mission-essential experiments while operating support facilities. This impact could be reduced or avoided by negotiating additional power purchases from commercial suppliers. In addition, the physical condition and reliability of the NNSS distribution system would deteriorate over time, although basic maintenance would continue under this alternative. If basic maintenance activities were not sufficient to maintain system reliability, NNSA would pursue more significant system upgrades (including replacement of some line sections, as described under the Expanded Operations Alternative) based on future NEPA analysis and decisions.

NNSA may enter into an agreement with a commercial entity to construct a solar power generation facility within Area 25. Currently, there are no specific proposals from private applicants for construction of a commercial-scale solar power generation facility at the NNSS. To support an NNSS decision allowing commercial-level power production as a land use, NNSA has analyzed a notional design based on other proposed facilities in southern Nevada. Were a specific design to be proposed by a private applicant, additional project-level NEPA analysis would be required. Under the No Action Alternative, a proponent would construct a commercial solar power generation facility with a net generating capacity of 240 megawatts and would utilize a "dry" parabolic mirror technology.

This solar power generation facility would result in an additional power demand during the construction phase (estimated to last 35 months), although some of this power demand would be met through the use of portable diesel-fuel-fired generators. This temporary power demand would likely be covered within the estimated 10 percent increase over existing levels assumed for this alternative. When this solar power generation facility is brought on line, it was assumed that it would supply a portion of its generating capacity to support NNSS needs, with the balance supplied to the outside commercial power grid.

The details of any power sharing arrangements and the need for additional transmission lines to supply the commercial grid are not known at this time, but would be addressed in a future NEPA analysis. The age and condition of the NNSS power system and the resulting voltage limitations would likely prevent expansion of the NNSS system's power capacity much beyond 40 megawatts, unless significant upgrades were made to the system that are not proposed within this alternative. However, any power supplied to the NNSS from this solar power generation facility would likely offset the potential losses from other commercial providers noted above and avoid adverse impacts on the NNSS distribution system. In addition, use of power from a solar power generation facility would reduce the NNSS's reliance on fossil fuel-generated power, resulting in an indirect beneficial impact on air quality.

Liquid Fuels. **Table 5–6** illustrates liquid fuel consumption at the NNSS for FY 2009, which NNSA estimates as representative of annual consumption rates under the No Action Alternative. The trend over the last several years has been a decline in petroleum-based fuel usage. The majority of the NNSS fleet currently operates on alternative fuels; E85 fuel is used for Alternative Fuel Vehicles (AFVs) and B-20 biodiesel is used for all diesel vehicles and off-road equipment. Biodiesel is used in all equipment except emergency generators and boilers, representing the maximum foreseeable usage level for the current equipment inventory. As of December 2008, the NNSS has 548 AFVs that are E85-capable, which equates to 94 percent of the NNSS vehicle fleet.

Table 5–6 Estimated Annual Liquid Fuel Usage Under the No Action Alternative

Fuel Type	*Quantity*
#2 Red Dye Fuel Oil for Heating	66,000 gallons
Unleaded Gasoline	427,000 gallons
Ethanol/E85	217,000 gallons
#2 Diesel	65,000 gallons
Biodiesel	343,000 gallons

Source: NNSA/NSO 2010b.

The NNSS has two service stations, each capable of storing 10,000 gallons of unleaded gasoline and 9,500 gallons of biodiesel for vehicle fueling. Each service station is collocated with an E85 fueling station. The bulk storage tanks in Area 6 are capable of storing approximately 100,000 gallons of biodiesel and 40,000 gallons of unleaded gasoline (DOE 2008l). Both bulk storage tanks are filled and maintained to 80 percent of their storage capacity. In the event of a fuel shortage from outside suppliers, these reserves would be used on a priority basis to meet temporary shortfalls (NSTec 2008b).

Under the No Action Alternative, the NNSS would not experience significant increases in workforce, fleet vehicles, or the number or size of facilities (excluding the construction and operation of the commercial solar power generation facility). NNSA has not identified any activities that would result in long-term increases or large peak demands for liquid fuels under the No Action Alternative. Fuel consumption rates are expected to remain similar to the levels seen in FY 2009. Given the volume of existing storage capacity and existing commercial supply arrangements, NNSA does not foresee difficulty in obtaining liquid fuels from regional suppliers to meet its needs. The NNSS's annual fuel demands make up a very small proportion of total fuel use in the state for most liquid fuels (e.g., less than 0.05 percent of unleaded gasoline use) and are not expected to strain local and regional fuel supply networks (NSOE 2009). However, the NNSS is a major consumer of biodiesel in Nevada, making up approximately 60 percent of the statewide total demand of 575,000 gallons (NSOE 2009). Although not anticipated, if demand were to exceed regional supply, the NNSS could temporarily switch to petroleum-based diesel for most applications until biodiesel is available again.

Construction of a commercial solar power generation facility would result in large numbers of personal vehicles, construction equipment, and diesel generators operating on the NNSS for up to 35 months. However, these activities are not expected to use NNSS fuel supplies; fuel for this activity would be the responsibility of the commercial entity conducting the construction. Similarly, small quantities of fuel may be needed for the operation of the solar power generation facility (supporting heaters, emergency generators, etc.), but this demand would be met by the commercial operator of the facility.

Energy Conservation. Under all alternatives, NNSA would continue to identify and implement energy conservation measures and renewable energy projects in compliance with all applicable Executive orders and DOE orders and policies. These initiatives would serve to reduce consumption of electrical power and liquid fuels on a per-unit basis, suggesting that the estimates for total consumption under this alternative are conservative in nature, as well as potentially avoid adverse impacts related to energy capacity. These measures would also result in a greater proportion of energy use coming from renewable sources, reducing dependence on fossil fuels, and potentially resulting in indirect beneficial impacts on air quality and other environmental resources. The following are some specific examples of energy conservation measures:

- NNSA would improve energy efficiency and reduce greenhouse gas emissions through reduction of energy intensity by 3 percent annually and a total of 30 percent through the end of FY 2015, relative to the energy use baseline in FY03. Energy intensity is the energy consumption per gross square foot of building space, including industrial and laboratory facilities.

- NNSA would continue installation of advanced electric metering systems to the extent practicable at all NNSS buildings, as well as implementation of a centralized data collection, reporting, and management system.

- NNSA would maximize installation of onsite renewable energy projects at the NNSS where technically and economically feasible, with the goal of acquiring at least 7.5 percent of the NNSS's annual electricity and thermal consumption from onsite renewable sources.

- NNSA would ensure that new construction and renovation projects include design, construction, maintenance, and operation practices in support of the high-performance building goals of Executive Order 13423.

5.1.2.2.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, the NNSS would experience a workforce increase of approximately 25 percent, support several new or expanded facilities, and see an overall increase in the frequency and scope of defense experiments and other activities. These changes have the potential to noticeably increase long-term demands for electrical power and liquid fuels, as well as produce demand peaks during major construction efforts or specific experiment events. However, NNSA is also proposing upgrades to the electrical distribution system, development of onsite renewable energy sources, consolidation or closure of unused facilities, and measures to improve energy conservation and efficiency that would collectively reduce or avoid adverse impacts on energy capacity or supply. Specific activities and their potential effects are discussed in the following subsections.

Electrical Energy. NNSA is proposing new or expanded facilities in locations including Areas 6, 12, 16, 17, and 23 (Mercury), as well as the Desert Rock and Pahute Mesa Airstrips. Section 5.1.2.1, "Infrastructure," provides a detailed description of facility sizes, configurations, and locations. All construction or renovation activities would result in temporary increases in electrical power demand, although some of this temporary demand would be met through the use of portable generators rather than tie-ins to the NNSS electrical distribution system. As noted in Chapter 3 of this SWEIS, some facilities are still in the conceptual planning phase and would be analyzed in future NEPA documents when planning and design have evolved.

Operation of new facilities that would support new mission elements or capabilities would result in a clear increase in electrical power demand on the NNSS. However, these new facilities would likely be more energy-efficient than existing buildings, due to implementation of more energy-efficient components and practices. In cases where new facilities would be constructed to relocate or consolidate existing functions (e.g., consolidation of security functions in Area 23), long-term power demand associated with those functions would likely be lower than previous levels.

Proposals under the Expanded Operations Alternative could result in development of more than 400,000 square feet of building space (added to the approximate 2.45 million square feet currently managed) on the NNSS, or an approximate 16 percent increase. It is reasonably foreseeable that NNSA would also decommission any existing buildings that are no longer needed, as it has committed to an ongoing reduction of the total building footprint through its Facility and Infrastructure Assessment Process. Up to approximately 28 percent of the existing managed building square footage at NNSS could be dispositioned under the Expanded Operations Alternative (NNSA/NSO 2010d, 2010e). However, the period between completion of a new construction project and initiation of decommissioning activities is unknown; when dispositioning occurs, it would further reduce the electrical energy demand.

To account for any uncertainties regarding changes in building square footage and associated power demands in any particular year, implementation of energy efficiency measures to new and existing buildings, and an anticipated 25 percent increase in NNSS workforce numbers, NNSA estimates that average power demand would increase by no more than 25 percent from that analyzed under the No Action Alternative in any year, while peak power demand (including demand associated with construction or renovation activities) would increase by no more than 35 percent. A 35 percent increase over NNSA's 2009 average electrical demand of 84,600 megawatt-hours would amount to approximately 105,700 megawatt-hours. During 2009, NV Energy and Valley Electric Association provided about 21,675,000 megawatt-hours, collectively. Under the Expanded Operations Alternative, NNSS use of electricity would represent approximately 0.49 percent of the regional electrical demand (NSOE 2010).

The projected increases would result in an average power demand of approximately 28 megawatts, with a peak demand of approximately 41 megawatts. The capacity of the existing NNSS distribution system (estimated at approximately 36 megawatts) would be sufficient to meet average demand, but peak demand periods could exceed the capacity, potentially resulting in voltage fluctuations or blackouts. As noted under the No Action Alternative, any reduction in supply to the NNSS from commercial power suppliers would also reduce the effective supply to the NNSS, making these adverse effects more likely.

Under the Expanded Operations Alternative, NNSA would propose to upgrade the existing 138-kilovolt electrical distribution system to better provide for this projected demand, increase service reliability, and leave capacity to support any future growth on the NNSS. About 39 miles of the existing system would be replaced between Mercury Switching Center in Area 23 and Valley Substation in Area 2. The replacement transmission line would be constructed on steel towers on a right-of-way generally paralleling the existing system. Sufficient separation between the existing transmission line and the new line would be required to ensure electrical safety during construction of the new line and demolition of the old line.

The transmission line replacement project would occur in three distinct and separately operable stages: (1) Mercury Switching Center to Frenchman Flat Substation, with a loop tap at Mercury Distribution Substation (approximately 15 miles); (2) Frenchman Flat Substation to Tweezer Substation in Area 6 (approximately 9.5 miles); and (3) Tweezer Substation to Valley Substation in Area 2 (approximately 14 miles). NNSA would coordinate this upgrade, or distinct stages of it, with other proposed activities under this alternative to ensure that additional system capacity and reliability were in place prior to significant additional power demands coming on line.

The new transmission line would increase the capacity of the system from the current level of about 36 megawatts up to approximately 100 megawatts and improve the efficiency of the system (NNSA/NSO 2010c). However, to utilize any capacity above the current level of 36 megawatts, NNSA would need to purchase additional power from a supplier and could seek to negotiate additional power through an offsite commercial provider, such as NV Energy or Valley Electric Association, if the onsite solar power generation facility is not constructed. If additional power is available from these outside commercial providers, the NNSS's distribution system would be adequate to meet all projected demands, and no adverse impacts would be expected. However, it is not known whether these commercial providers would be able to accommodate NNSS's additional power demands at that time.

Under the Expanded Operations Alternative, NNSA may allow the construction and operation of one or more solar power generation facilities similar to the facility described under the No Action Alternative, but with a net generating capacity of approximately 1,000 megawatts. If these facilities are constructed, NNSA would likely seek to purchase a portion of the facilities' power, while the balance would be exported to the commercial power grid. This arrangement would allow NNSS's electrical distribution system to meet all projected demands, and no adverse impacts are expected. Such a power-sharing agreement would also enable the NNSS to better meet its goals for use of renewable energy sources, as well as reduce the NNSS's reliance on fossil fuel-generated power, resulting in an indirect beneficial impact on air quality and other environmental resources.

In addition, under the Expanded Operations Alternative, NNSA would construct a 5-megawatt photovoltaic solar power generation facility near the Area 6 Construction Facilities. While this project would result in a temporary additional demand for electrical power during construction (covered within the increases estimated under this alternative), it would later provide an additional source of power for the NNSS distribution system and further NNSA's progress toward reducing dependence on fossil-fuel-based electricity.

NNSA would also evaluate the feasibility of demonstrating a pilot-scale, enhanced geothermal power system. The primary objective would be to demonstrate the viable recovery of a practical operating level energy (5 to 50 megawatts) from rock that is hot (greater than 180 degrees Celsius [ºC]), but does not contain mobile water. The size of the pilot-scale geothermal power system would be unique to each site's geothermal characteristics and based on the optimal balance of temperature, rock reservoir size, heat exchange rate, water pressure, and flow rate, among other factors. If this pilot-scale geothermal power system demonstration project were found to be technically feasible, it would then serve as a testing facility for improvements applicable to similar systems elsewhere, as well as supply some additional electrical power to the NNSS. A decision on the best location for a geothermal power system would depend on a combination of the system's power generation potential, environmental constraints, and economic considerations. Because there are no location-specific proposals for development of a geothermal power system on the NNSS at this time, additional NEPA analysis would be required before such work could be conducted.

Liquid Fuels. NNSA is proposing new or expanded facilities in locations including Areas 6, 12, 16, 17, and 23 (Mercury), as well as Desert Rock and Pahute Mesa Airstrips. Section 5.1.2.1, "Infrastructure," provides a detailed description of facility sizes, configurations, and locations. All construction or renovation activities would result in temporary increases in liquid fuel demand. In some cases, long-term increases in total fuel usage may be required to operate additional buildings and equipment and meet the greater vehicle fuel needs associated with the increased frequency of certain experiments and training activities.

However, the planned consolidation of certain functions (e.g., consolidation of security functions in Area 23) would reduce the need to travel between locations, thereby reducing associated vehicle requirements and fuel consumption. All new buildings are also expected to be more fuel-efficient on a square-foot basis due to the inclusion of "green" technologies in building design. As noted in Chapter 3 of this SWEIS, some other facilities are still in the conceptual planning phase and would be analyzed in future NEPA documents when planning and design have evolved further.

To account for changes in building square footage, the timing of construction projects, implementation of energy efficiency measures, and an anticipated 25 percent increase in NNSS workforce numbers, NNSA estimates that annual liquid fuel demand would increase by no more than 25 percent from that analyzed under the No Action Alternative in any year. While additional demand associated with vehicles would likely be associated with nonpetroleum fuels (E85 and biodiesel), it is reasonably foreseeable that other uses (boilers, emergency generators) would increase the use of petroleum-based fuels (heating oil, #2 diesel, unleaded gasoline) if they could not be configured for alternative fuels. **Table 5–7** presents estimated annual liquid fuel demand under the Expanded Operations Alternative.

Table 5–7 Estimated Annual Liquid Fuel Usage Under the Expanded Operations Alternative

Fuel Type	*Quantity*
#2 Red Dye Fuel Oil for Heating	83,000 gallons
Unleaded Gasoline	534,000 gallons
Ethanol/E85	271,000 gallons
#2 Diesel	81,000 gallons
Biodiesel	429,000 gallons

New facilities with boilers or liquid-fuel-fired heating units would include adjacent fuel storage tanks in their designs. NNSA would also retain the vehicle service stations and the Area 6 bulk storage tanks (kept filled to 80 percent capacity) described under the No Action Alternative. Given the volume of existing storage tanks and existing commercial supply arrangements, NNSA does not foresee difficulty in obtaining liquid fuels from regional suppliers to meet its needs. The NNSS's projected annual fuel demands would make up a very small proportion of the current, total fuel use in the state for most liquid fuels (e.g., approximately 0.05 percent of unleaded gasoline use) and are not expected to strain local and regional fuel supply networks (NSOE 2009). However, the NNSS is a major consumer of biodiesel in Nevada, making up approximately 60 percent of the statewide total demand of 575,000 gallons (NSOE 2009); under this alternative NNSA would increase consumption of biodiesel to about 75 percent. Although not anticipated, if demand were to exceed regional supply, the NNSS could temporarily switch to petroleum-based diesel for most applications until biodiesel is available again.

Construction of one or more commercial solar power generation facilities with a 1,000-megawatt combined capacity would result in large numbers of personal vehicles, construction equipment, and diesel generators operating on the NNSS for up to 42 months. However, these activities are not expected to use NNSS fuel supplies; fuel for this activity would be the responsibility of the commercial entity conducting the construction. Similarly, small quantities of fuel may be needed for operation of the commercial solar power generation facility (supporting heaters, emergency generators, etc.), but this demand would be met by the commercial operator of the facility.

Construction and operation of the 5-megawatt photovoltaic solar power generation facility in Area 6, and the geothermal demonstration project (no specific location proposed at this time) would also use small quantities of liquid fuel to supply emergency generators, heaters, and/or boilers. NNSA estimates that the fuel demand from these activities would be captured within the 25 percent overall demand increase associated with this alternative.

Energy Conservation. NNSA would continue to identify and implement the energy conservation measures and renewable energy projects described under the No Action Alternative. These initiatives would serve to reduce consumption of electrical power and liquid fuels on a per-unit basis, suggesting that the estimates for total consumption under this alternative are conservative in nature and would potentially avoid adverse impacts related to energy capacity. These measures would also result in a greater proportion of energy use coming from renewable sources, reducing dependence on fossil fuels, and potentially resulting in indirect beneficial impacts on air quality and other environmental resources.

5.1.2.2.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the NNSS would operate below current levels, and a number of facilities would be decommissioned, thereby reducing energy needs. Conservation and renewable energy goals would continue to be pursued, further reducing energy demand.

NNSA would continue to maintain, repair, and modify operating facilities and infrastructure, as needed and within funding limits, and would conduct small projects to maintain the present capabilities of NNSA/NSO facilities (described under the No Action Alternative). Under the Reduced Operations Alternative, however, all activities would cease in the northwestern portion of the NNSS within Areas 18, 19, 20, 29, and 30, with the exception of maintenance and operation of the Echo Peak, Motorola, and Shoshone communications facilities; the Echo Peak, Castle Rock, and Stockade Wash Substations, including electrical transmission lines interconnecting these substations; and Well 8. NNSA would continue environmental restoration, environmental monitoring, site security operations, and military training and exercises within these areas. No infrastructure projects would be conducted in these northwestern areas beyond maintaining mission-essential facilities and critical electrical and communication systems. The Reduced Operations Alternative also includes a 100-megawatt commercial solar power generation facility in Area 25.

Additional information on energy use (electrical and liquid fuels) and energy conservation and efficiency is provided below.

Electrical Energy. Under the Reduced Operations Alternative, net NNSS power demand would be reduced as numerous activities across the NNSS were scaled back or eliminated. Based on a projected 10 percent decrease in staffing at the NNSS and the eventual closure of several facilities, NNSA estimates that average power demand would decrease by 10 percent (to 20 megawatts) compared to demand under the No Action Alternative, and peak demand also decreasing by 10 percent (to 27 megawatts). A 10 percent decrease from NNSA's 2009 average electrical demand of 85,600 megawatt-hours would reduce demand to approximately 76,140 megawatt-hours. During 2009, NV Energy and Valley Electric Association provided about 21,675,000 megawatt-hours, collectively. Under the Reduced Operations Alternative, use of electricity would represent approximately 0.35 percent of the regional electrical demand (NSOE 2010). These projected demand reductions, along with ongoing implementation of energy efficiency measures, would make the current distribution system capacity of 36 megawatts adequate for both average and peak power demands.

As noted under other alternatives, any reduction in power to the NNSS from commercial suppliers would reduce the effective power supply on the NNSS, which would make adverse effects (e.g., voltage fluctuations and temporary loss of service) possible, but still unlikely. In addition, the physical condition and reliability of the NNSS distribution system would deteriorate over time, although basic maintenance would continue under this alternative. If basic maintenance activities were insufficient to maintain system reliability, NNSA would pursue the more-significant system upgrades (including replacement of some line sections) as described under the Expanded Operations Alternative, based on a future NEPA analysis and decision.

Under the Reduced Operations Alternative, NNSA may allow construction and operation of a solar power generation facility similar to that described under the No Action Alternative. However, the size of this facility would be reduced, resulting in a net generating capacity of approximately 100 megawatts. If this facility were constructed, NNSA would likely seek to purchase a portion of this facility's power, and the balance would be exported to the commercial power grid. This arrangement would allow NNSS's distribution system to meet all projected demands with more confidence, and no adverse impacts would be expected. Such a power-sharing agreement would also enable the NNSS to better meet its goals for use of renewable energy sources by reducing the NNSS's reliance on fossil fuel-generated power, resulting in an indirect beneficial impact on air quality and other environmental resources.

Liquid Fuels. Under the Reduced Operations Alternative, liquid fuel demand from all uses would decrease as activity and staffing levels were reduced. NNSA estimates that demand for all fuel types would decrease by approximately 10 percent from the levels seen in the No Action Alternative. **Table 5–8** presents estimated annual fuel demand under the Reduced Operations Alternative.

Table 5–8 Estimated Annual Liquid Fuel Usage Under the Reduced Operations Alternative

Fuel Type	*Quantity*
#2 Red Dye Fuel Oil for Heating	59,000 gallons
Unleaded Gasoline	384,000 gallons
Ethanol/E85	195,000 gallons
#2 Diesel	59,000 gallons
Biodiesel	309,000 gallons

Given the volume of existing storage tanks (described under the No Action Alternative) and existing commercial supply arrangements, NNSA does not foresee difficulty in obtaining liquid fuels from regional suppliers to meet its needs. The NNSS's projected annual fuel demands would make up a very small proportion of current, total fuel use in the state for most liquid fuels (for example, less than 0.04 percent of unleaded gasoline use) and are not expected to strain local and regional fuel supply networks (NSOE 2009). However, the NNSS is a major consumer of biodiesel in Nevada, making approximately 60 percent of the statewide total demand of 575,000 gallons (NSOE 2009); under this alternative NNSA would decrease consumption of biodiesel to about 54 percent. Although not anticipated, if demand were to exceed regional supply, the NNSS could temporarily switch to petroleum-based diesel for most applications until biodiesel is available again.

Construction of a commercial 100-megawatt solar power generation facility would result in large numbers of personal vehicles, construction equipment, and diesel generators operating on the NNSS for up to 32 months. However, these activities are not expected to use NNSS fuel supplies; fuel for this activity would be the responsibility of the commercial entity conducting the construction. Similarly, small quantities of fuel may be needed for operation of the solar power generation facility (supporting heaters, emergency generators, etc.), but this demand would be met by the commercial operator of the facility.

Energy Conservation. NNSA would continue to identify and implement the energy conservation measures and renewable energy projects described under the No Action Alternative. These initiatives would reduce consumption of electrical power and liquid fuels on a per-unit basis, suggesting that the estimates for total consumption under this alternative are conservative in nature, and would potentially avoid adverse impacts related to energy capacity. These measures would also result in a greater proportion of energy use coming from renewable sources, reducing dependence on fossil fuels, and potentially resulting in indirect beneficial impacts on air quality and other environmental resources.

5.1.3 Transportation and Traffic

Section 5.1.3.1 evaluates both radiological and nonradiological impacts from shipment of radioactive waste to the NNSS, onsite shipment of radioactive waste, and shipment of other radioactive materials to and from the NNSS; only nonradiological impacts would result from shipment of nonradioactive materials. Radiological impacts are those associated with the effects of low levels of radiation emitted during incident-free transportation and those resulting from the accidental release of radioactive materials;

radiological impacts are expressed as additional latent cancer fatalities (LCFs). Nonradiological impacts are independent of the nature of the cargo being transported and are expressed as traffic accident fatalities when there is no release of radioactive material. Note that all shipments must meet U.S. Department of Transportation (DOT) regulations, and the packaging of radioactive materials must meet U.S. Nuclear Regulatory Commission regulations, as discussed in Appendix E, Sections E.3.1 and E.3.2. NNSS shipments have never exceeded regulatory requirements for transportation radiation limits.

Section 5.1.3.2 discusses the traffic impacts that would result from changes in the current numbers of personnel trips and trucks transporting radioactive and nonradioactive materials due to the differing activity levels among alternatives. Traffic impacts are expressed as the percent change in the number of onsite and regional (i.e., offsite) daily vehicle trips and changes in roadway levels of service associated with transporting personnel, materials, and waste.

The following criteria are used to analyze the risks of potential transportation activities during incident-free operations and accidents:

- Radiation dose and risk to the public, including cumulative effects to the population and effects to maximally exposed individuals (MEIs)
- Radiation dose and risk to workers, including cumulative effects to the worker population and effects to MEIs
- Number of traffic fatalities resulting from traffic accidents (not related to the radioactive cargo)

These criteria are used to evaluate potential impacts on onsite and regional traffic conditions:

- Percent change in average daily traffic for onsite and regional traffic conditions
- Degree of change in the volume-to-capacity and resulting level of service for key roadways under regional traffic conditions

Increases in nonradioactive pollutants from traffic emissions are discussed in Chapter 5, Section 5.1.8, "Air Quality and Climate." Appendix E contains a more-detailed description of the transportation analysis and results.

Transportation—American Indian Perspective

CGTO

Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation arise resulting from Nevada National Security Site (NNSS)-related activities, including the transportation of hazardous and radioactive waste, it could result in the closure of the main transportation artery to that land. If a major (only) road into a reservation closes, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays or separation from their families or support systems. Delays could also occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use or medical supplies. Emergency medical services en route to or from the reservation, and purchases by patrons of tribal enterprises could be dramatically impeded. Potential investors interested in expanding tribal enterprises, as well as on-going considerations by tribal governments for future or current tribal enterprises, may significantly diminish because of the real and perceived risks from the transportation of hazardous and radioactive waste associated with NNSS-related activities.

Because of these potential transportation impacts relating directly to NNSS activities, the Consolidated Group of Tribes and Organizations (CGTO) recommends the U.S. Department of Energy (DOE) collaborate with potentially affected tribes to develop emergency response measures regarding transportation.

See Appendix C for more details.

5.1.3.1 Transportation

Methodology and Assumptions. Shipping packages containing radioactive materials emit low levels of radiation; the amount of radiation depends on the kind and amount of transported materials. DOT regulations (49 CFR Part 173 Subpart I) require shipping packages containing radioactive materials to have sufficient radiation shielding to limit the radiation to 10 millirem per hour at a distance of 6.6 feet from the transporter. For incident-free transportation, the potential human health impacts of the radiation field surrounding the transportation packages were estimated for transportation workers and the general population along the route (off-traffic, or off-link), as well as for people sharing the route (in-traffic or on-link) and at rest areas and other stops along the route. The Radioactive Material Transportation Risk Assessment Code 6 (RADTRAN)] computer program (SNL 2009b) was used to estimate the impacts on transportation workers, the public, and an MEI (e.g., a person stuck in traffic, a gas station attendant, an inspector).

Waste Transportation through the Las Vegas Valley

Historically, the U.S. Department of Energy (DOE) committed to the State of Nevada that it would avoid shipping low-level radioactive waste through the Interstate 15/U.S. 95 interchange in Las Vegas, Nevada. This commitment was made when major highways, such as Interstate 15 and U.S. Route 95 were unable to accommodate increased traffic volumes. The commitment as stated in the Waste Acceptance Criteria for the Nevada National Security Site (NNSS) avoided Hoover Dam and Las Vegas. In compliance with this requirement, commercial carriers of low-level radioactive waste used alternate shipping routes, such as Nevada State Route 160.

Now, the transportation infrastructure throughout metropolitan Las Vegas, such as Interstate 15, U.S. Route 95 have been expanded and improved. In addition, the 215 Beltway was built to take traffic around the center of Las Vegas. Moreover, highways that continue to be used to transport waste, such as Nevada State Route 160, have experienced increased traffic as the population has grown in that area of the valley.

The National Nuclear Security Administration (NNSA) has analyzed two transportation cases: one that reflects the existing commitment (constrained case) and one that permits shipments through the greater metropolitan Las Vegas (unconstrained case). This analysis was undertaken to develop a greater understanding of the potential environmental consequences of shipping such waste through and around metropolitan Las Vegas, and to provide information relevant to consideration of potential highway routing-related revisions to NNSS's Waste Acceptance Criteria. Although an analysis of low-level/mixed low-level waste shipping routes is included in this site-wide environmental impact statement, individual decisions on routing will not be made as part of this National Environmental Policy Act process; such decisions are developed in accordance with NNSA's standard practices which include consultation with the State of Nevada, and when finalized become publicly available through publication on NNSS' website.

Transportation accidents involving radioactive materials present both nonradiological and radiological risks to workers and the public. Nonradiological impacts of transportation accidents include traffic accident fatalities. Radioactive material would be released during transportation accidents only when the package carrying the material is subjected to forces that exceed the package design standard. Only a severe fire and/or a powerful collision, both events of extremely low probability, could damage a transportation package of the type used to transport radioactive material to the extent that radioactivity would be released to the environment with significant consequences.

The radiological impact of a specific accident is expressed in terms of probabilistic risk (i.e., dose-risk), which is defined as the accident probability (accident frequency) multiplied by the accident consequences (dose). The overall radiological risk estimate is obtained by summing the individual radiological risks from all reasonably conceivable accidents. Analysis of accident risks accounts for a spectrum of accident severities, ranging from high-probability accidents of low severity (e.g., fender benders) to hypothetical high-severity accidents that have a low probability of occurrence. In addition to calculating the radiological risks that would result from all reasonably conceivable accidents during transportation of radioactive materials, this SWEIS assesses the highest consequences of a maximum reasonably foreseeable accident with a radioactive release frequency greater than 1×10^{-7} (1 chance in 10 million) per year in an urban or suburban population area along the route.

This latter analysis used the Risks and Consequences of Radioactive Material Transport (RISKIND) computer program to estimate doses to individuals and populations (Yuan et al. 1995).

Incident-free radiological health impacts are expressed in terms of additional LCFs. Radiological health impacts from accidents are also expressed as additional LCFs. Nonradiological accident impacts are expressed as additional immediate (traffic accident) fatalities. LCFs associated with radiological exposure were estimated by multiplying the occupational (worker) and public dose by a dose conversion factor of 0.0006 LCFs per rem or person-rem of exposure (DOE 2003d). The health impacts associated with the shipment of radioactive wastes were calculated assuming that all wastes would be transported using either truck or rail transport. Health impacts associated with the shipment of special nuclear material (SNM) and nuclear weapons were calculated assuming these materials would be transported by DOE safeguards transporters.

In determining transportation risks, per-shipment risk factors were calculated for incident-free and accident conditions using the RADTRAN 6 computer program (SNL 2009b) in conjunction with the Transportation Routing Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) to choose transportation routes in accordance with DOT regulations. The TRAGIS program provides population density estimates for rural, suburban, and urban areas along the routes based on the 2000 U.S. census. The population density estimates were escalated to 2016 population density estimates using state-level 2000 and 2010 census data and assuming population growth between 2000 and 2010 would continue through 2016. For incident-free operations, the affected population includes individuals living within 0.5 miles of each side of the road or rail line. For accident conditions, the affected population includes individuals living within 50 miles of the accident, and the MEI was assumed to be a receptor located 330 feet directly downwind from the accident. Additional details on the analytical approach and on modeling and parameter selections are provided in Appendix E of this SWEIS.

Route-specific accident and fatality rates for commercial truck transports and rail shipments were used to determine the risk of traffic accident fatalities (Saricks and Tompkins 1999) after being adjusted for possible under-reporting (UMTRI 2003). Statistics specific to DOE safeguards transporters are used for safeguards transporters shipments (Phillips, Clauss, and Blower 1994). The methodology for obtaining and using accident and fatality rates is provided in Appendix E, Section E.6.2, “Accident Rates.”

Maximally Exposed Individual (MEI) – A hypothetical individual whose location and habits result in the highest total radiological exposure (and thus dose) from a particular source for all relevant exposure routes (e.g., inhalation, ingestion, direct exposure).

Rem – A unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem is estimated by a formula that accounts for the type of radiation, the total absorbed dose, and the tissues involved. One thousandth of a rem is a millirem. The average dose to an individual in the United States primarily from natural background sources of radiation is about 310 millirem per year; the national average including medical sources is about 620 millirem per year.

Person-rem – A unit of collective radiation dose applied to a population or group of individuals. It is calculated as the sum of the estimated doses, in rem, received by each individual of the specified population. For example, if 1,000 people each received a dose of 1 millirem, the collective dose would be 1 person-rem (1,000 persons × 0.001 rem).

Latent cancer fatalities (LCFs) – Deaths from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens. This site-wide environmental impact statement focuses on LCFs as the primary means of evaluating health risk from radiation exposure. The values reported for LCFs are the increased risk of a fatal cancer for a MEI or noninvolved worker or the increased risk of a single fatal cancer occurring in an identified population.

This NNSS SWEIS presents a transportation analysis of two cases; a constrained case and an unconstrained case.

Constrained Case

For the constrained case, it was assumed that DOE would maintain current operational practices by avoiding transporting waste and materials across the Colorado River near the Hoover Dam and on the interstate system within Las Vegas. It was further assumed that shipments approaching the NNSS from the south (via Interstate 40), would use U.S. Route 95 to Nevada State Route 164, to Interstate 15, to Nevada State Route 160, to U.S. Route 95. Shipments approaching the NNSS from the north would use U.S. Routes 50, 6, and 95. The constrained case is analyzed for all alternatives and addresses both radioactive waste and other radioactive material transports.

As appropriate, for each SWEIS alternative, transportation impacts were evaluated for transport of (1) LLW and MLLW to the NNSS for disposal and from the NNSS to a treatment facility and then returned; (2) transuranic (TRU) waste from the NNSS to Idaho National Laboratory (INL) for treatment and certification; (3) SNM to and from the NNSS; (4) nuclear weapons to and from the NNSS for exchange of limited life components; (5) nuclear weapons to the NNSS for dismantlement and subsequent transport of plutonium to Pantex, canned subassemblies to the Y-12 Plant, and milliwatt generators to Los Alamos National Laboratory; (6) sealed sources from San Antonio; Texas to the NNSS, and (7) nonradioactive hazardous and sanitary waste and recyclables from the NNSS. The number of transports of LLW and MLLW to the NNSS were based on DOE projections as estimated by waste generators (see Appendix E, Table E–3). The number of transports for other wastes and materials were based on programmatic needs as described in Appendix A.

For the Expanded Operations Alternative, LLW and MLLW volumes from waste generators were determined using data from the Waste Management Information System. These waste volumes were apportioned to containers and number of shipments using historical data regarding the types of containers typically received (note that containers may be used to transport waste to NNSS that were not assumed as part of this analysis as described in Appendix E, Table E–4). These volumes are apportioned to regions of the United States (see Appendix E, Figure E–2) based on the locations of the waste generators. The following regions were used for analyzing radioactive waste shipments: Northeast, South, Southeast, Upper Midwest, Southwest, Mountain West, West, and Northwest (see Appendix E, Figure E–2, for a depiction of the regions). The transportation analysis is based on the regional waste volume totals so that waste generators would not be limited to those obtained from the Waste Management Information System. The waste volume from each region is assumed to be received from a regional location that would provide a conservative estimate of the impacts from transporting from that region based on distance traveled and population density along the route. This approach was used because not all potential waste generators may be identified in the Waste Management Information System and to account for the amount of uncertainty in the magnitude of waste volume projections.

For the No Action Alternative and Reduced Operations Alternative, it was assumed that the total amount of LLW to be received over a ten-year period, 15,000,000 cubic feet, would be based on the average annual volumes received between FY 1997 and the end of FY 2010. The volume of MLLW analyzed under the No Action and Reduced Operations Alternatives is 900,000 cubic feet, which is based on the permitted volume of Cell 18 at the Area 5 Radioactive Waste Management Complex (RWMC) (the actual permitted volume is 899,996 cubic feet). This volume was apportioned to the waste generators shown in Appendix E, Table E–3 using the percentage of the total volume each waste generator contributed to the waste projections under the Expanded Operations Alternative.

DOE has completed NEPA documentation for other projects in the DOE Complex in which waste was projected to be transported to NNSS and are not yet included in the Waste Management Information System. These waste streams are included under the Expanded Operations Alternative with their transportation impacts shown separately. These waste streams include conversion products from Portsmouth, Ohio, and Paducah, Kentucky (DOE 2004e, 2004d), decommissioning waste from the West Valley Demonstration Project (DOE 2010c), and uranium-233 downblending waste from Oak Ridge National Laboratory (DOE 2010b).

To assess incident-free and transportation accident impacts related to radioactive waste shipments, radioactive waste shipments were assumed to be conducted by truck or by a combination of rail and truck. Rail transport to the NNSS is not possible; therefore, rail cargo must be transferred to trucks at a transfer station. For purposes of analysis only for the constrained case, two transfer station sites were assumed: Parker, Arizona, and West Wendover, Nevada. These stations are those outside of Las Vegas, but nearest to the NNSS, at which transfers have occurred in the past. The overall transportation impacts associated with using transfer stations at Parker and West Wendover would be comparable to other locations in the vicinity of the NNSS. For instance, use of a transfer station at Arden, south of Las Vegas, would yield comparable results because it is located along the truck route between Parker and the NNSS. For LLW and MLLW waste shipments, Appendix E, Figure E–3 depicts the analyzed truck and rail routes from each region of the United States while Appendix E, Figure E–4 depicts the analyzed truck routes from the transfer stations at Parker, Arizona and West Wendover, Nevada to the NNSS.

The NNSS would send TRU waste to INL for treatment and certification before shipping it to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Rail transport was not analyzed for TRU waste. The INL contractor would assume responsibility for treating, certifying, and transporting the TRU waste to WIPP.

Nuclear weapons and SNM would be transported to and from the NNSS by safeguards transporters. Types of SNM are identified in Appendix A, Section A.2.1.1. Truck routes between specific origination and destination sites were analyzed for the transportation of SNM. For nuclear weapons, routes from different regions of the United States were analyzed and the route that yields the highest impacts was used for the analysis.

Unconstrained Case. In the unconstrained case, transportation by (a) all truck and (b) the combination rail-truck are analyzed.

(a) All truck: Impacts are analyzed for two route segments. The first segment is from the originating regional site to an entry point to Las Vegas (see Appendix E, Figure E–5). These entry points are Henderson (at the intersection of I-515 and U.S. Route 95), Apex (on I-15 north of Las Vegas), and Arden (on I-15 just south of the junction of I-15 and I-215). Only a portion of the offsite shipments are analyzed to each entry point with the sum entering all three points being 100 percent of the shipments. This provides a more realistic analysis such that truck shipments would only enter the Las Vegas area from a direction that makes the most sense (for example, shipments from the West region would not go to Henderson, but would enter the Las Vegas area at Arden). The second segment consists of different routes from these entry points to NNSS. It was assumed that there would be no route limitations in the Las Vegas area; shipments could proceed through or around Las Vegas on several different possible routes, as depicted in **Figure 5–4**. Truck routes were analyzed in segments to make it easier to analyze multiple routes (different segments can be added together).

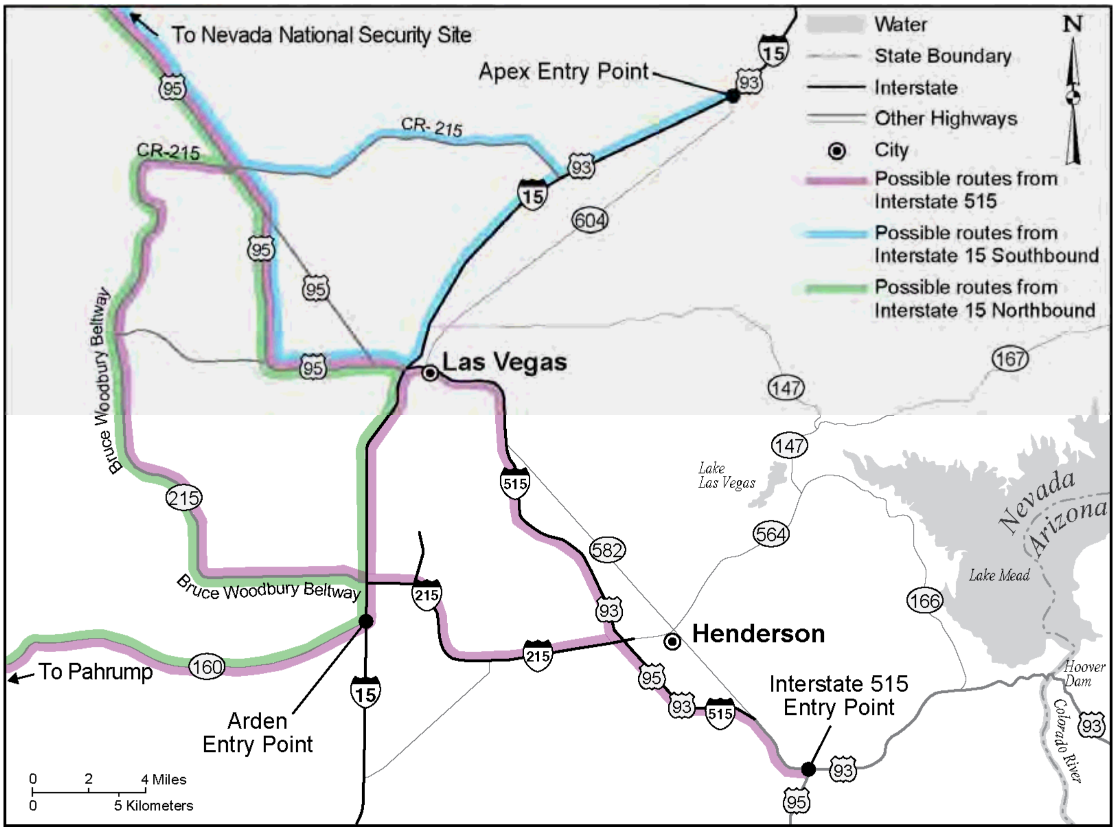


Figure 5–4 Transportation Routes Analyzed in Las Vegas for the Transport of Low-Level and Mixed Low-Level Radioactive Waste for the Unconstrained Case

(b) Rail-Truck: Rail-truck transportation impacts are also analyzed by route segment. The first segment is rail transport from each region of the United States to a transfer station location in the Las Vegas region. All of the rail shipments are assumed to be transported to five different transfer station locations where they would be transferred to truck. As depicted in **Figure 5–5**, these five locations are West Wendover, Apex, and Arden, Nevada; and Parker and Kingman, Arizona. [Note: In practice, the location at which shipments would be received would be dependent on arrangements made by the shipper. The actual impacts would fall within the range of results determined in this analysis.] Appendix E, Figures E–7 through E–8 show the rail routes to each transfer station location. When analyzing rail-to-truck transportation, truck transport from an analyzed transfer station to a Las Vegas entry point (identified in (a) above) is evaluated as a segment, as depicted in Appendix E, Figure E–9. Note that the truck segment from the transfer station to the entry point is only applicable to West Wendover, Parker, and Kingman because the transfer stations at Apex and Arden are already located at an entry point to Las Vegas. Truck transport from West Wendover would proceed to the Apex entry point; truck transport from Parker would proceed to Henderson via U.S. Route 95; and truck transport from Kingman would proceed to Henderson via U.S. Route 93 over the bridge downstream of the Hoover Dam. The final segment is truck travel from a Las Vegas entry point to NNSS as described in (a) above and depicted in Figure 5–4.

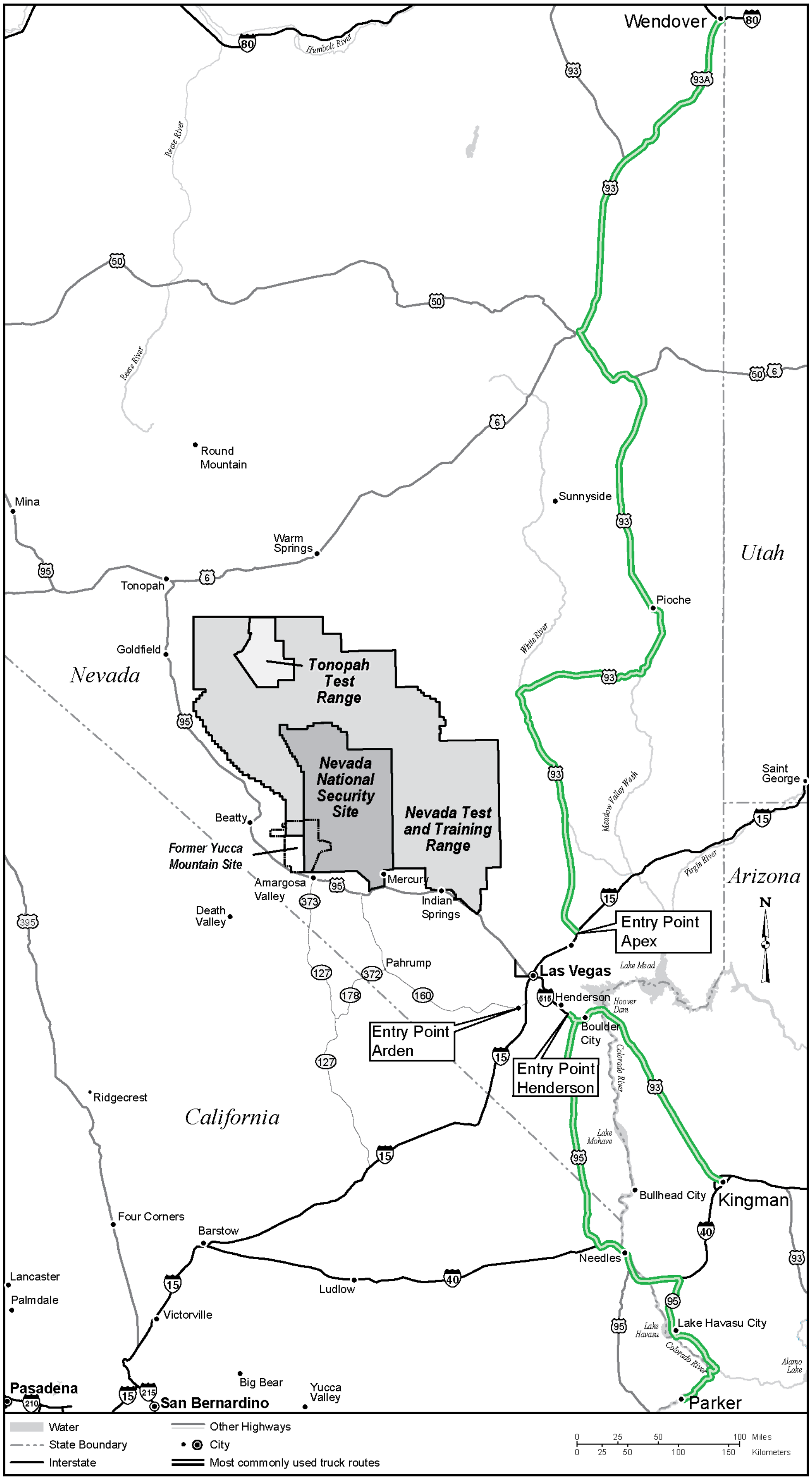


Figure 5–5 Transfer Station Locations and Analyzed Routes from These Locations to Las Vegas for the Unconstrained Case

In addition to analyzing the use of transfer stations in the Las Vegas region, truck-to-rail transfer station locations are analyzed for three different regions of the United States: Southwest region, Northeast region, and West region (see Appendix E, Figure E–2, for a depiction of the regions). This analysis is performed to provide representative impacts associated with transporting LLW/MLLW from generating sites in these regions to a regional transfer station. These regions were selected because there are known possible LLW and/or MLLW generating sites in these regions that do not have direct access to rail.

Comparison of Impacts. Table 5–9 provides the estimated number of waste truck shipments under each alternative from each region, by container type for LLW and MLLW. A shipment is defined as the amount of waste transported on a single truck or a single railcar. The number of rail shipments would be half of the number of truck shipments. The different types of containers shown in the table are described in Appendix E, Section E.4.2.

TRU waste would be generated at the NNSS under all alternatives. Projected TRU waste shipments would include waste in storage, TRU waste generated by the Joint Actinide Shock Physics Experimental Research (JASPER) operations from 2011 through 2020, and waste from environmental restoration activities at the TTR and the Nevada Test and Training Range. **Table 5–10** shows the number of shipments of TRU waste, radioisotopic thermoelectric generators, sealed sources, SNM, and nuclear weapons under each alternative.

Impacts are presented for the constrained case for the No Action, Reduced Operations, and Expanded Operations Alternatives for transport of all radioactive waste and materials. **Tables 5–11** and **5–12** present the estimated impacts associated with the constrained case for each alternative for radioactive waste and radioactive materials, respectively. Section 5.1.3.1.2.2, presents the estimated impacts associated with the unconstrained case.

Table 5–9 Estimated Number of Truck Shipments of Low-Level and Mixed Low-Level Radioactive Waste Under Each Alternative Over a 10-Year Period [a]

In-State/Out-of-State Source	*Total Number of Shipments*	*Container Type*				
		Drums	*B-25 Box*	*Sealand [b]*	*B-12 Box*	*Type B Container [c]*
No Action and Reduced Operations Alternative						
Northeast	140	13	88	39	0	0
South	9,100	520	1,500	3,200	0	3,900
Southeast	120	15	26	75	0	0
Upper Midwest	10,000	480	2,400	7,100	0	0
Southwest	3,100	3,000	9	10	0	0
Mountain West	1,200	1	310	340	470	94
West	1,000	660	120	270	0	0
Northwest	7	1	2	4	0	0
Other Out-of-State Shipments [e]	1,600	N/A	N/A	1,600	N/A	N/A
In-state [g]	2,300	790	0	1,500	0	0
Total – Out-of-State Waste	**26,000**	**4,700**	**4,500**	**13,000**	**470**	**4,000**
Total – All	**29,000**	**5,500**	**4,500**	**14,000**	**470**	**4,000**
Expanded Operations Alternative [d]						
Northeast	290	24	190	80	0	0
South	19,000	50	3,100	7,800	0	8,200
Southeast	310	30	100	180	0	0
Upper Midwest	20,000	1,000	5,100	14,000	0	14
Southwest	7,800	7,800	20	19	0	0
Mountain West	3,100	1	1,200	740	990	190
West	3,000	2,200	250	560	0	0
Northwest	24	4	16	4	0	0
Other Out-of-State Shipments [f]	26,000	N/A	N/A	N/A	N/A	N/A
In-State [g, h]	15,000	100	0	15,000	0	0
Total – Out-of-State Waste	80,000	11,000	10,000	23,000	990	8,400
Total – All	94,000	11,000	10,000	38,000	990	8,400

N/A = not applicable.
Note: Totals may not sum correctly due to rounding.
[a] Number of rail shipments was assumed to be one-half of the number of truck shipments, except for the number of rail shipments for transporting depleted uranium conversion products (see footnote f).
[b] For purposes of analysis, it was assumed that supersacks would be transported in Sealand containers.
[c] A Type B container is used to transport remote-handled low-level or mixed low-level radioactive waste.
[d] In addition to shipments estimated from the DOE Waste Management Information System, these numbers include estimated shipments of waste from operation and D&D of the U.S. Enrichment Corporation lead cascade fuel enrichment facility and operation of the U.S. Enrichment Corporation fuel enrichment full-scale facility.
[e] Includes shipments analyzed in other NEPA documents as follows: 1,026 truck shipments from Paducah in the South region (DOE 2004b), and 553 truck shipments from Portsmouth in the Upper Midwest region (DOE 2004a). These shipments are assumed to consist of Sealand containers transporting depleted uranium conversion products.
[f] Includes shipments analyzed in other NEPA documents as follows: 12,243 truck shipments from the West Valley Demonstration Project in the Northeast region (DOE 2010b); 367 shipments of uranium-233 downblending waste from Oak Ridge National Laboratory in the South region; and uranium oxide conversion product consisting of 7,240 truck shipments from Paducah (DOE 2004b) in the South region, and 5,834 truck shipments from Portsmouth in the Upper Midwest region (DOE 2004a). For the uranium oxide conversion products, the number of truck shipments is based on depleted uranium hexafluoride cylinders being filled with uranium oxide conversion product, two cylinders per truck. The numbers of rail shipments required for shipment of uranium oxide conversion products are 5,963 from Paducah, Kentucky, in the South region (DOE 2004a) and 3,216 from Portsmouth, Ohio, in the Upper Midwest region (DOE 2004b). This does not include shipments that would occur after 2020.
[g] Includes radioactive waste generated by environmental restoration activities at the Nevada Test and Training Range and Tonopah Test Range (230 shipments of Sealand containers for the No Action and Reduced Operations Alternatives and 13,000 shipments of Sealand containers for the Expanded Operations Alternative).
[h] Includes shipment of MLLW from the NNSS to the Oak Ridge area for treatment, and return to the NNSS.

Table 5–10 Estimated Number of Shipments of Transuranic Waste, Radioisotopic Thermoelectric Generators, Sealed Sources, and Special Nuclear Material Over a 10-Year Period [a]

Origin or Activity	*Number of Shipments No Action*	*Number of Shipments Expanded Operations*	*Number of Shipments Reduced Operations*
Transuranic Waste			
JASPER [b]	16	36	11
Environmental Restoration	6	6	6
Radioisotopic Thermoelectric Generators			
Norfolk, Virginia	3	10	3
Sealed Sources			
San Antonio, Texas	120	240	120
Special Nuclear Material			
LLNL (Global Security SNM)	0	1	0
LLNL (HEU)	0	1	0
LANL (Uranium-233)	0	1	0
INL (ZPPR)	0	7	0
INL (ZPPR) – plutonium material	0	8	0
ORNL U-233	0	32	0
LLNL (target material for JASPER)	120	240	60
Nuclear Weapons			
Transport to/from the NNSS	0	8,200 [c]	0
Weapon Component Disposition [d]	0	2,010	0

HEU = highly enriched uranium, INL = Idaho National Laboratory, JASPER = Joint Actinide Shock Physics Experimental Research Facility, LANL = Los Alamos National Laboratory, LLNL = Lawrence Livermore National Laboratory, NNSS = Nevada National Security Site, ORNL = Oak Ridge National Laboratory; SNM = special nuclear material, ZPPR = zero power plutonium reactor.

[a] Number of shipments are for one-way. The analysis accounts for any return trips or if material is forwarded to another site.

[b] Includes number of shipments related to transuranic waste in storage.

[c] Includes 100 shipments per year for transporting nuclear weapons to the NNSS for disassembly, and 360 shipments per year of nuclear weapons to the NNSS to support component exchange. Includes return shipments of refurbished weapons.

[d] Includes 100 shipments per year of canned subassemblies to Y-12 and plutonium to Pantex, and 1 shipment per year of milliwatt generators to LANL.

Table 5–11 Risks of Transporting Radioactive Waste Under Each Alternative (Constrained Case) [a]

					Incident-Free Conditions				*Accident Conditions*	
					Crew		*Population*			
Region	*Transport Mode*	*Number of Shipments*	*One-Way Kilometers Traveled (million)*	*One-Way Miles Traveled (million)*	*Dose (person-rem)*	*Risk [b]*	*Dose (person-rem)*	*Risk [b]*	*Radiological Risk [b]*	*Roundtrip Nonradiological Risk [b]*
No Action Alternative										
Northeast	Truck	140	0.67	0.42	8.2	5×10^{-3}	2.6	2×10^{-3}	3×10^{-6}	2×10^{-2}
	Rail only [c]	70	0.34	0.21	2.5	1×10^{-3}	1.1	6×10^{-4}	5×10^{-7}	5×10^{-2}
	Rail/Truck [d]	210	0.41	0.26	3.4	2×10^{-3}	1.6	1×10^{-3}	8×10^{-7}	6×10^{-2}
South	Truck	9,100	31.73	19.72	1400	9×10^{-1}	220	1×10^{-1}	6×10^{-5}	1
	Rail only [c]	4,500	16.84	10.46	330	2×10^{-1}	110	7×10^{-2}	2×10^{-5}	3
	Rail/Truck [d]	13,600	21.78	13.53	550	3×10^{-1}	150	9×10^{-2}	2×10^{-5}	3
Southeast	Truck	120	0.45	0.28	6.7	4×10^{-3}	1.9	1×10^{-3}	2×10^{-6}	1×10^{-2}
	Rail only [c]	60	0.24	0.15	1.8	1×10^{-3}	0.69	4×10^{-4}	5×10^{-7}	4×10^{-2}
	Rail/Truck [d]	180	0.31	0.19	2.7	2×10^{-3}	0.92	6×10^{-4}	6×10^{-7}	2×10^{-3}
Upper Midwest	Truck	10,000	33.77	20.99	510	3×10^{-1}	130	8×10^{-2}	1×10^{-4}	1
	Rail only [c]	5,000	16.44	10.22	120	7×10^{-2}	32	2×10^{-2}	2×10^{-5}	3
	Rail/Truck [d]	15,100	21.90	13.61	200	1×10^{-1}	51	3×10^{-2}	3×10^{-5}	3
Southwest	Truck	3,100	4.28	2.66	64	4×10^{-2}	28	2×10^{-2}	9×10^{-6}	1×10^{-1}
	Rail only [c]	1,500	2.69	1.67	22	1×10^{-2}	5.9	4×10^{-3}	2×10^{-6}	4×10^{-1}
	Rail/Truck [d]	4,600	4.36	2.71	42	3×10^{-2}	14	9×10^{-3}	4×10^{-6}	5×10^{-1}
Mountain West	Truck	1,200	1.58	0.98	27	2×10^{-2}	6.0	4×10^{-3}	2×10^{-6}	5×10^{-2}
	Rail only [c]	610	0.32	0.20	5.6	3×10^{-3}	2.3	1×10^{-3}	2×10^{-7}	5×10^{-2}
	Rail/Truck [d]	1,800	1.23	0.76	21	1×10^{-2}	5.4	3×10^{-3}	5×10^{-7}	7×10^{-2}
West	Truck	1,000	1.20	0.75	16	9×10^{-3}	6.0	4×10^{-3}	5×10^{-6}	4×10^{-2}
	Rail only [c]	530	0.53	0.33	5.1	3×10^{-3}	2.1	1×10^{-3}	7×10^{-7}	8×10^{-2}
	Rail/Truck [d]	1,600	1.10	0.68	13	8×10^{-3}	4.7	3×10^{-3}	2×10^{-6}	1×10^{-1}
Northwest	Truck	7	0.02	0.01	0.25	1×10^{-4}	0.085	5×10^{-5}	1×10^{-7}	6×10^{-4}
	Rail only [c]	4	0.01	0.01	0.08	5×10^{-5}	0.029	2×10^{-5}	2×10^{-8}	2×10^{-3}
	Rail/Truck [d]	10	0.01	0.01	0.13	8×10^{-5}	0.04	3×10^{-5}	2×10^{-8}	2×10^{-3}
Total – Offsite LLW/MLLW from all regions	Truck	24,700	73.7	45.8	2,100	1.2	390	2×10^{-1}	2×10^{-4}	2
	Rail only [c]	12,300	37.4	23.2	490	3×10^{-1}	160	9×10^{-2}	4×10^{-5}	6
	Rail/Truck [d]	37,000	51.1	31.8	840	5×10^{-1}	220	1×10^{-1}	6×10^{-5}	6
Onsite	Truck	2,000	0.05	0.03	4.0	2×10^{-3}	1.5	9×10^{-4}	2×10^{-8}	1×10^{-3}
ER Waste (TTR/Nevada Test and Training Range)	Truck	230	0.09	0.06	0.015	9×10^{-6}	0.0022	1×10^{-6}	4×10^{-13}	2×10^{-3}
TRU waste [e]	Truck	20	0.03	0.02	1.08	6×10^{-4}	0.36	2×10^{-4}	2×10^{-8}	9×10^{-4}
RTGs	Truck	3	0.01	0.01	0.37	2×10^{-4}	0.49	3×10^{-3}	3×10^{-10}	2×10^{-3}
Total – radioactive waste transport	Truck	27,000	73.9	45.9	2,100	1.2	390	2×10^{-1}	2×10^{-4}	2
	Rail/Truck [d]	39,300	51.3	31.9	850	5×10^{-1}	230	1×10^{-1}	6×10^{-5}	6
Transport through Nevada [f]	Truck	24,800	8.12	5.01	200	1×10^{-1}	38	2×10^{-2}	3×10^{-6}	2×10^{-1}

					Incident-Free Conditions				*Accident Conditions*	
					Crew		*Population*			
Region	***Transport Mode***	***Number of Shipments***	***One-Way Kilometers Traveled (million)***	***One-Way Miles Traveled (million)***	***Dose (person-rem)***	***Risk*** [b]	***Dose (person-rem)***	***Risk*** [b]	***Radiological Risk*** [b]	***Roundtrip Nonradiological Risk*** [b]
Expanded Operations Alternative										
Northeast	Truck	290	1.40	0.87	17	1×10^{-2}	5.5	3×10^{-3}	6×10^{-6}	5×10^{-2}
	Rail only [c]	150	0.70	0.44	5.2	3×10^{-3}	2.2	1×10^{-3}	1×10^{-6}	1×10^{-1}
	Rail/Truck [d]	440	0.86	0.54	7.1	4×10^{-3}	2.8	2×10^{-3}	1×10^{-6}	1×10^{-1}
South	Truck	19,300	67.32	41.83	3,500	2	460	3×10^{-1}	4×10^{-5}	2
	Rail only [c]	9,600	36.16	22.47	700	4×10^{-1}	240	1×10^{-1}	4×10^{-5}	6
	Rail/Truck [d]	28,900	46.65	28.99	1,200	7×10^{-1}	310	2×10^{-1}	5×10^{-5}	6
Southeast	Truck	310	1.22	0.76	17	1×10^{-2}	5.1	3×10^{-3}	5×10^{-6}	4×10^{-2}
	Rail only [c]	160	0.66	0.41	4.8	3×10^{-3}	1.9	1×10^{-3}	1×10^{-6}	1×10^{-1}
	Rail/Truck [d]	470	0.83	0.51	7.2	4×10^{-3}	2.5	1×10^{-3}	2×10^{-6}	5×10^{-3}
Upper Midwest	Truck	20,100	67.60	42.01	,1000	6×10^{-1}	260	2×10^{-1}	2×10^{-4}	2
	Rail only [c]	10,100	32.90	20.44	250	1×10^{-1}	64	4×10^{-2}	4×10^{-5}	5
	Rail/Truck [d]	30,200	43.82	27.23	410	2×10^{-1}	100	6×10^{-2}	6×10^{-5}	5
Southwest	Truck	7,800	10.91	6.78	160	1×10^{-1}	70	4×10^{-2}	2×10^{-5}	3×10^{-1}
	Rail only [c]	3,900	6.86	4.26	56	3×10^{-2}	15	9×10^{-3}	5×10^{-6}	1
	Rail/Truck [d]	11,700	11.09	6.89	110	6×10^{-2}	37	2×10^{-2}	1×10^{-5}	1
Mountain West	Truck	3,100	4.03	2.50	64	4×10^{-2}	15	9×10^{-3}	6×10^{-6}	1×10^{-1}
	Rail only [c]	1,600	0.81	0.50	14	8×10^{-3}	5.8	3×10^{-3}	6×10^{-7}	1×10^{-1}
	Rail/Truck [d]	4,700	3.14	1.95	50	3×10^{-2}	13	8×10^{-3}	1×10^{-6}	2×10^{-1}
West	Truck	3,000	3.48	2.16	45	3×10^{-2}	18	1×10^{-2}	1×10^{-5}	1×10^{-1}
	Rail only [c]	1,500	1.52	0.95	15	9×10^{-3}	6.0	4×10^{-3}	2×10^{-6}	2×10^{-1}
	Rail/Truck [d]	4,600	3.17	1.97	36	2×10^{-2}	14	8×10^{-3}	5×10^{-6}	3×10^{-1}
Northwest	Truck	24	0.06	0.04	0.68	4×10^{-4}	0.25	1×10^{-4}	3×10^{-7}	2×10^{-3}
	Rail only [c]	12	0.04	0.02	0.24	1×10^{-4}	0.096	6×10^{-5}	4×10^{-8}	5×10^{-3}
	Rail/Truck [d]	36	0.05	0.03	0.39	2×10^{-4}	0.14	8×10^{-5}	6×10^{-8}	5×10^{-3}
Total – Offsite LLW/MLLW from all regions	Truck	5	156	96.9	4,900	2.9	830	5×10^{-1}	3×10^{-4}	5
	Rail only [c]	26,900	79.6	49.5	1,000	6×10^{-1}	340	2×10^{-1}	8×10^{-5}	12
	Rail/Truck [d]	80,900	110	68.4	1,800	1.1	480	3×10^{-1}	1×10^{-4}	13
Onsite	Truck	2,300	0.06	0.04	4.15	2×10^{-3}	1.5	9×10^{-4}	2×10^{-8}	2×10^{-3}
ER Waste (TTR/Nevada Test and Training Range)	Truck	13,100	4.91	3.05	0.82	5×10^{-4}	0.28	2×10^{-4}	2×10^{-11}	1×10^{-1}
TRU waste [e]	Truck	32	0.04	0.03	1.6	9×10^{-4}	0.52	3×10^{-4}	2×10^{-8}	1×10^{-3}
RTGs	Truck	10	0.05	0.03	1.2	7×10^{-4}	1.6	1×10^{-3}	9×10^{-10}	7×10^{-3}
Paducah DUF_6 DOE/EIS-359 [g]	Truck	7,200	20.4	12.7	120	7×10^{-2}	80	5×10^{-2}	3×10^{-3}	5×10^{-1}
	Rail	2,900	9.93	6.19	370	2×10^{-1}	14	8×10^{-3}	2×10^{-3}	2×10^{-1}
Portsmouth DUF_6 DOE/EIS-360 [g]	Truck	5,800	19.6	12.2	11	7×10^{-3}	78	5×10^{-2}	7×10^{-3}	4×10^{-1}
	Rail	2,300	9.37	5.84	330	2×10^{-1}	14	9×10^{-3}	3×10^{-3}	3×10^{-1}
West Valley	Truck	12,000	48.0	29.9	230	1×10^{-1}	64	4×10^{-2}	9×10^{-6}	9×10^{-1}

Region	*Transport Mode*	*Number of Shipments*	*One-Way Kilometers Traveled (million)*	*One-Way Miles Traveled (million)*	*Incident-Free Conditions*				*Accident Conditions*	
					Crew		*Population*		*Radiological Risk* [b]	*Roundtrip Nonradiological Risk* [b]
					Dose (person-rem)	*Risk* [b]	*Dose (person-rem)*	*Risk* [b]		
DOE/EIS-0226 [g]	Rail	6,100	26.5	16.5	9.3	6×10^{-3}	14	8×10^{-3}	3×10^{-6}	2
ORNL (uranium-233) DOE/EA-1651 [h]	Truck	367	No data	No data	No data	No data	9.5	6×10^{-3}	7×10^{-12}	<1
Total – radioactive waste transport	Truck	94,800	249	155	5,300	3.1	1,100	6×10^{-1}	1×10^{-2}	7
	Rail/Truck [d]	108,000	161	100	2,500	1.5	540	3×10^{-1}	5×10^{-3}	16
Transport through Nevada [f]	Truck	54,100	17.92	11.14	440	3×10^{-1}	82	5×10^{-2}	8×10^{-6}	5×10^{-1}
Reduced Operations Alternative										
All Regions	Truck	See No Action Alternative								
	Rail	See No Action Alternative								
Onsite	Truck	See No Action Alternative								
TRU waste [e]	Truck	17	0.02	0.01	0.83	5×10^{-4}	0.28	2×10^{-4}	1×10^{-8}	7×10^{-4}
Transport through Nevada [f]	Truck	See No Action Alternative								

< = less than; DUF_6 = depleted uranium hexafluoride; EA = Environmental Assessment; ER = Environmental Restoration; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; ORNL = Oak Ridge National Laboratory; rem = roentgen equivalent man; RTG = radioisotope thermoelectric generator; TRU = transuranic; TTR = Tonopah Test Range.

[a] LLW and MLLW were assumed to be transported in 55-gallon drums, B-25 boxes, B-12 boxes, and 20-foot International Organization for Standardization (Sealand) containers based on historical information regarding prevalence of use.

[b] Risk is expressed in terms of LCFs, except for nonradiological risk, where it refers to the number of traffic accident fatalities. Accident dose risk can be calculated by dividing the risk values by 0.0006 (DOE 2003).

[c] These values reflect only the portion of the routes traveled by railcar.

[d] These values reflect the combined use of railcar and truck shipments to transport waste to the NNSS.

[e] Transuranic waste is first transported to Idaho National Laboratory for characterization and then transported back to the NNSS with final disposal at WIPP.

[f] The cited risk values are representative of the portion of the routes for transporting LLW and MLLW within Nevada to the NNSS, excluding shipments identified in other National Environmental Policy Act documentation. The stated risks for travel within Nevada are included in the risks for the regional routes shown in the table. The values for the Reduced Operations Alternative are similar to those for the No Action Alternative.

[g] The risks from transporting Paducah and Portsmouth DUF_6 conversion wastes and the West Valley wastes to the NNSS are directly from their respective site EISs (DOE 2004a, 2004b, 2010b), proportionally adjusted for a 10-year period. The rail transport risk values for these analyses consider direct transport to the NNSS; therefore, the risks do not include truck transport from a transfer station. If rail-truck transport was used for these shipments, the incident-free risk would be lower while the accident risk would be slightly higher, given the results of transporting LLW and MLLW. Transportation risks from transporting wastes associated with these waste streams generated beyond this 10-year period are included in the cumulative impacts (Chapter 6).

[h] DOE 2010a.

Note: To convert kilometers to miles, multiply by 0.62137. Total may not equal the sum of the contributions due to rounding. Also due to rounding, the cited risk values are different from multiplication of dose by dose risk factor of 0.0006 LCFs per person-rem.

Table 5–12 Risks of Transporting Radioactive Materials Under Each Alternative – Constrained Case

				Incident-Free Conditions				*Accident Conditions*	
				Crew		*Population*			
Material	*Number of Shipments*	*One-Way Kilometers Traveled (million)*	*One-Way Miles Traveled (million)*	*Dose (person-rem)*	*Risk* [b]	*Dose (person-rem)*	*Risk* [a]	*Radiological Risk* [b]	*Roundtrip Nonradiological Risk* [a]
No Action Alternative									
Special Nuclear Material	120	0.14	0.088	0.13	8×10^{-5}	0.12	7×10^{-5}	5×10^{-8}	5×10^{-3}
Special Nuclear Material – in Nevada	120	0.04	0.02	0.028	2×10^{-5}	0.023	1×10^{-5}	7×10^{-9}	9×10^{-5}
Sealed Sources	120	0.27	0.17	17	1×10^{-2}	4.3	3×10^{-3}	2×10^{-11}	9×10^{-3}
Sealed Sources – in Nevada	120	0.04	0.02	2.2	1×10^{-3}	0.55	3×10^{-4}	4×10^{-13}	1×10^{-3}
Expanded Operations Alternative									
Special Nuclear Material	290	0.41	0.25	0.39	2×10^{-4}	0.39	2×10^{-4}	1×10^{-7}	1×10^{-2}
Special Nuclear Material – in Nevada	290	0.09	0.06	0.097	6×10^{-5}	0.11	7×10^{-5}	1×10^{-8}	2×10^{-4}
Weapon Component Disposition	2,000	3.49	2.17	10	6×10^{-3}	12	7×10^{-3}	4×10^{-8}	1×10^{-2}
Weapon Component Disposition – in Nevada	2,000	0.71	44.1	1.3	8×10^{-4}	1.5	9×10^{-4}	3×10^{-8}	2×10^{-3}
Weapon Transport	8,200	38.15	23.71	210	1×10^{-1}	240	1×10^{-1}	6×10^{-6}	1×10^{-1}
Weapon Transport – in Nevada	8,200	2.50	1.55	14	9×10^{-3}	16	1×10^{-2}	2×10^{-7}	6×10^{-3}
Sealed Sources	240	0.55	0.34	33	2×10^{-2}	8.5	5×10^{-3}	5.E-11	2×10^{-2}
Sealed Sources – in Nevada	240	0.07	0.05	4.4	3×10^{-3}	1.1	7×10^{-4}	7.E-13	2×10^{-3}
Reduced Operations Alternative									
Special Nuclear Material	60	0.07	0.04	0.083	5×10^{-5}	0.081	5×10^{-5}	2×10^{-8}	5×10^{-3}
Special Nuclear Material – in Nevada	60	0.02	0.01	0.015	9×10^{-6}	0.013	8×10^{-6}	3×10^{-9}	5×10^{-5}
Sealed Sources	See No Action Alternative								
Sealed Sources – in Nevada	See No Action Alternative								

rem = roentgen equivalent man.

[a] Risk is expressed in terms of latent cancer fatalities, except for the nonradiological risk, where it refers to the number of traffic accident fatalities. Accident dose risk can be calculated by dividing the risk values by 0.0006 (DOE 2003).

Table 5–13 provides the estimated dose and risk to an individual and population from a maximum foreseeable truck or rail transportation accident with the highest consequences under each alternative. The highest consequences for the maximum foreseeable accident would be from accidents involving a severe collision with a truck or railcar carrying LLW or MLLW in a 20-foot International Organization for Standardization (ISO) container in conjunction with a long-lasting fire. The calculated population doses shown are based on the maximum population density.

Table 5–13 Estimated Dose to the Population and to Maximally Exposed Individuals Under Most Severe Accident Conditions [a]

Alternative/ Transport Mode [b]		*Waste Material in the Accident With the Highest Consequences*	*Likelihood of the Accident (per year)*	*Population* [c]		*MEI* [d]	
				Dose (person-rem)	*Risk (LCF)*	*Dose (rem)*	*Risk (LCF)*
No Action and Reduced Operations	Truck	LLW/MLLW in 20-foot ISO container	3.1×10^{-7}	180	0.1	0.034	2×10^{-5}
Expanded Operations	Truck	LLW/MLLW in 20-foot ISO container	6.1×10^{-7}	180	0.1	0.034	2×10^{-5}
Transport within Nevada [e]		LLW/MLLW in 20-foot ISO container	2.4×10^{-6}	27	0.02	0.034	2×10^{-5}

ISO = International Organization for Standardization, LCF = latent cancer fatality, LLW = low-level radioactive waste, MEI = maximally exposed individual, MLLW = mixed low-level radioactive waste; rem = roentgen equivalent man.

[a] The likelihood of accidents is based on the annual estimated number of transports from each region to the NNSS. The cited likelihood of accidents is the highest calculated value among all transports. Note that the likelihood of rail accidents is less than 10^{-7} per year, therefore rail accident impacts are not shown.

[b] The maximum probability for a rail accident is less than 1 in 10 million per year, therefore, no consequences are presented for rail transportation in this table.

[c] Population extends at a uniform density to a radius of 50 miles. The weather condition was assumed to be Pasquill Stability Class D with a wind speed of 8.8 miles per hour. Unless otherwise noted, the population doses and risks are presented for an urban area on the transportation route.

[d] The MEI was assumed to be 330 feet downwind from the accident and exposed to the entire plume of the radioactive release. The weather condition was assumed to be Pasquill Stability Class F with a wind speed of 2.2 miles per hour.

[e] Population dose and risk are for a suburban area along the route. The probability of a maximum foreseeable accident in an urban area along the transportation route is less than 10^{-7} per year. The cited likelihood of an accident is for the Expanded Operations Alternative. The likelihood of accidents under the No Action and Reduced Operations Alternatives is 1.2×10^{-6} per year.

5.1.3.1.1 No Action Alternative (Constrained Case)

Under the No Action Alternative, approximately 27,000 truck shipments of LLW and MLLW over a 10-year period would be transported to disposal facilities at the NNSS, 24,700 of which would come from outside Nevada. Approximately 20 shipments of TRU waste would be made to INL; after treatment, this waste would be transported to WIPP. About 240 shipments associated with radioisotopic thermoelectric generators and sealed sources would be made.

Impacts of Incident-Free Transportation. Under this alternative, the impacts of transporting LLW and MLLW by truck would be about double the impacts of rail-truck transport, (rail-truck transport is the use of rail to move waste and materials to a transfer station in the Nevada region where it is transferred to trucks to complete the trip to NNSS), as discussed below. Transportation of LLW or MLLW from outside of Nevada would be the primary contributor to the total radiological and nonradiological impacts of transportation activities. The following sections discuss the impacts of incident-free transportation on transportation crew members, intermodal workers, and the public.

- Crew – The transport of LLW and MLLW by truck from out-of-state would incur about 2,100 person-rem of exposure, resulting in approximately 1 (1.2) LCF to a crew member, assuming no administrative controls were implemented. If rail-truck transport were used, the cumulative dose to rail and truck crew members during the transportation of waste under this alternative would be about 840 person-rem (490 person-rem to rail crew and 350 person-rem to truck crew), resulting in 1 (0.5) additional LCF.

  Transport of TRU waste, radioisotopic thermoelectric generators, sealed sources, and SNM would contribute only a very small additional increment to the total crew exposures (about 20 person-rem, resulting in less than 1 [0.01] LCF) compared to transport of LLW and MLLW because there would be fewer shipments.

  Impacts to individual crew members would be managed through the implementation of administrative controls to minimize radiation exposure. A transportation worker would be restricted to an exposure level of 100 millirem per year unless that individual were a trained radiation worker subject to administrative procedures that would limit his or her annual dose to 2 rem (DOE 1999f). The potential risk of a trained radiation worker developing an LCF from the maximum annual exposure is 0.0012. Therefore, an individual transportation worker would not be expected to develop a lifetime LCF from radiation exposure during these activities.

- Transfer station workers – Workers at transfer stations would be exposed to external radiation fields surrounding the waste shipping containers. The dose estimates per unit handling (person-rem per container) for transferring LLW or MLLW containers from railcars to trucks were based on the estimates provided in the *NTS Intermodal Study* (DOE 1999d). For waste containers with an exposure rate of 1 millirem per hour at 3.3 feet, the worker dose per transfer was estimated to be 3.4×10^{-4} person-rem. The number of container transfers under the No Action Alternative would be 24,700, leading to a total transfer station worker population dose of about 8.4 person-rem, or a risk of less than 1 (0.005) LCF.

- Public – The cumulative dose to the general population during transportation of LLW and MLLW by truck from out-of-state would be about 390 person-rem, resulting in less than 1 (0.2) additional LCF. If rail-truck transport were used, the cumulative dose to the general population would be about 220 person-rem (160 person-rem to the population along the rail route and 60 person-rem to the population along the truck route), resulting in less than 1 (0.1) additional LCF. Rail-truck transport would lead to lower doses to the general population because (1) the number of rail shipments would be about half of the shipments using all trucks, and (2) truck transports would occur primarily in areas of low population density and over shorter distances.

  Transport of TRU waste, radioisotopic thermoelectric generators, sealed sources, SNM, and nuclear weapons would contribute only a very small additional amount of population dose (about 5 person-rem, resulting in less than 1 [0.003] LCF) compared to transport of LLW and MLLW from out-of-state.

Impacts of Transportation Accidents. As described previously, two sets of radiological transportation accident impacts were analyzed: (1) impacts of maximum reasonably foreseeable accidents (accidents with radioactive release probabilities greater than 1×10^{-7} [1 chance in 10 million] per year) and (2) impacts of all conceivable accidents (total transportation accidents).

For waste shipped under any of the alternatives, the maximum reasonably foreseeable offsite truck or rail transportation accident with the highest consequences would be a severe collision involving a truck or railcar carrying LLW or MLLW in a 20-foot ISO container (Sealand container) in conjunction with a long-lasting fire. The calculated population doses are based on the maximum population density.

The probabilities of a truck or railcar accident involving this type of waste shipment are slightly different. Transportation accident probabilities were calculated for all route segments (rural, suburban, urban), and maximum consequences were determined for those route segments with a likelihood of release frequency exceeding 1 in 10 million per year. The maximum reasonably foreseeable probability of a truck accident involving this waste type would be 3.1×10^{-7} per year in an urban area, while the maximum probability for a rail accident would be 8.4×10^{-8} per year in an urban area. Because the maximum probability for a rail accident is less than 1 in 10 million per year, no consequences are presented for rail in Table 5–13. The consequences of the truck transport accident in terms of population dose would be about 180 person-rem. Such exposures could result in less than 1 (0.1) additional LCF among the exposed population. The maximum dose from a truck accident to an MEI located 330 feet from the accident and exposed to the accident plume for 2 hours would be about 0.034 rem, with a risk of 0.00002 LCFs.

Under the No Action Alternative, estimates of the total transportation accident risks for all projected accidents are as follows: a radiological dose risk[1] to the general population of 0.17 person-rem if all trucks are used to transport all radioactive waste and materials, and 0.08 person-rem if a combination of rail and truck are used. This would resulting in less than 1 LCF (0.0002 LCF for all trucks and 0.00006 LCF for a combination of rail and truck). The accident dose risk to the general population if a combination of rail and truck is used is therefore about half of the dose risk associated with using only trucks. Nonradiological accident risks for transporting LLW and MLLW would range from 2 to 6 fatalities to the general population for all truck transport and a combination of rail and truck transport, respectively. Nonradiological risks for all radioactive wastes and materials other than LLW and MLLW would be less than 1 (0.02) fatalities.

Accidents at transfer stations have also been considered. Railcars or trucks carrying LLW or MLLW while on the property of a transfer station would have the potential for some of the same accidents that could occur outside of transfer stations. The low speeds at which they would be traveling would result in impacts much less severe than those possible while they are traveling at higher speeds outside the transfer station. However, transfer station activities introduce an additional accident scenario associated with the transfer of containers between railcars and trucks. Shipments and transfer of LLW or MLLW would not present unique nonradiological risks to workers at a transfer station as containers are moved between trucks and railcars. Transfer facilities routinely receive materials shipped in large containers (for example, ISO containers) and have established procedures for safely transferring them between transport vehicles. In the course of transferring containers, there is the possibility of a mechanical or human error that could result in a dropped container. This presents a physical hazard to workers involved in the transfer, but use of safe working practices should prevent workers from being in locations where they could be hit by a falling container.

There would be a small possibility of an environmental release of radioactive material resulting from a dropped container. In order to cause a release to the environment, the drop would have to cause a breach of the outer container, as well as a failure of the packaging within the container (for example, 55-gallon drums or soft-sided containers). Assuming that such a release did occur, however, the released material would result only in localized contamination; the drop of a container would not have sufficient energy to eject material and cause widespread contamination. There would be a potential for a dose to workers in the immediate vicinity of such an accident, but the magnitude of the dose could vary widely depending on the size of the breach, proximity of workers, and air currents. No impact to a noninvolved worker or a

[1] *The term "dose risk" is used because the value includes both the likelihood of the accident as well the consequence of that accident. The likelihood arises from the accident rate and the probability of container failure along with the potential for the quantities being released and becoming airborne.*

member of the public would be expected due to the expected small release amount and distance to these receptors. A more severe accident with enough energy to spread radioactive material beyond the immediate vicinity (e.g., a drop and breach followed by a fire) could result in impacts beyond the immediate vicinity of the accident; impacts would be comparable to or less than those calculated above for the maximum reasonably foreseeable truck accident.

Impacts of Nonradioactive Waste Transport. The impacts of transporting sanitary waste, hazardous waste, and other wastes and recyclables generated at NNSS facilities to onsite or offsite disposal or reuse facilities were also evaluated (including impacts from construction and operation of a commercial solar power generation facility)), with results shown in Appendix E, Table E–19. The estimated transportation impacts under this alternative would be 2 (1.5) traffic accident and less than 1 (0.06) traffic accident fatality in 2.0 million two-way miles traveled.

Impacts Within the State of Nevada. For both truck and rail-truck transport, transport in Nevada would result in a cumulative dose of about 200 person-rem to crew members, resulting in less than 1 (0.1) LCF; this dose would be managed and minimized using administrative controls, as discussed in the previous paragraphs. For the public, a cumulative population dose in Nevada of about 39 person-rem would occur, resulting in less than 1 (0.02) LCF.

Estimates of the total transportation accident risks that would occur in Nevada under this alternative for all projected accidents involving radioactive materials and waste shipments, regardless of waste type, are as follows: a maximum radiological dose risk to the general population of 0.005 person-rem over the life of expected shipments, resulting in less than 1 (0.000003) LCF, and a maximum nonradiological accident risk of less than 1 (0.2) fatality in the general population over 5.0 million one-way miles traveled.

5.1.3.1.2 Expanded Operations Alternative

5.1.3.1.2.1 Constrained Case

Under the Expanded Operations Alternative, a total of about 94,800 truck shipments of LLW and MLLW would be made to disposal facilities at the NNSS, about 79,300 of which would come from offsite locations. About 32 shipments of TRU waste would be made to INL for treatment; after treatment, this waste would be transported to WIPP. There would be 290 shipments of SNM, 8,200 shipments of nuclear weapons to and from the NNSS for either component replacement or disassembly, and about 2,000 shipments of disassembled parts from weapon dismantlement. There would also be 240 shipments of sealed sources.

Impacts of Incident-Free Transportation

Under this alternative, the radiological impacts of transporting LLW and MLLW by truck would be greater than the impacts of rail-truck transport. Transportation of LLW and MLLW from offsite locations would be the primary contributor to the total radiological and nonradiological impacts of transportation activities. Impacts to crew members, transfer station workers, and the public are discussed below.

- Crew – Transport of LLW and MLLW by truck would incur about 5,300 person-rem of exposure, resulting in approximately 3 (3.1) additional LCFs to crew members, assuming no administrative controls were implemented. If rail-truck transport were used, the cumulative dose to crew members during the transportation of waste under this alternative would be about 2,500 person-rem, resulting in about 2 (1.5) additional LCFs.

  The transportation of sealed sources, TRU waste, radioisotopic thermoelectric generators, SNM, and nuclear weapons would contribute only a very small additional amount to total crew exposures (about 250 person-rem, resulting in less than 1 [0.2] LCF) compared to the transport of LLW and MLLW because there would be fewer shipments.

- Transfer station worker – Workers at transfer facilities would be exposed to external radiation fields surrounding the waste shipping containers. As stated under the No Action Alternative, a dose rate of 3.4×10^{-4} person-rem per container transfer from railcar to truck was used. The number of container transfers under the Expanded Operations Alternative would be about 54,000, leading to a total transfer station worker dose of about 18 person-rem.

- Public – The cumulative dose to the general population during transportation of LLW and MLLW by truck would be about 1,100 person-rem, resulting in about 1 (0.6) additional LCF. If rail-truck transport were used, the cumulative dose to the general population would be about 520 person-rem (about 480 person-rem to the population along the rail route and 40 person-rem to the population along the truck route), resulting in less than 1 (0.3) additional LCF. Rail-truck transport would lead to lower doses to the general population because (1) such shipments would be fewer and (2) truck transports would occur primarily in areas of low population density and over shorter distances. Transportation of TRU waste, SNM, radioisotopic thermoelectric generators, sealed sources, and nuclear weapons would contribute about an additional 260 person-rem to the dose to the general populaiton, resulting in less than 1 [0.2] LCF).

Impacts of Transportation Accidents. As described previously, the maximum reasonably foreseeable offsite truck or rail transportation accident with the highest consequences would be a severe collision involving a truck or railcar carrying LLW or MLLW in a 20-foot ISO container in conjunction with a long-lasting fire. The calculated population doses are based on the maximum population density. These waste shipments are expected to occur over the 10-year period. The impacts in terms of dose and risks to the public and individuals are the same as those provided under the No Action Alternative in Section 5.1.3.1.1, although with a greater foreseeable probability of 6.1×10^{-7} per year in an urban area (about twice the probability as compared to the No Action Alternative).

Under the Expanded Operations Alternative, estimates of the total transportation accident risks for all projected accidents are as follows: a radiological dose risk to the general population of 17 person-rem if all trucks are used to transport LLW and MLLW, and 8 person-rem if a combination of rail and truck are used. This would resulting in less than 1 LCF (0.01 LCF for all trucks and 0.005 LCF for a combination of rail and truck). The dose risk to the general population for transporting wastes and materials other than LLW and MLLW would be about 0.01 person-rem, resulting in less than 1 (0.000006) LCF if all trucks are used. Nonradiological accident risks for transporting LLW and MLLW would range from 6 to 15 fatalities to the general population for all truck transport and a combination of rail and truck transport, respectively. Nonradiological risks for all radioactive wastes and materials other than LLW and MLLW would cause less than 1 (0.1) fatality.

Impacts of Nonradioactive Waste Transport. The impacts of transporting sanitary waste, hazardous waste, and other wastes and recyclables generated at NNSS facilities to onsite or offsite disposal or reuse facilities were also evaluated (including impacts from concentration and operation of a commercial solar power generation facility), with results shown in Appendix E, Table E–19. The estimated transportation impacts under this alternative would be 3 (2.8) traffic accident and less than 1 (0.11) traffic accident fatality in 3.8 million two-way miles traveled.

Impacts Within the State of Nevada. The transport of all radioactive materials through Nevada would incur less than one-tenth of the total incident-free radiological impacts. For both truck and rail-truck transport, transport in Nevada would result in a cumulative dose of about 460 person-rem to crew members, resulting in less than 1 (0.3) LCF; this dose would be managed using administrative controls, as discussed in the previous paragraphs. For the public in Nevada, a cumulative population dose of about 100 person-rem would occur, resulting in less than 1 (0.06) LCF.

Under the Expanded Operations Alternative, estimates of the total transportation accident risks that would occur in Nevada for all projected accidents involving radioactive materials and waste shipments, regardless of waste type, would be a maximum radiological dose risk to the general population of 0. 0.008 person-rem over the life of expected shipments, resulting in less than 1 (0.000005) LCF for rail-truck transport, and a maximum nonradiological accident risk of about 1 (0.45) fatality to the general population for rail-truck transport over 21.2 million one-way miles traveled.

5.1.3.1.2.2 Unconstrained Case

The unconstrained case addresses the transportation of offsite LLW/MLLW from regions of the United States to NNSS by (a) all truck, and (b) a combination of rail-truck, as described in Section 5.1.3.1, Methodology and Assumptions. Appendix E provides more detailed data regarding the analysis of the unconstrained case.

All Truck: Table 5–14 summarizes the range of impacts for transporting offsite LLW/MLLW to NNSS and compares these impacts to the comparable impacts from the constrained case (from Table 5–12). The range of impacts reflects multiple routes that could be taken from the Las Vegas entry point to NNSS. A range is only shown where there is a measurable difference due to using different routes. Based on Table 5–14, if routes are unconstrained, the total incident-free dose to the crew and population would be lower than if routes are constrained, but not significantly enough to lower the incident-free or accident risk. Nonradiological risks (fatalities due to accidents) would remain the same.

Table 5–14 Range of Risks for Unconstrained Truck Transport from U.S. Regions to the Nevada National Security Site [a]

From Regions Through Below Entry Point to NNSS	*Number of Shipments*	*Incident-Free*				*Accident*	
		Crew		*Population*			
		Dose (person-rem)	*Risk (LCF)*	*Dose (person-rem)*	*Risk (LCF)*	*Radiological Risk (LCF)*	*Nonradiological Risk (fatalities)*
Apex [b]	23,500	960 – 1000	0.6	230 – 260	0.1 – 0.2	0.0002	2
Arden [b]	3,040	38 – 46	0.2 – 0.3	14 – 17	0.009 – 0.01	5×10^{-6} – 7×10^{-6}	0.1
Henderson [b]	27,400	3,100 – 3,200	2	510 – 540	0.3	0.0002	2
Total (unconstrained) [c]	**54,000**	**4,100 – 4,200**	**2 – 3**	**760 – 810**	**0.5**	**0.0003 – 0.0004**	**5**
Total (constrained) [c]	**54,000**	**4,900**	**3**	**830**	**0.5**	**0.0003**	**5**

LCF = latent cancer fatality, NNSS = Nevada National Security Site; rem = roentgen equivalent man.

[a] Ranges are shown only where there are differences in results among the routes, assuming three significant figures for shipments, two significant figures for dose, and one significant figure for risk.

[b] There would be two possible routes from Apex, three possible routes from Arden, and four possible routes from Henderson to NNSS, as analyzed in this NNSS SWEIS.

[c] Results are from Table 5–12. The results do not reflect shipments of LLW/MLLW analyzed in other NEPA documents.

Note: Totals may not sum due to rounding.

Rail-Truck: Rail transport of offsite LLW/MLLW to five possible transfer station locations in the Las Vegas region were analyzed: Apex, Arden and West Wendover in Nevada; and Kingman and Parker in Arizona. This analysis assumed all rail shipments would go to each of these transfer stations. **Table 5–15** summarizes the range of impacts for transporting offsite LLW/MLLW to each of these transfer stations, trucking the waste from each transfer station to Las Vegas, and subsequently traveling through Las Vegas to NNSS using different routes as shown in Figure 5–4. Based on the results in

Table 5–15, the incident-free dose to the rail and truck crews would be highest if a transfer station would be located at West Wendover because of the longer distance traveled by truck, as compared to other transfer station locations. The risk to the crews, however, would be about the same (1 LCF) among all locations analyzed. While the incident-free population dose and risk can vary somewhat, these differences are small. There would be small differences in radiological accident risks among the different transfer station alternatives. The risk for traffic fatalities would range from 12 to 14 with the use of a transfer station at Parker incurring the highest risk.

Table 5–15 Range of Risks for Unconstrained Rail-Truck Transport from U.S. Regions to the Nevada National Security Site [a]

From Regions To Below Transfer Station Location to NNSS	*Number of Shipments*	*Incident-Free*				*Accident*	
		Crew		*Population*			
		Dose (person-rem)	*Risk (LCF)*	*Dose (person-rem)*	*Risk (LCF)*	*Radiological Risk (LCF)*	*Non-radiological Risk (fatalities)*
Apex	81,000	1,300 – 1,500	0.8 – 0.9	360 – 470	0.2 – 0.3	0.00008 - 0.0001	13
Arden	81,000	1,300 – 1,400	0.8 – 0.9	390 – 410	0.2	0.00009 - 0.0001	13
Kingman [b]	81,000	1,400 – 1,600	0.8 – 1	440 – 490	0.3	0.0002	12
Parker [c]	81,000	1,700 – 1,900	1	490 – 540	0.3	0.0001 – 0.0002	14
West Wendover [d]	81,000	1,900 – 2,200	1	430 – 530	0.2 – 0.3	0.00008 - 0.0001	12
Total (constrained) [e]	**81,000**	**1,800**	**1**	**480**	**0.3**	**0.0001**	**13**

LCF = latent cancer fatality, NNSS = Nevada National Security Site; rem = roentgen equivalent man.
[a] Ranges are shown only where there are differences in results among the routes, assuming three significant figures for shipments, two significant figures for dose, and one significant figure for risk.
[b] Truck transports from Kingman would use US-93 (across the bridge downstream of the Hoover Dam) and enter the Las Vegas area through Henderson, from which there would be four possible routes to NNSS.
[c] Truck transports from Parker would use U.S. Route 95 and enter the Las Vegas area through Henderson, from which there would be four possible routes to NNSS.
[d] Truck transports from West Wendover would enter the Las Vegas area through Apex, from which there would be two possible routes to NNSS.
[e] Results are from Table 5–15 and represent the combined use of a transfer station at Parker and one at West Wendover. The results do not reflect shipments of LLW/MLLW analyzed in other NEPA documents.
Note: Totals may not sum due to rounding.

Regional Transfer Stations: It is possible that a waste generator may want to transport LLW/MLLW to NNSS for disposal by rail, but does not have access on-site to rail. In this case, the waste generator would transport waste by truck to a rail-truck transfer station in their region. At least one known waste generator without direct rail access within the Southwest, Northeast, and West regions exists. There would be transportation impacts associated with transport of wastes from these waste generators to a regional transfer station. Because of the uncertainty in whether currently known or unknown waste generators would use a regional transfer station, impacts are estimated for the Southwest, Northeast, and West regions in such a way that would be generally representative of use of a regional transfer station located within a given distance of a generator. **Table 5–16** shows these impacts, assuming a number of shipments that are forecasted to be received from a known generator. Note that these impacts can be proportionally adjusted for other numbers of shipments.

Table 5–16 Transport to Regional Transfer Stations – Impacts

Region	*One-way distance* [a] *(km/miles)*	*Number of Shipments*	*One-way travel (million km/million miles)*	*Incident Free* [b]				*Accident* [b]	
				Crew		*Population*			
				Dose (rem)	*Risk (LCF)*	*Dose (person-rem)*	*Risk (LCF)*	*Radiological Risk (LCF)*	*Traffic Fatality (roundtrip)*
Southwest	155/96	7750	1.20/0.75	15	8×10^{-3}	6.7	4×10^{-3}	4×10^{-6}	3×10^{-5}
Northeast	54/34	25	0.0014/0.00087	0.014	8×10^{-6}	0.0071	4×10^{-6}	2×10^{-8}	7×10^{-6}
West	104/65	360	0.037/0.023	0.66	4×10^{-4}	0.28	2×10^{-4}	9×10^{-7}	1×10^{-5}

km = kilometers, LCF = latent cancer fatality; rem = roentgen equivalent man.

[a] It is assumed that the one-way distance for each region encompasses a reasonable distance from a waste generator to a regional transfer station.

[b] The incident-free and accident impacts were calculated using rural, suburban, and urban population densities considered to be representative of the region.

5.1.3.1.3 Reduced Operations Alternative (Constrained Case)

Under the Reduced Operations Alternative, the same number of shipments of LLW and MLLW, and radioisotopic thermoelectric generators would occur as that projected under the No Action Alternative. There would be a reduction in the number of shipments of TRU waste (17 shipments under the Reduced Operations Alternative versus 20 under the No Action Alternative) and SNM (60 shipments under the Reduced Operations Alternative versus 120 under the No Action Alternative). Because the total number of shipments for all waste and materials under these two alternatives is essentially the same, the potential radiological and nonradiological impacts under the Reduced Operations Alternative would be equivalent to the risks under the No Action Alternative.

The impacts of transporting sanitary waste, hazardous waste, and other wastes and recyclables generated at NNSS facilities to onsite or remote disposal or reuse facilities would be slightly less than those under the No Action Alternative, with results shown in Appendix E, Table E–19. The potential impacts under this alternative would be 1 (1.4) traffic accident and less than 1 (0.05) traffic accident fatality in 1.8 million two-way miles traveled.

5.1.3.2 Traffic

5.1.3.2.1 Methodology and Assumptions

Onsite traffic. Onsite traffic impacts at the NNSS were analyzed by evaluating changes in the traffic volume of privately owned vehicles, trucks transporting radioactive waste and nonradioactive waste, and miscellaneous service vehicles. The estimated changes in daily onsite traffic volumes are presented in **Table 5–17**. It was assumed that rates of bus usage by employees under all alternatives would be similar to current conditions; that is, 50 percent of personnel would commute to and from the NNSS using the bus service (see Chapter 4, Section 4.1.3.1). The majority of the truck trips were assumed to transport wastes, based on waste projections. Daily truck shipments of radioactive wastes and materials were estimated based on projections presented in Section 5.1.3.1.

The only available onsite traffic data come from a 1999 traffic study of Mercury Highway (PBS&J 1999); therefore, the onsite traffic impacts in this section are discussed in terms of impacts on Mercury Highway. The study recorded daily traffic volumes on three segments of Mercury Highway. Because Mercury Highway is the main roadway at the NNSS, it was assumed that impacts on this highway represent an upper bound to potential traffic impacts that could occur on other key roadways at the NNSS.

For this analysis, the percent change in the number of daily vehicle trips associated with personnel vehicles and truck transport of miscellaneous wastes and materials reflects the degree of impact on baseline traffic conditions at the NNSS. A "trip" is defined as a one-way vehicle movement from an origin to a destination. Current traffic conditions on Mercury Highway were estimated based on the 1999 onsite traffic study, as discussed in Chapter 4, Section 4.1.3.1. Approximately 90 percent of vehicles currently accessing the NNSS on a daily basis are privately owned vehicles used by commuting workers. The remaining 10 percent of vehicles are trucks (PBS&J 1999). The number of trips made per day and per peak morning and evening hours were estimated for each alternative and compared with current traffic volumes. To evaluate potential impacts on other principal roadways within the NNSS, the total daily vehicle trips projected to occur on Mercury Highway under each alternative were compared with the capacities of these roadways (main roadways throughout the NNSS are estimated to have capacities exceeding 2,000 vehicles per hour for both directions combined).

Table 5–17 Incremental Change in Onsite Daily Vehicle Trips on Mercury Highway at the Nevada National Security Site

	No Action		*Expanded Operations*		*Reduced Operations*	
Segment of Mercury Highway	***POVs***	***Trucks***	***POVs***	***Trucks***	***POVs***	***Trucks***
Between U.S. Route 95 and Mercury	+0	+20	+670	+130	-170	+20
Between Mercury and Tippipah Highway	+0	+20	+410	+140	-100	+10
North of Tippipah Highway	+0	+10	+270	+100	-70	+5

POVs = privately owned vehicles.
Note: These estimates do not include traffic volumes associated with the construction and operation of any solar power facilities as this traffic would access facilities from a gate located on Lathrop Wells Road and would not likely contribute to traffic volumes on Mercury Highway.

Regional traffic. The impacts analysis of regional (i.e., offsite) traffic was based on a determination of the number of personnel and truck trips that would occur under each alternative. Offsite traffic impacts in the region were assessed by estimating the changes in the numbers of daily vehicle trips made under each alternative and applying the changes to baseline traffic volumes on key roadways (for comparison to future baseline conditions, see Chapter 4, Table 4–11, for projected traffic volumes to the year 2020). The estimated changes in daily traffic volumes that were used for the regional traffic analysis are the same as those listed for "Between U.S. Route 95 and Mercury" in Table 5–17, as they reflect the incremental increase in daily traffic volumes that could occur off site. In addition, under the No Action, Expanded Operations, and Reduced Action Alternatives, vehicles associated with the solar power generation facilities were added to these estimates (1,000; 1,500; and 800 daily vehicle trips were respectively added to represent peak construction traffic for conservative estimates). Current traffic volumes, or "average daily traffic," for 2008 were obtained from the Nevada Department of Transportation (NDOT 2008a, 2008b) (see Chapter 4, Table 4–9, for the 2008 average daily traffic volumes).

> The *2000 Highway Capacity Manual* defines six categories of **level of service** that reflect the level of traffic congestion and qualify the operating conditions of a roadway or intersection. The six levels are given letter designations ranging from *A* to *F*, with "*A*" representing the best operating conditions (free flow, little delay) and "*F*" the worst (congestion, long delays) (TRB 2000).

The region of influence (ROI) for the regional traffic analysis includes the principal roadways leading to the NNSS and offsite project locations, with emphasis on the areas surrounding each site; the ROI is limited to Nye and Clark Counties. The geographic distribution of additional vehicle trips is based on the location of main entry points for each of the locations (the NNSS, NLVF, RSL, and TTR) and travel patterns. To determine the travel patterns of future personnel, it was assumed that residential choices for new personnel would correspond to the ratio of current personnel (NSTec 2009d). The geographic distribution of vehicle trips from trucks transporting radioactive waste was based on routes described in Chapter 4, Section 4.1.3.2. Routes for miscellaneous trucks (such as vendors) were assumed to originate and end in the Las Vegas metropolitan area.

To account for increases in traffic from population growth, baseline traffic volumes were projected to the year 2020, assuming an annual increase in traffic volumes of 5 percent for Nye County and Clark County (Nevada State Demographer's Office 2008). To better reflect operating conditions of the roadways, volume-to-capacity ratios and levels of service on key roadways were determined for the peak hour (see Chapter 4, Table 4–10, for the level of service designations for associated ratio values).

5.1.3.2.2 Summary of Impacts (Nevada National Security Site)

Onsite traffic. Onsite potential impacts from increased daily vehicle trips would include increased traffic congestion and delays, increased need for road maintenance and improvements, and increased risks regarding road safety. Table 5–17 summarizes the incremental changes in daily vehicle trips projected under each alternative that would result from trips made by privately owned vehicles and trucks along the three analyzed segments of Mercury Highway. **Table 5–18** presents the total daily traffic volumes projected under each alternative along the three analyzed segments of Mercury Highway.

Table 5–18 Projected Traffic Volumes on Mercury Highway

Traffic Volume Component	*Segment of Mercury Highway*		
	Between U.S. Route 95 and Mercury Highway	*Between Mercury Highway and Tippipah Highway*	*North of Tippipah Highway*
Baseline Conditions			
Average Daily Traffic	1,748	1,151	764
A.M. Peak Hour	349	172	75
P.M. Peak Hour	349	172	152
No Action Alternative			
Average Daily Traffic	1,768	1,171	774
A.M. Peak Hour	354	176	78
P.M. Peak Hour	354	176	155
Expanded Operations Alternative			
Average Daily Traffic	2,548	1,701	1,134
A.M. Peak Hour	511	255	113
P.M. Peak Hour	511	255	226
Reduced Operations Alternative			
Average Daily Traffic	1,598	1,061	699
A.M. Peak Hour	319	159	70
P.M. Peak Hour	319	159	140

Regional traffic. For regional traffic impacts, increases in traffic volumes could potentially result in traffic congestion and delays, degradation of operating capacities on roadways, degradation of road surfaces and increased frequency in road maintenance, and increased traffic accidents. For each of the alternatives, **Tables 5–19** and **5–20**, located at the end of this section, summarize the projected average daily traffic volumes for 2020, the percent of traffic volume change expected to occur, the volume-to-capacity ratios, and the levels of service for key roadways in Nye and Clark Counties, respectively.

Under future baseline conditions (i.e., traffic conditions in the year 2020 without the NNSS activities proposed under the alternatives), it is predicted that the majority of roadways analyzed would remain similar to current levels of service (see Chapter 4, Table 4–11). As noted in Tables 5–19 and 5–20, the contribution of additional vehicle volumes associated with NNSS activities is considered relatively low (under the No Action and Reduced Operations Alternatives) to moderately high (under the Expanded Operations Alternative) when compared to projected traffic volumes in the region. Only Mercury Highway, which provides direct access to NNSS from U.S. Route 95, is predicted to experience a degradation of level of service—from level A to B under the Expanded Operation Alternative—as a result of new NNSS activities. Potential impacts on the regional traffic system resulting from construction and operation of renewable energy projects and other development in the area are discussed in Chapter 6, Section 6.3.3.

5.1.3.2.3 No Action Alternative

Onsite traffic. The total daily vehicle trips projected for Mercury Highway under the No Action Alternative would increase by approximately 2 percent from current conditions. The additional traffic volumes on Mercury Highway would be attributable to trucks transporting wastes and materials; minimal incremental traffic increases are expected from privately owned vehicles because the only personnel increase would occur from the proposed solar power generation facility in Area 25, which is not expected to generally use Mercury Highway at the NNSS. Based on the traffic volumes during peak hours, it is expected that Mercury Highway would operate at a level of service of A. It was assumed that peak traffic volumes on key onsite roadways throughout the NNSS would not exceed the levels projected for Mercury Highway; therefore, no capacity issues are expected on other key roadways, except possibly for those serving the commercial solar power generation facilities in Area 25.

The projected traffic volumes presented in Tables 5–19 and 5–20 do not include potential increases in traffic volumes from construction and operation of the solar power generation facility because personnel and trucks associated with the facility would access the facility from a gate located on Lathrop Wells Road and would not likely contribute to traffic volumes on Mercury Highway. Approximately 500 and 1,000 workers are estimated to be required for construction of this facility during average and peak construction conditions, respectively. Assuming that 50 percent of the construction workers would carpool to the site, approximately 250 (average) and 500 (peak) additional vehicle trips could occur during the peak commute hours (or a total of 500 and 1,000 additional vehicle trips could occur on a daily basis during average and peak construction activities, respectively) on roads leading up to the project site in Area 25. The addition of these vehicles and associated construction trucks on a daily basis (estimated to occur over a 35-month period) would increase the rate of pavement deterioration and degrade levels of service and could require increased road maintenance and upgrades for roads in the project area.

Regional traffic. U.S. Route 95, State Route 160, and State Route 372 would experience the greatest percent increases in daily traffic volumes because these roadways serve an area that is considered characteristically rural and generally experience relatively low daily traffic volumes. The volume-to-capacity ratios would remain similar for all roadways analyzed, and levels of service are predicted to be the same as those under future baseline traffic volumes (see Chapter 4, Table 4–11). The similarity of traffic conditions under the No Action Alternative and future baseline conditions reflect the minor contribution of NNSS-related activities to overall traffic volumes in the region. The increase in daily trips under this alternative would have minor impacts on traffic congestion in the ROI. Coordination with public safety and maintenance agencies would aid in planning for and mitigating delays resulting from the anticipated increase in traffic volumes.

5.1.3.2.4 Expanded Operations Alternative

Onsite traffic. The total daily vehicle trips projected for the three segments of Mercury Highway analyzed under the Expanded Operations Alternative would increase by approximately 50 percent above current traffic levels, mainly due to the 25-percent increase in NNSS personnel and traffic from construction-related vehicles. Based on the traffic volumes during peak hours, it is expected that Mercury Highway would operate at a level of service of B or better and other key roadways would not have any capacity issues. Drivers accessing the main entry gate would experience longer delays during the peak morning and evening traffic hours, and increased traffic congestion would occur throughout Mercury due to the increase in privately owned vehicles. Drivers on Mercury Highway could experience longer delays or reduced travel speeds due to the high increase in daily truck traffic. Because the incremental increase in onsite traffic volumes would be moderately high, the number of repairs and required maintenance on NNSS roadways would increase at a greater rate than currently experienced.

The projected traffic volumes presented in Tables 5–19 and 5–20 do not include potential increases in traffic volumes from the construction of the solar power generation facility. Personnel and trucks associated with the solar power generation facility would access the facility from a gate located on Lathrop Wells Road. Approximately 750 and 1,500 workers are estimated to be required for construction of this facility during average and peak construction conditions, respectively. Assuming that 50 percent of the workers would carpool to the site, approximately 375 (average) and 750 (peak) additional vehicle trips could occur during the peak commute hours (or a total of 750 and 1,500 additional vehicle trips could occur on a daily basis during average and peak construction activities, respectively) on roads leading up to the project site in Area 25. The addition of these vehicles and associated construction trucks on a daily basis (estimated to occur over a 42-month period) would increase the rate of pavement deterioration, degrade levels of service, and could require increased road maintenance and upgrades for roads in the project area.

Regional traffic. Roadways in Nye and Clark Counties would generally experience higher increases in traffic volumes. When compared to the No Action Alternative, Mercury Highway and segments of Nevada State Route 372, State Route 160, U.S. Route 95, and State Route 164 would experience moderately high percent increases in daily traffic; however, the operating capacities would remain similar to those under future baseline traffic volumes (see Chapter 4, Table 4–11). Only Mercury Highway would experience a substantially high increase in traffic (increase by approximately 80 percent) and degrade in level of service (from a Level A to a Level B). As most of the increases in daily traffic volumes during the peak hours would be attributable to workers commuting to the NNSS, any detectable changes in traffic volumes would primarily occur during the main commuting hours and at the entry gates of the NNSS (the main entrance gate for regular NNSS employees and Gate 510 for those associated with the construction and operation of the commercial solar power generation facilities in Area 25). Coordination with public safety and maintenance agencies would aid in planning for and mitigating delays resulting from the anticipated increase in traffic volumes.

Table 5–19 includes traffic volumes from the truck transport of radioactive waste and materials under the unconstrained case (as discussed in Section 5.1.3.1). Under the constrained case, it was assumed that DOE would maintain its current operational practice of avoiding transporting waste and materials on the interstate system within Las Vegas. Table 5–20 denotes which study locations would not experience these additional truck volumes under the constrained case.

5.1.3.2.5 Reduced Operations Alternative

Onsite traffic. The total daily vehicle trips projected for Mercury Highway under the Reduced Operations Alternative would decrease by approximately 10 percent from current conditions mainly because the number of NNSS workers is expected to decrease by 10 percent. Compared with current conditions, the number of daily trips from privately owned vehicles would decline. Impacts under this alternative would be similar or slightly reduced compared to those under the No Action Alternative; key roadways, including Mercury Highway, would operate well below maximum capacities.

The projected traffic volumes presented in Tables 5–19 and 5–20 do not include potential increases in traffic volumes from the construction and operation of the solar power generation facility because personnel and trucks associated with the facility would enter from a gate located on Lathrop Wells Road and would not likely contribute to traffic volumes on Mercury Highway. Approximately 400 and 800 workers are estimated to be required for construction of this facility during average and peak construction conditions, respectively. Assuming that 50 percent of the workers would carpool to the site, approximately 200 (average) and 400 (peak) additional vehicle trips could occur during the peak commute hours (or a total of 400 and 800 additional vehicle trips could occur on a daily basis during average and peak construction activities, respectively) on roads leading up to the project site in Area 25. The addition of these vehicles and associated construction trucks on a daily basis (estimated to occur over a 32-month period) would increase the rate of pavement deterioration, degrade levels of service, and could require increased road maintenance and upgrades for roads in the project area.

Regional traffic. Under the Reduced Operations Alternative, traffic volumes would increase slightly during peak hours on almost all of the roadways analyzed because the number of personnel at the NNSS would be reduced and most of the additional traffic volumes would be attributable to vehicles associated with the construction and operation of the commercial solar power generation facility. Impacts on regional traffic under this alternative would therefore be slightly less or similar to those described under the No Action Alternative; volume-to-capacity ratios and levels of service would remain unchanged from future baseline conditions (see Chapter 4, Table 4–11).

Table 5–19 Traffic Volumes and Level of Service Impacts on Key Roads in Nye County During Peak Hour Conditions [a]

Route	Location	*No Action Alternative*				*Expanded Operations Alternative*				*Reduced Operations Alternative*			
		AADT in 2020	*Percent Change [b]*	*V/C*	*LOS*	*AADT in 2020*	*Percent Change [b]*	*V/C*	*LOS*	*AADT in 2020*	*Percent Change [b]*	*V/C*	*LOS*
U.S. Route 6	0.3 miles east of Nevada State Route 375 (Warm Springs Road)	364	2	0.02	A	394	10%	0.02	A	361	1	0.02	A
	200 feet west of Nevada State Route 375 (Warm Springs Road)	495	1	0.03	A	524	7%	0.03	A	492	1	0.03	A
	0.2 miles east of Nevada State Route 376 (Tonopah-Austin Road)	1,020	6	0.06	A	1,008	5%	0.06	A	975	1	0.06	A
	0.2 miles west of Nevada State Route 376	1,851	3	0.11	A	1,838	3%	0.11	A	1,806	1	0.11	A
Nevada State Route 373	0.5 miles south of U.S. Route 95	1,511	2	0.09	A	1,509	2%	0.09	A	1,492	1	0.09	A
Nevada State Route 372	0.8 miles west of Nevada State Route 160	19,748	1	0.58	C	19,987	2%	0.59	C	19,673	1	0.58	C
	0.1 miles east of Nevada–California state line	1,537	15	0.10	A	1,776	33%	0.12	A	1,462	9	0.10	A
U.S. Route 95	In Tonopah, 100 feet south of Bryan Avenue	11,275	0	0.43	B	11,248	0%	0.43	B	11,245	0	0.43	B
	500 feet north of Cemetery Road, north of Tonopah	6,877	1	0.53	D	6,850	0%	0.53	D	6,847	0	0.53	D
	0.2 miles south of U.S. Route 6 in Tonopah	8,820	0	0.34	B	8,837	0%	0.34	B	8,805	0	0.34	B
	9 miles south of Scotty's Junction (State Route 267)	3,774	1	0.22	B	3,794	1%	0.22	B	3,758	0	0.22	B
	1 mile north of Beatty (State Route 374)	4,101	1	0.24	B	4,124	1%	0.24	B	4,085	0	0.24	B
	0.2 miles west of Amargosa Valley (State Route 373)	4,264	1	0.25	C	4,276	1%	0.25	C	4,245	0	0.25	C
	1.5 miles east of Amargosa (State Route 373)	4,753	1	0.28	C	4,765	1%	0.28	C	4,734	0	0.28	C
	4 miles west of Mercury Interchange	4,951	5	0.29	C	5,100	8%	0.30	C	4,858	3	0.29	C
Mercury Highway	0.2 miles north of Mercury Interchange on U.S. Route 95	1,116	1	0.07	A	2,886	162%	0.19	B	962	-13	0.06	A

Route	Location	*No Action Alternative*				*Expanded Operations Alternative*				*Reduced Operations Alternative*			
		AADT in 2020	***Percent Change*** [b]	***V/C***	***LOS***	***AADT in 2020***	***Percent Change*** [b]	***V/C***	***LOS***	***AADT in 2020***	***Percent Change*** [b]	***V/C***	***LOS***
Nevada State Route 160	0.1 mile west of U.S. Route 95	1,864	14	0.11	A	2,179	34%	0.12	A	1,783	9	0.10	A
	7.7 miles east of Nevada State Route 372	2,842	9	0.17	B	3,156	21%	0.19	B	2,761	6	0.16	A
	0.1 miles east of Nevada State Route 372 (near Pahrump)	37,700	1	1.11	F	38,015	1%	1.12	F	37,619	0	1.11	F
	200 feet west of Nevada State Route 372 (near Pahrump)	34,442	1	1.01	F	34,755	2%	1.02	F	34,361	0	1.01	F
	0.6 miles east of the Clark–Nye County Line	14,732	2	0.43	B	15,046	4%	0.44	B	14,651	1	0.43	B

AADT = annual average daily traffic; LOS = level of service; V/C = volume-to-capacity ratio.
Note: See Chapter 4, Table 4–11, for future (i.e., 2020 without new NNSS activities) baseline traffic volumes, volume-to-capacity ratios, and levels of service.
[a] Source: NDOT 2008a, Nye County.
[b] Percent change in annual average daily traffic under future conditions (i.e., in the year 2020) due to the change in the number of vehicle trips predicted under an alternative.

Table 5–20 Traffic Volumes and Level of Service Impacts on Key Roads in Clark County During Peak Hour Conditions [a]

		No Action Alternative				*Expanded Operations Alternative*				*Reduced Operations Alternative*			
Route	***Location***	***AADT in 2020***	***Percent Change [b]***	***V/C***	***LOS***	***AADT in 2020***	***Percent Change [b]***	***V/C***	***LOS***	***AADT in 2020***	***Percent Change [b]***	***V/C***	***LOS***
Nevada State Route 160	12 miles west of Interstate 15	11,190	3	0.44	D	11,549	6%	0.45	D	11,075	2	0.43	D
	4 miles west of Interstate 15	29,870	1	0.66	D	30,230	2%	0.67	D	29,755	1	0.66	D
	200 feet west of Interstate 15	48,685	1	0.48	B	49,044	1%	0.48	B	48,570	0	0.48	B
U.S. Route 95	West of Indian Springs	5,542	15	0.11	A	6,459	34%	0.13	A	5,238	8	0.10	A
	4 miles east of Indian Springs [c]	9,305	8	0.18	A	10,222	19%	0.20	A	9,001	5	0.18	A
	0.5 miles south of Snow Mountain Interchange (in northwest Las Vegas) [c]	13,068	6	0.26	A	13,985	13%	0.27	A	12,764	3	0.25	A
	0.4 miles north of Ann Road Interchange (in northwest Las Vegas) [c]	113,593	1	1.48	F	114,510	1%	1.50	F	113,289	0	1.48	F
	0.5 miles west of I-15 (between Rancho Drive and Martin Luther King Boulevard) [c]	285,614	0	2.24	F	286,532	1%	2.25	F	285,310	0	2.24	F
	0.5 miles east of I-15 (between Las Vegas Boulevard and Main Street) [c]	237,233	0	2.33	F	238,151	1%	2.33	F	236,929	0	2.32	F
	Between Russell Road and Sunset Road (in southwest Las Vegas) [c]	149,448	0	1.95	F	149,762	0%	1.96	F	149,338	0	1.95	F
	0.8 miles north of State Route 163 (west of Bullhead City)	10,895	0	0.43	B	10,942	1%	0.43	B	10,895	0	0.43	B
	1 mile south of Nevada State Route 163 (Nevada–California state line)	4,310	0	0.17	B	4,357	3%	0.17	B	4,309	0	0.17	B

Route	Location	No Action Alternative				Expanded Operations Alternative				Reduced Operations Alternative			
		AADT in 2020	Percent Change [b]	V/C	LOS	AADT in 2020	Percent Change [b]	V/C	LOS	AADT in 2020	Percent Change [b]	V/C	LOS
Interstate 215	Between Green Valley Parkway and Valle Verde Drive (in southwest Las Vegas) [c]	191,109	0	1.87	F	191,424	0%	1.88	F	191,000	0	1.87	F
	Between Decatur Boulevard and I-15 (in central south Las Vegas) [c]	203,204	0	1.99	F	203,519	0%	2.00	F	203,095	0	1.99	F
	0.2 miles north of State Route 159 (in central west Las Vegas) [c]	62,093	0	1.22	F	62,408	1%	1.22	F	61,916	0	1.21	F
Losee Road	0.3 miles south of Cheyenne Avenue (north of NLVF)	20,159	0	0.52	C	20,511	2%	0.53	C	20,223	0	0.52	C
	0.2 miles south of Carey Avenue (south of NLVF)	22,847	0	0.59	C	23,423	3%	0.60	C	22,814	0	0.59	C
Las Vegas Boulevard	0.3 miles south of Nellis Boulevard (west of RSL)	17,529	0	0.45	B	17,621	1%	0.45	B	17,499	0	0.45	B
Nellis Boulevard	300 feet north of Cheyenne Avenue (west of RSL)	36,286	0	0.62	C	36,308	0%	0.62	C	36,277	0	0.62	C
Nevada State Route 164	1.1 miles west of U.S. Route 95 (west of Searchlight)	937	2	0.04	A	983	12%	0.05	A	936	2	0.04	A

Route	Location	No Action Alternative				Expanded Operations Alternative				Reduced Operations Alternative			
		AADT in 2020	Percent Change [b]	V/C	LOS	AADT in 2020	Percent Change [b]	V/C	LOS	AADT in 2020	Percent Change [b]	V/C	LOS
Interstate 15	At the Nevada–California state line	51,078	0	1.00	E	51,125	0%	1.00	E	51,078	0	1.00	E
	5 miles north of Interstate 215 (in south central Las Vegas) [c]	353,748	0	3.47	F	354,161	0%	3.47	F	353,536	0	3.47	F
	1 mile north of Interstate 515 (in central Las Vegas) [c]	197,894	0	1.55	F	198,387	0%	1.56	F	197,744	0	1.55	F
	5 miles north of Interstate 515 (near central Las Vegas) [c]	96,983	0	0.95	E	97,411	1%	0.96	E	96,848	0	0.95	E
	5.5 miles north of Interstate 515 (in north central Las Vegas) [c]	45,914	0	0.90	D	46,342	1%	0.91	D	45,779	0	0.90	D
	North of West Mesquite Interchange (Nevada–Utah state line)	25,534	0	0.50	B	25,600	0%	0.50	B	25,508	0	0.50	B

AADT = annual average daily traffic; LOS = level of service; NLVF = North Las Vegas Facility; RSL = Remote Sensing Laboratory; V/C = volume-to-capacity ratio.
Note: See Chapter 4, Table 4–11, for future (i.e., 2020 without new NNSS activities) baseline traffic volumes, volume-to-capacity ratios, and levels of service.
[a] Source: NDOT 2008b, Clark County.
[b] Percent change in annual average daily traffic under future conditions (i.e., in the year 2020) due to the change in the number of vehicle trips predicted under an alternative.
[c] Under the constrained case for the Expanded Operations Alternative, trucks transporting radioactive waste and material would not pass through this location. Therefore, the daily traffic volumes shown for this alternative could be reduced by up to 30 trips.

5.1.4 Socioeconomics

This section addresses potential impacts on the region's socioeconomic conditions. The discussion focuses on the region's economic activity, population, and housing, public finances, and public services. DOE assessed the potential for impacts, both beneficial and adverse, based on whether the proposed activities would directly or indirectly result in any of the following:

- Alterations in the projected rates of population growth
- Effects on the housing market
- Effects on local businesses and the economy
- Displacement of existing jobs
- Effects on local employment or the workforce

5.1.4.1 No Action Alternative

5.1.4.1.1 Economic Activity, Population, and Housing

Under the No Action Alternative, a 240-megawatt solar power generation facility would be constructed. Operation of this solar power generation facility would be the sole source of new permanent employment at the NNSS, adding 150 full-time equivalent (FTE) positions to the current employment level of 1,699 (see **Table 5–21** and **Table 5–22**).

Table 5–21 Onsite Employment

	NNSS					
Alternative	***NNSS Only***	***Including Solar Power Generation Facility Employees***	***NLVF***	***RSL***	***TTR***	***Total***
No Action	1,699	1,849	1,442	132	106	3,379
Expanded Operations	2,124 [a]	2,324	1,803 [a]	132	43	4,102
Reduced Operations	1,529 [b]	1,654	1,298 [b]	132	39 [c]	2,998

NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range.
[a] Current employment number plus 25 percent.
[b] Current employment number minus 10 percent.
[c] Number from the *Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* minus 10 percent.

Table 5–22 Construction Employment

Alternative	***NNSS*** [a]	***NLVF***	***RSL***	***TTR***
No Action	For commercial solar facilities, average of 500 FTE positions over 35 months, peak of 1,000 FTE positions.	0	0	0
Expanded Operations	For commercial solar facilities, average of 750 FTE positions over 42 months, peak of 1,500 FTE positions. 250 additional FTE positions from other projects.	0	0	0
Reduced Operations	For commercial solar facilities, average of 400 FTE positions over 32 months, peak of 800 FTE positions.	0	0	0

FTE = full-time equivalent; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range.
[a] NNSA Plant Construction Numbers based on Amargosa Farm Road Solar Energy Project.

Approximately 10 percent of the 150 FTE positions, or 15 individuals, are expected to relocate as a result of the No Action Alternative. It was assumed that 77 percent would live in Clark County (12 workers) and 23 percent in Nye County (3 workers), consistent with current workforce demographics

(NSTec 2009). Projected rates of population growth would not be altered as a result of the No Action Alternative. Sufficient housing exists in the area (208,275 and 3,202 housing vacancies in Clark and Nye Counties, respectively) to support an increase in population of 15 people. This would result in a 0.01 percent reduction in housing vacancy rates in Clark County and a 0.1 percent reduction in Nye County.

The remaining 135 individuals filling the new jobs are expected to be already living in Clark and Nye counties. Of the 135 individuals, it was assumed that 77 percent would live in Clark County (104 workers) and 23 percent in Nye County (31 workers), consistent with current workforce demographics (NSTec 2009d). This would decrease the unemployment rate in Clark County by 0.07 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). It also would decrease the unemployment rate in Nye County, by about 0.99 percent (a total of 3,133 Nye County residents were unemployed as of August 2010).

Daily spending by these new employees would positively affect the immediate area of the NNSS. Purchases made would typically include gasoline, automobile servicing, food and beverages, laundry services, and other retail items. Therefore, a minor beneficial impact on economic activity would occur under the No Action Alternative due to the increase in employment.

The Regional Input-Output Modeling System II (RIMS II) developed for the U.S. Department of Commerce, Bureau of Economic Analysis, was used to evaluate the indirect economic impact on employment of constructing the solar power generation facility. RIMS II provides two types of multipliers, final-demand and direct-effect, for estimating the impacts of changes on employment. An estimate of the change in the total number of jobs in a region's economy was calculated by multiplying the initial change in jobs by a direct-effect employment multiplier. By adding 150 FTE positions to support the solar power generation facility, the analysis showed that approximately 394 secondary jobs would be created. The combined effect of direct and indirect employment would result in a decrease in the unemployment rate in Clark County of about 0.3 percent and about 3.9 percent in Nye County.

Approximately 500 FTE positions over 35 months, with a peak of 1,000 FTE positions, would be hired for construction of the solar power generation facility. Given the high unemployment rates in Clark and Nye Counties (14.72 and 17.2 percent, respectively, as of August 2010), it was assumed that the majority of construction workers hired for construction of the solar power generation facility would currently be living in the area. Between January 2009 and January 2010, 29,800 construction jobs were lost in the State of Nevada (LVRJ 2010). Because relocation of construction workers is unlikely, an increase in population and a decrease in housing availability are not anticipated; only negligible impacts on population and housing are anticipated during construction.

The addition of construction jobs would have a direct economic impact on employment in the region. As construction firms are hired to support the solar power generation facility, regional economic activity (purchases of building materials, construction supplies, and equipment, as well as spending by the construction workers) would also increase. Therefore, construction would have a minor beneficial impact on employment and the local economy.

As described previously, RIMS II was used to calculate the indirect economic impact of the project on employment. An estimate of the change in the total number of jobs in a region's economy was calculated by multiplying the initial change in jobs by a direct-effect employment multiplier. By adding 500 to 1,000 FTE positions, the analysis showed that approximately 930 to 1,860 secondary jobs would be created as a result of construction of the solar power generation facility (RIMS II 2010). This would reduce the unemployment rate in the region and temporarily benefit the economy and employment in the region.

Public finance. Increased sales transactions for the purchase of materials and supplies for construction of the solar power generation facility would generate some additional revenues for local governments. These impacts would be minor, but beneficial. In addition, revenues for Clark and Nye Counties would increase due to increases in personal income and total employment, which could lead to increased spending.

5.1.4.1.2 Public Services

Public education. For the 2009 to 2010 school year, the Clark County School District student–teacher ratio was 21:1. The student–teacher ratio for the Nye County School District was 18.6:1. Under the No Action Alternative, a total of 28 children could relocate to the area based on a state average of 1.89 children per family (Census 2000). This represents an increase of 22 children in the Clark County School District (77 percent of the children would reside in Clark County, consistent with current NNSS workforce demographics [NSTec 2009d]) and an increase of 6 children in the Nye County School District (23 percent of the children would reside in Nye County). It is unlikely that all students relocating to the area would be the same age and living in the same neighborhood. However, based on an increase of 22 children to the Clark County School District, one additional teacher may be required in Clark County to maintain the 21:1 student-teacher ratio. No new teachers would be required in Nye County as a result of the No Action Alternative.

Police protection. Under the No Action Alternative, the number of daytime occupants on the NNSS would increase, which could result in more calls for police services. Civilian law enforcement at the NNSS is provided under a contract with the Nye County Sheriff's Department. To maintain the existing level of service, the NNSS would need to increase the number of civilian law enforcement officers under contract due to the increase of 150 permanent employees. Because the increase in number of employees that would relocate to Clark and Nye Counties is only 15 total, there would be no affect on levels of service at the Las Vegas Metropolitan Police Department, the North Las Vegas Police Department, or the Nye County Sheriff's Department. In addition, law enforcement is not provided by the Las Vegas Metropolitan Police Department or the North Las Vegas Police Department.

Fire protection. Construction and operation of the solar power generation facility would increase building density on the NNSS, which could result in additional calls for fire protection. NNSS Fire and Rescue operates out of two fire stations: one in Mercury and a newly constructed station in Area 6 that provides rapid response to emergencies in the forward areas of the NNSS. This impact is expected to be minor and would not affect levels of service at the Clark County Fire Department, the Las Vegas Fire Department, or the Nye County volunteer fire departments.

Health care. It was assumed that the majority of the 150 employees hired to operate the solar power generation facility would be currently living within the ROI. Therefore, the current person to hospital bed ratio within the ROI would remain the same. Construction and operation of the solar power generation facility under the No Action Alternative would not displace any health care facilities nor conflict with local and regional plans for health care or emergency services. Therefore, construction and operation of the solar power generation facility would not increase the need for hospital personnel.

5.1.4.2 Expanded Operations Alternative

5.1.4.2.1 Economic Activity, Population, and Housing

Under the Expanded Operations Alternative, it was assumed that operation of commercial solar power facilities as well as other permanent positions created at the NNSS would increase employment from 1,699 to 2,324, which would be an increase of 625 jobs (see Table 5–21).

Approximately 10 percent, or 63 individuals, are expected to relocate as a result of the Expanded Operations Alternative. It was assumed that 77 percent would live in Clark County (49 workers) and 23 percent in Nye County (14 workers), consistent with current workforce demographics (NSTec 2009). Projected rates of population growth would not be altered as a result of the Expanded Operations Alternative. Sufficient housing exists in the area (208,275 and 3,202 housing vacancies in Clark and Nye Counties, respectively) to support an increase in population of 63 people. This would result in a 0.02 percent reduction in housing vacancy rates in Clark County and a 0.4 percent reduction in Nye County.

The remaining 563 individuals filling the jobs are expected to be already living in the region. Of these 563 jobs, it was assumed that 77 percent (a total of 434) would live in Clark County and 23 percent (a total of 130) in Nye County, consistent with current workforce demographics (NSTec 2009d).

The 434 jobs added in Clark County would decrease the unemployment rate by 0.31 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, the 130 new jobs would decrease the unemployment rate by about 4.2 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). These additional jobs would represent a minor beneficial impact on employment in Clark County and a moderately beneficial impact on Nye County.

As described under the No Action Alternative, RIMS II was used to calculate the indirect economic impact of the project on employment. By adding 625 direct jobs under the Expanded Operations Alternative, approximately 920 indirect jobs would be created in the ROI. The combined effect of direct and indirect employment would result in a decrease in the unemployment rate in Clark County of about 0.8 percent and about 11.0 percent in Nye County.

Daily spending by new employees would positively affect the immediate area of the NNSS. Purchases made would typically include gasoline, automobile servicing, food and beverages, laundry, and other retail items. Therefore, a minor beneficial impact on economic activity would occur under the Expanded Operations Alternative due to the increase in employment.

Approximately 750 FTE positions over 42 months, with a peak of 1,500 FTE positions, would need to be hired for construction of the solar power generation facility. Other construction projects at the NNSS would require approximately 250 FTE positions over the next 10 years. Given the high unemployment rates in Clark and Nye Counties (14.72 and 17.2 percent, respectively as of August 2010), it is estimated that the majority of the construction workers would come from within the region. This would temporarily reduce the unemployment rate in the region and would have a short-term beneficial impact on the economy and employment in the region.

RIMS II was used to calculate the indirect economic impact on employment resulting from solar power generation facility construction and other construction projects at the NNSS. An estimate of the change in the total number of jobs in a region's economy was calculated by multiplying the initial change in jobs by a direct-effect employment multiplier. By adding 750 to 1,500 FTE positions, approximately 1,400 to 2,790 jobs would be created as a result of solar power generation facility construction. The other construction projects would add 250 FTE positions which would create approximately 466 jobs in the ROI. This would have a moderately beneficial impact on the economy and employment in the region during the period of construction.

As described under the No Action Alternative, regional economic activity would increase as construction firms are hired to support the solar power generation facility due to the purchase of building materials and construction supplies and equipment, as well as spending by the construction workers. Therefore, construction would have a minor beneficial impact on employment and the economy under the Expanded Operations Alternative due to the increase in employment.

Public finance. As described under the No Action Alternative, increased sales transactions from purchases of materials and supplies for construction of the solar power generation facility would generate additional revenues for local governments. These impacts would be minor but beneficial. In addition, property taxes collected as a result of the relocation of 49 households in Clark County and 14 in Nye County would increase revenue for local governments.

5.1.4.2.2 Public Services

Public education. As described under the No Action Alternative, for the 2009 to 2010 school year, the Clark County School District student–teacher ratio was 21:1. The student–teacher ratio for the Nye County School District was 18.6:1. Under the Expanded Operations Alternative, a total of 119 children could relocate to the area based on an average of 1.89 children per family (USCB 2008b). This represents an increase of 92 children in the Clark County School District (77 percent of the children would reside in Clark County) and an increase of 27 children in the Nye County School District (23 percent of the children would reside in Nye County). Four additional teachers would be needed in Clark County to maintain the current student–teacher ratio. One new teacher would be required in Nye County under the Expanded Operations Alternative.

Police protection. Under the Expanded Operations Alternative, the number of daytime occupants on the NNSS would increase by 625 employees, which could result in more calls for police services. To maintain the existing level of service, the NNSS would need to increase the number of civilian law enforcement officers under contract due to the increase of 625 permanent employees. As described under the No Action Alternative, this impact on police and public safety is expected to be negligible. It would not affect levels of service at the Las Vegas Metropolitan Police Department, the North Las Vegas Police Department, or the Nye County Sheriff’s Department because law enforcement is handled under a separate contract.

Fire protection. Activities under the Expanded Operations Alternative could result in additional calls for fire protection. NNSS Fire and Rescue operates out of two fire stations: one in Mercury and a newly constructed station in Area 6, which provides rapid response to emergencies in the forward areas of the NNSS. This impact is expected to be minor and would not impact levels of service at the Clark County Fire Department, the Las Vegas Fire Department, or the Nye County volunteer fire departments.

Health care. The addition of 625 employees would have only a minor impact on area hospitals and hospital personnel. An eight-bed dispensary in Mercury serves as a clinic for the NNSS. The activities associated with the Expanded Operations Alternative are not anticipated to increase the need for hospital care or personnel within the ROI. However, due to the increase in the number of employees at the NNSS, the clinic in Mercury may need to expand its number of beds.

5.1.4.3 Reduced Operations Alternative

5.1.4.3.1 Economic Activity, Population, and Housing

Under the Reduced Operations Alternative, it was assumed that total employment at the NNSS would decrease from 1,699 to 1,654, with employment from the operation of the solar power generation facilities offsetting most losses associated with a reduction in activity associated with other NNSS programs. This decrease would be equal to about 45 jobs lost: 35 in Clark County and 10 in Nye County. In Clark County, this would increase the unemployment rate by about 0.02 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, the increase in unemployment would be about 0.32 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). Daily spending in the immediate area of the NNSS would decrease correspondingly, which would have a minor adverse impact on economic activity. Housing vacancies would increase and demand for public services would decrease due to the reduction in the permanent workforce.

Approximately 400 FTE positions over 32 months, with a peak of 800 positions, would need to be hired for construction of the commercial solar power generation facility. As described under the No Action Alternative, RIMS II was used to calculate the indirect economic impact of the project on employment. An estimate of the change in the total number of jobs in a region's economy was calculated by multiplying the initial change in jobs by a direct-effect employment multiplier. By adding 400 to 800 FTE positions, approximately 745 to 1,490 jobs would be created as a result of the solar power generation facility construction (RIMS II 2010), which would have a moderately beneficial impact on the economy and employment in the region.

As described under the No Action Alternative, regional economic activity would increase as construction firms are hired by the commercial sponsor of the solar power generation facility due to purchases of building materials and construction supplies and equipment, as well as spending by construction workers. Therefore, construction would have a minor beneficial impact on employment and the economy under the Reduced Operations Alternative due to the increase in employment.

Public finance. As described under the No Action Alternative, increased sales transactions from purchases of materials and supplies for construction of the solar power generation facility would generate some additional revenues for local governments under the Reduced Operations Alternative. These impacts would be minor, but beneficial.

5.1.4.3.2 Public Services

Public education. For the 2009 to 2010 school year, the Clark County School District student–teacher ratio was 21:1. The student–teacher ratio for the Nye County School District was 18.6:1. Under the Reduced Operations Alternative, no individuals are expected to relocate to these counties; therefore, no new students would enroll in Clark County or Nye County schools and no new teachers would be required as a result of the Reduced Operations Alternative.

Police protection. Under the Reduced Operations Alternative, the number of daytime occupants on the NNSS would decrease, which could result in fewer calls for police services, which would be a minor beneficial impact on police protection resources.

Fire protection. Construction and operation of the solar power generation facility would result in increased building density on the NNSS, which could result in additional calls for fire protection. NNSS Fire and Rescue operates out of two fire stations, one in Mercury and a newly constructed station in Area 6, which provides rapid response to emergencies in the forward areas of the NNSS. This impact is expected to be minor and would not impact levels of service at the Clark County Fire Department, the Las Vegas Fire Department, or the Nye County volunteer fire departments.

Health care. Under the Reduced Operations Alternative, a small staff reduction of 45 people is anticipated, but would not result in any impact on health care in the region. Existing levels of services would be maintained.

Socioeconomics—American Indian Perspective

Indian people prefer to live in our traditional homelands. One primary reason for this is because Indian people have special ties to our traditional lands and a unique relationship with each other. When Indian people receive employment near our reservations, we can remain on the reservations while commuting to work. This pattern of employment tends to have positive benefits for both the Indian community and tribal enterprises like housing. The reservation Indian community has the participation of the individual and his (her) financial contribution. The individual payment for housing is tied to income level, so the more a person earns with the job, the more they pay to the tribal housing office, and thus making tribally sponsored housing more economically sustainable and attractive for tribal governments.

When employment opportunities decline on reservations, however, Indian families must often move away from our reservations to seek employment elsewhere. As Indian people move away, Indian culture is threatened because the number of families living on reservations declines. Tribal members who choose to relocate from their reservations impact reservation economies, school, housing, and emergency services. Both schools and economies are impacted because federal funding available to tribes is based on population statistics.

With local employment opportunities such as those offered by the Nevada National Security Site (NNSS) for eligible tribal representatives, prices of tribal housing rise because they are based on income. If a positive balance between increased income and increased cost of living in tribal reservations is achieved, then both individual members and the tribe benefit from employment opportunities.

Tribal housing programs become jeopardized if vacancies occur in rental properties and dwellings remain unoccupied. If vacancies occur, tribal revenues and federal funding are adversely impacted and making it more difficult to expand housing programs in future years.

Additionally, vacant units require more maintenance. If tribal members are unavailable to occupy a tribal housing unit, then tribes make units available to non-Indians, and this, too, potentially impacts Indian culture. The increased presence of non-Indians on a reservation or in an Indian community reduces the privacy needed for the conduct of certain ceremonies and traditional practices. When non-Indian children are in constant interaction with Indian children, it creates a situation that potentially disrupts the perpetuation of cultural learning opportunities that occur in everyday life.

When Indian people move away from our reservations several dilemmas occur. Typically, Indian people experience a feeling of isolation from their tribe, culture, and family. When an Indian person relocates to an off-reservation area, the individual finds that there are fewer people of their tribe and culture around them. As a result, Indian people must decide on the appropriateness of practicing traditional ceremonies in the presence of non-Indian people. Indian people are continually torn between the decision to stay in the city or return to the reservation to participate in traditional ceremonies and interact with other tribal members. This dilemma occurs on a regular basis and potentially impacts the livelihood and cultural well-being of off-reservation employees and their families. When off-reservation individuals choose to return to our homelands to participate in traditional ceremonies or renew familial ties, they risk losing their jobs or being subjected to disciplinary actions against their children who attend public schools due to excessive absenteeism.

Under federal and tribal law, American Indian children can be educated in tribally-controlled and federally-certified schools located on Indian reservations (also known as Indian Trust Land). Federal funds are available through the Indian Education Act for the education of Indian children. Compensation from the federal government is provided to any school district that has entered into a cooperative agreement with federally-recognized tribes, whether it be public, private, or an Indian-controlled school.

Small rural Indian reservations must have a sufficient number of people to generate an emergency response capability. The need for emergency services will decline as people move away from the reservation. Tribal members employed in these emergency service occupations may move away because of their marketable skills. Tribal revenues for administration, school, housing, and emergency services will be reduced accordingly, due to a decline in population size.

Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation occur resulting from NNSS-related activities, including the transportation of hazardous and radioactive waste, it could result in the closure of the main or only transportation artery to our land. If a major (only) road into a reservation closes, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays. Delays also could occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use. Emergency medical services en route to or from the reservation, and purchases by patrons of tribal enterprises could be dramatically impeded. Potential investors interested in expanding tribal enterprises, as well as on-going considerations by tribal governments for future tribal enterprises, may significantly diminish because of the real and perceived risks from the transportation of hazardous and radioactive waste associated with NNSS-related activities.

See Appendix C for more details.

5.1.5 Geology and Soils

This section addresses the impacts on geology and soils under the No Action, Expanded Operations, and Reduced Operations Alternatives. Under each alternative, the impact discussion is broken down into the missions and associated programs. The physical setting under review in this section includes the topography, physiography, economic mineral resources, unique geologic features, soils, and local geologic hazards.

Impact Assessment Criteria. Activities under an alternative would have an adverse impact on the geology or soils if they result in any of the following effects:

- Substantial soil erosion or loss of topsoil
- Direct conversion of prime and unique farmland to nonagricultural uses;
- Loss of availability of a known mineral resource that would be of value to the region and/or the residents of the state
- Increased instability of a geologic unit or soil due to project activities, potentially leading to an onsite or offsite landslide, subsidence, or collapse
- Exposure of people or structures to substantial adverse effects from seismic activity
- Contamination of soil or mineral resources

Maps, past studies and regional models were used to determine the impacts from the alternatives to the physical setting based on the criteria described above. Activities that would occur in already established facilities, tunnels, or labs generally would not have an impact on the geologic resources. Mitigation measures used to minimize adverse impacts on the physical setting are presented in Chapter 7.

5.1.5.1 No Action Alternative

Chapter 3 describes the activities that would occur under the No Action Alternative. Many of the activities are similar to those described in the ROD for the *1996 NTS EIS* (and subsequent amendments) and other completed NEPA documents. The NNSS was withdrawn from public access and entry. This withdrawn status prevents exploration for economic minerals at the NNSS. The existence of past mines prior to the land withdrawal suggests that metallic and other economic minerals are present at the NNSS. However, the activities outlined under the No Action Alternative are not expected to affect the presence of economic mineral deposits, which would allow their extraction in the future. The unavailability of the minerals and other economic materials from the NNSS has had little effect on Nevada's mining, manufacturing, and construction industries and would probably have little effect on those industries in the future.

Open borrow pits at the NNSS may continue to be used to supply the NNSS with fill for construction or operations purposes. No new borrow pits would be opened under the No Action Alternative. Removing alluvial materials for fill would not substantially reduce the aggregate resources in the region. The NNSS has a low potential for oil and gas resources, so there would be no impact on the regional energy mineral resources.

The National Resources Conservation Service has not characterized soils at the NNSS and the presence of prime farmland is not known. As agriculture production in Nevada requires irrigation, the best potential for prime farmland soils would be located in the deepest sections of Yucca Flat, Frenchman Flat, and

Plutonium Valley (see Chapter 4, Section 4.1.5.3). However, as there are no plans for irrigating the valley floors, the presence of prime farmland soils at the NNSS is extremely unlikely. Therefore, the actions under all of the alternatives would not have an impact on regional prime farmland soil availability.

The following discussion presents the potential for impacts from the programs and activities proposed under the No Action Alternative that could affect geologic or soil resources.

5.1.5.1.1 National Security/Defense Mission

Stockpile Stewardship and Management Program. Under the No Action Alternative, NNSA would maintain the capability to conduct underground nuclear weapons testing. As maintenance of the facilities and utilities would occur at already disturbed outdoor or enclosed locations, maintaining this capability and the nuclear weapons stockpile would not impact geologic or soil resources.

There would be no impact on the physical setting from conducting dynamic experiments at the U1a Complex, or in unused vertical emplacement holes or other locations within the Nuclear Test and Nuclear High Explosive Test Zones. These experiments would occur within areas previously excavated for facility construction or past tests. Some alluvial materials may need to be excavated if the U1a Complex needs additional experiment alcoves. However, the excavated material could be used for construction or as fill at the NNSS, which would reduce the overall need for alluvial materials from other borrow pits.

Conducting conventional high-explosives experiments would impact soils and geology. Activities would consist of up to 20 conventional high-explosives experiments per year at BEEF and up to 10 per year at other locations at the NNSS. Open-air high-explosives experiments at BEEF would occur on a constructed firing table in locations previously disturbed through construction and past tests, which would preclude impacts on the soil and alluvial geologic deposits. However, surface soils would be disturbed if an open-air detonation were to occur at previously undisturbed locations. This would increase the potential for soil erosion by wind and water at the experiment location. Depending on the type of experiments and composition of the high-explosive material that would be used, soils could be contaminated with chemicals, heavy metals, hydrocarbons, or small amounts of radiological isotopes. Additional impacts would be seen through the alteration of natural drainage paths, which would result in a potential for preferential erosion of alluvial deposits, and increased sediment deposition in the valleys. However, the potential experiment locations (Areas 1, 2, 3, 4, 12, and 16) have been previously disturbed, so the surface disturbance would be minor. If soils were significantly contaminated by explosives experiments, they would be identified as a corrective action site and would be remediated as necessary.

There would be no impact on the physical setting from NNSA's conduct of shock physics experiments under the No Action Alternative. The experiments would occur within existing facilities at JASPER in Area 27 and the U1a Complex in Area 1. Any additional construction required at the U1a Complex to accommodate the Large-Bore Powder Gun would occur in areas that were previously disturbed by surface construction and would likely use alluvial materials previously excavated from the complex.

The physical setting would not be impacted by conducting criticality experiments, training and other activities or pulsed-power and plasma physics and fusion experiments because these tests would occur within current facilities. Stockpile management activities at the NNSS would also occur within existing facilities and would not require additional surface or subsurface disturbance.

Some localized impacts on the surface soil structure would occur in off-road locations from NNSA and the U.S. Department of Defense (DoD) conducting training activities for the Office of Secure Transportation in off-road locations. Driving vehicles through undisturbed soils and vegetation would disturb the soil structures and increase soil erosion by wind.

NNSA would perform up to five drillback operations during the next 10 years. Each operation would disturb approximately 5 acres for the construction laydown area, borehole, and temporary storage of excavated material. The drillback sites would be located adjacent to an existing UGTA, so the surface disturbance would be minimal compared to the original test area.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Most of the activities under these programs would be located at existing disturbed areas and developed facilities at the NNSS and, therefore, would not impact the physical setting. Support for the following activities would not impact the physical setting: consequence management through the Federal Radiological Monitoring and Assessment Center, Accident Response Group, Radiological Assistance Program, and weapons of mass destruction emergency responder training. The disposition of improvised nuclear and radiological dispersion devices would also occur within existing facilities and would not result in land disturbance.

Some nonproliferation- and counterterrorism-related activities would use existing facilities at the NNSS, so they would not impact the physical setting. An Arms Control Treaty Verification Test Bed would use existing capabilities, such as the Nonproliferation Test and Evaluation Complex (NPTEC), BEEF, various tunnels, laboratories, and training facilities, to support design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures. An existing building at Mercury would be retrofitted for uses not supplied by the other facilities. No impacts on the physical setting would occur because the activities would occur at existing structures at the NNSS.

Nonproliferation programs would use several areas and facilities at the NNSS as a base of operations for collaboration and experiments. Unique facilities at the NNSS, including NPTEC, previously contaminated surface locations, and tunnels, would be used to support training and exercises. Although some exercises would likely cause minor soil disturbance, it would be in areas already disturbed by historical testing. Nuclear forensics activities would occur in previously disturbed areas and existing facilities and would not impact soils or geologic media.

The NNSS would also be used for a counterterrorism training program with various U.S. agencies and possibly international participants. This program would be conducted at BEEF, NPTEC, and other locations at the NNSS. Some high explosives would be used as part of the training, so the impacts would be similar to those described for the high-explosion experiments under the Stockpile Stewardship and Management Program. There would be a potential for increased soil erosion and surface instability where training occurs in the rugged terrain and previously undisturbed areas of the NNSS.

Work for Others Program. Several projects are included in the Work for Others Program. Some of the activities would use existing facilities and would not impact the physical setting. Others may require construction or experiments that would introduce additional surface disturbances at the NNSS.

No impacts would occur from NNSA hosting activities for treaty verification, including research and development, because the activities would occur within the existing facilities.

Conventional weapons effect tests (including live drop and static high-explosive detonations) using up to 30,000-pound-class weapon systems with up to 20,000 pounds of TNT [2,4,6-trinitrotoluene]-equivalent explosives would be performed within the Nuclear and High Explosives Test Zone. Other types of explosives experiments would occur in various locations at the NNSS, as described in Chapter 3, Section 3.1.1.3. Surface soils would be disturbed if an open-air explosive experiment were to occur at a previously undisturbed location. This would increase the potential for soil erosion by wind and water at the testing location. Surface drainage may be altered, which would increase the potential for erosion from increased gullying. Many locations in Areas 1, 2, 3, 4, 12, and 16 have been disturbed by past tests, so the surface disturbance would not be unique to these areas.

Other activities, such as development and demonstration of capabilities and technologies against deeply buried hardened targets, would be primarily based in the U16b Tunnel of Area 16, but could also be conducted at other existing locations at the NNSS. Elsewhere, up to 20 controlled chemical and biological simulant release experiments would be conducted annually to test sensors and train first responders. The location of these experiments has not been determined. The release of simulants would not affect the physical setting.

Joint counterterrorism training between DoD, DHS, and other Federal agencies would occur in the remote areas of the NNSS. Small arms live-fire and small explosions would be used as part of the training; however, the impacts would be similar to those described for the high-explosion experiments under the Stockpile Stewardship and Management Program. There would be a potential for increased soil erosion and surface instability where training occurs in the rugged terrain and previously undisturbed areas of the NNSS. Other training would include overland navigation techniques, which would introduce more soil disturbance to locations that may not be previously disturbed. This would generate minor soil impacts by increasing the potential for erosion and introducing some surface instability to the area.

The criticality experiments for NASA and the miscellaneous Work for Others Program activities would not introduce impacts because they would use existing facilities.

5.1.5.1.2 Environmental Management Mission

Waste Management Program. DOE operates facilities at the NNSS to manage radioactive waste generated both within Nevada and out-of-state by NNSA and other authorized generators. The Area 5 RWMC evaluates, processes, stores, and disposes LLW and MLLW wastes. The facility uses excavated trenches, pits, and boreholes in an approximately 740-acre area.

On December 1, 2010, the Nevada Division of Environmental Protection issued a permit to NNSA/NSO for a new MLLW Disposal Unit at the Area 5 RWMC. The new MLLW Disposal Unit consists of a single lined cell (Cell 18) with a capacity of about 900,000 cubic feet (actual permitted disposal volume is 899,996 cubic feet). Construction of Cell 18 is complete and it began accepting MLLW for disposal in January 2011.

Under the No Action Alternative, less than 50 percent of the approximately 740-acre Area 5 RWMC would be used for LLW and MLLW disposal cells over the next 10 years. Once filled, disposal cells would be operationally capped, pending final closure. Preshipment storage of TRU waste, mixed TRU waste, MLLW, and hazardous wastes at the NNSS would not generate impacts on soils, because the wastes would be stored on existing storage pads.

The Area 3 Radioactive Waste Management Site (RWMS) was constructed by excavating underground nuclear test subsidence craters that met specific design criteria and would be closed with an engineered cap. The Area 3 RWMS is not active, although it would be reactivated, if necessary, and its existing craters would be used for disposal of onsite LLW or nonhazardous solid waste.

Open-air detonation of old or unusable explosives would continue at the Explosive Ordnance Disposal Unit in Area 11 and would not result in additional soil disturbance.

The hydrocarbon-contaminated waste disposal sites (Area 6 Hydrocarbon Solid Waste and U10c Solid Waste Disposal sites) would continue to operate under their respective permits issued by the Nevada Division of Environmental Protection (NDEP) and would not create any additional impacts on geologic resources or soils.

Environmental Restoration Program. The Soils Sites Project under the Environmental Restoration Program would continue to investigate, characterize, and close contaminated soil sites previously identified in the corrective action units. Under the Environmental Restoration Program, each contaminated site is prioritized and evaluated to determine the appropriate corrective action. Depending on the nature and extent of the contamination, either a streamlined or complex corrective action process would be used. Some soil sites may be closed in place with appropriate controls; others may be closed with other actions, such as stabilization and/or excavation of contaminated soil and disposal (FFACO 2008). Closure of these sites is conducted under the Federal Facility Agreement and Consent Order (FFACO) with approval by the NDEP. If the appropriate corrective action includes contaminated soil removal, there would be a temporary increase in erosion from the disturbance of the soil. This would increase the potential that soil could be moved by wind and water processes.

Under the Soils Sites Project outlined in the *1996 NTS EIS* (DOE 1996c), approximately 3,257 acres of plutonium-contaminated soils would be dispositioned at the NNSS, the TTR, and the Nevada Test and Training Range (formerly the Nellis Air Force Range Complex) (DOE 1996e). As of 2009, several corrective action sites in Frenchman Flat, Oak Spring, Yucca Flat, and Buckboard Mesa were declared closed by a corrective action document (FFACO 2009). NNSA anticipates that all identified Soils Project sites would be closed under the Environmental Restoration Program by the end of 2022.

Drilling additional monitoring wells under the UGTA Project would result in localized erosion around the drilling locations. Similar impacts would result from the decontamination and demolition of industrial sites, remediation of Defense Threat Reduction Agency (DTRA) sites, and the borehole management program.

Because petroleum fuels, lubricants, and a variety of chemicals are used and stored at the NNSS, there is a chance that an accidental spill could contaminate the soil surface. If an accidental release of hydrocarbons were to occur, the soils contaminated with hydrocarbons would be removed and disposed in permitted and approved landfills. With spill prevention and mitigation measures in place, the potential for soil contamination would be reduced.

5.1.5.1.3 Nondefense Mission

General Site Support and Infrastructure Program. Under the No Action Alternative, infrastructure-associated activities would be primarily limited to projects that maintain the present facility capabilities, such as repairs and replacements. There would be no increasing of the capabilities or extending the ranges of the existing infrastructure. Although repairs may require some surface disturbance around the existing facilities, it would be limited to areas that were previously disturbed, and would not significantly increase surface erosion around at the NNSS.

Conservation and Renewable Energy Program. Under the No Action Alternative, implementing efficiency and conservation for energy and water, continuing transportation and fleet management, and upgrading the facilities at the NNSS to high-performance, sustainable buildings under the NNSS Conservation and Renewable Energy Program would result in no impacts on the local geology or soils.

A 240-megawatt commercial solar power generation facility would be constructed in Area 25 under the No Action Alternative. Construction of the commercial solar power generation facility and associated transmission lines could disturb up to 2,650 acres. Most of the soils in Area 25 have not been modified through construction or other uses, so construction of the solar power facility would affect topsoil and increase the potential for erosion in Jackass Flats.

Other Research and Development Programs. The NNSS would continue to host environmental research projects, but would not actively promote the National Environmental Research Park Program.

Each research project would be reviewed by NNSA on a case-by-case basis. Although minor amounts of soil may be disturbed during the data-gathering or research procedures, the effects would be temporary.

5.1.5.2 Expanded Operations Alternative

The potential impacts of implementing the Expanded Operations Alternative would largely be similar to those discussed above under the No Action Alternative. However, some additional facilities and activities are proposed, and some activities would be expanded or increased, which could magnify the impacts of the No Action Alternative. The sections below present the alternative activities that have different impacts from those described in Section 5.1.5.1.

5.1.5.2.1 National Security/Defense Mission

Stockpile Stewardship and Management Program. There would be no additional impacts from NNSA's maintenance of the potential to conduct underground nuclear weapons testing under the Expanded Operations Alternative. Several activities under the Stockpile Stewardship and Management Program would remain the same as those under the No Action Alternative, including: disposition damaged U.S. nuclear weapons, criticality experiments, and drillback operations. The potential impacts would be the same as those described under the No Action Alternative.

Under the Expanded Operations Alternative, the number of dynamic experiments would increase to 20 per year, all within the Nuclear Test and Nuclear and High Explosive Test Zones at the NNSS. The increase would not impact the physical setting because they would occur within existing facilities. At BEEF, up to 100 conventional explosives experiments would occur every year. A new firing table and ancillary facilities would also be constructed to support the additional experimental needs. These features would be constructed within the existing developed BEEF facility area. Therefore, the potential for erosion would likely be minor. NNSA would increase the size and number of high explosives at the High Explosives Test Zone. The impacts are described further in the Work for Others Program section.

NNSA would establish up to three areas dedicated to conducting explosive experiments with depleted uranium in Areas 2, 4, 12, or 16. Up to 20 experiments would be performed each year using a cumulative maximum of 4,000 pounds of depleted uranium and 12,000 pounds (TNT-equivalent) of high explosives. These detonations would impact soils in the area, because the explosions would remove the topsoil and increase the potential for erosion by wind. The use of depleted uranium in the experiments would increase the radioactivity in the soils at the experiment locations. These experiments would be located in research areas that have previously hosted extensive underground and atmospheric testing. Some of the experiment sites would likely be located on areas (e.g., Yucca Flat, Rainier Mesa, and Shoshone Mountain) that had undergone previous underground nuclear testing. After the experiments and cleanup, radiation monitoring would determine whether a site would need to be included in the Soils Project of the Environmental Restoration Program.

There would be no impact on the physical setting from NNSA's increasing the number of shock physics experiments under the Expanded Options Alternative. The experiments would occur within existing facilities, and opening the facilities to academic and other research would not require constructing new buildings. There would be no impacts on the physical setting from increasing the number of pulsed-power experiments at the Atlas Facility. There would be no impact from the staging of SNM under the stockpile management activities because it also would occur within existing facilities on NNSS property.

No impact on the physical setting would occur by expanding the use of the NNSS Dense Plasma Focus machine. There is no indication that moving the machine to another building in Area 6 would require the construction of additional facilities, so moving the equipment to a new location would not disturb soils or affect unique geologic resources. The old building in Area 11 would be placed on standby.

Under the Expanded Operations Alternative, NNSA would construct new support facilities near Eleana Ridge in Area 17 to support the Office of Secure Transportation training programs. The new facilities, consisting of buildings and training areas would occupy approximately 10,000 acres, including about 25 miles of internal roads and firebreaks around the active training areas. A 4.5-mile utility corridor for electrical lines and a water pipeline would be built to support the new facility. As a result, there would be temporary impacts on soils from construction surface disturbance. Additionally, facilities would be expanded in the Area 12 Camp, Area 6 Control Point, or in Mercury (Area 23), which would temporarily increase the soil erosion around the construction site

Soils would be disturbed from grading the facilities location, developing roads, and excavating the pipeline trench, as well as from construction equipment moving across the desert surface. Soils disturbed during construction would have a potential for increased erosion from wind and water, and some soils would be permanently disturbed underneath the new structures and roads. The utility corridor would be restored by replacing topsoil and encouraging native vegetation growth. Some of the roads would not be paved; the existing soil structure would be compacted for stability. The facilities would be sited and designed to minimize the geotechnical hazards (e.g., shrink-swell soils, slope instability) that could affect the new structures.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Under the Expanded Operations Alternative, there would be no changes from under the No Action Alternative for the following projects and activities under the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs: consequence management support for the Federal Radiological Monitoring and Assessment Center, the Accident Response Group, and the Radiological Assistance Program; weapons of mass destruction emergency responder training; assistance for the Emergency Communications Network; and the Disposition Forensics Program.

Some of the nonproliferation- and counterterrorism-related activities would remain similar to those under the No Action Alternative, however new facilities would be constructed to support program requirements. These new facilities are still conceptual in nature, so additional NEPA analysis may be required once locations and plans are finalized. The Arms Control Treaty Verification Test Bed project would need both indoor and outdoor laboratory and test areas, which would require a total of 100 acres of land. The facilities would be sited at various locations within the NNSS. Approximately 0.23 acres would be needed to construct a new facility for data fusion analysis and visualization. This facility would be located near the other Arms Control Treaty Verification facilities. Construction of the new facilities would increase the potential for erosion of the soils and permanently disturb about 100 acres of soils. This would result in minor impacts on soils.

A new facility would be constructed to contain a nonproliferation test bed, which would simulate clandestine chemical and radiological releases. The impacts on the soils would be similar to the impacts of the Arms Control Treaty Verification facilities, i.e., about 100 acres of land disturbance.

In addition to conducting counterterrorism training at existing facilities, an Urban Warfare Complex would be constructed at the NNSS. This complex would include full-scale, modular replicas of the types of urban areas where terrorists and insurgents typically seek refuge. The Urban Warfare Complex would be constructed on about 100 acres in a remote area on the NNSS. The impacts on the soils would be similar to the Arms Control Treaty Verification facilities. Further NEPA analysis would be required once more information about the proposed facilities and locations becomes available.

Work for Others Program. The treaty verification activities under the Work for Others Program would be the same as those described under the No Action Alternative; as a result, they would have no impact on the physical setting. The Nonproliferation Projects and Counterproliferation Research and Development would add additional sensor technologies and active interrogation programs to detect nuclear material. The impacts would be the same as those described under the No Action Alternative.

New facilities would be constructed to support counterterrorism activities. Approximately 75 acres of land would be disturbed to build test beds (roads, intersections, small towns, etc.) and support facilities for research and development of improvised explosive device sensors. Additional DHS counterterrorism operations support facilities would disturb 25 acres of land. As a result, there would be minor, temporary impacts on soils from construction activities. Further NEPA analysis would be required after more information about the proposed facilities and locations becomes available.

NNSA would support NASA nuclear rocket motor development by allowing the use of an existing borehole for tests of a prototype nuclear rocket motor. As an existing borehole would be used, impacts would be limited to surface disturbance around the test site. Although it is not likely that NASA would test an actual nuclear rocket motor, spiked xenon may be used for proof-of-concept tests. As a result, soils would be contaminated with short-lived xenon isotopes with half-lives of a few hours to days.

Several new facilities would be constructed to support the increased use of aerial platforms at the NNSS. Approximately 4.6 acres would be disturbed at Desert Rock Airport for support hangars and other buildings. Another 4.6 acres would be disturbed at the Area 6 Aerial Operations Facility, and minor improvements would be made to the Pahute Mesa Airstrip. Other aerial platform facilities at other locations at the NNSS would disturb up to a total of 0.11 acres. In addition, 100 acres of previously undisturbed land in Area 6 would be needed for expansion of the RNCTEC facility for DHS. Construction would disturb soils and increase the potential for erosion, especially in previously disturbed locations.

Radioactive tracer experiments would be conducted under the Expanded Operations Alternative. Underground releases of radioactive noble gases with noncritical detonations would temporarily contaminate the subsurface with radiological isotopes. However, these isotopes have short half-lives, typically 5 to 36 days. Up to 12 experiments involving open-air releases would be conducted each year. There would be temporary impacts to soils from contamination by these short-half-life radioisotopes.

New research and development test beds supporting national security initiatives would be constructed on 200 acres of previously undisturbed land throughout NNSS. The test beds would be used by several agencies and for a variety of uses. Construction would disturb soils and increase the potential for their erosion, especially in previously disturbed locations. This would cause a minor impact on the soils, as surface disturbance would increase the potential for erosion.

5.1.5.2.2 Environmental Management Mission

Waste Management Program. Under the Expanded Operations Alternative, the greatest impact on geologic media and soils would result from the increased volumes of LLW and MLLW that would be disposed at the Area 5 RWMC (and potentially the Area 3 RWMS). New disposal cell construction for the increased volumes of LLW and MLLW, combined with previously constructed cells, would use essentially all of the available land within the Area 5 RWMC. To handle the increased volumes and increased shipment rates of LLW and/or MLLW, a waste off-loading and a container staging area would be built at the Area 5 RWMC. Construction of the new waste off-loading and a container staging area would increase surface disturbance and increase soil erosion; it would be located within the approximately 740-acre area of the Area 5 RWMC. The Area 3 RWMS would be reopened, which may result in additional surface disturbance.

NNSA would construct a new sanitary waste landfill in Area 23. Fifteen acres of land would be required for construction and operation of the new landfill. A construction and demolition debris landfill would be constructed in Area 25, which would require 20 acres of surface disturbance. These landfills would not impact the subsurface geology, although the surface disturbance would increase the potential for soil erosion around the construction site. Once the landfills are operational, soil erosion would be negligible.

Environmental Restoration Program. Under the Expanded Operations Alternative, the Environmental Restoration Program would continue, in compliance with the FFACO. Therefore, the impacts would be the same as those described under the No Action Alternative. The UGTA, Soils, and Industrial Sites Projects, remediation of DTRA sites, and Borehole Management Program would also continue.

5.1.5.2.3 Nondefense Mission

General Site Support and Infrastructure Program. The Expanded Operations Alternative would implement the same small projects to maintain the present capabilities at the NNSS; as a result, these projects would have similar impacts on soils as those described under the No Action Alternative. In addition to these maintenance activities, new infrastructure enhancements, which could affect soils by disturbing the topsoil during construction and demolition activities, would be implemented. Outdated facilities in Area 23 would be replaced with a new security building. Construction of this security building would disturb up to an acre of soils, which would increase the potential for erosion. The outdated structures would be demolished or used for other purposes. Other projects would include replacing about 35 miles of the existing 138-kilovolt electrical transmission system, increasing the number of cell towers at the NNSS, and constructing/demolishing buildings in Mercury. Each of these projects would disturb topsoil and increase the potential for erosion during construction and demolition. In remote locations with fewer structures and more previously undisturbed land, such as the cell-tower locations, the potential for erosion and soil disturbance would be higher.

Conservation and Renewable Energy Program. NNSA would implement energy efficiency conservation and water measures, continue transportation and fleet management efforts, and upgrade the facilities at the NNSS under the NNSS Conservation and Renewable Energy Program. These activities would not affect the local geology or soils.

Under the Expanded Operations Alternative, NNSA would build a 5-megawatt photovoltaic solar power generation facility near the Area 6 Construction Facilities. Based on a similar project on the Nellis Air Force Base, construction and operation of this solar power generation facility would disturb 50 acres of land (USAF 2006). NNSA would also permit one or more commercial solar power generation facilities with a generating capacity of up to 1,000 megawatts in Area 25. These commercial solar power facilities would disturb approximately 10,300 acres of land. Additional construction would be needed to update and add electrical transmission capacity off the NNSS. As there are no specific designs or private-sector proponents for the commercial solar power generation facilities, additional NEPA review would be required prior to its construction.

A geothermal laboratory could be developed on NNSS property. Exploratory studies at the NNSS would evaluate the feasibility of implementing such a project. The location of the facility would vary depending on the geothermal potential, zone use restrictions, environmental and economic considerations, and other factors. If an appropriate location on the NNSS is identified, the facility would be used to test an enhanced geothermal power generating system. Approximately 30 to 50 acres of land would be disturbed during construction of the facility. An excavated, lined sump to hold drilling water would be built adjacent to the main structures. Drilling the geothermal wells would remove some of the bedrock within the construction disturbance area. However, the drilling would not impact geologic features unique to the area. Operating the facility would not impact the geology or soils. The data gained during construction and operation of the geothermal demonstration project may be considered a beneficial impact. A separate, but related facility, a geothermal research center, would not affect the soils because it would be built in a previously disturbed area at Mercury.

Other Research and Development Programs. Additional research projects would be performed at the NNSS as part of the National Environmental Research Park Program. Each research project would be reviewed by NNSA on a case-by-case basis. Although minor amounts of soil may be disturbed during the data gathering or research procedures, the effects would be temporary.

5.1.5.3 Reduced Operations Alternative

The Reduced Operations Alternative includes all of the activities actually conducted at the NNSS since 1996. For most of the programs, the activity levels and frequencies would be limited to those ongoing since 1996. The Reduced Operations Alternative would also curtail all activities other than environmental restoration, environmental monitoring, site security operations, military training and exercises, and maintenance of Well 8 and critical communications and electrical transmission systems in Areas 18, 19, 20, 29, and 30 in the northwestern NNSS.

Soils would experience a general beneficial impact from the cessation of all activities except for Environmental Restoration Program activities, environmental monitoring, and other site maintenance activities. Maintenance of old roads would be discontinued, allowing previously disturbed soils to reform their structure. There would be no impacts on economic minerals or energy resources, although public access would continue to be restricted at the NNSS. The following discussion presents the programs and activities that would have different impacts than those under the No Action Alternative.

5.1.5.3.1 National Security/Defense Mission

NNSA would continue its readiness to conduct an underground nuclear test, so the impacts would be similar to those described under the No Action Alternative. There would be no change from under the No Action Alternative for the following activities: shock physics experiments, disposition of damaged nuclear weapons, criticality experiments, training support for the Office of Secure Transportation, staging of SNM, and readiness-related training and exercises using various kinds of nuclear weapon simulators.

The conventional high-explosives experiments at BEEF and other locations in the Nuclear and High Explosives Test Zone, including hydrodynamic and explosively-driven pulsed-power experiments that directly support the Stockpile Stewardship and Management Program, would continue; however, all other high-explosives experiments would be curtailed. The high-explosives experiments at BEEF would have similar impacts on the soils to those under the No Action Alternative; however, the effects would be less because there would be fewer experiments overall. The other experiments would not affect the physical setting because they would be located in already existing facilities.

No impacts would result from conducting up to 10 dynamic experiments at the NNSS. Dynamic experiments would not be conducted in the Limited Use Zone on the NNSS.

There would be minor impacts on the soils from the conventional high-explosives experiments under the Reduced Operations Alternative. There would be up to 10 experiments per year to directly support the Stockpile Stewardship and Management Program, less than the number under the No Action Alternative. The experiment locations would primarily be at BEEF. Minor soil impacts would result from decommissioning and dispositioning the Atlas Facility. Construction equipment used to dismantle the facility would disturb soils directly around the facility. This would increase the potential for erosion; however, the cleared facility location would allow the soils to redevelop.

There would be no impact on the physical setting from NNSA's conduct of shock physics experiments under the Reduced Operations Alternative. No more than 12 shock physics experiments would occur within existing facilities at JASPER and 10 would be conducted at the Large-Bore Powder Gun at U1a.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. There would be no change in programmatic activities from under the No Action Alternative, so the impacts would be the same.

Work for Others Program. Under the Work for Others Program, NNSA would still host the projects of other Federal agencies, state and local governments, and nongovernmental organizations; however, certain activities, primarily those requiring high-explosives testing or involvement, would not be conducted. No Work for Others Program activities, except military training and exercises, would be conducted in Areas 18, 19, 20, 29, and 30. This would reduce impacts on soils and geologic media at the NNSS, compared to those under the No Action Alternative.

5.1.5.3.2 Environmental Management Mission

The Waste Management and Environmental Restoration Programs under the Reduced Operations Alternative would function the same as under the No Action Alternative. Therefore, the impacts would be the same as those described in the Environmental Management Mission section in Section 5.1.5.1.

5.1.5.3.3 Nondefense Mission

General Site Support and Infrastructure Program. Under the Reduced Operations Alternative, fewer repair and replacement activities would occur at the NNSS. Only critical infrastructure within Areas 18, 19, 20, 29 and 30 would be maintained. Roads within these areas would only be maintained to provide access necessary to maintain the noted infrastructure (maintenance and operation of the Echo Peak, Motorola, and Shoshone communications facilities; the Echo Peak, Castle Rock, and Stockade Wash Substations, including electrical transmission lines interconnecting these substations; and Well 8). Because of fewer enhancements and maintenance activities, the soils would be affected to a lesser degree than under the No Action Alternative.

Conservation and Renewable Energy Program. NNSA would permit the construction of a 100-megawatt commercial solar power generation facility in Area 25, disturbing approximately 1,200 acres of soils. Construction would temporarily increase the potential for erosion of the topsoil, and additional NEPA analysis would be required after site selection occurs.

Other Research and Development Programs. The NNSS would continue to host environmental research projects, but would not actively promote the National Environmental Research Park Program. Each research project would be reviewed by NNSA on a case-by-case basis. Although minor amounts of soil may be disturbed during the data-gathering or research procedures, the effects would be temporary.

Geology and Soils

CGTO During the evaluation of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*, the Consolidated Group of Tribes and Organizations (CGTO) noted repeated nuclear testing activities had resulted in severe disturbances to the geology and soils, or minerals, in large portions of the Nevada National Security Site (NNSS). This seemingly irreparable damage has made certain areas unfit for human use and inaccessible to American Indians who have relied on the earth and rocks for medicine and religious purposes. Sedan Crater, for example, continues to be a dead site; the spirits of the site and resources on it were destroyed in 1962 and the loss can still be felt by members of the CGTO.

The CGTO visited the NNSS in February 2010 and believes the geology and soils are in even poorer condition than they were during the *1996 NTS EIS* due to the continued drought. Drought conditions, ground disturbing site activities, and damage to the soil from previous underground nuclear testing are significantly enhancing erosion. Negative impacts to these resources are long-lasting.

Activities that alter geologic structure also alter hydrologic systems. Such actions result in changes to important geologic and soil features that directly connect the tribes to their homelands in specific, spiritual ways. These changes require spiritual and cultural intervention necessary for restoring balance.

According to tribal elders, *"Bombs have melted the soil. It turned to glass…Severe disturbances are still out there. Everything is still suffering from it. …All Tribes are in agreement that they want to be here to do what they can to help stop this terrible pressure put on the earth and to sing the songs to help the site and to say prayers. The land has its own songs and when you sing the songs to the land, it'll sing back to you. These songs must be sung to help heal the earth and to restore harmony and balance."*

See Appendix C for more details.

5.1.6 Hydrology

5.1.6.1 Surface Water Hydrology

Impacts on surface hydrology were assessed by reviewing the proposed activities described in Chapter 3 to determine whether they have the potential to directly or indirectly affect surface water resources. Impacts are based on qualitative assessments of the range of potential activities that may occur under the three missions for the three alternatives. Activities under an alternative would have an adverse impact on surface water resources if they result in any the following effects:

- Alteration of natural drainage pathways (pools, channels, or the ground surface)
- Contamination of surface waters via chemical and/or biological agents
- Sedimentation to surface waters
- Conflict with the provisions of approved water discharge permits
- Alteration of 100-year or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property

It is important to note that, as described in Chapter 4, Section 4.1.6.1, springs are the only perennial sources of surface water at the NNSS; therefore, the only perennial surface waters occur as pools at some large springs. Springs are located outside of locations used for testing and training events and are generally upgradient. In addition, onsite springs are fed by locally derived or "perched" groundwater (Hansen et al. 1997; Moore 1961) (i.e., groundwater in a saturated zone of material separated from other groundwater bodies by a relatively impervious zone) that is not hydrologically connected to any of the aquifers that may be affected by underground nuclear tests (Bechtel Nevada 1998a; DOE/NV 1999); therefore, no potential impacts are anticipated to occur to perennial surface waters at the NNSS under any of the alternatives.

Overall, impacts would be minimized through use of the mitigation measures described in Chapter 7. For example, impacts related to surface disturbances (e.g., sedimentation to ephemeral waters) would be mitigated on a site-specific basis depending on several factors (e.g., soil characteristics); erosion and sediment controls would include a variety of measures, such as use of filter or silt berms or fences and timely revegetation of exposed surfaces. Where practicable, NNSA would use areas disturbed by past activities to minimize erosion.

5.1.6.1.1 No Action Alternative

The following sections describe impacts associated with the various activities that may potentially occur under the three missions. With respect to the aforementioned impact criteria, no activities would be expected to conflict with the provisions of approved water discharge permits or cause alteration to 100- or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property.

The following activities are not expected to alter natural drainage pathways: dynamic experiments, drillback operations, and training activities for the Office of Secure Transportation under the Stockpile Stewardship and Management Program; counterterrorism activities under the Work for Others Program; UGTA Project and Soils Project activities and remediation of the DTRA sites under the Environmental Restoration Program; and activities under the General Site Support and Infrastructure Program.

The following activities are not expected to contaminate surface waters via chemical and/or biological agents: dynamic experiments, drillback operations, and training activities for the Office of Secure Transportation under the Stockpile Stewardship and Management Program; counterterrorism activities under the Work for Others Program; LLW and MLLW management activities under the Waste Management Program; Industrial Sites Project and Borehole Management Program activities under the Environmental Restoration Program; activities under the General Site Support and Infrastructure Program; and activities under the Other Research and Development Program.

The following activities are not expected to deposit sediment in surface waters: dynamic experiments and conventional high-explosives experiments under the Stockpile Stewardship and Management Program; nonproliferation projects and counterproliferation research and development under the Work for Others Program; LLW and MLLW management activities and explosives waste treatment under the Waste Management Program; remediation of DTRA sites and Borehole Management Program activities under the Environmental Restoration Program; and activities under the General Site Support and Infrastructure Program.

5.1.6.1.1.1 National Security/Defense Mission

Stockpile Stewardship and Management Program – Dynamic Experiments. Up to 10 dynamic experiments would be conducted per year at locations within the Nuclear Test and Nuclear and High Explosives Test Zones. Experiments using SNM coupled with conventional explosives would be conducted underground and/or in confinement vessels and would not cause surface disturbances that could alter natural drainage pathways or contaminate ephemeral waters.

Stockpile Stewardship and Management Program – Conventional High-Explosives Experiments. Up to 20 conventional high-explosives experiments per year would be conducted at BEEF, and up to 10 per year would be conducted at other locations within the Nuclear and High Explosives Test Zone. Experiments at BEEF would be conducted on the firing table and are not expected to cause surface contamination or significant changes in natural drainage pathways. Detonations would be contained within the firing table, which generally consists of a 66-foot × 66-foot gravel area 6 to 8 feet deep, though it can be extended or deepened if an experiment warrants it. Materials dispersed during experiments would consist of solid debris that is recovered following the experiment or contained within the gravel, which would be periodically removed and replaced. For experiments at other locations within the Nuclear and High Explosives Test Zone, some minor alteration of natural drainage pathways for storm-generated sheetflow and flows in ephemeral waters (if located in close proximity to the experiment location) could occur due to surface disturbances resulting from detonations. In addition, experiments conducted at or above the ground surface could cause surface contamination and, ultimately, some contamination of ephemeral waters.

Stockpile Stewardship and Management Program – Drillback Operations. Up to five drillback operations may take place during the 10-year planning period. Drillback operations would occur within the area of a former underground nuclear test event and would require approximately 5 acres of land. Earth-disturbing activities during site preparation and drilling (e.g., vehicle and equipment movements) could result in a small degree of sedimentation in nearby ephemeral waters.

Stockpile Stewardship and Management Program – Training for Office of Secure Transportation. Training for the Office of Secure Transportation would occur on existing roads and nearby off-road areas on the NNSS. Should off-road training activities occur in areas near ephemeral waters, particularly those involving vehicle maneuvers, a small degree of sedimentation may occur in those waters from nearby land surface disturbances.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs – Nonproliferation and Counterterrorism-Related Activities. Under the No Action Alternative, a Nonproliferation and Counterterrorism Training Program would be established. Experiments and training events using explosives may cause surface disturbances that could alter natural drainage pathways in terms of storm-generated sheetflow and flows in ephemeral waters. Overall, no permanent change in surface-water quality is expected because springs are located outside of experiment and training areas and are generally upgradient. Ephemeral flows could experience decreases in water quality from the introduction of chemical contaminants; however, these impacts would be localized to the experiment or training area and would occur only when local surface water features contain water (e.g., after a storm event). Should off-road training activities, particularly those involving vehicle maneuvers, occur in areas near ephemeral waters, a small degree of sedimentation may occur in those waters from nearby land surface disturbances.

Work for Others Program – Nonproliferation Projects and Counterproliferation Research and Development. Under this program, NNSA would support other agencies on nonproliferation projects and counterproliferation research and development. These projects would include high-explosives detonations, which may cause surface disturbances that could alter natural drainage pathways in terms of storm-generated sheetflow and flows in ephemeral waters. Overall, no permanent change in surface-water quality is expected because springs are located outside of experiment areas and are generally upgradient. Ephemeral flows could experience decreases in water quality from the introduction of chemical contaminants; however, these impacts would be localized to the experiment area and would occur only when local surface water features contain water (e.g., after a storm event).

Up to 20 controlled chemical and biological simulant releases would occur per year. These releases would have no impact on natural water bodies. Chemicals would not be released to any surface-water bodies. Biological simulants could be released into Cambric Ditch, an existing manmade ditch; however, most liquid releases would be to lined sewage lagoons or ponds. No releases to natural springs or ephemeral waters would occur (DOE 2004c).

Work for Others Program – Counterterrorism. Under this program, NNSA would support other agencies on counterterrorism projects. These could include training for engaging and neutralizing adversaries. Off-road activities (e.g., training exercises, ordnance development, and vehicle testing) could cause a small degree of sedimentation to ephemeral waters located near training areas from nearby land surface disturbances.

5.1.6.1.1.2 Environmental Management Mission

Waste Management Program – Low-Level Radioactive Waste and Mixed Low-Level Radioactive Waste Management. Waste management operations would continue to include LLW and MLLW management, including the development of new disposal cells at the Area 5 RWMC and, potentially, a new MLLW facility. Chapter 4, Section 4.1.6.1, describes potential flood hazards on the NNSS. Flood protection is an important issue when siting waste management facilities; thus, consideration of flood potential would be necessary when siting and designing new disposal cells in the Area 5 RWMC (estimated to occur at a rate of two to three new cells per year) or a new MLLW storage facility. There is a 100-year flood hazard area along the southwest corner of the Area 5 RWMC associated with Barren Wash (Schmeltzer et al. 1993) that would be avoided. Continued operation of the Area 5 RWMC would continue to alter of natural drainage pathways due to engineered berms designed to prevent run-on to the site, though this would not significantly alter the overall drainage of the area. Should the Area 3 RWMS become operational in the future, it would likely have a minimal beneficial impact on local drainage patterns because craters developed during past underground nuclear tests would continue to be used to dispose materials. Continued filling of craters and their engineered closure would restore the natural topography and drainage patterns in the affected portions of Area 3.

Waste Management Program – Explosives Waste Treatment. NNSA would treat old and/or unusable explosives by open-air detonation at the Explosives Ordnance Disposal Unit in Area 11. Open-air detonations could cause surface contamination through deposition of explosive residues and, ultimately, some contamination of ephemeral waters.

Waste Management Program – Manage Sanitary Solid Waste. NNSA would continue to operate existing waste disposal sites, with no additional land disturbance expected and therefore no impact to drainage pathways.

Environmental Restoration Program – Underground Test Area Project. This project would monitor groundwater quality and evaluate closure strategies in areas of groundwater contamination. The UGTA Project would produce water from characterization and monitoring wells, which could only be discharged to the surface if the water complies with the requirements of the NDEP-approved UGTA Fluid Management Plan (DOE 2009k). The water would be monitored and sediment erosion would be reduced through the use of onsite sumps and designated infiltration areas as needed; thereby eliminating most impacts on natural drainage pathways or downgradient springs and surface impoundments. Accidental discharges of water contaminated with radionuclides or other hazardous substances could occur, potentially contaminating the surface. This is considered unlikely, however, because the standard practice is to contain discharged water from near-field wells in lined sumps.

Environmental Restoration Program – Soils Project. This project would continue to investigate soil sites to determine whether contamination exists and to perform corrective actions as needed. Land-disturbing activities associated with these corrective actions (e.g., vehicular and equipment movements) could cause some minor sedimentation to ephemeral waters. During corrective action activities, excavated or exposed contaminated materials could potentially be transported to downgradient land surfaces during storm events that generate runoff. Appropriate site-specific dust and drainage controls would be implemented for each corrective action (e.g., establishing temporary diversion berms), which would minimize the potential for impacts to occur; however, it is possible that moderate impacts on the water quality of ephemeral surface waters could occur if contaminants were transported to such features.

Environmental Restoration Program – Industrial Sites Project. This project would continue to identify, characterize, and remediate industrial sites. Following the remediation of industrial sites, the facilities would be demolished with foundations normally left in place. Land-disturbing activities associated with demolition (e.g., vehicular and equipment movements) could cause some minor sedimentation to ephemeral waters.

Environmental Restoration Program – Defense Threat Reduction Agency Sites. Surface disturbing activities for the DTRA sites have been completed, and only environmental monitoring, such as water sampling, would continue. Monitoring would not result in any changes to the physical environment.

Environmental Restoration Program – Borehole Management Program. Unneeded boreholes would continue to be plugged; it is estimated that 183 would be plugged from 2010 through 2013. Open boreholes may capture a small proportion of the surface water that would otherwise continue to flow across the surface as sheetflow. Therefore, plugging of these unneeded boreholes is expected to have a minor beneficial impact in terms of restoring the natural hydrology of these locations.

5.1.6.1.1.3 Nondefense Mission

General Site Support and Infrastructure Program. Infrastructure-associated activities would continue to maintain facilities' present capabilities. Continued wastewater discharges to the Area 6 Yucca Lake and Area 23 Mercury sewage lagoon systems, as well as the E-Tunnel Waste Water Disposal System ponds, are not expected to affect natural surface-water resources. Wastewater would be contained within the lagoons and ponds and would not be released to the ground surface or any natural water bodies. In 2009, all contaminant concentrations in discharged effluent were within permitted levels.

Conservation and Renewable Energy Program – Renewable Energy. A large-scale commercial solar power generation facility covering approximately 2,400 acres could be established in Area 25. It was assumed that, if developed, this facility would be sited to avoid disturbing larger ephemeral waters located in Area 25, such as Fortymile Wash, Topopah Wash, and Rock Valley Wash.

Land preparation associated with the development of solar power generation facility (e.g., land grading) could cause sedimentation in ephemeral waters, as well as long-term alteration of natural drainage pathways. Considering the relatively large land area that the facility would cover, it is likely that some smaller ephemeral waters would be altered; however, as previously stated, it was assumed that larger surface water features would not be disturbed.

Stormwater runoff from an operational solar power generation facility would be diverted to an appropriately sized detention basin, as well as to appropriate conveyance features (e.g., ditches and culverts), to contain flows from storm events on site. The potential for surface contamination resulting from the use of process chemicals would be minimized through the use of standard best management practices and standard operating procedures (e.g., providing secondary containment around petroleum storage areas and responding to spills as soon as possible), as well as establishment of a bioremediation area to manage any soils contaminated with toxic materials.

Other Research and Development Programs. The DOE National Environmental Research Park Program would continue to perform environmental research activities. It is possible that ground-disturbing activities associated with developing and performing experiments could result in sedimentation to ephemeral waters and alterations of natural drainage pathways; however, assuming research projects are conducted in an environmentally responsible manner, these impacts could be minimized.

5.1.6.1.2 Expanded Operations Alternative

The following sections describe impacts associated with the various activities that may potentially occur under the three missions. With respect to the aforementioned impact criteria, no activities would be expected to conflict with the provisions of approved water discharge permits or cause alteration to 100- or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property.

The following activities are not expected to alter natural drainage pathways: dynamic experiments and drillback operations under the Stockpile Stewardship and Management Program; NASA support under the Work for Others Program; and UGTA Project and Soils Project activities and remediation of DTRA sites under the Environmental Restoration Program.

The following activities are not expected to contaminate surface waters via chemical and/or biological agents: dynamic experiments, drillback operations, and training activities for the Office of Secure Transportation under the Stockpile Stewardship and Management Program; counterterrorism and miscellaneous activities under the Work for Others Program; management of LLW, MLLW, and sanitary solid waste under the Waste Management Program; Industrial Sites Project and Borehole Management Program activities under the Environmental Restoration Program; activities under the General Site Support and Infrastructure Program; and activities under the Other Research and Development Program.

The following activities are not expected to deposit sediment in surface waters: dynamic experiments under the Stockpile Stewardship and Management Program; nonproliferation projects, counterproliferation research and development, and NASA support under the Work for Others Program; LLW and MLLW management and explosives waste treatment under the Waste Management Program; and remediation of DTRA sites and Borehole Management Program activities under the Environmental Restoration Program.

5.1.6.1.2.1 National Security/Defense Mission

Stockpile Stewardship and Management Program – Dynamic Experiments. Up to 20 dynamic experiments could be conducted per year. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1; therefore, no impacts on surface hydrology would be expected.

Stockpile Stewardship and Management Program – Conventional High-Explosives Experiments. NNSA would conduct up to 100 high-explosives experiments per year at BEEF and various locations in the Nuclear and High Explosives Test Zone and would develop new facilities and features within the already developed areas of BEEF. Impacts of these experiments would be similar to those described under the No Action Alternative (see Section 5.1.6.1.1.1), but would be intensified because the number of experiments would increase. Therefore, no impacts would be expected as a result of experiments conducted at BEEF; however, experiments at other locations within the Nuclear and High Explosives Test Zone could cause impacts. In comparison to the impacts described under the No Action Alternative, the additional tests would likely result in increased amounts of sedimentation to ephemeral waters, alterations of natural drainage pathways, and instances of surface contamination and other impacts that could occur over a larger land area as a result of the greater number of experiments. New facility construction activities at BEEF could cause some minor sedimentation in ephemeral waters and alteration of natural drainage pathways by introducing structures that would impede natural flows.

NNSA would establish up to three 40-acre sites within Areas 2, 4, 12, or 16 to conduct explosives experiments with depleted uranium. These experiments could cause surface disturbances that could alter natural drainage pathways in terms of storm-generated sheetflow and flows in ephemeral waters. Overall, no permanent change in surface-water quality is expected because springs are located outside of the experiment areas and are generally upgradient. Ephemeral flows could experience decreases in water quality resulting from the introduction of pollutants (e.g., sedimentation and chemicals); however, these impacts would be localized to the experiment area and would occur only when local surface water features contain water (e.g., after a storm event). However, depending on their size and location, these experiments could cause more significant surface contamination (lead and depleted uranium primarily).

Stockpile Stewardship and Management Program – Drillback Operations. Impacts of drillback operations would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1.

Stockpile Stewardship and Management Program – Training for Office of Secure Transportation. Activities associated with training for the Office of Secure Transportation would include development of several new facilities and expansions of existing facilities. Construction of new facilities and support infrastructure (e.g., roads, utility lines, and a firing range) to support training activities in Area 17 could cause sedimentation in ephemeral waters and short-term alterations of natural drainage pathways because it is likely that ephemeral waters would be crossed by linear features (e.g., pipelines), thus causing short-term disturbances to local surface water features. Natural topographies would be restored following construction, to the extent practicable. Operation of the training areas could also result in a small degree of sedimentation in ephemeral waters, primarily from vehicular movement. New construction proposed for Area 17 (37,400 square feet of facilities) could cause long-term alterations of natural drainage pathways by introducing structures that would impede natural flows. In addition, construction of the support infrastructure would likely cause long-term alterations of natural drainage pathways, primarily due to new roads and land-grading associated with development of the firing range. Expansion of facilities in Areas 6, 12, 17, or 23 could also cause long-term alterations of natural drainage pathways by introducing structures that would impede natural flows.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs – Nonproliferation and Counterterrorism-Related Activities. Impacts of nonproliferation and counterterrorism-related activities would be similar to those described under the No Action Alternative (see Section 5.1.6.1.1.1). Impacts of experiments and training events also would be the same as those described under the No Action Alternative (alterations of natural drainage pathways, sedimentation to ephemeral waters, and surface chemical contamination); however, in addition, new construction of nonproliferation and counterterrorism facilities would occur in additional locations (more than 200 acres). Construction of the facilities could cause sedimentation in ephemeral waters, and the presence of the new facilities could cause long-term alterations of natural drainage pathways by impeding natural flows.

Work for Others Program – Nonproliferation Projects and Counterproliferation Research and Development. Impacts of nonproliferation projects and counterproliferation research and development would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1.

Work for Others Program – Counterterrorism. Impacts of counterterrorism activities would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.1 (sedimentation to ephemeral waters). However, in addition, new facility construction activities would disturb approximately 100 acres of land, which could cause localized sedimentation in ephemeral waters and long-term alteration of natural drainage pathways by introducing structures that would impede natural flows.

Work for Others Program – Support for the National Aeronautics and Space Administration. NNSA would provide support to NASA on nuclear rocket motor development. The use of boreholes to sequester the emissions of a prototype nuclear rocket motor could result in minimal amounts of localized surface contamination, which could be introduced to ephemeral waters; however, because this activity would likely occur in the Yucca Flat area, any surface contamination would be confined to the NNSS.

Work for Others Program – Miscellaneous Work for Others. Activities would include increased research, development, and use of aerial platforms, as well as construction of additional facilities at Desert Rock Airport, the Area 6 Aerial Operations Facility, Pahute Mesa, and other locations. Additional construction could cause localized sedimentation in ephemeral waters from construction-related land disturbing activities and long-term alteration of natural drainage pathways by introducing structures that would impede natural flows. Minimal impacts are expected. Experiments using releases of biological simulants into water are expected to have no impact on natural water bodies because releases would be contained in manmade features (i.e., Cambric Ditch or sewer and septic systems).

5.1.6.1.2.2 Environmental Management Mission

Waste Management Program – Low-Level Radioactive Waste and Mixed Low-Level Radioactive Waste Management. Impacts would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.2; however, these impacts would increase somewhat because waste disposal volumes would increase, so more disposal cells would be developed. In addition, the Area 3 RWMS would be reactivated, as opposed to its possible reactivation under the No Action Alternative. Therefore, impacts at the Area 5 RWMC under the Expanded Operations Alternative would likely be the same as those under the No Action Alternative because engineered berms would continue to alter natural drainage pathways; no flood hazard impacts would be expected because flood hazard areas would be avoided. Increased use of the Area 3 RWMS would have a greater beneficial impact on natural drainage pathways compared to the impact under the No Action Alternative because additional craters would be filled to manage greater waste volumes, thus restoring natural surface topographies and drainage patterns over a larger area.

Waste Management Program – Explosives Waste Treatment. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Waste Management Program – Manage Sanitary Solid Waste. NNSA would continue to operate existing waste disposal sites and develop a new landfill on approximately 15 acres of land. In addition, a 20-acre construction/demolition debris landfill would be established in Area 25. Chapter 4, Section 4.1.6.1, describes potential flood hazards on the NNSS. Flood protection is an important issue when siting waste management facilities. NNSA would consider flood potential when siting and designing new landfills. Land preparation activities associated with the development of new landfills (e.g., land grading) could alter natural drainage pathways and cause sedimentation in ephemeral waters.

Environmental Restoration Program – Underground Test Area Project. Impacts would be similar to those described under the No Action Alternative (see Section 5.1.6.1.1.2); however, these impacts could be somewhat greater because activities could occur at an accelerated rate. Therefore, as compared to the No Action Alternative, an increased potential for surface contamination would occur as well as increased sedimentation to ephemeral waters.

Environmental Restoration Program – Soils Project. Impacts would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.2; however, these impacts could be greater because activities could occur at an accelerated rate. Therefore, compared to the No Action Alternative, an increased potential for surface contamination would occur as well as increased sedimentation to ephemeral waters under the Expanded Operations Alternative.

Environmental Restoration Program – Industrial Sites Project. Impacts would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.2; however, these impacts could be greater because activities could occur at an accelerated rate. Therefore, compared to the No Action Alternative, more work would be done to restore natural topographies and drainage patterns in areas where remediated facilities are demolished and increased sedimentation to ephemeral waters would occur.

Environmental Restoration Program – DTRA Sites. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Environmental Restoration Program – Borehole Management Program. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

5.1.6.1.2.3 Nondefense Mission

General Site Support and Infrastructure Program. Infrastructure-related activities would cause impacts similar to those described under the No Action Alternative in Section 5.1.6.1.1.3. Therefore, continued wastewater discharges would not be expected to cause any impacts on surface hydrology. However, there would be additional impacts associated with several new facility construction projects and expansion of some existing facilities. Demolition and construction of facilities and infrastructure could cause short-term sedimentation and increased loads of inorganic compounds in ephemeral waters, as well as long-term alteration of natural drainage pathways. Improvements within and adjacent to existing developed areas would likely have lower impacts compared to those resulting from improvements in more pristine areas.

Conservation and Renewable Energy Program. Impacts resulting from construction and operation of one or more commercial solar power generation facilities with up to 1,000 megawatts of combined capacity in Area 25 would be similar to the impacts described under the No Action Alternative in Section 5.1.6.1.1.3; however, these impacts would occur to a larger area of land because the facilities would be considerably larger, occupying a land area of approximately 10,300 acres. Therefore, compared to the No Action Alternative, increased amounts of long-term alterations to natural drainage pathways would occur over a larger land area, as well as sedimentation to ephemeral waters. In addition, the potential for surface contamination would apply to a larger land area.

In addition to the large-scale solar power generation facility, a 5-megawatt photovoltaic solar power generation facility would be developed near the Area 6 Construction Facilities on 50 acres of land. Geothermal energy production would also be explored. Development of a geothermal demonstration project would require approximately 30 to 50 acres of land and include an excavated, lined sump to store water during drilling and reservoir development. Land preparation activities associated with development of the photovoltaic solar power generation facility and construction of geothermal power system facilities (e.g., land grading) could cause sedimentation and increased loads of inorganic compounds in ephemeral waters, as well as long-term alteration of natural drainage pathways.

Other Research and Development Programs. Operation of the Nevada National Environmental Research Park would continue and could include new research and development projects. Impacts would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.3; however, the development of additional research projects could result in somewhat greater impacts or could generate additional ones. Therefore, compared to the No Action Alternative, increased amounts of alterations of natural drainage pathways as well as sedimentation to ephemeral waters could occur under the Expanded Operations Alternative.

5.1.6.1.3 Reduced Operations Alternative

The following sections describe impacts associated with the various activities that may potentially occur under the three missions. With respect to the aforementioned impact criteria, no activities would be expected to conflict with the provisions of approved water discharge permits or cause alteration to 100- or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property.

The following activities are not expected to alter natural drainage pathways: dynamic experiments, drillback operations, and training activities for the Office of Secure Transportation under the Stockpile Stewardship and Management Program; counterterrorism activities under the Work for Others Program; UGTA Project and Soils Project activities and remediation of DTRA sites under the Environmental Restoration Program; and activities under the General Site Support and Infrastructure Program.

The following activities are not expected to contaminate surface waters via chemical and/or biological agents: dynamic experiments, pulsed-power experiments, drillback operations, and training activities for the Office of Secure Transportation under the Stockpile Stewardship and Management Program; counterterrorism activities under the Work for Others Program; LLW and MLLW management under the Waste Management Program; Industrial Sites Project and Borehole Management Program activities under the Environmental Restoration Program; activities under the General Site Support and Infrastructure Program; and activities under the Other Research and Development Program.

The following activities are not expected to deposit sediment in surface waters: dynamic and conventional high-explosives experiments under the Stockpile Stewardship and Management Program; nonproliferation projects and counterproliferation research and development under the Work for Others Program; LLW and MLLW management and explosives waste treatment under the Waste Management Program; remediation of DTRA sites and Borehole Management Program activities under the Environmental Restoration Program; and activities under the General Site Support and Infrastructure Program.

5.1.6.1.3.1 National Security/Defense Mission

Stockpile Stewardship and Management Program – Dynamic Experiments. Up to six dynamic experiments could be conducted per year. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1; therefore, no impacts on surface hydrology are expected.

Stockpile Stewardship and Management Program – Conventional High-Explosives Experiments. Up to 10 conventional high-explosives experiments could be conducted per year. Impacts would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.1; however, these impacts would generally be reduced because the number of experiments conducted would be lower. Therefore, no impacts would be expected for experiments conducted at BEEF; however, experiments at other locations within the Nuclear and High Explosives Test Zone could cause impacts. In comparison to the impacts described under the No Action Alternative, the additional tests would likely result in decreased amounts of sedimentation to ephemeral waters and alterations of natural drainage pathways; instances of surface contamination and impacts could occur over a smaller land area (if possible) if fewer experiments are conducted.

Stockpile Stewardship and Management Program – Pulsed-Power Experiments. Pulsed-power experiments at the Atlas Facility would be discontinued and the facility would be decommissioned. Earth-disturbing activities during decommissioning (e.g., facility demolition) could cause a small degree of sedimentation in ephemeral waters; however, should the facility be demolished to ground level, decommissioning could restore the natural topography and drainage patterns at location of the Atlas Facility.

Stockpile Stewardship and Management Program – Drillback Operations. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1.

Stockpile Stewardship and Management Program – Training for Office of Secure Transportation. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs – Nonproliferation and Counterterrorism-Related Activities. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1.

Work for Others Program – Counterterrorism. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.1.

5.1.6.1.3.2 Environmental Management Mission

Waste Management Program – Low-Level Radioactive Waste and Mixed Low-Level Radioactive Waste Management. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Waste Management Program – Explosives Waste Treatment. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Waste Management Program – Manage Sanitary Solid Waste. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Environmental Restoration Program – Underground Test Area Project. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Environmental Restoration Program – Soils Project. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Environmental Restoration Program – Industrial Sites Project. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Environmental Restoration Program – DTRA Sites. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

Environmental Restoration Program – Borehole Management Program. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.2.

5.1.6.1.3.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.1.6.1.1.3; therefore, no impacts on continued wastewater discharges would be expected.

Conservation and Renewable Energy Program. Impacts of the commercial solar power generation facility in Area 25 would be similar to those described for a similar facility under the No Action Alternative in Section 5.1.6.1.1.3. However, these impacts would generally be reduced because the facility would have less than one-half the generating capacity and occupy a smaller land area of approximately 1,200 acres. In addition, due to the smaller overall facility size, about 12 acres would be devoted to stormwater detention ponds. Therefore, compared to the No Action Alternative, decreased amounts of long-term alterations to natural drainage pathways would occur over a smaller land area as well as sedimentation to ephemeral waters. In addition, the potential for surface contamination would be over a smaller land area.

Other Research and Development Programs. NNSA would continue to host existing environmental research projects at the NNSS, but would not actively promote the Nevada National Environmental

Research Park. Impacts would be similar to those described under the No Action Alternative in Section 5.1.6.1.1.3; however, these impacts would generally be reduced because fewer research projects would be performed overall. Therefore, compared to the No Action Alternative, alterations of natural drainage pathways and sedimentation to ephemeral waters could decrease.

5.1.6.2 Groundwater

Groundwater impacts were assessed by reviewing the proposed activities described in Chapter 3 to determine whether they have the potential to directly or indirectly affect groundwater resources. Activities under an alternative would have an adverse impact on groundwater resources if they result in any the following effects:

- Noncompliance with applicable water quality standards
- Water level declines in areas adjacent to operating wells that adversely affect other uses in that aquifer
- Alteration of groundwater recharge to another downgradient aquifer to the degree that it reduces that aquifer's sustainable yield or adversely affects current uses of that aquifer
- Eexceedance of the sustainable withdrawal capacity of an aquifer

Impacts on groundwater availability were analyzed by comparing current groundwater demand for each individual basin found throughout the NNSS, as discussed in Chapter 4, Section 4.1.6, to the sustainable yield of each individual basin, under each alternative. Chapter 4, Table 4–24, presents the sustainable yield (the perennial yield of the basin minus any rights already committed to other users by the State Engineer) of each basin, as well as the percent of total NNSS water demand historically met by withdrawals from each basin. NNSA has made the following assumptions for purposes of analysis of the impacts on groundwater supply:

- Future groundwater withdrawals at the NNSS would continue to occur in the four basins that are currently developed (Frenchman Flat, Yucca Flat, and the Buckboard Mesa and Jackass Flats subdivisions of Fortymile Canyon). Of the remaining six basins underlying the NNSS, most only slightly overlap the NNSS near its borders and are not likely to be developed in the future due to their remote location relative to existing and proposed facilities. Any future project requiring water withdrawals from a new basin would require additional NEPA analysis. The Mercury Valley Basin is not considered viable for new withdrawals under any alternative at this time.
- Recent patterns of water use distribution among the four developed basins (i.e., the percent of the NNSS's total demand met from each basin) would be representative of future water withdrawal patterns under each alternative, with the exception of a commercial solar power generation facility, whose additional demand would be met solely through withdrawals from the Fortymile Canyon, Jackass Flats subdivision (Basin 227a).
- The sustainable yield used for each basin is based only on the recharge from precipitation within that basin and does not include recharge associated with subsurface inflow from upgradient basins. Annual water withdrawals from a basin that are below the sustainable yield of that basin are generally assumed not to reduce outflow (recharge) to other downgradient basins. In cases where withdrawals approach sustainable yield, or where other site-specific aspects affect the potential for reduction of recharge to other basins, NNSA would consider flow modeling efforts and studies to reach determinations about the potential for adverse impacts.

Potential impacts on water quality (e.g., contamination resulting in exceedance of water quality standards) were assessed qualitatively by examining a project or activity's potential for release of hazardous constituents and the likely pathways for contaminants to reach groundwater resources.

5.1.6.2.1 No Action Alternative

Under the No Action Alternative, activities at the NNSS would primarily continue at frequencies and levels consistent with those experienced since 1996. NNSA would continue to maintain and repair facilities and associated infrastructure as needed to maintain the present capabilities of NNSA facilities. The only significant new facility considered would be construction of a large solar power generation facility by an outside commercial entity.

From 2005 through 2009, measured annual water usage at the NNSS from the active wells ranged between approximately 173 million and 225 million gallons per year, with an average of approximately 198 million gallons per year. NNSA estimates that total water withdrawals across all programs (excluding construction or operation of a commercial solar power generation facility) would not exceed 225 million gallons per year; the highest measured value since 2005. However, the implementation of water conservation efforts in support of the NNSS Energy Executable Plan (see Section 5.1.6.1.3) would result in a downward trend in potable water consumption. Therefore, an amount of 225 million gallons per year (691 acre-feet per year) is viewed as a conservative estimate of total water consumption for activities excluding construction or operation of a solar power generation facility. As acre-feet is the conventional unit of measurement for capacity of an aquifer, this unit is used in the remainder of this analysis in lieu of gallons per year.

Annual water withdrawals from each basin on the NNSS between 2005 and 2009 are presented in Chapter 4, Table 4–27. For purposes of analysis, the five-year average of the percentage of total water demand met by each basin (e.g., 68.6 percent of total demand on Frenchman Flat) was used to estimate the future demand on each basin. **Table 5–23** presents the individual demands on each basin to support a total demand of 691 acre-feet per year, as well as additional demands associated with a commercial solar power generation facility (discussed in subsequent paragraphs), and compares these demands to the sustainable yield of each basin.

A commercial solar power generation facility was analyzed in the *1996 NTS EIS*, but was never implemented. In the *1996 NTS EIS,* both Areas 25 and 22 were analyzed as potential facility sites. A sensitive environmental area, Devils Hole, exists downgradient from Area 22; therefore, potential groundwater impacts from large-scale pumping would be much higher in Area 22 compared to Area 25. For that reason, Area 22 is no longer considered a viable option for siting a commercial solar power generation facility.

Currently, there are no specific proposals from private applicants for a commercial-scale solar power generation project at the NNSS. To support an NNSS decision regarding allowing commercial-level power production as a land use, NNSA has analyzed a notional design based on other proposed facilities in southern Nevada. Were a specific design to be proposed by a private applicant, additional project-level NEPA analysis would be required. The existing NNSS water system may be used to convey water from the point of extraction.

Construction and operation of a 240-megawatt commercial solar power generation facility would represent the largest water demand from any single activity or project on the NNSS. Operation of a 240-megawatt solar power generation facility in Area 25 would add an additional demand of approximately 250 acre-feet per year. During construction of the solar power generation facility, there would be a temporary demand of approximately 350 acre-feet per year for 35 months to support dust suppression, soil compaction, and other facility construction needs. This analysis assumes that all water demand for the solar power generation facility would be withdrawn from the Fortymile Canyon, Jackass Flats Subdivision (Basin 227a).

Table 5–23 Impacts on Groundwater Supply Under the No Action Alternative

Basin	*Water Demand, Excluding Solar Power Generation Facility (acre-feet per year)*	*Water Demand, Including Construction Demand from Solar Power Generation Facility (acre-feet per year)*	*Water Demand, Including Operational Demand from Solar Power Generation Facility (acre-feet per year)*	*Sustainable Yield of Basin (acre-feet per year)*	*Maximum Percentage of Sustainable Yield Consumed During Construction*	*Maximum Percentage of Sustainable Yield Consumed During Operation*
Frenchman Flat (160)	474	474	474	1,070	44%	44%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	42	42	42	3,600	1%	1%
Fortymile Canyon, Jackass Flats Subdivision (227a)	47	397	297	824 – 3,944 [a]	10% – 48%	8% – 36%
Yucca Flat (159)	128	128	128	350	37%	37%

[a] While the Nevada Department of Conservation and Natural Resources, Division of Water Resources lists the perennial yield as 4,000 acre-feet per year, studies conducted by DOE show a range of values as low as 880 acre-feet per year.

Source: Derived from Chapter 4, Tables 4–24, 4–27, and 4–30.

As illustrated in Table 5–23, annual withdrawals from each basin under the No Action Alternative would be below the sustainable yield of each basin. The greatest demand would likely be placed on Frenchman Flat, with approximately 44 percent of the basin's sustainable yield consumed on an annual basis. Construction and operation of a commercial solar power generation facility would result in a marked increase in water consumption in Basin 227a (and likely the single largest use of water on the NNSS), with the resulting demand ranging between 10 and 48 percent of sustainable yield of Basin 227a, depending on the recognized perennial yield of this basin. While the Nevada State Engineer lists the perennial yield of the Fortymile Canyon, Jackass Flats Subdivision as 4,000 acre-feet per year, this value actually represents an aggregation of yield values for several basins adjacent to Basin 227a (i.e., a regional yield value). Studies conducted by DOE show a range of values as low as 880 acre-feet per year (DOE 2008d). While the true value of the perennial yield of this basin may be greater than 800 acre-feet per year, a range of 880 to 4,000 acre-feet per year is used for purposes of analysis in this SWEIS.

These demands on each basin would be unlikely to reduce groundwater recharge to another downgradient aquifer to the degree that it reduces that aquifer's sustainable yield or adversely affects current uses of that aquifer. However, NNSA would still continue to monitor groundwater levels and flow patterns across the NNSS, would employ site-specific modeling to estimate specific impacts of future projects, and would modify the points of diversion and pumping rates if needed to avoid adversely impacting any single aquifer. Therefore, no adverse effects to groundwater supply are expected under the No Action Alternative.

No proposed activities under the No Action Alternative are expected to result in violations of water quality standards, water level draw-downs precluding other uses of an aquifer, or alterations of groundwater recharge adversely affecting downgradient aquifers. Aspects of specific projects and activities under the NNSS missions, particularly water quality effects, are discussed in the remainder of Section 5.1.6.2.

5.1.6.2.1.1 National Security/Defense Mission

Past underground nuclear testing has contaminated some groundwater resources at the NNSS, as discussed in Chapter 4, Section 4.1.6. The NNSS must maintain the capability to conduct nuclear tests under the Stockpile Stewardship and Management Program.

Under the Stockpile Stewardship and Management Program, the NNSS would conduct up to 10 dynamic experiments per year in Areas 1-4, 6-12, 16, 19, and 20 and would perform up to 30 conventional high-explosives experiments per year at BEEF and other locations in Areas 1-4, 12 and 16. While these types of experiments can release hazardous materials at or below ground surface, the NNSS operates under standard operating procedures that ensure no experiments are conducted within approximately 300 feet of the groundwater table. Given these operational restrictions and the depth of groundwater at the NNSS (up to 2,000 feet below the ground surface), these experiments are not expected to result in any adverse impacts on groundwater quality.

The NNSS would conduct five "post-shot" drillback operations over the next 10 years under the Stockpile Stewardship and Management Program. Drillback operations provide essential data on the results and post-shot underground environment of areas previously used for an underground nuclear test. Drillback activities have been conducted since the end of underground nuclear testing as a means of exercising the capability to do such drilling (maintenance of capability) and to obtain data for groundwater studies. There is the potential for small quantities of drilling fluids to be introduced to groundwater during drillback operations. However, the drillback operations are conducted in former underground nuclear test sites that are already contaminated, and any contamination resulting from the drillback activities would not result in any new violation of water quality standards.

NNSA's Office of Secure Transportation conducts exercises on the NNSS to maintain the skills of personnel transporting nuclear weapons. Convoy exercises may be conducted up to six times annually and could include activities such as refueling of vehicles in off road areas. Any potential impacts associated with substances (i.e., fuels, oils, and other lubricants) leaking into soils and entering groundwater aquifers would be avoided through the use of best management practices (BMPs) to prevent spills or leaks, as well as the extreme depth to groundwater at most locations. Such BMPs would include regular inspection of vehicles and routine maintenance checks to limit adverse impacts.

Under the Work for Others Program, NNSA/NSO would support DoD in unmanned aerial vehicle field-testing and training activities. Should unmanned aerial vehicle operations encounter complications (e.g., an emergency landing), there is the possibility that aircraft fuel or other hazardous materials could leak and result in localized soil contamination. However, the depth to groundwater and existing procedures for emergency response and site remediation make it highly unlikely that contaminants would impact groundwater resources.

While other activities under the National Security/Defense Mission require the use of hazardous materials, or would generate hazardous or radioactive wastes, these activities are performed in contained locations and use operational procedures that preclude the release of contaminants to groundwater.

5.1.6.2.1.2 Environmental Management Mission

Groundwater monitoring at the Area 5 RWMC indicates that no contamination of groundwater resources has occurred as a result of waste management activities. Annual modeling exercises used to support the performance assessment for the Area 5 RWMC conclude that no groundwater pathway exists for this disposal facility (NSTec 2010f). Given the depth to groundwater at waste disposal facilities at Area 3, and the stringent operating controls and monitoring programs, LLW and MLLW disposal operations are not expected to adversely affect groundwater resources.

Hazardous waste generated at the NNSS would be stored up to 1 year prior to shipment for offsite treatment. Additionally, the JASPER facility would generate approximately 24 cubic meters of TRU waste per year that would be stored at the TRU Storage Pad pending characterization and shipment off site. While small releases of hazardous or TRU waste are possible during storage or transportation, stringent operating procedures would reduce the likelihood of such an event. The depth to groundwater in most areas of the NNSS and the stringent operating controls and inspection programs in place would preclude contamination of groundwater resources from a release.

Environmental Restoration Program activities at the NNSS include the UGTA Project, which monitors groundwater in the interest of developing groundwater flow and transport models to assist in remediation strategies. Groundwater use during environmental activities under the UGTA Project would be limited to dust control, drilling and testing of wells, decontamination of sampling materials, and purging of wells prior to sampling. The greatest demand for nonpotable water would be during drilling of a new well. It is estimated that water demand for drilling of a new well would be approximately 6 acre-feet. Through 2020, it is expected that a maximum of 5 new wells a year would be drilled throughout the NNSS, totaling an annual nonpotable demand of approximately 30 acre-feet per year. This demand is included with the estimate of total demand across the NNSS for this alternative.

The Industrial Sites Project would continue decontaminating and decommissioning facilities through 2012. Decommissioning of facilities is unlikely to affect groundwater due to the short duration of these activities, the small quantity of contaminants that could be released, and the extreme depth of the groundwater. Nonpotable water demands for dust suppression during D&D would be temporary and minor (estimated at less than 1 percent of total water use).

The Borehole Management Program plugs unneeded boreholes that exist throughout the NNSS. Based on the current schedule, NNSA would complete plugging by 2013 (see Table A–3). This activity would serve to eliminate potential pathways for contaminants to reach groundwater resources.

5.1.6.2.1.3 Nondefense Mission

NNSA may enter into an agreement with a commercial entity to construct a solar power generation facility within Area 25. The additional water demand associated with this project is presented in the previous overview subsection for this alternative, and is not expected to result in adverse impacts related to groundwater supply. While numerous hazardous materials (e.g., fuel, lubricants, heat transfer fluid) would be stored and used during both construction and operation of the commercial solar power generation facility, any releases are not expected to adversely impact groundwater quality. These materials would be handled and stored in accordance with established spill prevention and response procedures, and any releases would be promptly contained, and contaminated soil managed appropriately.

The NNSS would continue to employ water conservation measures through Executive Order 13423 and DOE Order 430.2B under the Renewable Energy Program. One of the goals of these mandates is to reduce the use of energy and water in NNSA/NSO facilities by advancing water conservation.

As per the NNSA/NSO Energy Executable Plan of December 2008, the goal is to reduce potable water production by at least 16 percent from the 2007 level. This reflects an average reduction in water consumption of approximately 2 percent per year (see **Table 5–24**). To accomplish this positive effect on groundwater resources, the NNSS began saving water through several water conservation measures and BMPs for water efficiency. Examples include the installation of water-conserving products (more-efficient toilets, urinals, faucets, showerheads, boiler systems, and other items), xeric landscaping, water-efficient irrigation, system audits and repairs of leaks, use of nonpotable water for dust suppression when possible, and institution of 4-day work weeks.

Table 5–24 Potable Water Production Goals

Year	*Potable Water Production Goals (millions of gallons)*	*Cumulative Percent Reduction*	*Actual Water Production (millions of gallons)*
2007	210.6	Base Year	225.2
2008	206	2	172.6
2009	202	4	190
2010	198	6	N/A
2011	194	8	N/A
2012	190	10	N/A
2013	185	12	N/A
2014	181	14	N/A
2015	177	16	N/A

Source: NSTec 2008b.

5.1.6.2.2 Expanded Operations Alternative

This section describes the proposed changes to activities under the Expanded Operations Alternative and their associated impacts on groundwater resources.

Under the Expanded Operations Alternative, the NNSS workforce would increase by approximately 25 percent from the No Action Alternative, activity levels of existing programs would increase, and some new facilities and operations would be phased in over the 10-year planning period. The NNSS water supply system would also be expanded as necessary to connect to new facilities that would be constructed.

As potable water uses would likely continue to represent the majority of total water demand (see Chapter 4, Section 4.1.6.2), it is estimated that total water use (i.e., potable and nonpotable) (excluding construction and operation of a solar power generation facility) would increase by approximately 25 percent from the value analyzed under the No Action Alternative. This results in an estimate of approximately 862 acre-feet per year for all activities excluding construction or operation of a commercial solar power generation facility. However, the implementation of water conservation efforts in support of the NNSS Energy Executable Plan would likely result in more efficient potable and nonpotable water uses, making this a conservative estimate.

Under the Expanded Operations Alternative, one or more commercial solar power generation facilities with a combined capacity of up to 1,000 megawatts would add an additional demand of approximately 700 acre-feet per year. During construction of the solar power generation facility, there would be a temporary demand of approximately 1,000 acre-feet per year for 42 months to support dust suppression, soil compaction, and other facility construction needs.

Table 5–25 summarizes the demand on each basin associated with a withdrawal of 862 acre-feet per year, as well as additional demands associated with a commercial solar power generation facility (discussed in subsequent paragraphs), and compares these demands to the sustainable yield of each basin.

Table 5–25 Impacts on Groundwater Supply Under the Expanded Operations Alternative

Basin	Water Demand, Excluding Solar Power Generation Facility (acre-feet per year)	Water Demand, Including Construction Demand from Solar Power Generation Facility (acre-feet per year)	Water Demand, Including Operational Demand from Solar Power Generation Facility (acre-feet per year)	Sustainable Yield of Basin (acre-feet per year)	Maximum Percentage of Sustainable Yield Consumed During Construction	Maximum Percentage of Sustainable Yield Consumed During Operation
Frenchman Flat (160)	591	591	591	1,070	55%	55%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	53	53	53	3,600	1%	1%
Fortymile Canyon, Jackass Flats Subdivision (227a)	59	1,059	759	824 – 3,944 [a]	27 – 129%	19 – 92%
Yucca Flat (159)	159	159	159	350	46%	46%

[a] While the Nevada Department of Conservation and Natural Resources, Division of Water Resources lists the perennial yield as 4,000 acre-feet per year, studies conducted by DOE show a range of values as low as 880 acre-feet per year.
Source: Derived from Chapter 4, Tables 4–24, 4–27, and 4–30.

As illustrated in Table 5–25, annual withdrawals from each basin under the Expanded Operations Alternative would be well below the sustainable yield of each basin. The greatest demand from DOE/NNSA activities would be placed on Frenchman Flat, with approximately 55 percent of the basin's sustainable yield consumed on an annual basis. Construction of a commercial solar power generation facility would result in a temporary marked increase in water consumption in Basin 227a (with construction demand exceeding all other uses of water on the NNSS), with the resulting demand ranging from about 27 to 129 percent of the sustainable yield of Basin 227a, depending on the recognized perennial yield of this basin. Operation of the commercial solar power generation facility would also result in a marked increase in water consumption in Basin 227a, resulting in a demand ranging from 19 to 92 percent of the sustainable yield, depending on the recognized perennial yield of Basin 227a. While the Nevada State Engineer lists the perennial yield of this basin as 4,000 acre-feet per year, this value actually represents an aggregation of yield values for several basins adjacent to Basin 227a (i.e., a regional yield value). Studies conducted by DOE show a range of values as low as 880 acre-feet per year (DOE 2008d). While the true value of the perennial yield of this basin may be greater than 880 acre-feet per year, a range of 880 to 4,000 acre-feet per year is used for purposes of analysis in this SWEIS. If total projected water demand on Basin 227a were to approach the estimated perennial yield, DOE would work with the project proponent to select an alternate source of water (particularly during the construction phase), or modify the facility size or design to reduce its water demand.

The demands on each basin would be unlikely to reduce groundwater recharge to another downgradient aquifer to the degree that it reduces that aquifer's sustainable yield or adversely affects current uses of that aquifer as the flow out of each basin would be less than the flow into each basin. However, NNSA would continue to monitor groundwater levels and flow patterns across the NNSS, would employ site-specific modeling to estimate specific impacts of future projects, and would modify the points of diversion and pumping rates if needed to avoid adversely impacting any single aquifer.

No proposed activities under the Expanded Operations Alternative are expected to result in violations of water quality standards, water level draw-downs precluding other uses of an aquifer, or alterations of groundwater recharge adversely affecting downgradient aquifers. Aspects of specific projects and activities under the NNSS missions, particularly water quality effects, are discussed in the remainder of Section 5.1.6.2.2.

5.1.6.2.2.1 National Security/Defense Mission

New facilities. NNSA is proposing 39,000 square feet of permanent facilities for the Office of Secure Transportation in Area 17 to support training activities, as well as a mock town and live-fire training area. The Office of Secure Transportation also proposes to construct 30,000 square feet of maintenance and administrative buildings and a 20,000-square-foot dormitory in Areas 6, 12, or 23. Approximately 85,000 square feet of new facilities are also proposed under the Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs, collectively disturbing an additional 500 acres of land, although locations for these facilities are not yet known. Depending on the exact location and final design of these facilities, additional water supply infrastructure, such as distribution pipelines and water storage tanks would also be constructed. It is not known at this time whether additional water supply wells would be required to support these facilities.

Various types and quantities of hazardous materials (e.g., fuel, lubricants, and paints) would be stored and used at construction sites, and small spills or leaks could possibly occur. Adherence to established spill control procedures would reduce the likelihood of such an event, and the depth to groundwater across most of the NNSS would generally preclude such spills from reaching groundwater sources. Additionally, the location of the permanent facilities and construction sites would also be evaluated for their proximity to water supply wells to avoid wellhead contamination. Therefore, impacts on groundwater quality are not expected to occur from facility construction activities.

Construction would require water for activities such as mixing concrete, washing equipment, dust control and soil compaction, and meeting the sanitary needs of construction employees. It is anticipated that this water would be obtained from the NNSS's groundwater distribution system via a temporary service connection or would be trucked to the point-of-use, especially during the early stages of construction. Although the timing and intensity of individual construction activities are not known at this time, it is estimated that approximately 250 construction employees (excluding those associated with a proposed commercial solar power generation facility) would be present at the NNSS at any given time (see Section 5.1.4, "Socioeconomics"). Assuming that construction workers would each use approximately 30 gallons of potable water per day, total potable water demand for these workers is estimated at approximately 1.8 million gallons (5.5 acre-feet) annually. However, use of portable toilets by construction personnel could greatly reduce this demand.

Annual nonpotable water demands from these construction projects would vary greatly depending on the type of facility and the construction phase of each project, and are not well known at this time. However, the assumption of a 25 percent increase in all water uses (including nonpotable uses) from the No Action Alternative provides a conservative estimate of demand associated with these and other nonpotable uses in any given year. Given the remaining sustainable capacity of the water supply system at the NNSS, no adverse impacts are expected to aquifer supply and recharge from these construction activities.

The design of new facilities would include more-efficient water conservation design and measures (e.g., installation of WaterSense™ products [toilets, urinals, faucets, showerheads, boiler systems, and other items] and xeric landscaping) combined with demolition of existing facilities under the Environmental Management Mission, which would help offset water use once these facilities become operational. The estimate of a 25 percent increase in total annual water consumption noted in the introduction to Section 5.1.6.2.2 incorporates the demand from personal and nonpersonal uses of water once new facilities are occupied.

Experiments and activities. Under the Expanded Operations Alternative, NNSA proposes increases in both the frequency and intensity of ongoing activities described under the No Action Alternative. For example, within the Stockpile Stewardship and Management Program, the number of conventional high explosive detonations would increase to as high as 100 per year (from 20), and the size of the charges would increase to up to 120,000 pounds (from 70,000 pounds) of TNT-equivalent explosives. This increase in operational tempo would also result in increased levels of waste generation (e.g., a three-fold increase in TRU waste from experiments at JASPER) throughout the NNSS. However, the same factors that preclude impacts on groundwater quality (e.g., contained and/or aboveground nature of experiments, depth to groundwater, operational controls, and groundwater monitoring programs) under the No Action Alternative would continue to all ongoing activities in the Expanded Operations Alternative. NNSA does not estimate any additional impacts on groundwater quality from activities under the Expanded Operations Alternative.

Several new or significantly revised activities are also proposed under the Expanded Operations Alternative. Within the Stockpile Stewardship and Management Program, NNSA would establish up to three areas at the NNSS for conducting explosive experiments with depleted uranium. While the locations and operational parameters of these experiments have not been fully defined, NNSA would consider site- and project-specific criteria (e.g., local groundwater depth and movement rates, solubility of potential contaminants) in the planning process to ensure that depleted uranium or other chemical contaminants would not adversely affect groundwater resources.

Under the Work for Others Program, NNSA would support NASA nuclear rocket motor development, including the use of existing boreholes to test their suitability for sequestering of emissions. Although testing of an actual nuclear rocket is not planned at this time, NASA may conduct a proof-of-concept experiment using a surrogate, such as xenon, in a borehole. Any radioactive materials released in the subsurface in this or other related experiments (such as radioactive tracer experiments) would have short half-lives, be used well above the groundwater table, and are not expected to adversely affect groundwater quality.

As noted in Chapter 3 of this SWEIS, there are several activities and facilities considered for the NNSS that are still conceptual in nature, without any detailed design or siting information at this time. These include construction of test beds and support facilities for nonproliferation and counterterrorism activities; new counterterrorism training facilities and reconfiguration of the RNCTEC facility for DHS; and additional facilities for nuclear material detection training for DHS and other Federal agencies. These types of conceptual facilities and activities would undergo an appropriate level of NEPA analysis and documentation before they would be implemented.

5.1.6.2.2.2 Environmental Management Mission

Waste management activities on the NNSS would increase under the Expanded Operations Alternative, with up to 44,498,253 cubic feet of LLW and 2,790,583 cubic feet of MLLW disposed at the Area 5 RWMC and Area 3 RWMS. TRU waste amounts stored at the TRU Storage Pad pending characterization and shipment off site would increase to approximately 1,766 cubic feet. Annual modeling exercises used to support performance assessments for the Area 5 RWMC and Area 3 RWMS conclude that no groundwater pathway exists for these disposal facilities (NSTec 2010f). Although the waste management activities would increase, the absence of a groundwater pathway, the depth to groundwater at waste disposal facilities at Areas 3 and 5, and the stringent operating controls and monitoring programs, LLW and MLLW disposal operations are not expected to adversely affect groundwater resources.

NNSA would construct sanitary solid waste disposal facilities as needed in Area 23, and develop a new sanitary solid waste disposal site in Area 25 to support environmental restoration activities as well as the construction associated with potential solar energy projects in Area 25. These facilities would incorporate contaminant containment strategies in their design, and are not to result in adverse impacts on groundwater quality during their construction or operational phases.

No changes to environmental restoration activities are proposed under the Expanded Operations Alternative.

5.1.6.2.2.3 Nondefense Mission

Infrastructure-related activities, including repairs and replacements, would include increasing the capacities, capabilities, and ranges of facilities to accommodate expanded operations. Approximately 300,000 square feet of new facilities would be constructed to support air operations, Desert Rock Airport, and security requirements. Similarly to the construction activities described in Section 5.1.6.1.2, these activities are not expected to result in any adverse impacts on groundwater quality or supply.

Any facilities that are no longer required and economically salvageable would be decommissioned. Decommissioning activities are unlikely to affect groundwater quality due to their short durations, operational controls applied, and the depth of the groundwater. Nonpotable water demands for dust suppression during decommissioning would be smaller than those required for construction activities, and would not strain the sustainable capacity of the NNSS. The estimated 25 percent increase in total water use under the Expanded Operations Alternative incorporates any water demand that would occur as a result of decommissioning facilities.

NNSA may enter into an agreement with a commercial entity to construct one or more solar power generation facilities within Area 25. Under the Expanded Operations Alternative, the generating capacity of the commercial solar power generation facilities would increase to 1,000 megawatts. While numerous hazardous materials (e.g., fuel, lubricants, heat transfer fluid) would be stored and used during both construction and operation of the commercial solar power generation facility, any releases are not expected to adversely impact groundwater quality. These materials would be handled and stored in accordance with established spill prevention and response procedures, and any releases would be promptly contained, and contaminated soil managed appropriately. The notional design for this solar power generation facility includes a bioremediation call for the segregation and remediation of contaminated soil.

Additionally, NNSA proposes to construct a 5-megawatt photovoltaic solar power generation facility near the Area 6 Construction Facilities. It is estimated that annual nonpotable water use would total approximately 165,000 gallons (0.5 acre-feet) per year; only a small fraction of the total water use on the NNSS.

The NNSA would additionally explore the NNSS for geothermal energy to evaluate the feasibility of developing a geothermal demonstration facility. There are seven locations on the NNSS that have enhanced geothermal potential, as depicted in Appendix A, Figure A–3. Several boreholes may be drilled up to 20,000 feet in depth and the development of a reservoir would be necessary to store water during drilling. Minor quantities of drilling fluids may be introduced to groundwater during drilling operations, but are not expected to result in violation of any water quality standards or otherwise threaten potable water sources. The nonpotable water demand to initially prime the system (which includes the boreholes and reservoir) would be approximately 20 acre-feet on a one-time basis; about 2 percent of the NNSS's water use in any year. Once a geothermal power plant is continuously operating, it is estimated that 50 acre-feet of water would be required annually (about 6 percent of the NNSS average annual water use).

The seven locations on the NNSS to possibly be explored for enhanced geothermal potential are located within six separate hydrographic basins. Of the six basins, Yucca Flat, with 350 acre-feet available for withdrawal, has the lowest remaining yield for groundwater withdrawals (see Chapter 4, Table 4–24). An annual operational use of 50 acre-feet per year would represent 14 percent of this basin's available yield resulting in a minor impact. Impacts on the remaining five hydrographic basins would be lower as the remaining yield for withdrawals are greater. Therefore, neither construction, initial priming, or operational water demands from this project are expected to significantly affect groundwater supply in any of the six basins to possibly be explored.

5.1.6.2.3 Reduced Operations Alternative

This section describes the proposed changes to activities under the Reduced Operations Alternative and their associated impacts on groundwater resources. Under the Reduced Operations Alternative, the frequency and scope of most ongoing activities at the NNSS would be reduced, and no new activities and facilities (even if selected in a previous NEPA decision) would be implemented. Several activities would be more geographically restricted than under the other alternatives in this SWEIS, and a 10 percent reduction in workforce from the No Action Alternative is expected.

As potable water uses would likely continue to represent the majority of total water demand (see Section 4.1.6.2), it is estimated that total water use (excluding construction and operation of a solar power generation facility) would also decrease by 10 percent from that projected for the No Action Alternative; to approximately 622 acre-feet per year. However, the implementation of water conservation efforts in support of the NNSS Energy Executable Plan would likely result in more efficient potable and nonpotable water uses, making this a conservative estimate.

Under the Reduced Operations Alternative, the size of the commercial solar power generation facility would decrease to 100 megawatts in generating capacity. This facility would add an additional demand of approximately 175 acre-feet per year. During construction of the solar power generation facility, there would be a temporary demand of approximately 200 acre-feet per year for 32 months to support dust suppression, soil compaction, and other facility construction needs.

Table 5–26 summarizes the demand on each basin associated with a withdrawal of 622 acre-feet per year, as well as additional demands associated with a commercial solar power generation facility (discussed in subsequent paragraphs), and compares these demands to the sustainable yield of each basin.

As illustrated in Table 5–26, annual withdrawals from each basin under the Reduced Operations Alternative would be well below the sustainable yield of each basin. The greatest demand would be placed on Frenchman Flat, with approximately 40 percent of the basin's sustainable yield consumed on an annual basis. While construction and operation of a commercial solar power generation facility would result in a marked increase in water consumption in Basin 227a (construction demand would likely be the single largest use of water on the NNSS), the resulting demand would range from about 6 to 29 percent of sustainable yield of Basin 227a depending on the recognized perennial yield of this basin. While the Nevada State Engineer lists the perennial yield of the Fortymile Canyon, Jackass Flats Subdivision, as 4,000 acre-feet per year, this value actually represents an aggregation of yield values for several basins adjacent to Basin 227a (i.e., a regional yield value). Studies conducted by DOE show a range of values as low as 880 acre-feet per year (DOE 2008d). While the true value of the perennial yield of this basin may be greater than 880 acre-feet per year, a range of 880 to 4,000 acre-feet per year was used for purposes of analysis in this SWEIS.

Table 5–26 Impacts on Groundwater Supply Under the Reduced Operations Alternative

Basin	Water Demand, Excluding Solar Power Generation Facility (acre-feet per year)	Water Demand, Including Construction Demand from Solar Power Generation Facility (acre-feet per year)	Water Demand, Including Operational Demand from Solar Power Generation Facility (acre-feet per year)	Sustainable Yield of Basin (acre-feet per year)	Maximum Percentage of Sustainable Yield Consumed During Construction	Maximum Percentage of Sustainable Yield Consumed During Operation
Frenchman Flat (160)	427	427	427	1,070	40%	40%
Fortymile Canyon, Buckboard Mesa Subdivision (227b)	38	38	38	3,600	1%	1%
Fortymile Canyon, Jackass Flats Subdivision (227a)	42	242	217	824 – 3,944 [a]	6 – 29%	6% – 26%
Yucca Flat (159)	115	115	115	350	33%	33%

[a] While the Nevada Department of Conservation and Natural Resources, Division of Water Resources lists the perennial yield as 4,000 acre-feet per year, studies conducted by DOE show a range of values as low as 880 acre-feet per year.
Source: Derived from Chapter 4, Tables 4–24, 4–27, and 4–30.

These demands on each basin would be unlikely to reduce groundwater recharge to another downgradient aquifer to the degree that it would reduce that aquifer's sustainable yield or adversely affect current uses of that aquifer. However, NNSA would continue to monitor groundwater levels and flow patterns across the NNSS, employ site-specific modeling to estimate specific impacts of future projects, and modify the points of diversion and pumping rates if needed to avoid adversely impacting any single aquifer. Therefore, no adverse effects to groundwater supply are expected under the Reduced Operations Alternative.

No proposed activities under the Reduced Operations Alternative are expected to result in violations of water quality standards, water level draw-downs precluding other uses of an aquifer, or alterations of groundwater recharge adversely affecting downgradient aquifers. Aspects of specific projects and activities under the NNSS missions, particularly water quality effects, are discussed in the remainder of Section 5.1.6.2.3.

5.1.6.2.3.1 National Security/Defense Mission

Under the Reduced Operations Alternative NNSA would reduce the frequency and scope of experiments and activities and place additional geographic restrictions on ongoing activities. Specifically, Areas 12, 18, 19, and 20 would not support most activities within the National Security/Defense Mission. This would effectively curtail most activities (other than environmental restoration) in the northwest portion of the NNSS. NNSA does not anticipate any adverse impacts on groundwater quality from National Security/Defense Mission activities under the Reduced Operations Alternative.

5.1.6.2.3.2 Environmental Management Mission

Under the Reduced Operations Alternative, LLW and MLLW waste disposal would remain the same as under the No Action Alternative. Onsite generation of hazardous, nonhazardous, and TRU waste would decrease relative to the No Action Alternative. NNSA does not anticipate any adverse impacts on groundwater quality from waste management activities under the Reduced Operations Alternative.

No change in Environmental Restoration Program activities is proposed under this alternative. Although most defense-related activities would cease in the northwest portion of the NNSS, environmental restoration and environmental monitoring activities would continue as described under the No Action Alternative. Therefore, impacts would remain the same as those under the No Action Alternative.

5.1.6.2.3.3 Nondefense Mission

Under the Reduced Operations Alternative, the only new infrastructure considered would be a solar power generation facility, whose net generating capacity would be reduced to 100 megawatts. The additional water demand associated with this project is presented in the previous introductory subsection for this alternative and is not expected to result in adverse impacts related to groundwater supply. While numerous hazardous materials (e.g., fuel, lubricants, heat transfer fluid) would be stored and used during both construction and operation of the commercial solar power generation facility, any releases are not expected to adversely impact groundwater quality. These materials would be handled and stored in accordance with established spill prevention and response procedures; any releases would be promptly contained, and contaminated soil would be managed appropriately. The notional design for this solar power generation facility includes a bioremediation cell for the segregation and remediation of contaminated soil.

Hydrology—American Indian Perspective

CGTO

The Consolidated Group of Tribes and Organizations (CGTO) knows we are in a drought because humans have disrespected the earth. It is affecting the balance of our earth's climate. One inevitable implication of the current 100-year drought is that the surface water[1] on the Nevada National Security Site (NNSS) and immediate areas have diminished and become more sporadic. The modification and availability of surface water has the ability to affect all trophic levels on the NNSS.

Other tribal elders noted, *"Water has been disrespected and therefore it is disappearing. It is a medicine—used to heal and used for healing. It is used for ceremonial purposes in prayer. It is alive and must be awakened. It is spiritual--an essential component to begin religious ceremonies, and part of sweat ceremonies. Historically, water was pure and available to those who respected it. Bathing was a ritual. Now we do not trust the purity of the water because it has been disrespected. Hot springs have been affected and are no longer at the temperatures they used to be."*

When humans respect water, it sustains them and life-forms on the surface, but when water is not treated well, it withdraws its life-giving support and returns to the underworld. The CGTO knows that the springs on Pahute and Rainier mesas and near Buckboard Mesa have dried up. Water has returned to the underworld because it has not been treated correctly by the U.S. Department of Energy (DOE) activities. There are places on the NNSS where the rain falls but does not nurture the plants and animals. The CGTO wants to be involved in DOE hydrology studies because if the water continues to be treated in inappropriate ways, it will totally remove itself from the NNSS.

See Appendix C for more details.

[1] *Surface water is defined here as water available for shallow rooted plants during rainfall, water available during post-rain ponding, runoff, and absorption, and water recharged into near-surface aquifers.*

5.1.7 Biological Resources

Biological resources addressed in this impact analysis include native and nonnative vegetation and wildlife that inhabit or otherwise use NNSA sites in Nevada. Nonnative invasive or introduced species are generally considered deleterious. Both RSL and NLVF are located within developed urban settings that are devoid of natural habitat and are maintained with ornamental plant species. For this reason, detailed analysis of impacts on biological resources is limited to the NNSS and the TTR in this *NNSS SWEIS*.

Adverse impacts on wildlife include damage to or loss of habitat, direct mortality, and disturbance. Adverse impacts on vegetation include direct removal and reduction in suitable growing area. Loss of habitat and reduction in growing area are directly related to acres of land disturbed. Adverse impacts on soils, wells, and springs would also result in adverse impacts on vegetation and wildlife. NNSA is subject to and complies with existing laws, regulations, and policies regarding protection of sensitive and otherwise regulated plant and animal species and has established practices to minimize or avoid potential adverse effects on biological resources.

The following criteria are used in this analysis of potential impacts on biological resources resulting from activities of DOE/NNSA in Nevada:

- Area of land disturbance, i.e., habitat loss, particularly important habitats, and potential damage to biologically important habitat features, such as wells, springs, wetlands, and other resources that support biological resources. Impacts on habitats by land disturbance could affect both wildlife and native vegetation.

- The potential of proposed activities to cause damage to any species protected by applicable statutes, including exceeding the terms and conditions in the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada (2009 Biological Opinion)* (USFWS 2009a). It is important to note that the analyses of potential impacts on biological resources in this SWEIS are conservative and are not intended to represent a biological assessment within the meaning of the U.S. Fish and Wildlife Service (USFWS) in its regulations implementing the Endangered Species Act. For this reason, where the take of desert tortoises may appear to exceed the tems and conditions of the *2009 Biological Opinion*, this is only for purposes of comparing the relative impacts of the alternatives addressed in this SWEIS.

Table 5–27 shows the potential area of land that would be disturbed for each mission and program area under each of the three alternatives. Potential land disturbance related to UGTA and Soils Projects activities on the Nevada Test and Training Range (except the TTR) are included in the analysis of potential impacts on biological resources at the NNSS. In 2008, NNSA/NSO estimated that about 790,400 acres, or about 91 percent of the total area of the NNSS, were considered undisturbed land based on implementation of the Expanded Use Alternative from the *1996 NTS EIS* (DOE 2008f). Although some projects envisioned in 1996 were not implemented, such as construction of a large defense industrial complex or a commercial solar power generation facility, there have been other land-disturbing projects, such as the RNCTEC and various security improvements in the areas around some facilities. For purposes of this analysis, it was assumed that about 790,400 acres of the NNSS would remain undisturbed and that all undisturbed land would continue to provide habitat for wildlife.

Table 5–27 Habitat Disturbance from Proposed Projects and Activities at the Nevada National Security Site

Mission or Program	***No Action Alternative***		***Expanded Operations Alternative***		***Reduced Operations Alternative***	
	Disturbed Area (acres)	***Percentage of Undisturbed Area on the NNSS*** [a]	***Disturbed Area (acres)***	***Percentage of Undisturbed Area on the NNSS*** [a]	***Disturbed Area (acres)***	***Percentage of Undisturbed Area on the NNSS*** [a]
Stockpile Stewardship and Management Program	685	0.09	12,805	1.62	415	0.05
NERNC Program	15	0.002	215	0.03	15	0.002
Work for Others Program	0	0	435	0.06	0	0
National Security/Defense Mission	**700**	**0.09**	**13,455**	**1.70**	**430**	**0.05**
Waste Management Program	190	0.02	635	0.08	190	0.02
Environmental Restoration Program [b]	920	0.12	920	0.12	920	0.12
Environmental Management Mission	**1,110**	**0.14**	**1,555**	**0.2**	**1,110**	**0.14**
General Site Support and Infrastructure Program	0	0	467	0.06	0	0
Conservation and Renewable Energy Program	0	0	50	0.01	0	0
Other Research and Development Program	0	0	0	0	0	0
Nondefense Mission	**0**	**0**	**517**	**0.07**	**0**	**0**
Total for Alternative for DOE/NNSA	**1,810**	**0.23**	**15,527**	**2.00**	**1,540**	**0.2**
Commercial Solar Power Generation Facility	2,650	0.34	10,300	1.30	1,200	0.15
Geothermal Power Demonstration Project	0	0	50	0.006	0	0
Total Commercial/ Demonstration Projects	**2,650**	**0.34**	**10,350**	**1.31**	**1,200**	**0.15**
Total DOE/NNSA and Commercial/ Demonstration Projects	**4,460**	**0.56**	**25,877**	**3.27**	**2,740**	**0.35**

NERNC = Nuclear Emergency Response, Nonproliferation, and Counterterrorism; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.

[a] Percentages may not sum due to rounding.

[b] Land disturbance for Environmental Restoration activities includes 500 acres for new Underground Test Area Project groundwater characterization and monitoring wells and 420 acres for Soils Project sites. It was assumed that about one-half (250 acres) of the disturbance for new characterization and monitoring wells would occur on land owned or managed by others adjacent to the NNSS on the Nevada Test and Training Range, BLM land, and privately owned land. Almost all of the 420 acres of land disturbance for the Soils Projects sites would occur on the Nevada Test and Training Range. For purposes of analysis and because of the close proximity of the portions of the Nevada Test and Training Range, BLM land, and privately owned land that would be disturbed, all land disturbances associated with these Environmental Restoration Program activities are included with NNSS land disturbances.

Disturbance impacts on vegetation are considered permanent when there is no evidence to indicate that predisturbance levels of biomass, cover, density, soils, and plant community structure could be achieved within approximately 5 years of the disturbance or of conducting reclamation efforts. Based on this, all vegetation disturbances under each of the alternatives would be considered permanent because reclamation is not required for all land disturbances at the NNSS; therefore, reclamation was not assumed for any land disturbances.

Under all alternatives, disturbance of native vegetation either by direct removal or by mechanical damage from off-road vehicular or pedestrian traffic could promote the proliferation of nonnative invasive weeds, such as Russian thistle. This species is currently not listed on the Nevada noxious weed list, but is considered aggressive and opportunistic, and often portrays weed-like trends. Other weed species that could invade the disturbed areas over the long term include puncture vine (*Tribulus terrestris*), perennial pepperweed (*Lepidium latifolium*), gumweed (*Grindelia* spp.), yellow star thistle (*Centaurea solstitialis*), and Russian knapweed (*Acroptilion repens*). Other impacts on vegetation include soil compaction, spread of weeds already present in the disturbance footprint to areas not currently infested, and accidental introduction of new weed species from contaminated equipment brought in from other regions.

Endangered Species Act Definitions

Endangered Species – Any species that is in danger of extinction throughout all or a significant portion of its range.

Threatened Species – Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Take – To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Harm – Includes any act that actually kills or injures fish or wildlife; such acts may include habitat modification or degradation that significantly impairs essential behavioral patterns of fish or wildlife.

Harass – To intentionally or negligently, through act or omission, create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns such as breeding, feeding, and sheltering.

Critical Habitat – Specific geographic areas, whether occupied by a listed species or not, that are essential for its conservation and that have been formally designated by rule published in the *Federal Register*.

Habitat – The place or environment where a plant or animal naturally lives and grows (a group of particular environmental conditions).

Biological Assessment – A document prepared by a Federal agency to determine whether a proposed major construction activity under its authority is likely to adversely affect listed species, proposed species, or designated critical habitat.

Biological Opinion – A document stating the opinion of the U.S. Fish and Wildlife Service as to whether a Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

In 1998, DOE/NNSA evaluated biotic and abiotic data collected from ecological landform units to identify areas of the NNSS that may warrant active protection from land-disturbing activities (DOE/NV 1998d). Four habitat types on the NNSS were identified as “important habitats”: (1) Pristine habitat includes areas that have few manmade disturbances; (2) unique habitats contain uncommon biological resources, such as a natural wetland; (3) sensitive habitat includes areas where vegetation recovers very slowly from direct disturbance (i.e., areas with high susceptibility to wind erosion); and (4) diverse habitats have high plant species diversity (DOE/NV 1998d). Important habitats are shown in Chapter 4, Figure 4–15. NNSA believes that the long-term protection of these important habitats is one method by which overall cumulative impacts on biological resources may be minimized. During siting for new projects, these important habitats (pristine, sensitive, and diverse) are avoided whenever possible. Unique habitats, such as wetlands and springs, are particularly sensitive to disturbance and are avoided for all activities. Important habitats on the NNSS are not based on regulatory requirements but were developed as management tools.

Sensitive species are defined as species that are at risk of extinction or serious decline or whose long-term viability has been identified as a concern. Protected/regulated species are those that are protected or regulated by Federal or state law, such as the Endangered Species Act (16 *United States Code* [U.S.C.] 1531 et seq.), Migratory Bird Treaty Act (16 U.S.C. 703 et seq.), Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and Wild Free-Roaming Horses and Burros Act (16 U.S.C. 1331 et seq.). Resources important to sensitive species include cover sites, nest or burrow sites, roost sites, or water sources. There are 88 sensitive and protected/regulated species known to occur on or adjacent to the NNSS (NSTec 2010j): 1 moss, 18 flowering plants (excluding 3 species of yucca, one of agave, 18 of cacti, single-leaf pinyon pine [*Pinus monophylla*], and juniper [*Juniperus osteosperma*]), 1 mollusk, 2 reptiles (including the desert tortoise), 15 birds (all bird species on the NNSS are protected by the Migratory Bird Treaty Act, except chukar [*Alectois chukkar*], Gambel's quail [*Callipepla gambelii*], English house sparrow [*Passer domesticus*], rock dove [*Columba livia*], and European starling [*Sturnus vulgaris*]), and 27 mammals. Two bird species, chukar and Gambel's quail, and seven mammals are regulated as game species (pronghorn antelope [*Antilocarpra Americana*], Rocky Mountain elk [*Cervus elaphus*], desert bighorn sheep [*Ovis canadensis nelsoni*], mule deer [*Odocoileus hemionus*], mountain lion [*Puma concolor*], Audubon's cottontail [*Sylvilagus audubonii*], and Nuttall's cottontail [*Sylvilagus nuttallii*]). Three species of mammals are regulated as furbearers: bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), and kit fox (*Vulpes velox macrotis*). Protected and sensitive species of plants and animals are listed in Appendix F, Table F–1.

The desert tortoise (*Gopherus agassizii*), a threatened species, is the only federally listed species that occurs on the NNSS. The southern approximately one-third of the NNSS, including all or parts of Areas 5, 6, 11, 14, 22, 23, 25, 26, 27, and 29, is within the range of the desert tortoise, an area of about 328,400 acres. Approximately 7,350 acres, or 2 percent of NNSS land within desert tortoise range, has been disturbed in the past by construction of facilities and infrastructure and other activities. The net area of desert tortoise habitat at the NNSS is about 321,050 acres (about 42 percent of the undisturbed land on the NNSS). The population density of desert tortoises on the NNSS is unknown but considered to be "very low" (USFWS 2009a).

In July 2008, NNSA/NSO provided USFWS with a biological assessment of activities anticipated to occur on the NNSS over the following 10 years and entered into formal consultation to update the *1996 Biological Opinion* **(**USFWS 1996) and obtain a new Biological Opinion. In February 2009, USFWS issued the *2009 Biological Opinion* (USFWS 2009a) to NNSA/NSO, which authorized the incidental "take" (accidental killing, injury, harassment, etc.) of desert tortoises that may occur during NNSS activities. Before implementing any new activity in desert tortoise habitat, NNSA provides specified information and consults with USFWS to determine whether the anticipated incidental take for each action, at the project level, complies with the programmatic *2009 Biological Opinion*. Both the *1996 Biological Opinion* and *2009 Biological Opinion* concluded that activities anticipated to occur on the NNSS would not jeopardize the continued existence of the Mojave population of desert tortoises and that no critical habitat would be destroyed or adversely modified. NNSS activities occurring within the range of the desert tortoise must comply with the terms and conditions outlined in the *2009 Biological Opinion*, as shown in **Table 5–28**. The *2009 Biological Opinion* also states that, if the level of incidental take is reached and anticipated to be exceeded during the course of actions, such an incidental take would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures. If a proposed activity or group of activities would result in an exceedance of the *2009 Biological Opinion*, NNSA would consult with USFWS, in accordance with Section 7 of the Endangered Species Act.

The NNSA/NSO Desert Tortoise Compliance Program was developed in 1992, with the issuance by USFWS of the first Biological Opinion for the NNSS. The Desert Tortoise Compliance Program serves to implement the terms and conditions of the most current version of the Biological Opinion for the NNSS, to document compliance actions taken, and to assist NNSA/NSO with USFWS consultations. Some of the activities of the Desert Tortoise Compliance Program include (1) reviewing proposed activities at the NNSS to determine whether they may be located in tortoise habitat and whether clearance surveys and/or monitoring are required, (2) conducting clearance surveys at project sites within 1 day of the start of project construction, (3) ensuring that environmental monitors are on site during heavy equipment operations, (4) developing training modules and ensuring that all personnel working on the NNSS are trained in the requirements of the *2009 Biological Opinion* (USFWS 2009a)**,** and (5) preparing annual compliance reports for submittal to USFWS. By implementing the Desert Tortoise Compliance Program, NNSA/NSO would ensure that most if not all impacts on desert tortoises addressed in this analysis would involve harassment rather than injury or mortality.

Table 5–28 Parameters and Threshold Values for Desert Tortoise Take on the Nevada National Security Site

Mission or Program	*Maximum Allowable Land Disturbance (acres)*	*Maximum Number of Tortoises Anticipated to be Incidentally Taken*	
		Killed/Injured	*Other*
Stockpile Stewardship and Management Program	500	1	10
Work for Others Program	500	1	10
National Security/Defense Mission Total	1,000	2	20
Waste Management Program	100	1	2
Environmental Restoration Program	10	1	2
Environmental Management Mission Total	110	2	4
Other Research and Development	1,500	2	35
General Site Support and Infrastructure Program	100	1	10
Nondefense Mission Total	1,600	3	45
Nonprogrammatic Take on Existing Roads [b]	0	15 [c]	125
Overall Totals	2,710	22	194

[a] Other Research and Development was designated as “Nondefense Research and Development” in the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada (2009 Biological Opinion)* (USFWS 2009a).
[b] Refers to tortoises that may be taken by vehicular traffic on existing roads, as opposed to those that may be taken through ground-disturbing activities.
[c] No more than 4 desert tortoises may be killed or injured by nonprogrammatic take on existing NNSS roads during any calendar year and no more than 15 during the term of the *2009 Biological Opinion*.
Source: Modified from Table 3 in USFWS 2009a.

In addition to the Desert Tortoise Compliance Program, NNSA/NSO conducts a comprehensive program to monitor and protect sensitive plant and animal species and other biological resources on the NNSS, including the following:

- Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species, their associated habitat, and other important biological resources. Survey reports document species and resources found and provide mitigation recommendations.

- Beginning in 2004, in compliance with DOE Order 450.1A, *Environmental Protection Program*, NNSA/NSO began annual surveys each spring to assess wildland fire hazards on the NNSS. NNSS ecologists conduct these wildland fire surveys in coordination with NNSS Fire and Rescue.

- Under the NNSS Sensitive Plant Monitoring Program, the status or ranking of sensitive plant species known to occur on the NNSS is evaluated annually to ensure such plants are afforded the appropriate protection under Federal and state laws. Sensitive plant species populations on the NNSS are routinely monitored to assess plant density, plant vigor, or identify any threats or impacts on the species. Currently, there are 19 species of sensitive plants that are being monitored on the NNSS. A full list of sensitive plant species on the NNSS may be found in Appendix F, Table F–1.

- As part of the Sensitive and Protected/Regulated Animal Monitoring Program, to ensure such animal species are afforded the appropriate protection under Federal and state laws, NNSA/NSO currently monitors 18 animal species on the NNSS. The monitored species include 13 species of bats, wild horses (*Equus caballus*), mule deer, mountain lion, dark kangaroo mouse (*Microdipodops meacephalus*), and pale kangaroo mouse (*Microdipodops pallidus*). In addition, NNSA/NSO monitors raptorial bird species, including the western burrowing owl (*Athene cunicularia hypugaea*). The western red-tailed skink, a potentially sensitive species of reptile, has been under evaluation since 2006 to determine its abundance and distribution on the NNSS and whether it should be added to the list of actively monitored animal species. A list of all sensitive and protected/regulated animal species known to occur on the NNSS may be found in Appendix F, Table F–1.

- Additional monitoring is conducted for such things as natural wetlands to characterize seasonal baselines and trends in physical and biological parameters; to help the Southern Nevada Health District ascertain the presence and/or prevalence of the West Nile virus in the NNSS mosquito population; and to assess the use of constructed water sources by wildlife and develop and implement mitigation measures to prevent them from causing significant harm to wildlife.

- The Habitat Restoration Program involves the revegetation of disturbed land and evaluation of previous revegetation efforts. These activities are conducted at both the NNSS and the TTR.

- An *Ecological Monitoring and Compliance Program Report* is published each year documenting the previous year's activities and accomplishments in all of the above noted areas.

These activities are all elements of NNSA/NSO's program to ensure compliance with DOE Order 450.1A, *Environmental Protection Program*, and all applicable statutes and regulations.

Most activities described in Chapter 3 for the three alternatives have the potential to adversely affect biological resources at the NNSS. Direct impacts on biological resources would occur as a result of ground-disturbing activities, such as drilling new monitoring/characterization wells; grading; excavation; detonations of explosives; remediation of contaminated soils sites; construction of fencing, buildings, roads, firebreaks, and utilities; building modifications; and decontamination or demolition of buildings. Vehicular access to areas containing biological resources would increase the potential for direct mortality for wildlife and disturbance of native vegetation. NNSS activities at existing facilities are expected to have no new direct impacts on biological resources, although impacts such as startled reactions and flight due to detonation of explosives or operation of machinery would continue to occur.

The discussion of potential impacts on biological resources resulting from activities addressed in this SWEIS evaluates those impacts at the alternative level and by mission and program under each of the three alternatives. In this analysis, the overall area of land disturbance for each alternative may differ from the area of desert tortoise habitat that may be disturbed. Any potentially disturbed land area that clearly would not be located within desert tortoise habitat was excluded from the desert tortoise analyses, including the Project 57 Soils Project site (about 100 acres) located on the Nevada Test and Training

Range, dynamic experiments conducted in boreholes, one-half of open-air explosives experiments, drillback operations, depleted uranium experiment sites, a 5-megawatt photovoltaic power generation facility, about one-half of proposed UGTA Project characterization and monitoring wells, about one-half of the Office of Secure Transportation training and exercises, and the proposed 10,000-acre Office of Secure Transportation training facility in Area 17. Because of implementation of the NNSS Desert Tortoise Compliance Program and based on NNSS operating experience, this analysis assumes that all of the impacts on tortoises from project/activity-related actions under all three alternatives would be takes by harassment; however, takes resulting from collisions with motor vehicles would not be considered harassment and, for reasons discussed below, are not included with the analysis of missions, programs and activities. It is acknowledged that some tortoises could be taken by injury or mortality; however, based on experience at the NNSS from 1992 to 2010, for DOE/NNSA programs, projects, and activities, there would be no tortoises taken by injury or mortality by project activities and less than one per year taken due to non-project-related impacts by vehicles on NNSS roads. Vehicular traffic associated with a commercial solar power generation facility located in Area 25 of the NNSS could result in additional desert tortoise take, but would be addressed under a separate project-specific Biological Opinion that would need to be obtained by the proponent of such a project.

For all proposed activities that could result in habitat disturbance under each alternative, disturbances occurring during the nesting season for birds could affect the eggs or young in nests located within the project area. Most birds that nest within the NNSS are protected under the Migratory Bird Treaty Act and other statutes, such as the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c). A migratory bird is any species or family of birds that lives, reproduces, or migrates within or across international borders at some point during their annual life cycle. The Migratory Bird Treaty Act prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests except as authorized under a valid permit (50 CFR 21.11). Originally passed in 1940, the Bald and Golden Eagle Protection Act provides for the protection of the bald and golden eagle by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 U.S.C. 668(a); 50 CFR Part 22). "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb (16 U.S.C. 668c; 50 CFR 22.3).

The following sections describe potential impacts on biological resources from DOE/NNSA activities under the alternatives that have not already been addressed.

5.1.7.1 No Action Alternative

5.1.7.1.1 Impacts on Vegetation

DOE/NNSA proposed activities at NNSS would impact native vegetation directly by clearing areas or by crushing or breaking due to vehicular or pedestrian traffic. Table 5–1 displays estimated areas of land disturbance under each alternative, mission, and program for continuing and proposed DOE/NNSA activities and commercial and demonstration projects at the NNSS. DOE/NNSA activities would disturb a small portion of undisturbed habitat on the NNSS, regardless of alternative. However, some of the areas where activities could occur may be considered important habitats and are addressed under each alternative, mission, and program, as appropriate. The impacts of habitat disturbance on wildlife and sensitive and protected species under the No Action Alternative are addressed in Sections 5.1.7.1.2 and 5.1.7.1.3, respectively.

Overall, under the No Action Alternative, less than 1 percent (4,460 acres) of undisturbed habitat on the NNSS would be affected. Over one-half of land disturbances under the No Action Alternative would be due to potential development of a commercial solar power generation facility (2,650 acres) and are addressed under the Conservation and Renewable Energy Program. For DOE/NNSA activities, most vegetation disturbance (1,810 acres) would occur in areas generally along Mercury Highway in Yucca Flat and Frenchman Flat, although some activities, such as releases of chemicals and biological simulants and Office of Secure Transportation training and exercises, may occur in almost any area of the NNSS.

Under the No Action Alternative, over one-half of the 1,810 acres of land disturbance attributed to DOE/NNSA activities would be caused by short-term activities that would occur in small increments across a broad geographical area. The primary vegetation alliances that would be impacted are creosote bush/white bursage (*Larrea tridentata*/*Ambrosia dumosa*) shrubland, Nevada jointfir (*Ephedra nevadensis*) shrubland, saltbush (*Atriplex* spp.) shrubland, and burrobush/wolfberry (*Lycium andersonii*/*Hymenoclea salsola*) shrubland. These vegetation alliances cover about 150,800 acres, 106,000 acres, 25,900 acres, and 20,250 acres, respectively, or a total of about 36 percent of the NNSS (Ostler et al. 2000). Because of the prevalence of the potentially affected vegetation types on the NNSS, as well as regionally, as well as the geographical distribution of impacts, this level of habitat disturbance would not reduce the viability of any of the potentially affected vegetation alliances or have substantial negative impacts on biodiversity.

Some areas of the creosote bush/white bursage vegetation alliance in Frenchman Flat are considered sensitive habitat because the soils are particularly vulnerable to wind erosion and require long periods of time to recover from disturbance. NNSA would avoid siting new facilities or activities in this sensitive habitat to the extent reasonably possible; however, as noted below, ongoing development of the Area 5 RWMC would affect up to 190 acres of this sensitive habitat.

5.1.7.1.1.1 National Security/Defense Mission

Disturbances to up to 700 acres of habitat resulting from National Security/Defense Mission activities under the No Action Alternative would include removal of vegetation to clear areas or crushing plants by vehicular and pedestrian traffic. Crushed plants may recover if they are not too severely damaged and the cause of crushing does not damage their roots. Where vegetation must be removed to accomplish the activity, even though the activity would last only a relatively short period of time, recovery of the site would likely take many years. In addition, removal or weakening of native vegetation would increase the opportunity for invasive and weedy species to invade the disturbed areas, which could prolong or even preclude the ability of native vegetation to recolonize the area. As previously mentioned, some National Security/Defense Mission activities that occur in Frenchman Flat could impact sensitive habitat, but those habitat areas would be avoided if reasonably possible.

Stockpile Stewardship and Management Program. With the exception of a potential underground nuclear test (if so directed by the President), some explosives experiments, drillback operations, and Office of Secure Transportation training and exercises, all Stockpile Stewardship and Management Program activities would occur at existing facilities and would not cause any new or additional direct impacts on biological resources. Stockpile Stewardship and Management Program activities that would occur outside of existing facilities would likely affect vegetation directly due to disturbance of up to about 685 acres of land (less than 0.10 percent of undisturbed NNSS land). In many cases, vegetation would not need to be removed, but would be damaged by vehicular traffic and the setting up of equipment associated with the activities.

Nuclear Emergency Response and Nonproliferation and Counterterrorism Program. The NNSS would provide research, development, and training in support of the Arms Control, Nuclear Forensics, and Nuclear Emergency Response and Nonproliferation and Counterterrorism Programs. Most of these activities would occur at existing facilities. Under the No Action Alternative, the only new land disturbance expected to occur in this program area would be associated with releases of chemicals and biological simulants, which would temporarily disturb up to 15 acres of previously undisturbed land at the NNSS.

Arms control and counterterrorism activities would include training exercises in large, remote areas that involve the use of explosives and live fire. Areas where these exercises would be conducted would be accessible to pedestrians and on- and off-road vehicles; however, areas used for these activities have been used for similar activities for many years, and no new land areas would be affected.

Work for Others Program. Under the No Action Alternative, NNSA would continue to host the projects of other Federal agencies such as DoD and DHS, as well as other Federal, state, and local government agencies and nongovernmental organizations. Projects such as treaty verification activities, nonproliferation projects, counterproliferation research and development, and counterterrorism projects would include localized on-the-ground operations, including explosives detonations, military hardware field testing, chemical and biological simulant releases, and personnel field training. These operations would occur in various locations at the NNSS, many in remote, high-desert environments, and could potentially disturb native vegetation; however, the areas used for these activities have been used for similar activities for many years, and no additional land areas would be affected.

5.1.7.1.1.2 Environmental Management Mission

Under the No Action Alternative, up to 1,110 acres of land (0.14 percent of undisturbed land on the NNSS) would be disturbed by Environmental Management Program activities, including the Project 57 (located on the Nevada Test and Training Range to the north of NNSS Area 15) and Small Boy (located on the eastern edge of Frenchman Flat in Area 5 of the NNSS and extending onto the Nevada Test and Training Range) sites and new groundwater characterization and monitoring wells. A significant portion of the areas that would be disturbed under the Environmental Restoration Program is located on the Nevada Test and Training Range. Specific impacts related to habitat disturbance are discussed for each Environmental Management Mission program.

Waste Management Program. Under the No Action Alternative, waste management facilities would continue to operate in Areas 5, 6, 9, 11, and 23. The Area 5 RWMC would continue to operate within the approximately 740-acre area set aside for radioactive waste management, and approximately 190 acres of that area would be permanently disturbed by construction of new disposal cells. When closing these waste disposal cells, DOE/NNSA would in most if not all cases use a vegetated cap, which would, in the long term, offset most of the habitat disturbance impacts.

All of the area that would be disturbed for the Area 5 RWMC is located within the creosote bush/white bursage vegetation alliance in Frenchman Flat. As land is disturbed within the Area 5 RWMC, it would be immediately managed for waste disposal purposes, and erosion of the soil would be controlled by application of water sprays and other treatments to stabilize exposed soils. Operations within other existing waste management facilities are not anticipated to disturb additional land and would not result in any additional habitat loss.

Environmental Restoration Program. Under the No Action Alternative, the NNSA Environmental Restoration Program would continue in compliance with the most recent version of the FFACO to characterize, monitor, and remediate, as necessary, identified contaminated areas, facilities, soils, and groundwater.

Land disturbance for Environmental Restoration Program activities would include 500 acres for new UGTA Project groundwater characterization and monitoring wells and 420 acres for Soils Project sites. It was assumed that about one-half (250 acres) of the disturbance for new characterization and monitoring wells would occur on land owned or managed by others adjacent to the NNSS on the Nevada Test and

Training Range, and BLM land. Almost all of the 420 acres of land disturbance for the Soils Projects sites would occur on the Nevada Test and Training Range. For purposes of analysis and because of the close proximity of the portions of the Nevada Test and Training Range, and BLM land that would be disturbed, all land disturbances associated with these Environmental Restoration Program activities are included with NNSS land disturbances.

Ground-disturbing soils remediation project activities would include onsite surveys and monitoring, soil sampling, clean closure, and/or closure in place. Clean closure would entail mechanical removal and disposal of contaminated soils in an NNSS LLW waste management facility (based on approved clean-up levels). Closure in place would create very low levels of land disturbance and would consist of establishing appropriate administrative controls (land use restrictions) and/or physical barriers (fences) to control access to contaminated sites and allowing radioactive decay to gradually decrease the level of contamination. Up to approximately 420 acres of land on the NNSS and Nevada Test and Training Range (exclusive of the TTR) would be affected if clean closure were selected for remediating both the Project 57 and Small Boy soils sites. Those areas have been previously disturbed, although they continue to support native vegetation and are used by wildlife. The Project 57 site consists of about 100 acres of four-wing saltbush (*Atriplex canescens*)/Anderson's wolfberry vegetation, and the Small Boy site consists of about 320 acres of shadscale saltbush/rabbit thorn or Shockley's desert thorn (*Atriplex confertifolia-Lycium pallidum* or *Lycium shockleyi*) vegetation in the eastern portions of Frenchman Flat. Both the Project 57 and Small Boy sites are in areas that would be considered sensitive habitats due to high susceptibility of their soils to wind erosion if disturbed.

Development of up to 50 groundwater characterization and monitoring wells on the NNSS and Nevada Test and Training Range would disturb up to 500 acres; approximately one-half of which are located on the Nevada Test and Training Range in blackbrush (*Coleogyne ramosissima*)/Nevada jointfir (*Ephedra nevadensis*), spiny mendora (*Menodora spinescens*)/Anderson's wolfberry, Anderson's wolfberry/spiny hopsage (*Grayia spinosa*), and four-wing saltbush/Anderson's wolfberry vegetation associations, with the balance located on the NNSS in primarily blackbrush shrubland and Nevada jointfir shrubland. These are all common vegetation alliances and associations. On the NNSS, the blackbrush and Nevada jointfir shrubland alliances are the first and fifth most prevalent vegetation alliances, respectively, accounting for a combined 286,221 acres. Because the locations of the characterization and monitoring wells are not known at this time, it is not possible to know for certain, but it is very possible that some of them could be located in habitats that would be considered pristine, sensitive, or diverse The amount of vegetation and soil that would be disturbed is not expected to reduce the viability of any of the potentially affected vegetation alliances or associations or have a substantial negative impact on biodiversity, or wetlands and springs in these areas. In the longer term, Environmental Restoration Program activities at the NNSS would have a beneficial effect on biological resources because contamination would be removed or stabilized, some buildings would be removed, and areas would be revegetated with native plant species appropriate to the sites, thus improving existing habitat conditions.

5.1.7.1.1.3 Nondefense Mission

Under the No Action Alternative, DOE/NNSA would continue maintaining and repairing existing infrastructure and taking measures to improve energy efficiency and conservation. These activities may create some minor disturbances at existing facilities, but would not disturb previously undisturbed land. Therefore, there would be no new or additional impacts on vegetation. All new land disturbances related to the Nondefense Mission (2,650 acres) would be related to potential construction of a 240-megawatt commercial solar power generation facility in Area 25. This project is discussed below under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. Under the No Action Alternative, small projects to maintain and repair NNSS facilities would occur at existing facilities in previously disturbed areas and are not anticipated to directly affect biological resources.

Conservation and Renewable Energy Program. Measures taken to increase energy efficiency, fuel efficiency, and water conservation would occur at existing facilities and are not anticipated to directly affect biological resources.

Under the No Action Alternative, NNSA would allow construction of up to 240 megawatts of commercial solar power generation that would permanently disturb about 2,650 acres of creosote bush/white bursage habitat in Area 25 and nearby off-NNSS areas (for transmission line construction). Much of the area of potential disturbance, primarily north and west of Lathrop Wells Road, is considered to be sensitive habitat. The entire facility would be graded and stabilized to minimize soil erosion and maintained in an unvegetated condition. Additionally, access roads and utilities would be constructed to support the facilities. There are approximately 150,800 acres of creosote bush/white bursage habitat on the NNSS. Disturbance of up to 2,650 acres for a commercial solar power generation facility and associated transmission lines would affect about 1.8 percent of the habitat type on the NNSS and only about 0.3 percent of overall undisturbed land. The amount of vegetation and soil that would be disturbed is not expected to reduce the viability of creosote bush/white bursage vegetation in the region or have a substantial negative impact on biodiversity in this area.

Other Research and Development Programs. The Nevada National Environmental Research Park in Area 5 contains two existing facilities used to support outside scientific research on long-term environmental health. Future research programs could include activities such as habitat reclamation and remediation, which could potentially cause impacts on vegetation and soils due to ground disturbance and increased access to previously undisturbed land. No such activities are being proposed at this time.

5.1.7.1.2 Impacts on Wildlife

Under the No Action Alternative, most impacts on wildlife from DOE/NNSA activities would be temporary. Many of those temporary disturbances would occur in areas adjacent to previously disturbed areas that may possess marginal value as wildlife habitat, such as off-road vehicular traffic associated with Office of Secure Transportation training and exercises, which would occur within about 100 feet from the edge of existing roads. During periods of any human activity in an area, larger and more mobile species of wildlife would leave the area during the period of disturbance but smaller and less mobile species may be subject to direct injury and mortality. In addition to these direct effects, disturbance of vegetation, particularly in large blocks, could adversely impact wildlife populations through loss and fragmentation of cover, breeding, traveling, and foraging habitat. However, disturbance of up to 4,460 acres of habitat would represent only about 0.56 percent of undisturbed habitat on the NNSS, with the largest contiguous area of land disturbance being 2,650 acres for a commercial solar power generation facility. In addition, predation could increase as construction displaces wildlife from protective cover to uncovered habitat.

Noise associated with DOE/NNSA activities would impact wildlife in various ways, depending on the nature and location of the noise source and the particular species of wildlife. Where noises from human activities are fairly constant, such as the Area 5 RWMC, animals become accustomed and use the habitat around the noise source in accordance with their individual comfort levels. For some species, such as coyotes, human occupation of an area may be an opportunity for foraging. Other species are less adaptable to human presence. Sudden loud noises such as explosives detonations could startle wildlife, resulting in impacts on certain species. If sudden loud noises were to occur near vital water sources, they could cause large and mobile species of wildlife to avoid them until the disturbance subsides, which could affect animal species that depend on those water sources. Most DOE/NNSA activities that would create sudden loud noises or other large disturbances that would cause wildlife to flee an area are sporadic and of such short duration that it is doubtful they would cause significant interference with wildlife activities, including foraging and visiting drinking water sources. Nesting birds may flush from their nests in response to a sudden loud noise; however, based on experience at Cape Canaveral, nesting birds respond to Space Shuttle launch noise by flying away from the nests and then returning within a few minutes (FAA 2002).

5.1.7.1.3 Impacts on Sensitive and Protected Species

Based on previous studies, data are available to delineate desert tortoise habitat on the NNSS (Rautenstrauch et al. 1994) (see Chapter 4, Figure 4–16) and to make quantitative estimates of potential impacts on desert tortoises (DOE/NV 1998b) at the alternative, mission, and program levels for proposed activities at the NNSS. Similar detailed data are not available for other sensitive and protected species that inhabit the NNSS. For those species, the impact assessment is qualitative and only at the alternative level.

Table 5–29 displays the potential impacts on the desert tortoise under the No Action Alternative. Overall, implementation of the No Action Alternative, including all DOE/NNSA activities and a 240-megawatt commercial solar power generation facility, would result in disturbance of up to 3,705 acres of desert tortoise habitat (about 1.2 percent of remaining tortoise habitat on the NNSS) and impact 133 to 213 tortoises. DOE/NNSA activities under the No Action Alternative would disturb a total of 1,055 acres of tortoise habitat; this represents about 0.3 percent of the remaining tortoise habitat on the NNSS. Disturbance of this amount of habitat and associated activities would result in a potential take of 8 to 29 tortoises due to projects and activities, as well as up to 125 on NNSS roads for a total of 133 to 172, all by harassment; however, as noted earlier in this section, based on operating experience at the NNSS since 1992, an average of no more than 1 desert tortoise is expected to be taken by injury or mortality due to vehicle collisions each year. These values do not exceed the total threshold limits (2,710 acres and 194 tortoises) of the *2009 Biological Opinion* (USFWS 2009a). Potential impacts on the desert tortoise from development of a commercial solar power generation facility under the No Action Alternative are addressed below under the Conservation and Renewable Energy Program.

In the following discussion of potential impacts on desert tortoises resulting from missions and programs under the No Action Alternative, if the level of incidental take is reached and anticipated to be exceeded during the course of actions, such an incidental take would represent new information requiring reinitiation of consultation with USFWS and review of the reasonable and prudent measures in the *2009 Biological Opinion* (USFWS 2009a).

Compared to most other special status animal species on the NNSS, the western burrowing owl (*Athene cunicularia hypugaea*,) requires greater management attention because it occupies the flat, open valley bottoms in each of the three ecoregions found on the NNSS; primarily Yucca Flat (Transition Ecoregion), Frenchman Flat, Jackass Flats (both Mojave Desert Ecoregion), and near Buckoard Mesa (Great Basin Desert Ecoregion). Except for Buckboard Mesa, these are areas on the NNSS where most ongoing activities occur and where most future activities are likely to occur (Hall et al. 2003). NNSA/NSO activities, such as emplacing culverts and pipes, road building, digging pits and channels, and mound building have benefited the burrowing owl directly by increasing the number of available burrows for owls to use and indirectly by altering the natural habitat so it is more suitable for owls (Hall et al. 2003). Data developed by Hall et al. 2003 indicate that creation of a buffer area of about 60 meters around active burrowing owl burrows would preclude flushing birds by either human pedestrian or vehicular activity. Because the burrowing owl is protected under the Migratory Bird Treaty Act, NNSA enforces this buffer area around active burrows.

Table 5–29 Potential Impacts on Desert Tortoises Under the No Action Alternative

Mission/Program	***Primary Locations of Activities***	***Area of Desert Tortoise Habitat Disturbance (acres) <allowable take>***	***Maximum Desert Tortoise Abundance (number per square mile)*** [a]	***Number of Desert Tortoises Affected*** [b] ***<allowable take>***
Stockpile Stewardship and Management Program	Yucca Flat and Frenchman Flat	280 [c] <500>	Low (10–45)	4 to 20 <10>
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs	Frenchman Flat, Yucca Flat, and Mercury Valley	15	Low (10–45)	0 to 1
Work for Others Program	Yucca Flat, Frenchman Flat, Mercury Valley, and Fortymile Canyon	None <500>	N/A	N/A <10>
National Security/Defense Mission Total		295 <1,000>		4 to 21 <20>
Waste Management	Frenchman Flat	190 <100>	Very Low (0–10)	0 to 3 <2>
Environmental Restoration – Soils Project	Frenchman Flat, and, Nevada Test and Training Range	320 [d] <10>	Very Low (0–10)	0 to 5 <2>
Environmental Restoration – Underground Test Area Project	Yucca Flat and Frenchman Flat	250 [e]	Low (10–45)	4 to 18 [e]
Environmental Management Mission Total		760 <110>		4 to 26 <4>
General Site Support and Infrastructure	NNSS	None <100>	N/A	N/A <10>
Renewable Energy (DOE/NNSA)	NNSS	None <1,500>	N/A	N/A <35>
Nondefense Mission Total		None		N/A
Nonprogrammatic Takes on NNSS Roads	NNSS	None <None>		125 <125>
Total DOE/NNSA		1,055 <2,710>		133 to 172 <194>
Commercial Solar Power Generation Facility	Jackass Flats	2,650 [f]	Very Low (0–10)	0 to 41
Total		3,705		133 to 213

N/A = not applicable; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.

[a] Desert tortoise abundance class from Woodward et al. 1998.

[b] Acres of Disturbance/640 × Maximum Desert Tortoise Abundance range

[c] Dynamic experiments in boreholes, drillback operations, and one-half of high explosives experiments and Office of Secure Transportation training proposed under the No Action Alternative would be located outside of the range of the desert tortoise and are not included in this table.

[d] A total of 420 acres would be disturbed at Soils Project sites on the NNSS and Nevada Test and Training Range but only the Small Boy site (320 acres) in the Frenchman Flat area would be within desert tortoise habitat.

[e] A total of 10 acres of tortoise habitat disturbance and 2 takes by harassment are allowable for all Environmental Restoration activities at the NNSS under the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada*.

[f] 2,400 acres would be required for a commercial solar power generation facility with 240 megawatts capacity and about 250 acres would be used for transmission line right-of-way to connect the facility to the main transmission grid.

Other sensitive and protected bird species would be primarily impacted by disturbance during the nesting season. If active nests of sensitive and otherwise protected bird species are located during pre-project biological surveys NNSA would avoid impacting the nests until the young birds fledge. In compliance with the Migratory Bird Treaty Act, if it were imperative to disturb an active nest of any bird species protected under the act, NNSA would consult with USFWS prior to taking any action that would affect the nest or nesting birds. For example, in 2009, three nests with chicks were protected from harm, including one Say's phoebe nest with four chicks and two nests of unknown species, each with chicks. Activities that may have caused harm to these nests were postponed until the chicks fledged and the nests were empty (DOE/NV 2010).

Impacts on the western red-tailed skink (*Eumeces gilberti rubricaudatus*), a potentially sensitive species of reptile, would be small because it is widespread regionally and occupies small pockets of isolated habitat in the western and northwestern portions of the NNSS (NSTec 2010j) that would not be subject to land disturbance under the No Action Alternative. The western red-tailed skink may be found in dry rocky areas, but tends to be more abundant in rocky areas near intermittent or permanent streams and springs (Stebbins 2003; NSTec 2007).

At least 13 sensitive species of bats are known to occur at the NNSS or in adjacent areas. Tunnels, abandoned mine shafts and adits, natural caves and alcoves, and buildings at the NNSS may be used by bats as maternity roosts, night roosts, day roosts, and foraging sites (NSTec 2010j). Closure of unused tunnels and abandoned mine features could impact bats by reducing habitat necessary for them to reproduce and raise young and to fulfill other functions important to their survival. Prior to closing such facilities, NNSA/NSO conducts surveys and determines the level and type of use, if any, of these sites and installs bat gates and other means to ensure adequate closure and still provide access for bats. When bats are found occupying buildings, they are captured and relocated to other areas of the NNSS. These measures reduce any impacts on bats from DOE/NNSA activities at NNSS to very low and in large measure are beneficial to the various species of bats that inhabit the NNSS.

Appendix F, Figure F–1, shows the known locations of sensitive plant populations on the NNSS. NNSA routinely monitors the populations of these species to assess plant density and vigor and to identify any threats or impacts on the species. As new populations of sensitive plants are found on the NNSS, maps and databases are updated to ensure they are afforded the appropriate protection under Federal and state law. NNSA uses this information in planning projects to avoid impacting sensitive plant species. In addition to regular monitoring, biological surveys are conducted before any potential ground-disturbing activities, and if previously unknown populations of sensitive plants were discovered, NNSA would take reasonable measures to avoid those areas; however, if avoidance is not possible, there are no specified mitigation measures and the susceptible population would be lost. In this regard, it is important to note that most sensitive plant populations are located in portions of the NNSS that would be unlikely to be disturbed by any of the activities proposed under the No Action Alternative. Two sensitive species of plants occur in the valleys and would be more susceptible to being impacted: *Camisonnia megalantha*, *Cymopterus ripleyi* var. *saniculoides*. Others like *Eriogonum concinnum* are growing on disturbed areas, such as road cuts and cut slopes for well pads.

5.1.7.1.3.1 National Security/Defense Mission

Land disturbance of about 295 acres for National Security/Defense Mission activities in desert tortoise habitat could result in the potential take of from 4 to 21 tortoises, all by harassment. The amount of potential land disturbance is within the threshold value given in the *2009 Biological Opinion* (USFWS 2009a) for the National Security/Defense Mission (1,000 acres). The take of tortoises could marginally exceed the threshold value (20) given in the *2009 Biological Opinion* for the National Security/Defense Mission.

Stockpile Stewardship and Management Program. Most Stockpile Stewardship and Management Program activities would occur in the Yucca Flat and Frenchman Flat areas of the NNSS and incur about 280 acres of potential land disturbance within desert tortoise habitat in these areas. The estimated number of tortoises taken by harassment would range from 4 to 20. The acres of potential disturbance would meet the threshold value in the *2009 Biological Opinion* (USFWS 2009a), but the maximum potential take of desert tortoises would exceed the threshold value (10).

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Releases of chemicals and biological simulants would occur at many locations at the NNSS, mostly within previously disturbed areas such as NPTEC, Test Cell C, and established training areas; however up to 15 such releases may occur in undisturbed desert tortoise habitat, resulting in 15 acres of disturbance, which would impact up to 1 tortoise. The *2009 Biological Opinion* (USFWS 2009a) does not include a designation for this program area; however, biological simulant and chemical releases would result primarily from Work for Others Program activities. As such, the 15 acres of potential disturbance would be within the 500 acres allotted to the Work for Others Program, and the number of tortoises potentially taken by harassment would be well within the allowable take (10) in the *2009 Biological Opinion.*

Work for Others Program. Because no new land disturbances are anticipated under the Work for Others Program, none of the parameters of the *2009 Biological Opinion* (USFWS 2009a) would likely be exceeded.

5.1.7.1.3.2 Environmental Management Mission

Under the No Action Alternative, DOE/NNSA Environmental Management Program activities would disturb a total of 760 acres of land within desert tortoise habitat because 100 acres of land at Project 57 under the Soils Project and one-half of the proposed groundwater characterization and monitoring wells under the UGTA Project would not be within desert tortoise habitat. The potential take of desert tortoises would range from 4 to 26, all by harassment. The area of desert tortoise habitat that would be disturbed exceeds the threshold (110 acres) of the *2009 Biological Opinion* (USFWS 2009a) and the potential take of tortoises could exceed the allowable take (4) of the *2009 Biological Opinion*.

Waste Management Program. The Area 5 RWMC is located in Frenchman Flat, and the 1,900 acres of new land disturbance would potentially affect up to three desert tortoises, all by harassment. The acres of potential disturbance and the number of potentially affected desert tortoises would exceed the allowable take (100 acres and 2 tortoises) in the *2009 Biological Opinion* (USFWS 2009a).

Environmental Restoration Program. The only Soils Project site located within the range of the desert tortoise is the Small Boy site (320 acres). Although some groundwater characterization and monitoring wells may be developed within desert tortoise habitat, most would be sited outside of such habitat in the northwestern NNSS and adjacent Nevada Test and Training Range. For purposes of this analysis, it was assumed that 250 acres of land disturbance associated with such well development would occur in desert tortoise habitat. The 570 acres of new land disturbance would potentially affect from 4 to 23 desert tortoises, all by harassment. The acres of potential disturbance and the number of potentially affected desert tortoises would exceed the allowable take of the *2009 Biological Opinion* (i.e., 10 acres and 2 tortoises).

5.1.7.1.3.3 Nondefense Mission

Under the No Action Alternative, DOE/NNSA Nondefense Mission activities would not disturb previously undisturbed land; however they could cause some temporary short-term elevated noise levels in the immediate vicinity of the facilities that would temporarily disturb wildlife in the local area. Therefore, there would be no new or additional impacts on the desert tortoise. A potential solar power generation facility considered under this alternative is discussed below under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. Under the No Action Alternative, small projects to maintain and repair NNSS facilities would occur at existing facilities in previously disturbed areas and are not anticipated to affect desert tortoises.

Conservation and Renewable Energy Program. Measures taken to increase energy efficiency, fuel efficiency, and water conservation would occur at existing facilities and are not anticipated to affect desert tortoises.

Under the No Action Alternative, NNSA would consider allowing development of a commercial solar power generation facility on about 2,400 acres in Area 25 of the NNSS. To interconnect a commercial solar power generation facility to the electrical grid would require some construction of transmission lines. Assuming that up to 10 miles of new transmission line with a right-of-way 200 feet wide would be needed for a solar power generation facility with 240 megawatts of capacity on the NNSS, an additional approximately 250 acres of land would be disturbed. Most of the transmission line impacts would occur off of the NNSS on BLM and private land. The 240-megawatt facility would be located within the range of the desert tortoise and would permanently disturb its habitat. The number of desert tortoises potentially affected by this project would range from none to 41. This estimate is conservative because, within the portion of Area 25 where a solar power generation facility would be located, the soils tend to be too sandy to provide suitable tortoise burrow sites and there are very few, if any, tortoises actually inhabiting the area. The commercial solar power generation facility is not covered by the *2009 Biological Opinion* (USFWS 2009a) and would require consultation among the project proponents, USFWS, and BLM to develop a project-specific Biological Opinion.

5.1.7.2 Expanded Operations Alternative

5.1.7.2.1 Impacts on Vegetation

Under the Expanded Operations Alternative, DOE/NNSA proposed activities at NNSS would impact native vegetation directly by clearing areas or by crushing or breaking due to vehicular or pedestrian traffic. Crushed plants may recover if they are not too severely damaged and the cause of crushing does not damage their roots. Where vegetation must be removed to accomplish the activity, even though the activity would last only a relatively short period of time, recovery of the site would likely take many years. In addition, removal or weakening of native vegetation would increase the opportunity for invasive and weedy species to invade the disturbed areas, which could prolong or even preclude the ability of native vegetation to recolonize the area. Some of the areas where activities would occur may be considered important habitats and are addressed, as appropriate, in this section. Table 5–1 displays estimated areas of land disturbance by alternative, mission, and program for DOE/NNSA activities and commercial and demonstration projects at the NNSS. The impacts of habitat disturbance on wildlife and sensitive and protected species under the Expanded Operations Alternative are addressed in Sections 5.1.7.2.2 and 5.1.7.2.3, respectively.

Overall, under the Expanded Operations Alternative about 3.3 percent (25,877 acres) of undisturbed habitat on the NNSS would be disturbed. Most of this disturbance would occur in Yucca Flat, Frenchman Flat, and Jackass Flats, although some activities, such as releases of chemicals and biological simulants and Office of Secure Transportation training and exercises may occur in almost any area of the NNSS. About 10,350 acres of land disturbance under the Expanded Operations Alternative would be the result of potential development of commercial solar power generation facilities (including associated transmission lines) in the Jackass Flats in Area 25 and 50 acres the result of development of a geothermal demonstration project. The remaining 15,527 acres of land disturbances would be attributed to DOE/NNSA activities.

The primary vegetation alliances that would be impacted by Expanded Operations Alternative activities are creosote bush/white bursage shrubland, Nevada jointfir shrubland, saltbush shrubland, blackbrush shrubland, and burrobush/wolfberry shrubland. These vegetation alliances cover about 150,800 acres, 106,000 acres, 25,900 acres, 180,250 acres, and 20,250 acres, respectively, or a total of about 56 percent of the NNSS (DOE/NV 2000d). Because of the prevalence of the affected vegetation types on the NNSS, as well as regionally, and the geographical distribution of impacts, this level of habitat disturbance would not reduce the viability of any of the potentially affected vegetation alliances or have substantial negative impacts on biodiversity. However, some areas of creosote bush/white bursage vegetation in Frenchman Flat and blackbrush vegetation in Yucca Flat are considered sensitive habitat because the soils are particularly vulnerable to wind erosion if disturbed and require long periods of time to recover. NNSA would avoid activities that would disturb soils in this sensitive habitat to the extent reasonably possible.

5.1.7.2.1.1 National Security/Defense Mission

Up to 13,455 acres of vegetation (about 1.7 percent of undisturbed land on the NNSS) would be impacted by National Security/Defense Mission projects and activities under the Expanded Operations Alternative. A number of new facilities for supporting the National Security/Defense Mission programs are proposed under the Expanded Operations Alternative. Some National Security/Defense Mission activities that occur in portions of Frenchman Flat could impact sensitive habitat, but those habitat areas would be avoided if reasonably possible.

Stockpile Stewardship and Management Program. With the exception of a potential underground nuclear test (if so directed by the President), some explosives experiments, depleted uranium experiment sites, drillback operations, and Office of Secure Transportation training and exercises, all Stockpile Stewardship and Management Program activities would occur at existing facilities and would not cause any new or additional direct impacts on biological resources. Stockpile Stewardship and Management Program activities that would occur outside of existing facilities would likely affect vegetation directly due to disturbance of up to about 12,805 acres of land, which represents about 1.6 percent of undisturbed land on the NNSS.

Development of the proposed training facility for the Office of Secure Transportation would displace 10,000 acres of blackbrush and Nevada jointfir shrublands along the western margins of Yucca Flat. These two vegetation alliances cover about 286,250 acres of the NNSS. The proposed training facility would disturb about 3.5 percent of the combined area covered by these two vegetation alliances on the NNSS. The remaining 2,805 acres of potential land disturbance attributed to the Stockpile Stewardship and Management Program under the Expanded Operations Alternative would be primarily located in the Yucca Flat and Frenchman Flat areas.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. The NNSS would provide research, development, and training in support of the Arms Control, Nuclear Forensics, Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. To provide increased support to these activities, NNSA would develop an Arms Control Treaty Verification Test Bed and an Urban Warfare Complex at the NNSS. These new facilities would result in about 200 acres of permanent land disturbance in the Frenchman Flat and Yucca Flat areas and would most likely affect one or more of the following vegetation alliances: creosote bush/white bursage, saltbrush, Nevada jointfir, blackbrush, and burrobush/wolfberry. As under the No Action Alternative, about 15 acres of land would be temporarily disturbed for experiments involving releases of biological simulants and chemicals.

Other arms control and counterterrorism activities would include training exercises in large, remote areas that involve the use of explosives and live fire. Areas where these exercises would be conducted would be accessible to pedestrians and on- and off-road vehicles; however, areas used for these activities have been used for similar activities for many years and no additional land areas would be affected. These activities are expected to disturb native vegetation, but are not expected to reduce the viability of vegetation, including special status plant species.

Work for Others Program. Under the Expanded Operations Alternative, NNSA would continue to host the projects of other Federal agencies such as DoD and DHS, as well as other Federal, state, and local government agencies and nongovernmental organizations. Projects such as treaty verification activities, nonproliferation projects, counterproliferation research and development, and counterterrorism projects would include localized on-the-ground operations, including explosives detonations, military hardware field testing, chemical and biological simulant releases, and personnel field training. These operations would occur in various locations at the NNSS, many in remote, high-desert environments, and could potentially disturb native vegetation; however, the areas used for these activities have been used for similar activities for many years, and no additional land areas would be affected.

About 15 acres of land would be disturbed by construction of new support buildings at existing aviation facilities on the NNSS. About 20 acres of land would be disturbed in Area 15 of the NNSS for radioactive tracer experiments. In addition, as part of its Work for Others Program, NNSA would permanently disturb about 400 acres of land for various facilities, such as an Improvised Explosives Device Research and Defeat Facility and Active Interrogation Facilities. At this time, there are no specific plans or locations for these facilities, but they would most likely be located in Frenchman Flat or Yucca Flat, potentially affecting the same vegetation alliances as noted under Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs, above. Some areas of sensitive habitat may be impacted, but these areas would be avoided to the extent possible.

5.1.7.2.1.2 Environmental Management Mission

Under the Expanded Operations Alternative, up to 1,555 acres of land (about 0.2 percent of undisturbed land on the NNSS) would be disturbed, for Environmental Management activities, over the next 10 years. Specific impacts related to habitat disturbance are discussed for each Environmental Management program.

Waste Management Program. Under the Expanded Operations Alternative, waste management facilities would continue to operate in Areas 5, 6, 9, 11, and 23. The Area 5 RWMC would continue to operate within the approximately 740-acre area set aside for radioactive waste management, and approximately 600 acres of that area would be permanently disturbed by construction of new disposal cells. If necessary, DOE/NNSA would develop two new sanitary waste facilities at the NNSS. One would be located in Mercury Valley and would permanently disturb up to 15 acres of Nevada jointfir shrubland. A second sanitary waste facility would be developed in Area 25 to accept waste from Environmental Restoration demolition projects under the Industrial Sites Project. The new Area 25 sanitary waste disposal facility would permanently disturb about 20 acres of creosote bush/white bursage shrubland. Operations within other existing waste management facilities are not anticipated to disturb additional land and would not result in any additional habitat loss.

Environmental Restoration Program. Under the Expanded Operations Alternative, the NNSA Environmental Restoration Program would continue in compliance with the most recent version of the FFACO to characterize, monitor, and remediate, as necessary, identified contaminated areas, facilities, soils, and groundwater. Impacts on vegetation from these activities would be the same as under the No Action Alternative.

5.1.7.2.1.3 Nondefense Mission

Under the Expanded Operations Alternative, DOE/NNSA Nondefense Mission activities would disturb up to 517 acres of previously undisturbed land; about 467 acres for the rebuild of the 138-kilovolt electric transmission line on the NNSS and about 50 acres for a proposed 5 megawatt photovoltaic electrical generation facility in Area 6. A potential commercial solar power generation facility and a potential geothermal power generation facility demonstration project considered under this alternative are discussed below under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. NNSA would continue to conduct small projects to maintain and repair NNSS facilities in previously disturbed areas that are not anticipated to directly affect vegetation. A proposed rebuild of the existing 138-kilovolt transmission line between Mercury Substation in the south and Valley Substation in the northern part of the NNSS would disturb an estimated 467 acres of vegetation. Most of that disturbance would be from crushing vegetation due to vehicular access, with only a small area around the base of each transmission line structure, and some new access roads resulting in the only areas that would be cleared of vegetation. Being a linear project, it would affect a large number of different vegetation alliances and associations, but would only affect an important habitat in Frenchman Flat, where it would cross sensitive creosote bush/white bursage shrubland. Applications of water sprays and other measures during construction would reduce wind erosion in this sensitive habitat.

Conservation and Renewable Energy Program. Measures taken to increase energy efficiency, fuel efficiency, and water conservation would occur at existing facilities and are not anticipated to directly affect biological resources.

NNSA proposes to construct, operate, and maintain a 5-megawatt photovoltaic solar power generation facility in Area 6, on Yucca Flat. The proposed facility would result in permanent disturbance to about 50 acres of saltbrush shrubland and would not affect any important habitats on the NNSS. There are about 25,900 acres of saltbrush shrubland on the NNSS (DOE/NV 2000d), of which the proposed photovoltaic solar power generation facility would impact about 0.2 percent.

Under the Expanded Operations Alternative, NNSA would host a Geothermal Demonstration Project. The potential location for such a facility is unknown, but would likely be located in one of the areas identified as having potential hot dry rocks in Areas 10, 12, 15, 18 or 25 (see Figure A–2 in Appendix A). Up to about 50 acres of vegetation would be disturbed for development of a Geothermal Demonstration Project, but it is not possible at this time to determine the specific impacts.

Under the Expanded Operations Alternative, NNSA would allow construction of one or more commercial solar power generation facilities with up to 1,000 megawatts of generating capacity. Development of these facilities and associated electrical transmission lines to interconnect with the main transmission grid would permanently disturb about 10,000 acres and 300 acres, respectively, of creosote bush/white bursage habitat in Area 25 and other vegetation alliances in nearby offsite areas. Much of the area of potential disturbance, primarily north and west of Lathrop Wells Road, is considered to be sensitive habitat due to susceptibility of the soils to wind erosion. However, the entire facility would be graded and stabilized to minimize soil erosion and maintained in an unvegetated condition. Disturbance of up to 10,000 acres on the NNSS (300 acres of disturbance would be off of the NNSS for transmission line construction) for commercial solar power generation facilities would affect about 1.3 percent of undisturbed land and about 6.6 percent of creosote bush/white bursage shrubland on the NNSS. The amount of vegetation and soil that would be disturbed is not expected to reduce the viability of creosote bush/white bursage vegetation in the region or have a substantial negative impact on biodiversity in this area.

Other Research and Development Programs. The Nevada National Environmental Research Park in Area 5 contains two existing facilities used to support outside scientific research on long-term environmental health. Future research programs could include activities such as habitat reclamation and remediation, which could potentially cause impacts on vegetation and soils due to ground disturbance and increased access to previously undisturbed land. No specific activities are proposed at this time.

5.1.7.2.2 Impacts on Wildlife

Under the Expanded Operations Alternative, most impacts on wildlife from DOE/NNSA activities would be sporadic and short term. Many of those disturbances would occur in areas adjacent to previously disturbed areas that may possess marginal value as wildlife habitat, such as off-road vehicular traffic associated with Office of Secure Transportation training and exercises, which would occur within about 100 feet from the edge of an existing road. During periods of any human activity in an area, larger and more mobile species of wildlife would leave the area during the period of disturbance, but smaller and less mobile species may be subject to direct injury and mortality. In addition to these direct effects, loss of large blocks of habitat, such as for commercial solar power generation facilities or the Office of Secure Transportation training area, could adversely impact wildlife populations through loss and fragmentation of cover, breeding, traveling, and foraging habitat. In addition, predation could increase as construction and other disturbances displace wildlife from protective cover to uncovered habitat.

Noise associated with DOE/NNSA activities would impact wildlife in various ways, depending on the nature and location of the noise source and the particular species of wildlife. Where noises from human activities are fairly constant, such as the Area 5 RWMC, animals become accustomed and use the habitat around the noise source in accordance with their individual comfort levels. For some species, such a coyotes, human occupation of an area may be an opportunity for foraging on trash. Other species are less adaptable to human presence. Sudden loud noises such as explosives detonations could startle wildlife, resulting in impacts on certain species. If sudden loud noises were to occur near vital water sources, they could cause large and mobile species of wildlife to avoid them until the disturbance subsides, which could affect animal species that depend on those water sources. Most DOE/NNSA activities that would create sudden loud noises or other large disturbances that would cause wildlife to flee an area are sporadic and of such short duration that it is doubtful that they would cause significant interference with wildlife activities, including foraging and visiting drinking water sources. Nesting birds may flush from their nests in response to a sudden loud noise; however, based on experience at Cape Canaveral, nesting birds respond to Space Shuttle launch noise by flying away from the nests and then returning within a few minutes (FAA 2002).

In addition to these general impacts on wildlife, under the Expanded Operations Alternative, NNSA would conduct some activities under the Stockpile Stewardship and Management Program that could have additional impacts. Most Stockpile Stewardship and Management Program activities would continue to occur at existing facilities. At locations other than BEEF within the Nuclear and High Explosives Test Zone on the NNSS, the amount of explosives that may be used in experiments would be increased to 120,000 pounds of TNT-equivalent explosives. In addition, up to three 40-acre areas would be established in Areas 2, 4, 12, and 16 for conducting explosives experiments involving depleted uranium. Use of larger amounts of explosives at locations other than BEEF would result in a greater amount of noise and increase the area in which wildlife would be startled.

Use of depleted uranium in experiments with explosives would deposit depleted uranium particles in the soil in a localized area. Because depleted uranium is a low-activity, alpha-emitting radioactive material, it would have to be internalized by wildlife to induce radiologic effects (USAF 2006d). Because of its high density, the air transport of depleted uranium is generally limited to relatively small particles, and most of the depleted uranium dust would be deposited within a distance of 100 meters from the source

(EPA 1999). In general, depleted uranium deposited by airborne transport would be present on or near the soil surface, but would show minimal uptake by plant roots. Depleted uranium is not effectively transported through the food chain because low-level organisms tend to excrete soluble uranium species quickly (Littleton 2006). For this reason, the main pathways for incorporation into an organism would be inhalation and dermal absorption. Dermal contact is considered a relatively unimportant type of exposure because little of the depleted uranium would pass across the skin into the blood. However, depleted uranium could enter systemic circulation through open wounds or from embedded fragments (WHO 2001). Inhalation is the most likely pathway for depleted uranium to be internalized in wildlife. In humans, inhaled depleted uranium particles that reside in the lungs for long periods of time may damage lung cells and increase the possibility of lung cancer after many years (Littleton 2006). Smaller species of mammals and reptiles and animals that live in burrows would be most susceptible to inhaling depleted uranium particles. However, development of most cancers, including lung cancer, require a number of years, and the majority of smaller/burrowing species do not live sufficiently long for such cancers to develop. For instance, the life span of burrowing owls is less than 10 years.

5.1.7.2.3 Impacts on Sensitive and Protected Species

Based on previous studies, data are available to delineate desert tortoise habitat on the NNSS (Rautenstrauch et al. 1994) (see Chapter 4, Figure 4–16) and to make quantitative estimates of potential impacts on desert tortoises (DOE/NV 1998b) at the alternative, mission, and program levels for proposed activities at the NNSS. Similar detailed data are not available for other sensitive and protected species that inhabit the NNSS. For those species, the impact assessment is qualitative and only at the alternative level.

Table 5–30 displays the potential impacts on the desert tortoise under the Expanded Operations Alternative. Overall, implementation of the Expanded Operations Alternative, including all DOE/NNSA activities and one or more commercial solar power generation facilities with a 1,000-megawatt combined capacity, would result in disturbance of up to 13,760 acres of desert tortoise habitat (about 4.3 percent of remaining tortoise habitat on the NNSS) and potentially affect 163 to 346 tortoises (this estimate includes up to 125 tortoises taken by harassment on NNSS roads). DOE/NNSA activities would disturb a total of 3,370 acres of desert tortoise habitat (about 1 percent of the remaining tortoise habitat on the NNSS) and result in a potential take ranging from 38 to 60 tortoises due to DOE/NNSA project-related activities, as well as up to 125 on NNSS roads, for a total of 163 to 185, all by harassment. As noted under the No Action Alternative, based on NNSA operating experience at the NNSS since 1992, all takes resulting from DOE/NNSA project activities would be by harassment, with no more than one desert tortoise per year expected to be taken by injury or mortality due to non-project/activity-related vehicle collisions. Although the area of tortoise habitat that would be affected exceeds the threshold (2,710 acres) of the *2009 Biological Opinion* (USFWS 2009a), the number of tortoises taken would not exceed the overall allowable takes (194 tortoises). Potential impacts on the desert tortoise from development of a commercial solar power generation facility under the Expanded Operations Alternative are addressed below under the Conservation and Renewable Energy Program.

Under the Expanded Operations Alternative, DOE/NNSA would continue to implement protective measures for sensitive species of plants and animals, as described under the No Action Alternative. Although the level of activities would be greater than under the No Action Alternative, the protective measures would greatly reduce the potential for adversely impacting any sensitive species, such as the burrowing owl, other migratory bird species, or bats. Because there would be a greater amount of habitat disturbance in NNSS valleys under the Expanded Operations Alternative, sensitive plant species that inhabit the valley floors, such as *Camisonnia megalantha*, *Cymopterus ripleyi* var. *saniculoides* would be subject to more impact if avoidance is not possible.

Table 5–30 Potential Impacts on Desert Tortoises Under the Expanded Operations Alternative

Mission/Program	***Primary Locations of Activities***	***Area of Desert Tortoise Habitat Disturbance (acres) <allowable take>***	***Maximum Desert Tortoise Abundance (number per square mile)*** [a]	***Number of Desert Tortoises Affected*** [b] ***<allowable take>***
Stockpile Stewardship and Management	Yucca Flat and Frenchman Flat	1,280 [c] <500>	Low (10–45)	20 to 90 <10>
Nuclear Emergency Response, Nonproliferation, and Counterterrorism	Frenchman Flat, Yucca Flat, and Mercury Valley	215	Low (10–45)	3 to 15
Work for Others	Yucca Flat, Frenchman Flat, Mercury Valley, and Fortymile Canyon	435 <500>	Low (10–45)	7 to 31 <10>
National Security/Defense Mission Total		1,930 <1,000)		30 to 136 <20>
Waste Management	Frenchman Flat, Mercury Valley, and Jackass Flats	635 <100>	Very Low (0–10)	0 to 10 <2>
Environmental Restoration – Soils Project	Frenchman Flat, and Nevada Test and Training Range	320 [d]	Very Low (0–10)	0 to 5 <2>
Environmental Restoration – Underground Test Area Project	Yucca Flat and Frenchman Flat	250 [e]	Low (10–45)	4 to 18 [e]
Environmental Management Mission Total		1,205 <110>		4 to 33<4>
General Site Support and Infrastructure	Frenchman Flat Mercury Valley Yucca Flat	235 <100>	Low (10–45)	4 to 17 <10>
Renewable Energy (DOE/NNSA)		None <1,500>	Low (10–45)	N/A <35>
Nondefense Mission Total		235 <1,600>		4 to 17 <45>
Nonprogrammatic Takes on NNSS Roads	NNSS	None <None>		125 <125>
Total DOE/NNSA		3,370 <2,710>		163 to 185 <194>
Commercial Solar Power Generation Facility	Jackass Flats	10,300 [f]	Very Low (0–10)	0 to 161
Total		13,670		163 to 346

NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.

[a] Desert tortoise abundance class from DOE/NV 1998b.

[b] Acres of Disturbance/640 × Maximum Desert Tortoise Abundance

[c] The Office of Secure Transportation training facility, dynamic experiments in boreholes, drillback operations, and one-half of high explosives experiments and Office of Secure Transportation training proposed under the Expanded Operations Alternative would be located outside of the range of the desert tortoise and are not included in this table.

[d] A total of 420 acres would be disturbed at Soils Project sites on the NNSS and Nevada Test and Training Range but only the Small Boy site (320 acres) in the Frenchman Flat area would be within desert tortoise habitat.

[e] A total of 10 acres of tortoise habitat disturbance and 2 takes by harassment are allowable for all Environmental Restoration activities at the NNSS under the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada*.

[f] One or more commercial solar power generation facilities with a combined capacity of 1,000 megawatts would require 10,000 acres; about 300 acres would be used for transmission line right-of-way to connect the facility to the main transmission grid.

In the following program-level analyses under the Expanded Operations Alternative, take values that exceed the threshold limits of the *2009 Biological Opinion* are noted. If the level of incidental take is reached or anticipated to be exceeded during the course of actions, such an incidental take would represent new information requiring reinitiation of consultation with USFWS and review of the reasonable and prudent measures in the *2009 Biological Opinion*.

5.1.7.2.3.1 National Security/Defense Mission

Under the Expanded Operations Alternative, National Security/Defense Mission activities could result in disturbance of up to 1,930 acres of desert tortoise habitat and the potential take of from 30 to 136 tortoises due to projects and activities, all by harassment. This take would exceed the threshold values (1,000 acres and 20 tortoises) given in the *2009 Biological Opinion* (USFWS 2009a) for the National Security/Defense Mission.

Stockpile Stewardship and Management Program. Most Stockpile Stewardship and Management Program activities would occur in the Yucca Flat and Frenchman Flat areas of the NNSS and incur about 1,280 acres of potential land disturbance within desert tortoise habitat in these areas. The estimated number of tortoises taken by harassment would range from 20 to 90. The acres of potential disturbance and the consequent potential take of desert tortoises would exceed the allowable take (500 acres and 10 tortoises) in the *2009 Biological Opinion* (USFWS 2009a).

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Under the Expanded Operations Alternative, releases of chemicals and biological simulants that would occur outside of existing developed areas would temporarily disturb up to 15 acres of land during the next 10 years and construction of an Arms Control Verification Test Bed and a mock urban complex would permanently disturb up to 200 acres of land. The *2009 Biological Opinion* (USFWS 2009a) does not include a designation for this program area; however the land-disturbing activities of this program are closely associated with the Work for Others Program and are included in the discussion of that program below.

Work for Others Program. Most Work for Others Program activities would occur in the Yucca Flat, Frenchman Flat, Mercury Valley, and Fortymile Canyon areas of the NNSS and would potentially affect desert tortoises. Proposed construction of new test beds and other facilities to support the Work for Others Program would disturb up to 435 acres of land. When the 215 acres of tortoise habitat disturbance under the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs are included, this total disturbance would be 650 acres. Assuming that all of this disturbance would occur within desert tortoise habitat, the number of affected tortoises would range from 10 to 46. This level of take could exceed the allowable take (10 tortoises) in the *2009 Biological Opinion* (USFWS 2009a), and the area of potential land disturbance would exceed the 500 acres allowed.

5.1.7.2.3.2 Environmental Management Mission

Under the Expanded Operations Alternative, DOE/NNSA Environmental Management Program activities would disturb a total of 1,205 acres of land within desert tortoise habitat. The potential take of desert tortoises would range from 4 to 33, all by harassment. This would exceed both the allowable tortoise habitat disturbance, (110 acres) and could exceed the allowable take (4) in the *2009 Biological Opinion* (USFWS 2009a).

Waste Management Program. Construction of new LLW/MLLW cells at the Area 5 RWMC in Frenchman Flat and new sanitary landfills in Areas 23 and 25 would disturb 635 acres and potentially affect up to 10 desert tortoises, all by harassment. The acres of potential disturbance and the number of potentially affected desert tortoises would exceed the allowable take (100 acres and 2 tortoises) in the *2009 Biological Opinion* (USFWS 2009a).

Environmental Restoration Program. The only Soils Project site located within the range of the desert tortoise is the Small Boy site (320 acres). Although some groundwater characterization and monitoring wells may be developed within desert tortoise habitat, most would be sited outside of such habitat in the northwestern NNSS and adjacent Nevada Test and Training Range. For purposes of this analysis, it was assumed that one-half of such well development (250 acres of land disturbance) would occur in desert tortoise habitat. The 570 acres of new land disturbance would potentially impact from 4 to 23 desert tortoises, all by harassment. The acres of potential disturbance and the number of potentially affected desert tortoises would exceed the terms and conditions of the *2009 Biological Opinion* (USFWS 2009a) (i.e., 10 acres and 2 tortoises).

5.1.7.2.3.3 Nondefense Mission

Under the Expanded Operations Alternative, DOE/NNSA Nondefense Mission activities would disturb about 235 acres of land in desert tortoise habitat. A proposed rebuild of the existing 138-kilovolt transmission line is the only proposed activity under the Nondefense Mission that would potentially cause a take of desert tortoises and is addressed under the General Site Support and Infrastructure Program, discussion below. One or more potential commercial solar power generation facilities considered under this alternative are discussed below under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. In addition to ongoing maintenance, repair, and replacement activities to support NNSS facilities, NNSA/NSO would construct and modify facilities as needed to support NNSS programs. Under the Expanded Operations Alternative, NNSA proposes to rebuild the main 138-kilovolt electrical transmission system between Mercury Switchyard in Area 23 and Valley Substation in Area 2. This rebuild is the only proposed infrastructure project that would potentially affect desert tortoises. It would disturb up to 235 acres of desert tortoise habitat located generally adjacent to the existing transmission line. The proposed transmission line rebuild would affect from 4 to 17 tortoises, by harassment. These potential impacts exceed the allowable acres of tortoise habitat disturbance (100 acres) and could exceed the allowable take for this program (10 tortoises) in the *2009 Biological Opinion* (USFWS 2009a).

Conservation and Renewable Energy Program. NNSA/NSO would continue current energy efficiency and water conservation measures, fleet management improvements, and sustainable building practices. Because these activities would occur at existing facilities, they are not expected to affect the desert tortoise.

In addition, under the Expanded Operations Alternative, NNSA would allow construction of one or more commercial solar power generation facilities with a combined capacity of up to 1,000 megawatts within the Renewable Energy Zone in Area 25. It is estimated that the potential permanent land disturbance associated with such a project would be 10,000 acres. To interconnect a commercial solar power generation facility to the electrical grid, construction of new transmission lines would be required. Assuming that up to 10 miles of new transmission line with a right-of-way 250 feet wide would be needed for one or more solar power generation facilities on the NNSS, an additional approximately 300 acres of land would be disturbed. Most of the transmission line impacts would occur off of the NNSS on BLM and private land. The commercial solar power generation facility(ies) and new transmission line would be located within the range of the desert tortoise and would disturb 10,300 acres of habitat. The number of desert tortoises potentially affected by this project would range from none to 161. While most of these affected desert tortoises would be taken by harassment, the permanent loss of 10,000 acres of tortoise habitat for solar power generation facilities could slightly diminish the capacity of the surrounding area to support tortoises and the overall population in the region could slightly decrease; however, as noted under the No Action Alternative, the soils in much of the potential siting area for commercial solar power generation facilities tend to be too sandy to provide suitable tortoise burrow sites, and there are very few, if any, tortoises actually inhabiting the area. The commercial solar power generation facility is not covered by the *2009 Biological Opinion* and would require consultation among the project proponents, NNSA, USFWS, and BLM, as well as development of a project-specific Biological Opinion.

Other Research and Development Programs. The Nevada National Environmental Research Park in Area 5 contains two existing facilities used to support outside scientific research on long-term environmental health. Future research programs could include activities such as habitat reclamation and remediation, which could potentially cause disturbance in desert tortoise habitat; however, there are no proposed projects at this time and impacts on desert tortoises cannot be estimated. Any such projects proposed in the future would be subject to the then current Biological Opinion and the NNSA/NSO Desert Tortoise Compliance Program.

5.1.7.3 Reduced Operations Alternative

5.1.7.3.1 Impacts on Vegetation

DOE/NNSA proposed activities at NNSS would affect native vegetation directly by clearing areas or by crushing or breaking due to vehicular or pedestrian traffic. Table 5–29 displays estimated areas of land disturbance by alternative, mission, and program for DOE/NNSA activities and commercial and demonstration projects at the NNSS. DOE/NNSA activities under the Reduced Operations Alternative would disturb a small portion of undisturbed habitat on the NNSS. However, some of the areas where activities could occur may be considered important habitats. The impacts of habitat disturbance on wildlife under the Reduced Operations Alternative are addressed in Section 5.1.7.3.2; impacts on sensitive and protected/regulated species are discussed in Section 5.1.7.3.3.

Overall, under the Reduced Operations Alternative, about 2,740 acres (about 0.35 percent) of undisturbed habitat on the NNSS would be affected. Almost one-half of the land disturbances under the Reduced Operations Alternative would be due to potential development of a commercial solar power generation facility (1,200 acres) in Area 25 and are addressed under the Conservation and Renewable Energy Program. For DOE/NNSA activities, a total of 1,540 acres of land would be disturbed, mostly generally along Mercury Highway in Yucca Flat and Frenchman Flat, although some activities, such as releases of chemicals and biological simulants and Office of Secure Transportation training and exercises, may occur in almost any area of the NNSS.

Under the Reduced Operations Alternative, almost all activities with the potential to disturb vegetation would be short-term and would occur in small increments across a broad geographical area. The primary vegetation alliances that would be affected are creosote bush/white bursage shrubland, Nevada jointfir shrubland, saltbush shrubland, and burrobush/wolfberry shrubland. These vegetation alliances are among the most prevalent on the NNSS, covering a total of about 302,150 acres (Ostler et al. 2000). Because of the prevalence of the affected vegetation types on the NNSS, as well as regionally, and the geographical distribution of impacts, this level of habitat disturbance would not reduce the viability of any of the potentially affected vegetation alliances or have substantial negative impacts on biodiversity. However, some areas of creosote bush/white bursage vegetation alliance in Frenchman Flat and Jackass Flats are considered sensitive habitat because the soils are particularly vulnerable to erosion if disturbed and they require long periods of time to recover. NNSA would avoid siting new facilities or activities in this sensitive habitat to the extent reasonably possible. There are permanent impacts on vegetation when there is no evidence to indicate that predisturbance levels of biomass, cover, density, soils, and plant community structure could be achieved within approximately 5 years. Based on this, all vegetation disturbances under the Reduced Operations Alternative would be considered permanent because reclamation is not required for all land disturbances; therefore, reclamation is not assumed for any land disturbances. Disturbance of unique habitats, such as wetlands and springs, would be avoided for all activities.

Disturbance of native vegetation either by direct removal or by mechanical damage from off-road vehicular or pedestrian traffic could promote the proliferation of nonnative invasive weeds, such as Russian thistle. This species is currently not listed on the Nevada noxious weed list, but is considered aggressive and opportunistic and often portrays weed-like trends. Other weed species that could invade the disturbed areas over the long term include puncture vine (*Tribulus terrestris*), perennial pepperweed (*Lepidium latifolium*), gumweed (*Grindelia* spp.), yellow star thistle (*Centaurea solstitialis*), and Russian knapweed (*Acroptilion repens*). Other indirect impacts on vegetation include soil compaction, spread of weeds already present in the disturbance footprint to areas not currently infested, and accidental introduction of new weed species from contaminated equipment brought in from other regions.

5.1.7.3.1.1 National Security/Defense Mission

Disturbances to up to 430 acres of habitat resulting from National Security/Defense Mission activities under the Reduced Operations Alternative would include removal of vegetation to clear areas or crushing plants by vehicular and pedestrian traffic. Crushed plants may recover if they are not too severely damaged and the cause of crushing does not damage their roots. Where vegetation must be removed to accomplish the activity, even though the activity would last only a relatively short period of time, recovery of the site would likely take many years. In addition, removal or weakening of native vegetation would increase the opportunity for invasive and weedy species to invade the disturbed areas, which could prolong or even preclude the ability of native vegetation to recolonize the area. As previously mentioned, National Security/Defense Mission activities that occur in Frenchman Flat could impact sensitive habitat, but those habitat areas would be avoided if reasonably possible.

Stockpile Stewardship and Management Program. Activities that would occur outside of existing facilities would likely affect vegetation directly due to disturbance of up to about 415 acres of land. In many cases, vegetation would not need to be removed but would be damaged by vehicular traffic and the setting up of equipment associated with the activities.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Under the Reduced Operations Alternative, the only new land disturbance expected to occur in this program area would be associated with releases of chemicals and biological simulants, which would temporarily disturb up to 15 acres of previously undisturbed land at the NNSS.

Arms control and counterterrorism activities would include training exercises in large, remote areas that involve the use of explosives and live fire. Areas where these exercises would be conducted would be accessible to pedestrians and on- and off-road vehicles; however, areas used for these activities have been used for similar activities for many years and no additional land areas would be affected. These activities are expected to disturb native vegetation, but are not expected to reduce the viability of any plant species. However, by changing the land use zone designations of Areas 18, 19, 20, 29 and 30 to Limited Use and precluding most activities in these areas, potential impacts in those areas would be reduced relative to the No Action Alternative.

Work for Others Program. Under the Reduced Operations Alternative, NNSA would continue to host the projects of other Federal, state, and local government agencies and nongovernmental organizations and activities, and impacts would be similar to those under the No Action Alternative. However, by changing the land use zone designations of Areas 18, 19, 20, 29 and 30 to Limited Use and precluding most activities in these areas, potential impacts from Work for Others Program activities in those areas would be reduced relative to the No Action Alternative.

5.1.7.3.1.2 Environmental Management Mission

As with the No Action Alternative, approximately 1,110 acres of land that would be disturbed by Environmental Management Program activities under the Reduced Operations Alternative. A significant portion of the areas that would be disturbed under the Environmental Restoration Program are located on the Nevada Test and Training Range.

Waste Management Program. Under the Reduced Operations Alternative, impacts on vegetation resulting from the Waste Management Program would be the same as those under the No Action Alternative.

Environmental Restoration Program. Under the Reduced Operations Alternative, the NNSA Environmental Restoration Program would continue in compliance with the most recent version of the FFACO to characterize, monitor, and remediate, as necessary, identified contaminated areas, facilities, soils, and groundwater. Impacts on vegetation resulting from Environmental Restoration Program activities would be the same as those under the No Action Alternative.

5.1.7.3.1.3 Nondefense Mission

Under the Reduced Operations Alternative, DOE/NNSA Nondefense Mission activities would not disturb previously undisturbed land. Therefore, there would be no new or additional impacts on biological resources. A potential commercial solar power generation facility considered under this alternative is discussed below under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. Under the No Action Alternative, small projects to maintain and repair NNSS facilities would occur at existing facilities in previously disturbed areas and are not anticipated to directly affect biological resources.

Conservation and Renewable Energy Program. Measures taken to increase energy efficiency, fuel efficiency, and water conservation would occur at existing facilities and are not anticipated to directly affect biological resources.

In addition, under the Reduced Operations Alternative, NNSA would allow construction of a commercial 100-megawatt solar power generation facility that would permanently disturb about 1,200 acres of creosote bush/white bursage habitat in Area 25. Much of the area of potential disturbance, primarily north and west of Lathrop Wells Road, is considered to be sensitive habitat. The entire facility would be graded and stabilized to minimize soil erosion and maintained in an unvegetated condition. Additionally, access roads, and utilities would be constructed to support the facilities. There are approximately 150,800 acres of creosote bush/white bursage habitat on the NNSS. Disturbance of up to 1,200 acres for the commercial solar power generation facility would affect about 1.0 percent of the habitat type on the NNSS and only about 0.2 percent of overall undisturbed land. The amount of vegetation and soil that would be disturbed is not expected to reduce the viability of creosote bush/white bursage vegetation in the region or have a substantial negative impact on biodiversity in this area.

Other Research and Development Programs. The Nevada National Environmental Research Park in Area 5 contains two existing facilities used to support outside scientific research on long-term environmental health. Future research programs could include activities such as habitat reclamation and remediation, which could potentially cause impacts on vegetation and soils due to ground disturbance and increased access to previously undisturbed land. No such activities are being proposed at this time.

5.1.7.3.2 Impacts on Wildlife

Under the Reduced Operations Alternative, most impacts on wildlife from DOE/NNSA activities would be the result of short-term experiments and exercises. Many of those short-term disturbances would occur in areas adjacent to previously disturbed areas that may possess marginal value as wildlife habitat, such as off-road vehicular traffic associated with Office of Secure Transportation training and exercises, which would occur within about 100 feet from the edge of an existing road. During periods of any human activity in an area, larger and more mobile species of wildlife would leave the area during the period of disturbance, but smaller and less mobile species may be subject to direct injury and mortality. In addition to these direct effects, disturbance of vegetation, particularly in large blocks, could adversely impact wildlife populations through loss and fragmentation of cover, breeding, traveling, and foraging habitat. In addition, predation could increase as construction displaces wildlife from protective cover to uncovered habitat.

Noise associated with DOE/NNSA activities would impact wildlife in various ways depending on the nature and location of the noise source and the particular species of wildlife. Where noises from human activities are fairly constant, such as the Area 5 RWMC, some animals become accustomed and use the habitat around the noise source in accordance with their individual comfort levels. For some species, such a coyotes, human occupation of an area may be an opportunity for foraging. Other species are less adaptable to human presence. Sudden loud noises such as explosives detonations could startle wildlife, resulting in impacts on certain species. If sudden loud noises were to occur near vital water sources, they could cause large and mobile species of wildlife to avoid them until the disturbance subsides, which could affect animal species that depend on those water sources. Most DOE/NNSA activities that would create sudden loud noises or other large disturbances that would cause wildlife to flee an area are sporadic and of such short terms that it is doubtful that they would cause significant interference with wildlife activities, including foraging and visiting drinking water sources. Nesting birds may flush from their nests in response to a sudden loud noise; however, based on experience at Cape Canaveral, nesting birds respond to Space Shuttle launch noise by flying away from the nests and then returning within a few minutes (FAA 2002).

5.1.7.3.3 Impacts on Sensitive and Protected Species

Under the Reduced Operations Alternative, DOE/NNSA would continue to implement protective measures for sensitive species of plants and animals, as described under the No Action Alternative. Impacts on these species would be somewhat less than those described under the No Action Alternative due to the reduced level of activities that would occur at the NNSS. Because there would be habitat disturbance in NNSS valleys under the Reduced Operations Alternative, sensitive plant species that inhabit the valley floors, such as *Camisonnia megalantha*, *Cymopterus ripleyi* var. *saniculoides*, would be subject to less impact than under the No Action Alternative. Nevertheless, DOE/NNSA would continue to avoid impacts on sensitive species resulting from its activities to the greatest reasonable extent.

Based on previous studies, data are available to delineate desert tortoise habitat on the NNSS (Rautenstrauch et al. 1994) (see Chapter 4, Figure 4–16) and to make quantitative estimates of potential impacts on desert tortoises (DOE/NV 1998b) at the alternative, mission, and program levels for proposed activities at the NNSS. Similar detailed data are not available for other sensitive and protected species that inhabit the NNSS. For those species, the impact assessment is qualitative and only at the alternative level.

Table 5–31 displays the potential impacts on the desert tortoise under the Reduced Operations Alternative. Overall, implementation of the Reduced Operations Alternative, including all DOE/NNSA activities and a commercial 100-megawatt commercial solar power generation facility, would result in disturbance of up to 2,120 acres of desert tortoise habitat (about 0.7 percent of remaining tortoise habitat on the NNSS) and potentially affect 131 to 181 tortoises (this estimate includes up to 125 tortoises taken by harassment on NNSS roads). DOE/NNSA activities would disturb a total of about 920 acres of desert tortoise habitat (representing about 0.3 percent of the 321,050 acres of remaining tortoise habitat on the NNSS) and result in a take ranging from 6 to 37 tortoises, as well as up to 125 on NNSS roads for a total of 131 to 162 tortoises, all by harassment. Neither the area of tortoise habitat that would be impacted nor the number of tortoises taken would exceed the overall threshold limits (2,710 acres and 194 tortoises) in the *2009 Biological Opinion* (USFWS 2009a). Although all of the tortoises taken by project-related activities would be by harassment, based on NNSA experience between 1992 and 2010, fewer than one tortoise per year would be taken by injury or mortality due to non-project-related collisions by vehicles on NNSS roadways. Potential impacts on the desert tortoise from development of a commercial solar power generation facility under the Reduced Operations Alternative are addressed below under the Conservation and Renewable Energy Program.

In the following program-level analyses under the Reduced Operations Alternative, take values that exceed the threshold limits of the *2009 Biological Opinion* are noted. If the level of incidental take is reached or anticipated to be exceeded during the course of actions, such an incidental take would represent new information requiring reinitiation of consultation with USFWS and review of the reasonable and prudent measures in the *2009 Biological Opinion* (USFWS 2009a).

5.1.7.3.3.1 National Security/Defense Mission

Land disturbance of up to 160 acres for National Security/Defense Mission activities in desert tortoise habitat could result in the potential take of from 2 to 11 tortoises, all by harassment. This take would be within the threshold values (1,000 acres and 20 tortoises) in the *2009 Biological Opinion* (USFWS 2009a) for the National Security/Defense Mission.

Stockpile Stewardship and Management Program. Most Stockpile Stewardship and Management Program activities would occur in the Yucca Flat and Frenchman Flat areas of the NNSS and into about 145 acres of potential land disturbance within desert tortoise habitat in these areas. The estimated number of tortoises taken by harassment would range from 2 to 10. The acres of potential disturbance and incidental take would meet the threshold values for this program in the *2009 Biological Opinion* (500 acres and 10 tortoises) (USFWS 2009a).

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Experiments that employ releases of chemicals and biological simulants would occur at many locations at the NNSS, mostly within previously disturbed areas such as NPTEC, Test Cell C, and established training areas; however, up to 15 such experiments may occur in undisturbed desert tortoise habitat over the next 10 years, resulting in 15 acres of disturbance, which would result in an estimated take of 1 tortoise. The *2009 Biological Opinion* (USFWS 2009a) does not include a designation for this program area; however, experiments involving chemical and biological simulant releases would primarily be for Work for Others Program activities. As such, the 15 acres of potential disturbance would be within the 500 acres allotted to the Work for Others Program, and the number of tortoises potentially taken by harassment would be well within the allowable take (10) in the *2009 Biological Opinion*.

Work for Others Program. Because no new land disturbances are anticipated under the Work for Others Program, none of the parameters of the *2009 Biological Opinion* (USFWS 2009a) would likely be exceeded.

Table 5–31 Potential Impacts on Desert Tortoises Under the Reduced Operations Alternative

Mission/Program	***Primary Locations of Activities***	***Area of Desert Tortoise Habitat Disturbance (acres) <allowable take>***	***Maximum Desert Tortoise Abundance (number per square mile)*** [a]	***Number of Desert Tortoises Affected*** [b] ***<allowable take>***
Stockpile Stewardship and Management Program	Yucca Flat and Frenchman Flat	145 [c] <500>	Low (10–45)	2 to 10 <10>
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs	Frenchman Flat, Yucca Flat, and Mercury Valley	15	Low (10–45)	0 to 1
Work for Others Program	Yucca Flat, Frenchman Flat, Mercury Valley, and Fortymile Canyon	None <500>	N/A	N/A <10>
National Security/Defense Mission Total		160 <1,000>		2 to 11 <20>
Waste Management Program	Frenchman Flat	190 <100>	Very Low (0–10)	0 to 4 <2>
Environmental Restoration Program – Soils Project	Frenchman Flat, and, Nevada Test and Training Range	320 [d] <10>	Very Low (0–10)	0 to 5 <2>
Environmental Restoration Program – Underground Test Area Project	NNSS and Nevada Test and Training Range	250 [e]	Low (10–45)	4 to 18 [e]
Environmental Management Mission Total		760 <110>		4 to 26 <4>
General Site Support and Infrastructure	NNSS	None <100>	N/A	N/A <10>
Renewable Energy (DOE/NNSA)		None <1,500>	Low (10–45)	N/A <35>
Nondefense Mission Total		None 1,600>		N/A <45>
Nonprogrammatic Takes on NNSS Roads	NNSS	None <None>		125 <125>
Total DOE/NNSA		1,685		131 to 162
Commercial Solar Power Generation Facility	Jackass Flats	1,200	Very Low (0–10)	0 to 19
Total		2,120		131 to 181

N/A = not applicable; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.

[a] Desert tortoise abundance class from Woodward et al. 1998.

[b] Acres of Disturbance/640 × Maximum Desert Tortoise Abundance.

[c] Dynamic experiments in boreholes, drillback operations, and one-half of high explosives experiments and Office of Secure Transportation training proposed under the Reduced Operations Alternative would be located outside of the range of the desert tortoise and are not included in this table.

[d] A total of 420 acres would be disturbed at Soils Project sites on the NNSS and Nevada Test and Training Range but only the Small Boy site (320 acres) in the Frenchman Flat area would be within desert tortoise habitat.

[e] A total of 10 acres of tortoise habitat disturbance and 2 takes by harassment are allowable for all Environmental Restoration activities at the NNSS under the *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada*.

5.1.7.3.3.2 Environmental Management Mission

Under the Reduced Operations Alternative, potential impacts on desert tortoises from DOE/NNSA Environmental Management Program activities would be the same as those under the No Action Alternative.

Waste Management Program. Potential impacts on desert tortoises resulting from DOE/NNSA Waste Management activities would be the same under the Reduced Operations Alternative as those under the No Action Alternative.

Environmental Restoration Program. Under the Reduced Operations Alternative, the potential impacts on desert tortoises from Environmental Restoration Program activities would be the same as those under the No Action Alternative.

5.1.7.3.3.3 Nondefense Mission

Under the Reduced Operations Alternative, the only Nondefense Mission activities that would potentially impact desert tortoises would be associated with development of a commercial solar power generation facility, which is discussed below under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. Under the Reduced Operations Alternative, small projects to maintain and repair NNSS facilities would occur at existing facilities in previously disturbed areas and are not anticipated to affect biological resources.

Conservation and Renewable Energy Program. Measures taken to increase energy efficiency, fuel efficiency, and water conservation would occur at existing facilities and are not anticipated to affect biological resources.

A commercial 100-megawatt solar power generation facility would be located within the range of the desert tortoise in Area 25 of the NNSS and would permanently disturb its habitat. The 100-megawatt facility would permanently disturb about 1,200 acres of land. The existing electrical transmission system at the NNSS and in the region would be able to accommodate this additional generation without construction of new transmission lines. The number of desert tortoises potentially affected by this project would range from 0 to 19. The commercial solar power generation facility is not covered by the *2009 Biological Opinion* (USFWS 2009a) and would require consultation among the project proponents, USFWS, and BLM to develop a project-specific Biological Opinion.

Biological Resources—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) knows the current 100-year drought has increasingly stressed the physical and spiritual nature of the plants and animals on the Nevada National Security Site (NNSS). Its environmental impacts are unprecedented in the history of the operation and management of these lands. The CGTO knows the 100-year drought has modified the abundance and distribution of all animals and plants. The quality, quantity, and distribution of indigenous plants, animals, and insects necessary to sustain a healthy environment and to maintain a productive animal habitat are clearly affected.

Water – both as free flowing springs and absorbed by plants and distributed to animals -- has diminished. Certain springs have dried up making animals travel into other unfamiliar lands. Food foraging becomes difficult and land dries up. Wildlife has less body fat, which results in shorter hibernation cycles. Indian people have observed that ground squirrels are becoming cannibalistic to survive. Other animals are changing their habits as the environment continues to be impacted by this drought. For example, rabbits are now forced to eat unusual foods like Yucca. According to one tribal elder, *"The cries of some birds have changed since the drought began."*

See Appendix C for more details.

Other Research and Development Programs. The Nevada National Environmental Research Park in Area 5 contains two existing facilities used to support outside scientific research on long-term environmental health. Future research programs could include activities such as habitat reclamation and remediation, which could potentially cause disturbance in desert tortoise habitat; however, there are no proposed projects at this time and impacts on desert tortoises cannot be estimated. Any such projects proposed in the future would be subject to the then-current Biological Opinion and the NNSA/NSO Desert Tortoise Compliance Program.

5.1.8 Air Quality and Climate

This section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside the NNSS under each of the alternatives addressed in this *NNSS SWEIS*: No Action, Expanded Operations, and Reduced Operations. The ROI for each alternative in this air quality analysis encompasses Nye and Clark Counties in Nevada.

Air quality is determined, in part, by measuring concentrations of certain pollutants (referred to as "criteria pollutants") in the atmosphere. The U.S. Environmental Protection Agency designates an area as "in attainment" for a particular pollutant if ambient air concentrations of that pollutant are below the National Ambient Air Quality Standards. Criteria pollutants regulated under these standards by both the U.S. Environmental Protection Agency and the State of Nevada include ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and particulate matter with an aerodynamic diameter less than or equal to 10 micrometers and less than or equal to 2.5 micrometers.

In general, emissions-generating activities within the NNSS would be widely dispersed over the 1,360-square-mile area of the NNSS. Thus, at the boundaries of the NNSS, ambient concentrations of criteria pollutants under each alternative are expected to be below ambient air quality standards, and Nye County would continue its present attainment/nonclassified designation for all criteria pollutants. In Clark County, these emissions would not cause or contribute to any new air quality violations or increase the frequency of severity of any existing violation of any air quality standard.

Hazardous air pollutants (HAPs) are pollutants known or suspected to cause cancer or other serious health effects, such as birth defects. The U.S. Environmental Protection Agency, under the Clean Air Act, established emission standards (the National Emission Standards for Hazardous Air Pollutants) for 188 such pollutants, most of which originate from manmade sources. Benzene, for example, is found in gasoline. In establishing the standards, the Agency identified various industries and corresponding emission limits that, if exceeded, would require the use of additional control technologies to reduce such emissions to the maximum achievable. The NNSA found that in all alternatives HAP emissions are well below this threshold at less than 1 ton per year for all sources and because these emissions are also widely dispersed, similar to the criteria air pollutants, these emissions are not expected to pose an undue health risk to workers or the public.

Additional details supporting the information presented in this section can be found in Appendix D, Section D.2.1.1.

General conformity determination. EPA published the General Conformity Rule (40 CFR Part 6; 40 CFR Part 51; 40 CFR Part 93) to implement Section 176(c) of the Clean Air Act as amended in 1990. This rule requires Federal actions to conform to the appropriate State Implementation Plan. As defined in the Clean Air Act, such conformity means compliance and cooperation with the requirements of the State Implementation Plan to eliminate or reduce the severity and number of violations of the National Ambient Air Quality Standards and achieve expeditious attainment of such standards. A formal conformity determination is required for Federal actions occurring in nonattainment areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specific annual *de minimis* (threshold) values. Because ozone is a secondary pollutant, the conformity determination for ozone uses the precursor emissions of volatile organic compounds (VOCs) and nitrogen dioxide as surrogate pollutants. The *de minimis* thresholds are presented in **Table 5–32**; the total emissions in Clark County under the No Action, Expanded Operations, and Reduced Operations Alternatives would not exceed the *de minimis* levels for carbon monoxide, nitrogen oxides, VOCs, or particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}) in all cases. Therefore, a general conformity analysis would not be required for any of the alternatives addressed in this *NNSS SWEIS*.

Table 5–32 *De minimis* Thresholds in Nonattainment Areas

Criteria Pollutant	*Degree of Nonattainment*	*Annual Emissions (tons per year)*
Ozone ($VOCs$ and NO_2)	Serious	50
	Severe	25
	Extreme	10
	Other ozone nonattainment areas (outside of ozone transport region)	100
VOCs	Marginal/moderate nonattainment (within ozone transport region)	50
NO_2	Marginal/moderate nonattainment (within ozone transport region	100
CO	All	100
PM_{10}	Moderate	100
	Serious	70
SO_2, NO_2	All	100
Lead	All	25

CO = carbon monoxide; NO_2 = nitrogen dioxide; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Greenhouse gas emissions general information. The greenhouse gas emissions are presented in carbon-dioxide-equivalent form and are partitioned by various mobile and stationary source types. These emissions levels were derived from fuel use, vehicle activity, and power consumption data. Note that carbon dioxide emissions from onsite government vehicles were calculated for 2008 using measured fuel usage data. As only vehicle-miles-traveled projections were available for the No Action Alternative, a simplified vehicle-miles-traveled approach was used for onsite government vehicles. The greenhouse gas emissions were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010b). Because these carbon dioxide emission projections were based on the 2008 car fleet, fuel economy improvement due to the recently mandated Corporate Average Fuel Economy fuel standards (49 CFR Part 531; 49 CFR Part 533) for light-duty vehicles (passenger cars) and light-duty passenger trucks (light-duty trucks) was incorporated into the carbon dioxide emission estimate by reducing the ratio of the 2015 average fuel economy to the 2008 average fuel economy for these vehicle types.

These greenhouse gas emissions are compared with a reference amount of 25,000 metric tons (27,558 tons), the threshold level identified by the President's Council on Environmental Quality, for which a quantitative assessment may be meaningful (CEQ 2010).

Power generation (electrical energy generation) is by far the largest single source of greenhouse gas emissions related to ongoing NNSS activities. This generation includes reductions due to energy conservation measures to be implemented under the three alternatives.

Greenhouse gas emissions, while estimated to decrease relative to the 2008 baseline level, would still contribute to global climate change. More specifically, emissions of carbon monoxide, nitrogen oxides, and greenhouse gases attributable to the level of operations would decrease relative to existing levels under any alternative. These reductions are due, primarily, to the introduction over time of newer NNSA fleet and worker vehicles with improved fuel economy, and improved combustion and emissions treatment efficiencies of electric power generating sources on the NNSS.

5.1.8.1 No Action Alternative

5.1.8.1.1 Air Quality

Calculations of emissions on and near the NNSS. Table 5–33 shows the midpoint (year 2015) annual air emissions of the criteria pollutants and hazardous air pollutants associated with various NNSS activities under the No Action Alternative. Most emissions are associated with mobile source activity (e.g., vehicles and portable construction equipment). The stationary source emissions include emissions from the operation of a 240-megawatt commercial solar power generation facility that may be constructed under the No Action Alternative. Table 5–33 does not show construction-related emissions because these would be temporary (see **Table 5–34** for construction-related emissions). The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The NNSS contribution to the mobile source emissions in Clark County would continue to be small and would decrease relative to 2008 emission levels (see Chapter 4, Table 4–40). By 2015, VOC emissions from NNSS mobile sources in Clark County would increase relative to 2008 emission levels by 0.4 tons per year due to the widespread use of ethanol blends in southern Nevada. Only a small fraction of the sulfur dioxide, PM_{10} and $PM_{2.5}$ emissions are from mobile sources so these air pollutants show a small overall increase relative to 2008 of 0.32, 3.5, and 0.7 tons per year, respectively. This is due to the potential increase in activity at the NNSS under the No Action Alternative relative to 2008. These small increases would not be expected to lead to any violations of the air quality standards in Nye County. Emissions of nitrogen oxides, carbon monoxide, and PM_{10} from NNSS mobile sources in Clark County would decrease relative to 2008 emission levels by 12.6, 31.5, and 0.20 tons per year, respectively. Thus, this action would not contribute to or cause additional violations of the carbon monoxide or PM_{10} air quality standards. In addition, VOC emissions would not be expected to violate the ozone air quality standard because the increase would be relatively small and such mobile source emissions would be dispersed throughout the Las Vegas Valley. Appendix D, Section D.2.1.1.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

Under the No Action Alternative, LLW and MMLW would be transported to the NNSS using either a truck-only or mostly rail scenario. Table 5–34 shows the average annual air emissions for the criteria and hazardous air pollutants under these two scenarios. For all pollutants, the mostly rail scenario has much lower emissions than the truck-only scenario. This is due to the greater energy efficiency of using rail to transport the waste. Further details on the transport scenario can be found in Section 5.1.3.1.2. The majority of these emissions would occur outside of Nevada and would be widely distributed over various routes from the nine origin locations.

Construction activities emissions. Under the No Action Alternative, construction emissions from new development at the NNSS would be limited to emissions from construction of the 240-megawatt commercial solar power generation facility in Area 25. **Table 5–35** summarizes emissions from construction activities and construction workers commuting to and from the NNSS. These emissions are for the first year of construction and represent the highest emission rates as construction activity is linear over the multi-year period of construction and mobile source emission factors are highest in the first year. See Appendix D, Section D.2.1.1.1, for more information regarding how these emissions were determined and further portioning by source type and vehicle type for mobile sources. These results are shown separately from those in Table 5–34 because they span only a few years and, thus, are considered temporary.

Table 5–33 No Action Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Nevada National Security Site in 2015

	Annual Air Emissions (tons per year)														
	Stationary Sources	Government-Owned Vehicles	NNSS Commuters			Commercial Vendors			Radiological Waste Trucks			Total			
	Nye County	Nye County		Nye County			Nye County			Nye County			Nye County		
Pollutant	On-NNSS	On-NNSS	Clark County	On-NNSS	Off-NNSS	Clark County	On-NNSS	Off-NNSS	Clark County	On-NNSS	Off-NNSS	Clark County	On-NNSS	Off-NNSS	Total
PM_{10}	4.0	0.86	0.71	0.040	0.21	0.096	0.043	0.012	0.20	0.031	0.55	*1.0*	*5.0*	*0.77*	*6.8*
$PM_{2.5}$	1.4	0.68	0.39	0.027	0.12	0.078	0.036	0.010	0.17	0.027	0.49	*0.64*	*2.2*	*0.62*	*3.4*
CO	2.6	29.5	66.3	3.3	18.8	0.36	0.17	0.049	0.56	0.088	1.6	*67.2*	*35.7*	*20.4*	*123.3*
NO_x	4.0	7.5	12.4	0.69	3.5	0.96	0.43	0.12	2.5	0.40	7.2	*15.9*	*13.0*	*10.8*	*39.7*
SO_2	0.21	0.080	0.18	0.011	0.045	0.0022	0.00095	0.00027	0.0056	0.00088	0.016	*0.19*	*0.30*	*0.061*	*0.55*
VOCs	1.8	0.51	1.8	0.64	0.52	0.10	0.049	0.014	0.11	0.017	0.31	*2.0*	*3.0*	*0.84*	*5.9*
Lead	<0.03	0.000031	0.000052	0.0000033	0.000014	0.0000041	0.0000020	0.00000056	0.0000035	0.00000061	0.000011	*0.00006*	*0.030*	*0.000026*	*0.030*
Criteria Pollutant Total	*14.0*	*39.1*	*81.8*	*4.7*	*23.2*	*1.6*	*0.73*	*0.21*	*3.5*	*0.56*	*10.2*	*86.9*	*59.1*	*33.6*	*179.6*
HAPs	~0.1	0.041	0.14	0.0065	0.043	0.014	0.0064	0.0018	0.014	0.0023	0.041	*0.17*	*0.16*	*0.086*	*0.41*

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 5–34 No Action Alternative Annual Average Emissions of Criteria Pollutants and Hazardous Air Pollutants from the Transport of Low-Level and Mixed Low-Level Radioactive Waste to the Nevada National Security Site

Pollutant	***Annual Air Emissions (tons per year)***	
	Low-Level and Mixed Low-Level Radioactive Waste Shipped via Mostly Rail	***Low-Level and Mixed Low-Level Radioactive Waste Shipped via Truck Only***
PM_{10}	4.5	21.5
$PM_{2.5}$	4.1	19.5
CO	14.1	66.4
NO_x	63.8	300.6
SO_2	0.1	0.7
VOCs	2.7	12.5
Lead	0.0001	0.000
Criteria Pollutant Total	*89.3*	*421.2*
HAPs	0.4	1.7

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 5–35 No Action Alternative Construction Emissions of Criteria Pollutants and Hazardous Air Pollutants

Pollutant	*Peak Year Air Emissions from Construction Activities (tons per year)*				
	Construction	*Commuting by Construction Workers*			
	Nye County		*Nye County*		
	On-NNSS	*Clark County*	*On-NNSS*	*Off-NNSS*	*Total*
PM_{10}	19.9	0.11	0.0097	0.023	*20.0*
$PM_{2.5}$	5.9	0.064	0.0068	0.014	*6.0*
CO	30.0	11.2	0.96	2.6	*44.8*
NO_x	52.8	2.4	0.22	0.55	*56.0*
SO_2	0.11	0.027	0.0026	0.0052	*0.14*
VOC	5.7	0.40	0.029	0.087	*6.2*
Lead	Not applicable	0.0000067	0.00000078	0.0000014	*0.0000089*
HAPs	Not applicable	0.029	0.0023	0.0069	*0.038*

CO = carbon monoxide; HAP = hazardous air pollutant; NOx = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO2 = sulfur dioxide; VOC = volatile organic compound.

During the period of construction, most of the $PM_{2.5}$ emissions are from the combustion of diesel construction equipment and vehicles. These diesel particulate matter emissions would be widely dispersed over the commercial solar power generation facility. Screening-level air quality modeling of these emissions found that, on an annual basis, the maximum annual average diesel particulate matter concentration on site was 0.37 micrograms per cubic meter. EPA has established an inhalation reference concentration level of 5 micrograms per cubic meter that is designed to protect against chronic noncarcinogenic health effects (EPA 2003). Thus, no adverse noncancer inhalation impacts are expected from the operation of the construction equipment and vehicles. EPA has identified that diesel particulate matter is likely to be a human carcinogen by inhalation, but has not established a carcinogenic unit risk because the exposure response data in human studies are considered too uncertain. Chapter 7, Section 7.8, identifies possible mitigation measures to reduce PM exposure.

Chemical release emissions. Chemical releases would be subject to release criteria developed in applicable NEPA analyses (DOE 2002g, 2004f) and terms and conditions in the NNSS Air Quality Operating Permit. Releases would not occur unless the meteorological conditions at the release site were appropriate for the release. Prior to an experiment, air dispersion modeling would be conducted to ensure that it would be conducted within the limitations of applicable release criteria. In compliance with the NNSS Air Quality Operating Permit, NNSA/NSO would submit a detailed test plan to the Nevada Bureau of Air Pollution Control before the planned release, monitor the release, and submit a final analysis of each chemical release test. NNSA/NSO would notify the Nevada Bureau of Air Pollution Control within 24 hours of any malfunction or upset of a test process that would result in an emission above allowable limits.

5.1.8.1.2 Radiological Air Quality

No activities under the No Action Alternative are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions in Chapter 4, Section 4.1.8.3.

5.1.8.1.3 Climate Change

See Chapter 4, Section 4.1.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to NNSS-related activities. Table 5–36 shows greenhouse gas emissions levels for NNSS-related activities under the No Action Alternative. The midpoint year (2015) represents the average annual emissions over the 10-year planning period. Greenhouse gas emissions would continue beyond the 10-year planning period. The color coding in Table 5–36 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by NNSS (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–36 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–36 No Action Alternative Greenhouse Gas Emissions by the Nevada National Security Site Activity in 2015

Source Type	***Carbon-Dioxide-Equivalent Emissions (tons per year)***	***Fraction of Reference Point of 27,558 Tons Per Year***
STATIONARY SOURCES		
Power generation	19,106	0.69
Natural gas heating	0	0
Other stationary sources, excluding air conditioning/refrigeration, natural gas heating, and sources related to the solar power generation facility	501	0.02
Stationary sources related to solar power generation facility operation	9	0.01
Sulfur hexafluoride from refrigeration/air conditioning	462	0.02
Hydrofluorocarbons from refrigeration/air conditioning	218	0.01
ALL STATIONARY SOURCES	*20,296*	*0.74*
MOBILE SOURCES		
Onsite government vehicles	5,238	0.19
Temporary construction vehicles related to the solar power generation facility (about 3 years' duration)	4,642	0.17
Commuting by regular NNSS employees	9,481	0.34
Commuting by temporary solar power generation facility construction employees (about 3 years' duration)	1,044	0.04
Hazardous material and waste transport (nongovernment)	2,922	0.11
Commercial vendors	1,753	0.06
ALL MOBILE SOURCES, excluding temporary construction vehicles and construction employee commuting	*19,394*	*0.70*
ALL MOBILE SOURCES, including temporary construction vehicles and construction employee commuting	*25,080*	*0.912*
ALL SCOPE 1 SOURCES	*6,428*	*0.23*
ALL SCOPE 2 SOURCES	*19,106*	*0.69*
ALL SCOPE 3 SOURCES	*19,842*	*0.72*
TOTAL, excluding temporary construction employee commuting and construction vehicles	***39,690***	***1.44***
TOTAL, including temporary construction employee commuting and construction vehicles	***45,376***	***1.65***

NNSS = Nevada National Security Site.

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Overall, NNSS-related activities under the No Action Alternative would create about 39,690 carbon-dioxide-equivalent tons of greenhouse gas emissions per year (45,376 when including temporary construction worker commuting), about 44 percent over the threshold reporting level (65 percent when including temporary construction worker commuting). This represents a net reduction over current greenhouse gas emissions (50,478 tons in 2008) of about 21 percent, but these emissions would continue to contribute towards global climate change.

LLW and MLLW may be transported to the NNSS under the Expanded Operations using either a truck-only or mostly rail scenario. Under the truck-only scenario, about 8,078 carbon dioxide equivalent tons of greenhouse gas emissions would be created per year. For the mostly rail scenario, about 1,753 carbon dioxide equivalent tons of greenhouse gas emissions would be created per year. This lower rate of greenhouse gas emissions is due to the greater energy efficiency of using rail to transport the waste.

5.1.8.2 Expanded Operations Alternative

5.1.8.2.1 Air Quality

This section addresses air quality impacts from stationary, mobile, and fugitive criteria pollutant sources that would occur within and outside the NNSS under the Expanded Operations Alternative.

Calculations of emissions on and near the NNSS. Table 5–37 shows the midpoint (year 2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various NNSS activities under the Expanded Operations Alternative. These emissions would be expected to continue beyond the 10-year planning period. Most emissions are associated with mobile source activity (e.g., vehicles and portable construction equipment). The stationary source emissions include emissions resulting from the operation of a 1,000-megawatt commercial solar power generation facility that may be constructed under the Expanded Operations Alternative. Table 5–37 does not show construction-related emissions because these would be temporary. See **Table 5–38** for construction-related emissions. The midpoint year represents the average annual emissions over the next 10 years. VOC and PM_{10} emissions from NNSS mobile sources in Clark County would increase relative to 2008 emission levels by 1.0 and 0.20 tons per year, respectively; nitrogen oxide and carbon monoxide emissions from NNSS mobile sources in Clark County would decrease 7.1 and 13.9 tons per year, respectively. Only a small fraction of the sulfur dioxide, PM_{10} and $PM_{2.5}$ emissions are from mobile sources so these air pollutants show a small overall increase relative to 2008 of 0.69, 16.8, and 5.4 tons per year, respectively. This is due to the projected increase in activity at the NNSS under the Expanded Operations Alternative relative to 2008. These small increases would not be expected to lead to any violations of the air quality standards in Nye County. The VOC increase would be due to the widespread use of ethanol blends in southern Nevada by 2015. Thus, this action would not contribute to or cause additional violations of the carbon monoxide air quality standards. The small increases in VOC and PM_{10} emissions in Clark County would be attributable to mobile sources and would be widely distributed over the Las Vegas Valley. They would not lead to any additional violations of the ozone or PM_{10} air quality standards. See Appendix D, Section D.2.1.2.1, for more detail on how these emissions were determined, as well as source-type and vehicle-type characterization data for mobile sources.

In addition, under the Expanded Operations Alternative, LLW and MMLW would be transported to the NNSS using either a truck-only or mostly rail scenario. **Table 5–39** shows the average annual air emissions for the criteria and hazardous air pollutants under these two scenarios. For all pollutants, the mostly rail scenario has much lower emissions than the truck-only scenario. This is due to the greater energy efficiency of using rail to transport the waste. Further details on the transport scenario can be found in Section 5.1.3.1.2. The majority of these emissions would occur outside of Nevada and would be widely distributed over various routes from the nine origin locations.

Table 5–37 Expanded Operations Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Nevada National Security Site in 2015

Pollutant	*Annual Air Emissions (tons per year)*														
	Stationary Sources	*Government-Owned Vehicles*	*NNSS Commuters*			*Commercial Vendors*			*Radiological Waste Trucks*			*Total*			
	Nye County	*Nye County*	*Clark County*	*Nye County*		*Clark County*	*Nye County*		*Clark County*	*Nye County*		*Clark County*	*Nye County*		*Total*
	On-NNSS	*On-NNSS*		*On-NNSS*	*Off-NNSS*		*On-NNSS*	*Off-NNSS*		*On-NNSS*	*Off-NNSS*		*On-NNSS*	*Off-NNSS*	
PM_{10}	16.2	1.1	0.89	0.05	0.26	0.12	0.054	0.015	0.37	0.055	1.0	*1.4*	*17.5*	*1.3*	***20.1***
$PM_{2.5}$	5.1	0.86	0.49	0.034	0.15	0.098	0.045	0.013	0.32	0.05	0.91	*0.91*	*6.1*	*1.1*	***8.1***
CO	7.9	37.1	83.3	4.1	23.6	0.45	0.21	0.062	1.0	0.17	3.0	*84.8*	*49.5*	*26.7*	***160.9***
NO_x	5.8	9.4	15.6	0.87	4.4	1.2	0.54	0.15	4.6	0.77	13.3	*21.4*	*17.4*	*17.9*	***56.6***
SO_2	0.68	0.10	0.22	0.014	0.057	0.0028	0.0012	0.00034	0.010	0.0017	0.030	*0.22*	*0.80*	*0.087*	***1.1***
VOCs	5.6	0.64	2.3	0.80	0.65	0.13	0.062	0.018	0.20	0.032	0.58	*2.6*	*7.1*	*1.2*	***11.0***
Lead	<0.010	0.000039	0.000065	0.0000041	0.000018	0.0000052	0.0000025	0.00000070	0.0000065	0.0000011	0.000020	*0.000077*	*~0.010*	*0.000039*	***~0.010***
Criteria Pollutant Total	*41.3*	*49.2*	*102.8*	*5.9*	*29.1*	*2.0*	*0.9*	*0.3*	*6.5*	*1.1*	*18.8*	*111.3*	*98.3*	*48.2*	***257.8***
HAPs	~0.1	0.051	0.18	0.0082	0.054	0.018	0.0080	0.0023	0.026	0.0043	0.076	*0.22*	*~0.17*	*0.13*	***~0.53***

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 5–38 Expanded Operations Alternative Construction Emissions of Criteria Pollutants and Hazardous Air Pollutants

Pollutant	***Peak Year Air Emissions from Construction Activities (tons per year)***						
	NNSS Construction for Work for Others	***NNSS Construction for Solar Power Generation Facility***	***Other NNSS Construction***	***Commuting by Construction Workers***			***Total***
	Nye County			***Clark County***	***Nye County***		
	On-NNSS	***On-NNSS***	***On-NNSS***		***On-NNSS***	***Off-NNSS***	
PM_{10}	11.3 (61% from vehicles)	83.2	34.4 (12% from vehicles)	0.17	0.015	0.035	*129.1*
$PM_{2.5}$	6.7	24.7	4.1	0.096	0.01	0.021	*35.6*
CO	92.2	125.6	56.6	16.8	1.4	3.9	*296.5*
NO_x	100.9	220.9	62.0	3.6	0.33	0.83	*388.6*
SO_2	0.09	0.48	0.06	0.041	0.0039	0.0078	*0.68*
VOC	10.5 [a]	23.8 [a]	6.4 [a]	0.6	0.044	0.13	*41.6*
Lead	Not applicable	N/A	N/A	0.00001	0.0000012	0.0000021	*0.000013*
HAPs	Not applicable	N/A	N/A	0.044	0.0035	0.01	*0.058*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] VOC emissions are assumed to be equal to the hydrocarbon emissions.

Table 5–39 Expanded Operations Alternative Annual Average Emissions of Criteria Pollutants and Hazardous Air Pollutants from the Transport of Low-Level and Mixed Low-Level Radioactive Waste to the Nevada National Security Site

Pollutant	*Annual Air Emissions (tons per year)*	
	Low-Level and Mixed Low-Level Radioactive Waste Shipped via Mostly Rail	*Low-Level and Mixed Low-Level Radioactive Waste Shipped via Truck Only*
PM_{10}	16.3	56.0
$PM_{2.5}$	14.8	50.9
CO	50.6	173.1
NO_x	229.3	783.8
SO_2	0.5	1.7
VOCs	9.5	32.6
Lead	0.0003	0.001
Criteria Pollutant Total	*321.1*	*1098.1*
HAPs	1.3	4.4

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Construction activities emissions. Short-term emissions are expected during construction of new buildings at the NNSS. A full list of all construction activities under the Expanded Operations Alternative can be found in Appendix D, Section D.2.1.2.1. Construction emissions from onsite activities at the NNSS are presented in Table 5–38. These emissions are for the first year of construction and represent the highest emission rates as construction activity is linear over the multi-year period of construction and mobile source emission factors are highest in the first year. The emissions would be dispersed over numerous locations on the NNSS; however, emissions from the commercial solar power generation facility would be more concentrated in Area 25 of the NNSS. These emissions would not increase the ambient pollutant concentrations in Nye County above the ambient air quality standards. The construction emissions shown in Table 5–38 include steps to control fugitive dust emissions using best practices along with compliance with the requirements for controlling fugitive dust in accordance with the State surface disturbance permit. Additional details are presented in Appendix D, Section D.2.1.2.1.

During the period of construction, most of the $PM_{2.5}$ emissions are from combustion of diesel-fueled construction equipment and vehicles. These diesel particulate matter emissions would be widely dispersed over the commercial solar power generation facility. Screening-level air quality modeling of these missions found that on an annual basis, the maximum annual average diesel particulate matter concentration on site was 0.57 micrograms per cubic meter. EPA has established an inhalation reference concentration level of 5 micrograms per cubic meter that is designed to protect against chronic noncarcinogenic health effects (EPA 2003). Thus no adverse noncancer inhalation impacts are expected from the operation of the construction equipment and vehicles. EPA has identified that diesel particulate matter is likely to be a human carcinogen by inhalation, but has not established a carcinogenic unit risk because the exposure response data in human studies are considered too uncertain. Chapter 7, Section 7.8, identifies possible mitigation measures to reduce diesel particulate matter exposure.

Chemical release emissions. Chemical release experiments would be conducted within the same parameters described under the No Action Alternative and would comply with all applicable requirements of the NNSS Air Quality Operating Permit.

5.1.8.2.2 Radiological Air Quality

Except for the depleted uranium and radiotracer experiments, no activities under the Expanded Operations Alternative are expected to produce aboveground radiation via the air pathway beyond that documented for 2008 baseline conditions in Chapter 4, Section 4.1.8.3. Before conducting any activity that is designed to include an atmospheric release of radiological materials, NNSA/NSO would model the potential releases using CAP-88 (at a minimum, additional models may be used) and, if the results indicate a potential dose exceeding 0.1 millirem at the nearest boundary, NNSA/NSO would submit an application to construct to Nevada Bureau of Air Pollution Control (with a copy to EPA) in compliance with 40 CFR Part 61 Subpart H (Section 61.96). NNSA/NSO would ensure that the cumulative annual dose to the nearest offsite individual remains within the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) standard of 10 millirem per year.

Explosive testing using depleted uranium. Radiological air releases are typically assessed using the CAP-88 model; however, that model and other EPA-approved models are designed for a nonexplosive, long-term, continuous release of radioactive material and would not be appropriate for the depleted uranium/high explosives experiments, which are not continuous and are, by definition, highly explosive. The modeling of these experiments was performed with the MACCS2 computer code, as discussed in Appendix G. The results of the modeling are presented in Appendix G and Section 5.1.12.1. The maximum annual amount of materials allowed is 4,000 pounds of depleted uranium and 12,000 TNT-equivalent pounds of explosives across 20 tests. The typical single-test are estimated to be

200 pounds of depleted uranium and 600 pounds of TNT-equivalent explosives. Modeling results from the typical single test and potential health impacts analyses are discussed in Section 5.1.12.1.2.

The modeling results show that no publicly accessible area would receive a radiation dose greater than the NESHAPs effective dose equivalent limit of 10 millirem per year.

Radiotracer experiments. Radiotracer experiments conducted at the NNSS may include up to 3 underground and 12 open-air experiments a year. Up to 4 different experiments may be conducted at the NNSS, including the following scenarios:

- Explosive release of radioactive and stable gases: These releases would consist of up to 10^{15} becquerels each of radioactive noble gases (xenon-127, xenon-131m, xenon-133, krypton 85, and argon-37) and 10,000 liters of stable gases (helium-3, sulfur hexafluoride, and stable xenon). The gases would be buried underground with explosive materials. Once detonated, the gases would travel to the surface through various physical processes. Continuous monitoring and sampling of surrounding atmospheric and soil conditions would be conducted.

- Pressurized release of radioactive and stable gases: Using the same gases as the explosive experiment, this experiment would pump the gas along with large quantities of air into a pressurized underground cavity and release the gas through various physical processes. The same monitoring and sampling would be conducted as with the explosive experiment.

- Explosive release of radioactive particulates: Shallow explosions would release up to 10^{15} becquerels each of short-lived radioactive particulates (rubidium-86, zirconium-95, technetium-99m, molybdenum-99, rubidium-103, cesium-136, barium-140, cerium-141, neodymium-147, and samarium-153). Gamma-ray survey instruments would be used to measure radiation. Contamination from these experiments would be short-lived, as each particulate has a half-life of less than 1 year.

- Baseline survey of legacy contamination: No new materials would be released under this experiment. High- and medium-resolution gamma-ray spectra would be measured.

A discussion of the potential radiological dose associated with these tracer experiments can be found in Section 5.1.12.1.

The modeling results show that the no publicly accessible area would receive a cumulative (explosive testing and radiotracer experiments) radiation dose greater than the NESHAPs dose equivalent limit of 10 millirem per year. Also see Section 5.1.12.1 for a discussion of worker exposure levels.

5.1.8.2.3 Climate Change

See Chapter 4, Section 4.1.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to NNSS-related activities. Table 5–40 shows greenhouse gas emissions levels for NNSS-related activities under the Expanded Operations Alternative. The color coding in Table 5–40 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by NNSS (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–40 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–40 Expanded Operations Alternative Greenhouse Gas Emissions at the Nevada National Security Site in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATIONARY SOURCES		
Power generation	22,740	0.83
Natural gas heating	0	0
Other stationary sources, excluding air conditioning/refrigeration, natural gas heating, and sources related to the solar power generation facility	596	0.02
Stationary sources related to solar power generation facility operation	18	0.01
Sulfur hexafluoride from refrigeration/air conditioning	550	0.02
Hydrofluorocarbons from refrigeration/air conditioning	260	0.01
ALL STATIONARY SOURCES	*24,164*	*0.88*
MOBILE SOURCES		
Onsite government vehicles	6,540	0.24
Temporary construction vehicles not including solar facility vehicles (about 3 years' duration)	3	0.01
Commuting by regular NNSS employees	11,916	0.43
Temporary construction vehicles from solar facility vehicles only (about 3 years' duration)	19,438	0.71
Commuting by temporary solar power generation facility construction employees (about 3 years' duration)	1,717	0.06
Hazardous material and waste (nongovernment)	4,987	0.18
Commercial vendors	1,696	0.06
ALL MOBILE SOURCES, excluding temporary construction vehicles and employee commuting	*25,049*	*0.91*
ALL MOBILE SOURCES, including temporary construction vehicles and employee commuting	*50,156*	*1.83*
ALL SCOPE 1 SOURCES	*7,964*	*0.29*
ALL SCOPE 2 SOURCES	*22,740*	*0.83*
ALL SCOPE 3 SOURCES	*43,706*	*1.59*
TOTAL, excluding temporary construction employee commuting and construction vehicles	***49,303***	***1.79***
TOTAL, including temporary construction employee commuting and construction vehicles	***74,410***	***2.71***

NNSS = Nevada National Security Site.

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Overall, NNSS-related activities under the Expand Operations Alternative would create about 49,303 carbon-dioxide-equivalent tons of greenhouse gas emissions per year (74,410 when including temporary construction worker commuting and construction vehicles), about 79 percent over the threshold reporting level (171 percent when including temporary construction worker commuting and construction vehicles). This represents a net decrease over current greenhouse gas emissions (50,478 tons in 2008) of about 2 percent (1,175 carbon-dioxide-equivalent tons per year) over the 10-year horizon. Early in the period, it is possible that these greenhouse gas emissions may be slightly higher than current greenhouse gas emissions. Even with this relatively small change from current emission rates, these emissions would continue to contribute towards global climate change.

LLW and MLLW may be transported to the NNSS under the Expanded Operations using either a truck-only or mostly rail scenario. Under the truck-only scenario, about 36,234 carbon dioxide equivalent tons of greenhouse gas emissions would be created per year. For the mostly rail scenario, about 4,987 carbon dioxide equivalent tons of greenhouse gas emissions would be created per year. This lower rate of greenhouse gas emissions is due to the greater energy efficiency of using rail to transport the waste.

5.1.8.3 Reduced Operations Alternative

5.1.8.3.1 Air Quality

This section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside the NNSS under the Reduced Operations Alternative.

Calculations of emissions on and near the NNSS. Table 5–41 shows the midpoint (2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various NNSS activities under the Reduced Operations Alternative. Most emissions are associated with mobile source activity (e.g., vehicles and portable construction equipment). The stationary source emissions include emissions resulting from the operation of a 100-megawatt commercial solar power generation facility that may be constructed under the Reduced Operations Alternative. Table 5–41 does not show construction-related emissions because these would be temporary. The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The NNSS contribution to the emissions in Clark County would continue to be small and would decrease relative to 2008 emission levels (see Chapter 4, Table 4–37), except for VOCs, which would increase by 0.2 tons per year by 2015 due the widespread use of ethanol blends in southern Nevada. Only a small fraction of the sulfur dioxide and PM_{10} emissions are from mobile sources so these air pollutants show a small overall increase relative to 2008 of 0.02 and 1.1 tons per year, respectively. This is due to the possible increase in activity at the NNSS under the Reduced Operations Alternative relative to low activity levels in 2008. These small increases would not be expected to lead to any violations of the air quality standards in Nye County. Nitrogen oxide, carbon monoxide, and PM_{10} emissions would all decrease in Clark County relative to 2008 emission levels by 14.1, 38.5, and 0.28 tons per year, respectively. The small increase in VOC emissions is from mobile sources and would be widely distributed over the Las Vegas Valley. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone, or PM_{10} air quality standards. Appendix D, Section D.2.1.3.1, provides more detail regarding how these emissions were determined, as well as source-type and vehicle-type characterization data for mobile sources.

Under the Reduced Operations Alternative, LLW and MMLW would be transported to the NNSS using either a truck-only or mostly rail scenario. **Table 5–42** shows the average annual air emissions for the criteria and hazardous air pollutants under these two scenarios. For all pollutants, the mostly rail scenario has much lower emissions than the truck-only scenario. This is due to the greater energy efficiency of using rail to transport the waste. Further details on the transport scenario can be found in Section 5.1.3.1.2. The majority of these emissions would occur outside of Nevada and would be widely distributed over various routes from the nine origin locations.

Table 5–41 Reduced Operations Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Nevada National Security Site in 2015

	Annual Air Emissions (tons per year)														
	Stationary Sources	*Government-Owned Vehicles*	*NNSS Commuters*			*Commercial Vendors*			*Radiological Waste Trucks*			*Total*			
	Nye County	*Nye County*		*Nye County*			*Nye County*			*Nye County*			*Nye County*		
Pollutant	*On-NNSS*	*On-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Total*
PM_{10}	1.8	0.77	0.64	0.036	0.19	0.086	0.038	0.011	0.19	0.03	0.54	*0.92*	*2.7*	*0.74*	*4.4*
$PM_{2.5}$	0.70	0.61	0.35	0.024	0.11	0.07	0.032	0.0089	0.17	0.026	0.48	*0.59*	*1.4*	*0.6*	*2.6*
CO	1.6	26.3	59.3	3	16.8	0.32	0.15	0.044	0.54	0.088	1.6	*60.2*	*31.2*	*18.4*	*109.8*
NO_x	3.6	6.7	11.1	0.62	3.1	0.86	0.38	0.11	2.4	0.39	7	*14.4*	*11.7*	*10.2*	*36.3*
SO_2	0.10	0.071	0.16	0.0098	0.04	0.002	0.00085	0.00024	0.0054	0.00088	0.016	*0.17*	*0.18*	*0.056*	*0.41*
VOCs	1.1	0.45	1.6	0.57	0.47	0.089	0.044	0.013	0.11	0.017	0.3	*1.8*	*2.2*	*0.78*	*4.8*
Lead	0.0023	0.000028	0.000047	0.000003	0.000013	0.0000037	0.0000018	0.0000005	0.0000034	0.00000061	0.000011	*0.000054*	*0.0023*	*0.000025*	*0.0024*
Criteria Pollutant Total	*8.9*	*34.9*	*73.2*	*4.3*	*20.7*	*1.4*	*0.6*	*0.2*	*3.4*	*0.6*	*9.9*	*78.0*	*49.3*	*30.8*	*158.1*
HAPs	0.090	0.036	0.13	0.0058	0.038	0.013	0.0057	0.0016	0.014	0.0023	0.04	*0.16*	*0.10*	*0.08*	*0.4*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 5–42 Reduced Operations Alternative Annual Average Emissions of Criteria Pollutants and Hazardous Air Pollutants from the Transport of Low-Level and Mixed Low-Level Radioactive Waste to the Nevada National Security Site

	Annual Air Emissions (tons per year)	
Pollutant	***Low-Level and Mixed Low-Level Radioactive Waste Shipped via Mostly Rail***	***Low-Level and Mixed Low-Level Radioactive Waste Shipped via Truck Only***
PM_{10}	4.5	21.5
$PM_{2.5}$	4.1	19.5
CO	14.1	66.4
NO_x	63.8	300.6
SO_2	0.1	0.7
VOCs	2.7	12.5
Lead	0.0001	0.000
Criteria Pollutant Total	*89.3*	*421.2*
HAPs	0.4	1.7

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Construction Activities Emissions. Short-term emissions are expected during the construction of a 100-megawatt commercial solar power generation facility in Area 25 of the NNSS. **Table 5–43** summarizes the emissions from the construction activities and from the construction workers commuting to and from the NNSS. These emissions are for the first year of construction and represent the highest emission rates as construction activity is linear over the multi-year period of construction and mobile source emission factors are highest in the first year. The construction emissions in Table 5–43 include steps to control fugitive dust emissions using best practices along with compliance with the requirements for controlling fugitive dust in accordance with the State surface disturbance permit. These construction emissions are for the first year of construction and represent the highest emission rates as the activity is linear over the multi-year period and mobile source emission factors are highest in the first year. Additional details are presented in Appendix D, Section D.2.1.3.1. These results are shown separately from those in Table 5–41 because they would last only a few years and are thus considered temporary.

Table 5–43 Reduced Operations Alternative Construction Emissions of Criteria Pollutants and Hazardous Air Pollutants

	Peak Year Air Emissions from Construction Activities (tons per year)				
	Construction	*Commuting by Construction Workers*			
	Nye County		*Nye County*		
Pollutant	*On-NNSS*	*Clark County*	*On-NNSS*	*Off-NNSS*	*Total*
PM_{10}	8.3	0.088	0.0078	0.018	*8.4*
$PM_{2.5}$	2.5	0.051	0.0054	0.011	*2.6*
CO	12.5	9.0	0.77	2.1	*24.4*
NO_x	21.9	1.9	0.18	0.44	*24.4*
SO_2	0.050	0.022	0.0021	0.0042	*0.08*
VOC	2.4	0.32	0.023	0.070	*2.8*
Lead	Not applicable	0.0000054	0.00000062	0.0000011	*0.0000071*
HAPs	Not applicable	0.023	0.0018	0.0055	*0.03*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

5.1.8.3.2 Radiological Air Quality

No activities under the Reduced Operations Alternative are expected to produce aboveground radiation via the air pathway beyond that documented for 2008 baseline conditions in Chapter 4, Section 4.1.8.3.

5.1.8.3.3 Climate Change

See Chapter 4, Section 4.1.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to NNSS-related activities. Table 5–44 shows greenhouse gas emissions levels for NNSS-related activities under the Reduced Operations Alternative. The color coding in Table 5–44 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by NNSS (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–44 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–44 Reduced Operations Alternative Greenhouse Gas Emissions at the Nevada National Security Site in 2015

Source Type	***Carbon-Dioxide-Equivalent Emissions (tons per year)***	***Fraction of Reference Point of 27,558 Tons Per Year***
STATIONARY SOURCES		
Power generation	19,106	0.69
Natural gas heating	0	0
Other stationary sources, excluding air conditioning/refrigeration, natural gas heating, and sources related to the solar power generation facility	501	0.02
Stationary sources related to solar power generation facility operation	4	0.01
Sulfur hexafluoride from refrigeration/air conditioning	462	0.02
Hydrofluorocarbons from refrigeration/air conditioning	218	0.01
ALL STATIONARY SOURCES	*20,291*	*0.74*
MOBILE SOURCES		
Onsite government vehicles	4,681	0.17
Temporary construction vehicles on-site related to the solar power generation facility (about 3 years' duration)	1,934	0.07
Commuting by regular NNSS employees	8,483	0.31
Commuting by temporary solar power generation facility construction employees (about 3 years' duration)	840	0.03
Hazardous material and waste transport (nongovernment)	2,840	0.10
Commercial vendors	1,750	0.06
ALL MOBILE SOURCES, excluding temporary construction vehicles and construction employee commuting	*17,754*	*0.65*
ALL MOBILE SOURCES, including temporary construction vehicles and construction employee commuting	*20,528*	*0.75*
ALL SCOPE 1 SOURCES	*5,866*	*0.21*
ALL SCOPE 2 SOURCES	*19,106*	*0.69*
ALL SCOPE 3 SOURCES	*15,847*	*0.58*
TOTAL, excluding temporary temporary construction employee commuting and construction vehicles	***38,045***	***1.38***
TOTAL, including temporary temporary construction employee commuting and construction vehicles	***40,819***	***1.48***

NNSS = Nevada National Security Site.

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Overall, NNSS-related activities under the Reduced Operations Alternative would create about 38,045 carbon-dioxide-equivalent tons of greenhouse gas emissions per year (40,819 when including temporary construction worker commuting and construction vehicles), about 38 percent over the threshold reporting level (48 percent when including temporary construction worker commuting and construction vehicles). This represents a net reduction over current greenhouse gas emissions (50,478 tons in 2008) of about 25 percent, but these emissions would continue to contribute towards global climate change.

LLW and MLLW may be transported to the NNSS under the Reduced Operations using either a truck-only or mostly rail scenario. Under the truck-only scenario, about 8,078 carbon dioxide equivalent tons of greenhouse gas emissions would be created per year. For the mostly rail scenario, about 1,753 carbon dioxide equivalent tons of greenhouse gas emissions would be created per year. This lower rate of greenhouse gas emissions is due to the greater energy efficiency of using rail to transport the waste.

Air Quality and Climate—American Indian Perspective

Indian people know air can be destroyed, causing pockets of dead air. There is only so much alive air that surrounds the world. If you kill the living air, it is gone forever and cannot be restored.

Dead air lacks the spirituality and life necessary to support other life forms. Airplanes crash when they hit dead air. During a previous Consolidated Group of Tribes and Organizations (CGTO) evaluation of the area, one member of the CGTO compared this Indian view of killing air with what happens when a jet flies through the air and consumes all of the oxygen, producing a condition where another jet cannot fly through it.

As one tribal elder noted, *"The spiritual journey of the Southern Paiute Salt Songs are affected as the air quality is not the same as in the days of old. This Salt Singer wonders what is going to happen if the situation isn't corrected. Southern Paiutes need this spiritual journey to ascend their deceased to the next life."*

As people are emitting things into the air that are unnatural, such as radiation from atomic blasts or dust and debris from decontaminating and decommissioning old Nevada National Security Site (NNSS) buildings, climatic changes such as droughts are occurring because the air is being disrespected. As the air continues to be disrespected, it perpetuates and intensifies imbalance throughout the environment. This impacts many resources, including the land, soil, water, plants, and animals.

Dust devils in various forms and sizes are culturally significant to Indian people and known to bring harm. The CGTO knows the frequency and intensity of dust devils have increased within the NNSS and the surrounding area. Dust devils contain negative energy, and can disperse hazardous and radioactive contaminants from the soil at the NNSS. Their spirits can bring harm if the air is disrespected and if you watch it or allow them to come near or pass through you. If this occurs, a person will become ill and must seek cultural intervention to heal.

Some Indian people who were present during aboveground nuclear tests at the Nevada Test Site (now NNSS) believe that the sickness they have came from the radiation. To some of these people, the effects of the radiation were in addition to what happened when the air itself was killed. Some tribal elders believe that even when the plants survived the effects of radiation, the dead air killed many of them or made some lose their spiritual power to heal things.

As noted by tribal elders, *"Sheep and other animals are being born out of season, which places them at greater risk from predators and from living full lives. Consequently, their loss adversely impacts our cultural survival, as many of our stories and traditions surround these animals. Weather is out of balance. For example, when it snows, one can also hear thunder. Native people observe the changed nature of the vegetation and blame the atmospheric change on the air quality from the bomb testing on the NNSS."*

The CGTO recognizes that climatic change is occurring and will continue to impact the natural resources of the NNSS and the surrounding region. When rain gauge data are averaged over a decade they can mask the reality that plants and animals are adjusted to regular cycles of rain and snow. Isolated heavy rain events can increase the annual rainfall amounts, but are largely not useful for sustaining life. Plants and animals need the climate to return to its historic, normal annual rainfall that is more evenly dispersed by season.

The CGTO knows that ceremonies have historically helped manage the climate in the NNSS region. Unfortunately, we have not been able to perform these ceremonies since the NNSS area was used for nuclear testing and our Holy Land continues to suffer. To facilitate the healing of this area, DOE must make provisions for the CGTO to access the land and perform these rituals, which are further described below.

See Appendix C for more details.

5.1.9 Visual Resources

This section describes the potential environmental impacts on visual resources under the No Action, Expanded Operations, and Reduced Operations Alternatives. As described in Chapter 4, the threshold for determining impacts are effects on the view from public vantage points, namely local roadways in the project vicinity, factored with viewer sensitivity (see Chapter 4, Figure 4–22). Therefore, only actions that would be visible to the public are discussed. For example, Environmental Restoration Program activities and operations would continue at the NNSS under all alternatives. Restoration efforts would demolish existing structures, restore the landscape to a natural-looking appearance, and improve existing visual resources associated with environmental restoration sites, which would have a beneficial effect. However, all of these activities and operations would occur out of the public viewshed; therefore, they are not discussed below.

Visual Resources—American Indian Perspective

Central to the Indian experience of viewscapes is isolation and serenity in an uncompromised landscape. If construction and operation of the proposed activities proceed in a culturally-inappropriate manner, then visual resources within the Nevada National Security Site (NNSS) area will be adversely impacted, further perpetuating an unbalanced environment. To restore balance to the environment and it's visual resources, the U.S. Department of Energy (DOE) must provide access for Indian people to conduct religious and cultural ceremonies to fulfill traditional obligations. In this manner, we can restore and preserve our spiritual harmony as a whole.

The Consolidated Group of Tribes and Organizations (CGTO) knows many of the activities described in this site-wide environmental impact statement (SWEIS), such as those associated with facility construction and environmental restoration, will adversely impact visual resources. For Indian people, the adverse impact to visual resources will most certainly impact the spiritual harmony of the environment as a whole. Facility construction and operation will impede visual resources, and affect the solitude and cultural integrity of the land.

In particular, visual resources may be negatively impacted if proposed solar enterprise zones and geothermal projects are pursued. The CGTO must be part of any additional, future discussions of these projects at a minimum as these may impact visual resources and may degrade traditional and cultural ceremonies.

See Appendix C for more details.

An action may have an adverse effect if it alters or degrades the existing visual character, introduces a new source of light or glare, negatively affects a scenic vista or view, or negatively affects a view along a designated scenic route. There are no scenic routes near the NNSS, RSL, NLVF, and TTR.

5.1.9.1 No Action Alternative

Under the No Action Alternative, current activities and operations would continue. There would be no visible changes to the public at RSL, NLVF, and the TTR. None of the current activities and operations would affect existing visual resources associated with the NNSS except construction of a solar power generation facility and the Concentrating Solar Power Validation Project in Area 25. While viewer sensitivity would change from moderate to high (3,000 or more average annual daily traffic) near Mercury (4,980 average daily trips), views from U.S. Route 95 near Mercury would not be affected because ongoing current activities and operations would not affect existing visual resources. Portions of the study area visible from U.S. Route 95 and Amargosa Valley have a Class B scenic quality rating, as established in the *1996 NTS EIS* (DOE 1996c). As described in Chapter 4, Section 4.1.9, "Visual Resources," a Class B visual quality means that "the visual environment is made up of a combination of outstanding natural and manmade physical features and those that are common to the region."

Under this alternative, as represented by projected traffic volumes for the year 2020 (see Section 5.1.3, "Transportation and Traffic"), viewer sensitivity would remain moderate (1,000 to 2,999 average annual daily traffic) near the Area 25 Renewable Energy Zone (approximately 3,000 average daily trips). While some of this increase in traffic is associated with NNSS activities under this alternative, approximately 2,960 of the projected 3,000 average daily trips near the Renewable Energy Zone would occur without traffic related to NNSS activities and operations, and roadway viewers near Area 25 comprise mostly traffic unrelated to the NNSS.

The solar power generation facility would be composed of solar fields (making up 90 percent of the facility footprint), power blocks, an office and maintenance building, parking area, laydown area, switchyard, a stormwater detention basin(s), and an area designated for bioremediation of soil contaminated by heat transfer fluid, petroleum, or other process chemicals. Such a facility would introduce considerable infrastructure over approximately 2,400 acres of land for a 240-megawatt facility in the Area 25 Renewable Energy Zone that would be directly visible in middleground (0.5 to 4 miles) views from U.S. Route 95 and Amargosa Valley. Construction and operation of the commercial solar power generation facility would require a separate NEPA analysis (including a visual impacts analysis) if a specific design were proposed.

Construction of the solar power generation facility would create temporary changes in views of Area 25. Construction activities would require vegetation removal and grading, have the potential to create dust clouds, and introduce considerable heavy equipment and associated vehicles into middleground views from U.S. Route 95 and Amargosa Valley. Dust control would be implemented during construction. The location of construction staging areas and associated facilities would also be visible in the middleground. Because construction would likely not occur over an extended period of time, visual changes resulting from construction are considered short-term and temporary. Viewers would not be accustomed to seeing construction in Area 25 because construction operations are not common in this portion of the study area. While construction would be temporary, visual effects would be adverse because viewers are moderately sensitive and construction is not a common visual element.

Operation of any concentrated solar power generation facility of this size would introduce a considerable source of glare from the reflective surfaces of the solar collectors; use nighttime lighting for security; alter the existing visual character of the landscape, which is largely undeveloped; be visible to moderately sensitive viewers; and reduce the existing visual quality from a Class B to a Class C rating (meaning that "the visual environment is made up of natural and manmade physical features that are common to the region") because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array; therefore, this effect is considered adverse and unavoidable. Measure VIS-1, "Apply Minimum Lighting Standards," would reduce the potential for overlighting facilities, but the introduction of nighttime light where none presently exists would be adverse and unavoidable.

5.1.9.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be no visible changes to the public at RSL, NLVF, and the TTR. New facilities would be built or existing facilities would be reconfigured, an existing electrical transmission line would be upgraded, and geothermal and solar renewable energy projects could be implemented at the NNSS. Portions of the study area visible from U.S. Route 95 and Amargosa Valley have a Class B scenic quality rating, as established in the *1996 NTS EIS* (DOE 1996c). Under this alternative, as represented by projected traffic volumes for the year 2020 (see Section 5.1.3, "Transportation and Traffic"), viewer sensitivity would change from moderate to high near Mercury (5,310 average daily trips) and near the Area 25 Renewable Energy Zone (3,030 average daily trips). However, while some of the increase near the Area 25 Renewable Energy Zone is associated with NNSS activities under this alternative, approximately 2,960 of the projected 3,030 average daily trips would occur without traffic related to the Expanded Operations Alternative. In addition, roadway viewers near Area 25 are composed mostly of traffic unrelated to the NNSS.

A new two-story, 85,000-square-foot security facility would be constructed in Area 23, replacing existing, outdated buildings, and would be visible in the background (4+ miles) from U.S. Route 95 near Mercury. Construction activities would not be very visible given the distance and presence of other structures that would screen most construction activities. Once built, this new security building would blend with existing buildings at this location and retain the existing visual character. There would be no adverse effects.

Approximately 200,000 square feet of additional facilities would be added at Desert Rock Airport near Mercury. These changes would include lengthening the existing runway and construction of new hangars and support facilities. Construction of these facilities would require vegetation removal and grading, has the potential to create dust clouds, and would introduce considerable heavy equipment and associated vehicles into middleground views from U.S. Route 95. Dust control would be implemented during construction. The location of construction staging areas and associated facilities would also be visible in the middleground. Because construction would not likely occur over an extended period of time, visual changes resulting from construction are considered short-term and temporary. Viewers would not be accustomed to seeing construction at this location because construction operations are not common in this portion of the study area. While construction would be temporary, visual effects would be adverse because viewers are highly sensitive and construction is not a common visual element. Once in operation, these features would be visible in the middleground of views from U.S. Route 95, be visible to highly sensitive viewers, introduce nighttime lighting for security, have an adverse affect on visual resources because of the intrusion of manmade elements, and reduce the existing visual quality from a Class B to a Class C rating. This could introduce an adverse effect based on the presence of sensitive receptors and the distance from receptors. Measure VIS-1, "Apply Minimum Lighting Standards," would reduce the potential for overlighting facilities, but the introduction of nighttime light where none presently exists would be adverse and unavoidable. The scale and coloring of facilities would play a large part in the visual prominence of the new facilities. Measure VIS-2, "Reduce Visibility of New Structures," would help to reduce the visual appearance of such facilities from U.S. Route 95 by painting buildings and structures or by using materials to ensure that they recede into the surrounding environment, but the effects would be adverse and unavoidable.

The existing 138-kilovolt electrical transmission line and poles would be upgraded between Mercury and Valley Substation in Area 2, paralleling the existing wooden-poled transmission line with a single steel pole structure. The upgraded transmission line would occur within the background of views from U.S. Route 95. Although a different material is being used, a visual change would not be substantial because a single pole structure similar to the existing structure would be used, and distance would make these changes imperceptible from U.S Route 95. The existing line and poles would be removed and the new line would not alter the existing visual character. Effects would not be adverse.

The existing Mercury would be reconfigured under the Expanded Operations Alternative. Demolition of specific facilities and construction of new facilities would not greatly alter the existing visual character or degrade the existing visual quality because new buildings would blend with the existing buildings at this location and would not create a new, substantial source of nighttime lighting. This would retain the existing visual character. In addition, modifications would be indiscernible due to the distance from U.S. Route 95, which is over 4 miles from the roadway. Effects would not be adverse.

Under the Expanded Operations Alternative, a small 5-megawatt photovoltaic solar power generation facility would be built on 50 acres of land in Area 6 that would not be visible from public vantage points. Construction and operation of one or more commercial solar power generation facilities in Area 25 would have adverse visual effects because the facility would introduce considerable infrastructure over approximately 10,000 acres of land for facilities with a combined 1,000-megawatt capacity, a large portion of which would be directly visible in middleground views from U.S. Route 95 (see Chapter 3,

Figure 3–2). Portions of the study area visible from U.S. Route 95 and Amargosa Valley have a Class B scenic quality rating, and viewer sensitivity is high. Construction and operation of the commercial solar power generation facility and solar demonstration would require a separate NEPA analysis (including a visual impacts analysis) if a specific design were proposed.

Construction of the solar power generation facility(ies) would create temporary changes in views of Area 25. Construction activities would require vegetation removal and grading, have the potential to create dust clouds, and introduce considerable heavy equipment and associated vehicles into middleground views from U.S. Route 95 and Amargosa Valley. Dust control would be implemented during construction. The location of construction staging areas and associated facilities would also be visible in the middleground. Because construction would not likely occur over an extended period of time, visual changes resulting from construction are considered short-term and temporary. Viewers would not be accustomed to seeing construction in Area 25 because construction operations are not common in this portion of the study area. While construction would be temporary, visual effects would be adverse because viewers are highly sensitive and construction is not a common visual element.

Operation of the concentrated solar power generation facility(ies) would introduce a considerable source of glare from the reflective surfaces of the solar collectors; use nighttime lighting for security; alter the existing visual character of the landscape, which is largely undeveloped; and reduce the existing visual quality from a Class B to a Class C rating because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array; therefore, this effect is considered adverse and unavoidable. No mitigation is proposed.

A Geothermal Demonstration Project would introduce facilities associated with capturing, converting, and transferring geothermal power such as a power plant, transmission lines, and associated infrastructure that would occur over 30 to 50 acres of land. If facilities are built along U.S. Route 95, they would be visible in the foreground or middleground from U.S. Route 95 and Amargosa Valley and have the potential to introduce built features and nighttime lighting in a landscape where none presently exist, altering the existing visual character and reducing visual quality. This could introduce an adverse effect based on presence of sensitive receptors and distance from receptors. Measure VIS-1, "Apply Minimum Lighting Standards," would reduce the potential for overlighting facilities but the introduction of nighttime light where none presently exists would be adverse and unavoidable. Measure VIS-2, "Reduce Visibility of New Structures," would help to reduce the visual appearance of such facilities from U.S. Route 95 by painting buildings and structures or by using materials to ensure that they recede into the surrounding environment, but affects would be adverse and unavoidable.

5.1.9.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be no changes visible to the public at RSL, NLVF, and the TTR. While viewer sensitivity would change from moderate to high near Mercury (4,880 average daily trips), there would be no change to existing buildings visible at the NNSS or to the existing visual environment from activities and operations. Under this alternative, as represented by projected traffic volumes for the year 2020 (see Section 5.1.3, "Transportation and Traffic"), viewer sensitivity would remain moderate near the Area 25 Renewable Energy Zone (2,980 average daily trips). Approximately 2,960 of the projected 2,980 average daily trips would occur without traffic related to the Reduced Operations Alternative, and roadway viewers near Area 25 are mostly composed of traffic unrelated to the NNSS. Under the Reduced Operations Alternative, construction of a commercial solar power generation facility in Area 25 may occur and have adverse visual effects because the facility would introduce considerable infrastructure over approximately 1,200 acres of land for a 100-megawatt facility, a large portion of which would be directly visible in middleground views from U.S. Route 95 (see Chapter 3, Figure 3–3). Portions of the study area visible from U.S. Route 95 have a Class B scenic quality rating and viewer sensitivity is moderate. Construction of the commercial solar power generation facility and solar demonstration would require a separate NEPA analysis (including a visual impacts analysis) if a specific design were proposed.

Operation of any concentrated solar power generation facility of this size would introduce a considerable source of glare from the reflective surfaces of the solar collectors; use of nighttime lighting for security; alter the existing visual character of the landscape, which is largely undeveloped; and reduce the existing visual quality from a Class B to a Class C rating because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array; therefore, this effect is considered adverse and unavoidable. Measure VIS-1, "Apply Minimum Lighting Standards," would reduce the potential for overlighting facilities, but the introduction of nighttime light where none presently exists would be adverse and unavoidable.

5.1.10 Cultural Resources

Cultural resources include prehistoric and historic archaeological districts, sites, buildings, structures, or objects created or modified by human activity. Cultural resources also include traditional cultural properties—properties that are eligible for inclusion in the National Register of Historic Places (NRHP) because of their association with cultural practices or beliefs of a living community that are (a) rooted in that community's history and (b) important in maintaining the continuing cultural identity of the community (Parker and King 1998). Under Federal regulations, a significant cultural resource, designated a "historic property," warrants consideration with regard to potential adverse impacts resulting from proposed Federal actions (DOE 2002e). A cultural resource is a historic property if its attributes make it eligible for listing in the NRHP. Federal agencies also are required to consider the effects of their actions on sites, locations, and other resources that are of cultural or religious significance to American Indians, as established under the 1978 American Indian Religious Freedom Act. American Indian graves, associated funerary objects, and objects of cultural patrimony are protected by the 1990 Native American Graves Protection and Repatriation Act (Public Law [P.L.] 101-601).

The ROI for cultural resources is the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. Based on current knowledge of cultural resources in the region, all undisturbed areas could potentially contain cultural resources.

Cultural resources impacts in this SWEIS are assessed based on the estimated number of sites that may be affected by land-disturbing activities associated with ongoing and proposed projects at the NNSS, TTR, and environmental restoration sites on the Nevada Test and Training Range. Estimates are based on the site densities of known cultural resources in each hydrographic basin; these density values were extrapolated to estimate the number of sites that may exist in each hydrographic basin where program facilities and activities may be located. Those impacts would affect cultural resource sites in general (both prehistoric and historic) and sites that would be considered eligible for inclusion on the NRHP. An area's potential for containing cultural resource sites is strongly site-specific and is influenced by factors such as presence of water, a food source, shelter (i.e., caves or rock alcoves), a source of materials for building shelters, and less tangible but equally important factors such as features that may have spiritual value to a culture. While all areas of the NNSS have the potential to possess cultural resources, areas with the highest number of recorded cultural resources are Rainier and Pahute Mesas in the northwest (largely within the Fortymile Canyon-Buckboard Mesa Hydrographic Basin), followed by Jackass Flats in the southwest (within the Fortymile Canyon–Jackass Flats Hydrographic Basin), and Yucca Flat in the east (within the Yucca Flat Hydrographic Basin) (DOE 2010a). In general, any new development on the NNSS would be located near or in similar terrain as existing facilities for which cultural resources surveys have been conducted. Although it is not possible to predict with a high degree of certainty the potential for a particular area to contain cultural resources, the record provided by cultural resources surveys conducted at the NNSS provides a means to estimate site densities and, therefore, the likelihood of encountering a cultural resource site within a given hydrographic basin. By multiplying the acres that would be disturbed within a particular hydrographic basin by the calculated site density for that basin, the number of sites that may be affected was estimated for this SWEIS. There are a number of uncertainties associated with this approach; however, it is adequate for the purpose of estimating potential cultural resources impacts at the NNSS of ongoing and proposed activities addressed in this SWEIS. **Table 5–45** provides the site densities (in number of sites per acre) for each hydrographic basin on the NNSS that were used in this analysis.

Cultural resources impacts would potentially occur as a result of activities that involve modification of buildings and ground disturbance in previously undisturbed locations. These impacts would occur through drilling; grading; excavation; fencing; training and exercises in remote areas; cleanup activities; construction of buildings, roads, firebreaks, and utilities; and building modification, decontamination, or demolition. Vehicular and pedestrian access to areas containing cultural resources would increase the potential for vandalism or unauthorized artifact collection to occur that could affect archaeological sites and archaeologically sensitive areas.

Although increased access to areas containing cultural resources could raise the potential for vandalism or unauthorized artifact collection, these are impacts that cannot be reasonably estimated; however, by not disclosing cultural resource sites locations and administrative controls, NNSA/NSO would reduce these kinds of impacts to the maximum extent possible.

The precise number of cultural resources affected by NNSA/NSO activities will be unknown until cultural resource studies are completed prior to program activities described under the three alternatives. Cultural resource surveys and Section 106 consultations would be completed prior to ground-disturbing activities in previously unsurveyed areas and impacts on sites eligible for listing in the NRHP would be avoided or mitigated through measures described in Chapter 7. Historic NNSS buildings and structures designated for modification, decommissioning, or demolition would be evaluated for historical significance, and those buildings and structures eligible for listing in the NRHP would be mitigated through measures described in Chapter 7.

The estimated cultural resources impacts do not take into account that, for many project sites, impacts would be avoided completely by identifying their locations during Section 106 surveys and relocating or redesigning project features. In addition, this analysis does not take into account mitigation measures that may reduce potential impacts on significant cultural resources to a "no adverse effect" level.

In addition to impacts from DOE/NNSA activities, the development of commercial solar power generation facilities within the Fortymile Canyon, Jackass Flats Hydrologic Basin under each of the alternatives and a geothermal demonstration project under the Expanded Operations Alternative would affect additional cultural resources. There is no specific schedule for constructing either a solar power generation facility or a geothermal demonstration project at the NNSS. Under the No Action Alternative, up to 2,650 acres of previously undisturbed land in the Fortymile Canyon, Jackass Flats Hydrologic Basin would be disturbed for solar power generation facilities, affecting an estimated 3,511 cultural resources sites, 1,089 of them eligible for inclusion on the NRHP. Under the Expanded Operations Alternative, up to 10,300 acres of previously undisturbed land would be disturbed for solar power generation facilities, affecting an estimated 13,647 cultural resources sites, 4,233 of them eligible for inclusion on the NRHP. A geothermal demonstration project would disturb up to 50 acres of land and result in impacts on an estimated 2 cultural resource sites, of which 1 would be NRHP-eligible. Under the Reduced Operations Alternative, up to 1,200 acres would be disturbed for solar power generation facilities, affecting an estimated 1,590 cultural resources sites, 493 of which would be eligible for inclusion on the NRHP. This SWEIS addresses the potential impacts of such a project to enable DOE/NNSA to make a decision about whether to make land and infrastructure currently under DOE/NNSA control available for use by a commercial entity.

Table 5–45 Approximate Nevada National Security Site Cultural Resource Site Densities by Hydrographic Basin

Hydrographic Basin	*Acres Surveyed*	*Number of Prehistoric Sites* [a]	*Prehistoric Sites per Acre*	*Number Historic Sites* [a]	*Historic Sites per Acre*	*Untyped Sites* [a]	*Untyped Sites per Acre*	*Total Sites* [a]	*Total Sites per Acre*	*NRHP-Eligible Sites* [a]	*NRHP Sites per Acre*
Mercury Valley	338	3	0.009	3	0.009	0	0.0	6	0.018	2	0.006
Rock Valley	445	18	0.040	1	0.002	0	0.0	19	0.043	4	0.009
Fortymile Canyon–Jackass Flats	575	367	0.640	16	0.055	9	0.031	392	0.680	120	0.210
Fortymile Canyon-Buckboard Mesa	6,138	445	0.073	3	0.001	54	0.009	502	0.082	346	0.056
Oasis Valley	3,477	125	0.036	1	0.03	2	0.001	128	0.037	49	0.014
Gold Flat	6,371	264	0.041	3	0.001	1	0.0001	268	0.042	169	0.027
Kawich Valley	2,635	72		2		8		82		58	
Emigrant Valley/ Groom Lake Valley	60	5	0.083	0	0.0	0	0.0	5	0.083	0	0.0
Yucca Flat	9,030	309	0.034	69	0.008	17	0.002	395	0.044	176	0.020
Frenchman Flat	9,047	109	0.012	45	0.005	0	0.0	154	0.017	58	0.006
Totals	**38,116**	**1,717**	**0.045**	**143**	**0.004**	**91**	**0.002**	**1,951**	**0.051**	**982**	**0.026**

NRHP = National Register of Historic Places.
[a] Source: Chapter 4, Table 4–44.

The following discussion of potential cultural resources impacts resulting from DOE/NNSA activities under each of the three alternatives addressed in this SWEIS evaluates the impacts by mission and program under each of the three alternatives. Most of the above discussion applies to sections of this SWEIS that address cultural resources impacts at RSL, NLVF, the TTR, and environmental restoration sites on the Nevada Test and Training Range.

5.1.10.1 No Action Alternative

Table 5–46 displays the estimated number of cultural resource sites that would be potentially affected by DOE/NNSA activities at the NNSS and environmental restoration sites on the Nevada Test and Training Range under the No Action Alternative. Overall, under the No Action Alternative, 4,460 acres of land would be disturbed, with impacts on an estimated 1,855 cultural resource sites, 575 of which would be eligible for inclusion on the NRHP. This overall total includes both DOE/NNSA activities and a potential 240-megawatt commercial solar power generation facility and associated transmission lines discussed below in Section 5.1.10.1.3. DOE/NNSA activities would disturb up to 1,810 acres of land and affect an estimated 53 cultural resources sites. About 18 affected cultural resource sites would be eligible for inclusion on the NRHP. Mission- and program-level impacts on cultural resources under the No Action Alternative are addressed in the following discussion.

5.1.10.1.1 National Security/Defense Mission

National Security/Defense Mission activities occur at a variety of locations on the NNSS, but primarily in the Yucca Flat and Frenchman Flat Hydrologic Basins and, to a lesser extent, in the Fortymile Canyon–Jackass Flats Basin. Under the No Action Alternative, National Security/Defense Mission activities at the NNSS would disturb up to 700 acres of previously undisturbed land. This level of land disturbance would potentially affect an estimated 24 cultural resource sites, 10 of which may be eligible for inclusion on the NRHP.

Stockpile Stewardship and Management Program. Stockpile Stewardship and Management Program activities occur primarily at existing facilities within the Yucca Flat and Frenchman Flat Hydrographic Basins. Although most Stockpile Stewardship and Management Program activities are conducted at existing facilities, some activities have the potential to disturb previously undisturbed areas and affect cultural resources. These include high-explosives experiments at locations other than BEEF, drillback operations, and Office of Secure Transportation training and exercises. These potential Stockpile Stewardship and Management Program activities would disturb up to 685 acres of previously undisturbed land and affect an estimated 21 cultural resource sites. Of those potentially affected cultural resources sites, an estimated 9 would be eligible for inclusion on the NRHP.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. The NNSS would provide research, development, and training in support of the Arms Control, Nuclear Forensics, Nonproliferation, and Counterterrorism Programs. Most of these activities would occur at existing facilities. No new facilities would be constructed, but existing buildings would likely be modified. Structural modifications would have the potential to affect potentially historic buildings. Such impacts on historic buildings would be mitigated using the measures identified in Chapter 7.

Table 5–46 No Action Alternative – Estimated Number of Potentially Affected Cultural Resource Sites on the Nevada National Security Site and Nevada Test and Training Range (except Tonopah Test Range)

Program	*Area Disturbed (acres)* [a]	*Assumed Primary Locations of Activities by Hydrographic Basin*	*Number of Sites* [b]	*Number of NRHP-Eligible Sites* [b]
Stockpile Stewardship and Management	343 343	Frenchman Flat Yucca Flat	6 15	2 7
Nuclear Emergency Response, Nonproliferation, and Counterterrorism	5 5 5	Frenchman Flat Yucca Flat Fortymile Canyon–Jackass Flats	0 [c] 0 [c] 3	0 [c] 0 [c] 1
Work for Others	None	Frenchman Flat Yucca Flat Mercury Valley Fortymile Canyon–Jackass Flats	0	0
Total National Security/Defense Mission	700		24	10
Waste Management (Area 5 RWMC) [d]	190	Frenchman Flat	0	0
Environmental Restoration Soils Project [e]	320 100	Frenchman Flat Emigrant Valley	5 8	2 0 [c]
Environmental Restoration Underground Test Area	167 167 167	Frenchman Flat Yucca Flat Oasis Valley [f]	3 7 6	1 3 2
Total Environmental Management Mission	1,110		29	7
General Site Support and Infrastructure	None	Frenchman Flat Mercury Valley Yucca Flat	0	0
Renewable Energy (DOE/NNSA)	None	None	0	0
Total Nondefense Mission	None		0	0
Total DOE/NNSA	**1,810**		**53**	**18**
240-MW Commercial Solar Power Generation Facility	2,650	Fortymile Canyon–Jackass Flats	1,802	557
Total Non–DOE/NNSA	**2,650**		**1,802**	**557**
Total	**4,460**		**1,855**	**575**

NNSA = National Nuclear Security Administration; NRHP = National Register of Historic Places; RWMC= Radioactive Waste Management Complex MW = megawatts.

[a] Where a program could affect multiple hydrologic basins, if potentially disturbed area for the basin was known, it was used; if not, the total potentially disturbed acres for that program were equally apportioned among the affected basins. Area disturbed for each program may not add up to the total area disturbed for its applicable mission due to rounding.

[b] The number of sites was calculated by multiplying the number of acres potentially disturbed by the Total Sites Per Acre or NRHP Sites Per Acre columns, as appropriate, from Table 5–45. Where programs could occur in more than one hydrologic basin, the range of numbers of potentially affected cultural resource sites was used.

[c] Calculated value less than 0.5 sites per acre.

[d] The 740-acre Area 5 RWMC has been surveyed for cultural resources and no NRHP-eligible sites were found.

[e] The Small Boy and Project 57 sites are disturbed but considered by the NNSA Nevada Site Office to be historically significant sites.

[f] Site density for Underground Test Area projects on the Nevada Test and Training Range was assumed to be the same as the density for the Oasis Valley Hydrographic Basin because most of the groundwater characterization and monitoring wells that would be developed on USAF land would be adjacent to the northwestern portions of the NNSS.

Releases of chemicals and biological simulants could occur throughout the NNSS, but would most likely occur in areas within the Yucca Flat, Frenchman Flat, and Fortymile Canyon–Jackass Flats Hydrographic Basins. Although many of these activities would be conducted at existing facilities or disturbed areas, for purposes of this analysis, it was assumed that all would occur on previously undisturbed land. These release activities would potentially disturb up to 15 acres of previously undisturbed land and affect an estimated 3 cultural resource sites, of which 1 would be eligible for inclusion on the NRHP.

Work for Others Program. Under the No Action Alternative, Work for Others Program activities would not disturb previously undisturbed land areas.

5.1.10.1.2 Environmental Management Mission

Activities under the Environmental Management Mission would potentially disturb up to 1,110 acres of previously undisturbed land. However, for reasons discussed for the separate programs, the estimated number of potentially affected cultural resource sites would be 29, lower than expected, with 9 of those sites eligible for inclusion on the NRHP.

Waste Management Program. Under the No Action Alternative, waste management facilities would be operated in Areas 5, 6, 9, 11, and 23. The Area 5 RWMC would continue to operate within the 740-acre area set aside for waste management and would be the only waste management facility that would disturb previously undisturbed land at the NNSS. Up to 190 acres of land would be disturbed for disposal of LLW and MLLW. The entire 740-acre Area 5 RWMC has been surveyed for cultural resources and no significant cultural resources were found. Therefore, Waste Management Program activities under the No Action Alternative would not affect significant cultural resources.

Environmental Restoration Program. Drilling of groundwater characterization and monitoring wells would occur on the NNSS and Nevada Test and Training Range. Development of these wells has the potential to disturb up to 500 acres of previously undisturbed land and affect an estimated 16 cultural resource sites, of which 6 would be eligible for inclusion on the NRHP. Ground-disturbing soils remediation project activities would occur at the Small Boy site in the Frenchman Flat area and at the Project 57 site on the Nevada Test and Training Range. NNSA/NSO considers both of these sites eligible for inclusion on the NRHP, although the State Historic Preservation Office has not been formally consulted. When such consultation occurs, if the State Historic Preservation Office concurs with NNSA/NSO's determination, appropriate mitigation measures would be implemented, as discussed in Chapter 7. However, based on calculated site densities in the two affected basins (Frenchman Flat and Emigrant Valley) a total of 13 total resource sites may be impacted by Soils Projects activities; two of these sites may be eligible for inclusion on the NRHP. The Industrial Sites Project includes identifying and decontaminating and/or decommissioning facilities through clean closure or closure in place. Actions associated with the Industrial Sites Project have the potential to cause the alteration or neglect of a historic building, thereby affecting the character-defining features that make the building eligible for listing in the NRHP. Before performing any actions that would adversely affect these buildings, NNSA/NSO would conduct appropriate surveys and consultations pursuant to Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470 et seq.) and take mitigative actions, as discussed in Chapter 7.

5.1.10.1.3 Nondefense Mission

DOE/NNSA activities under the Nondefense Mission would not be expected to impact cultural resources; however, development of up to 24 megawatts of solar energy generation by commercial interests would impact cultural resources, as discussed below, under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. Under the No Action Alternative, small projects to maintain and repair NNSS facilities would occur at existing facilities in previously disturbed areas and would not affect archaeological resources. However, modification of potentially historic buildings would affect potentially historic structures that are not yet evaluated for eligibility for the NRHP.

Conservation and Renewable Energy Program. NNSA would undertake measures to increase energy efficiency, fuel efficiency, and water conservation. These actions would occur on existing facilities, some of which may be considered historic properties.

In addition to improving energy efficiency, fuel efficiency, and water conservation at existing facilities, under the No Action Alternative, NNSA would also consider allowing development of a commercial 240-megawatt solar power generation facility in Area 25 of the NNSS. Such a facility would also require an additional electrical transmission line to interconnect with the existing main transmission system to the south of the NNSS. A total of about 10 miles of new transmission line, disturbing about 250 acres of previously undisturbed land, all of which would be off the NNSS, was assumed in this analysis. The commercial solar power generation facility and associated transmission line would disturb a total of about 2,650 acres of land and affect an estimated 1,802 cultural resource sites, of which 557 would be considered eligible for inclusion on the NRHP.

Other Research and Development Programs. The Nevada National Environmental Research Park in Area 5 contains two existing facilities used to support outside scientific research on long-term environmental health. Future research programs could include activities, such as habitat reclamation and remediation, that have the potential to affect cultural resources because of ground disturbance and increased access to previously undisturbed land. There are no such projects proposed at this time; if there were, they would be evaluated on a case-by-case basis and all appropriate steps would be taken pursuant to Section 106 of the NHPA.

5.1.10.2 Expanded Operations Alternative

As shown in **Table 5–47**, under the Expanded Operations Alternative, DOE/NNSA activities at the NNSS and environmental restoration sites on the Nevada Test and Training Range would disturb up to 25,877 acres of previously undisturbed land, including about 10,300 acres for one or more commercial solar power generation facilities and associated transmission lines (discussed in Section 5.1.10.2.3), which would affect an estimated 7,688 cultural resource sites, 2,447 of which would be eligible for inclusion on the NRHP. DOE/NNSA activities would potentially affect 682 cultural resources sites, 283 of which would be eligible for inclusion on the NRHP. Mission- and program-level impacts on cultural resources are addressed in the following discussion.

Table 5–47 Expanded Operations Alternative – Estimated Numbers of Potentially Affected Cultural Resource Sites on the Nevada National Security Site and Nevada Test and Training Range (except Tonopah Test Range)

Program	***Area Disturbed (acres)*** [a]	***Assumed Primary Locations of Activities by Hydrographic Basin***	***Number of Sites*** [b]	***Number of NRHP-Eligible Sites*** [b]
Stockpile Stewardship and Management	1,403 11,403	Frenchman Flat Yucca Flat	24 501	8 228
Nuclear Emergency Response, Nonproliferation and Counterterrorism	100 100 15	Frenchman Flat Yucca Flat Fortymile Canyon–Jackass Flats	2 4 10	1 2 3
Work for Others	109 109 109 109	Frenchman Flat Yucca Flat Mercury Valley Fortymile Canyon-Jackass Flats	2 5 2 74	1 2 1 23
Total National Security/Defense Mission	13,455		624	265
Waste Management (Area 5 RWMC) [c]	600	Frenchman Flat	0	0
Waste Management Sanitary Landfill Facility (Area 23)	15	Mercury Valley	0 [d]	0 [d]
Waste Management Landfill Facility (Area 25)	20	Fortymile Canyon–Jackass Flats	14	4
Environmental Restoration Soils Project [e]	320 100	Frenchman Flat Emigrant Valley	5 8	2 0
Environmental Restoration Underground Test Area	167 167 167	Frenchman Flat Yucca Flat Oasis Valley	3 7 6	1 3 2
Total Environmental Management Mission	1,555		43	12
General Site Support and Infrastructure	156 156 156	Frenchman Flat Mercury Valley Yucca Flat	3 3 7	1 1 3
Renewable Energy (DOE/NNSA)	50	Yucca Flat	2	1
Total Nondefense Mission	517		15	6
Total DOE/NNSA	**15,527**		**682**	**283**
1000 Megawatts of Commercial Solar Power Generation Facilities	10,300	Fortymile Canyon–Jackass Flats	7,004	2,163
Geothermal Demonstration Project	50	Yucca Flat	2	1
Total Non-DOE/NNSA	**10,350**		**7,006**	**2,164**
Total	**25,877**		**7,688**	**2,447**

NNSA = National Nuclear Security Administration; NRHP = National Register of Historic Places; RWMC = Radioactive Waste Management Complex.

[a] Where a program could affect multiple hydrologic basins, if potentially disturbed area for the basin was known, it was used; if not, the total potentially disturbed acres for that program were equally apportioned among the affected basins. Area disturbed for each program may not add up to the total area disturbed for its applicable mission due to rounding.

[b] The number of sites was calculated by multiplying the number of acres potentially disturbed by the Total Sites Per Acre or NRHP Sites Per Acre columns, as appropriate, from Table 5–45. Where programs could occur in more than one hydrologic basin, the range of numbers of potentially affected cultural resource sites was used.

[c] The 740-acre Area 5 RWMC has been surveyed for cultural resources and no NRHP-eligible sites were found.

[d] The calculated value is less than 0.5 sites.

[e] The Small Boy and Project 57 sites are disturbed but considered by the NNSA Nevada Site Office to be historically significant sites.

[f] Site density for Underground Test Area projects on the Nevada Test and Training Range was assumed to be the same as the density for the Oasis Valley Hydrographic Basin because most of the groundwater characterization and monitoring wells that would be developed on U.S. Air Force land would be adjacent to the northwestern portions of the Nevada National Security Site.

5.1.10.2.1 National Security/Defense Mission

National Security/Defense Mission activities occur at a variety of locations on the NNSS, but primarily in the Yucca Flat and Frenchman Flat Hydrologic Basins and, to a lesser extent, in the Fortymile Canyon–Jackass Flats Basin. Under the Expanded Operations Alternative, National Security/Defense Mission activities at the NNSS would disturb up to 13,455 acres of previously undisturbed land. This land disturbance would potentially affect an estimated 624 cultural resource sites. Of those sites, 265 would be eligible for inclusion on the NRHP.

Stockpile Stewardship and Management Program. As under the No Action Alternative, Stockpile Stewardship and Management Program activities under the Expanded Operations Alternative would occur primarily at existing facilities within the Yucca Flat and Frenchman Flat Hydrographic Basins. Although most Stockpile Stewardship and Management Program activities would be conducted at existing facilities, some activities could potentially disturb previously undisturbed areas and affect cultural resources. These include high-explosives experiments at locations other than BEEF, drillback operations, and Office of Secure Transportation training and exercises along NNSS roads. By far, the largest single land-disturbing activity would be development of a new Office of Secure Transportation training facility in Area 17, which would disturb up to 10,000 acres. Overall, these potential Stockpile Stewardship and Management Program activities would disturb up to 12,805 acres of previously undisturbed land and affect an estimated 525 cultural resource sites (440 at the proposed training facility in Area 17), of which about 236 would be eligible for inclusion in the NRHP.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Proposed activities under the Expanded Operations Alternative would disturb 15 acres for conducting releases of chemicals and biological simulants, as well as 100 acres each for an Arms Control Treaty Verification Test Bed and a Mock Urban Complex. This disturbance of 215 acres of previously undisturbed land would affect an estimated 16 cultural resource sites, of which 6 would be eligible for inclusion on the NRHP.

Work for Others Program. Construction of various new test beds and additional aviation-related facilities at various locations on the NNSS, as well as establishment of an area to conduct radioactive tracer experiments, would disturb an estimated 435 acres of land. This disturbance would result in impacts on an estimated 83 cultural resource sites, of which 27 would be eligible for inclusion in the NRHP.

5.1.10.2.2 Environmental Management Mission

Activities under the Environmental Management Mission would potentially disturb up to 1,555 acres of previously undisturbed land. However, for reasons discussed for the separate programs, the number of potentially affected cultural resource sites are estimated to be 43, 12 of which would be eligible for inclusion on the NRHP.

Waste Management Program. Under the Expanded Operations Alternative, waste management facilities would be operated in Areas 5, 6, 9, 11, and 23. The Area 5 RWMC would continue to operate within the 740-acre area set aside for waste management and would use up to 600 acres of land for disposal of LLW and MLLW. The entire 740-acre Area 5 RWMC has been surveyed for cultural resources and no significant cultural resources were found. Sanitary waste disposal facilities would be developed in Areas 23 (15 acres) and 25 (20 acres). Development of these sanitary waste disposal sites would affect an estimated 14 cultural resource sites, 4 of which would be eligible for inclusion on the NRHP. All other operations would continue within their current capacities.

Environmental Restoration Program. Activities under the Environmental Restoration Program would be the same as those described under the No Action Alternative. Therefore, impacts on cultural resources would be the same as those described under the No Action Alternative.

5.1.10.2.3 Nondefense Mission

DOE/NNSA activities under the Nondefense Mission would potentially affect up to 15 cultural resources sites, 6 of which may be considered eligible for inclusion on the NHRP. Development of up to 1,000 megawatts of solar energy generation by commercial interests would impact cultural resources, as discussed below, under the Conservation and Renewable Energy Program.

General Site Support and Infrastructure Program. In addition to ongoing maintenance, repair, and replacement activities to support NNSS facilities, NNSA/NSO would modify facilities as needed to support NNSS programs. In addition, several infrastructure additions would be completed, including the construction of a new security building on previously disturbed land in Area 23 (2 acres), replacement of the existing 138-kilovolt electrical transmission system, expansion of the cellular telecommunication system, and reconfiguration of Mercury in Area 23. Cultural resources impacts include damage to cultural resources resulting from construction of facilities, access roads, transmission lines, and cell towers; increased off-road vehicular and pedestrian access; expansion of facilities; and modification, relocation, or demolition of historic buildings. Historic period buildings at Mercury that are proposed for modifications, rebuilding, or demolition would be evaluated for listing in the NRHP and eligible buildings would require mitigation. It is estimated that a total of 467 acres of previously undisturbed land would be affected by infrastructure projects under the Expanded Operations Alternative. This amount of land disturbance would affect an estimated 13 cultural resource sites, 5 of which would be NRHP-eligible. A proposed 5-megawatt photovoltaic solar power generation facility, while considered infrastructure, is addressed under the Conservation and Renewable Energy Program.

Conservation and Renewable Energy Program. NNSA/NSO would continue current energy efficiency measures, water conservation measures, fleet management improvements, and sustainable building practices. Cultural resources impacts from implementation of conservation measures would be the same as those described under the No Action Alternative.

NNSA would build a renewable energy facility consisting of a 5-megawatt photovoltaic solar power generation facility in Area 6 that would require about 50 acres of land. This would affect an estimated two cultural resource sites in the Yucca Flat Hydrographic Basin. One of those sites would be eligible for inclusion in the NRHP.

Under the Expanded Operations Alternative, NNSA would consider allowing one or more commercial solar power generation facilities with a combined capacity of up to 1,000 megawatts to be built in Area 25 in the Fortymile Canyon–Jackass Flats Hydrographic Basin. This development, including an estimated 10 miles of new transmission lines, would introduce considerable infrastructure over approximately 10,300 acres of land, affecting up to an estimated 7,004 cultural resource sites, up to 2,163 of which might be eligible for the NRHP. If NNSA were to allow it, construction of commercial solar power generation facilities would require separate NEPA analyses (including a cultural resources analyses). However, any solar power generation facility would require a considerable amount of clearing and grading that would directly and permanently impact all archaeological resources, built environment resources, and historic landscapes by damaging, displacing, or destroying artifacts, features, sites, and buildings in the project footprint. Proposed projects would be evaluated on a case-by-case basis and all appropriate steps would be taken pursuant to Section 106 of the NHPA.

NNSA would develop a Geothermal Demonstration Project on the NNSS under the Expanded Operations Alternative. This project would disturb an estimated 50 acres of previously undisturbed land impacting an estimated 2 cultural resource sites, 1 of which would be considered eligible for inclusion on the NRHP. Implementation of a Geothermal Demonstration Project would require a project-specific NEPA analysis and cultural resources analysis.

Other Research and Development Programs. Under the Expanded Operations Alternative, current programs would continue but DOE would actively promote and expand the National Environmental Research Park Program. Potential cultural resources impacts would be the same as those described under the No Action Alternative. No such projects are proposed at this time, but if there were, they would be evaluated on a case-by-case basis and all appropriate steps would be taken pursuant to Section 106 of the NHPA.

5.1.10.3 Reduced Operations Alternative

As shown in **Table 5–48**, under the Reduced Operations Alternative, DOE/NNSA activities at the NNSS and environmental restoration sites on the Nevada Test and Training Range would disturb up to 1,540 acres of previously undisturbed land, which would affect an estimated 45 cultural resources sites, 14 of which are eligible for listing on the NRHP. Overall, under the Reduced Operations Alternative, 2,170 acres of previously undisturbed land would be disturbed, including about 1,200 acres of disturbance for construction of a commercial solar power generation facility (discussed in Section 5.1.10.3.3). The total estimated number of cultural resource sites potentially affected is 861, 266 of which are eligible for inclusion on the NRHP. Mission- and program-level impacts on cultural resources are addressed in the following discussion.

5.1.10.3.1 National Security/Defense Mission

Under the Reduced Operations Alternative, National Security/Defense Mission activities would continue to occur in the locations described under the No Action Alternative. National Security/Defense Mission activities at the NNSS would disturb up to 430 acres of previously undisturbed land. This land disturbance would potentially affect an estimated 16 cultural resource sites, of which 6 would be eligible for inclusion on the NRHP.

Stockpile Stewardship and Management Program. Under the Reduced Operations Alternative, Stockpile Stewardship and Management Program activities would be the same as under current conditions, except that some high-explosives testing would be curtailed, and the number of dynamic experiments, conventional high-explosives testing, shock physics testing, and nuclear weapons staging would be reduced relative to the No Action Alternative. A reduction in these activities would reduce the potential for ground-disturbing activities and increased access, resulting in fewer potential impacts on cultural resources. Up to 415 acres of previously undisturbed land would be disturbed by Stockpile Stewardship and Management Program activities, resulting in impacts on an estimated 13 cultural resources sites. An estimated 5 of those sites would be eligible for inclusion on the NRHP.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Under the Reduced Operations Alternative, activities under these programs would continue and cultural resources impacts would be the same as those described under the No Action Alternative.

Table 5–48 Reduced Operations Alternative – Estimated Number of Potentially Affected Cultural Resource Sites on the Nevada National Security Site and Nevada Test and Training Range

Program	*Area Disturbed (acres)* [a]	*Assumed Primary Locations of Activities by Hydrographic Basin*	*Number of Sites* [b]	*Number of NRHP-Eligible Sites* [b]
Stockpile Stewardship and Management	208 208	Frenchman Flat Yucca Flat	4 9	1 4
Nuclear Emergency Response, Nonproliferation and Counterterrorism	5 5 5	Frenchman Flat Yucca Flat Fortymile Canyon–Jackass Flats	0 [c] 0 [c] 3	0 [c] 0 [c] 1
Work for Others	None	Frenchman Flat Yucca Flat Mercury Valley Fortymile Canyon–Jackass Flats	0	0
Total National Security/Defense Mission	430		16	6
Waste Management (Area 5 RWMC) [d]	190	Frenchman Flat	0	0
Environmental Restoration Soils Project [e]	320 100	Frenchman Flat Emigrant Valley	5 8	2 0[c]
Environmental Restoration Underground Test Area	167 167 167	Frenchman Flat Yucca Flat Oasis Valley [f]	3 7 6	1 3 2
Total Environmental Management Mission	1,110		29	8
General Site Support and Infrastructure	None	Frenchman Flat Mercury Valley Yucca Flat	0	0
Renewable Energy (DOE/NNSA)	None	None	0	0
Total Nondefense Mission	None		0	0
Total DOE/NNSA	**1,540**		**45**	**14**
100 MW Commercial Solar Power Generation Facility	1,200	Fortymile Canyon–Jackass Flats	816	252
Total Non-DOE/NNSA	**1,200**		**816**	**252**
Total	**2,170**		**861**	**266**

NNSA = National Nuclear Security Administration; NRHP = National Register of Historic Places; RWMC = Radioactive Waste Management Complex; MW = megawatts.

[a] Where a program could affect multiple hydrologic basins, if potentially disturbed area for the basin was known, it was used; if not, the total potentially disturbed acres for that program were equally apportioned among the affected basins.

[b] The number of sites was calculated by multiplying the number of acres potentially disturbed by the Total Sites Per Acre or NRHP Sites Per Acre columns, as appropriate, from Table 5–45. Where programs could occur in more than one hydrologic basin, the range of numbers of potentially affected cultural resource sites is used. Area disturbed for each program may not add up to the total area disturbed for its applicable mission due to rounding.

[c] The calculated value is less than 0.5 sites.

[d] The 740-acre Area 5 RWMC has been surveyed for cultural resources and no NRHP-eligible sites were found.

[e] The Small Boy and Project 57 sites are disturbed but considered by the NNSA Nevada Site Office to be historically significant sites.

[f] Site density for Underground Test Area projects on the Nevada Test and Training Range was assumed to be the same as the density for the Oasis Valley Hydrographic Basin because most of the groundwater characterization and monitoring wells that would be developed on U.S. Air Force land would be adjacent to the northwestern portions of the Nevada National Security Site.

Work for Others Program. Under the Reduced Operations Alternative, large-scale explosive tests and experiments would not be conducted. No Work for Others Program activities, except for military training and exercises, would be conducted in Areas 18, 19, 20, 29, and 30 of the NNSS. Cultural resources impacts would be the same as those under the No Action Alternative.

5.1.10.3.2 Environmental Management Mission

Activities under the Environmental Management Mission would be the same as those described under the No Action Alternative. Therefore, cultural resources impacts would be the same as those described under the No Action Alternative.

5.1.10.3.3 Nondefense Mission

General Site Support and Infrastructure Program. There would be no infrastructure projects conducted beyond maintenance of critical elements in Areas 18, 19, 20, 29, and 30. Otherwise, all other maintenance and replacement projects would be the same as those described under the No Action Alternative.

Conservation and Renewable Energy Program. The NNSS would continue current energy efficiency measures, water conservation measures, fleet management improvements, and sustainable building practices. Cultural resources impacts would be the same as those described under the No Action Alternative.

Under the Reduced Operations Alternative, NNSA would consider allowing development of a solar power generation facility of up to 100 megawatts capacity in Area 25 in the Fortymile Canyon–Jackass Flats Hydrographic Basin. This development would introduce considerable infrastructure over approximately 1,200 acres of land, affecting up to an estimated 816 cultural resource sites, up to 252 of which might be eligible for the NRHP. If NNSA were to allow it, construction of commercial solar power generation facilities would require separate NEPA analyses (including cultural resources analyses). However, any solar power generation facility would require a considerable amount of clearing and grading that would directly and permanently impact all archaeological resources, built environment resources, and historic landscapes by damaging, displacing, or destroying artifacts, features, sites, and buildings in the project footprint. Proposed projects would be evaluated on a case-by-case basis and all appropriate steps would be taken pursuant to Section 106 of the NHPA.

Other Research and Development Programs. Under the Reduced Operations Alternative, current programs would continue as described under the No Action Alternative, but no programs would be conducted in Areas 18, 19, 20, 29, and 30. There would be fewer cultural resources impacts relative to those described under the No Action Alternative because ground-disturbing activity would be less likely. There are no such projects proposed at this time, but if there were, they would be evaluated on a case-by-case basis and all appropriate steps would be taken pursuant to Section 106 of the NHPA.

5.1.11 Waste Management

DOE operations, environmental restoration, and decontamination and decommissioning (D&D) activities at the NNSS would generate LLW and MLLW; TRU waste; hazardous waste (including waste regulated under the Toxic Substances Control Act and other statutes); explosive waste; and nonhazardous wastes, including sanitary solid waste, hydrocarbon-contaminated soil and debris, and construction and demolition debris.

Waste management impacts are assessed by comparing the projected waste volumes generated or disposed under each SWEIS alternative to current waste management practices and/or the availability of onsite or offsite waste management capacity. Adverse impacts on waste management would occur if any of the different types of wastes lacked appropriate management capacity. For example, adverse impacts on LLW and MLLW management could occur if the projected volumes for disposal at the NNSS exceeded the available NNSS disposal capacity.

> **Nevada National Security Site (NNSS) Low-Level and Mixed Low-Level Radioactive Waste Management Programs**
>
> The NNSS low-level radioactive waste (LLW) management program addresses waste containing radioactive constituents (LLW as defined in Chapter 12, "Glossary") as well as LLW containing regulated (friable) asbestos, polychlorinated biphenyls (PCBs) in low concentrations (e.g., radioactive PCB bulk product waste containing PCBs in concentrations less than 50 parts per million), or hydrocarbon-contaminated soil and debris. The NNSS mixed low-level radioactive waste (MLLW) program addresses waste containing both radioactive and hazardous constituents (MLLW as defined in Chapter 12, "Glossary"), as well as radioactive waste containing PCBs in sufficient concentrations (e.g., radioactive PCB remediation waste containing PCBs in large capacitors or fluorescent light ballasts).

Section 5.1.12.1.4, "Waste Disposal Facilities Performance Assessments," addresses the potential long-term (over thousands of years) public and environmental impacts that could occur after closure of the NNSS LLW and MLLW disposal facilities.

Tables 5–49 and **5–50**, respectively, summarize the projected types and volumes of radioactive and nonradioactive wastes generated and disposed at the NNSS under the three SWEIS alternatives. The top portion of Table 5–49 addresses LLW, MLLW, and TRU waste projected to be generated at the NNSS, while the bottom portion addresses LLW and MLLW projected to be disposed of at the NNSS from all authorized in-state and out-of-state generators. The top portion of Table 5–50 addresses hazardous and solid wastes projected to be generated by all NNSA Nevada facilities, as well as hazardous and solid wastes projected to be generated by a commercial solar power generation facility located at the NNSS; the bottom portion of Table 5–50 addresses solid waste projected to be disposed at NNSS from NNSA Nevada facilities as well as from a commercial solar power generation facility located at the NNSS. NNSS landfill disposal of solid wastes from a commercial solar power generation facility would require revisions to the NNSS landfill operating permits; this waste would most likely be disposed offsite.

There are differences between the volumes generated and disposed at the NNSS because some wastes generated at the NNSS are sent off site for disposition (e.g., all TRU and hazardous wastes), while others are dispositioned on site (e.g., all LLW). In addition, the NNSS receives for disposal LLW and MLLW from in-state generators from locations other than the NNSS (e.g., TTR), as well as numerous authorized out-of-state generators. Some solid wastes generated at the NNSS are recycled off site, while other solid wastes, such as sanitary solid waste or construction debris, are disposed on site. DOE also receives solid wastes at the NNSS for disposition from other authorized in-state generators, such as the RSL.

Wastes generated by ongoing operations at the NNSS (e.g., experiments at JASPER) and the other NNSA Nevada facilities would continue to be generated and disposed beyond the next 10 years. Other wastes would be generated on an episodic, project-specific basis. These episodic wastes would include those generated from specific projects such as facility construction, facility D&D, and specific environmental restoration projects that would take place over a finite period of time. The start and completion dates for many projects that could generate waste are uncertain (e.g., because of possible funding fluctuations or revised program needs). In addition, the timing and quantity of waste generation from environmental restoration activities are subject to future agreements or regulatory determinations. For similar reasons the timing and quantity of wastes received from out-of-state generators are also uncertain. Due to these uncertainties, Tables 5–49 and 5–50 list total waste volumes projected over the next 10 years, rather than average or peak waste volumes that may be projected on an annual basis. After 10 years, waste generation and as-permitted or authorized waste disposal at NNSS would continue.

Table 5–49 Projected 10-Year Volumes of Radioactive Wastes Generated and Disposed at the Nevada National Security Site

Waste Stream [a]	*Alternatives*		
	No Action (cubic feet)	***Expanded Operations (cubic feet)***	***Reduced Operations (cubic feet)***
Waste Volumes Generated at the NNSS			
Low-level radioactive waste	1,000,000	1,300,000	1,000,000
Mixed low-level radioactive waste	520,000	520,000	520,000
Transuranic waste [b]	9,600	19,000	7,100
Waste Volumes Disposed at the NNSS [c]			
Low-level radioactive waste	15,000,000 [d]	48,000,000 [e]	15,000,000 [d]
Mixed low-level radioactive waste [f]	900,000 [g]	4,000,000 [h]	900,000

NNSS = Nevada National Security Site.

[a] Tritiated liquids would also be generated and disposed of (see text).

[b] TRU waste (including mixed TRU waste) includes TRU waste projected for storage at the Area 5 RWMC through the end of 2010, TRU waste generated by NNSS operations and in-state environmental restoration activities over the next 10 years, and two 3-foot diameter legacy spheres containing plutonium. All TRU waste was assumed to be shipped in standard waste boxes, and the listed volumes reflect the approximate disposal (external) volumes of these boxes.

[c] Comprises all LLW and MLLW projected for NNSS disposal as received from all authorized in-state and out-of-state generators.

[d] Includes approximately 1.0 million cubic feet of LLW generated by NNSS operations, environmental restoration, and facility D&D. Some of the LLW from environmental restoration could be MLLW.

[e] Includes approximately 1.3 million cubic feet of LLW generated by NNSS operations, environmental restoration, and facility D&D, plus approximately 11 million cubic feet of LLW generated by environmental restoration at in-state locations outside the NNSS, for a total of approximately 12 million cubic feet of LLW from all in-state waste generators. Some of the LLW from environmental restoration could be MLLW.

[f] Includes approximately 520,000 cubic feet of MLLW generated by operations, environmental restoration, and facility D&D at the NNSS and other in-state locations.

[g] The actual permitted volume of MLLW that may be disposed of in Cell 18 is 899,996 cubic feet.

[h] Expanded MLLW disposal in excess of Cell 18 capacity (899,996 cubic feet) would require new Resource Conservation and Recovery Act (RCRA) permit(s) from the Nevada Division of Environmental Protection prior to construction of any additional disposal cells.

Note: Totals may not equal the sum of individual values because of rounding.

Table 5–50 Projected 10-Year Volumes of Nonradioactive Wastes Generated and Disposed at the Nevada National Security Site

Waste Stream [a]	*Alternatives*		
	No Action (cubic feet)	*Expanded Operations (cubic feet)*	*Reduced Operations (cubic feet)*
Waste Volumes Generated at the NNSS			
Hazardous waste [b]			
From NNSS generators	170,000	170,000	170,000
From commercial solar power generation facility	42,000	170,000	17,000
Total hazardous waste	210,000	340,000	190,000
Solid waste [c]			
From NNSS generators	3,700,000	9,400,000	3,600,000
From commercial solar power generation facility	160,000	630,000	77,000
Total solid waste	3,800,000	10,000,000	3,700,000
Waste Volumes Disposed at the NNSS			
Solid waste [c]			
From NNSA Nevada generators [d]	3,400,000	8,500,000	3,300,000
From commercial solar power generation facility [e]	160,000	630,000	77,000
Total solid waste	3,500,000	9,200,000	3,400,000

NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site.

[a] Explosive wastes would also be generated (see text).

[b] Includes wastes containing constituents regulated under the Toxic Substances Control Act or other applicable statutes. All hazardous waste would be sent to offsite recycle or treatment, storage, and disposal facilities.

[c] Includes sanitary solid waste, and construction and demolition debris. Offsite recycling, rather than landfill disposal, is projected for about 370,000 cubic feet of solid waste under the No Action Alternative, 970,000 cubic feet under the Expanded Operations Alternative, and 360,000 cubic feet under the Reduced Operations Alternative. It is assumed the remaining solid waste would be disposed of.

[d] Includes solid waste generated at the NNSS, the North Las Vegas Facility, the Remote Sensing Laboratory, and the Tonopah Test Range.

[e] Disposal of solid waste from a commercial solar power generation facility at NNSS landfills would require modifications to the landfill permits. Most likely this waste would be disposed of at an offsite landfill. Estimates in this table assume the commercial solar power generation facility for all alternatives would operate for 5 years during the 10-year planning period.

Note: Totals may not equal the sum of individual values because of rounding.

The following subsections address waste management consequences in detail under each alternative. The impacts of managing LLW and MLLW at the NNSS are discussed simultaneously because operational and disposal practices are similar for both types of waste.

5.1.11.1 No Action Alternative

5.1.11.1.1 DOE/NNSA Activities

Adequate disposal capacity is available at the NNSS for the volumes of LLW and MLLW projected under this alternative. Adequate TRU waste disposal capacity at WIPP is expected. Adequate recycle or treatment, storage, or disposal (TSD) capacity is expected for the hazardous and nonhazardous wastes projected under this alternative because of the large number of available offsite recycle or TSD facilities for hazardous waste, the availability of NNSS disposal capacity for nonhazardous solid waste, and the availability of extensive offsite solid waste recycle and disposal capacity.

Low-level and mixed low-level radioactive wastes – LLW and MLLW would continue to be generated at the NNSS as part of operations, environmental restoration, and D&D of excess facilities and structures. Consistent with current practice, some MLLW would be repackaged before disposal at the Area 5 RWMC

(Chapter 4, Section 4.1.11.1.2). MLLW that does not meet the EPA Resource Conservation and Recovery Act (RCRA) (P.L. 94-580) Land Disposal Restrictions would be sent to offsite TSD facilities for treatment. Treated waste would then be disposed at a permitted non–NNSS facility or returned to the NNSS for disposal. Because several permitted TSD facilities exist in the United States for MLLW (e.g., in Florida, Tennessee, Texas, Washington, and Utah), and additional facilities may be used as they are available and appropriate for the waste content or characteristics, adequate offsite treatment capacity exists for the quantity of MLLW projected under this alternative.

LLW and MLLW generated at the NNSS or received from authorized in-state and out-of-state waste generators would be disposed at the Area 5 RWMC. The Area 3 RWMS is on standby status, but could be reopened as needed for disposal of LLW and/or nonhazardous solid waste. All LLW and MLLW disposed at the NNSS would meet the NNSS Waste Acceptance Criteria.

Up to 15,000,000 cubic feet of LLW and 900,000 cubic feet of MLLW would be accepted for disposal from all in-state and out-of-state generators, or a total over 10 years of about 15,900,000 cubic feet of combined LLW and MLLW. The combined waste volume would include approximately 1,200,000 cubic feet of LLW from all in-state operations, environmental restoration activities, and facility D&D (Table 5–49, footnote d). It would also include approximately 520,000 cubic feet of MLLW from all NNSS operations, environmental restoration activities, and D&D (Table 5–49, footnote f).

LLW and MLLW disposal operations would take place at the Area 5 RWMC. Waste management and disposal operations at this facility would be comparable to current annual levels based on the projected waste volumes. The average annual level of effort, however, would be lower than 2003 and 2004 levels. Disposal units, including pits and trenches, would continue to be designed and sized to reflect operational needs.

The operationally closed area within the Area 5 RWMC, historically known as the "92-Acre Area," would be permanently closed, and disposal activities would continue in other locations within the Area 5 RWMC (Chapter 4, Section 4.1.11.1.1.2). Assuming that disposal practices would be similar to past practices, the disposal units required for disposal of 15,900,000 cubic feet of LLW and MLLW would commit about 190 acres of the Area 5 RWMC, in addition to the approximately 160 acres so far committed to waste disposal. The total quantity of land dedicated to waste disposal at the Area 5 RWMC since it opened would amount to about 350 acres, or about 50 percent of the Area 5 RWMC disposal capacity.

At the Area 5 RWMC, DOE would continue to conduct MLLW management support activities such as real-time radiography, operation of a permitted MLLW storage area, and repackaging before disposal of some in-state-generated MLLW.

The Area 3 RWMS is expected to remain in standby status, but could be reopened for disposal of onsite-generated LLW or nonhazardous solid waste. Two disposal units are currently open, albeit inactive, and could be used as needed. Additional disposal units could be readily constructed from existing undeveloped disposal cells (U-3az and/or U-3bg).

Transuranic waste. TRU and mixed TRU wastes generated by NNSS operations or environmental restoration activities would continue to be stored at the Area 5 RWMC. Storage would be temporary pending shipment off site, either directly to WIPP for disposal or to INL for additional characterization and preparation before its eventual shipment to WIPP for disposal.

Assuming storage of 20 standard waste boxes through the end of 2010, annual generation of approximately 12 standard waste boxes from JASPER, projected generation of about 2,000 cubic feet of waste from environmental restoration activities, and storage of two 3-foot-diameter legacy spheres, the total volume of stored and newly generated TRU waste over the next 10 years would be about 9,600 cubic feet. This waste would be shipped off site to INL and/or WIPP (Section 5.1.3.1). The two 3-foot-diameter legacy spheres would be stored pending the availability of TRUPACT III packaging. Because TRUPACT III packaging is expected to be available during the period considered in this SWEIS, shipment of the spheres to INL or WIPP is addressed in this SWEIS (Section 5.1.3.1).[2]

The TRU waste volume projected under this alternative would account for only about 0.2 percent of the 6.3 million cubic feet of authorized waste disposal capacity at WIPP under the WIPP Land Withdrawal Act (P.L. 102-579). The WIPP disposal capacity is sufficient for disposal of all NNSS TRU waste generated under this alternative.

Tritiated liquids. Tritiated liquids would continue to be treated on site by evaporation into the air from ponds, open tanks, and sewage lagoons (see Chapter 4, Section 4.1.11.1.4). Existing procedures would not be changed and treatment capacity would be adequate. The potential impacts of the release of tritium to the atmosphere through evaporation are addressed in Section 5.1.8, "Air Quality and Climate," and Section 5.1.12, "Human Health."

Hazardous waste. Hazardous waste and wastes regulated under the Toxic Substances Control Act (P.L. 94-469) or other statutes would be collected and temporarily stored at the source of generation as needed in compliance with applicable regulations or, if packaged, at the Area 5 Hazardous Waste Storage Unit before being sent off site for disposition. Bulk hazardous waste generated by activities such as environmental restoration would generally be shipped directly from the source of generation to an offsite location for disposition. Disposition options would depend on waste characteristics. To the extent reasonably achievable, materials such as used oil, batteries, computer equipment, fluorescent light bulbs, scrap lead materials, or unused hazardous chemicals would be sold or sent to permitted offsite recycle facilities. These activities would be conducted in accordance with DOE's ongoing Pollution Prevention and Waste Minimization Program. Some materials could be directed to new onsite users. Otherwise, hazardous waste would be shipped to offsite TSD facilities. (This does not include solid wastes containing PCBs in concentrations less than 50 parts per million, which generally may be disposed in permitted solid waste facilities at the NNSS or elsewhere.)

Over the next 10 years, approximately 170,000 cubic feet of hazardous waste would be generated by NNSS generators. Additionally, about 42,000 cubic feet would be generated from construction and operation of a commercial solar power generation facility (Section 5.1.11.1.2). Most of this waste would be dispositioned by offsite recycling or reuse rather than offsite disposal. Adequate offsite capacity exists for this waste because of the large number of permitted hazardous waste recycle or TSD facilities that exist in Nevada and neighboring states. As of 2009, for example, 10 facilities were permitted in Nevada for recycle of used oil, antifreeze, and photographic solutions (NDEP 2009b); as of 2010, several dozen facilities in Nevada were permitted for recycle of batteries, electronic equipment, fluorescent lamps, and other materials (NDEP 2010a). In California, as of 2007, 26 facilities were permitted for recycle of batteries, 24 for fluorescent lighting, 20 for solvent recovery, and 37 for used oil and antifreeze (DTSC 2007). As of 2009, 4 hazardous waste TSD facilities were permitted in Nevada (NDEP 2009c). Additional facilities in neighboring states include 3 permitted landfills in California as of 2007 (DTSC 2007), 13 permitted TSD facilities in Utah as of 2005 (UTDEQ 2006), and 10 permitted TSD facilities in New Mexico as of 2008 (NMED 2008). As of March 2010, EPA identified 39 permitted companies in the United States that are capable of performing treatment or disposal of PCBs using chemical dechlorination, incineration, physical separation or decontamination, landfill, and other technologies (EPA 2010d).

[2] *'TRUPACT III' and 'standard waste' box are defined in Chapter 12, "Glossary."*

Explosive waste. Nonradioactive explosive waste generated by tunnel operations, the NNSS Security Firing Range, resident national laboratories, or other DOE/NNSA activities would continue to be treated by open detonation at the Area 11 Explosives Ordnance Disposal Unit in accordance with the following permit conditions: no more than 100 pounds of approved explosive waste would be detonated at one time; there would be no more than one detonation event per hour; and the maximum quantity treated each year would be 4,100 pounds. There would be no lack of capacity at the NNSS for explosive waste.

Nonhazardous waste. To the extent reasonably achievable, nonhazardous solid waste generated at the NNSS would be recycled under the NNSS Pollution Prevention and Waste Minimization Program. Materials recycled under this program include scrap metals, mixed paper and cardboard, shipping materials, spent toner cartridges, cafeteria food wastes, and aluminum cans.[3] Surplus chemicals, equipment, and supplies would be preferentially directed to appropriate new users rather than being disposed as waste. These recycling operations would not consume waste disposal capacity and would only result in temporary staging activities at the NNSS, pending shipment to recycling facilities capable of accepting the materials.

It is projected that approximately 3,700,000 cubic feet of nonhazardous solid waste would be generated by authorized NNSS generators over the next 10 years. About 370,000 cubic feet of nonhazardous solid waste would be recycled (see Table 5–50, footnote c). Adequate offsite recycle capacity exists due to the large number of available recycle facilities. In Nevada, several dozen recycle facilities existed as of 2010 for nonhazardous material, including aluminum, glass bottles and jars, paper, cardboard, food waste, scrap metal, and wood (NDEP 2010a). Additional nonhazardous material recycle facilities exist in neighboring states (e.g., see DTSC 2007).

Wastes that are not reused or recycled would be disposed in permitted NNSS or offsite landfills. Solid wastes disposed at the NNSS would be received from NNSS generators and, as needed, from authorized in-state generators such as the TTR, RSL, or NLVF. Sanitary solid waste generated by these sites is usually managed by means other than shipment to the NNSS. Nonetheless, for security reasons, there may be an occasional need to ship some solid wastes from these facilities to the NNSS for landfill disposal. In addition, construction and demolition debris generated by DOE/NNSA at the TTR, RSL, or NLVF could be sent to NNSS landfills or permitted commercial landfills.[4]

About 3,500,000 cubic feet of sanitary solid waste and construction and demolition debris from NNSA Nevada facilities is projected for disposal at the NNSS over the next 10 years. As of 2008, the estimated remaining waste capacities for the three NNSS landfills were as follows: 2,800,000 cubic feet at Area 6, hydrocarbon landfill; 15,000,000 cubic feet at Area 9, U10c landfill; and 13,000,000 cubic feet at Area 23 landfill (Chapter 4, Section 4.1.11.2.3). The projected waste volumes under the No Action Alternative are significantly smaller than the remaining landfill capacity; thus, available solid waste disposal capacity at the NNSS would not be exceeded. Adequate waste disposal capacity would also be available in the event that solid waste from a commercial solar power generation facility is disposed at permitted NNSS landfills (Section 5.1.11.1.2).

5.1.11.1.2 Commercial Solar Power Generation Facility

Hazardous and nonhazardous solid wastes would be generated by construction and operation of a commercially operated solar power generation facility at Area 25. Waste quantities would vary

3 Recyclable material such as scrap metal would continue to be shipped from NNSA Nevada facilities (e.g., RSL, NLVF) to the NNSS for consolidation pending offsite shipment (e.g., to be sold or recycled).

4 NNSS solid waste disposal facilities are permitted to receive waste only from sources specified in the facility permits (e.g., FFACO sites), and other waste as approved on a case-by-case basis by the Nevada Division of Environmental Protection.

depending on the electrical power capacity of the power plant, which differs under each SWEIS alternative. Construction of a 240-megawatt power plant under the No Action Alternative is projected to generate approximately 6,500 cubic feet of hazardous waste and 140,000 cubic feet of construction debris and sanitary solid waste. Operation of this same plant is projected to annually generate approximately 7,100 cubic feet of hazardous waste and 4,100 cubic feet of sanitary solid waste. Operational waste would be generated throughout the life of the facility (likely 30 years or more).

Construction of a 240-megawatt commercial solar power generation facility would take approximately 35 months.[5] The commercial solar power generation facility would begin operations after construction, and is assumed to operate for 5 years during the 10-year planning period. Under these assumptions, about 42,000 cubic feet of hazardous waste and 160,000 cubic feet of sanitary solid waste and construction debris would be generated during the 10-year planning period.

There is no specific schedule for constructing a commercial solar power generation facility at the NNSS; the waste projections are included in this SWEIS to assist DOE in determining whether to make land and infrastructure now under DOE control available for another use by a commercial entity in the future. Any hazardous or nonhazardous waste generated by construction or operation of the solar power generation facility would be managed by the commercial operator of the facility, who would be required to comply with applicable laws and regulations related to recycling, treatment and/or disposal of wastes. Because numerous hazardous waste recycle or TSD facilities exist in Nevada and nearby states, as well as numerous landfills for industrial and sanitary solid waste, therefore offsite disposal capacity would be adequate for the waste projected from a commercial solar power generation facility (Section 5.1.11.1.1).

If permitted by NDEP, the projected solid waste may be disposed of in NNSS landfills. Assuming an additional 160,000 cubic feet of solid waste from the commercial solar power generation facility, the total volume of solid waste to be disposed at NNSS landfills over the next 10 years would increase to 3,500,000 cubic feet. Because this volume would still be significantly smaller than the projected remaining NNSS disposal capacity (Section 5.1.11.1.1), adequate solid waste management capacity at the NNSS would be available. Most likely solid waste from a commercial solar generation facility would be disposed of offsite.

5.1.11.2 Expanded Operations Alternative

5.1.11.2.1 DOE/NNSA Activities

Adequate disposal capacity exists at the NNSS for the volumes of LLW and MLLW conservatively projected under this alternative, provided the Area 3 RWMS is reopened for in-state generated waste. Adequate disposal capacity also exists if the Area 5 RWMC is expanded or operational disposal practices at the Area 5 RWMC are modified to allow more-efficient use of available disposal space (e.g., construction of larger and/or deeper disposal units). Adequate TRU waste disposal capacity at WIPP is available. Adequate recycle or TSD capacity exists for the hazardous and nonhazardous wastes projected under this alternative because of the large number of available offsite recycle or TSD facilities for hazardous waste, the availability of NNSS disposal capacity for nonhazardous solid waste, and the availability of extensive offsite solid waste recycle and disposal capacity.

Low-level and mixed low-level radioactive wastes – LLW and MLLW would continue to be generated at the NNSS as part of operations, environmental restoration, and D&D of excess facilities and structures. Onsite MLLW treatment capability would be developed at the Area 5 RWMC to enable permitted treatment of MLLW received from all authorized generators. In-state-generated MLLW that does not

5 *Under all alternatives it is assumed that a commercial solar power generation facility would operate over 5 of the next 10 years.*

meet the EPA RCRA Land Disposal Restrictions would be sent to offsite TSD facilities for treatment, then be disposed off site or returned to the NNSS for disposal. As under the No Action Alternative (Section 5.1.11.1.1), adequate offsite TSD capacity is available for the NNSS-generated MLLW projected under this alternative.

LLW generated at the NNSS or received from authorized in-state and out-of-state waste generators would be disposed at the Area 5 RWMC or the Area 3 RWMS if the latter disposal facility is reopened. MLLW generated at the NNSS or received for disposal from authorized in-state and out-of-state waste generators would be disposed at the Area 5 RWMC. All waste disposed at the Area 5 RWMC or the Area 3 RWMS would meet the NNSS Waste Acceptance Criteria.

Up to about 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW would be accepted for disposal from all in-state and out-of-state generators over the next 10 years, or a total of approximately 52,000,000 cubic feet of combined LLW and MLLW. The combined volume of LLW and MLLW from in-state generators alone would include approximately 12,000,000 cubic feet of LLW (see Table 5–49, footnote e) and 520,000 cubic feet of MLLW. The combined total volumes of LLW and MLLW that would be disposed at the NNSS under the Expanded Operations Alternative would be about three times as much as those under the No Action Alternative. Disposal units, including pits and trenches, would be designed and sized to reflect operational needs.

The operationally closed 92-Acre Area within the Area 5 RWMC would be permanently closed and disposal activities would continue in other locations within the Area 5 RWMC. Assuming that disposal practices would be similar to past practices, the disposal units required for disposal of approximately 52,000,000 cubic feet of LLW and MLLW would require about 600 acres of the Area 5 RWMC. Therefore, the land area used for LLW/MLLW disposal at the Area 5 RWMC would exceed by about 20 acres the Area 5 RWMC acreage available for waste disposal. To accept the projected volumes of LLW and MLLW, DOE/NNSA would need to modify disposal operations to allow construction of larger and/or deeper disposal units.

To preclude the need to expand the Area 5 RWMC or modify operations, the Area 3 RWMS could be reactivated to receive in-state-generated LLW from environmental restoration and other activities. The currently developed capacity of the Area 3 RWMS is about 1.9 million cubic feet. Two currently undeveloped disposal cells (U-3az and/or U-3bg) would be opened, leading to a total of approximately 9,100,000 cubic feet of disposal capacity at the Area 3 RWMS.

The commitment of disposal capacity at the Area 5 RWMC may also be affected by decisions made as part of the Environmental Restoration Program under the FFACO, primarily for sites managed by the Soils Project. The projected 11,000,000 cubic feet of LLW generated from in-state environmental restoration at locations outside of the NNSS (see Table 5–49, footnote e) would consist of low-activity soil and debris (a portion may be MLLW). Rather than removing this environmental restoration waste and transporting it to the NNSS for disposal, NDEP, DOE/NNSA, and the USAF (on the TTR and Nevada Test and Training Range sites only) may determine that the safest and most-effective management strategy for some sites would be to close the contamination in place or open dedicated disposal facilities that are proximal to the contamination sources. Either option would reduce the amount of disposal space at the Area 5 RWMC that is committed to this environmental restoration waste, thereby extending the availability of the Area 5 RWMC for waste disposal, reducing the need to reopen the Area 3 RWMS, and reducing the costs and impacts associated with transporting the waste to the NNSS for disposal. Impacts from transporting this waste to the NNSS are addressed in Section 5.1.3.1.

NNSA/NSO would continue to conduct MLLW support activities, including real-time radiography, operation of a permitted MLLW storage area, and repackaging activities. Additional MLLW treatment capacity at the Area 5 RWMC would be developed under this alternative. This treatment capability would allow acceptance of MLLW from across the DOE complex for treatment, pursuant to EPA's land disposal restriction requirements, before disposal at the Area 5 RWMC. It is expected that treatment methods would include technologies such as macroencapsulation, microencapsulation, sorting and segregation, repackaging, neutralization, and amalgamation. DOE/NNSA would obtain the appropriate RCRA permit from NDEP before developing or implementing any MLLW treatment capability.

MLLW treatment and storage capacity would be housed in appropriately modified and permitted existing buildings at the Area 5 RWMC (e.g., the Visual Reexamination and Repackaging Building or TRU Pad Cover Building) to the extent feasible. A modular panel containment/confinement system structure with HEPA (high-efficiency particulate air) exhaust filtration could be constructed as needed within the TRU Pad Cover Building. If existing buildings are not adequate to house the MLLW treatment and storage capacity, DOE/NNSA would construct new facilities within the Area 5 RWMC.

Transuranic waste. The 10-year volume of TRU (including mixed TRU) waste projected under the Expanded Operations Alternative is about twice as large as that under the No Action Alternative because of the increased number of annual tests projected at JASPER. Annual generation of TRU waste would increase from 12 to 24 standard waste boxes, and the total quantity of TRU waste would increase to about 19,000 cubic feet. Similar to the No Action Alternative, this waste would be shipped off site to INL and/or WIPP (Section 5.1.3). As under the No Action Alternative, the two 3-foot-diameter legacy spheres would be stored pending the availability of TRUPACT III packaging. Because TRUPACT III packaging is expected to be available during the period considered in this SWEIS, shipment of the spheres to INL or WIPP is addressed in this SWEIS (Section 5.1.3.1).

Similar to the No Action Alternative (Section 5.1.11.1.1), the projected volume of TRU waste under the Expanded Operations Alternative is modest. The projected volume would account for only about 0.3 percent of the 6.3 million cubic feet of waste authorized for disposal at WIPP under the WIPP Land Withdrawal Act. The WIPP disposal capacity would be sufficient for disposal of all TRU waste generated under this alternative.

Tritiated liquids. Under the Expanded Operations Alternative, the impacts of treating liquid tritium waste by evaporation would be the same as those described under the No Action Alternative (Section 5.1.11.1.1).

Hazardous waste. Hazardous waste generation and management activities would be similar to those under the No Action Alternative (Section 5.1.11.1.1). Under the Expanded Operations Alternative, approximately 170,000 cubic feet of hazardous waste would be generated by NNSS generators over the next 10 years. Additionally, about 170,000 cubic feet would be generated from construction and operation of a commercial solar power generation facility (Section 5.1.11.2.2). Most of this waste would be dispositioned by offsite recycling or reuse rather than offsite disposal. Because numerous permitted hazardous waste recycle or TSD facilities are in operation in Nevada or neighboring states, adequate offsite waste management capacity is expected for the hazardous waste projected under this alternative.

Explosive waste. The impacts of disposing nonradioactive explosive waste by detonation would be the same under the Expanded Operations Alternative as those under the No Action Alternative (Section 5.1.11.1.1).

Nonhazardous waste. The volumes of nonhazardous solid wastes from NNSS generators would be larger than those under the No Action Alternative, principally because of additional personnel requirements and the generation of debris from new construction activities at the NNSS. As under the No Action Alternative, it is projected that about 930,000 cubic feet of this waste would be recycled.

Because dozens of solid waste recycle facilities are in operation in Nevada and neighboring states (Section 5.1.11.1.1), the projected level of nonhazardous waste generation under this alternative would not strain waste management capacity at these facilities.

About 8,500,000 cubic feet of sanitary solid waste and construction and demolition debris is projected for disposal from all NNSA Nevada generators over the next 10 years. The projected volume of solid waste would not exceed the available disposal capacity at the NNSS; however, assuming all construction and demolition debris would be disposed at the U10C Landfill in Area 9, about 53 percent of the capacity of that disposal facility would be used. Adequate waste disposal capacity would also be available in the event that solid waste from a commercial solar power generation facility is disposed at permitted NNSS landfills (Section 5.1.11.2.2).

Packaging, staging, and maintenance support. DOE proposes to establish staging and maintenance support capacity at the Area 5 RWMC for radioactive material shipping packages. DOE would temporarily stage, inspect, and perform maintenance on DOE-certified (and possibly commercial) shipping packages for transport of radioactive material. The shipping packages would be emptied of radioactive material before inspection, maintenance, or staging. This proposed capability would allow consolidation of specialty packaging at a centralized location that is convenient to DOE sites in the western United States. The proposed capability would be located in a fenced area within the Area 5 RWMC on approximately 1 acre of previously disturbed land. The area would be graded and covered with a gravel or asphalt pad. There would be five to six shipping packages staged within the area at any time with monthly movement of one shipping package (one in and one out). Operation of the area would use a small amount of electrical power and require only two to three workers on an as-needed basis to perform radiation surveys, container maintenance, or pre-use inspections. Minimal waste generation is expected.

New construction. New construction may occur at the NNSS under the Expanded Operations Alternative to enable expanded MLLW storage and treatment capacity, as well as packaging, staging, and maintenance support activities at the Area 5 RWMC. Construction would principally occur within existing structures with minimal generation of construction waste. In addition, a waste offloading and staging area would be constructed as needed within a previously disturbed area at the Area 5 RWMC.

New or expanded solid waste landfills would be constructed as needed at the NNSS. An expansion of the Area 23 landfill would affect approximately 15 acres of land. In addition, a new landfill for construction and demolition debris may be constructed in Area 25 that would disturb up to 25 acres. Development of these landfills would reduce the risk and expense of transporting construction and demolition debris from Area 25 (or other areas) to the U10C Landfill, as well as extend the operational lifetimes of both the U10C and Area 23 Landfills. NNSA/NSO would seek appropriate permits from NDEP for the new or expanded landfills.

5.1.11.2.2 Commercial Solar Power Generation Facility

Construction of commercial solar power generation facilities with up to 1,000 megawatts of generating capacity under this alternative would take about 42 months and is projected to generate approximately 27,000 cubic feet of hazardous waste and 600,000 cubic feet of construction debris and sanitary solid waste. Operation of these facilities is projected to generate approximately 30,000 cubic feet of hazardous waste and 5,400 cubic feet of sanitary solid waste each year throughout the lives of the facilities (likely 30 years or more).

The commercial solar power generation facilities would begin operations after construction, and are assumed to operate for 5 years during the 10-year planning period. Under these assumptions, about

170,000 cubic feet of hazardous waste and 630,000 cubic feet of sanitary solid waste and construction debris would be generated during the 10-year planning period.

As under the No Action Alternative (Section 5.1.11.1.2), these waste projections are included in this SWEIS to assist DOE in determining whether to make land and infrastructure now under DOE control available for another use by a commercial entity. Any waste generated by construction and operation of commercial solar power generating facilities would be managed by the operator(s) of the facility. Because numerous hazardous waste recycle or TSD facilities exist in Nevada and nearby states, as well as numerous landfills for industrial and sanitary solid waste, it is expected that offsite disposal capacity would be adequate for the waste projected from the commercial solar power generation facilities (Section 5.1.11.1.1).

If permitted by NDEP, another option may be to dispose of the projected sanitary solid waste and construction debris in NNSS landfills. The total volume of sanitary solid waste and construction and demolition debris, including waste from DOE/NNSA activities and commercial solar power generation facilities would increase to 9,200,000 cubic feet over the next 10 years. The projected volume of sanitary waste would not exceed the projected remaining NNSS disposal capacity at the Area 23 landfill (Section 5.1.11.1.1); thus, it is expected that adequate sanitary solid waste management capacity would be available. The projected volume of construction and demolition debris would not exceed the projected available capacity at the U10C Landfill in Area 9, although approximately 57 percent of the capacity of that disposal facility would be used. As noted in Section 5.1.11.2.1, development of a new landfill for construction and demolition debris in Area 25, as well as the expanded sanitary waste landfill proposed for Area 23, would reduce the risk and expense of transporting construction and demolition debris to the existing U10C Landfill and extend the operational lifetimes of both the U10C and Area 23 Landfills. NNSA/NSO would seek appropriate permits from NDEP for the new or expanded landfills. Most likely solid waste from commercial solar generation facilities would be disposed of offsite

5.1.11.3 Reduced Operations Alternative

5.1.11.3.1 DOE/NNSA Activities

Under this alternative, DOE would manage the same quantities of LLW and MLLW as those described under the No Action Alternative and would treat the same quantities of tritiated liquids by evaporation and explosive waste by detonation. Impacts resulting from management of these waste types would be the same as those under the No Action Alternative (Section 5.1.11.1.1).

TRU (and mixed TRU) waste volumes generated under this alternative are expected to be about 26 percent smaller than those under the No Action Alternative because of the reduced number of annual experiments projected at JASPER. Annual generation of TRU waste would decrease to six standard waste boxes, and the total 10-year volume of TRU waste under this alternative would decrease to about 7,100 cubic feet. Similar to the No Action Alternative, this waste would be shipped off site to INL and/or WIPP (Section 5.1.3). As under the No Action Alternative, the two 3-foot-diameter legacy spheres would be stored pending the availability of TRUPACT III packaging. Because TRUPACT III packaging would be available during the period considered in this SWEIS, shipment of the spheres to INL or WIPP is addressed in this SWEIS (Section 5.1.3.1).

The volume of TRU waste projected under this alternative would account for only about 0.1 percent of the 6,300,000 cubic feet of waste authorized for disposal at WIPP under the WIPP Land Withdrawal Act. The WIPP disposal capacity would be sufficient for disposal of all TRU waste generated under this alternative.

Hazardous waste generation and management activities are expected to be similar to those under the No Action Alternative (Section 5.1.11.1.1). Under the Reduced Operations Alternative, approximately 170,000 cubic feet of hazardous waste would be generated by NNSS generators over the next 10 years. Additionally, about 17,000 cubic feet would be generated from construction and operation of a commercial solar power generation facility (Section 5.1.11.3.2). Most of this waste would be dispositioned by offsite recycling or reuse rather than offsite disposal. Because numerous permitted hazardous waste recycle or TSD facilities are in operation in Nevada or neighboring states, adequate offsite waste management capacity is expected for the hazardous waste projected under this alternative.

Compared to the No Action Alternative, a smaller quantity of sanitary solid waste would be generated because of reduced personnel requirements, as well as a smaller quantity of construction and demolition debris. About 3,600,000 cubic feet of sanitary solid waste and construction and demolition debris would be generated by authorized NNSS generators over the next 10 years. About 360,000 cubic feet of nonhazardous waste would be recycled. Because dozens of solid waste recycle facilities are in operation in Nevada and neighboring states (Section 5.1.11.1.1), the projected level of nonhazardous waste generation under this alternative would not strain waste management capacity at these facilities.

About 3,300,000 cubic feet of combined sanitary solid waste and construction and demolition debris from NNSA Nevada generators would be disposed of at NNSS landfills over the next 10 years. These projected waste volumes would not exceed the solid waste disposal capacity at the NNSS. Adequate waste disposal capacity would also be available in the event that solid waste from a commercial solar power generation facility is disposed at permitted NNSS landfills (Section 5.1.11.3.2).

5.1.11.3.2 Commercial Solar Power Generation Facility

Construction of a 100-megawatt commercial solar power generation facility under the Reduced Operations Alternative is projected to generate approximately 2,700 cubic feet of hazardous waste and 60,000 cubic feet of construction debris and sanitary solid waste. Operation of this plant is projected to generate approximately 3,000 cubic feet of hazardous waste and 3,400 cubic feet of sanitary solid waste each year. Operational waste would be generated throughout the life of the facility (likely 30 years or more).

Construction of a 100-megawatt commercial solar power generation facility would take approximately 32 months. The commercial solar power generation facility would begin operations after construction, and is assumed to operate for 5 years during the 10-year planning period. Under these assumptions, about 17,000 cubic feet of hazardous waste and 77,000 cubic feet of sanitary solid waste and construction debris would be generated during the 10-year planning period.

As under the No Action Alternative (Section 5.1.11.1.2), these waste projections are included in this SWEIS to assist DOE in determining whether to make land and infrastructure currently under DOE control available for another use by a commercial entity. Any waste generated by construction and operation of the power plant would be managed by the commercial operator of the facility. Because numerous hazardous waste recycle or TSD facilities exist in Nevada and nearby states, as well as numerous landfills for industrial and sanitary solid waste, it is expected that offsite disposal capacity would be adequate for the waste projected from the solar power generation facility (see Section 5.1.11.1.1).

If permitted by NDEP, another option may be to dispose the projected sanitary solid waste and construction debris in NNSS landfills. The total volume of sanitary solid waste and construction and demolition debris, including waste from a commercial solar power generation facility, would increase to 3,400,000 cubic feet over the next 10 years. Because this volume would be significantly smaller than the projected remaining NNSS disposal capacity (Section 5.1.11.1.1), adequate solid waste management capacity at the NNSS would be available. Most likely solid waste from a commercial solar generation facility would be disposed of offsite.

Waste Management—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) continues to strongly oppose the transportation, storage and disposal of radioactive waste at the Nevada National Security Site (NNSS); however, Indian people must continue to fulfill our birth-rite obligation to care for our Holy Land and do what we can to try to restore balance to Area 5 and other contaminated locations.

The CGTO knows the NNSS is used to dispose of low-level radioactive waste and low-level mixed radioactive waste (i.e., containing certain hazardous wastes) in Area 5, and non-hazardous waste and debris. Indian people hold traditional and scientific views of radioactive materials and waste. As an example, the former builds on the view that all resources–including the rocks–are alive. Radioactive rocks are powerful, but they can become "angry rocks" if they are removed without proper ceremony, used in a culturally inappropriate way, disposed of without ceremony, or placed where they do not want to be (Stoffle et al., 1989a and 1990c). The practice of dealing with "bad medicine" or neutralizing negative forces is a part of our traditional culture. Indian knowledge and use of radioactive rocks, or minerals, in the western United States goes back for thousands of years. Areas with high concentrations of these minerals are called dead zones. Such areas contain places of power or energy and can only be visited or certain minerals used under the supervision of specially-trained Indian people, who are sometimes referred to in the English language as a shaman or medicine man (Stoffle and Arnold 2003). Therefore, the U.S. Department of Energy (DOE) would benefit from this knowledge if applied correctly.

A head Salt Song singer and religious leader for the Chemehuevi Paiutes once explained the impacts of radiation as follows:

"Our spirits will paint their faces and become angry because they are disturbed by the presence of angry rocks. When we are out there now, it is still and peaceful; it is like being in a church chamber. Radiation will disturb the harmony… It will no longer be the same. It will be violated. All the previous songs stories that have been shared in the area will be disturbed. Once a song is sung it continues to be there. When you sing a song you are on the trail – your spirit is making that trip. You are describing where you are at and what is happening. You tell in the song where you are and what you are doing. When people go to these areas today a person can get a song. Previous songs live in the mountains in the canyons. If you were a gifted person that was meant to be an owner of the song you can actually hear it… There are still areas today where you can go and hear the song. Some people hear the songs and it scares them because they do not know what it is. Young people need to be told what it is they are hearing. The places need to be protected from damage so the songs continue to be there for future generations. It is like a delayed echo that never goes away and can come again and again to new people."

We are very concerned about the tritiated liquids disposed at the NNSS and treated by evaporation into the air from ponds, open tanks, and sewage lagoons. The CGTO is concerned about the ponds drying up and the airborne residue adversely impacting the environment.

According to tribal elders, *"Evaporating tritium like this is not a natural process. The natural environment is altered. The wildlife could drink this contaminated water, birds could land on the ponds, insects and vegetation can become contaminated. This contamination would then adversely impact the food chain. We are concerned the animals will become contaminated or sick if they ingest other contaminated species in the food chain. How can they clean themselves to survive? How can DOE contain this contamination? "*

We are also concerned about adverse impacts to the land, animals, plants, water, air, and insects from the waste and noise generated during explosive waste detonation at the Area 11 Explosives Ordnance Disposal Unit. Indian people have witnessed the destructive force of explosive detonations and the resulting destruction to the environment. For example, animals relocate to unfamiliar habitats, which adversely impact their survival rate. Air is adversely impacted, increasing the occurrence of dead air[1]. Noise and vibration from the detonations impact the insects, and disrupt vegetation growth.

Indian people know if the earth and environment are being disrespected, such as in Areas 5 and 11, the spirits that protect and watch over these can become upset and respond negatively. This can result in the characteristics of the environment changing, causing animals to leave their natural habitats, reducing the native vegetation[2], further reducing water resources, and increasing occurrences of perceived mishaps.

[1] *For additional information on dead air, see Appendix C.2.8.*

[2] *Reducing the natural vegetation may result in the introduction of noxious weeds.*

Waste Management—American Indian Perspective (cont'd)

The CGTO is also concerned about transporting hazardous and radioactive waste through American Indian homelands and adversely impacting their health and environment. Many of the Indian land within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation resulting from NNSS related activities including the transportation of hazardous and radioactive waste occur, it could result in the closure of a major reservation road. If a major (only) road into a reservation is closed, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays. Delays also could occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use. Purchases by patrons of tribal enterprises and emergency medical services in route to or from the reservation could be dramatically impeded. Potential investors interested in expanding tribal enterprises and on-going considerations by tribal governments for future tribal developments may significantly diminish because of the perceived risks associated with NNSS related activities including the transportation of radioactive waste.

Finally, the CGTO struggles with the ethics of relocating radioactive waste from other American Indian lands so those people can live without fear of radioactivity. We are greatly concerned about the adverse spiritual, environmental, and health impacts associated with relocating these angry rocks from their current locations to our Holy Land. We believe transporting these to our land perpetuates animosity and discord among tribal governments. We strongly encourage DOE to host a break out session among the culturally affiliated tribes associated with the NNSS and the multi-state waste generator facilities during the 2011 NNSS Generator Workshops to facilitate further discussion and understanding, and each, annual generator workshop thereafter.

See Appendix C for more details.

5.1.12 Human Health

Continued operations at the NNSS present potential health impacts associated with radioactive materials, hazardous chemicals, industrial accidents, and noise. This section presents an assessment of the potential radiological, chemical, industrial accident, and noise impacts on workers and the general public associated with normal operations and hypothetical accident conditions. Specific details of the methodologies employed for determining radiological, chemical, and industrial impacts are presented in Appendix G.

Radiological impacts are presented for two public receptors: the general population living within 50 miles of a radioactive materials release location and an MEI. The MEI was assumed to be at the offsite location that would result in the maximum radiological impact. General population impacts were evaluated for a residential scenario whereby people are exposed to radioactive materials emitted from operational facilities, other locations where experiments are to be performed, or legacy testing areas that emit tritium or are contaminated with particulate radioactive materials. Radiation exposure can occur through inhalation, direct exposure to a radioactive plume or radioactive material deposited on the ground, or ingestion of contaminated food products from animals raised locally and fruits and vegetables grown in a family garden. Impacts on the MEI were evaluated for a scenario that includes the same exposure pathways assumed for the general population, but assumes an increased amount of time spent outdoors and a higher rate of contaminated food consumption.

Potential impacts are also presented for two categories of workers, workers directly involved in activities associated with assigned missions and nearby noninvolved workers.

In the event of an accident, involved workers could receive a radiation dose or be exposed to hazardous chemicals. Potential impacts on workers at a facility at which an accident was assumed to occur could range from minor to lethal. The impacts on these workers would depend on a number of factors, including the nature of the accident-initiating event, their proximity to the accident, and conditions in the vicinity of the accident (e.g., meteorological conditions or localized airflow). In this SWEIS, LCF's are not calculated for involved workers as a result of a fatal accident.

Maximally Exposed Individual (MEI) – A hypothetical individual whose location and habits result in the highest total radiological exposure (and thus dose) from a particular source for all relevant exposure routes (e.g., inhalation, ingestion, direct exposure).

Rem – A unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem is estimated by a formula that accounts for the type of radiation, the total absorbed dose, and the tissues involved. One thousandth of a rem is a millirem. The average dose to an individual in the United States primarily from natural background sources of radiation is about 310 millirem per year; the national average including medical sources is about 620 millirem per year.

Person-rem – A unit of collective radiation dose applied to a population or group of individuals. It is calculated as the sum of the estimated doses, in rem, received by each individual of the specified population. For example, if 1,000 people each received a dose of 1 millirem, the collective dose would be 1 person-rem (1,000 persons × 0.001 rem).

Latent cancer fatalities (LCFs) – Deaths from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens. This site-wide environmental impact statement focuses on LCFs as the primary means of evaluating health risk from radiation exposure. The values reported for LCFs are the increased risk of a fatal cancer for an MEI or noninvolved worker or the increased risk of a single fatal cancer occurring in an identified population.

A noninvolved worker is a person working at the site who is incidentally exposed to radiological or chemical emissions, either during normal operations or as a result of an accident. The location of a noninvolved worker could be a facility or nearby locale that is expected to be staffed on a daily basis. Because the various areas at which activities occur are widely separated, it is unlikely that there would be a noninvolved worker nearby. Additionally, because the sources of normal operations emissions are widely separated, no single noninvolved worker would receive significant exposures from multiple locations. For purposes of accident analyses, the noninvolved worker was generally assumed to be 110 yards downwind of the emission point, except for those instances where the presence of a noninvolved worker is not logical (e.g., inside the exclusion zone of a high-explosives experiment).

Potential radiological impacts are presented in terms of dose and increased risk of an LCF.

For normal operations, the following criteria were used to evaluate the radiological impacts on an MEI:

- NESHAPs annual dose limit of 10 millirem per year for air emissions from a DOE site (40 CFR Part 61, Subpart H)
- Increased risk of an LCF

For a radiation worker, under normal operations, the following criteria were used to evaluate the radiological impacts:

- DOE's radiation worker protection requirement of 5 rem per year
- DOE guidance for maintaining doses below 2 rem per year
- NNSA/NSO guidance for maintaining doses below 0.5 rem per year
- Increased risk of an LCF

For the public, the MEI, and a noninvolved worker, there are no established standards for doses associated with an accident, however, DOE uses an offsite individual dose of 25 rem in its safety analysis as an evaluation guideline as to whether safety class or safety significant controls are required. In this SWEIS, the following criteria were used to evaluate the impacts from facility accident:

- Dose and increased risk of an LCF if the accident were to occur and
- Overall risk of an LCF when the probability of the accident is considered

For all workers, including construction workers, the following criteria were used to evaluate the impacts from industrial accidents:

- Number of total recordable cases and the cases resulting in days away, restricted or transferred
- Number of fatal accidents from construction across the worker population

For chemicals, measures were derived from comparisons with standards or guidelines for chemical exposure, such as the American Industrial Hygiene Association's Emergency Response Planning Guidelines.

Noise from most activities at the NNSS or any offsite location would not propagate beyond the site's boundaries at discernable levels. In general, noise levels associated with activities for each of the alternatives would have the greatest impacts on onsite workers. Activities that would generate the greatest onsite noise levels would include construction, military training, and high-explosives experiments. Activities evaluated for potential noise impacts on onsite workers included high-explosives experiments under the Stockpile Stewardship and Management and Work for Others Programs and the use of aircraft under the Work for Others Program.

Principal noise sources with the largest potential to create an impact in long-term baseline noise conditions to offsite receptors include vehicles transporting workers and materials to the sites. Thus, potential noise impacts on offsite receptors were assessed by estimating the number of employees using privately owned vehicles and the number of shipments to and from the site (primarily under the Waste Management Program).

5.1.12.1 Normal Operations

Under all alternatives, existing sources of radiation exposure would continue to result in a potential radiation dose to the public. These existing sources include tritium from evaporation or evapotranspiration of water and resuspension of radioactive particulates in surface soils; both of these sources are from past nuclear weapons testing performed at the NNSS. Potential radiation doses from these activities are discussed in Chapter 4, Section 4.1.12. For this SWEIS analysis, these sources were estimated to result in a dose to the population of about 43,000 of about 0.47 person-rem per year and a dose to the MEI of 2.6 millirem per year (5-year average). Incremental doses from operational activities performed under each of the alternatives could add to these baseline doses.

5.1.12.1.1 No Action Alternative

Under the No Action Alternative, radioactive materials would be released as a result of some of the proposed activities. National Security/Defense Mission experiments would be performed with radioactive materials at JASPER and the U1a Complex, but the design of the facilities and experiments would not allow releases to the environment. Similarly, activities performed in Device Assembly Facility (DAF) would not release radioactive materials that could affect receptors outside of the facility. Activities that could result in additional radioactive emissions include experiments at the Dense Plasma Focus Facility. Waste management activities performed as part of the Environmental Management Mission would not result in radioactive air emissions that would be distinguishable from the tritium and particulate emissions from legacy contamination in the vicinities of the Area 3 RWMS and the Area 5 RWMC. Activities related to D&D and environmental restoration could result in additional radioactive air emissions from the resuspension of radioactive materials previously deposited on building surfaces or the ground. Nondefense Mission activities would not be expected to result in radioactive emission.

Table 5–51 presents the estimated annual doses to an MEI and to the population within 50 miles of projected emissions, and the associated annual risks of an LCF. As shown in Table 5–51, the incremental doses to the public from proposed activities at the site would be small compared to doses from baseline sources. The annual risk of an LCF to the MEI from the total dose of 2.8 millirem would be 2×10^{-6} (1 chance in 500,000 of an LCF). The calculated risk of 0.0003 LCFs to the surrounding population of approximately 54,000[6] means that the most likely outcome would be no additional LCFs in that population resulting from the estimated annual total population dose of 0.5 person-rem. Based on the premise that there is some risk associated with any radiation dose, the population risk of 0.0003 implies that there would be an annual risk of 1 chance in 3,300 of a single LCF in the population.

Table 5–51 Nevada National Security Site Annual Radiological Impacts of Normal Operations – No Action Alternative

Release Location	*MEI*		*Offsite Population within 50 Miles*	
	Dose (millirem)	***LCF Risk***	***Dose (person-rem)*** [a]	***LCF Risk***
Baseline from diffuse sources [b]	2.6	2×10^{-6}	0.47	3×10^{-4}
National Security/Defense Mission				
Dense Plasma Focus Facility (Area 11)	0.14	8×10^{-8}	0.027	2×10^{-5}
Environmental Management Mission				
Environmental restoration/D&D [c]	< 0.01	$< 6 \times 10^{-9}$	< 0.002	$< 1 \times 10^{-6}$
Total Offsite Impact	**2.8**	$\mathbf{2 \times 10^{-6}}$	**0.5**	$\mathbf{3 \times 10^{-4}}$

< = less than; D&D = decontamination and decommissioning; LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.

[a] The approximate populations within 50 miles of facilities are: Dense Plasma Focus Facility – 54,000.

[b] Baseline for the MEI is based on the dose reported in annual site environmental reports; the population dose is based on an historical calculation from a national emission standards for hazardous air pollutants report (DOE/NV 2005a, 2005f, 2006a, 2007d, 2008a, 2009d).

[c] Estimates based on projections for D&D of the Reactor Maintenance, Assembly, and Disassembly (R-MAD), the Engine Maintenance, Assembly, and disassembly (E-MAD), Pluto Facility, Building 26-2106 and environmental restoration of corrective action units 300 and 543. The annual doses to the MEI associated with any of these activities were less than 0.01 millirem. The population dose is based on the population-to-MEI dose ratio for the baseline for diffuse sources, which was assumed to have similar resuspension and dispersion/deposition characteristics.

A portion of the workers at the NNSS would receive a radiation dose in the course of performing their jobs. Under the No Action Alternative, activities would continue at approximately the same level as they have over the last few years. Therefore, it is expected that the number of workers receiving a measurable radiation dose and the average annual dose would continue at about the same level. About 75 workers would be expected to receive a measurable dose, with a collective worker dose of about 5.2 person-rem. The average annual dose would be about 70 millirem per worker.

The potential for occupational injury and illness was estimated for NNSA activities at the NNSS using rates based on DOE experience (DOE 2010i) and for activities associated with the construction and operation of a commercial solar power facility using general industrial experience (DOL 2010b, 2010c)

[6] *Differences in exposed populations are because different locations are used as the center of the 50-mile population, depending on the source of the emission.*

(see Appendix G for details). The number of total recordable cases (TRCs) and days away, restricted, or transferred (DART) cases were projected based on the number of FTEs estimated for this alternative. Under this alternative, a total of 32 TRCs and 14 DART cases are projected annually for all activities being performed at NNSS. NNSA operations at NNSS are estimated to result in 26 TRCs and 11 DART cases annually. Under this alternative, a commercial solar power facility could be constructed. Solar power facility operations would result in 6.2 TRCs and 3.2 DART cases annually. Construction of the solar power facility by 500 FTEs over a 35-month period is projected to result in 60 TRCs and 31 DART cases. The estimated annual risk of a fatality during the construction period is 0.019.

Noise Impacts. Under the No Action Alternative, construction of a new solar power generation facility would involve movement of workers and equipment and would result in localized, intermittent, and temporary increases in noise levels near the construction site. DOE would implement appropriate hearing protection programs to minimize noise impacts on workers during construction, including the use of administrative controls to ensure adherence to appropriate Occupational Safety and Health Act standards (29 CFR 1926.52), engineering controls, and personal hearing protective equipment.

High-explosives experiments under the Stockpile Stewardship and Management and Work for Others Programs would be conducted at BEEF and other locations in the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, and 16). To protect onsite workers and visitors, an exclusion zone would be established around an experiment based on the size of the explosion and the predicted noise levels. During preparations, only authorized personnel would be allowed in the vicinity of the experiment and would be required to wear personal protective equipment. All personnel would be prevented from entering the exclusion zone during the performance of the experiment. Under the No Action Alternative, up to 30 conventional high-explosives experiments (using up to 70,000 pounds of TNT-equivalent explosives) per year would occur at BEEF or other locations within the Nuclear and High Explosives Test Zone at the NNSS. These detonations would be conducted under ground and in the open air. It is estimated that a detonation of a 70,000-pound TNT-equivalent explosive could result in noise levels of 160 dB at 1 mile from a blast site (DTRA 1981). At this noise level, a human without hearing protection could experience tinnitus (or “ringing” of the ears); however, it is expected that this level would decrease substantially to barely audible levels at distances beyond the NNSS boundary. Potential noise impacts on residents in areas adjacent to the NNSS would be minimal, because the NNSS is in a remote area and is buffered by the Nevada Test and Training Range to the north, east, and partially on the west. The distances from the closest location of high-explosives experiments (within the Nuclear and High Explosives Test Zone) to the NNSS site boundary (not buffered by the Nevada Test and Training Range) and to the nearest community (Amargosa Valley) are approximately 15 and 25 miles, respectively.

Periodic military training exercises at the NNSS under the Work for Others Program would include the operation of manned and unmanned aerial vehicles, including fixed-wing aircraft (airplanes) and helicopters, which would result in local noise levels ranging from 80 to 90 dBA (DOE 2001a). Flights associated with NNSS activities originate off site at various airports and military airfields and land at the Aerial Operations Facility (Area 6), Desert Rock Airport, and Yucca Lake Airstrip. The majority of flight activities occur within the NNSS boundary. Aerial vehicles would fly at altitudes and on flight paths approved by the Federal Aviation Administration (FAA) or military controllers. Noise impacts associated with use of these aerial vehicles would generally be limited to within the NNSS boundary or may be detected on U.S. Route 95, the closest publicly available area. Increases in noise levels from these activities would be intermittent and temporary and are not expected to result in any appreciable noise level increases to offsite receptors near the NNSS boundary. Worker hearing protection for these activities would be required, as necessary.

Potential noise impacts on offsite receptors from NNSS activities under the No Action Alternative would primarily result from traffic noise generated by privately owned vehicles of commuting employees (regular operations and construction); by trucks transporting waste and materials, and vehicles associated with the construction of the commercial solar power generation facilities. As discussed in Section 5.1.3.2, "Traffic," regional daily traffic volumes projected under this alternative would increase by up to approximately 35 percent from future baseline conditions on roadways analyzed (not including Mercury Highway, which mainly serves the NNSS and does not include any private residential areas) (Tables 5–18 and 5–19). The increase in daily vehicle trips by privately owned vehicles from construction workers related to commercial solar power generation facilities would increase baseline noise conditions along the main commuter routes to the NNSS; however, increases in traffic noise would generally occur during the morning and afternoon commuter hours. The increase in daily truck trips is not expected to increase baseline noise levels substantially along the primary highways leading to the NNSS because the truck transports would be distributed throughout the day.

5.1.12.1.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, the baseline dose from legacy source emissions would be the same as under the No Action Alternative. A higher level of activities would occur to support the National Security/Defense Mission, which would increase the release of radioactive materials. A larger number of experiments with high explosives would be performed at BEEF and other locations in the Nuclear and High Explosives Test Zone; some of these experiments would use a larger quantity of explosives than that used under the No Action Alternative. Additionally, 20 uncontained experiments would be conducted using depleted uranium. A larger number of experiments would also be performed at the Dense Plasma Focus Facility. Weapons maintenance, weapons disassembly, or both would be performed at DAF under the Expanded Operations Alternative; these activities, however, would not be expected to result in the release of radioactivity to the environment.

Studies using radioactive tracers in the open environment would be conducted under this alternative. These studies would use short-lived noble gas and particulate radionuclides that would be released above or below ground. The largest potential for offsite radiological impacts from typical tracer experiments is associated with the underground release of radioactive gases or particulates and their transport to the surface because larger quantities of radionuclides would be used for subsurface experiments. Because these experiments are still at the conceptual stage, the actual amounts of radioactive materials that might reach the surface and be available for transport to the public are unknown. For purposes of this SWEIS, it is assumed that the tracer experiments would comply with project-specific safety and environmental goals established to prevent exceeding the overall NNSS National Emission Standards for Hazardous Air Pollutants airborne radiation standard of 10 millirem per year to the MEI. For this SWEIS, it was assumed that the MEI annual dose limit goal from tracer studies would be 1 millirem per year for all experiments conducted.

Table 5–52 shows the calculated offsite doses that could occur under the Expanded Operations Alternative.

Under the Expanded Operations Alternative, the level of activity associated with experiments using radioactive materials would increase. There would also be new activities performed at DAF involving limited-life component exchanges in nuclear weapons or weapons disassembly that would result in worker doses. The number of workers receiving a radiation dose under this alternative was assumed to increase proportionally to the increase in the overall workforce (Section 5.1.4). Therefore, the number of workers receiving a measurable radiation dose would increase from 75 to about 94. Use of work practices and procedures to maintain exposures as low as reasonably achievable would continue; assuming the average dose remains at recent levels, the collective dose to the worker population would be about 6.6 person-rem.

Table 5–52 Nevada National Security Site Annual Radiological Impacts of Normal Operations – Expanded Operations Alternative

Release Location	Offsite Population			
	MEI		Population within 50 Miles	
	Dose (millirem)	LCF Risk	Dose (person-rem) [a]	LCF Risk
Baseline from diffuse sources [b]	2.6	2×10^{-6}	0.47	3×10^{-4}
National Security/Defense Mission				
BEEF high-explosives experiments (Area 4)	0.62	4×10^{-7}	0.067	4×10^{-5}
Dense Plasma Focus Facility (Area 11)	0.6	4×10^{-7}	0.27	2×10^{-4}
Tracer experiments [c, d]	< 1.0	$< 6 \times 10^{-7}$	0.076	5×10^{-5}
Environmental Management Mission				
Environmental restoration/D&D [e]	< 0.01	$< 6 \times 10^{-9}$	< 0.002	$< 1 \times 10^{-6}$
Total Offsite Impact	**4.8** [f]	$\mathbf{3 \times 10^{-6}}$	**0.89**	$\mathbf{5 \times 10^{-4}}$

< = less than; BEEF = Big Explosives Experimental Facility; D&D = decontamination and decommissioning; LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.

[a] The approximate populations within 50 miles of facilities are: BEEF – 10,500; DPFF – 54,000; and Area 5 (assumed location of tracer experiments) – 54,000.

[b] Baseline for the MEI is based on the dose reported in annual site environmental reports; the population dose is based on an historical calculation from a national emission standards for hazardous air pollutants report (DOE/NV 2005a, 2005f, 2006a, 2007d, 2008a, 2009d).

[c] The annual MEI dose for the tracer experiments is a proposed environmental goal.

[d] Values modeled using the MACCS2 computer code. For conservatism in modeling population dose impacts, tracer experiments were assumed to be conducted in Area 5 because it is closer to population centers. For the MEI calculation, the receptor was conservatively assumed to be at the closest BEEF site boundary location (9 miles east of BEEF).

[e] Estimates based on projections for D&D of R-MAD, E-MAD, Pluto Facility, Building 26-2106 and environmental restoration of corrective action units 300 and 543. The annual doses to the MEI associated with any of these activities were less than 0.01 millirem. The population dose is based upon the population-to-MEI dose ratio for the baseline for diffuse sources, which are assumed to have similar resuspension and dispersion/deposition characteristics.

[f] Note that derivation of this dose is based on highly conservative modeling assumptions and that mitigation measures and/or reductions in testing quantities, frequencies, or both would be invoked to ensure that the 10 millirem annual dose limit would not be exceeded.

The potential for occupational injury and illness was estimated for NNSA activities at the NNSS using rates based on DOE experience (DOE 2010i) and for activities associated with the construction and operation of a commercial solar power facility using general industrial experience (DOL 2010b, 2010c) (see Appendix G for details). Under this alternative, a total of 44 TRCs and 20 DART cases are projected annually for all activities being performed at NNSS. NNSA operations at NNSS are estimated to result in 32 TRCs and 14 DART cases annually. In addition, NNSA construction activities involving 250 FTEs per year would result in 3.8 TRCs and 1.7 DART cases annually. Under this alternative, a commercial solar power facility could be constructed. Solar power facility operations would result in 8.3 TRCs and 4.2 DART cases annually. Construction of the solar power facility by 750 FTEs over a 42-month period is projected to result in 110 TRCs and 31 DART cases. The highest estimated annual risk of a fatality for all construction activities is 0.031. The estimated risk of a fatality from NNSA construction activities at NNSS would be 0.0029 per year; the estimated annual risk of a fatality during construction of the commercial solar power facility is 0.029.

Noise Impacts. Under the Expanded Operations Alternative, potential onsite noise impacts would be similar to those described under the No Action Alternative; however, the frequency of increased noise levels would increase because the number of personnel and activities would be higher under this alternative. For example, as under to the No Action Alternative, aerial vehicles would be used for periodic military training exercises under the Work for Others Program; however, usage rates would increase under the Expanded Operations Alternative. Under the Stockpile Stewardship and Management and Work for Others Programs, up to 100 conventional high-explosives experiments per year would occur at BEEF and other locations within the Nuclear and High Explosives Test Zone at the NNSS. Although the experiments would still be limited to 70,000 pounds TNT-equivalent explosives at BEEF, up to 120,000 pounds TNT-equivalent explosives would be the maximum limit for experiments within the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, or 16). It is estimated that a detonation of a 120,000-pound TNT-equivalent explosive could result in a noise level of 160 dB at 1.2 miles from the blast site (DTRA 1981). Similar to the No Action Alternative, potential noise impacts on residents in areas adjacent to the NNSS would be minimal, as this noise level would substantially decrease with distance. Depending on meteorological conditions, a temporary rumbling sound, similar to distant thunder, may be detected in nearby communities (DTRA 1981).

Potential noise impacts on offsite receptors under the Expanded Operations Alternative would primarily result from traffic noise generated by privately owned vehicles of commuting employees and by trucks transporting waste and materials to and from the NNSS. As discussed in Section 5.1.3.2, "Traffic," regional daily traffic volumes projected for this alternative would increase by approximately 25 percent from future baseline conditions (Tables 5–18 and 5–19). The increase in daily vehicle trips by personnel vehicles would primarily increase baseline noise conditions along the main roadways leading to these sites; however, this would be limited to the morning and afternoon commuter hours. The increase in daily truck trips would moderately increase baseline noise levels along the primary highways leading to the NNSS.

5.1.12.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the baseline dose from existing sources at the NNSS would be the same as under the No Action Alternative. The number of experiments conducted in support of the National Security/Defense Mission at the Dense Plasma Focus Facility would be half of the number proposed under the No Action Alternative. Environmental restoration activities under the Environmental Management Mission would be performed at about the same level as under the No Action Alternative. **Table 5–53** presents the estimated doses from normal operations for the Reduced Operations Alternative.

Table 5–53 Nevada National Security Site Annual Radiological Impacts of Normal Operations – Reduced Operations Alternative

	MEI		*Offsite Population within 50 Miles*	
Release Location	***Dose (millirem)***	***LCF Risk***	***Dose (person-rem)* [a]**	***LCF Risk***
Baseline from diffuse sources [b]	2.6	2×10^{-6}	0.47	3×10^{-4}
National Security/Defense Mission				
DPFF (Area 11)	0.07	2×10^{-8}	0.013	8×10^{-6}
Environmental Management Mission				
Environmental restoration [c]	< 0.01	$< 6 \times 10^{-11}$	< 0.002	$< 1 \times 10^{-6}$
Total Offsite Impact	**2.7**	$\mathbf{2 \times 10^{-6}}$	**0.48**	$\mathbf{3 \times 10^{-4}}$

DPFF = Dense Plasma Focus Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.

[a] The approximate populations within 50 miles of facilities are: DPFF – 54,000.

[b] Baseline for the MEI is based on the dose reported in annual site environmental reports; the population dose is based on an historical calculation from a national emission standards for hazardous air pollutants report (DOE/NV 2005a, 2005f, 2006a, 2007d, 2008a, 2009d).

[c] Estimates based on projections for D&D of R-MAD, E-MAD, Pluto Facility, Building 26-2106 and environmental restoration of corrective action units 300 and 543. The annual doses to the MEI associated with any of these activities were less than 0.01 millirem. The population dose is based on the population-to-MEI dose ratio for the baseline for diffuse sources, which are assumed to have similar resuspension and dispersion/deposition characteristics.

Under the Reduced Operations Alternative, the level of activity associated with experiments using radioactive materials would decrease compared to the No Action Alternative. The number of workers receiving a radiation dose under this alternative was assumed to decrease slightly, proportional to the decrease in the overall workforce (Section 5.1.4). The number of workers receiving a measurable radiation dose would decrease from 75 to about 68. Use of work practices and procedures to maintain exposures as low as reasonably achievable would continue; assuming the average dose remains at recent levels, the collective dose to the worker population would be about 4.8 person-rem.

The potential for occupational injury and illness was estimated for NNSA activities at the NNSS using rates based on DOE experience (DOE 2010i) and for activities associated with the construction and operation of a commercial solar power facility using general industrial experience (DOL 2010b, 2010c) (see Appendix G for details). Under this alternative, a total of 28 TRCs and 13 DART cases are projected annually for all activities being performed at NNSS. NNSA operations at NNSS are estimated to result in 23 TRCs and 10 DART cases annually. Under this alternative, a commercial solar power facility could be constructed. Solar power facility operations would result in 5.2 TRCs and 2.7 DART cases annually. Construction of the solar power facility by 400 FTEs over a 32-month period is projected to result in 44 TRCs and 23 DART cases. The estimated annual risk of a fatality during the construction period is 0.015.

Noise Impacts. Under the Reduced Operations Alternative, potential noise impacts would be similar to those described under the No Action Alternative; however, the frequency of increased noise levels would decrease because the number of personnel and activities would be reduced under this alternative. Similar to the No Action Alternative, high-explosives experiments under the Stockpile Stewardship and Management and Work for Others Programs would be conducted at BEEF and other locations in the Nuclear and High Explosives Test Zone. Up to 10 conventional high-explosives experiments per year would occur at BEEF and up to 6 per year would occur at other locations at the NNSS under the Reduced Operations Alternative. The frequency of aerial vehicle usage for periodic military training exercises under the Work for Others Program would decrease compared to the No Action Alternative.

Potential noise impacts on offsite receptors under the Reduced Operations Alternative would primarily result from traffic noise generated by vehicles associated with the construction of the commercial solar power generation facilities and trucks transporting waste and materials to and from the NNSS. As discussed in Section 5.1.3.2, "Traffic," regional daily volumes projected for this alternative would increase by up to approximately 10 percent from future baseline conditions (Tables 5–18 and 5–19). The increase in daily vehicle trips by privately owned vehicles from construction workers related to commercial solar power generation facilities would increase baseline noise conditions along the main commuter routes to the NNSS; however, increases in traffic noise would generally occur during the morning and afternoon commuter hours. The increase in daily truck trips is not expected to increase baseline noise levels substantially along the primary highways leading to the NNSS because the truck transports would be distributed throughout the day.

5.1.12.1.4 Waste Disposal Facilities Performance Assessments

As addressed in Chapter 4, Section 4.1.11.1.1.3, radioactive waste disposal occurs at the NNSS in accordance with authorizations issued by DOE that consider analyses of possible long-term (over thousands of years) impacts on the public and the environment after the disposal facilities are closed. For disposal of LLW (and the radioactive component of MLLW), DOE requires preparation and maintenance of site-specific performance assessments and composite analyses in compliance with DOE Order 435.1. For disposal of TRU waste, DOE requires analyses in accordance with the requirements of "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes" (40 CFR Part 191).

Performance Assessment – An analysis of a radioactive waste disposal facility conducted to demonstrate that for waste disposed of after September 26, 1988, there is a reasonable expectation that performance objectives for the long-term protection of the public and the environment will not be exceeded following closure of the facility. The performance objectives address (1) doses to representative members of the public through all pathways, (2) doses to representative members of the public through the air pathway alone, and (3) release of radon gas. The analysis must also assess possible water resources impacts, as well as possible impacts on hypothetical future inadvertent intruders into the disposal facility.

Composite Analysis – An analysis that accounts for all sources of radioactive material that may contribute to the long-term dose projected to a hypothetical member of the public from an active or planned low-level radioactive waste disposal facility. The analysis is a planning tool intended to provide a reasonable expectation that current low-level radioactive waste disposal activities will not result in the need for future corrective or remedial actions to ensure protection of the public and environment. If the combined dose from all interacting sources exceeds 30 millirem (total effective dose equivalent) per year, as evaluated for a specified period, a cost-benefit analysis must be performed to determine whether cost-effective options exist to reduce the dose further (DOE 1999e).

LLW management performance. A combined Area 3 RWMS performance assessment and composite analysis was completed in July 2000. The Area 5 RWMC performance assessment was completed in 1998, and the Area 5 RWMC composite analysis was completed in 2001. The analyses determined that, because of the great excess of evapotranspiration over precipitation and other site-specific factors, there was little to no potential for transport of disposed radionuclides to groundwater. Further, the Intergovernmental Panel on Climate Change, in its Fourth Assessment Report estimates that although increases in precipitation extremes (such as storms associated with "El Niño" events) are possible for the Great Basin, annual-mean precipitation is projected to decrease in the southwest United States (IPCC 2007). This would tend to make it even more unlikely that a path to groundwater would develop in the future.

The analyses also concluded that all performance objectives would be met. The results of the initial performance assessments are summarized in **Table 5–54** for the air pathway, all pathways, groundwater protection, radon gas, and intruder performance objectives. The results of the initial composite analyses were well below the 30-millirem-per-year decision criterion for both the Area 3 RWMS and Area 5 RWMC.[7]

Subsequently, the performance assessment and composite analyses have been amended and updated annually to reflect new information such as revised estimates of disposed waste inventories or modifications to waste disposal operations (Chapter 4, Section 4.1.11.1.1.3). The updates have included enhanced probabilistic modeling techniques. The most recent review and update of the Area 3 and 5 performance assessments and composite analyses concluded that the results and conclusions of the performance assessments and composite analyses remained valid (NSTec 2010f).

[7] *The Area 5 composite analysis also considered the possible long-term impacts of TRU waste and other waste in the greater confinement disposal boreholes and TRU waste in the Area 5 trench.*

Table 5–54 Summary of Low-Level Radioactive Waste Disposal Facility Performance Assessments Results

Scenario	Performance Objective	*Area 5 RWMC* Scenario	*Area 5 RWMC* PA Result [a]	*Area 3 RWMS* Scenario	*Area 3 RWMS* PA Result [b]
Air pathway	10 millirem in a year	Transient occupancy [c]	0.17	U-3ah/at Community with agriculture [h]	2×10^{-3}
		Resident farmer [d]	0.77		
		Open rangeland/ Cane Spring [e]	4×10^{-4}	U-3bh Community with agriculture [i]	5×10^{-3}
All pathways	25 millirem in a year	Transient occupancy [c]	0.59	U-3ah/at Community with agriculture [h]	0.03
		Resident farmer [d]	3.4		
		Open rangeland/ Cane Spring [e]	0.17	U-3bh Community with agriculture [i]	0.01
Intruder protection	100 millirem in a year	SLB intruder agriculture [f]	160 [j]	U-3ah/at Intruder agriculture [f]	0.05
		SLB postdrilling intruder [g]	0.71	U-3bh Intruder agriculture [f]	0.03
				U-3ah/at Postdrilling intruder [g]	0.03
		Pit 6 postdrilling intruder [g]	0.90	U-3bh Postdrilling intruder [g]	0.05
Radon-222 flux density	20 pCi $/m^2$/second	SLB units	5.7	U-3ah/at	0.01
		Pit 6	5.7	U-3bh	6×10^{-3}
Groundwater protection	40 CFR Part 141	No groundwater pathway during compliance period.			

CFR = *Code of Federal Regulations*, PA = performance assessment, pCi/m^2/second = picocuries per square meter per second, RWMC = Radioactive Waste Management Complex; RWMS = Radioactive Waste Management Site; SLB = shallow land burial.

[a] Analysis over a 10,000-year period of compliance.
[b] Analysis over a 1,000-year period of compliance.
[c] Exposure scenario where receptors visit the closed site but do not reside at it.
[d] Exposure scenario involving receptor consumption of products from range-fed cattle that have access to the closed site.
[e] Exposure scenario where receptors live at a ranch established at the closed site boundary.
[f] Exposure scenario where an intruder lives in a house (with garden) constructed on top of a disposal unit assuming a temporary disruption in institutional controls following disposal site closure.
[g] Exposure scenario where an intruder lives in a house (with garden) on an area contaminated with cuttings from a well drilled through a disposal unit assuming a temporary disruption in institutional controls following disposal site closure.
[h] Exposure scenario where receptors live, garden, and manage livestock in a small community established at the site boundary; exposure occurs from radionuclides released to the air from Pit U-3ah/at.
[i] Exposure scenario where receptors live, garden, and manage livestock in a small community established at the site boundary; exposure occurs from radionuclides released to the air from Pit U-3bh.
[j] Calculated assuming continuation of the operational disposal unit cap. Installation of a thicker cap as part of closure of the Area 5 RWMC would reduce doses to levels in compliance with the performance objective limits (Bechtel Nevada 2000).

Source: Bechtel Nevada 2006.

Transuranic waste management performance. As discussed in Chapter 4, Section 4.1.11.1.1.3, DOE conducted analyses of compliance with EPA's TRU waste disposal requirements in 40 CFR Part 191 for the TRU waste disposed both intentionally in greater confinement disposal (GCD) boreholes and inadvertently in an Area 5 RWMC trench.[8] The EPA regulations were first promulgated in 1985 and revised in 1993; they include assurance requirements and three sets of quantitative safety requirements: (1) a containment requirement limiting the quantities of specific radionuclides that may be released over 10,000 years, (2) an individual protection requirement limiting the annual dose to be received by a member of the public, and (3) a groundwater protection requirement.

It was determined that disposal of TRU waste in the GCD boreholes and disposal trench would meet all applicable EPA containment, individual protection, and groundwater protection requirements. For both

[8] Unclassified records accompanying a shipment of about 1,100 cubic feet of classified waste indicated the shipment contained LLW. Subsequent investigation revealed the shipment contained TRU waste (NSTec 2008a).

analyses, it was determined that the projected cumulative releases would meet the probabilities specified in the EPA standard of exceeding specified quantities of radionuclides. Regarding the EPA individual protection requirement, the mean annual dose to a member of the public from all waste in the boreholes over 1,000 years was about 0.0062 millirem to the whole body and 0.12 millirem to bone. For the TRU waste inadvertently disposed of in the trench, the maximum total effective dose equivalent for a member of the public over 10,000 years was about 1.4 millirem in a year, predominantly from assumed inhalation of radon-222 progeny in air produced by LLW in the same trench. The results of both assessments indicated compliance with applicable EPA requirements. Regarding the EPA groundwater protection requirement, it was determined for the boreholes that the 1983 EPA standard did not specifically apply to the boreholes; for the TRU waste inadvertently disposed of in the trench site characterization and hydrologic processes modeling supported a conclusion of no groundwater pathway within 10,000 years (SNL 2001b; Shott et al. 2008).[9]

5.1.12.2 Facility Accidents

This section presents the estimated impacts of potential accidents. The analysis considered a range of accidents associated with the activities to be performed in support of the National Security/Defense, Environmental Management, and Nondefense Missions. The accidents for which detailed analyses were performed were those with the highest potential for offsite impacts. For each accident, the offsite population includes residents living within 50 miles of the accident location; the MEI, a hypothetical individual living along the site boundary in the direction of largest impact; and the noninvolved worker, a hypothetical individual assumed to be 110 yards from the accident location. Using the site boundary of the NNSS as the location of the MEI results in a conservative estimate of impacts because, for most of the site boundary, the Nevada Test and Training Range provides a buffer area between the NNSS and areas accessible to the general public. Since many accidents result in ground-level releases, a nominal distance of 100 meters (110 yards) was selected to provide a conservative indication of the dose a potential noninvolved worker might receive. In reality, any worker not directly involved in an activity or facility would likely be much further away. Operational safety practices, including emergency preparedness and training, would make it very unlikely that any worker would receive the high doses often associated with this closeby receptor location. Additional accident analysis details are included in Appendix G.

Public and worker radiological consequences and risks of hypothesized accidents at the NNSS under the No Action, Expanded Operations, and Reduced Operations Alternatives are presented in **Tables 5–55** and **5–56**. Because the same types of activities occur at the facilities under all of the alternatives, the accident scenarios and consequences would be the same across the alternatives. Differences in accident frequencies due to the level of operations are within the uncertainty range of the accident events. Table 5–51 presents the potential consequences of an accident—that is, the dose and corresponding LCF risk (for an individual) or number of LCFs (for the population), assuming the accident occurs. Table 5–52 combines the estimated frequency of the postulated accidents with the potential consequences to present the estimated annual risk of an LCF due to the accidents.

[9] *Although the groundwater protection requirement in the 1983 EPA standard did not strictly apply to the TRU waste in the boreholes (SNL 2001b), the conclusion reached in 2008 regarding the lack of a groundwater pathway for TRU waste inadvertently disposed of in the trench (Shott et al. 2008) would be expected to apply to the boreholes as well.*

Table 5–55 Nevada National Security Site Facility Accident Radiological Consequences – No Action, Expanded Operations, and Reduced Operations Alternatives

	Offsite Population					
	Maximally Exposed Individual		*Population within 50 Miles*		*Onsite Noninvolved Worker*	
Accident Scenario	*Dose (rem)*	*LCF Risk* [a]	*Dose (person-rem)*	*Number of LCFs* [b]	*Dose (rem)*	*LCF Risk* [a]
National Security/Defense Mission						
DAF explosion involving 55 pounds of high explosives and 1 kilogram of plutonium	0.18	1×10^{-4}	23	$0\ (1 \times 10^{-2})$	6.5	4×10^{-3}
DAF design basis earthquake	0.86	5×10^{-4}	113	$0\ (7 \times 10^{-2})$	2,800	1 [c]
Criticality Experiment Facility Godiva -burst reactivity induced accident	0.00045	3×10^{-7}	0.059	$0\ (4 \times 10^{-5})$	1.5	9×10^{-4}
Criticality Experiment Facility beyond-design-basis vault fire – unmitigated	0.022	1×10^{-5}	2.9	$0\ (2 \times 10^{-3})$	74	9×10^{-2}
Criticality Experiment Facility beyond-design-basis Godiva excess reactivity insertion	0.048	3×10^{-5}	6.3	$0\ (4 \times 10^{-3})$	130	2×10^{-1}
JASPER UCVS failure	2.9×10^{-7}	2×10^{-10}	9.9×10^{-5}	$0\ (6 \times 10^{-8})$	0.00091	5×10^{-7}
JASPER Target Building fire	8.0×10^{-9}	5×10^{-12}	2.8×10^{-6}	$0\ (2 \times 10^{-9})$	2.5×10^{-5}	2×10^{-8}
Tracer surface explosion of short-lived particulates (Expanded Operations Alternative only)	0.45	3×10^{-4}	0.81	$0\ (5 \times 10^{-4})$	6.7	8×10^{-3}
Environmental Management Mission – Waste Management Program						
Area 5 – transuranic waste container – vehicle impact and fire	0.36	2×10^{-4}	0.65	$0\ (4 \times 10^{-4})$	7.9	5×10^{-3}
Area 5 – classified transuranic material container - vehicle impact and fire	0.83	5×10^{-4}	1.8	$0\ (1 \times 10^{-3})$	20.5	2×10^{-2}
Area 5 design basis earthquake	0.020	1×10^{-5}	0.043	$0\ (3 \times 10^{-5})$	0.49	3×10^{-4}
Area 5 TRUPACT Type A container drop, breach, and fire	1.6	1×10^{-3}	3.4	$0\ (2 \times 10^{-3})$	39	5×10^{-2}
Environmental Management Mission – Environmental Restoration Program [d]						
One-container spill	4.8×10^{-7}	3×10^{-10}	8.7×10^{-7}	5×10^{-10}	1.0×10^{-5}	6×10^{-9}
Three-container fire	3.6×10^{-6}	2×10^{-9}	7.8×10^{-6}	5×10^{-9}	8.8×10^{-5}	5×10^{-8}
Aircraft crash and fire	0.047	3×10^{-5}	0.090	5×10^{-5}	1.0	6×10^{-4}

DAF = Device Assembly Facility; JASPER = Joint Actinide Shock Physics Experimental Research; LCF = latent cancer fatality; rem = roentgen equivalent man; TRUPACT = Transuranic Packaging Transporter; UCVS = ultrafast closure valve system.

[a] Increased risk of an LCF to an individual, assuming the accident occurs. The risk value is doubled for individual doses exceeding 20 rem (NCRP 1993).

[b] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number. The result calculated by multiplying the collective population dose by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

[c] Because this represents the increased likelihood of an individual developing an LCF, a value of 1 indicates that the person would likely develop a cancer if prompt death did not occur from acute exposure. The value cannot exceed 1.

[d] Environmental restoration accidents assumed to occur at the Area 5 RWMC.

Table 5–56 Nevada National Security Site Facility Accident Radiological Risks [a] – No Action, Expanded Operations, and Reduced Operations Alternatives

Accident	*Frequency [b]*	*Offsite Population*		*Onsite Noninvolved Worker*
		Maximally Exposed Individual	*Population within 50 Miles*	
National Security/Defense Mission				
DAF explosion involving 55 pounds of high explosives and 1 kilogram of plutonium	8×10^{-4}	9×10^{-8}	1×10^{-5}	3×10^{-6}
DAF design basis earthquake	10^{-6} to 10^{-7}	5×10^{-10}	7×10^{-8}	1×10^{-6}
Criticality Experiment Facility Godiva – burst reactivity induced accident	10^{-2} to 10^{-4}	3×10^{-9}	4×10^{-7}	9×10^{-6}
Criticality Experiment Facility beyond-design-basis vault fire – unmitigated	$< 10^{-6}$	1×10^{-11}	2×10^{-9}	9×10^{-8}
Criticality Experiment Facility beyond-design-basis Godiva excess reactivity insertion	$< 10^{-6}$	3×10^{-11}	4×10^{-9}	2×10^{-7}
JASPER UCVS failure	10^{-1} to 10^{-2}	2×10^{-11}	6×10^{-9}	5×10^{-8}
JASPER Target Building fire	10^{-4} to 10^{-6}	5×10^{-16}	2×10^{-13}	2×10^{-12}
Tracer surface explosion of short-lived particulates (Expanded Operations Alternative only)	10^{-4} to 10^{-6} per test	3×10^{-8}	5×10^{-8}	4×10^{-7}
Environmental Management Mission – Waste Management Program				
Area 5 – transuranic waste container - vehicle impact and fire	10^{-4} to 10^{-6}	2×10^{-8}	4×10^{-8}	5×10^{-7}
Area 5 – classified transuranic material container - vehicle impact and fire	10^{-4} to 10^{-6}	5×10^{-8}	1×10^{-7}	2×10^{-6}
Area 5 design basis earthquake	5×10^{-4}	5×10^{-9}	2×10^{-8}	2×10^{-7}
Area 5 TRUPACT Type A container drop, breach and fire	10^{-4} to 10^{-6}	1×10^{-7}	2×10^{-7}	5×10^{-6}
Environmental Management Mission – Environmental Restoration Program [c]				
One-container spill	3×10^{-2}	9×10^{-12}	2×10^{-11}	2×10^{-10}
Three-container fire	4×10^{-6}	8×10^{-15}	2×10^{-14}	2×10^{-13}
Aircraft crash and fire	1.2×10^{-6}	4×10^{-11}	6×10^{-11}	7×10^{-10}

< = less than; DAF = Device Assembly Facility; JASPER = Joint Actinide Shock Physics Experimental Research; TRUPACT = Transuranic Packaging Transporter; UCVS = ultrafast closure valve system.

[a] The risk is the annual increased likelihood of an LCF in the MEI or noninvolved worker and the increased likelihood of a single LCF occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.

[b] The estimated frequency is on an annual basis unless noted otherwise.

[c] Environmental restoration accidents assumed to occur at the Area 5 RWMC.

5.1.12.2.1 No Action Alternative

As part of its National Security/Defense Mission, the NNSS retains an ongoing role in stockpile stewardship and management activities. Activities that would result in the largest offsite radiological consequences and highest radiological risk include accidents at DAF that might result in the explosive dispersal of plutonium from the building. Other experimental activities, such as those at BEEF, JASPER, and the U1a Complex, involve smaller quantities of radioactive material with limited potential for accidental dispersal in quantities that would have impacts on persons other than involved workers. The accident risks for many of the activities under the Stockpile Stewardship and Management Program are small and have no reasonably foreseeable accident scenarios that would likely result in exposure to noninvolved workers or the public.

The accidents with the highest potential consequences and highest radiological risks are shown in Tables 5–51 and 5–52. The highest consequence and risk accidents are those associated with accidents at DAF. At DAF, there are both large quantities of radioactive materials and explosives in close proximity, so there is a potential mechanism to disperse the radioactive material and release it to the atmosphere. Because DAF is designed for these activities, all of the accidents that would result in release of radioactive material to the environment would require extremely unlikely failure of multiple safety systems. The maximum reasonably foreseeable accidents at DAF could result in the explosive dispersal of 1 to 5 kilograms of plutonium and have estimated probabilities in the range of 1×10^{-6} to 8×10^{-4} per year of operation. The highest consequence accident would be an earthquake-initiated accident. If the accident were to occur, the MEI would receive a dose of 0.86 rem, corresponding to an LCF risk of 0.0005 (1 chance in 2,000). The offsite population of about 42,100 within 50 miles of DAF would receive a dose of 113 person-rem; the calculated number of LCFs associated with this dose is 0.07, implying that the most likely outcome would be no additional LCFs in the exposed population. An involved worker within DAF could be fatally injured in the seismically induced explosion. A noninvolved worker outside of DAF could receive a dose of 2,800 rem, resulting in an acute fatality due to receipt of a lethal dose. When the annual probability of the accident occurring is taken into account, the increased risk of an LCF to the MEI would be 5×10^{-10} (1 chance in 2 billion); the increased risk of a single LCF in the exposed population would be 7×10^{-8} (1 chance in 14 million); and the increased risk of an LCF to a noninvolved worker would be 1×10^{-6} (1 chance in 1 million).

Maximum Reasonably Foreseeable Accident

A maximum reasonably foreseeable accident is an accident with the most severe consequences that can reasonably be expected to occur.

The DAF accident that presents the highest risk to the public, that is, when the probability of the accident occurring is considered in conjunction with the consequences of the accident, would be an explosion in DAF followed by the release of a kilogram of plutonium. As shown in Table 5–52, the consequences of this accident would be less than those of the earthquake accident discussed previously. However, because this accident is estimated to be more likely to occur, the overall risk to the public is higher. The explosion followed by a plutonium release accident represents a latent cancer fatality risk to the MEI of 9×10^{-8} (1 chance in 11 million), the risk of a single latent cancer fatality in the population of 1×10^{-5} (1 chance in 100,000), and a latent cancer fatality risk to a noninvolved worker of 3×10^{-6} (1 chance in 300,000).

More-severe accidents at DAF would have much lower probabilities than the explosions that result in dispersion of plutonium. The highest potential consequence accident that has been postulated in DAF safety analyses is an inadvertent nuclear detonation. The physical conditions that would be required to get the plutonium and explosive materials in a configuration that might result in a nuclear yield are extraordinarily unlikely. It is much more likely that accidents involving both high explosives and plutonium would just result in explosive dispersal of plutonium with no nuclear yield. An inadvertent nuclear yield accident is considered in the DAF safety analyses as a beyond design basis accident and safety controls are in place to prevent such an accident. The safety controls that prevent the explosive dispersal of plutonium would also prevent the conditions that might result in an inadvertent detonation. The DAF safety analyses indicate that "this event has a vanishingly small likelihood (i.e., below 10^{-6} per year)" and at least two orders of magnitude less likely than a high explosive dispersal accident. When the mitigation controls are considered, the likelihood of an inadvertent nuclear yield occurring as a result of an accident is expected to far below the 10^{-6} to 10^{-7} per year range and is not considered further in this SWEIS.

No reasonably foreseeable major accident scenarios different than those evaluated for the Stockpile Stewardship and Management Program would occur under the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. A number of activities would involve experiments using radioactive materials in the form of sealed sources or well-packaged, unopened materials, for which substantial radiological accidents would not be expected.

The activities included in this program include the disposition of a damaged U.S. nuclear weapon and disposition of an improvised nuclear devise or radiological dispersion device. U.S. nuclear weapons are designed with multiple layers of safeguards to prevent the accidental detonation of a weapon, even a damaged weapon. These safeguards and the design knowledge that would be available to personnel handling the weapon would be expected to prevent an inadvertent detonation. Therefore, the potential radiological impacts associated with managing a damaged U.S. nuclear weapon are expected to be comparable to the accident scenarios identified for DAF. An improvised nuclear device or radiological dispersion device is considered the result of an intentional destructive act; intentional destructive acts are discussed later in this section and analyzed in a classified appendix.

No reasonably foreseeable major accident scenarios different than those evaluated for the Stockpile Stewardship and Management Program that could result in public or noninvolved workers exposure were identified for the Work for Others Program. All activities at shared facilities, such as BEEF, NPTEC, RNCTEC, and the T-1 Training Area, present extremely low risks to the public and noninvolved workers.

Under the Environmental Management Mission, Waste Management Program, activities that have the potential for accidents that might result in offsite radiological consequences all involve impact and a subsequent fire involving containers with large quantities of radioactive material. In all cases, these containers are designed and maintained in such a configuration that vehicle impacts are very unlikely and rupture of a container and a subsequent fire are even less likely. All of the accidents that might result in a substantial release of radioactive materials from the container are classified as "extremely unlikely," with an estimated probability of occurrence of 10^{-6} to 10^{-4} (1 chance in 10,000 to 1 million) per year. Because wastes are typically stored in containers that would be appropriate for over-the-road transportation, the likelihood that an onsite impact would substantially damage one or more containers is low.

Many of the activities under the Waste Management Program have no reasonably foreseeable accident scenarios that could result in public or noninvolved workers exposure.

The accidents with the highest potential consequences, as shown in Table 5–51, are those associated with the breach of a waste container in conjunction with a fire at the Area 5 RWMC. In these cases, there are both radioactive materials and combustible materials within waste packages, so there is a potential mechanism to disperse the radioactive material and release it to the atmosphere if the waste package is breached and ignition occurs. Because the waste packages and waste handling and storage practices are designed to protect waste while in storage, all of the accidents that would result in release of radioactive material to the environment would require a failure of multiple safety systems. The maximum reasonably foreseeable accident at the Area 5 RWMC is a container rupture due to impact and a subsequent fire that results in dispersal of up to 126 grams of plutonium. The estimated probability of this type of event is in the range of 10^{-6} to 10^{-4} (1 chance in 10,000 to 1 million) per year of operation. If this accident were to occur, the MEI would receive a dose of 1.6 rem, which corresponds to an LCF risk of 0.001 (1 chance in 1,000). The offsite population of about 54,000 within 50 miles would receive a dose of 3.4 person-rem; the calculated number of LCFs associated with this dose is 0.002, implying that the most likely outcome would be no additional LCFs in the exposed population. A noninvolved worker within Area 5 could receive a dose of 39 rem. This dose could result in radiological injury without prompt medical treatment and represents an LCF risk of 0.05 (1 chance in 20). When the annual probability of the accident occurring is taken into account, the increased risk of an LCF to the MEI would be 1×10^{-7} (1 chance in 10 million); the increased risk of a single LCF in the exposed population would be 2×10^{-7} (1 chance in 5 million); and the increased risk of an LCF to a noninvolved worker would be 5×10^{-6} (1 chance in 200,000).

For Environmental Restoration Program activities at the NNSS, the analyzed accident would involve the release of radioactive material due to a single container spill, a multiple container fire, or an aircraft crash into multiple containers. These accidents could occur any place on the NNSS where environmental remediation occurs. For purposes of analysis, these accidents were modeled as occurring at the Area 5 RWMC; because this location is towards the southern end of the site and near the site boundary, the population and MEI doses would be conservative. The preceding paragraph discusses accidents associated with the Waste Management Program at the Area 5 RWMC that have a higher estimated frequency than an airplane crash. Only small quantities of radiological materials would be involved and potentially released. The maximum reasonably foreseeable accident for the NNSS Environmental Restoration Program activities is a military aircraft crash that results in a large fire in which a large quantity of contaminated soil is involved in the fire. The estimated probability of this type of event is 1.2×10^{-6} (1 chance in 800,000) per year of operation. If this accident were to occur, the MEI would receive a dose of 0.047 rem, with a corresponding LCF risk of 3×10^{-5} (1 chance in 33,000). The offsite population of 54,000 within 50 miles would receive a dose of 0.09 person-rem; the calculated number of LCFs associated with this dose is 5×10^{-5}, implying that the most likely outcome would be no additional LCFs in the exposed population. A noninvolved worker outside the immediate area of the crash could receive a dose of 1.0 rem, with an associated LCF risk of 6×10^{-4} (1 chance in 1,700). When the probability of the accident is taken into consideration, the risk to the offsite public or a noninvolved worker would be essentially zero (7×10^{-10} [1 chance in 1 billion] or less).

No accidents specific to the Nondefense Mission were identified that would present any relevant accident scenarios other than those already addressed for other missions.

Accidents involving hazardous chemicals. The potential for accidents involving hazardous chemicals to affect noninvolved workers or the public is quite limited. The potential for hazardous chemical impacts on the public was evaluated in the *1996 NTS EIS* (DOE 1996c) and no substantial impacts were found. Consistent with current practice, inventories of hazardous chemicals would be maintained and reported annually to the State of Nevada. Those inventories imply that only small quantities of most types of hazardous chemicals are used at the NNSS and that these chemicals present accident risks primarily to workers directly handling the chemicals. DOE safety programs are in place to minimize the risks to workers from both routine operations and accidents involving these materials. The larger quantities of hazardous materials that would be unique to NNSS-type activities include large quantities of lead metal typically used for shielding, but these materials do not present an accident risk.

Regarding risks from handling toxic or hazardous chemicals, worker safety programs at the NNSS are enforced via required adherence to Federal and state laws, DOE orders, Occupational Safety and Health Administration (OSHA) and EPA guidelines, and plans and procedures for performing work, including training, monitoring, use of personal protective equipment, and administrative controls. Although chemical inventories have varied to a limited extent over recent years, administrative controls continually ensure that quantities do not approach those levels that pose undue risk due to storage, concentration, bulk quantity, or logistical factors. Any amount(s) that potentially exceed threshold planning quantities require reporting under Federal regulations (40 CFR Part 355, 40 CFR Part 370). Over the last 4 years, no hazardous chemicals have been stored on site in quantities sufficient to exceed the threshold planning quantities for that chemical and trigger the need to implement OSHA Process Safety Management requirements to prevent or mitigate accidental releases.

Because of the NNSS's remote location and large size, there is limited risk of chemical exposure to the surrounding public population resulting from normal site operations or accidents. Nevertheless, monitoring efforts and baseline studies are regularly performed. However, certain workers at the NNSS are at risk of chemical exposure, depending on their job function and proximity to various sources.

Some experiments proposed under the alternatives would involve use of hazardous chemicals and their intentional release to the atmosphere. For purposes of this analysis, the releases of these chemicals were treated as sporadic, planned releases rather than accidental releases. For example, small quantities of beryllium and lithium may be released to the atmosphere by experiments involving nuclear explosive-like devices. These proposed experiments would have specific job safety hazards analysis, as required by DOE rules, that would minimize potential impacts.

At NPTEC, future experimental activities could include evaluating the potential impacts of releasing larger quantities of chemicals; inadvertent release of a large quantity of chlorine has been identified as the expected limiting chemical accident. Any proposed experiments would undergo a through environmental and safety review prior to authorization of an experiment involving large quantities of hazardous materials. In most cases, an accident involving such hazardous materials would release the materials in an unplanned and uncontrolled manner. In the event of an accident, a release would occur that was not in accordance with proper experimental procedures. Workers may not be properly sheltered and weather conditions may not be the same as those for planned experiments. As such, accidents involving the hazardous materials have the potential to affect both involved and noninvolved workers, and to release the materials at a higher rate than planned in the controlled experiment.

To evaluate the potential environmental impacts of an accident related to future experiments at the NNSS involving hazardous chemicals, a large, accidental chlorine gas release from a railcar at the Nonproliferation Test and Evaluation Complex was postulated. This hypothetical accident is expected to be in the "extremely unlikely" to "beyond extremely unlikely" frequency category, i.e., in the 10^{-4} to 10^{-6} per year or lower frequency range. Catastrophic accidents involving a full, 90-ton railcar of chlorine have resulted in fatalities, including the January 6, 2005, accident that resulted in puncture of a 90-ton chlorine railcar in Graniteville, South Carolina. In that accident, about 60 tons of chlorine escaped through a fist-sized hole in one of the railcars and nine people were killed (NTSB 2005).

Modeling results with ALOHA, assuming the release occurs quickly over 1 hour, indicate that potentially fatal concentrations (exceeding Emergency Response Planning Guideline level 3 concentrations [ERPG-3]) could extend downwind a few miles under typical daytime conditions and for 5 to 6 miles or more under stable nighttime conditions. Concentrations that could lead to potentially serious impacts (exceeding ERPG-2) could extend downwind even further, as could concentrations that could lead to odor and irritation (exceeding ERPG-1). In real-world accidents, the releases have occurred over many hours and resulted in lower concentrations than predicted in the models. Because of the nature of chlorine, the complexities of trying to model such a complex accident, and the dispersion of the heavier-than-air gas, these results have a high degree of uncertainty. If such an accident were to occur at the NNSS, it would likely not affect members of the public because of the long distances to publicly accessible locations. The remote location of the facility on the NNSS and the additional buffer provided by the Nevada Test and Training Range would keep members of the public at least 8 miles away. Involved or noninvolved workers could be exposed to fatal concentrations of the gas at the outset of the accident. Once an accident condition was recognized, in accordance with procedures and training, workers would be take actions to protect themselves and emergency response teams would intervene and evacuate personnel and implement measures to reduce or stop the leak.

For the Area 5 hazardous waste storage area, the maximum reasonably foreseeable accidents identified in the *1996 NTS EIS* still represent a reasonable upper range of accidents, although those quantities of hazardous materials have not typically been present and would not be expected under any of the alternatives. **Table 5–57** presents the results of the chemical accident analysis for all alternatives.

Table 5–57 Nevada National Security Site Facility Accident Chemical Risks – No Action, Expanded Operations, and Reduced Operations Alternatives

Accident	Frequency	*Offsite Population* Maximally Exposed Individual	Onsite Noninvolved Worker
Environmental Management Mission – Waste Management Program			
Area 5 Chemical Area WMH2: explosion/fire in multiple hazardous waste containers.	8×10^{-5}	None	ERPG-3 [a]
Area 5 Chemical Area WMH3: airplane crash into hazardous waste storage unit.	$< 1 \times 10^{-7}$	None	ERPG-3 [a]
WMH1, Area 5	2.96×10^{-2}	None	ERPG-3 [a]
NDRDH1, Area 5	1.7×10^{-2}	None	ERPG-3 [a]
NDRDH2, Area 5	1×10^{-4}	None	ERPG-3 [a]
NDRDH3, Area 5	1.7×10^{-7}	ERPG-1	ERPG-3 [a]
Nonproliferation Test and Evaluation Complex	1×10^{-4} to 1×10^{-6}	ERPG-1	ERPG-3 [a]

ERPG = Emergency Response Planning Guideline.
[a] The concentration at the location of the onsite noninvolved worker (110 yards away) would exceed the American Industrial Hygiene Association's Emergency Response Planning Guideline level 3 (ERPG-3).

5.1.12.2.2 Expanded Operations Alternative

The potential accident impacts under the Expanded Operations Alternative at the NNSS would be similar to those under the No Action Alternative. Although some activities would expand under this alternative and some new activities would occur, the radiological and hazardous chemical accident impacts would be the same as for the accidents identified under the No Action Alternative. New activities would include assessing the performance of limited-life component exchanges on nuclear weapons and dismantling nuclear weapons removed from the stockpile. These activities would occur in DAF, which was designed and constructed specifically to safely perform these activities. The largest credible accident at DAF, an earthquake that involves the release of 5 kilograms of plutonium-equivalent material, would result in the most conservative impacts of any credible accident at DAF.

Under the Expanded Operations Alternative, the level of some activities would increase. Given the uncertainty in accident frequency estimation for accidents that are not expected to happen within the operating lifetime of a facility or activity, the overall accident frequencies would remain within the broad frequency categories, such as "extremely unlikely" (10^{-6} to 10^{-4} [1 chance in 10,000 to 1 million] per year). Because more experiments would be performed, the risk of an accident would increase slightly under the Expanded Operations Alternative.

Under the Expanded Operations Alternative, tracer experiments would be performed. These studies would use short-lived noble gas and particulate radionuclides that would be released above or below ground. Because these experiments are still at the conceptual stage, the actual amounts of radioactive materials that might be used are unknown. For purposes of this SWEIS, it was assumed that a container with the maximum quantity of each of the short-lived radioactive particulates was accidentally explosively released on the surface rather than underground. The accident consequences and risks for the Expanded Operations Alternative would be similar to those under the No Action Alternative and are presented in Tables 5–51, 5–52, and 5–53.

5.1.12.2.3 Reduced Operations Alternative

The potential accident impacts under the Reduced Operations Alternative would be similar to those under the No Action Alternative. Although some activities would be reduced and others eliminated, all of the radiological and hazardous chemical accident scenarios that exist under the No Action Alternative would still be relevant. Accidents at the NNSS that could potentially affect noninvolved workers or the public would be the same under this alternative as the accidents identified under the No Action Alternative. None of the reduced activities was found to make more than negligible changes in the radiological or chemical impacts on noninvolved workers, the public, or the environment.

With reduced activities, the frequencies of some hazardous activities that might lead to accidents could change. Even with these changes, given the uncertainty in accident frequency estimation for very rare accidents not expected to happen within the operating lifetime of a facility or activity, the overall accident frequencies would still remain within the broad frequency categories, such as "extremely unlikely" (10^{-4} to 10^{-6} per year).

The accident risks for the Reduced Operations Alternative at the NNSS would be similar to those under the No Action Alternative, which are presented in Tables 5–51, 5–52, and 5–53. No accidents were identified under the Reduced Operations Alternative that would represent a change in accident risks.

5.1.12.3 Intentional Destructive Acts

The impacts analysis of intentional destructive acts is described in a classified appendix to this SWEIS. The impacts of some intentional destructive acts would be similar to the accident impacts described earlier in this section, while some intentional destructive acts may have more-severe impacts. This section describes how NNSA assesses the vulnerability of its sites to terrorist threats and designs its response systems.

5.1.12.3.1 Assessment of Vulnerability to Terrorist Threats

In accordance with DOE Order 470.3B, "Graded Security Protection Policy," and DOE Order 470.4A, "Safeguards and Security Program," NNSA conducts vulnerability assessments and risk analyses of the facilities and sites under its management to evaluate the possible threats and the protection elements, technologies, and administrative controls used to protect against these threats. DOE Order 470.4A establishes the roles and responsibilities for the conduct of DOE's Safeguards and Security Program. DOE Order 470.3B establishes requirements designed to prevent unauthorized access, theft, diversion, or sabotage (including unauthorized detonation or destruction) of all nuclear weapons, nuclear weapons components, and SNM under DOE's control. Among other provisions, the order (a) specifies those national security assets that require protection; (b) outlines threat considerations for safeguards and security programs to provide a basis for planning, design, and construction of new facilities or modifications to existing facilities; and (c) provides an adversary threat basis for evaluating the performance of safeguards and security systems. NNSA also protects against espionage and sabotage, as well as theft of radiological, chemical, or biological materials; classified matter; non-nuclear weapon components; and critical technologies.

NNSA's safeguards and security programs and systems employ state-of-the-art technologies to accomplish the following:

- Deny access to nuclear weapons, nuclear test devices, and completed nuclear assemblies
- Prevent theft, sabotage, or an unauthorized nuclear yield (criticality) of SNM and credible rollup quantities of SNM
- Protect the public and employees from unacceptable impacts resulting from an adversary's use of radiological, chemical, or biological materials
- Protect classified matter and designated critical facilities and activities from sabotage, espionage, and theft

NNSA's vulnerability assessments employ a rigorous methodology based on guidance from the September 2004 *DOE Vulnerability Assessment Process Guide* and the Vulnerability Assessment Certification course. Typically, a vulnerability assessment involves analyses of modeling, simulation, and performance testing results by subject matter experts to determine the effectiveness of a safeguard and security system against an adversary's objectives.

Vulnerability assessments generally include the following activities:

Characterizing the threat. Threat characterization provides a detailed description of a malevolent adversary's physical threat to a site's physical protection systems. Usually the description includes information about potential adversary types, motivations, objectives, actions, physical capabilities, and site-specific tactical considerations. Much of the information required to develop a threat characterization is described in DOE Order 470.3B and the Adversary Capabilities List. DOE also issues additional site-specific threat clarification and guidance.

Determining the target. Target determination involves identifying, describing, and prioritizing potential targets among NNSA's security interests that meet the criteria outlined in DOE Order 470.3B. Target determination results are used to help characterize potential threats and target facilities, as well as protective force and neutralization requirements.

Defining the scope. The scope of a vulnerability assessment is determined by agreement among DOE Headquarters, Field staff, and contractor personnel. In addition to defining the threat and applicable targets to be assessed, the scope establishes the key assumptions and interpretations that will guide the analyses, as well as the objectives, methods, schedule, personnel responsibilities, and format for documenting the results of the assessment.

Characterizing the facility or site. This activity requires defining and documenting aspects of the facility or site, particularly existing security programs (personnel security, information security, physical security, material control and accountability, etc.), to assist in identifying strengths and weaknesses. Results are used as inputs to the pathway analyses used to develop representative case scenarios for evaluating the security system. Facility and site characterization modeling tools include Analytical System and Software for Evaluating Safeguards and Security (ASSESS), Adversary Time-Line Analysis System (ATLAS), VISA, tabletop analysis, and others.

Characterizing the protective force. To assess a facility or site's vulnerability, analysts must accurately characterize the associated protective force's capabilities against a defined threat and objective, particularly the force's ability to detect, assess, respond to, interrupt, and neutralize an adversary. Specific data used for this activity include SNM categorization; configuration, flow, as well as movement of SNM within or from a facility or site; defined threats; detection and assessment times; and adversary delay and task time. The protective force's equipment, weapons, number, and locations also are considered in the characterization. The characterization information is validated and verified via observation, alarm response assessments, limited scope performance tests, force-on-force exercises, Joint Conflict and Tactical Simulations (JCATS) software, and tabletop analyses. The JCATS software tool is used for training, analysis, planning, and mission rehearsal, as well as characterization of the protective force. It employs detailed graphics and models of buildings, natural terrain features, and roads to simulate realistic operations in urban and rural environments.

Analyzing adversary pathways. This activity identifies and analyzes base case adversary pathways based on the results of threat, target, facility, and protective force characterization, as well as ancillary analyses such as explosives analysis. ASSESS and ATLAS are two primary tools used in this analysis. Analysts also conduct insider analysis as part of this activity.

Developing base case scenarios. Base case scenarios are developed for use in performance testing and to determine the effectiveness of the security system in place against a potential adversary's capabilities and objectives. As part of this activity, data from the base case adversary pathways analyses are used to identify applicable threats, threat strategies, and objectives, and combined with protective force strategies and capabilities to develop scenarios that include specific adversary resources, capabilities, and projected task times to complete their objectives successfully. Specialists also work with the vulnerability assessment team to develop realistic scenarios that provide a structured, intellectually honest analysis of the strengths and weaknesses of the terrorist adversary.

Determining the probability of neutralization. The probability of neutralization is a numeric value representing the probability that the protective force can prevent an adversary from achieving its objectives. The calculated number is derived from more than one source, one of which must be based on joint tactical simulation, JCATS analysis, or force-on-force exercises.

Determining system effectiveness. System effectiveness is determined by applying an equation that reflects the capabilities of a multilayered protection system. Analysis data derived from the various vulnerability assessment activities are used to calculate this equation, which reflects the security system's effectiveness against each of the scenarios developed for the vulnerability assessment. If system effectiveness is unacceptable for a scenario, the root cause of the weakness must be analyzed and security upgrades must be identified. The scenarios are reanalyzed with the upgrades, and the successful upgrades are documented in the vulnerability analysis report.

Implementation. The culmination of the vulnerability assessment is development of a report documenting the analyses and results and a plan for implementing any necessary upgrades to achieve the required security system effectiveness. NNSA verifies the results of the vulnerability assessment report and the conclusions of the implementation plan. NNSA also provides management oversight of the actual implementation of security system upgrades.

5.1.12.3.2 Terrorist Impacts Analysis

Substantive details of terrorist attack scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited by terrorists to plan attacks. Depending on the nature of malevolent, terrorist, or intentionally destructive acts, impacts may be similar to or could exceed the impacts of accidents analyzed for this SWEIS. A separate classified appendix to this SWEIS has been prepared that considers the underlying facility threat assumptions with regard to malevolent, terrorist, or intentionally destructive acts. Based on these threat assumptions, the classified appendix evaluates the potential human health impacts using appropriate analytical models, similar to the methodology used in this SWEIS to analyze accident impacts. These data provide NNSA with information on which to base, in part, decisions regarding activities at the NNSS.

Human Health—American Indian Perspective

As discussed previously in our assessment of Section 4.7, Biological Resources, it is widely known that many tribal representatives still collect and use plants and animals found within the Nevada National Security Site (NNSS) region. Many of the plants and animals cannot be gathered or found in other places. Consumption patterns of Indian people who still use plants and animals for food, medicine, and other cultural or ceremonial purposes force the Consolidated Group of Tribes and Organizations (CGTO) to question if its member tribes are still being exposed to radiation, and possibly hazardous waste located at the NNSS.

The CGTO is aware that, typically, risk assessment models have been used and accepted as a means of mathematically calculating potential risks and assessments to human health and safety. While these models project the potential impacts based on a worst-case scenario, they do not consider the perceived risks which are considered meaningful to Indian people. The lack of knowledge of an unfamiliar concept can lead to a feeling of perceived danger. A perceived danger or hazard associated with something can be very real to Indian people. Indian people view things holistically and believe that everything is interrelated resulting in a cause-and-effect model. This is contrary to scientific models that tend to compartmentalize things from a mathematical point of view, calculating potential risks to health and safety. This viewpoint often does not consider perceived risks, which play an integral role to American Indian cultural beliefs. To address this important issue, U.S. Department of Energy (DOE) listened to the recommendations from our people and commissioned a study in 1998 to evaluate perceived risks of radiation to Indian people. (See C.2.5 for additional information regarding this study.)

Emergency Preparedness

The CGTO knows that some of our member tribes are within close proximity to the NNSS and Tonopah Test Range (TTR). These Indian people will be directly, adversely, and potentially irrevocably impacted if an emergency occurs from DOE activities.

Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation resulting from NNSS-related activities, including the transportation of hazardous and radioactive waste occur, it could result in the closure of the main transportation artery to that land. If a major (only) road into a reservation closes, access to hospitals and medical facilities could be impeded or cut off entirely. Delays could occur for regular deliveries of necessary supplies, such as food and medicine. Emergency medical services en route to or from the reservation could result in death.

Accordingly, the CGTO recommends DOE collaborate with potentially affected tribes to develop emergency response measures. In particular, we understand DOE has developed the NNSS Emergency Preparedness Plan and an emergency management program. Each tribal government must have a copy of this plan, and participate in the training and implementation of the emergency management program set forth by DOE and its contractors.

Noise and Vibration

Numic people sing the souls of deceased tribal members to the afterlife in a multiple day ceremony called the Cry. The songs sung are called Salt Songs, a name derived from a spiritual journey taken by two sisters. The path of the journey is punctuated by topographically special places, which are reached at the end of various songs or sets of songs. The interactions between songs and places create a songscape (Stoffle, Halmo, and Austin 1997). The CGTO knows Salt Songs follow a spiritual trail. Salt Songs are still sung by Indian people today.

Noise can be a deterrent and a distraction. Noise upsets the spirituality of the area, negatively impacting the ability of salt songs to be heard. Because the thoughts and focus are interrupted, the balance, harmony, and well-being of the community as a whole become affected.

Increased aircraft activities proposed in the site-wide environmental impact statement (SWEIS) will increase the noise and vibration throughout the area. According to one tribal elder, *"Noise and vibrations [from the proposed increased air traffic] will cause the animals to migrate from the area. The animals are placed where they are by the Creator. Forcing them to move results in their loss of power, their life span is shortened, and their very existence is endangered. This could disrupt the entire food chain. If these are used culturally and traditionally for medicines, stories, and songs, then harmony is broken. The Creator put them in their area. If you move them outside of their home, then their spirit dies and will cause undo and irreparable stress. They are grounded in the area. If habitats and animals are disturbed, then the benefit of salt songs and stories are diminished and will harm the culture of our people. The mountain needs to hear our songs, to hear our voices, and to still know that we are here. If we are not out there performing these, then the mountain, the wind, the water, and all of the others will continue to be unbalanced. This needs to be part of the Environmental Restoration process. People don't understand harmony. This is our destiny and our responsibility. We are all woven together. The spirits are waiting for the Indian people to come back and to talk to them so that they can heal. We believe it is now time to allow the Indian people to begin the healing process. To do this, we propose balancing ceremonies."*

See Appendix C for more details.

5.1.13 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental impacts of Federal programs, policies, and activities on minority and low-income populations. Environmental justice analysis in this SWEIS is based on the geographic distribution of low-income and minority populations in Clark and Nye Counties (hereafter the Region of influence or ROI), as described in Chapter 4, Section 4.1.13.

Environmental justice analysis involves two tiers of investigation. One is the determination of significant and adverse impacts as a result of the alternative. The other is an evaluation of whether a minority or low-income population is disproportionately affected by these significant and adverse impacts. If no significant and adverse impacts are expected, there would be no disproportionately high and adverse impacts on minority and low-income populations.

To determine whether human health impacts would be adverse and disproportionately high for low-income and minority populations, the following factors were considered:

- Whether the human health impacts, which may be measured in risks and rates, are significant, unacceptable, and above generally accepted norms (Adverse human health impacts may include bodily impairment, infirmity, illness, or death.)
- Whether the risk or rate of exposure of a minority or low-income population to an environmental hazard is significant and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population
- Whether human health impacts occur in a minority or low-income population affected by total or multiple adverse exposures from environmental hazards

To determine whether environmental impacts would be adverse and disproportionately high for low-income and minority communities, the following three factors were considered to the extent practicable:

- Whether there is an impact on the natural or physical environment that significantly and adversely affects a minority community or low-income community
- Whether environmental effects are significant and have an adverse impact on minority or low-income populations that appreciably exceeds or is likely to appreciably exceed impacts on the general population or other appropriate comparison group
- Whether the environmental impacts occur in a minority or low-income population affected by total or multiple adverse exposures from environmental hazards

5.1.13.1 No Action Alternative

Impacts to human health would not be significant under any alternative. For example, the total number of latent cancer fatalities among the general population associated with transportation of LLW, MLLW and special nuclear material are estimated at less than 1 for incident-free transportation and accident scenarios under each alternative. If unconstrained routing of shipments in the Las Vegas metropolitan area (see Section 5.1.3.1.2.2 of this SWEIS) were to occur, shipments would pass in proximity to more densely populated areas, and could be more likely to pass near census blocks with higher minority and low-income populations. However, the analysis of unconstrained routing concludes that transportation risk (latent cancer fatalities) to the public would be the same as that seen in current constrained routing, and the population dose (expressed in person-rem) would be slightly lower than in constrained routing.

Similarly, direct and cumulative effects on environmental resources are not expected to result in significant adverse impacts to the public within the ROI.

Both human health and environmental impacts on low-income and minority populations would be the same as those on the general population within the ROI. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected. In addition, an increase in jobs due to the construction of the solar power generation facility could provide needed jobs to unemployed individuals in the area, which would have a beneficial impact on low-income individuals in the ROI.

5.1.13.2 Expanded Operations Alternative

Impacts under the Expanded Operations Alternative would be the same as those described under the No Action Alternative in Section 5.1.13.1.

5.1.13.3 Reduced Operations Alternative

Impacts under the Reduced Operations Alternative would be the same as those described under the No Action Alternative in Section 5.1.13.1.

Environmental Justice—American Indian Perspective

CGTO The Consolidated Group of Tribes and Organizations (CGTO) knows that federal agencies are directed by Executive Order (EO) 12898, Environmental Justice, to detect and mitigate potentially disproportionately high and adverse human health or environmental effects of its planned programs, policies, and activities to promote nondiscrimination among various populations in the United States. In the Record of Decision for the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*, the U.S. Department of Energy (DOE) recognized the need to address environmental justice concerns of the CGTO based on disproportionately high and adverse impacts to their member tribes from DOE Nevada National Security Site (NNSS) activities. In the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)*, DOE concluded that the selection and implementation of the Preferred Alternative would impact its member tribes at a disproportionately high and adverse level, perpetuating environmental justice concerns. The CGTO maintains that environmental justice concerns continue to exist.

Of special concern to the CGTO is the potential for Holy Land violations, cultural survival-access violations, and disproportionately high and adverse human health and environmental impacts to the Indian population. These environmental justice issues need to be addressed in the SWEIS.

There is no question that the Holy Lands of Indian people have been, continue to be, and will be impacted by activities at the NNSS. It is also well known that only Indian people have lost cultural traditions because they have been denied free access to many places on the NNSS where ceremonies need to occur, where plants need to be gathered, and where animals need to be hunted in a traditional way. Prior to undertaking or approving activities at the NNSS, the CGTO recommends that DOE comply with EO 12898 and EO 13127 by facilitating tribal access to the NNSS, sponsoring an Indian subsistence consumption study, and sponsoring a study to determine perceived health risks and environmental impacts resulting from NNSS activities to CGTO member tribes.

The CGTO has concerns that fall within the context of EO 12898, such as subsistence consumption. Subsistence consumption requires the DOE to collect, maintain, and analyze information on consumption patterns such as those of Indian populations who rely principally on fish and/or wildlife for existence. Most importantly, the EO mandates each federal agency to apply equally their environmental justice strategy to Native American programs and assume the financial costs necessary for compliance.

Environmental Justice—American Indian Perspective (cont'd)

To date, DOE has not shared its design and implementation strategy for Environmental Justice with the CGTO, nor has it identified and analyzed subsistence consumption patterns of natural resources by Indian people within the region of influence. Since the EO specifically addresses equity to Indian people and low-income populations, it is critical that the DOE immediately address the concerns of Indian tribes and communities by conducting systematic ethnographic studies and eliciting input necessary for administrative compliance and in the spirit of the DOE American Indian Policy. This policy outlines seven principles in its decision making and interaction with Federally-recognized Tribal governments. It requests that all Departmental elements ensure Tribal participation and interaction regarding pertinent decisions that may affect the environmental and cultural resources of Tribes. Of particular interest within these seven guiding principles is (1) Recognize the Department's trust responsibility. (2) Commit to a government-to-government relationship. (3) Consult with Tribes to assure rights and concerns are considered prior to taking actions, making decisions, or implementing programs. (4) Consult with Tribes about potential impacts of proposed DOE actions on cultural resources or religious concerns that will avoid unnecessary interference with traditional religious practices. (5) The Department will initiate a coordinated effort for technical assistance, economic self determination opportunities and training.

In the Record of Decision for the *1996 NTS EIS*, DOE recognized the need to address environmental justice concerns of the CGTO based on disproportionately high and adverse impacts to their member tribes from DOE Nevada Test Site activities (now NNSS). In the *2002 NTS SA*, DOE concluded that the selection and implementation of the Preferred Alternative would impact its member tribes at a disproportionately high and adverse level, perpetuating environmental justice concerns. The CGTO maintains that environmental justice concerns continue to exist and include (1) holy land violations, (2) cultural survival-access violations, and (3) disproportionately high and adverse human health and environmental impacts to the Indian population.

Holy Land Violations

American Indian people who belong to the CGTO consider the NNSS lands to be as central to their lives today as they have been since the creation of their people. The NNSS lands are part of the holy lands of Western Shoshone, Southern Piute, and Owens Valley Piute, and Shoshone people. The CGTO perceives that the past, present, and future pollution of these holy lands constitutes both Environmental Justice and equity violations. No other people have had their holy lands impacted by NNSS-related activities. Prior to undertaking or approving new activities, the CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study.

Cultural Survival-Access Violations

One of the most detrimental consequences to the survival of American Indian culture, religion, and society has been the denial of free access to their traditional lands and resources. Loss to access to traditional food sources and medicine has greatly contributed to undermining the cultural well-being of Indian people. These Indian people have experienced, and will continue to experience, breakdowns in the process of cultural transmission due to lack of free access to government-controlled lands and resources such as those in the NNSS area. No other people have experienced similar cultural survival impacts due to lack of free access to the NNSS area.

In 1996, President Clinton signed EO 13007, Indian Sacred Sites. The EO promotes accommodation of access to American Indian sacred sites by Indian religious practitioners and provides for the protection of the physical integrity of such sites located on federal lands. The CGTO recommends that open access be allowed for American Indians who must conduct their traditional ceremonies and obtain resources within the NNSS study area. Unfortunately, however, land disturbance and irreparable damage of cultural landscapes, potential Traditional Cultural Properties (TCPs), and cultural resources may render certain locations unusable.

Disproportionately High and Adverse Human Health and Environmental Impacts to the Indian Population

It is widely known that many tribal representatives still collect and use plants and animals that are found within the NNSS region. Many of the plants and animals cannot be gathered or found in other places. Consumption patterns of Indian people who still use plants and animals for food, medicine, and other cultural or ceremonial purposes force the CGTO to question if its member tribes are still being exposed to radiation, and possibly hazardous waste located at the NNSS.

See Appendix C for more details.

5.2 Remote Sensing Laboratory

The following sections describe the potential environmental consequences associated with alternatives and programs at RSL.

5.2.1 Land Use

No changes to land use were identified under any alternative for the Remote Sensing Laboratory (RSL), therefore no land use impacts, including impacts on surrounding land uses, were identified for any alternative. However, any new constructions at RSL would require close coordination with Nellis Air Force Base and would be subject to the availability of open space within or near RSL. A corresponding environmental study will be conducted as part of the new construction effort to determine any impacts on the baseline conditions.

While RSL does make use of airspace for its aircraft activities out of Nellis Air Force Base, there were no changes to airspace operations identified under the alternatives analyzed in this SWEIS. All activities involving RSL's use of airspace are under control of Nellis Air Force Base and all operations are conducted in compliance with applicable requirements, including FAA and USAF requirements. No airspace impacts were identified.

5.2.2 Infrastructure and Energy

5.2.2.1 Infrastructure

5.2.2.1.1 No Action Alternative

There would be no change to RSL under this alternative.

5.2.2.1.2 Expanded Operations Alternative

There would be no change to RSL under this alternative.

5.2.2.1.3 Reduced Operations Alternative

There would be no change to RSL under this alternative.

5.2.2.2 Energy

5.2.2.2.1 No Action Alternative

Electrical energy at RSL is provided by the USAF (Nellis Air Force Base), which in turn is supplied by three sources: 65 percent from NV Energy; 10 percent from Western Area Power Administration (hydropower); and 23 percent from Solar Star, Inc., (the Nellis Air Force Base Solar Photovoltaic Project). In FY 2009, RSL's electrical usage was 4,850 megawatt-hours (NNSA/NSO 2010b), which is a small portion of total power use (approximately 100,000 megawatt-hours) on Nellis Air Force Base. The existing electrical distribution system at RSL is capable of supporting present demands, although it is slated for minor improvements in 2014.

Natural gas at RSL is provided by the Southwest Gas Corporation through Nellis Air Force Base. In FY 2009**,** RSL used 33,673 therms of natural gas (NNSA/NSO 2010b). There is adequate capacity to serve current demands, and the condition of the gas lines are satisfactory (NSTec 2010i). The existing liquid fuel tanks and resupply schedules are adequate to support all heating, vehicular, and portable generator needs. RSL uses approximately 111,000 gallons of JP-8 jet fuel annually (NNSA/NSO 2010b) for aircraft operations, and an adequate supply is available directly through Nellis Air Force Base. RSL currently does not use any alternative form of fuel (e.g., E85).

As no changes in facilities, activities, or personnel staffing have been identified under this alternative, the existing electrical power and liquid fuel systems would be adequate to meet future needs.

5.2.2.2.2 Expanded Operations Alternative

As no changes in facilities, activities, or personnel staffing have been identified under this alternative, the existing electrical power and liquid fuel systems would be adequate to meet future needs.

5.2.2.2.3 Reduced Operations Alternative

As no changes in facilities, activities, or personnel staffing have been identified under this alternative, the existing electrical power and liquid fuel systems would be adequate to meet future needs.

5.2.3 Transportation and Traffic

5.2.3.1 Transportation

No radioactive waste would be generated at RSL; therefore, there would be no associated transportation impacts. Transport of any nonradioactive materials associated with RSL is encompassed by the analysis described for the NNSS in Sections 5.1.3.1 and 5.1.3.2.

5.2.3.2 Traffic

For all alternatives, the number of personnel at RSL is expected to remain the same and no construction projects are expected at RSL; therefore, no increases in vehicle traffic would occur and there would be no impacts on onsite and regional traffic associated with RSL. Traffic conditions of roadways near RSL are represented by Las Vegas Boulevard and Nellis Boulevard shown in Table 5–19.

5.2.4 Socioeconomics

There would be no change to the number of employees at RSL under any of the alternatives. As a result, there would be no impacts on economic activity, population, and housing; public finances; or public services.

5.2.5 Geology and Soils

5.2.5.1 No Action Alternative

RSL at Nellis Air Force Base consists of a small collection of buildings where most of its activities occur. Under the No Action Alternative, the mission of RSL would consist of remote sensing research, training, and logistical support. No construction is anticipated from continuation of the current activities. There are no prime farmland soils at RSL, so there would be no impacts on this resource under any of the alternatives.

5.2.5.1.1 National Security/Defense Mission

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Under the No Action Alternative, RSL would be used to support the Nuclear Emergency Support Team. Fixed-wing and rotary-wing aircraft stationed at RSL would be used for emergency response and aerial mapping as part of the Aerial Measuring System. RSL would also host some activities supporting U.S. nonproliferation and counterterrorism efforts at the NNSS. No additional construction would be required for implementation of these activities, so the geology and soils would not be impacted.

Work for Others Program. Under the Work for Others Program, existing facilities and resources at RSL would host other agencies for defense and homeland security applications. Should any new construction at RSL be needed, a corresponding environmental study would be conducted as a part of the new construction effort to determine any impacts on the geology or soils.

5.2.5.1.2 Environmental Management Mission

Waste Management Program. Waste produced at RSL consists primarily of office waste, nonhazardous solid waste, and small quantities of hazardous waste. There are no disposal or treatment facilities at RSL. Because oil and hazardous waste are present at the facility, there is a chance of a spill that could contaminate the soil surface. If an accidental release of hydrocarbons were to occur at the facility, the spill would be contained, and the contaminated soils would be disposed at a facility permitted to receive such waste. However, with spill prevention and mitigation measures in place, the potential for soil contamination would be reduced.

5.2.5.1.3 Nondefense Mission

General Site Support and Infrastructure Program. The activities described under the No Action Alternative would occur in existing facilities at RSL. No additional construction or demolition on the site would be required, so there would be no impacts on the geology or soils.

5.2.5.2 Expanded Operations Alternative

Should any new construction at RSL be needed, a corresponding environmental study would be conducted as a part of the new construction effort to determine any impacts on the geology or soils.

5.2.5.3 Reduced Operations Alternative

Should any new construction at RSL be needed, a corresponding environmental study would be conducted as a part of the new construction effort to determine any impacts on the geology or soils.

5.2.6 Hydrology

5.2.6.1 Surface Water Hydrology

5.2.6.1.1 No Action Alternative

Overall, no impacts under any of the impact criteria would be expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.1.1 National Security/Defense Mission

No impacts are expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.1.2 Environmental Management Mission

No impacts are expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.1.3 Nondefense Mission

General Site Support and Infrastructure Program. RSL would continue wastewater discharges, which are expected to have no impact on surface-water resources, assuming these activities adhere to all permit limitations on discharged water quality. In 2009, all contaminant concentrations in discharged effluent were within permitted levels.

5.2.6.1.2 Expanded Operations Alternative

Overall, no impacts under any of the impact criteria would be expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.2.1 National Security/Defense Mission

No impacts are expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.2.2 Environmental Management Mission

No impacts are expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.2.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.2.6.1.1.3.

5.2.6.1.3 Reduced Operations Alternative

Overall, no impacts under any of the impact criteria would be expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.3.1 National Security/Defense Mission

No impacts are expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.3.2 Environmental Management Mission

No impacts are expected at RSL because no activities are proposed that would affect surface hydrology.

5.2.6.1.3.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.2.6.1.1.3.

5.2.6.2 Groundwater

5.2.6.2.1 No Action Alternative

NNSA does not directly withdraw any groundwater at RSL (potable water is provided by Nellis Air Force Base) and does not directly discharge any contaminants that would threaten groundwater quality. The Nellis Air Force Base water system supplying RSL reportedly suffers from low pressure and limited supply capability. NNSA continues to work with Nellis Air Force Base officials to address these issues (DOE 2008f). While no expansion or addition of water-consuming facilities can be made at RSL until a new water source can be installed by Nellis Air Force Base, NNSA has not proposed any new facilities or activities that would exacerbate this problem or otherwise adversely impact groundwater quality or supply.

5.2.6.2.2 Expanded Operations Alternative

NNSA has not proposed any changes in activities at RSL under the No Action Alternative and has not identified any adverse impacts on groundwater quality or supply.

5.2.6.2.3 Reduced Operations Alternative

NNSA has not proposed any changes in activities at RSL under the No Action Alternative and has not identified any adverse impacts on groundwater quality or supply.

5.2.7 Biological Resources

Under all alternatives, activities at RSL in support of DOE and NNSA programs would continue in developed, previously disturbed areas characterized by an urban habitat for biological resources. No land-disturbing construction activities are proposed at RSL over the next 10 years under any of the three alternatives analyzed in this SWEIS. Therefore, DOE/NNSA activities at RSL under all missions and programs would not affect either biological resources in general or any sensitive or protected species.

5.2.8 Air Quality and Climate

5.2.8.1 No Action, Expanded Operations, and Reduced Operations Alternatives

5.2.8.1.1 Air Quality

DOE/NNSA activities at RSL would be the same under all three alternatives addressed in this *NNSS SWEIS*: No Action, Expanded Operations, and Reduced Operations. Therefore, this section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside RSL under all three of alternatives. The ROI for this air quality analysis encompasses Clark County in Nevada. Emissions from stationary and aircraft-related sources occur within RSL; emissions from other mobile sources occur mostly outside RSL, but within Clark County. Additional details supporting the information presented in this section can be found in Appendix D, Section D.2.2.1.1.

Calculations of emissions on and near RSL. **Table 5–58** shows the midpoint (year 2015) annual air emissions of the criteria pollutants and hazardous air pollutants associated with various RSL activities under the No Action Alternative. Most emissions are associated with mobile source activity. The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The RSL contribution to the air emissions in Clark County would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–53). The VOCs, nitrogen oxides, carbon monoxide, and PM_{10} from RSL sources (both mobile and stationary) in Clark County would decrease relative to 2008 emission levels by 0.02, 0.5, 0.4, and 0.026 tons per year, respectively. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone, or PM_{10} ambient air quality standards. Appendix D, Section D.2.2.1.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

Table 5–58 No Action Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Remote Sensing Laboratory in 2015

Pollutant	*Annual Air Emissions (tons per year)*						
	Stationary Sources	*Aircraft-Related Sources*	*RSL Commuters*	*Commercial Vendors*	*Total*		
	Clark County						
	On-RSL	*On-RSL*	*Off-RSL*	*Off-RSL*	*On-RSL*	*Off-RSL*	*Total*
PM_{10}	0.038	0.00040	0.03	0.016	*0.038*	*0.046*	*0.084*
$PM_{2.5}$	0.038	0.00037	0.016	0.013	*0.038*	*0.029*	*0.067*
CO	0.36	0.88	2.8	0.060	*1.2*	*2.9*	*4.1*
NO_x	0.9	0.045	0.53	0.16	*0.95*	*0.69*	*1.6*
SO_2	0.01	0.016	0.0072	0.00036	*0.026*	*0.0076*	*0.034*
VOCs	0.032	>0.17	0.079	0.017	*~0.2*	*0.096*	*~0.3*
Lead	<0.01	0.00040	0.0000020	0.00000068	*~0.01*	*0.0000027*	*~0.01*
Criteria Pollutant Total	*1.4*	*~1.1*	*3.4*	*0.25*	*~2.4*	*3.7*	*~6.1*
HAPs	0.0071	~0.17	0.006	0.0023	*~0.18*	*0.0083*	*~0.19*

< = less than; > = greater than; ~ = approximately; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; RSL = Remote Sensing Laboratory; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

General Conformity Determination. See Section 5.1.8 for a discussion of General Conformity Determinations. Based on the *de minimis* thresholds presented in **Table 5–59**; the total emissions in Clark County under the all three alternatives considered in this *NNSS SWEIS* do not exceed the *de minimis* levels for carbon monoxide, nitrogen oxides, PM_{10}, or VOCs in all cases. Therefore, a general conformity analysis would not be required under any of the alternatives.

Table 5–59 No Action Alternative Greenhouse Gas Emissions by RSL Activity in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATIONARY SOURCES		
Power generation	1,371	0.05
Natural gas heating	136	0.01
Other stationary sources, except natural gas heating	7	0.01
ALL STATIONARY SOURCES	*1,514*	*0.05*
MOBILE SOURCES		
Aircraft and ground support equipment	1,184	0.04
Commuting	311	0.01
Commercial vendors	138	0.01
ALL MOBILE SOURCES	*1,633*	*0.06*
ALL SCOPE 1 SOURCES	*1,327*	*0.05*
ALL SCOPE 2 SOURCES	*1,371*	*0.05*
ALL SCOPE 3 SOURCES	*449*	*0.02*
TOTAL	**3,147**	**0.11**

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

5.2.8.1.2 Radiological Air Quality

No activities under the No Action Alternative are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions in Chapter 4, Section 4.2.8.3.

5.2.8.1.3 Climate Change

See Chapter 4, Section 4.2.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to RSL-related activities. Table 5–59 shows greenhouse gas emissions levels for RSL-related activities under the No Action Alternative. See Section 5.1.8 of this *NNSS SWEIS* for a discussion of the methodology for this analysis. The color coding in Table 5–59 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by RSL (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–59 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Overall, RSL-related activities under all three alternatives would create about 3,147 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 89 percent smaller than the reporting level. This represents a net reduction over current greenhouse gas emissions (4,055 tons in 2008) of about 22 percent, but these emissions would continue to contribute towards global climate change.

5.2.9 Visual Resources

5.2.9.1 No Action Alternative

Under the No Action Alternative, current activities and operations would continue. These activities and operations occur indoors. No proposed changes would affect existing visual resources associated with RSL, and the scenic quality would remain Class C. No mitigation would be required.

5.2.9.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be no changes at RSL from the No Action Alternative and current activities and operations would continue. There would be no changes to the existing visual environment, and the scenic quality would remain at Class C. There would be no effect. No mitigation would be required.

5.2.9.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be no changes at RSL from the No Action Alternative and current activities and operations would continue. There would be no changes to the existing visual environment, and the scenic quality would remain at Class C. There would be no effect. No mitigation would be required.

5.2.10 Cultural Resources

Under all of the alternatives addressed in this SWEIS, activities at RSL supporting all NNSA/NSO programs would occur in developed, previously disturbed areas and would not be expected to affect cultural resources.

5.2.11 Waste Management

Under all alternatives, RSL may generate small quantities of LLW, but is not expected to generate any MLLW, TRU waste, or mixed TRU wastes. RSL would continue to be a small-quantity generator of hazardous waste; this waste would be stored for no more than 90 days before being transferred off site to permitted facilities for recycle or treatment, storage, or disposal. Hazardous waste removal and disposition services would continue to be provided by the USAF, which would also continue to provide removal and disposition of sanitary solid wastes generated by RSL personnel. Some materials, such as scrap metals, are expected to continue to be shipped as needed to the NNSS, where they would be combined with NNSS materials and shipped off site for recycle under the NNSS Pollution Prevention and Waste Minimization Program (Section 5.1.11.1.1).

Under all of the alternatives, about 68 cubic feet of hazardous waste would be annually generated at RSL; this waste would require offsite treatment and disposal. About 490 cubic feet of solid and hazardous wastes (e.g., scrap metal and electronic equipment) would be annually generated and would be subject to offsite reuse and recycle. In addition, based on the relatively small level of projected employment under all of the alternatives, RSL would annually generate about 4,000 cubic feet of sanitary solid waste that would require USAF removal and disposition, as discussed above.

Based on the availability of permitted facilities in Nevada and neighboring states (Section 5.1.11.1.1), waste management activities at RSL are not expected to generate wastes that exceed available TSD or recycle capacity under any alternative.

5.2.12 Human Health

The approach to evaluating human health impacts is discussed in Section 5.1.12. The criteria for evaluating human health impacts are included in that discussion.

5.2.12.1 Normal Operations

5.2.12.1.1 No Action Alternative

No radiological or chemical impacts from normal operations activities performed for the National Security/Defense, Environmental Management, or Nondefense Missions are expected at RSL under the No Action Alternative. The potential for occupational injury and illness was estimated for RLS activities using rates based on DOE experience (DOE 2010i) (see Appendix G for details). The number of TRCs and DART cases were projected based on the number of FTEs estimated for this alternative. Under this alternative, a total of 2 TRCs and 0.9 DART cases per year were calculated.

Noise – Under the No Action Alternative, minimal noise impacts on offsite receptors are expected to result from activities at RSL because there would be no new activities on site that would generate increased noise levels. Daily volumes of privately owned vehicles and trucks would remain essentially unchanged and would not contribute to additional traffic noise.

5.2.12.1.2 Expanded Operations Alternative

As under the No Action Alternative, no radiological or chemical impacts are expected at RSL under the Expanded Operations Alternative. The number of TRCs and DART cases from industrial accidents would also be the same as the No Action Alternative.

Noise – Potential noise impacts at RSL under the Expanded Operations Alternative would be similar to those under the No Action Alternative. No new activities on site would generate increased noise levels. Daily volumes of privately owned vehicles and trucks would remain essentially unchanged and would not contribute to additional traffic noise.

5.2.12.1.3 Reduced Operations Alternative

As under the No Action Alternative, no radiological or chemical impacts are expected at RSL under the Reduced Operations Alternative. The number of TRCs and DART cases from industrial accidents would also be the same as the No Action Alternative.

Noise – Potential noise impacts at RSL under the Reduced Operations Alternative would be similar to those under the No Action Alternative. No new activities on site would generate increased noise levels. Daily volumes of privately owned vehicles and trucks would remain essentially unchanged and would not contribute to additional traffic noise.

5.2.12.2 Facility Accidents

5.2.12.2.1 No Action Alternative

No RSL accident scenarios that would cause impacts other than negligible radiological or hazardous chemical risks to the public, workers, or the environment were identified under the No Action Alternative.

5.2.12.2.2 Expanded Operations Alternative

As under the No Action Alternative, no RSL accident scenarios that would cause impacts other than negligible radiological or hazardous chemical risks to the public, workers, or the environment were identified under the Expanded Operations Alternative.

5.2.12.2.3 Reduced Operations Alternative

As under the No Action Alternative, no RSL accident scenarios that would cause impacts other than negligible radiological or hazardous chemical risks to the public, workers, or the environment were identified under the Reduced Operations Alternative.

5.2.13 Environmental Justice

5.2.13.1 No Action Alternative

Impacts to human health would not be significant under any alternative. Similarly, direct and cumulative effects on environmental resources are not expected to result in significant adverse impacts to the public within the ROI.

Impacts on low-income and minority populations under the No Action Alternative, as discussed in the other sections in this chapter, would be the same as to those of the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.

5.2.13.2 Expanded Operations Alternative

Impacts under the Expanded Operations Alternative would be the same as those described under the No Action Alternative in Section 5.2.13.1.

5.2.13.3 Reduced Operations Alternative

Impacts under the Reduced Operations Alternative would be the same as those described under the No Action Alternative in Section 5.2.13.1.

5.3 North Las Vegas Facility

The following sections describe the potential environmental consequences associated with alternatives and programs at NLVF.

5.3.1 Land Use

No changes to NLVF land use were identified under any alternative; therefore, no land use impacts, including impacts on surrounding land uses, were identified under any alternative. No impacts on airspace were identified.

5.3.1.1 No Action Alternative

No changes to land use were identified under any alternative for NLVF.

5.3.1.2 Expanded Operations Alternative

No changes to land use were identified under any alternative for NLVF.

5.3.1.3 Reduced Operations Alternative

No changes to land use were identified under any alternative for NLVF.

5.3.2 Infrastructure and Energy

5.3.2.1 Infrastructure

5.3.2.1.1 No Action Alternative

There would be no change to NLVF under the No Action Alternative.

5.3.2.1.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, the number of employees would increase by 10 percent over the level projected under the No Action Alternative level, thereby slightly increasing demand for utilities at NLVF. Existing infrastructure and utilities are adequate to handle this increased demand (see Section 5.3.2.2 “Energy,” for a discussion of energy-related utilities).

5.3.2.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the number of employees would decrease by 10 percent from the No Action Alternative level, thereby reducing demand for utilities at NLVF.

5.3.2.2 Energy

5.3.2.2.1 No Action Alternative

Under the No Action Alternative, no new facilities, changes in activity levels, or changes in personnel staffing are projected for NLVF.

In FY 2009, NLVF's electrical usage was approximately 15,000 megawatt-hours (NNSA/NSO 2010b). The peak demand recorded during 2008 and 2009 was approximately 3.2 megawatts, recorded in August 2008 during on-peak afternoon hours. NNSA estimates that these power demand levels are representative of future demand under the No Action Alternative. Given the capacity of the NLVF distribution system (approximately 8 megawatts at main switch) and the reliable supply from the utility provider (NV Energy), there is adequate electrical power supply to support all future needs under this alternative.

In FY 2009, NLVF used approximately 48,000 therms of natural gas (NNSA/NSO 2010b), primarily for heating and boilers. NNSA estimates that these demand levels are representative of future demand under the No Action Alternative. There is adequate capacity to serve current demands, and the condition of the gas lines is satisfactory. NLVF also uses small quantities of diesel and unleaded gasoline for emergency generators and miscellaneous equipment; storage capacity is less than 400 gallons of each. These existing tanks would provide sufficient capacity to support incidental needs under this alternative.

Under all alternatives, NNSA is planning to install additional building-level electrical, water, and gas meters throughout NLVF, thus improving its ability to identify future conservation opportunities.

5.3.2.2.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, staffing levels at NLVF are estimated to increase by approximately 25 percent, and plasma fusion and physics experiments would increase by approximately 66 percent. However, it is likely that this increase in workforce population and activity levels would not result in a direct one-to-one increase in average and peak power demand. NNSA would conduct facility maintenance projects to maintain all current capabilities, but no new or modified facilities are planned. Direct power increases associated with the increased workforce would be attributed to minor additions such as computer workstations and some increased demand for lighting and cooling. Increases in plasma experiments would use existing equipment, although on a more frequent basis. NNSA estimates that average and peak power demand would increase by no more than 10 percent above demand under the No Action Alternative. The capacity of the NLVF distribution system is adequate to support all future needs under this alternative. Demands for liquid fuel are not likely to increase more than 10 percent above the demand under the No Action Alternative, and current storage capacity and resupply arrangements would be sufficient to satisfy this demand.

5.3.2.2.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, staffing levels at NLVF are estimated to decrease by approximately 10 percent, and plasma fusion and physics experiments would decrease by approximately 42 percent. NNSA would conduct facility maintenance projects to maintain all current capabilities, but no new or modified facilities are planned. NNSA estimates that average and peak power demand would remain at or below the levels seen under the No Action Alternative. The capacity of the NLVF distribution system is adequate to support all future needs under this alternative. Demands for liquid fuel are also estimated to remain at or below levels under the No Action Alternative, and current storage capacity and resupply arrangements would be sufficient to satisfy this demand.

5.3.3 Transportation and Traffic

5.3.3.1 Transportation

Water containing tritium is periodically transported by tanker truck from NLVF to the NNSS. Tritium is a beta-emitter and, therefore, would not be a source of an external radiation dose. The concentration of tritium in the water being transported is, on average, 900 picocuries per liter, which is about 20 times lower than the drinking water standard of 20,000 picocuries per liter for tritium (NSTec 2010e). Therefore, any impacts associated with a transportation accident would be much lower than those of other transportation accidents analyzed. Due to these considerations, radiological impacts for these shipments were not quantified for any of the alternatives.

Transport of any nonradioactive materials associated with NLVF under the three alternatives is encompassed by the analysis described for the NNSS in Sections 5.1.3.1 and 5.1.3.2.

5.3.3.2 Traffic

Any onsite or regional traffic impacts from NLVF would primarily be associated with incremental changes in personnel. The change in workforce numbers at NLVF is expected to remain the same under the No Action Alternative, increase by 25 percent under the Expanded Operations Alternative, and decrease by 10 percent under the Reduced Operations Alternative. Increased traffic congestion within the internal roadways of NLVF and longer delays during peak commute hours at the main entrance point on Energy Way would occur under the Expanded Operations Alternative. Traffic conditions of roadways near NLVF are represented by Losee Road in Table 5–19. As the table indicates, under the No Action and Reduced Operations Alternatives, Losee Road would experience minimal, if any, increases in daily traffic volumes as a result of NNSS personnel. Under the Expanded Operations Alternative, a 3 percent increase in traffic volumes during the peak hour may occur; however, the volume-to-capacity ratio and levels of service on this roadway would remain the same as those under future baseline conditions (Chapter 4, Table 4–11, and Table 5–19).

5.3.4 Socioeconomics

5.3.4.1 No Action Alternative

There would be no change to the number of employees at NLVF under the No Action Alternative. As a result, there would be no impacts on economic activity, population, and housing; public finances; or public services.

5.3.4.2 Expanded Operations Alternative

5.3.4.2.1 Economic Activity, Population, and Housing

Under the Expanded Operations Alternative, it is estimated that employment would increase from 1,442 to 1,803 at NLVF. This represents an increase of 361 jobs.

Approximately 10 percent, or 36 individuals, are expected to relocate. Projected rates of population growth would not be altered as a result of the Expanded Operations Alternative. The 36 new households would reduce housing vacancy rates by 0.02 percent in Clark County. Sufficient housing exists in the region to support this increase in population.

The remaining 325 individuals filling the new jobs are expected to be already living in Clark and Nye Counties. Of the 325 individuals, it was assumed that 99 percent (322 jobs) would live in Clark County and 1 percent (3) in Nye County.

The 322 direct jobs added in Clark County would decrease the unemployment rate by about 0.23 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, 3 direct jobs would decrease the unemployment rate by about 0.10 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). This would be a minor, but beneficial, impact on employment in Clark and Nye Counties.

As described under the No Action Alternative, RIMS II was used to calculate the indirect economic impact of DOE activities on employment. An estimate of the change in the total number of jobs in a region's economy was calculated by multiplying the initial change in jobs by a direct-effect employment multiplier. By adding 361 permanent employees at the NLVF under the Expanded Operations Alternative, approximately 699 jobs would be created in the ROI. The combined effect of direct and indirect employment would result in a decrease in the unemployment rate in Clark County of about 0.5 percent and about 0.22 percent in Nye County.

Daily spending by new employees would positively affect the immediate area of NLVF. Purchases would typically include gasoline, automobile servicing, food and beverages, laundry, and other retail items. Therefore, a minor beneficial impact on economic activity would occur under the Expanded Operations Alternative due to the increase in employment.

Public finance. Increased sales transactions for the purchase of materials and supplies for construction of the solar power generation facility(ies) would generate some additional revenues for local governments. These impacts would be minor but beneficial. Revenues for Clark County would increase due to increases in personal income and total employment, which could lead to increased spending. This would have a beneficial impact on the local economy.

5.3.4.2.2 Public Services

Public education. As described under the No Action Alternative, for the 2009 to 2010 school year, the Clark County School District student–teacher ratio was 21:1. The student–teacher ratio for the Nye County School District was 18.6:1. Under the Expanded Operations Alternative, a total of 68 children could relocate to the area based on an average of 1.89 children per family. It was assumed that all 68 children would relocate to Clark County; therefore, to maintain the 21:1 student teacher ratio, three additional teachers would be needed in Clark County.

Police protection. Under the Expanded Operations Alternative, the number of daytime occupants at NLVF would increase by 361 employees, which could result in more calls for services. This increase could have an impact on police protection resources due to a reduced level of service.

Fire protection. No changes to building density would occur under the Expanded Operations Alternative. Therefore, it is unlikely that any additional calls for fire protection would take place. Levels of service would not be impacted.

Health care. The addition of 361 employees would have a negligible impact on area hospitals and hospital personnel, as only 36 households are expected to relocate. The activities associated with the Expanded Operations Alternative are not anticipated to increase the need for hospital care or personnel.

5.3.4.3 Reduced Operations Alternative

5.3.4.3.1 Economic Activity, Population, and Housing

Under the Reduced Operations Alternative, there would be an employment reduction of 144 individuals at NLVF, estimated at 143 employees in Clark County and 1 employee in Nye County. In Clark County, this would increase the unemployment rate by about 0.10 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). Within Nye County, this would increase the unemployment rate by about 0.03 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). These increases would represent a minor adverse impact on Clark County's unemployment rate and a negligible impact on Nye County's unemployment rate. As a result of this jobs reduction, daily spending in the vicinity of NLVF would decrease correspondingly, which would have a minor impact on economic activity in the area immediately adjacent to NLVF.

Public finance. Revenues for Clark County could decrease due to reductions in personal income and total employment, which could lead to reduced spending. This small decrease in spending (due to a loss of 144 jobs) would have a negligible adverse impact on the local economy.

5.3.4.3.2 Public Services

Public education. Under the Reduced Operations Alternative, no individuals are expected to relocate to work at NLVF; therefore, no new students would enroll in Clark County or Nye County schools. No new teachers would be required as a result of the Reduced Operations Alternative.

Police protection. Under the Reduced Operations Alternative, the number of daytime occupants at NLVF would decrease, which could result in fewer calls for service. Therefore, a minor beneficial impact on police protection resources is anticipated under this alternative.

Fire protection. No changes to building density would occur under the Reduced Operations Alternative. Therefore, it is unlikely that any additional calls for fire protection would take place. Levels of service would not be impacted.

Health care. As stated previously, under the Reduced Operations Alternative, a small staff reduction of 144 people is anticipated. No impact on health care in the region is anticipated. Existing levels of services would be maintained.

5.3.5 Geology and Soils

5.3.5.1 No Action Alternative

NLVF is a collection of buildings on DOE-owned property within the North Las Vegas city boundary. Under the No Action Alternative, the mission at NLVF would continue to consist of energy experiments and coordination activities. There are no prime farmland soils at NLVF, so there would be no impacts on the resource from any of the alternatives.

5.3.5.1.1 National Security/Defense Mission

Stockpile Stewardship and Management Program. Under the No Action Alternative, fusion experiments on Dense Plasma Focus machines would be conducted at NLVF. These tests would be conducted inside existing facilities and labs. No additional construction would be required for these tests, so there would be no impacts on the physical setting from the fusion experiments.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. NLVF would host some activities supporting U.S. nonproliferation and counterterrorism efforts on the NNSS. These activities would primarily include research and development and some training activities, most of which would occur on the NNSS. No new facilities would be constructed at NLVF to support these activities, which would primarily occur within the existing buildings. Therefore, there would be no impacts on the physical setting from implementation of the No Action Alternative.

Work for Others. Under the Work for Others Program, existing facilities and resources at NLVF would host other agencies for defense and homeland security applications. No new structures would need to be built at NLVF, so no impacts on the geology or soils would occur.

5.3.5.1.2 Environmental Management Mission

Waste Management Program. Waste produced at NLVF consists primarily of office waste, nonhazardous solid waste, and small quantities of hazardous waste. There are no disposal or treatment facilities at NLVF. Because oil and hazardous waste are present at the facility, there is a chance of an accidental spill that could contaminate the soil surface. If an accidental release of hydrocarbons were to occur at the facility, the spill would be contained, and the contaminated soils would be disposed at a facility permitted to receive such waste. Although the soils at NLVF have been previously disturbed to construct the facility, disturbance from spill cleanup would increase the potential for increased erosion from wind and precipitation runoff. However, with spill prevention and mitigation measures in place, the potential for impact on the soils from a spill would be reduced.

5.3.5.1.3 Nondefense Mission

General Site Support and Infrastructure Program. The activities described under the No Action Alternative would be completed in the existing facilities at NLVF. No additional construction nor demolition on site would be required, so there would be no impacts on the geology or soils at the facility.

5.3.5.2 Expanded Operations Alternative

The impacts on the geology and soils at NLVF would be very similar to the No Action Alternative. Under the Expanded Operations Alternative, fusion experiments on Dense Plasma Focus machines would at NLVF. These tests would be conducted inside existing facilities and labs. No additional construction would be required for these tests, so there would be no impacts on the physical setting from the fusion experiments.

5.3.5.3 Reduced Operations Alternative

There would be no changes to NLVF under the Reduced Operations Alternative, so the impacts would be the same as discussed under the No Action Alternative.

5.3.6 Hydrology

5.3.6.1 Surface Water Hydrology

5.3.6.1.1 No Action Alternative

Overall, no impacts under any of the impact criteria would be expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.1.1 National Security/Defense Mission

No impacts are expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.1.2 Environmental Management Mission

No impacts are expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.1.3 Nondefense Mission

General Site Support and Infrastructure Program. NLVF would continue stormwater and wastewater discharges, which are expected to have no impact on surface-water resources, assuming the activities adhere to all permit limitations on discharged water quality. In 2009, all contaminant concentrations in discharged effluent were within permitted levels.

5.3.6.1.2 Expanded Operations Alternative

Overall, no impacts under any of the impact criteria would be expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.2.1 National Security/Defense Mission

No impacts are expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.2.2 Environmental Management Mission

No impacts are expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.2.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.3.6.1.1.3.

5.3.6.1.3 Reduced Operations Alternative

Overall, no impacts under any of the impact criteria would be expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.3.1 National Security/Defense Mission

No impacts are expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.3.2 Environmental Management Mission

No impacts are expected at NLVF because no activities are proposed that would affect surface hydrology.

5.3.6.1.3.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.3.6.1.1.3.

5.3.6.2 Groundwater

5.3.6.2.1 No Action Alternative

Under the No Action Alternative, current activities and operations would continue at NLVF. The dewatering program that was established to control encroaching groundwater beneath Building A-1 would continue. This dewatering program is regulated under NPDES Permit (NV0023507), which would continue to allow the discharge of water from dewatering operations to groundwater via percolation, when used for landscape irrigation and dust suppression, and into the Las Vegas Wash via direct discharge into the City of North Las Vegas stormwater drainage system.

Water extracted from the sump well located in the basement of Building A-1 for dewatering purposes is disposed at the NNSS Area 5 sewage lagoon in the winter months and is evaporated through swamp coolers located at NLVF during the summer months. As discussed in Chapter 4, Section 4.3.6.2, the sump well was previously used in tritium remediation efforts. Although the levels of tritium are now only one-twentieth of the limit established by the Safe Drinking Water Act, NNSA continues to dispose this water separately (June 2010 report).

These discharge programs will continue to comply with all permit conditions and regulatory requirements, and are not expected to result in any adverse impacts on groundwater quality or supply.

NLVF does not withdraw any groundwater for production purposes; it receives its potable water from a large municipal supplier (i.e., the Las Vegas Valley Water District).

5.3.6.2.2 Expanded Operations Alternative

While a 25 percent increase in the workforce is estimated at NLVF under the Expanded Operations Alternative, this increase is not expected to adversely affect the municipal supplier of potable water. NNSA has not proposed any activities that would require groundwater withdrawals for production purposes, and has not identified any new activities that would present a risk to groundwater quality.

5.3.6.2.3 Reduced Operations Alternative

NNSA estimates that a 10 percent workforce reduction would occur under the Reduced Operations Alternative and that a corresponding 10 percent reduction in potable water demand would occur. NNSA has not proposed any activities that would require groundwater withdrawals for production purposes and has not identified any new activities that would present a risk to groundwater quality.

5.3.7 Biological Resources

Under all alternatives, activities at NLVF in support of NNSA/NSO programs would occur in developed, previously disturbed areas. No land-disturbing construction activities are proposed at NLVF over the next 10 years under any of the three alternatives analyzed in this SWEIS. Therefore, DOE/NNSA activities at NLVF under all missions and programs would not affect either biological resources in general or any sensitive or protected species.

5.3.8 Air Quality and Climate

This section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside NLVF under each of the alternatives addressed in this *NNSS SWEIS*: No Action, Expanded Operations, and Reduced Operations. The ROI for each alternative in this air quality analysis encompasses Nye and Clark Counties in Nevada. Stationary sources emissions occur within NVLF, while mobile sources emissions occur mostly outside NLVF, but still within Clark County. Additional details supporting the information presented in this section can be found in Appendix D, Section D.2.3.1.1.

General conformity determination. See Section 5.1.8 for a discussion of general conformity determinations. Based on the *de minimis* thresholds presented in Table 5–31; the total emissions in Clark County under each of the three alternatives considered in this *NNSS SWEIS* would not exceed the *de minimis* levels for carbon monoxide, nitrogen oxides, PM_{10}, or VOCs in all cases. Therefore, a general conformity analysis would not be required for any of the alternatives.

5.3.8.1 No Action Alternative

5.3.8.1.1 Air Quality

This section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside NLVF under the No Action Alternative. The ROI for this air quality analysis includes Nye and Clark Counties in Nevada.

Calculations of emissions on and near NLVF. Table 5–60 shows the midpoint (2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various NLVF activities under the No Action Alternative. Most emissions are associated with mobile source activity. The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The NLVF contribution to Clark County emissions would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–59). Emissions of VOCs, nitrogen oxides, carbon monoxide, and PM_{10} from NLVF sources (both mobile and stationary) in Clark County would decrease relative to 2008 emission levels by 0.02, 2.9, 2.2, and 0.13 tons per year, respectively. Most of the emission reductions at the NLVF are associated with the phasing in of newer worker vehicles with lower emission reduction technology. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone, or PM_{10} air quality standards. Appendix D, Section D.2.3.1.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

Table 5–60 No Action Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the North Las Vegas Facility in 2015

Pollutant	Annual Air Emissions (tons per year)											
	Stationary Sources	NLVF Commuters		Commercial Vendors	Radiological Waste Trucks			Total				
	Clark County	Clark County	Nye County	Clark County	Clark County	Nye County		Clark County		Nye County		
	On-NLVF	Off-NLVF	Off-NNSS	Off-NLVF	Off-NLVF	On-NNSS	Off-NNSS	On-NLVF	Off-NLVF	On-NNSS	Off-NNSS	Total
PM_{10}	0.037	0.25	0.0016	0.069	0.0017	0.00010	0.00015	0.037	0.32	0.00010	0.0018	0.36
$PM_{2.5}$	0.037	0.14	0.00095	0.057	0.0014	0.000090	0.00013	0.037	0.20	0.000090	0.0011	0.24
CO	0.19	23.8	0.14	0.26	0.0046	0.00030	0.00045	0.19	24.1	0.00030	0.14	24.4
NO_x	0.73	4.4	0.027	0.70	0.021	0.0013	0.0020	0.73	5.1	0.0013	0.029	5.9
SO_2	0.017	0.060	0.00034	0.0016	0.000046	0.0000029	0.0000044	0.017	0.062	0.0000029	0.00034	0.079
VOCs	0.028	0.66	0.0041	0.076	0.00091	0.000057	0.000086	0.028	0.74	0.000057	0.0042	0.77
Lead	<0.01	0.000017	0.00000010	0.0000030	0.000000029	0.0000000020	0.0000000030	<0.01	0.000020	0.0000000020	0.00000010	<0.01
Criteria Pollutant Total	1.0	29.2	0.17	1.1	0.028	0.0018	0.0027	1.0	30.3	0.0018	0.17	31.5
HAPs	0.0026	0.049	0.00033	0.010	0.00012	0.0000076	0.000011	0.0026	0.059	0.0000076	0.00034	0.062

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

5.3.8.1.2 Radiological Air Quality

No activities under the No Action Alternative are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions in Chapter 4, Section 4.3.8.3.

5.3.8.1.3 Climate Change

See Chapter 4, Section 4.3.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to NLVF-related activities. **Table 5–61** shows greenhouse gas emissions due to NLVF-related activities under the No Action Alternative. See Section 5.1.8 of this *NNSS SWEIS* for a discussion of methodology for this analysis. The color coding in Table 5–61 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by NLVF (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–61 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–61 No Action Alternative Greenhouse Gas Emissions at the North Las Vegas Facility in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATIONARY SOURCES		
Power generation	5,623	0.20
Other stationary sources	10	0.01
ALL STATIONARY SOURCES	5,633	0.20
MOBILE SOURCES		
Mobile sources – Commuting	2,601	0.09
Mobile sources – Hazardous material and waste transport (nongovernment)	7	0.01
Mobile sources – Commercial vendors	138	0.01
ALL MOBILE SOURCES	2,746	0.10
ALL SCOPE 1 SOURCES	10	0.01
ALL SCOPE 2 SOURCES	5,623	0.20
ALL SCOPE 3 SOURCES	2,746	0.10
TOTAL	**8,379**	**0.30**

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Overall, NLVF-related activities under the No Action Alternative would create about 8,379 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 70 percent lower than the reporting level. This represents a net reduction over current greenhouse gas emissions (13,355 tons in 2008) of about 37 percent, but these emissions would continue to contribute towards global climate change.

5.3.8.2 Expanded Operations Alternative

5.3.8.2.1 Air Quality

This section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside NLVF under the Expanded Operations Alternative. The ROI for this air quality analysis includes Nye and Clark Counties in Nevada. Stationary sources emissions occur within NVLF, while mobile sources emissions occur mostly outside NLVF, but almost entirely within Clark County. Additional details supporting the information presented in this section can be found in Appendix D, Section D.2.3.1.1.

Calculations of emissions on and near NLVF. **Table 5–62** shows the midpoint (2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various NLVF activities under the Expanded Operations Alternative. Most emissions are associated with mobile source activity. The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The NLVF contribution to Clark County air emissions would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–59). Emissions of VOCs and carbon monoxide from NNSS mobile sources in Clark County would increase relative to 2008 emission levels by 0.17 and 3.8 tons per year, respectively; however, emissions of nitrogen oxides and PM_{10} would decrease relative to 2008 emission levels by 1.6 and 0.05 tons per year, respectively. Because these emissions would be small and the increased emissions would come from mobile sources spread out over the Las Vegas Valley, the additional burden would not produce additional violations of the carbon monoxide or ozone ambient air quality standard. Appendix D, Section D.2.3.2.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

5.3.8.2.2 Radiological Air Quality

No activities under the Expanded Operations Alternative are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions in Chapter 4, Section 4.3.8.3.

5.3.8.2.3 Climate Change

See Chapter 4, Section 4.3.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to NLVF-related activities. **Table 5–63** shows greenhouse gas emissions levels from NLVF-related activities under the Expanded Operations Alternative. See Section 5.1.8 of this *NNSS SWEIS* for a discussion of the methodology for this analysis. The color coding in Table 5–63 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by NLVF (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–63 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–62 Expanded Operations Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the North Las Vegas Facility in 2015

	Annual Air Emissions (tons per year)											
	Stationary Sources	***NLVF Commuters***		***Commercial Vendors***	***Radiological Waste Trucks***			***Total***				
	Clark County	***Clark County***	***Nye County***	***Clark County***	***Clark County***	***Nye County***		***Clark County***		***Nye County***		
Pollutant	***On-NLVF***	***Off-NLVF***	***Off-NNSS***	***Off-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***On-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***Total***
PM_{10}	0.037	0.31	0.0020	0.086	0.0021	0.00013	0.00019	*0.037*	*0.40*	*0.00013*	*0.0022*	*0.44*
$PM_{2.5}$	0.037	0.17	0.0020	0.071	0.0018	0.00011	0.00016	*0.037*	*0.24*	*0.00011*	*0.0022*	*0.28*
CO	0.19	29.8	0.19	0.33	0.0058	0.00038	0.00056	*0.19*	*30.1*	*0.00038*	*0.19*	*30.5*
NO_x	0.73	5.5	0.033	0.88	0.026	0.0016	0.0025	*0.73*	*6.4*	*0.0016*	*0.036*	*7.2*
SO_2	0.017	0.076	0.00043	0.0020	0.000058	0.0000036	0.0000055	*0.017*	*0.078*	*0.0000036*	*0.00044*	*0.095*
VOCs	0.028	0.83	0.0051	0.095	0.0011	0.000071	0.00011	*0.028*	*0.93*	*0.000071*	*0.0052*	*0.096*
Lead	<0.01	0.000022	0.00000013	0.0000038	0.000000036	0.0000000025	0.0000000038	*<0.01*	*0.000026*	*0.0000000025*	*0.00000013*	*<0.01*
Criteria Pollutant Total	*1.0*	*36.5*	*0.23*	*1.4*	*0.035*	*0.0022*	*0.0034*	*1.0*	*37.9*	*0.0022*	*0.23*	*39.2*
HAPs	0.0026	0.062	0.00041	0.013	0.00015	0.0000095	0.000014	*0.0026*	*0.075*	*0.0000095*	*0.00042*	*0.078*

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NLVF=North Las Vegas Facility; NNSS=Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 5–63 Expanded Operations Alternative Greenhouse Gas Emissions at the North Las Vegas Facility in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 25,000 Metric Tons Per Year* [a]
STATIONARY SOURCES		
Power generation	5,623	0.20
Other stationary sources	10	0.01
ALL STATIONARY SOURCES	*5,632*	*0.20*
MOBILE SOURCES		
Mobile sources – commuting	3,252	0.12
Mobile sources – hazardous material and waste transport (nongovernment)	9	0.01
Mobile sources – commercial vendors	138	0.01
ALL MOBILE SOURCES	*3,399*	*0.12*
ALL SCOPE 1 SOURCES	*10*	*0.01*
ALL SCOPE 2 SOURCES	*5,623*	*0.20*
ALL SCOPE 3 SOURCES	*3,399*	*0.12*
TOTAL	***9,031***	***0.33***

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Overall, NLVF-related activities under the Expanded Operations Alternative would create about 9,031 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 67 percent smaller than the reporting level. This represents a net reduction over current greenhouse gas emissions (13,355 tons in 2008) of about 32 percent, but these emissions would continue to contribute towards global climate change.

5.3.8.3 Reduced Operations Alternative

5.3.8.3.1 Air Quality

This section addresses air quality impacts from stationary, mobile, and fugitive air pollutant sources that would occur within and outside NLVF under the Reduced Operations Alternative. The ROI for this air quality analysis includes Nye and Clark Counties in Nevada. The emissions from stationary sources occur within NVLF, while the emissions from mobile sources occur mostly outside NLVF, but within Clark County. Additional details supporting the information presented in this section can be found in Appendix D, Section D.2.3.3.1.

Calculations of emissions on and Near NLVF. **Table 5–64** shows the midpoint (2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various NLVF activities under the Reduced Operations Alternative. Most emissions are associated with mobile source activity. The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The NLVF contribution to Clark County air emissions would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–59). Emissions of VOCs, nitrogen oxides, carbon monoxide, and PM_{10} from NLVF sources (both mobile and stationary) in Clark County would decrease relative to 2008 emission levels by 0.09, 3.4, 4.7, and 0.16 tons per year, respectively. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone, or PM_{10} air quality standards. Appendix D, Section D.2.3.3.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization of mobile sources.

Table 5–64 Reduced Operations Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the North Las Vegas Facility in 2015

	Annual Air Emissions (tons per year)											
	Stationary Sources	***NLVF Commuters***		***Commercial Vendors***	***Radiological Waste Trucks***			***Total***				
	Clark County	***Clark County***	***Nye County***	***Clark County***	***Clark County***	***Nye County***		***Clark County***		***Nye County***		
Pollutant	***On-NLVF***	***Off-NLVF***	***Off-NNSS***	***Off-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***On-NLVF***	***Off-NLVF***	***On-NNSS***	***Off-NNSS***	***Total***
PM_{10}	0.037	0.23	0.0014	0.062	0.0015	0.00009	0.000090	*0.037*	*0.29*	*0.00009*	*0.0015*	*0.33*
$PM_{2.5}$	0.037	0.12	0.00085	0.051	0.0013	0.000081	0.000081	*0.037*	*0.17*	*0.000081*	*0.00093*	*0.21*
CO	0.19	21.4	0.13	0.23	0.0041	0.00027	0.00027	*0.19*	*21.6*	*0.00027*	*0.13*	*22*
NO_x	0.73	4.0	0.024	0.63	0.019	0.0012	0.0012	*0.73*	*4.6*	*0.0012*	*0.025*	*5.4*
SO_2	0.017	0.054	0.00031	0.0014	0.000041	0.0000026	0.0000026	*0.017*	*0.055*	*0.0000026*	*0.00031*	*0.072*
VOCs	0.028	0.60	0.0037	0.068	0.00082	0.000051	0.000051	*0.028*	*0.67*	*0.000051*	*0.0038*	*0.7*
Lead	<0.01	0.000015	0.000000094	0.0000027	0.000000026	0.0000000018	0.0000000018	*<0.01*	*0.000018*	*0.0000000018*	*0.000000096*	*<0.01*
Criteria Pollutant Total	*1.0*	*26.3*	*0.16*	0.23	0.025	0.0024	0.0016	*1.0*	*26.6*	*0.0024*	*0.16*	*27.7*
HAPs	0.0026	0.044	0.00029	0.009	0.00011	0.0000068	0.0000068	*0.0026*	*0.053*	*0.0000068*	*0.00030*	*0.056*

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

5.3.8.3.2 Radiological Air Quality

No activities under the Reduced Operations Alternative are expected to produce aboveground radiation beyond those documented for 2008 baseline conditions in Chapter 4, Section 4.3.8.3.

5.3.8.3.3 Climate Change

See Chapter 4, Section 4.3.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to NLVF-related activities. **Table 5–65** shows greenhouse gas emissions due to NLVF-related activities under the Reduced Operations Alternative. See Section 5.1.8 of this *NNSS SWEIS* for a discussion of methodology for this analysis. The color coding in Table 5–65 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by NLVF (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–65 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–65 Carbon-Dioxide-Equivalent Emissions of Greenhouse Gases by Activities Related to the North Las Vegas Facility Under the Reduced Operations Alternative for 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATIONARY SOURCES		
Power generation	5,623	0.20
Other stationary sources	10	0.01
ALL STATIONARY SOURCES	*5,632*	*0.20*
MOBILE SOURCES		
Commuting	2,341	0.08
Hazardous material and waste transport (nongovernment)	6	0.01
Commercial vendors	138	0.01
ALL MOBILE SOURCES	*2,485*	*0.09*
ALL SCOPE 1 SOURCES	*10*	*0.01*
ALL SCOPE 2 SOURCES	*5,623*	*0.20*
ALL SCOPE 3 SOURCES	*2,485*	*0.09*
TOTAL	***8,118***	***0.29***

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Overall, NLVF-related activities under the Reduced Operations Alternative would create about 8,118 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 71 percent smaller than the reporting level. This represents a net reduction over current greenhouse gas emissions (13,355 tons in 2008) of about 39 percent.

5.3.9 Visual Resources

5.3.9.1 No Action Alternative

Under the No Action Alternative, current activities and operations would continue. These activities and operations occur indoors. No proposed changes would affect existing visual resources associated with NLVF, and the scenic quality would remain Class C. No mitigation would be required.

5.3.9.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be no changes at NLVF from under the No Action Alternative and current activities and operations would continue. There would be no changes to the existing visual environment, and the scenic quality would remain at Class C. There would be no effect. No mitigation would be required.

5.3.9.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be no changes at NLVF under the No Action Alternative, current activities and operations would continue, and there would be no change to the existing visual environment. The scenic quality would remain at Class C. There would be no effect. No mitigation would be required.

5.3.10 Cultural Resources

Under all alternatives addressed in this SWEIS, there are no proposed activities or projects that would affect Building A-17, which NNSA/NSO considers to be historically significant due to its connection with nuclear weapons testing. In addition, activities at NLVF supporting all NNSA/NSO programs would occur in developed, previously disturbed areas and would not be expected to affect cultural resources.

5.3.11 Waste Management

Under all of the alternatives, NLVF would generate no TRU or mixed TRU wastes. However, under all of the alternatives, NLVF would generate liquids containing small quantities of tritium collected from the sump of an NLVF building (tritium concentrations in the collected water are expected to continue to be below the maximum concentration limits for tritium specified in EPA primary drinking-water standards). Disposal of the collected tritiated water would continue, either by introducing it to the NLVF evaporative coolers or by collecting it in tanker trucks and transporting it to the NNSS for evaporation (Section 5.1.11.1.1). The potential impacts of the release of tritium to the atmosphere through evaporation are addressed in Section 5.1.8, "Air Quality and Climate," and Section 5.1.12, "Human Health."

Under all of the alternatives, NLVF would remain a conditionally exempt, small-quantity generator of hazardous waste; this waste would be stored on site before being transferred off site to permitted facilities for recycle or treatment, storage, or disposal. NLVF would annually generate approximately 34 cubic feet of hazardous and other regulated wastes (e.g., asbestos) for offsite treatment and disposal, 21 cubic feet of hazardous waste (including universal waste) for offsite recycle, and 55 cubic feet of used oil or antifreeze for offsite recycle.

Sanitary solid waste generation at NLVF would vary under each of the three SWEIS alternatives based on the estimated number of personnel stationed there (Section 5.2.4). Annual generation of sanitary solid wastes would total approximately 39,000 to 49,000 cubic feet under the No Action and Expanded Operations Alternatives, respectively, and approximately 35,000 cubic feet under the Reduced Operations Alternative. It is expected that sanitary solid waste generated by NLVF personnel would continue to be removed and dispositioned by a municipal service. In addition, occasional shipments of solid waste, consisting mainly of materials containing sensitive information, would be sent to the NNSS for disposal.

In addition, D&D of certain structures at NLVF is conservatively projected to generate up to approximately 150 cubic feet of LLW and 110,000 cubic feet of (nonradioactive) demolition debris under all alternatives. The LLW would be shipped to the NNSS for disposal in the Area 5 RWMC, while the demolition debris could be disposed at a local landfill or transported to the NNSS for disposal at an NNSS landfill. The LLW and demolition debris volumes are both included in the volumes of waste projected for disposal at the NNSS, which are presented in Table 5–46.

The quantities of LLW projected for shipment to the NNSS are small under all of the alternatives and are within available NNSS disposal capacity (Section 5.1.11). Under all of the alternatives, the quantities of tritiated liquids projected for shipment to the NNSS would be within the NNSS's treatment capability. In addition, under all of the alternatives, recycle or TSD capacity is expected to be adequate for the nonradioactive wastes from NLVF, given the availability of large numbers of permitted recycle or TSD facilities in Nevada and neighboring states (Section 5.1.11.1.1).

5.3.12 Human Health

The approach to evaluating human health impacts is discussed in Section 5.1.12. The criteria for evaluating human health impacts are included in that discussion.

5.3.12.1 Normal Operations

5.3.12.1.1 No Action Alternative

In support of the National Security/Defense Mission, 600 small plasma physics and fusion experiments would be conducted at NLVF, but these experiments are not expected to cause measurable releases of radioactive materials. As described in Chapter 4, Section 4.3.12, tritium from a previous spill continues to be emitted from the A-1 Building. It was estimated that the small amount of tritium expected to be released annually (an average of 0.0111 curies per year) would result in a dose of 0.00035 millirem per year to the MEI at the facility boundary or to a noninvolved worker (approximately 330 feet away). This dose represents a negligible annual risk of an LCF (about 1 chance in 5 billion). The estimated dose to the population of approximately 2,390,000 within 50 miles of NLVF is 4.1×10^{-5} person-rem per year; the calculated number of LCFs associated with this dose is 2×10^{-8}, implying that the most likely outcome would be no additional LCFs in the exposed population. The tritium emissions and, therefore, the potential doses and risks could vary over the years due to factors such as meteorological conditions, but would trend downward due to radioactive decay (tritium has a half-life of 12.3 years).

The potential for occupational injury and illness was estimated for NLVF activities using rates based on DOE experience (DOE 2010i) (see Appendix G for details). The number of TRCs and DART cases were projected based on the number of FTEs estimated for this alternative. Under this alternative, a total of 22 TRCs and 9.5 DART cases per year were calculated.

No radiological or chemical impacts are expected at NLVF from any activities related to the Environmental Management or Nondefense Missions.

Noise. Under the No Action Alternative, potential noise impacts on offsite receptors from activities at NLVF would primarily result from traffic noise generated by privately owned vehicles of commuting employees and would occur along the principal roadways leading to the facility. As discussed in Section 5.1.3.2, "Traffic," Losee Road, which is representative of the offsite traffic near NLVF, would not increase in personnel and is expected to experience a negligible increase in traffic noise along the roadways.

5.3.12.1.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would approximately 1,000 small plasma physics and fusion experiments performed at NLVF; however, these experiments are not expected to cause measurable releases of radioactive material. Therefore, the impacts from normal operations under the Expanded Operations Alternative would be the same as those under the No Action Alternative.

The potential for occupational injury and illness for NLVF activities would be greater under the Expanded Operations Alternative than the No Action Alternative because of the larger number of employees at this location. Based on the number of FTEs estimated for this alternative, a total of 27 TRCs and 12 DART cases per year were calculated.

Noise. Similar to under the No Action Alternative, potential noise impacts on offsite receptors from activities at NLVF would primarily result from traffic noise generated by privately owned vehicles of commuting employees and would occur along the principal roadways leading to the facility. As discussed in Section 5.3.3.2, "Traffic," Losee Road would experience an approximate 3 percent increase in daily traffic volumes in comparison to future baseline conditions. The increase in daily vehicle trips by personnel vehicles would primarily increase baseline noise conditions along the main roadways leading to these sites; however, this would be limited to the morning and afternoon commuter hours.

5.3.12.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, 350 plasma physics and fusion experiments would be performed at NLVF; however, because these experiments are not expected to cause measurable releases of radioactive material, the impacts from normal operations under the Reduced Operations Alternative would be the same as those under the No Action Alternative.

The potential for occupational injury and illness for NLVF activities would be slightly less under the Reduced Operations Alternative than the No Action Alternative because of the fewer number of employees at this location. Based on the number of FTEs estimated for this alternative, a total of 20 TRCs and 8.6 DART cases per year were calculated.

Noise. Under the Reduced Operations Alternative, potential noise impacts on offsite receptors from activities at NLVF would be less than those described under the No Action Alternative because the number of personnel would be reduced. As discussed in Section 5.3.3.2, "Traffic," Losee Road would experience a negligible decrease in daily traffic volumes in comparison to future baseline conditions. This decrease in personnel vehicles would cause a negligible decrease in baseline noise levels during morning and afternoon commuter hours along the main roadways leading to the facility.

5.3.12.2 Facility Accidents

5.3.12.2.1 No Action Alternative

No NLVF accident scenarios that would cause impacts other than extremely small radiological or hazardous chemical risks to the public, workers, or the environment were identified under the No Action

Alternative. A range of potential accidents at NLVF, including accidents involving sealed sources stored and used at Building A-1, were considered. The nature of sealed sources and the manner and location in which they are stored make the probability of an accident very small and the probability of an accident that results in a substantive release is even smaller. Based on the low probability of any accidents that could result in offsite doses, no NLVF accidents were analyzed in detail.

5.3.12.2.2 Expanded Operations Alternative

As under the No Action Alternative, no NLVF accident scenarios that would cause impacts other than extremely small radiological or hazardous chemical risks to the public, workers, or the environment were identified under the Expanded Operations Alternative.

5.3.12.2.3 Reduced Operations Alternative

As under the No Action Alternative, no NLVF accident scenarios that would cause impacts other than extremely small radiological or hazardous chemical risks to the public, workers, or the environment were identified under the Reduced Operations Alternative.

5.3.12.2.4 Intentional Destructive Acts Analysis

Substantive details of terrorist attack scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited by terrorists to plan attacks. A separate classified appendix to this SWEIS has been prepared that considers the underlying facility threat assumptions with regard to intentionally destructive acts. Based on these threat assumptions, the classified appendix evaluates potential human health impacts using appropriate analytical models, similar to the methodology used in this SWEIS to analyze accident impacts. These data provide NNSA with information on which to base, in part, decisions regarding activities at NLVF.

5.3.13 Environmental Justice

5.3.13.1 No Action Alternative

Impacts to human health would not be significant under any alternative. Similarly, direct and cumulative effects on environmental resources are not expected to result in significant adverse impacts to the public within the ROI.

Impacts on low-income and minority populations under the No Action Alternative, as discussed in the other sections in this chapter, would be the same as those on the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.

5.3.13.2 Expanded Operations Alternative

Impacts under the Expanded Operations Alternative would be the same as those described under the No Action Alternative in Section 5.3.13.1.

5.3.13.3 Reduced Operations Alternative

Impacts under the Reduced Operations Alternative would be the same as those described under the No Action Alternative in Section 5.3.13.1.

5.4 Tonopah Test Range

The following sections describe the potential environmental consequences associated with alternatives and programs at the TTR.

5.4.1 Land Use

This section describes the potential environmental consequences for land use and airspace associated with NNSA missions at the TTR. No land use impacts were identified for any alternative at the TTR, including impacts on surround land uses. The only activities that would affect airspace would be defense-related. Therefore, only the National Security/Defense Mission is discussed and evaluated for airspace impacts resulting from implementation of the alternatives.

5.4.1.1 National Security/Defense Mission

5.4.1.1.1 No Action Alternative

Airspace. Under the No Action Alternative, NNSA activities at the TTR would continue at the level of current operations; therefore, no new impacts are expected from anticipated airspace activities and requirements. NNSA would continue to coordinate the use of airspace with the controlling entity responsible for TTR airspace, the Nellis Air Traffic Control Facility. A variety of NNSA programs that require occasional flights of helicopters and fixed-wing aircraft carrying supplies and personnel would continue to occur.

5.4.1.1.2 Expanded Operations Alternative

Airspace. Impacts would be similar to those described under the No Action Alternative in Section 5.4.1.1.1.

5.4.1.1.3 Reduced Operations Alternative

Airspace. Impacts would be similar to those described under the No Action Alternative in Section 5.4.1.1.1; however, impacts would be minimized as a result of the discontinuation of fixed rocket launch operations, cruise missile operations, and fuel-air explosives at the TTR. This would increase the restricted airspace for other military uses as coordinated and scheduled by the Nellis Air Traffic Control Facility.

5.4.2 Infrastructure and Energy

5.4.2.1 Infrastructure

5.4.2.1.1 No Action Alternative

Under the No Action Alternative, infrastructure-related activities would include small projects to maintain the present capabilities of the TTR, including repairs and replacements. There would be no increases in capabilities, facilities, or demand for utilities at the TTR.

5.4.2.1.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, the number of employees at the TTR would decrease from under the No Action Alternative level, thereby reducing demand for utilities.

5.4.2.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the number of employees at the TTR would decrease from the level under the No Action Alternative, thereby reducing demand for utilities.

5.4.2.2 Energy

5.4.2.2.1 No Action Alternative

Under the No Action Alternative, NNSA operations at the TTR would continue at current levels, and no activities have been identified that would create additional long-term demands for electrical power or liquid fuel supply.

The existing 13.8-kilovolt electrical distribution line for DOE operations (stepped down from the 120-kilovolt USAF main line) would continue to meet all facility power demands, and no adverse effects are expected to system capacity. For any routine facility repair activities associated with the No Action Alternative, the current power resources would be adequate to handle the temporary increased demand. All remote operations would continue to be supplied with electrical power by portable generators.

NNSA operations at the TTR use propane for most heating needs, and gasoline and diesel to support emergency generators. The TTR maintains diesel-fired generators, gasoline generators, and propane-fired boilers. The TTR has onsite propane storage tanks, with a collective permitted storage capacity of 23,563 gallons (NDEP 2007). Current liquid fuel storage and resupply capacity would be sufficient to meet ongoing demands.

5.4.2.2.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, the number of employees at the TTR would decrease compared to under the No Action Alternative level (consistent with the implementation of the ROD from the *Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (DOE 2008l), which would reduce demand for electrical power and liquid fuels. The existing electrical distribution line for DOE operations would continue to meet all facility power demands, and no adverse effects on system capacity are expected. For any routine facility repair activities associated with the Expanded Operations Alternative, the current power resources would be adequate to handle the temporary increased demand. All remote operations would continue to be supplied with electrical power by portable generators. Current liquid fuel storage and resupply capacity would be sufficient meet ongoing demands.

5.4.2.2.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the number of employees at the TTR would decrease further from under the Expanded Operations Alternative level, which would reduce demand for electrical power and liquid fuels. The existing electrical distribution line for DOE operations would continue to meet all facility power demands, and no adverse effects are expected to system capacity. For any routine facility repair activities associated with the Reduced Operations Alternative, the current energy resources would be adequate to handle the temporary increased demand. All remote operations would continue to be supplied with electrical power by portable generators. Current liquid fuel storage and resupply capacity would be sufficient meet ongoing demands.

5.4.3 Transportation and Traffic

5.4.3.1 Transportation

There would be about 230 shipments of low-level radioactive waste due to environmental restoration activities to NNSS for disposal under the No Action and Reduced Operations Alternatives. There would be about 13,100 shipments of radioactive waste to NNSS for disposal under the Expanded Operations Alternative. Table 5–11 and the following subsections summarize the impacts associated with these shipments.

5.4.3.1.1 No Action Alternative

The transport of LLW and MLLW by truck to NNSS for disposal would result in a cumulative dose of about 0.015 person-rem, resulting in less than 1 (9×10^{-6}) LCF to the crew. The cumulative dose to the general population would be about 0.0022 person-rem, resulting in less than 1 (1×10^{-6}) additional LCF. The accident risk would be very small (4×10^{-13} LCF). Nonradiological accident risks for transporting LLW and MLLW would also be less than 1 (0.002) fatalities.

5.4.3.1.2 Expanded Operations Alternative

The transport of LLW and MLLW by truck to NNSS for disposal would result in a cumulative dose of about 0.82 person-rem, resulting in less than 1 (0.0005) LCF to the crew. The cumulative dose to the general population would be about 0.28 person-rem, resulting in less than 1 (0.0002) additional LCF. The accident risk would be very small (2×10^{-11} LCF). Nonradiological accident risks for transporting LLW and MLLW would also be less than 1 (0.1) fatalities.

5.4.3.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, the impacts associated with transportation of TTR environmental restoration waste to NNSS for disposal would be the same as described in Section 5.4.3.1.1 for the No Action Alternative.

5.4.3.2 Traffic

The number of personnel at the TTR is expected to remain the same under the No Action Alternative and decrease under the Expanded Operations and Reduced Operations Alternatives. The number of shipments of radioactive waste from the TTR could result in up to 4 truck trips daily for the No Action and Reduced Operations Alternatives and up to 14 trips daily under the Expanded Operations Alternative. These additional vehicles trips are considered relatively low and are expected to result in minor impacts on regional traffic. The shipments of radioactive waste would primarily occur on U.S. Routes 6 and 95. Traffic conditions on these roadways are shown in Table 5–18.

5.4.4 Socioeconomics

5.4.4.1 No Action Alternative

Under the No Action Alternative, the number of employees and the level of operations at TTR would continue at current levels. There would be no increases in capabilities, facilities, or services at the TTR. Because there would be no increase or decrease in the number of employees and the level of operations would continue, no impacts on economic activity, population, and housing; public finances; or public services would occur.

5.4.4.2 Expanded Operations Alternative

5.4.4.2.1 Economic Activity, Population, and Housing

Under the Expanded Operations Alternative, there would be an employment reduction of 63 individuals at the TTR, including 14 employees in Clark County (about 22 percent of the reduction) and 42 employees in Nye County (about 67 percent of the reduction), with the balance of eliminated positions (11 percent of the reduction, 7 employees) affecting employees residing in other counties or states. In Clark County, this would increase the unemployment rate by about 0.01 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, this reduction would increase the unemployment rate by about 1.34 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). This reduction would represent a minor adverse impact on Clark County's unemployment rate and a moderate adverse impact on Nye County's unemployment rate (however, because 23 percent of the jobs added at the NNSS would be allocated to Nye County, this impact could be partially offset). As a result of the reduction in jobs, daily spending in the vicinity of the TTR would decrease, causing a minor adverse impact on economic activity in the area immediately adjacent to the TTR.

Public finance. Revenues for Clark and Nye Counties could decrease due to decreases in personal income and total employment, which could lead to reduced spending. This small decrease in spending (due to a loss of 63 jobs) would have a negligible adverse impact on local economies.

5.4.4.2.2 Public Services

Public **e**ducation. Under the Expanded Operations Alternative, no individuals are expected to relocate to work at the TTR; therefore, no new students would enroll in Clark County or Nye County schools. No new teachers would be required under the Reduced Operations Alternative.

Police protection. Under the Expanded Operations Alternative, the number of daytime occupants at the TTR would decrease, which could result in fewer calls for service. Therefore, a minor beneficial impact on police protection resources is anticipated under this alternative.

Fire protection. No changes in building density at the TTR would occur under the Expanded Operations Alternative. Therefore, it is unlikely that any additional calls for fire protection would take place under the Expanded Operations Alternative. Levels of service at the volunteer fire departments in Nye County would not be impacted.

Health care. Under the Expanded Operations Alternative, a small reduction in staff of 63 people is anticipated. No impact on health care in the region is anticipated. Existing levels of service would be maintained.

5.4.4.3 Reduced Operations Alternative

5.4.4.3.1 Economic Activity, Population, and Housing

Under the Reduced Operations Alternative, there would be an employment reduction of 67 individuals at the TTR, including 15 in Clark County and 45 in Nye County, with the other 7 reductions affecting individuals residing in other counties or states. In Clark County, this reduction would increase the unemployment rate by about 0.01 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, this would increase the unemployment rate by about 1.44 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). This would represent a minor adverse impact on Clark County's unemployment rate and a moderate adverse impact on Nye County's unemployment rate (however, because 23 percent of the jobs added at the NNSS would be allocated to

Nye County, this impact would be partially offset). As a result of the reduction in jobs, daily spending in the vicinity of the TTR would decrease, which would have a minor adverse impact on economic activity in the area immediately adjacent to the TTR.

Public **f**inance. Revenues for Clark and Nye Counties could decrease due to reductions in personal income and total employment, which could lead to reduced spending. This small decrease in spending (due to a loss of 67 jobs) would have a negligible adverse impact on local economies.

5.4.4.3.2 Public Services

Public education. Under the Reduced Operations Alternative, no individuals are expected to relocate to work at the TTR; therefore, no new students would enroll in Clark County or Nye County schools. No new teachers would be required under the Reduced Operations Alternative.

Police protection. Under the Reduced Operations Alternative, the number of daytime occupants at the TTR would decrease, which could result in fewer calls for service. Therefore, a minor beneficial impact on police protection resources in calls for service is anticipated under this alternative.

Fire protection. Similar to under the Expanded Operations Alternative, no changes in building density would occur as a result of the Reduced Operations Alternative. Therefore, it is unlikely that any additional calls for fire protection would take place. Levels of service at the volunteer fire departments in Nye County would not be impacted.

Health care. Under the Reduced Operations Alternative, a small reduction in staff of 67 people is anticipated. No impact on health care in the region is anticipated. Existing levels of services would be maintained.

5.4.5 Geology and Soils

The TTR is used to test weapon systems using noncritical high-explosives experiments and aerial training. The TTR has contaminated soils sites that are managed as part of the Environmental Restoration Program.

5.4.5.1 No Action Alternative

5.4.5.1.1 National Security/Defense Mission

Stockpile Stewardship and Management Program. Several Stockpile Stewardship and Management Program activities occur at the TTR, which would impact the local geology and soils. Operations that would have a potential to impact the soils or geology would include impact tests (nonexplosive) using gravity weapons (bombs), joint test assemblies, and inert projectiles. Soils and geology would be affected by these operations because large sections of soils would be disturbed and contaminated, drainage patterns would be modified, and surface instability could be introduced into rugged areas. Although none of the tests would result in a nuclear yield, other chemicals and heavy metals could contaminate the impact surface. Many of the tests are designed to penetrate the ground surface, which results in impacts on soils from the penetration itself, as well as subsequently, when the ground is excavated to retrieve the test object. The operations at the TTR would be located in isolated areas that were previously used for similar tests. The passive tests using high-resonance energy, lasers, and ultrasound techniques would not affect soils because the activities would occur within existing facilities.

Work for Others. Under the Work for Others Program, and in conjunction with the DoD, NNSA would use the restricted air space at the TTR to conduct counterterrorism operations. There would be no impacts on the physical setting from performing the military operations.

Other Work for Others Program activities at the TTR would include robotics development and experiments for handling chemical materials; smart transportation-related experiments; smoke obscuration operations; infrared tests; and rocket development, testing, and deployment. These experiments would result in some localized soil disturbance, but would be unlikely to result in increased erosion or sedimentation.

5.4.5.1.2 Environmental Management Mission

Waste Management Program. At the TTR, Environmental Restoration Program activities may produce some LLW depending on negotiated cleanup levels and corrective action decisions and could produce minor quantities of TRU waste (a few drums). The wastes produced at the TTR would be disposed at the Area 5 RWMC or brought to the NNSS TRU Storage Pad, which would not generate any impacts on soils or the geology. Other wastes produced at the TTR, including small quantities of hazardous waste, used oil, asbestos, and PCB wastes, would be shipped offsite for disposal and would not produce impacts at the TTR. The USAF TTR sanitary landfill that receives sanitary solid waste produced by TTR facilities would not increase its footprint under the No Action Alternative and, therefore, would not impact soils or geologic resources.

Because oil and hazardous waste are present at the TTR, there is a chance of an accidental spill that could contaminate the soil surface. If an accidental release of hydrocarbons were to occur at the TTR, the soils contaminated with hydrocarbons would be removed to be disposed in permitted and approved landfills. With spill prevention and mitigation measures in place, the potential for impact on the soils from a spill would be reduced. The removal of the contaminated soils would be a positive impact on the soils at the TTR, and the use of existing landfills would not increase surface disturbance.

Environmental Restoration. The Environmental Restoration Program at the TTR would continue to investigate and characterize contaminated soil sites as described under the NNSS No Action Alternative. The corrective action sites for soils at the TTR are primarily related to the plutonium contamination from the Clean Slate 1, 2, and 3 experiments. In total, there are 43 source units (environmental restoration sites) on the TTR, which includes underground storage tanks, landfills and lagoons, soil contamination sites, surface and near-surface radioactive sites, and unexploded ordnance sites. The corrective action sites at the TTR would be closed under the FFACO by the end of 2022.

5.4.5.1.3 Nondefense Mission

General Site Support and Infrastructure Program. The existing infrastructure at the TTR would be able to support the activities described under the No Action Alternative. No additional construction nor demolition on site would be required, so there would be no impacts on the geology or soils around the buildings.

5.4.5.2 Expanded Operations Alternative

5.4.5.2.1 National Security/Defense Mission

National Security/Defense Mission activities at the TTR under the Expanded Operations Alternative would be the same as the No Action Alternative. Therefore, the impacts would be the same as those described in Section 5.4.5.1.

5.4.5.2.2 Environmental Management Mission

Environmental Management Mission activities at the TTR under the Expanded Operations Alternative would be the same as those under the No Action Alternative, so the impacts on the geology and soils at the TTR would not change. No new waste facilities would be needed to accept wastes from the TTR, so impacts resulting from increased erosion or surface disturbance would not occur. The Environmental Restoration Program would also not change.

5.4.5.2.3 Nondefense Mission

Nondefense Mission program activities at the TTR under the Expanded Operations Alternative would be the same as those under the No Action Alternative, so there would be no additional impacts on the geology or soils.

5.4.5.3 Reduced Operations Alternative

5.4.5.3.1 National Security/Defense Mission

Most of the National Security/Defense Mission activities at the TTR would be the same as those under the No Action Alternative. However, under the Reduced Operations Alternative, NNSA would not conduct ground/air launched rocket and missile operations, or fuel-air explosives operations at the TTR, so impacts related to surface disturbance and alteration of drainage pathways would be less than those seen under the No Action Alternative.

5.4.5.3.2 Environmental Management Mission

Environmental Management Mission activities at the TTR would be the same as those under the No Action Alternative, so the impacts on the geology and soils at the TTR would not change. No new waste facilities would be needed to accept wastes from the TTR, so impacts resulting from increased erosion or surface disturbance would not occur. The Environmental Restoration Program would also not change.

5.4.5.3.3 Nondefense Mission

The Nondefense Mission programs at the TTR under the Reduced Action Alternative would be the same as those under the No Action Alternative, so there would be no impacts on the geology or soils.

5.4.6 Hydrology

5.4.6.1 Surface Water Hydrology

As described in Chapter 4, Sections 4.1.6.1 and 4.4.6.4, springs are the only perennial sources of surface water at the TTR; therefore, the only perennial surface waters occur as pools at some large springs. Springs are located outside of locations used for testing and training events and are generally upgradient; therefore, there are no potential impacts anticipated to occur to perennial surface waters at the TTR under any of the alternatives.

5.4.6.1.1 No Action Alternative

The following sections describe impacts associated with the various activities that may potentially occur under the three missions. With respect to the aforementioned impact criteria, no activities would be expected to conflict with the provisions of approved water discharge permits or cause alteration to 100- or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property.

Soils Project activities under the Environmental Restoration Program and activities under the General Site Support and Infrastructure Program are not expected to alter natural drainage pathways.

Industrial Sites Project activities under the Environmental Restoration Program and activities under the General Site Support and Infrastructure Program are not expected to contaminate surface waters with chemical and/or biological agents.

The following TTR operations and activities under the Stockpile Stewardship and Management Program and General Site Support and Infrastructure Program are not expected to deposit sediment in surface waters.

5.4.6.1.1.1 National Security/Defense Mission

Stockpile Stewardship and Management Program – Operations at the TTR. Under the No Action Alternative, operations would continue at the TTR to ensure that nuclear weapons systems meet the highest standards of safety and reliability. NNSA would conduct tests and experiments on gravity weapons, including flight tests of weapon and delivery systems, as well as impact testing to study the parameters of a weapon as it is dropped and as it penetrates the ground surface. At the TTR, following tests and experiments, recovery operations are conducted to minimize damage to the environment. All test assets and associated hardware are recovered with the use of a mobile crane and transport vehicle. When necessary, subsurface recovery excavations are performed using either an excavator or a drill rig to create an entry shaft. Surface water is controlled by building an earthen dike around the recovery area or the excavation; following recovery operations, all excavations and dikes are backfilled and/or leveled. Gravity weapon drops could cause minor alterations of natural drainage pathways and introduce chemical contamination into ephemeral waters. If these exercises would occur in areas where similar exercises occurred previously, impacts from drainage alterations would be less prominent.

Work for Others Program – Work for Others at the TTR. Under the No Action Alternative, the Work for Others Program would provide support to other agencies at the TTR. As described above under "Stockpile Stewardship and Management Program," following tests and experiments, recovery operations are performed to minimize damage to the environment, including controlling surface water with earthen dikes, which are leveled following recovery. The operation of ground-based remote control vehicles could cause localized sedimentation to ephemeral waters. Rocket and missile testing could cause alterations of natural drainage pathways and introduce chemical contamination into the soil where weapons impacts occur. If these exercises would occur in areas where similar exercises occurred previously, impacts from drainage alteration would be less prominent.

5.4.6.1.1.2 Environmental Management Mission

Environmental Restoration Program – Soils Project. The Soils Project would continue to investigate soil sites to determine whether contamination exists and to perform corrective actions as needed. Land-disturbing activities associated with these corrective actions (e.g., vehicular and equipment movements) could cause some minor sedimentation to ephemeral waters. During corrective action activities, excavated or exposed contaminated materials could potentially be transported to downgradient land surfaces during storm events that generate runoff. Appropriate site-specific dust and drainage controls would be implemented for each corrective action (e.g., establishing temporary diversion berms), which would minimize the potential for impacts to occur; however, it is possible that moderate impacts on the water quality of ephemeral surface waters could occur if contaminants were transported to such features.

Environmental Restoration Program – Industrial Sites Project. Following the complete remediation and closure of industrial sites, the facilities would be demolished to the ground level where practical. Therefore, where facilities are demolished to ground level, natural drainage pathways would be restored, resulting in minimal beneficial impacts. Land-disturbing activities associated with demolition (e.g., vehicular and equipment movements) could cause some minor sedimentation to ephemeral waters.

5.4.6.1.1.3 Nondefense Mission

General Site Support and Infrastructure Program. At the TTR, continued wastewater discharges are expected to have no impact on surface-water resources, assuming they adhere to all permit limitations on discharged water quality. In 2009, all contaminant concentrations in discharged effluent were within permitted levels.

5.4.6.1.2 Expanded Operations Alternative

The following sections describe impacts associated with the various activities that may potentially occur under the three missions. With respect to the aforementioned impact criteria, no activities would be expected to conflict with the provisions of approved water discharge permits or cause alteration to 100- or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property.

Soils Project activities under the Environmental Restoration Program and activities under the General Site Support and Infrastructure Program are not expected to alter natural drainage pathways.

Industrial Sites Project activities under the Environmental Restoration Program and activities under the General Site Support and Infrastructure Program are not expected to contaminate surface waters via chemical and/or biological agents.

TTR operations under the Stockpile Stewardship and Management Program and activities under the General Site Support and Infrastructure Program are not expected to deposit sediment in surface waters.

5.4.6.1.2.1 National Security/Defense Mission

Stockpile Stewardship and Management Program – Operations at the TTR. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.1.

Work for Others Program – Work for Others at the TTR. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.1.

5.4.6.1.2.2 Environmental Management Mission

Environmental Restoration Program – Soils Project. Impacts would be similar to those described under the No Action Alternative in Section 5.4.6.1.1.2; however, these impacts could be exacerbated because activities could occur at an accelerated rate. Therefore, compared to the No Action Alternative, an increased potential for surface contamination would occur, as well as increased sedimentation to ephemeral waters.

Environmental Restoration Program – Industrial Sites Project. Impacts would be similar to those described under the No Action Alternative in Section 5.4.6.1.1.2; however, these impacts could be exacerbated because activities could occur at an accelerated rate. Therefore, compared to the No Action Alternative, more work would be done to restore natural topographies and drainage patterns in areas where remediated facilities are demolished and increased sedimentation to ephemeral waters would occur.

5.4.6.1.2.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.3.

5.4.6.1.3 Reduced Operations Alternative

The following sections describe impacts associated with the various activities that may potentially occur under the three missions. With respect to the aforementioned impact criteria, no activities would be expected to conflict with the provisions of approved water discharge permits or cause alteration to 100- or 500-year floodplains or other flood hazard areas in a manner that would endanger lives and property.

Soils Project activities under the Environmental Restoration Program and activities under the General Site Support and Infrastructure Program are not expected to alter natural drainage pathways. Industrial Sites Project activities under the Environmental Restoration Program and activities under the General Site Support and Infrastructure Program are not expected to contaminate surface waters via chemical and/or biological agents. TTR operations under the Stockpile Stewardship and Management Program and activities under the General Site Support and Infrastructure Program are not expected to deposit sediment in surface waters.

5.4.6.1.3.1 National Security/Defense Mission

Stockpile Stewardship and Management Program – Operations at the TTR. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.1.

Work for Others Program – Work for Others at the TTR. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.1.

5.4.6.1.3.2 Environmental Management Mission

Environmental Restoration Program – Soils Project. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.2.

Environmental Restoration Program – Industrial Sites Project. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.2.

5.4.6.1.3.3 Nondefense Mission

General Site Support and Infrastructure Program. Impacts would be the same as those described under the No Action Alternative in Section 5.4.6.1.1.3.

5.4.6.2 Groundwater

5.4.6.2.1 No Action Alternative

Under the No Action Alternative, current NNSA activities at the TTR would continue, and no new facilities or activities are proposed.

Production Well 6 supplies drinking water and fire water distribution systems at the TTR Main Compound in Area 3 and is the only well that is monitored for contaminants. Water appropriations on the TTR total 200 acre-feet per year, and their source basins are considered over appropriated (i.e., the appropriations exceed the perennial yield in each basin). However, the estimated water demand for the entire TTR (including USAF operations) is much lower, at approximately 18 acre-feet per year (DOE 2008l). Specific water usage or demand for NNSA activities is not calculated separately. NNSA has not identified any activities or projects that would place a greater demand for groundwater withdrawals, and no adverse impacts on water supply are anticipated from NNSA activities.

5.4.6.2.1.1 National Security/Defense Mission

Flight tests for gravity weapons, including impact testing and open-air and underground detonations, would continue at the TTR under the Stockpile Stewardship and Management Program. When weapons are dropped, they strike and penetrate the ground surface. These activities could release hazardous constituents near the ground surface, which could migrate downward. Groundwater at the TTR is relatively deep (90 to 450 feet), which affords protection and makes the contamination of groundwater from these activities unlikely. As no contamination has occurred in the past, it is expected that the continuation of these activities would not negatively impact the resource.

5.4.6.2.1.2 Environmental Management Mission

The TTR is considered a small-quantity generator of hazardous waste and can accumulate hazardous waste for 180 days before transferring the waste off site for disposal. It is possible that small leaks or spills or hazardous waste could occur during accumulation or storage, although such releases would likely be discovered and contained promptly. As previously stated, the depth of the groundwater also makes groundwater contamination from waste releases unlikely.

The Industrial Sites Project would continue decommissioning facilities, which is unlikely to affect groundwater availability or quality due to the short duration of activity, the small quantity of contaminants that could be released, and the depth of the groundwater. Nonpotable water demands for dust suppression during decommissioning would be temporary and make up only a small fraction of total water demand on the TTR.

5.4.6.2.1.3 Nondefense Mission

No new activities or facilities are proposed for the TTR; thus, no adverse impacts on groundwater quality or supply would occur.

5.4.6.2.2 Expanded Operations Alternative

No new activities or facilities are proposed for the TTR; thus, no adverse impacts on groundwater quality or supply would occur.

5.4.6.2.2.1 National Security/Defense Mission

As a result of the decision made under the *Complex Transformation SPEIS* (DOE 2008l), employment at the TTR would drop from the existing 106 personnel under the No Action Alternative to approximately 43 personnel. The amount of potable water use for NNSA would decrease by over 50 percent compared to the amount required under the No Action Alternative and would not result in any adverse impacts on groundwater availability. No adverse impacts on groundwater quality at the TTR are expected under the Expanded Operations Alternative.

5.4.6.2.2.2 Environmental Management Mission

Impacts on groundwater quality and supply at the TTR under the Expanded Operations Alternative would be the same as those under the No Action Alternative.

5.4.6.2.2.3 Nondefense Mission

No new activities or facilities are proposed for the TTR; thus, no adverse impacts on groundwater quality or supply would occur.

5.4.6.2.3 Reduced Operations Alternative

5.4.6.2.3.1 National Security/Defense Mission

Under the Reduced Operations Alternative, activities involving fixed rocket launches, cruise missile operations, and fuel air explosives conducted under the Stockpile Stewardship and Management Program would cease. The workforce associated with NNSA activities would decrease an additional 10 percent from the levels identified in the *Complex Transformation SPEIS* (DOE 2008l), to approximately 39 staff. The amount of potable water use for NNSA activities would decrease by over 50 percent compared to the amount required under the No Action Alternative and would not result in any adverse impacts on groundwater availability. No adverse impacts on groundwater quality at the TTR are expected under the Reduced Operations Alternative.

5.4.6.2.3.2 Environmental Management Mission

Impacts on groundwater quality and supply at the TTR under the Reduced Operations Alternative would be the same as those under the No Action Alternative.

5.4.6.2.3.3 Nondefense Mission

No Nondefense Mission activities or facilities are proposed for the TTR; thus, no adverse impacts on groundwater quality or supply would occur.

5.4.7 Biological Resources

Impacts on biological resources would occur at the TTR due to ground-disturbing activities such as building modifications and environmental restoration (the criteria for evaluating biological impacts are listed in Section 5.1.7). These impacts would result from military equipment field testing; drilling; grading; excavation; soil disturbance due to explosives testing; environmental remediation; fencing construction; and building decontamination or demolition. Increased vehicular access would have a potential direct impact on wildlife in these areas due to the risk of road kills.

There are very minor differences among the three alternatives addressed in this SWEIS regarding the types and levels of DOE/NNSA activities at the TTR. For this reason, the following section addresses impacts at the TTR under all three alternatives.

5.4.7.1 No Action, Expanded Operations, and Reduced Operations Alternatives

5.4.7.1.1 National Security/Defense Mission

Stockpile Stewardship and Management Program. Weapons impact testing, flight test operation of gravity weapons, and passive testing would occur at the TTR. Although these activities could potentially disturb native vegetation and affect wildlife habitat, they are generally conducted in sparsely to nonvegetated playa (the flat-floored bottom of an undrained desert basin that becomes at times a shallow lake) areas and in existing facilities. For this reason, Stockpile Stewardship and Management Program activities at the TTR are not expected to reduce the viability of special status wildlife species significantly or have a negative impact on biodiversity, ecosystem functions, or springs in these areas. Explosives tests and detonations could startle wildlife, resulting in impacts on certain species. If these detonations and explosives tests were to occur near vital water sources, they could cause wildlife to avoid them, which could significantly affect species that depend on those water sources. Additionally, if detonations were to occur during the nesting season for birds, explosions could startle nesting birds, causing them to abandon their nests and resulting in a loss of eggs or young.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. Other than providing airspace for counterterrorism activities, no nuclear emergency response, nonproliferation, and counterterrorism activities would be conducted at the TTR. Therefore, no impacts on biological resources are anticipated.

Work for Others Program. Military research and development activities, such as ground-based robotics testing, remote-controlled vehicle testing, and rocket development, would be conducted under this program in previously undisturbed areas and existing facilities and would not disturb native vegetation. Activities that create sudden loud noises, such as rocket motor tests or rocket launches, would potentially disturb nesting birds, causing them to abandon their eggs or young in nests located within the project area.

5.4.7.1.2 Environmental Management Mission

Waste Management Program. Short-term storage of hazardous waste, hydrocarbon-contaminated soil, asbestos, and PCB waste would continue at the TTR before this waste is disposed off site at a permitted facility. Disposal of sanitary solid waste would continue on site at the TTR sanitary landfill. No additional impacts on biological resources are expected to result from these ongoing activities.

Environmental Restoration Program. Soil remediation activities at the TTR may include onsite radiation surveys, soil cleanup, and fencing of contaminated areas. These activities would likely occur on previously disturbed land. However, fencing and soil excavation could potentially disturb native vegetation, although the amount of vegetation and soil that would be disturbed is not expected to reduce the viability of special status wildlife species or have a negative impact on biodiversity, ecosystem functions, or springs in these areas. However, if disturbance of native vegetation occurs during the nesting season for birds, the eggs or young in nests located within the project area could be destroyed. In the longer term, Environmental Restoration Program activities at the TTR would have a beneficial effect on biological resources because contamination would be removed or stabilized, some buildings would be removed, and areas would be revegetated with native plant species appropriate to the sites.

Regarding the Industrial Sites Project, all but 1 of the 64 corrective action sites at the TTR have been closed. Under each of the alternatives, operations involving field investigations to identify contaminated sites would continue, as would characterization and remediation of sites and D&D of facilities. No impacts on biological resources are anticipated to result from these project activities.

5.4.7.1.3 Nondefense Mission

General Site Support and Infrastructure Program. TTR facilities include 195 buildings, towers, and sheds. Under each of the alternatives, small projects to maintain and repair TTR facilities would occur in previously disturbed areas, but are not expected to affect biological resources.

The TTR area supports a number of nesting and wintering birds. Of particular note is the presence of large raptors. Raptors, due to their large size, and use of utility poles as perches are most susceptible to electrocution through the potential contact with phase conductors or other electrical equipment.

Extensive research has been conducted, and continues to be studied on the causes of bird electrocution and collision associated with electric transmission and distribution systems. Much if this research has been summarized by the Avian Power Line Interaction Committee (APLIC 2006). Typically, avian risk occurs where 1) poles provide perching opportunities and conductor separation/spacing and/or proximity to other energized hardware creates electrocution potential and 2) where overhead wires cross traditional bird use areas and create collision potential. The risk is greatest for large raptors. The risk may increase in weather that hinders flight maneuverability or when feathers are wet, thereby increasing conductivity.

In August 2010, NNSA/SSO completed retrofitting four electrical transmission/distribution structures to reduce the risk of electrocution of larger birds, particularly raptors. The retrofitting included new insulator caps, the re-routing of and insulation of jumpers and insulation of grounding wires.

In the future, new construction and refurbishments at TTR would use of raptor safe pole design and wire configuration to help reduce avian mortality. Regular surveys along the power lines will be conducted. Monitoring would be increased for any structures or lines segments that have any avian issues. If the need for any type of mortality reduction measures are identify they will be fully developed in cooperation with state and federal agencies.

Bird mortality incidents reported as a result of power outages or through incidental observations will be reviewed immediately. If the cause is related to an unprotected power pole or conductor issue, a mortality reduction action (i.e., retrofitting poles, installing protective coverings or installation of perch deterrents diverters) will be implemented accordingly, consistent with standard practices recommended by the Avian Power Line Interaction Committee (APLIC 2006).

When a nest is detected in or around electrical transmission/distribution facilities, a risk assessment will be conducted to determine if nest removal or relocation is needed. If it is determined that the nest poses no risk to system function, maintenance procedures, or to the birds, the nest would be allowed to remain. If it is determined that the nest poses a potential risk, then a further assessment will be conducted to determine if the risk is imminent or not imminent. TTR will coordinate with the USFWS to determine whether the nest would need to be removed and discarded or relocated to an alternative location.

Unless there is an immediate threat to birds or system function, nest removal or relocation (excluding eagles and state or federally listed species) would occur only during the non-breeding season when the nest is not being used or during the breeding season if the nest is unoccupied. If removal or relocation of an eagle or state or federally listed species nest is necessary, TTR would coordinate with the USFWS regarding permitting and authorization pursuant to applicable regulations. Nest removal or relocation would occur when the nest is occupied only in cases where it is deemed warranted based on the risk to system function or electrocution risk of the birds. Removal or relocation of an occupied nest would require coordination and permitting/authorization with the USFWS and/or Nevada Department of Wildlife.

Conservation and Renewable Energy Program. No renewable energy projects are planned for the TTR. Energy efficiency measures, conservation measures, and best management practices would consist of small projects located in or adjacent to extant facilities. These activities could potentially disturb native vegetation, although the amount of vegetation and soil that would be disturbed is not expected to reduce the viability of special status wildlife species significantly or have a negative impact on biodiversity, ecosystem functions, or springs in these areas. However, if disturbance of native vegetation occurs during the nesting season for birds, the eggs or young in nests located within the project area could be destroyed.

5.4.8 Air Quality and Climate

This section addresses air quality impacts from stationary and mobile air pollutant sources that would occur within and outside the TTR under the No Action, Expanded Operations, and Reduced Operations Alternatives. For each of the alternatives, the ROI for air quality analysis encompasses Nye and Clark Counties in Nevada. Stationary sources emissions would occur entirely within the TTR, while mobile sources emissions would occur mostly outside the TTR boundaries. Emissions-generating activities within the TTR would be widely dispersed over the 280-square-mile area of the TTR. Under all of the alternatives, emissions levels would not increase over current levels, so Nye County would continue its present attainment/nonclassified designation for all criteria pollutants. Additional details supporting the information presented in this section can be found in Appendix D, Section D.2.4.1.1.

General conformity determination. Section 5.1.8 of this *NNSS SWEIS* includes a discussion of general conformity determinations. Based on the *de minimis* thresholds presented in Table 5–31, the total emissions in Clark County under the No Action Alternative would not exceed the *de minimis* levels for carbon monoxide, nitrogen oxides, PM_{10}, or VOCs in all cases. Therefore, a general conformity analysis would not be required for any of the alternatives considered in this *NNSS SWEIS*.

5.4.8.1 No Action Alternative

5.4.8.1.1 Air Quality

Calculations of emissions on and near the TTR. **Table 5–66** shows the midpoint (year 2015) annual air emissions of the criteria pollutants and hazardous air pollutants associated with various TTR activities under the No Action Alternative (from a combination of stationary and mobile sources). The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. The TTR contribution to the air emissions in Clark County would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–71). Emissions of VOCs, nitrogen oxides, carbon monoxide, and PM_{10} from TTR sources (both mobile and stationary) in Clark County would decrease relative to 2008 emission levels by 0.11, 0.70, 0.40, and 0.076 tons per year, respectively. Most of the emission reductions at the TTR are associated with the phasing in of newer worker vehicles with lower emission reduction technology. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone, or PM_{10} air quality standards. Appendix D, Section D.2.4.1.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

5.4.8.1.2 Radiological Air Quality

No activities under the No Action Alternative are expected to produce any aboveground radiation beyond the levels documented for 2008 baseline conditions in Chapter 4, Section 4.4.8.3.

Table 5–66 No Action Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Tonopah Test Range in 2015

	Annual Air Emissions (tons per year)											
	Stationary Sources	*Government-Owned Vehicles*	*TTR Commuters*			*Commercial Vendors*			*Total*			
	Nye County	*Nye County*		*Nye County*			*Nye County*			*Nye County*		
Pollutant	***On-TTR***	***On-TTR***	***Clark County***	***On-TTR***	***Off-TTR/ Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR/ Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR/ Off NNSS***	***Total***
PM_{10}	<3.7	0.067	0.0099	0.0040	0.036	0.044	0.0019	0.19	0.054	<3.8	0.23	<4.0
$PM_{2.5}$	<3.7	0.051	0.0048	0.0024	0.021	0.036	0.0016	0.16	0.041	<3.8	0.18	<4.0
CO	<2.9	2.5	0.84	0.36	3.3	0.17	0.0078	0.77	1.0	<5.8	4.1	<10.8
NO_x	<13.3	0.58	0.16	0.065	0.60	0.44	0.020	1.9	0.60	<14.0	2.5	<17.1
SO_2	<0.91	0.007	0.0021	0.00084	0.0076	0.00099	0.000043	0.0042	0.0031	<0.92	0.012	<0.93
VOCs	<0.96	0.044	0.023	0.010	0.091	0.048	0.0022	0.22	0.071	<1.0	0.31	<1.4
Lead	<0.01	0.0000027	0.00000062	0.00000026	0.0000024	0.0000019	0.000000090	0.0000089	0.0000025	<0.010	0.000011	<0.010
Criteria Pollutant Total	<21.8	3.2	1.0	0.44	4.0	0.70	0.032	3.1	1.7	<25.5	7.1	<34.3
HAPs	<1.1	0.0036	0.0018	0.00082	0.0074	0.0063	0.00029	0.029	0.0081	<1.1	0.036	<1.1

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; TTR = Tonopah Test Range; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

5.4.8.1.3 Climate Change

See Chapter 4, Section 4.4.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to TTR-related activities. See Section 5.1.8 of this *NNSS SWEIS* for a discussion of methodology for this analysis. **Table 5–67** shows greenhouse gas emissions levels for TTR-related activities under the No Action Alternative. The color coding in Table 5–67 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by TTR (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–67 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Traffic from commercial vendors would be by far the largest single source of greenhouse gas emissions related to TTR activities. Overall, TTR-related activities under the No Action Alternative would create about 3,653 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 87 percent smaller than the reporting level. This represents a net reduction over current greenhouse gas emissions (4,166 tons in 2008) of about 12 percent.

Table 5–67 No Action Alternative Greenhouse Gas Emissions by Tonopah Test Range Activity in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATIONARY SOURCES		
Power generation	185	0.01
Other stationary sources	332	0.01
ALL STATIONARY SOURCES	*517*	*0.02*
MOBILE SOURCES		
Onsite government vehicles	444	0.02
Commuting	482	0.02
Commercial vendors	2,210	0.08
ALL MOBILE SOURCES	*3,136*	*0.11*
ALL SCOPE 1 SOURCES	*776*	*0.03*
ALL SCOPE 2 SOURCES	*185*	*0.01*
ALL SCOPE 3 SOURCES	*2,692*	*0.10*
TOTAL	***3,653***	***0.13***

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

5.4.8.2 Expanded Operations Alternative

5.4.8.2.1 Air Quality

This section addresses air quality impacts from stationary and mobile air pollutant sources that would occur within and outside the TTR under the Expanded Operations Alternative.

Calculations of emissions on and near the TTR. **Table 5–68** shows the midpoint (year 2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various TTR activities under the Expanded Alternative (from a combination of stationary and mobile sources). The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. These emissions would be less than the levels projected under the No Action Alternative, as the Record of Decision for the *Complex Transformation SPEIS* (DOE 2008l) would occur under this Expanded Operations Alternative, resulting in smaller, more efficient operations and fewer employees at the TTR.

The TTR contribution to air emissions in Clark County would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–71). Emissions of VOCs, nitrogen oxides, carbon monoxide, and PM_{10} from all TTR sources would decrease in Clark County relative to 2008 emission levels by 0.15, 1.1, 0.99, and 0.11 tons per year, respectively. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone, or PM_{10} air quality standards. Appendix D, Section D.2.4.2.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

5.4.8.2.2 Radiological Air Quality

Potential remediation activities may occur for the Soils Project corrective action units at the Clean Slate II and Clean Slate III sites. If this remediation activity occurs, it would likely result in increased suspended particulates and higher radiological air emissions relative to those observed in the 2008 baseline conditions, as discussed in Chapter 4, Section 4.4.8.3. However, if this remediation activity takes place at these sites, simultaneous ambient radiological air monitoring would also be performed to assess the potential for offsite impacts and the need for mitigating action.

Table 5–68 Expanded Operations Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Tonopah Test Range in 2015

	Annual Air Emissions (tons per year)											
	Stationary Sources	***Government-Owned Vehicles***	***TTR Commuters***			***Commercial Vendors***			***Total***			
	Nye County	***Nye County***		***Nye County***			***Nye County***			***Nye County***		
Pollutant	***On-TTR***	***On-TTR***	***Clark County***	***On-TTR***	***Off-TTR/ Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR/ Off-NNSS***	***Clark County***	***On-TTR***	***Off-TTR/ Off NNSS***	***Total***
PM_{10}	<3.7	0.027	0.0040	0.0016	0.015	0.018	0.00077	0.077	*0.022*	*<3.7*	*0.092*	*<3.8*
$PM_{2.5}$	<3.7	0.021	0.0019	0.00097	0.0085	0.015	0.00065	0.065	*0.017*	*<3.7*	*0.074*	*<3.8*
CO	<2.9	1.0	0.34	0.15	1.3	0.069	0.0032	0.31	*0.41*	*<4.1*	*1.6*	*<6.1*
NO_x	<13.3	0.24	0.065	0.026	0.24	0.18	0.0081	0.77	*0.25*	*<13.3*	*1.0*	*<14.8*
SO_2	<0.91	0.0029	0.00085	0.00034	0.0031	0.00040	0.000017	0.0017	*0.0013*	*<0.91*	*0.0048*	*<0.92*
VOCs	<0.96	0.018	0.0093	0.0041	0.037	0.019	0.00089	0.089	*0.028*	*<0.98*	*0.13*	*<1.1*
Lead	<0.01	0.0000011	0.00000025	0.00000011	0.00000097	0.00000077	0.000000037	0.0000036	*0.0000010*	*<0.010*	*0.0000046*	*<0.01*
Criteria Pollutant Total	*<21.8*	*1.3*	*0.42*	*0.18*	*1.6*	*0.29*	*0.013*	*1.2*	*0.71*	*<23.3*	*2.8*	*<26.8*
HAPs	<1.1	0.0015	0.00073	0.00033	0.0030	0.0026	0.00012	0.012	*0.0033*	*<1.1*	*0.015*	*<1.1*

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; TTR = Tonopah Test Range; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers;; SO_2 = sulfur dioxide; VOC = volatile organic compound.

5.4.8.2.3 Climate Change

See Chapter 4, Section 4.4.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse gas emissions due to TTR-related activities. See Section 5.1.8 for a discussion of methodology for this analysis. **Table 5–69** shows greenhouse gas emissions levels for TTR-related activities under the Expanded Operations Alternative. The color coding in Table 5–69 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by TTR (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–69 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Traffic from commercial vendors would be by far the largest single source of greenhouse gas emissions related to TTR activities. Overall, TTR-related activities under the Expanded Operations Alternative would create about 1,791 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 94 percent lower than the threshold reporting level. This represents a net reduction over current greenhouse gas emissions (4,166 tons in 2008) of about 57 percent.

Table 5–69 Expanded Operations Alternative Greenhouse Gas Emissions at the Tonopah Test Range in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATIONARY SOURCES		
Power generation	185	0.01
Other stationary sources	332	0.01
ALL STATIONARY SOURCES	*517*	*0.02*
MOBILE SOURCES		
Onsite government vehicles	182	0.01
Commuting	196	0.01
Commercial vendors	896	0.03
ALL MOBILE SOURCES	*1,274*	*0.05*
ALL SCOPE 1 SOURCES	*514*	*0.02*
ALL SCOPE 2 SOURCES	*185*	*0.01*
ALL SCOPE 3 SOURCES	*1,092*	*0.04*
TOTAL	***1,791***	***0.06***

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

5.4.8.3 Reduced Operations Alternative

5.4.8.3.1 Air Quality

This section addresses air quality impacts from stationary and mobile air pollutant sources that would occur within and outside the TTR under the Reduced Operations Alternative.

Calculations of emissions on and near the TTR. **Table 5–70** shows the midpoint (2015) annual air emissions for the criteria pollutants and hazardous air pollutants associated with various TTR activities under the Reduced Operations Alternative (from a combination of stationary and mobile source emissions). The midpoint year represents the average annual emissions over the 10-year planning period, however these emissions would be expected to continue beyond the 10-year period. These emissions would be less than the levels projected under the No Action Alternative, as the Record of Decision for the *Complex Transformation SPEIS* (DOE 2008l) would be implemented under this Reduced Operations Alternative, resulting in smaller, more-efficient operations and fewer employees at the TTR. The TTR contribution to Clark County air emissions would continue to be small and would decrease relative to 2008 emission levels (Chapter 4, Table 4–71).

Emissions of VOCs, nitrogen oxides, carbon monoxide, and PM_{10} from all TTR sources would decrease in Clark County relative to 2008 emission levels by 0.15, 1.1, 1.0, and 0.11 tons per year, respectively. Thus, this action would not contribute to or cause additional violations of the carbon monoxide, ozone or PM_{10} air quality standards. Appendix D, Section D.2.4.3.1, provides more detail on how these emissions were determined, as well as source-type and vehicle-type characterization for mobile sources.

5.4.8.3.2 Radiological Air Quality

No activities under the Reduced Operations Alternative are expected to produce aboveground radiation beyond the levels documented for 2008 baseline conditions in Chapter 4, Section 4.4.8.3.

5.4.8.3.3 Climate Change

See Chapter 4, Section 4.4.8.4, for general details on climate change science and greenhouse gas emissions.

Greenhouse Gas Emissions Due to TTR-related Activities. See Section 5.1.8 for a discussion of methodology for this analysis. **Table 5–71** shows greenhouse gas emissions levels from TTR-related activities under the Reduced Operations Alternative. The color coding in Table 5–71 corresponds to the greenhouse gas accounting requirement scopes under Executive Order 13514 (74 FR 52117) – blue shading corresponds to scope 1 direct emissions (on-site stationary and fugitive emissions, as well as on-site company-owned vehicular emissions), orange shading corresponds to scope 2 indirect emissions (purchased electricity), and green shading corresponds to scope 3 indirect emissions not owned or directly controlled by TTR (commuting, product and waste transport and disposal, business travel, and product use). However, because efforts to account for scope 3 emissions are recent and accepted methods for calculating emissions are evolving the scope 3 emissions categories reported here are for those categories for which reliable and accessible data are available for estimating emissions (commuting and commercial vendor transport activity). Specifically, Table 5–71 does not include emissions from business travel, leased assets, and outsourced assets or the greenhouse gas emissions associated with the extraction and production of purchase material and services.

Table 5–70 Reduced Operations Alternative Emissions of Criteria Pollutants and Hazardous Air Pollutants at the Tonopah Test Range in 2015

	Annual Air Emissions (tons per year)												
	Stationary Sources	*Government-Owned Vehicles*	*TTR Commuters*			*Commercial Vendors*			*Total*				
	Nye County	*Nye County*		*Nye County*			*Nye County*			*Nye County*			
Pollutant	*On-TTR*	*On-TTR*	*Clark County*	*On-TTR*	*Off-TTR/ Off-NNSS*	*Clark County*	*On-TTR*	*Off-TTR/ Off-NNSS*	*Clark County*	*On-TTR*	*Off-TTR/ Off NNSS*	*Total*
PM_{10}	<3.7	0.025	0.0036	0.0015	0.013	0.016	0.0007	0.07	*0.02*	*<3.7*	*0.083*	*<3.8*
$PM_{2.5}$	<3.7	0.019	0.0018	0.00088	0.0077	0.013	0.00059	0.059	*0.015*	*<3.7*	*0.067*	*<3.8*
CO	<2.9	0.93	0.31	0.13	1.2	0.063	0.0029	0.28	*0.37*	*<4.0*	*1.5*	*<5.8*
NO_x	<13.3	0.21	0.059	0.024	0.22	0.16	0.0074	0.7	*0.22*	*<13.5*	*0.92*	*<14.7*
SO_2	<0.91	0.0026	0.00077	0.00031	0.0028	0.00036	0.000016	0.0015	*0.0011*	*<0.91*	*0.0043*	*<0.92*
VOCs	<0.96	0.016	0.0085	0.0037	0.033	0.018	0.00081	0.081	*0.027*	*<0.98*	*0.11*	*<1.1*
Lead	<0.01	0.000001	0.00000023	0.000000096	0.00000088	0.0000007	0.000000033	0.0000033	*0.00000093*	*<0.010*	*0.0000042*	*<0.010*
Criteria Pollutant Total	*<21.8*	*1.2*	*0.38*	*0.16*	*1.5*	*0.26*	*0.012*	*1.1*	*0.64*	*<23.2*	*2.6*	*<26.4*
HAPs	<1.1	0.0013	0.00066	0.0003	0.0027	0.0023	0.00011	0.011	*0.003*	*<1.1*	*0.014*	*<1.1*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; TTR = Tonopah Test Range; NNSS = Nevada National Security Site; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table 5–71 Reduced Operations Alternative Greenhouse Gas Emissions at the Tonopah Test Range in 2015

Source Type	*Carbon-Dioxide-Equivalent Emissions (tons per year)*	*Fraction of Reference Point of 27,558 Tons Per Year*
STATOINARY SOURCES		
Power generation	185	0.01
Other stationary sources	332	0.01
ALL STATIONARY SOURCES	*516*	*0.02*
MOBILE SOURCES		
Onsite government vehicles	164	0.01
Commuting	177	0.01
Commercial vendors	813	0.03
ALL MOBILE SOURCES	*1,155*	*0.04*
ALL SCOPE 1 SOURCES	*496*	*0.02*
ALL SCOPE 2 SOURCES	*185*	*0.01*
ALL SCOPE 3 SOURCES	*990*	*0.04*
TOTAL	***1,671***	***0.06***

Blue	Scope 1 emissions
Orange	Scope 2 emissions
Green	Scope 3 emissions

Traffic from commercial vendors would be by far the largest single source of greenhouse gas emissions related to TTR activities. Overall, TTR-related activities under the Reduced Operations Alternative would create about 1,671 carbon-dioxide-equivalent tons of greenhouse gas emissions per year, about 94 percent lower than the threshold reporting level. This represents a net reduction over current greenhouse gas emissions (4,166 tons in 2008) of about 60 percent.

5.4.9 Visual Resources

5.4.9.1 No Action Alternative

Under the No Action Alternative, current activities and operations would continue. No proposed changes would affect existing visual resources associated with the TTR, and the scenic quality would remain Class B. No mitigation would be required.

5.4.9.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be no changes at the TTR under the No Action Alternative and current activities and operations would continue. There would be no changes to the existing visual environment, and the scenic quality would remain at Class B. There would be no effect. No mitigation would be required.

5.4.9.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be no changes at the TTR under the No Action Alternative and current activities and operations would continue. There would be no changes to the existing visual environment, and the scenic quality would remain at Class B. There would be no effect. No mitigation would be required.

5.4.10 Cultural Resources

At the TTR, Stockpile Stewardship and Management and Work for Others Program activities would not differ significantly among any of the alternatives. All such activities would take place at existing facilities and would not, under normal operations, affect previously undisturbed land. Construction of new buildings or development of new facilities is not proposed under any of the alternatives. Therefore, Stockpile Stewardship and Management and Work for Others Program activities under all alternatives would not affect cultural resources.

Environmental Restoration Program activities at the TTR would be the same under all three alternatives. The Clean Slate II and III sites would be remediated in accordance with an agreement among DOE/NNSA, the USAF, and the NDEP. These Soils Project sites are previously disturbed, but are themselves considered by DOE/NNSA to be historically significant. Therefore, prior to undertaking any remediation actions, DOE/NNSA, in compliance with Section 106, would consult with the State Historic Preservation Office prior to initiating such work to determine eligibility of the Clean Slate sites for inclusion on the NRHP and, if necessary, identify and implement appropriate mitigation measures.

5.4.11 Waste Management

DOE is expected to generate wastes from site operations at the TTR and from environmental restoration at the Nevada Test and Training Range, which includes the TTR. Adequate management capacity is expected for all wastes as discussed below.

Under all SWEIS alternatives, TTR operations are not expected to generate LLW, MLLW, TRU, or mixed TRU wastes. (Environmental restoration, however, is projected to generate LLW as discussed below.) The TTR would continue to be a small-quantity generator of hazardous waste under all alternatives; this waste would be stored on site for no more than 180 days before being transferred off site to permitted recycle or TSD facilities. Under all of the alternatives, TTR operations would annually generate approximately 4 tons of hazardous waste that would be sent off site for disposal (including wastes regulated under authorities other than RCRA, such as PCBs and asbestos), as well as approximately 4 tons of waste that would be sent off site for recycling (including used oil, solid wastes, and other regulated wastes).

Under all of the alternatives, DOE would annually generate approximately 460 cubic feet of construction debris that would be disposed at the TTR within USAF-operated landfills, as well as approximately 6,100 cubic feet of solid waste that would be annually disposed on site.[10] It is expected that this waste would be generated episodically; estimates were projected by averaging waste generation rates over 3 years of data (DOE 2009a; SNL 2007, 2008). Under all of the alternatives, the TTR would annually generate a few thousand cubic feet of sanitary solid waste per year; this small quantity is not expected to vary significantly among the alternatives because TTR personnel requirements are small and are not expected to vary among the alternatives (Section 5.4.4). It is expected that this waste would continue to be disposed at a TTR landfill operated by the USAF.

Under the No Action and Reduced Operation Alternatives, environmental restoration at the TTR and Nevada Test and Training Range would generate approximately 2.9 million cubic feet of LLW over 10 years, a portion of which may be TRU waste[11] The volume of this environmental restoration waste

---

[10] *Adequate disposal capacity is expected at the NNSS and commercial landfills. NNSS landfill capacity is addressed in Section 5.1.11. Regarding commercial landfills, as of 2010, over three dozen municipal solid and industrial waste landfills were permitted in Nevada (NDEP 2010b).*

[11] *Any TRU generated at the TTR would be sent to the NNSS Area 5 RWMC for storage pending offsite shipment to WIPP for disposal or INL for characterization.*

would rise to approximately 11 million cubic feet of LLW under the Expanded Operations Alternative (again, a portion of this may be TRU waste).

Under the No Action and Reduced Operations Alternatives, waste management activities from operations and environmental restoration are not expected to generate wastes that cannot be accommodated by existing recycle or TSD capacity. It is expected that LLW from environmental restoration activities would be transported to the NNSS for disposal in the Area 5 RWMC, although disposal could also occur at the Area 3 RWMS if that facility were reopened. It is not expected that the combined LLW volumes from all in-state and out-of-state generators would exceed available waste disposal capacity at the NNSS; however, additional options for managing environmental restoration waste could be considered, as discussed below and in Section 5.1.11.1.1.

Regarding nonradioactive wastes, there are several dozen facilities for disposal of hazardous waste in Nevada or nearby states, and disposal capacity for solid waste is available at the TTR and offsite locations, including the NNSS and commercial landfills. Recycle capacity for solid and hazardous materials is also available (Section 5.1.11.1.1). Consequently, generation of nonradioactive wastes under the No Action and Reduced Operations Alternatives is not expected to strain available nonradioactive waste disposal capacity.

Under the Expanded Operations Alternative, additional LLW is projected to be generated from environmental restoration activities, as discussed above. One option for disposition of this waste is to transport it to the NNSS for disposal in the Area 5 RWMC, although disposal could also occur at the Area 3 RWMS if that facility were reopened. Under this option, waste from environmental restoration activities at the TTR and Nevada Test and Training Range could constitute approximately 21 percent of all LLW to be disposed at the NNSS under the Expanded Operations Alternative. For this reason, as well as the large number of shipments of LLW that would be required to transport the waste to the NNSS for disposal (Section 5.4.3), additional options for managing this environmental restoration waste could be considered, including closure in place (stabilizing existing contamination in place) or construction and operation of dedicated disposal facilities for this waste that are proximal to the waste generation sources (Section 5.1.11.1.1).

Under the Expanded Operations Alternative, the same quantities of nonradioactive wastes are projected as under the No Action and Reduced Operations Alternatives. Therefore, the same conclusions regarding adequate disposition capacity for nonradioactive wastes apply under all of the alternatives.

5.4.12 Human Health

The approach to evaluating human health impacts is discussed in Section 5.1.12. The criteria for evaluating human health impacts are included in that discussion.

5.4.12.1 Normal Operations

5.4.12.1.1 No Action Alternative

National Security/Defense, Environmental Management, and Nondefense Mission activities are not expected to cause radioactive releases that would affect the public or workers. Radiological doses from the TTR would be from legacy radioactive materials that become resuspended and transported by the wind. The annual dose to an MEI and the population within 50 miles of the TTR would be 0.024 millirem and much less than 1 person-rem, respectively, as reported in Chapter 4, Section 4.4.12.1. The increased risk of an LCF for the MEI would be 1×10^{-8} (1 chance in 100 million). The calculated number of LCFs associated with this annual population dose is 0.0006, implying that the most likely result would be no additional LCFs in the population.

Radiological doses to workers could also come from legacy radioactive materials. Because the source would be legacy contamination, it was assumed that all workers would receive a dose and that the dose would approximate the average historical dose received by radiation workers at TTR (12 millirem per year [see Chapter 4, Section 4.4.12.2]). Based on an estimate of 106 workers under the No Action Alternative (see Section 5.1.4.1), the estimated worker dose would be 1.3 person-rem per year. The calculated annual LCF risk of 0.0008 implies that no additional LCFs would be expected in the worker population.

The potential for occupational injury and illness was estimated for TTR activities using rates based on DOE experience (DOE 2010i) (see Appendix G for details). The number of TRCs and DART cases were projected based on the number of FTEs estimated for this alternative. Under this alternative, a total of 1.6 TRCs and 0.7 DART cases per year were calculated.

Noise. Fuel–air explosives experiments at the TTR under the Stockpile Stewardship and Management Program would instantaneously cause high noise levels. These increases would be intermittent and temporary and are not expected to result in any appreciable noise level increases beyond the TTR boundary. Additionally, because the TTR is located in a remote area and is essentially surrounded by the Nevada Test and Training Range to the west, east, and south, potential noise impacts on residents near the TTR would be minimal. Daily traffic volumes are expected to remain unchanged or similar to current conditions, and negligible increases in traffic noise are expected under the No Action Alternative.

5.4.12.1.2 Expanded Operations Alternative

Under the Expanded Operations Alternative, no new activities would occur, but a larger amount of environmental restoration work would be performed. Because additional soil would be disturbed from the higher level of environmental restoration cleanup, it is assumed that the dose rate would be higher by a factor of 2. Based on an estimate of 43 workers (see Section 5.1.4.1), the estimated worker dose would be 1.0 person-rem per year. The calculated annual LCF risk of 0.0006 implies that no additional LCFs would be expected in the worker population.

The potential for occupational injury and illness for TTR activities would be less under the Expanded Operations Alternative than the No Action Alternative because fewer employees would be at the site. Based on the number of FTEs estimated for this alternative, a total of 0.7 TRCs and 0.3 DART cases per year were calculated.

Noise – Under the Expanded Operations, noise impacts on offsite receptors would mainly result from the increase in daily truck traffic. Similar to the No Action Alternative, fuel–air explosives experiments at the TTR under the Stockpile Stewardship and Management Program would instantaneously cause high noise levels. The number of shipments to the TTR under the Waste Management Program would increase threefold. Up to 14 daily truck trips to the TTR could occur on any given day. This increase would contribute to small increases in baseline noise conditions along the main roadways leading to the TTR.

5.4.12.1.3 Reduced Operations Alternative

Under the Reduced Operations Alternative, there would be an overall reduction in the level of activity at TTR. Using the same basis of analysis as used for the No Action Alternative and an estimate of 39 workers (see Section 5.1.4.1), the estimated worker dose would be 0.47 person-rem per year. The calculated annual LCF risk of 0.0003 implies that no additional LCFs would be expected in the worker population.

The potential for occupational injury and illness for TTR activities would be less under the Reduced Operations Alternative than the No Action Alternative because fewer employees would be at the site. Based on the number of FTEs estimated for this alternative, a total of 0.6 TRCs and 0.3 DART cases per year were calculated.

Noise. Under the Reduced Operations Alternative, fuel–air explosives experiments at the TTR would not occur; therefore, any potential noise impacts on onsite workers or offsite receptors would be eliminated. Daily vehicle trips to the TTR and, therefore, associated traffic noise, would be similar to those described under the No Action Alternative.

5.4.12.2 Facility Accidents

5.4.12.2.1 No Action Alternative

Table 5–72 presents the public and worker radiological consequences (the impacts of an accident if it were to occur) of accidents at the TTR under the No Action Alternative. **Table 5–73** combines the estimated frequency of the postulated accidents with the potential consequences to present the estimated annual risk of an increased likelihood of an LCF due to accidents at the TTR. Appendix G presents the methods used to develop the estimated consequences and risks.

Under the No Action Alternative, National Security/Defense Mission activities would include experiments with joint test assemblies, which are part of a nuclear-explosive-like assembly. The maximum reasonably foreseeable accident would involve the release of radioactive and toxic material due to a structural failure, drop, seismic event, fire, explosion, or aircraft impact involving a joint test assembly. The accident could release small quantities of uranium, lithium, and beryllium.

Since the *1996 NTS EIS* (DOE 1996c), Stockpile Stewardship and Management Program activities at the TTR have changed substantially, with the result that some of the activities evaluated in the *1996 NTS EIS* are not included under the No Action Alternative. For example, the activity that resulted in the maximum reasonably foreseeable radiological accident, the failure of an artillery-fired test assembly, is not included under any of the alternatives evaluated in this SWEIS.

Accident scenarios associated with environmental restoration activities at the TTR that are performed as part of the Environmental Management Mission were evaluated under the No Action Alternative. These accident scenarios involved the release of radioactive material due to a single container spill, a multiple container fire, and an aircraft crash into multiple containers. The maximum reasonably foreseeable accident for the TTR environmental restoration activities is an aircraft crash and fire. The estimated probability of this type of event is in the range of 1.7×10^{-6} (1 chance in 590,000) per year of operation. If this accident were to occur, the MEI would receive a dose of 0.00034 rem, with a corresponding LCF risk of 2×10^{-7} (1 chance in 5,000,000). The offsite population within 50 miles would receive a dose of 0.012 person-rem; the calculated number of LCFs associated with this dose is 7×10^{-6}, implying that the most likely outcome would be no additional LCFs in the exposed population. A noninvolved worker outside the immediate area of the crash could receive a dose of 1.5 rem, with an associated LCF risk of 9×10^{-4} (1 chance in 1,100). When the probability of the accident is taken into consideration, the risk to the offsite public or a noninvolved worker would be negligible.

No reasonably foreseeable major TTR accident scenarios that could cause exposure to noninvolved workers or the public were identified for the ongoing Nondefense Mission.

Table 5–72 Tonopah Test Range Accident Radiological Consequences – No Action, Expanded Operations, and Reduced Operations Alternatives

Accident Scenario	*Offsite Population*				*Onsite Noninvolved Worker*	
	Maximally Exposed Individual		*Population within 50 Miles*			
	Dose (rem)	*LCF Risk* [a]	*Dose (person-rem)*	*Number of LCFs* [b]	*Dose (rem)*	*LCF Risk* [a]
National Security/Defense Mission						
Joint test assembly – radiological	1.7×10^{-5}	1×10^{-8}	5.9×10^{-4}	$0 (4 \times 10^{-7})$	0.075	5×10^{-5}
Sealed source aircraft impact fire	2.5×10^{-9}	2×10^{-12}	1.1×10^{-7}	$0 (7 \times 10^{-11})$	1.2×10^{-5}	7×10^{-9}
Environmental Management Mission – Environmental Restoration Program						
One-container spill	3.4×10^{-9}	2×10^{-12}	1.2×10^{-7}	$0 (7 \times 10^{-11})$	1.5×10^{-5}	9×10^{-9}
Three-container fire	2.5×10^{-8}	2×10^{-11}	1.1×10^{-6}	$0 (7 \times 10^{-10})$	1.2×10^{-4}	7×10^{-8}
Aircraft crash and fire	3.4×10^{-4}	2×10^{-7}	0.012	$0 (7 \times 10^{-6})$	1.5	9×10^{-4}

LCF = latent cancer fatality; rem = roentgen equivalent man.
[a] Increased risk of an LCF to an individual, assuming the accident occurs. The risk value is doubled for individual doses exceeding 20 rem.
[b] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number. The result calculated by multiplying the collective population dose by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

Table 5–73 Tonopah Test Range Accident Radiological Risks [a] – No Action, Expanded Operations, and Reduced Operations Alternatives

Accident	*Frequency* [b]	*Offsite Population*		*Onsite Noninvolved Worker*
		Maximally Exposed Individual	*Population within 50 Miles*	
National Security/Defense Mission				
Joint test assembly – radiological	6×10^{-6}	6×10^{-14}	2×10^{-12}	3×10^{-10}
Sealed source aircraft impact fire	10^{-4} to 10^{-6}	2×10^{-16}	7×10^{-15}	7×10^{-13}
Environmental Management Mission – Environmental Restoration Program				
One-container spill	3×10^{-2}	6×10^{-14}	2×10^{-12}	3×10^{-10}
Three-container fire	4×10^{-6}	8×10^{-17}	3×10^{-15}	3×10^{-13}
Aircraft crash and fire	1.7×10^{-6}	3×10^{-13}	1×10^{-11}	2×10^{-9}

[a] The risk is the annual increased likelihood of an LCF in the MEI or noninvolved worker or the increased likelihood of a single LCF occurring in the offsite population, accounting for the estimated probability (frequency) of the accident occurring.
[b] The estimated frequency is on an annual basis.

After accounting for the frequency of the postulated accidents, the estimated highest risk accident would be the aircraft crash and fire accident. Table 5–73 shows that the annual increased likelihood of an LCF from this accident for the MEI, the offsite population, or a noninvolved worker is essentially zero.

5.4.12.2.2 Expanded Operations Alternative

The accident impacts at the TTR under the Expanded Operations Alternative would be the same as those under the No Action Alternative, as presented in Tables 5–72 and 5–73. None of the new or expanded activities was determined to have potential accident impacts that would have more than negligible radiological or chemical impacts on noninvolved workers, the public, or the environment. At the expanded level of operations, the frequencies of some hazardous activities that might lead to accidents could change. However, given the uncertainty in accident frequency estimation regarding very rare accidents that are not expected to happen within the operating lifetime of a facility or activity, the overall accident frequencies would still remain within the broad frequency categories, such as "extremely unlikely" (10^{-4} to 10^{-6} per year).

5.4.12.2.3 Reduced Operations Alternative

The accident impacts at the TTR under the Reduced Operations Alternative would be the same as those under the No Action Alternative, as presented in Tables 5–72 and 5–73. Although some National Security/Defense Mission activities would be reduced or eliminated under this alternative, environmental restoration activities would continue the same as under the No Action Alternative. None of the reductions in activities was determined to result in more than negligible changes in the radiological or chemical risks to the public or workers.

5.4.13 Environmental Justice

5.4.13.1 No Action Alternative

Impacts to human health would not be significant under any alternative. Similarly, direct and cumulative effects on environmental resources are not expected to result in significant adverse impacts to the public within the ROI.

Impacts on low-income and minority populations under the No Action Alternative, as discussed in the other sections in this chapter, would be the same as those on the general population. Therefore, no disproportionately high and adverse impacts on minority and low-income populations are expected.

5.4.13.2 Expanded Operations Alternative

Impacts under the Expanded Operations Alternative would be the same as those described under the No Action Alternative in Section 5.4.13.1.

5.4.13.3 Reduced Operations Alternative

Impacts under the Reduced Operations Alternative would be the same as those described under the No Action Alternative in Section 5.4.13.1.

5.5 Aggregated Environmental Consequences

The preceding sections of this chapter present potential environmental consequences (impacts) associated with activities at specific NNSA facilities. The majority of these impacts would occur in geographically separate settings or over different periods of time and would not directly affect the same environmental resources or populations. However, NNSA has identified some instances in which impacts associated with two or more facilities could occur within the same environmental setting and time periods and can be quantitatively added to determine the total (aggregated) impact on the affected resources.

Table 5–74 presents aggregated direct impacts on socioeconomics and air quality associated with the three alternatives evaluated in this SWEIS.

Table 5–74 Aggregated Impacts from all National Nuclear Security Administration Sites

Impact Category	*No Action*	*Expanded Operations*	*Reduced Operations*
Socioeconomics – Direct Employment Change in Clark County, Nevada [a]	+115	+759	–146
Socioeconomics – Direct Employment Change in Nye County, Nevada [a]	+35	+163	–110
Air Emissions – Criteria Pollutants in Clark County, Nevada (tons per year) [b]	122.8	156.11	112.44
Air Emissions – Criteria Pollutants in Nye County, Nevada (tons per year) [b]	113.97	166.23	104.16
Air Emissions – Hazardous Air Pollutants in Clark County, Nevada (tons per year) [b]	0.43	0.49	0.41
Air Emissions – Hazardous Air Pollutants in Nye County, Nevada (tons per year) [b]	1.39	1.41	1.29
Air Emissions – Greenhouse Gas Emissions (tons per year; all sites combined) [b]	54,870	63,713	50,962

[a] Excludes temporary construction-related employment and indirect economic effects, but includes permanent positions associated with a commercial solar power generation facility.
[b] Includes emissions from ongoing activities and employees' commutes, calculated at the midpoint year, and excludes temporary construction activities.

Note that previous discussions of traffic (Section 5.1.3.2) and waste management (Section 5.1.11) already present aggregated impacts in summary form, where appropriate. For example, traffic levels and level of service on local roadways are included in accounts for commuter traffic associated with multiple NNSA facilities. LLW disposed at the NNSS under each alternative includes environmental remediation wastes that may be generated at the TTR.

Chapter 6, "Cumulative Impacts," presents a discussion of cumulative effects that considers the effects of past and reasonably foreseeable future actions, as well as actions proposed under this SWEIS, and also considers a larger ROI than that analyzed in this chapter.

CHAPTER 6
CUMULATIVE IMPACTS

6.0 CUMULATIVE IMPACTS

Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations (42 *United States Code* [U.S.C.] 4321 et seq.) define a cumulative impact as the "impact on the environment which results from the incremental impact of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time" (40 *Code of Federal Regulations* [CFR] 1508.7). Thus, the cumulative impacts of an action are the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource no matter what entity is acting. This cumulative impacts analysis is based on continued operations at National Nuclear Security Administration (NNSA) sites in Nevada, including the Nevada National Security Site (NNSS) (formerly the Nevada Test Site), Remote Sensing Laboratory (RSL), North Las Vegas Facility (NLVF), Tonopah Test Range (TTR), and U.S. Department of Energy (DOE) environmental restoration sites on the U.S. Air Force (USAF) Nevada Test and Training Range, as well as reasonably foreseeable future actions at these sites and reasonably foreseeable actions that are ongoing or planned within each site's region of influence (ROI).

6.1 Methodology and Analytical Baseline

The analysis in this chapter was conducted in accordance with CEQ NEPA regulations, as outlined in the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997), *and Guidance on the Consideration of Past Actions on Cumulative Effects Analysis* (Connaughton 2005).

Cumulative impacts assessment is based on both geographic (spatial) and time (temporal) considerations. Historical impacts at NNSA facilities in Nevada are captured in the environmental baseline conditions described in Chapter 4 of this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*. Geographic boundaries for impact assessment vary by resource depending on the time an effect remains in the environment, the extent to which the effect can migrate, and the magnitude of the potential impact. The ROI that NNSA used for identifying potential projects for the cumulative impacts analysis includes the area within 50 miles of the boundaries of the NNSS and the TTR and within 10 miles of the boundaries of RSL and NLVF. All of these ROIs intersect, forming a single cumulative impacts ROI, as shown in **Figure 6–1**. The cumulative impacts ROI encompasses about 15,737,760 acres and includes most of Nye County and parts of Clark, Lincoln, and Esmeralda Counties in Nevada, as well as a portion of Inyo County in California. The cumulative impacts ROI was selected because, for most resource areas, there is little likelihood of any impact from activities at NNSA facilities having a cumulative effect beyond the ROIs. For some resource areas, such as transportation and air quality, cumulative impacts may occur in an area far outside of the cumulative impacts ROI just described. Where cumulative impacts may occur over a wider area, an appropriately expanded area is analyzed. For instance, the cumulative impacts analysis for transportation of radiological materials considers a nationwide ROI.

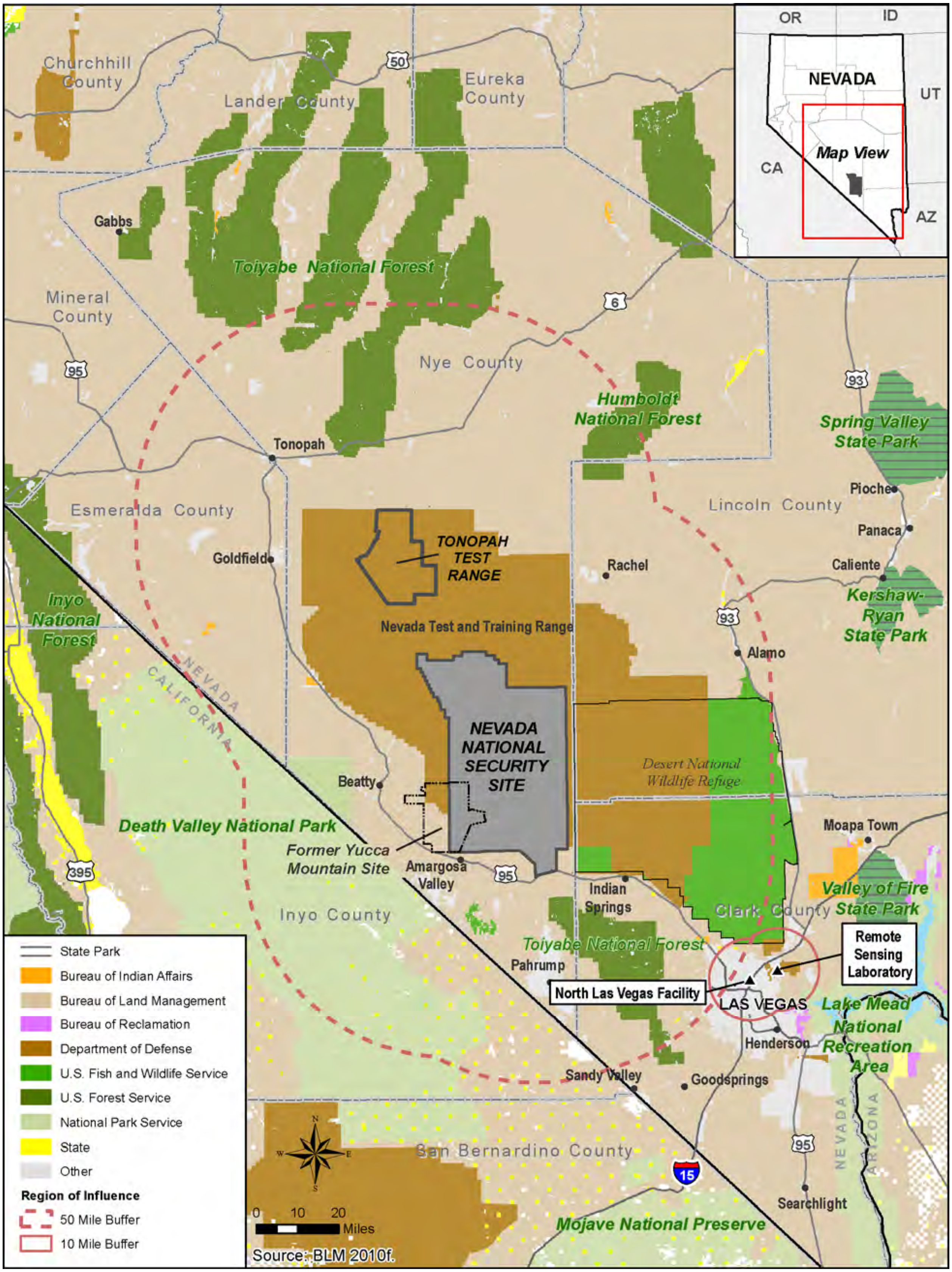


Figure 6–1 Cumulative Impacts Analysis Region of Influence

The cumulative impacts analysis for this *NNSS SWEIS* includes (1) an examination of cumulative impacts presented in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE/EIS-0243); (2) impacts from activities since the *1996 NTS EIS* was issued; and (3) a review of the environmental impacts of past, present, and reasonably foreseeable actions of other Federal and non-Federal agencies and individuals in the ROI. For DOE/NNSA contributions to cumulative impacts, the analysis primarily uses the Expanded Operations Alternative as it tends to result in the highest estimates of potential cumulative impacts associated with alternatives analyzed in this *NNSS SWEIS*. In order to provide a comparison of the cumulative impacts associated with each of the three alternatives considered in this *NNSS SWEIS*, i.e., No Action, Expanded Operations, and Reduced Operations, **Table 6–15**, in Section 6.4, provides a summary of the cumulative impacts by alternative.

Plans for a number of reasonably foreseeable actions identified for this analysis have not reached a sufficient level of development for specific potential impact information to be readily available (e.g., solar power generation projects that have not met the minimum requirements of the U.S. Department of the Interior Bureau of Land Management [BLM] to begin the NEPA process). In those cases, to quantify potential cumulative impacts, a reasonable effort was made to estimate potential impacts by using known information from similar projects.

6.2 Potentially Cumulative Actions

Most of the land within the cumulative impacts ROI for this *NNSS SWEIS* is managed by Federal agencies. In addition to NNSA, other Federal agencies that manage lands within the ROI include BLM, DOE, the USAF, the U.S. Fish and Wildlife Service (USFWS), the National Forest Service, and the National Park Service. In addition, there are lands and facilities under the jurisdiction of agencies of the State of Nevada and the State of California; Nye, Clark, Esmeralda, and Lincoln Counties in Nevada; Inyo County in California; various municipal governments; and private landowners. NNSA identified reasonably foreseeable future actions of others by conducting a review of publicly available documents prepared by Federal, state, tribal, and local government agencies and organizations. In addition, NNSA requested information regarding potential future actions that may not yet have been addressed in publicly available documents. The information obtained through that process formed the basis for this cumulative impacts analysis and is discussed below.

6.2.1 U.S. Department of Energy

This section addresses proposed DOE actions that are not under the auspices of NNSA or are not environmental restoration activities. The proposed Greater-Than-Class C Low-Level Waste Disposal Facility and the formerly proposed Yucca Mountain repository projects are separate from the NNSA programs, projects, and activities addressed in this *NNSS SWEIS*. In addition, the DOE Office of Energy Efficiency and Renewable Energy is proposing to develop a Concentrating Solar Power (CSP) Validation Project in Area 25 of the NNSS. The Office of Energy Efficiency and Renewable Energy will undertake an appropriate level of NEPA analysis for the CSP Validation Project; however, based on available information, this section addresses the proposed project.

6.2.1.1 Concentrating Solar Power Validation Project

DOE's Office of Energy Efficiency and Renewable Energy invests in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil. One of the programs within the Office of Energy Efficiency and Renewable Energy, the Solar Energy Technologies Program, is committed to facilitating the demonstration of utility-scale, concentrating solar power generation technologies, including concentrating solar power, with the goal of making them broadly competitive with wholesale electricity rates under all conditions by the end of the decade. To achieve this goal, DOE supports the demonstration of not-yet-commercial technologies at a sufficient scale to demonstrate their readiness for commercial, utility-scale power production. Systems that connect to intermediate- or high-voltage power transmission lines and are greater than 20 megawatts are generally considered utility-scale electric power generating systems. The intent is to demonstrate technology advancements that are proven at a prototype level and are ready for commercialization, but have not yet been demonstrated at a scale or for a sufficient period of time to secure project financing.

The DOE Solar Energy Technologies Program is proposing to conduct a CSP Validation Project at the NNSS. As part of the CSP Validation Project, DOE would provide partial funding of solar technology demonstration projects through a competitive solicitation opportunity. Additionally, DOE would provide land at the NNSS and basic infrastructure such as power, water, telecommunications, and security, as well as other operation and support facilities. The funding provided by DOE would partially cover the construction, operation, and decommissioning (dismantling and removal) of various solar technology demonstration projects. The CSP Validation Project would be located on 300 acres within Area 25 of the NNSS along its southern border, just east of Lathrop Wells Road. Access to the proposed project site from U.S. Route 95 would be via Lathrop Wells Road through Gate 510. Gate 510 facilitates restricted access to the project site because it is located in the southern part of Area 25 of the NNSS. Approximately 114 of the 300 acres would be disturbed: 94 acres (34 percent) would be fully disturbed by blading and grading the land and approximately 20 acres (7 percent) would be slightly disturbed by cutting or mowing the vegetation; approximately 165 acres (59 percent) would be undisturbed.

Approximately six demonstration projects of various sizes and technologies would be conducted at this site. The intent would be to demonstrate technology advancements that are proven at a prototype level and are ready for commercialization, but have not yet been demonstrated at a scale or for a sufficient period of time to secure project financing. Some of the technology projects would generate power, and some would demonstrate subsystems of concentrating solar power and require power to operate. Although the specific demonstration projects that would be deployed would not be certain until the completion of the competitive solicitation opportunity, **Table 6–1** contains a list of the representative technologies that could be demonstrated.

Table 6–1 Representative Concentrating Solar Power Validation Technologies

Type	*Equivalent Size*	*Description*	*Power Feed*	*Generator or Consumer* [a]
Dish	1.00 MW	Dish Technology with Thermal Storage	1,250 kVA	Generator
Trough	0.75 MW	Linear Trough System with Molten Salt	100 kVA	Consumer
Linear	0.75 MW	Linear Trough System with Direct Steam	100 kVA	Consumer
Tower	5.00 MW	Tower Compact Heliostat Molten Salt	500 kVA	Consumer
Tower	0.50 MW	Modular Brayton Cycle Tower	750 kVA	Generator
Tower	0.75 MW	Tower Graphite Storage Direct Steam	1,000 kVA	Generator
Tower	0.75 MW	Tower Distant Helio	1,000 kVA	Consumer
Totals	10.00 MW	Total Equivalent MW		
	2.75 MW	Electrical Generation		
	7.25 MW	Equivalent Thermal Only		

CPV = concentrating photovoltaic; kVA = kilovolt-ampere; kW = kilowatt; MW = megawatt.
[a] Generator indicates a facility that would produce power. Consumer indicates a facility that would use power.

The proposed CSP Validation Project at the NNSS is part of DOE's solar demonstration initiative, which addresses demonstration-scale projects focused on subcommercial-scale systems and components with the specific objective of developing the operational and performance data needed to secure technical and financial validation of the technologies.

6.2.1.2 Greater-Than-Class C Low-Level Radioactive Waste Disposal

On February 25, 2011, DOE issued a Notice of Availability for the *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (GTCC EIS)* (76 *Federal Register* [FR] 10574) (DOE 2011). The Draft *GTCC EIS* addresses the disposal of low-level radioactive waste (LLW) that contains radionuclides in concentrations exceeding 10 CFR Part 61 Class C limits, generated by activities licensed by the U.S. Nuclear Regulatory Commission (NRC) or an Agreement State, as well as DOE-owned or generated LLW and non-defense-generated transuranic (TRU) waste with characteristics similar to GTCC LLW and for which there may be no path to disposal. The NNSS is one of a number of DOE sites analyzed for disposal of GTCC and GTCC-like waste. In addition to the NNSS and other DOE sites, DOE also evaluated generic commercial disposal sites in four regions of the United States. The disposal technologies considered for the NNSS are intermediate-depth borehole disposal, enhanced near-surface trench disposal, and/or above-grade vault disposal. A combination of disposal methods and locations might be appropriate depending on the characteristics of the waste and other factors.

> **U.S. Nuclear Regulatory Commission (NRC) Classification System for Low-Level Radioactive Waste (LLW)**
>
> The NRC classification system for the four classes of LLW (A, B, C, and greater-than-Class C [GTCC]) is established in 10 *Code of Federal Regulations* (CFR) 61.55 and is based on the concentrations of specific short- and long-lived radionuclides given in two tables. Classes A, B, and C LLW are generally acceptable for disposal in near-surface land disposal facilities. GTCC LLW is LLW "that is not generally acceptable for near-surface disposal," as specified in 10 CFR 61.55(a)(2)(iv). As stated in 10 CFR 61.7(b)(5), there may be some instances where waste with radionuclide concentrations greater than permitted for Class C would be acceptable for near-surface disposal with special processing or design.
>
> Section 3(b)(1)(D) of the Low-Level Radioactive Waste Policy Amendments Act of 1985 specifies that the Federal Government is responsible for disposal of GTCC LLW generated by NRC and agreement state licensees. The U.S. Department of Energy is the Federal Agency responsible for disposal of GTCC LLRW.

All of the disposal technologies would have common supporting infrastructure, such as facilities or buildings for receiving and handling waste packages or containers and space for a retention pond to collect runoff and truck washdown. Each of the facilities, described below, would accommodate the full 12,000 cubic meters (about 420,000 cubic feet) of waste evaluated in the Draft *GTCC EIS*.

Based on the conceptual design for the intermediate-depth borehole disposal facility, about 110 acres of land would be required for 930 boreholes and supporting infrastructure. The conceptual design evaluated in the Draft *GTCC EIS* employs boreholes that are 14 feet in diameter and 130 feet deep with 100 feet between boreholes. Deeper or shallower boreholes than those evaluated in the Draft *GTCC EIS* could be used, depending on site-specific considerations (e.g., depth to groundwater).

The conceptual design for enhanced near-surface trench disposal includes 29 trenches occupying a footprint of about 50 acres. Each trench would be approximately 10 feet wide, 36 feet deep, and 330 feet long. This method of disposal would user deeper trenches than the 21-foot depth typically used for LLW at the Area 5 Radioactive Waste Management Complex (RWMC).

An above-grade vault disposal facility would consist of 12 vault units (each with 11 vault cells) and occupy a footprint of about 60 acres. Each vault would be about 36 feet wide, 310 feet long, and 26 feet tall, with 12 vault units situated in a linear array. The vault cell would be 27 feet wide, 25 feet long, and 18 feet high, with an internal volume of 12,000 cubic feet per vault cell.

The GTCC reference location at the NNSS is southeast of the Area 5 RWMC. If the NNSS were to be selected as the site for a GTCC waste disposal facility, there would be changes to facilities and operations at the NNSS and cumulative impacts in a number of areas, including cultural and biological resources, transportation, air emissions, number of workers, health and safety, energy consumption, and groundwater use.

6.2.2 U.S. Air Force

The USAF operates the Nevada Test and Training Range (formerly known as the Nellis Air Force Range) in south-central Nevada, a national test and training facility for military equipment and personnel that consists of approximately 3 million acres. In *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement* (USAF 1999), the USAF addressed potential environmental impacts of extending the land withdrawal to continue use of the Nevada Test and Training Range lands for military use. The Military Lands Withdrawal Act of 1999 (Public Law [P.L.] 106-65) renewed the land withdrawal for the Nevada Test and Training Range for a period of 25 years, beginning November 6, 2001. In addition, the act assigned to DOE lands that were formerly withdrawn for use by the USAF (portions of Areas 19 and 20 of the NNSS) and made additional adjustments to the boundary between the NNSS and Nevada Test and Training Range (see Chapter 2, Figure 2–2, of this *NNSS SWEIS*).

About 394,000 acres (BLM 2010g) of the 1,301,628-acre (BLM 2011) BLM-administered Nevada Wild Horse Range is within the boundary of the Nevada Test and Training Range, including TTR (see Section 6.2.5.2). More than 800,000 acres of the Nevada Test and Training Range are located within the Desert National Wildlife Range (see Section 6.2.3.1, "Desert Wildlife Refuge Complex"). The USAF and USFWS jointly manage this area.

Nellis Air Force Base lies within the cumulative impacts ROI for this *NNSS SWEIS* and is the host site for RSL. The main gate for the base is located approximately 8 miles northeast of downtown Las Vegas. The base covers more than 14,000 acres. Nellis Air Force Base is home to the USAF Warfare Center, an advanced air combat training mission. Nellis Air Force Base provides training for composite strike forces that include every type of aircraft in the USAF inventory. Training is conducted in conjunction with air and ground units of the U.S. Army, Navy, and Marine Corps, as well as air forces from allied nations.

In 2005, the USAF made the Indian Springs Air Force Auxiliary Airfield an air base and renamed it Creech Air Force Base. The USAF expanded its mission and infrastructure at Creech Air Force Base to play a major role in the war on terrorism. The base is home to two key military operations: the MQ-1 unmanned aerial vehicle and the Unmanned Aerial Vehicle Battle Laboratory.

NEPA documents are periodically completed for proposed new or changing activities at Nellis and Creech Air Force Bases, the TTR, and the Nevada Test and Training Range. **Table 6–2** is a summary of USAF NEPA documents related to these facilities completed since the *1996 NTS EIS* was issued. Most of these NEPA documents address activities and projects at existing facilities that are consistent with the designated missions of those facilities. A few proposed projects would affect previously undisturbed areas, but most would not.

Table 6–2 U.S. Air Force National Environmental Policy Act Documents Completed for Activities Within the Cumulative Impacts Region of Influence Since 1996

Title and Date	***Description***
Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement (USAF 1999)	The U.S. Air Force (USAF) addressed potential environmental impacts of extending the land withdrawal to continue use of the Nevada Test and Training Range lands for military use. The Military Lands Withdrawal Act of 1999 (Public Law 106-65) renewed the land withdrawal for a period of 25 years, beginning November 6, 2001.
Final Environmental Assessment for Predator Force Structure Changes at Indian Springs Air Force Auxiliary Field, Nevada (USAF 2003a)	The proposed action included changes to personnel assignments, upgrades to existing facilities, construction of new facilities, and extension of a runway by 120 meters (400 feet). The USAF issued a Finding of No Significant Impact (FONSI). The USAF completed facilities for the Predator unmanned aerial vehicles in 2006.
Nevada Training Initiative Environmental Assessment (USAF 2003c)	To fulfill the USAF's need to train aircrews and security forces in a modern urban and airfield environment at the Nevada Test and Training Range, the USAF proposed the Nevada Training Initiative, which would implement two separate proposed actions: (1) establish and operate a set of integrated, realistic targets and assets that simulate an urban environment for aircrews at one of two locations in the South Range of the Nevada Test and Training Range and (2) construct and operate a Military Operations in Urban Terrain complex at Range 63A that realistically simulates an airbase environment and construct facilities and infrastructure to support security forces training at one of two locations in the Indian Springs area.
Environmental Assessment Nellis Air Force Base Pipeline Project, Nevada (USAF 2005)	The proposed action would increase the refueling and fuel storage capacity of Nellis Air Force Base by installing a new 8-inch-diameter steel pipeline to the West Operational Bulk Storage Area and the East Side Operations Storage, constructing two new 420,000-gallon storage tanks, and a new 6-inch-diameter liquid fuel steel pipeline connecting the new storage tanks to the East Side Operations Storage.
Wing Infrastructure Development Outlook (WINDO) Environmental Assessment, June 2006 (USAF 2006a)	The proposed USAF action consisted of implementing over 630 Wing Infrastructure Development Outlook (WINDO) projects at Nellis Air Force Base, Creech Air Force Base, Nevada Test and Training Range, and the Tonopah Test Range (TTR). Most of the projects addressed were minor improvement, repair, and maintenance projects. Over 80 proposed projects would involve new construction, expansion, or demolition of existing facilities and infrastructure. All of the proposed WINDO projects would occur within functionally compatible areas and would likely be sited on previously used and/or disturbed land; occur within areas similarly zoned for such uses; and avoid important cultural resources, sensitive habitat, and environmental restoration sites. The USAF issued a FONSI.
Expeditionary Readiness Training (ExperRT) Course Expansion Final Environmental Assessment, June 2006 (USAF 2006b)	The USAF proposed to increase Security Forces Expeditionary Readiness Training course student capacity at the Regional Training Center at Silver Flag Alpha and Creech Air Force Base, Nevada. Training and use of facilities would continue at both Creech Air Force Base and Silver Flag Alpha. Improvements at the Silver Flag Alpha complex would include construction of convoy combat training route, two academic facilities, a laundry/shower/ latrine facility, a leach field, and water storage tanks, as well as installation of communication, water, and power lines at the existing tent complex and Military Operation in Urban Terrain training site. All of these infrastructure improvements would occur within the already developed area of Silver Flag Alpha. The USAF issued a FONSI and began implementation of the proposed actions.
Final Environmental Assessment for Leasing Nellis Air Force Base Land for Construction & Operation of a Solar Photovoltaic System, Clark County, Nevada, August 2006 (USAF 2006c)	The USAF proposed to lease 140 acres of land for construction of a solar photovoltaic system that would provide Nellis Air Force Base with a cost-efficient renewable energy source to augment the existing energy provided by its commercial supplier. The system would generate an 18-megawatt direct current that would be transformed into a 13.5-megawatt alternating current. The USAF issued a FONSI, and the photovoltaic system was constructed and is in operation.

Title and Date	***Description***
Environmental Assessment for Increased Depleted Uranium Use on Target 63-10, Nevada Test and Training Range, September 2006 (USAF 2006d)	The proposed action authorized an increase in the annual use of depleted uranium rounds from 7,900 to 19,000 (and high-explosive incendiary rounds from 1,600 to 3,800) to provide sufficient depleted uranium rounds to accomplish essential training requirements. The USAF issued a FONSI.
Final Environmental Assessment for Sanitary Landfill Expansion on the Tonopah Test Range, Nye County, Nevada, January 2007 (USAF 2007a)	The USAF proposed to construct, operate, and maintain an expansion of its Class II landfill at the TTR to support continued operations. The landfill would be located adjacent to the existing solid waste facility. The total life expectancy of the landfill expansion would be 30 years. The USAF issued a FONSI.
Base Realignment and Closure (BRAC) Environmental Assessment for Realignment of Nellis Air Force Base, March 2007 (USAF 2007b)	The USAF proposed to implement and supplement the 2005 Base Realignment and Closure Commission's mandated realignment for Nellis Air Force Base. Realignment would add 13 F-16 aircraft and 18 F-15C aircraft to Nellis Air Force Base. The proposed action would include construction of 18 new facilities for personnel and equipment scheduled for fiscal year 2007 through fiscal year 2009. The proposed action would also encompass increases of 509 permanently based personnel and 60 part-time Reservists. The proposed action would result in an increase of 1,400 sorties, but the total number of sorties would not exceed the previously approved maximum. The USAF issued a FONSI.
Draft Environmental Assessment For the Integrated Natural Resource Management Plan Nellis Air Force Base and Nevada Test and Training Range, Nevada, May 2007 (USAF 2007c)	The proposed Integrated Natural Resource Management Plan provides guidance for the conservation of natural resources at the Nevada Test and Training Range and Nellis Air Force Base to the extent practicable. The guidelines were developed within the context of the military mission of the affected facilities. A primary goal of the plan is to sustain military readiness while maintaining ecosystem integrity and dynamics.
Range 74 Target Complexes Environmental Assessment Nevada Test and Training Range, Nevada, July 2007 (USAF 2007d)	The USAF proposed to construct mountainous terrain target complexes at three locations within Range 74: Limestone Ridge, Saucer Mesa, and Cliff Springs. The Saucer Mesa target complex comprises 9 discrete sites totaling approximately 131 acres in the hills and valleys along an existing network of two-track trails east of Saucer Mesa. The Limestone Ridge target complex includes 10 discrete sites totaling approximately 245 acres along an existing unimproved road network between Limestone Ridge and the Belted Range. The Cliff Springs target complex comprises 1 linear site situated in a 15-acre corridor along an existing road. The USAF issued a FONSI.
Draft F-35 Force Development Evaluation and Weapons School Beddown Environmental Impact Statement (May 2008) (USAF 2008a)	The USAF proposes to base 36 F-35 fighter aircraft at Nellis Air Force Base between 2012 and 2022. The aircraft would be assigned to the Force Development Evaluation Program and Weapons School at Nellis Air Force Base. Flight activities would occur at Nellis Air Force Base and the Nevada Test and Training Range. The F-35 beddown would also require construction of new facilities and alteration and demolition of existing facilities at Nellis Air Force Base.
BLM Communications Use Lease to USAF to Conduct Patriot Communications Exercises in Lincoln County, Nevada, August 2008 (USAF 2008b)	The USAF proposed to obtain from the Bureau of Land Management a 15-year Communications Use Lease for 14 sites on public land in Lincoln County, Nevada. Each site would be 500 feet by 500 feet (5.7 acres) in size, for a total of approximately 79.8 acres, and would be used for electronic air defense systems to support training with an integrated air defense system. Both the USAF and BLM issued FONSIs.
Nellis and Creech AFBs Capital Improvements Program Environmental Assessment, September 2008 (USAF 2008c)	The USAF proposed to implement updates of the Nellis and Creech Air Force Bases' general plans. The Capital Improvements Plan would include new construction, repair/replacement, installation, maintenance, demolition, and environmental projects. These projects would occur within previously developed or otherwise disturbed lands at both Nellis and Creech Air Force Bases. The USAF issued a FONSI.

Title and Date	***Description***
Environmental Assessment for Enhanced Use Lease of U.S. Air Force Lands to the City of North Las Vegas for Construction and Operations of a Water Reclamation Facility, Nellis Air Force Base, Nevada, April 2008 (USAF 2008d)	The USAF proposed to initiate an Enhanced Use Lease with the City of North Las Vegas for 40 acres of property that was part of the Nellis Air Force Base Sunrise Golf Course. The city of North Las Vegas would construct a water reclamation facility on the property and supply Nellis Air Force Base with reclaimed water from the facility sufficient to irrigate the golf course, as well as for other non-potable uses on the installation. Excess reclaimed water would be discharged to Sloan Channel, located approximately 500 feet east of the property. The USAF issued a FONSI.
AAFES Gas Station at Creech Air Force Base Environmental Assessment, July 2009 (USAF 2009a)	The USAF proposed to construct and operate a single-pump gasoline station on currently undeveloped land within a developed portion of Creech Air Force Base. The USAF issued a FONSI.
Final Environmental Assessment Upgrade of the Indian Springs Collection and Treatment System, December 2009 (USAF 2009b)	The USAF proposed to improve the wastewater collection and treatment system for the town of Indian Springs, Nevada. All activities associated with the project would occur in previously disturbed areas, except about 6.2 acres of land adjacent to the existing treatment ponds that would be disturbed for construction of two new percolation basins and possibly an additional 8 acres for a solar photovoltaic system for generating electrical power.
Draft Standard Army Qualification Ranges at Nellis AFB Small Arms Range Environmental Assessment, March 2010 (USAF 2010a)	The Nevada Army National Guard proposed to establish and operate new Standard Army Qualification Ranges immediately adjacent to the existing Nellis Air Force Base Small Arms Range. The proposed project would occur in three phases; Phase I and Phase II would require a total of approximately 67 acres of ground-clearing activities. The third phase of the project would be addressed as a separate action under a tiered or separate environmental assessment.
Expeditionary Readiness Course Expansion Final Supplemental Environmental Assessment, September (USAF 2010b)	In a 2006 environmental assessment, the USAF proposed to expand ground combat training facilities for the Expeditionary Readiness Training Course (USAF 2006d) and is now proposing to further expand facilities to accommodate up to 8,000 students each year. Five new buildings would be constructed at Creech Air Force Base in previously disturbed areas. A power projection platform would be installed in the northeast corner of the base on approximately 9 acres of land disturbed by previous training operations. Improvements at Range 63C would include new buildings; two mock overpasses; road improvements; placement of guardrails; and parking areas, pavilions, and sidewalks where needed around existing and new buildings. Existing roads within the TTR would be used to access the proposed convoy training route. Approximately 9.3 miles of the existing Stonewall Flat Road (east and portions of the south and north roads) would be graded and possibly paved to improve the convoy route; road widening is not expected to be necessary. A new road, approximately 1.4 miles long, would be constructed between South Stonewall Flat Road and North Stonewall Flat Road. The training area along the roads would be improved to provide realistic scenarios and handle various tactical vehicles, including low- and high-speed sections for tactical live fire. These additional improvements would be constructed over a period of 5 or more years.
Final Environmental Assessment, Outgrant for Construction and Operation of a Solar Photovoltaic System in Area 1, Nellis Air Force Base, Clark County, Nevada, March 2011 (USAF 2011)	The USAF proposes to lease 160 acres of its land to Nevada Energy for construction of a solar photovoltaic system that would provide Nellis Air Force Base with a cost-efficient renewable energy source that would be used primarily by the USAF. The system would generate an 18-megawatt direct current that would be transformed into 10 to 15 megawatts of alternating current. This would be the second solar photovoltaic system to be located on Nellis Air Force Base. The first such system is located in the northern portion of the base (USAF 2006c).

6.2.3 U.S. Fish and Wildlife Service

6.2.3.1 Desert Wildlife Refuge Complex

USFWS manages the Desert National Wildlife Refuge Complex, which encompasses more than 1.6 million acres of land in Nye, Clark, and Lincoln Counties in southern Nevada and includes the Desert National Wildlife Range and Ash Meadows, Moapa Valley, and Pahranagat National Wildlife Refuges. Each refuge within the Desert National Wildlife Refuge Complex provides important and unique habitat for wildlife, including several endemic species (species native to the refuges and often not found anywhere else). The Ash Meadows and Moapa Valley National Wildlife Refuges were established to protect endangered and threatened species, while the Pahranagat National Wildlife Refuge was established to provide a habitat for migratory birds, and the Desert National Wildlife Range was established to protect desert bighorn sheep and other wildlife (USFWS 2009b).

All of these ranges and refuges except Moapa Valley are located within the cumulative impacts ROI for this *NNSS SWEIS* (see Figure 6–1). The closest of these to the NNSS, the Desert Wildlife Range, is located about 1 mile east of the NNSS. As noted in Section 6.2.2, over 800,000 acres of the western portion of the Desert Wildlife Range is managed as joint use between the USAF and USFWS.

In August 2009, USFWS issued the *Desert National Wildlife Refuge Complex – Ash Meadows, Desert, Moapa Valley, and Pahranagat National Wildlife Refuges Final Comprehensive Conservation Plan and Environmental Impact Statement (DNWR Complex EIS)*. Under the plan, various habitat restoration and management activities would occur and some visitor services facilities would be improved and/or constructed. There would be impacts on various resources from the proposed activities, but the net impacts of the habitat restoration and management activities would generally benefit natural plant and animal populations in the region. Construction activities would result in some localized adverse impacts on wildlife habitat and other resources, but these would be relatively minor and temporary. Because the comprehensive conservation plan is largely conceptual, specific impacts on resources were not addressed in the *DNWR Complex EIS*, but will be evaluated in subsequent NEPA processes. Therefore, although there could be some cumulative impacts with actions proposed in this *NNSS SWEIS*, those impacts cannot be quantified at this time but are expected to be small. For instance, USFWS is proposing to conduct restoration work at Fairbanks and Soda Springs at Ash Meadows National Wildlife Refuge (USFWS 2009c). This would result in small temporary local air quality impacts but would not result in any other impacts that would be cumulative with impacts at the NNSS.

6.2.3.2 Clark County Multi-Species Habitat Conservation Plan

Section 9 of the Endangered Species Act, as amended (16 U.S.C. 1531 et seq.), and Federal regulations prohibit the ‘‘take’’ of a fish or wildlife species listed as endangered or threatened. Under the Endangered Species Act, the following activities are defined as take: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect listed wildlife species or to attempt to engage in such conduct (16 U.S.C. 1532). However, under Section 10(a)(1)(B) of the act, USFWS may issue permits to authorize ‘‘incidental take’’ of listed wildlife species to non-Federal entities. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Regulations governing permits for endangered and threatened species are found in 50 CFR 17.22 and 17.32, respectively.

In September 2000, USFWS issued a permit to the Cities of Boulder City, Henderson, Las Vegas, Mesquite, and North Las Vegas; Clark County; and the Nevada Department of Transportation for incidental take of 78 covered species, including the federally threatened desert tortoise (*Gopherus agassizii*) by the development of up to 145,000 acres in Clark County, Nevada. The permit was based on the Clark County Multi-Species Habitat Conservation Plan (MSHCP) (USFWS 2000). The permit is effective as of February 1, 2001, and expires on January 31, 2031. Activities included in the MSHCP for the permitted projects include, but are not limited to, development of residential and commercial areas, urban parks and recreation facilities, utility and transportation facilities, and other capital improvements; operations; and flood control. As noted in the MSHCP, the permit applies to all non-Federal lands that currently exist and all non-Federal lands that result from sales or transfers from the Federal Government after the issuance of the Section 10(a) permit.

In September 2009, USFWS announced that the permitted parties intend to request a permit amendment for the incidental take of covered species on up to 215,000 additional acres in Clark County, Nevada. Activities that would be covered by the MSHCP amendment are not likely to change from the existing MSHCP (74 FR 50239). USFWS is preparing an environmental impact statement (EIS) to address the potential impacts of issuance of a modified incidental take permit.

The combined areas under the current and amended permit would total up to 360,000 acres. However, it is assumed that any amended permit resulting from this process would also apply to all non-Federal lands that currently exist and all non-Federal lands that result from sales or transfers from the Federal Government after issuance of the amendment. For this reason, in calculating potential areas of disturbance within the cumulative impacts ROI, the acres of land that would disposed by BLM, described below in Section 6.2.4.6, “Las Vegas Valley Land Disposal,” should be excluded to prevent double counting. Therefore, about 36,000 acres is deducted from the 360,000 acres that would be developed under the modified incidental take permit. The remaining 324,000 acres is used as part of the estimate of potential cumulative environmental impacts in this *NNSS SWEIS*.

6.2.4 Bureau of Land Management

BLM administers public lands within the cumulative impacts ROI for this *NNSS SWEIS*. BLM administers the land immediately adjacent to the southern end of the NNSS and land surrounding much of the Nevada Test and Training Range and the TTR. With the exception of almost 740 acres of the Area 5 RWMC at the NNSS, the NNSS and the Nevada Test and Training Range, including the TTR, are located on land under BLM jurisdiction that is withdrawn from public use by DOE and the USAF, respectively.

Section 102 of the Federal Land Policy and Management Act (P.L. 94-579) states that “the national interest will be best realized if the public lands and their resources are periodically and systematically inventoried and their present and future use is projected through a land use planning process coordinated with other Federal and State planning efforts.” In compliance with this policy, BLM uses a public process to prepare resource management plans that serve as the basis for all activities that occur on BLM-administered lands. The purpose of a resource management plan is to provide direction for management of renewable and nonrenewable resources found on public lands administered by BLM and to guide decisionmaking for future site-specific actions. The cumulative impacts ROI for this *NNSS SWEIS* includes parts of the Ely, Southern Nevada, and Battle Mountain Districts of BLM. The Ely District completed its new resource management plan in August 2008 (BLM 2008c). The Las Vegas District initiated the process to revise its resource management plan with public scoping meetings in January 2010 (BLM 2010d). The Battle Mountain District has initiated the process to update and combine the Shoshone, Eureka, and Tonopah resource management plans into a district-wide resource management plan and EIS, but has not yet begun public scoping (BLM 2010e). In 2004, BLM prepared a resource management plan for about 2.2 million acres of withdrawn public lands on the Nevada Test and Training Range (BLM 2004a). The plan guides the management of the affected natural resources through 2024. The decisions, directions, allocations, and guidelines in the plan are based on the primary use of the withdrawn area for military training and testing purposes.

6.2.4.1 Renewable Energy Projects

On May 29, 2008, DOE and BLM issued an NOI to prepare an EIS (73 FR 30908) in response to the following mandates: (1) Executive Order 13212, *Actions to Expedite Energy-Related Projects*, and (2) Title II, Section 211, of the Energy Policy Act of 2005. DOE and BLM identified utility-scale solar energy development as a potentially critical component in meeting these mandates and jointly prepared the *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States (Solar Energy PEIS)* (BLM/DOE 2010) to evaluate utility-scale solar energy development in Arizona, California, Colorado, Nevada, New Mexico, and Utah. In the course of the *Solar Energy PEIS* analyses, DOE and BLM identified a number of tracts of BLM-administered land for in-depth study for solar development. On June 30, 2009, DOE and BLM issued a Notice of Availability for the solar energy study area maps (74 FR 31307). Seven areas identified for in-depth study are located in Nevada and three are within the cumulative impacts ROI of this *NNSS SWEIS*: Amargosa Valley (31,625 acres), Gold Point (4,810 acres), and Miller's (16,787 acres) (BLM/DOE 2010). Based on the information and analyses in the *Solar Energy PEIS*, DOE and BLM will develop and implement agency-specific programs that establish environmental policies and environmental impact mitigation strategies for solar energy development. The *Solar Energy PEIS* does not provide specific analysis to support any particular project. However, information is available regarding the specific proposed renewable energy projects being considered by BLM for land use permitting within the cumulative impacts ROI in this *NNSS SWEIS*, as discussed below.

As noted in the *Final Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project* (BLM 2010a), there are uncertainties in any large-scale, complex, and costly industrial project as it moves from concept toward realization. However, the level of uncertainty with some proposed renewable energy projects is high for the following reasons: (1) not all of the developers will develop the detailed information necessary to meet BLM standards; (2) following completion of BLM's NEPA process, the developers must obtain any necessary permits required by Federal, state, and local regulatory authorities; (3) the developers must secure funding to construct the project (if not already obtained), which may be affected by the status of competing renewable energy projects; and (4) proposed renewable energy projects must successfully compete for power purchase agreements with utility organizations that are working to meet their state-mandated renewable portfolio standards. Cumulative impacts analysis under NEPA requires consideration of the likelihood that the proposed projects actually will occur. To be conservative, all of the proposed solar energy projects listed in **Table 6–3** were included in the cumulative impacts analysis in this *NNSS SWEIS*.

Table 6–3 Summary of Renewable Energy Projects Within the Cumulative Impacts Region of Influence [a]

Project Name	*Estimated Facility Area (acres)*	*Proposed Plant Capacity (megawatts)*	*Estimated Operational Water Demand [b] (acre-feet per year) [c]*	*Proposed Technology*
Projects for which a Decision has been Made by BLM and a Right-of-Way Permit Issued or Pending				
Solar Millennium LLC; Amargosa Farm Road Solar Energy Project [d]	4,350	500	400	Parabolic Trough
Tonopah Solar Energy LLC; Crescent Dunes Solar Energy Project [e]	1,620	110	600 [f]	Concentrating Solar Power (power tower)
Projects that are in the Permitting Process with BLM				
Abengoa Solar, Inc.; Lathrop Wells Solar Facility [g]	5,336	250 to 520	200 to 405 [h]	Parabolic Trough plus 20 megawatts of photovoltaic
Pacific Solar, Inc.; Amargosa North Solar Project [i]	7,500	150	5 to 10	Photovoltaic
Projects for which BLM has received an Application for Right-of-Way (first-in-line projects only)				
Amargosa Flats Energy, LLC (Ausra) [j]	4,480	140	112 [i]	Linear Fresnel Reflector
Cogentrix Solar [j]	13,440	1,000	800 [h]	Solar Thermal (troughs)
Cogentrix Solar [j]	12,800	1,000	800 [h]	Solar Thermal (troughs)
Cogentrix Solar [j]	22,400	1,000	800 [h]	Solar Thermal (troughs)
Cogentrix Solar [j]	30,720	1,000	800 [h, k]	Concentrating Solar Power
EwindFarm, Inc. [j]	11,238	500	17 [k]	Photovoltaic
Nye County Solar One, LLC [j]	14,160	300	240 [h]	Parabolic Trough
Pacific Solar, Inc.; Amargosa South Solar Project [l]	4,000	500	400 [h]	Parabolic Trough
Element Power [j]	1,039	Unknown	Unknown [k]	Photovoltaic
Totals for Solar Energy Projects	**133,083**	**5,480 to 5,750**	**5,174 to 5,379**	
Sierra Geothermal Power Corp. Alum [j]	9,660	33	Unknown [m]	Geothermal
Sierra Geothermal Power Corp. Silver Peak [j]	Unknown	15	Unknown [m]	Geothermal
Totals for Geothermal Projects	**9,660**	**48**	**Unknown**	
Totals for All Renewable Energy Projects	**142,743**	**5,528 to 5,798**	**5,174 to 5,379**	

BLM = Bureau of Land Management.

[a] Values in this table are based on sources with varying degrees of certainty, from those that are derived from final EIS to those that are derived from initial plans of development. None of these values represent a built project, and all are subject to change. Some of the projects listed in this table are likely to not be built.

[b] Unless otherwise noted, water withdrawals would most likely be from the Amargosa Desert Hydrographic Basin.

[c] 1 acre-foot of water is equal to 325,851 gallons.

[d] BLM 2010a.

[e] BLM 2010f.

[f] Water would be withdrawn from groundwater within the Tonopah Flat member of the Great Smokey Valley Hydrographic Basin.

[g] 75 FR 41231.

[h] Value estimated by assuming dry-cooled technology and scaling from the *Final Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project* (BLM 2010a), i.e., 0.8 acre-feet of water for each megawatt of generating capacity.

[i] 74 FR 66147.

[j] BLM Renewable Energy Table at http://www.blm.gov/pgdata/etc/medialib/blm/nv/energy.Par.56189.File.dat/renewable_energy_project_table_aug2010.pdf. Accessed on January 24, 2010.

[k] Located within the Pahrump Hydrographic Basin.

[l] PSI 2007.

[m] Located in northwestern Esmeralda County.

As shown in Table 6–3, within the cumulative impacts ROI, there are 13 proposed solar facilities and two proposed geothermal projects. There are no wind energy projects proposed within the cumulative impacts ROI, but two firms are evaluating potential wind energy sites west of the NNSS: Altagas Renewable Energy is evaluating a site about 5.5 miles west-southwest of Beatty in Nye County, Nevada (BLM 2010k), and Pacific Wind Development, LLC, a subsidiary of Iberdrola Renewables Inc., is evaluating a site located about 14 miles west-northwest of Lida in Esmeralda County, Nevada (BLM 2010j). As of January 2011, two of the proposed solar energy projects have completed BLM's NEPA process and may proceed: Amargosa Farm Road Solar Energy Project (BLM 2010i), located in Amargosa Valley about 5 miles southwest of the NNSS, and Crescent Dunes Solar Energy Project (BLM 2010h), located north of Tonopah, Nevada. In addition, two of the proposed projects have entered the BLM permitting process and are preparing EISs (74 FR 66147 and 75 FR 41231): Lathrop Wells Solar Facility, located in Amargosa Valley just south of the intersection of U.S. Route 95 and Nevada State Route 373 and Amargosa North Solar Project, located in Amargosa Valley between 5 and 6 miles west of the NNSS. The other seven proposed solar facilities have submitted applications for a right-of-way but have not submitted an approved plan of development to BLM to initiate the permitting process. There are also several solar developers who have submitted applications to BLM that are "second in line," meaning that they proposed development of sites for which applications have already been submitted. The proponents have not submitted detailed project-specific information for these projects, but only basic information such as type of technology to be used, proposed size, and requested acreage. These "second-in-line" applications are not included in this cumulative impacts analysis to preclude double counting potential impacts. In addition, a potential solar project that has submitted an application to BLM that would be located on the NNSS (BLM 2010a) is not addressed in this cumulative impacts analysis because, as the holder of the withdrawal for the land proposed to be used, NNSA has not been consulted regarding this project and believes that the capacity of the facility described in the application to BLM (8,000 megawatts) is unreasonably large and cannot be supported by available resources, particularly groundwater.

6.2.4.2 National Wild Horse Range

Under the Wild Free-Roaming Horses and Burros Act, BLM manages wild horses and burros in herd areas where they were found when the act went into effect in 1971. Herd areas that can provide adequate food, water, cover, and space to sustain healthy and diverse wild horse and burro populations over the long term are designated by BLM as Herd Management Areas. There are 20 BLM Herd Management Areas (19 in Nevada and 1 in California) that lie wholly or in part within the cumulative impacts ROI for this *NNSS SWEIS* (BLM 2009d), as follows:

Amargosa Valley	Johnnie	Sand Springs West
Ash Meadows	Montezuma Peak	Saulsbury
Bullfrog	Nevada Wild Horse Range	Silver Peak
Chicago Valley	Paymaster	Stone Cabin
Goldfield	Pilot Mountain	Stonewall
Gold Mountain	Redrock	Wheeler Pass
Hot Creek	Reville	

As mentioned in Section 6.2.2, BLM administers the Nevada Wild Horse Range located within the boundary of the TTR and Nevada Test and Training Range (BLM 2010g). While the primary purpose of the TTR and Nevada Test and Training Range is weapons development and flight training, the management of wild horses is a secondary use of the lands.

6.2.4.3 Designation of Energy Corridors on Federal Land

Section 368 of the Energy Policy Act of 2005 (P.L. 109-58), directed the Secretaries of Agriculture, Commerce, Defense, Energy, and the Interior to designate, under their respective authorities, corridors on Federal land in the 11 western states for oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities (energy corridors); perform any environmental reviews that may be required to complete the designation of such corridors; incorporate the designated corridors into relevant agency land use and resource management plans; ensure that additional corridors for oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities on Federal land are promptly identified and designated as necessary; and expedite applications to construct or modify oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities within such corridors. In partial response to that direction, DOE and BLM, as lead agencies, prepared the *Final Programmatic Environmental Impact Statement for the Designation of Energy Corridors on Federal Land in 11 Western States* (DOE/EIS-0386) *(Energy Corridors PEIS)* (DOE 2009j) to conduct a detailed programmatic environmental analysis of potential energy corridors and to integrate NEPA at the earliest possible time.

The *Energy Corridors PEIS* identified potential Section 368 corridors; evaluated effects of potential future development within designated corridors; identified mitigation measures for such effects; and developed interagency operating plans applicable to planning, construction, operation, and decommissioning of future projects within the corridors. In January 2009, BLM issued a Record of Decision (ROD) to amend relevant resource management plans and designate Section 368 energy corridors therein. Several Section 368 corridor segments identified in the *Energy Corridors PEIS* are within the cumulative impacts ROI for this *NNSS SWEIS*. Those corridor segments parallel existing transmission lines and major roadways, such as U.S. Route 95. There were no specific energy transmission projects identified for these corridor segments in the *Energy Corridors PEIS*.

6.2.4.4 Electrical Transmission Line Projects

As part of its long-term planning to support renewable energy development in the Amargosa Valley, the Valley Electric Association intends to upgrade its existing transmission lines in its service territory (BLM 2010a). The first phase would include the upgrade of an existing transmission line located south of U.S. Route 95 and west of Nevada State Route 160 from 138 to 230 kilovolts. The second phase would consist of construction of a new 230-kilovolt transmission line from the existing Valley Electric Association substation at the corner of Powerline Road and Anvil Road to the existing Valley Switching Station. The new 230-kilovolt line would then parallel Valley Electric Association’s existing 138-kilovolt transmission line to the site of the proposed Johnnie substation that would be located 5 to 10 miles south of U.S. Route 95 near Nevada State Route 160. Valley Electric Association is currently performing system impact studies based on interconnection requests to determine whether other upgrades are required to accommodate future load growth. Valley Electric Association will file a right-of-way application or update to accommodate these upgrades, and BLM will prepare a separate NEPA review of Valley Electric Association’s proposed action.

In January 2010, Renewable Energy Transmission Company filed an application with BLM for the proposed Solar Express Transmission Line Project (RetCo 2010). The Solar Express Transmission Line Project would consist of two 500 kilovolt, double circuit, electric transmission lines which would run 122 miles between the existing Eldorado Valley Substation Complex, south of Boulder City, Clark County, Nevada, and a new 500 kilovolt substation, located in the Amargosa Valley in Nye County, Nevada. An additional 500 kilovolt substation is planned as a mid-terminal, at a location south of the town of Pahrump, close to the Nye and Clark County line. The proposed line would also interconnect with Valley Electric Association’s 230-kilovolt system at its proposed Johnnie Substation. The Solar Express Transmission Line would be routed within Section 368 corridors 18–224, 224–225, and 225–231 identified in the *Energy Corridors PEIS*. Renewable Energy Transmission Company filed an application in September 2010 with Western Area Power Administration for its Transmission Infrastructure Program to receive consideration for funding under Section 402 of the American Recovery and Reinvestment Act. The purpose of the proposed project is to connect new generation facilities with the Eldorado Valley Substation Complex, which is a major point of connection of the western power grid. While it is envisioned that the generation that would be connected will be mostly solar generation, it is possible that wind, geothermal or natural gas fired generation may also connect to the Solar Express Transmission Line Project.

The Southwest Intertie Project and the ON Line Project have both been subject to BLM NEPA processes. The Southwest Intertie Project is a proposed 520-mile, 500-kilovolt transmission line for which BLM originally granted right-of-way permits to Idaho Power Company in December 1994 (BLM 2008b). Idaho Power Company did not undertake final permitting or construction of the Southwest Intertie Project, and the rights to the southern portion were eventually transferred to Great Basin Transmission, LLC (BLM 2008b). The southern portion of the Southwest Intertie Project would extend from the proposed Thirty Mile Substation about 18 miles northwest of Ely, Nevada, south approximately 230 miles to the existing Harry Allen Substation, located about 20 miles northeast of Las Vegas, Nevada. The ON Line Project is an NV Energy-proposed 236-mile, 500-kilovolt transmission line between a new Robinson Summit Substation, located less than 1 mile southeast of the proposed Thirty Mile Substation, and the Harry Allen Substation (BLM 2010k). Both of these transmission line projects would interconnect with the existing Falcon-Gonder 345-kilovolt transmission line at their northern ends (BLM 2008b and 2010k). The alignment of the southernmost portions of both of these transmission lines would follow the Southwest Intertie Project right-of-way and would be outside of the cumulative impacts ROI for this *NNSS SWEIS*.

TransWest Express, LLC, filed an application with BLM for a right-of-way to construct and operate a 600-kilovolt overhead direct current transmission line to cross public and private lands for the TransWest Express 600-kilovolt Project (76 FR 379). The extra-high-voltage line would transmit up to 3,000 megawatts of power generated by renewable energy projects in Wyoming to the desert southwest. The project would begin in south-central Wyoming, cross northwestern Colorado, and Utah, and end south of Las Vegas at the Marketplace hub in the Eldorado Valley near Boulder City, Nevada. Western Area Power Administration plans to partially fund the project under the American Recovery and Reinvestment Act of 2009. The project schedule calls for it to be in operation by 2015. Although one alternative corridor currently under consideration would cross the northern portion of the Las Vegas Valley and would be within the cumulative impacts ROI for this *NNSS SWEIS*, the proposed route would be outside of the ROI.

NV Energy is considering several potential transmission lines within the cumulative impacts ROI (NV Energy 2009). The potential projects are 500-kilovolt transmission lines and associated facilities beginning at the Harry Allen Substation, then going to the Northwest Substation, located in the northwestern area of Las Vegas Valley and then westerly and north along the western part of the state of Nevada, to NV Energy's existing Blackhawk Substation near Carson City. The potential projects could ultimately interconnect with a proposed Raven Substation in northern California. This or an equivalent electrical transmission system, such as the Solar Express Transmission Line project discussed above, would be essential to effectively market the renewable energy generation that is either proposed or considered in southern Nevada. The potential transmission system additions could include a 500-kilovolt interconnection between Amargosa Valley and Mead Substation near Boulder City, Nevada. It is reasonably likely that these 500-kilovolt transmission lines would be primarily routed within the Section 368 corridors identified in the *Energy Corridors PEIS* discussed in Section 6.2.4.3.

6.2.4.5 Groundwater Development Projects

The Southern Nevada Water Authority submitted an application to BLM for a groundwater development project in southern Nevada called the Clark, Lincoln, and White Pine Counties Groundwater Development Project. Based on information in the BLM Round Two Scoping Package, the Southern Nevada Water Authority Groundwater Development Project would withdraw water from the Spring Valley, Snake Valley, Cave Valley, Dry Lake Valley, Delamar Valley, and Coyote Spring Valley hydrographic basins (BLM 2006a). All of the affected hydrographic basins are within the Great Salt Lake or the White River Groundwater Flow Systems and are some distance from the NNSS.

6.2.4.6 Las Vegas Valley Land Disposal

To address issues associated with rapid growth and the need for developable lands and the management of public lands in southern Nevada, Congress passed the Southern Nevada Public Land Management Act in 1998 (P.L. 105-263), which was later amended by the Clark County Conservation of Public Land and Natural Resources Act (Clark County Act) (P.L. 107-282). The Southern Nevada Public Land Management Act and Clark County Act authorized BLM to dispose Federal lands in Clark County, Nevada, consistent with applicable law, population growth, and community land use plans and policies. The disposal boundary established by the two acts encompasses much of the Las Vegas Valley and totals about 46,700 acres. Public lands within the northern portion of the disposal area include the Upper Las Vegas Wash, which is within the cumulative impacts ROI for this *NNSS SWEIS*.

BLM prepared the *Las Vegas Valley Disposal Boundary Final Environmental Impact Statement* (BLM 2004b) to identify the environmental consequences that may result from the disposal and use of the remaining BLM-managed lands within the disposal boundary. The *Las Vegas Valley Disposal Boundary Final Environmental Impact Statement Record of Decision* (BLM 2004c) selected the Conservation Transfer Alternative (BLM 2004b), which allowed BLM to dispose approximately 46,700 acres of land in the Las Vegas Valley. The ROD also required additional study, collaboration, and environmental analysis of approximately 5,000 acres in the Upper Las Vegas Wash area, known collectively as the Conservation Transfer Area, that were withheld from sale because of a high concentration of sensitive resources. Although the ROD identified approximately 5,000 acres of land to be withheld from disposal, it also stipulated that the boundaries were adaptable. Based on input received during public interaction and its own review, BLM expanded the Conservation Transfer Area study area to 13,622 acres. In January 2010, BLM issued the *Draft Supplemental Environmental Impact Statement Upper Las Vegas Wash Conservation Transfer Area, Las Vegas, Nevada* (BLM/NV/EL/ES-10-06+1793) (BLM 2010b) to address the potential environmental impacts of six alternative Conservation Transfer Area configurations and sizes, ranging from about 1,448 to 12,952 acres. The BLM-preferred alternative would protect about 11,008 acres from development, leaving about 35,692 acres for BLM disposition. According to the Clark County Regional Transportation Plan 2009–2030, the area within the Public Land Management Act boundary can accommodate nearly all the growth expected over the next 20 years (RTCSN 2008).

6.2.4.7 Amargosa River Area of Critical Environmental Concern

The BLM Barstow Field Office, located in Barstow, California, published a draft *Amargosa River Area of Critical Environmental Concern Implementation Plan* with an associated environmental assessment in October 2006 (BLM 2006b). The Amargosa River Area of Critical Environmental Concern (ACEC) encompasses 21,552 acres of land in three distinct parcels located in northeastern San Bernardino and southeastern Inyo Counties, California, near the communities of Tecopa and Death Valley Junction, California. The purpose of the draft implementation plan is to guide BLM’s on-the-ground management of public lands within the ACEC over the next 20 years. The ACEC implementation plan would have generally beneficial impacts for the lower reaches of the Amargosa River but would have little or no cumulative effects with NNSA activities at the NNSS.

Certain stretches of the Amargosa River in California were designated as either wild, scenic, or recreational by the March 30, 2009, Designation of Wild and Scenic Rivers Act (P.L. 111-11, Section 1805(a)(196)(A)-(E)). One 7.9-mile stretch was designated as "wild," two stretches totaling 12.1 miles were designated as "scenic," and two stretches totaling 6.3 miles were designated as "recreational." These stretches begin approximately 40 miles downstream of the river's confluence with Fortymile Wash, the main Amargosa River tributary originating on the NNSS. The influx of pollutants (i.e., sedimentation and chemical contaminants) from NNSS activities to Amargosa River tributaries is expected to have little effect on water quality in the designated areas, considering the large distance between them and the mostly dry nature of these ephemeral surface waters.

6.2.5 U.S. Department of Justice

In October 2010, the U.S. Department of Justice, Office of the Federal Detention Trustee, opened a contractor-operated detention facility located on 120 acres in Pahrump, Nevada. The facility employs about 235 people.

6.2.6 Federal Aviation Administration

The Federal Aviation Administration is proposing to develop an Air Tour Management Plan for Death Valley National Park, pursuant to the National Parks Air Tour Management Act of 2000 (P.L. 106-181) and its implementing regulations (14 CFR Part 136, Subpart B) (75 FR 2922). The objective of the plan is to develop acceptable and effective measures to mitigate or prevent the significant adverse impacts, if any, of commercial air tour operations on the natural resources, cultural resources, and visitor experiences of a national park unit and any tribal lands within or abutting the park. The Air Tour Management Plan would have no authorization over other non-air-tour operations such as military and general aviation operations; therefore, it should not affect or be affected by aviation activities at the NNSS.

6.2.7 National Park Service

The U.S. Department of Interior, National Park Service (NPS), operates Death Valley National Park. This is the only NPS unit located within the cumulative impacts ROI for this *NNSS SWEIS*. The NPS Planning, Environment and Public Comment website identified 10 proposed projects for Death Valley as of October 2010. The following are brief descriptions of proposed projects that are within the cumulative impacts ROI for this *NNSS SWEIS*.

Wilderness and Backcountry Management Plan – In September 2009, NPS initiated a combined Wilderness and Backcountry Stewardship Plan for Death Valley National Park (NPS 2009). The purpose of the plan is to guide NPS and to make decisions regarding the future use and protection of the park's vast wilderness and backcountry lands. As part of the planning effort, over the next 3 to 4 years, NPS will complete a NEPA environmental analysis.

Keane Wonder Mine Complex and Multi-Mine Safety Installations – NPS published two environmental assessments and Findings of No Significant Impact for the installation of safety features at the Keane Wonder Mine Complex and other abandoned mines within Death Valley National Park (NPS 2010a, 2010b, 2010c, 2010d). NPS determined to use a variety of proven techniques to prevent human and undesired wildlife intrusion while allowing adequate ingress and egress by wildlife, principally bats.

Devils Hole Site Plan – Devils Hole is a 40-acre site located within Ash Meadows Wildlife Refuge that is managed by NPS, in close cooperation with USFWS. The site contains a cave pool, formed by the collapse of the top of a stretch fault leading to a flooded cave system. The cave pool is the habitat of the only remaining population of the endangered Devils Hole pupfish (*Cyprinodon diabolis*). The Devils Hole Site Plan includes improvements to site security, installation of a ladder to improve access to Devils Hole for research and monitoring activities, installing a webcam to improve visitor interpretation, and revegetation of disturbed areas (NPS 2010e).

Devils Hole Long-Term Ecosystem Monitoring Plan – NPS is proposing to implement a Long-Term Ecosystem Monitoring Plan for Devils Hole. This plan represents a more holistic commitment to greater scientific understanding and effective fulfillment of NPS's stewardship of Devils Hole and the resident population of Devils Hole pupfish (NPS 2010g).

Scotty's Castle Waterline Replacement – NPS proposes to replace about 1 mile of waterline that services the Death Valley Scotty Historic District and in June 2010, initiated public scoping to identify potential issues and concerns and determine the appropriate level of NEPA analysis for the project (NPS 2010f).

6.2.8 U.S. Forest Service

Portions of Humbolt–Toiyabe National Forest are located within the cumulative impacts ROI in Nye and Clark Counties. The majority of proposed actions identified for the Forest Service within the cumulative impacts ROI consist of activities to manage National Forest lands, such as vegetation management; development and rehabilitation of trails, campgrounds, and picnic areas; mineral exploration; and livestock grazing (USFS 2007, 2009c, 2010a).

On January 14, 2009, the U.S. Department of Agriculture, Forest Service, signed a ROD for the *Energy Corridors PEIS* (USFS 2009e) to amend relevant forest management plans and designate Section 368 energy corridors therein. There are no Section 368 energy corridor segments on Forest Service land within the cumulative impacts ROI.

In 2009, the Forest Service permitted the Las Vegas Ski and Snowboard Resort to increase the size of the snowmaking water storage pond from an existing full pond water surface of 0.6 acres to approximately 1.2 acres of water surface area, increase pond depth by approximately 15 feet, and increase the northeastern embankment by about 15 feet (USFS 2009b).

In a December 2009 ROD under the final EIS for the Middle Kyle Complex, the Forest Service decided to implement, with modifications, the Market-Supported Alternative and authorized construction of recreation and administrative facilities in the Kyle Canyon area of the Spring Mountain National Recreation Area. The ROD also provided direction to manage recreation use such as dispersed camping in the Kyle Canyon, Lee Canyon, and Deer Creek areas (USFS 2009d). Construction of the Market-Supported Alternative would permanently disturb approximately 330 acres and temporarily disturb about 580 acres. A total of 44 miles of new trails and trail improvements would be constructed, including multiuse trails in previously undisturbed vegetation communities (USFS 2009c).

6.2.9 Nye County

Nye County is proposing several projects within the cumulative impacts ROI that it considers to be reasonably foreseeable future actions. Most of the following information was derived from input provided by Nye County, which is reproduced in its entirety in Section 6.2.9.4.

6.2.9.1 Nye County Water District

In 2007, the State of Nevada passed a law (Chapter 542, Statutes of Nevada 2007, pp. 3396–3402) creating the Nye County Water District, with jurisdiction consisting of all the land within the boundaries of Nye County. Future actions by the Nye County Water District are likely to involve acquisition of land and water rights and other resources related to water resources management and supply. One of the major environmental and socioeconomic issues associated with residential and commercial development in southern Nye County is the demand and competition for scarce water resources. Groundwater resource limitations have the potential to affect both residential and commercial development in Nye County. Included in these concerns is the quantity and quality of groundwater from the NNSS, which naturally flows into southern Nye County along multiple flow paths, and has the potential to directly impact the quality and quantity of water available to communities, residents, and developers in the area from Beatty to Amargosa Valley (see Section 6.3.6.2, "Groundwater"). Nye County has been participating with DOE, NNSA, U.S. Geological Survey, and Desert Research Institute to study and understand groundwater availability and quality in the Amargosa Valley area and southern portions of Nye County.

6.2.9.2 U.S. Route 95 Technology Corridor

Nye County has outlined a strategy for a Technology Corridor along U.S. Route 95 (EDEN 2007). The corridor would extend from Indian Springs in Clark County in the south to Tonopah in the north, passing through the Pahrump Valley, Mercury (entrance to the NNSS), Amargosa Valley, Beatty, and Goldfield (Esmeralda County). Nye County would like to increase industrial space to accommodate new high-technology businesses by completing the Amargosa Valley Science and Technology Park at Lathrop Wells (see Section 6.2.9.3, "Nye County's Amargosa Valley Land Use Concept Plan"), assisting Beatty to reuse the Barrick Bullfrog site adaptively for new industry and encouraging Pahrump to facilitate a business park for the Pahrump Valley. As part of its technology corridor, a major goal of Nye County is to pursue development of renewable energy along the U.S. Route 95 corridor (EDEN 2007). There are no specific facilities or other developments proposed as part of this strategy at this time.

6.2.9.3 Nye County's Amargosa Valley Land Use Concept Plan

Nye County prepared the *Yucca Mountain Project Gateway Area Concept Plan* with proposed land use designations for an area of about 5,760 acres around the entrance to the formerly proposed Yucca Mountain site (Giampaoli 2007). The former Yucca Mountain Project has been determined to be "not a workable option for a nuclear waste repository" and has been discontinued; however, Nye County's *Yucca Mountain Project Gateway Area Concept Plan* presents a proposed multiphase land use plan for the area of the town of Amargosa Valley that is adjacent to the southwest corner of the NNSS. Nye County proposed this plan to ensure that land development in the area occurs in an orderly manner and to increase opportunities for industrial and commercial development consistent with NNSS-related activities and other activities along the U.S. Route 95 Technology Corridor, such as development of renewable energy projects. Nye County also plans to nominate Crater Flat lands for disposal in the BLM resource management plan amendment process.

As the host county for the NNSS and a cooperating agency in development of this *NNSS SWEIS*, Nye County requested inclusion of their input on cumulative impacts. The following section was prepared by Nye County to present its perspective regarding cumulative impacts within the county. This Nye County perspective should in no way be construed to represent the position of DOE or NNSA on any particular issue.

6.2.9.4 Nye County Input for this Site-Wide Environmental Impact Statement

Nye County Input for the Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)

Nye County is proposing several projects that can be considered as reasonably foreseeable future actions and there are other activities, underway or planned, that will impact Nye County.

Water Resources and Nye County Water District

The State of Nevada, in 2007, passed a law (Chapter 542, Statutes of Nevada 2007, pages 3396-3402) creating the Nye County Water District (District), with jurisdiction consisting of all the land within the boundaries of Nye County. The law provides for the acquisition, storage, sale, and distribution of water by the District, and authorizes the District to levy and collect taxes to assist in covering operational expenses. The governing Board of the District was established by the Nye County Board of County Commissioners in 2009. The District has the power to manage water resources and to supply water to any department or agency of the U.S government, the State of Nevada, Nye County, and any town, corporation, association, or person in Nye County, for an appropriate charge. Although water supply is not a current function, future actions by the District are likely to involve acquisition of land and water rights and other resources related to water resources management and supply.

Under Cooperative Agreements with the DOE Yucca Mountain Project Office, Nye County has conducted over 15 years of geologic and hydrogeologic studies related to characterization of groundwater and groundwater resources in the area southwest (down gradient) of the NNSS. This work involved the drilling of over 40 wells. Related studies include aquifer testing, alluvial tracer testing, geochemistry, structural geology, and surface and borehole geophysical surveys. Much of this work is summarized in reports on each phase of drilling (references from the Nye County Nuclear Waste Repository Project Office [NWRPO] website below).

NWRPO, 2001 (Summary FY96-01):
http://www.nyecounty.com/RID_data/RID4527/RID4527text.pdf

NWRPO, 2003 (Phase III): http://www.nyecounty.com/RID_data/rid5579/RID5579_rpt.pdf

NWRPO, 2005 (Phase IV): http://www.nyecounty.com/RID_data/RID6801_Text.pdf

NWRPO, 2009 (Phase V): http://www.nyecounty.com/RID_data/rid7668_report.pdf

Currently, Nye County is conducting an evaluation of groundwater resources in southern Nye County under a grant from the DOE. Studies completed to date include shallow geophysical and geologic investigations of sub-surface hydrogeology at Ash Meadows. A groundwater flow model was developed by Desert Research Institute (DRI) for the Pahrump Valley, and is currently in the calibration stage. Additional major tasks planned under this grant include: drilling and construction of 15 water table piezometer wells in the Oasis, Amargosa, and Pahrump valleys; collection and analysis of water samples to establish baseline water quality at selected wells in Amargosa Desert and Pahrump Valley; evaluation of perennial yield in Basin 230, which lies just to the south of the NNSS, through a cooperative Nye County-U.S. Geological Survey (USGS) evapotranspiration study; and simulation/evaluation of the effects of pumping in key areas in Amargosa Valley and Ash Meadows through development and use of a USGS groundwater flow model.

One of the major environmental and socioeconomic issues associated with residential and commercial development in southern Nye County is the demand and competition for scarce water resources, particularly in the case of wet-cooled solar thermal designs that have been proposed. Groundwater resource limitations have the potential to affect both residential and commercial development in Nye County. Included in these concerns is the quantity and quality of groundwater from the NNSS, which naturally flows into southern Nye County along multiple flow paths, and has the potential to directly impact the quality and quantity of water available to communities, residents, and developers in the area from Beatty to Amargosa Valley. Nye County is also concerned about future County access to water resources on the NNSS and is making an effort to work with the Nevada Site Office to increase understanding of water volume, flow paths, and quality. Increased understanding would benefit not only the County, but all agencies and communities downstream from the NNSS.

Continued protest of Nye County's water rights applications by federal agencies (including the U.S. National Park Service, U.S. Fish &Wildlife Service, U.S. Air Force, and DOE) could result in cessation of development in areas on and/or near the NNSS and in Amargosa Valley, where several renewable energy projects are planned (see Section 6.2.2.x.4). The primary rationale for protesting water rights has been the restrictions on the right to access the land (Nevada State Engineer, 2008a,), and the protection of the Devils Hole Pupfish (Nevada State Engineer, 2008b). However, it has not been proven that pumping in the Amargosa Farms area affects the water level in Devils Hole. Based on scientific work by Nye County, Inyo County, and other agencies, it appears that faults in the area (particularly the Gravity fault, which lies between the Amargosa Farms area and Devils Hole) may act as barriers to groundwater flow that would protect Devils Hole from the potential effects of pumping.

Land-Use Planning

Bureau of Land Management and Other Agency Planning. Nye County participates in the updating of the Battle Mountain and Southern Nevada BLM District Resource Management Plans (RMPs). Participation includes discussion of actions and activities as well as the preparation of formal comments concerning current and planned actions that may affect BLM, Nye County, and adjacent counties; and the identification of disposal lands.

Nye County's experience has shown that the early discussion of federal- and state-agency plans and actions prior to their implementation is frequently beneficial to both the agency and Nye County. These discussions allow the informal introduction of problems and concerns, and the development of solutions to address them. These discussions have proven to be beneficial in that they reduce or eliminate what could otherwise be lengthy and acrimonious legal and political disputes. It also tends to eliminate misunderstandings and hard feelings that would otherwise delay or derail current and future actions and agreements.

Yucca Mountain Project Gateway Area Concept Plan. Nye County has completed a *Yucca Mountain Project Gateway Area Concept Plan* (Concept Plan) with proposed land use designations for the area around the entrance to the proposed Yucca Mountain repository site (Giampaoli, 2007). Whether or not the repository is developed, this land (nine sections) has been designated by the Bureau of Land Management (BLM) for disposal. The Concept Plan presents Nye County's proposed multiphase land use plan for the portion of the town of Amargosa Valley that is adjacent to and near the Yucca Mountain site entrance at the southwest corner of the NNSS. Nye County proposed this Concept Plan to ensure orderly land development associated with potential Yucca Mountain and NNSS-related activities, or with other activities along the U.S. 95 Technology Corridor, such as development of renewable energy projects. Nye County views this plan as a starting point for development of the infrastructure, institutional capacity, and facilities to offset the potential impacts associated with activities in the vicinity, while also benefiting these activities. Nye County developed the plan to use and manage existing initiatives while expanding and improving the area. The stated purposes of the Concept Plan are applicable to development in the vicinity of the NNSS and the proposed Yucca Mountain Project Gateway:

Describe key objectives and methods to manage the expected impacts of reasonably foreseeable activities, which would include growth in neighboring towns;

Review existing conditions and identify necessary planning and infrastructure improvements;

Review financial options for land and utility development; and

Present a land use concept to ensure orderly and compatible development for the area near the Yucca Mountain site entrance at the southwest corner of the NNSS.

Nye County plans to nominate Crater Flat lands for disposal (transfer of land) in the Bureau of Land Management Resource Management Plan amendment process.

U.S. Highway 95 Technology Corridor

Nye County has outlined a strategy for a Technology Corridor along U.S. Highway 95 (EDEN, Inc., 2007). The corridor extends from Indian Springs in Clark County in the south to Tonopah in the north, passing through the Pahrump Valley, Mercury (entrance to the NNSS), Amargosa Valley, Beatty, and Goldfield (Esmeralda County). Nye County would like to increase industrial space to accommodate new high-technology businesses by completing the Amargosa Valley Science and Technology Park at Lathrop Wells, assisting Beatty to adaptively reuse the Barrick Bullfrog site for new industry, and encouraging Pahrump to facilitate a business park for the Pahrump Valley. Nye County's goals for the Technology Corridor are to change economic diversity of the region's industries, transform the regional economy to one more closely associated with national trends, and increase the presence of green energy industry in the region.

As part of its Technology Corridor, a major goal of Nye County is to pursue development of renewable energy along the U.S. Highway 95 corridor (EDEN, Inc., 2007, Goal 1-7, p. C-1). Wide expanses, sunny climate, and high solar incidence offer abundant opportunity to employ solar energy options to meet energy demand and lower operating costs for households and businesses. Nevada has created an incentive for power utilities to invest in alternative energy. To increase renewable energy research and development activities, Nye County plans to work cooperatively with: 1) the DOE National Laboratory for Renewable Energy to provide contracts to regional providers; 2) private industry to attract investments to promote renewable energy projects; 3) installation providers to recruit and provide skill training through Great Basin College to local workers; and 4) utilities to develop additional transmission capacity for renewable energy projects.

Renewable Energy Developments

Nye County is signatory to the Nye County-BLM Memorandum of Understanding (MOU) for Renewable Energy. Signatories include Nye County and each of the four BLM District Offices with responsibilities within Nye County (Battle Mountain, Southern Nevada, Elko, and Carson City). Under the Nye County-BLM MOU for Renewable Energy, the County is a Cooperating

Agency and provides input to all Environmental Impact Statements (EISs) and actions that apply to or affect renewable energy within the County. This includes transmission capacity development in areas outside of Nye County that will have effects upon developments within Nye County. Nye County is also a cooperating agency on the DOE-BLM Programmatic Environmental Impact Statement to Develop and Implement Agency-Specific Programs for Solar Energy Development (74 FR 31307, June 30, 2009), which covers solar energy and transmission development in six western states, of which Nevada is one.

The BLM has received right-of-way permit applications from renewable energy developers for numerous solar, wind, and geothermal energy facilities in Nye County. The locations of the applications by developers for land within a 50-mile area around the NNSS, Nevada Test and Training Range, and Tonapah Test Range are depicted on the map located at the end of this section. The applications are in varying stages of the review process for obtaining Right-of-Way (ROW) leases from BLM. Nye County facilitates communications between the developers and federal, state, and local agencies to ensure information is fully and properly communicated, and to encourage cooperative efforts in moving renewable energy projects forward. This includes communications with transmission developers and providers, and agencies such as the DOE, the U.S. Department of Agriculture, the Public Utilities Commission of Nevada, the Federal Energy Regulatory Commission, the Western Area Power Administration, and similar California agencies that are concerned with the production and transmission of renewable energy.

Nye County coordinates with the Department of Defense regarding the applications submitted by renewable energy developers and related transmission developers and providers, and intends to continue the cooperative effort in the future. Nye County is also working to facilitate development of transmission lines to support transmission of the energy produced by the proposed renewable energy facilities to markets in Nevada, California, and other states. Nye County works closely with federal and state agencies (e.g., the DOE-Energy Efficiency and Renewable Energy Office, the U.S. Environmental Protection Agency, the Nevada State Office of Energy, etc.) to increase the use of renewable energy and increase transmission capacity within Nye County, adjacent counties, and the State of Nevada.

Water resources are of particular interest to Nye County and its communities and residents because of the arid nature of the area. Nye County provides input to and coordination with all state and federal agencies whose actions impact the quantity and quality of water within the County. Renewable energy developers are encouraged to use dry cooling whenever possible. Where dry cooling cannot be used, hybrid technology is recommended and encouraged. Particular attention is paid to blow back, cooling, and storm water diversion ponds because of concern regarding the proper handling and disposal of evaporate products, the condition of brine and ground water at renewable energy sites, and water naturally returning to or reinjected into the water table. Included in these concerns is water from the NNSS, which flows into southern Nye County to the south and west of the NNSS and has the potential to affect the quality and quantity of water available to communities, residents, and developers.

Four of the applications for ROW leases submitted to date in Nye County are drafting or completing Environmental Impact Statements: Solar Reserve, Solar Millennium, Abengoa Solar, and Pacific Solar Investments.

Solar Reserve has submitted a plan of development to BLM for a 100-megawatt (MW) concentrated solar power project (Crescent Dunes) capable of producing approximately

500 gigawatt hours (GWh) of renewable energy annually. The 653-foot power tower and its surrounding heliostats will heat liquid salt, which will be stored and used to generate electrical energy through a conventional steam turbine cycle, after which the cooled salt will be recycled through the system for reheating. The Solar Reserve site is approximately 16 miles north-northwest of the Tonopah Airport.

Solar Millennium has submitted a plan of development for two 242-MW concentrating solar trough projects on approximately 4,350 acres, located north of Amargosa Farm Road and east of Valley View Road, in Amargosa Valley, approximately 5 miles south of U.S. Highway 95 and 5 miles west of State Highway 373. The plan calls for dry cooling towers, which would be approximately 140 feet high.

Abengoa Solar has submitted a plan of development for a 250-MW net parabolic trough solar power plant with an option to expand the facility by adding a second 250-MW unit. Additionally, the Lathrop Wells Solar Facility may include up to 20-MW of photovoltaic (PV) solar power. The Lathrop Wells Solar Facility would be located on 5,336 acres south of US Highway 95 and west of State Highway 373, in Amargosa Valley, at the former Jackass Aeropark. The plan calls for dry cooling towers that would be approximately 140 feet high.

Pacific Solar Investments has submitted a plan of development for a 300-MW photovoltaic (PV) facility north of the Big Dune Area of Critical Environmental Concern (ACEC) in Amargosa Valley, south of U.S. Highway 95. A second facility is proposed to be located to the south of the Big Dune ACEC, which will be a 500-MW PV facility. Both facilities are located on the west side of the town of Amargosa Valley.

In addition, Ewind Farms has submitted a request for a right-of-way lease for a commercial solar power generation facility of 8 gigawatts on land within and adjacent to the Nevada National Security Site, south and west of the Yucca Mountain tunnel.

DOE has advised Nye County that it is considering locating two solar renewable energy sites on 25 square miles of land in Area 25, just north of the area covered by the *Yucca Mountain Project Gateway Area Concept Plan*. One site would be a solar demonstration facility comprising four to six demonstration plants ranging from 1 to 10 MW each, generating up to 30 MW of power to be used on the NNSS. A second site would be a commercial facility that could possibly generate up to 1 gigawatt of power. Development of the transmission lines being facilitated by Nye County would also be available to support renewable energy and other development on the NNSS.

Several renewable energy developers have entered into agreements with Nye County regarding the development of a PV facility at the Tonopah Airport. Nye County is working with the developers and an EPA contractor to address transmission accessibility at the airport, a former Brownfield's site.

U.S. Department of Justice Detention Facility

The U.S. Department of Justice (DOJ) Office of the Federal Detention Trustee and the U.S. Marshals Service determined that there was a need to house federal detainees at a facility near Las Vegas. In March 2008, the DOJ published the *Final Environmental Impact Statement for the Proposed Contractor Detention Facility, Las Vegas, Nevada Area* (DOJ, 2008). The preferred alternative identified in the EIS was a 120-acre site in Pahrump, about 25 miles from the NNSS. Facility operation is expected to begin in October 2010 and employ 200 to 250 people. Operation of the detention facility is anticipated to result in a number of new contractor employees who are either current residents of Nye County or who relocate to Nye County, with the remainder of the new contractor employees expected to be current residents of Clark County who would continue to reside in Clark County within commuting distance.

Coordination and Cooperation with Government Programs

Nye County has worked cooperatively with the DOE Yucca Mountain Project to provide a number of services normally provided by local government to its residents. These services have significantly benefited the Yucca Mountain Project through reduced costs and high-quality service. They have also benefited Nye County by increasing its capability to provide services to both local communities and to DOE for Yucca Mountain. Nye County believes that similar agreements with the NNSS would be equally beneficial to both parties and should be incorporated in future agreements. Those services would be provided on a government-to-government basis and could include normal Public Works, Law Enforcement, and Emergency Services, strengthening the abilities of both Nye County and the NNSS to meet both normal and anticipated emergency needs. Such agreements would also allow better implementation of the National Incident Management System (NIMS), the National Response Framework, and related programs and Presidential Directives.

References

Department of Justice, 2008. *Final Environmental Impact Statement for the Proposed Contractor Detention Facility, Las Vegas, Nevada Area.*

EDEN, Inc., 2007. *Comprehensive Economic Development Strategy for Nye County, Nevada.*

Giampaoli, MaryEllen, 2007. *Yucca Mountain Project Gateway Area Concept Plan.* Prepared for Nye County.

Nevada State Engineer, 2008a. Nevada State Engineer's Ruling 5858. http://images.water.nv.gov/images/rulings/5858r.pdf

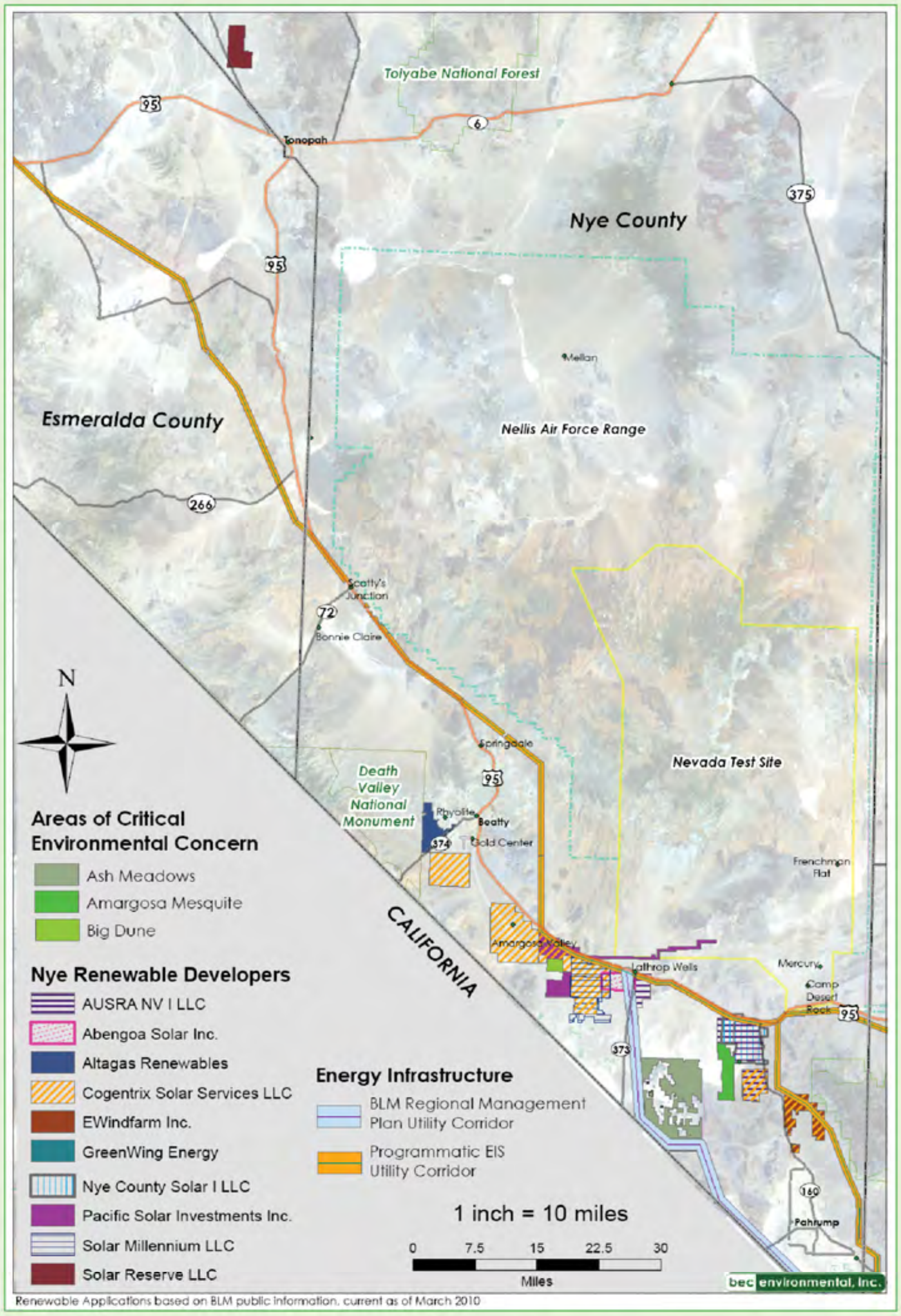
Nevada State Engineer, 2008b. Nevada State Engineer's Order 1197. http://images.water.nv.gov/images/orders/1197o.pdf

NWRPO, 2001 (Summary FY96-01): http://www.nyecounty.com/RID_data/RID4527/RID4527text.pdf

NWRPO, 2003 (Phase III): http://www.nyecounty.com/RID_data/rid5579/RID5579_rpt.pdf

NWRPO, 2005 (Phase IV): http://www.nyecounty.com/RID_data/RID6801_Text.pdf

NWRPO, 2009 (Phase V): http://www.nyecounty.com/RID_data/rid7668_report.pdf



Renewable Energy Developer Permit Application Land Areas

6.2.10 Clark County and Las Vegas Area, Nevada

The Regional Transportation Plan for Clark County (RTCSN 2008) projected that, by 2020, the population of Clark County will increase by 1,143,071, from about 1,912,955 in 2006 to about 3,056,026 in 2020 (RTCSN 2008), an approximate 60 percent increase. A number of factors will influence this projected growth and attendant development, including water availability, air quality, the strength of the tourism industry (particularly the gaming sector), and the cost of housing. The Regional Transportation Plan further projected that about 63,533 acres of land will be developed within Clark County during the 2010 to 2020 timeframe (RTCSN 2008). Some of that land is outside the cumulative impacts ROI for this *NNSS SWEIS*. To refine the estimate of potentially developed land, the acreage for Henderson (14,523 acres) was subtracted, resulting in a conservative estimate of 49,010 acres of land within the ROI that is projected to be developed. This area of potential development is included within the areas that may be developed under the BLM Las Vegas Valley Land Disposal and the USFWS Clark County MSHCP, but is not included in the potential land disturbance areas in this cumulative impacts assessment.

Within the cumulative impacts ROI, in rural Clark County and the Las Vegas metropolitan area, no specific projects were identified for analysis from reviews of the following: the *Clark County Comprehensive Plan* (CCCP 2010), the *Northeast Clark County Land Use Plan* (CCCP 2006), the *Northwest Clark County Land Use Plan* (CCCP 2007), planning documents from the City of Las Vegas (LVPC 2000, DFBS 2009), the City of North Las Vegas Downtown Master Plan (NLV 2009), and the *Coyote Springs Development Environmental Impact Statement* (USFWS 2008). Most of the proposed or ongoing projects that were identified during that review were urban development within already-disturbed areas, such as Las Vegas and North Las Vegas, and would have little or no cumulative effect with NNSA activities in the state of Nevada. One large proposed project, the Coyote Springs Development, is located outside of the ROI.

6.2.11 Lincoln County, Nevada

BLM has proposed two separate but related potential projects of concern to cattlemen, ranchers, sportsmen, mining companies, and offroad vehicle enthusiasts in Lincoln County (Maxwell 2010). The first is a draft concept for a National Conservation Area consisting of 600,000 acres in Garden and Coal Valleys. The second consists of the consideration of two areas for solar development in Lincoln County: Delamar Valley (approximately 2,850 acres) and Dry Lake Valley (approximately 19,980 acres).

The National Conservation Area that is proposed would not affect existing rights (i.e., roads, rights-of-way, mining claims, or other valid existing rights). Grazing, hunting, fishing, and trapping would continue in the conservation area, in accordance with Federal and state law (Maxwell 2010). Access to and use of other private parcels within the National Conservation Area would not be affected. A management plan for the conservation area is expected to be completed by BLM within 3 years (Maxwell 2010).

A potential solar energy project in Rachel, Nevada, on Toreson Industries property, off Nevada State Route 375 heading east on Smith Well Road, may be implemented. No permit applications have been submitted for this project at this time.

A possible upgrade to the Tempiute power line may occur within the next 10 years; no permits for this project have been submitted at this time.

6.2.12 Esmeralda County, Nevada

Several projects that may occur in Esmeralda County are still in a speculative phase and are not considered reasonably foreseeable. These include future storm drain projects in Goldfield and Silver Peak; a potential airport north of Goldfield; and rerouting U.S. Route 95 in the Goldfield area.

6.2.13 Inyo County, California

Almost all of the land in Inyo County, California, that falls within the cumulative impacts ROI for this *NNSS SWEI*S is Federal (BLM and NPS) or state land (Inyo County 2002). The communities of Shoshone, Tecopa, and Tecopa Springs are the main towns in the area. There were no nonfederally proposed actions identified within the portion of Inyo County that is included in the cumulative impacts ROI. Proposed Federal actions within Inyo County are addressed in Sections 6.2.4, "Bureau of Land Management," and 6.2.7, "National Park Service."

6.2.14 US Ecology, Inc., Beatty, Nevada

US Ecology operates a permitted solid waste treatment, storage, and disposal facility near Beatty, Nevada, located about 100 miles northwest of Las Vegas in the Amargosa Desert. Among other waste types, at its Beatty facility, US Ecology accepts Resource Conservation and Recovery Act (RCRA) hazardous wastes, polychlorinated biphenyl (PCB)-contaminated materials, and asbestos or asbestos/RCRA debris. US Ecology is currently not permitted to accept LLW or mixed low-level radioactive waste (MLLW) (US Ecology 2010); however, between September 1962 and December 1992, the site disposed about 4,862,000 cubic feet of radioactive waste containing about 709 curies of byproduct material, about 4,807,000 pounds of source material, and about 606 pounds of special nuclear material (Laney 2010). Since acceptance of radioactive waste ceased at its Beatty facility, US Ecology completed a state-approved closure plan to stabilize the site and establish proper security measures. The plan was intended to ensure that the LLW disposed during the operational phase of the facility continued to remain in a suitable, stable, and safe condition after site closure. The Nevada State Health Division continues to monitor for radioactivity in groundwater, air, soil, and vegetation (NSHD 2010). The US Ecology facility at Beatty is a RCRA-permitted facility with engineered barriers and systems and administrative controls that minimize the potential for offsite migration of hazardous constituents, and the Nevada State Health Division continues to monitor the site. In addition, the regional climate of southern Nevada is very arid, with an evapotranspiration rate that far exceeds precipitation, and the depth to groundwater is several hundred feet. For these reasons, NNSA determined that cumulative postclosure impacts from the Beatty LLW disposal facility would be very unlikely.

6.3 Cumulative Impacts Analysis

The following analysis addresses the potential cumulative impacts from past, present, and reasonably foreseeable actions at NNSA sites and facilities in the state of Nevada and similar actions by other Federal and state agencies, local governments, and private parties. Where appropriate, impacts from the NNSS (including environmental restoration activities on the Nevada Test and Training Range), RSL, NLVF, and the TTR are considered separately; otherwise they are combined. **Table 6–4** shows the area of potential land disturbance for all applicable resources. The land disturbance figures were derived from the information contained in Section 6.2, "Potentially Cumulative Actions" and Table 5–1, "Potential Area of Land Disturbance at the Nevada National Security Site for Each Mission Area, Program, and Activity by Alternative" and may differ slightly from figures in those tables due to rounding.

Table 6–4 Area of Potential and Existing Ground Disturbance Used in the Cumulative Impacts Analysis

Cause of Disturbance	***Disturbed Area (acres)*** [a]
Estimated Potential Land Disturbance Within the Cumulative Impacts Region of Influence	
Proposed renewable energy facilities (BLM)	143,000 [b]
Yucca Mountain Project Gateway Area (Nye County)	5,800 [c]
Targets at Nevada Test and Training Range (U.S. Air Force)	400 [d]
GTCC Waste disposal (DOE)	110 [e]
EERE Concentrating Solar Power Validation Project (DOE)	110
Las Vegas Valley land disposal (BLM)	36,000 [f]
Las Vegas Valley estimated land disturbance under a modified Multi-Species Desert Habitat Conservation Plan	324,000 [g]
U.S. Forest Service, Middle Kyle Complex	330 [h]
Total Potential Non-NNSA-Related Land Disturbance	**509,750**
NNSA Actions at the NNSS and the TTR (based on Expanded Operations Alternative), including one or more potential commercial solar power generation facilities in Area 25 of the NNSS and Geothermal Demonstration Project	4,500 No Action 26,000 [I] Expanded Operations 2,700 Reduced Operations
Total Potential Land Disturbance	**514,250** No Action **535,750** Expanded Operations **512,450** Reduced Operations
Estimated Existing Land Disturbance Within the Cumulative Impacts Region of Influence	
Estimated Existing Disturbed Area in Clark County	215,000
Estimated Existing Disturbed Area in Nye County	51,000
Estimated Existing Disturbed Area at the NNSS	80,000
Total Estimated Existing Disturbed Land	**346,000**
Estimated Total Potential and Existing Land Disturbance Within the Cumulative Impacts Region of Influence	**860,250** No Action **881,750** Expanded Operations **858,450** Reduced Operations

BLM = Bureau of Land Management; EERE = DOE Office of Energy Efficiency and Renewable Energy; GTCC = greater-than-Class C; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; TTR = Tonopah Test Range.

[a] Number of acres of potential and existing land disturbance represent estimates of areas of disturbance and have been rounded.

[b] From Table 6–3, "Summary of Renewable Energy Projects Within the Cumulative Impact Region of Influence."

[c] *Yucca Mountain Project Gateway Area Concept Plan* (Giampaoli 2007).

[d] *Range 74 Target Complexes Environmental Assessment Nevada Test and Training Range, Nevada*, July 2007 (USAF 2007d).

[e] *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE/EIS-0375-D) (DOE 2011).

[f] *Draft Supplemental Environmental Impact Statement Upper Las Vegas Wash Conservation Transfer Area, Las Vegas, Nevada* (BLM/NV/EL/ES-10-06+1793) (BLM 2010b).

[g] Clark County Multi-Species Habitat Conservation Plan (USFWS 2000) and Notice of Intent to prepare an EIS; and notice of public scoping meetings for a proposed Amendment of the Clark County Multi-Species Habitat Conservation Plan and Issuance of an Amended Incidental Take Permit (74 FR 50239).

[h] *Final Environmental Impact Statement Middle Kyle Complex, Spring Mountains National Recreation Area, Humboldt Toiyabe National Forest, Clark County, Nevada* (USFS 2009c).

[i] From Chapter 5, Table 5–1, "Potential Area of Land Disturbance at the Nevada National Security Site for Each Mission Area, Program, and Activity by Alternative."

6.3.1 Land Use

Under both the Expanded Operations and Reduced Operations Alternatives, NNSA is proposing changes in the NNSS land use zones. Under all three alternatives, the name of the Solar Enterprise Zone would be changed to the Renewable Energy Zone. Under the Expanded Operations Alternative, the designation for Area 15 would be changed from Reserved Zone to Research, Test and Experiment Zone, and the Renewable Energy Zone in Area 25 would expand from about 2,400 acres to 39,600 acres. Under the Reduced Operations Alternative, NNSA would change the designation of Nuclear Test Zone for Areas 19 and 20 and Reserved Zone for Areas 18, 29, and 30 to Limited Use Zone.

Although land use zones under both alternatives would change, this change is not considered an adverse impact. The NNSS developed the land use zones for internal organizational and functional uses and to group similar uses and activities into specific areas based on the support needs of the NNSS mission as determined by previous and anticipated uses. Because the land use changes that would occur under the Expanded Operations or Reduced Operations Alternative would be consistent with the missions of DOE and NNSA at the NNSS and would not affect land uses outside of the NNSS boundaries, there would be no cumulative impacts on land use from any of the alternatives addressed in this *NNSS SWEIS*. Although there would be no cumulative impacts on land use from changes of use of NNSS lands, there may be cumulative impacts on other resources, such as wildlife, vegetation, cultural resources, and socioeconomics, which will be addressed under the appropriate resource areas. However, current land use for large areas of undisturbed land in Amargosa Valley would be changed by construction of reasonably foreseeable solar energy generation projects and Nye County's Yucca Mountain Project Gateway Area development. The cumulative impacts of these land use changes would be withdrawal of approximately 148,800 acres of land in Nye County from public use and commitment of that land to use for renewable energy facilities or commercial/industrial uses.

In Clark County, BLM would dispose up to about 36,000 acres of public land. Use of this land would be changed from its current public uses and it would be made available for private and/or municipal uses.

A very large percentage of the land in Nye County is owned by the Federal Government and administered by several different agencies. Much of the land managed by BLM is available for public use; however, lands managed by the U.S. Department of Defense and DOE have very strict access controls and are not available for any public use. This limits the land available in the county for development of industrial, commercial, municipal, or residential uses. There are no proposals to make large-scale reductions in the amount of land managed by Federal agencies in Nye County; likewise, there are no proposals to increase the amount of such lands. In fact, BLM land disposal actions from time to time make parcels of federally owned land available, thus marginally reducing the proportion of Federal land in the county. It is also important to note there is sufficient undeveloped non-Federal land available in Nye County that growth and development are not being hampered by lack of available land at this time.

6.3.2 Infrastructure and Energy

Impacts on infrastructure are primarily captured in other resource areas. NNSA would construct new infrastructure as needed and continue to appropriately disposition excess infrastructure. As new infrastructure is added, there would be impacts on various resources, such as soils, biology, air, and socioeconomics. Likewise, when infrastructure is dispositioned, there would be other impacts on some of the same resources. For instance, if a building or road is removed and the disturbed area is revegetated with appropriate native species, there would be a positive impact on wildlife habitat and soils along with temporary adverse air quality impacts.

Construction of new facilities, particularly large projects, would place cumulative demands on goods and services. All of the proposed renewable energy projects in Amargosa Valley and Area 25 of the NNSS would have similar needs for large tracts of undeveloped land and water; use earth-moving/grading equipment, cranes, and other construction equipment; require similar materials, such as concrete, steel, wood, wiring, cables, etc.; and require the services of both general and specialized construction workers. The cumulative effects of these impacts are captured in the analyses for each affected resource.

Large-scale construction projects, particularly renewable energy facilities in Amargosa Valley and Area 25 of the NNSS, that would create cumulative impacts on traffic and roadways in the region are addressed in Section 6.3.3, "Transportation."

In 2009, NNSA facilities in Nevada used almost 84,600 megawatt-hours of electricity. During the same year, NV Energy (southern division) and Valley Electric Association provided about 21,200,000 megawatt-hours and 470,000 megawatt-hours, respectively, of electricity to their customers (NSOE 2010), totaling almost 21,670,000 megawatt-hours. NNSA's use of electricity represents about 0.4 percent of the total electricity supplied by the two major electrical utilities in southern Nevada. The Nevada Public Utilities Commission forecasts a 1.5 percent growth rate in electricity sales through 2020 (NDEP 2008). Based on that growth rate, by 2020, total electricity sales in southern Nevada would be about 25,530,000 megawatt-hours. Based on the projected level of activities and number of employees at NNSA facilities in Nevada under the Expanded Operations Alternative, it is estimated that the cumulative demand for electrical energy at the NNSS, RSL, NLVF, and the TTR in 2020 would be about 150,000 megawatt-hours. This would represent about 0.6 percent of the total demand for electrical energy in southern Nevada by 2020, which represents a slight increase in the proportion of electrical energy consumed by NNSA-related activities in the region. This estimate does not take into account energy conservation measures that are being implemented, nor does it consider the reduction in commercial electrical service demand at the NNSS due to construction of a proposed 5-megawatt photovoltaic electrical generating facility in Area 6, from the DOE Office of Energy Efficiency and Renewable Energy-proposed CSP Validation Project, or from any commercial solar power generation facilities that would be constructed at the NNSS. Any one of these factors could result in a decrease in the proportion of NNSA's demand for electrical power in the region.

Currently, in southern Nevada, there are about 7,800 megawatts of electrical generating capacity available. Based on projected southern Nevada electrical energy demand in 2020, the available generating capacity would be adequate; however, much of that capacity is owned by or contractually obligated to electrical utilities in other regions such as Arizona and southern California. For instance, most of the electricity generated at Hoover Dam is transmitted for use outside of Nevada. However, with development of up to about 5,800 megawatts of solar power generation facilities in the Amargosa Valley area, electrical generating capacity in southern Nevada would continue to be adequate to meet projected demand, provided adequate electrical transmission line capacity is developed to transmit the power (see Section 6.2.2.4).

6.3.3 Transportation

Increased traffic on U.S. Route 95 and other local roadways, primarily in Nye County, resulting from construction and operation of renewable energy projects in Amargosa Valley (including one or more commercial solar power generation facilities in Area 25 of the NNSS) and development of the Yucca Mountain Project Gateway Area would increase wear and tear on the roads and, consequently, maintenance requirements. During construction, roads in Nye County could experience high levels of incremental increases in daily traffic, ranging from a 2- to 5-fold increase in some instances on primary roads such as U.S. Route 95 and Nevada State Route 160, which could degrade levels of service from A to D during peak commuting hours. During operations, primary roadways could experience 30 to 50 percent increases in daily traffic, and levels of service could degrade one level during peak commuting hours. The degradation in levels of service caused by increased traffic volumes on these roads could generate the need for additional travel lanes and other improvements.

The assessment of cumulative impacts for past, present, and reasonably foreseeable future actions involving radioactive material transports concentrates on impacts from offsite transportation throughout the Nation that would result in potential radiation exposure to a greater portion of the general population than onsite and NNSS-vicinity transportation; transportation of radioactive materials could also result in fatalities from traffic accidents. Cumulative radiological impacts from transportation are measured using the collective dose to the general population and workers because dose can be directly related to latent cancer fatalities (LCFs) using a cancer risk coefficient, as described in Appendix D, Section D.5.1, of this *NNSS SWEIS*.

In addition to those impacts addressed in this *NNSS SWEIS* (see Chapter 5, Section 5.1.3), the cumulative impacts of the transportation of radioactive material consist of impacts from historical shipments of radioactive waste and spent nuclear fuel; reasonably foreseeable actions that include transportation of radioactive material identified in Federal, non-Federal, and private environmental impact analyses; and general radioactive material transportation that is not related to a particular action. The timeframe of impacts was assumed to begin in 1943 and continue to some foreseeable future date. The current list of reasonably foreseeable DOE activities estimates risks up to 2042 (DOE 1999d). Projections for commercial radioactive material transport extend to 2073.

Table 6–5 provides a summary of total worker and general population collective doses from past, present, and reasonably foreseeable future transportation activities, as estimated in published NEPA documents. Impacts from these activities are not included in the analysis presented in Chapter 5 of this *NNSS SWEIS*.

Historical Shipments. The impact values provided for historical shipments to the NNSS include shipments of spent nuclear fuel from 1951 through 1993 and the impacts from radioactive waste shipments to the NNSS from 1974 through 1994 (DOE 1996c). The impact values also include historical shipments of spent nuclear fuel from the NNSS to Idaho National Laboratory, the Savannah River Site, the Hanford Site, and the Oak Ridge Reservation, as well as shipments of naval spent fuel and test specimens (DOE 1996a).

There are considerable uncertainties in these historical estimates of collective dose. For example, the population densities and transportation routes used in the dose assessment were based on the data from the 1990 U.S. census and the U.S. highway network as it existed in 1995. The U.S. population has continuously increased over the time covered in this assessment, thereby increasing the cumulative population dose. In addition, using interstate highway routes as they existed in 1995 may slightly underestimate doses for shipments that occurred in the 1950s and 1960s, because a larger portion of the transport routes would have been on noninterstate highways, where the population may have been closer to the road. By the 1970s, the structure of the interstate highway system was largely fixed and most shipments would have been made using interstate routing.

Reasonably Foreseeable Actions. The values provided for reasonably foreseeable actions could lead to some double-counting of impacts. For example, the LLW transportation impacts in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* may also be included in the individual DOE facilities' site-wide EISs. In addition, for reasonably foreseeable actions where no preferred alternative was identified or no ROD was issued, impact values are included for the alternative that has the largest transportation impacts. It was assumed that this *NNSS SWEIS* and other NEPA documents listed in Table 6–5, such as the *Final Sitewide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico,* and the *Sitewide Environmental Impact Statement for the Y-12 National Security Complex*, would address transportation impacts associated with the *Complex*

Transformation Supplemental Programmatic Environmental Impact Statement; therefore, that NEPA document is not included in Table 6–5.

Table 6–5 Transportation-Related Radiological Collective Doses and Risks from Other U.S. Department of Energy Actions

Category	Worker		General Population	
	Collective Dose (person-rem)	*Risk (LCF)*	*Collective Dose (person-rem)*	*Risk (LCF)*
Historical Shipments (1943–1994) [a]				
Spent Nuclear Fuel Shipments to the NNSS	1.4	0.00	0.70	0.00
Radioactive Waste to the NNSS	82	0.05	100	0.06
Other Spent Nuclear Fuel Shipments	250	0.15	130	0.08
Subtotal	**330**	**0.20**	**230**	**0.14**
Reasonably Foreseeable Actions [b]				
Surplus Plutonium Disposition EIS	60	0.04	67	0.04
Naval Reactor Disposal	5.8	0.00	5.8	0.00
Treatment of Mixed Low-level Radioactive Waste EIS [c]	18	0.01	1.34	0.00
Waste Management PEIS [d]	15,000	9.0	17,700	10.6
WIPP SEIS II	790	0.47	5,900	3.54
Idaho High-Level Waste and Facilities Disposition Final EIS	520	0.31	2,900	1.74
Sandia National Laboratories SWEIS	94	0.06	590	0.35
Tritium Production in Commercial Light Water Reactor EIS	16	0.01	80	0.05
LANL SWEIS	580	0.35	310	0.19
Plutonium Residues at Rocky Flat EIS	2.1	0.00	1.3	0.00
Disposition of Surplus Highly Enriched Uranium Final EIS	400	0.24	520	0.31
Molybdenum-99 Production EIS	240	0.14	520	0.31
Import of Russian Plutonium-238 EA	1.8	0.00	4.4	0.00
Pantex SWEIS	250	0.15	490	0.29
Storage and Disposition of Fissile Material	N/A	N/A	2,400 [e]	1.44
Stockpile Stewardship	N/A	N/A	38 [e]	0.02
Container System for Naval Spent Nuclear Fuel	11	0.01	15	0.01
S3G and D1G Prototype Reactor Plant Disposal EIS	2.9	0.00	2.2	0.00
S1G Prototype Reactor Plant Disposal EIS	6.7	0.00	1.9	0.00
ETTP DUF_6 Transport to Portsmouth [f]	99	0.06	3.2	0.00
Spent Nuclear Fuel PEIS	360	0.22	810	0.49
Foreign Research Reactor Spent Nuclear Fuel EIS [g]	90	0.05	222	0.13
Private Fuel Storage Facility Final EIS [h]	30	0.02	190	0.11
Mixed Oxide Fuel Fabrication at Savannah River Site [i]	530	0.32	560	0.34
Enrichment Facility in Lea County EIS [j]	1,500	0.9	450	0.27
GTCC EIS [l]	500	0.32	180	0.1
Draft TC&WM EIS [m]	2,884	1.7	425	0.3
West Valley Waste Management EIS	520	0.31	410	0.25
West Valley Demonstration Project EA for the D&D and Removal of Certain Facilities	14	0.01	11	0.01
Draft Y-12 SWEIS [n]	Not listed	Not listed	Not listed	0.18
West Valley Decommissioning EIS [o]	1,900	1	310	0.2
Paducah DUF6 Conversion Final EIS [p]	174	0.06	120	0.06
Portsmouth DUF6 Conversion Final EIS [q]	93	0.04	62	0.04
Subtotal [t]	**24,800** [r]	**15**	**35,000** [r]	**21**

Category	*Worker* Collective Dose (person-rem)	*Worker* Risk (LCF)	*General Population* Collective Dose (person-rem)	*General Population* Risk (LCF)
General Radioactive Material Transport [b, t]				
1943–1982 [r]	220,000	132	170,000	102
1983–2073 [s]	154,000	92	168,000	101
1943–2073	**374,000**	**224**	**338,000**	**203**
Total Transportation Impacts Unrelated to this *NNSS SWEIS*				
Total Impacts (up to 2073)	**399,000 [t]**	**240**	**373,000 [r]**	**224**

DUF_6 = depleted uranium hexafluoride; ETTP = Eastern Tennessee Technology Park; LCF = latent cancer fatality; N/A = not available (the data are provided as a sum for workers and the public); NNSS = Nevada National Security Site; rem = roentgen equivalent man.

[a] *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996c). Estimates for NNSS transportation impacts for the years 1995 to 2010 are not available.

[b] Unless it is specified otherwise, all values are taken from the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002e) and the *Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2008g).

[c] *Environmental Impact Statement for Treatment of Low-Level Mixed Waste*, February 1998 (JEGI 1998).

[d] The values are for the low-level and mixed low-level radioactive waste transportation impacts on the NNSS, based on the amended Record of Decision for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, 65 FR 10061, February 25, 2000.

[e] Includes worker and general population doses.

[f] DOE/EIS-0360, *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio,* Site, June 2004 (DOE 2004e).

[g] DOE/EIS-0218, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, February 1996 (DOE 1996b).

[h] NUREG-1714, *Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County, Utah*, December 2001 (NRC 2001). The impacts shown in this table reflect only those impacts associated with radioactive waste being transported to disposal sites other than the NNSS.

[i] NUREG-1767, *Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site*, January 2005 (NRC 2005a).

[j] NUREG-1790, *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico*, June 2005 (NRC 2005b). The risk values presented in this report are per year of operation. The values presented in this table are for 30 years of operation.

[k] DOE/EA-1651, *Final Environmental Assessment for U-233 Material Downblending and Disposition Project at the Oak Ridge National Laboratory Oak Ridge, Tennessee*, January 2010 (DOE 2010b).

[l] DOE/EIS-0375D, Draft *Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (DOE 2011).

[m] DOE/EIS-0391, *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, October 2009 (DOE 2009g).

[n] DOE/EIS-0387, *Draft Site-Wide Environmental Impact Statement for the Y-12 National Security Complex*, October 2009 (DOE 2009o)

[o] DOE/EIS-0226, *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*, January 2010 (DOE 2010c). The impacts between 2011 and 2020 are included in Chapter 5 transportation impacts, and reflect the preferred alternative with eventual clean closure. Impacts beyond 2020 are not included because no decision has been made as to the activities to be conducted beyond 2020.

[p] DOE/EIS-0359, *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site* (DOE 2004d). Includes those transportation impacts occurring beyond the next 10 years.

[q] DOE/EIS-0360, *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at Portsmouth, Ohio, Site* (DOE 2004e). Includes those transportation impacts occurring beyond the next 10 years.

[r] These estimates are very conservative, since few shipments were made in the 1950s and 1960s. In addition, the nonexclusive shipment dose estimates are based on a very conservative method. See the text in *General Radioactive Materials Transports* for dose estimates for shipments performed in 1975 and 1983. Totals are rounded.

[s] The annual dose estimates are similar to those for the period 1975–1982.

[t] The summed values are rounded to three significant figures.

General Radioactive Materials Transports. General radioactive material transports are shipments not related to a particular action; they include shipments of radiopharmaceuticals, industrial and radiography sources, and uranium fuel cycle materials, as well as shipments of commercial LLW to commercial disposal facilities. The collective dose estimates from transportation of these types of materials were based on the following: (1) for the period 1943 through 1982, an NRC analysis documented in U.S. Nuclear Regulatory Commission Regulation (NUREG) 0170 for shipments made in 1975 (NRC 1977) and (2) for the period 1983 through 2043, an analysis of unclassified shipments in 1983, documented in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a). The NRC report estimated collective doses to the workers and population of 5,600 and 4,200 person-rem, respectively, for transports in 1975. The modes of transportation included truck, rail, and plane. The collective doses to workers and the general public for 1943 through 1982 (39 years) were estimated to be 220,000 and 170,000 person-rem, respectively (NRC 1977). The estimated collective doses to workers and populations for shipments in 1983 using a combination of truck and plane shipments were 1,690 and 1,850 person-rem, respectively (DOE 1995a). These doses were calculated using more-refined models than those used in the 1977 NRC report. Even though the number of shipments was larger than those of the 1977 NRC report, the estimated doses are smaller by a factor of 2 to 3. As shown in Table 6–5, the collective doses over 91 years, from 1983 through 2073, would be 154,000 and 168,000 person-rem for workers and population, respectively.

Table 6–6 provides impacts on transport workers and the general population from future transportation activities considered in this *NNSS SWEIS* in comparison to the total worker and general population collective doses estimated in Table 6–5. The impacts from transportation in this *NNSS SWEIS* are quite small compared with the overall cumulative transportation impacts. The estimated total collective worker dose from all types of shipments (historical, reasonably foreseeable actions, and general transportation) is about 399,000 person-rem (240 LCFs) for the period from 1943 through 2073 (131 years). The estimated total general population collective dose is about 373,000 person-rem (224 LCFs). To place these numbers in perspective, the National Center for Health Statistics indicates that the average annual number of cancer deaths in the United States from 1999 through 2004 was about 554,000, with less than a 1 percent fluctuation in the number of deaths in any given year (CDC 2007). The total number of LCFs (among the workers and general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 is 468, or an average of about 4 LCFs per year. The transportation-related LCFs are about 0.0007 percent of the annual number of cancer deaths; therefore, it is indistinguishable from the natural fluctuation in the total annual death rate from cancer. Note that the majority of the cumulative risks to workers and the general population were due to the general transportation of radioactive material unrelated to activities evaluated in this *NNSS SWEIS*.

6.3.4 Socioeconomics

Cumulative socioeconomic impacts are the impacts that result from the incremental impact of the action added to other past, present, and reasonably foreseeable future actions in Clark and Nye Counties. Because either expanding or reducing operations may have adverse impacts on different aspects of the socioeconomic environment, information from the Expanded Operations and Reduced Operations Alternatives are considered, as appropriate, in this analysis.

Under the Expanded Operations Alternative, there would be a net increase of 723 jobs to support DOE/NNSA activities over the next 10 years. In addition, operation of up to 1,000 megawatts of commercial solar power generation facilities would require an estimated 200 employees. This increase in the number of jobs would have an overall beneficial impact on economic activity in the area, as described in Chapter 5, Section 5.1.2. This increase in economic activity would have a minor contribution to overall cumulative economic impacts in Clark and Nye Counties.

Table 6–6 Cumulative Transportation Impacts Under the Expanded Operations Alternative

	Worker		***General Population***	
	Collective Dose (person-rem)	***Risk (LCFs)***	***Collective Dose (person-rem)***	***Risk (LCFs)***
NNSS Transportation Risk (2011–2020)				
NNSS SWEIS [a]	5,500	3	1,300	0.8
Other Transportation Impacts Not Related to this *NNSS SWEIS*				
Historical Shipments to the NNSS	330	0.20	230	0.14
Reasonably Foreseeable Actions	**24,800**	**15**	**35,000**	**21**
General Radioactive Material Transport	374,000	224	338,000	203
Total	**399,000**	**240**	**373,000**	**224**
Cumulative Total [b]				
Total Impacts [c]	405,000	243	374,000	225

LCF = latent cancer fatality; NNSS = Nevada National Security Site; rem = roentgen equivalent man.
[a] The values provided are for the Expanded Operations Alternative, which has the greatest impacts.
[b] The cumulative total is the sum of the projected impacts for this *NNSS SWEIS* with the impacts from the other nonrelated transportation activities.
[c] Totals are rounded to three significant digits.

Approximately 10 percent (about 92) of the individuals hired to support both DOE/NNSA activities and to operate of commercial solar power generation facilities on the NNSS under the Expanded Operations Alternative are expected to relocate to Clark and Nye Counties from other areas. Given the economic downturn, the population of Clark and Nye Counties decreased by 0.8 and 2.1 percent, respectively, in 2009 (NSBDC 2010), as noted in Chapter 2, Section 2.5.2, and Las Vegas had one of the highest home foreclosure rates in the Nation. In the short term, the increased NNSA-related workforce would likely slightly reduce the adverse impacts of the economic downturn due to new employees purchasing or renting housing and purchasing goods and services in Clark and Nye Counties. In the longer term, this increase would be so small as to be easily absorbed with almost undetectable impacts on local economies. In addition, because there would only be a small increase in population, the need for additional public services would be negligible. Therefore, this increase would not contribute to cumulative impacts on public services.

Under the Reduced Operations Alternative, a net decrease in DOE/NNSA jobs of approximately 381, relative to the No Action Alternative would occur over the next 10 years. This decrease would have an overall minor adverse economic impact in the area, as described in Chapter 5, Section 5.1.2. However, due to the high current unemployment rate, this decrease in economic activity would have a negligible contribution to overall cumulative impacts on the economy in Clark and Nye Counties. The demand for public services is expected to remain the same under the Reduced Operations Alternative. Therefore, no cumulative impacts on public services would occur.

6.3.5 Geology and Soils

Dynamic experiments using plutonium or other radioactive materials not conducted within a containment vessel would result in incremental increases in the deposition of radioactive material in the mined cavities at the U1a Complex. Dynamic experiments would not cause radiologic contamination of the land surface under normal circumstances. These types of activities are not conducted at any other locations in the United States. Therefore, the resulting cumulative impacts on geologic media would be incremental to the direct impacts and confined to the NNSS.

As shown in Table 6–4, construction of new facilities and other infrastructure by DOE/NNSA at the NNSS would result in long-term disturbance of up to 26,000 acres of previously undisturbed soils and near-surface geologic media. This disturbance, when added to previous similar disturbance at the NNSS (an estimated 80,000 acres), would amount to about 13 percent of the total area of the NNSS. Based on reviews of available documentation, potential non-DOE/NNSA land disturbance within the cumulative impacts ROI would be approximately 509,750 acres; the total area of the cumulative impacts ROI is about 15,737,760 acres. This potential disturbance includes areas specified in EISs, environmental assessments, and other planning documents and assumes that all land that would be disposed by BLM in the Las Vegas Valley would be developed. This new land surface disturbance represents about 3.2 percent of the cumulative impacts ROI. The area of existing land disturbance in the cumulative impacts ROI is about 346,000 acres, or 2.2 percent of the total area. When potential land disturbance resulting from DOE/NNSA actions (26,000 acres) is considered, the existing and potential land disturbance within the ROI would be about 881,750 acres, or 5.6 percent of the ROI.

In addition to direct impacts on soils and geologic media resulting from DOE/NNSA and other agencies, limited access to large areas of land in Nye County would have impacts related to geological resources. Access to almost all of the NNSS and the Nevada Test and Training Range has been restricted since October 1940, when land was withdrawn for establishment of the Tonopah Bombing and Gunnery Range (Karl 1951). Since 1940, additional lands have been added to the withdrawn areas and the agencies responsible for management of various portions of the withdrawn lands have changed, resulting in the most recent configuration of the NNSS and Nevada Test and Training Range.

Based on review of existing data, the Special Nevada Report (SAIC/DRI 1991) concluded that, in areas at the NNSS that are outside of known mining districts, the following base and precious metals could occur: one small-to-medium-sized precious metal deposit, one or two tungsten skarn deposits and/or polymetallic replacement deposits, and one gold deposit. Possible deposits within known mining districts include (1) a low-to-moderate potential for a precious metal or a porphyry-molybdenum deposit in the Calico Hills mining district (in the northern portion of Area 25), (2) a high potential for gold-silver resources in the Wahmonie district (generally located in Area 26) that could support a moderate-sized mining operation, (3) a high potential for skarn tungsten mineralization and porphyry molybdenum mineralization in the Oak Spring district (in the northeastern portion of the NNSS), and (4) disseminated gold deposits in the Mine Mountain district (generally located in the northwestern portion of Area 6). The Nevada Test and Training Range, including the TTR, has the following known and potential minable mineral deposits: (1) up to three small, low-to-moderate potential base-metal replacement deposits, as well as one Carlin-type gold deposit; (2) a moderate-to-high potential for discovery one or more precious metal deposits in volcanic rocks at any of the 10 established mining districts within the Nevada Test and Training Range; (3) a low-to-moderate potential for small base-metal replacement deposits; and (4) a moderate-to-high potential for small vein deposits of precious metals in parts of the Groom Mountain Range.

Continued mining restrictions in the NNSS and Nevada Test and Training Range would result in the continued unavailability of potential mineral resources for evaluation or extraction. Although the potential exists for extractable minerals and precious metals on the NNSS and Nevada Test and Training Range, extensive exploration and testing would be required to determine whether this potential is realizable and, if so, what the potential quantities of those resources would be. Therefore, it is not possible to further analyze the impact of restricted access to these potential mineral resources.

Disposal of BLM land in Las Vegas Valley could affect access to mineral resources; however, there are no economically viable locatable or leasable minerals located within the disposal area (BLM 2004b). The use of aggregate resources on the NNSS would result in a cumulative impact on regional aggregate supply; however, aggregate resources on the NNSS are more than adequate to meet projected needs. No new sand and gravel operations would be developed within the BLM land disposal area in Las Vegas Valley (BLM 2004b). There are abundant sand and gravel resources available outside of the BLM land disposal area throughout southern Nevada.

6.3.6 Hydrology

6.3.6.1 Surface Water

Aside from seeps and springs, there are no perennial water bodies on the NNSS. Closed basins capture surface runoff for the eastern portion of the NNSS (Frenchman Flat and Yucca Flat). The western and southern portions of the NNSS are within the Amargosa River Basin. The Amargosa River (also known as the Amargosa Arroyo) is atypical of most North American rivers because it seldom flows; runoff is infrequent because much of the basin receives less than 6 inches of precipitation annually (Hardman 1965). The Amargosa River originates in the mountains surrounding Beatty, Nevada, flows through the Amargosa Desert region, and terminates at Bad Water in Death Valley National Park. Most of the river course is underground, but about 17 miles of surface flow exist in the areas of Shoshone, Tecopa, and the Amargosa Canyon in California. This perennial surface flow has created lush riparian and wetland habitats that support endemic and sensitive species such as the endangered Amargosa vole (*Microtus californicus scirpensis*). The Amargosa Canyon contains some of the lusher cottonwood–willow gallery forest in the Mojave Desert (BLM 2006b). Under some conditions, unusually heavy precipitation events can produce sufficient runoff to cause the Amargosa River to have flowing water from its headwaters to its terminus (Tanko and Glancy 2001).

The major tributaries to the northern reach of the Amargosa River are Thirsty Canyon Wash and Beatty Wash, which drain the northwestern part of the NNSS. Major tributaries to the central reach of the Amargosa River are Fortymile Wash, Topopah Wash, Rock Valley Wash, and Carson Slough. Fortymile Wash drains the southern part of Pahute Mesa, the western part of Jackass Flats, and the eastern slopes of Yucca Mountain. Topopah Wash drains the eastern part of Jackass Flats. Rock Valley Wash drains the southernmost part of the NNSS in the Rock Valley basin. Carson Slough drains the Ash Meadows area off the NNSS.

Because the only flows off the NNSS go to the Amargosa River via Fortymile Wash and Topopah Wash, this is the only contribution that is made to regional surface waters from the NNSS. In addition, ephemeral surface flows on the NNSS are infrequent, with no flow in some years, while in other years, flows may occur for only a few days. For example, measurements of stream flows in Fortymile Wash near the NNSS boundary from 2002 through 2004 showed no flow at all (USGS 2002, 2004). In 2003, a discharge of less than 0.1 cubic feet per second was measured as the yearly maximum, and the flow was not sufficient to measure a water height (USGS 2003).

In the southwestern portion of Area 25, this *NNSS SWEIS* assumes development of 100 to 1,000 megawatts of commercial solar power generation in the Renewable Energy Zone. These renewable energy activities would result in up to about 10,300 acres of land being disturbed by construction activities in the short term and covered by solar-power-related facilities in the long term. During the construction period, land surface disturbance would likely result in some erosion of soil into Fortymile and Topopah Washes, although implementation of best management practices would minimize this impact. Once construction is complete, erosion of soil and movement of any contaminants from the solar sites would be controlled by a combination of engineered features, such as berms, and implementation of administrative measures, such as spill control plans. Any sediment or contamination that reaches either Fortymile Wash or Topopah Wash potentially could be transported off the NNSS and would have a cumulative impact on erosion from other developed areas, such as Nye County's proposed Yucca Mountain Project Gateway Area development and other renewable energy projects that would disturb up to 94,300 acres in the drainage area of the Amargosa River in southern Nevada and increase the potential for erosion during the construction period; however, implementation of best management practices would minimize this impact.

6.3.6.2 Groundwater

Past underground nuclear testing resulted in a cumulative impact on groundwater under the NNSS. From 1951 to 1992, 828 underground nuclear tests were conducted at the NNSS. Most were conducted hundreds of feet above the groundwater table; however, about one-third of these tests were detonated in proximity of or within the water table in the saturated zone (DOE/NV 2010). These underground tests were conducted primarily on Pahute Mesa, Rainier Mesa, Frenchman Flat, and Yucca Flat (see **Figure 6–2**). Between 1965 and 1992, a total of 82 underground nuclear tests were conducted in deep vertical boreholes on Pahute Mesa. Sixty-four of these tests were conducted on Central Pahute Mesa and 18 on Western Pahute Mesa (SNJV 2006). In a 2001 report, scientists from Los Alamos National Laboratory and Lawrence Livermore National Laboratory calculated the underground inventory of radionuclides resulting from underground nuclear testing at the NNSS between 1951 and 1992 (Bowen et al. 2001). That report estimated the remaining underground inventory of radionuclides as of September 23, 1992 to be about 132 million curies. A general description of underground nuclear testing and its effects is provided in Appendix H.

DOE/NNSA's Underground Test Area Project (UGTA) was established to assess and evaluate the effects of underground nuclear tests on local and regional groundwater through the Federal Facilities Agreement and Consent Order (FFACO). In compliance with the FFACO and in consultation with the Nevada Division of Environmental Protection (NDEP), the UGTA currently uses a total of 89 characterization wells (63 on the NNSS, 11 on the Nevada Test and Training Range, and 15 on public land) and will construct additional wells, as needed. The purpose of these wells is to obtain data to improve understanding of groundwater flow paths, flow velocities, and transport of radioactive contamination resulting from underground nuclear testing. As new information is obtained, DOE/NNSA, in consultation with NDEP, identifies new locations for characterization and monitoring wells. The ultimate purpose of the UGTA Project is to evaluate if there is a potential risk to the public from contaminated groundwater under the NNSS or from radionuclide migration off of the NNSS.

The UGTA has established four corrective action units (CAUs) for system characterization and preparation of groundwater flow and transport models: 1) Western and Central Pahute Mesa, 2) Rainier Mesa-Shoshone Mountain, 3) Frenchman Flat, and 4) Yucca Flat-Climax Mine. Of these CAUs, Pahute Mesa is the only one in which radioactive contamination has been detected off of the NNSS. In October 2009, DOE/NNSA recorded the first detectable amount of underground nuclear testing-related tritium in the newly constructed groundwater characterization well ER-EC-11, located less than one-half mile off the NNSS on lands managed by the USAF as part of the Nevada Test and Training Range (DOE/NV 2010). The results showed the level of tritium in the groundwater at that location to be about 12,000 picocuries per liter, i.e., about 60 percent of the U.S. Environmental Protection Agency (EPA) National Drinking Water Standard of 20,000 picocuries per liter. Groundwater beneath Pahute Mesa generally flows in a southwesterly direction, primarily through fractures in lava-flow and welded tuff aquifers. The ER-EC-11 characterization well is located along the interpreted groundwater flow path from western Pahute Mesa (SNJV 2006, NSTec 2010k). As shown in Figure 6–2, well ER-EC-11 is located about 14 miles from the nearest public or private water supply well along the expected primary groundwater flow path from studied testing areas on western Pahute Mesa.

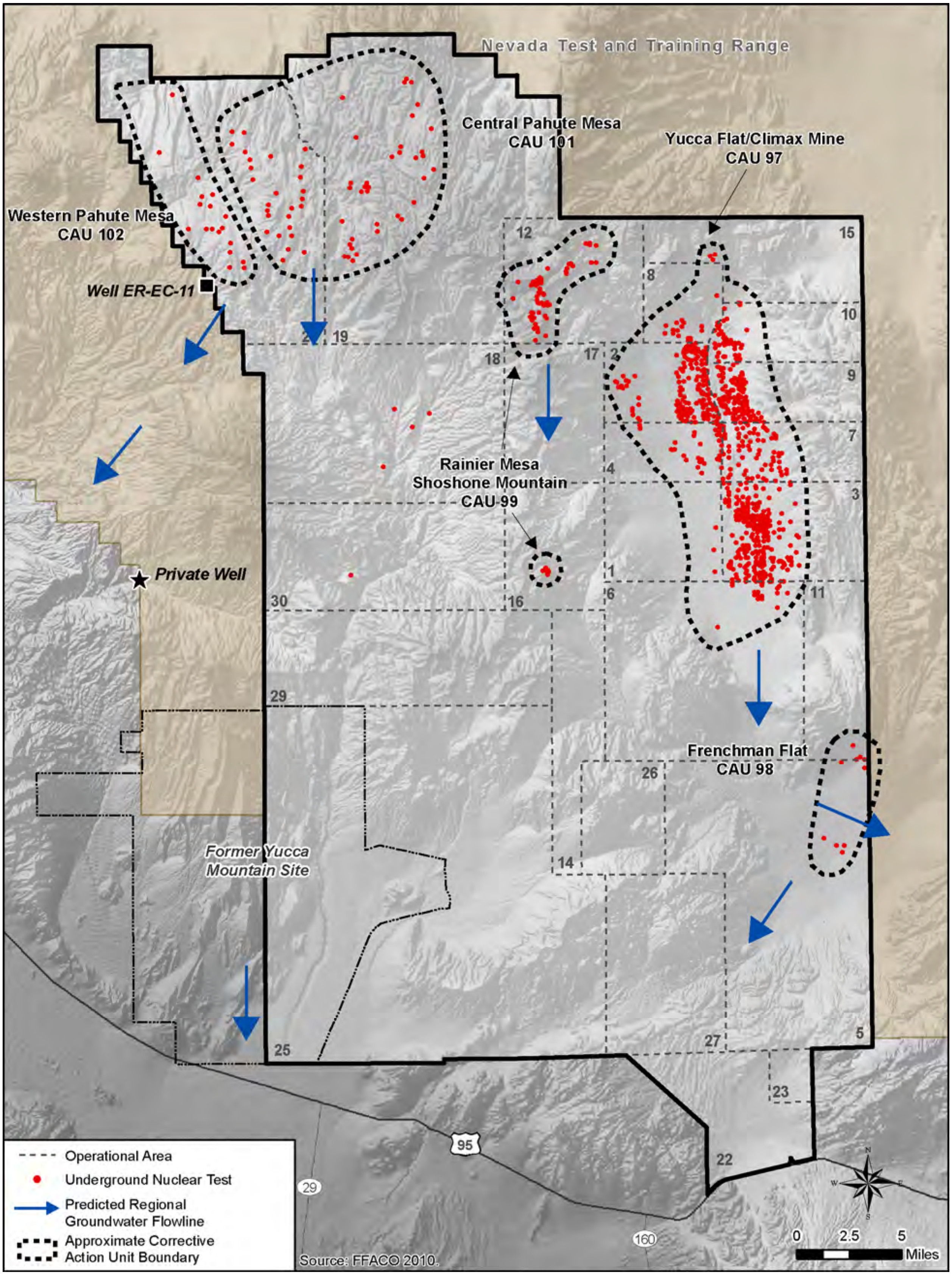


Figure 6–2 Location of Underground Test Area Corrective Action Units, Projected Groundwater Flow Directions, Characterization Well ER-EC-11, and the Nearest Private Water Well

It is difficult to reasonably estimate the volume of groundwater that may have some level of radionuclide contamination resulting from past underground nuclear testing. However, to date, the only radioactively contaminated groundwater that has been detected outside of the boundaries of the NNSS is that mentioned above, which meets EPA national drinking water standards. Because tritium is an isotope of hydrogen, it combines readily in water and is very mobile in the groundwater and probably moves at the approximately the velocity of groundwater flow. A number of factors may actually cause the apparent front of a contaminated zone to move more slowly than the average velocity of the groundwater in a fracture. Some of these factors are lateral dispersion (the tendency of particles to move in all directions in the water and to become less concentrated), matrix diffusion (the diffusive mass transfer of solutes between flowing water in fractures and relatively stagnant water in the surrounding rock matrix), and ionic exchange (attachment to the rock matrix by ionic bonding). In addition, the heterogeneity of the geologic media that the groundwater flows through adds a great deal of complexity to determining the transit times of radionuclides from their points of origin to any particular point, such as a public or private drinking water well.

Groundwater travel times for various flow paths between Pahute Mesa and Oasis Valley were estimated using variations in carbon and radioactive carbon isotopic values in 2002 (Rose et al. 2002). In that study, travel times for all flow paths between Pahute Mesa and Oasis Valley were estimated to range from less than 1,000 years to over 3,900 years. In the 2009 transport model study for Pahute Mesa-Oasis Valley, travel times for flow paths were estimated based on radioactive carbon data (SNJV 2009). Travel time for groundwater was calculated for one segment of a flow path (from well U-20-WW in east-central Pahute Mesa to characterization well ER-EC-6, located a short distance west of the NNSS on the Nevada Test and Training Range), yielding estimated travel times of about 3,264 years (with 95 percent confidence limits of 337 to 6,191 years). A rough extrapolation of travel time to the nearest public or private water well can be made based on these data. As noted above, there contaminant transport in groundwater is a very complex problem but for the purpose of providing an example a simple calculation may be used. The length of the flow path segment just noted is about 5.7 miles (30,096 feet). By assuming a straight-line flow path, groundwater velocity may be estimated by dividing the length of the flow path segment by the travel time, which yields about 9.2 feet per year (30,096 feet/3,264 years = 9.2 feet per year), with a range of from 4.8 feet per year (6,191 year travel time) to 89 feet per year (337 year travel time). As noted, there is considerable uncertainty in this flow rate. In order to help resolve this uncertainty, DOE/NNSA, in consultation with NDEP is developing additional characterization wells to obtain additional data to help refine model predictions for groundwater flow and transport.

For purposes of illustration, it is reasonable to assume that the geology between Pahute Mesa and Oasis Valley is similar to and as complex as that on the mesa. Therefore, by applying the flow rate for the U-20-WW to ER-EC-6 segment to the entire flow path, it can be estimated that the travel time for tritium-contaminated groundwater noted at well ER-EC-11 to the nearest public or private well (14 miles) would be from about 830 to over 15,000 years. The half-life of tritium is about 12.3 years. That means that every 12.3 years, there is one-half as much tritium in the groundwater under the NNSS due to natural radioactive decay. Within the uncertainties regarding groundwater flow and contaminant transport that remain, it appears that given the groundwater flow rate and the decay rate of tritium, it is unlikely that groundwater contaminated with tritium from underground nuclear testing would reach wells used to obtain water for human or livestock consumption in sufficient concentration to exceed today's Safe Drinking Water Standard of 20,000 picocuries per liter.

Cumulative impacts on groundwater availability and quality may result from activities at NNSA facilities in Nevada. RSL and NLVF acquire water from Nellis Air Force Base and Las Vegas Valley Water District, respectively (see Chapter 4, Sections 4.2.2.2 and 4.3.2.2, respectively, for additional information). The water demand by these facilities is a very small proportion of the overall water demand in the Las Vegas region and contributes minimally to the cumulative impact on that system.

This cumulative impacts analysis considers groundwater contamination resulting from past underground nuclear testing but also considers potential impacts associated with the proposed actions addressed in this SWEIS. Proposed activities that would release chemicals and/or radiological materials to the soil or underground environment include disposal of LLW and MLLW, radiological tracer experiments, and chemical release experiments. These activities would all occur well above the water table, which is hundreds to thousands of feet below the ground surface at all locations on the NNSS. The NNSS is located in a very arid region with low precipitation and high rates of evapotranspiration, which result in a net upward movement of soil moisture in the upper portion of the vadose zone (NSTec 2011). As noted in Chapter 5, Sections 5.1.6.2.1 and 5.1.6.2.2, a number of factors would preclude contamination of the groundwater beneath the NNSS from activities that release chemicals and/or radiological materials, including containment measures and/or aboveground nature of most experiments, depth to groundwater, operational controls, and groundwater monitoring programs.

As described in Chapter 4, Section 4.1.11.1.1.3, DOE/NNSA disposes of radioactive waste at the NNSS and, in accordance with DOE requirements, conducts analyses of possible long-term (over thousands of years) impacts on the public and environment after the disposal facilities are closed, i.e., performance assessments and composite analyses. Chapter 5 Section 5.1.12.1.4 notes that these analyses for radioactive waste disposal sites on the NNSS determined that, because of site-specific factors such as the predominance of evapotranspiration over precipitation, there is little or no potential for transport of disposed radionuclides to the groundwater. Further, the Intergovernmental Panel on Climate Change, in its Fourth Assessment Report estimates that although increases in precipitation extremes (such as storms associated with "El Niño" events) are possible for the Great Basin, annual-mean precipitation is projected to decrease in the southwest United States (IPCC 2007). This would tend to make it even more unlikely that a path to groundwater would develop in the future.

Because of the geographical proximity of the NNSS and the TTR, their combined use of groundwater, combined with other ongoing and reasonably foreseeable uses, could have cumulative impacts on groundwater availability. The cumulative analysis for groundwater availability is focused on locations either up- or down-gradient from the NNSS and the TTR. The NNSS and the TTR both acquire potable and nonpotable water from onsite water wells (see Chapter 4, Sections 4.1.2.2 and 4.4.2.2, respectively, for more information). **Table 6–7** shows potential groundwater demand at the NNSS and the TTR under the Expanded Operations Alternative.

Table 6–7 Annual Cumulative Water Demand at the Nevada National Security Site and the Tonopah Test Range Under the Expanded Operations Alternative

	NNSS	***TTR*** [a]	***Total***
Sustainable Site Capacity (acre-feet)	5,844 to 8,964	200	6,044 to 9,164
Operational Water Requirements [b] (acre-feet)	1,562	18	1,580
Percent of Sustainable Site Capacity	17.4 to 26.7	9.0	17.2 to 26.1

NNSS = Nevada National Security Site, TTR = Tonopah Test Range.
[a] TTR sustainable site capacity is based on water appropriations rather than perennial yield of the underlying hydrographic basins. TTR water requirements include both National Nuclear Security Administration and U.S. Air Force uses.
[b] Total water demand for the NNSS includes assumed operation of 1,000 megawatts of commercial power generation.
Note: 1 acre-foot of water is equal to 325,851 gallons.
Source: Chapter 4, Table 4–29, and Chapter 5, Table 5–21.

Proposed activities under the Expanded Operations Alternative at the NNSS and the TTR would cumulatively use up to 1,580 acre-feet of water each year, assuming operation of up to 1,000 megawatts of commercial solar power generation in Area 25 of the NNSS. While the water used by NNSA at the NNSS and the TTR would not be available for use by others, such NNSA water use would not preclude down-gradient uses of an aquifer by others because NNSA activities would only use a maximum of 17.2 to 26.1 percent of the sustainable capacity.

The town of Beatty, Nevada, is located to the west and down-gradient of the northwestern portion of the NNSS. During 2006, the annual water use for Beatty was about 138,210,050 gallons (BWSD 2008), or approximately 424 acre-feet. The town of Beatty is situated in the Oasis Valley Hydrographic Basin, and most of its water is assumed to be withdrawn from that basin. DOE/NNSA does not withdraw any groundwater from the Oasis Valley Hydrographic Basin but it is assumed that groundwater flows from the Gold Flat and Fortymile Canyon-Buckboard Mesa Hydrographic Basins into that basin. Of these two basins, DOE/NNSA would withdraw about 53 acre-feet of groundwater (about one percent of the sustainable yield of the basin) from the Fortymile Canyon-Buckboard Mesa Hydrographic Basin.

The volume of potential groundwater withdrawn for use at the NNSS and the TTR and by the town of Beatty, added to other reasonably foreseeable down-gradient uses in the region (i.e., nine proposed renewable energy projects in the Amargosa Desert Hydrographic Basin), yields an estimated total of almost 6,000 acre-feet per year. However, if only the four solar energy projects that are either approved or in the permitting process (i.e., Amargosa Farm Road Solar Energy Project, Crescent Dune Solar Energy Project, Lathrop Wells Solar Facility, and Amargosa North Solar Project) are considered, that total would be only about 2,800 acre-feet per year. These combined withdrawals could represent a significant impact on the groundwater resource; however, as discussed below, the total amount of groundwater rights currently approved in the Amargosa Desert Hydrographic Basin (which is part of the Death Valley Flow System) is not likely to increase due to implementation of the reasonably foreseeable projects in that area.

The majority of reasonably foreseeable future projects that could have cumulative groundwater impacts with actions of DOE/NNSA at the NNSS and TTR are solar energy developments on Federal lands in the Amargosa Desert Hydrographic Basin and generally down-gradient from the NNSS; the inferred northern boundary of the Amargosa Desert Hydrographic Basin in the vicinity of the NNSS, generally follows the southern boundary of the NNSS. Nevada State Engineer Order 1197 states in part, "…any applications to appropriate additional underground water and any application to change the point of diversion of an existing ground-water right to a point of diversion closer to Devils Hole, described as being within a 25-mile radius from Devils Hole within the Amargosa Desert Hydrographic Basin, will be denied." For any project needing a stable water supply within the area subject to Order 1197, the developer would need to either lease or purchase water currently being pumped under an existing certified water right. Since the water user can only pump up to the authorized duty of the water right, there would be no net increase in groundwater pumping within the basin. Converting agricultural water rights to industrial water rights could reduce return flow (recharge) from irrigation because the water would be used primarily for cooling and would not be applied to the ground as it would if used for irrigation of crops.

As of September 2010, only two proposed solar projects within the Amargosa Desert Hydrographic Basin, the Lathrop Wells Solar Facility and Amargosa North Solar Project, had reached the Federal permitting stage (BLM 2010a), and only the Amargosa Farm Road Solar Energy Project had been approved by BLM (BLM 2010i). Information about each project's water needs is limited. However, based on industry standards, it is anticipated that the two projects using parabolic trough concentrating solar technology, the Amargosa Farm Road Solar Energy Project and the Lathrop Wells Solar Facility, would require about 400 acre-feet and 200 to 405 acre-feet of water per year, respectively. The Amargosa North Solar Project, a multiphase photovoltaic project, would require substantially less water (5 to

10 acre-feet per year) (BLM 2010a). The water used for the three solar projects would result in a conversion of almost 1,000 acre-feet per year of existing water rights from their current permitted use to industrial use.

In addition to converting existing water rights from their current use to use in a solar energy project, the Amargosa Farm Road Solar Energy Project was required, as mitigation, to acquire no less than 236 acre-feet per year of water rights to hold in abeyance (BLM 2010i). To avoid significant impacts on water resources, both resulting from an individual project and in terms of cumulative impacts of multiple projects, it is likely that NPS, USFWS, and BLM would require other solar developers to agree to water mitigation measures like those required for the Amargosa Farm Road Solar Energy Project. This may result in additional groundwater being retired or held in abeyance until it can be proven that its use would not affect sensitive resources at Ash Meadows National Wildlife Refuge or Devils Hole. No net increase (and a possible decrease) in water usage resulting from these restrictions would avoid significant cumulative impacts on water resources and potential impacts on sensitive species. However, because water must be obtained from an existing water right holder, and there are limited senior water rights within the basin, implementation of such measures would reduce the amount of water that is available for other uses, which might constrain other types of economic development in the region.

Because new water rights would not be granted to potential or proposed projects that would be located within the Amargosa Desert Hydrographic Basin, there would be no cumulative impacts from DOE/NNSA's use of groundwater at the NNSS. Further, the likely requirement that future projects acquire existing water rights in addition to their needs and hold those rights in abeyance will reduce the overall potential use of groundwater resources in the Amargosa Desert Hydrographic Basin and result in net positive cumulative impacts on those resources; however, as noted above, this requirement could constrain some types of development in the region.

As described in Section 4.1.6.2, "Groundwater," there are 10 hydrographic basins underlying the NNSS. The total available, or uncommitted, groundwater within these 10 basins is estimated to be in excess of 32,000 acre-feet per year. In addition, there over 1,800 acre-feet per year are committed to non-DOE/NNSA users. NNSA withdraws water for use on the NNSS from 4 of the 10 hydrologic basins: Yucca Flat, Frenchman Flat, Fortymile Canyon–Buckboard Mesa, and Fortymile Canyon–Jackass Flats). As noted in Table 6–7, there are conservatively about 5,844 acre-feet per year of groundwater available in the four hydrographic basins that currently provide the source for water on the NNSS. Under the Expanded Operations Alternative, DOE/NNSA would use up to 1,562 acre-feet per year, or less than 27 percent, of that available groundwater. Theoretically, this would leave 4,282 acre-feet per year available for other uses. Because the NNSS is a secure facility and may not be accessed by the public, non-DOE/NNSA access to available resources is precluded. Therefore, to use groundwater that flows beneath the NNSS, a potential user would need to withdraw that resource at a down-gradient point off the NNSS. DOE/NNSA, along with other Federal agencies involved in land and resource management in the region (i.e., BLM, USFS, and NPS), have for various reasons protested applications for water withdrawals by others. In DOE/NNSA's case, the protests were based on the need to protect its Federal reserve water rights where the requested withdrawals could affect those rights. To date, it has not been demonstrated that lack of access to NNSS groundwater has adversely affected development in the region. However, it is possible that the restrictions imposed on future groundwater withdrawals within the Amargosa Desert Hydrographic Basin by Nevada State Engineer Order 1197, combined with a lack of access to other sources of water, could constrain certain types of development.

6.3.7 Biological Resources

Cumulative impacts on desert tortoises would occur throughout the region, although the intensity of the impacts would vary from location to location depending on the habitat. Under the Clark County MSHCP, a total of 145,000 acres out of an estimated 4,000,000 acres of desert tortoise habitat may be developed for other purposes, equal to approximately 3.6 percent of available desert tortoise habitat in Clark County (USFWS 2000). USFWS is evaluating a proposal by the permitted parties to amend the permit to increase the take of covered species on 215,000 additional acres (74 FR 50239) (for more information regarding the Clark County MSHCP, see Section 6.2.3.2). If approved as requested, the modified permit would be for a period of 50 years and allow for incidental take on about 360,000 acres, or about 9 percent of available desert tortoise habitat in the county. The Las Vegas Valley does not have large "islands" of habitat capable of sustaining viable desert tortoise populations; such habitat is randomly dispersed across the valley, and the tortoises are unable to move between habitat areas in most cases. As a result, this loss of habitat is not expected to jeopardize the continued existence of the Mojave population of the desert tortoise.

Within Nye County, desert tortoise habitat would be affected by a number of reasonably foreseeable actions. The development of solar energy projects would remove up to about 131,500 acres of desert tortoise habitat (the two geothermal projects and the Crescent Dunes Solar Energy Project are located outside of the range of the desert tortoise), and development of the Nye County Yucca Mountain Project Gateway Area would remove up to 5,800 acres.

DOE/NNSA activities at the NNSS would affect up to 3,300 acres of desert tortoise habitat. Development of up to 1,000 megawatts of solar power electric generation and associated transmission lines would affect an additional approximately 10,300 acres of tortoise habitat. The total amount of desert tortoise habitat that could be impacted by activities related to DOE/NNSA and other reasonably foreseeable actions in Clark and Nye Counties would affect a total of up to 507,600 acres of desert tortoise habitat in southern Nevada.

Between August 1996 and February 2009, NNSA activities at the NNSS were covered under a Biological Opinion issued by USFWS (USFWS 1996). In February 2009, USFWS issued a new Biological Opinion for the NNSS (USFWS 2009a). Both of these Biological Opinions concluded that under the terms and conditions set forth, the proposed NNSA activities would not likely jeopardize the continued existence of the Mojave population of the desert tortoise and that no critical habitat would be destroyed or adversely modified (DOE/NV 2009d). NNSA established a Desert Tortoise Compliance Program to implement the terms and conditions applicable under any Biological Opinion (DOE/NV 2009d). The Desert Tortoise Compliance Program documents compliance actions taken under the Biological Opinion, conducts pre-activity surveys of potentially disturbed areas within the distribution range of the desert tortoise on the NNSS, and assists NNSA/Nevada Site Office (NSO) in consultations with USFWS.

Table 6–8 shows the Biological Opinion compliance measures and cumulative impacts between 1992 and 2008.

Table 6–8 Cumulative Incidental Take and Desert Tortoise Habitat Disturbance from 1992 to 2008 at the Nevada National Security Site

Compliance Measure	***Threshold Value from 1996 NNSS Biological Opinion***	***Cumulative Total [a]***
Number accidentally injured or killed due to NNSS activities	3 per year	0
Number captured and displaced from NNSS project sites	10 per year	102
Number taken by injury or mortality on paved roads on the NNSS by vehicles other than those in use during a project	Unlimited	12
Number of acres of habitat disturbed by NNSS project construction	3,015 acres	311.46 acres

NNSS = Nevada National Security Site.
[a] Cumulative totals were derived from Table 2 of USFWS 2009a.

Between 1992 and the end of 2008, a cumulative total of about 312 acres was disturbed, or about 10.3 percent of allowable disturbance of tortoise habitat and less than 0.1 percent of the 328,400 acres of desert tortoise habitat on the NNSS. Overall, about 7,350 acres, or 2 percent of NNSS land within desert tortoise range, have been disturbed in the past by construction of facilities and infrastructure and other activities. Disturbance of desert tortoise habitat by NNSA activities is mitigated in one of two ways. Between 1992 and 2004, NNSA paid a designated dollar amount into the Clark County Desert Conservation Fund for each acre, or portion thereof, of desert tortoise habitat that was disturbed on the NNSS. Since 2005, with USFWS's approval, NNSA has, as an alternative to payment into the conservation fund, reclaimed previously disturbed areas of tortoise habitat. Between 2005 and the end of 2007, a total of 67.11 acres of desert tortoise habitat were disturbed and 14.08 acres were reclaimed under this program.

In addition to cumulative impacts on the desert tortoise through direct impacts and indirectly through conversion of habitat into solar power generation facilities, commercial/industrial uses, or other potential activities, other species of wildlife, as well as vegetation, would be subject to cumulative impacts. The development of about 535,750 acres of land in the region would cumulatively affect wildlife and wildlife habitat. While it is not likely that all of the projects addressed in Section 6.2 would be implemented, the loss of large areas of habitat could have a number of adverse cumulative effects. These adverse effects would include reduction of the available habitat for native wildlife; federally listed species such as the desert tortoise; and other special status species, such as Le Conte's thrasher and burrowing owl. Cumulative impacts would contribute to the loss, fragmentation, and degradation of Mojave Desert scrub habitat, which would result in impacts on habitat connectivity, genetic integrity of wildlife populations, wildlife movement corridors, fragmentation of species populations, significant alteration of natural riparian habitat and function, and loss of occupied habitat for a variety of animals. Cumulative impacts would also encourage nonnative invasive species of plants, thereby eliminating or degrading natural plant communities on which wildlife depend. Wildlife species occupying small, isolated patches of habitat are more susceptible to disturbance than species that are more widely distributed over the landscape.

As part of the Expanded Operations Alternative in this NNSS SWEIS, use of depleted uranium with explosives in up to three locations and radioisotope tracer experiments could add an increment of radioactive contamination at the NNSS. The radioisotopes used in the tracer experiments would have very short half-lives and would not likely have any cumulative impact with existing radioactive contamination at the NNSS. Experiments involving detonations of explosives in combination with depleted uranium would add a small increment of added radioactive contamination in the soil at specific locations on the NNSS. As noted in Chapter 5, Section 5.1.7.2.2, inhalation is the most likely pathway for depleted uranium to be internalized in wildlife. In general, wildlife species do not have sufficiently long enough life spans to experience the adverse effects (i.e., damage to lung cells and an increase in the possibility of lung cancer) of inhaling depleted uranium and there would, therefore, be no additional impacts on NNSS wildlife populations.

Perhaps the longest-lived species of wildlife that inhabits the NNSS is the desert tortoise. Given its long lifespan, it is conceivable that inhaled radioactive particles could cause cancer in affected desert tortoises. Although there have been studies of impacts of radionuclides on vegetation and wildlife at the NNSS and NNSA is conducting ongoing monitoring, as noted in Chapter 4, Section 4.1.7.5 and 4.1.7.5, there is no specific data addressing the desert tortoise. However, the only area on the NNSS within desert tortoise habitat where there is radiological contamination in the soil is Frenchman Flat, which provides very poor habitat for the species. Because radioactive contamination within the range of the desert tortoise on the NNSS is in poor habitat for the species and proposed experiments using depleted uranium in combination with explosives would be conducted only in the more northerly portions of the NNSS and outside of desert tortoise habitat, there would be no cumulative impact on that threatened species.

6.3.8 Air Quality and Climate

The analysis criterion for cumulative impacts on air quality and climate is the potential for emissions of criteria or hazardous air pollutants to contribute to or create a nonattainment with applicable National Ambient Air Quality Standards (NAAQS). Based on that threshold, only NNSA-related emissions sources in Clark County received detailed analysis. Greenhouse gas emissions were also analyzed for cumulative impact.

6.3.8.1 Criteria and Hazardous Air Pollutants

Table 6–9 displays the criteria and hazardous air pollutants emissions that would be generated by NNSA activities in Nevada, including those that are unregulated, such as employee commuting, vendor transportation, and shipments of waste to or from the NNSS.

Cumulative diesel emissions from NNSA sources in southern Nevada in 2015 are estimated to be about 3.3 tons per year. This estimate was derived by summing PM_{10} and $PM_{2.5}$ [particulate matter with an aerodynamic diameter less than or equal to 10 and 2.5 micrometers, respectively] emissions for commercial vendors and trucks transporting radioactive waste, all of which are assumed to be powered by diesel engines, from Chapter 5, Tables 5–32, 5–50, 5–56, and 5–58.

Table 6–9 Criteria and Hazardous Air Pollutants from All Sources; Total Emissions for National Nuclear Security Administration Operations in Nevada Under the Expanded Operations Alternative

Pollutant	*NNSS* [a]	*RSL* [b]	*NLVF* [c]	*TTR* [d]	*Total NNSA* [e]
	(tons per year)				
PM_{10}	20.1	0.084	0.44	<3.8	24.42
$PM_{2.5}$	8.1	0.067	0.28	<3.8	12.25
Carbon monoxide	160.9	4.1	30.5	<6.1	201.60
Nitrogen oxides	56.6	1.6	7.2	<14.8	80.20
Sulfur dioxide	1.1	0.034	0.095	<0.92	2.15
Volatile organic compounds	11.0	~0.3	0.096	<1.1	12.50
Lead	~0.010	~0.01	<0.01	<0.01	0.04
Criteria Pollutant Total	**249.7**	**~6.1**	**39.2**	**<26.8**	**321.80**
Hazardous air pollutants	~0.53	~0.19	0.078	<1.1	1.90

NLVF = North Las Vegas Facility; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range.

[a] From Chapter 5, Table 5–37.

[b] From Table 5–58.

[c] From Table 5–62.

[d] From Table 5–68.

[e] Values rounded.

6.3.8.1.1 Nye County

DOE/NNSA activities at the NNSS and the TTR would produce emissions of criteria and hazardous air pollutants in Nye County, as shown in **Table 6–10**.

Table 6–10 Current and Projected Emissions of Criteria and Hazardous Air Pollutants in Nye County, Nevada, from Activities Associated With the Nevada National Security Site and the Tonopah Test Range Under the Expanded Operations Alternative

Pollutant	*NNSS 2008 Actual Emissions (tons)* [a]	*TTR 2008 Actual Emissions (tons)* [a]	*Total 2008 DOE/NNSA Air Emissions in Nye County (tons)*	*Projected Total DOE/NNSA Air Emissions in Nye County (tons)* [b]
PM_{10}	2	4	6	23
$PM_{2.5}$	2	4	6	11
CO	83	13	96	82
NO_x	36	20	56	50
SO_2	1	1	2	2
VOCs	3	2	5	10
Lead	0.001	0.04	0.04	0.2
HAPs	0.03	1	1	1

CO = carbon monoxide; HAP = hazardous air pollutant; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC =volatile organic compound.
[a] Emissions taken from Chapter 4, Tables 4–40 and 4–71; numbers are rounded and may not match original tables.
[b] Projected emissions from Chapter 5, Tables 5–37 and 5–71; numbers are summed for each pollutant and are rounded.

Cumulative diesel emissions from NNSA sources in Nye County in 2015 are estimated to be about 2.6 tons per year. This estimate was derived by summing PM_{10} and $PM_{2.5}$ emissions for commercial vendors and trucks transporting radioactive waste, all of which are assumed to be powered by diesel engines (see Chapter 5, Tables 5–32, 5–56, and 5–58).

Because Nye County has been designated by EPA as an attainment/nondesignated area for purposes of compliance with NAAQS, no air monitoring data are available to determine the quantitative cumulative impact; however, the projected levels of criteria and hazardous air pollutant emissions are not considered to be sufficient to precipitate a change in Nye County's designation relative to NAAQS.

6.3.8.1.2 Clark County

Of the air sheds within which NNSA-related activities are located, only parts of Clark County, principally the Las Vegas Valley metropolitan area, are classed as nonattainment areas for compliance with NAAQS. The Las Vegas Valley is designated as a nonattainment area for carbon monoxide and PM_{10}. A larger area, comprising about 60 percent of Clark County, is in nonattainment for ozone (RTCSN 2008). Quantities of these three pollutants generated by NNSA-related mobile sources activities in Clark County would by 2015 annually contribute about 1.87 tons of PM_{10}, 119.26 tons of carbon monoxide, and up to 31.786 tons of ozone (determined by summing ozone precursors nitrogen oxides and volatile organic compounds), as shown in **Table 6–11**. Additional quantities of these pollutants would be generated in Clark County by mobile sources associated with NNSA-related construction, but these would be short-term effects and would likely be spread over several years. Table 6–11 also shows the total quantity of construction-related emissions of PM_{10}, carbon monoxide, nitrogen oxides, and volatile organic compounds.

Table 6–11 Estimated Annual Mobile Source Emissions of Criteria Pollutants that have been in Nonattainment from National Nuclear Security Administration Activities in Clark County, Nevada, Under the Expanded Operations Alternative

Pollutant	*Operations (tons per year)*					*Construction (tons per year)* [e]
	NNSS [a]	*RSL* [b]	*NLVF* [c]	*TTR* [d]	*Total*	*(10-year total)*
PM_{10}	1.4	0.046	0.403	0.022	1.87	0.17
Carbon monoxide	84.8	3.740	30.310	0.410	119.26	16.80
Nitrogen oxides	21.4	0.700	6.470	0.250	28.820	3.60
VOCs	2.6	0.270	0.068	0.028	2.966	0.60

NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range; VOC = volatile organic compound.
[a] From Chapter 5, Table 5–37.
[b] From Table 5–58.
[c] From Table 5–62.
[d] From Table 5–68.
[e] From Table 5–38.

State implementation plans prepared by Clark County Air Quality and Environmental Management contain modeled nonattainment pollutant emissions from mobile sources in specific horizon years. **Table 6–12** compares these modeled emissions with NNSA-related emissions of the nonattainment pollutants.

Emissions of PM_{10}, carbon monoxide, volatile organic compounds, and nitrogen oxides would contribute only a very small fraction of the total projected emissions of these pollutants by 2015.

Cumulative diesel particulate matter emissions from NNSA sources in Clark County in 2015 are estimated to be about 0.7 tons per year. This estimate was derived by summing PM_{10} and $PM_{2.5}$ emissions for commercial vendors and trucks transporting radioactive waste, all of which are assumed to be powered by diesel engines, from Chapter 5, Tables 5–32, 5–50, 5–56, and 5–58. The *Regional Transportation Plan 2009–2030: A Plan for Mobility in the Las Vegas Region Over the Next 20 Years* (RTCSN 2008), which provided the data for estimating future air emissions in Clark County, did not include an estimate of diesel particulate matter emissions.

Table 6–12 Comparison of Estimated National Nuclear Security Administration-Related Mobile Source Emissions of Nonattainment Pollutants in Clark County with Emissions Projected for All Clark County Mobile Sources

Pollutant	*Regional Transportation Plan Modeled Emissions* [a, b] *(tons per year)*	*NNSA-Related Emissions* [c] *(tons per year)*	*Percentage of Regional Transportation Plan-Modeled Emissions (tons per year)*
PM_{10}	28,744	2	0.07
Carbon monoxide	140,160	119	0.09
Nitrogen oxides	11,625	29	0.26
VOCs	12,399	3	0.02

NNSA = National Nuclear Security Administration; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; VOC = volatile organic compound.
[a] RTCSN 2008, Appendix 4, page 58.
[b] RTCSN 2008 values were in tons per day. The annual emissions displayed in this column were derived by multiplying the tons per day by 365. These values are rounded to the nearest whole number.
[c] Values from Table 6–11 rounded to the nearest whole number.

6.3.8.1.3 Inyo County

Inyo County, California, is part of the Great Basin Unified Air Pollution Control District (GBUAPCD), which also includes Mono and Alpine Counties. Owens Lake, located in the west-central area of Inyo County, is the largest single source of PM_{10} in the United States. The GBUAPCD, in compliance with the Clean Air Act, developed a state implementation plan for dealing with PM_{10} at Owens Lake and has installed dust control measures to meet NAAQS (GBUAPCD 2010). Because the prevailing winds at the NNSS are generally from the southwest or north-northwest (see Chapter 4, Section 4.1.8), it is not likely that emissions of criteria or hazardous air pollutants would create a cumulative effect with similar emissions in Inyo County, leading to a violation of NAAQS.

6.3.8.2 Greenhouse Gas Emissions

Nevada's estimated total gross emissions of greenhouse gases in 2010 were 55.8 million metric tons; these emissions are expected to rise to 78.4 million metric tons by 2020 (NDEP 2008). These estimated emission levels were for the state as a whole. To estimate greenhouse gas production for the cumulative impacts ROI, the proportion of the population of the state residing in Nye, Clark, Esmeralda, and Lincoln Counties was identified. In 2009, the Nevada state demographer estimated the population of the state to be 2,711,206 and the populations of the selected counties as follows: Clark, 1,952,040; Nye, 46,360; Lincoln, 4,317; and Esmeralda, 1,187 (NSBDC 2010), for a total of 2,003,904. These four counties contain about 74 percent of the population of Nevada. By using population as a rough way to apportion greenhouse gas production for the state, approximately 41.3 and 58 million metric tons per year of greenhouse gases would be produced in the four counties in 2010 and 2020, respectively.

NNSA activities in Nevada would generate about 65,430 tons of greenhouse gases by 2015 under the Expanded Operations Alternative. To compare greenhouse gas generation from NNSA activities to the amounts estimated for the four counties, the metric tons values of the state estimates were converted to short tons by multiplying by 1.10. This yields 45.43 and 63.8 million tons of greenhouse gas emissions for the four counties in 2010 and 2020, respectively. NNSA greenhouse gas emissions in 2015 (estimated at 54.6 tons) would account for about 0.12 percent of the combined greenhouse gas emissions for Clark, Nye, Esmeralda, and Lincoln Counties. Thus, the NNSA greenhouse gas contribution is small compared to the four-county greenhouse gas emissions.

6.3.9 Visual Resources

Construction and operation of one or more commercial solar power generation facilities in Area 25 would have adverse visual effects because the facility would introduce considerable infrastructure over approximately 10,000 acres of land, a large portion of which would be directly visible in middleground views from U.S. Route 95 (see Chapter 3, Figure 3–2). In addition, the CSP Validation Project would introduce smaller scale yet similar facilities on up to 300 acres of land in Area 25 that would also be visible from the middleground of U.S. Route 95. A new 500-kilovolt electrical transmission line would be required to interconnect such commercial solar facilities with the main transmission system; most of that new transmission line and attendant visual impacts would be located outside of NNSS boundaries. Portions of the study area visible from U.S. Route 95 have a Class B scenic quality rating, and the viewer sensitivity is moderate (see Chapter 4, Section 4.1.9, "Visual Resources," for a description of scenic quality and viewer sensitivity ratings). Viewer sensitivity would remain the same under the No Action and Reduced Operations Alternatives and would change from moderate to high under the Expanded Operations Alternative from an increase in the number of average daily trips over time. A concentrated solar power generation facility of this size, in addition to the CSP Validation Project, would introduce a considerable source of glare from the reflective surfaces of the solar collectors, alter the existing visual character of the landscape that is largely undeveloped, and reduce the existing visual quality to a Class C rating because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array and, therefore, this effect would be adverse and unavoidable.

According to the *Final Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project* (BLM 2010a), over 106,000 acres of land could be developed for solar project projects in Amargosa Valley. The potential additional conversion of over 10,000 acres of land to solar power generation facilities in Area 25 for the Renewable Energy Zone would make the total potentially affected land area over 116,000 acres, primarily located along U.S. Route 95 in the Amargosa Valley. All of these renewable energy projects would require new transmission lines to be constructed to integrate the power they produce into the main electrical transmission system. In addition to the potential solar power generation facilities in Amargosa Valley, Nye County is proposing to develop the Yucca Mountain Project Gateway Area in an approximately 5,800 acre area surrounding the intersection of U.S. Route 95 and Nevada State Route 373. These developments would result in cumulative visual impacts from public roadways, recreation areas, and residential areas. Viewsheds in Amargosa Valley are extensive given the topography, lack of vegetative screening, and dispersed nature of sensitive viewers. Potential cumulative visual impacts would result from the full build-out, operation, and maintenance of the proposed Renewable Energy Zone in Area 25 of the NNSS in the context of current and proposed projects within the Amargosa Valley. Most of the proposed projects are solar power generation facilities and would have similar visual effects when compared to the proposed Renewable Energy Zone. The Yucca Mountain Project Gateway Area would result in a large commercial/light industrial area that would be interposed between the closest viewpoints of the Renewable Energy Zone from U.S. Route 95. Current and future projects would incrementally modify the setting in a similar manner, as compared to the proposed project, which would result in an industrial landscape character. This change in landscape character, in conjunction with potential viewer impacts, would result in adverse cumulative visual impacts.

The proposed project, along with the past, present, and reasonably foreseeable projects, would substantially alter the visual character of the areas within Amargosa Valley. Many of the reasonably foreseeable projects would have the potential to create new visual impacts within the viewsheds that could be affected by the proposed project from public roadways, recreation areas, and residential areas.

6.3.10 Cultural Resources

As noted in Chapter 5, Table 5–38, the overall density of cultural resources sites at the NNSS is 0.051 sites per acre, and the density of sites eligible for inclusion in the National Register of Historic Places (NRHP) is 0.026 sites per acre. However, it is important to note that the potential for an area to contain cultural resource sites is strongly site specific and is influenced by factors such as presence of water, a food source, shelter, and less tangible but equally important factors such as features that may have spiritual value to a culture. While all areas of the NNSS have the potential to possess cultural resources, areas with the highest number of recorded cultural resources are Rainier and Pahute Mesas in the northwest, followed by Jackass Flats in the southwest, and Yucca Flat in the east (DOE 2010a). Prehistoric archaeological sites make up 90 percent of recorded cultural resources on the NNSS. The remaining 10 percent are historic period archaeological sites and structures, more-recent facilities and locations associated with recent scientific research, or sites of unknown age (DOE 2010a). Numerous evaluations of nuclear testing facilities and events have been conducted since the *1996 NTS EIS* was completed, resulting in 38 sites and historic districts associated with NNSS activities becoming eligible for listing in the NRHP.

BLM estimated site density for the southern Nevada region to be about 0.024 sites per acre, and the Nevada State Historic Preservation Officer estimated that approximately 12 percent of all sites identified in Nevada are eligible for inclusion in the NRHP (DOE 1996c). For purposes of this cumulative impacts analysis, it was assumed that for non-DOE/NNSA programs and projects, approximately 509,750 acres of previously undeveloped land are likely to be disturbed over the next decade. Using the more conservative site density value derived from the NNSS, almost 26,000 cultural resource sites may be located within the potentially disturbed area of the cumulative impacts ROI (excluding the NNSS and the TTR) for this *NNSS SWEIS*. Over 13,000 of these sites could be eligible for inclusion in the NRHP. When potentially affected cultural resources sites from DOE/NNSA activities (including commercial solar power generation facilities) (see Chapter 5, Section 5.1.10.2, "Cultural Resources, Expanded Operations Alternative") are included, the overall number of sites that may be affected would be almost 34,000, of which almost 15,500 would be considered eligible for inclusion in the NRHP.

Cultural resources associated with Federal and state undertakings are subject to Section 106 of the National Historic Preservation Act. For these cultural resources, identification, evaluation, and data recovery, when appropriate, are likely to occur, resulting in increases of cultural resources information in the regional database. Cultural resources on about 20 percent of potentially disturbed acreage (estimated amount of privately held land) may be destroyed without data recovery, resulting in a serious loss of information those resources may contain.

6.3.11 Waste Management

DOE/NNSA activities at the NNSS and other in-state locations generate and manage radioactive and nonradioactive wastes.

Radioactive waste

Table 6–13 presents the estimated quantities of radioactive and nonradioactive solid wastes that have been disposed at the NNSS, both historically and since the *1996 NTS EIS*, as well as the quantities of wastes that could be generated for disposal over the next 10 years. The waste volumes projected for disposal reflect those for the Expanded Operations Alternative (see Chapter 5, Section 5.1.11.2).

The estimates of LLW and MLLW in the table include wastes that are projected from environmental restoration activities at contaminated sites at the NNSS and offsite in-state locations. Generation of these wastes is uncertain and depends on future regulatory actions or agreements. In addition, there may be other options for management of the contaminated sites, including closure in place or development of new disposal units for this waste that are nearer the contaminated sites than the Area 5 RWMC or Area 3 Radioactive Waste Management Site.

The estimates in the table do not include waste that could result from incidents involving nuclear or radioactive materials, such as an accident involving a nuclear weapon or remediation of a site contaminated due to a possible intentional destructive act. Generation of such waste would be unplanned and episodic, but is expected to consist mostly of soil and debris. If the waste were generated, the NNSS could be considered as a disposal location.

LLW and MLLW generation at the NNSS and offsite locations is expected to continue beyond the next 10 years, as is disposal of these wastes at the NNSS along with wastes received from authorized out-of-state generators, consistent with applicable disposal authorizations and permits. Assuming implementation of the Expanded Operations Alternative, up to 52 million cubic feet of combined LLW and MLLW would be received for disposal.

It is expected that available disposal capacity at the Area 5 RWMC would be eventually used and disposal operations would continue at the NNSS by expanding the acreage of the Area 5 RWMC, by transferring disposal operations elsewhere at NNSS, or by re-opening the Area 3 Radioactive Waste Management Site. Additional disposal capacity could be developed on the NNSS or offsite locations to address disposal of wastes generated from in-state environmental restoration or decontamination and decommissioning activities. It is expected that permitted in-state treatment of MLLW would continue, as would offsite shipment of those mixed wastes generated within Nevada that lack in-state treatment capacity.

Table 6–13 Historical and Projected Waste Disposal at the Nevada National Security Site

Transuranic Waste (cubic feet)	*Low-Level Radioactive Waste (cubic feet)*	*Mixed Low-Level Radioactive Waste (cubic feet)* [a]	*Solid Waste (cubic feet)* [b]
Waste historically disposed at the NNSS through 1995			
11,300 [c]	17,600,000 [d]	283,000 [e]	No information
Waste volumes from 1996 through 2010			
0 [f]	21,700,000 [g]	395,000 [g]	8,660,000 [h]
Waste projected over the next 10 years for NNSS disposal under the Expanded Operations Alternative			
0 [f]	48,000,000 [i]	4,000,000 [i]	9,200,000 [i]
Total historical and projected NNSS waste disposal over the next 10 years [j]			
11,300	87,400,000	4,720,000	>17,800,000

NNSS = Nevada National Security Site.

[a] Includes radioactive materials regulated under the Atomic Energy Act of 1954, as amended, as well as constituents regulated under the Resource Conservation and Recovery Act and some substances regulated under the Toxic Substances Control Act.

[b] Includes sanitary solid waste and construction and demolition debris.

[c] Includes all waste disposed in the greater confinement disposal boreholes (about 10,347 cubic feet) and about 1,959 cubic feet of TRU waste inadvertently disposed at the Area 5 Radioactive Waste Management Complex.

[d] Volume as of December 31, 1995 (DOE 2008a); disposal in both the Area 5 Radioactive Waste Management Complex and the Area 3 Radioactive Waste Management Site.

[e] Source: DOE 1996c.

[f] No TRU (including mixed TRU) waste is projected for NNSS disposal.

[g] Source: Denton 2011.

[h] Estimated by adding all solid waste disposed at the NNSS for 1996 through 2008 (DOE/NV 1997b, 1998c, 1999, 2000c, 2001c, 2002b, 2003a, 2004d, 2005f, 2006a, 2007d, 2008a, 2009d) to the estimated waste quantities disposed at the NNSS in 2009 and 2010, and converting from tons to cubic feet, assuming 0.55 cubic yards per ton.

[i] From Chapter 5, Section 5.1.11.1, includes solid waste generated by commercial solar power generation facilities in Area 25 of the NNSS. Sanitary solid waste generated by a commercial entity could not be disposed on the NNSS under current permit conditions.

[j] Totals may not add precisely because of rounding to three significant figures.

If the NNSS were selected, a licensed GTCC waste disposal facility would not be expected to be operational within the next 10 years. Current GTCC waste volumes and radionuclide activities projected for generation through 2083 are listed in **Table 6–14**, as are wastes owned or generated by DOE that have characteristics similar to GTCC waste and could be considered for disposal in a GTCC waste disposal facility. Only about 24 percent of the total stored and projected waste volume and 1 percent of the total stored and projected activity in this table would be generated by DOE waste generators. Note that these projections include wastes that may never be generated depending on the outcome of DOE or regulatory decisions that are independent of this *NNSS SWEIS*. In addition, there may be other options for managing the identified wastes. For example, it is possible that, rather than being declared waste, sealed sources could be recycled or reused. (Decisions to recycle or reuse sealed sources would be made by others outside of NNSA/NSO and are not part of this *NNSS SWEIS*.) Furthermore, additional disposal options may be available for DOE wastes having characteristics similar to GTCC waste. If a GTCC waste disposal facility were sited at the NNSS, as an NRC-licensed facility, its operation would be independent of other waste management activities at the NNSS or other in-state DOE locations. It would use NNSS infrastructure resources such as roads and utilities.

Table 6–14 Projected Greater-Than-Class C Waste Generation Rates through 2083

	In Storage		*Projected*		*Total Stored and Projected*	
Waste Type	***Volume (cubic feet)***	***Activity (curies)***	***Volume (cubic feet)***	***Activity (curies)***	***Volume (cubic feet)***	***Activity (curies)***
GTCC Waste						
Activated metal	2,100	1,400,000	67,000	160,000,000	71,000	160,000,000
Sealed sources	-	-	100,000	2,000,000	100,000	2,000,000
Other waste	2,600	5,100	140,000	530,000	140,000	530,000
Total GTCC Waste	*4,600*	*1,400,000*	*310,000*	*160,000,000*	*310,000*	*160,000,000*
DOE Waste						
Activated metal	220	230,000	230	4,900	460	240,000
Sealed sources	7	6	22	71	29	77
Other waste	34,000	110,000	67,000	670,000	99,000	790,000
Total DOE Waste	*34,000*	*340,000*	*67,000*	*670,000*	*99,000*	*1,000,000*
Total GTCC & DOE waste	39,000	1,700,000	390,000	160,000,000	420,000	160,000,000

GTCC = greater-than-Class C.
Note: Because all values have been rounded, totals may not equal the sum of individual components.
Source: DOE 2011.

A commercial LLW disposal facility operated from 1962 to the end of 1992 in Beatty, Nevada, about 45 miles west of Mercury on the NNSS, and about 102 miles northwest of Las Vegas, Nevada. (A hazardous waste disposal facility still operates adjacent to the closed LLW facility.) During operation, the Beatty facility disposed about 4,862,000 cubic feet of radioactive waste containing about 709,000 curies of byproduct material, about 4,807,000 pounds of source material, and about 606 pounds of special nuclear material (Laney 2010).[1] Because of a lack of a groundwater pathway from NNSS radioactive waste management facilities, the large distances between this facility and DOE waste management operations at the NNSS, the TTR, RSL, and NLVF, this closed disposal facility is not expected to have any projected operational or long-term cumulative impacts on members of the public with DOE waste management activities.

Additional disposal of TRU waste at the NNSS is not expected, and there are no active TRU waste disposal facilities within Nevada. It is expected that TRU (including mixed TRU) waste would continue to be generated beyond the next 10 years as part of DOE/NNSA operations or from environmental restoration or decontamination and decommissioning activities. This waste would be characterized, packaged, and prepared for disposal at the Waste Isolation Pilot Plant.

Nonradioactive waste

DOE/NNSA is expected to continue to generate and manage nonradioactive hazardous and nonhazardous wastes at the NNSS and other in-state facilities. With respect to hazardous waste, after the next 10 years, DOE/NNSA would continue to temporarily store hazardous wastes in permitted storage facilities, as needed, pending shipment to offsite recycle or treatment, storage, or disposal facilities. No operating hazardous waste disposal facilities are located at the NNSS or other in-state NNSA facilities, although there are numerous hazardous waste recycle or treatment, storage, or disposal facilities in operation within Nevada and other nearby states (see Chapter 5, Section 5.1.11.1). None of these facilities would affect DOE/NNSA waste management infrastructure at the NNSS or other in-state locations, and their existence assures that adequate capacity for offsite disposition of hazardous waste would continue. If needed, permitted treatment capacity at the NNSS or offsite locations could be developed consistent with the existing DOE pollution prevention and waste minimizations programs and Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*.

[1] *As-disposed (un-decayed) activities.*

The quantities of solid waste disposed at the NNSS over the next 10 years are projected to exceed 9 million cubic feet, as shown in Table 6–13. Following the next 10 years, DOE/NNSA is expected to continue to dispose sanitary solid waste and construction and demolition debris within permitted landfills at the NNSS or other in-state DOE/NNSA locations and continue to recycle solid wastes as appropriate, consistent with DOE pollution prevention and waste minimization programs and Executive Order 13514. In addition to as-needed augmentation of permitted solid waste disposal capacity at the NNSS or other NNSA in-state locations (e.g., a possible new sanitary waste facility in Area 23 and a possible construction/demolition landfill in Area 25), DOE/NNSA is expected to continue to use offsite disposal facilities as needed. As discussed in Chapter 5, Section 5.1.11.1, numerous solid waste disposal and recycle facilities exist in Nevada. None of these facilities would affect DOE/NNSA waste management infrastructure at the NNSS or other in-state locations, and their existence assures that adequate capacity for offsite disposition of solid waste would continue as needed.

6.3.12 Human Health

Nuclear testing began at the NNSS in 1951. There were 100 atmospheric nuclear explosions before the Limited Test Ban Treaty was implemented in August 1963. Residents who were present during the periods when nuclear weapons testing occurred (in particular, atmospheric weapons testing from 1951 to the early 1960s) would have received up to 5 rem to the thyroid gland from iodine-131 releases, equal to an effective dose of approximately 250 millirem (SNL 2007). Because of the length of time since the end of atmospheric weapons testing, this potential legacy dose would not apply to current residents that were not in the ROI at the time of the testing.

Nuclear tests were conducted underground until October 1992, when the nuclear testing moratorium was implemented. Between 1970 and 1992, there were 126 nuclear tests that released approximately 54,000 curies of radioactivity to the atmosphere. Of this amount, 11,500 curies were accidental due to containment failure (massive releases or seeps) and late-time seeps (seeps are small releases after a test when gases diffuse through pore spaces of overlying soil and rock). The remaining 42,500 curies were operational releases. From the perspective of human health risk, if the same person stood at the boundary of the NNSS in the area of maximum concentration of radioactivity for every test since 1970, that person's total exposure would be equivalent to 32 extra minutes of normal background exposure, or the equivalent of one-thousandth of a single chest x-ray (OTA-ISC-414).

Performance Assessment – An analysis of a radioactive waste disposal facility conducted to demonstrate that for waste disposed of after September 26, 1988, there is a reasonable expectation that performance objectives for the long-term protection of the public and the environment will not be exceeded following closure of the facility. The performance objectives address (1) doses to representative members of the public through all pathways, (2) doses to representative members of the public through the air pathway alone, and (3) release of radon gas. The analysis must also assess possible water resources impacts, as well as possible impacts on hypothetical future inadvertent intruders into the disposal facility.

Composite Analysis – An analysis that accounts for all sources of radioactive material that may contribute to the long-term dose projected to a hypothetical member of the public from an active or planned low-level radioactive waste disposal facility. The analysis is a planning tool intended to provide a reasonable expectation that current low-level radioactive waste disposal activities will not result in the need for future corrective or remedial actions to ensure protection of the public and environment. If the combined dose from all interacting sources exceeds 30 millirem (total effective dose equivalent) per year, as evaluated for a specified period, a cost-benefit analysis must be performed to determine whether cost-effective options exist to reduce the dose further (DOE 1999e).

The annual radiation dose received by the offsite population within about 50 miles of the NNSS would be 0.89 person-rem per year; the annual dose received by the population with 50 miles of NLVF would be 4.1×10^{-5} person-rem. The 10-year cumulative population dose would be 8.9 person-rem. This cumulative population dose over the next 10 years would be expected to result in no (actual estimated number = 0.005) LCFs. Statistically, the probability of a single LCF occurring in the population within 50 miles of the NNSS as a result of this cumulative dose would be 1 in 200.

Based on the distance between potential sources of contamination and the nearest public or private water supply wells, no impacts on the public are expected from exposure to groundwater containing radioactivity from underground nuclear testing or other NNSS sources (see Section 6.3.6.2, "Groundwater").

As addressed in Chapter 4, Section 4.1.11.1.1.3, and Chapter 5, Section 5.1.12.1.4, radioactive waste disposal occurs at the NNSS in accordance with authorizations issued by DOE that consider analyses of possible long-term (over thousands of years) impacts on the public and the environment after the disposal facilities are closed.

LLW management performance. A combined Area 3 RWMS performance assessment and composite analysis was completed in July 2000. The Area 5 RWMC performance assessment was completed in 1998, and the Area 5 RWMC composite analysis was completed in 2001. These analyses are updated annually to reflect new information such as revised estimates of disposed waste inventories or modifications to waste disposal operations. The analyses determined that, because of the great excess of evapotranspiration over precipitation and other site-specific factors, there was little to no potential for transport of disposed radionuclides to groundwater. The analyses also concluded that all performance objectives would be met. As noted in Chapter 5, Section 5.1.12.1.4, the results of the initial composite analyses were well below the 30-millirem-per-year decision criterion for both the Area 3 RWMS and Area 5 RWMC. The most recent review and update of the Area 3 and 5 performance assessments and composite analyses concluded that the results and conclusions of the performance assessments and composite analyses remained valid (NSTec 2010f).

TRU waste management performance. As discussed in Chapter 4, Section 4.1.11.1.1.3 and Chapter 5, Section 5.1.12.1.4, DOE conducted analyses of compliance with EPA's TRU waste disposal requirements in 40 CFR Part 191 for the TRU waste disposed both intentionally in greater confinement disposal (GCD) boreholes and inadvertently in an Area 5 RWMC trench. It was determined that disposal of TRU waste in the GCD boreholes and disposal trench would meet all applicable EPA containment, individual protection, and groundwater protection requirements. For both analyses, it was determined that the projected cumulative releases would meet the probabilities specified in the EPA standard of exceeding specified quantities of radionuclides. Regarding the EPA individual protection requirement, the mean annual dose to a member of the public from all waste in the boreholes over 1,000 years was about 0.0062 millirem to the whole body and 0.12 millirem to bone. For the TRU waste inadvertently disposed of in the trench, the maximum total effective dose equivalent for a member of the public over 10,000 years was about 1.4 millirem in a year, predominantly from assumed inhalation of radon-222 progeny in air produced by LLW in the same trench. The results of both assessments indicated compliance with applicable EPA requirements. Regarding the EPA groundwater protection requirement, hydrologic processes modeling supported a conclusion of no groundwater pathway within 10,000 years (SNL 2001b; Shott et al. 2008).

Industrial accidents. Based on occupational injury and fatality rates for industrial activities inclusive of construction (DOL 2010a, DOE 2010b), construction activities at NNSS, including construction of one or more solar power generation facilities with a combined capacity of 1,000 megawatts, would result in less than 1 (actual calculated number = 0.08) fatality over the next 10 years. Assuming an average construction period of 36 months for all of the renewable energy projects in Amargosa Valley and a total average number of construction workers of 6,025, a single (actual calculated number = 0.69) worker fatality could be expected during the construction period. There would be a cumulative total of 1 (calculated number = 0.77) worker fatality for large-scale construction projects in the area over the 10-year period. Based on incidence rates for total recordable cases (TRCs) and days away, restricted or transferred (DART) cases as a result of accidents (DOL 2010b, DOE 2010b) across a broad range of activities, projected TRC and DART cases for 10 years of activities (operations and construction) at the NNSS, RSL, NLVF, and the TTR were estimated. The estimate includes the construction and 5 years of operation of one or more solar power generation facilities. Over a 10-year period, there would be an estimated 810 TRCs and 370 DART cases. Based on the estimated number of workers and construction duration for renewable energy projects in Amargosa Valley (see above), an additional 750 TRCs and 380 DART cases would be expected, for totals of 1,560 TRCs and 750 DART cases.

Noise

At the regional level, it is expected that ambient noise levels would increase, especially in areas undergoing urban development and those that are adjacent to industrial and mineral extraction activities. Noise impacts associated with activities at the NNSS would be restricted to the geographical area contained therein and would not affect residents in adjacent areas or add measurably to regional noise levels.

6.3.13 Environmental Justice

American Indian environmental justice concerns, as identified by the Consolidated Group of Tribes and Organizations, include holy land violations, perceived risks from radiation, and cultural survival. Increased land disturbance associated with all forms of development in the ROI could result in a decrease in access to these areas for American Indians. Limiting access could reduce the traditional use of the area and affect its sacred nature. Increased development throughout the ROI has the potential for greater disturbance and vandalism of American Indian cultural resources. Such impacts would be perceived, in the main, by American Indian groups who would make up the population group experiencing disproportionate impacts of project implementation.

6.4 Summary of Cumulative Impacts

Table 6–15 contains a summary of cumulative impacts addressed in Section 6.3. As noted at the beginning of this chapter, the impacts associated with the NNSS in the preceeding analyses are based on the Expanded Operations Alternative, unless otherwise noted. Table 6–15 includes summary information for all three alternatives addressed in this *NNSS SWEIS*, i.e., No Action, Expanded Operations, and Reduced Operations.

Table 6–15 Summary of Cumulative Impacts

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Land Use	In Nye County, approximately 143,000 acres of public land managed by BLM would be committed to use for renewable energy facilities or commercial/industrial uses. In Clark County, BLM would dispose up to about 36,000 acres of public land. Use of this land would be changed from its current public uses to private and/or municipal uses.	The following land use changes would occur under the noted *NNSS SWEIS* alternatives: **No Action** – There would be no changes to NNSS Land Use Zones. – Construction of a commercial solar power generation facility would affect land use patterns outside of the NNSS due to construction of a 230-kilovolt transmission line. **Expanded Operations** – Area 15 – Change from Reserved Zone to Research, Test and Experiment Zone. – Area 25 – Designate about 39,600 acres as a Renewable Energy Zone. – Construction of a commercial solar power generation facility would affect land use patterns outside of the NNSS due to construction of a 500-kilovolt transmission line. **Reduced Operations** – Areas 19 and 20 – Change from Nuclear Test Zone to Limited Use Zone. – Areas 18, 29, and 30 – Change from Reserved Zone to Limited Use Zone. – Construction of a commercial solar power generation facility would not affect land use patterns outside of the NNSS.	Regardless of the implement6ation of any alternative in this *NNSS SWEIS*, changes in NNSS land use zone designations or functions are not expected to affect land use patterns in areas outside of the NNSS, except for the potential construction of interconnecting transmission lines for commercial solar power generation facilities under the No Action (250 acres) and Expanded Operations (300 acres) Alternatives. Land uses at RSL, NLVF, and the TTR are expected to remain unchanged and would not affect land uses in other areas. A total of over 185,000 acres of public land managed by BLM would be either disposed or withdrawn for non-public uses within Clark and Nye Counties.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Infrastructure and Energy	***Infrastructure***		
	Construction of new facilities, particularly large projects, would place cumulative demands on goods and services. The proposed renewable energy projects in Amargosa Valley and Area 25 of the NNSS would all have similar needs for large tracts of undeveloped land and water; use earth-moving/grading equipment, cranes, and other construction equipment; require similar materials, such as concrete, steel, wood, wiring and cables, etc.; and require the services of both general and specialized construction workers.	Construction of new facilities at the NNSS, particularly one or more solar power generation facilities with a capacity of 240 megawatts under the No Action Alternative, a combined capacity of 1,000 megawatts under the Expanded Operations Alternative, and 100 megawatts under the Reduced Operations Alternative,, would cause a demand for construction materials and skilled labor, in proportion to their size, similar to those of other large construction projects.	Large-scale construction projects, particularly renewable energy facilities in the Jackass Flats area of the NNSS and in Amargosa Valley and construction of new high voltage transmission lines, would create an increase in demand for and cumulatively affect availability of construction materials, supplies, and labor. Because of the relative number and/or size of new facility construction considered in this *NNSS SWEIS*, the noted cumulative impact would be substantially greater for the Expanded Operations Alternative than for the No Action Alternative. The Reduced Operations Alternative would create the least demand on construction materials, supplies, and labor and would contribute the least to cumulative impacts.
	Energy		
	In 2009, NV Energy (southern division) and Valley Electric Association provided a total of about 21,670,000 megawatt-hours of electricity to their customers (NSOE 2010). The Nevada Public Utilities Commission forecasts a 1.5 percent growth rate in electricity sales through 2020 (NDEP 2008). Based on that growth rate, by 2020, total electricity sales in southern Nevada would be about 25,500,000 megawatt-hours, an increase of almost 4,000,000 megawatt-hours. There are proposals for renewable energy projects in southern Nevada that would produce a total of about 5,800 megawatts of new generating capacity.	The 2020 projected cumulative annual electrical energy demand for DOE/NNSA activities in Nevada under No Action Alternative is about 113,000 megawatt-hours; under the Expanded Operations Alternative about 127,000 megawatt-hours; and under the Reduced Operations Alternative, about 96,000 megawatt-hours. A portion of the electrical energy demand under the Expanded Operations Alternative would be offset by development of a 5-megawatt photovoltaic solar power generation facility in Area 6 of the NNSS.	Cumulatively, the projected increase in electrical energy demand, regardless of the demand under any of the alternatives, would be offset by development up to 5,800 megawatts of new generating capacity from proposed renewable energy facilities. In addition, construction of new high voltage transmission lines, such as the Solar Express Transmission Line Project, the Transwest Express Transmission Project, etc. would provide a stronger connection with other regions to support electrical demand in southern Nevada.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Transportation and Traffic		***Traffic***	
	During construction of proposed renewable energy projects in Amargosa Valley and the Yucca Mountain Project Gateway Area development, roads in Nye County could experience increases in daily traffic ranging from a 2- to 5-fold on primary roads such as U.S. Route 95 and Nevada State Route 160, which could degrade levels of service from A to D during peak commuting hours. During operations, primary roadways could experience increases in daily traffic, and levels of service could degrade one level during peak commuting hours. The degradation in levels of service caused by increased traffic volumes on these roads could generate the need for additional travel lanes and other improvements.	Personnel and trucks associated with one or more commercial solar power generation facilities in Area 25 would increase daily vehicle trips on local roadways by 500 to 1,000 through the 36-month construction period under the No Action Alternative; by 750 to 1,500 through the 42-month construction period under the Expanded Operations Alternative; and by 400-800 under the Reduced Operations Alternative. The addition of these vehicles and associated construction trucks on a daily basis would increase the rate of pavement deterioration, degrade levels of service, and could require increased road maintenance and upgrades for roads in the project area.	The cumulative impact of increased traffic on local roadways in southern Nye County, nearby the NNSS, associated with NNSS operations and construction and operation of commercial solar power generation facilities in Area 25 would be a reduction in level of service on U.S. route 95 from B to C, relative to the 2008 baseline, regardless of the traffic increases resulting from implementation of any of the alternatives. When combined with increased traffic from other large construction projects in Amargosa Valley, the level of service would degrade to D, causing accelerated deterioration and associated increased need for maintenance and repair. Some roadways and traffic control measures would need to be upgraded.
		Radiological Transportation	
	Collective worker dose (1943 to 2073) = 399,000 person-rem, equivalent to 240 LCFs over 130 years. Collective general population dose (1943 to 2073) = 373,000 person-rem, equivalent to 224 LCFs over 130 years.	**No Action Alternative** – Worker dose = 2,100 person-rem, equivalent to 1.2 LCFs. – Population dose = 390 person-rem, equivalent to 0.2 LCF. **Expanded Operations Alternative** – Worker dose = 5,500 person-rem, equivalent to 3 LCFs. – Population dose = 1,300 person-rem, equivalent to 1 LCF. **Reduced Operations Alternative** – Worker dose = 2,100 person-rem, equivalent to 1.2 LCFs. – Population dose = 390 person-rem, equivalent to 0.2 LCF.	**No Action Alternative** – Worker dose = 401,000 person-rem, equivalent to 241 LCFs over 130 years. – Population dose = 374,000 person-rem, equivalent to 224 LCFs over 130 years. **Expanded Operations Alternative** – Worker dose = 405, 000 person rem, equivalent to 243 LCFs over 130 years. – Population dose = 374,000 person-rem, equivalent to 225 LCFs over 130 years. **Reduced Operations Alternative** – Worker dose = 401,000 person-rem, equivalent to 241 LCFs over 130 years. – Population dose = 374,000 person-rem, equivalent to 224 LCFs over 130 years.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Geology and Soils	Within the cumulative impacts ROI, about 215,000 acres of Clark County and 51,000 acres of Nye County have been disturbed by previous development. A total of about 509,750 acres of additional soil and near-surface geologic media would be impacted by reasonably foreseeable land development activities in Nye and Clark Counties. This would result in a total of about 775,750 acres of soil and near surface geologic media being disturbed.	An unknown but substantial amount of deep subsurface geologic media has been affected by underground nuclear tests conducted on the NNSS. Approximately 80,000 acres of land on the NNSS has been disturbed by previous DOE/NNSA activities. Overall, new disturbance of soils and near-surface geological media resulting from proposed DOE/NNSA actions at the NNSS would be as follows: **No Action**: About 1,800 acres plus an additional 2,650 acres for a commercial solar power generation facility. **Expanded Operations**: About 15,500 acres, plus an additional 10,350 acres for commercial solar power generation facilities and a Geothermal Demonstration Project. **Reduced Operations**: About 1,540 acres plus an additional 1,200 acres for a commercial solar power generation facility.	Previous combined actions within the cumulative impacts ROI have disturbed about 346,000 acres. Reasonably foreseeable actions would disturb additional soil and near-surface geological media within the ROI, as follows: **No Action:** About 514,250 acres **Expanded Operations:** About 535,750 acres **Reduced Operations:** About 512,450 The total potential cumulative area of land disturbance would range from about 858,450 to 881,750 acres, which represents about 5.5 to 5.6 percent of the total area of the ROI (15,737,760 acres).

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Hydrology	***Surface Water***		
	Disturbing about 94,300 acres in Amargosa Valley for constructing solar power generation facilities and developing the Yucca Mountain Project Gateway Area could potentially result in erosion and slightly increase sedimentation in the Amargosa River during the construction period. However, BLM prescribed and enforced erosion control measures would reduce the likelihood of such an impact.	Within areas that drain off the NNSS, under the No Action, Expanded Operations, and Reduced Operations Alternatives, a total of 2,650, 10,300, and 1,200 acres, respectively, of land could be disturbed for construction of one or more commercial solar power generation facilities and under each alternative 110 acres of land would be disturbed for a Solar Demonstration Project. During construction of these facilities, the potential for soil erosion affecting surface waters would be greater due to removal of vegetation and other earth-disturbing activities. If such erosion were to occur it would likely result in increased sediments being transported into Fortymile Wash and eventually into the Amargosa River. However, implementation of erosion control measures would reduce the likelihood of such erosion.	Although the potential for increased sedimentation in the Amargosa River drainage is a potential cumulative impact regardless of alternative considered in this SWEIS, implementation of recognized measures to prevent erosion would reduce the likelihood of such impacts occurring.
	Groundwater		
	The town of Beatty, Nevada, uses just under 500 acre-feet of water per year obtained from the Oasis Valley Hydrographic Basin. Operational water requirements for the solar power generation facilities proposed in Amargosa Valley would require almost 6,000 acre-feet of groundwater each year, primarily from the Amargosa Desert, Oasis Valley, and Crater Flats Hydrographic Basins. Nevada State Engineer Order 1197 requires that water for new uses in the Amargosa Desert Hydrographic Basin be obtained by acquisition of existing water rights.	Past underground nuclear testing has contaminated an unknown volume of groundwater beneath the NNSS. That contamination is not expected to impact publicly available water supplies within the next 100 years. DOE/NNSA proposed activities under this *NNSS SWEIS* would not cause new or additional groundwater contamination. DOE/NNSA activities at the NNSS and the TTR, as well as operation of solar power generation facilities in Area 25 of the NNSS, under all three alternatives addressed in this *NNSS SWEIS*, would require withdrawal of groundwater, as follows: **No Action:** 959 acre feet **Expanded Operations:** 1,580 acre-feet **Reduced Operations:** 815 acre feet This volume of groundwater represents about 16 percent, 27 percent, and 14 percent, respectively, of the cumulative sustainable yield for all of the affected hydrographic basins.	Regardless of alternative considered in this *NNSS SWEIS*, groundwater monitoring programs conducted by DOE/NNSA and other organizations, such as the U.S. Geological Survey and Desert Research Institute, would ensure that there would be sufficient lead-time for DOE/NNSA to identify and implement, appropriate protective and mitigative measures if contamination associated with underground nuclear testing were to affect any water supply located off Federal land. Due to the implementation of Nevada State Engineer Order 1197, there would be no new cumulative impacts associated with groundwater availability resulting from DOE/NNSA proposed actions and reasonably foreseeable projects in the Amargosa Desert Hydrographic Basin.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Hydrology (cont'd)		DOE/NNSA would not withdraw groundwater from the Oasis Valley, Crater Flats, or Amargosa Valley Hydrographic Basins.	
Biological Resources	Reasonably foreseeable actions by USFWS would result in a total of about 360,000 acres of desert tortoise habitat in Clark County, Nevada, being permitted under the Endangered Species Act for incidental take of desert tortoises (USFWS 2000; 74 FR 50239). This represents about 9 percent of the estimated 4,000,000 acres of tortoise habitat in Clark County. Within Nye County, desert tortoise habitat would be affected by a number of reasonably foreseeable actions. The development of solar energy projects in Nye County would remove up to about 131,500 acres of desert tortoise habitat; development of the Nye County Yucca Mountain Project Gateway Area would remove up to 5,800 acres. The development of over 509,000 acres of currently open land in the region would cumulatively affect wildlife and wildlife habitat. The loss of large areas of habitat would reduce the available habitat for native wildlife, including federally listed species and other special status species. Development of undisturbed land would contribute to loss, fragmentation, and degradation of habitat and encourage nonnative invasive species, thereby eliminating or degrading natural plant communities on which wildlife depend.	Currently, approximately 80,000 acres of the NNSS are considered disturbed. Overall, new wildlife habitat disturbed by DOE/NNSA actions would be as follows: **No Action**: About 1,810 acres plus an additional 2,650 acres for a commercial solar power generation facility. **Expanded Operations**: About 15,500 acres, plus an additional 10,350 acres for commercial solar power generation facilities and a Geothermal Demonstration Project. **Reduced Operations**: About 1,540 acres plus an additional 1,200 acres for a commercial solar power generation facility. Impacts to the threatened desert tortoise under all alternatives would be the result of harassment. **No Action**: DOE/NNSA activities at the NNSS would affect about 1,055 acres of desert tortoise habitat and impact up to 47 tortoises; a commercial solar power generation facility would affect an additional 2,650 acres of tortoise habitat and up to 41 tortoises. **Expanded Operations**: DOE/NNSA activities at the NNSS would affect about 3,370 acres of desert tortoise habitat and impact up to 60 tortoises; commercial solar power facilities would disturb about 10,300 acres of tortoise habitat and up to 161 desert tortoises. **Reduced Operations**: DOE/NNSA activities at the NNSS would disturb about 920 acres of desert tortoise habitat and impact up to 37 tortoises; a commercial solar power generation facility would affect an additional 1,200 acres of tortoise habitat and up to 19 tortoises.	The development of from about 512,000 (Reduced Operations Alternative) to 535,750 acres (Expanded Operations Alternative) of currently open land in the region would cumulatively affect wildlife and wildlife habitat. The loss of large areas of habitat would reduce the available habitat for native wildlife, including federally listed species and other special status species. Development of undisturbed land would contribute to loss, fragmentation, and degradation of habitat and encourage nonnative invasive species, thereby eliminating or degrading natural plant communities on which wildlife depend. DOE/NNSA proposed actions and reasonably foreseeable actions by others within the cumulative impacts ROI would result in the loss of over 522,000 acres of tortoise habitat under the Expanded Operations Alternative or about 508,000 acres under the No Action and Reduced Operations Alternatives. However, because a large portion of that habitat loss would be permitted by USFWS under the Endangered Species Act, pursuant to Section 10(a)(1)(B) non-Federal entities and Section 7 for Federal agencies this habitat loss would not threaten the continued existence of the desert tortoise.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Biological Resources (cont'd)		An additional 125 tortoises may experience impacts due to harassment on NNSS roads under all three alternatives The Concentrating Solar Power Validation Project would disturb an additional 110 acres of desert tortoise habitat, but based on a survey of the area by qualified tortoise biologists, would not likely impact tortoises. Overall, wildlife habitat disturbed by DOE/NNSA actions would total about 26,000 acres.	
Air Quality and Climate	***Nye County***		
	Because Nye County is considered an attainment/nondesignated area for purposes of compliance with NAAQS, there are no countywide air monitoring data available.	Annual DOE/NNSA air emissions in Nye County from all sources in 2015: **No Action Alternative:** PM_{10} = 9.8 tons $PM_{2.5}$ = 6.8 tons CO = 66 tons NO_x = 40 tons SO_2 = 1.3 tons VOCs = 5.2 tons Lead = 0.04 tons HAPs = 1.4 tons **Expanded Operations Alternative:** PM_{10} = 22.6 tons $PM_{2.5}$ = 11 tons CO = 82 tons NO_x = 50 tons SO_2 = 2 tons VOCs = 10 tons Lead = 0.2 tons HAPs = 1.4 tons **Reduced Operations Alternative:** PM_{10} = 7.2 tons $PM_{2.5}$ = 5.8 tons CO = 55 tons NO_x = 36 tons SO_2 = 1.2 tons VOCs = 4.1 tons Lead = 0.01 tons HAPs = 1.3 tons	Cumulatively, the annual air emissions from Federal and non-Federal activities in Nye County from all sources in 2015, regardless of the level of projected emissions under any of the alternatives considered in this *NNSS SWEIS*, are not expected to cause a nonattainment condition with respect to NAAQS.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Air Quality and Climate (cont'd)	***Clark County***		
	Clark County, principally the Las Vegas Valley, is classed as a nonattainment area for some air pollutants i.e., not in compliance with NAAQS. Criteria pollutants for which the Las Vegas Valley have been out of attainment and the projected (2013) annual mobile source emissions are: PM_{10} = 28,744 tons CO = 140,160 tons NO_x = 11,625 tons VOCs = 12,399 tons	Estimated annual mobile source emissions related to DOE/NNSA activities in Clark County, including worker commuting, for the criteria pollutants that are in nonattainment in the Las Vegas Valley are: **No Action Alternative:** PM_{10} = 1.5 tons CO = 97 tons NO_x = 24 tons VOCs = 3.1 tons **Expanded Operations Alternative:** PM_{10} = 2 tons CO = 119 tons NO_x = 29 tons VOCs = 3.9 tons **Reduced Operations Alternative:** PM_{10} = 2 tons CO = 86 tons NO_x = 22 tons VOCs = 3 tons	The estimated 2015 cumulative total of annual mobile source emissions of criteria pollutants that are currently in nonattainment in the Las Vegas Valley are: **No Action Alternative:** PM_{10} = 28,746 tons CO = 140,257 tons NO_x = 11,649 tons VOCs = 12,402 tons **Expanded Operations Alternative:** PM_{10} = 28,746 tons CO = 140,279 tons NO_x = 11,654 tons VOCs = 12,403 tons **Reduced Operations Alternative:** PM_{10} = 28,746 tons CO = 140,246 tons NO_x = 11,647 tons VOCs = 12,402 tons
	Greenhouse Gas Emissions		
	Estimated annual greenhouse gas emissions in Nye, Clark, Lincoln, and Esmeralda Counties in 2015 are projected to be about 54.6 million tons.	DOE/NNSA activities in Nye and Clark County would annually generate of the following estimated amounts of greenhouse gas emissions in 2015: **No Action Alternative:** 60,555 tons **Expanded Operations Alternative:** 88,679 tons **Reduced Operations Alternative:** 53,755 tons	Estimated annual cumulative greenhouse gas emissions in 2015 would in Nye, Clark, Lincoln, and Esmeralda Counties would be: **No Action:** 54,661,000 tons **Expanded Operations:** 54,689,000 tons **Reduced Operations:** 54,654,000 tons
Visual Resources	In Nye County, in the vicinity of the NNSS, development of solar power generation facilities would substantially alter the visual character along U.S. Route 95 in Amargosa Valley.	Under all three alternatives addressed in this SWEIS, the development of one or more solar power generation facilities with generating capacities ranging from 100 to 1,000 megawatts in Area 25 of the NNSS would reduce the visual quality rating of that viewshed from Class B to Class C due to intrusion of manmade elements. Under the Expanded Operations Alternative, construction of additional facilities at Desert Rock Airport would adversely impact the viewshed along U.S. Route 95 in Mercury Valley.	Regardless of the alternative considered in this *NNSS SWEIS*, development of solar power generation facilities, the Yucca Mountain Gateway Project, and new facilities at Desert Rock Airport (only under the Expanded Operations Alternative) would substantially alter the visual character along U.S. Route 95 in Amargosa and Mercury Valleys, reducing the visual quality rating from Class B to Class C.

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Cultural Resources	An estimated 26,000 cultural resources sites would be affected by land-disturbing activities within the cumulative impacts ROI, with about 13,000 of those sites being considered eligible for inclusion in the NRHP.	The estimated number of cultural resources sites potentially affected by DOE/NNSA activities and development of commercial solar power generation facilities under each alternative are as follows: **No Action Alternative:** DOE/NNSA activities would potentially affect up to 53 sites; 18 could be considered eligible for inclusion in the NRHP Development of a 100 megawatt commercial solar power generation facility would potentially affect up to 802 sites; 557 could be considered eligible for inclusion in the NRHP. **Expanded Operations Alternative:** DOE/NNSA activities would potentially affect up to 682 sites; 283 could be considered eligible for inclusion in the NRHP Development of up to 1,000 megawatts of commercial solar power generation facilities and a Geothermal Demonstration Project would potentially affect up to 7,006 sites; 2,163 could be considered eligible for inclusion in the NRHP. **Reduced Operations Alternative:** DOE/NNSA activities would potentially affect up to 45 sites; 14 could be considered eligible for inclusion in the NRHP. Development of a 100 megawatt commercial solar power generation facility would potentially affect up to 816 sites; 252 could be eligible for inclusion in the NRHP.	The estimated cumulative total of potentially affected cultural resource sites including both proposed and reasonably foreseeable activities under each alternative are as follows: **No Action Alternative:** Total sites – 26,855 NRHP-eligible sites – 13,565 **Expanded Operations Alternative:** Total sites – 33,688 NRHP-eligible sites – 15,446 **Reduced Operations Alternative:** Total sites – 26,861 NRHP-eligible sites – 13,266

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
		Radioactive Waste	
Waste Management	The NNSS is the only active disposal facility for LLW and MLLW in Nevada. It accepts for disposal only LLW and MLLW that meet the NNSS Waste Acceptance Criteria. A commercial LLW disposal facility operated from 1962 to the end of 1992 in Beatty, Nevada, about 45 miles west of Mercury on the NNSS. Because of a lack of a groundwater pathway from NNSS radioactive waste management facilities, the large distances between this facility and DOE/NNSA waste management operations, depth to groundwater, high evaporation rate in the region, and monitoring by the Nevada Division of Environmental Protection to ensure continued proper function of closure/containment measures, this closed disposal facility is not expected to have any cumulative impacts with DOE/NNSA waste management activities.	Historic disposal of LLW, MLLW, and some TRU waste at the NNSS totaled about 40,000,000 cubic feet through 2010. During the next 10 years, the following estimated volumes of radioactive waste would potentially be disposed at the NNSS: **No Action and Reduced Operations Alternatives:** LLW = 15,000,000 cubic feet MLLW = 900,000 cubic feet **Expanded Operations Alternative:** LLW = 48,000,000 cubic feet MLLW = 4,000,000 cubic feet	Because the NNSS operates the only LLW/MLLW disposal facilities in Nevada, there would be no cumulative impacts from management of such wastes outside of the NNSS.
		Nonradioactive Waste	
	There are a number of hazardous waste treatment, storage, and disposal facilities in Nevada and neighboring states that treat and dispose such wastes from many generators.	The following estimated volumes of hazardous waste would be generated by DOE/NNSA activities and commercial solar power generation facilities over the next 10 years: **No Action Alternative:** DOE/NNSA activities—170,000 cubic feet Commercial solar facility—42,000 cubic feet **Expanded Operations Alternative:** DOE/NNSA activities—170,000 cubic feet Commercial solar facilities—170,000 cubic feet **Reduced Operations Alternative**: DOE/NNSA activities—170,000 cubic feet Commercial solar facility—17,000 cubic feet All hazardous waste generated by DOE/NNSA activities would be transported to commercial treatment, storage, and disposal facilities for treatment and/or disposal. Hazardous waste generated by commercial solar facilities would be managed by the operator in accordance with applicable statutes and regulations.	The volume of hazardous waste that DOE/NNSA and commercial solar power generation facilities would dispose at commercial treatment, storage, and disposal facilities would not exceed the capacity of such facilities and would represent a very small portion of the overall volume of such waste disposal, regardless of the alternative considered.

Resource Area	*Non-DOE/NNSA Contribution to Cumulative Impacts*	*DOE/NNSA Contribution to Cumulative Impacts*	*Cumulative Impacts*
Human Health	***Radiological***		
	There are no other non-background sources of potential radiological exposure for an offsite member of the public within the cumulative impacts ROI.	The dose to the offsite population resulting from DOE/NNSA activities in southern Nevada under each alternative addressed in this SWEIS would be: **No Action Alternative:** Dose = 5.0 person-rem over 10 years Consequence = No (0.003) LCFs **Expanded Operations Alternative:** Dose = 8.9 person-rem over 10 years Consequence = No (0.005) LCFs **Reduced Operations Alternative:** Dose = 4.8 person-rem over 10 years Consequences = No (0.003) LCFs	Because there is no other source for above-background level of exposure to radioactivity in the cumulative impacts ROI, DOE/NNSA is the sole contributor to the cumulative dose analyzed in this *NNSS SWEIS*. Cumulatively, the impacts would then be as follows: **No Action Alternative:** Dose = 5.0 person-rem over 10 years Consequence = No (0.003) LCFs **Expanded Operations Alternative:** Dose = 8.9 person-rem over 10 years Consequence = No (0.005) LCFs **Reduced Operations Alternative:** Dose = 4.8 person-rem over 10 years Consequences = No (0.003) LCFs
	Nonradiological		
	During construction of proposed renewable energy projects in Amargosa Valley, industrial accidents could result in an estimated one worker fatality for 750 total recordable cases, and 380 days away, restricted or transferred.	The following estimated nonradiological consequences would occur over a 10-year period from DOE/NNSA activities at NNSS, RSL, NLVF, and TTR and construction of commercial solar power facilities at the NNSS under each alternative addressed in this SWEIS: **No Action Alternative:** Operations Total recordable cases = 578 Days away, restricted, or transferred = 253 Construction Total Recordable Cases = 60 Days Away, Restricted, or Transferred = 31 TOTAL for Alternative Total Recordable Cases = 638 Days Away, Restricted, or Transferred = 314	Industrial accidents from all activities at DOE/NNSA sites over a 10-year period, and construction of renewable energy projects in Amargosa Valley could result in the following Total Recordable Cases and Days Away, Restricted or Transferred for each alternative: **No Action Alternative:** Total recordable cases = 1,328 Days away, restricted, or transferred = 633

Resource Area	***Non-DOE/NNSA Contribution to Cumulative Impacts***	***DOE/NNSA Contribution to Cumulative Impacts***	***Cumulative Impacts***
Human Health (cont'd)		**Expanded Operations Alternative:** Operations Total Recordable Cases = 700 Days Away, Restricted, or Transferred = 314 Construction Total Recordable Cases = 148 Days Away, Restricted, or Transferred = 48 TOTAL for Alternative Total Recordable Cases = 848 Days Away, Restricted, or Transferred = 362 **Reduced Operations Alternative:** Operations Total recordable cases = 508 Days away, restricted, or transferred = 225 Construction Total Recordable Cases = 44 Days Away, Restricted, or Transferred = 23 TOTAL for Alternative Total Recordable Cases = 552 Days Away, Restricted, or Transferred = 248	**Expanded Operations Alternative:** Total recordable cases = 1,598 Days away, restricted, or transferred = 742 **Reduced Operations Alternative:** Total recordable cases = 1,302 Days away, restricted, or transferred = 628
Environmental Justice	Non-DOE/NNSA actions would account for approximately 509,750 acres of new land disturbances within the cumulative impacts ROI. Land disturbance of this magnitude would likely have adverse impacts on American Indian traditional cultural properties by destroying places important to the continuation of those cultures.	Potential new land disturbances on the NNSS for both DOE/NNSA activities and development of commercial solar generation facilities would result in new land disturbance on up to about 4,500 acres 26,000 acres, and 2,700 acres, respectively under the No Action, Expanded Operations, and Reduced Operations Alternatives. Previously undisturbed lands may be important to American Indians. Land disturbances on the NNSS could affect traditional cultural properties of concern for various American Indian tribes with a cultural affiliation with the NNSS.	The potential disturbance of up to 514,250 acres (No Action Alternative), 535,750 acres (Expanded Operations Alternative), or 512,450 acres (Reduced Operations Alternative) of currently undisturbed land within the cumulative impacts ROI would likely have adverse impacts on American Indian traditional cultural properties by affecting places important to the continuation of those cultures.

BLM = Bureau of Land Management; CO = carbon monoxide; HAP = hazardous air pollutant; LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NAAQS = National Ambient Air Quality Standards; NLVF = North Las Vegas Facility; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; NRHP = National Register of Historic Places; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; rem = roentgen equivalent man; ROI = region of influence; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; USFWS = U.S. Fish and Wildlife Service; VOC = volatile organic compound.

CHAPTER 7
MITIGATION MEASURES

7.0 MITIGATION MEASURES

Chapter 7 presents the proposed mitigation measures that would be implemented by the U.S. Department of Energy (DOE) to avoid, minimize, rectify, reduce, eliminate, or compensate for potential adverse impacts on the environment (40 *Code of Federal Regulations* [CFR] 1508.20) resulting from any of the three alternatives analyzed in this site-wide environmental impact statement (SWEIS). These proposed mitigation measures are listed by resource category and address specific adverse environmental impacts identified in Chapter 5. Where the potential impacts and mitigation measures vary across the three alternatives, measures specific to each alternative are described. Some of these resource areas include American Indian perspectives prepared by the American Indian Writers Subgroup (AIWS); the AIWS input is in text boxes identified with a Consolidated Group of Tribes and Organizations (CGTO) feather icon.

DOE considers planning and implementation of mitigation measures throughout the environmental analysis process. This SWEIS represents the latest phase of DOE's environmental analysis of activities occurring at the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other Nevada sites managed by the National Nuclear Security Administration (NNSA). As such, these mitigation measures build on those developed through prior environmental analyses covering the history of the NNSS and NNSA-managed sites in Nevada.

In accordance with DOE regulations (10 CFR 1021.331), DOE will prepare a mitigation action plan for those mitigation commitments made in a future Record of Decision associated with the continued management and operation of the NNSS and other NNSA-managed sites in Nevada. This mitigation action plan will identify specific mitigation measures associated with the alternative selected in the Record of Decision and describe plans for implementing the mitigation measures, monitoring their implementation and effectiveness, and reporting the results of mitigation efforts to DOE management and applicable Federal, state, local, and tribal entities and the public. DOE may revise the mitigation action plan as more-specific and -detailed information regarding the various missions, programs, capabilities, and projects at the NNSS and other offsite locations in Nevada becomes available.

Mitigation Measures—American Indian Perspective

CGTO

Indian people bring a unique perspective based on our traditional ecological knowledge which guides us on how and where to interact with the earth and its resources. As a means of minimizing impacts to these precious resources, we continuously strive to maintain a delicate balance and sustain its spiritual integrity. According to tribal elders, *"Indian people have the conviction that the ecology of the natural environment is inter-connected. We have been blessed from the beginning of creation as having a unique understanding of being a good steward, and a clear path to care for the land and its resources. The songs, stories, traditions and customs provide the foundation for this conviction. It is like the world is a huge stage and there are many cast members--using their roles to make possible for a successful event."*

With this in mind, the Consolidated Group of Tribes and Organizations (CGTO) is providing the U.S. Department of Energy (DOE) recommendations in Section 7.0 in an effort to avert or minimize impacts. We must emphasize recommendations made by the CGTO do not imply we support the proposed action or alternatives. These are merely our attempt to restore harmony and balance to the resources impacted or potentially impacted by DOE activities using the National Environmental Policy Act (NEPA) process.

In 1996 and 2000, the DOE invited the CGTO to participate in the development of the Nevada Test Site (NTS)/DOE Resource Management Plan (RMP) in an effort to mitigate impacts to resources. The CGTO provided culturally-appropriate resource management strategies for the NTS based on traditional Indian perspectives. The CGTO's long-term objective is to see our existing government-to-government relationship evolve and expand into co-management of the Nevada National Security Site (NNSS) (formally NTS) land and its resources. Therefore, the CGTO believes the continued collaborative development of the RMP is essential to blending elements of two world views. In turn, this promotes implementation of culturally-sensitive strategies for the land, which is mutually beneficial to the DOE and the culturally affiliated tribes. The CGTO understands the RMP is a dynamic, living document that requires periodic evaluation and updates. Accordingly, the CGTO recommends the DOE continue to hold annual tribal update meetings, which should include current and proposed activities at the NNSS, and discussions regarding the RMP, mitigation measures, and their potential implications.

See Appendix C for more details.

7.1 Land Use

No adverse impacts on land use that would require mitigation have been identified at the NNSS or at offsite locations under the No Action, Expanded Operations, or Reduced Operations Alternatives.

Additional projects that are conceptual in nature but are anticipated to be located on the NNSS, such as the development of a commercial solar power generation facility, would be subject to additional National Environmental Policy Act review. These future reviews would require identification of environmental impacts, including land use impacts, as well as formulation of measures to mitigate these impacts to the extent practicable.

No adverse airspace impacts that would require mitigation at any project location have been identified under any of the alternatives.

Land Use—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) is concerned with the U.S. Department of Energy's (DOE's) plans to continue to restrict access and potentially close areas within the Nevada National Security Site (NNSS). As discussed in earlier environmental impact statement (EIS) sections, the NNSS area is part of the traditional Holy Lands for the Western Shoshone, Southern Paiute and Owens Valley Paiute and Shoshone people. These lands are central in the lives of our people and mutually shared for religious ceremony, resource use, and social events (Stoffle et al., 1990a and b).

Since the early 1990's, DOE has funded representatives of the CGTO to visit portions of the NNSS (formerly NTS). This involvement has allowed tribal representatives to identify places, spiritual trails, and cultural landscapes of traditional and contemporary cultural significance. CGTO remains committed in our assertion that portions of the NNSS must be set aside for traditional and contemporary ceremonial use.

In order to fulfill the Holy Land use expectations, the CGTO also recommends continuing to identify special places, spiritual trails, and landscapes, and setting aside these places for unique and innovative co-stewardship activities and ceremonial access. For example, studies have begun regarding the identification of places, spiritual trails and cultural landscapes in the Timber Mountain Caldera. We strongly encourage DOE to pursue these studies, which, when completed, will add an American Indian cultural component that will broaden the understanding and importance of this National Natural Landmark. The CGTO recommends the Gold Meadows area continue to be set aside for exclusive Indian use because of significant cultural resources. Similarly, the CGTO recommends DOE set aside Water Bottle Canyon, Scrugham Peak, Prow Pass, Timber Mountain, select areas within the Calico Hills and portions of Shoshone Mountain for exclusive Indian use. As such, areas should be made to forego any additional land disturbances within these areas and provide reasonable access for Indian people. The CGTO also recommends tribal visits to areas designated for repatriation such as Pahute Mesa, and periodic assessments conducted to compliance with the Native American Graves Protection and Repatriation Act (NAGPRA).

See Appendix C for more details.

7.2 Infrastructure and Energy

The NNSS would continue to utilize measures for energy and water conservation, including the following:

- Implementing strategies and policies to support energy-efficient commuting and travel
- Identifying, promoting, and implementing water reuse strategies that reduce potable water consumption (Water efficiency practices could include water management planning; system audits; repairs of water leaks; water-efficient landscaping and irrigation; installation of water-efficient [WaterSense™] products, including toilets and urinals, faucets and showerheads, and boiler systems; and other water uses.)
- Increasing diversion of compostable and organic material from waste streams to reduce energy used in disposal

- Managing existing building systems to reduce consumption of energy, water, and materials
- Identifying opportunities to consolidate and dispose existing assets to optimize real property portfolios

7.3 Transportation

Radiological and nonradiological risks to the public would result from overland transport of radioactive and nonradioactive wastes. These risks would be reduced by choosing (to the extent practicable) waste transportation routes that minimize both impacts from potential exposure to radiation during incident-free transport and postulated accidents and the potential for traffic accidents. Other measures to mitigate impacts could include (to the extent practicable) scheduling transports of wastes during periods of lighter traffic volume and training local emergency response personnel.

7.4 Socioeconomics

No adverse impacts are expected over the course of the next 10 years. Therefore, no mitigation measures are proposed.

Socioeconomics—American Indian Perspective

Although the U.S. Department of Energy (DOE) continues to make strides to diversify their workforce, the Consolidated Group of Tribes and Organizations (CGTO) strongly encourages DOE to enhance efforts to hire more Indian people and promote the hiring of Indian-owned businesses to mitigate socioeconomic impacts to our people. To facilitate this effort, the CGTO could serve as a point of contact to assist DOE and its contractors in identifying and promoting employment opportunities for American Indians at the Nevada Site Office and the Nevada National Security Site (NNSS).

See Appendix C for more details.

7.5 Geology and Soils

Impacts related to surface disturbance would be mitigated on a site-specific basis, depending on factors such as the size of the area of disturbance, future use of the site, soil characteristics, annual precipitation, and site slope. Following removal of soils and vegetation, disturbed sites would be stabilized using water or commercially available soil stabilizers, such as polymers. Potential mitigation measures could include planting natural vegetation, gravel re-armoring, chemical stabilization, and seeding. Where intensive revegetation techniques are necessary, subsoils could be amended and irrigation may be used to encourage germination and plant establishment.

Instability of slopes resulting from excavation could be mitigated by shoring, bolting, and grouting.

Where possible, DOE would use areas disturbed by past activities for staging, parking, and equipment storage during construction to minimize erosion.

7.6 Hydrology

During development projects, DOE would use site planning, design, construction, and maintenance strategies to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. Such strategies could include use of biological systems and engineered systems such as, but not necessarily limited to, the following:

- Rain gardens, bioretention, and infiltration planters
- Porous pavements
- Vegetated swales and bioswales
- Trees and tree boxes

Geology and Soils—American Indian Perspective

During the evaluation of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*, the Consolidated Group of Tribes and Organizations (CGTO) noted severe disturbances to the geology and soils, or minerals, in large portions of the Nevada National Security Site (NNSS) (formerly the Nevada Test Site [NTS]) stemming from previous testing activities. This seemingly irreparable damage has made certain areas unfit for human use and inaccessible to American Indians who have relied on the earth, soil and minerals for medicine and religious purposes.

In general, the mitigation measures proposed by the U.S. Department of Energy (DOE) for geology and soils include erosion control through stabilization and re-vegetation. The CGTO is concerned about the unnatural erosion control methods proposed by DOE. In particular, the CGTO struggles with activities that require relocating rocks and soil away from where they were originally placed by the Creator and using them contrary to the Creator's intention. Indian people know relocating the soil in a culturally-unacceptable manner can cause adverse impacts to the environment, such as the increased potential for noxious weed growth. This could potentially threaten nearby native vegetation and harm people and wildlife that rely on it for survival.

Therefore, the CGTO recommends DOE implement culturally-appropriate stabilization efforts and re-vegetation techniques based on traditional ecological knowledge. Indian people stabilize our land by offering prayers to explain to the soil why it is being removed, how we intend to use it, and thanking it for its use. We then remove and protect the top soil for future use. We replace the soil with dirt and gravel from nearby land only after once again offering prayers, and re-contour the land out of respect to the visual landscape and unseen song and storyscapes. Indian people re-vegetate our land by determining suitable locations, offering prayers to bless the seeds and plants so they can grow strong. We take great care in placing the seedlings in the direction of the morning sun and give thanks for the opportunity to plant them, and for the water that is used to provide nourishment. Plants must be compatible with their new homes, neighboring plants, animal habitats, and soil composition. We believe a holistic approach helps to sustain balance and protects and restores our ancestral lands.

In the *1996 NTS EIS* and in the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (2002 NTS SA)*, the CGTO continued to express concerns about the removal of contaminated soils and the need for religious leaders to conduct balancing ceremonies and healing prayers at these disturbed locations. In particular, the CGTO recommended tribal representatives provide information useful in the re-vegetation of a portion of the Double Tracks site located on the Tonopah Test Range (TTR). The CGTO maintains our involvement is still necessary for the Double Tracks site as well as the Clean Slates site also located on TTR; however, we are awaiting DOE's approval to proceed so we may begin to heal these lands and its resources.

See Appendix C for more details.

- Pocket wetlands
- Reforestation/revegetation using native plants
- Protection and enhancement of riparian buffers and floodplains
- Rainwater harvesting for use (e.g., irrigation; heating, ventilation, and air-conditioning; nonpotable indoor uses)

Surface-water resources could be affected by disposal unit construction or environmental restoration activities that could alter drainage patterns, leading to possible erosion and deposition of sediments and inundation of areas or ponding of water. Impacts of sediment generation could be minimized by limiting exposed surfaces and intercepting runoff from exposed surfaces prior to discharge. Erosion and sediment controls would include use of runoff interceptor trenches or swales, filter or silt berms or fences, sediment barriers or basins, rock-lined ditches or swales, or stormwater drainage structures, as well as timely revegetation of exposed surfaces. Where practicable, NNSA would use areas disturbed by past activities for staging, parking, and equipment storage during construction to minimize erosion.

DOE would delineate a Wellhead Protection Area using site-specific modeling or a standard 1,000-foot radius around all drinking water source wells to protect against the introduction of contaminants. No experiments, construction, placement of facilities, parking, or hazardous material storage would occur in this area. NNSA would also continue to perform detailed hydrographic studies of its water supply system

> **Hydrology—American Indian Perspective**
>
> When water is respected, it sustains all life forms. Conversely, when water is mistreated, it withdraws life-giving support and returns to the underworld. The Consolidated Group of Tribes and Organizations (CGTO) knows the hydrological systems throughout the Nevada National Security Site (NNSS) have been impacted from drought. Drainage patterns have been unnaturally altered from U.S. Department of Energy (DOE) activities and will continue to be impacted if these proceed. There are places on the NNSS where the rain falls but does not nurture the plants and animals. Therefore, the CGTO must be involved with DOE in mitigating impacts to hydrological resources because if the water is mistreated, it will remove itself from the NNSS.
>
> To minimize some adverse impacts to hydrological resources, the CGTO recommends the DOE allow Indian people access to clean the natural tanks and pohs (natural catchment basins) to bring and gather water from the rain and to nourish the plants and animals that rely on it. The water within these features is central to our ceremonies in restoring balance. By supporting the CGTO in this proposed project, DOE will help reduce drought conditions. In turn, this project will provide spiritual, cultural and ecological benefits to the land and the environment, thereby facilitating our obligation to sustain the spiritual and ecological balance. Implementation will require cultural experts to identify sites, inventory and evaluate site resources and conditions, and to implement culturally-appropriate mitigation measures.
>
> *See Appendix C for more details.*

to ensure that new withdrawals of groundwater would allow sufficient groundwater aquifer recharge for future uses.

DOE would utilize water conservation measures to the maximum extent practicable (for example, efficient landscaping and recycling of wastewater).

When scheduling experiments, DOE would consider weather and ground conditions to minimize certain potential impacts that may be exacerbated by sheet flow during storm events, such as erosion and the spread of contaminants.

7.7 Biological Resources

In February 2009, the U.S. Fish and Wildlife Service (USFWS) issued a programmatic Biological Opinion (Opinion) to the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) that authorized the incidental "take" (accidental killing, injury, harassment, etc.) of desert tortoises that may occur during NNSS activities. Before implementing any new activity in desert tortoise habitat, NNSA provides specified information and consults with USFWS to determine if the anticipated incidental take for each action, at the project level, complies with the Opinion. The Opinion concluded that activities anticipated to occur on the NNSS would not jeopardize the continued existence of the Mojave population of desert tortoises and that no critical habitat would be destroyed or adversely modified. NNSS activities occurring within the range of the desert tortoise must comply with the terms and conditions outlined in the Opinion, as shown in Table 5–27 in Chapter 5, Section 5.1.7. The 2009 Opinion also states that, if the level of incidental take is reached and anticipated to be exceeded during the course of actions, such an incidental take would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures in the Opinion. If a proposed activity or group of activities would result in an exceedance of the parameters of the Opinion, NNSA would consult with USFWS, in accordance with Section 7 of the Endangered Species Act.

The NNSA/NSO Desert Tortoise Compliance Program was developed in 1992, with the issuance by USFWS of the first Biological Opinion for the NNSS. The Desert Tortoise Compliance Program serves to implement the terms and conditions of the most current version of the Biological Opinion for the NNSS, to document compliance actions taken, and to assist NNSA/NSO with USFWS consultations. Some of the activities of the Desert Tortoise Compliance Program include (1) reviewing proposed activities at the NNSS to determine if they may be located in tortoise habitat and if clearance surveys and/or monitoring is required (2) conducting clearance surveys at project sites within 1 day of the start of project construction, (3) ensuring that environmental monitors are on site during heavy equipment operations, (4) developing training modules and ensuring that all personnel working on the NNSS are trained in the requirements of the Opinion, and (5) preparing annual compliance reports for submittal to

USFWS. By implementing the Desert Tortoise Compliance Program, NNSA/NSO would ensure that most if not all impacts on desert tortoises addressed in this analysis would involve harassment, rather than injury or mortality.

In addition to the Desert Tortoise Compliance Program, NNSA/NSO conducts a comprehensive program to monitor and protect sensitive plant and animal species and other biological resources on the NNSS, including the following:

- Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species, their associated habitat, and other important biological resources. Survey reports document species and resources found and provide mitigation recommendations.
- Beginning in 2004, in compliance with DOE Order 450.1A, Environmental Protection Program, NNSA/NSO began annual surveys each spring to assess wildland fire hazards on the NNSS. NNSS ecologists conduct these wildland fire surveys in coordination with NNSS Fire and Rescue.
- Under the NNSS Sensitive Plant Monitoring Program, the status or ranking of sensitive plant species known to occur on the NNSS is evaluated annually to ensure such plants are afforded the appropriate protection under Federal and state laws. Sensitive plant species populations on the NNSS are routinely monitored to assess plant density, plant vigor, or identify any threats or impacts to the species.
- As part of the Sensitive and Protected/Regulated Animal Monitoring Program to ensure such animal species are afforded the appropriate protection under Federal and state laws, NNSA/NSO currently monitors 18 animal species on the NNSS. State and Federal lists of sensitive and protected/regulated animal species are reviewed annually to update the list of animal species that are included in this program.
- Additional monitoring is conducted for such things as natural wetlands to characterize seasonal baselines and trends in physical and biological parameters; West Nile virus to help the Southern Nevada Health District ascertain the presence and/or prevalence of the virus in the NNSS mosquito population; and constructed water sources to assess their use by wildlife and to develop and implement mitigation measures to prevent them from causing significant harm to wildlife.
- The Habitat Restoration Program involves the revegetation of disturbed land and evaluation of previous revegetation efforts. These activities are conducted at both the NNSS and the Tonopah Test Range (TTR).
- An Ecological Monitoring and Compliance Program Report is published each year documenting the previous year's activities and accomplishments in all of the above noted areas.

These activities are all elements of NNSA/NSO's program to ensure compliance with DOE Order 450.1A, Environmental Protection Program, and all applicable statutes, and regulations.

At TTR NNSA's Sandia Site Office (SSO) has an ecology program that serves to conserve flora and fauna (NNSA/SSO 2010). The primary objectives of the Ecology Program include:

- Collect ecological resource inventory data to support site activities, while preserving ecological resources, and maintaining regulatory compliance
- Collect information on plant and animal species present to further the understanding of ecological resources on site

- Collect biota contaminant data on an as needed basis in support of site projects and regulatory compliance
- Assist Sandia organizations comply with regulations and laws
- Provide information to employees regarding ecological resource conservation
- Support Sandia line organizations with biological surveys in support of site activities

Enhancement measures that have been utilized in the past include installing artificial nest platforms, boxes and perches.

In 2010, an Avian Protection Plan was adopted and implemented at TTR (Lacy 2011). The Avian Protection Plan was developed to describe procedures that would be taken by NNSA at TTR to address potential impacts from its associated transmission and distribution lines to avian species that are known to occur in the area (NNSA/SSO 2010).

In August 2010, NNSA/SSO completed retrofitting four electrical transmission/distribution structures to reduce the risk of electrocution of larger birds, particularly raptors. The retrofitting included new insulator caps, the re-routing of and insulation of jumpers and insulation of grounding wires.

In the future, new construction and refurbishments at TTR would use of raptor safe pole design and wire configuration to help reduce avian mortality. Regular surveys along the power lines will be conducted. Monitoring would be increased for any structures or lines segments that have any avian issues. If the need for any type of mortality reduction measures are identify they will be fully developed in cooperation with state and Federal agencies.

Bird mortality incidents reported as a result of power outages or through incidental observations will be reviewed immediately. If the cause is related to an unprotected power pole or conductor issue, a mortality reduction action (i.e., retrofitting poles, installing protective coverings or installation of perch deterrents diverters) will be implemented accordingly, consistent with standard practices recommended by the Avian Power Line Interaction Committee (APLIC 2006).

When a nest is detected in or around electrical transmission/distribution facilities, a risk assessment will be conducted to determine if nest removal or relocation is needed. If it is determined that the nest poses no risk to system function, maintenance procedures, or to the birds, the nest would be allowed to remain. If it is determined that the nest poses a potential risk, then a further assessment will be conducted to determine if the risk is imminent or not imminent. TTR will coordinate with the USFWS to determine whether the nest would need to be removed and discarded or relocated to an alternative location.

Unless there is an immediate threat to birds or system function, nest removal or relocation (excluding eagles and state or federally listed species) would occur only during the non-breeding season when the nest is not being used or during the breeding season if the nest is unoccupied. If removal or relocation of an eagle or state or federally listed species nest is necessary, TTR would coordinate with the USFWS regarding permitting and authorization pursuant to applicable regulations. Nest removal or relocation would occur when the nest is occupied only in cases where it is deemed warranted based on the risk to system function or electrocution risk of the birds. Removal or relocation of an occupied nest would require coordination and permitting/authorization with the USFWS and/or Nevada Department of Wildlife.

Biological Resources—American Indian Perspective

The mitigation measures presented by the U.S. Department of Energy (DOE) in Section 7.7 focus on avoidance of biological resources, relocation of animals species and monitoring plants, animals, and their habitats. The Consolidated Group of Tribes and Organizations (CGTO) recommends DOE mitigate adverse impacts to biological resources through avoidance, culturally-appropriate re-vegetation efforts, reintroduction of native animals, and traditional plant and animal management methods. Indian people have extensive traditional ecological knowledge and deep concern for the biological resources of the area and should participate directly with DOE to mitigate impacts and protect their resources.

According to tribal elders, *"Prior to re-vegetation efforts, we talk to the land to let it know what we plan to do and ask the Creator for help. We choose our seeds from the sweetest and best plants and store them for the winter to dry. When the winter is over, we place the seeds in a moist towel or sock until they are ready to transplant into the ground. This is a long and delicate process, requiring patience, skill and knowledge passed down from our ancestors. If the plants are struggling to grow, we tag them and move them to face the same direction of the sun."*

The DOE would benefit from this knowledge to enhance their re-vegetation efforts. The CGTO knows DOE struggles with success rates regarding the density and diversity of native plants during re-vegetation efforts. A co-stewardship approach with us would enable DOE to enhance their re-vegetation efforts, thus saving time, money and resources.

Part of the mitigation measures presented by DOE in this section includes notifying the U.S. Fish and Wildlife Service (FWS) of incidental taking of desert tortoises. The desert tortoise is culturally significant to Indian people because of its healing powers, longevity and wisdom. It is integral to our traditional winter stories, well-being and perpetuation of our native culture. Incidental taking of this traditionally-important animal is particularly disturbing to native people. Accordingly, the CGTO must be notified concurrently with the FWS to prepare our people and the environment of this loss.

Over the past 14 years, various initiatives have been undertaken to restore animal habitats and reintroduce certain animals such as the desert big horn sheep near the southern portions of the Nevada National Security Site (NNSS) without participation from the CGTO. Modification of habitat or the restocking of animals is considered a highly sensitive religious act and requires participation from Indian people. For these activities to be successful, it is essential to have tribal representatives involved throughout this process.

See Appendix C for more details.

7.8 Air Quality and Climate

To reduce emissions from mobile sources, NNSA would provide further incentives for the NNSS commuter program to encourage more employees to travel by bus to the NNSS, rather than by privately owned vehicles.

NNSA would extend the Conservation and Renewable Energy Program to activities beyond 2015 and continue improving energy efficiency measures in new and existing buildings through at least 2020. To reduce dependence on energy generated from fossil fuels, NNSA would pursue using at least a portion of the electricity generated from the solar power projects proposed under all of the alternatives.

Waste management, facility decommissioning, and environmental restoration activities have the potential to release radioactive constituents and nonradioactive pollutants from suspension of particulates from soil, operation of heavy equipment, evaporation of tritium, and treatment of explosive waste. The release of these pollutants would be controlled by compliance with DOE and external regulatory requirements, and pursuing site closure in place when appropriate.

Emissions from construction equipment would be minimized through activities such as properly maintaining the equipment, applying diesel engine refit technology as practicable (e.g., catalytic particulate filters), and limiting unnecessary equipment idling times. To reduce diesel particulate matter, DOE would require the use of U.S. Environmental Protection Agency (EPA) Tier 4 certified diesel engine construction equipment. During a transition period to EPA Tier 4 equipment, DOE would require that equipment meets the EPA Tier 3 standards. Other measures to reduce diesel particulate emissions would include using construction equipment that runs on compressed natural gas as well as some smaller construction equipment with electric engines.

Release of dust and particulates to air would be controlled using standard best management practices, including watering and/or using surfactants to control dust emissions, revegetating exposed areas, watering roadways, and minimizing activities under windy conditions. Work could also be performed under containment structures, as needed.

7.9 Visual Resources

Recent studies have shown that painting structures one to two shades darker than the color of the general surrounding area reduces the visual impact of the structure compared with painting it a matching or lighter hue (BLM 2008a). Therefore, new structures would be painted accordingly. In addition, shotcrete[1] structures would implement integral color, in the same nature, to reduce visibility. Colors would be chosen from the U.S. Bureau of Land Management Standard Environmental Colors Chart CC-001: June 2008. Because color selection would vary by location, color panels would be evaluated from key observation points during common lighting conditions (front and back lighting) to aid in the appropriate color selection. Panels would be a minimum of 3 feet by 2 feet in dimension and would be evaluated from various distances to ensure the best possible color selection.

All paints used for the color panels and structures would be color-matched directly from the physical color chart, not digital or color-reproduced versions of the color chart. Paints would have a dull, flat, or satin finish only. Appropriate paint types would be selected for the finished structures to ensure long-term durability of the painted surfaces. The paint color would be maintained over time.

Mitigation Measure 1: Apply Minimum Lighting Standards. Lights will be installed at the lowest practicable height, and the lowest practicable wattage will be used. Lights will be screened and directed downward, away from the night sky, to the highest degree possible. The number of nighttime lights will be minimized to the highest degree possible.

Visual Resources—American Indian Perspective

All landforms within the Nevada National Security Site (NNSS) have high sensitivity levels for American Indians. The ability for us to see the land without the distraction of buildings, towers, cables, roads and other objects is critical to establishing the spiritual connection between Indian people and our traditional lands. We rely on unobstructed views, as we share our songs and stores. These activities help us reaffirm the importance of the land and the tie to American Indian ceremonialism that is necessary for our cultural survival.

The Consolidated Group of Tribes and Organizations (CGTO) knows that many of the activities described under the proposed action and alternatives, such as those associated with facility construction and environmental restoration, will adversely impact visual resources. For Indian people, the adverse impact to visual resources will most certainly impact the spiritual harmony of the environment as a whole. Facility construction and operation will impede visual resources and affect the solitude and cultural integrity of the land.

Although the U.S. Department of Energy (DOE) proposes to mitigate visual resource impacts by painting structures to reduce visibility, the CGTO knows additional mitigation measures are necessary. The CGTO recommends that landscape modifications, including those associated with environmental restoration activities, be done in consultation with tribal representatives. Specifically, DOE should make provisions for Indian people to participate in annual monitoring of land disturbing activities through the duration of the project. The CGTO should also participate in restoring the land, and concealing infrastructure using traditional Indian re-vegetation methods (See American Indian Perspective for Section 7.7, Biological Resources). Finally, the CGTO recommends that DOE make provisions for Indian people to conduct ceremonies and offer prayers and songs in an effort to re-balance this adversely impacted resource.

See Appendix C for more details.

[1] *Shotcrete is concrete projected through a hose at high speeds onto a surface.*

7.10 Cultural Resources

NNSA/NSO is committed to ensuring that the Cultural Resources Management program for the NNSS meets the requirements of Federal mandates, addresses the concerns of external groups, minimizes adverse impacts on cultural resources, and integrates historic preservation into routine management and project-specific compliance activities. At all times the NNSS Cultural Resources Management program attempts to combine preservation and mitigation strategies to meet the needs of the NNSA/NSO mission. As part of this commitment and as part of compliance with Section 106 of the National Historic Preservation Act, NNSA/NSO conducts cultural resource surveys and identifies cultural resources within the area of potential effect for all proposed projects and activities (undertakings) that may affect cultural resources. If possible, NNSA/NSO avoids significant cultural resources impacts by adjusting the location of a proposed undertaking. When avoidance is not practicable, NNSA/NSO consults with the Nevada State Historic Preservation Officer, and possibly the Advisory Council on Historic Preservation, to identify measures to mitigate adverse impacts on those resources.

Under all of the alternatives, projects and activities would have the potential for adverse impacts on cultural resources. Several strategies for mitigating adverse impacts on cultural resources could be employed. For archaeological resources, these strategies would consist of avoidance, evaluation and data recovery, and monitoring. For structure-related (also known as built environment) resources, strategies would consist of avoidance, evaluation and archival documentation, and monitoring. The *Cultural Resources Management Plan for the Nevada Test Site* (DOE 2010a) provides cultural resources compliance guidance to NNSA/NSO, its contractors, and other users of the NNSS. Under Federal regulations, a significant cultural resource, designated as a "historic property," warrants consideration with regard to potential adverse impacts resulting from proposed Federal actions (DOE 2002e). The descriptions of mitigation measures below summarize those actions described in the Cultural Resources Management Plan.

Mitigation Measure 1: Avoidance of Significant Cultural Resources. When specific project information becomes available, it may be possible to avoid impacts on cultural resources through project design. For archaeological resources, prior to determining whether avoidance is feasible, it may be necessary to conduct test excavations to determine the vertical and horizontal extent of the resource. Once avoidance can be assured, resource location information would be delineated on project plans or sensitive areas would be fenced off prior to project implementation as areas to be avoided and periodically monitored. If, during the project, avoidance is determined to be infeasible, the processes outlined in Mitigation Measure 2 (for archaeological resources) and Mitigation Measure 3 (for built environment resources, i.e., buildings, structures, engineered features, etc.) would be followed, as applicable.

Mitigation Measure 2: Evaluation and Data Recovery of Significant Archaeological Resources. It is presumed that it would not be possible to avoid all cultural resources within the various areas of program implementation. Resources that cannot be avoided would be subject to test excavations to determine their significance and, if determined to be significant, would be subject to data recovery. The process that would be followed to determine resource significance and conduct data recovery would be developed in a Historic Properties Treatment Plan. All archaeological work on properties eligible for listing in the National Register of Historic Places would be conducted in accordance with *Treatment of Archaeological Properties: A Handbook* (ACHP 1980), the Advisory Council on Historic Preservation's *Archaeology Guidance* (ACHP 2009), and *Archaeology and Historic Preservation: the Secretary of the Interior's Standards and Guidelines* (*Standards and Guidelines*) (NPS 1983). Investigations would be performed under the supervision of professionals whose education and experience meet or exceed the Secretary of the Interior's professional qualifications standards, as described in the *Standards and Guidelines* (NPS 1983).

Mitigation Measure 3: Archival Documentation of Significant Built Environment Resources. If project implementation requires removal of a built environment resource (e.g., buildings, structures, engineered features), Historic American Building Survey/Historic American Engineering Record (HABS/HAER) documentation would be completed. DOE/NNSA would contact the Nevada State Historic Preservation Officer to determine the level and kind of HABS/HAER documentation that would be required for the resource. DOE/NNSA would ensure that the required documentation is completed and accepted by HABS/HAER before the resource is deconstructed.

Mitigation Measure 4: Monitoring of Significant Archaeological Resources. Portions of the area of potential effects have been determined to have the potential for buried archaeological resources. During project implementation, archaeological monitoring would be conducted within these areas. Any unanticipated resources identified during monitoring would be evaluated and treated in accordance with Mitigation Measures 1 and 2. If human remains were discovered during monitoring, the regulatory requirements described in Mitigation Measure 6 would be followed.

Mitigation Measure 5: Monitoring of Significant Built Environment Resources. Significant built environment resources would be periodically monitored to ensure protection of the resources. If unexpected effects on significant built environment resources were identified, provisions for protection, stabilization, or mitigation would be made in consultation with the Nevada State Historic Preservation Officer.

Mitigation Measure 6: Discovery of Human Remains. Should human remains be discovered during project implementation, NNSA would follow the requirements of the Native American Graves Protection and Repatriation Act and other applicable Federal laws.

Cultural Resources—American Indian Perspective

The Consolidated Group of Tribes and Organizations (CGTO) understands the mitigation measures proposed by the U.S. Department of Energy (DOE) in this site-wide environmental impact statement (SWEIS) include avoidance, evaluation and data recovery, and monitoring, as described further under Mitigation Measures 1 through 6 of the Nevada Test Site (NTS) Cultural Resource Management Plan (Drollinger and Beck 2010). Accordingly, the CGTO must be an integral part of these mitigation measures so impacts on American Indian cultural resources can be minimized or averted. American Indian people know the Nevada National Security Site (NNSS) landscape in great depth and can help DOE identify and protect traditional-use plants, animals, geography, archaeological sites, and traditional cultural properties that have been or may be adversely impacted by NNSS programs and activities.

The CGTO recommends DOE make provisions for Indian people to continue to identify culturally significant locations so potentially impacted resources can be identified, alternative solutions discussed, and adverse impacts averted. These studies will address and guide DOE in developing culturally-appropriate Best Management Practices to protect cultural resources and more effectively implement Mitigations Measures 1 through 6. To accomplish this, Indian people must be involved with the following actions:

- Assess and determine culturally-appropriate measures to protect geological formations important to the spiritual landscape.
- Implement culturally-appropriate environmental restoration techniques that require minimal ground disturbance.
- Restore impacted plant and animal species essential to the spiritual and cultural landscape.
- Provide American Indian people access to CGTO designated areas so we can conduct purification and balancing ceremonies in an attempt to restore the natural and spiritual harmony of the NNSS landscape.
- Complete Traditional Cultural Property (TCP) Nomination process previously recommended by the CGTO in 2009 for Shoshone Mountain and initiated for Water Bottle Canyon.
- Complete the Indian History Project report prepared collaboratively with DOE, the U.S. Department of Defense (DOD) and CGTO in 2001.
- Develop and implement systematic American Indian ethnographic studies to better understand the interconnectedness of the cultural landscape, and implement culturally-appropriate methods to protect the landscape and sustain spiritual and cultural balance.
- Complete the re-vegetation efforts for the restoration of Clean Slates dating back to 1996.

In addition, the CGTO recommends Gold Meadows continue to be set aside for exclusive Indian use because of significant cultural resources. Similarly, the CGTO recommends DOE set aside Water Bottle Canyon, Scrugham Peak, Prow Pass, Timber Mountain, and select areas within Calico Hills and Shoshone Mountain for exclusive Indian use. Efforts should be made to forego any additional land disturbances within these areas and provide access to Indian people.

The CGTO agrees with the mitigation measures proposed by DOE in this SWEIS regarding site monitoring, and recommends Indian people serve as site monitors. As a minimum, the CGTO recommends annual tribal visits to monitor the condition of cultural sites located within the NNSS and off-site locations to offer appropriate. The CGTO further recommends visits to areas designated or potentially designated for repatriation such as Pahute Mesa. Finally, we recommend Indian people conduct periodic assessments in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA) and other federal mandates.

See Appendix C for more details.

7.11 Waste Management

Waste management activities at the NNSS would result in the permanent commitment of land for disposal of radioactive and nonradioactive waste. This land commitment would be reduced through continuation of the DOE Waste Minimization and Pollution Prevention Program, which reduces the quantity of waste generated each year and enhances the recycle or reuse of waste or excess materials, resulting in less waste that requires disposal each year. Land commitment would also be reduced by restricting waste disposal to approved, designated areas.

Waste Management—American Indian Perspective

We continue to strongly oppose the transportation, storage and disposal of radioactive waste at the Nevada National Security Site (NNSS); however, Indian people must continue to fulfill our birth-rite obligation to care for our Holy Land and do what we can to try to restore balance to Area 5 and other contaminated locations. The Consolidated Group of Tribes and Organizations (CGTO) recommends U.S. Department of Energy (DOE) allocate funds and resources for Indian people to conduct systematic ethnographic studies of these waste management programs. If DOE selects the expanded use alternative, the CGTO must conduct a cultural assessment of the Area 3 Radioactive Waste Management Site (RWMS) prior to new use to mitigate potential impacts.

The CGTO supports DOE's intention to minimize waste within the NNSS area. We encourage the DOE to partner with us to develop and participate in DOE's waste minimization and pollution prevention programs. In particular, the waste minimization efforts described in the SWEIS regarding land commitments must include members of the CGTO to ensure that cultural implications of these decisions are considered prior to implementation.

Finally, the CGTO struggles with the ethics of transporting and relocating radioactive waste from other American Indian lands so those people can live without fear of unnatural radioactivity. We are greatly concerned about the adverse spiritual, environmental, and health impacts associated with relocating these angry rocks from their current locations to our Holy Land. We believe transporting these to our land perpetuates animosity and discord among tribal governments and disproportionately impacts the natural balance of the area. Because these decisions adversely impact our land and our relationships with other tribal governments, the CGTO recommends DOE host a break-out session for culturally-affiliated tribes associated with the NNSS and the multi-state waste generator facilities during DOE's Annual Waste Generator Conference. These efforts will facilitate further discussion, understanding, and develop culturally-appropriate mitigation measures.

See Appendix C for more details.

7.12 Human Health

Impacts on the health and safety of workers would be minimized by continued implementation of formal radiation protection and chemical hazards management programs in compliance with DOE radiation protection and occupational safety and health requirements. Among other measures, DOE has implemented an Integrated Safety Management System that integrates environment, safety, and health management programs at DOE sites. The use of an Integrated Safety Management System helps ensure that (1) all levels of program organizations are accountable for environmental protection; (2) all projects are planned with environment, safety, and health concerns in mind; and (3) continuous improvements in program implementation occur.

Radiation protection mitigation measures would include formal analysis of proposed work in a radiological environment by workers, supervisors, and radiation protection personnel and identification of methods to reduce worker exposures to levels as low as reasonably achievable, e.g., use of personal protection equipment, shielding, time management in radiation areas, and training, as well as distribution of the workload across a larger number of workers.

Mitigation measures to protect workers from physical hazards would involve safety reviews of planned activities and implementation of safety measures, including bracing and stabilizing buildings and excavations, wearing personal protective equipment, and conducting safety monitoring and inspections.

Mitigation measures to protect workers from hazardous or toxic materials include training, monitoring, use of personal protective equipment, administrative controls, and compliance with the NNSS Hazardous Materials Control and Management Program. Among other things, this program subjects the purchase of chemicals to a review process to ensure that toxic chemicals and products are not purchased when less-hazardous substitutes are available. The Chronic Beryllium Disease Prevention Program established at the NNSS and other DOE sites reduces the number of workers potentially exposed to beryllium while at work, minimizes the levels of and potential for exposure to beryllium, and maintains a medical surveillance program for early detection of disease.

Very small impacts on members of the public could result from release of radioactive materials to air, particularly from environmental restoration activities, or from release of other airborne pollutants from activities such as heavy equipment operation. These impacts would be minimized by continued compliance with applicable DOE, other Federal, and state requirements (e.g., requirements implemented under the Atomic Energy and Clean Air Acts). Impacts on the public from releases of radioactive and nonradioactive pollutants to air would be reduced via control measures such as using water or surfactants to reduce suspension of contaminated particulates and continuing environmental monitoring programs that track releases, impacts, and trends and publish their results.

7.13 Environmental Justice

Although no environmental justice impacts have been identified in this SWEIS, NNSA would continue the following activities to avoid disproportionate impacts on low-income and minority populations:

- Expand opportunities for low-income and minority communities to provide input within the public involvement process by seeking the constructive involvement of affected stakeholders.

- Encourage the participation of the Consolidated Group of Tribes and Organizations in DOE-sponsored cultural resources investigations, including those associated with ground-disturbing activities such as environmental restoration.

- Encourage Consolidated Group of Tribes and Organizations participation when developing educational programs, so that students and researchers receive proper guidance regarding how to interact with the physical environment and cultural landscape.

7.14 Environmental Management Systems

Nevada Site Office Environmental Management System – NNSA/NSO conducts activities at its facilities in Nevada in a manner that ensures protection of the environment, the worker, and the public. This is accomplished through the implementation of an Environmental Management System. An Environmental Management System is a business management practice that incorporates concern for environmental performance throughout an organization, with the ultimate goal being continual reduction of the organization's impact on the environment. An Environmental Management System ensures that environmental issues are systematically identified, controlled, and monitored, and it provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual improvement. The NNSA/NSO Environmental Management System incorporates environmental stewardship goals that are identified in the Federal Environmental Management System directives applicable to all DOE and NNSA sites.

Based on independent evaluation of the NNSA/NSO Environmental Management System, certification was maintained for 2009 and 2010. The Environmental Policy underlying the Environmental Management System contains the following key goals and commitments:

- Protect environmental quality and human welfare by implementing Environmental Management System practices
- Identify and comply with all applicable DOE orders and Federal, state, and local environmental laws and regulations
- Identify and mitigate environmental aspects early in project planning
- Establish environmental objectives, targets, and performance measures
- Collaborate with employees, customers, subcontractors, and key suppliers on sustainable development and pollution prevention efforts
- Communicate and instill an organizational commitment to environmental excellence through processes of continual improvement.

NNSA/NSO operations are evaluated to determine whether they have an environmental aspect and to implement the Environmental Management System to minimize or eliminate any potential impacts. Operations are evaluated by performing Hazard Assessments, preparing Health and Safety Plans and Execution Plans, and preparing and reviewing National Environmental Policy Act documents. All of these documents require that mitigation actions be identified to minimize the risk of adverse impacts.

NNSA/NSO operations are reviewed annually to determine what Environmental Management System objectives and targets will be implemented to address specific environmental aspects.

CHAPTER 8
RESOURCE COMMITMENTS

8.0 RESOURCE COMMITMENTS

In accordance with the National Environmental Policy Act (NEPA), Section 102 (42 *United States Code* [U.S.C.] 4332), and the Council on Environmental Quality's NEPA implementing regulations (40 *Code of Federal Regulations* [CFR] 1502.16), Chapter 8 addresses the following:

- Any unavoidable adverse effects associated with implementation of the alternatives presented in Chapter 3, "Description of Alternatives"
- The relationship between short-term uses of the environment and maintenance and enhancement of long-term productivity
- Any irreversible and irretrievable commitments of resources associated with implementation of the alternatives

8.1 Unavoidable Adverse Effects

The potential environmental consequences of implementing the alternatives are discussed in Chapter 5 of this site-wide environmental impact statement (SWEIS). During implementation of any of the alternatives, the National Nuclear Security Administration (NNSA) would take all reasonable measures to avoid or minimize potential environmental impacts. These measures would include best management practices as well as the mitigation measures presented in Chapter 7 of this SWEIS. Following a Record of Decision, NNSA would also commit to development and implementation of a Mitigation Action Plan in accordance with 10 CFR 1021.331, if mitigation commitments are made in the Record of Decision. However, there could be unavoidable adverse impacts associated with implementation of the alternatives. This section provides a summary of those unavoidable adverse impacts.

8.1.1 No Action Alternative

8.1.1.1 Nevada National Security Site

Most air emissions at the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) would be associated with mobile source (e.g., vehicles and portable equipment) activity. The NNSS contribution to the mobile source emissions in Clark and Nye Counties would continue to be small and would decrease relative to 2008 emission levels. By 2015, volatile organic compound (VOC) emissions from NNSS mobile sources in Clark County would increase relative to 2008 emission levels by 0.4 tons per year due to the widespread use of ethanol blends in southern Nevada. VOC emissions are not expected to violate the ozone air quality standard because the increase would be relatively small and such mobile source emissions would be dispersed throughout the Las Vegas Valley and the United States (U.S.) Route 95 corridor. NNSS-related activities under the No Action Alternative would create about 40,000 carbon-dioxide-equivalent tons of greenhouse gas emissions per year (40,300 tons when temporary construction worker commuting is included).

8.1.1.1.1 National Security/Defense Mission

The NNSS must maintain the capability to conduct nuclear tests under the Stockpile Stewardship and Management Program. Should nuclear testing be reinstated, it would be conducted in Pahute Mesa, Rainier Mesa, or Yucca Flat. Unavoidable adverse effects, both in terms of the magnitude of the impacts and their duration, would result from underground testing. As noted in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 1996c), other activities conducted at the NNSS "for the most part are registered immediately and those effects are very small in comparison with the effects of underground nuclear testing." The major unavoidable effects of underground testing include the release of large quantities of radioactivity into the subsurface, the formation of new subsidence craters, and the generation of ground motion that might be felt outside the boundaries of the NNSS.

Underground nuclear tests would contaminate the subsurface with a large amount of short- and long-lived radionuclides. Tritium is likely to be the most abundant radionuclide. Many of the other radionuclides would remain bound up in the melted glass in the test cavity. Some groundwater might be unavoidably contaminated if the test cavity is below or intercepts the water table. The surface areas below which the contaminants are released would be strictly controlled for safety and security reasons. An underground nuclear test would also unavoidably disrupt the integrity of the subsurface geologic environment. Contamination might extend as far as five times the radii of the cavity from the shot point. Following tests, subsidence craters often form because of the collapse of the geologic units. These impacts would preclude the use of the geologic values inherent at the site for the long term.

Ground motions accompanying underground nuclear tests conducted at the NNSS have been felt in Las Vegas, Nevada, and elsewhere in the surrounding region. Any potential future tests conducted at the direction of the President would likely be limited to 150 kilotons in yield. Occasionally, ground motion from a larger test might cause nonstructural offsite damage, such as plaster cracks. A larger underground test could cause perceptible motion at offsite locations, particularly in high-rise structures in Las Vegas.

Airspace restrictions would continue to prohibit commercial and general aviation use. NNSA would continue to coordinate the use of airspace with the Nellis Air Traffic Control Facility, the controlling entity responsible for NNSS airspace.

Ground-disturbing activities that encroach on undisturbed areas are likely to have adverse impacts on vegetation and soils, including essential components of the desert tortoise's habitat. These activities could potentially disturb native vegetation, although the amount of vegetation and soil that would be affected is not expected to reduce the viability of special status wildlife significantly or have substantial negative impacts on biodiversity, ecosystem functions, or springs in these areas. If native vegetation were disturbed during the nesting season for birds, the eggs or young in nests located within the project area could be destroyed. Most birds that nest within the NNSS are protected under the Migratory Bird Treaty Act. If detonations and explosives tests were to occur near vital water sources, they could cause wildlife to avoid them, adversely affecting wildlife that depend on those water sources. If detonations were to occur during the nesting season for birds, explosions could startle nesting birds, causing them to abandon their nests and resulting in a loss of eggs or young.

8.1.1.1.2 Environmental Management Mission

The Nevada Division of Environmental Protection (NDEP) issued a Resource Conservation and Recovery Act (RCRA) Part B permit to NNSA effective December 1, 2010, for a new mixed low-level radioactive waste (MLLW) disposal unit, Cell 18, at the Area 5 Radioactive Waste Management Complex (RWMC). Construction of the new MLLW disposal unit was completed and began accepting MLLW for disposal in January 2011.

By the end of the 10-year period analyzed in this SWEIS, about 61 percent (450 acres) of the approximately 740-acre Area 5 RWMC would be used for low-level radioactive waste (LLW) and

MLLW disposal cells as necessary. The remaining area would be subject to use for disposal cells beyond the 10-year period. Once filled, disposal cells would be operationally capped, pending final closure.

8.1.1.1.3 Nondefense Mission

Land preparation activities associated with the development of a commercial solar power generation facility (240 megawatts), to be located within the Renewable Energy Zone in Area 25, would disturb an area of approximately 2,400 acres. Most of the soils in Area 25 have not been modified through construction or other uses, so construction of the plant would affect topsoil and increase the potential for erosion in Jackass Flats. Ground-disturbing activities and increased vehicular access to previously undisturbed land would adversely affect wildlife in the immediate area of the solar power generation facility by direct mortality of individuals and loss of habitat. The solar power generation facility would be located within the range of the desert tortoise and its habitat. Implementation of the measures identified in the U.S. Fish and Wildlife Service’s 2009 Biological Opinion (USFWS 2009a) would be required to minimize the potential for take of desert tortoises.

The solar power generation facility would introduce considerable infrastructure in Area 25 that would be directly visible in middle ground views from U.S. Route 95. Portions of the study area visible from U.S. Route 95 have a Class B scenic quality rating. Viewer sensitivity would change from moderate to high near the Area 25 Renewable Energy Zone. A solar power generation facility would introduce a considerable amount of glare from the reflective surfaces of the solar collectors, alter the existing visual character of the landscape that is largely undeveloped, be visible to highly sensitive viewers, and reduce the existing visual quality to a Class C rating because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array; therefore, this effect is considered adverse and unavoidable.

8.1.1.2 Remote Sensing Laboratory

No unavoidable adverse impacts have been identified for this facility.

8.1.1.3 North Las Vegas Facility

No unavoidable adverse impacts have been identified for this facility.

8.1.1.4 Tonopah Test Range

Airspace restrictions would continue to prohibit commercial and general aviation use. NNSA would continue to coordinate the use of airspace with the controlling entity responsible for the Tonopah Test Range (TTR) airspace, the Nellis Air Traffic Control Facility.

Weapons impact testing, flight test operation of gravity weapons, and passive testing would occur during TTR operations using gravity weapons; passive testing would occur on the TTR. These activities could potentially disturb native vegetation. If disturbance of native vegetation occurs during the nesting season for birds, the eggs or young in nests located within the project area could be destroyed. Explosives tests and detonations could startle wildlife, resulting in adverse impacts. If these detonations and explosives tests were to occur near vital water sources, they could cause wildlife to avoid them, which could adversely affect wildlife that depends on those water sources. Additionally, if detonations were to occur during the nesting season for birds, explosions could startle nesting birds, causing them to abandon their nests and resulting in a loss of eggs or young.

8.1.2 Expanded Operations Alternative

Unavoidable adverse impacts resulting from implementation of the Expanded Operations Alternative include those presented above for the No Action Alternative. The discussion in this section focuses on the differences between the unavoidable adverse impacts under both the Expanded Operations and No Action Alternatives.

8.1.2.1 Nevada National Security Site

Most air emissions at the NNSS would be associated with mobile source (e.g., vehicles and portable combustion equipment) activity. The stationary source emissions include emissions resulting from the operation of a 1,000-megawatt commercial solar power generation facility that may be constructed under the Expanded Operations Alternative. These emissions (PM_{10}[1] and $PM_{2.5}$[2]) would mainly occur from the cooling tower and during colder ambient temperatures, as the heat transfer fluid is heated to prevent freezing. VOC and PM_{10} emissions from NNSS mobile sources in Clark County would increase relative to 2008 emission levels by 1.0 and 0.20 tons per year, respectively. The VOC increase would be due to the widespread use of ethanol blends in southern Nevada by 2015. The small increases in VOC and PM_{10} emissions would be attributable to mobile sources and would be widely distributed over the Las Vegas Valley and through the U.S. Route 95 corridor. They would not lead to any additional violations of the ozone or PM_{10} air quality standards. NNSS-related activities under the Expand Operations Alternative would create about 49,700 carbon-dioxide-equivalent tons of greenhouse gas emissions per year (51,500 tons when temporary construction worker commuting is included).

8.1.2.1.1 National Security/Defense Mission

Under the Expanded Operations Alternative, as part of the Stockpile Stewardship and Management Program, NNSA would add additional equipment and ancillary features within the existing Big Explosives Experimental Facility (BEEF) to support activities occurring in the Nuclear and High Explosives Test Zone. Depleted uranium experiment sites would occupy 40 acres per experiment, with up to 3 experiments during the period of analysis, while high-explosives experiments would occupy 5 acres per experiment, with up to 500 experiments during the period of analysis. The areas for these experiments would be located in appropriately zoned operational areas on the NNSS; however, reserving these areas for the depleted uranium and high-explosives experiments would prevent other activities or uses from occurring within these reserved areas.

New support facilities would be constructed for Office of Secure Transportation (OST) training purposes in Area 17. About 16,000 acres of currently undisturbed land would be reserved for use as an active training area, where live-fire training areas and other training facilities and supporting infrastructure would be developed. Additionally, OST would expand facilities in either Area 12 (12 Camp), Area 6 (Control Point Complex), or Area 23 (Mercury). Temporary impacts on soils would result from construction-related surface disturbance. Some localized impacts on the surface soil structure would occur from NNSA and U.S. Department of Defense training of OST personnel in offroad locations because driving vehicles through undisturbed soils and vegetation could disturb soil structures and increase soil erosion by wind. Construction of new OST facilities on previously undisturbed lands would result in a permanent loss of native vegetation and wildlife habitat. Construction of new roads would result in increased vehicular access to previously undisturbed land. Construction activities related to expansion of OST facilities would cause adverse impacts on wildlife through direct mortality of

---

[1] PM_{10} is particulate matter with an aerodynamic diameter less than or equal to 10 micrometers.
[2] $PM_{2.5}$ is particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

individuals and loss of habitat. For example, expansion of facilities in Areas 6 and 23 would occur within the range of the desert tortoise and could potentially result in an incidental taking of desert tortoises.

The proposed projects for the Nuclear Emergency Response and Nonproliferation and Counterterrorism Programs and the proposed relocation of the Federal Bureau of Investigation Disposition Forensics Program would cause environmental impacts at the NNSS. Construction of additional nonproliferation and counterterrorism facilities, which are still conceptual in nature, would result in 200 acres of surface disturbance, which would cause short- and long-term impacts on soils.

NNSA would construct additional hangars, shops, and buildings totaling approximately 200,000 square feet (4.6 acres) at Desert Rock Airport, which would result in temporary impacts on soils from surface disturbance. The additional facilities at Desert Rock Airport may include lengthening of the existing runway and construction of new hangars and support facilities. These features would be visible in the middle ground (0.5 to 5 miles) of views from U.S. Route 95 and would adversely affect visual resources. The scale and coloring of facilities would play a large part in the visual prominence of the new facilities.

8.1.2.1.2 Environmental Management Mission

Waste disposal activities would increase which would result in reactivation of the Area 3 Radioactive Waste Management Site. Within these areas, new disposal units would be constructed, filled, and closed to accommodate the waste volumes and types.

Development of new landfills in Area 23 and Area 25 would convert a combined total of 35 acres of currently unused land into waste management facilities and preclude that land from being used for other purposes. Construction of the sanitary waste disposal facility in Area 25 could also result in loss of habitat and direct mortality of tortoises. Increased roadway traffic in Area 25 could also result in incidental takes of desert tortoise from injury or mortality.

8.1.2.1.3 Nondefense Mission

Under the Expanded Operations Alternative, NNSA would allow development of one or more commercial solar power generation facilities to be located within a 39,600-acre Renewable Energy Zone, with a maximum combined generating capacity of 1,000 megawatts. Most of the soils in Area 25 have not been modified through construction or other uses, so construction of the plant would affect topsoil and increase the potential for erosion in Jackass Flats. Ground-disturbing activities and increased vehicular access to previously undisturbed land would adversely affect wildlife in the immediate area of the solar power generation facility by direct mortality of individuals and loss of habitat. The solar power generation facility would be located within the range of the desert tortoise and its habitat. The implementation of the measures identified in the U.S. Fish and Wildlife Service's 2009 Biological Opinion (USFWS 2009a) would be required to minimize the potential for take of desert tortoises.

The solar power generation facility would introduce considerable infrastructure in Area 25 that would be directly visible in middle ground views from U.S. Route 95. Portions of the study area visible from U.S. Route 95 have a Class B scenic quality rating. Viewer sensitivity would change from moderate to high near the Area 25 Renewable Energy Zone. A solar power generation facility would introduce a considerable amount of glare from the reflective surfaces of the solar collectors, alter the existing visual character of the landscape that is largely undeveloped, be visible to highly sensitive viewers, and reduce the existing visual quality to a Class C rating because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array; therefore, this effect is considered adverse and unavoidable.

The Geothermal Power Project has the potential to introduce facilities associated with capturing, converting, and transferring geothermal power such as a power plant, transmission lines, and associated infrastructure that would occur on 30 to 50 acres of land.

8.1.2.2 Remote Sensing Laboratory

No unavoidable adverse impacts have been identified for this facility.

8.1.2.3 North Las Vegas Facility

No unavoidable adverse impacts have been identified for this facility.

8.1.2.4 Tonopah Test Range

No unavoidable adverse impacts have been identified for this facility.

8.1.3 Reduced Operations Alternative

Unavoidable adverse impacts under the Reduced Operations Alternative include those presented above for the No Action Alternative. The discussion in this section focuses on the differences between the unavoidable adverse impacts under both the Reduced Operations and No Action Alternatives.

8.1.3.1 Nevada National Security Site

Most air emissions at the NNSS would be associated with mobile source (e.g., vehicles and portable combustion equipment) activity. The NNSS contribution to the emissions in Clark County would continue to be small and would decrease relative to 2008 emission levels, except for VOCs, which could increase by 0.2 tons per year by 2015 due the widespread use of ethanol blends in southern Nevada. The small increase in VOC emissions is from mobile sources and would be widely distributed over the Las Vegas Valley and the U.S. Route 95 corridor. NNSS-related activities under the Reduced Operations Alternative would create about 37,500 carbon-dioxide-equivalent tons of greenhouse gas emissions per year (38,340 tons including temporary construction worker commuting).

Under the Reduced Operations Alternative, employment is assumed to decrease from 1,699 to 1,654, with employment from the operation of the solar power plant offsetting most losses associated with a reduction in activity associated with other NNSS programs. This decrease would be equal to about 45 jobs: 35 in Clark County and 10 in Nye County. In Clark County, this would increase the unemployment rate by about 0.03 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, unemployment would increase by about 0.32 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). Daily spending in the immediate area of the NNSS would decrease correspondingly, which would have a minor impact on economic activity.

8.1.3.1.1 National Security/Defense Mission

No unavoidable adverse impacts have been identified for this mission.

8.1.3.1.2 Environmental Management Mission

No unavoidable adverse impacts have been identified for this mission.

8.1.3.1.3 Nondefense Mission

NNSA would continue to support the development of a commercial solar power generation facility in Area 25 that would be sited on 1,200 acres of land; the net generating capacity under the Reduced Operations Alternative would be 100 megawatts. Most of the soils in Area 25 have not been modified through construction or other uses, so construction of the plant would affect topsoil and increase the potential for erosion in Jackass Flats. Ground-disturbing activities and increased vehicular access to previously undisturbed land would adversely affect wildlife in the immediate area of the solar power generation facility by direct mortality of individuals and loss of habitat. The solar power generation facility would be located within the range of the desert tortoise and its habitat. The implementation of the measures identified in the U.S. Fish and Wildlife Service's 2009 Biological Opinion (USFWS 2009a) would be required to minimize the potential for take of desert tortoises.

The solar power generation facility would introduce considerable infrastructure in Area 25 that would be directly visible in middle ground views from U.S. Route 95. Portions of the study area visible from U.S. Route 95 have a Class B scenic quality rating. Viewer sensitivity would change from moderate to high near the Area 25 Renewable Energy Zone. A solar power generation facility would introduce a considerable amount of glare from the reflective surfaces of the solar collectors, alter the existing visual character of the landscape that is largely undeveloped, be visible to highly sensitive viewers, and reduce the existing visual quality to a Class C rating because of the intrusion of manmade elements. There is no mitigation to reduce adverse effects associated with the proposed solar array; therefore, this effect is considered adverse and unavoidable.

8.1.3.2 Remote Sensing Laboratory

No unavoidable adverse impacts have been identified for this facility.

8.1.3.3 North Las Vegas Facility

Under the Reduced Operations Alternative, there would be a small reduction in employment of 144 individuals at the North Las Vegas Facility (NLVF), including 143 employees in Clark County and 1 employee in Nye County. In Clark County, this would increase the unemployment rate by about 0.10 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). Within Nye County, this would increase the unemployment rate by about 0.03 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). As a result of this jobs reduction, daily spending in the vicinity of NLVF would decrease correspondingly.

8.1.3.4 Tonopah Test Range

Airspace impacts would be similar to those described for the No Action Alternative in Section 8.1.1.4; however, impacts would be minimized as a result of the discontinuation of fixed rocket launch operations, cruise missile operations, and fuel-air explosives at the TTR. This would increase the restricted airspace availability for other military uses as coordinated and scheduled by the Nellis Air Traffic Control Facility.

Under the Reduced Operations Alternative, there would be a reduction in employment of 67 individuals at the TTR, including 15 in Clark County and 45 in Nye County. In Clark County, this reduction would increase the unemployment rate by about 0.01 percent (a total of 142,137 Clark County residents were unemployed as of August 2010). In Nye County, this would increase the unemployment rate by about 1.44 percent (a total of 3,133 Nye County residents were unemployed as of August 2010). As a result of the reduction in jobs, daily spending in the vicinity of the TTR would decrease.

8.2 Relationship of Short-Term Uses and Long-Term Productivity

Council on Environmental Quality regulations implementing the procedural requirements of NEPA (40 CFR 1502.16) require consideration of the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity. This includes using:

> *"… all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" (NEPA, Section 101, 42 U.S.C. 4331).*

Short-term uses are defined as those that would take place during the 10-year timeframe analyzed within this SWEIS. While this section discusses the short-term use of the environment and the maintenance of its long-term productivity, Chapter 5 provides a more detailed discussion of the impacts and resource utilization associated with each of the alternatives. The majority of effects on long-term productivity would result from the continuation of present land use and from future land uses associated with the three alternatives. Under each alternative, lands previously withdrawn from public use would continue to be unavailable for alternate uses by the public.

Developed areas of the NNSS, as well as offsite locations within Nevada (including facility footprints and buffer areas), would continue to be unproductive ecologically, but would continue their long-term contributions to the NNSA mission through their support of research and development and training. No new facility development is proposed for the TTR, Remote Sensing Laboratory (RSL), or NLVF under any of the three alternatives.

Establishment of new developed areas at the NNSS would occur under all alternatives in this SWEIS. As an example, construction of a commercial solar power generation facility in Area 25 of the NNSS would result in the conversion of approximately 2,400 acres of land to support energy infrastructure under the No Action Alternative, and 9,400 or 1,200 acres under the Expanded or Reduced Operations Alternatives, respectively.

Under the Expanded Operations Alternative, there would be an additional irreversible and irretrievable commitment of land resources associated with the development of facilities in Area 17, including offices, classrooms, a live-fire shoot house, a live-fire training area, and a simulated town to support training for OST. This complex in Area 17 would be approximately 10,000 acres in size (including buffer zones), and could result in up to 3,500 acres of surface disturbance. NNSA would also upgrade or construct new facilities in Areas 6, 12, or 23 to provide approximately 50,000 square feet of building space.

While some facilities would be considered for closure and demolition under the Reduced Operations Alternative, restoration of these areas to preconstruction conditions may not be practicable over the next 10 years, and these sites may also be considered for alternate uses in support of NNSS mission activities.

Underground subcritical experiments would result in the mined cavity being unavailable for the long term, but the land surface would be unaffected and unrestricted.

The Area 3 and Area 5 Waste Management Program sites would have disturbed areas that would be restricted from subsurface access for the long term, and the surface would be restricted from most uses. Rehabilitation of the surface following closure of a disposal site would restore ecological productivity unless rock armor (rocks used to protect against erosion) was used in closure. Although not expected to be used, rock armor or other solid surface coatings would result in a sterile surface for the long term. The area in the buffer zones would have some restrictions on surface uses designed to prevent intrusion into the buried waste. Because it would likely remain undisturbed, the buffer zones' ecological productivity would remain unimpaired for the long term.

Environmental restoration activities at the NNSS and TTR under all three alternatives would contribute to long-term productivity through the remediation of surface and subsurface contamination and their return to other productive uses. The rate of return to ecological productivity would vary at individual sites, depending upon the revegetation measures employed and local soil conditions. In the short term, productivity would be reduced at some sites if contaminated soil were removed for disposal.

8.3 Irreversible and Irretrievable Commitment of Resources

NEPA Section 102 (42 U.S.C. 4332) and Council on Environmental Quality regulations implementing the procedural requirements of NEPA (40 CFR 1502.16) require environmental analyses to include identification of "… any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." An irreversible commitment of resources represents a loss of future options. It applies primarily to nonrenewable resources, such as minerals or cultural resources, and to those factors that are renewable only over long time spans, such as soil productivity. An irretrievable commitment of resources represents opportunities that are foregone for the period of the proposed action. Examples include the loss of production, harvest, or use of renewable resources. The decision to commit the resources is reversible, but the past utilization opportunities are irretrievable.

Implementation of any of the alternatives would result in a permanent commitment of certain air, groundwater, soil, biota, mineral, surface, and subsurface resources. There would be an irreversible and irretrievable commitment of these natural resources.

Under each alternative, developed areas on the NNSS would remain in urban or industrial land uses. This long-term land use commitment would preclude other uses of the land and prohibit natural habitat productivity. Even with any removal of structures and infrastructure, completely natural conditions would be difficult to achieve. Construction of a commercial solar power generation facility in Area 25 of the NNSS and associated transmission lines would result in an irreversible and irretrievable commitment of land resources of approximately 2,650 acres under the No Action Alternative, 10,300 acres under the Expanded Operations Alternative, or 1,200 acres the Reduced Operations Alternative.

As stated previously, under the Expanded Operations Alternative, there would be an additional irreversible and irretrievable commitment of land resources associated with the development of facilities in Area 17, including offices, classrooms, a live-fire shoot house, a live-fire training area, and a simulated town to support training for OST and the proposed upgrade or construction of new facilities in Areas 6, 12, or 23. Designation and development of a 39,600-acre Renewable Energy Zone in Area 25 under the Expanded Operations Alternative would constitute an additional irreversible, but not necessarily irretrievable, commitment of land resources.

Use of the radioactive waste management facilities for waste disposal would result in an irreversible and irretrievable commitment of land resources. Land uses and access to the subsurface would be severely restricted at the sites and in surrounding buffer areas. Some areas would be rehabilitated on closure and would provide natural habitat. Although not expected, if closures were designed using rock armor, this would inhibit vegetation or burrowing animals and thereby severely limit their use as natural habitat. Sanitary and construction landfills would represent an irreversible and irretrievable commitment of the subsurface and would limit surface uses.

Underground subcritical experiments would result in an irreversible and irretrievable commitment of the mined cavity. Following subcritical experiments, the land surface would be unaffected and unrestricted.

Decontamination and decommissioning activities would produce mixed results depending on the remedy selected. Most decontamination and decommissioning activities would result in either decontamination, resulting in the consequent availability of the facility for other use, or demolition of the facility and disposal. In-place disposal of basements would result in an irretrievable and irreversible commitment of the subsurface for most land use. Reuse would entail the facility remaining in an industrial mode, which would represent a long-term commitment to that type of land use. Demolition of the facility could result in the land's availability for other development or for site rehabilitation and use as natural habitat.

Closure in place would result in an irreversible and irretrievable commitment for those Resource Conservation and Recovery Act industrial sites that are so treated. Land use on these sites and in a surrounding buffer zone would be severely constrained. Rehabilitation by revegetation would permit their functioning as natural habitat, but closure would likely be designed using rock armor to inhibit vegetation or burrowing animals.

Continued airspace restriction would represent an irreversible and irretrievable commitment because access would be limited to government use only. Airspace access would be prohibited for general aviation and commercial users.

Energy and materials utilized in the construction, operation, maintenance, decontamination, demolition, and closure of the facilities would be irreversibly and irretrievably committed. Groundwater would be withdrawn to support all NNSS programs under each alternative. This water use would represent an irreversible and irretrievable commitment of this resource.

Continued restriction of harvesting products like game, pine nuts, or grass, and maintenance of areas in development that precludes their natural productivity, would represent an irretrievable commitment of resources.

Removal of soils for environmental restoration projects would result in their irreversible and irretrievable loss because they would be landfilled and any associated natural resource services that they provide would be lost as well. Environmental restoration activities would mostly involve land that has been previously disturbed. The amount that would be redisturbed during remediation depends, first, upon the levels of contamination that would be determined during characterization and, second, upon the agreements reached with the State of Nevada regarding cleanup levels.

CHAPTER 9
LAWS, REGULATIONS, AND PERMITS

9.0 LAWS, REGULATIONS, AND PERMITS

Chapter 9 presents the environmental, safety, and health laws, regulations, and permits that potentially apply to the alternatives in this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*. Federal, State of Nevada, Executive Orders, and U.S. Department of Energy (DOE) environmental, safety, and health requirements are summarized in Section 9.1. Applicable permits that may be required to implement the alternatives are identified in Section 9.2.

9.1 Introduction

The major Federal and State of Nevada laws and regulations, Executive Orders, DOE Orders, and other requirements that may apply to the various alternatives analyzed in this site-wide environmental impact statement (SWEIS) are identified in **Table 9–1**. These compliance requirements are summarized in Sections 9.1.1 through 9.1.14. Executive Orders and DOE Orders that are new or that have been revised since the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* are easily identified in this chapter with their date of issuance and change date(s) transpiring after 1996.

Table 9–1 Potentially Applicable Laws, Regulations, Orders, and Other Requirements

Law, Regulation, Order, or Other Requirement	*Citation/Date*
Environmental Quality	
National Environmental Policy Act of 1969	42 U.S.C. 4321 et seq.
Council on Environmental Quality Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act	40 CFR Parts 1500–1508
U.S. Air Force Environmental Impact Analysis Process	32 CFR Part 989 (July 15, 1999)
National Environmental Policy Act Implementing Procedures	10 CFR Part 1021
Protection and Enhancement of Environmental Quality, as amended by Executive Order 11991	Executive Order 11514 (May 24, 1977)
Environmental Protection Program	DOE Order 450.1A (June 4, 2008)
Environment, Safety, and Health Reporting	DOE Order 231.1A (August 19, 2003; Change 1, June 3, 2004)
Land Use	
Federal Land Policy and Management Act of 1976	43 U.S.C. 1701–1784, enacted by P.L. 94-579, as amended
Military Lands Withdrawal Act of 1999	P.L. 106-65
Real Property Assessment Management	DOE Order 430.1B (September 24, 2003; Change 1, February 8, 2008)
Infrastructure and Energy	
Energy Policy Act of 2005	42 U.S.C. 15801 et seq.
Strengthening Federal Environmental, Energy, and Transportation Management	Executive Order 13423 (January 24, 2007)
Federal Leadership in Environmental, Energy, and Economic Performance	Executive Order 13514 (October 5, 2009)
Departmental Energy, Renewable Energy, and Transportation Management	DOE Order 430.2B (February 27, 2008)
Transportation	
Hazardous Materials Transportation Act of 1975, as amended	49 U.S.C. 5101 et seq.
Packaging and Transportation of Radioactive Material	10 CFR Part 71

Law, Regulation, Order, or Other Requirement	***Citation/Date***
Packaging and Transfer or Transportation of Materials of National Security Interest	DOE Order 461.1A (April 26, 2004)
Departmental Materials Transportation and Packaging Management	DOE Order 460.2A (December 22, 2004)
Packaging and Transportation Safety	DOE Order 460.1B (April 4, 2003)
Geology and Soils	
Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction	Executive Order 12699 (December 22, 2005)
Facility Safety	DOE Order 420.1B (December 22, 2005)
Hydrology	
Clean Water Act of 1972, as amended	33 U.S.C. 1251 et seq.
Safe Drinking Water Act of 1974, as amended	42 U.S.C. 300(f) et seq.
National Wellhead Protection Program	Established by the 1986 Amendments to the Safe Drinking Water Act
National Primary Drinking Water Regulations	40 CFR Part 141 (July 1, 2003)
National Primary Drinking Water Regulations Implementation	40 CFR Part 142 (July 1, 2003)
National Secondary Drinking Water Regulations	40 CFR Part 143 (July 1, 2003)
Compliance with Floodplain and Wetland Environmental Review Requirements	10 CFR Part 1022
Floodplain Management	Executive Order 11988 (May 24, 1977)
Underground Water and Wells	NRS 534
Water Controls – Public Water Systems	NAC 445A
Water Controls – Water Pollution Control and Sanitation	NAC 445A and 444
Underground Injection Control Program	NAC 445A.810–445A.925
Fluid Management Plan for the Underground Test Area Project	DOE/NV-370-Rev. 4 (May 2009)
Biological Resources	
Bald and Golden Eagle Protection Act of 1973, as amended	16 U.S.C. 668–668d
Clean Water Act, Section 404, Jurisdictional Wetlands	33 U.S.C. 1251 et seq., Section 404
Endangered Species Act of 1973, as amended	16 U.S.C. 1531 et seq.
Migratory Bird Treaty Act of 1918, as amended	16 U.S.C. 703 et seq.
National Wildlife Refuge System Administrative Act of 1966, as amended	16 U.S.C. 668dd-668ee
Wild Horses and Burros Act of 1971	16 U.S.C. 1331–1340
Protection of Wetlands	Executive Order 11990 (May 24, l977)
Invasive Species	Executive Order 13112 (February 3, 1999)
Responsibilities of Federal Agencies to Protect Migratory Birds	Executive Order 13186 (January 10, 2001)
Five-Party Cooperative Agreement	1977 (see also Wild Horses and Burros Act of 1971)
Protection of Wildlife	NAC 503.010 – 503.104
Air Quality and Climate	
Clean Air Act of 1970, as amended	42 U.S.C. 7401 et seq.
National Ambient Air Quality Standards	40 CFR Part 50
National Emission Standards for Hazardous Air Pollutants	40 CFR Part 61
Stratospheric Ozone Protection	40 CFR Part 82
Mandatory Greenhouse Gas Reporting	40 CFR Part 98
Standards of Quality for Ambient Air	NAC 445B.22097
Class II Operating Permits	NAC 445B.3455 – 445B.3477
Air Pollution Alternative Fuels; Clean Burning Fuels	NRS 445B.100 – 445B.825 and NRS 486A.010 – 486A.180
Visual Resources	
Visual Resource Management	BLM Manual Section 8400

Law, Regulation, Order, or Other Requirement	***Citation/Date***
Cultural Resources	
American Indian Religious Freedom Act of 1978	42 U.S.C. 1996
Antiquities Act of 1906, as amended	16 U.S.C. 431–433
Archaeological and Historic Preservation Act of 1960, as amended	16 U.S.C. 469–469c-2
Archaeological Resources Protection Act of 1979, as amended	16 U.S.C. 470aa et seq.
National Historic Preservation Act of 1966, as amended	16 U.S.C. 470 et seq.
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001 et seq.
Protection and Enhancement of the Cultural Environment	Executive Order 11593 (May 13, 1971)
Indian Sacred Sites	Executive Order 13007 (May 24, 1996)
Consultation and Coordination with Indian Tribal Governments	Executive Order 13175 (November 6, 2000)
Preserve America	Executive Order 13287 (March 3, 2003)
American Indian Tribal Government Interactions and Policy	DOE Order 144.1 (January 16, 2009; Change 1, November 6, 2009)
Waste Management	
Atomic Energy Act of 1954	42 U.S.C. 2011 et seq.
Resource Conservation and Recovery Act of 1976, as amended	42 U.S.C. 6901 et seq.
Federal Facility Compliance Act of 1992	P.L. 102-386
Federal Facility Agreement and Consent Order, as amended	February 2008
Low-Level Radioactive Waste Policy Act of 1980, as amended	42 U.S.C. 2021 et seq.
Toxic Substances Control Act of 1976	15 U.S.C. 2601 et seq.
Disposal of Solid Waste	NAC 444.570 – 444.7499
Disposal of Hazardous Waste	NAC 444.850 – 444.8746
Storage Tanks	NAC 459.9921 – 459.999
Polychlorinated Biphenyl	NAC 444.940 – 444.9555
Radioactive Waste Management	DOE Order 435.1 (July 9, 1999; Change 1, August 28, 2001; Certified, January 9, 2007)
Mutual Consent Agreement	January 1994; modified 1995 and 1998
Settlement Agreement for Mixed Transuranic Waste	June 1992
Human Health	
Occupational Safety and Health Act of 1970	29 U.S.C. 651 et seq.
Noise Control Act of 1972, as amended	42 U.S.C. 4901 et seq.
Procedural Rules for DOE Nuclear Facilities	10 CFR Part 820
Nuclear Safety Management	10 CFR Part 830
Occupational Radiation Protection	10 CFR Part 835
Worker Safety and Health Program	10 CFR Part 851
Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction, as amended by Executive Order 13286	Executive Order 12699 (January 5, 1990)
Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities	DOE Order 5480.20A (November 15, 1994; Change 1, July 12, 2001)
Conduct of Operations Requirements for DOE Facilities	DOE Order 5480.19 (July 9, 1990; Change 1, May 18, 1992; Change 2, October 23, 2001)
Radiation Protection of the Public and the Environment	DOE Order 458.1 (February 11, 2011)
Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees	DOE Order 440.1B (May 17, 2007)
Maintenance Management Program for DOE Nuclear Facilities	DOE Order 433.1B (April 21, 2010)
Verification of Readiness to Startup or Restart Nuclear Facilities	DOE Order 425.1D (April 16, 2010; cancels DOE Order 425.1C, March 13, 2003)
Facility Safety	DOE Order 420.1B (December 22, 2005; Change 1, April 19, 2010)

Law, Regulation, Order, or Other Requirement	***Citation/Date***
Quality Assurance	DOE Order 414.1C (June 17, 2005)
DOE Radiological Health and Safety Policy	DOE Policy 441.1 (April 26, 1996)
Environmental Justice	
Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations	Executive Order 12898 (February 11, 1994)
Protection of Children from Environmental Health Risks and Safety Risks, as amended by Executive Order 13229	Executive Order 13045 (April 21, 1997)
Emergency Planning, Pollution Prevention, and Conservation	
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (also known as Superfund)	42 U.S.C. 9601 et seq.
Emergency Planning and Community Right-to-Know Act of 1986	42 U.S.C. 11001 et seq.
Pollution Prevention Act of 1990	42 U.S.C. 13101 et seq.
Homeland Security Act of 2002	6 U.S.C. 101 et seq. enacted by Public Law 107-296
Management of Domestic Incidents	Homeland Security Presidential Directive 5 (February 28, 2003)
National Preparedness	Homeland Security Presidential Directive 8 (December 17, 2003)
Designation, Reportable Quantities, and Notification	40 CFR 302.1 – 302.8
Federal Compliance with Pollution Control Standards, as amended by Executive Order 12580, Superfund Implementation	Executive Order 12088 (October 13, 1978)
Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements	Executive Order 12856 (August 3, 1993)
Strengthening Federal Environmental, Energy, and Transportation Management	Executive Order 13423 (January 24, 2007)
Federal Leadership in Environmental, Energy, and Economic Performance	Executive Order 13514 (October 5, 2009)
Safeguards and Security Program	DOE Order 470.4A (May 25, 2007)
Independent Oversight and Performance Assurance Program	DOE Order 470.2B (October 31, 2002)
Comprehensive Emergency Management System	DOE Order 151.1C (November 2, 2005)
Departmental Radiological Emergency Response Assets	DOE Order 153.1 (June 27, 2007)
State of Nevada Chemical Catastrophe Prevention Act and the Chemical Accident Prevention Program	Nevada Legislature Senate Bill 641 (July 1991) and NRS 459.380 – 459.3874

BLM = Bureau of Land Management; CFR = Code of Federal Regulations; EPA = U.S. Environmental Protection Agency; NAC = Nevada Administrative Code; NRS = Nevada Revised Statute; P.L. = Public Law; U.S.C. = United States Code.

9.1.1 Environmental Quality

National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.). The purposes of NEPA, as amended, are: (1) to declare a national policy that will encourage productive and enjoyable harmony between man and his environment; (2) to promote efforts that will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; (3) to enrich the understanding of the ecological systems and natural resources important to the Nation; and (4) to establish a Council on Environmental Quality (CEQ). NEPA establishes a national policy requiring that Federal agencies consider the environmental impacts of major Federal actions that significantly affect the quality of the human environment before making decisions and taking actions to implement those decisions. Implementation of NEPA requirements in accordance with CEQ regulations (40 CFR Part 1500 et seq.) may result in a categorical exclusion, an environmental assessment and Finding of No Significant Impact, or an environmental impact statement. This *NNSS SWEIS* has been prepared in accordance with NEPA requirements, CEQ regulations (40 CFR Part 1500 et seq.), and DOE provisions for implementing the procedural requirements of NEPA (10 CFR Part 1021; DOE Order 451.1B, Change 1). It discusses reasonable alternatives and their potential environmental consequences.

U.S. Air Force (USAF) Environmental Impact Analysis Process (32 CFR Part 989). This regulation implements the USAF environmental impact analysis process and provides procedures for environmental impact analysis both within the United States and abroad. The National Nuclear Security Administration (NNSA) would comply with U.S. Department of Defense and USAF management policies and directives that are applicable to the activities discussed in this SWEIS and/or are conducted on USAF installations and ranges (e.g., the Nevada Test and Training Range, the Tonopah Test Range, and Nellis Air Force Base). Such USAF policies and directives standardize implementation of higher-level guidance, including laws and statutes, across the entire USAF. One example of such higher-level guidance is 32 CFR Part 989, "Environmental Impact Analysis Process," which deals with implementing NEPA on USAF real property.

Executive Order 11514, *Protection and Enhancement of Environmental Quality* (March 5, 1970), as amended by Executive Order 11991 (May 24, 1977). This Order requires Federal agencies to continuously monitor and control their activities (1) to protect and enhance the quality of the environment and (2) to develop procedures to ensure the fullest practicable provision of timely public information and understanding of Federal plans and programs that may have potential environmental impacts so that interested parties can submit their views. DOE issued regulations (10 CFR Part 1021) and DOE Order 451.1B, *National Environmental Policy Act Compliance Program*, in compliance with this Order.

DOE Order 450.1A, *Environmental Protection Program* (June 4, 2008). The purpose of this Order is to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources affected by DOE operations and that allow DOE to cost-effectively meet or exceed compliance with applicable environmental, public health, and resource protection requirements. The objectives are: (1) to implement sustainable practices for enhancing environmental, energy, and transportation management performance, as stipulated in Section 3(a) of Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, through environmental management systems that are part of Integrated Safety Management systems established pursuant to DOE Policy 450.4, *Safety Management System Policy*, dated 10-15-96; and (2) to achieve the DOE Sustainable Environmental Stewardship goals found in the attachment to this Order.

DOE Order 231.1A, *Environment, Safety, and Health Reporting* (August 19, 2003; Change 1, June 3, 2004). In accordance with DOE Order 231.1A, *Environment, Safety, and Health Reporting*, Annual Site Environmental Reports are prepared and submitted annually to DOE Headquarters, regulatory agencies, and interested stakeholders. These reports summarize calendar year environmental monitoring data at DOE sites (1) to describe the performance of the site's environmental management system, (2) to confirm compliance with standards and regulations, and (3) to highlight important programs.

9.1.2 Land Use

Federal Land Policy and Management Act (FLPMA) of 1976 (43 U.S.C. 1701–1784, enacted by Public Law 94-579, as amended). FLPMA governs the use of Federal lands that may be overseen by several agencies and establishes the procedure for applying to the Bureau of Land Management (BLM) for land withdrawals and rights-of-way. Land use is addressed in Chapter 4, Sections 4.1.1, 4.2.1, 4.3.1, and 4.4.1.

Military Lands Withdrawal Act of 1999 (Public Law 106-65). On October 5, 1999, this Act renewed withdrawal of lands known as Pahute Mesa that are an integral part of the Nevada National Security Site (NNSS) and include the site of nuclear weapons testing activities. Pursuant to the Act, these lands were transferred from the U.S. Department of Defense to DOE, thus aligning jurisdictional responsibilities consistent with DOE's retention of environmental, safety, and health responsibilities at the NNSS.

DOE Order 430.1B, *Real Property Assessment Management* (September 24, 2003; Change 1, February 8, 2008). The objective of this Order is to establish a corporate, holistic, and performance-based approach to real property life-cycle asset management that links real property asset planning, programming, budgeting, and evaluation to program mission projections and performance outcomes. To accomplish the objective, this Order sets forth the requirements for the major real property asset management functional components of planning, real estate, acquisition, maintenance and recapitalization, disposition and long-term stewardship, value engineering, and performance goals and measures. One of the requirements is documentation of the results of real property asset site planning and performance in a Ten-Year Site Plan (TYSP) that is kept current and covers a 10-year planning horizon. The content of the TYSP must address how the site's real property assets will support the DOE's strategic plan, the Secretary of Energy's 5-year planning guidance, and appropriate program guidance. It must be a comprehensive site-wide plan encompassing the needs of tenant activities. This Order applies to DOE/NNSA for operations on the NNSS, as well as at the North Las Vegas Facility (NLVF) and Remote Sensing Laboratory (RSL).

9.1.3 Infrastructure and Energy

Energy Policy Act of 2005 (42 USC 15801 et seq.). Signed on August 8, 2005, this Act was the first omnibus energy legislation enacted in more than a decade. Major provisions include tax incentives for domestic energy production and energy efficiency, a mandate to double the Nation's use of biofuels, repeal of restrictions on interstate utility holding companies, faster procedures for energy production on Federal lands, and authorization of numerous Federal energy research and development programs. Applicability for DOE ranges from energy management requirements, procurement of energy-efficient products, assessment of renewable energy resources, and Price-Anderson Amendments Act requirements.

Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (January 24, 2007). This Order sets goals for Federal agencies to conduct their environmental, transportation, and energy-related activities in support of their respective missions in an integrated, efficient, continuously improving, and sustainable manner that complies with the law and all regulatory requirements and is environmentally, economically, and fiscally sound.

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (October 5, 2009). This Order focuses on improving and strengthening the overall sustainability of the Federal Government. All Federal agencies are required to inventory their greenhouse gas (GHG) emissions, set targets to reduce their emissions by 2020, and develop a plan for meeting a wide range of goals for improving sustainability, such as water efficiency, waste reduction, sustainable community development planning, high-performance buildings, sustainable acquisition, electronics stewardship, and environmental management.

In accordance with Executive Order 13514, DOE published its *Strategic Sustainability Performance Plan – Discovering Sustainable Solutions to Power and Secure America's Future* (Strategic Sustainability Performance Plan) (DOE 2010f) in September 2010. The Strategic Sustainability Performance Plan, will be updated annually, and progress toward its goals will be reported. The Plan includes the following: (1) sustainability goals and targets, including GHG reduction targets; (2) integration with overall strategic planning and budgeting processes within DOE; (3) activities, policies, plans, procedures, goals, schedules, and milestones needed to implement Executive Order 13514; (4) performance metrics and evaluation of projects based on lifecycle return on investment; (5) involvement of DOE employees in achieving sustainability goals; and (6) climate change adaptation planning.

DOE Order 430.2B, *Departmental Energy, Renewable Energy, and Transportation Management* (February 27, 2008). This Order provides the requirements and responsibilities for DOE or NNSA sites to assist DOE in meeting its energy efficiency goals and objectives in electricity, water, and thermal consumption, conservation, and savings, including goals and objectives contained in Executive Order 13423. This Order requires sites to develop an energy management program and to have an Executable Plan for the program in place by December 31, 2008. The Executable Plan must be integrated with the site's TYSP.

9.1.4 Transportation

Hazardous Materials Transportation Act of 1975, as amended (49 U.S.C. 5101 et seq.). The transportation of radioactive materials is regulated jointly by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT). DOT regulates shippers and carriers of hazardous materials, including radioactive material. DOT's responsibility includes vehicle safety, routing, shipping papers, and emergency response information and shipper/carrier training requirements. NRC regulates users of radioactive material in 17 states (33 states regulate material within their borders) and approves the design, fabrication, use, and maintenance of shipping containers for more-hazardous radioactive material shipments (NTA 2009). NRC requires radioactive materials to be shipped in accordance with the hazardous materials transportation safety regulations of DOT. DOT regulations prescribe limits on the maximum amounts of radioactivity that can be transported, such that doses from any accidents involving these packages would have no substantial health risks.

Transportation of hazardous materials that occurs entirely on DOE property (i.e., on the NNSS), to which public access is controlled at all times through the use of gates and guards, is subject to applicable DOE directive and transportation safety requirements set forth in 10 CFR Part 830, Subpart B. DOE transport of hazardous materials (e.g., mixed low-level radioactive waste) off site for treatment, over highways to which the public has access, would be subject to applicable DOT, DOE, and U.S. Environmental Protection Agency (EPA) directives. Potential transportation impacts from implementation of the alternatives analyzed in this SWEIS are discussed in Chapter 5, Sections 5.1.3, 5.2.3, 5.3.3, and 5.4.3.

10 CFR Part 71, "Packaging and Transportation of Radioactive Material." These NRC regulations include detailed packaging design requirements and package certification testing requirements. Complete documentation of design and safety analysis and the results of the required testing are submitted to NRC to certify the package for use. This certification testing involves the following components: heat, physical drop onto an unyielding surface, water submersion, puncture by dropping the package onto a steel bar, and gas tightness.

DOE Order 461.1A, *Packaging and Transfer or Transportation of Materials of National Security Interest* (April 26, 2004). This Order establishes the requirements and responsibilities for offsite shipments of naval nuclear fuel elements, Category I and Category II special nuclear material (SNM), nuclear explosives, nuclear components, special assemblies, and other materials of national security interest; onsite transfers of naval nuclear fuel elements, Category I and II SNM, nuclear components, special assemblies and other materials of national security interest; and certification of packages for Category I and II SNM, nuclear components, and other materials of national security interest. This Order is applicable to primary DOE organizations, including NNSA.

DOE Order 460.2A, *Departmental Materials Transportation and Packaging Management* (December 22, 2004). This Order states that DOE operations shall be conducted in compliance with all applicable international, Federal, state, local, and tribal laws, rules, and regulations governing materials transportation that are consistent with Federal regulations, unless exemptions or alternatives are approved in accordance with DOE Order 460.1B. This Order also states that it is DOE policy that shipments will comply with the DOT requirements of 49 CFR Parts 100–185, except those that infringe on maintenance of classified information. This Order applies to NNSA.

DOE Order 460.1B, *Packaging and Transportation Safety* (April 4, 2003). The objective of this Order is to establish safety requirements for the proper packaging and transportation of NNSA offsite shipments and onsite transfers of hazardous materials and for modal transport. (Offsite is any area within or outside a DOE site to which the public has free and uncontrolled access; onsite is any area within the boundaries of a DOE site or facility to which access is controlled.) Operations conducted under DOE Order 461.1, *Packaging and Transfer or Transportation of Materials of National Security Interest,* are excluded from this Order.

9.1.5 Geology and Soils

Executive Order 12699, *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction* (January 5, 1990), as amended by Executive Order 13286 (February 28, 2003). This Order requires Federal agencies to: (1) reduce risks to occupants of buildings owned, leased, or purchased by the Federal government or buildings constructed with Federal assistance and to persons who would be affected by failures of Federal buildings in earthquakes; (2) improve the capability of existing Federal buildings to function during or after an earthquake; and (3) reduce earthquake losses of public buildings, all in a cost-effective manner. Each Federal agency responsible for the design and construction of a Federal building shall ensure that the building is designed and constructed in accordance with appropriate seismic design and construction standards. This requirement pertains to all building projects for which development of detailed plans and specifications is initiated subsequent to the issuance of this Order; therefore, it applies to the proposed activities evaluated in this SWEIS. Seismic risks and potential impacts are evaluated in Chapters 4 and 5 of this SWEIS.

DOE Order 420.1B, *Facility Safety* (December 22, 2005). This Order requires that nuclear and nonnuclear facilities be designed, constructed, and operated so that the public, workers, and environment are protected from adverse impacts of natural phenomena hazards, including earthquakes. The Order stipulates natural phenomena hazards mitigation for DOE facilities and specifically provides for reevaluation and upgrade of existing DOE facilities when there is a significant degradation in the safety basis for the facility. The design and construction of new facilities and major modifications to existing facilities proposed in this SWEIS must address natural phenomena mitigation design.

9.1.6 Hydrology

Clean Water Act of 1972, as amended (33 U.S.C. 1251 et seq.). The Clean Water Act, which amended the Federal Water Pollution Control Act, was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The Act prohibits the unpermitted discharge of toxic pollutants in toxic amounts to navigable waters of the United States. Section 313 of the Clean Water Act requires all branches of the Federal Government engaged in any activity that might result in a discharge or runoff of pollutants to surface waters to comply with Federal, state, interstate, and local requirements.

Section 404 of the Clean Water Act, providing the U.S. Army Corps of Engineers permitting authority over activities that discharge dredge or fill materials into waters of the United States, including wetlands, is addressed in Section 9.1.7, "Biological Resources."

The Act also provides guidelines and limitations for effluent discharges from point-source discharges and establishes the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES program is administered by EPA, pursuant to regulations in 40 CFR Part 122 et seq., and may be delegated to states. Stormwater provisions of the NPDES program are set forth in 40 CFR 122.26, and require discharge permits for industrial and construction activities disturbing 0.4 hectares (1 acre) or more. The NNSS operations do not require any NPDES permits (DOE/NV 2009d). At NLVF, a NPDES permit regulates the discharge of pumped groundwater. At the NNSS, Clean Water Act regulations are followed through compliance with wastewater discharge permits issued by the Nevada Division of Environmental Protection (NDEP). Wastewater discharge permits held by NNSA for the NNSS and other locations are identified in this chapter in Section 9.2, "Applicable Permits."

Safe Drinking Water Act of 1974, as amended (42 U.S.C. 300(f) et seq.). The primary objective of the Safe Drinking Water Act is to protect the quality of public drinking water supplies and sources of drinking water. The implementing regulations, administered by EPA unless delegated to states, establish national primary drinking water standards applicable to public water systems. These regulations (40 CFR Parts 123, 141, 145, 147, and 149) specify maximum contaminant levels, including those for radioactivity, in public water systems, which are generally defined as systems that have at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents. These standards apply to the NNSS and other locations for community and non-community water supplies. The State of Nevada implements its own safe drinking water program under authority of the Safe Drinking Water Act. Nevada has adopted standards at least as stringent as the EPA's and has a safe drinking water program in place to make sure water systems meet these standards. NDEP's Bureau of Safe Drinking Water is responsible for enforcement of these standards.

National Wellhead Protection Program (established by the 1986 amendments to the Safe Drinking Water Act). The Safe Drinking Water Act amendments require each state to develop a Comprehensive State Groundwater Protection Program and encourage local water systems to develop wellhead protection plans for their community water systems.

40 CFR Part 141, "National Primary Drinking Water Regulations." These regulations provide maximum contaminant levels, monitoring and analytical requirements, reporting and record-keeping requirements, special regulations such as prohibition of lead use, maximum contaminant level goals, national primary drinking water regulations, filtration and disinfection rules; and control of lead and copper requirements, as well as other subparts to follow.

40 CFR Part 142, "National Primary Drinking Water Regulations Implementation." These regulations provide the proper measures for implementation and enforcement of the National Primary Drinking Water Regulations (40 CFR Part 141).

40 CFR Part 143, "National Secondary Drinking Water Regulations." This part establishes national secondary drinking water regulations pursuant to Section 1412 of the Safe Drinking Water Act, as amended (42 U.S.C. 300g-1). These regulations control contaminants in drinking water that primarily affect the aesthetic qualities relating to the public acceptance of drinking water. At considerably higher concentrations of these contaminants, health implications may also exist as well as aesthetic degradation. The regulations are not federally enforceable, but are intended as guidelines for the states.

10 CFR Part 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements." DOE requirements for compliance with Executive Order 11988, "Floodplain Management," and Executive Order 11990, "Protection of Wetlands," are set forth in 10 CFR Part 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements." 10 CFR Part 1022 establishes policy and procedures for DOE responsibilities under both Executive Orders, including: (1) DOE policy regarding the consideration of floodplain and wetland factors in DOE planning and decisionmaking and (2) DOE procedures for identifying proposed actions located in a floodplain or wetland, providing opportunity for early public review of such proposed actions, preparing floodplain or wetland assessments, and issuing statements of findings for actions in a floodplain. DOE shall accommodate the requirements of Executive Order 11988 and Executive Order 11990, to the extent possible, through applicable DOE NEPA procedures or, when appropriate, using the environmental review process under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (see Section 9.1.14 of this Chapter). Additionally, DOE must specifically to adhere to the flood design and evaluation criteria specified in DOE Standards 1020–2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, and 1023–95, *Natural Phenomena Hazards Assessment Criteria*. Chapter 5 of this SWEIS addresses the potential floodplain impacts associated with the activities analyzed for each of the alternatives.

Executive Order 11988, *Floodplain Management* (May 24, 1977). This Order (implemented by DOE in 10 CFR Part 1022) directs Federal agencies to evaluate the potential effects of any actions that may be taken in a floodplain. When conducting activities in a floodplain, Federal agencies are required to take actions to reduce the risk of flood damage; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

State of Nevada, Nevada Revised Statutes (NRS) 534, "Underground Water and Wells." The Nevada Division of Water Resources oversees these regulations. This statute regulates the drilling, construction, and licensing of new wells and reworking of existing wells to prevent the contamination and excess use (i.e., waste) of groundwater. NNSA complies with this NRS as a matter of comity, holding to the position that state licensing requirements do not apply to the Federal government and its contractors as a matter of law, under the principle of Federal supremacy and associated case law. Two current operations that voluntarily comply with this Nevada Administrative Code (NAC) are the Underground Test Area (UGTA) Project, which drills new wells and reworks old wells, and the Borehole Management Program, which plugs abandoned the NNSS boreholes (DOE/NV 2009d). For information on the current status of the Borehole Management Program, see Chapter 3 of this SWEIS.

State of Nevada, NAC 445A, "Water Controls (Public Water Systems)." This regulation enforces Safe Drinking Water Act requirements and sets standards for permitting, design, construction, operation, maintenance, certification of operators, and water quality of public water systems. NDEP's Bureau of Safe Drinking Water oversees and enforces compliance with public water system permit requirements. Permits issued by the Bureau for three of the NNSS public water systems and two potable water hauler trucks are listed in Section 9.2.

NAC 445A and 444, "Water Controls (Water Pollution Control and Sanitation)." This regulation protects the waters of the state from the discharge of pollutants. NDEP's Bureau of Water Pollution Control oversees and enforces compliance with Nevada's water pollution control laws and regulations. These regulations apply to the collection, treatment, and disposal of wastewater and sewage at the NNSS. The requirements are issued in permits to NNSA as shown in Table 9-2. NNSA also obtains underground injection control (UIC) permits from NDEP for tracer tests in UGTA Project characterization wells (DOE/NV 2009d).

NAC 445A.810–445A.925, "UIC Program." NDEP's Bureau of Safe Drinking Water issues permits to protect the public health and safety and the general welfare of the people of Nevada. An applicant for a permit to inject fluids must satisfy the state that the underground injection will not endanger any source of drinking water (NAC 445A.865, NAC 445A.867). Construction of an injection well for which a permit is required may not begin until the permit has been issued **(NAC 445A.905).** Plugging and abandonment requirements may be added as a condition to the permit or the requirements in the NAC must be followed. (See NRS 534 above for information on plugging abandoned boreholes on the NNSS.)

Fluid Management Plan for the UGTA Project. UGTA Project wells are regulated by the State of Nevada through an agreement between NNSA and the NDEP called the Fluid Management Plan for the

UGTA Project (DOE 2009l). The plan was developed in place of issuing separate water pollution control permits for each UGTA characterization well under the Clean Water Act. The plan identifies the methods for disposing groundwater pumped from UGTA wells during drilling, construction, development, testing, experimentation, and/or well water sampling based on radiological contamination levels.

9.1.7 Biological Resources

Bald and Golden Eagle Protection Act of 1973, as amended (16 U.S.C. 668–668d). The Bald and Golden Eagle Protection Act, as amended, makes it unlawful to take, pursue, molest, or disturb bald (American) and golden eagles, their nests, or their eggs anywhere in the United States. A permit must be obtained from the U.S Department of Interior to relocate a nest that interferes with resource development or recovery operations. Both bald and golden eagles occur on the NNSS (DOE/NV 2009d). During the project planning phase and prior to construction, biological surveys are conducted to prevent direct harm to eagles and their nests and eggs. See Chapter 5, Sections 5.1.7, 5.2.7, 5.3.7, and 5.4.7, for bald and golden eagle impact analysis.

Clean Water Act, Section 404, Jurisdictional Wetlands. The Clean Water Act prohibits the discharge of pollutants (including dredged or fill material) into "waters of the United States," except as authorized by a permit. Joint guidance by EPA and the U.S. Army Corps of Engineers, issued in response to a June 2006 Supreme Court decision, provides new guidelines for determining whether tributaries and wetlands are waters of the United States and are regulated under the Clean Water Act (EPA and Army 2007). Based on the new guidance, no wetlands at the NNSS are expected to qualify as waters of the United States; a site-specific evaluation by the U.S. Army Corps of Engineers, based on the new guidance, will be determinative.

Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The Endangered Species Act is intended to prevent the further decline of endangered and threatened species and to restore these species and habitats. Section 7 of this Act requires Federal agencies having reason to believe that a prospective action may affect an endangered or threatened species or its habitat to consult with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to ensure that the action does not jeopardize the species or destroy its habitat (50 CFR Part 17). If, despite reasonable and prudent measures to avoid or minimize such impacts, the species or its habitat would be jeopardized by the action, a review process is specified to determine whether the action may proceed as an incidental taking. Chapter 4 identifies potential endangered, threatened, or listed species in the affected environment. Chapter 5 describes the potential impacts on those species from implementation of the alternatives.

Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 et seq.). The Migratory Bird Treaty Act, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying conditions such as mode of harvest, hunting seasons, and bag limits. The Act stipulates that it is unlawful, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess…any migratory bird…or any part, nest, or egg of any such bird." Of the 239 species of birds observed on the NNSS, 234 are protected under the Migratory Bird Treaty Act (DOE/NV 2009d). During the project planning phase and prior to construction, biological surveys are conducted to prevent direct harm to the birds and their nests and eggs. Potential impacts on migratory birds from implementation of the alternatives are analyzed in Chapter 5, Sections 5.1.7 and 5.4.7.

National Wildlife Refuge System Administrative Act of 1966, as amended (16 U.S.C. 668dd-668ee). This Act provides for the administration and management of the national wildlife refuge system, including wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

The Desert National Wildlife Refuge is protected under this act. Biological monitoring is conducted to verify that tests conducted at the Nonproliferation Test and Evaluation Complex in Area 5 on the NNSS do not disperse toxic chemicals that could harm Desert National Wildlife Refuge biota (DOE/NV 2009d).

Wild Horses and Burros Act of 1971 (16 U.S.C. 1331–1340). This Act requires the protection, management, and control of wild free-roaming horses and burros on public lands. Wild horses on the NNSS may wander off the site onto public lands; therefore, they are protected under this Act (DOE/NV 2009d). Potential impacts on wild horses and burros protected under this Act are analyzed in Chapter 5, Sections 5.1.7, 5.2.7, 5.3.7, and 5.4.7.

Executive Order 11990, *Protection of Wetlands* (May 24, l977). This Order, implemented by DOE through 10 CFR Part 1022, directs Federal agencies to ensure consideration of wetlands protection in decisionmaking and to evaluate the potential impacts of any new construction proposed in a wetland. Federal agencies shall avoid the destruction or modification of wetlands and avoid direct or indirect support of new construction in wetlands if a practicable alternative exists.

Executive Order 13112, *Invasive Species* (February 3, 1999). This Order establishes the National Invasive Species Council. It requires Federal agencies to act to prevent the introduction of invasive species and provide for their control; to implement restoration with native species; and to minimize actions that could spread invasive species. This Order applies to NNSA as land-disturbing activities on the NNSS have resulted in the spread of numerous invasive plant species (DOE/NV 2009d). Potential impacts and habitat reclamation to control invasive species are addressed in Chapter 5, Sections 5.1.7 and 5.4.7.

Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (January 10, 2001). This Order directs Federal agencies taking actions with a measurable negative effect on migratory bird populations to develop and implement a Memorandum of Understanding with the U.S. Fish and Wildlife Service that promotes the conservation of migratory bird populations, in support of the Migratory Bird Treaty Act.

Five-Party Cooperative Agreement (1977 – see also Wild Horses and Burros Act of 1971). This five-party agreement between NNSA, the U.S. Air Force, the U.S. Fish and Wildlife Service, BLM, and the Nevada State Clearinghouse seeks coordination and cooperation in conducting resource inventories and developing management plans for wild horses and burros, and to maintain desirable habitat on federally withdrawn lands for these animals.

NAC 503.010–503.104, "Protection of Wildlife." This regulation identifies Nevada animal species (i.e., protected and not protected), and prohibits harm to protected species without a special permit. This applies to NNSA; potential impacts are addressed in Chapter 5, Sections 5.1.7, 5.2.7, 5.3.7, and 5.4.7.

9.1.8 Air Quality and Climate

Clean Air Act of 1970, as amended (42 U.S.C. 7401 et seq.). The Clean Air Act is intended to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." Section 118 of the Clean Air Act (42 U.S.C. 7418) requires that each Federal agency with jurisdiction over any property or facility engaged in any activity that might result in the discharge of air pollutants comply with "all Federal, state, interstate, and local requirements" with regard to the control and abatement of air pollution. Emissions of air pollutants from DOE facilities are regulated by EPA under 40 CFR Parts 50–99. Potential air quality impacts from implementation of the alternatives in this SWEIS are analyzed in Chapter 5, Sections 5.1.8, 5.2.8, 5.3.8, and 5.4.8.

40 CFR Part 50, "National Ambient Air Quality Standards (NAAQS)." The Clean Air Act requires EPA to set NAAQS for pollutants considered harmful to public health and the environment. The Clean Air Act establishes two types of NAAQs. *Primary standards* set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. *Secondary standards* set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. Air quality permits for the NNSS, NLVF, and RSL demonstrate compliance with NAAQS criteria pollutants as well as requirements such as applicable reporting and recordkeeping, opacity field monitoring, emission quantities of hazardous air pollutants (e.g., lead) and criteria pollutants, and summaries of significant malfunctions and repairs.

40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants (NESHAPs)." DOE facility emissions of radionuclides and other hazardous air pollutants, including a release of asbestos during demolition and renovation activities, are regulated under the NESHAPs program (40 CFR Part 61, and 40 CFR Part 63, "NESHAPs for Source Categories" [i.e., Maximum Achievable Control Technology]). The NNSS radioactive air emissions are monitored on site to determine the public dose from inhalation and to determine compliance with NESHAPs under the Clean Air Act (DOE 2009d).

40 CFR Part 82, "Stratospheric Ozone Protection." The Clean Air Act establishes limits on the production and consumption of certain ozone-depleting substances according to specified schedules. At the NNSS, ozone-depleting substances are mainly used in air conditioning units in vehicles, buildings, refrigerators, drinking water fountains, vending machines, and laboratory equipment. While there are no reporting requirements, recordkeeping to document the usage of ozone-depleting substances and technician certification is required, and EPA may conduct random inspections to determine compliance (DOE/NV 2009d).

40 CFR Part 98, "Mandatory Greenhouse Gas Reporting." On October 30, 2009, EPA issued this regulation, which requires reporting of GHG emissions from large sources and suppliers in the United States. Its purpose is to collect accurate and timely emissions data for future policy decisions. Suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions are required to submit annual reports to EPA. EPA's GHG reporting system will provide a better understanding of where GHGs are coming from and guide development of sound policies and programs to reduce emissions. These comprehensive, nationwide emissions data will help in the study of climate change.

On July 20, 2010, EPA signed revisions to certain provisions of the Mandatory Greenhouse Gas Reporting Rule. These proposed amendments primarily make clarifying and technical changes to specific sections of the final rule that either were not clear or did not have the intended effect. This proposal is complementary to the proposed rulemaking, *Technical Corrections, Clarifying and Other Amendments to Certain Provisions of the Mandatory Greenhouse Gas Reporting Rule* (FR 75 114), published on June 15, 2010. Together, these two proposed rulemakings address the most significant questions raised during implementation. This proposed rule was published in the *Federal Register* on August 11, 2010.

NAC 445B.22097, "Standards of Quality for Ambient Air." This regulation identifies the minimum standards of quality for ambient air in Nevada, as required by NRS 445B.210. These standards shall be used when considering issuance of a permit for a stationary source and shall ensure that the stationary source will not cause the Nevada standards to be exceeded in areas where the general public has access. Minimum standards for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter smaller or equal to 10 microns in size (PM_{10}), lead, and hydrogen sulfide are identified. This regulation applies to NNSA; potential impacts are addressed in Chapter 5, Sections 5.1.8, 5.2.8, 5.3.8, and 5.4.8.

NAC 445B.3455 – 445B.3477, "Class II Operating Permits." These regulations specify the general requirements for obtaining a Class II air quality operating permit in Nevada for a proposed stationary source or a proposed modification to a stationary source. The application process is outlined and a list of required contents of the permit is provided. Necessary steps toward either applying for a revision or renewing an existing permit are also identified. All Class II operating permits must be renewed 5 years after their date of issuance. In accordance with NAC 445B.3477, a Class II general permit covering numerous similar stationary sources may be issued. NNSA has Class II permits for its facilities in Nevada. Impacts to air quality are addressed in Chapter 5, Sections 5.1.8, 5.2.8, 5.3.8, 5.4.8.

State of Nevada, NRS 445B.100–445B.825, "Air Pollution," and NRS 486A.010–486A.180, "Alternative Fuels; Clean Burning Fuels." The mission of NDEP's Bureau of Air Pollution Control is to achieve and maintain levels of air quality to protect human health and safety; prevent injury to plant and animal life; prevent damage to property; and preserve visibility and the scenic, esthetic, and historic values of the state (NDEP 2009a). The authority for the Bureau to implement air pollution control requirements has been established in NRS 445B.100 – 445B.825, inclusive, and NRS 486A.010 – 486A.180, inclusive. DOE works with the Bureau's Compliance and Enforcement Branch to ensure that all air quality sources operate in compliance with Federal and state laws and regulations. For example, NNSA must allow the Clark County Department of Air Quality and Environmental Management to conduct inspections of NLVF and RSL permitted equipment.

9.1.9 Visual Resources

BLM Manual Section 8400 – Visual Resource Management (BLM 2009a). This manual describes BLM's policy that it has a basic stewardship responsibility to identify and protect visual values on all BLM lands (BLM 2009b). BLM is responsible for ensuring that the scenic values of public lands are considered before allowing uses that may have negative visual impacts. This is accomplished through BLM's Visual Resource Management system described in Section 8400 of the manual, a system that involves inventorying scenic values and establishing management objectives for those values through the resource management planning process, and evaluating proposed activities to determine whether they conform to management objectives (BLM 2009c). The visual resource impacts on public lands from implementation of the proposed alternatives are presented in Chapter 5, Sections 5.1.9, 5.2.9, 5.3.9, and 5.4.9.

9.1.10 Cultural Resources

American Indian Religious Freedom Act of 1978, as amended (42 U.S.C. 1996 and 1996a). This Act reaffirms American Indian religious freedom rights under the First Amendment and establishes U.S. policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. It includes access to sites on Federal properties integral to religious ceremonies and traditional rites. It also directs agencies to consult with interested American Indian groups and leaders to develop and implement policies and procedures to protect and preserve cultural and spiritual traditions and sites. Potential impacts from implementation of the SWEIS alternatives are analyzed in Chapter 5, Sections 5.1.10, 5.2.10, 5.3.10, and 5.4.10.

Antiquities Act of 1906, as amended (16 U.S.C. 431–433). This Act was the first Federal involvement in the protection and management of cultural resources on public lands and allows the President to set aside federally owned land as historic landmarks. It also established that objects of antiquity on Federal lands had to be preserved, restored, and maintained; could only be disturbed under permit from a Federal agency; and could only be disturbed for scientific and educational purposes by qualified personnel. It required that artifacts and associated documents be cared for in public museums; a system be created to establish national historic monuments; and criminal penalties be assessed for violations by any person who excavates, injures, obtains objects from, or destroys any historical ruin or monument on federally owned or controlled land without the permission of the appropriate Federal department (DOE/NV 2009d). Potential impacts from implementation of the SWEIS alternatives are analyzed in Chapter 5, Sections 5.1.10, 5.2.10, 5.3.10, and 5.4.10.

Archaeological and Historic Preservation Act of 1960, as amended (16 U.S.C. 469–469c-2). The purpose of this Act is to provide for the preservation of historical and archaeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as a result of Federal actions. Potential impacts from implementation of the SWEIS alternatives are analyzed in Chapter 5, Sections 5.1.10, 5.2.10, 5.3.10, and 5.4.10.

Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa et seq.). This Act protects cultural resources on Federal lands greater than 100 years old and prohibits looting, vandalism, and unauthorized excavation. No one may sell, buy, or trade items from a cultural resource on Federal land. Criminal and civil penalties for violations are mandated, including forfeiture of equipment and vehicles used in any violations. Permits for excavation and removal of cultural resources on Federal lands by qualified persons are obtained from the appropriate Federal agency and for the purpose of furthering archaeological knowledge for the benefit of the public. The Federal land manager must contact any American Indian tribe or organization with an interest in the cultural resource to be excavated. Recovered items remain the property of the United States and are to be preserved by a qualified institution. Federal agencies cannot reveal the location of a cultural resource if by doing so the cultural resource is at risk of being altered or destroyed. Agencies are also to develop plans for surveying lands other than those scheduled for undertakings and to record and report violations of the Act. Potential impacts from implementation of the SWEIS alternatives are analyzed in Chapter 5, Sections 5.1.10, 5.2.10, 5.3.10, and 5.4.10.

Historic Sites, Buildings, and Antiquities Act of 1935. This Act established a national policy of preserving historic sites, buildings, and objects of national significance. It gave the Secretary of Interior authority to acquire, restore, and maintain such sites and established the National Survey of Historic Sites and Buildings (now known as the National Register of Historic Places [NRHP]), the Historic Sites Survey, the Historic American Buildings Survey (HABS), and the Historic American Engineering Record (HAER).

National Historic Preservation Act (NHPA) of 1966, as amended (16 U.S.C. 470 et seq.). This Act establishes a leadership role for the Federal government in the preservation of cultural resources and promotes a policy of cooperation between Federal agencies, states, tribes, and local governments. The Act also created the Advisory Council on Historic Preservation to serve as an independent counsel on historic preservation issues to the President, Congress, and Federal and state agencies. Most importantly, the Act explains the responsibilities of Federal agencies and outlines a process by which significant cultural resources are recognized and protected from undertakings and potential effects. Key sections of the NHPA pertaining to this SWEIS are described below.

- **NHPA Section 106** requires Federal agencies to consider in the planning stages of undertakings the potential impacts on historic properties listed on or eligible for the NRHP and provide consulting agencies, including the Nevada State Historic Preservation Office and the Advisory Council on Historic Preservation, sufficient information and time to comment on the effects of the undertaking.

- **NHPA Section 110** requires Federal agencies to inventory cultural resources under their jurisdiction, evaluate and nominate eligible cultural resources for listing on the NRHP, and establish a historic preservation program. Compliance with Section 110 implies monitoring the conditions of historic properties and taking action to preserve them, stressing that Federal agencies must take an active role in the preservation and management of all significant cultural resources under their jurisdiction.

- **NHPA Section 112** requires that both agency and contracting personnel conducting cultural resources investigations meet certain professional qualifications and that their investigations meet certain standards. All data and records for historic properties are to be maintained and available for research purposes.

- **NHPA Section 304** directs Federal agencies, after consultation with the Secretary of the Interior, to withhold from the public information regarding the location or character of a cultural resource when such disclosure may cause substantial risk, such as theft or destruction, to the resource.

Potential impacts from implementation of the alternatives are analyzed in Chapter 5, Sections 5.1.10, 5.2.10, 5.3.10, and 5.4.10. In addition, DOE has started consultations under Section 106 with the State Historic Preservation Officer, Advisory Council on Historic Preservation, and American Indian tribes on the possible adverse impacts of the proposed actions and alternatives being evaluated in this SWEIS. For further information on consultations with American Indians, see Chapter 10 of this SWEIS.

Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 U.S.C. 3001 et seq.). This Act requires Federal agencies to consult with American Indian tribes regarding human remains and materials in their collections. The Act acknowledges tribal rights to American Indian human remains, funerary objects, sacred objects, and objects of cultural patrimony. Persons can be prosecuted who knowingly sell or purchase, use for profit, or transport for sale or profit American Indian human remains or objects covered by this Act. In the case of unexpected discoveries of American Indian graves or grave goods during activities on Federal lands, the tribes or organizations are to be notified and procedures are agreed upon to establish affiliation and for disposition of the remains or objects. The Act provides for the repatriation of these cultural items from Federal archaeological collections and collections held by museums receiving Federal funding to federally recognized tribes when cultural affiliations can be established. This regulation applies to NNSA during implementation of activities analyzed in this SWEIS. Impacts of proposed DOE/NNSA activities on cultural resources important to American Indians, are addressed in Chapter 5, Sections 5.1.10, 5.2.10, 5.3.10, and 5.4.10.

Executive Order 11593, *Protection and Enhancement of the Cultural Environment* (May 13, 1971). This Order formally designates the Federal Government as the leader in preserving, restoring, and maintaining the historic and cultural environment of the Nation. It gives Federal agencies the responsibility for locating, inventorying, and nominating cultural resources to the NRHP.

Executive Order 13007, *Indian Sacred Sites* (May 24, 1996). This Order directs Federal agencies to accommodate the access and ceremonial use of American Indian sacred sites on their lands by American Indian religious practitioners. The confidentiality of these sites is to be maintained by the Federal agency and their physical integrity is not to be adversely affected.

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments* (November 6, 2000). This Order supplements the Executive Memorandum (dated April 29, 1994) entitled "Government-to-Government Relations with Native American Tribal Governments," and states that each executive department and agency shall consult, to the greatest extent practicable and to the extent permitted by law, with tribal governments prior to taking actions that affect federally recognized tribal governments. This Order also states that each executive department and agency shall assess the impact of Federal Government plans, projects, programs, and activities on tribal trust resources and ensure that tribal government rights and concerns are considered during the development of such plans, projects, programs, and activities.

Executive Order 13287, *Preserve America* (March 3, 2003). This Order reemphasizes the Federal Government policy to provide leadership in advancing the protection, enhancement, and contemporary use of federally owned historic properties and to promote intergovernmental cooperation and partnerships for the preservation and use of the historic properties. Federal agencies are to maximize their efforts to integrate the policies, procedures, and practices of the NHPA and this Order into their program activities to efficiently and effectively advance historic preservation objectives in the pursuit of their missions.

DOE Order 144.1, *American Indian Tribal Government Interactions and Policy* (January 16, 2009; Change 1, November 6, 2009). This Order communicates responsibilities for interacting with American Indian governments and transmits the DOE American Indian and Alaska Native Tribal Government Policy (i.e., "Indian Policy"), including its guiding principles. This policy outlines the requirements to be followed by DOE in its interactions with federally recognized American Indian tribes. It is based on the U.S. Constitution, treaties, Supreme Court decisions, Executive Orders, statutes, existing Federal policies, and tribal laws, as well as the dynamic political relationship between Indian nations and the Federal Government. The policy principles include DOE's responsibilities to implement a proactive outreach effort consisting of notice and consultation regarding current and proposed actions affecting the tribes and to ensure integration of Indian nations into the decisionmaking processes.

9.1.11 Waste Management

Atomic Energy Act (AEA) as amended in 1954 (42 USC 2011 et seq.). The AEA provides fundamental jurisdictional authority to DOE and NRC over governmental and commercial use of nuclear materials. The AEA authorizes DOE to establish standards to protect health and minimize danger to life or property for activities under DOE's jurisdiction. DOE has issued a series of departmental orders to establish an extensive system of standards and requirements to ensure safe operation of DOE facilities. DOE regulations are found in 10 CFR. The DOE regulations that are the most relevant to radioactive waste and materials management include:

- Nuclear Safety Management (10 CFR Part 830)
- Occupational Radiation Protection (10 CFR Part 835)
- Byproduct Material (10 CFR Part 962)

The AEA also gives EPA the authority to develop generally applicable standards for protection of the general environment from radioactive materials. EPA has promulgated several regulations under this authority. The EPA regulation that is the most relevant to radioactive waste and materials management activities addressed by this SWEIS (e.g., transuranic waste at the NNSS) is 40 CFR Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes." Transuranic waste (including mixed transuranic waste) generated as part of NNSS operations or from in-state environmental restoration programs is sent to the Area 5 Radioactive Waste Management Complex for temporary storage before shipment off site for further characterization and/or final disposition. See Chapter 4, Section 4.1.11.1.3, for a summary of transuranic waste management at NNSS.

Resource Conservation and Recovery Act (RCRA) of 1976, as amended (42 U.S.C. 6901 et seq.). RCRA has four main goals: (1) to protect human health and the environment from hazards posed by waste disposal; (2) to conserve energy and natural resources through waste recycling and recovery; (3) to reduce or eliminate the generation of waste, including hazardous waste; and (4) to ensure that wastes are managed in an environmentally safe manner. RCRA focuses only on active and planned facilities. *(Note: Hazardous waste cleanup operations at NNSS [i.e., nonhistoric waste management activities, including satellite accumulation and the RCRA Part B Permit for the hazardous waste accumulation facility] are regulated under RCRA; they are not regulated under CERCLA. Historic contamination from the nuclear testing era is covered by the Federal Facilities Agreement and Consent Order [described below in Section 9.1.11]. Typically, the CERCLA regulations apply to historic cleanups such as Superfund and emergency response. The applicable emergency response requirements of CERCLA, as well as an overview of CERCLA, are described in Section 9.1.14.)*

The transportation and treatment, storage, and disposal (TSD) of solid and hazardous wastes are regulated by EPA under the authority of RCRA. The EPA regulations implementing RCRA (40 CFR Parts 260–282) define and identify hazardous waste; establish standards for waste transportation and TSD; and require permits for persons engaged in hazardous waste activities.

RCRA applies mainly to owners and operators of facilities that generate and manage hazardous waste. This Act imposed management requirements on generators and transporters of hazardous waste and upon owners and operators of TSD facilities. EPA has established a comprehensive set of regulations governing all aspects of TSD facilities, including location, design, operations, and closure. Any state that seeks to administer and enforce a hazardous waste program pursuant to RCRA may apply to EPA for authorization to administer its state program in lieu of the Federal program. EPA has authorized the State of Nevada to implement the state hazardous waste management program in lieu of the Federal RCRA program. Waste management is discussed in Chapter 4, "Affected Environment," and Chapter 5, "Environmental Consequences."

Federal Facility Compliance Act of 1992 (Public Law 102-386). The Federal Facility Compliance Act, enacted on October 6, 1992, amended RCRA Section 6961 and other sections and requires DOE to prepare plans that develop treatment capacity for mixed waste stored or generated at each facility, except for those facilities subject to a permit that establishes a schedule for treatment of such waste or an existing agreement or order governing the treatment of such waste to which the state is a party. The host state and/or EPA must approve each plan. Compliance with this Act by NNSA per the State of Nevada requires the identification of existing quantities for mixed waste, the proposal of methods and technologies of mixed treatment and management, the creation of enforceable timetables, and the tracking and completion of deadlines.

Federal Facility Agreement and Consent Order, as amended (February 2008). This Consent Order, agreed to by the State of Nevada, DOE Environmental Management, the U.S. Department of Defense, and DOE Legacy Management, became effective in May 1996. It addresses the environmental restoration of historically contaminated sites at the NNSS, parts of the Tonopah Test Range, parts of the Nevada Test and Training Range, the Central Nevada Test Area, and the Project SHOAL Area (DOE/NV 2009d). The Federal Facility Agreement and Consent Order incorporates RCRA and CERCLA elements that promulgate the characterization, restoration, and closure of identified sites.

Low-Level Radioactive Waste Policy Act, as amended in 1985 (42 USC 2021b et. seq.). This Act amended the AEA to specify that the Federal government (i.e., DOE and NRC) is responsible for disposal of low-level radioactive waste (LLW). If authorized by NRC under interstate compacts, states may regulate disposal of LLW from commercial sources. DOE remains responsible for the disposition of defense LLW (i.e., from DOE and U.S. Navy origin).

Toxic Substances Control Act of 1976 (15 U.S.C. 2601 et seq.). The Toxic Substances Control Act provides EPA with the authority to require testing of chemical substances entering the environment and to regulate them as necessary. EPA is also authorized to impose strict limitations on the use and disposal of polychlorinated biphenyls (PCBs), chlorofluorocarbons, asbestos, dioxins, certain metalworking fluids, and hexavalent chromium. The EPA regulations that establish prohibitions of and requirements for PCBs and PCB items are found in 40 CFR Part 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." Removal of any PCB transformers remaining at facilities on the NNSS and other locations would require disposition in compliance with this Act.

NAC 444.570–444.7499, "Disposal of Solid Waste." These regulations set standards for solid waste management systems, including the storage, collection, transportation, processing, recycling, and disposal of solid waste in Nevada. These regulations apply on the NNSS for active and inactive landfills as described in Chapter 4, Sections 4.1.11, 4.2.11, 4.3.11, and 4.4.11.

NAC 444.850–444.8746, "Disposal of Hazardous Waste." These regulations apply to the operation of hazardous waste disposal facilities in Nevada to comply with Federal RCRA regulations. These regulations apply on the NNSS for the operation of a hazardous waste storage unit in Area 5, the Explosives Ordnance Disposal Unit in Area 11, and the disposal of mixed low-level radioactive waste from DOE offsite facilities into a mixed waste disposal unit (DOE/NV 2009d). The impacts of hazardous waste storage on the NNSS from implementation of the alternatives proposed in this SWEIS are analyzed in Chapter 5, Sections 5.1.11, 5.2.11, 5.3.11, and 5.4.11.

NAC 459.9921–459.999, "Storage Tanks." These regulations enforce Federal RCRA regulations for the maintenance and operation of storage tanks, including underground storage tanks, to prevent environmental contamination. The underground storage tanks located on the NNSS and RSL–Nellis are either: (1) fully regulated under RCRA and registered with the state, (2) regulated under RCRA and registered with the state, but deferred from leak detection requirements, or (3) excluded from Federal and state regulations. For example, at RSL, Clark County enforces these regulations under approval from NDEP and issues permits to NNSA (DOE/NV 2009d). Underground storage tanks would be used not to store waste, but to store consumable materials such as fuel oil (e.g., diesel) or gasoline.

NAC 444.940–444.9555, "Polychlorinated Biphenyl." These regulations enforce Federal requirements for the handling, storage, and disposal of PCBs and contain record-keeping requirements for PCB activities.

DOE Order 435.1, *Radioactive Waste Management,* and DOE's associated, *Radioactive Waste Manual* (DOE M 435.1-1; July 9, 1999; Change 1, August 28, 2001; Certified, January 9, 2007). The objective of this Order is to ensure that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment. DOE radioactive waste management activities are required to be systematically planned, documented, executed, and evaluated.

Mutual Consent Agreement (January 1994; modified 1995 and 1998). This agreement between NNSA and the State of Nevada covered the storage and management of mixed waste on the NNSS that was generated or identified after March 1996. The Mutual Consent Agreement authorized the storage of newly identified mixed waste at the NNSS Area 5 Radioactive Waste Management Site. State of Nevada approval of a Treatment and Disposal Plan is required for mixed waste storage greater than 9 months (DOE 2008f).

Settlement Agreement for Mixed Transuranic Waste (June 1992). The NNSA Nevada Site Office signed this agreement with the State of Nevada that requires operation of the NNSS Area 5 TRU Waste Storage Pad in accordance with 40 CFR Part 264, Subpart I. Transuranic waste is discussed in Chapter 4, Sections 4.1.11, 4.2.11, 4.3.11, and 4.4.11.

9.1.12 Human Health

Occupational Safety and Health Act (OSHA) of 1970 (29 U.S.C. 651 et seq.). Section 4(b)(1) of OSHA exempts DOE and its contractors from the occupational safety requirements of OSHA. However, 29 U.S.C. 668 requires Federal agencies to establish their own occupational safety and health programs for their places of employment, consistent with OSHA standards. DOE Order 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*, states that DOE will implement a written worker protection program appropriate for the facility hazards that: (1) provides a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees and (2) integrates all requirements contained in paragraphs 4a through 4m of this Order, program requirements contained in 29 CFR Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters;" applicable functional area requirements contained in Attachment 1; and other related site-specific worker protection activities. Potential impacts on human health associated with implementation of the proposed alternatives are analyzed in Chapter 5, Sections 5.1.12, 5.2.12, 5.3.12, and 5.4.12.

Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.). Section 4 of the Noise Control Act of 1972, as amended, directs all Federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise jeopardizing health and welfare. Chapter 5 addresses the noise impacts associated with the activities analyzed for each of the alternatives.

10 CFR Part 835, "Occupational Radiation Protection." This regulation establishes radiation protection standards, limits, and program requirements for protecting occupational workers and visitors from ionizing radiation resulting from the conduct of DOE activities. These requirements are applicable to employees involved in activities being considered in this SWEIS that could result in the occupational exposure of an individual to radiation or radioactive materials.

10 CFR Part 851, "Worker Safety and Health Program." Effective February 9, 2007, DOE established worker safety and health regulations to govern contractor activities at DOE sites. This program established the framework for a worker protection program that will reduce or prevent occupational injuries, illnesses, and accidental losses by requiring DOE contractors to provide their employees with safe and healthful workplaces. Also, the program established procedures for investigating whether a requirement has been violated, for determining the nature and extent of such violation, and for imposing an appropriate remedy.

Executive Order 12699, *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction* (January 5, 1990). See Section 9.1.5, "Geology and Soils."

DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (July 9, 1990; Change 1, May 18, 1992; Change 2, October 23, 2001). The purpose of this Order is to provide requirements and guidelines for DOE, including NNSA, to use in developing directives, plans, and/or procedures relating to the conduct of operations at DOE facilities, to result in improved quality and uniformity of operations.

DOE Order 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees* (May 17, 2007). This Order establishes the framework for an effective worker protection program to reduce or prevent injuries, illnesses, and accidental losses by providing safe and healthful DOE Federal and contractor workplaces.

Radiological Safety Oversight and Radiation Protection

10 CFR Part 820, "Procedural Rules for DOE Nuclear Facilities." DOE issued procedural rules for use in applying its substantive regulations and orders relating to nuclear safety. These procedural rules are intended to be an essential part of the framework through which DOE deals with its contractors, subcontractors, and suppliers to ensure its nuclear facilities are operated in a manner that protects public and worker safety and the environment. In particular, this part sets forth the procedures to implement the provisions of the Price-Anderson Amendments Act of 1988, which subjects DOE contractors to potential civil and criminal penalties for violations of DOE rules, regulations, and orders relating to nuclear safety (DOE Nuclear Safety Requirements). DOE also published its enforcement policy to inform contractors and other persons of the bases and anticipated processes for various enforcement actions.

10 CFR Part 830, "Nuclear Safety Management." Specific requirements in these regulations apply to DOE contractors, DOE personnel, and other persons conducting activities (including providing items and services) that affect, or may affect, the safety of DOE nuclear facilities. These regulations include quality assurance (10 CFR Part 830, Subpart A) and safety-basis (10 CFR Part 830, Subpart B) requirements. The latter require the contractor responsible for a DOE nuclear facility to analyze the facility, work to be performed and associated hazards, and to identify the conditions, safe boundaries, and hazard controls necessary to protect workers, the public, and the environment from adverse consequences. DOE relies on these analyses and hazard controls to operate facilities safely.

DOE Order 5480.20A, ***Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*** **(November 15, 1994; Change 1, July 12, 2001).** The purpose of this Order is to establish selection, qualification, and training requirements for management and operating contractor personnel involved in the operation, maintenance, and technical support of DOE and NNSA Category A and B reactors and nonreactor nuclear facilities. DOE objectives are to ensure the development and implementation of contractor-administered training programs that provide consistent and effective training for personnel at DOE nuclear facilities. This Order contains minimum requirements that must be included in training and qualification programs. The requirements are based on DOE, NRC, and related industry standards, and are applicable to all operable DOE nuclear facilities. Because the operation of DOE reactor and nonreactor nuclear facilities involves certain risks to employees, the public, and the environment, well-trained and qualified operating organization personnel are of extreme importance.

DOE Order 458.1, ***Radiation Protection of the Public and the Environment*** **(February 11, 2011).** This Order establishes requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of the DOE pursuant to the Atomic Energy Act of 1954, as amended. The objectives of this Order are to (1) conduct DOE radiological activities so that exposure to members of the public is maintained within the dose limits established in this Order; (2) control the radiological clearance of DOE real and personal property; (3) ensure that potential radiation exposures to members of the public are as low as is reasonably achievable; (4) ensure that DOE sites have the capabilities, consistent with the types of radiological activities conducted, to monitor routine and non-routine radiological releases and to assess the radiation dose to members of the public; and (5) provide protection of the environment from the effects of radiation and radioactive material. NNSA employees and contractors shall comply with their respective responsibilities under this Directive.

DOE Order 433.1B, ***Maintenance Management Program for DOE Nuclear Facilities*** **(April 21, 2010).** The objective of this Order is to define the safety management program required by 10 CFR 830.204(b)(5) for maintenance and reliable performance of structures, systems, and components that are part of the safety basis required by 10 CFR 830.202 at hazard category 1, 2 and 3 DOE nuclear facilities. Radiological facilities (e.g., facilities with quantities of hazardous radioactive materials that fall below the hazard category 3 threshold per DOE Standard 1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*) are excluded from the provisions of this order; however, the maintenance management program requirements of DOE Order 430.1B, *Real Property Asset Management*, are applicable to radiological facilities. Radiological facilities that warrant additional controls may apply appropriate requirements of this Order until further guidance is issued. A single maintenance program may be used to address the requirements of this Order and the requirements of DOE Order 430.1B.

DOE Order 425.1D, *Verification of Readiness to Startup or Restart Nuclear Facilities* (April 16, 2010; cancels DOE Order 425.1C, March 13, 2003). This Order establishes DOE requirements for verifying readiness for startup of new hazard category 1, 2, and 3 nuclear facilities, activities, and operations, and for restart of existing hazard category 1, 2, and 3 nuclear facilities, activities, and operations that have been shut down. The requirements specify a readiness review process (e.g., operational readiness reviews or readiness assessments) that provides an independent verification of readiness to start or restart operations. DOE Standard 3006–2010, *Planning and Conducting Readiness Reviews*, provides guidance on approaches and methods approved as acceptable for implementing the requirements of this Order. In all cases, the readiness review process must demonstrate there is a reasonable assurance for adequate protection of workers, the public, and the environment from adverse consequences from the start (or restart) of a hazard category 1, 2, or 3 nuclear facility, activity, or operation. Such facilities, activities, or operations may be started (or restarted) only after readiness reviews have been conducted and the approvals specified in this Order have been received.

DOE Order 420.1B, *Facility Safety* (December 22, 2005; Change 1, April 19, 2010). This Order establishes facility safety requirements related to nuclear and explosives safety design criteria; a comprehensive fire protection program for DOE sites, facilities, and emergency service organizations; nuclear criticality safety (i.e., a criticality safety program that is applicable to DOE nuclear facilities and activities, including transportation activities, that have a potential for criticality hazards); natural phenomena hazards mitigation; and a system engineer program for hazard category 1, 2, and 3 nuclear facilities to ensure continued operational readiness of the systems within its scope. This Order requires that all DOE facilities and sites be designed, constructed, and operated so that the public, workers, and environment are protected from impacts of natural phenomena hazards (e.g., earthquake, wind, flood, and lightning). This Order applies to design and construction of new DOE hazard category 1, 2, and 3 nuclear facilities, as well as to major modifications to such nuclear facilities that could substantially change the approved facility safety analysis.

DOE Order 414.1C, *Quality Assurance* (June 17, 2005). DOE uses two requirements documents to express identical sets of quality assurance requirements for two distinct organizational groups. The first, DOE Order 414.1C, applies to practically all DOE organizations and all contractors whose contract includes the DOE Order. The second is a regulation, 10 CFR Part 830 (including Subpart A), that applies to nuclear facility contractors indemnified under the Price Anderson Amendments Act and suppliers of items and services to those nuclear facilities. Application of quality assurance basic requirements (i.e., management, performance, assessment) extends from the planning and conduct of basic and applied research, scientific investigation, and engineering design to operations, maintenance and repair of facilities, and eventual environmental restoration. These basic requirements reflect a comprehensive way of doing business throughout the life cycle of DOE programs and projects (DOE 2009h).

DOE Policy 441.1, *DOE Radiological Health and Safety Policy* (April 26, 1996). This document states that it is DOE policy to conduct its radiological operations in a manner that ensures the health and safety of all its employees, contractors, and the general public. The policy states that in achieving this objective, DOE will ensure that radiation exposures of its workers and the public and releases of radioactivity to the environment are maintained below regulatory limits, and deliberate efforts are taken to further reduce exposures and releases to as low as is reasonably achievable levels. DOE is committed to implementing a radiological control program of the highest quality that consistently reflects this policy.

9.1.13 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994). This Order requires each Federal agency to identify and address disproportionately high and adverse human health and environmental effects of its programs, policies, and activities on minority and low-income populations. CEQ, which oversees the Federal Government's compliance with Executive Order 12898 and NEPA, has developed guidelines to assist Federal agencies in incorporating the goals of Executive Order 12898 in the NEPA process. This guidance, published in 1997, was intended to "…assist Federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed." As part of this process, DOE has performed an analysis to determine whether implementing any of the proposed alternatives would result in disproportionately high or adverse impacts on minority or low-income populations. The results of this analysis are discussed in the environmental justice sections of Chapter 5 of this SWEIS for each of the alternatives under consideration.

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), as amended by Executive Order 13229 (October 9, 2001). This Order requires each Federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

9.1.14 Emergency Planning, Pollution Prevention, and Conservation

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980/Superfund Amendments and Reauthorization Act (SARA) (42 U.S.C. 9601 et seq.). CERCLA provides a statutory framework for the remediation of abandoned or historical waste sites, including Federal facilities, containing hazardous substances. Using a hazard-ranking system, Federal and private contaminated sites are ranked and may be included on the National Priorities List. CERCLA requires Federal facilities with contaminated sites to undertake investigations, remediation, and natural resource restoration, as necessary. Hazardous waste clean-up operations on the NNSS are not regulated under CERCLA.

CERCLA, as amended by SARA, also provides an emergency response program for releases or threatened releases of hazardous substances, pollutants, and contaminants that may endanger public health or the environment. Releases of hazardous substances exceeding reportable quantities must be reported on a timely basis to the National Response Center. The emergency response program requirements of CERCLA are applicable on the NNSS and other locations. This is addressed in Chapter 4, Section 4.1.12.6.

Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 (42 U.S.C. 11001 et seq.). This Act requires that Federal, state, and local emergency planning authorities be provided information regarding the presence and storage of hazardous substances and their planned and unplanned environmental releases, including provisions and plans for responding to emergency situations involving hazardous materials. For NNSA compliance, see the Executive Order 12856 summary below.

Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq.). The Pollution Prevention Act establishes a national policy for waste management and pollution control. Source reduction is given first preference, followed by environmentally safe recycling, with disposal or releases to the environment as a last resort. Current waste management and pollution prevention practices are discussed in Chapter 4, Sections 4.1.11, 4.2.11, 4.3.11, and 4.4.11.

Homeland Security Act of 2002 (6 U.S.C. 101 et seq. enacted by Public Law 107-296). This Act established the U.S. Department of Homeland Security, integrating the functions of organizations related to national security. The Act authorizes the U.S. Department of Homeland Security to enter into work agreements, joint sponsorships, contracts, and any other agreement with DOE regarding the use of the national laboratories or sites and support of the science and technology base at those facilities.

Homeland Security Presidential Directive 5, *Management of Domestic Incidents* (February 28, 2003). The purpose of this Directive is to enhance the ability of the United States to manage domestic incidents by establishing a single, comprehensive national incident management system. The system provides a consistent, integrated nationwide approach for Federal, State, local and tribal governments to work effectively and efficiently together to prepare for, prevent, respond to, and recover from domestic incidents (e.g., terrorist attacks, major disasters, and other emergencies), regardless of cause, size, or complexity.

Homeland Security Presidential Directive 8, *National Preparedness* (December 17, 2003). This Directive establishes policies to strengthen the United States preparedness in order to prevent and respond to threatened or actual domestic terrorist attacks, major disasters, and other emergencies. It requires a national domestic all-hazards preparedness goal, with established mechanisms for improved delivery of Federal preparedness assistance to State and local governments. This directive is a companion to Homeland Security Presidential Directive 5, which identifies steps for improved coordination in response to incidents. This *National Preparedness* Directive describes the way Federal departments and agencies will strengthen preparation for such a response, including prevention activities during the early stages of a terrorism incident.

Executive Order 12088, Federal Compliance with Pollution Control Standards (October 13, 1978), as amended by Executive Order 12580, Superfund Implementation (January 23, 1987). This Order directs Federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the Clean Air Act, the Noise Control Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and RCRA.

Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements* (August 3, 1993). This Order requires that all Federal facilities comply with the provisions of EPCRA. The NNSA Nevada Site Office is required to submit reports pursuant to EPCRA Sections 302–303 (Planning Notification), 304 (Extremely Hazardous Substances Release Notification), 311–312 (Material Safety Data Sheet/Chemical Inventory), and 313 (Toxic Chemical Release Inventory Reporting).

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (October 5, 2009). See Section 9.1.3, "Infrastructure and Energy."

DOE Order 470.4A, *Safeguards and Security Program* (May 25, 2007). This Order establishes responsibilities for the DOE Safeguards and Security Program and the managerial framework for implementing DOE Policy 470.1, "*Integrated Safeguards and Security Management*," dated May 8, 2001. The requirements identified in this Order and its topical manuals are based on national policy promulgated in laws, regulations, and Executive Orders to prevent unacceptable adverse impacts on national security and the health and safety of DOE and contractor employees, the public, or the environment. Assignment of roles and responsibilities in this Order include identification and definition of interfaces and necessary interactions between safeguards and security programs and other disciplines such as safety, emergency management, counterintelligence, facility operations, cyber system operations, and business/budget operations (including property management).

DOE Order 470.2B, *Independent Oversight and Performance Assurance Program* (October 31, 2002). The Independent Oversight Program is designed to enhance the DOE safeguards and security; cyber security; emergency management; and environment, safety, and health programs by providing DOE and contractor managers, Congress, and other stakeholders with an independent evaluation of the adequacy of DOE policy and the effectiveness of line management performance in safeguards and security; cybersecurity; emergency management; environment, safety, and health; and other critical functions as directed by the Secretary of Energy. The following are to be used as the basis for independent oversight: DOE Orders, Notices, and Manuals; approved site safeguards and security plans, cyber security plans, and other security plans; DOE threat statements; emergency management program plans; approved site safety management system description documents, integrated safety management contract clauses, other integrated safety management implementation documents, and other quality assurance documentation; safety basis, authorization basis, and authorization agreements; applicable statutes and rules; other contractually mandated requirements; and approved deviations.

DOE Order 151.1C, *Comprehensive Emergency Management System* (November 2, 2005). This Order establishes policy; assigns roles and responsibilities; and provides the framework for developing, coordinating, controlling, and directing DOE's emergency management system (i.e., emergency planning, preparedness, response, recovery, and readiness assurance). Emergency planning must include identification of hazards and threats, hazard mitigation, development and preparation of emergency plans and procedures, and identification of personnel and resources needed for an effective response. Emergency preparedness must include acquisition and maintenance of resources, training, drills, and exercises. Emergency response must include the application of resources to mitigate consequences to workers, the public, the environment, and the national security, and the initiation of recovery from an emergency. Recovery must include planning for and actions taken following termination of the emergency to return the facility/operations to normal. Readiness assurance must include assessments and documentation to ensure that stated emergency capabilities are sufficient to implement emergency plans.

DOE Order 153.1, *Departmental Radiological Emergency Response Assets* (June 27, 2007). This Order establishes requirements and responsibilities for NNSA's national radiological emergency response assets and capabilities and Nuclear Emergency Support Team assets. The assets described in this Order consist of both the personnel and equipment needed to perform carefully defined missions related to nuclear/radiological emergency response. Other existing statutes, regulations, directives, and standards applicable to emergency response assets also apply for planning, preparedness, and response.

State of Nevada Chemical Catastrophe Prevention Act (Nevada Legislature Senate Bill 641, July 1991) and Chemical Accident Prevention Program (CAPP) (NRS 459.380 through 459.3874). In July 1991, the Nevada Legislature passed Senate Bill 641, the Chemical Catastrophe Prevention Act, primarily in response to a large chlorine release in Henderson, Nevada, in May 1991 and a large ammonium perchlorate explosion in May 1988, also in Henderson. The resulting statute, codified at NRS 459.380–459.3874, directed NDEP to develop and implement an accident prevention program, which was renamed CAPP.

CAPP requirements fall into one of three categories: accident prevention, emergency response, or public right-to-know. For accident prevention, facilities are required to evaluate and mitigate hazards, understand the design parameters of their processes and operate within the appropriate design limits, prepare comprehensive operating procedures, thoroughly train operators in those procedures, and maintain the facility equipment and instruments to prevent premature failure. For emergency response, facilities are required to develop an action plan for dealing with potential emergency situations and they are further required to coordinate emergency response activities with local responders, to ensure that the responders are prepared to deal with the emergencies appropriately. For the public right-to-know, all information disseminated by the facilities is available to the public, as are all site inspection reports generated by CAPP staff (NDEP 2009b).

9.2 Applicable Permits

Implementation of activities and alternatives proposed in this SWEIS would require compliance with existing environmental permits, modification to existing permits, or the acquisition of new permits, if applicable. A list of all required Federal and state environmental permits that are issued for NNSS, NLVF, RSL, and TTR operations is presented in **Table 9–2**.

Future environmental permits, including modifications to existing permits that may be required for implementation of the alternatives analyzed in this SWEIS are identified below.

NNSS Drinking Water System Permits are renewed annually; modification of the applicable permits would be required to include potable water system tie-in(s) to new facilities. Coordination with NDEP's Bureau of Safe Drinking Water is necessary.

The NNSS Water Pollution Control General Permit was renewed in August 2010, and will require renewal in 5 years. Stormwater Pollution Prevention Plans would need to be updated to include provisions for new construction activities prior their undertaking.

The NNSS Class II Air Quality Operating Permit is renewed every 5 years. This permit would require modification to include new construction and operation activities associated with implementation of the *NNSS SWEIS* preferred alternative. For example, dust control measures for proposed activities would need to be identified and incorporated into the permit. Coordination with the NDEP's Bureau of Air Pollution Control for permit modification is mandatory.

The NNSS Hazardous Waste Management Permit expires on December 1, 2015. When applying for renewal, RCRA-related activities associated with this SWEIS would need to be included.

Table 9–2 Environmental Permits Required for the Nevada National Security Site and the Nevada National Security Site Facility Operations

Permit Number	*Description*	*Location/Notes*
Air Quality		
AP9711-0549.01	NNSS Class II Air Quality Operating Permit	NNSS
08-29	NNSS Burn Variance (various locations)	NNSS
08-30	NNSS Open Burn Variance, A-23, Facility #23-T00200	NNSS Fire and Rescue Training Center
Facility 657, Mod. 3	Clark County Authority to Construct/Operating Permit for a Testing Laboratory	NLVF
Facility 348, Mod. 2	Clark County Authority to Construct/Operating Permit for a Testing Laboratory	RSL-Nellis
AP8733-0680.02	Class II Air Quality Operating Permit	TTR
Drinking Water		
NY-0360-12NTNC	Areas 6 and 23	NNSS
NY-4098-12NC	Area 25	NNSS
NY-4099-12NC	Area 12	NNSS
NY-0835-12NP	NNSS Water Hauler #84846	NNSS
NY-0836-12NP	NNSS Water Hauler #84847	NNSS
NY-3014-12NTNC	Well 6 Production Well	TTR
NY-3014-1112NTNC	Permit to Operate a Treatment Plant	TTR
NNSS Septic Systems and Pumpers		
NY-1054	Septic System, Area 3	Waste Management Offices
NY-1069	Septic System, Area 18	820th Red Horse Squadron
NY-1076	Septic System, Area 6	Airborne Response Team Hanger
NY-1077	Septic System, Area 27	Baker Compound
NY-1079	Septic System, Area 12	U12g Tunnel
NY-1080	Septic System, Area 23	Building 1103
NY-1081	Septic System, Area 6	Control Point-170
NY-1082	Septic System, Area 22	Building 22-01
NY-1083	Septic System, Area 5	Radioactive Material Management Site
NY-1084	Septic System, Area 6	Device Assembly Facility
NY-1085	Septic System, Area 25	Central Support Area
NY-1086	Septic System, Area 25	Reactor Control Point
NY-1087	Septic System, Area 27	Able Compound
NY-1089	Septic System, Area 12	Camp
NY-1090	Septic System, Area 6	Los Alamos National Laboratory Construction Camp Site
NY-1091	Septic System, Area 23	Gate 100
NY-1103	Septic System, Area 22	Desert Rock Airport
NY-1106	Septic System, Area 5	Hazmat Spill Center
NY-1110-HAA-A	Individual Sewage Disposal System	A12, Building 12-910
NY-1112	Commercial Sewage Disposal System, Area 1	U1a
NY-1113	Commercial Sewage Disposal System, Area 1	Building 121
NY-1124	Commercial Individual Sewage Disposal System, Area 6	NNSS
NY-1128	Commercial Individual Sewage Disposal System, Area 6	NNSS, Yucca Lake Project
NY-17-03313	Septic Tank Pumper E 106785	

Permit Number	***Description***	***Location/Notes***
NY-17-03315	Septic Tank Pumper E 107107	
NY-17-03317	Septic Tank Pumper E 105918	
NY-17-03318	Septic Tank Pumping Contractor	One unit
NY-17-06838	Septic Tank Pumper E 105919	
NY-17-06839	Septic Tank Pumper E 107103	
Wastewater Discharge		
GNEV93001	Water Pollution Control General Permit	NNSS sewage lagoons (both operational and inactive)
NEV96021	Water Pollution Control Permit	NNSS, E Tunnel Wastewater Disposal System and Monitoring Well ER-12-1
VEH-112	NLVF Wastewater Contribution Permit	NLVF
NV0023507	North Las Vegas National Pollutant Discharge Elimination System Permit	NLVF
CCWRD-080	Industrial Wastewater Discharge Permit	RSL–Nellis
SNL/NM-NV 10031	Backfilling Horse Pond	TTR
Hazardous Materials		
2287-5146	Hazardous Materials Permit	NNSS
2287-5147	Nonproliferation Test and Evaluation Complex	NNSS
2287-5144	Hazardous Materials Permit	NLVF
2287-5145	Hazardous Materials Permit	RSL–Nellis
212 FDID 13007	Hazardous Materials Permit	TTR
Hazardous Waste		
NEV-HW0021	NNSS Hazardous Waste Management Permit	NNSS
0510003453	Utah Generator Site Access Permit	NNSS
NNSS Waste Management		
U1576-33N-01	Waste Management Permit – Underground Storage Tank	RSL–Nellis
NNSS Disposal Sites		
SW 13 000 01	Asbestiform Low-Level Solid Waste Disposal Site, Area 5	
SW 13 097 02	Hydrocarbon Disposal Site, Area 6	
SW 13 097 03	U10c Solid Waste Disposal Site, Area 9	
SW 13 097 04	Solid Waste Disposal Site, Area 23	
Endangered Species/Wildlife/Special Use		
File No. 1-5-96-F-33	U.S. Fish and Wildlife Service – Desert Tortoise Incidental Take Authorization (Biological Opinion for Programmatic NNSS Activities)	
MB008695-0	U.S. Fish and Wildlife Service – Migratory Bird Scientific Collecting Permit	
MB037277-1	U.S. Fish and Wildlife Service – Migratory Bird Special Purpose Possession – Dead Permit	
S29157	Nevada Division of Wildlife – Scientific Collection of Wildlife Samples	

NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; RSL = Remote Sensing Laboratory; TTR = Tonopah Test Range.
Source: DOE/NV 2009d; SNL 2010b.

CHAPTER 10
CONSULTATION AND COORDINATION

10.0 CONSULTATION AND COORDINATION

Chapter 10 presents an overview of the National Nuclear Security Administration's (NNSA's) consultation and coordination efforts with other Federal, state, and local government agencies and American Indian groups during the development of this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*. Discussions regarding NNSA's public involvement efforts are presented in Chapter 1, Section 1.6, of this *NNSS SWEIS*.

10.1 Cooperating Agencies

Council on Environmental Quality regulations provided in 40 *Code of Federal Regulations* (CFR) 1501.6 and 1508.5 emphasize agency cooperation early in the National Environmental Policy Act (NEPA) process and allow a lead agency (in this case, NNSA) to request the assistance of other agencies that have either jurisdiction by law or special expertise regarding issues considered in an environmental impact statement. For this *NNSS SWEIS*, the U.S. Bureau of Land Management (BLM), the U.S. Air Force (USAF), and Nye County, Nevada, accepted roles as cooperating agencies. Their respective roles and expertise are discussed in the remainder of this section.

BLM is an agency within the U.S. Department of the Interior and is responsible for administering more than 250 million acres of public lands, mostly in 12 western states, including Alaska. BLM administers much of the land in the general vicinity of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and the Tonopah Test Range (TTR), and offers special expertise regarding environmental resources on and near these sites. As the lead agency for many other NEPA studies in this region, BLM also offers special expertise regarding other Federal actions considered in the cumulative effects analysis in this *NNSS SWEIS*. BLM has also played an integral role in the establishment of land withdrawals for the NNSS.

The mission of the USAF, in conjunction with the United States' other armed services, is to preserve the peace and security and provide for the defense of the United States, its Territories, Commonwealths, and possessions, and any U.S.-occupied areas. The USAF controls much of the land and airspace in the vicinity of the NNSS and operates the Nevada Test and Training Range, which borders the NNSS on three sides, as well as the Remote Sensing Laboratory (RSL) and the TTR, on which NNSA is a tenant. The USAF offers special expertise regarding environmental resources on and near the NNSS, RSL, and the TTR, as well as areas of environmental contamination (and ongoing remediation activities) resulting from historic national-defense-related activities. The geographic proximity of USAF and NNSA facilities also require the two agencies to review their proposed actions carefully to ensure that one agency does not adversely affect the other's missions and operations.

The NNSS and the TTR are located in Nye County, Nevada. Nye County has special expertise regarding the relationship of NNSA's proposed actions to the objectives of regional and local land use plans, policies, and controls, as well as to the current and planned infrastructure in the county, including public services and traffic conditions. Nye County also possesses special expertise regarding local governmental actions considered in the cumulative effects analysis in this site-wide environmental impact statement (SWEIS).

In addition to the special expertise and roles described above, all cooperating agencies have provided support to NNSA during preparation of this *NNSS SWEIS* by:

- Participating in technical group meetings and workshops throughout the NEPA process
- Assisting in development of action alternatives
- Providing land use plans, policy documents, and NEPA documents to assist in describing the affected environment and conducting the environmental consequences analyses
- Participating in internal reviews of preliminary draft SWEIS sections and providing comments within their respective areas of expertise
- Assisting with public involvement and preparation of responses to public comments

Table 10–1 summarizes specific meetings and workshops involving cooperating agencies.

Table 10–1 Cooperating Agency Meetings

Meeting Date	*Attending Agencies* [a]	*Scope of Discussions*
January 25, 2010	Nye County	Kickoff meeting, discussion of Nye County role and supporting personnel
February 1, 2010	USAF, BLM	Kickoff meeting, discussion of renewable energy initiatives potentially within the scope of this SWEIS
February 8, 2010	BLM	Discussion of preliminary alternatives, specific NNSS projects, and BLM role in review process
April 20, 2010	BLM, USAF, Nye County	Distribution of preliminary draft SWEIS sections (Introduction, Purpose and Need, Alternatives), discussion of options for alternatives, and requests for comments from attendees
May 19, 2010	USAF	Discussion of USAF comments regarding the preliminary draft SWEIS sections (Introduction, Purpose and Need, Alternatives)

BLM = Bureau of Land Management; NNSS = Nevada National Security Site; SWEIS = site-wide environmental impact statement; USAF = U.S. Air Force.
[a] NNSA was present at all meetings.

10.2 American Indian Groups

NNSA has been conducting government-to-government consultation with American Indian tribes since 1987. During this process, the Consolidated Group of Tribes and Organizations (CGTO) was established to facilitate consultation with the NNSS. CGTO comprises 17 tribes and organizations that represent three ethnic groups from Arizona, California, Nevada, and Utah that are culturally and historically affiliated with the NNSS and surrounding areas: the Western Shoshone, Southern Paiute, and Owens Valley Paiute (Stoffle et al. 1990). As such, CGTO has a long-standing relationship with NNSA.

During preparation of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS*), a small committee of American Indian people representing the previously mentioned ethnic groups was appointed by CGTO to provide American Indian input for the *1996 NTS EIS*. This committee is called the American Indian Writers Subgroup (AIWS). AIWS' input for the *1996 NTS EIS* was documented in Appendix G of that document, and specific comments made by AIWS were inserted in various chapters of the *1996 NTS EIS*.

NNSA has continued this model of consultation and cooperative writing with CGTO and AIWS in this *NNSS SWEIS*. Appendix C, "American Indian Resource Document," of this *NNSS SWEIS* contains CGTO's comprehensive perspective regarding past and ongoing impacts of NNSA activities at the NNSS on those resources that are important to American Indian people. Appendix C was prepared in response to the consultation required for this *NNSS SWEIS* in accordance with DOE Order 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*. Excerpts from Appendix C, selected by AIWS, have been inserted throughout this *NNSS SWEIS* to reinforce CGTO's perspective and recommendations regarding specific resources and NNSA activities.

Based on CGTO's and AIWS's previous involvement in the *1996 NTS EIS* and similar NEPA documents, CGTO expressed its desire for AIWS to become involved in the development of culturally appropriate text for this new *NNSS SWEIS*. This effort was achieved through convening four meetings for the purpose of reviewing draft text and formatting tribal perspectives on behalf of CGTO. Each week-long writing session provided a mechanism for AIWS to develop text that represents the tribal perspective for incorporation in this *NNSS SWEIS*.

Accordingly, AIWS members were selected because of their knowledge and past experience with the *1996 NTS EIS* and similar NEPA documents. This familiarity provided the opportunity for tribal representatives to maximize their involvement using thorough reviews of text and supporting documents, in addition to determining which areas to focus on.

After the completion of text development, AIWS presented its results at the 2010 Annual Meeting of CGTO in Las Vegas. The presentation consisted of an overview of the NEPA process specific to this SWEIS and a description of the AIWS writing process, followed by the formal presentation of the tribal text for tribal review and approval. As is customary, tribal representatives met in executive session to deliberate on the information presented. At the conclusion of the session, the meeting was reconvened and tribal representatives accepted the AIWS text for inclusion in this *NNSS SWEIS*.

Table 10–2 summarizes specific meetings and workshops involving CGTO/AIWS.

Table 10–2 Consolidated Group of Tribes and Organizations/American Indian Writers Subgroup Meetings

Meeting Date	*Scope of Meeting*
September 1, 2009	Kickoff meeting, introduction to the SWEIS process and timeline, affirmation of previous model of consultation, and NNSS site tour.
February 21–26, 2010	Field visit to selected sites on the NNSS to establish a foundation for writing and an understanding of the topics to be discussed in this *NNSS SWEIS*. Review of the proposed SWEIS schedule, meeting expectations, and anticipated deliverables with primary focus on Chapter 1, "Introduction;" Chapter 2, "Purpose and Need;" Chapter 4, "Affected Environment;" and Chapter 5, "Environmental Consequences" (Introduction).
April 4–9, 2010	Review of selected Chapter 5 resource areas: visual resources, land use, geology and soils, biological resources, cultural resources, socioeconomics, hydrology, air quality, climate, waste management, human health, and environmental justice.
July 18–23, 2010	Completion of review of Chapter 5 resource areas, followed by a review of Chapter 6, "Cumulative Impacts." Regular reviews of previous chapters to ensure accuracy and completeness.
August 15–20, 2010	Development of American Indian text for Chapters 7–10, with a focus on Chapter 7, "Mitigation," and development of Appendix C. Final reviews of preceding text of all SWEIS chapters before submittal to NNSA.

NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; SWEIS = site-wide environmental impact statement.

CHAPTER 11
REFERENCES

11.0 REFERENCES

AAAS (American Association for the Advancement of Science), 2008, *Nuclear Forensics, Role, State of the Art, and Program Needs*, Joint Working Group of the American Physical Society and American Association for the Advancement of Science (accessed January 7, 2010, https://cstsp.aaas.org/files/complete.pdf), February.

ACHP (Advisory Council on Historic Preservation), 1980, *Treatment of Archaeological Properties: A Handbook*, Washington, DC.

ACHP (Advisory Council on Historic Preservation), 2009, *Section 106 Archaeology Guidance* (available at http://www.achp.gov/docs/ACHP%20ARCHAEOLOGY%20GUIDANCE.pdf).

Anderson, R. E., compiler, 1998a, Fault number 1067, Cane Spring fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed January 29, 2010, 12:38 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1998b, Fault number 1066, Mine Mountain fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed January 29, 2010, 12:54 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1998c, Fault number 1042, Yucca fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed February 1, 2010, 10:27 AM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1998d, Fault number 1090, Cactus Flat fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed March 31, 2010, 05:37 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1998e, Fault number 1091, Unnamed faults of Cactus Flat, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed March 31, 2010, 05:40 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1998f, Fault number 1088, Stonewall Mountain fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed March 31, 2010, 05:39 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1999a, Fault number 1120, Las Vegas Valley faults, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed March 29, 2010, 03:46 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1999b, Fault number 1117, Frenchman Mountain fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed March 29, 2010, 03:57 PM, http://earthquakes.usgs.gov/regional/qfaults).

Anderson, R. E., compiler, 1999c, Fault number 1733, Eglington fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website (accessed March 29, 2010, 04:23 PM, http://earthquakes.usgs.gov/regional/qfaults).

Angerer, J. P., W. K. Ostler, W. D. Gabbert, and B. W. Schultz, 1994, *Secondary Succession on Disturbed Sites at Yucca Mountain, Nevada*, EG&G Energy Measurements Topical Report, EGG 11265-1118 UC-702, Las Vegas, Nevada.

ANL (Argonne National Laboratory), 2009, Map of Solar Energy Study Areas for In-Depth Study in Nevada (accessed March 29, 2010, http://solareis.anl.gov/documents/maps/studyareas/Solar_Study_Area_NV_Ltt_6-09.pdf), Argonne, Illinois.

APLIC (Avian Power Line Interaction Committee), 2006, *Suggested Practices for Avian Protection on Power Lines: State of the Art in 2006*, Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC and Sacramento, California.

ASI (Abengoa Solar, Inc.), 2009, *Plan of Development for the Lathrop Wells Solar Facility*, NVN-086571, Amargosa Valley, Nevada.

ASN (Aviation Safety Network), 2004, Flight Safety Foundation (available at http://aviation-safety.net/database/record.php?id=20040316-0), Victorville, California, December.

Beatley, J. C., 1975, "Climates and Vegetation Pattern Across the Mojave/Great Basin Desert Transition of Southern Nevada," *American Midland Naturalist*, Vol. 93, pp, 53-77.

Beatley, J. C., 1976, Vascular Plants of the Nevada Test Site and Central-Southern Nevada: Ecologic and Geographic Distributions, U.S. Energy Research and Development Administration Report TID-26881.

Bechtel Nevada, 1998a, *Nevada Test Site Routine Radiological Environmental Monitoring Plan*, DOE/NV/11718-244, Las Vegas, Nevada, December.

Bechtel Nevada, 1998b, *Ecological Monitoring and Compliance Program Fiscal Year 1998 Report*, DOE/NV-11718-255, Las Vegas, Nevada, December.

Bechtel Nevada, 1999, *Ecological Monitoring and Compliance Program Fiscal Year 1999 Report*, DOE/NV/11718-387, Las Vegas, Nevada, December.

Bechtel Nevada, 2000, Addendum 1: *Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*, "Update of Scenarios and Waste Acceptance Criteria Through the Performance Assessment Maintenance Program, Revision 1.0," DOE/NV-608, Nevada Operations Office, Las Vegas, Nevada, April.

Bechtel Nevada, 2003, *Annual Site Environmental Report—2002* (DOE/NV11718-842), Las Vegas, Nevada, October.

Bechtel Nevada, 2005, *Nevada Test Site 2004*, U.S. Department of Energy, October.

Bechtel Nevada, 2006, *Nevada Test Site 2005 Waste Management Monitoring Report Area 3 and Area 5 Radioactive Waste Management Sites*, DOE/NV/25946-021, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, January.

Becht, W., Nye County Sheriff's Office, 2010, Personal communication (email) with R. Griffin, Potomac Hudson Engineering, "General Information for the Nye County Sheriff's Office", April 7.

Beck, C. M., N. Goldenberg, W. G. Johnson, C. Sellers (Desert Research Institute) and Carey & Company, Inc., 1996, *Nevada Test Site Historic Structures Survey*, Technical Report No. 87, DOE/NV/95NV11508-05 UC-702, Las Vegas, Nevada.

Bergin, K. A., C. B. Crownover, C. Stevens, R. Stockton, S. Vaughan, D. Jenkins, R. Brooks, D. Ferraro, A. Turner, L. Kirkberg, P. Olson, R. Maus, G. Stough, R. Scheuch and G. Tullis, 1979, *Final Report on the Archaeological Investigations of the Nellis Air Force Bombing and Gunnery Ranges, Nye, Lincoln, and Clark Counties, Nevada*, Archaeological Research Center, Museum of Natural History, University of Nevada, Las Vegas.

BLM (Bureau of Land Management), 1979, *Final Environmental Impact Statement: Proposed Public Land Withdrawal: Nellis Air Force Bombing Range*: Nye, Clark and Lincoln Counties, Nevada, U.S. Department of Interior, Washington, DC.

BLM (Bureau of Land Management), 1980, *Visual Resource Management Program*, Stock No. 024-001-00116-6, Division of Recreation Cultural Resources, Washington, DC.

BLM (Bureau of Land Management), 2004a, Record of Decision for the *Approved Nevada Test & Training Range Resource Management Plan and Final Environmental Impact Statement*, Las Vegas, Nevada, U.S. Department of the Interior.

BLM (Bureau of Land Management), 2004b, *Las Vegas Valley Disposal Boundary Final Environmental Impact Statement*, Las Vegas Field Office, Las Vegas, Nevada.

BLM (Bureau of Land Management), 2004c, *Las Vegas Valley Disposal Boundary Final Environmental Impact Statement Record of Decision*, FES 04-048, Las Vegas Field Office, Las Vegas, Nevada, December 23.

BLM (Bureau of Land Management), 2006a, Second Round Scoping Package for proposed Clark, Lincoln, and White Pine Counties Groundwater Development (GWD) Project Environmental Impact Statement (EIS), U.S. Department of the Interior, Las Vegas Field Office, Las Vegas, Nevada.

BLM (Bureau of Land Management), 2006b, *Amargosa River Area of Critical Environmental Concern Implementation Plan*, Barstow Field Office, Barstow, California, October.

BLM (Bureau of Land Management), 2008a, *Visual Resource Management Program*, Course 8400-05, Las Vegas, Nevada.

BLM (Bureau of Land Management), 2008b, *Southwest Intertie Project Southern Portion Environmental Assessment*, NV-040-07-048, Ely District Office, Ely, Nevada, July.

BLM (Bureau of Land Management), 2008c, *Ely District Record of Decision and Approved Resource Management Plan*, BLM/NV/EL/PL-GI08/25+1793, Ely, Nevada, August.

BLM (Bureau of Land Management), 2009a, *BLM Manual Section 8400 – Visual Resource Management*, U.S. Department of the Interior (accessed 12/1/09, http://www.blm.gov/nstc/VRM/ 8400.html).

BLM (Bureau of Land Management), 2009b, *Visual Resource Management, BLM's Responsibilities*, U.S. Department of the Interior (accessed December 1, 2009, at http://www.blm.gov/wo/st/en/prog/Recreation/ recreation_national/RMS/travel_mgt_planning.html).

BLM (Bureau of Land Management), 2009c, *Draft Supplemental Environmental Impact Statement for the ON Line Project* (BLMNV/EL/EIS-GI-10/01+1793), Ely District Office, Ely, Nevada, November.

BLM (Bureau of Land Management), 2009d, Nevada Herd Management Areas Map, U.S. Department of the Interior, Nevada State Office (available at http://www.blm.gov/pgdata/etc/ medialib/blm/nv/wild_horse_burro/nevada_wild_horse.Par.16182.File dat/hma_map_may2009.pdf), May.

BLM (Bureau of Land Management), 2009e, Rhyolite Wind Energy Site Testing and Monitoring Project Area, Installation of One Meteorological Tower Near Rhyolite, Nye County, Nevada, Environmental Assessment, DOI-BLM-NV-B020-2009-0071-EA, U.S. Department of the Interior, Tonopah, Nevada, October.

BLM (Bureau of Land Management), 2010a, *Final Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project*, (NVN-084359), DOI No. FES 10-53, U.S. Department of the Interior, Pahrump Field Office, Las Vegas, Nevada, October.

BLM (Bureau of Land Management), 2010b, *Draft Supplemental Environmental Impact Statement Upper Las Vegas Wash Conservation Transfer Area, Las Vegas, Nevada,* BLM/NV/EL/ES-10-06+1793, Las Vegas District Office, Las Vegas, Nevada, January.

BLM (Bureau of Land Management), 2010c, *Draft Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project (NVN-084359)* (BLM/NV/LV/ES-10/16+1793), Pahrump Field Office, Las Vegas, Nevada, March.

BLM (Bureau of Land Management), 2010d, Final Scoping Report for the Las Vegas/Pahrump Resource Management Plan and Environmental Impact Statement for Public Lands Administered by the Bureau of Land Management Southern Nevada District Office, Southern Nevada District Office, Las Vegas, Nevada, May.

BLM (Bureau of Land Management), 2010e, *Projects and Planning Schedule*, Battle Mountain District, Mt. Lewis Field Office, Tonopah Field Office, May.

BLM (Bureau of Land Management), 2010f, Mapping Sciences, Nevada State Office, Landowner - Digital Data, Nevada.

BLM (Bureau of Land Management), 2010g, "Nevada's Wild Horses and Burros," U.S. Department of the Interior, Wild Horses and Burros Program (accessed October 13, 2010, http://www.blm.gov/nv/st/en/prog/wh_b.html).

BLM (Bureau of Land Management), 2010h, *Record of Decision for the Crescent Dunes Solar Energy Project*, (BLM Case File Serial Number 86292), U.S. Department of the Interior, Battle Mountain District, Tonopah Field Office, December.

BLM (Bureau of Land Management), 2010i, *Record of Decision November 2010 Amargosa Farm Road Solar Energy Project* (NV84359), U.S. Department of the Interior, Washington, DC, November 15.

BLM (Bureau of Land Management), 2010j, Oasis Divide Wind Energy Testing Site and Monitoring Project, Installation of One Meteorological Tower in Esmeralda County, Nevada, Environmental Assessment, File Number: N-87324 (DOI-BLM-NV-B020-2009-0071-EA), U.S. Department of the Interior, Tonopah Field Office, June.

BLM (Bureau of Land Management), 2010k, *Final Environmental Impact Statement for the ON Line Project*, BLM/NV/EL/11-04+1793, Ely District Office, Ely, Nevada, December.

BLM (Bureau of Land Management), 2011, "Herd Area Statistics FY 09 Data," BLM Nevada State Office website (accessed April 1, 2011, http://www.blm.gov/wo/st/en/prog/wild_horse_and_burro/wh_b_information_center/statistics_and_maps/ha_and_hma_data.html).

BLM/DOE (Bureau of Land Management/U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States*, DES10-59, DOE/EIS-0403, Washington, DC, December.

Borg, I. Y., R. Stone, H. B. Levy, and L. D. Ramspott, 1976, Information Pertinent to the Migration of Radionuclides in Ground Water at the Nevada Test Site, Part I: Review and Analysis of Existing Information, UCRL-52078 Pt. 1, Lawrence Livermore National Laboratory, Livermore, California.

Boulder City Hospital, 2010, Bolder City Hospital (accessed at http://www.bouldercityhospital.org/), March 6.

Bowen, S. M., D. L. Finnegan, J. L. Thompson, C. M. Miller, P. L. Baca, L. F. Olivas, C. G. Geoffrion, D. K. Smith, W. Goishi, B. K. Esser, J. W. Meadows, N. Namboodiri, and J. F. Wild, 2001, *Nevada Test Site Radionuclide Inventory, 1951--1992*, LA-13859-MS, Los Alamos National Laboratory, Los Alamos, New Mexico, September.

Bradley, W. G. and K. S. Moor, 1975, "Ecological Studies of Small Vertebrates in Pu-Contaminated Study Areas of NTS and TTR," *The Radioecology of Plutonium and Other Transuranics in Desert Environments* (NVO-153), U.S. Energy Research and Development Administration, Nevada Operations Office, Las Vegas, Nevada.

Brown, 2009, *Hot Dry Rock Geothermal Energy: Important Lessons from Fenton Hill*, Proceedings, Thirty-Fourth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 9-11.

Buehler, D. A., 2000, Bald Eagle (*Haliaeetus leucocephalus*), In A. Poole and F. Gill (eds.), *The Birds of North America*, No. 506, Academy of Natural Sciences, Philadelphia, PA, and American Ornithologists' Union, Washington, DC.

BWSD (Beatty Water & Sanitation District), 2008, *Beatty Water & Sanitation District Water Conservation Plan,* Beatty, Nevada, November.

Byers Jr., F. M., W. J. Carr, and P. P. Orkild, 1989, "Volcanic Centers of Southwestern Nevada: Evolution of understanding, 1960-1988," Journal of Geophysical Research, Vol. 94, No. B5, pp. 5908-5924.

Carilli, J. T. and S. K. Krenzien, 2007, "Overview of Low-Level Waste Disposal Operations at the Nevada Test Site," Waste Management 2007 Conference, Tucson, Arizona, February 25 – March 1.

Carr, W. J., 1974, Summary of tectonic and structural evidence for stress orientation at the Nevada Test Site, U.S. Geological Survey Open-File Report 74-176, Denver, Colorado.

Castetter, R. C. and H. O. Hill, 1979, "Additions to the Birds of the Nevada Test Site," *Western Birds*, 10, pp. 221-223.

Castle, B., Las Vegas Police Department, 2010, Personal communication with J. Martin-McNaughton, Potomac Hudson Engineering, "Police Department Personnel and Statistics", March 4.

CCCP (Clark County Department of Comprehensive Planning), 2006, *Northeast Clark County Land Use Plan*, Las Vegas, Nevada, September.

CCCP (Clark County Department of Comprehensive Planning), 2007, *Northwest Clark County Land Use Plan*, Las Vegas Nevada, November.

CCCP (Clark County Department of Comprehensive Planning), 2010, *Clark County Comprehensive Plan* (accessed July 14, http://www.accessclarkcounty.com/depts/comprehensive_planning/compplanelements/Documents/ComprehensivePlan1206.pdf), Las Vegas, Nevada.

CCFD (Clark County Fire Department), 2008, 2008 Quick Facts (accessed March 5, 2010, http://fire.co.clark.nv.us/(S(4d5tcw55lzdkbrfvldgawa55))/Facts.aspx).

CDC (Centers for Disease Control and Prevention), 2007, Total Number of Deaths for 113 Selected Causes, 1999-2004, National Center for Health Statistics (accessed August 8, 2007, http://www.cdc.gov/nchs/datawh/statab/unpubd/mortabs/gmwk250a_10.htm), August.

CDC/NCI, 2001, Progress Report to Congress: A Feasibility Study of the Health Consequences to the American Population of Nuclear Weapons Tests Conducted by the United States and Other Nations, August.

CEMP (Community Environmental Monitoring Program), 2009, Dynamically-Created Wind Rose for the Tonopah Station, Wind rose creator (accessed December 2, http://cemp.dri.edu/cgi-bin/cemp_stations.pl?stn=tono&prod=11).

Centennial Hills Hospital, 2011, Centennial Hills Hospital webpage (accessed March 13, 2011, http://www.centennialhillshospital.com), Las Vegas, Nevada.

CEQ (Council on Environmental Quality), 1981, *NEPA's Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, Executive Office of the President, Washington, DC, March 16.

CEQ (Council on Environmental Quality), 1997, *Considering Cumulative Effects Under the National Environmental Policy Act*, Executive Office of the President, Washington, DC, January.

CEQ (Council on Environmental Quality), 2010, *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* (accessed June 22, 2010, http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf), Executive Office of the President, Washington, DC, February 18.

Chapman and Lyles, 1993, *Groundwater Chemistry at the Nevada Test Site: Data and Preliminary Interpretations*, DOE/NV/10845-16, Desert Research Institute, Water Resources Center, Las Vegas, Nevada.

Chapman, J., 1994, Classification of Groundwater at the Nevada Test Site, August.

Christensen, R. C. and N. E. Spahr, 1980, *Flood Potential of Topopah Wash and Tributaries, Eastern Part of Jackass Flats, Nevada Test Site, Southern Nevada*, U.S. Geological Survey, Water-Resources Investigations Open-File Report 80-963.

Clark County, 2008, Financial Statements with Accompanying Information Pertaining to Expenditures of Federal Awards for the Year Ended June 30, 2008 and Independent Auditors Reports (accessed at http://www.accessclarkcounty.com/depts/comptroller/pages/singleaudit.aspx).

Clark County, 2010, Nevada Department of Air Quality and Environmental Management (DAQEM), (accessed 2010, http://www.accessclarkcounty.com/depts/daqem/Pages/index.aspx).

Clark County School District, 2009, District Improvement Plan and AMAO Plan for Implementation in 2009-2010, Page 6-8.

Clark, D. K., M. B. Brown, and M. K. Schwartzwalter, 2005, "Unique Low-Level Waste Disposal Challenges at the Nevada Test Site," Waste Management 2005 Conference, Tucson, Arizona, February 27 – March 3.

CMPO (Cheyenne Metropolitan Planning Organization), 2006, *Cheyenne Area Transportation Master Plan*, November.

CMU (Carnegie Mellon University), 2004, *Environmental Indicators for Carnegie Mellon University: Baseline Assessment 2004*, Table 9 Water Management Indicators (accessed April 14, 2010, http://www.cmu.edu/greenpractices/campus-assessment/environmental-indicators/water_management.pdf).

Cohn, L. M., Nevada National Security Site, 2010, Personal communication (email) to S. B. Enyeart, Science Applications International Corporation, "NNSS Floodplain Analysis," December 14.

Colarusso, A., B. Crowe, and J. R. Cochran, 2003, "Completion of the Transuranic Greater Confinement Disposal Borehole Performance Assessment for the Nevada Test Site," Waste Management 2003 Conference, Tucson, Arizona, February 23-27.

Cole, J. C., 1997, Major Structural Controls on the Distribution of Pre-Tertiary Rocks, Nevada Test Site Vicinity Southern Nevada, U.S. Geological Survey Open-File Report 97-533.

Cole, J. C., and P. H. Cashman, 1997, Geologic Map of the Mine Mountain Area, Nevada Test Site, Southern Nevada. Open-File Report 97-697.

Cole, J. C., and P. H. Cashman, 1999, *Structural Relationships of Pre-Tertiary Rocks in the Nevada Test Site Region, Southern Nevada*, U.S. Geological Survey Professional Paper 1607, U.S. Geological Survey, Denver, Colorado.

Congressional Research Service, 2007, Arsenic in Drinking Water Regulatory Developments and Issues, Mary Tiemann, Specialist in Environmental Policy Resources, Science and Industry Division, May 1.

Connaughton, J. L., 2005, *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis*, Memorandum to Heads of All Federal Agencies, Council on Environmental Quality, Washington, DC, June 24.

Coolbaugh, M., R. Zehner, C. Kreemer, D. Blackwell, G. Oppliger, D. Sawatzky, G. Blewitt, A. Pancha, M. Richards, C. Helm-Clark, L. Shevenell, G. Raines, G. Johnson, T. Minor, and T. Boyd, 2005, *Geothermal Potential Map of the Great Basin Region, Western United States*, Nevada Bureau of Mines and Geology.

CRS (Center for Regional Studies), 2009, Census Block Group-Level Demographic Estimates, University of Nevada, Reno, July 1.

CRWMS M&O (Civilian Radioactive Waste Management System, Management and Operating Contractor), 1997, *Meteorological Monitoring Program Particulate Matter Ambient Air Quality Monitoring Report January through December 1996*, BA0000000-01717-5705-00001 REV 00, Las Vegas, Nevada.

CRWMS M&O (Civilian Radioactive Waste Management System, Management and Operating Contractor), 1999, *Environmental Baseline File for Meteorology and Air Quality*, B00000000-01717-5705-00126 REV 00, Las Vegas, Nevada.

DAQEM (Clark County Department of Air Quality & Environmental Management), 2009, *Annual Network Plan Report, June 2009*, Las Vegas, Nevada, 2009.

Denton, R., National Security Technologies, LLC, 2011, Personal communication (email) to L. M. Cohn, National Nuclear Security Administration, "Request for Info on Waste Volumes," March 1.

DFBS (Department of Financial and Business Services), 2009, *City of Las Vegas Five-Year Capital Improvement Plan*, City of Las Vegas, Nevada, July.

Di Sanza, E. F., J. T. Carilli, 2006, "Innovative Disposal Practices at the Nevada Test Site to Meet its Low-Level Waste Generator's Future Disposal Needs," Waste Management 2006 Conference, Tucson, Arizona, February 26 – March 2.

DOC (U.S. Department of Commerce), 2010, RIMS II, Regional Input-Output Modeling System II, Bureau of Economic Analysis, Washington, DC.

DOD (U.S. Department of Defense), 2004, Source Characterization Model (SCM), A Predictive Capability for the Source Terms of Residual Energetic Materials from Burning and/or Detonating Activities, Final Report, ARI-RR-1384, Strategic Environmental Research and Development Program (SERDP)/Environmental Security Technology Certification Program, Billerica, Massachusetts, 2004.

DOE (U.S. Department of Energy), 1988, *Site Characterization Plan, Yucca Mountain Site, Nevada Research and Development Area*, Nevada, Volumes 1 and 2. DOEIRW-0199, Office of Civilian Radioactive Waste Management, Washington, DC.

DOE (U.S. Department of Energy), 1990, *Radiation in Perspective*, Nevada Operations Office, Las Vegas, Nevada (accessed December 11, 2009, http://www.wrcc.dri.edu/cemp/Radiation.html).

DOE (U.S. Department of Energy), 1992, *Water Conservation Plan for the Tonopah Test Range, Range 4809*, Nevada Operations Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1994, *Nevada Solar Enterprise Zone Development Study*, Nevada Operations Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1995a, Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement, DOE/EIS-0203, Office of Environmental Management, Idaho Operations Office, April.

DOE (U.S. Department of Energy), 1995b, Final Environmental Assessment for Device Assembly Facility Operations, Nevada Test Site, Nye County, Nevada, DOE/EA-0971, May.

DOE (U.S. Department of Energy), 1996a, Geology, Soils, Water Resources, Radionuclide Inventory – Technical Resource Report for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, August.

DOE (U.S. Department of Energy), 1996b, Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel, DOE/EIS-0218, Washington, DC, February.

DOE (U.S. Department of Energy), 1996c, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 1996d, Technical Resource Document for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, August.

DOE (U.S. Department of Energy), 1996e, Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management, DOE/EIS-0236, Washington, DC, September.

DOE (U.S. Department of Energy), 1997, Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste, DOE/EIS-0200F, May.

DOE (U.S. Department of Energy), 1999a, *Environmental Baseline File for Meteorology and Air Quality [for the Yucca Mountain Project]*, B00000000-01717-5705-00126, Yucca Mountain Site Characterization Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1999b, Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor, DOE/EIS-0288, Washington, DC, March.

DOE (U.S. Department of Energy), 1999c, Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride, DOE/EIS-0269, April.

DOE (U.S. Department of Energy), 1999d, Life-Cycle Cost and Risk Analysis of Alternative Configurations for Shipping Low-Level Radioactive Waste to the Nevada Test Site, DOE/CH/CRE-6-1999, Pacific Northwest National Laboratory, Richland, Washington, December.

DOE (U.S. Department of Energy) 1999e, *Implementation Guide for Use with DOE M 435.1-1*, DOE G 435.1-1, Chapter IV, Low-Level Waste Requirements, Washington, DC, July 9.

DOE (U.S. Department of Energy), 1999f, DOE Standard DOE-STD-1098-99, *Radiological Control*, Washington, DC, July.

DOE (U.S. Department of Energy), 2000a, The Nevada Test Site Development Corporation's Desert Rock Sky Park at the Nevada Test Site Environmental Assessment, DOE/EA-1300, March.

DOE (U.S. Department of Energy), 2000b, Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, DC, December.

DOE (U.S. Department of Energy), 2001a, Aerial Operations Facility, Nevada Test Site Environmental Assessment, DOE/EA-1334, March.

DOE (U.S. Department of Energy), 2001b, *Atlas Relocation and Operation at the Nevada Test Site, Final Environmental Assessment*, DOE/EA-1381, National Nuclear Security Administration, May.

DOE (U.S. Department of Energy), 2001c, *Ecology of the Nevada Test Site*, DOE/NV 11718-597 (updated 2010), Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2002a, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota, DOE STD-1153-2002, Washington, DC.

DOE (U.S. Department of Energy), 2002b, Lessons-Learned (2002-NV-NTSBN-035), *Injuries Driven to Zero when Lessons Learned Roundtable Involves Workers*.

DOE (U.S. Department of Energy), 2002c, *Calendar Year 2001 Annual Site Environmental Report for Tonopah Test Range, Nevada*, SAND2002-2565, National Nuclear Security Administration Sandia Site Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 2002d, Office of Civilian Radioactive Waste Management, Site Environmental Report for Calendar Year 2001, Yucca Mountain Site, Nye County, Nevada, PGM-MGR-EC-000002 REV 00, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2002e, Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, DOE/EIS-0250F, Office of Civilian Radioactive Waste Management, North Las Vegas, Nevada, February.

DOE (U.S. Department of Energy), 2002f, *Origins of the Nevada Test Site*, DOE/MA-0518, Nevada Operations Office, Las Vegas, Nevada, February.

DOE (U.S. Department of Energy), 2002g, Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, DOE/EIS-0243-SA-01, July.

DOE (U.S. Department of Energy), 2002h, Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory, DOE/EIS-0319, National Nuclear Security Administration, Washington, DC, August.

DOE (U.S. Department of Energy), 2002i, *Hazardous Materials Testing At the Hazardous Materials Spill Center, Nevada Test Site, Environmental Assessment*, DOE/EA-0864, National Nuclear Security Administration, Nevada Operations Office, Las Vegas, Nevada, September.

DOE (U.S. Department of Energy), 2002j, *Ecological Monitoring and Compliance Program Fiscal Year 2002 Report*, DOE/NV/11718-753, Nevada Operations Office, Las Vegas, Nevada, December.

DOE (U.S. Department of Energy), 2003a, *Calendar Year 2002 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii*, SAND2003-2550, National Nuclear Security Administration, Sandia Site Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 2003b, *Site Environmental Report for the Yucca Mountain Project Calendar Year 2002*, PGM-MGR-EC-000004 REV 00, Office of Repository Development, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2003c, Air, Water, and Radiation Info Brief, "Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE) ISCORS Technical Report No. 1," DOE/EH-412/0015/0802, Rev. 1, Office of Environmental Policy and Guidance, Washington, DC, January.

DOE (U.S. Department of Energy), 2003d, *Recommended Radiation Risk Factors Updated*, National Environmental Policy Act Lessons Learned, Office of NEPA Policy and Compliance, Quarterly Report, Issue No. 34, Washington, DC, March 3.

DOE (U.S. Department of Energy), 2003e, Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada to Address the Increase in Activities Associated with the National Center for Combating Terrorism and Counterterrorism Training and Related Activities, DOE/EIS-0243-SA-02, November.

DOE (U.S. Department of Energy), 2004a, *Calendar Year 2003 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii*, SAND2004-2812, National Nuclear Security Administration Sandia Site Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 2004b, *Site Environmental Report for the Yucca Mountain Project Calendar Year 2003*, PGM-MGR-EC-000005 REV 00, Office of Repository Development, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2004c, *Final Environmental Assessment for Activities Using Biological Simulants and Releases of Chemicals at the Nevada Test Site*, National Nuclear Security Administration, Nevada Site Office, DOE/EA-1494, June.

DOE (U.S. Department of Energy), 2004d, Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site, DOE/EIS-0359, June.

DOE (U.S. Department of Energy), 2004e, Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site, DOE/EIS-0360, June.

DOE (U.S. Department of Energy), 2004f, *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site, Final Environmental Assessment*, DOE/EA-1499, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 2004g, Final Environmental Assessment for Aerial Operations Facility Modifications Nevada Test Site, DOE/EA-1512, October.

DOE (U.S. Department of Energy), 2005a, *Site Environmental Report for the Yucca Mountain Project Calendar Year 2004*, PGM-MGR-EC-000006, Rev. 00, Office of Repository Development, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2005b, *Calendar Year 2004 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii*, SAND2005-4628, National Nuclear Security Administration Sandia Site Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 2006a, *DOE Occupational Radiation Exposure, 2005 Report*, Office of Health, Safety and Security, Washington, DC.

DOE (U.S. Department of Energy), 2006b, *Site Environmental Report for the Yucca Mountain Project Calendar Year 2005*, PGM-MGR-EC-000007, Rev. 00, Office of Repository Development, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2006c, *Department of Energy Strategic Plan*, Office of Program Analysis and Evaluation, Washington, DC.

DOE (U.S. Department of Energy), 2006d, *Nevada Test Site Environmental Management End State Vision*, DOE/NV--948, January.

DOE (U.S. Department of Energy), 2006e, Draft 2006 Revised Environmental Assessment, Large-Scale, Open-Air Explosive Detonation, DIVINE STRAKE, at the Nevada Test Site, DOE/EA-1550, December.

DOE (U.S. Department of Energy), 2006f, *DOE Explosives Manual*, DOE M 440.1-1A, January.

DOE (U.S. Department of Energy), 2007b, *Nevada Test Site Environmental Report 2006*, DOE/NV/25946--259, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2007c, FY 2008 NNSA/NSO *Ten-Year Site Plan*, March.

DOE (U.S. Department of Energy), 2007d, Draft Supplement Analysis for Location(s) to Dispose of Depleted Uranium Oxide Conversion Product Generated from DOE's Inventory of Depleted Uranium Hexafluoride, DOE/EIS-0359-SA1 and DOE/EIS-0360-SA1, March.

DOE (U.S. Department of Energy), 2007e, *Draft FY2007 Mission Need Statement, Nevada Test Site, Mercury Complex Reconfiguration*, DE-AC52-06NA25946, National Nuclear Security Administration, Nevada Site Office, September.

DOE (U.S. Department of Energy), 2007a, Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, DOE/EIS-0250F-S1D, Office of Civilian Radioactive Waste Management, Las Vegas, Nevada, October.

DOE (U.S. Department of Energy), 2008a, *Nellis Air Force Base Remote Sensing Laboratory Emissions Inventory for Calendar Year 2008, Revision 2,* National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008b, *National Emission Standards for Hazardous Air Pollutants Calendar Year 2007*, DOE/NV/25946--483, National Nuclear Security Administration Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008c, *North Las Vegas Facility Emissions Inventory for Calendar Year 2008*, National Nuclear Security Administration Nevada Site Office, Las Vegas, Nevada, 2008.

DOE (U.S. Department of Energy), 2008d, Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada, Office of Civilian Radioactive Waste Management, DOE/EIS-0369, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008e, DOE Order 430.1B, Change 1, *Real Property Asset Management*, Washington, DC, February 8.

DOE (U.S. Department of Energy), 2008f, Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada, DOE/EIS-0243-SA-03, National Nuclear Security Administration, Nevada Operations Office, Las Vegas, Nevada, April.

DOE (U.S. Department of Energy), 2008g, Final Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, DOE/EIS-0250F-S1, Office of Civilian Radioactive Waste Management, Las Vegas, Nevada, June.

DOE (U.S. Department of Energy), 2008h, Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada – Nevada Rail Transportation Corridor and Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada, DOE/EIS-0250-S2 and DOE/EIS-0369, Office of Civilian Radioactive Waste Management, Las Vegas, Nevada, June.

DOE (U.S. Department of Energy), 2008i, *FY 2009 NNSA/NSO Ten-Year Site Plan*, DOE/NV 1271, Nevada Operations Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 2008j, Calendar Year 2007 Annual Site Environmental Report Sandia National Laboratories, Tonopah Test Range, Nevada & Kauai Test Facility, Hawaii, SAND2008-5070P, National Nuclear Security Administration, Sandia Site Office, Albuquerque, New Mexico, August.

DOE (U.S. Department of Energy), 2008k, *Nevada Test Site Environmental Report 2007*, DOE/NV/25946--543, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, September.

DOE (U.S. Department of Energy), 2008l, *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4, National Nuclear Security Administration, Washington, DC, October.

DOE (U.S. Department of Energy), 2009a, *Calendar Year 2008 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii*, SAND2009-4474P, National Nuclear Security Administration, Sandia Site Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 2009b, *Nevada Test Site Class II Air Quality Operating Permit AP9711-0549.01, Appendix 7, Air Quality Impact Modeling*, National Nuclear Security Administration/Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2009c, Air Monitoring Network at Tonopah Test Range: Letter Report No. 1: Network Description and Capabilities, National Nuclear Security Administration**,** Nevada Site Office, Nevada.

DOE (U.S. Department of Energy), 2009d, *National Emission Standards for Hazardous Air Pollutants – Radionuclide Emissions Calendar Year 2008*, DOE/NV/25946--742, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2009e, *Summary Emissions Report, Class II Air Quality Operating Permit AP9711-0549.01, 4th Quarter, Calendar Year 2008*, National Nuclear Security Administration Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2009f, *2009 Site Assets Management Plan*, Nevada Operations Office, Las Vegas, Nevada. **OUO**

DOE (U.S. Department of Energy), 2009g, Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington, DOE/EIS-0391, Richland, Washington.

DOE (U.S. Department of Energy), 2009h, *Quality Assurance in the Department of Energy*, Office of Health, Safety, and Security, Quality Assurance (accessed 12/3/09, https://www.directives.doe.gov/ directives/current-directives/414.1-BOrder-c).

DOE (U.S. Department of Energy), 2009i, Alternatives Summary Table for NTS SWEIS 2010, prepared by M. Skougard.

DOE (U.S. Department of Energy), 2009j, Final Programmatic Environmental Impact Statement (PEIS) for the Designation of Energy Corridors on Federal Land in 11 Western States (DOE/EIS-0386), U.S. Department of the Interior, Bureau of Land Management, Washington, DC, January.

DOE (U.S. Department of Energy), 2009k, *Underground Test Area Project Waste Management Plan Revision Number 3*, DOE/NV-343-Rev.3, National Nuclear Security Administration, Nevada Site Office, May.

DOE (U.S. Department of Energy), 2009l, *Underground Test Area (UGTA) Project Waste Management Plan*, Attachment 1, Fluid Management Plan for the UGTA Project, DOE/NV-370-Rev. 4, National Nuclear Security Administration, Nevada Site Office, May.

DOE (U.S. Department of Energy), 2009m, *Operating Experience Summary*, OE Summary 2009-07, Office of Health, Safety and Security, August.

DOE (U.S. Department of Energy) 2009n, *DOE 2008 Occupational Radiation Exposure*, Office of Health, Safety and Security, Washington, DC, October.

DOE (U.S. Department of Energy), 2009o, *Draft Site-Wide Environmental Impact Statement for the Y-12 National Security Complex*, DOE/EIS-0387, National Nuclear Security Administration, Washington, DC, October.

DOE (U.S. Department of Energy), 2009p, *Cultural Resources Management Plan for the Nevada Test Site*, DOE/NV11508-47 (Rev. 2), Review Draft, November 16.

DOE (U.S. Department of Energy), 2009q, U.S. Department of Energy Radiation Exposure Monitoring System, http://www.hss.energy.gov/csa/analysis/rems/rems/ri.htm, NTS data pull on November 20.

DOE (U.S. Department of Energy), 2009r, U.S. Department of Energy Radiation Exposure Monitoring System, http://www.hss.energy.gov/csa/analysis/rems/rems/ri.htm, TTR data pull on November 29.

DOE (U.S. Department of Energy), 2009s, Occurrence Reporting and Processing System database; data pull on 12/2/09 for Nevada Operations Office, Office of Health, Safety, and Security, December.

DOE (U.S. Department of Energy), 2010a, *Cultural Resources Management Plan for the Nevada Test Site*, Draft, DOE/NV/26383–13, Desert Research Institute, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2010b, Final Environmental Assessment for U-233 Material Downblending and Disposition Project at the Oak Ridge National Laboratory Oak Ridge, Tennessee, DOE/EA-1651, Oak Ridge Office, Oak Ridge, Tennessee, January.

DOE (U.S. Department of Energy), 2010c, Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center, DOE/EIS-0226, Washington, DC, January.

DOE (U.S. Department of Energy), 2010d, SWEIS NTS WS recd 1-21-10.

DOE (U.S. Department of Energy), 2010e, *Blue Ribbon Commission on America's Nuclear Future* (accessed May 20, 2010, http://brc.gov/).

DOE (U.S. Department of Energy), 2010f, *Strategic Sustainability Performance Plan – Discovering Sustainable Solutions to Power and Secure America's Future*, Report to the White House Council on Environmental Quality and Office of Management and Budget (accessed September 22, 2010, http://www.energy.gov/media/DOE_Sustainability_Plan_2010.PDF), September.

DOE (U.S. Department of Energy), 2010g, *NOI—Demonstration Project for Concentrating Solar Technologies*. (available at http://www1.eere.energy.gov/financing), DOE Office of Energy Efficiency and Renewable Energy, Washington, DC, December 16.

DOE (U.S. Department of Energy), 2010h, Desert Research Institute, *Community Environmental Monitoring Program Station Information* (accessed January 2, 2010, http://www.cemp.dri.edu/cgi-bin/cemp_stations.pl).

DOE (U.S. Department of Energy), 2010i, Computerized Accident/Incident Reporting System, "Occupational Injury and Illness Summary Report," Office of Health, Safety and Security (available at http://www.hss.doe.gov/csa/analysis/cairs/cairs/summary/oipds094/sum.html).

DOE (U.S. Department of Energy), 2011, *Draft Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*, DOE/EIS-0375-D, Washington, DC, February.

DOE (U.S. Department of Energy), undated, *Storm Water Pollution Prevention Plan for the North Las Vegas Facility*, prepared in accordance with Nevada Division of Environmental Protection Permit Number NVR050000 (Stormwater General Permit).DOE/DRI (U.S. Department of Energy and Nevada System of Higher Education Desert Research Institute), 2009a, *A Brief History of the Community Environmental Monitoring Program* (accessed December 11, http://www.cemp.dri.edu/cemp/CEMPhist.html).

DOE and U.S. Department of Air Force, 1988, *Final Environmental Impact Statement Tonopah Test Range Area 10*, Nye County, Nevada, February.

DOE/DRI (U.S. Department of Energy and Nevada System of Higher Education Desert Research Institute), 2009b, *Climatological and Gamma Radiation Summary [from Community Environmental Monitoring Program* (accessed December 11, http://www.cemp.dri.edu/cemp/climate/).

DOE/NDEP (U.S. Department of Energy and Nevada Division of Environmental Protection), 1994, *Mutual Consent Agreement*, January.

DOE/NNSA/NSO (U.S. Department of Energy/National Nuclear Security Administration/Nevada Site Office), 2008, *Groundwater Protection Program Plan for the National Nuclear Security Administration Nevada Site Office*, September.

DOE/NNSA/NSO (U.S. Department of Energy/National Nuclear Security Administration/Nevada Site Office), 2010, *Nevada Test Site Groundwater Questions and Answers*, DOE/NV--618 REV3 (available at http://www.nv.doe.gov/library/factsheets), April.

DOE/NV (U.S. Department of Energy, Nevada), 1994, Development of the Town Data Base: Estimates of Exposure Rates and Times of Fallout Arrival Near the Nevada Test Site, DOE/NV-374, Nevada Operations Office, September.

DOE/NV (U.S. Department of Energy, Nevada), 1997a, Regional Groundwater Flow and Tritium Transport Modeling and Risk Assessment of the Underground Test Area, Nevada Test Site, Nevada, DOE/NV-477 UC-700, Nevada Site Office, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 1997b, *Nevada Test Site Annual Site Environmental Report for Calendar Year 1996,* DOE/NV/11718-137, Nevada Operations Office, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 1998a, Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada (Rev. 2.1), DOE/NV/11718-176, Nevada Site Office, Las Vegas, Nevada, January.

DOE/NV (U.S. Department of Energy, Nevada), 1998b, *The Relative Abundance of Desert Tortoises on the Nevada Test Site Within Ecological Landform Units,* DOE/NV/11718-245, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 1998c, *Nevada Test Site Annual Site Environmental Report for Calendar Year 1997*, DOE/NV/11718–231, National Nuclear Security Administration, Nevada Site, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 1998d, *Nevada Test Site Resource Management Plan,* DOE/NV-518. Las Vegas, Nevada, December.

DOE/NV (U.S. Department of Energy, Nevada), 1999, *Nevada Test Site Annual Site Environmental Report for Calendar Year 1998*, DOE/NV/11718--361, National Nuclear Security Administration, Nevada Site, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2000a, Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada, Addendum 1, Update of Scenarios and Waste Acceptance Criteria Through the Performance Assessment Maintenance Program, Revision 1.0, DOE/NV-608, Las Vegas, Nevada, April.

DOE/NV (U.S. Department of Energy, Nevada), 2000b, Performance Assessment/Composite Analysis for the Area 3 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada (Revision 2.1), DOE/NV-491, Nevada Site Office, Las Vegas, Nevada, July.

DOE/NV (U.S. Department of Energy, Nevada), 2000c, *Nevada Test Site Annual Site Environmental Report for Calendar Year 1999*, DOE/NV/11718–463, National Nuclear Security Administration, Nevada Site, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2000d, *Classification of Vegetation of the Nevada Test Site* (DOE/NV/11718–477), Las Vegas, Nevada, December.

DOE/NV (U.S. Department of Energy, Nevada), 2000e, *United States Nuclear Tests, July 1945 Through September 1992*, DOE/NV-209-Rev 15, Nevada Operations Office, Las Vegas, December.

DOE/NV (U.S. Department of Energy, Nevada), 2001a, *Composite Analysis for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*, DOE/NV-594, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2001b, *Integrated Closure and Monitoring Plan for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site*, DOE/NV/11718-449-REV1, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2001c, *Nevada Test Site Annual Site Environmental Report for Calendar Year 2000*, DOE/NV/11718–605, National Nuclear Security Administration Nevada Site, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2001d, *Composite Analysis for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada,* DOE/NV–594-ADD1, Nevada Operations Office, Las Vegas, Nevada, November.

DOE/NV (U.S. Department of Energy, Nevada), 2001e, *Nevada Test Site Guide*, DOE/NV 715, Rev. 1, Nevada Operations Office, Las Vegas, Nevada, November.

DOE/NV (U.S. Department of Energy, Nevada), 2002a, Maintenance Plan for the Performance Assessments and Composite Analyses for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Sites, DOE/NV/11718-491-Rev.1, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2002b, *Nevada Test Site Annual Site Environmental Report for Calendar Year 2001*, DOE/NV/11718–747, National Nuclear Security Administration Nevada Site, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2002c, Supplemental Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off Site Locations in the State of Nevada, Task Order DE-AT08-01NV14088, Nevada Site Office, July.

DOE/NV (U.S. Department of Energy, Nevada), 2003a, *Nevada Test Site Annual Site Environmental Report for Calendar Year 2002*, DOE/NV/11718–842, National Nuclear Security Administration, Nevada Site, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2004a, *Nevada Test Site 2003 Waste Management Monitoring Report*, *Area 3 and Area 5 Radioactive Waste Management Sites*, DOE/NV/11718-930, Nevada Site Office, Las Vegas, Nevada, June.

DOE/NV (U.S. Department of Energy, Nevada), 2004b, *Subcritical Experiments at the U1a Facility*, DOE/NV-1016, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2004c, *Device Assembly Facility*, DOE/NV-1014, Nevada Operations Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2004d, *Nevada Test Site Environmental Report 2003*, DOE/NV/11718-971, Nevada Site Office, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2005a, *Nevada Test Site National Emission Standards for Hazardous Air Pollutants Calendar Year 2004;* DOE/NV/11718-1065, National Nuclear Security Administration, Las Vegas, Nevada.

DOE/NV (U.S. Department of Energy, Nevada), 2005b, *Annual Report – FY 2004, Radioactive Waste Shipments To and From the Nevada Test Site (NTS)*, DOE/NV-1032, National Nuclear Security Administration, Nevada Site Office Las Vegas Nevada, January.

DOE/NV (U.S. Department of Energy, Nevada), 2005c, *Big Explosives Experimental Facility*, DOE/NV-711, Rev. 3, Nevada Operations Office, Las Vegas, Nevada, January.

DOE/NV (U.S. Department of Energy, Nevada), 2005d, Integrated Closure and Monitoring Plan for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site, DOE/NV/11718–449-REV2, Nevada Site Office, Las Vegas, Nevada, June.

DOE/NV (U.S. Department of Energy, Nevada), 2005e, *Nonproliferation Test and Evaluation Complex*, DOE/NV-1062, Nevada Operations Office, Las Vegas, Nevada, June.

DOE/NV (U.S. Department of Energy, Nevada), 2005f, *Nevada Test Site Environmental Report 2004*, DOE/NV/11718-1080, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada), 2005g, *Annual Transportation Report for Radioactive Waste Shipments to and from the Nevada Test Site*, DOE/NV-1096, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, December.

DOE/NV (U.S. Department of Energy, Nevada), 2006a, *Nevada Test Site Environmental Report 2005*, National Nuclear Security Administration, Nevada Site Office, DOE/NV/11718--1214 and DOE/NV/25946--007, Las Vegas, Nevada.

DOE/NV (U.S. Department of Energy, Nevada), 2006b, Factsheet: Mixed Low-Level Waste Acceptance Guidelines at the Nevada Test Site, DOE/NV-742-REV5, Las Vegas, Nevada, February.

DOE/NV (U.S. Department of Energy, Nevada), 2006c, Factsheet: Transuranic Waste at the Nevada Test Site, DOE/NV-787-REV2, Las Vegas, Nevada, February.

DOE/NV (U.S. Department of Energy, Nevada), 2006d, *Nevada Test Site 2005 Waste Management Monitoring Report, Area 3 and Area 5 Radioactive Waste Management Sites*, DOE/NV/11718-1241, DOE/NV/25946-021, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, August.

DOE/NV (U.S. Department of Energy, Nevada), 2006e, "Update…Transuranic (TRU) Waste in the Trenches," Community Advisory Board, Transportation Waste Committee Meeting, December 20.

DOE/NV (U.S. Department of Energy, Nevada), 2007a, *Annual Transportation Report for Radioactive Waste Shipments to and from the Nevada Test Site*, DOE/NV-1187, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, January.

DOE/NV (U.S. Department of Energy, Nevada), 2007b, *Closure Strategy: Nevada Test Site Area 5 Radioactive Waste Management Site*, DOE/NV/25946–153, Nevada Site Office, Las Vegas, Nevada, March.

DOE/NV (U.S. Department of Energy, Nevada), 2007c, *Closure Plan for the Area 3 Radioactive Waste Management Site at the Nevada Test Site*, DOE/NV/25946–289, Nevada Site Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2007d, *Nevada Test Site Environmental Report 2006*, DOE/NV/25946—259, Nevada Site Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2007e, *Annual Transportation Report for Radioactive Waste Shipments to and from the Nevada Test Site*, DOE/NV-1238, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, December.

DOE/NV (U.S. Department of Energy, Nevada), 2008a, *Nevada Test Site Environmental Report 2007*, DOE/NV/25946-543, Nevada Site Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2008b, *Closure Plan for the Area 5 Radioactive Waste Management Site at the Nevada Test Site*, DOE/NV/25946—553, Nevada Site Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2008c, FY 2007 Utility Management Plan.

DOE/NV (U.S. Department of Energy, Nevada), 2009a, *Annual Transportation Report for Radioactive Waste Shipments to and from the Nevada Test Site*, DOE/NV-1309, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, February.

DOE/NV (U.S. Department of Energy, Nevada), 2009b, *Nevada Test Site Waste Acceptance Criteria*, DOE/NV-325-Rev. 7-01, Nevada Site Office, Las Vegas, Nevada, May.

DOE/NV (U.S. Department of Energy, Nevada), 2009c, *Nevada Test Site 2008 Waste Management Monitoring Report, Area 3 and Area 5 Radioactive Waste Management Sites*, DOE/NV/25946–736, Nevada Site Office, Las Vegas, Nevada, June.

DOE/NV (U.S. Department of Energy, Nevada), 2009d, *Nevada Test Site Environmental Report 2008*, DOE/NV/25946-790, Nevada Site Office, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada), 2010, *Nevada Test Site Environmental Report 2009,* DOE/NV/25946-1067, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, September.

DOL (U.S. Department of Labor), 2010a, Revisions to the 2008 Census of Fatal Occupational Injuries (CFOI) Counts, Bureau of Labor Statistics.

DOL (U.S. Department of Labor), 2010b, "Census of Fatal Occupational Injuries (CFOI) – Current and Revised Data," Bureau of Labor Statistics (accessed at http://www.bls.gov/iif/oshcfoi1.htm), April 21.

DOL (U.S. Department of Labor), 2010c, "Workplace Injuries and Illnesses – 2009," News Release USDL-10-1451, Bureau of Labor Statistics, October 21.

DOT (U.S. Department of Transportation), 2007, Ten Year Hazardous Materials Incident Data, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Material Safety (accessed August 9, 2007, http://hazmat.dot.gov/pubs/ inc/data/10yearfrm.htm), August 9.

Drollinger, H., 2003, An Archaeological Investigation of the Bower Cabin Site, Nevada Test Site, Nye County, Nevada, Technical Report No. 100, DOE/NNSA/13609-10, Las Vegas, Nevada.

Drollinger, H., and F. Nials, 1996, Archaeological Data Recovery for Site 26NY1958, Nevada Test Site, Nye County, Nevada, DRI Technical Report No. 86, DOE/NV/10845-54 UC-702, Las Vegas, Nevada.

Drollinger, H., C. M. Beck, and R. C. Jones, 2000, The Petroglyphs of Upper Fortymile Canyon, Nevada Test Site, Nye County, Nevada, DRI Technical Report No. 96, DOE/NV/11508-50, Las Vegas, Nevada.

Drollinger, H., R. C. Jones, T. F. Bullard, L. J. Ashbaugh, and W. R. Griffin, 2009, A Historical Evaluation of the U12t Tunnel, Nevada Test Site, Nye County, Nevada, DRI CR Technical Report No. 105, DOE/NV/26383-109, Nevada.

DTRA (Defense Threat Reduction Agency), 1981, High-Explosive Field Tests: Explosion Phenomena and Environmental Impacts, October 1.

DTSC (California Department of Toxic Substances Control), 2007, Envirostor – Commercial Offsite Hazardous Waste Facilities (accessed April 20, 2010 at http://www.envirostor.dtsc.ca.gov/ public/commercial_offsite.asp).

DuBarton, A., and H. Drollinger, 1996, Results of a Class III Survey at Tub Spring, Reitmann Seep, and Captain Jack Spring, Nevada Test Site, Nye County, Nevada, DRI Technical Report No. 90, DOE/NV/11508-10 UC-702, Las Vegas, Nevada.

DuBarton, A. E. and W. G. Johnson, 1996, A Class III Cultural Resources Reconnaissance of Proposed Access Roads and Staging Areas for the Clean Slate I, II, and III Event Sites, Tonopah Test Range, Nye County, Nevada, Desert Research Institute short Report No. SR102896-1, Las Vegas, Nevada.

Duke, S., National Security Technologies, LLC, 2009, Personal communication (email) to G. Roles, Science Applications International Corporation, "Re" WM activities at RSL and North Las Vegas Facility," December 19.

Dunaway, P. B., and M. G. White, 1974, *The Dynamics of Plutonium in Desert Environments* (NV)-142), U.S. Energy Research and Development Administration, Nevada Operations Office, Las Vegas, Nevada.

EDEN, Inc., 2007, Comprehensive Economic Development Strategy for Nye County, Nevada, Nye County, Nevada, May.

Edleman, A., U.S. Department of Energy, 2010, Personal communication (email) to J. Carilli, U.S. Department of Energy, et al., "RE: Request for GTCC info," January 25.

Edwards, S., 1997, Atomic Age Training Camp: The Historical Archaeology of Camp Desert Rock, M.A. Thesis, Department of Anthropology and Ethnic Studies, UNLV, Las Vegas.

EG&G (EG&G Energy Measurements, Inc.), 1991, *The Distribution and Abundance of Desert Tortoises on the Nevada Test Site*, EGG 10617-2081, Santa Barbara Operations, Goleta, California, January.

EG&G (EG&G Energy Measurements, Inc.), 1995, Preactivity and Reclamation Survey Reports for Five Tonopah Test Range Explosive Ordnance Disposal Sites, Survey Report LV94-SRB-59, Las Vegas, Nevada.

EG&G/EM (EG&G Energy Measurements, Inc.), 1993, *Yucca Mountain Biological Resources Monitoring Program, Annual Report FY92*, EGG 10617-2195, Santa Barbara Operations, Goleta, California.

EG&G/EM (EG&G Environmental Measurements, Inc.), 1993b, *Baseline Vegetation Contamination at Safety Test Sites on the Nevada Test Site and Tonopah Test Range*, Environmental Sciences Department Summary Report, Las Vegas, Nevada.

Enyeart, T., 2009, Personal communication (email) to G. Waldman, Science Applications International Corporation, "FW: CY 2008 Occupational Doses," November 9.

EPA (U.S. Environmental Protection Agency), 1974, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," March 1974.

EPA (U.S. Environmental Protection Agency), 1992, *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, EPA420-R-92-009, Office of Air and Radiation, December.

EPA (U.S. Environmental Protection Agency), 1995, *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*, Office of Air Quality Planning and Standards and Office of Air and Radiation (accessed January 7, 2010, http://www.epa.gov/ttn/chief/ap42/index.html), Research Triangle Park, North Carolina.

EPA (U.S. Environmental Protection Agency), 1999, *Understanding Variation in Partition Coefficient, K_d, Values*, EPA 402-R-99-004A, Office of Air and Radiation, and U.S. Department of Energy, Office of Environmental Restoration, Washington, DC, August.

EPA (U.S. Environmental Protection Agency), 2003, *Integrated Risk Information System, Reference Concentration for Chronic Inhalation Exposure, Diesel Engine Exhaust* (http://www.epa.gov/iris/subst/0642.htm#refinhal), February 28.

EPA (U.S. Environmental Protection Agency), 2009a, *Calculating Aviation Gasoline Lead Emissions in the 2008 NEI*, March.

EPA (U.S. Environmental Protection Agency), 2009b, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, EPA 430-R-09-004, Washington, DC, revision July 14, 2009 (accessed August 5, 2009, http://www.epa.gov/climatechange/emissions/usinventoryreport.html).

EPA (U.S. Environmental Protection Agency), 2009c, *Motor Vehicle Emissions Simulator (MOVES) 2010 User Guide*, EPA-420-B-09-041, Office of Transportation and Air Quality, (accessed March 2, 2010, http://www.epa.gov/otaq/models/moves/420b09041.pdf), December.

EPA (U.S. Environmental Protection Agency), 2009d, *Technical Support Document for Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, Office of Atmospheric Programs Climate Change Division*, Washington, District of Columbia, December 07, 2009, 210 pages.

EPA (U.S. Environmental Protection Agency), 2010a, *AirData*, Office of Air and Radiation (accessed February 10, 2010, http://www.epa.gov/air/data/index.html), Washington, DC.

EPA (U.S. Environmental Protection Agency), 2010b, How to Calculate your Carbon Footprint, Simplified GHG Emissions Calculator (v2.8), (accessed March 22, 2010, http://www.epa.gov/climateleaders/smallbiz/footprint.html), March 11.

EPA (U.S. Environmental Protection Agency), 2010c, *The Green Book Nonattainment Areas for Criteria Pollutants* (accessed January 20, 2010, http://epa.gov/air/oaqps/greenbk/index.html), Washington, DC.

EPA (U.S. Environmental Protection Agency), 2010d, *Commercially Permitted PCB Disposal Companies* (available at http://www.epa.gov/epawaste/hazard/tsd/pdbs,pubs/stordisp.htm), March 12.

EPA and Army (U.S. Environmental Protection Agency and U.S. Department of the Army), 2007, Clean Water Act Jurisdiction, Following the U.S. Supreme Court's Decision in Rapanos v. United States & Carabell v. United States Memorandum, June 5.

FAA (Federal Aviation Administration), 2000, Final Environmental Assessment for the Site Launch, Reentry and Recovery Operations at the Kistler Launch Facility, Nevada Test Site (NTS), Associate Administrator for Commercial Space Transportation, Washington, DC, April.

FAA (Federal Aviation Administration), 2002, *Final Environmental Assessment for the Site, Launch, Reentry and Recovery Operations at the Kistler Launch Facility, Nevada Test Site (NTS)*, Office of the Associate Administrator for Commercial Space Transportation, Washington, DC, April.

FAA (Federal Aviation Administration), 2009, *Emissions and Dispersion Modeling System (EDMS) Version 5 Technical Manual*, FAA-AEE-07-7, Office of Environment and Energy, Washington, DC.

Faulds, J. E. and C. D. Henry, 2008, "Tectonic influences on the spatial and temporal evolution of the Walker Lane: An incipient transform fault along the evolving Pacific-North American plate boundary," in Spencer, J.E., and Titley, S.R., eds., "Ores and orogenesis: Circum-Pacific tectonics, geologic evolution, and ore deposits," *Arizona Geological Society Digest 22*, p. 437-470.

FEMA (U.S. Federal Emergency Management Agency), 2002a, *Flood Insurance Rate Map – Clark County, Nevada and Incorporated Areas, Panel 2160 of 4090*, Map Number 32003C2160 E (map revised September 27, 2007).

FEMA (U.S. Federal Emergency Management Agency), 2002b, *Flood Insurance Rate Map – Clark County, Nevada and Incorporated Areas, Panel 2200 of 4090*, Map Number 32003C2200 E (map revised September 27, 2007).

FFACO (Federal Facility Agreement and Consent Order), 2008, Appendix VI. Corrective Action Strategy, Revision No: 2., February.

FFACO (Federal Facility Agreement and Consent Order), 2009, Appendix IV, Corrective Action Strategy, Revision No: 26, July.

FFACO (Federal Facility Agreement and Consent Order), 2010, Appendix VI, Corrective Action Strategy, Revision No. 3, March.

FHA (Federal Highway Administration), 1988, Visual impact assessment for highway projects, FHWA-HI-88-054, U.S. Department of Transportation.

Fiero, B., 1986, Geology of the Great Basin, Reno, University of Nevada Press, Reno, Nevada.

Forester, R. M., J. P. Bradbury, C. Carter, A. B. Elvidge-Tuma, M. L. Hemphill, S. C. Lundstrom, S. A. Mahan, B. D. Marshall, L. A. Neymark, J. B. Paces, S. E. Sharpe, J. F. Whelan, and P. E. Wigand, 1999, *The Climatic and Hydrologic History of Southern Nevada During the Late Quaternary*, U.S. Geological Survey Open-File Report 98-635.

Francis, C. W., 1973, "Plutonium Mobility in Soil and Uptake in Plants: A Review," *Journal of Environmental Quality*.

Friesen, H. N., 1992, Summary of the Nevada Applied Ecology Group and Correlative Programs, DOE/NV-357 (Version 2), Las Vegas, Nevada.

Frizzell, Jr., V. A., and J. Schulters, 1990, Geologic Map of the Nevada Test Site, Southern Nevada, Miscellaneous Investigations Series Map 1-2046, Scale 1:100,000, U.S. Geological Survey, Denver, Colorado.

Garside, L. L, R. H. Hess, K. L. Fleming, and B. S. Weimer, 1988, *Oil and Gas Developments in Nevada*, Nevada Bureau of Mines and Geology Bulletin 104, University of Nevada, Reno, Nevada.

GBUAPCD (Great Basin Unified Air Pollution Control District), 2010, Website (accessed July 21, 2010, http://www.gbuapcd.org/background.htm).

Giampaoli, M. E., 1986, Trip Report: Hydrologic Field Reconaissance Led by Robert Coache, Water Resources Division, Nevada Department of Natural Resources and Conservation, April 24, 1986, Science Applications International Corporation, Memo to J. Younker, May 7.

Giampaoli, M., 2007, Yucca Mountain Project Gateway Area Concept Plan, Nye County, Nevada.

Gilbert R. O., J. H. Shinn, E. H. Essington, T. Tamura, E. M. Romney, K. S. Moor, and T. P. O'Farrell, 1988, "Radionuclide Transport from Soil to Air, Native Vegetation, Kangaroo Rats and Grazing Cattle on the Nevada Test Site," *Health Physics*, December.

Giles, K. R., and J. Cooper, 1975, *Characteristics and Migration Patterns of Mule Deer and the Nevada Test Site*, EPA/600/4-85-030, U.S. Environmental Protection Agency, Las Vegas, Nevada.

Glasstone S. and P. J. Dolan, 1977, The Effects of Nuclear Weapons, Third Edition, U.S. Department of Defense and U.S. Department of Energy.

Gordon, S., National Security Technologies, LLC, 2009a, Personal communication (email) to G. Roles, Science Applications International Corporation, "FW: Information commitments from Alternatives meetings," October 12.

Gordon, S., National Security Technologies, LLC, 2009b, Personal communication (email) to G. Roles, Science Applications International Corporation, "Re: Updated NTS Information for SWEIS," October 12.

Gordon, S., National Security Technologies, LLC, 2009c, Personal communication (email) to G. Roles, Science Applications International Corporation, "Re: WM activities at RSL and North Las Vegas Facility," December 8.

Greger, P. and E. M. Romney, 1994, "Status of Large Mammals and Birds on the Nevada Test Site, 1993," in R. Hunter (ed.) *Status of the Flora and Fauna on the Nevada Test Site*, 1992. DOE/NV/11432-58, Reynolds Electrical & Engineering Co., Inc., Las Vegas, Nevada.

Griffin, W. R., Special Projects Manager, Navarro-Interra, 2011, Personal communication (email) to L. M. Cohn, National Nuclear Security Administration Nevada Site Office, "Safety Information," January 27.

Grow, J. S., C. A Barker, and A. G. Harris, 1994, "Oil and Gas Exploration near Yucca Mountain, Southern Nevada, High-Level Radioactive Waste Management," in Proceedings of the Fifth International Conference, Las Vegas, Nevada, May 11-16.

Hakonson, T. E., 1975, "Environmental Pathways of Plutonium into Plants and Animals. *Health Physics.*

Hakonson, T. E., and J. W. Nyhan, 1980, "Ecological Relationships of Plutonium in Southwest Ecosystems," *Transuranic Elements in the Environment*, W. C. Hanson (ed.), U.S. Department of Energy TIC-22800, Washington, DC.

Hall, D. B., P. D. Greger, A. V. Cushman, and C. A. Wills, 2003, *Ecology of the Western Burrowing Owl on the Nevada Test Site,* DOE/NV/11718-701, U.S. Department of Energy, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, December.

Hansen, D. J., P. D. Greger, C. A. Wills, and W. K. Ostler, 1997, *Nevada Test Site Wetlands Assessment*, Nevada Operations Office, May.

Hanson, W. C., 1975, "Ecological Considerations of the Behavior of Plutonium in the Environment" *Health Physics*, Vol. 28.

Hardman, G., 1965, *Nevada precipitation map:* University of Nevada Agricultural Experimentation Bulletin 183, 57 p.

Harrill, J. R., J. S. Gates, and J. M. Thomas, 1988, *Major Ground-Water Flow Systems in the Great Basin Region of Nevada, Utah and Adjacent States*, Hydrological Investigations Atlas HA-694-C Scale 1:1,000,000, U.S. Geological Survey, Denver, Colorado.

Hayward, C. L., M. L. Killpack, and G. L. Richards, 1963, "Birds of the Nevada Test Site," *Brigham Young University Science Bulletin*, Biological Series, Vol. III, No. 1, Provo, Utah.

Healthgrades, 2010, *Healthgrades for Sunrise Hospital and Medical Center* (available at http://www.healthgrades.com/hospital-directory/nevada-nv/sunrise-hospital-and-medical-center-hgstd4f70596290003), March 6.

Hess, R. H. and G. L. Johnson, 1996, *Nevada Oil and Gas Wells 1907-1996*, Nevada Bureau of Mines and Geology, Reno, Nevada.

Hevesi, J. A., A. L. Flint, and L. E. Flint, 2003, Simulation of Net Infiltration and Potential Recharge Using a Distributed-Parameter Watershed Model of the Death Valley Region, Nevada and California, U.S. Geological Survey, Water-Resources Investigations Report 03-4090 (available at http://water.usgs.gov/pubs/wri/wri034090/), Sacramento, California.

Howard, W. A., P. B. Dunaway, and R. G. Fuller, 1985, *The radioecology of Transuranics and Other Radionuclides in Desert Ecosystems* (NVO-224), U.S. Department of Energy, Nevada Operations Office, Las Vegas, Nevada.

Howard, W. A., and R. G. Fuller, 1987, *The Dynamics of Transuranics and Other Radionuclides in Natural Environments* (NVO-272), U.S. Department of Energy, Nevada Operations Office, Las Vegas, Nevada.

HRCES (Harry Reid Center for Environmental Studies and Professional Analysis, Inc.), 1994, *Preliminary Assessment of Geothermal Potential, Nevada Test Site, Nye County, Nevada*, Las Vegas, Nevada, December.

Hunter, R. B. (compiler), 1992, *Status of the Flora and Fauna on the Nevada Test Site, 1988*, DOE/NV-10630-29, Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nevada.

Hunter, R. B., (compiler), 1994a, "Trends in Perennial Plant Population on the Nevada Test Site, 1989-1991" in *Status of the Flora and Fauna on the Nevada Test Site, 1989-1991*, DOE/NV-11432-57, Reynolds Electrical & Engineering Co., Inc., Las Vegas, Nevada.

Hunter, R. B. (compiler), 1994b, *Status of the Flora and Fauna on the Nevada Test Site 1989-1991*, DOE/NV-11432-57, Reynolds Electrical & Engineering Co., Inc., Las Vegas, Nevada.

Hunter, R. B. (compiler), 1994c, *Status of the Flora and Fauna on the Nevada Test Site, 1992*, DOE/NV-11432-58, Reynolds Electrical & Engineering Co., Inc., Las Vegas, Nevada.

Hunter, R. B. (compiler), 1995, *Status of the Flora and Fauna on the Nevada Test Site, 1994*, DOE/NV-11432-195, Department of Energy, Nevada Operations Office, Las Vegas, Nevada, September.

ICBO (International Conference of Building Officials), 1991, Uniform Building Code, Whittier, California.

ICC (International Code Council, Inc.), 2009 International Building Code (available at http://publicecodes.citation.com/icod/ibc/2009/index.htm).

IPCC (Intergovernmental Panel on Climate Change), 2007, *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA.

Inyo County, 2002, Inyo County General Plan, Land Use and Conservation/Open Space Elements, Diagram 1, Inyo County Planning Department website (accessed July 15, 2010, http://inyoplanning.org/general_plan/landuse.htm).

JEGI (Jacobs Engineering Group Inc.), 1998, *Final Environmental Impact Statement for Treatment of Low-Level Mixed Waste*, Richland, Washington, February.

Johnson, P. E., and R. D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) – User's Manual*, ORNL/NTRC-006, Rev. 0 (available at http://apps.ntp.doe.gov/tragis/tragis.htm), U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June.

Johnson, W. G., B. A. Holz and R. Jones, 2000, *A Cold War Battlefield: Frenchman Flat Historic District, Nevada Test Site, Nye County, Nevada*, Cultural Resources Technical Report No. 97, DE-AC08-00NV13609-001, Las Vegas, Nevada.

Johnson, W. G., R. Jones, H. Drollinger and A. DuBarton, 1999, *Archaeological Data Recovery at Site 26NY10133, Nevada Test Site, Nye County, Nevada*, DRI CR Technical Report No. 95, DOE/NV/11508-39, Las Vegas, Nevada.

Johnson, W. G., and S. R. Edwards, 2000, *Survival Town: The Apple-2 Historic District, Nevada Test Site, Nye County, Nevada*, Technical Report No. 99, DOE/NV/13609-04, Las Vegas, Nevada.

Jones, R. C., 2001, Carey & Company Inc., *Results of Historic Research and Archaeological Investigations at Cane Spring*, Nevada Test Site, Nye County, Nevada, Technical Report No. 98, DOE/NV1360901, Las Vegas, Nevada.

Jones, R. C., C. M. Beck, and B. Holz, 2005, Yucca Lake Historic District, Area 6, Nevada Test Site, Nevada, DRI CR Technical Report No. 102, DOE/NV/13609-27, Las Vegas, Nevada.

Kaminski, M. A., 2008, *Fact Sheet, Permittee Name: U.S. Air Force, Permit Number NEV20001,* Bureau of Water Pollution Control, Nevada Division of Environmental Protection, Fact sheet regarding renewal of the Tonopah Test Range discharge permit (accessed February 3, 2010, http://ndep.nv.gov/docs_08/nev20001_f08.pdf), June 3.

Karl, T. R., J. M. Melillo and T. C. Peterson, 2009, *Global Climate Change Impacts in the United States*, Cambridge University Press, Cambridge, United Kingdom.

Kral, V. E., 1951, *Mineral Resources of Nye County, Nevada*, Bulletin, Geology and Mining Series No. 50, Nevada Bureau of Mines and Geology and the McKay School of Mines, University of Nevada, Reno, Nevada, January.

Lacy, S., 2011, National Nuclear Security Administration/Sandia Site Office, Personal communication (email) to M. Skougard, "TTR APP," March 24.

Laczniak, R. L., J. C. Cole, D. A. Sawyer, and D. A. Trudeau, 1996, Hydrogeologic Controls on the Movement of Groundwater at the Nevada Test Site, Nye County, Nevada – A Summary Description for Environmental Restoration, Draft USGS Open File Report 92-4109, U.S. Geological Survey, Las Vegas, Nevada.

Laney, C., 2010, U.S. Ecology, Personal communication (email) to G. Roles, Science Applications International Corporation, "RE: Waste disposal at the LLW site in Beatty, Nevada," May 17.

Lehrman, D. et al., 2006, *Ozone Characterization Study, Final Report (P.O. 210324),* Environmental Research Associates, Santa Rosa, California.

Littleton, B., 2006, *Depleted Uranium Technical Brief* (EPA 402-R-06-011), U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Radiation Protection Division, Washington, DC, December.

Liu, D., and B. Liptak, 1997, *Environmental Engineers' Handbook*, 2nd Edition, Lewis Publishers.NLV (City of North Las Vegas), 2010, *North Las Vegas Municipal Code, Title 17: Zoning*, Codified through Ordinance No. 2554, Las Vegas, Nevada, July.

LVPC (Las Vegas Planning Commission), 2000, *City of Las Vegas Master Plan 2020*, Nevada, September 6.

LVRJ (Las Vegas Review Journal), 2010, *Construction Industry Still Suffering*, (available at http://www.lvrj.com/ business/construction-industry-still-suffering-87561957.html), March 13.

LVVWD (Las Vegas Valley Water District), 2009, Water Quality Report.

LVVWD (Las Vegas Valley Water District), 2010a, Groundwater (available at http://www.lvvwd.com/about/wr_groundwater.html), January 28.

LVVWD (Las Vegas Valley Water District), 2010b, Water Resources (available at http://www.lvvwd.com/about/wr.html), January 28.

Lyneis, M. M., 1982, "Prehistory in the Southwestern Great Basin," *Man and Environment in the Great Basin*, pp. 172-185, Society for American Archaeology Papers 2, Washington, DC.

Maxwell, D., 2010, *Solar and National Conservation Areas Discussed*, Lincoln County Record (available at http://www.lincolncountyrecord.com/pages/100325_solar), March 25.

McArthur, R. D., 1991, *Radionuclides in Surface Soil at the Nevada Test Site*, DOEINVIl0845-02, U.S. Department of Energy, Las Vegas, Nevada.

McArthur R. D., and J. F. Kordas, 1985, Nevada Test Site Radionuclide Inventory and Distribution Program: Report #2, Areas 2 and 4, Desert Research Institute, DOE/NV/10162-20.

Medica, P. A, 1990, "Noteworthy Mammal Distribution Records for the Nevada Test Site," *Great Basin Naturalist*, Vol. 50, pp. 83-84.

Medica, P. A, O. L. Haworth, and M. S. Kelly, 1990, "Geographic Distribution, Eumeces gilberti rubricaudatus," *Herpetological Review*, Vol. 21, p. 40.

Miller, J. J., D. L. Gustafson, and S. E. Rawlinson, 1994, F*lood Assessment at the Proposed Area 6 Liquid Waste Treatment System - DOE/NV Test Site, Nye County, Nevada*, Draft Issue, Raytheon Services Nevada, October.

Moore, J. E., 1961, Records of Wells, Test Holes, and Springs in the Nevada Test Site and Surrounding Area, U.S. Geological Survey, USGS-TEI-781.

Morris, P., National Security Technologies, LLC, 2009, Personal communication (email) to S. Enyeart, Science Applications International Corporation, "FW: Noise Data Request," November 30.

NAFB (Nellis Air Force Base), 2005, 2005 Drinking Water Quality Report for Nellis Air Force Base.

NARAC (National Atmospheric Release Advisory Center), 2010, *HotSpot – Health Physics Codes, Version 2.07 User's Guide*, LLNL-TM-411345 (accessed June 27, 2010, https://narac.llnl.gov/HotSpot/HotSpot.html), March.

NCDC (National Climatic Data Center), 2009, U.S. Climate Averages (accessed December 2, 2009 at http://www.wrcc.dri.edu/summary/Climsmnv.html).

NCI (National Cancer Institute), 1997, Study Estimating Thyroid Doses of I-131 Received by Americans from Nevada Atmospheric Nuclear Bomb Test, Bethesda, Maryland.

NCRP (National Council on Radiation Protection and Measurements), 1993, *Risk Estimates for Radiation Protection*, NCRP Report No. 115, Bethesda, Maryland, December 31.

NCRP (National Council on Radiation Protection and Measurements), 2006, Report Number 160: *Ionizing Radiation Exposure of the Population of the United States*, Widely Available.

NCRP (National Council on Radiation Protection and Measurements), 2009, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 160, Bethesda, Maryland.

NDEP (Nevada Division of Environmental Protection), 1996, The State of Nevada Department of Conservation and Natural Resources, Division of Environmental Protection and the United States Department of Energy and the United States Department of Defense in the matter of Federal Facility Agreement and Consent Order, March 15.

NDEP (Nevada Department of Environmental Protection), 2005, Water Pollution Control General Permit GNEV93001, issued August 5, 2005 for the U.S. DOE, National Nuclear Security Agency, Nevada Site Office.

NDEP (Nevada Department of Environmental Protection), 2007, Bureau of Air Pollution Control, Class II Air Quality Operating Permit, Permit No. AP8733-0680.02, Facility ID No. A0025.

NDEP (Nevada Division of Environmental Protection), 2008, *Nevada Statewide Greenhouse Gas Emissions Inventory and Projections, 1990-2020*, Carson City, Nevada, December.

NDEP (Nevada Division of Environmental Protection), 2009a, Bureau of Air Pollution Control (BAPC) (accessed December 2, 2009, http://ndep.nv.gov/bapc/capp/capp1.html#).

NDEP (Nevada Division of Environmental Protection), 2009b, Bureau of Waste Management (accessed April 20, 2010, http://ndep.nv.gov/bwm/hazard01.htm), October 13.

NDEP (Nevada Division of Environmental Protection), 2009c, Hazardous Waste Recycling Facilities with Written Determinations Issued Under NAC 444.84555, November 19.

NDEP (Nevada Division of Environmental Protection), 2010a, NevadaRecycles.gov (accessed April 20, 2010, http://nevadarecycles.gov/main/recyclables.htm), March 4.

NDEP (Nevada Division of Environmental Protection), 2010b, Permitted Solid Waste Facilities (accessed April 20, 2010, http://ndep.nv.gov/bwm/landfill.htm), March 15.

NDEP (Nevada Department of Environmental Protection), 2010c, *Drinking Water Branch – Water Systems*. Online Nevada public drinking water information searchable database (accessed at https://ndwis.ndep.nv.gov/DWW/).

NDOT (Nevada Department of Transportation), 2003, Southern Nevada Transportation Study, October 6.

NDOT (Nevada Department of Transportation), 2008a, Annual Traffic Report – Nye County.

NDOT (Nevada Department of Transportation), 2008b, Annual Traffic Report – Clark County.

NDOT (Nevada Department of Transportation), 2008c, *Annual Traffic Report*, Traffic Information Division in cooperation with U.S. Department of Transportation Federal Highway Administration, Carson City, Nevada.

NDOT (Nevada Department of Transportation), 2010, Nevada Department of Transportation Annual Average Daily Traffic Monitoring Data received from W. Rosenthal of NDOT, June 6.

NDWR (Nevada Division of Water Resources), 2006, Hydrographic Boundaries – State of Nevada, Nevada.

NDWR (Nevada Division of Water Resources), 2010a, Summary of Hydrographic Area Nos. 147, 157, 158, 159, 160, 212, 225, 226, 227A, 227B, 228, State of Nevada Department of Conservation and Natural Resources Division of Water Resources (accessed January 27, 2010, http://water.nv.gov/WaterPlanning/UGactive/index.cfm).

NDWR (Nevada Division of Water Resources), 2010b, Hydrographic Area Summary of Hydrographic Area No. 212, State of Nevada Department of Conservation and Natural Resources Division of Water Resources (accessed January 27, 2010, http://water.nv.gov/WaterPlanning/UGactive/index.cfm).

NDWR (Nevada Division of Water Resources), 2010c, Northwest Region Groundwater Basin Information, Hydrographic Area Nos. 148, 147, 145, 141, and 149, State of Nevada Department of Conservation and Natural Resources Division of Water Resources (accessed February 4, 2010, http://water.nv.gov/WaterPlanning/wat-fact/gwinfo.cfm).

NEJM (New England Journal of Medicine), 1979, Lyon, Lauber, Gardner, Udall: "Childhood Leukemias Associated with Fallout from Nuclear Testing," *The New England Journal of Medicine*, February 22.

Neuhauser and Kanipe, 2003, *RADTRAN 5 User's Guide*, SAND 2003-2354, Sandia National Laboratories, Albuquerque, New Mexico, July.

Nevada Department of Conservation and Natural Resources, 2010a, Division of Water Resources, *Hydrographic Basin Summary by Manner of Use*, Basin 160 (available at http://water.nv.gov/water%20Rights/permitdb/UGactive2.cfm?CFID=777906&CFTOKEN=93208706).

Nevada Department of Conservation and Natural Resources, 2010b, Division of Water Resources, "2010 Nevada Water Facts," Groundwater Basin Information, February 4.

NV State Demographer's Office (Nevada State Demographer's Office), 2008, *Nevada County Population Projections 2008 to 2028*, Reno, Nevada, August.

NLV (City of North Las Vegas), 2006, *2006 Comprehensive Plan*, North Las Vegas, Nevada, November.

NLV (City of North Las Vegas), 2009, *City of North Las Vegas Downtown Master Plan & Investment Strategy*, North Las Vegas, Nevada, February.

NLV (City of North Las Vegas), 2010, *North Las Vegas Municipal Code, Title 17: Zoning*, Codified through Ordinance No. 2554, Las Vegas, Nevada, July.

NLVFD (North Las Vegas Fire Department), 2010, (accessed March 6, 2010, http://www.cityofnorthlasvegas.com/departments/fire/fire.shtm).

NLVPD (North Las Vegas Police Department), 2010, North Las Vegas Police Department Demographics Report (accessed at http://www.cityofnorthlasvegas.com/departments/Police/PDFs/DemographicsReport.pdf), January 4.

NMED (New Mexico Environment Department), 2008, Hazardous Waste Facilities (accessed April 20, 2010, http://www.nmenv.state.nm.us/hwb/hwb_facil.html).

NNSA (National Nuclear Security Administration), 2000, 2000 NTS Employment – Pages from 2000.

NNSA (National Nuclear Security Administration), 2007, Personal communication, "FW: Updated Mileage Chart," M. Skougard, National Nuclear Security Administration, to K. Owens, Science Applications International Corporation, December 13.

NNSA (National Nuclear Security Administration), 2008, 2008 NTS 4th Quarter Employment Report.

NNSA (National Nuclear Security Administration), 2010, *2011 Biennial Plan and Budget Assessment on the Modernization and Refurbishment of the Nuclear Security Complex*, Annex D of the Stockpile Management Plan, Washington, DC, May.

NNSA/EM (National Nuclear Security Administration/Environmental Management), 2009, Low Levels of Tritium Detected in Groundwater on Federal Land Near the Nevada Test Site, October 20.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2007, *Annual Transportation Report for Radioactive Waste Shipments to and from the Nevada Test Site*, Fiscal Year 2007, DOE/NV-1238, December.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2009a, Personal communication with R. A. Reece, Manager, Facility and Infrastructure Planning, through E. Carr, or M. Skougard.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2009b, *Annual Transportation Report for Radioactive Waste Shipments to and from the Nevada Test Site*, Fiscal Year 2008, DOE/NV-1309, February.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office) 2009c, *Nevada Test Site Waste Acceptance Criteria*, DOE/NV-325-Rev.7-01, May.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2009d, Personal communication with G. Babero, Facility and Infrastructure Planning, through M. Skougard, November 13 and 24, 2009.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2009e, Personal communication with Y. Mason, Facility and Infrastructure Planning, Data on building square footage by function for NTS, RSL, NLVF, November 24.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2009f, Personal communication (email) with J. Prsybylski, from E. Carr, data provided on bus fleet and fuel for NTS, December 17.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010a, Personal communication (email) with K. Thornton and G. Babero, Office of the Assistant Manager for Site Operations, Information provided on existing electrical circuit configuration and capacity, April 14.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010b, (Parts 1-4), Personal communication with R. A. Reece, Manager at Facility and Infrastructure Planning, Data provided on electrical usage, natural gas, and liquid fuel usage (gallons) by type (red dye, E85, unleaded, biodiesel, #2 diesel, jet fuel) for NTS, RSL, and NLVF.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010c, (Parts 1-2), Personal communication with K. Thornton and G. Babero, Office of the Assistant Manager for Site Operations, text provided on proposed (Expanded Operations) NTS electrical and communication systems upgrade descriptions and approval, June 28 and July 1.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010d, Personal communications with G. Babero, Nevada Site Office, and M. Skougard, Potomac-Hudson Engineering, "Spreadsheet on Facilities Disposition Plan D&D Input," July 9.

NNSA/NSO (National Nuclear Security Administration/Nevada Site Office), 2010e, Personal communications with G. Babero, Nevada Site Office, and M. Skougard, Potomac-Hudson Engineering, "Spreadsheet on Demolition List for Mercury Redevelopment," July 9.

NOAA (National Oceanic and Atmospheric Administration), 2006, Air Resources Laboratory Special Operations Research Division, *Climatology of the Nevada Test Site*, SORD 2006-3 (available at http://www.sord.nv.doe.gov/climate/Climatology_of_The_Nevada_Test_Site. Soule.pdf), Las Vegas, Nevada.

NOAA (National Oceanic and Atmospheric Administration), 2007, Air Resources Laboratory Special Operations and Research Division, MEDA Station Information as of 12/07/07 (accessed December 2, 2009, http://www.sord.nv.doe.gov/MEDAStationInfo-tng.htm).

NOAA (National Oceanic and Atmospheric Administration), 2010a, Air Resources Laboratory Special Operations and Research Division (SORD), Personal communication between W. Schalk (SORD) and E. Carr, ICF International, March 2.

NOAA (National Oceanic and Atmospheric Administration), 2010b, National Climatic Data Center, ASOS Station List (accessed January 2, 2010, http://www.ncdc.noaa.gov/09/climate/surfaceinventories.html#inventories).

NPS (National Park Service), 1983, *Archaeology and Historic Preservation: the Secretary of the Interior's Standards and Guidelines* (available at http://www.nps.gov/history/local-law/arch_stnds_0.htm), Washington, DC.

NPS (National Park Service), 2000, Nevada Test Site, Pluto Facility, Disassembly Building Historic American Engineering Record.

NPS (National Park Service), 2001, *Las Vegas Wash Stabilization Project Environmental Assessment*, Lake Mead National Recreation Area, Clark County, Nevada, July.

NPS (National Park Service), 2009, *Death Valley National Park Invites Public Input On Wilderness & Backcountry Stewardship Plan*, Death Valley National Park, September.

NPS (National Park Service), 2010a, *Environmental Assessment Abandoned Mine Lands Safety Installations Keane Wonder Mine Complex Mine Openings, Death Valley National Park, California and Nevada*, Death Valley National Park, February.

NPS (National Park Service), 2010b, *Environmental Assessment Abandoned Mine Lands Safety Installations Multiple Mine Openings Death Valley National Park, California / Nevada*, Death Valley National Park, March.

NPS (National Park Service), 2010c, *Finding of No Significant Impact, Abandoned Mine Land Safety Installations, Keane Wonder Mine Complex, Death Valley National Park, California and Nevada*, Death Valley, California, April.

NPS (National Park Service), 2010d, *Finding of No Significant Impact Abandoned Mine Lands Safety Installations Multiple Mine Openings, Death Valley National Park, California and Nevada*, Death Valley National Park, April.

NPS (National Park Service), 2010e, *Finding of No Significant Impact, Devils Hole Site Plan*, Death Valley, California, March.

NPS (National Park Service), 2010f, Scoping letter for Scotty's Castle Waterline Replacement Project, Death Valley National Park, June.

NPS (National Park Service), 2010g, Death Valley National Park Planning webpage, Devils Hole Long-Term Ecosystem Monitoring Plan (accessed July 12, 2010, http://parkplanning.nps.gov).

NRC (U.S. Nuclear Regulatory Commission), 1977, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes*, NUREG-0170, Washington, DC, December.

NRC (U.S. Nuclear Regulatory Commission), 1986, *Tornado Climatology of the Contiguous United States*, NUREG/CR-4461, Office of Nuclear Reactor Regulation, Washington, DC.

NRC (U.S. Nuclear Regulatory Commission), 2001, *Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County, Utah*, NUREG-1714, Washington, DC, December.

NRC (U.S. Nuclear Regulatory Commission), 2005a, E*nvironmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina*, NUREG-1767, Office of Nuclear Material Safety and Safeguards, Washington, DC, January.

NRC (U.S. Nuclear Regulatory Commission), 2005b, *Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico*, NUREG-1790, Office of Nuclear Material Safety and Safeguards, Washington, DC, June.

NSBDC (Nevada Small Business Development Center), 2010, Nevada County Population Estimates July 1, 1990 to July 1, 2006, Includes Cities and Towns, Reno, Nevada.

NSHD (Nevada State Division of Health), 2010, Website (accessed July 7, 2010, http://health.nv.gov/HCQC_Radiological_LLWS.htm).

NSOE (Nevada State Office of Energy), 2009, *2008 Status of Energy in Nevada, Report to Governor Jim Gibbons and Legislature* (accessed January 19, 2011, http://www.leg.state.nv.us/Interim/75th2009/Committee/Studies/Energy/Other/2008StatusofEnergyinNevadaFinalReport.pdf), Carson City, Nevada.

NSOE (Nevada State Office of Energy), 2010, 2009 Status of Energy in Nevada, Report to Governor Jim Gibbons and Legislature, Carson City, Nevada, May.

NSTC (National Science and Technology Council), 2008, *Scientific Assessment of the Effects of Global Change on the United States*, Washington, DC.

NSTec (National Security Technologies, LLC), 2007, *Ecological Monitoring and Compliance Program 2006 Report* (DOE/NV/25946-174), Ecological Services, Las Vegas, Nevada, March.

NSTec (National Security Technologies, LLC), 2008a, *Special Analysis of Transuranic Waste in Trench T04C at the Area 5 Radioactive Waste Management Site, Nevada Test Site, Nye County, Nevada*, Revision 1.0, DOE/NV/25946-470, Las Vegas, Nevada.

NSTec (National Security Technologies LLC), 2008b, *FY 2009 NNSA/NSO Energy Executable Plan,* December.

NSTec (National Security Technologies, LLC), 2009a, *Ecological Monitoring and Compliance Program 2008 Report*, DOE/NV/25946-704, April.

NSTec (National Security Technologies LLC), 2009b, *Space Management Plan*, May.

NSTec (National Securities Technologies, LLC), 2009c, *NESHAP 2009 Annual Report*, Tritium Emissions from BLDG A-1 Source Well Water CY 2009, NESH-101, October 27.

NSTec (National Security Technologies, LLC), 2009d, Excel spreadsheet on employee residences, November.

NSTec (National Security Technologies LLC), 2010a, Personal communication between C. Ong, Potomac-Hudson Engineering, and Cindy (representative at National Security Technologies, LLC, Transportation Management).

NSTec (National Security Technologies LLC), 2010b, Analysis/Calculation (A/C) Sheet, FRM-2004, Tritium Emissions from Bldg A-1 Source Well Water CY 2009 [for NESHAP 2009 Annual Report for the North Las Vegas Facility], North Las Vegas, Nevada.

NSTec (National Security Technologies LLC.), 2010c, Water usage data for NTS active wells and fillstations between 2005 and 2009, Provided by D. D. Rudolph, Senior Scientist, Water and Waste Section, National Security Technologies, Data sent as 2005-2010wellFlowTotals.pdf and Fillstandsall.pdf (data compiled and summarized in Well Water DATA compiled AMW spreadsheets 1-21-10.xls), January 20.

NSTec (National Security Technologies LLC.), 2010d, Personal communication with D. D. Rudolph, Senior Scientist, Water and Waste Section, National Security Technologies, Information on NTS water systems, well and tank locations, January 21.

NSTec (National Security Technologies, LLC), 2010e, "CY 2009 Building A-1 Source Well Data," Analysis/Calculation No.: NESH-101, NESHAP 2009 Annual Report, March 1.

NSTec (National Security Technologies, LLC), 2010f, 2009 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site, Nye County, Nevada, "Review of the Performance Assessments and Composite Analyses," DOE/NV/25946-893, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, March.

NSTec (National Security Technologies LLC), 2010g, Personal communication with D. Rudolph, Senior Scientist, Water and Waste Section, National Security Technologies, Data provided on wastewater production at Mercury and Yucca Sewage Lagoons for 2005 through 2009, March 18.

NSTec (National Security Technologies LLC), 2010h, Personal communication with C. Bixby, Chief of Staff, Defense Experimentation and Stockpile Stewardship, National Security Technologies, Data provided on septic tanks at NTS, April 8.

NSTec (National Security Technologies LLC), 2010i, Personal communication with C. Bixby, National Security Technologies; and S. Mortensen, Manager, Facilities Management, “Energy systems for RSL and NLVF,” April 21.

NSTec (National Security Technologies LLC), 2010j, *Ecological Monitoring and Compliance Program 2009 Report,* (DOE/NV/25946-946), Ecological Services, Las Vegas, Nevada, July.

NSTec (National Security Technologies LLC), 2010k, *Completion Report for Well ER-20-7: Corrective Action Units 101 and 102: Central and Western Pahute Mesa*, Las Vegas, Nevada, April.

NSTec (National Security Technologies, LLC), 2011, *2010 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada National Security Site, Nye County, Nevada: Reviews of the Performance Assessments and Composite Analyses*, DOE/NV/25946-1158, Las Vegas, Nevada, March.

NTA (Nevada Technical Associates, Inc.), 2009, *Radioactive Materials Transport, Transportation of Radioactive Material* (accessed December 3, 2009, http://www.ntanet.net/transport-list.html).

NTS (Nevada Test Site), 2010, Water usage data for NTS active wells and fillstations between 2005 and 2009, Provided on January 20, 2010 by D. D. Rudolph, Senior Scientist, Water and Waste Section, National Security Technologies, Data sent as 2005-2010wellFlowTotals.pdf and Fillstandsall.pdf (data compiled and summarized in Well Water DATA compiled AMW spreadsheets 1-21-10.xls).

NTSB (National Transportation Safety Board), 2005, Railroad Accident Report, Collision of Norfolk Southern Freight Train 192 with Standing Norfolk Southern Local Train P22 with Subsequent Hazardous Materials Release at Graniteville, South Carolina, January 6, 2005, NTSB/RAR-05/04 (accessed January 29, 2011, http://aristatek.com/newsletter/0601January/RAR0504.pdf), Washington, DC, November.

NV Energy, 2009, NV Energy’s Statement of Interest (SOI) Submitted in Response to Western Area Power Administration’s Request for Interest (RFI), Reno, Nevada, March 4.

NV Energy, 2010a, Clark County Business Overview (accessed at http://www.nvenergy.com/economic development/county/clark/busoverview.cfm), March 4.

NV Energy, 2010b, Nye County Business Overview, (accessed at http://www.nvenergy.com/economic development/county/nye/busoverview.cfm), March 4.

NV Energy, 2010c, Economic Development, Nye County Quality of Life (accessed at http://www.nvenergy.com/economicdevelopment/county/nye/quality.cfm), March 6.

NWS VEF, 2009, Las Vegas National Weather Service Forecasting Office, *Climate of Las Vegas, NV* (accessed December 2, http://www.wrh.noaa.gov/vef/climate/index.php).

Nye County School District, 2009, Nye County School District Fast Facts 2009-2010 (accessed at www.nye.k12.nv.7us).

Nye (Nye County), 2010, *Nye County Water District* (accessed May 20, 2010, http://www.nyecounty.net/index.aspx?NID=566).

O'Farrell, T. P., and L. A. Emery, 1976, *Ecology of the Nevada Test Site: A Narrative Summary and Annotated Bibliography*, DOE/NVO-167, Desert Research Institute, Boulder City, Nevada.

OMB (U.S. Office of Management and Budget), 2010, *Budget of the United States Government, Fiscal Year 2011*, Washington, DC, February 10.

ORPS, 2009, Occurrence Reporting and Processing System database; data pull on 12/2/09 for Nevada Operations Office, U.S. Department of Energy, Office of Health, Safety, and Security.

OTA (Office of Technology Assessment), 1989, "The Containment of Underground Nuclear Explosions," OTA-ISC-414, Congressional Board of the 101st Congress, Washington, DC, November.

Parker, P. L., and T. F. King, 1998, "Guidelines for Evaluating and Documenting Traditional Cultural Properties," *National Register Bulletin*, U.S. Department of the Interior, National Park Service, National Register, History and Education, and National Register of Historic Places, Washington, DC.

PBS&J, 1999, Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways, Nevada Test Site, PBS&J Ref. No. 511036.00, Henderson, Nevada, June 25.

Phelps, G. A., V. E. Langenheim, and R. C. Jachens, 1999, "Thickness of Cenozoic Deposits of Yucca Flat Inferred from Gravity Data, Nevada Test Site, Nevada" USGS Open-File Report 99-310.

Phillips, J. S., D. B. Clauss, and D. F. Blower, 1994, *Determination of Influence Factors and Accident Rates for the Armored Tractor/Safe Secure Trailer,* SAND93-0111, Sandia National Laboratories, Albuquerque, New Mexico, April.

Pinnick, R. G., G. Fernandez, and B. D. Hinds, 1983, "Explosion dust particle size measurements," *Applied Optics*, Vol 22, No. 1, pp 95-102.

Pippin, L. C., 1986, *An Overview of Cultural Resources on Pahute and Ranier Mesas on the Nevada Test Site, Nye County, Nevada,* Technical Report No. 45, Las Vegas, Nevada.

Pippin, L. C., 1995, *Hunter-Gatherer Adaptations and Environmental Change in the Southern Great Basin: the View from Pahute and Ranier Mesas*, Technical Report No. 92, DOE/NV/11508-34 UC-702, Las Vegas, Nevada.

Pippin, L. C., 1998a, *Hunter-Gatherer Environmental Change in the Southern Great Basin: The Evidence from Pahute and Ranier Mesas*, DRI Technical Report No. 92, Las Vegas, Nevada.

Pippin, L. C., 1998b, *Changing Adaptive Strategies of the Ĕso and Ogwe'pi: Ethnohistoric Hunters and Gatherers in the Southern Great Basin*, Technical Report No. 94, DOE/NV/11508-40 UC-702, Las Vegas, Nevada.

Pippin, L. C., 2005, Class III Cultural Resources Inventory for Four Proposed Undertakings by Sandia National Laboratory on the Tonopah Test Range, Nevada, DRI Short Report No. SR012705-1, Albuquerque, New Mexico.

Poole, F. G., and C. A. Sandberg, 1991, "Mississippian Paleography and Conodont Biostratigraphy of the Western United States," *Paleozoic*, Paleogeography of the Western United States-II: Pacific Section, Society of Economic Paleontologists and Mineralogists, Vol. 67, pp. 107-136.

Price, K. R., 1973, "A Review of Transuranic Elements in Soils, Plants and Animals." *Journal of Environmental Quality*.

PSI (Pacific Solar Investments, Inc.), 2007, *Plan of Development NV-084466 PSI Amargosa PV Solar Project Nye County, Nevada*, Portland, Oregon, December.

Radack, P. M., Manager, Regulatory Services, National Security Technologies LLC, 2009, Personal communication (letter) to B. Hurley, U.S. Department of Energy, National Nuclear Security Administration, "North Las Vegas Facility No Exposure Certification for exclusion from National Pollutant Discharge Elimination System stormwater permitting," January 27.

Radack, P., 2010a, Manager, Regulatory Services, National Security Technologies LLC, Personal communication, "Clarification of active monitoring wells and groundwater containing tritium disposal," February 1.

Radack, P., 2010b, Manager, Regulatory Services, National Security Technologies LLC, Personal communication, "Clarification of tritium release date," February 1.

Ramsdell, J. V., and G. L. Andrews, 1986, *Tornado Climatology of the Contiguous United States*, NUREG/CR-4461, U.S. Nuclear Regulatory Commission, Washington, DC.

Rautenstrauch, K. R., G. A. Brown, and R. G. Goodwin, 1994, *The Northern Boundary of the Desert Tortoise Range on the Nevada Test Site*, EGG 11265-1103, EG&G Energy Measurements, Las Vegas, Nevada, December.

RCI (Resources Concepts, Inc.), 2005a, Nevada Community Wildfire Risk/Hazard Assessment Project – Nye County, Chapter 5 – Amargosa Valley (available at http://www.rci-nv.com/reports/nye/index.html), January.

RCI (Resources Concepts, Inc.), 2005b, Nevada Community Wildfire Risk/Hazard Assessment Project – Nye County, Chapter 6 – Beatty (available at http://www.rci-nv.com/reports/nye/index.html), January.

RCI (Resources Concepts, Inc.), 2005c, Nevada Community Wildfire Risk/Hazard Assessment Project – Nye County, Chapter 13 – Pahrump (available at http://www.rci-nv.com/reports/nye/index.html), January.

RCI (Resources Concepts, Inc.), 2005d, Nevada Community Wildfire Risk/Hazard Assessment Project – Nye County, Chapter 14 – Tonopah (available at http://www.rci-nv.com/reports/nye/index.html), January.

REECo (Reynolds Electric and Engineering, Company, Inc.), 1992, *Contaminated Areas Report*, Las Vegas, Nevada.

RetCo (Reliable Transmission Company, Inc.), 2010, Presentation to the Nye County Transmission Workshop The Solar Express 500kV Project, April 28.

Rodgers, A., 2008, Seismic Data for Evaluation of Ground Motion Hazards in Las Vegas in Support of Test Site Readiness Ground Motion, Lawrence Livermore National Laboratory: LLNL-TR-400563.

Rodgers, A., H. Tkalcic, and D. McCallen, 2005, The Las Vegas Valley Seismic Response Project: Ground Motions in Las Vegas Valley from Nuclear Explosions at the Nevada Test Site, Lawrence Livermore National Laboratory: UCRL-TR-210758.

Rogers, A. R., C. Harmsen, E. J. Corbett, K. Priestly, and D. de Polo, 1991, The Seismicity of Nevada and Some Adjacent Parts of the Great Basin, Geological Society of America.

Romney, L. M. and A. Wallace, 1977, "Plutonium Contamination of Vegetation in Dusty Field Environments," *Transuranics in Natural Environments*, Nevada Applied Ecology Group, U.S. Energy Research and Development Administration, Las Vegas, Nevada, June.

Rose, T. R., B. C. Benedict, Jr., J. M. Thomas, W. S. Sicke, R. L. Hershey, J. B. Paces, I. M. Farnham, and Z. E. Peterman, 2002, *Geochemical Data Analysis and Interpretation of the Pahute Mesa-Oasis Valley Groundwater Flow System, Nye County, Nevada, August 2002*, UCRL-TR-224559), Lawrence Livermore National Laboratory, Livermore, California, September.

RTCSN (Regional Transportation Commission of Southern Nevada), 2008, *Regional Transportation Plan 2009-2030 A Plan for Mobility in the Las Vegas Region Over the Next 20 Years*, Las Vegas, Nevada, November.

Rush, F. E., 1974, Static ground water levels of Nevada: Nevada Department of Conservation and Natural Resources, Division of Water Resources map.

Russell, C. E., and T. Minor, 2002, *Reconnaissance Estimates of Recharge Based on an Elevation-dependent Chloride Mass-balance Approach*, Division of Hydrologic Sciences, DOE/NV/11508-37, Las Vegas, Nevada, August.

SAIC (Science Applications International Corporation), 1992a, *Particulate Matter Ambient Air Quality Data Report for 1989 and 1990*, MOL, 19980331.0174, Las Vegas, Nevada.

SAIC (Science Applications International Corporation), 1992b, *Particulate Matter Ambient Air Quality Data Report for 1991*, NNA, 19921218.0092, Las Vegas, Nevada.

SAIC/DRI (Science Applications International Corporation/Desert Research Institute), 1991, *Special Nevada Report*, DE-AC08-88NV10715, U.S. Air Force, Tactical Weapons Center, Office of Public Affairs, Nellis Air Force Base, Las Vegas, Nevada, September 23.

Saricks, C., and M. M. Tompkins, 1999, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Center for Transportation Research, Argonne National Laboratory, Argonne, Illinois, April.

Schade, A. C., Sandia National Laboratories, 2010, Personal communication (email) to C. J. Wood, Sandia National Laboratories, et al., "RE: TTR Waste Assumptions," March 26.

Schaeffer, J. R., 1968, *Climatology of Tonopah Test Range, 1967*, SC-M-68-522, Sandia Laboratories, Albuquerque, NM.

Schmeltzer, J. S., J. J. Miller, and D. L. Gustafson, 1993, *Flood Assessment at the Area 5 Radioactive Waste Management Site and the Proposed Hazardous Waste Storage Unit*, DOE/Nevada Test Site, Nye County, Nevada, Raytheon Services Nevada, January.

Scott, B. R., T. J. Smales, F. E. Rush, and A. S. Van Denburgh, 1971, *Water for Nevada*, Water Planning Report 3, Nevada Department of Conservation and Natural Resources, Division of Water Resources, State of Nevada, Carson City, Nevada.

Sherlock, M. G., D. P. Cox, D. F. Huber, 1996, "Known Mineral Deposits and Occurrences in Nevada" in Singer, D. A., ed., An analysis of Nevada's metal-bearing mineral resources: Nevada Bureau of Mines and Geology Open-File Report 96-2, Chapter 10 (accessed June 10, 2010, http://www.nbmg.unr.edu/dox/ofr962/).

Shott, G. J., C. J. Muller, L. E. Barker, D. E. Cawlfield, F. T. Lindstrom, D. G. Linkenheil, M. J. Sully, D. J. Thorne, and L. McDowell-Boyer, 1995, *Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*, Reynolds Electrical and Engineering Co., Inc., Las Vegas, Nevada.Shott, G., V. Yucel, and L. Desotell, 2008, "A Title 40 Code of Federal Regulations Part 191 Evaluation of Buried Transuranic Waste at the Nevada Test Site – 8210," Waste Management 2008 Conference, Phoenix, Arizona, February 24–28.

Shott, G., V. Yucel, and L. Desotell, 2008, Special Analysis of Transuranic Waste in Trench T04C at the Area 5 Radioactive Waste Management Site, Nevada Test Site, Nye County, Nevada, Revision 1, DOE/NV/25946—470, National Security Technologies, LLC, Las Vegas, Nevada, May.

Shott, G., V. Yucel, L. Desotell, and J. T. Carilli, 2006, "Decision Support System for Management of Low-Level Radioactive Waste Disposal at the Nevada Test Site," Waste Management 2006 Conference, Tucson, Arizona, February 26 - March 2.

Slate, J. L., M. E. Berry, P. D. Rowley, C. J. Fridrich, K. S. Morgan, J. B. Workman, O. D. Young, G. L. Dixon, V. S. Williams, E. H. McKee, D. A. Ponce, T. G Hildenbrand, W. C. Swadley, S. C. Lundstrom, E. B. Ekren, R. G. Warren, J. C. Cole, R. J. Fleck, M. A. Lanphere, D. A. Sawyer, S. A. Minor, D. J. Grunwald, R. J. Laczniak, C. M. Menges, J. C. Yount, A. S. Jayko), 1999, "Digital geologic map of the Nevada Test Site and vicinity, Nye, Lincoln and Clark Counties, Nevada, and Inyo County, California" USGS Open-File Report 99-554-A.

Smith D. D., and S. C. Black, 1984, Animal Investigation Program for the Nevada Test Site: 1957-1981.

SNJV (Stoller-Navarro Joint Venture), 2004, *Phase II Hydrologic Data for the Groundwater Flow and Contaminant Transport Model of Corrective Action Unit 98*: Frenchman Flat, Nye County, Nevada, S-N/99205--032, Revision No. 0, Las Vegas, Nevada, December.

SNJV (Stoller-Navarro Joint Venture), 2006, *Groundwater Flow Model of Corrective Action Units 101 and 102: Central and Western Pahute Mesa, Nevada Test Site, Nevada*, Rev. 0, S-N/99205-076, Las Vegas, Nevada, June.

SNJV (Stoller-Navarro Joint Venture), 2009, *Phase I Transport Model of Corrective Action Units 101 and 102, Pahute Mesa, Nevada Test Site, Nye County, Nevada*, Rev, 0, S-N/99205-111, Las Vegas, Nevada, February.

SNL (Sandia National Laboratories), 1992, *Environmental Monitoring Plan for the Tonopah Test Range, Nevada*, U.S. Department of Energy Albuquerque Field Office, February 24.

SNL (Sandia National Laboratories), 2001a, Condition of TTR Buildings and Infrastructure Systems, July 26.

SNL (Sandia National Laboratories), 2001b, Compliance Assessment Document for the Transuranic Wastes in the Greater Confinement Disposal Boreholes at the Nevada Test Site, SAND2001-2977, Albuquerque, New Mexico, September.

SNL (Sandia National Laboratories), 2007, Calendar Year 2006: *Annual Site Environmental Report, Tonopah Test Range, Nevada & Kauai Test Facility, Hawaii*, SAND2007-4407P, Albuquerque, New Mexico, September.

SNL (Sandia National Laboratories), 2008, Calendar Year 2007: *Annual Site Environmental Report, Tonopah Test Range, Nevada & Kauai Test Facility, Hawaii*, SAND2008-5070P, Albuquerque, New Mexico, September.

SNL (Sandia National Laboratories), 2009a, *NESHAP Annual Report for CY 2008*, Nevada, Albuquerque, New Mexico.

SNL (Sandia National Laboratories) 2009b, RadCat 3.0 Users Guide, SAND2009-5129P, May.

SNL (Sandia National Laboratories), 2010a, Personal Communication regarding traffic associated with the NTS and off-site locations, Tonopah, Nevada, March 11.

SNL (Sandia National Laboratories), 2010b, Calendar Year 2009 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kauai Test Facility, Hawaii, SAND2010-5350P, Albuquerque, New Mexico, September.

SORD (Special Operations and Research Division), 2002, Meteorological Data Acquisition (MEDA) 1981-2001 Climate Summary for Station 35 (Tonopah Test Range) (accessed December 2, http://www.sord.nv.doe.gov/products/meda_climate_summaries/cli_sum_35.gif).

SORD (Special Operations and Research Division), 2004, MEDA Period-Average Wind Roses for MEDA Stations (accessed December 2, http://www.sord.nv.doe.gov/meda_wind_roses_by_station_numbe.htm).

SORD (Special Operations and Research Division), 2005, MEDA 1981-2004 Wind Roses for Station 35 (Tonopah Test Range) (accessed December 2, 2009, http://www.sord.nv.doe.gov/meda_wind_roses_by_station_numbe.htm).

SORD (Special Operations and Research Division), 2008, *Overview of the Climate of the Nevada Test Site (NTS)* (available at http://www.sord.nv.doe.gov/climate/climate.nts. general.pdf), Las Vegas, Nevada, January 2.

Soulé, D., 2006, *Climatology of the Nevada Test Site*, Special Operations and Research Division (SORD), National Oceanic and Atmospheric Administration Air Resources Laboratory, Las Vegas, Nevada, SORD 2006-3 (available at http://www.sord.nv.doe.gov/climate/Climatology_of_The_Nevada_Test_Site. Soule. pdf).

Southern Hills Hospital, 2011, Southern Hills Hospital and Medical Center webpage (accessed March 13, 2001, http://southernhillshospital.com), Las Vegas, Nevada.

Spring Valley Hospital, 2011, Spring Valley Hospital Medical Center webpage (accessed March 13, 2001, https://www.springvalleyhospital.com), Las Vegas, Nevada.

State of Nevada, 2008, *2008 Status of Energy in Nevada*, Office of Energy (accessed January 19, 2011, http://www.leg.state.nv.us/Interim/75th2009/Committee/Studies/Energy/Other/2008StatusofEnergyinNevadaFinalReport.pdf).

State of Nevada, 2009, State of Nevada Department of Taxation Final Budget for Nye County, May 4.

Stebbins, R. C., 2003, *Western Reptiles and Amphibians*, 3rd Edition, Peterson Field Guides, New York, New York.

Steward, J. H., 1938, "Basin-Plateau Aboriginal Sociopolitical Groups," *Bureau of American Ethnology*, Bulletin No. 120, Smithsonian Institution, Washington, DC.

Stoffle, R. W., and M. J. Evans, 1988, "American Indians and Nuclear Waste Storage: The Debate at Yucca Mountain, Nevada," *Policy Studies Journal*, Vol. 16, pp. 751-767.

Stoffle, R. W., M. J. Evans, and C. Harshbarger, 1989a, *Native American Interpretation of Cultural Resources in the Area of Yucca Mountain, Nevada*, Institute for Social Research, University of Michigan, Ann Arbor.

Stoffle, R. W., M. J. Evans, D. B. Halmo, W. E. Niles, and J. T. O'Farrell, 1989b, *Native American Plant Resources in the Yucca Mountain Area, Nevada*, Institute for Social Research, University of Michigan, Ann Arbor.

Stoffle, R. W., D. G. Halmo, J. E. Olmsted, and M. J. Evans, 1990, *Native American Cultural Resource Studies at Yucca Mountain, Nevada*, Institute for Social Research, University of Michigan, Ann Arbor, Michigan.

Stoffle, R. W., M. J. Evans, D. B. Halmo, M. E. DuFort, and B. K. Fulfrost, 1994, Native American Cultural Resources on Pahute and Ranier Mesas, Nevada Test Site, Desert Research Institute, Technical Report 84, BARA, University of Arizona, Tucson.

Stoffle, R. W., M. Nieves Zedeno, D. Austin, D. Halmo, 1996, Native American Graves Protection and Repatriation Act Consultation and the Nevada Test Site Collection, DRI CR Technical Report No. 89, Las Vegas, Nevada.

Stoffle, R. W., M. Nieves Zedeno, and D. B. Halmo (Eds.), 2001, American Indians and the Nevada Test Site: A Model of Research and Consultation, DOE/NV Report 13046-2001-01, Office of Scientific and Technical Information, Oak Ridge, Tennessee.

Szymanski, T., Public Education/Information Officer for Las Vegas Fire and Rescue, 2010, Personal communication, March 4.

Tanko, D. J. and P. A. Glancy, 2001, Flooding in the Amargosa River Drainage Basin, Southern Nevada and Eastern California, including the Nevada Test Site, USGS Fact Sheet 036-01, U.S. Geological Survey, Carson City, Nevada, February 23-24.

Tonopah Solar (Tonopah Solar Energy, LLC), 2009, *Crescent Dunes Solar Energy Project, N-86292, Plan of Development*, Santa Monica, California, May, Revision A, November.

Townsend, 2009, NTS SWEIS – Borehole Management Plan, Email to M. Skougard, November 19.

TRB (Transportation Research Board), 2000, *Highway Capacity Manual*.

Trexler, Jr., J.H., P.H. Cashman, and J.C., Cole, W.S. Snyder, R.M. Tosdal, and V.I. Davydov, 2003, *Widespread Effects of Middle Mississippian Deformation in the Great Basin of Western North America*, Geological Society of America Bulletin, Vol. 115, No. 10, pp. 1278-1288.

TRIP, 2007, *The Road Information Program Las Vegas Metro Area Report Card*, (available at http://www.fixnvroads.com/pdf/TRIP%20Las%20Vegas%20Metro%20Report%20Card.pdf).

TRIP, 2009, Future Mobility in Nevada: Meeting the State's Need for Safe and Efficient Mobility, October.

Ullrich, R., J. Aaron, J. Barryman, and C. Smith, 2005, Historic Building Survey, Sandia National Laboratories' Tonopah Test Range, Nye County, Nevada, Volume 1: Historic Building Survey, SAND2005-5090, Albuquerque, NM.

UMTRI (University of Michigan Transportation Research Institute), 2003, "Evaluation of the Motor Carrier Management Information System Crash File, Phase One," UMTRI-2003-06, Center for National Truck Statistics, Ann Arbor, Michigan, March.

United States Air Force Air Combat Command, 2008, *F-35 Force Development Evaluation and Weapons School Beddown Draft Environmental Impact Statement*, March.

UNLV (University of Nevada, Las Vegas), 2009, Southern Nevada Economic Outlook 2010, Center for Business and Economic Research, page 6, December 16.

UNLV (University of Nevada, Las Vegas), 2010a, Clark County Economic Indicators as of January 2010, Center for Business and Economic Research.

UNLV (University of Nevada, Las Vegas), 2010b, Facts and Stats and Centers/Institutes (available at http://www.unlv.edu/about/facts.html).

US Ecology (US Ecology, Inc.), 2010, Website (accessed June 10, 2010, http://www.americanecology.com/services.htm).

USAF (U.S. Air Force), 1999, *Renewal of the Nellis Air Force Range Land Withdrawal: Department of the Air Force Legislative Environmental Impact Statement*, Nellis Air Force Range, Nevada, March.

USAF (U.S. Air Force), 2002, "Permit to the National Nuclear Secretary Administration to use Property Located on the Nevada Test and Training Range, Nevada," Nellis Air Force Base, Nevada, April.

USAF (U.S. Air Force), 2003a, *Final Environmental Assessment for Predator Force Structure Changes at Indian Springs Air Force Auxiliary Field, Nevada*, U.S. Air Force Air Combat Command, Nellis Air Force Base, Las Vegas, Nevada, July.

USAF (U.S. Air Force), 2003b, "Operational Climatic Data Summary: Tonopah Test Range, Nevada, Station No. 724844," Air Force Climate Center (AFCCC/Don), July.

USAF (U.S. Air Force), 2003c, *Nevada Training Initiative Environmental Assessment*, U.S. Air Force Air Combat Command, Nellis Air Force Base, Las Vegas, Nevada, July.

USAF (U.S. Air Force), 2005, *Environmental Assessment Nellis Air Force Base Pipeline Project Nevada*, U.S. Air Force Air Combat Command, Nellis Air Force Base, Las Vegas, Nevada, March.

USAF (U.S. Air Force), 2006a, *Wing Infrastructure Development Outlook (WINDO) Environmental Assessment*, Nellis Air Force Base, Las Vegas, Nevada, June.

USAF (U.S. Air Force), 2006b, *Expeditionary Readiness Training (ExperRT) Course Expansion Final Environmental Assessment*, Creech Air Force Base, Indian Springs, Nevada, June.

USAF (U.S. Air Force), 2006c, *Final Environmental Assessment for Leasing Nellis Air Force Base Land for Construction and Operation of a Solar Photovoltaic System, Clark County, Nevada*, 99 CES/CEVN, Nellis Air Force Base, Las Vegas, Nevada, August.

USAF (U.S. Air Force), 2006d, *Environmental Assessment for Increased Depleted Uranium Use on Target 63-10, Nevada Test and Training Range, Air Combat Command*, Nellis Air Force Base, Las Vegas Nevada, September.

USAF (U.S. Air Force), 2007a, F*inal Environmental Assessment for Sanitary Landfill Expansion on the Tonopah Test Range, Nye County, Nevada*, Nellis Air Force Base, Las Vegas, Nevada, January.

USAF (U.S. Air Force), 2007b, *Base Realignment and Closure (BRAC) Environmental Assessment for Realignment of Nellis Air Force Base*, Nellis Air Force Base, Las Vegas, Nevada, March.

USAF (U.S. Air Force), 2007c, *Draft Environmental Assessment for the Integrated Natural Resource Management Plan – Nellis Air Force Base and Nevada Test and Training Range*, Nevada, May.

USAF (U.S. Air Force), 2007d, *Range 74 Target Complexes Environmental Assessment Nevada Test and Training Range*, Nevada, Nellis Air Force Base, Las Vegas, Nevada, July.

USAF (U.S. Air Force), 2007e, *Integrated Natural Resources Management Plan Nellis Air Force Base/Nevada Test and Training Range*, Nellis Air Force Base, 99th Civil Engineering Squadron, Environmental Management Flight, Las Vegas, Nevada, May.

USAF (U.S. Air Force), 2008a, BLM Communications Use Lease to USAF to Conduct Patriot Communications Exercises in Lincoln County, Nevada, Nellis Air Force Base, Las Vegas, Nevada, August.

USAF (U.S. Air Force), 2008b, *Nellis and Creech AFBs Capital Improvements Program Environmental Assessment*, Nellis Air Force Base, Las Vegas, Nevada, September.

USAF (U.S. Air Force), 2008c, *Draft F-35 Force Development Evaluation and Weapons School Beddown Environmental Impact Statement*, Nellis Air Force Base, Las Vegas, Nevada, May.

USAF (U.S. Air Force), 2008d, Environmental Assessment for Enhanced Use Lease of U.S. Air Force Lands to the City of North Las Vegas for Construction and Operations of a Water Reclamation Facility, Nellis Air Force Base, Nevada, Nellis Air Force Base, Las Vegas, Nevada, April.

USAF (U.S. Air Force), 2009a, *AAFES Gas Station at Creech Air Force Base Environmental Assessment*, Creech Air Force Base and Army Air Force Exchange Service, Las Vegas, Nevada, July.

USAF (U.S. Air Force), 2009b, *Final Environmental Assessment Upgrade of the Indian Springs Collection and Treatment System*, Creech Air Force Base, Indian Springs, Nevada, December.

USAF (U.S. Air Force), 2010a, *Draft Standard Army Qualification Ranges at Nellis AFB Small Arms Range Environmental Assessment*, Nellis Air Force Base, Las Vegas, Nevada, March.

USAF (U.S. Air Force), 2010b, *Expeditionary Readiness Course Expansion Final Supplemental Environmental Assessment*, September.

USAF (U.S. Air Force), 2010c, *Nellis Air Force Base Fact Sheet* (accessed November 11, 2009, http:///www.nellis.af.mil/library/factsheets/factsheet_print.asp?fsID=4096&page=1).

USAF (U.S. Air Force), 2011, *Final Environmental Assessment, Outgrant for Construction and Operation of a Solar Photovoltaic System in Area 1*, Nellis Air Force Base, Clark County, Nevada, March.

USCB (U.S. Census Bureau), 2000, "Census 2000 Summary File 1 (SF 1) 100-Percent Data, Detailed Tables", "Census 2000 Summary File 3 (SF 3) - Sample Data, Detailed Tables", "QuickFacts" (accessed August 2010, http://factfinder.census.gov/home/saff/main.html?_lang=en).

USCB (U.S. Census Bureau), 2008a, Appendix A Geographic Terms and Concepts, Redistricting Data Prototype (Public Law 94-171) Summary File, Page A-8.

USCB (U.S. Census Bureau) 2008b, "2008 Population Estimates, Detailed Tables "QuickFacts" (accessed January 2010, http://factfinder.census.gov/home/saff/main.html?_lang=en).

USDA (U.S. Department of Agriculture), 1985, Soil Survey of Las Vegas Valley Area Nevada: Part of Clark County.

USFS (U.S. Forest Service), 1995, *Landscape aesthetics: A handbook for scenery management*, Agriculture Handbook Number 701.

USFS (U.S. Forest Service), 2007, *Spring Mountains Hazardous Fuel Reduction Project Environmental Assessment Spring Mountains National Recreation Area Humboldt - Toiyabe National Forest Clark County, Nevada*, U.S. Department of Agriculture, Forest Service, Intermountain Region, November.

USFS (U.S. Forest Service), 2009a, *Cathedral Rock Picnic Area Rehabilitation Project Environmental Assessment Spring Mountains National Recreation Area Humboldt Toiyabe National Forest, Clark County, Nevada*, U.S. Department of Agriculture, Forest Service, Intermountain Region, March.

USFS (U.S. Forest Service), 2009b, *Decision Notice & Finding of No Significant Impact Las Vegas Ski and Snowboard Resort Snowmaking System and Lower Area Parking Improvements Project USDA Forest Service Spring Mountain National Recreation Area Humboldt-Toiyabe National Forest Clark County, Nevada*, Las Vegas, Nevada, July.

USFS (U.S. Forest Service), 2009c, *Final Environmental Impact Statement Middle Kyle Complex, Spring Mountains National Recreation Area, | Humboldt Toiyabe National Forest, Clark County, Nevada*, U.S. Department of Agriculture, Humboldt-Toiyabe National Forest, Sparks, Nevada, December.

USFS (U.S. Forest Service), 2009d, Record of Decision Middle Kyle Complex, Spring Mountains National Recreation Area, Humboldt Toiyabe National Forest, Clark County, Nevada, U.S. Department of Agriculture, Humboldt-Toiyabe National Forest, Sparks, Nevada, December.

USFS (U.S. Forest Service), 2009e, USDA Forest Service Designation of Section 368 Energy Corridors on National Forest System Land in 10 Western States Decision by Secretary of Agriculture To Amend Land Management Plans Described as the Environmentally Preferred Alternative January 14, 2009, U.S. Department of Agriculture, January.

USFS (U.S. Forest Service), 2010a, "Forest Service Schedule of Proposed Actions for the Humboldt-Toiyabe National Forest, July 01 to September 30, 2010," U.S. Department of Agriculture (accessed on July 12, http://www.fs.fed.us/sopa/forest-level.php?110417).

USFS (U.S. Forest Service), 2010b, Humboldt and Toiyabe National Forest (accessed July 12, http://www.fs.fed.us/r4/htnf/projects/forestplan/index.shtml).

USFWS (U.S. Fish and Wildlife Service), 1994, *Desert Tortoise (Mojave Population Recovery Plan*, U.S. Department of the Interior, Region 1, Portland, Oregon, June.

USFWS (U.S. Fish and Wildlife Service), 1996, *Final Programmatic Biological Opinion for Nevada Test Site Activities*, File no. 1-5-96-F-33, U.S. Department of the Interior, Reno, Nevada August.

USFWS (U.S. Fish and Wildlife Service), 2000, *Clark County Multi-Species Habitat Conservation Plan Environmental Impact Statement,* U.S. Department of the Interior, Las Vegas, Nevada, September.

USFWS (U.S. Fish and Wildlife Service), 2008, *Coyote Springs Investment Planned Development Project,* U.S. Department of the Interior, Reno, Nevada, July.

USFWS (U.S. Fish and Wildlife Service), 2009a, *Final Programmatic Biological Opinion for Implementation of Actions Proposed on the Nevada Test Site, Nye County, Nevada,* (File Nos. 84320-2008-F-0416 and 84320-2008-B-00 15), U.S. Department of the Interior, Nevada Fish and Wildlife Office, Las Vegas, Nevada, February 12.

USFWS (U.S. Fish and Wildlife Service), 2009b, *Desert National Wildlife Refuge Complex Ash Meadows, Desert, Moapa Valley, and Pahranagat National Wildlife Refuges Final Comprehensive Conservation Plan and Environmental Impact Statement*, U.S. Department of Interior, Pacific Southwest Region, Sacramento, California, August.

USFWS (U.S. Fish and Wildlife Service), 2009c, *Environmental Assessment for Fairbanks Spring and Soda Spring Restoration* (EA #84550-10-01), U.S. Department of Interior, Ash Meadows National Wildlife Refuge, Amargosa Valley, Nevada, September.

USGS (U.S. Geological Survey), 2002, *Water Resources Data, Nevada, Water Year 2002*, Water-Data Report NV-02-1.

USGS (U.S. Geological Survey), 2003, *Water Resources Data, Nevada, Water Year 2003*, Water-Data Report NV-03-1.

USGS (U.S. Geological Survey), 2004, *Water Resources Data, Nevada, Water Year 2004*, Water-Data Report NV-04-1.

USGS (U.S. Geological Survey), 2006, U.S. Geologic Survey – in cooperation with U.S. EPA and ESRI, Rivers and Streams, California.

USGS (U.S. Geological Survey), 2009, USGS/USDOE Cooperative Studies in Nevada, Nevada Test Site (accessed January 27, 2010, http://nevada.usgs.gov/doe_nv/ntsmap.htm), February 3.

USGS (U.S. Geological Survey), 2010a, "Nevada" Earthquake Hazards Program (accessed January 29, 2010, http://earthquake.usgs.gov/earthquakes/states/nevada/hazards.php).

USGS (U.S. Geological Survey), 2010b, "Earthquake Hazards Program: Routine United States Mining Seismicity" *Google Earth* (accessed January 29, 2010, http://neic.usgs.gov/neis/epic/kml/).

USGS (U.S. Geological Survey), 2010c, Circular Area Earthquake Search, USGS/NEIC (PDE) 1973-Present earthquake database (accessed 03/31/2010, http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_circ.php).

U.S. Soil Conservation Service, 1978, Procedure to establish priorities in landscape architecture (Technical Release No. 65), Washington, DC.

UTDEQ (Utah Department of Environmental Quality), 2006, Utah Hazardous Waste Generation and Management 2005, Division of Solid and Hazardous Waste, December.

Vortman, L. J., 1991, *An Evaluation of the Seismicity of the Nevada Test Site and Vicinity*, SAND86-7006, Sandia National Laboratories, Albuquerque, NM.

Warner, T., 2004, *Desert Meteorology*, Cambridge University Press, Cambridge, United Kingdom.

Warren, R., 2011, Environmental Monitoring, Nevada Security Technologies, LLC, Personal communication regarding population estimates used in historical environmental reports for the Nevada Test Site with G. Waldman, Science Applications International Corporation, January.

Warren, C. N. and R. H. Crabtree, 1986, "Prehistory of the Southwestern Area," *Great Basin*, Handbook of North American Indians, Volume 11, Smithsonian Institution, Washington, DC.

Warren, R. G., G. L. Cole, and D. Walther, 2000, *A Structural Block Model for the Three-Dimensional Geology of the Southwestern Nevada Volcanic Field*, Los Alamos National Laboratory Report LA-UR-00-5866.

Warren, R. G., D. A. Sawyer, F. M. Byers, Jr., and J. C. Cole, 2003, A Petrographic/Geochemical Database and Stratigraphic and Structural Framework for the Southwestern Nevada Volcanic Field (accessed February 11, 2010, http://www.pggdb-swnvf.lanl.gov/), LANL Report LA-UR-00-3791.

Webb, R. H. and H. G. Willshire, 1980, "'Recovery of Soils and Vegetation in a Mojave Desert Ghost Town, Nevada, U.S.A," *Journal of Arid Environments,* 3:291-303.

Weir, H. K., M. J. Thun, B. F. Hankey, L. A. Ries, H. L. Howe, P. A. Wingo, A. Jemal, E. Ward, R. N. Anderson, B. K. Edwards, 2003, *Journal of the National Cancer Institute*, 2003;95(17):1276–1299, Review. Erratum in: *Journal of the National Cancer Institute* 2003;95(21):1641.

West, M., 2010, Potomac-Hudson Engineering, "NTS SWEIS – Concept and Baseline Data Reference Sheet for Solar Power Plant," Las Vegas, Nevada, July.

White, M. G. and P. B. Dunaway, 1975, The Radioecology of Plutonium and Other Transuranics in Desert Environments (NVO 153).

White, M. G. and P. B. Dunaway, 1976, *Studies of Environmental Plutonium and Other Transuranics in desert Ecosystems* (NV)-159), U.S. Energy Research and Development Administration, Nevada Operations Office, Las Vegas, Nevada.

White, M. G. and P. B. Dunaway, 1977, *Transuranics in Natural Environments* (NVO-178), U.S. Energy Research and Development Administration, Nevada Operations Office, Las Vegas, Nevada.

White, M. G., P. B. Dunaway, and D. L. Wireman, 1977a, *Transuranics in Desert Ecosystems* (NVO-181), U.S. Department of Energy, Nevada Operations Office, Las Vegas, Nevada.

White, M. G., P. B. Dunaway, and W. A. Howard, 1977b, *Environmental Plutonium on the Nevada Test Site Environms* (NVO-171), U.S. Envergy Research and Development Administration, Nevada Applied Ecology Group, Las Vegas, Nevada.

White, M. G. and P. B. Dunaway, 1978, *Selected Environmental Plutonium Research Reports of the NA*EG (NVO-192), U.S. Department of Energy, Nevada Applied Ecology Group, Las Vegas, Nevada.

WHO (World Health Organization), 2001, *Depleted Uranium: Source, Exposure, and Health Effects*, Department of Protection of the Human Environment, Geneva, Switzerland, April.

Wilborn, W. W., National Nuclear Security Administration Nevada Site Office, 2011, Personal communication (email) to L. M. Cohn , National Nuclear Security Administration Nevada Site Office, "SWEIS Question," March 8.

Wills, C. A., and K. W. Ostler, 2001, *Ecology of the Nevada Test Site: An Annotated Bibliography,* Bechtel Nevada Ecological Services, Las Vegas, Nevada.

Winograd, I. J., and W. Thordarson, 1975, Hydrogeologic and Hydrochemical Framework, South-Central Great Basin, Nevada-California, with Special Reference to the Nevada Test Site, Professional Paper 712-C, U.S. Geological Survey, Washington, DC.

Wong, I. G., S. K. Pezzopane, N. A. Abrahamson, R. K. Green, J. I. Sun, R. C. Quittmeyer, 1996, *A preliminary Assessment of Earthquake Ground Shaking Hazard at Yucca Mountain, Nevada and Implications to the Las Vegas Region*, Seismic Hazards in the Las Vegas Conference Proceedings.

WRI (World Resources Institute), 2009, Climate Analysis Indicators Tool (CAIT) Version 6.0 (accessed August 28, 2009, http://cait.wri.org/).

Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire, 1995, RISKIND - A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.

Zedeno, N. M., R. Stoffle, G. Dewey-Hefley, and D. Shaul, 1999, Storied Rocks: American Inventory and Interpretation of Rock Art on the Nevada Test Site, Desert Research Institute Technical Report No. 93, DOE/Nevada/11508-38 UC-702, Las Vegas, Nevada.

Code of Federal Regulations

10 CFR Part 61, U.S. Nuclear Regulatory Commission, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR 835.202, U.S. Department of Energy, "Occupational Dose Limits for General Employees," widely available.

10 CFR 1022.330, U.S. Department of Energy, Programmatic (including site-wide) NEPA Documents

29 CFR 1926.52, Occupational Safety and Health Administration, Department of Labor, "Occupational noise exposure."

40 CFR 6, Code of Federal Regulations, Title 40, Part 6, Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act.

40 CFR 50, Code of Federal Regulations, Title 40, Part 50, *National Primary and Secondary Ambient Air Quality Standards*.

40 CFR 51, Code of Federal Regulations, Title 40, Part 51, Requirements for Preparation, Adoption, and Submittal of Implementation Plans.

40 CFR Part 61, Subpart H, Code of Federal Regulations, Title 40, Part 61, Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities.

40 CFR Part 61, Subpart H, Environmental Protection Agency, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities."

40 CFR 93, Code of Federal Regulations, Title 40, Part 93, Determining Conformity of Federal Actions to State or Federal Implementation Plans.

40 CFR Part 141, Environmental Protection Agency, "National Primary Drinking Water Regulations."

40 CFR Part 191, Environmental Protection Agency, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

40 CFR Part 355, Environmental Protection Agency, "Emergency Planning and Notification."

40 CFR Part 370, Environmental Protection Agency, "Hazardous Chemical Reporting: Community Right-to-Know."

40 CFR Parts 1500-1508, CEQ regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of NEPA.

49 CFR 531, Code of Federal Regulations, Title 49, Part 531, Passenger Automobile Average Fuel Economy Standards.

49 CFR 533, Code of Federal Regulations, Title 49, Part 533, Light Truck Fuel Economy Standards.

Federal Register Notices

61 FR 65551, U.S. Department of Energy, "Record of Decision: Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada," December 13, 1996.

61 FR 68014, U.S. Department of Energy, "Record of Decision, Programmatic Environmental Impact Statement for Stockpile Stewardship and Management," December 26, 1996.

63 FR 3629, U.S. Department of Energy, "Record of Decision for the Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste," January 23, 1998.

63 FR 41810, U.S. Department of Energy, "Record of Decision for the Department of Energy's Waste Management Program: Treatment of Non-wastewater Hazardous Waste," August 5, 1998.

64 FR 46542, Endangered and Threatened Wildlife and Plants; Final Rule To Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and To Remove the Similarity of Appearance Provision for Free-Flying Peregrines in the Conterminous United States, U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC, August 25, 1999.

64 FR 68853, *Chronic Beryllium Disease Prevention Program*, U.S. Department of Energy, Widely Available, 1999.

65 FR 10061, U.S. Department of Energy, "Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site," February 25, 2000.

65 FR 82985, U.S. Department of Energy, "Revision to the Record of Decision for the *Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste*," December 29, 2000.

66 FR 38646, U.S. Department of Energy, "Revision to the Record of Decision for the *Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste*," July 25, 2001.

67 FR 22479, Federal Aviation Administration, "Finding of No Significant Impact," regarding Draft Environmental Assessment for the Site Launch, Reentry and Recovery Operations at the Kistler Launch Facility, Nevada Test Site (NTS), May 3, 2002.

67 FR 56989, U.S. Department of Energy, "Revision to the Record of Decision for the *Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste*," September 6, 2002.

67 FR 79906, U.S. Department of Energy, National Nuclear Security Administration, "Record of Decision for the Final Environmental Impact Statement for the Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory," December 31, 2002.

69 FR 5897, Federal Real Property Management, *Federal Register*, Washington, DC, February 6, 2004.

69 FR 18557, U.S. Department of Energy, "Record of Decision on Mode of Transportation and Nevada Rail Corridor for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, NV," April 8, 2004.

69 FR 44649, U.S. Department of Energy, "Record of Decision for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, OH, Site," July 27, 2004.

69 FR 44654, U.S. Department of Energy, "Record of Decision for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, KY, Site," July 27, 2004.

71 FR 6857, Worker Protection Program Framework and Procedures, U.S. Department of Energy, Widely Available, 2006.

72 FR 3919, 2007, Executive Order 13423 of January 24, 2007 *Strengthening Federal Environmental, Energy, and Transportation Management*, Washington, DC, January 26, 2007.

72 FR 15869, U.S. Department of Energy, "Notice of Availability of a Draft Supplement Analysis for Disposal of Depleted Uranium Oxide Conversion Product Generated from DOE's Inventory of Depleted Uranium Hexafluoride," April 3, 2007.

73 FR 30908, U.S. Department of Energy and U.S. Department of the Interior, Bureau of Land Management, "Notice of Intent to Prepare a Programmatic Environmental Impact Statement to Evaluate Solar Energy Development and Implement Agency-Specific Programs, Conduct Public Scoping Meetings, Amend Relevant Agency Land Use Plans, and Provide Notice of Proposed Planning Criteria," May 29, 2008.

72 FR 37346, U.S. Department of the Interior, U.S. Fish and Wildlife Service, "Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife, Washington, DC, July 9, 2007.

72 FR 40135, Notice of Intent to Prepare an *Environmental Impact Statement for the Disposal of Greater-Than-Class-C Low-Level Radioactive Waste,* U.S. Department of Energy, Federal Register, vol. 72, no. 140, Washington, DC, July 23, 2007.

73 FR 29781, Notice of the Availability of the Record of Decision Concerning a Proposal To Award a Contract to House Federal Detainees Within a Contractor-Owned/Contractor-Operated Detention Facility in the Las Vegas, Nevada, Area, U.S. Department of Justice, Federal Register, vol. 73, Washington, DC, May 22, 2008.

73 FR 77644, U.S. Department of Energy, National Nuclear Security Administration, "Record of Decision for the Complex Transformation Supplemental Programmatic Environmental Impact Statement—Operations Involving Plutonium, Uranium, and the Assembly and Disassembly of Nuclear Weapons," December 19, 2008.

73 FR 77656, U.S. Department of Energy, National Nuclear Security Administration, "Record of Decision for the Complex Transformation Supplemental Programmatic Environmental Impact Statement—Tritium Research and Development, Flight Test Operations, and Major Environmental Test Facilities," December 19, 2008.

74 FR 2936, U.S. Environmental Protection Agency, "Proposed Rule to Implement the 1997 8-Hour Ozone National Ambient Air Quality Standard: Revision on Subpart 1 Area Reclassification and Anti-Backsliding Provisions Under Former 1-Hour Ozone Standard; Proposed Deletion of Obsolete 1-Hour Ozone Standard Provision," January 16, 2009.

74 FR 31307, U.S. Department of the Interior, Bureau of Land Management, "Notice of Availability of Maps and Additional Public Scoping for Programmatic Environmental Impact Statement To Develop and Implement Agency-Specific Programs for Solar Energy Development; Bureau of Land Management Approach for Processing Existing and Future Solar Applications," June 30, 2009.

74 FR 36691, U.S. Department of Energy, National Nuclear Security Administration, "Notice of Intent to Prepare an Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada Test Site and Off-Site Locations in the State of Nevada," July 24, 2009.

74 FR 56260, Code of Federal Regulations, Title 74, Part 56260, *Mandatory Reporting of Greenhouse Gases, Part II*, ACTION: Final rule.

74 FR 50239, Notice of intent to prepare an Environmental Impact Statement (EIS); and notice of public scoping meetings for a proposed Amendment of the Clark County Multiple Species Habitat Conservation Plan and Issuance of an Amended Incidental Take Permit, Clark County, Nevada, Federal Register vol. 74, No. 188, September 30, 2009.

74 FR 66147, Notice of Intent To Prepare an *Environmental Impact Statement for the Proposed Pacific Solar Investments Inc., Amargosa North Solar Project, Nye County, NV*, Bureau of Land Management, Federal Register, vol. 74, no. 238, Washington, DC, December 14, 2009.

75 FR 2922, Notice of Intent To Prepare an Environmental Assessment and Request for Public Scoping Comments for the Air Tour Management Plan Program at Death Valley National Park, U.S. Department of Commerce, Federal Aviation Administration, Federal Register, vol. 75, Washington, DC, January 19, 2010.

75 FR 41231, U.S. Department of the Interior, Bureau of Land Management, "Notice of Intent To Prepare an Environmental Impact Statement for the Proposed Abengoa Solar Inc., Lathrop Wells Solar Facility, Amargosa Valley, Nye County, NV," July 15, 2010.

76 FR 379, U.S. Department of the Interior, Bureau of Land Management and U.S. Department of Energy, Western Area Power Administration, "Notice of Intent To Prepare an Environmental Impact Statement for the TransWest Express 600 kV Direct Current Transmission Project in Wyoming, Colorado, Utah, and Nevada (DOE/EIS–0450), and Notice of Potential for Land Use Plan Amendments," January 4, 2011.

76 FR 10583, U.S. Environmental Protection Agency, "Notice of Availability of a Draft Environmental Impact Statement for the Disposal of Greater-Than-Class-C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste, Proposed Development, Operation, and Long-Term Management of Disposal Facility," EIS No. 20110049, Washington DC, February 25, 2011.

U.S. Department of Energy Standards and Orders

DOE Order 144.1, Department of Energy American Indian Tribal Government Interactions and Policy.

DOE Order 151.1C, Comprehensive Emergency Management System.

DOE Order 420.1B, Facility Safety.

Order 430.1B, Real Property Asset Management.

Order 430.2B, Renewable Energy and Transportation Management Requirements.

DOE Order 458.1

DOE Order 470.3B, Graded Security protection (GSP) Policy.

DOE Order 470.4A, Safeguards and Security Program.

DOE Order 5400.5, U.S. Department of Energy, “Radiation Protection of the Public and the Environment,” 1993.

DOE Standard 1098-99, U.S. Department of Energy, “Radiological Control”, 1999, 2004.

DOE Standard 1020-2002, “Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities,” DOE-STD-1020-2002 (accessed December 2, 2009, http://www.wbdg.org/ccb/DOE/TECHSTDS/std1020.pdf), January.

DOE Standard 1023-95, “Natural Phenomena Hazards Assessment Criteria,” DOE-STD-1023-95, March 1995, Change 1; January 1996; Reaffirmed with Errata; April 2002, (available at http://www.hss.doe.gov/nuclearsafety/ns/techstds/standard/std1023/std102395_reaf.pdf).

Executive Orders

Executive Order 13125, “Consultation and Coordination with Indian Tribal Governments.”

Executive Order 13212, “Actions to Expedite Energy-Related Projects”

Executive Order 13327, “ Federal Real Property Asset Management”

Executive Order 13423, “Strengthening Federal Environmental, Energy, and Transportation Management”

Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance”

U.S. Public Laws

P.L. 99-240, Low-Level Radioactive Waste Policy Amendments Act

P.L. 106-65, National Nuclear Security Administration Act

P.L. 106-65, Military Lands Withdrawal Act of 1999

P.L. 109-58, Energy Independence and Security Act of 2007

U.S. Supreme Court, United States v Cappaert. 426 U.S. 128 (1976)

United States Code

42 U.S.C 4332

Nevada Administrative Code

NAC 445A.865, Purpose of issuing permits; no vested right acquired by holder (NRS 445A.425, 445A.465).

NAC 445A.867, Application for permit (NRS 445A.425, 445A.465).

NAC 445A.905, Construction prohibited without permit (NRS 445A.425, 445A.465).

NAC 445B.22097, Nevada Administrative Code, Chapter 445B, Part 22097, *Standards of Quality for Ambient Air*.

CHAPTER 12
GLOSSARY

12.0 GLOSSARY

***absorbed dose*—**The energy imparted by ionizing radiation per unit mass of the irradiated material (e.g., biological tissue). The units of absorbed dose are the rad and the gray (Gy). (See gray, quality factor, rad, rem, and sievert.)

accident—An unplanned sequence of events that usually results in undesirable consequences.

actinides—A series of heavy radioactive metallic elements of increasing atomic number (Z number) beginning with actinium (89) and continuing through lawrencium (103).

***activities*—**In this SWEIS, activities are those physical actions used to implement missions, programs, capabilities, or projects.

aggregate—Hard inert materials such as sand, gravel, or slag used for mixing with a cementing material to form concrete.

air pollutant—Generally, an airborne substance that could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance of which emissions or atmospheric concentrations are regulated, or for which maximum guideline levels have been established because of potential harmful effects on human health and welfare.

air quality—The cleanliness of the air as measured by the levels of pollutants relative to standards or guideline levels established to protect human health and welfare. Air quality is often expressed in terms of the pollutant for which concentrations are the highest percentage of a standard (e.g., air quality may be unacceptable if the level of one pollutant is 150 percent of its standard, even if levels of other pollutants are well below their respective standards).

air quality standards—The legally prescribed level of constituents in the outside air that cannot be exceeded during a specified time in a specified area.

alpha-emitter (α-emitter)—A radioactive substance that decays by releasing an alpha particle.

alpha (α) particle—A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (Also see alpha radiation.)

alpha (α) radiation—A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the four common types of ionizing radiation (alpha, beta, gamma, and neutron). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting particle is ingested or inhaled by an organism.

ambient air—The surrounding atmosphere as it exists around people, plants, and structures.

aquifer— A permeable water-bearing unit of rock or sediment that yields water in a usable quantity to a well or spring.

aquitard (or confining unit)**—**A rock or sediment unit of relatively low permeability that retards the movement of water in or out of adjacent aquifers.

artesian**—**Where water in a lower aquifer is under pressure in relation to an overlying confining unit; when intersected by a well, the water will rise up the borehole.

as low as is reasonably achievable (ALARA)—The approach to radiation protection to manage and control exposures (both individual and collective) to the workforce and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. ALARA is not a dose limit but a process that has the objective of attaining doses as far below the applicable limits of Title 10 of the *Code of Federal Regulations* Part 835 (10 CFR Part 835) as is reasonably achievable.

asbestiform low-level radioactive waste—Any low-level radioactive waste containing friable asbestos material; Category I nonfriable asbestos-containing material that has become friable; Category I nonfriable asbestos-containing material that will be or has been subjected to sanding, grinding, cutting, or abrading; or Category II nonfriable asbestos-containing material that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder.

background concentration—The level of chemical elements, compounds, or radionuclides in the natural environment not affected by human activities, found by taking measurements in areas unaffected by contamination.

background radiation—Radiation from: (1) cosmic sources; (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material); and (3) global fallout as it exists in the environment (e.g., from the testing of nuclear explosive devices).

best management practices—Structural, nonstructural, and managerial techniques, other than effluent limitations, to prevent or reduce pollution of surface water. They are the most effective and practical means to control pollutants that are compatible with the productive use of the resource to which they are applied. Best management practices are used in both urban and agricultural areas. Best management practices can include schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

beta-emitter (β-emitter)—A radioactive substance that decays by releasing a beta particle.

beta (β) particle—A charged particle emitted from a nucleus during radioactive decay, with a mass equal to 1/1,837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron.

beta (β) radiation—Ionizing radiation consisting of fast-moving beta particles (negatively charged) and positrons (positively charged) emitted from the nucleus of an atom during radioactive decay. Beta radiation is more penetrating, but less energized, than alpha radiation. Beta radiation is stopped by clothing or a thin sheet of metal.

biological simulant—A biological substance, or microorganism that shares at least one physical or biological characteristic of a biological agent, that has been shown to be non-pathogenic, and can be used for biological defense testing to replace the agent under study.

biota (biotic)—The plant and animal life of a region.

borrow pit—An excavated area where material has been dug for use as fill at another location (e.g., a gravel pit).

capabilities—This term refers to the combination of facilities, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and to implement mission assignments. Capabilities at the Nevada National Security Site (NNSS) have been established over time, principally through mission assignments and activities directed by program offices.

cask—A heavily shielded container used to store or ship radioactive materials.

Caldera—A near-circular volcanic feature formed by the collapse of rocks overlying a magma chamber from rapid emptying of the chamber during large volume eruptions.

characteristic waste—Solid waste that is classified as hazardous waste because it exhibits any of the following properties or "characteristics": ignitability, corrosivity, reactivity, or toxicity, as described in 40 CFR 261.20 through 40 CFR 261.24 and Title 6 of the New York Code of Rules and Regulations Subpart 371.3 (6 NYCRR 371.3). (Also see hazardous waste, solid waste, and waste characterization.)

characterization (waste)—The determination of waste composition and properties, whether by review of process knowledge, nondestructive examination or assay, or sampling and analysis, generally done for the purpose of determining appropriate storage, treatment, handling, transport, and disposal requirements.

collective dose—The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. In this SWEIS, collective dose is expressed in units of person-rem. Person-sieverts is another term for collective dose. (See person-rem, and person-sievert.)

committed dose equivalent—The radiation dose to some specific organ or tissue in the body after the intake of radioactive material. The period examined is commonly 50 years. Committed dose equivalent is expressed in units of rem or sieverts.

committed effective dose equivalent—The radiation dose obtained by multiplying committed dose equivalents (see committed dose equivalent) by weighting factors (applicable to the specific organ or tissue that is irradiated) and summing the resulting products. The period examined is commonly 50 years. Committed effective dose equivalent is expressed in units of rem or sieverts.

communities (biological)—Assemblage of plants and animals (dominated by one to a few species) that live in the same environment and that are mutually sustaining and interdependent.

concentration—The quantity of a substance in a unit quantity of a sample (e.g., milligrams per liter or micrograms per kilogram).

construction and demolition debris—Discarded nonhazardous material including solid, semisolid, or contained gaseous material resulting from construction, demolition, industrial, commercial, mining, and agricultural operations and from community activities. The category does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act (Title 42 of the *United States Code* Section 2011 et seq. [42 U.S.C. 2011 et seq.]).

contact-handled waste—Radioactive waste or waste packages whose external dose rate is low enough to permit contact handling by humans during normal waste management activities (waste with a surface dose rate not greater than 200 millirem per hour). (See remote-handled waste.)

contamination—Unwanted chemical elements, compounds, or radioactive material on environmental media (e.g., soil, water, and air), structures (e.g., buildings), equipment, or personnel.

criticality (nuclear)—The condition in which a system is capable of sustaining a nuclear chain reaction.

cultural resources—A prehistoric or historic district, site, building, structure, or object considered to be important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Usually divided into three major categories: prehistoric and historic archaeological resources, architectural resources, and traditional cultural resources.

curie (Ci)—Is a unit to describe the intensity of radioactivity in a sample of material, equal to 3.7×10^{10} (i.e., 37,000,000,000) disintegrations per second. Also, a quantity of any radionuclide or mixture of radionuclides that decays at a rate of 37 billion disintegrations per second.

decommissioning—Removing facilities such as processing plants, waste tanks, and burial grounds from service and reducing or stabilizing radioactive contamination. Includes the following concepts: the decontamination, dismantling, and return of an area to its original condition without restrictions on use or occupancy; partial decontamination; isolation of remaining residues; and continued surveillance and restrictions on use or occupancy.

decontamination—The actions taken to reduce or remove chemical or radioactive substances from environmental media (e.g., soil, water, and air), structures (e.g., buildings), equipment, or personnel. Radioactive decontamination may be accomplished by washing, chemical action, mechanical cleaning, or other techniques.

depleted uranium (DU)—Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium. (See enriched uranium.)

deterministic—Referring to events that have no random or probabilistic aspects but proceed in a fixed, predictable fashion.

disposal—As used in this EIS, emplacement of waste so as to ensure isolation from the biosphere with no intent of retrieval, and requiring deliberate action to gain access after emplacement.

disposal facility—A natural and/or manmade structure in which waste is disposed. (Also see disposal.)

DOE Orders—Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dose (radiological)—The radioactive energy that is absorbed by one gram of material that has been irradiated. Dose measures include dose equivalent, effective dose equivalent, committed effective dose equivalent, or committed equivalent dose as defined elsewhere in this glossary.

dose equivalent—A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. Dose equivalent is expressed in rems or sieverts.

dose rate—The radiation dose delivered per unit time (e.g., rad per year, millirad per year).

downblending—A process in which an appropriate substance is added to a fissile material (generally) such as plutonium or enriched uranium to reduce the concentration of the fissile material in the resulting mixture. The quantity of the fissile material in the resulting mixture remains the same while the total quantity of the mixture increases.

downdraft table—A work area having a surface perforated with holes. A vacuum applied to the surface removes air containing particulates, gases, or vapors from the work area. Air thus removed is then normally treated by filtration or other processes before discharge.

drainage basin—A region or area bounded by a drainage divide and occupied by a drainage system; specifically, the tract of country that gathers water originating as precipitation and contributes to a particular stream channel or system of channels or a lake, reservoir, or other body of water.

drinking water standards—Prescriptive limits on the maximum contaminant level that may be in water for it to be considered safe for human consumption.

dynamic plutonium experiments—These are experiments designed to provide improved knowledge of plutonium material properties, including equation of state and strength, over broad ranges of relevant pressures, temperatures, and time scales. These experiments range from essentially static experiments, such as diamond anvil cell and quasi-static load frame, to increasingly dynamic experiments, such as gas-gun-driven, pulsed-power-driven, special nuclear material-mated-to-high-explosives-driven, and laser-driven experiments. None of these experiments reaches nuclear criticality or involves self-sustaining nuclear reactions.

effective dose equivalent—The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rems or sieverts. (Also see committed effective dose equivalent.)

electron—An elementary particle with a mass of 9.107×10^{-28} grams (or 1/1,837 of a proton) and a negative charge. Electrons surround the positively charged nucleus and determine the chemical properties of the atom. (See *nucleus*.)

endangered species—Any species which is in danger of extinction throughout all or a significant portion of its range from natural or manmade changes in the environment. The list of endangered species can be found in 50 CFR 17.11 (wildlife), 50 CFR 17.12 (plants), and 50 CFR 222.23(a) (marine organisms).

engineered barrier (controls)—Physical controls designed to isolate or contain wastes or hazardous materials (e.g., caps, entombment of facilities, contaminant immobilization).

enriched uranium—Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (See depleted uranium.)

environmental impact statement (EIS)—The detailed written statement that is required by section 102(2)(c) of the National Environmental Policy Act (NEPA) for a proposed major Federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality NEPA regulations in 40 CFR Parts 1500-1508, and DOE NEPA regulations in 10 CFR Part 1021. The statement includes, among other information, discussions of the environmental impacts of the Proposed Action and all reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

environmental justice—The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and Tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations.

environmental testing—Subjecting a test unit to specified environments such as vibration, shock, or static acceleration in a controlled environment.

erosion—Natural processes that include weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the Earth's surface.

ephemeral stream—A stream that flows only after a period of heavy precipitation.

exposure—The amount of radiation or pollutant present in a given environment that represents a potential health threat to living organisms.

fault (geologic)—Fracture in the Earth's crust accompanied by displacement of one side of the fracture with respect to the other.

fissile materials—An isotope that readily fissions after absorbing a neutron of any energy, either fast or slow. Fissile materials are uranium-235, uranium-233, plutonium-239, and plutonium-241. Uranium-235 is the only naturally occurring fissile isotope. Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning, namely, any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

fission—The splitting of a nucleus into at least two other nuclei (elements) and the release of a relatively large amount of energy.

fission products—Nuclei (new elements) formed from the fission of heavy elements.

floodplain—That portion of a river valley, adjacent to the river channel, that is built of sediments during the present regimen of the stream and that is covered with water when the river overflows its banks at flood stages.

gamma-emitter (γ-emitter)—A radioactive substance that decays by releasing gamma radiation.

gamma (γ) radiation—High-energy, short-wavelength electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma (γ) rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to x-rays, but are usually more energetic than x-rays. (Also see alpha radiation and beta radiation.)

glove box—A large enclosure that separates workers from equipment used to process hazardous material, while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel, with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

gradient—The elevation change within a given distance, particularly of a stream or a land surface.

gray (Gy)—The SI (International System of Units) unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (1 gray is equal to 100 rad). (The joule is the SI unit of energy.) (See absorbed dose, gray, quality factor, rem, and sievert.)

Greater-Than-Class C (GTCC)—Low-level radioactive waste that exceeds the concentration limits established for Class C waste in 10 CFR 61.55. Greater-than-Class C waste and transuranic waste can represent similar wastes. Waste containing transuranics that may be greater-than-Class C by U.S. Nuclear Regulatory Commission (NRC) classification could be considered transuranic by DOE.

groundwater—Water below the ground surface in a zone of saturation. *Related definition:* Subsurface water is all water that exists in the voids found in soil, rocks, and sediment below the land surface, including soil moisture, capillary fringe water, and groundwater. That part of subsurface water in voids completely saturated with water is called groundwater. Subsurface water above the groundwater table is called vadose water.

habitat—The environment or place where a plant or animal naturally or normally grows or lives (includes soil, water, climate, other organisms, and communities.)

half-life (biological)—The time required for a biological system, such as that of a human, to eliminate, by natural processes, half of the amount of a substance (such as a radioactive material) that has entered it.

half-life (radiological)—The time in which one-half of the atoms of a particular radionuclide disintegrate into another nuclear form. Half-lives for specific radionuclides vary from millionths of a second to billions of years.

hazardous chemical—Any chemical that is a physical hazard or a health hazard as defined under the Occupational Safety and Health Act and the Emergency Planning and Community Right-to-Know Act.

hazardous constituent—A constituent listed in 40 CFR Part 261, Appendix VII or VIII, that may cause a waste to be listed as a Resource Conservation and Recovery Act (RCRA) hazardous waste.

hazardous waste—A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20-24 (ignitability, corrosivity, reactivity, and toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

high-efficiency particulate air (HEPA) filter—An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inch) in diameter. These filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

high-level waste or high-level radioactive waste—High level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

hydraulic conductivity—A measure of the rate at which water can move through a permeable medium (e.g., soil) at a specified pressure and temperature.

hydraulic gradient—The change in elevation of the water table over a distance, resulting in groundwater movement.

hydrodynamic experiments—Hydrodynamic experiments are driven by high-explosives- to assess the performance and safety of nuclear weapons. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term hydrodynamic. These experiments are conducted using test assemblies that are representative of nuclear weapons. Hydrodynamic experimentation is a central component in maintaining nuclear weapons design and assessment capability. It is coupled with high-performance computer modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear physics package of weapons.

hydrodynamic test—A dynamic, integrated systems test of a mock-up nuclear package during which the high explosives are detonated and the resulting motions and reactions of materials and components are observed and measured. The explosively generated high pressures and temperatures cause some of the materials to behave hydraulically (like a fluid). Hydrodynamic tests are used to obtain diagnostic information on the behavior of a nuclear weapon's primary assembly (using simulant materials for the fissile materials in an actual weapon) and to evaluate the effects of aging on the nuclear weapons remaining in the stockpile.

hydrogeology—The study of the occurrence, distribution, and chemistry of all water, including groundwater, surface water, and rainfall.

hydrology—The study of water, including groundwater, surface water, and rainfall.

hydrophytic—A property of a plant that can grow in water or in soil too water-logged for most plants to survive.

industrial waste—As used in this EIS, nonradiological and nonhazardous solid, or semisolid material generated from site cleanup activities.

in situ—In the natural or original position.

institutional controls—Measures taken by Federal or state organizations to maintain waste management facilities safely for a period of time. The measures, active or passive, may include site access control, site monitoring, facility maintenance, and erosion control.

intensity (of an earthquake)—A measure of the effects (due to ground shaking) of an earthquake at a particular location, based on observed damage to structures built by humans, changes in the Earth's surface, and reports of how people felt the earthquake. Earthquake intensity is measured in numerical units on the Modified Mercalli scale. (Also see Modified Mercalli Intensity Scale.)

inventory, radionuclide—The total amount (by volume and/or activity) of radioactive material in a container, building, or disposal facility.

isotope—Any of two or more variations of an element in which the nuclei have the same number of protons (i.e., the same atomic number) but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical properties (e.g., carbon-12 and -13 are stable, but carbon-14 is radioactive).

latent cancer fatality (LCF)—A death from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

latent cancer morbidity—A statistically based estimate of cancer incidences from, and occurring some time after, exposure to ionizing radiation or other carcinogens.

long-term stewardship—Activities necessary to ensure protection of human health and the environment following closure of a site. Long-term stewardship includes engineered and institutional controls designed to contain or to prevent exposure to residual contamination and waste such as monitoring and maintenance activities, record-keeping activities, inspections, groundwater monitoring and treatment, access control, posting signs, and periodic performance reviews.

low-level radioactive waste (LLW)—Radioactive waste not classified as high-level radioactive waste, TRU waste, spent fuel, or byproduct material as defined by Section 11e(2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the concentration of TRU elements is less than 100 nanocuries per gram.

maximally exposed individual (MEI)—A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (inhalation, ingestion, external exposure).

***maximally reasonably foreseeable accident*—**A maximum reasonably foreseeable accident is an accident with the most severe consequences that can reasonably be expected to occur.

maximum contaminant level (MCL)—Under the Safe Drinking Water Act, the maximum permissible concentration of a specific constituent in drinking water that is delivered to any user of a public water system that serves 15 or more connections and 25 or more people. The standards set as maximum contaminant levels take into account the feasibility and cost of attaining the standard.

millirem—One thousandth (10^{-3}) of a rem. (Also see rem.)

***missions*—**In this site-wide environmental impact statement (SWEIS), the term "missions" refers to the major responsibilities assigned to the U.S. Department of Energy (DOE) and National Nuclear Security Administration (NNSA) (described in Section 1.1). DOE and NNSA accomplish these major responsibilities by assigning groups or types of activities to DOE's system of security laboratories, production facilities, and other sites.

mixed low-level radioactive waste—Low-level radioactive waste that also contains hazardous components regulated under RCRA (42 U.S.C. 6901 et seq.).

mixed waste—Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste such as mixed low-level radioactive waste (MLLW), and mixed TRU waste.

mitigation—(1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Modified Mercalli Intensity Scale—The Modified Mercalli Intensity Scale is a standard of relative measurement of earthquake intensity developed to fit construction conditions in most of the United States. It is a 12-step scale, with values from I (not felt except by a very few people) to XII (damage total). A Modified Mercalli Intensity is a numerical value on the Modified Mercalli Scale. (See intensity [of an earthquake].)

Mojave Global Change Facility (MGCF)—MGCF was established in Area 5 of the NNSS to examine the impact of global climate change factors other than increased carbon dioxide (i.e., increasing summer monsoon rains, increased nitrogen deposition, and disturbance or destruction of the desert soil crust) on the Mojave Desert ecosystem.

morphology—The observation of the form of lands.

nanocurie—0.000000001 (10^{-9}) of a curie. (Also see curie.)

neutron—An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1. (See *nucleus* and *proton*.)

neutron (n) radiation—The emission of neutrons from atomic nuclei. Neutrons are uncharged subatomic particles of nearly the same mass as protons. Interaction with atomic nuclei in matter results indirectly in ionization and thus an absorbed dose to biological material. Neutron bombardment of heavy nuclei (e.g., uranium, plutonium) can result in fission. Highly penetrating, neutrons can be stopped by thick masses of concrete, water or paraffin.

Nevada Desert Free-Air Carbon Dioxide Enrichment (FACE) Facility—An environmental research facilities located in Area 5 of the Nevada National Security Site (NNSS) that conducts long-term environmental research. FACE is a state-of-the-art facility designed to study responses of an undisturbed desert ecosystem to increasing levels of atmospheric carbon dioxide. This facility is in a standby condition due to lack of funding.

noncommunity water supply—a water system that provides water for drinking or household purposes to 25 or more persons at least 60 days per year or has 15 or more service connections. Noncommunity water systems serve either a transient or a nontransient population.

nontransient, noncommunity water system—A water system regularly serves at least 25 of the same people more than six months per year. For example, a school or business with its own water supply is considered a non-transient system.

nuclear forensics—Nuclear forensics, the analysis of nuclear materials recovered from either the capture of unused materials or the radioactive debris following a nuclear explosion, can contribute significantly to the identification of the sources of the materials and the industrial processes used to obtain them. In the case of an explosion, nuclear forensics can also reconstruct key features of the nuclear device.

nuclear material—A composite term applied to: (1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

nuclear testing—An underground nuclear weapons test of either a single underground nuclear explosion or two or more underground nuclear explosions conducted at NNSS within an area delineated by a circle having a diameter of two kilometers and conducted within a total period of 0.1 second. The yield of a test shall be the aggregate yield of all explosions in the test.

nuclear weapons simulator—A device that simulates some aspect of a nuclear weapon, but can not produce an explosion resulting from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

nuclear weapon pit— The pit is the central core of a nuclear weapon containing plutonium-239 and/or highly enriched uranium that undergoes fission when compressed by high explosives. The pit and the high explosive are known as the "primary" of a nuclear weapon.

nucleus—The positively charged central portion of an atom that composes nearly all of the atomic mass and consists of protons and neutrons, except in hydrogen, in which it consists of one proton only. (See *neutron* and *proton*.)

nuclide—An atomic nucleus specified by its atomic weight, atomic number, and energy state; a radionuclide is a radioactive nuclide.

occupational dose—Whole-body radiation dose received by workers participating in a given task or over the course of employment.

perennial stream—A stream that flows throughout the year.

permeability—The rate at which liquids or gasses pass through materials in a specified direction. In hydrology, it is used to describe the capacity of a rock, sediment, or soil for transmitting groundwater. Permeability depends on the size and shape of the pores between soil particles and how they are interconnected.

person-rem—A unit of collective radiation dose applied to populations or groups of individuals (see collective dose); that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-rem equals 0.01 person-sieverts.

person-sievert (person-Sv)—A unit of collective radiation dose applied to populations or groups of individuals (see collective dose); that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-sievert equals 100 person-rems.

photon—A unit of electromagnetic energy exhibiting behavior like that of a particle.

picocurie—0.000000000001 (10^{-12}) of a curie. (Also see curie.)

piezometer—An instrument used for measuring the pressure of groundwater.

pit (nuclear)—The pit is the central core of a nuclear weapon containing plutonium-239 and/or highly enriched uranium that undergoes fission when compressed by high explosives. The pit and the high explosive are known as the "primary" of a nuclear weapon.

pit (waste management)—An excavation similar to a trench within which waste is emplaced for disposal.

pollution prevention—The use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and waste into land, water, and air. For DOE, this includes recycling activities.

polychlorinated biphenyls (PCBs)—A group of toxic, persistent chemicals regulated under the Toxic Substances Control Act used for insulating purposes in electrical transformers and capacitors and in gas pipeline systems.

population dose—See collective dose.

programs—DOE and NNSA are organized into program offices, each of which has primary responsibilities within the set of DOE and NNSA missions. Funding and direction for activities at DOE facilities are provided through these program offices, and similarly coordinated sets of activities to meet program office responsibilities are often referred to as "programs." Programs are usually long-term efforts with broad goals or requirements.

projects—This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to major (such as a project to construct and start up a new nuclear facility). Projects are usually relatively short-term efforts and can cross multiple programs and missions, although they are usually "sponsored" by a primary program office. In this SWEIS, "projects" is usually used more narrowly to describe construction activities, including facility modifications (such as a project to build a new office building or to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at the NNSS over about a 10-year period are discussed and analyzed in this SWEIS.

proton—An elementary nuclear particle with a positive charge equal in magnitude to the negative charge of the electron; it is a constituent of all atomic nuclei. The atomic number of an element indicates the number of protons in the nucleus of each atom of that element. (See *electron* and *nucleus*.)

public—Anyone who may be impacted by, interested in, or aware of operations at NNSS or other DOE/NNSA facilities. With respect to normal operations or accidents analyzed in this environmental impact statement, the public includes anyone outside the boundary of the NNSA property that may be exposed to contaminants.

public water system (PWS)—A system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves at least twenty-five individuals.

pulse power—The technology of using electrical energy stores for producing multi-terawatt (10^{12} Watts or higher) pulses of electrical power for inertial confinement fusion, nuclear weapon effects simulation, and directed energy weapons.

quality factor—The factor by which the absorbed dose (rad or gray) is to be multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage (rem or sievert) to an exposed individual. It is used because some types of radiation, such as alpha particles, are more biologically damaging internally than other types. (See absorbed dose, gray, rad, rem, and sievert).

rad—See *radiation absorbed dose.*

radiation absorbed dose (rad)—A unit of absorbed dose. One rad is equal to an absorbed dose of 0.01 joule per kilogram (1 rad is equal to 0.01 gray). The joule is the SI (International System of Units) unit of energy. (See *absorbed dose, gray, quality factor, rem, and sievert*.)

radioactive decay—The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous emission from the atomic nuclei of either alpha or beta particles, often accompanied by gamma radiation. (Also see half-life.)

radioactive waste—Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

radioactivity—*Defined as a process:* The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation. *Defined as a property:* The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope thermoelectric generator (RTG)—An electrical generator that derives its electric power from heat produced by the decay of radioactive strontium-90, plutonium-238, or other suitable isotopes. The heat generated is directly converted into electricity, in a passive process, by an array of thermocouples.

radiological survey—The evaluation of the radiation hazard accompanying the production, use, or existence of radioactive materials under a specific set of conditions. Such evaluation customarily includes a physical survey of the disposition of land, materials, and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes affecting these materials to predict hazards resulting from unexpected or possible changes in land, materials, or equipment.

radionuclide—An unstable element that decays or disintegrates spontaneously, emitting radiation.

real-time radiography—A nondestructive test method whereby an image is produced electronically, rather than on film, so that very little lag time occurs between the item being exposed to radiation and the resulting image.

Record of Decision (ROD)—A concise public document that records a Federal agency's decision(s) concerning a Proposed Action for which the agency has prepared an EIS. The ROD is prepared in accordance with the requirements of the Council on Environmental Quality NEPA regulations (10 CFR 1021.315 and 40 CFR 1505.2). A ROD identifies the alternatives considered in reaching the decision, the decision made, the environmentally preferable alternative(s), factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not. (Also see environmental impact statement.)

region of influence (ROI)—A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

release fraction—The portion of the total inventory of radioactivity that could be released to the atmosphere in a given accident.

rem (roentgen equivalent man)—Is a unit of radiation dose equivalent. The dose equivalent in rems equals the absorbed dose in rads multiplied by the appropriate quality factor (1 rem is equal to 0.01 sievert). (See absorbed dose, gray, quality factor, and sievert.)

remote-handled waste—In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure (waste with a dose rate of 200 millirem per hour or more at the surface of the waste package). (See contact-handled waste.)

Resource Conservation and Recovery Act (RCRA)—A law that gives EPA and authorized states the authority to control hazardous waste from "cradle to grave" (i.e., from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. RCRA also sets forth a framework for the management of nonhazardous solid wastes. (Also see hazardous waste and solid waste.)

restricted airspace—An area of airspace in which the controlling authority has determined that air traffic must be restricted, if not continually prohibited. It denotes the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles.

risk—The probability of a detrimental effect on life, health, property, and/or the environment from exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (i.e., the product of these two factors).

roentgen—A unit of exposure to ionizing x or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air. (See *gamma radiation* and *x-rays*.)

runoff—That portion of precipitation, snow melt, or irrigation water that moves over the land surface as a sheet or channelized flow.

sanitary landfill—As defined in this EIS, a disposal facility that accepts nonhazardous and nonradioactive industrial waste. (Also see industrial waste.)

saturated zone—The area below the water table where all spaces (fractures and rock pores) are completely filled with water.

scientific notation—A notation adopted by the scientific community to deal with very large and very small numbers. Scientific notation uses a number times 10 and either a positive or negative exponent to show how many places to the left or right the decimal place has been moved. For example, in scientific notation, 120,000 would be written as 1.2×10^{5}, and 0.000012 would be written as 1.2×10^{-5}.

seep—A spot where groundwater discharges onto the land surface, often forming the source of a small stream.

seismicity—The study of the worldwide distribution of earthquakes; primarily related to location, size, and probability of occurrence.

shielding—Any material or obstruction used to absorb radiation in order to protect personnel or equipment.

sievert (Sv)—The SI (International System of Units) unit of radiation dose equivalent. The dose equivalent in sieverts equals the absorbed dose in grays multiplied by the appropriate quality factor (1 sievert is equal to 100 rem). (See absorbed dose, gray, quality factor, rad, and rem.)

silt—A sedimentary material consisting of fine mineral particles, intermediate in size between sand and clay. In general, soils categorized as silt show greater rates of erosion than soils categorized as sand.

solid waste—1. In general, solid wastes are nonliquid, nonsoluble discarded materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances. Solid wastes include sewage sludge, agricultural refuse, demolition wastes, and mining residues. 2. For purposes of RCRA regulation, solid waste is any garbage; refuse; sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and other discarded material. Solid waste includes solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. Solid waste does not include solid or dissolved material in domestic sewage or irrigation return flows or industrial discharges that are point sources subject to permits under Section 402 of the Clean Water Act. Finally, solid waste does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act. A more detailed regulatory definition of solid waste can be found in 40 CFR 261.2 and 6 NYCRR 360. (Also see hazardous waste and Resource Conservation and Recovery Act.)

source term—The amount of a specific pollutant (e.g., chemical, radionuclide) emitted or discharged to a particular environmental medium (e.g., air, water) from a source or group of sources. It is usually expressed as a rate (i.e., amount per unit time).

special nuclear material (SNM)—SNM is (1) plutonium, uranium-233, uranium enriched in isotopes of uranium-233 or -235, or any other material that the U.S. Nuclear Regulatory Commission determines to be SNM, or (2) any material artificially enriched by any of these radioactive materials.

special use airspace—Airspace where activities must be confined because of their nature or where limitations are imposed upon aircraft operations that are not part of those activities, or both. This airspace includes restricted airspace, military operations areas, and controlled firing areas.

spent nuclear fuel—Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

stabilization—Treatment of waste or a waste site to protect the biosphere from contamination.

stakeholder—Any person or organization with an interest in or affected by future activities impacting cleanup of the site. Stakeholders may include representatives from Federal and state agencies, Congress, American Indian Tribal governments, unions, educational groups, industry, environmental groups, other groups, and members of the general public.

stochastic (effects)—Effects that occur by chance. In the radiation protection context, the main stochastic health effects from exposure to high levels of radiation are cancer and genetic effects.

storage (waste)—The collection and containment of waste in a retrievable manner, requiring surveillance and institutional control, as not to constitute disposal.

storage facility (RCRA)—A building used for storing radioactive or hazardous wastes for greater than 90 days.

subcritical experiments—Subcritical experiments are performed with special nuclear material (for example, plutonium) in a manner that prevents the material from achieving a nuclear explosion. The experiments are designed to improve current knowledge of the dynamic properties of new or aged nuclear weapons parts and materials and to assess the effects of new manufacturing techniques on weapon performance. Subcritical experiments can vary any or all factors that influence criticality (mass, density, shape, volume, concentration, moderation, reflection, neutron absorption, enrichment, and interactions). Because there is no nuclear explosion, subcritical experiments are consistent with the U.S. nuclear testing moratorium.

succession—Relatively orderly, predictable, and progressive replacement of one plant community (called a stage) by another until a relatively stable climax community occupies the site (e.g., abandoned farm field to mature forest).

sump—A pit or reservoir serving as a drain or receptacle for liquids.

tectonic—Relating to the deformation of the crust of the Earth.

test bed—A test bed is an area that includes physical structures or designated terrain where tests and experiments are conducted.

transient, noncommunity water system—regularly serves at least 25 individuals, but not the same individuals, for more than 60 days per year. For example, a rest area, campground or restaurant with less than 25 employees on its own water supply is considered a transient water system.

transloading**—**Transfer of material at an intermodal transfer facility from one packaging to another for purposes of continuing the movement of the material in commerce.

transuranic—Refers to any artificially made, radioactive element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium.

transuranic (TRU) waste—Radioactive waste containing alpha particle-emitting radionuclides having an atomic number greater than 92 (the atomic number of uranium) and half-lives greater than 20 years, in concentrations greater than 100 nanocuries per gram.

tritium—A beta-emitting radioactive isotope of hydrogen whose nucleus contains one proton and two neutrons. Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion pathway. The symbols for tritium are T and ^{3}H; the latter symbol is more frequently encountered.

vadose zone (unsaturated zone)—The zone between the land surface and the water table (saturated zone); also called the zone of aeration.

waste acceptance criteria—A document that establishes NNSA/NSO waste acceptance criteria. The document provides the requirements, terms, and conditions under which NNSS accepts LLW and MLLW for disposal. It includes requirements for the generator's waste certification program, characterization, traceability, waste form, packaging, and transfer. The criteria apply to radioactive waste received at the NNSS Area 3 Radioactive Waste Management Site and Area 5 Radioactive Waste Management Complex for storage or disposal.

waste characterization—The identification of waste composition and properties by reviewing process knowledge, nondestructive examination, nondestructive assay, or sampling and analysis. Characterization provides the basis for determining appropriate storage, treatment, handling, transportation, and disposal requirements.

waste generator—An individual, facility, corporation, government agency, or other institution that produces waste material for certification, treatment, storage, or disposal.

wetlands**—**An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in those conditions, including swamps, marshes, bogs, and similar areas.

wind rose—A circular diagram showing, for a specific location, the percentage of the time the wind is from each compass direction. A wind rose is used in assessing consequences of airborne releases and shows the frequency of different wind speeds for each compass direction.

worker—Any worker whose day-to-day activities are controlled by process safety management programs and a common emergency response plan associated with a facility or facility area. This definition includes any individual within a facility/facility area who would participate in or support activities required for implementation of the alternatives.

x-rays—Penetrating electromagnetic radiation with a wavelength much shorter than that of visible light. X-rays are identical to gamma rays, but originate outside the nucleus, either when the inner orbital electrons of an excited atom return to their normal state or when a metal target is bombarded with high-speed electrons. (See *electron, gamma radiation, and nucleus*.)

zeolite—Any of various hydrous silicates utilized for their adsorbent and catalytic properties. Inorganic ion-exchange materials used for water purification or water softening are often zeolites.

CHAPTER 13
INDEX

13.0 INDEX

A

B

C

D

E

F

G

H

L

M

N

O

P

R

S

T

CHAPTER 14
DISTRIBUTION LIST

14.0 DISTRIBUTION LIST

The U.S. Department of Energy provided copies of the *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* to Federal, State, and local elected and appointed government officials and agencies; American Indian representatives; national, state, and local environmental and public interest groups; and other organizations and individuals as listed. Approximately 200 copies of the Draft SWEIS, 650 copies of the Summary of the Draft SWEIS, and 850 CDs of the Draft SWEIS were sent to interested parties.

Copies will be provided to others on request.

United States Congress

U.S. Senate

The Honorable Robert Bennett, Utah
The Honorable Barbara Boxer, California
The Honorable Michael D. Crapo, Idaho
The Honorable Dianne Feinstein, California
The Honorable Dean Heller, Nevada
The Honorable Orrin Hatch, Utah
The Honorable Jon Kyl, Arizona
The Honorable John McCain, Arizona
The Honorable Harry Reid, Nevada
The Honorable James Risch, Idaho

U.S. Senate Committees

The Honorable Daniel K. Inouye, Chairman, Committee on Appropriations
The Honorable Thad Cochran, Vice Chairman, Committee on Appropriations
The Honorable Byron L. Dorgan, Chairman, Subcommittee on Energy and Water Development
The Honorable Robert F. Bennett, Ranking Member, Subcommittee on Energy and Water Development
The Honorable Jeff Bingaman, Chairman, Committee on Energy and Natural Resources
The Honorable Lisa Murkowski, Ranking Member, Committee on Energy and Natural Resources
The Honorable Carl Levin, Chairman, Committee on Armed Services
The Honorable John McCain, Ranking Member, Committee on Armed Services
The Honorable Ben Nelson, Chairman, Subcommittee on Strategic Forces
The Honorable David Vitter, Ranking Member, Subcommittee on Strategic Forces

U.S. House of Representatives

The Honorable Shelly Berkley, Nevada
The Honorable Rob Bishop, Utah
The Honorable Jason Chaffetz, Utah
The Honorable Trent Franks, Arizona
The Honorable Joe Heck, Nevada
The Honorable Raul Labrador, Idaho
The Honorable Howard McKeon, California
The Honorable Jim Matheson, Utah
The Honorable Mike Simpson, Idaho

U.S. House of Representatives Committees

The Honorable David R. Obey, Chairman, Committee on Appropriations
The Honorable Jerry Lewis, Ranking Member, Committee on Appropriations
The Honorable Peter J. Visclosky, Chairman, Subcommittee on Energy and Water Development
The Honorable Rodney P. Frelinghuysen, Ranking Member, Subcommittee on Energy and Water Development
The Honorable Henry A. Waxman, Chairman, Committee on Energy and Commerce
The Honorable Joe Barton, Ranking Member, Committee on Energy and Commerce
The Honorable Ike Skelton, Chairman, Committee on Armed Services
The Honorable Howard P. "Buck" McKeon, Ranking Member, Committee on Armed Services
The Honorable Jim Langevin, Chairman, Subcommittee on Strategic Forces
The Honorable Michael Turner, Ranking Member, Subcommittee on Strategic Forces

Federal Agencies

Defense Nuclear Facilities Safety Board
U.S. Department of Defense
  United States Air Force
U.S. Department of Homeland Security
  FEMA Region IX – AZ, CA, HI, NV, Pacific Trust Territories
U.S. Department of the Interior
  Bureau of Land Management
  Bureau of Reclamation
  Fish and Wildlife Service
  Oakland Regional Office – AS, AZ, CA, CNMI, GU, HI, NV
U.S. Department of Transportation
  Federal Highway Administration
  Surface Transportation Board
U.S. Environmental Protection Agency
  EPA Region 9 – AS, AZ, CA, GU, HI, MP, NV

Federal Officials

Molly Roach, Office of the U.S. Attorney

State Government

Arizona State Government

Governor
Jan Brewer

State Official
Aubrey Godwin, Arizona Radiation Regulatory Agency
Bret Parke, Arizona Department of Environmental Quality

California State Government

Governor
Jerry Brown

Idaho State Government

Governor
C. L. "Butch" Otter

Nevada State Government

Governor
Brian Sandoval

State Officials
Catherine Cortez Masto, Attorney General
Brian K. Krolicki, Lieutenant Governor
Marta Adams, Sr. Deputy Attorney General
Leo Drozdoff, Department of Conservation and Natural Resources
Colleen Crips, Department of Conservation and Natural Resources
Timothy H. Murphy, Division of Environmental Protection
David Emme, Division of Environmental Protection
Michael Elges, Division of Environmental Protection
Joseph C. Strolin, Agency for Nuclear Projects

Utah State Government

Governor
Gary Herbert

State Officials
Rusty Lundberg, Utah Division of Radiation Control

State NEPA Clearinghouses

Governor of Alabama, State Capitol
Tracy L. Copeland, Manager, Arkansas State Clearinghouse
Governor of Colorado
James C. Hardeman, Manager, Environmental Radiation Program, Georgia Department of Natural Resources
James C. Hardeman, Georgia Department of Natural Resources
Governor of Illinois, Office of the Governor
Brad Baughn, Business and Legislative Liaison, Indiana
Richard Leopold, Director, Iowa Department of Natural Resources
Larry C. Taylor, Environmental Scientist IV, Office of the Commissioner, Department for Environmental Protection, Kentucky
Linda C. Janey, J.D., Assistant Secretary for Clearinghouse and Communications, Maryland Department of Planning
William Parkus, Coordinator, Regional Review Office, Southeast Michigan Council of Governments
Trudy Fisher, Executive Director, Mississippi Department of Environmental Quality
Robert Stout, Senior Policy Coordinator, Missouri Department of Natural Resources
Joe Francis, Department of Environmental Quality, Nebraska
Scott Brubaker, Office of Permit Coordination and Environmental Review, New Jersey Department of Environmental Protection
Ron Curry, Secretary, New Mexico Environment Department
Governor of New York, State Capitol
Jeff G. Hines, Chief, Southwest District Office, Ohio Environmental Protection Agency
Governor of Oklahoma, State Capitol
Governor of Oregon, State Capitol
Randal Duke Adams, Pennsylvania Department of Environmental Protection
State Clearinghouse, Office of State Budget, South Carolina
Shelly Wilson, Federal Facilities Liaison, South Carolina Department of Health and Environmental Control
Governor's Lead Point of Contact, Tennessee Department of Environment and Conservation, Attention: Mary Parkman
Chudi Nwangwa, Tennessee Department of Environment and Conservation
Denise Stines Francis, State Single Point of Contact, Governor's Office of Budget, Planning, and Policy; State Grants Team, Texas

Toby Baker, Governor's Advisor – Natural Resources and Agriculture, Texas
Terry Zrubek, Governor's Advisor – Water, Texas
Ellie L. Irons, Environmental Impact Review Manager, Virginia Department of Environmental Quality
Annie Szveteca, SEPA Policy Lead, Washington Department of Ecology
Kelly A. Bragg, Program Coordinator, West Virginia Division of Energy

Local Government

Mayors

Carolyn Goodman, Las Vegas

City Officials

Amargosa Valley Town Board
Beatty Town Board
Caliente Town Board
Pahrump Town Board
Pioche Town Board
Tonopah Town Board
James Eason, Town of Tonopah
Cindy Kaminski, Tonopah Town Board
Daniel McArthur, City of St. George

County Officials

Churchill County Commissioners, Nevada

Clark County Commissioners, Nevada
Susan Brager
Larry Brown
Tom Collins
Chris Giunchigliani
Steve Sisolak
Mary Beth Scow
Lawrence Weekly

Douglas County Commissioners, Nevada

Elko County Commissioners, Nevada

Esmeralda County Commissioners, Nevada

Eureka County Commissioners, Nevada

Humboldt County Commissioners, Nevada

Lander County Commissioners, Nevada

Lincoln County Commissioners, Nevada

Lyon County Commissioners, Nevada

Mineral County Commissioners, Nevada

Nye County, Nevada
L. Darrell Lacy, Nuclear Waste Repository Project Office
Richard Osborne, Manager
Roger McRae, H.M.H., C.E.M., (Nuclear Waste Repository Project Office)
Joe Ziegler, Nuclear Waste Repository Project Office

Nye County Commissioners, Nevada
Andrew Borasky
Joni Eastley
Gary Hollis
Dan Schinhofen
Lorinda Wichman

Pershing County Commissioners, Nevada

Washington County Commissioners, Utah

Washoe County Commissioners, Nevada

White Pine County Commissioners, Nevada

Native American Representatives

Chairpersons

The Honorable Richard Arnold, Chairman of the Pahrump Paiute Tribe
The Honorable Alvin Marques, Chairperson of Ely Shoshone Tribe
The Honorable Melvin R. Joseph, Chairman of the Lone Pine
The Honorable Dorothy Buff, Chairwoman of the Fort Independence Indian Tribe
The Honorable Bill Vega, Chairman of the Bishop Paiute Indian Tribe
The Honorable James Birchum, Chairman of the Yomba Shoshone Tribe
The Honorable Eldred Enas, Chairman of the Colorado River Indian Tribes
The Honorable Bill Saulque, Chairman of the Benton Paiute Indian Tribe
The Honorable Joe Kennedy, Chairman of the Timbisha Shoshone Tribe
The Honorable Virginia Sanchez, Chairman of the Duckwater Shoshone Tribe
The Honorable Virgil Moose, Chairman of the Big Pine
The Honorable Manual Savala, Chairman of the Kaibab Paiute Tribe
The Honorable William Anderson, Chairman of the Moapa Band of Paiutes
The Honorable Jeanine Borchardt, Chairwoman of the Paiute Indian Tribes of Utah
The Honorable Lucille Campa, Chairwoman of the Las Vegas Paiute Tribe
The Honorable Charles Wood, Chairman of the Chemehuevi Indian Tribe

Representatives

Bill Saulque, Benton Paiute Indian Tribe
Danelle Gutierrez, Big Pine Paiute Tribe
William J. Helmer, Big Pine Paiute Tribe
Gerald Kane, Bishop Paiute Tribe
Jay Kane, Bishop Paiute Tribe
Bill Vega, Bishop Paiute Indian Tribe
Ron Escobar, Chemehuevi Indian Tribe
Darryl King, Chemehuevi Indian Tribe
Johnny Hill, Colorado River Indian Tribes
Betty L. Cornelius, Colorado River Indian Tribes
Eldred Enas, Colorado River Indian Tribes
Philip Smith, Colorado River Indian Tribes
Kathy Blackeye, Duckwater Shoshone Tribe
Maurice Frank-Churchill, Duckwater Shoshone Tribe
Virginia Sanchez, Duckwater Shoshone Tribe
Sandra Barela, Ely Shoshone Tribe
Jerry Charles, Ely Shoshone Tribe
Alvin Marques, Ely Shoshone Tribe
Dorothy Buff, Fort Independence Indian Tribe
Richard Wilder, Fort Independence Indian Tribe
Julie Huber, Fort Independence Indian Tribe
Charlie Bullets, Kaibab Band of Southern Paiutes
Brittanni Wero, Kaibab Band of Southern Paiutes
Manuel Savala, Kaibab Paiute Tribe
Charley Bulletts, Kaibab Paiute Tribe
Brittanni Wero, Kaibab Paiute Tribe
Tonia Means, Las Vegas Paiute Tribe
Janice Aten, Lone Pine Paiute-Shoshone Tribe
Mel Joseph, Lone Pine Paiute/Shoshone Tribe
Lalovi Miller, Moapa Band of Paiutes
William Anderson, Moapa Paiute Tribe
Richard Arnold, Pahrump Paiute Tribe
Clarabelle Jim, Pahrump Paiute Tribe
Cynthia V. Lynch, Pahrump Paiute Tribe
Virgil Moose, Paiute Tribe of the Owens Valley
Carmen Martineau, Paiute Indian Tribe of Utah
Jeanine Borchardt, Paiute Indian Tribes of Utah
Dorena Martineau, Paiute Indian Tribes of Utah
Georgetta Wood, Paiute Indian Tribes of Utah
Shanandoah Martineau, Paiute Indian Tribes of Utah
Joseph Melvin, Paiute-Shoshone Tribe
Barbara Durham, Timbisha Shoshone Tribe
Joe Kennedy, Timbisha Shoshone Tribe
Johnny Kennedy, Timbisha Shoshone Tribe
Pauline Esteves, Timbisha Shoshone Tribe
Grace Goad, Timbisha Shoshone Tribe
James Birchim, Yomba Shoshone Tribe
Elisa Mockerman, Yomba Shoshone Tribe
Darlene Dewey, Yomba Shoshone Tribe

Public Reading Rooms and Libraries

Amargosa Valley Library
829 E. Farm Road
HCR 69 box 401-T
Amargosa, NV 89020

Beatty Library District
400 North Fourth Street
P.O. Box 129
Beatty, NV 89003-0129

Clark County Library
1401 E. Flamingo Road
Las Vegas, NV 89119

Green Valley Library
2797 N. Green Valley Parkway
Henderson, NV 89014

Indian Springs Library
P.O. Box 629
Indian Springs, NV 89018

Kingman Public Library
3269 North Burbank Street
P.O. Box 7000
Kingman, AZ 86402

Las Vegas Library
833 N. Las Vegas Blvd.
Las Vegas, NV 89101

Lincoln County Library
P.O. Box 330
Pioche, NV 89043

Nevada State Library and Archives
100 Stewart Street
Carson City, NV 89193

North Las Vegas Library
Main Branch
2300 Civic Center Drive
North Las Vegas, NV 89030

Pahrump Community Library
701 East Street
Pahrump, NV 89048-0578

Public Reading Room for the Nuclear Testing Archive
755C East Flamingo Road
Las Vegas, NV 89119

Rainbow Library
3150 N. Buffalo Drive
Las Vegas, NV 89128

Reno – Downtown Library
301 South Center Street
Reno, NV 89501

St. George Library
88 West 100 South
St. George, UT 84770

Summerlin Library
1771 Inner Circle Drive
Las Vegas, NV 89134

Tonopah Library
167 South Central Street
P.O. Box 449
Tonopah, NV 89049-0449

UNLV Lied Library
4505 Maryland Parkway
Las Vegas, NV 89154-7001

Organizations/Public Interest Groups

Susan Gordon, Alliance for Nuclear Accountability
Nick Roth, Alliance for Nuclear Accountability
Richard Nelson, BEC Environmental
Rev. Mac Legerton, Center for Community Action
Lisa Rutherford, Citizens for Dixies Future
Jenny Chapman, Desert Research Institute
Cynthia Martinez, Desert National Wildlife Refuge
Seth Kirshenberg, Energy Communities Alliance
Vickie Patton, Environmental Defense Fund
James Wright, Federation of American Scientists
Martina Roels, Flemish Center for Indigenous Peoples
David Culp, Friends Committee on National Legislation (Quaker)
Louis Clark, Government Accountability Project
Jennifer Viereck, Healing Ourselves and Mother Earth
Vanessa Pierce, Healthy Environment Alliance of Utah
Dennis Bechtel, Intertech Services
Tammi Tiger, Las Vegas Indian Center
Greg Mello, Los Alamos Study Group
Paula Cotter, National Association of Attorney Generals
Linda Sikkema, National Conference of State Legislators
Jerry Pardilla, National Tribal Environment Council
Margene Bullcreek, Native Community Action Council

David Goldstein, Natural Resources Defense Council
Kathleen Bienenstein, Nevada National Security Site Advisory Board
Donna Hruska, Nevada National Security Site Advisory Board
Robert Johnson, Nevada National Security Site Advisory Board
John McGrail, Nevada National Security Site Advisory Board
Gregory Minden, Nevada National Security Site Advisory Board
Michael Moore, Nevada National Security Site Advisory Board
Michael Voegele, Nevada National Security Site Advisory Board
James Weeks, Nevada National Security Site Advisory Board
Walter Wegst, Nevada National Security Site Advisory Board
Phil Klevorick, Nevada National Security Site Advisory Board
Genne Nelson, Nevada National Security Site Advisory Board
David Hermann, North Las Vegas Community Advisory Board
Diane D'Arrigo, Nuclear Information and Resource Service
Jay Coghlan, Nuclear Watch New Mexico
Steve Kovac, Nuclear Watch New Mexico
Glen Carrol, Nuclear Watch South
Ralph Hutchinson, Oak Ridge Environmental Peace Alliance
Kevin Martin, Peace Action Education Fund
Madeline Riley, Physicians for Social Responsibility
Jane Feldman, Sierra Club
Ed Hopkins, Sierra Club
Jimmie Powell, The Nature Conservancy
Sue Wainscott, The Nature Conservancy
Marylia Kelly, Tri-Valley Communities Against a Radioactive Environment
Dr. Donald Baepler, University of Nevada, Las Vegas, Harry Reid Center
Helen Neill, University of Nevada, Las Vegas
William E. Brown, Jr., University of Nevada, Las Vegas
Ella Jarvis, We The People (The Citizen's Party)
Rich Halvey, Western Governors' Association
Ian Zabarte, Western Shoshone Government
Western Shoshone National Council
Jacqueline Cabasso, Western States Legal Foundation
Susan Shaer, Women's Action for New Directions

Individuals

Adams, Elliott
Amaglio Alessandro
Amidon, John
Baber, Kathleen
Belisle, Mavis
Bergel, Peter
Blubaugh, Lisa
Bowlby, Brenda
Boyd, Ben
Brown, Chris
Brown, William E., Jr.
Buesch, David
Busse, Barbara
Calabro, Richard A.
Cardwell, Stephanie
Cavalier, Gary
Cherie, Cindy
Cherup, Alex
Chestnut, Ph.D., Dwayne A.
Clark, Ken
Clarke, Brenda
Conn, Rev., Jim
Cope, Julie
Corbus, Lorie
Coyle, T. Thorn
Creek-Water, Mark
Cummings, Terrence
D'Amato, Carla
Davis, Carol
Davison, Heather
Denzin, Jason
Denzin, Genelle
Dodd, Jody
Doub, Marian
Doyle, Kevin
Drekmeier, Peter
Duckett, Laurie
Dunn, Jesse
Dwyer, Anabel
Dyken, Mark
Ediger, Peter
Fallon, Jean
Fanning, Don G. Fireland
Ferreira, Karen
Free, Scott
Gable, Gregory
Gerhardt, Barbara
Giampaoli, MaryEllen
Goldberg, Norene
Gowans, Alan & LuAnn
Greenwald, Lynne
Haber, Jim
Hartsough, David
Hedrick, Kimberly
Hines, Lori
Houle, Jessice
Houx, Craig
Intino, Mario
Isaacs, Jennifer
Jahnkow, Carol
Jalbert, Greg
Johnson, Russ
Johnson, Molly
Kishner, Andrew
Knox, Meridel
Knutsen, Reinard
Kocher, Rob
Kostoff, K.J.
Lai, Ming
Lasahn, J.
Lonner Egert, Jolie
Mac, Pat
MacKenzie, Therese
Mann, Hugh
McCabe, Eileen
McCorkell, George
McGrail, John M.
McNeill Cebe, Genevieve
Medellin, Debra
Meola, Bob
Micciche, Linda
Miles, Yvonne
Miles, Loulena
Miller, Allison L.
Morgan, Patricia
Moriarty, Darlene
Morton, Jenna
Murphy, Ellen
Nathans, Suzanne
Nicodemus, Laura
Obermayer, Hank
Occhiogrosso, Julia
Page, Marcus
Pasbjerg, Lisa
Perchetti, Diane
Preston, David
Pretzer, C.
Reimer, Nancy
Rice, Megan
Richardson, Debra
Rodriguez, David
Rogers, Elizabeth
Romesburg, Denise
Russell, Bob
Russum, Charles
Sakulich, Alexander
Schlosser, Cindy
Schofield, Roger
Senn, Irene
Sharples, Vivien
Shaw, Lisa
Simon, Mark
Sislin, Caitlin
Slater, Alice
Spatz, Midgene
Spoon, Jeremy
Spotts, Richard
Stuart, Warren
Tatio-Medlin, April
Taylor, Deanna
Taylor, Dr., F.
Terrell, Walt
Thawley, Bob
Thomas, Kathleen
Trepanier, Lionel
Usik, Katherine
Vaeth, Terry
Vesperman, Gary
Wayman, Rick
Williamson-Page, Juliana
Wisniewski, Michael
Yundt, Scott

CHAPTER 15
LIST OF PREPARERS

15.0 LIST OF PREPARERS

This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* was prepared by the U.S. Department of Energy (DOE). The organizations and individuals listed below contributed to the overall effort in the preparation of this document.

LINDA COHN, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION, NEVADA SITE OPERATIONS
SWEIS RESPONSIBILITIES: U.S. DEPARTMENT OF ENERGY, DOCUMENT MANAGER

Education: Undergraduate Studies in Political Science

Experience/Technical Specialty:
Twenty-seven years. NEPA Compliance Officer. American Indian consultation program management and cultural resources management.

MICHAEL WEST, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: PROJECT MANAGER

Education: M.S., Environmental Engineering, Johns Hopkins University
B.S., Environmental Engineering, Syracuse University

Experience/Technical Specialty:
Seventeen years. NEPA analysis, environmental studies, regulatory analysis, and program management.

ANTHONY BECKER, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: HYDROLOGY (SURFACE WATER RESOURCES)

Education: M.S., Biology, William Paterson University
B.S., Biology, Richard Stockton College

Experience/Technical Specialty:
Five years. NEPA analysis, biological and water resources impact analyses, wetland evaluation, and analyses of land use compatibility.

KAREN O. BULL, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: ENVIRONMENTAL LAWS, REGULATIONS, AND PERMITS

Education: B.A., Aquatic Biology, University of California, Los Angeles

Experience/Technical Specialty:
Twenty-five years. Regulatory compliance, environmental permit compliance, audits and assessments, NEPA analysis, and water resources impact analysis.

FREDERICK J. CAREY, PRESIDENT, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: SENIOR TECHNICAL ADVISOR

Education: M.S., Environmental Engineering, Johns Hopkins University
B.S., Civil Engineering, University of Maryland
Registered Professional Engineer

Experience/Technical Specialty:
Eighteen years. NEPA analysis, engineering design, environmental studies, regulatory analysis, and program management.

EDWARD L. CARR, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: AIR QUALITY AND METEOROLOGY IMPACTS FOR RADIOLOGICAL AND NON-RADIOLOGICAL AIR QUALITY IMPACTS

Education: M.S., Atmospheric Science, University of Washington
B.S., Meteorology, San Jose State University

Experience/Technical Specialty:
Twenty-five years. Air quality impact assessments, air quality modeling, emission inventory development, and meteorological data collection and assessment.

JENNY B. CHAPMAN, DESERT RESEARCH INSTITUTE
SWEIS RESPONSIBILITIES: REVIEWER, ENVIRONMENTAL AND CULTURAL RESOURCE SECTIONS

Education: M.A., Geological, The University of Texas at Austin
B.S., Geology, Sul Ross State University

Experience/Technical Specialty:
Thirty-five years. Research hydrogeologist, studying groundwater flow and contaminant transport.

KAREN L. CRAWFORD, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: CULTURAL RESOURCES

Education: M.A., Anthropology, University of California, Davis
B.A., Anthropology, California State University Long Beach, 1997
Registered Professional Archeologist

Experience/Technical Specialty:
Fourteen years. NEPA analysis, historic and archaeological resources studies, and Native American consultation.

SANDY B. ENYEART, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER, CHAPTERS 1 AND 2

Education: B.S., Civil Engineering, Georgia Institute of Technology
B.F.A., Art, Idaho State University

Experience/Technical Specialty:
Thirty-five years. Professional Engineer (Civil), Idaho. NEPA analysis, cumulative impacts, safety analyses, environmental monitoring, and water resources management and impact analysis.

JEFFREY FRAHER, DTRA
SWEIS RESPONSIBILITIES: TECHNICAL REVIEWER

Education: M.S., Aviation Science
B.S., Civil Engineering

Experience/Technical Specialty:
Twenty years. Environmental and civil engineering, with 12 years military operations.

MILTON E. GORDEN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: TRANSPORTATION, RISK ASSESSMENT

Education: B.S., Nuclear Engineering, North Carolina State University

Experience/Technical Specialty:
Twenty years. Waste management, transportation, human health impacts, socioeconomics, and environmental remediation technologies.

JOSEPH A. GRIESHABER, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: TECHNICAL ADVISOR

Education: MBA, Finance
M.S., Biology
B.S., Biology

Experience/Technical Specialty:
Thirty-five years. Includes 23 years of environmental management, NEPA documentation, and analysis on projects for Federal agencies. Specialties include socioeconomics, land use, and environmental justice.

ROBIN W. GRIFFIN, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Education: M.S., Environmental Management
B.A., English

Experience/Technical Specialty:
Thirteen years. NEPA analysis, socioeconomics, environmental justice, community services, and land use.

SETH HARTLEY, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: TECHNICAL REVIEWER FOR AIR QUALITY AND AFFECTED ENVIRONMENT AND TECHNICAL SUPPORT FOR AIR QUALITY ANALYSIS

Education: M.S., Atmospheric Sciences
B.S., Physics

Experience/Technical Specialty:
Eight years. Air pollution and air quality, particularly as related to transportation; general numerical modeling; engineering; and data handling and analysis issues.

SHARON HEJAZI, NEVADA SITE OFFICE
SWEIS RESPONSIBILITIES: SITE LEGAL REVIEW (NSO FEDERAL)

Education: B.S., Psychology, University of Utah
J.D., University of Utah

Experience/Technical Specialty:
Twenty-three years. Twenty-one years as a Federal attorney providing environmental counsel.

ROY KARIMI, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: TRANSPORTATION, RISK ASSESSMENT

Education: Sc.D., Nuclear Engineering, Massachusetts Institute of Technology
N.E., Nuclear Engineering, Massachusetts Institute of Technology
M.S., Nuclear Engineering, Massachusetts Institute of Technology
B.S., Chemical Engineering, Abadan Institute of Technology

Experience/Technical Specialty:
Thirty years. Nuclear power plant safety, risk and reliability analysis, design analysis, criticality analysis, accident analysis, consequence analysis, spent fuel dry storage safety analysis, and probabilistic risk assessment.

DAVID LECHEL, LECHEL, INC.
SWEIS RESPONSIBILITIES: SUMMARY PREPARATION

Education: M.S., Fisheries Biology, Michigan State University
B.S., Fisheries Biology, Michigan State University

Experience/Technical Specialty:
Thirty-seven years. Thirty-one years in management and preparation of NEPA documents (biological resources, cumulative impacts) and regulatory compliance; 6 years in ecological studies and assessment.

JOHN L. LEPPERT, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION
SWEIS RESPONSIBILITIES: STOCKPILE STEWARDSHIP

Education: B.S., General Engineering

Experience/Technical Specialty:
Forty years, plus 10 years active duty U.S. Air Force Civil Engineering, including duties as Base Chief of Engineering. Vertical and Horizontal Construction, over 30 years Civil Service, including assignments with the U.S. Army Corps of Engineers, Civil Works Department.

JAMIE MARTIN-NAUGHTON, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: GEOLOGY AND SOILS

Education: B.S., Geology-Biology

Experience/Technical Specialty:
Eight years. Geology and soils, aesthetics, cultural resources, and field research for environmental and NEPA-related projects.

STEVE MIRSKY, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: HUMAN HEALTH, INTENTIONAL DESTRUCTIVE ACTS, AND ACCIDENTS

Education: M.S., Nuclear Engineering, The Pennsylvania State University
B.S., Mechanical Engineering, Cooper Union

Experience/Technical Specialty:
Thirty-four years. Professional Engineer (Mechanical), Maryland. Safety analysis, nuclear power plant design, operations, foreign nuclear power plant system analysis, accident analysis, thermal hydraulics, shielding and dose assessment, and spent nuclear fuel dry storage safety analysis.

CYNTHIA ONG, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: TRAFFIC, ENVIRONMENTAL NOISE

Education: M.S., Environmental Sciences, Miami University
B.S., Civil Engineering, Purdue University

Experience/Technical Specialty:
Ten years. NEPA analysis, transportation, traffic, noise, stormwater, and utilities.

DOUGLAS A. OUTLAW, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
EIS RESPONSIBILITIES: HUMAN HEALTH LEAD, FACILITY ACCIDENTS LEAD, TECHNICAL EXPERT

Education: Ph.D., Nuclear Physics, North Carolina State University
M.S., Nuclear Physics, North Carolina State University
B.S., Nuclear Physics, North Carolina State University

Experience/Technical Specialty:
Thirty-two years. Nuclear physics, safety analysis, and risk assessment.

KIRK OWENS, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: TECHNICAL LEAD HUMAN ENVIRONMENT

Education: B.S., Environmental Resource Management, The Pennsylvania State University

Experience/Technical Specialty:
Thirty-two years. Radioactive waste management, regulatory analysis, environmental compliance and assessment, and radiological impacts assessment.

POLLY QUICK, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: TECHNICAL ADVISOR, VISUAL RESOURCES IMPACT ANALYSIS

Education: Ph.D., Anthropology
M.A., Anthropology
B.A., Anthropology

Experience/Technical Specialty:
Thirty-five years. NEPA analysis, aesthetics, cultural resources, and environmental justice.

BRIAN RAMOS, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: CULTURAL RESOURCES REVIEWER

Education: Ph.D., Anthropology, University of California, Davis

Experience/Technical Specialty:
Fourteen years. NEPA analysis, cultural resources, and environmental justice.

GARY ROLES, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: WASTE MANAGEMENT

Education: M.A., Nuclear Engineering, University of Arizona
B.S., Mechanical Engineering, Arizona State University

Experience/Technical Specialty:
Thirty-one years. Radioactive waste management, regulatory and compliance analysis, and NEPA analysis.

ANNE ROTHWEILER, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: PROJECT SUPPORT

Education: M.S., Environmental Science, University of Nevada, Las Vegas
B.S., Biology, University of Tulsa

Experience/Technical Specialty:
Nine years. Environmental Scientist. NEPA analysis, administrative record management, and cumulative impacts.

DEBBIE SHINKLE, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: GIS TEAM LEAD, RESOURCE AUTHOR FOR LAND USE

Education: B.A., Environmental Studies, University of Pittsburgh

Experience/Technical Specialty:
Nine years. NEPA analysis, land use, utilities, Geographic Information Systems (GIS) and mapping, and graphics.

STACEY SHUELER, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: GROUNDWATER RESOURCES

Education: B.S., Environmental Science, University of North Carolina at Wilmington

Experience/Technical Specialty:
Nine years. NEPA documentation, site remediation, wetlands, biological resources, water resources, and geology and soils.

MIKE SKOUGARD, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: ALTERNATIVES DEVELOPMENT, CUMULATIVE IMPACTS

Education: M.S., Botany
B.S., Law Enforcement

Experience/Technical Specialty:
Thirty years. NEPA analysis, biological resources, water resources, utilities and infrastructure, and Federal program and project management.

CARRIE STEWART, STOLLER-NAVARO
SWEIS RESPONSIBILITIES: MANAGEMENT SUPPORT

Education: M.A., Computer and Information Technologies, Webster University
M.A., Human Resources and Development, Webster University
B.S., Geology, California Polytechnic University, Pomona

Experience/Technical Specialty:
Twenty-two years. NEPA specialist and advisor.

JENNIFER LYN STOCK, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: VISUAL RESOURCES ANALYSIS

Education: B.S., Landscape Architecture, Pennsylvania State University, University Park

Experience/Technical Specialty:
Eleven years. Visual resources analyses for PEAs, EAs, Iss, EISs, and EIRs.

NEIL SULLIVAN, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: DEPUTY PROJECT MANAGER

Education: M.S., Integrated Environmental Management
B.S., Human and Physical Geography

Experience/Technical Specialty:
Fourteen years. NEPA documentation for infrastructure and energy projects, environmental program management, and technical and policy analysis.

NATE WAGNOR, ICF INTERNATIONAL
SWEIS RESPONSIBILITIES: VISUAL RESOURCES

Education: M.S., Human Dimensions of Ecosystem Science and Management
B.S., Natural Resources Integrated Policy and Planning

Experience/Technical Specialty:
Five years. Parks and recreation and visitor use characteristics.

GILBERT H. WALDMAN, SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
SWEIS RESPONSIBILITIES: HUMAN HEALTH – NORMAL OPERATIONS AND ACCIDENTS

Education: M.S., Engineering Management, Johns Hopkins University
B.S., Nuclear Engineering, University of Florida

Experience/Technical Specialty:
Eighteen years. Radiological impacts analysis, radiological dose modeling, and radiological risk assessments.

DEBRA A. WALKER, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: QUALITY ASSURANCE LEAD

Education: B.S., Biology

Experience/Technical Specialty:
Thirty-three years. NEPA analysis, biological resources, water resources, quality assurance/controls, and program and project management.

BRIAN M. WHIPPLE, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: SENIOR RESOURCE LEAD FOR HYDROLOGY, TECHNICAL GUIDANCE, METHODOLOGY, AND QA/QC REVIEWS

Education: M.S., Information Science
B.S., Environmental Engineering

Experience/Technical Specialty:
Sixteen years. NEPA analysis, environmental remediation, engineering studies, and regulatory compliance.

ANDREA WILKES, POTOMAC-HUDSON ENGINEERING, INC.
SWEIS RESPONSIBILITIES: INFRASTRUCTURE, ENERGY

Education: M.A., Science Writing, Johns Hopkins University
B.S., Civil and Environmental Engineering, University of Wisconsin-Madison
B.S., English Literature, University of Wisconsin-Madison

Experience/Technical Specialty:
Twenty-four years. Environmental engineering, science writing, and NEPA documentation and analysis.

KAREN E. WILLIAMS, U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION
SWEIS RESPONSIBILITIES: WSE-RELATED

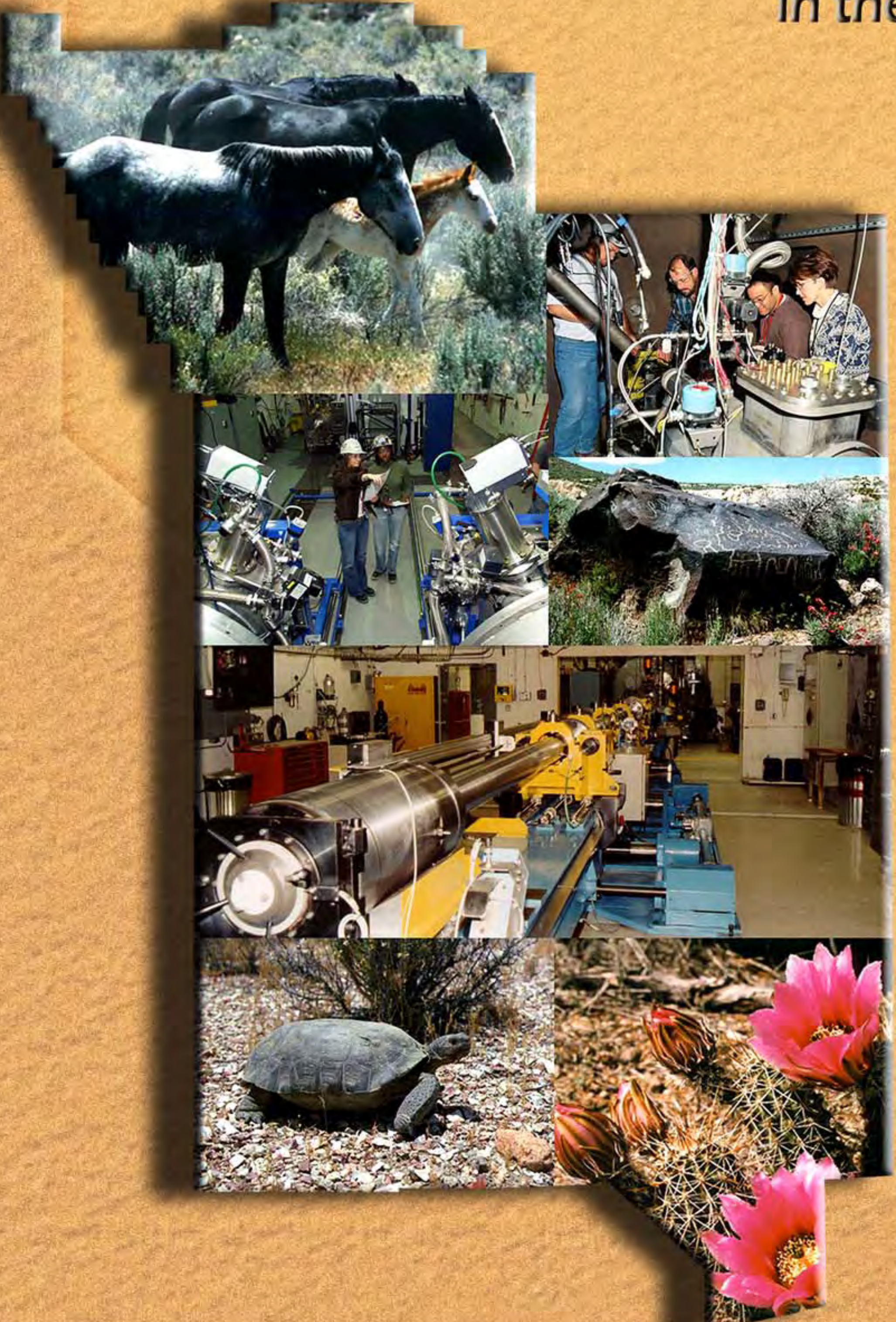
Education: B.A., Biology

Experience/Technical Specialty:
Thirty-three years. Radiological analysis (radiochemistry lab, Area 5 RWMS – low-level, transuranic, and mixed wastes).

DOE/EIS-0426D

Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada

Volume 2
(Appendices A through I)



U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

Availability of the Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/ National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)

For further information on this draft SWEIS, or to request a copy of the SWEIS or references, please contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518
Telephone: 702-295-0077
Fax: 702-295-5300
E-mail: nepa@nv.doe.gov

Printed with soy ink on recycled paper

COVER SHEET

Responsible Agency: U.S. Department of Energy/National Nuclear Security Administration

Cooperating Agencies: U.S. Air Force
U.S. Department of the Interior, Bureau of Land Management
Nye County, NV

Title: *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE/EIS-0426D)

Location: Nye and Clark Counties, Nevada

For additional information or for copies of this draft site-wide environmental impact statement (SWEIS), contact:

Linda M. Cohn, SWEIS Document Manager
NNSA Nevada Site Office
U.S. Department of Energy
P. O. Box 98518
Las Vegas, Nevada 89193-8518

Telephone: 702-295-0077
Facsimile: 702-295-5300
E-mail: nepa@nv.doe.gov

For general information on the DOE National Environmental Policy Act (NEPA) process, contact:

Carol M. Borgstrom, Director
Office of NEPA Policy and Compliance
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Telephone: 202-586-4600, or leave a message at 1-800-472-2756
Facsimile: 202-586-7031
E-mail: askNEPA@hq.doe.gov

Abstract: This *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)* analyzes the potential environmental impacts of proposed alternatives for continued management and operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site) and other U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA)-managed sites in Nevada, including the Remote Sensing Laboratory (RSL) on Nellis Air Force Base in North Las Vegas, the North Las Vegas Facility (NLVF), the Tonopah Test Range (TTR), and environmental restoration areas on the U.S. Air Force Nevada Test and Training Range. The purpose and need for agency action is to provide support for meeting NNSA's core missions established by Congress and the President, and to satisfy the requirements of Executive orders and comply with congressional mandates to promote, expedite, and advance the production of environmentally sound energy resources, including renewable energy resources such as solar and geothermal energy systems.

The NNSS has a long history of supporting national security objectives by conducting underground nuclear tests and other nuclear and nonnuclear activities. Since the October 1992 moratorium on nuclear testing, NNSA's primary mission at the NNSS has evolved from an active nuclear testing program to maintaining readiness and the capability to conduct underground nuclear weapons tests, if so directed by the President. Resources have been reallocated to introduce and expand other mission activities/programs at the NNSS, RSL, NLVF, and the TTR to support three DOE/NNSA core missions: National Security/Defense, Environmental Management, and Nondefense. The National Security/Defense Mission includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation and Counterterrorism, and Work for Others

Programs. The Work for Others Program supports other DOE programs and Federal agencies such as the U.S. Department of Defense, U.S. Department of Justice, and U.S. Department of Homeland Security. The Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. The Nondefense Mission includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

The NNSS, RSL, NLVF, and the TTR support DOE/NNSA's core missions by providing the capabilities to process and dispose of a damaged nuclear weapon or improvised nuclear device and to conduct high-hazard experiments involving special nuclear material and high explosives, non-nuclear experiments, and hydrodynamic testing. Nuclear stockpile stewardship activities at the NNSS include dynamic plutonium experiments that provide technical information to maintain the safety and reliability of the U.S. nuclear weapons stockpile and research and training in areas such as nuclear safeguards, criticality safety, and emergency response. Special Nuclear Materials are also stored at the NNSS. In addition, in accordance with the amended Record of Decision (ROD) (DOE/EIS-0243) for the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS*) , NNSA receives low-level and mixed low-level radioactive waste for disposal at the NNSS.

This *NNSS SWEIS* analyzes the environmental impacts of three reasonable alternatives for continued operations at the NNSS, RSL, NLVF, and the TTR during the 10-year period following the issuance of a ROD. These alternatives include a No Action Alternative and two action alternatives: Expanded Operations and Reduced Operations. The No Action Alternative, which is analyzed as a baseline for evaluating the two action alternatives, would continue implementation of the *1996 NTS EIS* ROD (DOE/EIS-0243) and subsequent amendments (61 FR 65551and 65 FR 10061), as well as other decisions supported by separate NEPA analyses completed since issuance of the final *1996 NTS EIS*. The No Action Alternative reflects activity levels consistent with those seen since 1996. The Expanded Operations Alternative would consider adding reasonably foreseeable new work at the NNSS in the areas of nonproliferation and counterterrorism, high-hazard and other experiments, research and development and testing. Such expanded operations could include developing test beds for concept testing of sensors, mitigation strategies, and weapons effectiveness. The Reduced Operations Alternative would reduce the overall level of operations and close specific buildings and structures. NNSA would also consider allowing the development of solar power generation facilities under each alternative.

Public Comments: DOE issued a Notice of Intent (NOI) in the *Federal Register* (74 FR 36691) on July 24, 2009, to solicit public input on the preparation of this Draft SWEIS. Comments received from the public during the scoping period (July 24, 2009 to October 16, 2009) have been considered in the preparation of this Draft SWEIS. Comments received after the close of the comment period also have been considered. Comments on this Draft SWEIS will be accepted following publication of the U.S. Environmental Protection Agency's Notice of Availability (NOA) in the *Federal Register* for a period of 90 days, and will be considered in the preparation of the Final SWEIS. Any comments received after the comment period will be considered to the extent practicable. Public meetings and locations will be identified at a later date.

TABLE OF CONTENTS

TABLE OF CONTENTS

Volume 2
Appendices A through I

Appendix A
Detailed Description of Alternatives

Appendix B
***Federal Register* Notices**

Appendix C
American Indian Assessment of Resources and Alternatives Presented in the SWEIS

Appendix D
Air Quality and Climate

Appendix E
Evaluation of Human Health Effects from Transportation

Appendix F
Biological Resources

Appendix G
Human Health Impacts

Appendix H
Underground Nuclear Testing

Appendix I
Contractor Disclosure Statements

LIST OF FIGURES

Appendix A

Appendix C

Appendix D

Appendix E

Appendix F

Appendix G

Appendix H

LIST OF TABLES

Appendix E

Appendix F

Appendix G

Appendix H

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

ACRONYMS, ABBREVIATIONS, AND CONVERSION CHARTS

AEGL	Acute Exposure Guideline Level
ARF	airborne release fraction
BEEF	Big Explosives Experimental Facility
CAS	corrective action site
CAU	corrective action unit
CEMP	Community Environmental Monitoring Program
CFR	*Code of Federal Regulations*
CH	contact-handled
D&D	decontamination and decommissioning
DAF	Device Assembly Facility
DAQEM	Department of Air Quality and Environmental Management
DART	days away from work, restricted duty, or transferred
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/NNSA	U.S. Department of Energy and the National Nuclear Security Administration
DOT	U.S. Department of Transportation
DPFF	Dense Plasma Focus Facility
DR	damage ratio
EA	Environmental Assessment
EDE	effective dose equivalent
EDMS	Emissions and dispersion Modeling System
EIS	environmental impact statement
EMAD	Engine Maintenance Assembly and Disassembly Facility
EODU	Explosives Ordnance Disposal Unit
EPA	U.S. Environmental Protection Agency
ERPGs	Emergency Response Planning Guidelines
FFACO	Federal Facility Agreement and Consent Order
FR	*Federal Register*
FRMAC	Federal Radiological Monitoring and Assessment Center
FY	fiscal year
GIS	geographic information system
HAP	hazardous air pollutant
HEST	High Explosive Simulation Technique
ICRP	International Commission on radiological Protection
IDLH	Immediately Dangerous to Life or Health
ISCORS	Interagency Steering Committee on Radiation Standards
ISO	International Organization for Standardization
JASPER	Joint Actinide Shock Physics Experimental Research
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LCF	latent cancer fatality

LLW	low-level radioactive waste
LPF	leak path factor
MAR	material at risk
MEI	maximally exposed individual
MLLW	mixed low-level radioactive waste
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NASA	U.S. National Aeronautics and Space Administration
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act of 1969
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NLVF	North Las Vegas Facility
NNSA	National Nuclear Security Administration
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NPTEC	Nonproliferation Test and Evaluation Complex
NRC	U.S. Nuclear Regulatory Commission
NRF	National Response Framework
NSO	Nevada Site Office
NTTR	Nevada Test and Training Range
NTS	Nevada Test Site
NNSS SWEIS	*Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada Test Site and Off-Site Locations in the State of Nevada*
OBODM	Open Burn/Open Detonation Model
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PM	particulate matter
rad	radiation absorbed dose
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RF	respirable fraction
RH	remote-handled
RNCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
ROD	Record of Decision
RSL	Remote Sensing Laboratory
RTG	radioisotope thermoelectric generator
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SGTs	safeguards transporters
SNM	special nuclear materials
STEL	Short-Term Exposure Limit
SWEIS	Site-Wide Environmental Impact Statement
TEELs	Temporary Emergency Exposure Limits

TLV	Threshold Limit Value
TNT	2,4,6-trinitrotoluene
TRC	total recordable cases
TRU	transuranic waste
TRUPACT	transuranic waste package transporter
TTR	Tonopah Test Range
UCVS	ultrafast closure valve system
UGTA	Underground Test Area
USAF	U.S. Air Force
VMT	vehicle miles traveled
VOC	volatile organic compound
Y-12	Y-12 National Security Complex
ZPPR	zero power plutonium reactor
ºC	degrees Centigrade
ºF	degrees Fahrenheit

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Hectares	2.471	Acres	Acres	0.40469	Hectares
Concentration					
Kilograms/square meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/square meter
Milligrams/liter	1 [a]	Parts/million	Parts/million	1 [a]	Milligrams/liter
Micrograms/liter	1 [a]	Parts/billion	Parts/billion	1 [a]	Micrograms/liter
Micrograms/cubic meter	1 [a]	Parts/trillion	Parts/trillion	1 [a]	Micrograms/cubic meter
Density					
Grams/cubic centimeter	62.428	Pounds/cubic feet	Pounds/cubic feet	0.016018	Grams/cubic centimeter
Grams/cubic meter	0.0000624	Pounds/cubic feet	Pounds/cubic feet	16,025.6	Grams/cubic meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F - 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cubic meters/second	2118.9	Cubic feet/minute	Cubic feet/minute	0.00047195	Cubic meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.315	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons

ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

APPENDIX A
DETAILED DESCRIPTION OF ALTERNATIVES

APPENDIX A
DETAILED DESCRIPTION OF ALTERNATIVES

This appendix contains detailed descriptions of the alternatives that are being evaluated by the U.S. Department of Energy National Nuclear Security Administration (DOE/NNSA) for continued operation of the Nevada National Security Site (NNSS) (formerly known as the Nevada Test Site), the Remote Sensing Laboratory (RSL) at Nellis Air Force Base, the North Las Vegas Facility (NLVF), and the Tonopah Test Range (TTR). Also addressed are environmental restoration sites located on the Nevada Test and Training Range (formerly the Nellis Air Force Range). Three alternatives are addressed in this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*: (1) the No Action Alternative, which represents the continuation of the levels of operations at the NNSS and offsite NNSA locations in Nevada; (2) the Expanded Operations Alternative, which includes the capabilities and projects described under the No Action Alternative, plus additional newly proposed capabilities and projects; and (3) the Reduced Operations Alternative, which reflects a reduction in the levels of operations for some programs, ceasing some activities, and limiting activities in some operational areas of the NNSS. This appendix provides additional technical content and detail to supplement the alternatives descriptions in Chapter 3. Section A.1 describes the No Action Alternative; Section A.2 describes the Expanded Operations Alternative; and Section A.3 describes the Reduced Operations Alternative.

Descriptions of the alternatives are organized under three mission areas, each with two or more associated programs. These missions and their associated programs are (1) the National Security/Defense Mission, which includes the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs; (2) the Environmental Management Mission, which includes the Waste Management and Environmental Restoration Programs; and (3) the

Terminology Used in this Site-Wide Environmental Impact Statement (SWEIS)

Missions. In this SWEIS, this term refers to the major responsibilities assigned to the U.S. Department of Energy (DOE) and the National Nuclear Security Administration (NNSA), which are described in this section. DOE and NNSA accomplish these missions by assigning groups or types of activities to DOE's system of national security laboratories, production facilities, and other sites.

Programs. DOE and NNSA are organized into Program Offices, each of which has primary responsibilities within the set of DOE and NNSA missions. Funding and direction for activities at DOE facilities are provided through these Program Offices, and similar coordinated sets of activities to meet Program Office responsibilities are often referred to as "programs," which are usually long-term efforts with broad goals or requirements.

Capabilities. This term refers to the combination of facilities, equipment, infrastructure, and expertise necessary to undertake types or groups of activities and implement mission assignments. Capabilities at NNSA facilities in Nevada have been established over time, principally through mission assignments and activities directed by Program Offices.

Projects. This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to large (such as a project to construct and start up a new nuclear facility). Projects are usually relatively short-term efforts, and they can cross multiple programs and missions, although they are usually "sponsored" by a primary Program Office. In this SWEIS, the term is usually used more narrowly to describe construction activities, including facility modifications (such as a project to build a new office building or to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at NNSA facilities in Nevada over about a 10-year period are discussed and analyzed in this SWEIS.

Activities. In this SWEIS, this term is used to describe physical actions used to implement missions, programs, capabilities, or projects.

Nondefense Mission, which includes the General Site Support and Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs.

For each of the proposed alternatives, mission-related capabilities, projects, activities, and facilities are identified.

The alternatives evaluated in this *NNSS SWEIS* comprise missions, programs, capabilities, and projects for which activities are currently in progress and/or future activities are proposed. Current activities include those that are ongoing or for which the capability is being maintained by NNSA. In evaluating the impacts of the projects and activities that make up the alternatives, the most reliable data are derived from current activities. Proposed projects are those that NNSA expects would be implemented over the next 10 years.

The projects proposed under the three alternatives have generally undergone sufficient conceptual development to allow a reasonable assessment. Those that have not been sufficiently defined to allow a reasonable assessment are noted in the text and will require further National Environmental Policy Act (NEPA) analysis should NNSA decide to implement them.

A.1 No Action Alternative

As defined in this *NNSS SWEIS,* the No Action Alternative reflects the use of existing facilities and ongoing projects to maintain operations consistent with those experienced in recent years at the NNSS and offsite locations in Nevada. For each mission area and its supporting programs, levels of operations for associated capabilities and projects were determined by evaluating historic absolute values since 1996, such as the amount of low-level radioactive waste (LLW) disposed through mid-2010; reasonable expectations for implemented projects, such as the number of projected shots for the Large-Bore Powder Gun; or the nature and number of proposed activities, such as training undertaken for the Office of Secure Transportation. For example, in 2004 and 2006, NNSA conducted 8 experiments with plutonium at the Joint Actinide Shock Physics Experimental Research Facility (JASPER); under the No Action Alternative, NNSA is analyzing up to 12 such experiments at JASPER. The operational level for disposal operations of LLW under the No Action Alternative is based on the volume of LLW disposed at the NNSS during Fiscal Years (FY) 1997 through 2010. The No Action Alternative level of operations represents the baseline against which the other alternatives are compared. In the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (*1996 NTS EIS*) (DOE 1996), NNSA identified land use zones in which certain categories of activities, such as nuclear, dynamic, and hydrodynamic experiments and other compatible defense and nondefense research and development and testing, would be conducted. **Figure A–1** depicts these land use zones and the major facilities at the NNSS that would continue under the No Action Alternative.

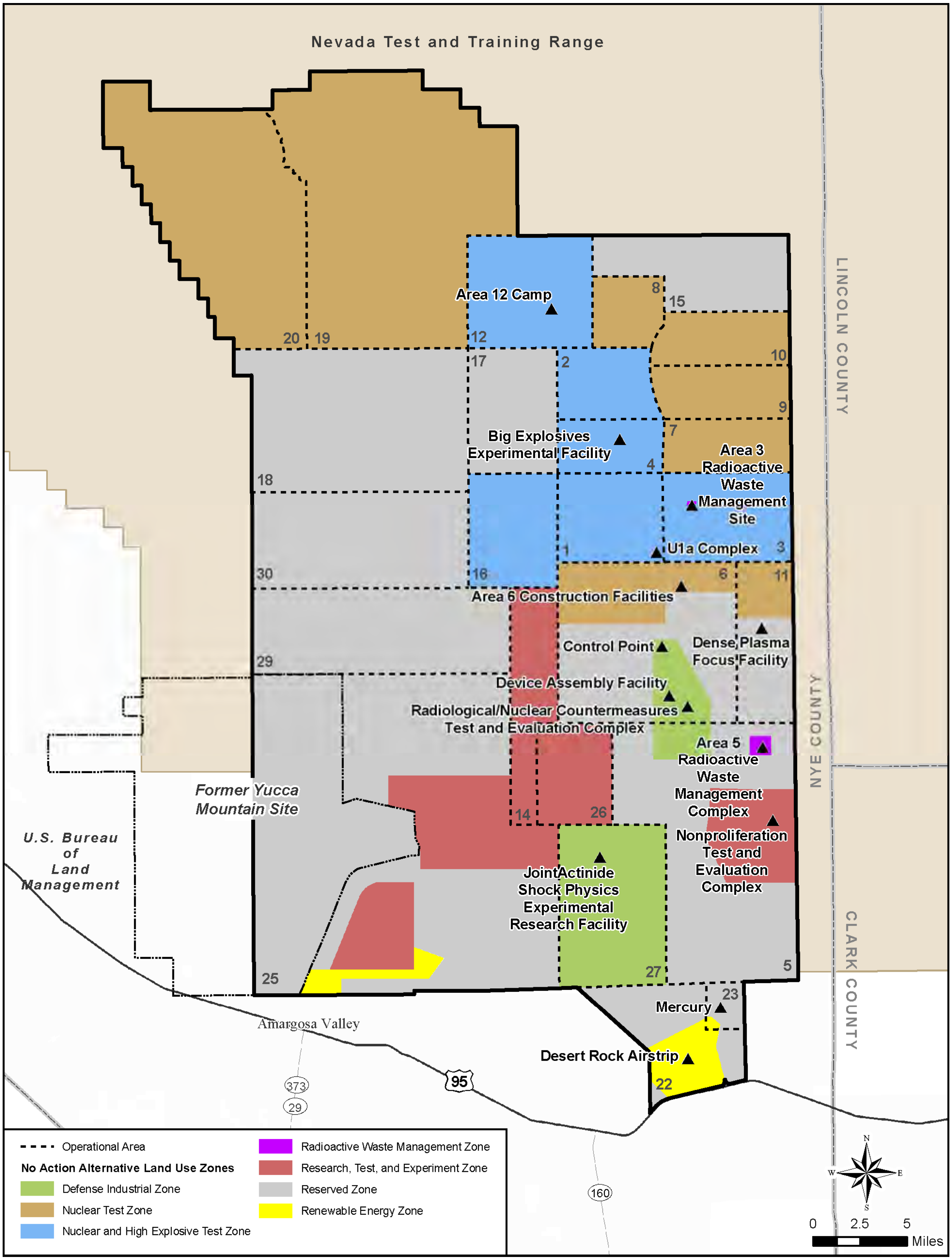


Figure A–1 Nevada National Security Site Land Use Zones and Major Facilities Under the No Action Alternative

A.1.1 National Security/Defense Mission

Under the No Action Alternative, NNSA would continue to pursue the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs. Projects and activities managed under these programs are described in the following sections.

A.1.1.1 Stockpile Stewardship and Management Program

As part of its National Security/Defense Mission, NNSA is tasked with strengthening national security through the military application of nuclear energy and reducing the global threat from terrorism and weapons of mass destruction. The NNSA Stockpile Stewardship and Management Program supports national security by providing the following capabilities:

- Maintenance of a safe, secure, and reliable nuclear weapons stockpile to ensure the security of the United States and its allies, deter aggression, and support international stability
- Maintenance of a fully capable, agile, responsive nuclear weapons complex infrastructure to continue to support the nuclear weapons stockpile and to be prepared for an uncertain and evolving threat environment
- Research and development activities to ensure U.S. leadership in science and technology (DOE 2006)

Special Nuclear Material (SNM) and Security Categories

SNM is (1) plutonium, uranium-233, uranium enriched in isotopes of uranium-233 or -235, and any other materials that the U.S. Nuclear Regulatory Commission determines to be SNM, or (2) any material artificially enriched by any of these radioactive materials.

The U.S. Department of Energy (DOE) uses a graded approach to provide SNM safeguards and security. Quantities of SNM stored at each DOE site are categorized into Security Categories I, II, III, and IV, with the greatest quantities included under Security Category I, and lesser quantities included in descending order under Security Categories II through IV.

The term "stockpile stewardship" refers to core competencies in activities associated with research, design, development, and testing of nuclear weapons components, as well as the assessment and certification of their safety and reliability. NNSA's science-based Stockpile Stewardship and Management Program maintains and enhances the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test weapons, to meet national security requirements. Stockpile stewardship and management activities at NNSA facilities in Nevada are conducted via a variety of methods, including experiments involving special nuclear material (SNM) and explosives, including high explosives (either in combination or separately), shock physics, nuclear criticality, pulsed power, and plasma physics and nuclear fusion. Under the No Action Alternative, diagnostics and other instrumentation would be developed and used in related tests and experiments. In addition, NNSA would conduct drillback operations; support Office of Secure Transportation training; and, as necessary, disposition damaged U.S. nuclear weapons. Major facilities at the NNSS where these activities are performed include the Device Assembly Facility (DAF), the U1a Complex, the Big Explosives Experimental Facility (BEEF), and JASPER. NNSA also conducts stockpile stewardship and management activities at the TTR.

Stockpile stewardship and management activities would continue at NNSA facilities in Nevada, particularly at the NNSS, under the conditions of the ongoing nuclear testing moratorium. These activities would emphasize science-based stockpile stewardship and management tests, experiments, and activities to maintain the safety and reliability of the nuclear weapons stockpile without underground nuclear testing. Historically, the primary mission of the NNSS was to conduct nuclear weapons tests. With the current moratorium on testing that began in October 1992, this mission changed to maintaining a readiness to conduct nuclear tests. For this reason, the No Action Alternative includes those activities necessary to maintain the capability to conduct nuclear tests if so directed by the President. Readiness-to-test activities include maintaining the necessary infrastructure and, more importantly, exercising the research and engineering disciplines of the Nation's nuclear weapons program through an active science-based Stockpile Stewardship and Management Program at the NNSS to ensure the continued competence of its technical staff. As part of its readiness-to-test activities, NNSA would conduct training and exercises using various kinds of nuclear weapon simulators.

In addition to maintaining the capability to conduct nuclear weapon tests and in support of stockpile stewardship and management, NNSA would perform a variety of activities under the No Action Alternative, as described below:

Dynamic experiments – Dynamic experiments include subcritical and hydrodynamic experiments. Subcritical experiments, a subset of dynamic plutonium experiments, use SNM coupled with explosives or explosive-driven flyer plates or impactors. These experiments would be conducted in alcoves at the U1a Complex, in unused nuclear test emplacement holes, or at other locations within the Nuclear Test and Nuclear and High Explosives Test Zones of the NNSS, which include all or parts of Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 16, 19, and 20.

Initially, subcritical experiments were conducted in alcoves in the U1a Complex that were designed and constructed to contain the detonation of explosives and contamination resulting from SNM used in the experiments. Following execution of these experiments, the alcoves were sealed and considered "expended." Since 1996, the operational concept for subcritical experiments has changed to include other methods. Lawrence Livermore National Laboratory (LLNL) introduced vessels to contain subcritical experiments that allowed multiple experiments to be conducted in a single alcove, and Los Alamos National Laboratory (LANL) introduced racklettes (small cylindrical racks), which are lowered into vertical emplacement holes within an alcove in the U1a Complex, and has also used vessels in a manner similar to LLNL. Subcritical experiments have been performed outside of the U1a Complex in vertical emplacement holes using racklettes similar to, but smaller than, the canisters used for underground nuclear testing. Experiments involving SNM are designed and conducted in a manner that contains the SNM and prevents release of contamination to an uncontrolled environment. This is accomplished by using a specially prepared alcove at the U1a Complex, stemming (engineered backfilling) emplacement holes, using a containment vessel, or a combination of these methods.

Hydrodynamic tests, which do not include SNM, may be conducted in the open air or underground, and may be contained or uncontained. Hydrodynamic tests and experiments would be conducted within some of the same areas as subcritical tests and other experiments (see the following discussion regarding conventional explosives tests and experiments).

Under the No Action Alternative in this site-wide environmental impact statement (SWEIS), 10 dynamic tests and experiments per year were evaluated over about a 10-year period. Over the next 10 years, a total of 5 dynamic experiments would be conducted in emplacement holes with each such experiment causing an estimated 20 acres of new land disturbance.

Conventional explosives experiments – Experiments using conventional explosives would continue to be conducted at BEEF and other locations in the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, and 16). These experiments would use up to 70,000 pounds TNT [2,4,6-trinitrotoluene]-equivalent of explosive charges per experiment and may be conducted at or above the ground surface or underground. Experiments within the BEEF operational area would include potentially hazardous materials, such as beryllium, depleted uranium, deuterium, and tritium. Conventional explosives experiments would support activities for the Stockpile Stewardship and Management Program (other conventional explosives operations are described below for the Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs). Under the No Action Alternative, up to 20 conventional explosives experiments would be conducted each year at BEEF, and up to 10 per year would be conducted at other locations at the NNSS. The experiments would consist of both open-air and contained (no release to the atmosphere) research and diagnostic experiments using a variety of explosive compounds. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*. These totals do not include the dynamic experiments discussed above.

Shock physics experiments – Shock physics experiments are a subset of dynamic experiments, but are not included in the dynamic experiments described above. There are two shock physics facilities at the NNSS: JASPER in Area 27, which uses a two-stage gas gun and is currently operational and the U1a Complex in Area 1, which uses a Large-Bore Powder Gun and is currently in development.

The basic concept of a gas gun is to use high-pressure gas to propel a projectile into a target at extremely high velocities. The JASPER gas gun is specifically designed to conduct research on plutonium and other actinides and surrogate materials as targets. The two-stage gas gun consists of a first-stage breech containing gunpowder and a chamber filled with helium, hydrogen, or argon (nitrogen is used as a purge gas), as well as a second-stage evacuated barrel for guiding the high-velocity projectile to the target. Hot gases from the burning propellant drive a heavy piston down the pump tube, compressing the gas. At sufficiently high pressures, the gas eventually breaks a rupture valve and enters the narrow barrel, propelling a projectile housed in the barrel toward the target, which is contained within a primary target chamber. The primary target chamber is designed to contain the experiment and prevent release of contaminants to the environment. For experiments using SNM, an ultrafast closure valve system traps debris, particles, and gases, including radioactive contaminants, within the primary target chamber after the projectile enters. When the projectile hits the target, it produces a high-pressure shock wave. In a fraction of a microsecond, the shock wave reverberates through the target. Triggered by the initial wave, diagnostic equipment measures the properties of the shocked material inside the target during this extremely brief period. The target is disintegrated by the impact of the projectile, but is contained within the primary target chamber. The primary target chamber is placed within a secondary confinement chamber prior to execution of the experiment. The secondary confinement chamber is designed and constructed to prevent release of SNM contamination to an uncontrolled environment. The data from these experiments are used by the national laboratories to refine the computer codes used to certify the U.S. nuclear stockpile. Up to 12 SNM shots per year using actinide targets would be conducted at JASPER under the No Action Alternative. Additional operations of the two-stage gas gun would be conducted without SNM for other experiments and to calibrate and evaluate the equipment.

There are two major project elements of the Large-Bore Powder Gun Project. The first is establishment of a development alcove in the U1a Complex and completion of engineering testing necessary to finalize designs. The second element is preparation of the actual test bed for the Large-Bore Powder Gun, which would be in an existing alcove in the U1a Complex and would be designed for conducting subcritical experiments using SNM. Once operational, the Large-Bore Powder Gun would use a powder charge to propel a projectile into a target within a confinement vessel. It operates at lower velocities than JASPER and uses a larger-diameter projectile and a larger target. The Large-Bore Powder Gun could also be used for experiments with materials other than SNM. These experiments would be designed to investigate the properties of SNM and enhance the understanding of the plutonium equation of state and constitutive models for plutonium alloys. Models would be used to perform higher-fidelity simulations of weapons performance. SNM experiments would be conducted using the Large-Bore Powder Gun firing into a single-use confinement vessel with a fast closure valve designed to confine SNM and avoid contamination of the alcove. The alcove would serve as a secondary confinement chamber for the Large-Bore Powder Gun. For experiments containing SNM, the confinement vessels would be entombed within the U1a Complex after the target is expended. The Large-Bore Powder Gun would be used to conduct a series of up to 10 subcritical experiments per year. Additional operations would be conducted without SNM for other experiments and to calibrate and evaluate the equipment.

Criticality experiments, training, and other activities – These activities were formerly performed at Technical Area 18 at LANL in New Mexico, but were moved to DAF after the December 5, 2002, Record of Decision (ROD) for the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (67 *Federal Register* [FR] 79906). As part of the relocation of these activities, critical assemblies and associated Category I/II SNM were relocated from LANL to the NNSS. Criticality experiments provide information on nuclear criticality control and understanding of chain reacting systems needed to support nuclear safety and U.S. national security in the broadest sense. This encompasses both national defense and energy policy. To accomplish this objective, the following activities would be carried out:

- Experiments below critical levels (subcritical), in the delayed critical region, and super-prompt critical (pulsed-power) region
- Support for nuclear emergency and accident response programs, as well as programs established to respond to national and international terrorism
- Development of safeguards and arms control methods and technology to detect and control nuclear materials
- Training in support of all the above activities
- Activities to maintain the capability to respond to future criticality accidents or nuclear-materials-handling or -control situations that cannot be understood without special experiments

Critical Assembly

A critical assembly is a machine used to manipulate a mass of fissile material (uranium-233, uranium-235, plutonium-239, plutonium-241, or neptunium-237) with or without a moderator in a specific proportion and shape. The critical assembly can be gradually built up by adding additional fissile material and/or a moderator until this system achieves the dimensions necessary for a criticality condition.

The capability to conduct criticality experiments provides a means to measure and evaluate integral cross sections, perform accident simulation, and develop nuclear instruments, dosimetry, and protocols for the detection and characterization of nuclear material. Under the No Action Alternative, NNSA would conduct up to 500 criticality operations within DAF each year for experiments, training, and other purposes in support of the Stockpile Stewardship and Management and Work for Others Programs.

Criticality experiments would initially be conducted using the refurbished or replaced critical assemblies relocated from Technical Area 18 at LANL to DAF. Four Category I/II SNM critical assembly machines are required to support NNSA's criticality-related activities:

- A general-purpose, vertical-lift table machine is used for training and initial assembly of new experiments. Vertical-lift machines are ideal for this purpose because the stored energy for disassembly is provided by gravity. At the present time, the Planet machine provides this capability.

- A fast-neutron spectrum benchmarked assembly is used for validation of calculation methods, basic measurements of nuclear data of interest to defense and nuclear nonproliferation programs, and training. At the present time, the Flattop assembly serves this purpose.

- A pulse assembly is used to validate dynamic weapons models, verify the function of criticality alarm systems to a fast transient, calibrate detectors, and validate radiation dosimetry. The Godiva assembly provides this function at the present time

- A large-capacity, general-purpose, vertical table machine is used to accommodate benchmark experiments designed to explore unknowns. The Comet machine is used for this purpose.

In the future, NNSA may need to expand its criticality experiments capability to include other experimental machines capable of using security Category I SNM, such as a general-purpose, horizontal split table designed for large experiments that cannot be accommodated on a vertical-lift split table, as well as a low-temperature (cryogenic) critical assembly machine designed to evaluate potential space reactor applications. Potential acquisition of these or any other new critical assembly machines is not included under the proposed actions; thus, their operation is not analyzed in this *NNSS SWEIS*.

Pulsed-power experiments – The Atlas Facility's Pulsed-Power Machine was moved to Area 6 of the NNSS from LANL in 2004 following publication of the *Atlas Relocation and Operation at the Nevada Test Site Final Environmental Assessment* (DOE/EA-1381) (NNSA 2001) and issuance of a Finding of No Significant Impact on May 30, 2001. Experiments that provide the high-quality, high-energy density hydrodynamics data needed to validate new Accelerated Scientific Computing Initiative codes for the Stockpile Stewardship and Management Program would be conducted at the Atlas Facility. Computer models based on such codes would be used to certify the safety and reliability of the Nation's nuclear stockpile, as part of the NNSA Stockpile Stewardship and Management Program. Experiments in support of basic research in nondefense areas would also be conducted at the Atlas Facility.

The physical environments produced at the Atlas Facility enable a wide range of safe, highly precise, reproducible, and controllable experiments. The extreme conditions of high-energy density, strongly coupled plasmas, and high magnetic fields aid in the understanding of planetary physics, condensed-matter physics, fusion-energy research, and astrophysics.

The Atlas Facility is designed to perform pulsed-power experiments on macroscopic targets; that is, targets that are larger than those possible when using lasers and other currently available diagnostic equipment. Larger targets approximately a cubic centimeter in size make measurement easier and allow the investigation of physical phenomena that cannot be scaled down to smaller sizes without affecting parameters of importance. The Atlas Facility's Pulsed-Power Machine is designed to deliver a pulse of very high electrical current through a high-precision cylindrical metal liner that surrounds the sample of interest. The electrical current produces a brief but powerful magnetic force on the liner, which implodes upon the sample. For hydrodynamic experiments, the Pulsed-Power Machine would deliver 25 to 30 mega-amperes to an imploding liner, which would reach velocities of over 15 centimeters per microsecond with final kinetic energies of 2 to 5 megajoules. Pressures of up to 20 megabars could be achieved, depending on the design of the experiment. Under the No Action Alternative, the Atlas Facility would be maintained in a standby status with the capability to conduct up to 12 pulsed-power experiments per year.

Plasma physics and fusion experiments – Using the OneSys Dense Plasma Focus Machine, located in Area 11 of the NNSS, and the Gemini Dense Plasma Focus Machine, located at NLVF, NNSA would conduct plasma physics and fusion experiments under the No Action Alternative. These machines cause fusion (the process the Sun uses to create energy) by compressing and heating a gas. Both machines support Stockpile Stewardship and Management Program experiments and the Work for Others Program with the Defense Threat Reduction Agency and the U.S. Department of Homeland Security (DHS). These Dense Plasma Focus Machines are flexible and powerful scientific tools. They can be configured to investigate plasma physics and to cause nuclear fusion (i.e., joining light atomic nuclei to release energy, in contrast to nuclear fission, the splitting of heavy atomic nuclei to release energy). The most frequently used fusion processes involve combining (fusing) two atoms of hydrogen-2 (deuterium) to form helium-3 and an energetic neutron and fusing deuterium and hydrogen-3 (tritium) to form helium-4 and an energetic neutron. The neutron radiation is emitted in a short, intense pulse. The OneSys machine uses a deuterium-tritium source and the Gemini machine uses a deuterium-deuterium source. Both machines generate approximately 10^{12} neutrons per pulse. Because initiation of the fusion process requires a large electrical current, capacitor banks are used to store electrical energy (up to 1 million joules) at voltages up to 70,000 volts. Safety, radiation exposure protection, and emission control are ensured through administrative controls and redundant engineered systems, including use of coated lead. Up to 650 plasma physics and fusion experiments would be conducted yearly under the No Action Alternative: 50 in Area 11 of the NNSS and 600 at NLVF.

Drillback operations – Also known as "post-shot drilling," drillback operations were performed routinely when underground nuclear tests were conducted at the NNSS. Drillback operations provide essential data on the results and post-shot underground environment of the underground nuclear test. Post-shot drilling provided the means for obtaining samples from the explosion cavity region for radiochemical analysis and determining the size of the collapse chimney, the effects of the explosion on the surrounding medium, and the distribution of radioactivity in the cavity area. Drillback activities have been conducted since the end of underground nuclear testing as a means of exercising the capability to do such drilling (maintenance of capability) and to obtain data for groundwater studies. Drillback activities include standard directional or slant drilling using equipment and monitoring/warning devices and procedures to prevent a release of radioactivity to an uncontrolled environment from the drilling activity. NNSA estimates that up to five drillback operations would take place under the No Action Alternative over the next 10 years. Each drillback project would be conducted in the area of a former underground nuclear test location and would disturb approximately 5 acres of land.

Stockpile management activities – Stockpile management activities are the hands-on, day-to-day functions and activities involved in maintaining an enduring nuclear weapons stockpile, including assembly, disassembly, modification, and maintenance of nuclear weapons; quality assurance testing of weapons components; and interim storage of nuclear weapons and components.

NNSA would conduct some or all of the following stockpile management activities at the NNSS under the No Action Alternative:

Disposition of damaged U.S. nuclear weapons – A damaged U.S. nuclear weapon would be transported to the NNSS, where it would be evaluated for further action, which could involve repair or disposition. Activities associated with repair would include full or partial disassembly of the damaged weapon, repair or replacement of damaged parts, and reassembly of the weapon. If the weapon were damaged beyond repair, it would be disassembled and its component parts prepared for shipment. Following completion of this work, the weapon or its component parts would be transported to the Pantex Plant or another appropriate NNSA facility.

Nuclear Weapon Pit

The pit is the central core of a nuclear weapon containing plutonium-239 and/or highly enriched uranium that undergoes fission when compressed by high explosives. The pit and the high explosive are known as the "primary" of a nuclear weapon.

Storage and staging of nuclear devices – Nuclear devices would be staged (i.e., programmatic material, such as SNM or other materials, would be stored in a safe and secure manner until needed in a test, experiment, or other activity; staging does not include storage of material with no reasonable expectation of use in the foreseeable future) at DAF pending an underground nuclear test, if so directed by the President. Nuclear weapons training devices would be staged at DAF as part of readiness training and exercises.

Assembly and disassembly of nuclear devices – NNSA would conduct assembly/disassembly operations on nuclear devices associated with an underground nuclear test, if so directed by the President. Nuclear weapons training devices also would be assembled/disassembled as part of readiness exercises and training.

Staging of SNM, including nuclear weapon pits – SNM would be staged at the NNSS for operational purposes associated with dynamic experiments, pulsed-power experiments, criticality experiments, and other activities. All SNM would be staged and used in strict compliance with all applicable requirements.

Training for the Office of Secure Transportation – Through its Office of Secure Transportation, NNSA safely and securely transports nuclear weapons, weapons components, and SNM to meet projected NNSA, U.S. Department of Defense (DoD), and other customer requirements. These shipments are highly guarded to provide the utmost protection of the public and U.S. national security. Throughout their careers, the Federal agents who do this work are given in-service training to defend, recapture, and recover nuclear materials in case of an attack. This training also includes preparing the agents for disruptive demonstrations by activist or other kinds of groups or armed attacks. The Office of Secure Transportation would use existing infrastructure at the NNSS to conduct training and exercises to maintain and improve the skills of its agents to safely and securely transport nuclear weapons, weapons components, and SNM. Training would include convoy activities on existing NNSS roads and adjacent off-road areas using weapons simulators and live-fire exercises at various locations on the NNSS. These activities would occur up to six times each year.

TTR operations – The primary mission of NNSA at the TTR is to ensure that U.S. nuclear weapons systems meet the highest standards of safety and reliability. In addition, Work for Others Program activities are conducted at the TTR. NNSA activities at the TTR are conducted under the conditions set forth in a land use permit from the U.S. Air Force (USAF) and are the responsibility of the Sandia Site Office, located in Albuquerque, New Mexico. Certain TTR activities that were included in the *1996 NTS EIS* ROD (61 FR 65551) (seismic verifications, hazardous burn-test operations, chemical effects testing of stockpile weapons, and thermal testing) are no longer conducted. Under the No Action Alternative, NNSA would use the TTR for the following stockpile stewardship and management tasks:

- Tests and experiments, including flight test operations for gravity weapons (bombs), would be conducted to ensure the compatibility of the hardware necessary for the interface between weapons and delivery systems and to assess weapon system functions in realistic delivery conditions. NNSA does not expect to use Category I/II SNM in flight tests.
- Impact testing would be conducted to test various parameters of a weapon while in flight or when dropped, including penetration of the ground surface. Weapons tested would include joint test assemblies and conventional and inert projectiles. For joint test assemblies and nuclear projectiles, a portion of the nuclear package would be omitted, making them incapable of achieving criticality and producing a nuclear detonation. Impact tests would include the following:
    - Air drop operations – Delivery of any test asset (i.e., gravity bomb, air-dropped sensor package, parachute deployment system, etc.) from an airborne platform
    - Ground/air-launched rocket operations
    - Ground/air-launched missile operations
    - Compressed-air gun operations
    - Davis Gun operations
    - Fuel-air explosives operations

- Open-air and underground detonation of explosives
- Post-test procedures and recovery operations

- Passive tests using high-resonance energy, lasers, and ultrasound techniques would be conducted to check the systems in joint test assemblies and conventional weapons. Tests would also be conducted in support of nonproliferation research to develop equipment and techniques for determining whether other countries are using or developing nuclear capabilities. Passive tests would include the use of the following:
  - Telemetry, microwave, and photometric operations
  - Radar operations
  - Laser tracker operations
  - Radiographic operations
  - Electromagnetic radiation testing

Although not listed under the Work for Others description in Section A.1.1.3, all of these Stockpile Stewardship and Management Program activities are similar to activities that may be conducted under the Work for Others Program at the TTR.

A.1.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

Although no land area is specifically dedicated to Nuclear Emergency Response Program activities, NNSA facilities in Nevada provide a broad support base for those activities, including a variety of areas and facilities that may be used for training and exercise activities. Under the No Action Alternative, NNSA would provide support for the following Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program activities:

- Personnel and logistical support for the Nuclear Emergency Support Team at RSL. The Nuclear Emergency Support Team provides specialized technical expertise in resolving nuclear or radiological terrorist incidents. NNSA assists the Federal Bureau of Investigation or U.S. Department of State in conducting, directing, and coordinating search and recovery operations for nuclear materials, weapons, or devices, and assists in identifying and deactivating an improvised nuclear device or a radiological dispersal device. Nuclear Emergency Support Team activities would also occur at the NNSS and other locations. This ongoing program provides search teams and equipment as required to respond to a nuclear/radioactive material dispersal event.

- Support would be provided for consequence management, including personnel with technical expertise from RSL. As part of this support, NNSA would continue to manage early-phase activities and provide personnel to staff the Federal Radiological Monitoring and Assessment Center (FRMAC). FRMAC coordinates the efforts of 17 agencies to integrate the Federal response to a radiological emergency within the United States. DOE's responsibility is to set up and initially manage FRMAC and NNSA provides the Consequence Management Response Team, which draws from NNSA Emergency Response Assets, including the Radiological Assistance Program and Aerial Measuring Systems. The Phase 1 Consequence Management Response Team is deployed from among NNSA Nevada Site Office (NNSA/NSO) assets. FRMAC is supported through activities at various locations in the United States, as required for training and/or response to a radiological emergency.

- Fixed-wing and rotary-wing aircraft would be provided for emergency response and aerial mapping activities as part of the Aerial Measuring System. The Aerial Measuring System provides rapid response to radiological emergencies with helicopters and fixed-wing aircraft equipped to detect and measure radioactive material. In addition, the Aerial Measuring System surveys DOE sites, participates in interagency exercises, and performs work for other Federal agencies. Aerial Measuring System can also provide detailed aerial photographs and multi-spectral imagery and analyses. The system is housed at and supported by RSL, and activities are conducted at various offsite locations.

- Personnel and logistical support would be provided to the Accident Response Group. The Accident Response Group develops and maintains readiness to efficiently manage the resolution of accidents or significant incidents involving nuclear weapons that are in DOE or DoD custody. The Accident Response Group's role in an emergency situation involving a nuclear weapon includes initial onsite assessment; evaluations to ensure the safety and health of emergency response personnel, the public, and the environment; weapon recovery; and support for onsite radiological monitoring, analysis, and assessment.

- Logistical support would be provided to the Radiological Assistance Program. The Radiological Assistance Program is a first-response resource that assesses a radiological emergency, conducts the initial radiological assessment of the area of the emergency, and provides assistance to minimize immediate radiation risks. The Radiological Assistance Program also provides emergency response training to first responders and is involved in the Weapons of Mass Destruction First Responder Training Program. The Radiological Assistance Program is implemented on a regional basis, with eight Regional Coordinating Offices in the United States. NNSA/NSO is part of Region 7, which is headquartered in Oakland, California.

- Weapons of mass destruction emergency responder training would be provided.

- Equipment and technical support would be provided to NNSA for the DOE-dedicated Emergency Communications Network.

- NNSA would disposition improvised nuclear devices on an as-needed basis at appropriate locations at the NNSS. This activity would include initial evaluation of an improvised nuclear device and, if considered safe to do so, disassembling the device. Throughout the disassembly process, the improvised nuclear device components would be turned over to the Disposition Forensics Program. The Disposition Forensics Program is an extension of the Disposition Program, and its function is to conduct forensics activities on an improvised nuclear device. Existing NNSS facilities would be used for staging, handling, and forensic analysis of improvised nuclear devices and their components. Training drills and exercises also would be conducted at the NNSS to maintain the readiness capability of the Disposition and Disposition Forensics Programs.

Nuclear Forensics

Nuclear forensics is the analysis of nuclear materials recovered from either the capture of unused materials or the radioactive debris following a nuclear explosion. Nuclear forensics can contribute significantly to the identification of the sources of the materials and the industrial processes used to obtain them. In the case of an explosion, nuclear forensics can also reconstruct key features of the nuclear device (AAAS 2008).

The Federal Bureau of Investigation has lead responsibility for nuclear forensics in response to a radiological event within the United States. However, for the most part, the scientific expertise and laboratory facilities for nuclear forensics and the assets for collection and storage of radiological samples reside in the DOE complex.

The NNSS has unique facilities and capabilities for staging, as well as experimentation with, nuclear materials and would provide a centralized location where currently dispersed nuclear forensics capabilities would be integrated. The Federal Bureau of Investigation Disposition Forensics Program would deploy a small number of personnel to the NNSS for training and exercises or for an actual incident, as needed. All activities would take place in existing facilities at the NNSS.

- Nonproliferation- and counterterrorism-related activities would continue in the areas of: (1) arms control (see below), (2) nonproliferation, (3) nuclear forensics (discussed above), and (4) counterterrorism. Nonproliferation- and counterterrorism-related activities would provide scientific research and development, technology realization, process and procedure development, equipment testing and certification, and training that support these areas. The kinds of activities that would be involved in supporting nonproliferation and counterterrorism include use of underground detonations of conventional explosives for seismic studies, releases of chemical and biological simulants, geological studies, and experiments to simulate radio frequencies resulting from various nuclear fuel cyle technologies. These activities are addressed in more detail in Section A.1.1.3. Activities supporting U.S. nonproliferation and counterterrorism efforts would occur at RSL and NLVF, but would primarily be conducted at the NNSS.

  The primary goal of the nonproliferation- and counterterrorism-related activities would be to integrate development, testing, and validation of technologies applied to control the spread of weapons of mass destruction, particularly those that are nuclear. This goal would be a platform for collaboration among a diverse group of Federal agencies and their partners, including allied and other foreign nations, international arms control organizations, and nongovernmental or industrial organizations, as appropriate. These activities would also support partnerships in counterterrorism and nuclear forensics. Nonproliferation- and counterterrorism-related activities would be designed for versatility to adapt to changing technology requirements and evolving global security conditions.

  Under the No Action Alternative, nonproliferation- and counterterrorism-related activities would integrate existing activities (i.e., research and development, training, nonproliferation tests and experiments, counterterrorism training, etc.) under an overall program. There would be no new facilities constructed, although existing buildings and other facilities would be used and modified as necessary to accommodate these activities.

Arms control – A key component of nonproliferation activities would be the use of existing facilities as part of an Arms Control Treaty Verification Test Bed dedicated to supporting U.S. arms control initiatives and commitments. Using existing capabilities (such as the Nonproliferation Test and Evaluation Complex [NPTEC], BEEF, various tunnels, laboratories, and training facilities), this component would support design and certification of treaty verification technology, training of inspectors, and development of arms control confidence-building measures. More specifically, in support of the work at the Arms Control Treaty Verification Test Bed, NNSA would conduct the following activities:

Test Bed

A test bed is an area that includes physical structures or designated terrain where tests and experiments are conducted. Test beds may be permanent facilities or temporary sites.

- Developing, testing, and certifying sensors for deployment with onsite arms control inspection teams

- Developing and testing technologies for seismic and electromagnetic pulse discrimination between nuclear and conventional explosions
- Developing and testing samples and measurements from aerial, surface, and subsurface environments for Comprehensive Test Ban Treaty verification purposes
- Developing and testing technologies and methods for nonintrusive observation of tunnel complexes and other underground facilities for potential nuclear weapons-related activities
- Providing training areas where inspectors can learn methods of conducting searches of large areas for radioactive debris or other evidence of nuclear activity
- Providing training in nuclear forensics of radiation-contaminated materials
- Training international inspectors for Strategic Arms Reduction Treaty follow-on and Comprehensive Test Ban Treaty inspections

Under the No Action Alternative, an existing facility in Mercury would be modified to provide important arms control functions such as data fusion, analysis, and visualization. This facility would integrate multiple disciplines and would use both state-of-the-art and experimental data analysis techniques and experimental methods to increase understanding of the means of detecting weapons materials, weapons of mass destruction, clandestine explosions, and hidden laboratories. These data would be combined with other data streams to facilitate turning raw data into actionable knowledge. In addition to treaty verification and weapons of mass destruction detection, this capability would be used for climate change studies, timely warning of natural disasters, environmental remediation, and advancement of earth sciences.

Nonproliferation – The NNSS would serve as a base of operations for the collaborative technical work that underlies nonproliferation programs. Facilities would be provided for Federal agencies to validate sensor performance. This capability would include a security-controlled environment for multinational collaboration in technology development and for technical training and information sharing. These multinational collaborations would be particularly aimed at U.S. allies that do not have ready access to areas where nuclear weapons have been tested in the past and would allow them to gain experience at former testing facilities and sites to aid in their nonproliferation programs. NNSA would use existing facilities in Nevada to support the following areas:

- Safeguarding fissile materials in nations with nuclear weapons or nuclear industries
- Tightening export controls on technology with potential application to weapons of mass destruction
- Improving border protection by installing detectors for radioactive materials
- Inspecting commercial shipments for smuggled nuclear materials
- Collaborating with law enforcement in these areas

For some specific tasks in support of nonproliferation and counterproliferation objectives, NNSA would use existing unique NNSS capabilities, such as NPTEC, areas contaminated by previous nuclear testing, and various tunnel complexes to conduct research, development, and training in the following areas:

- High-hazard experiments and evaluations of equipment and methods for detection of radioactive, chemical, or biological agents using simulants
- Hands-on training and exercises to “render safe” a contraband nuclear device

- Nuclear forensics field exercises involving collection of radioactive material dispersed by an explosion
- Airborne, electromagnetic, and seismic assessment of deep underground facilities

Counterterrorism – A counterterrorism training program would provide an advanced, immersive training environment that would include international participation. The ability to execute complex scenarios in field conditions, with various U.S. agencies and possibly international participants, would lead to refinement of tactics and a direct encounter with unanticipated problems. These training exercises would use the isolated, rugged terrain of the NNSS to simulate many current military areas of operation. The special attributes of the NNSS, which allow use of explosives, chemical and radiological substances, electronic countermeasures, and live weapons fire, would provide realistic training for the military, Federal agents, police officers, and others who conduct counterterrorism operations.

NNSA would support research, development, and training associated with detecting and countering various types of improvised explosive devices, including those that are vehicle-borne. These activities would occur at BEEF, NPTEC, and other NNSS locations. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*. In addition to BEEF and the Area 11 Explosives Ordnance Disposal Unit, NNSA is currently permitted under the NNSS Air Quality Operating Permit to conduct up to 10 explosive detonations per year, each using up to 2,000 pounds of explosives, at each of the following facilities: (1) the High Explosive Simulation Technique Facility in Area 14, (2) Test Cell C in Area 25, (3) Port Gaston in Area 26, and (4) NPTEC in Area 5.

A.1.1.3 Work for Others Program

The Work for Others Program, hosted by NNSA, facilitates the use by other agencies and organizations of NNSA facilities and capabilities, such as BEEF, NPTEC, the Radiological and Nuclear Countermeasures Test and Evaluation Complex (RNCTEC), and the T-1 Training Area, as well as resources at the NNSS, RSL, NLVF, and the TTR. Under the No Action Alternative, NNSA would continue to host the projects and activities of other Federal agencies such as DoD and DHS, as well as other Federal, state, and local government agencies and nongovernmental organizations, including the following:

Treaty verification – NNSA would host activities related to verification under a number of nuclear weapon-related treaties. The activities that would be conducted range from hosting inspections by other nations to conducting research and development in the area of detecting violations of treaties by others.

Nonproliferation projects and counterproliferation research and development – NNSA would provide the following support to other agencies:

- Conventional weapons effects testing, including live-drop and static high-explosives detonations using up to 30,000-pound-class weapon systems with up to 20,000 pounds TNT-equivalent explosives. These activities would be conducted primarily in the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, and 16 of the NNSS) and would be in compliance with the *DOE Explosive Safety Manual* (DOE Manual 440.1-1A) and other applicable requirements.
- Development and demonstration of capabilities and technologies to effectively threaten and defeat military missions protected in tunnels and other deeply buried hardened facilities. These activities would use military munitions and other explosives and nonexplosive methods. Existing tunnels and bunkers on the NNSS would be used for these activities.
- Conduct experiments and other operations using conventional explosives. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*. In addition to BEEF and the Area 11 Explosives Ordnance Disposal Unit, NNSA

is currently permitted under the NNSS Air Quality Operating Permit to conduct up to 10 explosive detonations per year, each using up to 2,000 pounds of explosives, at each of the following facilities: (1) the High Explosive Simulation Technique Facility in Area 11, (2) Test Cell C in Area 25, (3) Port Gaston in Area 26, and (4) NPTEC in Area 5.

- Controlled experiments involving releases (including explosive releases) of chemical and biological simulants. These experiments would support development of detectors, sensors, and equipment and methods to control leaking containers (i.e., tanks, truck and railroad tankers, etc.), and provide data for training first responders and others to detect biological and/or chemical traces that may indicate the manufacture or presence of a chemical or biological weapon. They would also support detection, control, and remediation of leaks and spills. Up to 20 controlled chemical and biological simulant release tests and experiments would be conducted yearly.

  Large releases of chemicals would be conducted at NPTEC and would comply with the parameters in *Hazardous Materials Testing at the Hazardous Materials Spill Center, Nevada Test Site* (DOE/EA-0864) (DOE 2002), including: (1) chemical concentrations must not exceed specific limits within three 3.1-mile-wide geographic impact zones established in the downwind direction from the NPTEC release point (see **Table A–1** for limitations for each zone); (2) restrictions on materials that have cumulative, long-term persistence in the environment; (3) restrictions on the duration of releases that are of sufficient quantity and/or concentration to have a potential for environmental impacts in downwind testing sectors; (4) restrictions on the frequency of releases that may approach the limits of the geographic impact zones; (5) windspeed must be calm to 33.5 miles per hour; and (6) specific wind direction requirements for each of the three geographic impact zones. Before NNSA/NSO accepts any particular chemical release test or experiment, the proponent of the test/experiment must provide specific documentation, including a proposal letter, a test plan, a safety assessment, and a test management summary. These documents provide information used by NNSA/NSO to evaluate the proposed releases to determine whether they would comply with all applicable requirements to protect human health and the environment.

Chemical Release Criteria

Immediately Dangerous to Life or Health (IDLH) – The National Institute of Occupational Safety and Health (NIOSH) defines IDLH as a situation that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.

Short-Term Exposure Limit (STEL) – An Occupational Safety and Health Administration (OSHA) or NIOSH 15-minute time-weighted average that cannot be exceeded at any time during the workday.

Permissible Exposure Limit – An OSHA time-weighted average concentration that must not be exceeded during any 8-hour work shift in a 40-hour workweek.

Recommended Exposure Limit – A NIOSH time-weighted average concentration for up to a 10-hour workday during a 40-hour workweek.

Threshold Limit Value (TLV) – The amount of chemical in the air established by the American Conference of Industrial Hygienists that almost all healthy adult workers are predicted to be able to tolerate without adverse effects. There are three types:

- The TLV-TWA (TLV Time-Weighted Average) is averaged over the normal 8-hour day/40-hour workweek.
- A TLV-STEL is a 15-minute exposure that should not be exceeded for even an instant. It is not a standalone value, but is accompanied by the TLV-TWA. It indicates a higher exposure that can be tolerated for a short time without adverse effect as long as the total TLV-TWA is not exceeded.
- The TLV-C (Ceiling limit) is the concentration that should not be exceeded during any part of the working exposure.

Table A–1 Nonproliferation Test and Evaluation Complex Geographic Impact Zones

Zone	*Description*	*Allowable Chemical Concentration*
I	A semicircular area with a radius of 3.1 miles centered on a bearing of 225 degrees from the release point	May contain lethal concentrations for exposures of less than 15 minutes to humans and wildlife
II	An area centered on a bearing of 225 degrees extending from 3.1 miles to 6.2 miles from the release point and bounded on either side by bearing lines 270 degrees on the south and 180 degrees on the north	May contain concentrations for which an exposure of less than 15 minutes would have a low probability of morality, but may cause respiratory damage to humans or animals
III	An area centered on a bearing of 225 degrees extending from 6.2 miles to 9.3 miles from the release point and bounded on either side by bearing lines 260 degrees on the south and 190 degrees on the north	May contain concentrations that cause mild and reversible respiratory tract irritation on wildlife and minor and reversible effects on vegetation

Low concentrations of chemicals may be released anywhere on the NNSS within the requirements presented in the *Final Environmental Assessment for Activities Using Biological Simulants and Releases of Chemicals at the Nevada Test Site* (*Chem/Bio EA*) (DOE/EA-1494) (DOE 2004a). Under those requirements, chemical concentrations would not exceed the "Immediately Dangerous to Life or Health Program" limit beyond a radius of 328 feet from the release point; would not exceed the "Short-Term Exposure Limit" beyond 1,000 feet from the release point; and would not exceed the more conservative of "Permissible Exposure Limits," "Recommended Exposure Limit," or "Threshold Limit Value" beyond 1,640 feet from the release point.

Releases of biological simulants at the NNSS are subject to specific parameters addressed in the *Chem/Bio EA*. In the *Chem/Bio EA*, based on scientific information regarding potential effects on human and ecological receptors, NNSA identified six microorganisms that may be used in experiments as simulants for biological agents: *Bacillus subtilis* var. *niger* (formerly *B. globigii*), *B. thuringiensis*, *Clostridium sporogenes*, *Erwinia herbicola* (also known as *Panoea aggloverans*), Bacteriophage MS2, and noninfectious (killed) influenza A virus. A biological agent is a pathogenic microorganism or any naturally occurring, genetically manipulated, or synthesized component of biological origin that is capable of causing death, disease, or other biological malfunction in humans, animals, or plants, or causing deterioration of food, water, equipment, or supplies. A biological simulant is a biologically derived substance or microorganism that shares at least one physical or biological characteristic of the biological agent it is simulating, has been shown to be nonpathogenic, and can replace the biological agent in testing. Biological simulants are intended to mimic the behavior of potentially more lethal or severely debilitating biological agents that may be used in warfare or by terrorist organizations.

Counterterrorism – NNSA would continue to support DoD and other Federal agencies in developing methods for engaging or neutralizing an adversary in a variety of topographical environments. These organizations would take advantage of the NNSS restricted access and remote high desert terrain to develop realistic scenarios that could be encountered in specific mission profiles. Activities would include the following:

- Training in direct-action live-fire take-down of high-fidelity target test beds
- Low-altitude fixed- and rotary-wing desert flight training and technique development
- Development of and training in remote area advanced personnel overland navigation techniques

- Development and field-testing of special-use military hardware, including new ordnance and vehicles
- Field-testing and training activities for unmanned aerial vehicles and/or unmanned aircraft systems
- Overland movement of military personnel and equipment through rugged terrain to assess fatigue and war-fighter capability

In addition to the ground-based military operations that occur at the NNSS, the USAF would conduct military operations in the restricted air space above the NNSS and the TTR.

DHS technology programs and DoD would continue to use NNSS facilities to assist in development of technology for homeland security applications. The NNSS would continue to provide land and infrastructure to support evaluation of radiological and nuclear detection devices for use in transportation-related applications. DHS would continue to use RNCTEC (a facility constructed at the NNSS on behalf of DHS), as well as other NNSS land and infrastructure for its activities. RNCTEC would continue to operate as a less-than-Category-3 nonreactor nuclear facility with a mock Primary Port of Entry, Active Interrogation Facility, storage and staging areas, and a Test Support Building. Radioactive and nuclear materials (including SNM) used in RNCTEC activities would not be released under normal operations. All radionuclides would be transported in strict compliance with applicable regulations of the U.S. Department of Transportation. A detailed description of RNCTEC facilities and activities is contained in the *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site, Final Environmental Assessment* (DOE/EA-1499) (DOE 2004b).

DOE Hazard Categories

In accordance with DOE Order 5480.23, *Nuclear Safety Analysis Report*, as part of establishing the safety basis of DOE nuclear facilities, contractors that design, construct, or operate such a facility are required to perform a hazard analysis of their nuclear activities and classify their processes, operations, or activities in accordance with the following requirements (cited from DOE Order 5480.23):

"The consequences of unmitigated releases of radioactive and/or hazardous material shall be evaluated and classified by the following hazard categories:

(a) Category 1 Hazard. The hazard analysis shows the potential for significant offsite consequences.

(b) Category 2 Hazard. The hazard analysis shows the potential for significant onsite consequences.

(c) Category 3 Hazard. The hazard analysis shows the potential for only significant localized consequences."

NNSA's Counterterrorism Operations Support Program would continue supporting the Federal Emergency Management Agency. This program involves development and implementation of a national program to enhance the capability of state and local agencies to respond to weapons of mass destruction incidents through coordinated training, equipment acquisition, technical assistance, and support for state and local exercise planning.

Military Training and Exercises – NNSA would continue to support DoD by providing land, airspace, and infrastructure for use by various branches of the military to conduct training and exercises. These activities range from small-scale, i.e., focused at a specific building or site, to large-scale exercises involving multiple air and/or ground assets with live-fire operations. These activities would include use of live fire of military munitions, including small arms, hand grenades, rocket-propelled grenades, etc. Military training and exercises may be conducted throughout the NNSS, but would be primarily conducted in the western portions, including Areas 18, 19, 20, 25 (northern portion), 29, and 30 to preclude interference with and from other NNSS activities. Military training and exercises are subject all applicable regulatory requirements and to NNSA/NSO work authorization processes (NSO O 412.X1E, *Real Estate/Operations Permit*, December 9, 2009), which are designed to minimize hazards to workers, the environment, and NNSS physical assets.

Support for the U.S. National Aeronautics and Space Administration (NASA) – NNSA would conduct criticality experiments at DAF in support of NASA's efforts to develop power sources for use in future missions to Mars and similar space exploration.

Miscellaneous Work for Others Program activities – Customers would continue to use aerial platforms for various purposes, including research and development, training and exercises, and deployment of sensors for detection of various items. These types of activities would use a variety of manned and unmanned aerial vehicles, including fixed-wing aircraft (airplanes) and helicopters. Existing aviation facilities at the NNSS, Nellis and Creech Air Force Bases, and other locations would be used as part of these activities.

Work for Others Program activities at the TTR – These activities would be similar to those addressed under the Stockpile Stewardship and Management Program (Section A.1.1.1), with the following additions:

- Robotics testing and development (handling, application, and recovery of hazardous [chemical] material)
- Smart transportation-related testing – preprogrammed/remote-controlled vehicles (air and ground)
- Smoke obscuration operations
- Infrared tests
- Rocket development, testing, and deployment

A.1.2 Environmental Management Mission

DOE/NNSA's Environmental Management Mission includes the Waste Management Program and Environmental Restoration Program. These programs are under the organizational control of DOE's Environmental Management Program. The Waste Management Program conducts waste management operations for all solid wastes, LLW, and mixed low-level radioactive waste (MLLW) generated by NNSA operations and environmental restoration operations. The Waste Management Program operates disposal facilities that receive various waste types, including the Area 5 Radioactive Waste Management Complex (RWMC) and Area 3 Radioactive Waste Management Site (RWMS), which dispose LLW and MLLW received from onsite- and offsite-approved waste generators. The Environmental Restoration Program conducts, as needed, characterization, monitoring, and remediation of facilities, sites, and groundwater contaminated by previous nuclear weapons-related and other activities at the NNSS, the TTR, and the Nevada Test and Training Range. The Environmental Restoration Program also implements the Borehole Management Program, which plugs unneeded boreholes for which NNSA is responsible.

A.1.2.1 Waste Management Program

Waste management operations support DOE and NNSA operations and environmental cleanup and restoration programs. The waste management objective is to conduct proper disposal and monitoring of wastes generated by NNSA and other approved generators. Waste types stored, treated, and/or disposed at the NNSS include LLW, MLLW, transuranic (TRU) waste, mixed TRU waste, hazardous waste, asbestos, polychlorinated biphenyl (PCB) wastes, hydrocarbon-contaminated soil and debris, and solid wastes such as construction or demolition debris or sanitary solid waste. Liquid nonhazardous wastes (such as sewage and other wastewater) are not included under the Waste Management Program, but are addressed in Section A.1.3.1, "General Site Support and Infrastructure." All NNSA waste management activities operate in compliance with applicable regulatory requirements. Waste management activities at the NNSS under the No Action Alternative would include the following:

LLW and MLLW management – LLW and MLLW from NNSS, DoD, and other approved generators that meet the NNSS waste acceptance criteria would continue to be accepted and disposed. The volume of LLW projected for disposal at the NNSS and analyzed under the No Action Alternative is based on the actual volume of LLW disposed at the NNSS from FY 1997 through FY 2010 and is estimated to total about 15,000,000 cubic feet. The volume of MLLW projected for disposal at the NNSS and analyzed under the No Action Alternative is estimated to total about 900,000 cubic feet. This estimated volume is based on the disposal capacity of the new Mixed Waste Disposal Unit, Cell 18; the actual permitted capacity of Cell 18 is 899,996 cubic feet. The volumes of LLW and MLLW include those from authorized out-of-state generators as well as those from operations and environmental restoration at the NNSS and other authorized in-state locations.

NNSA would continue to manage in-state-generated MLLW by a combination of several options: (1) repackage MLLW, as appropriate, at the TRU Pad in the Area 5 RWMC; (2) store in-state-generated MLLW at the TRU Pad or at a new MLLW storage facility, pending certification for disposal; or (3) ship in-state-generated MLLW to a permitted facility such

Waste Definitions and Information

Radioactive Waste – Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

Transuranic (TRU) Waste – Radioactive waste containing alpha particle-emitting radionuclides having an atomic number greater than 92 (the atomic number of uranium) and half-lives greater than 20 years, in concentrations greater than 100 nanocuries per gram.

Low-Level Radioactive Waste (LLW) – Radioactive waste not classified as high-level radioactive waste, TRU waste, spent nuclear fuel, or byproduct material as defined by Section 11e(2) of the Atomic Energy Act of 1954, as amended. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, provided the concentration of TRU elements is less than 100 nanocuries per gram.

Hazardous Waste – A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in Title 40 of the *Code of Federal Regulations* (CFR) 261.20-24 (ignitability, corrosivity, reactivity, and toxicity), or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

Mixed Waste – Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively. Mixed waste intended for disposal must meet the Land Disposal Restrictions as listed in 40 CFR Part 268. Mixed waste is a generic term for specific types of mixed waste, such as mixed low-level radioactive waste (MLLW) and mixed TRU waste.

Waste Generator – An individual, facility, corporation, government agency, or other institution that produces waste material for certification, treatment, storage, or disposal.

Waste Acceptance Criteria – A document that establishes the National Nuclear Security Administration Nevada Site Office waste acceptance criteria. The document provides the requirements, terms, and conditions under which the Nevada National Security Site (NNSS) accepts LLW and MLLW for disposal. It includes requirements for the generator's waste certification program, characterization, traceability, waste form, packaging, and transfer. The criteria apply to radioactive waste received at the NNSS Area 3 Radioactive Waste Management Site and Area 5 Radioactive Waste Management Complex for storage or disposal.

as Energy Solutions in Clive, Utah, or Materials and Energy Corporation in Oak Ridge, Tennessee, for appropriate treatment. MLLW treated at an offsite facility would be returned to the NNSS for disposal or would be disposed at a permitted commercial facility.

The Area 5 RWMC would continue to operate within the approximately 740-acre area set aside for waste management purposes. LLW and MLLW disposal units would be developed, filled, and closed as needed, in compliance with applicable regulatory requirements. NNSS- and offsite-generated LLW and MLLW would be disposed within these units. Individual disposal units would be operationally closed as they are filled to capacity, pending final closure at a later date. Final closure of existing operationally closed units, including the greater confinement disposal boreholes, began in calendar year 2011. LLW and permitted MLLW disposal would continue elsewhere at the Area 5 RWMC.

On December 1, 2010, the Nevada Division of Environmental Protection (NDEP) issued a permit to NNSA/NSO for a new MLLW Disposal Unit at the Area 5 RWMC. The new MLLW Disposal Unit consists of a single lined cell (Cell 18) with a capacity of about 900,000 cubic feet (actual permitted disposal volume is 899,996 cubic feet). Temporary storage operations for onsite-generated LLW and MLLW would continue. Support activities within the Area 5 RWMC, such as the Real-time Radiography Facility, would continue.

The Area 3 RWMS would be maintained in a standby status under the No Action Alternative.

Small quantities of LLW (a few to a few hundred cubic feet over the next 10 years) may be generated at RSL and NLVF. Normal operations at the TTR are not expected to generate radioactive waste, but environmental restoration activities would generate LLW and possibly unknown quantities of TRU waste. These environmental restoration wastes would be disposed at appropriate disposal facilities, such as the Area 5 RWMC and/or the Waste Isolation Pilot Plant, as appropriate.

TRU waste management – With the exception of two experimental spheres, the remaining legacy TRU waste previously stored at the NNSS was sent to Idaho National Laboratory for processing and then shipped to DOE's Waste Isolation Pilot Plant for disposal in 2009. Environmental Restoration Program projects at the NNSS, the TTR, and the Nevada Test and Training Range may generate some TRU waste, and experiments at JASPER and other national security activities would also generate small annual quantities (approximately 500 cubic feet per year) of TRU waste that would be safely stored at the TRU Pad pending characterization. Overall, NNSA estimates that about 9,600 cubic feet of TRU waste would be generated by its operations and the Environmental Restoration Program over the next 10 years. These TRU wastes would be shipped either directly to the Waste Isolation Pilot Plant for disposal or to another facility, such as Idaho National Laboratory, for processing before being sent to the Waste Isolation Pilot Plant.

TRU wastes would not be generated during RSL, NLVF, or NNSA Sandia Site Office activities at the TTR.

Hazardous waste management – DOE/NNSA activities would generate about 170,000 cubic feet of hazardous waste at the NNSS over the next 10 years under the No Action Alternative. The Hazardous Waste Storage Unit in Area 5 of the NNSS would continue to operate under a RCRA Part B permit issued by NDEP. Onsite-generated hazardous waste would be stored for up to 1 year prior to shipment to offsite treatment and/or disposal facilities.

RSL is a small-quantity generator of hazardous waste. Hazardous waste would continue to be accumulated at RSL for no more than 90 days before being transferred off site to a permitted facility for treatment and/or disposal. Waste management field activities at RSL are provided by the USAF as landlord services under a Memorandum of Agreement. USAF personnel pick up and dispose miscellaneous laboratory and process equipment wastes under the terms of Nellis Air Force Base Plan 12 (Hazardous Waste Management Plan, October 2007).

NLVF is a conditionally exempt small-quantity generator of hazardous waste. Hazardous waste would continue to be accumulated at NLVF for no more than 90 days before being transferred off site to a commercially permitted facility for treatment and/or disposal.

The TTR is a small-quantity generator of hazardous waste. Hazardous wastes would continue to be accumulated at the TTR for no more than 180 days before being transferred off site to a permitted treatment, storage, and disposal facility.

Used oil from all NNSA/NSO facilities and the TTR would continue to be collected and sent for recycling.

Asbestos and PCB waste management – Friable, nonradioactive asbestos waste would continue to be disposed at the Area 23 Solid Waste Disposal Site and possibly at the U10c Solid Waste Disposal Site, pending permit modification and review. Radioactive asbestos waste would continue to be disposed at the Area 5 RWMC. Nonfriable asbestos waste would continue to be disposed at the U10c Solid Waste Disposal Site. Nonradioactive PCB wastes would be stored at the Hazardous Waste Storage Unit in Area 5, pending transfer to a permitted treatment and/or disposal facility. Radioactive PCB-contaminated waste meeting U.S. Environmental Protection Agency (EPA) requirements (40 *Code of Federal Regulations* [CFR] Part 761) would continue to be disposed in a RCRA-permitted MLLW Disposal Unit through November 30, 2010. After that time, this waste type would be disposed in the new RCRA-permitted MLLW Disposal Unit described above. NNSA would continue to dispose asbestos and PCB wastes generated at the TTR at a permitted treatment, storage, and disposal facility.

Explosives waste treatment – NNSA would continue to treat old and/or unusable explosives by open-air detonation at the Explosives Ordnance Disposal Unit in Area 11. This treatment operation would continue to be governed by a RCRA Part B permit and the NNSS Air Quality Operating Permit.

Hydrocarbon-contaminated soil and debris management – The Area 6 Hydrocarbon Solid Waste Disposal Site would continue to operate under a permit issued by NDEP and would accept onsite-generated soil and debris contaminated with hydrocarbons. The U10c Solid Waste Disposal Site would also continue to operate under a permit issued by NDEP and would accept limited amounts of onsite-generated soil and debris contaminated with hydrocarbons. Onsite-generated, hydrocarbon-contaminated LLW would continue to be disposed in the Area 5 RWMC. If hydrocarbon-contaminated waste were generated due to an accidental release at RSL or NLVF, it would be disposed at a facility permitted to receive such waste. The TTR would continue to dispose hydrocarbon-contaminated soil and debris at a permitted/approved landfill.

Solid waste management – DOE/NNSA activities would generate about 3,700,000 cubic feet of sanitary solid waste and construction and demolation waste at the NNSS. NNSA would continue to operate the Area 23 Solid Waste Disposal Site. This permitted facility accepts less than 20 tons of sanitary waste per day. Industrial solid waste and construction and demolition debris would continue to be disposed at the U10c Solid Waste Disposal Site. About 370,000 cubic feet of sanitary solid waste would be sent off site to permitted facilties to be recycled.

At RSL and NLVF, sanitary solid waste would continue to be disposed by a municipal waste service.

At the TTR, sanitary solid waste would continue to be disposed at the USAF TTR sanitary landfill. Industrial solid waste, such as construction or demolition debris, would be disposed at a USAF landfill or shipped off site for disposal at the NNSS or a permitted commercial landfill.

Excess materials that are suitable for recycling or reuse, such as scrap metal, would be shipped off site.

A.1.2.2 Environmental Restoration Program

NNSA's Environmental Restoration Program is generally a DOE-funded activity under the organizational direction of the DOE Environmental Management Program. Under the No Action Alternative, the NNSA Environmental Restoration Program would continue, in compliance with the Federal Facility Agreement and Consent Order (FFACO), to characterize, monitor, and remediate identified contaminated areas, facilities, and the environment. Environmental restoration is not considered a land use, but is a necessary activity before reuse or disposition of land, facilities, and environmental media. The Environmental Restoration Program is organized into three projects and also supports the Defense Threat Reduction Agency in addressing its environmental restoration sites at the NNSS. The three projects are the Underground Test Area (UGTA) Project, Soils Project (includes contaminated soil sites from the TTR and the Nevada Test and Training Range), and Industrial Sites Project (includes the Decontamination and Decommissioning Project and facilities to be remediated at the TTR and the NNSS under the *1996 NTS EIS*). The *1996 NTS EIS* also included the Project Shoal Site and the Central Nevada Test Area as projects under the Environmental Restoration Program. These two sites have since been transferred to DOE's Office of Legacy Management and are not addressed in this SWEIS. NNSA Borehole Management Program work is executed by the Environmental Restoration Program. The following NNSA environmental restoration projects and activities would continue at the NNSS under the No Action Alternative:

Underground Test Area Project – The UGTA Project would monitor groundwater from existing wells; continue drilling characterization wells; expand groundwater monitoring to include new wells; develop groundwater flow and transport models; and continue to evaluate closure strategies, including adaptive monitoring and management. UGTA activities would occur on the NNSS, the Nevada Test and Training Range, U.S. Bureau of Land Management land, and privately owned land, as necessary and as permission is obtained. This project includes five corrective action units (CAUs): Yucca Flat/Climax Mine (CAU 97), Frenchman Flat (CAU 98), Rainier Mesa/Shoshone Mountain (CAU 99), Central Pahute Mesa (CAU 101), and Western Pahute Mesa (CAU 102). The UGTA Project has planned for Phase I and Phase II corrective action investigations for each CAU; however, depending on the results at the end of Phase I, NDEP may approve a Corrective Action Decision Document/Corrective Action Plan. In 2009, CAUs 101 and 102 began the second phase of characterization; a Phase II investigation was completed for CAU 98; and a Phase II Transport Model was submitted to NDEP. Also during 2009, a Phase I Flow Model was under preparation for CAU 97, and a Phase I Source Term Model was under preparation for CAU 99. The closure strategy for all CAUs in the UGTA Project is closure in place and long-term monitoring with institutional controls. An estimated five wells would be drilled for the UGTA Project each year for approximately 10 years, each affecting 10 acres due to construction of drill pads and fluid pits. Hydraulic testing would occur at many of these new wells, and possibly at existing wells, requiring the use of portable power generators and resulting in withdrawal of groundwater and disposition in the fluid pits. Tracer tests could also be conducted, which would involve injecting nonhazardous chemical substances (for example, bromide) into a well and monitoring their concentrations in an adjacent pumped well. Other characterization activities would include seismic or other geophysical tests.

Soils Project – The Soils Project would continue to investigate soil sites using in situ monitoring (thermoluminescent detectors, onsite radiation surveys, and aerial radiological surveys), air monitoring, surface-water contaminant transport studies, and soil sampling, as well as perform corrective actions using clean closure, closure in place, or a combination to ensure that the public and workers are protected. The Soils Project would ensure that proper use restrictions are in place to implement site closure, in compliance with access and posting requirements of DOE's *Occupational Radiation Protection* rules (10 CFR Part 835) and Nevada Test and Training Range radiation protection policies, which may include fencing and posting. The current closure strategy for Soils Project sites at the NNSS is based on a future industrial land use scenario with a 25-millirem-per-year exposure action level. This action level is used for the analysis under the No Action Alternative in this SWEIS. Soils sites on the Nevada Test and Training Range, including the TTR, are expected to be remediated to an action level that is mutually agreed upon by DOE/NNSA, the USAF, and NDEP. Activities would continue to be conducted in compliance with the FFACO, although alternate uses may require stricter cleanup levels than currently anticipated. The impacts of potential stricter cleanup levels are addressed under the Expanded Operations Alternative. Sixteen of the current 107 sites being addressed by the Soils Project have been closed. Over about 10 years, as more contaminated soil sites are found, the Soils Project is expected to add up to 20 additional sites. As these sites close, some may require postclosure monitoring and land use controls. NNSA anticipates that all identified Soils Project sites will be closed under the FFACO by the end of 2022.

Industrial Sites Project – The Industrial Sites Project would continue its field program to identify, characterize, and remediate industrial sites under the FFACO and to decontaminate and decommission unneeded facilities. Under the No Action Alternative, some industrial sites may require clean closure rather than closure in place. The majority of the FFACO industrial sites have been closed. Remediation, decontamination, and decommissioning activities are projected to be complete by the end of 2012, with the exception of CAU 114 (EMAD [Engine Maintenance Assembly and Disassembly Facility]). The current number of CAUs is 265, with a total of 1,870 corrective action sites (CASs) (including 64 CASs at the TTR, all of which have been closed as of September 2010). Twelve CAUs and 102 CASs remain to be closed at the NNSS. As of 2009, 8 of 9 Part A sites identified in the *1996 NTS EIS* (DOE 1996) were closed under RCRA. The remaining Part A site is expected to be closed by 2012. Some closed industrial sites may require monitoring and land use controls. Industrial Sites Project activities would continue at present levels, although alternate uses of remediated facilities may require revised cleanup levels.

Defense Threat Reduction Agency sites – The Defense Threat Reduction Agency sites are identified as part of the NNSA Environmental Restoration Program because their site activities are considered environmental remediation on the NNSS. However, the Defense Threat Reduction Agency is responsible for implementing and funding these activities in compliance with applicable agreements with NDEP. In September 2005, with the concurrence of NDEP, the Defense Threat Reduction Agency adopted a risk-based closure strategy for closure of nine CAUs (NDEP 2005). This risk-based closure strategy uses final action levels based on risks to human health and the environment. The final action levels were used to determine the risk a particular site poses to human health and the environment so that available resources would be used in the most effective manner in closing each site. Surface-disturbing activities have been completed and environmental monitoring, such as water sampling, would continue. The Environmental Restoration Program accepted responsibility for the E-Tunnel effluent ponds and associated long-term postclosure monitoring from the Defense Threat Reduction Agency in 2008.

Borehole Management Program – More than 4,000 boreholes were drilled on and off the NNSS in support of nuclear testing (DOE/NV 2009). The boreholes were drilled for various purposes, including post-shot investigation, exploratory holes, instrument holes, potable water wells, construction water supply wells, monitoring wells, and other special purposes. Unneeded boreholes would be plugged to reduce the potential for boreholes to act as conduits for contaminant transport from the surface or from contaminated aquifers to uncontaminated aquifers. To date, the Borehole Management Program has identified 874 unneeded boreholes (Townsend 2009) on the NNSS; 151 of these are believed to penetrate groundwater and underground nuclear test cavities (DOE/NV 2009). The NNSA Borehole Management

Program plugs unneeded boreholes as a matter of comity in accordance with *Nevada Administrative Code* 534.420-534.427 requirements, to the extent possible.

Through 2009, a total of 691 unneeded boreholes were plugged by the Borehole Management Program (Townsend 2009). Under the No Action Alternative, NNSA would continue to plug the remaining unneeded boreholes on the NNSS. Based on the current schedule and known inventory of unneeded boreholes on the NNSS that need to be plugged, the Borehole Management Program would be complete by the end of 2013.

A.1.3 Nondefense Mission

The Nondefense Mission generally includes those activities that are necessary to support mission-related programs, such as constructing and maintaining facilities, providing supplies and services, warehousing, and similar activities. Activities related to supply and conservation of energy, including renewable energy and other research and development projects, are also considered under the Nondefense Mission.

A.1.3.1 General Site Support and Infrastructure Program

Like any large facility, the NNSS has substantial infrastructure that provides all site-support services. Under the No Action Alternative, infrastructure-associated activities would continue, including small projects such as repairs and replacements to maintain present capabilities of NNSA facilities. For instance, maintenance and repair projects include, among other things, repairing the Area 23 sewer main; remediating underground storage tanks; replacing five roll-up doors; renovating and reactivating several water tanks; replacing electric hot water heaters; installing water tank security ladders; and replacing the roofs on several buildings. Increasing the capacities and capabilities or extending the ranges of facilities and/or services is not proposed under the No Action Alternative.

NNSS infrastructure includes buildings that house various functions, such as administration; storage; security, fire protection, and health care services; research and development; and industrial processes (see **Table A–2**). Utilities at the NNSS, NLVF, RSL, and the TTR include potable and nonpotable water systems, wastewater systems, electrical transmission and distribution systems, and communications systems. Although they are part of NNSA's infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed as part of the Environmental Management Program rather than the General Site Support and Infrastructure Program.

The TTR contains about 105 major buildings, providing 161,505 square feet of space. TTR infrastructure also includes about 90 smaller buildings, towers, and small sheds. Services available at the TTR include security, fire protection, and health care. Utilities at the TTR include water systems, wastewater systems, and electrical systems.

In addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain Repository. NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain Repository.

Table A–2 Building Floor Space and Functions for National Nuclear Security Administration Facilities in Nevada

Function	*Nevada National Security Site 484 Buildings (square feet)*	*Remote Sensing Laboratory 7 Buildings (square feet)*	*North Las Vegas Facility 30 Buildings (square feet)*	*Offsite Leased (square feet)*
Administration	383,336	0	444,090	117,263
Storage	332,877	16,454	22,179	1,104
Industrial/Production/Process	359,980	0	58,969	8,253
Research and Development	486,405	144,059	136,079	87,451
Services	413,948	0	4,023	0
Other	255,056	1,015	648	0
Total	2,231,602	161,528	665,988	214,071

Source: Mason 2009.

A.1.3.2 Conservation and Renewable Energy Program

Under the No Action Alternative, NNSA would continue to identify and implement energy conservation measures and renewable energy projects, in compliance with Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (72 FR 3919); DOE Order 430.2B, *Department of Energy, Renewable Energy and Transportation Management Requirements*; and Transformational Energy Action Management objectives.

Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, was signed by President Obama on October 5, 2009. Executive Order 13514 expands the requirements of Executive Order 13423 in the following areas:

- Measuring and reporting greenhouse gases
- Implementing strategies and policies to support low-carbon commuting and travel
- Identifying, promoting, and implementing water reuse strategies that reduce potable water consumption
- Increasing diversion of compostable and organic material from waste streams
- Ensuring that planning for new facilities/leases considers pedestrian-friendly sites near existing employment
- Managing existing building systems to reduce consumption of energy, water, and materials
- Identifying opportunities to consolidate and dispose existing assets to optimize real property portfolios

In accordance with DOE Order 430.2B, Executive Order 13423, and Executive Order 13514, NNSA would continue to identify and implement requirements in the following areas:

- Energy efficiency
- Renewable energy

Energy Efficiency and Intensity

Energy efficiency can be defined for a component or service as the amount of energy required in the production of that component or service; for example, the amount of steel that can be produced with 1 billion British thermal units of energy. Energy efficiency is improved when a given level of service is provided with reduced amounts of energy inputs, or services or products are increased for a given amount of energy input.

Energy intensity is the amount of energy used in producing a given level of output or activity. It is measured by the quantity of energy required to perform a particular activity (service), expressed as energy per unit of output or activity measure of service.

Source: http://www1.eere.energy.gov/ba/pba/intensityindicators/trend_definitions.html

- Water conservation
- Transportation/fleet management
- High-performance sustainable buildings

NNSA activities (as of December 2009) associated with selected requirements from DOE Order 430.2B, Executive Order 13423, and Executive Order 13514 are discussed below.

Energy efficiency– NNSA would improve energy efficiency and reduce greenhouse gas emissions at the NNSS by reducing energy intensity by 3 percent annually or a total of 30 percent through the end of FY 2015, relative to the baseline of energy use in FY 2003. Energy intensity measures energy consumption per gross square foot of building space, including industrial and laboratory facilities. Greenhouse gas emissions would be reduced by 28 percent by FY 2020.

Table A–3 presents energy intensity reduction goals from the FY 2003 baseline through FY 2015 based on the Energy Independence and Security Act of 2007, Section 431, "Energy Reduction Goals." Additional mission requirements may preclude accomplishing this goal at the NNSS.

Table A–3 National Nuclear Security Administration Energy Intensity Reduction Goals

Fiscal Year	*Annual British Thermal Units Per Square Foot*	*Cumulative Percent Reduction*
2003	115,729	Base Year
2006	113,414	2
2007	111,100	4
2008	105,313	9
2009	101,842	12
2010	98,370	15
2011	94,898	18
2012	91,426	21
2013	87,954	24
2014	84,482	27
2015	81,010	30

Source: NSTec 2008.

NNSA would install advanced electric metering systems to the maximum extent practicable at all NNSS buildings, in accordance with the DOE metering plan for site monitoring of electric energy, and implement a centralized data collection, reporting, and management system. Standard metering systems for steam, natural gas, and water would also be installed and centrally monitored. Advanced meters have the capability to measure and record interval data (at least hourly for electricity) and to communicate the data to a remote location in a format that can be easily integrated into an advanced metering system.

As of December 2008, there were 395 electrical meters installed in the 423 buildings identified for electrical meter installation at the NNSS, with a projected 28 facilities identified for future installations (NSTec 2008). NLVF consists of 30 buildings, 3 of which are metered. Electrical, gas, and water meters would be installed at buildings at NLVF to allow NNSA to better track its use of electricity, water, and gas, thus improving its ability to identify conservation opportunities.

NNSA would, to the extent practicable, use standardized operations and maintenance and measurement and verification protocols, coupled with real-time information collection and centralized reporting capabilities. NNSA also would expedite improvement in the quality, consistency, and centralization of data collected and reported through the use of commercially available software.

Renewable energy – NNSA would maximize installation of onsite renewable energy projects at the NNSS where technically and economically feasible. The initial goal would be to acquire at least 7.5 percent of the NNSS's annual electricity and thermal consumption from onsite renewable sources. NNSA installed solar-powered pathway lighting where such lighting is feasible at the NNSS. This is expected to result in an energy savings of 120 million British thermal units per year. To achieve the initial goal under the No Action Alternative, NNSA would consider various options, including the possibility of entering into an agreement with a commercial entity to construct a solar power generation project at the NNSS. A portion of the electricity generated by such a project would be used to meet NNSS electrical needs.

Commercial Solar Power Generation – The *1996 NTS EIS* analyzed the environmental impacts of constructing and operating a solar power generation facility at two potential Solar Enterprise Zone sites on the NNSS (Area 22 and Area 25) and three non-NNSS sites in southern Nevada. The locations of the Area 22 and Area 25 solar power generation facility sites are depicted in Figure A–1. (The Solar Enterprise Zone on the NNSS is now called the Renewable Energy Zone.) Although a solar power generation facility was not constructed at any of the sites evaluated in the *1996 NTS EIS*, as part of the No Action Alternative in this SWEIS, NNSA is evaluating a potential commercial solar power generation facility at the NNSS. NNSA has determined that the southwestern portion of Area 25 is the only reasonable location on the NNSS for a commercial solar power generation facility. Area 25 includes an extensive area of suitable terrain for solar power facilities, has existing vehicular access from Highway 95 (Lathrop Wells Road) and an existing 138-kilovolt transmission line, and would not interfere with national security-related activities on the NNSS that require limited access to uncleared individuals. Although it possesses many of the same attributes as Area 25, Area 22 is not being considered as a potential location for solar power development in this *NNSS SWEIS* because all current solar power technologies require substantial water for cooling and other purposes and there would be potential impacts on Devil's Hole (see Chapter 5, Section 5.1.6) resulting from construction of any facility that would withdraw groundwater from the Mercury Valley (Hydrographic Basin 225). Low-water-use renewable energy projects may be considered for Area 22 in the future.

The solar technologies that are most likely to be deployed at utility scale over the next 20 years are photovoltaic and concentrating solar power, such as the parabolic trough, power tower, and dish engine technologies (BLM/DOE 2010). It is unknown which technology would be used in a solar power generation facility at the NNSS, but the analysis in this *NNSS SWEIS* assumes a concentrating solar power parabolic trough facility, based on the prevalence of that technology in other operating, proposed, and potential solar energy projects in southern Nevada (see Table 6–2 in Chapter 6). It is estimated that a concentrating solar power generation facility using parabolic trough technology would require between 9 and 10 acres of land for each megawatt of generating capacity, based on the proposed Amargosa Farm Road Solar Energy Project (BLM 2010). This acre per megawatt of generating capacity is about double that used in the *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* (BLM/DOE 2010) but is consistent with proposed parabolic trough solar power generation facilities currently being considered in southern Nevada. The assumptions used in the *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* are shown in **Table A–4**. Using the ratio scaled from the Amargosa Farm Road Solar Energy Project, the area of land required for a 240-megawatt parabolic trough solar power generation facility would be about 2,400 acres. For this SWEIS, NNSA assumed that the 240-megawatt capacity would employ a dry-cooled concentrating solar power technology using parabolic troughs, similar to the Amargosa Farm Road Solar Energy Project (BLM 2010). Potential impacts of commercial solar power generation at the NNSS are scaled from the Amargosa Farm Road Solar Energy Project (West 2010). In addition, additional electrical transmission capacity would be required to integrate the electricity generated by a 240-megawatt facility into the regional system. Approximately 10 miles of new 230-kilovolt transmission line (all off of the NNSS) was assumed for purposes of this analysis. As noted in Chapter 6, Section 6.2.4.4, Valley Electric Association intends to upgrade its electrical transmission system in its service territory, which would likely provide a suitable interconnection for the electrical generation from a commercial solar power generation facility on the NNSS. In addition, independent of, and unrelated to, the commercial solar power generation facilities considered in this *NNSS SWEIS*, NV Energy, a commercial electrical energy company, and Renewable Energy Transmission Company are planning separate new large capacity transmission line projects that would accommodate the additional electrical generation (see Chapter 6, Section 6.2.4.4, for additional information). Currently, no commercial solar power generation projects are proposed at the NNSS. Therefore, additional NEPA analysis would be required before any such project could be implemented.

Table A–4 Technology-Specific Assumptions for Environmental Impact Analyses from the Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States

Parameter	*Parabolic Trough*	*Power Tower*	*Dish Engine*	*Photovoltaic*
Facility power capacities (megawatts)	100 – 400	100 – 400	10 – 750	10 – 750
Land area requirements (acres per megawatt) [a]	5	9	9	9
Operational water use (acre-feet per year per megawatt)				
Wet (recirculating) cooling [b]	4.5 – 14.5	4.5 – 14.5	N/A	N/A
Dry cooling [b]	0.2 – 1.0	0.2 – 1.0	N/A	N/A
Hybrid system [c]	0.9 – 2.9	0.9 – 2.9	N/A	N/A
Mirror/panel washing/other [d]	0.5	0.5	0.5	0.05
Chemicals/hazardous materials present on site	Heat transfer fluid, water treatment chemicals and herbicides	Heat transfer fluid, water treatment chemicals, and herbicides	Hydrogen tanks and herbicides	Encased semiconductor materials and herbicides

N/A = not applicable.

[a] Land area estimates were based on areas required for existing facilities and estimated areas for proposed facilities. In some cases disturbed area estimates were not available, so values were based on total plant area (which should approximate disturbed area). The estimated land use values for parabolic trough and tower facilities are minimums; the land area requirement could be higher if thermal energy storage is incorporated into facilities.

[b] Wet-cooling and dry-cooling requirements are based on estimates given as gallons per hour per megawatt in the *Nevada Test Site Environmental Report 2008* (DOE/NV 2009). An assumed range of operational hours of 30 to 60 percent of annual hours (1 gallon = ~3.1 x 10^{-6} acre-feet) was used to generate acre-feet per year per megawatt values.

[c] Hybrid systems were assumed to use 20 percent of the water requirements of wet-cooling systems.

[d] The mirror washing estimates originate from the assumed 2 percent of total water needs of wet-cooled parabolic trough facilities from DOE/NV (2009). This estimate equals 20 gallons per hour per megawatt, which corresponds to 0.5 acre-feet per year per megawatt, with no assumption on operational time (conservative estimate). The panel-washing estimate for photovoltaic facilities was assumed to be a factor of 10 less than that for concentrating solar power technologies (Appendix M).

Source: BLM/DOE 2010.

Water conservation – In FY 2007, NNSA established a water production baseline, 210.6 million gallons, in accordance with Executive Order 13423. Actual water consumption figures are not available because NNSS facilities do not have water meters attached to the buildings. Instead, water production data were used to provide metrics in this area. The FY 2007 production baseline was used during FY 2008 to identify trends, and make recommendations for the implementation of site-wide water conservation measures. NNSA sites began saving water through several conservation measures. Examples include the installation of WaterSense™ products, xeric landscaping, using nonpotable water for dust suppression, and the institution of 4-day workweeks.

Table A–5 presents potable water production goals from the FY 2007 baseline through FY 2015. Water production was reduced by 18 percent in FY 2008 compared with the FY 2007 baseline, thereby exceeding the FY 2015 goal of 16 percent water reduction. Water production was reduced by an additional 8 percent in FY 2009.

Table A–5 Potable Water Production Goals for the Nevada National Security Site

Fiscal Year	*Potable Water Production (millions of gallons)*	*Cumulative Percent Reduction*
2007	210.6	Base Year
2008	206	2
2009	202	4
2010	198	6
2011	194	8
2012	190	10
2013	185	12
2014	181	14
2015	177	16

Source: NSTec 2008.

Efforts to identify water-saving projects and obtain funding to complete them are ongoing to ensure that the water production reductions that have been achieved are maintained. NNSA would continue to use best management practices for water efficiency in the following areas: water management planning; system audits, leaks, and repairs; landscaping; irrigation; toilets and urinals; faucets and showerheads; boiler systems; and other water uses.

The NNSS does not have a water-recycling program. Water and sewage are discharged into either sewage lagoons or septic systems. NNSA evaluated recycling gray water at the NNSS and determined that the cost would be prohibitive given the quantity of flow and lack of means to redistribute the recycled water. The water could be used for dust control in some cases, but, depending on the extent of treatment, there are restrictions on how the water may be used. Water recycling is not being considered under the No Action Alternative.

Transportation/fleet management – The current NNSA fleet has 540 alternative-fuel vehicles, equal to 96 percent of the covered fleet. NNSA requires that its fleet operate any alternative-fuel vehicles exclusively on alternative fuels to the maximum extent practicable. In FY 2007, NNSA constructed an E85 fuel station in Mercury (E85 is an alcohol–fuel mixture that typically contains a mixture of up to 85 percent denatured fuel ethanol and gasoline or other hydrocarbon by volume) and implemented a successful plan to promote the use of the alternative fuel. In FY 2007, the total actual usage of E85 fuel was 135,141 gallons; the consumption in FY 2008 was 182,997 gallons, a 35 percent increase in usage. For every gallon of E85 fuel used, 85 percent of the petroleum base fuel is reduced; for every gallon of B-20 biodiesel fuel used, 20 percent of the petroleum base fuel is reduced; and for every gallon of unleaded gasoline used, 10 percent is reduced. Biodiesel fuel is used in all equipment, with the exception of emergency generators and boilers, and is currently at the maximum possible usage level.

High-performance sustainable buildings – NNSA would ensure that: (1) all new construction and renovation projects implement design, construction, maintenance, and operations practices in support of the high-performance building goals of Executive Order 13423 and statutory requirements; and (2) existing facilities' maintenance and operations practices meet the goals of Executive Order 13423. The High-Performance Building Plan would also align with Executive Order 13327 and DOE's Real Property Asset Management Plan. At a minimum, the High-Performance Building Plan would include employment of integrated design principles, optimization of energy efficiency, use of renewable energy, protection and conservation of water, enhancement of indoor environmental quality, and reduction of environmental impacts of materials in accordance with the guiding principles of DOE Order 430.2B, Attachment 1, and construction related to Executive Order 13423.

A.1.3.3 Other Research and Development Programs

In 1992, the NNSS became the seventh unit of the DOE National Environmental Research Park Program. The NNSS program initially operated under a cooperative agreement between the DOE Nevada Operations Office (now NNSA/NSO); the University of Nevada, Reno; and the University of Nevada, Las Vegas, whereby the DOE Nevada Operations Office's Environmental Management Office provided financial assistance to the two universities to conduct scientific research projects unique to the Nevada National Environmental Research Park. Areas of research would include, but would not be limited to, habitat reclamation, hydrogeologic systems, radionuclide transport, ecological change, waste management, monitoring processes, remediation, and characterization. In addition, scientific research projects conducted by parties other than those in the above-mentioned agreement could be conducted, but would be funded from sources other than DOE/NNSA.

The Nevada Desert Free-Air Carbon Dioxide Enrichment Facility and Mojave Global Change Facility are two environmental research facilities located in Area 5 of the NNSS that are conducting long-term environmental research.

The Nevada Desert Free-Air Carbon Dioxide Enrichment Facility is a state-of-the-art facility designed to study responses of an undisturbed desert ecosystem to increasing levels of atmospheric carbon dioxide. The experimental plots are designed to permit a controlled release of elevated carbon dioxide in the air around vegetation without disturbing other environmental and ecosystem conditions. There are nine experimental plots: three with elevated levels of atmospheric carbon dioxide and six without elevated carbon dioxide levels. Collaborators at the Nevada Desert Free-Air Carbon Dioxide Enrichment Facility include the Desert Research Institute; University of Nevada, Las Vegas; University of Nevada, Reno; and Brookhaven National Laboratory. The facility is supported by DOE and NNSA. This facility has been placed in a standby condition due to lack of funding.

The Mojave Global Change Facility was established in Area 5 of the NNSS and would continue to examine the impact of global climate change factors other than increased carbon dioxide (i.e., increasing summer monsoon rains, increased nitrogen deposition, and disturbance or destruction of the desert soil crust) on the Mojave Desert ecosystem. Three treatments at various levels are applied to the 96 196-square-meter plots. These treatments include three summer irrigation treatments, two levels of nitrogen fertilization, and soil crust disturbance.

An anticipated focus of research at these two facilities may be determining mechanisms by which carbon is sequestered in deserts. Results of research at the Mojave Global Change Facility and other arid region research sites suggest that arid regions sequester significantly more carbon than originally believed. Determining how this occurs would be a research priority.

A.2 Expanded Operations Alternative

The scope of the Expanded Operations Alternative in this SWEIS is defined to include all the capabilities and projects described under the No Action Alternative, plus additional newly proposed capabilities and projects. These additional activities would include modification or expansion of existing facilities and construction of new facilities. In addition, some ongoing activities would be conducted more frequently than under the No Action Alternative. For each activity addressed in this section, the differences from the No Action Alternative are noted. In addition to changes in activities, under the Expanded Operations Alternative, there would be two changes in NNSS land use zones: (1) the designated use for Area 15 would be changed from "Reserved" to "Research, Test, and Experiment"; and (2) approximately 39,600 acres within Area 25 would be designated as a Renewable Energy Zone. **Figure A–2** depicts the land use zones and major facilities at the NNSS under the Expanded Operations Alternative.

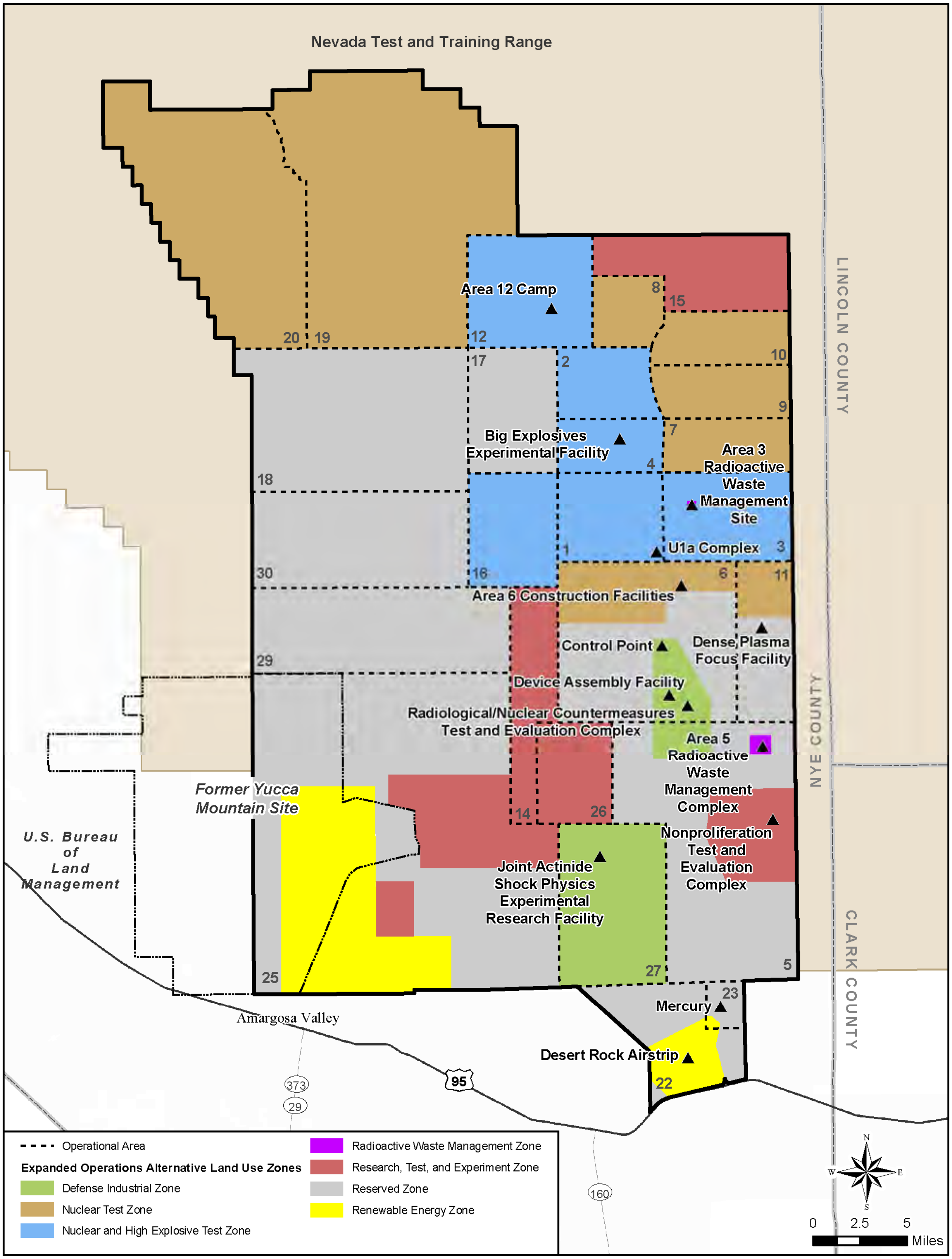


Figure A–2 Nevada National Security Site Land Use Zones and Major Facilities Under the Expanded Operations Alternative

A.2.1 National Security/Defense Mission

Under the Expanded Operations Alternative, NNSA would pursue additional activities associated with the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

A.2.1.1 Stockpile Stewardship and Management Program

Under the Expanded Operations Alternative, Stockpile Stewardship and Management Program operations would continue at NNSA facilities in Nevada, particularly at the NNSS, under the conditions of the ongoing nuclear testing moratorium. This alternative would include those activities necessary to maintain the capability to conduct nuclear tests if so directed by the President. Readiness-to-test activities include maintaining the necessary infrastructure and, more importantly, exercising the research and engineering disciplines of the Nation's nuclear weapons programs through an active science-based Stockpile Stewardship and Management Program at the NNSS to ensure the continued competence of its technical staff.

Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative (see Section A.1.1.1) for the following Stockpile Stewardship and Management Program projects and activities:

- Criticality experiments in DAF
- Drillback operations
- Disposition of damaged U.S. nuclear weapons
- Stockpile stewardship and management activities at the TTR

Stockpile stewardship and management activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Dynamic experiments, dynamic plutonium experiments (a type of subcritical experiment), and hydrodynamic tests – NNSA would conduct up to 20 dynamic experiments per year. Over the next 10 years, a total of 5 dynamic experiments would be conducted in emplacement holes, with each such experiment causing an estimated 20 acres of new land disturbance.

Conventional explosives experiments at BEEF and other locations in the Nuclear and High Explosives Test Zone – NNSA would conduct up to 100 explosives tests and experiments per year. NNSA would also add a firing table and ancillary features within the already developed area at BEEF. NNSA would also develop and test for proof of concept a high-energy x-ray capability at BEEF. Following successful testing, the new x-ray system would be moved to the U1a Complex for operational use.

In addition to activities at BEEF (limited to 70,000 pounds TNT-equivalent), NNSA would conduct tests and experiments using up to 120,000 pounds TNT-equivalent of explosives at various locations within the Nuclear and High Explosives Test Zone. These detonations would be conducted both underground and in the open air. Conventional explosives operations supporting other programs at the NNSS are described under those programs. All explosive operations would be conducted in compliance with DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

NNSA would establish up to three areas dedicated to conducting explosives tests and experiments using depleted uranium. Depleted uranium test and experiment areas may be established within Areas 2, 4, 12, or 16. Each of these depleted uranium test and experiment areas would be about 40 acres in size and dedicated to tests and experiments with depleted uranium and explosives. An annual maximum of 4,000 pounds of depleted uranium and 12,000 pounds TNT-equivalent of explosives would be used to conduct up to 20 of these types of tests and experiments per year. Individual experiments would use up to 200 pounds of depleted uranium and 600 pounds TNT-equivalent of explosives.

Shock physics experiments at JASPER, located in Area 27, and the Large-Bore Powder Gun, located in Area 1 in the U1a Complex – NNSA would make the shock physics experimental facilities available for academic and other research on a nonconflicting basis and would increase the number of experiments with actinide materials up to 36 per year at JASPER and 24 at the Large-Bore Powder Gun in the U1a Complex.

Pulsed-power experiments – Under the Expanded Operations Alternative, the Atlas Facility would be activated, and up to 24 pulsed-power experiments per year would be conducted.

Fusion experiments at the NNSS and NLVF – New experimental uses would be pursued for the Dense Plasma Focus Machines, requiring deuterium-deuterium, deuterium-tritium, and tritium-tritium fusion and pulsed x-ray production. These experiments also would require a much larger-capacity energy storage bank than the one currently in use at the Area 11 facility. These new experimental uses would include ensuring an enduring experimental capability to support nuclear resonance spectroscopy, neutron materials investigations, and other stockpile stewardship activities. To facilitate the new uses for the Dense Plasma Focus Machine currently located in Area 11 of the NNSS, it would be relocated to an existing building in Area 6 of the NNSS. Following the relocation, the Area 11 facility would be placed on standby. NNSA would conduct up to 1,650 plasma physics and fusion experiments per year: 1,000 in the Dense Plasma Focus Machine at NLVF, and 650 in the machine in Area 11 (or Area 6 if it is moved).

Stockpile management activities – NNSA would conduct nuclear explosives operations at the NNSS in association with conducting an underground nuclear test, if so directed by the President. In addition, under the Expanded Operations Alternative, NNSA would conduct the following activities:

- Staging of nuclear devices pending disassembly, modification/maintenance, and/or transportation to another location
- Dismantlement of select weapons or weapon systems to aid the United States in meeting its commitment to reduce its nuclear weapons stockpile (weapons shipments to the NNSS under this activity would not exceed 100 per year)
- Modification and maintenance of nuclear devices at DAF, including replacing limited-life components in selected nuclear weapons systems
- Weapons components testing for quality assurance purposes at DAF

Staging of SNM, including pits – NNSA would continue to stage SNM at appropriate facilities on the NNSS. SNM would be relocated from other DOE/NNSA sites. For example, the following materials would be moved to the NNSS: up to 4 metric tons of SNM currently part of the Zero Power Physics Reactor Program at Idaho National Laboratory (for use in criticality experiments); about 200 kilograms of global security SNM currently stored at Lawrence Livermore National Laboratory (for use in detector development and as radiation test objects); 2 kilograms of uranium-233 currently stored at Los Alamos National Laboratory (associated with test readiness); and 500 kilograms of highly enriched uranium, depleted uranium, and uranium stored at Lawrence Livermore National Laboratory (associated with criticality safety). In addition, NNSA would stage weapon pits at DAF, pending their transport to the Pantex Plant in Texas or another appropriate location.

Training for the Office of Secure Transportation – In addition to hosting training and exercises on NNSS roadways, NNSA would construct new support facilities in Area 17 to support Office of Secure Transportation training programs. The new facilities would include administrative offices (5,000 square feet), a mock town (20 acres), a 8,000- to 10,000-square-foot shooting house (a building that can simulate various kinds of structures for conducting scenario-driven tactics development and training), and target props. Support facilities would also include two modular training facilities with restrooms (2,000 square feet each), two Butler buildings (5,000 square feet each), an electrical substation (100 square feet), a communications trailer (300 square feet), a 10,000- to 20,000-gallon potable drinking water tank, and a septic system with a leach field. The entire training area, including buffer areas, would occupy approximately 10,000 acres (including a live-fire training area for the Office of Secure Transportation). A total of about 3,500 acres would be disturbed to provide individual training venues, and 25 miles of roads and firebreaks would be developed surrounding the whole active training area and between individual training venues. Most of these roads and firebreaks would be graded, single-lane dirt roads with shoulders; up to 4 miles would be paved asphalt, double-lane roads with shoulders. Potable water would be obtained from an existing well approximately 4.5 miles away, requiring construction of a water pipeline. An electrical distribution line would also be constructed to extend electrical service from the vicinity of the well to the new facilities. Main access to the complex would be from the Tippipah Highway.

The Office of Secure Transportation would expand its facilities in 12 Camp (Area 12), the Area 6 Control Point, or Mercury (Area 23), and maintenance buildings (20,000 square feet), administrative buildings (10,000 square feet), and a dormitory (20,000 square feet) would be constructed to support training operations.

These facilities would also be available to other NNSS customers (e.g., DoD and other Government agencies) when not in use by the Office of Secure Transportation.

A.2.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Nuclear Emergency Response Program, Nonproliferation, and Counterterrorism Program projects and activities:

- Nuclear Emergency Support Team support
- Consequence management support for FRMAC, the Aerial Measuring System, the Accident Response Group, and the Radiological Assistance Program
- Disposition of improvised nuclear devices on an as-needed basis
- Weapons of mass destruction emergency responder training
- Provision of equipment and technical support for the DOE-dedicated Emergency Communications Network
- Nuclear forensics

Activities associated with the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Nonproliferation and counterterrorism-related activities – NNSA nonproliferation- and counterterrorism-related activities would include four related areas: arms control, nonproliferation, nuclear forensics, and counterterrorism. Although the purpose of nonproliferation- and counterterrorism-related activities would be the same as that under the No Action Alternative, new nonproliferation and counterterrorism facilities, described below, would be constructed at various locations on the NNSS to undertake enhanced activities. Because the new nonproliferation and counterterrorism facilities (Arms Control Treaty Verification Test Bed, Nonproliferation Test Bed, and Urban Warfare Complex) are still conceptual in nature and their locations are unknown, they are not fully analyzed in this SWEIS, and an appropriate level of NEPA analysis would be required before they could be implemented.

Arms control – The Arms Control Treaty Verification Test Bed would require construction of both indoor and outdoor laboratory space and test areas for design and certification of treaty verification technology, training of inspectors, and development of arms-control-related confidence-building measures. These facilities would be sited at various locations at the NNSS; construction of new facilities would require a total of about 100 acres of land.

A new facility for data fusion, analysis, and visualization would also be constructed. The new building would have approximately 10,000 square feet of floor space and would be integrated with a building constructed to house other Arms Control Treaty Verification functions.

Nonproliferation – A Nonproliferation Test Bed would require construction of a new facility where users would simulate chemical and radiological processes that could be conducted clandestinely by an adversary.

Counterterrorism – In addition to counterterrorism training being conducted at existing facilities, an Urban Warfare Complex would be constructed at the NNSS. This would include full-scale, modular replicas of urban areas where terrorists and insurgents typically seek refuge. This urban warfare training ground would be wired and instrumented for continuous recording of exercises for post-event evaluations and classroom training. NNSA expects that the Urban Warfare Complex would cover about 100 acres in a remote location on the NNSS.

A.2.1.3 Work for Others Program

Under the Expanded Operations Alternative, there would be no changes from the No Action Alternative for the following Work for Others Program activities:

- Treaty verification activities
- Military training and exercises
- Work for Others Program activities at the TTR

Work for Others Program activities that would change relative to the No Action Alternative under the Expanded Operations Alternative include the following:

Nonproliferation projects and counterproliferation research and development – Support would be provided for development of radiation detection capabilities, additional sensor development, and active interrogation programs to detect nuclear material.

Counterterrorism – Under the Expanded Operations Alternative, NNSA's Work for Others Program would support the counterterrorism activities of other Federal agencies. Future USAF activities would include research, development, testing, and evaluation of unmanned aerial vehicles and/or unmanned aircraft systems, as well as integration of training and exercises. Other activities would include development and testing of sensors for detection and defeat of improvised explosive devices, which would require construction of test beds (roads, intersections, small towns, etc.) and support facilities. Construction of these facilities would require new buildings with about 10,000 square feet of new floor space and would disturb about 75 acres of land.

DHS counterterrorism operations support would include construction of new training facilities (about 10,000 square feet of floor space). In addition, RNCTEC would be operated up to the level of a Hazard Category 2 nonreactor nuclear facility, which would allow larger amounts of radioactive material in alternative configurations to be used in tests and experiments. A high-speed road, a short section of full-scale railroad line, a simulated seaport facility, and a mock urban area would also be added to RNCTEC (NNSA 2004), requiring about 125 acres of additional land in Area 6. Because these new facilities are still conceptual in nature and their locations are unknown, an appropriate level of NEPA analysis and documentation would be required before they could be implemented.

Support for NASA – NNSA would support NASA nuclear rocket motor development, including using existing boreholes to examine the use of deep alluvial basins for sequestering radionuclides released as part of emissions from tests of a yet-to-be-developed prototype nuclear rocket motor. Over about a 10-year period, NASA would not likely test a nuclear rocket motor, but may conduct proof-of-concept tests using a surrogate, such as spiked xenon, in a borehole to evaluate the effectiveness of the alluvium for this purpose. Research that could be performed in conjunction with this would use the results to determine field-scale properties of alluvial materials for improved modeling of transport of fluid and gases in unsaturated and saturated environments. If it becomes necessary to test an actual nuclear rocket motor, additional NEPA analysis would be conducted.

Aviation Work for Others – Activities would include increased research, development, and use of aerial platforms at the NNSS. To support these activities, additional facilities would be required at Desert Rock Airport (hangars, shops, and other buildings occupying approximately 200,000 square feet) and the Area 6 Aerial Operations Facility (a hangar occupying approximately 20,000 square feet). Additional facilities occupying approximately 5,000 square feet may be required at other locations to support air operations, including testing of various types of manned and unmanned aerial vehicles such as small, remote-controlled, fixed-wing airplanes and helicopters. Unmanned aerial vehicles would be tested for potential use carrying sensors for collecting environmental data (e.g., multi- and hyperspectral imagery) to be used in digital environmental model development and for terrain analysis in arid and semiarid regions.

Active Interrogation – Active interrogation uses penetrating nuclear radiation, such as neutrons or photons, as a probe to stimulate a unique radiation signature from fissionable material. It has been demonstrated as an effective way to sense the presence of SNM, even when it is shielded. Many active interrogation methods are based on the detection of neutrons from fission induced by fast neutrons or high-energy gamma rays (Pozzi n.d.). The energy spectrum of the fission neutrons provides data to identify the fissionable isotopes and materials such as shielding between the fissionable material and the detector. Active interrogation works by using an accelerator or other radiation-generating device to produce a pulsed radiation beam that is directed at a target, then the radiation that propagates from the target is measured, usually between the pulses.

Work for Others Program activities would include support for development of active interrogation systems to detect nuclear material and other materials of interest. NNSA would expand its support for research and development of active interrogation equipment, such as accelerators and other radiation-generating devices, as well as associated radiation detection systems, operations, methods, and training. DHS would use a facility at RNCTEC to conduct this activity, but other Federal agencies may require an additional facility, most likely located in Area 12 or 16. In addition to fixed facilities, temporary test beds would be used for testing accelerators and other radiation-generating devices and detectors. In general, temporary active interrogation test beds would use existing NNSS roads, but could also include some off-road areas. Operations at temporary test beds would most often involve the use of mobile accelerators/radiation-generating devices. Construction of additional support facilities and temporary test beds would disturb about 100 acres of previously undisturbed land over the next 10 years.

The accelerators/radiation-generating devices would be used to generate beams of electrons, x-rays, neutrons, gamma radiation, and other types of radiation, as appropriate, to interrogate target material. Test targets to be interrogated would include radioactive material, SNM, and various other materials utilized as shielding. The quantity of SNM that would be used as a target would be within subcritical limits, i.e., quantities that can be demonstrated to be subcritical under all normal, abnormal, and accident conditions (quantity and nature of process activities must preclude the potential for a nuclear criticality). Test targets would also incorporate various materials to better understand the physical properties associated with the exposure of materials to various forms of energy from the accelerators/radiation-generating devices.

The radiation from these machines would be penetrating, and significant transmission intensities could occur through shields of substantial thickness. Unshielded radiation from these devices would be primarily forward-directed and could travel over long distances (a few miles). This effect is beneficial for measurement situations focused on interrogating objects long distances away from the accelerator/radiation-generating device (often called standoff interrogation). Unshielded radiation fields in the vicinity of these devices are high, and occupational radiation exposure limits for personnel in the immediate vicinity of the device and for several hundred meters downrange could be exceeded without mitigating controls. However, with proper engineered and administrative controls, they can be readily used in a safe manner.

When energetic x-rays interact with materials, they have the potential to cause the ejection of neutrons (as well as protons and other charged particles) from atomic nuclei via photonuclear reactions including (γ,n), (γ,2n), and (γ,p). In fissionable materials, including uranium and plutonium, energetic x-rays can also induce fission to take place via the photofission (γ,fission) reaction. The x-ray energy thresholds and reaction probabilities for these reactions vary from isotope to isotope. Radiation, such as gamma rays, x-rays, or neutrons, produced during the interrogation pulse are called prompt radiation. Fission products also produce delayed radiation over a time period of several hundred seconds after the beam pulse. Radiation exposure from these interactions is expected to be relatively small when compared to the direct radiation from the beam itself at energies below 60 million electron-volts.

Unique differences exist in the energy, emission rates, and emission properties between these prompt and delayed radiations. Photonuclear active interrogation exploits these unique signatures to be able to detect, identify, and characterize different fissionable materials. Neutrons produced in the test object thermalize and are captured or produce fission in short time periods after each radiation pulse. Prompt and delayed photo-fission neutrons can remain in a test object for short periods of time (milliseconds) after each radiation beam pulse. In these short time periods, these residual neutrons can lead to additional neutron-induced fission events.

To measure these signatures, special detector systems must be employed that are simultaneously capable of withstanding the radiation fields generated when the device pulses and achieving very sensitive detection efficiencies for the delayed radiation products.

Initially, energy levels used in active interrogation research and development at the NNSS are not expected to exceed about 60 million electron-volts. Future activities may include machines that operate at energy levels in the range of 100 million electron-volts.

Radioactive tracer experiments – Radioactive tracer experiments would be conducted to validate sensor technology. These experiments would include both underground releases and open-air releases of radioactive noble gases and nonradioactive gases (helium and sulfur hexafluoride). The underground experiments would release up to 27 curies of radioactive noble gases with short half-lives (5 to 36 days); nonradioactive releases would include from about 300 gallons of helium to about 2,000 gallons of sulfur hexafluoride. The underground experiments would include explosive gas releases, pressurized releases, explosive radioactive particulate releases, and a baseline survey of legacy contamination. The open-air experiments would release small quantities of radionuclides with short half-lives. Up to 12 experiments involving open-air releases would be conducted each year. NNSA would comply with applicable requirements of 10 CFR Part 61, Subpart H, for all experiments that could result in a release of radioactive material to the air. Prior to conducting any experiment that would result in a release of radioactive materials to the air, NNSA would conduct an evaluation using EPA-approved methods to estimate the potential radiological dose to the maximally exposed individual at the boundary of the NNSS. For any release that may result in a dose of 0.1 millirem or more, NNSA would submit an application to the Nevada Bureau of Air Pollution Control and EPA for approval to conduct the experiment, in compliance with 40 CFR 61.96. NNSA would ensure that the cumulative annual radiological dose at the boundary of the NNSS resulting from all activities involving radioactive materials would comply with EPA's annual emission standard of 10 millirem (40 CFR 61.92).

New test beds – Additional test beds would be developed to support research and development for sensors, high-power microwaves, and high-power lasers, as required. These new test beds (including new buildings totaling approximately 50,000 square feet of floor space) would be constructed at various locations on the NNSS and would disturb approximately 200 acres of previously undisturbed land. Because there are no specific plans for construction of these new test beds at this time, additional NEPA analysis would be necessary before they could be implemented.

The following new test beds would be developed at the NNSS under the Expanded Operations Alternative:

Nuclear-Fuel-Cycle-Related Radionuclide Release, Diagnostics and Solids Detection, and Characterization Test Bed – In support of the various nuclear nonproliferation treaties in which the United States participates or anticipates participation, NNSA would establish test beds at the NNSS for use in developing sensors to support treaty verification and nonproliferation validation. Facilities to support deployment of fixed uranium oxides and controlled amounts of depleted uranium would include static concrete display pads, static target display pans, thermal targets, and ponds and pools of water.

Specialized Explosive Testing and Manufacture Test Bed – Support for DoD and the U.S. intelligence community would expand to include development of sensors and techniques for detection and defeat of improvised explosive devices, homemade explosives, conventional military ordnance, and chemical explosives, as well as explosives-driven, shaped-charge development and evaluation.

Radio Frequency Generation Test Bed – Technologies would be developed to detect, sample, characterize, and identify radio frequency signatures and observables. The test bed would be used to develop the ability to generate specific signals, to characterize the radio frequency environment, and to monitor tests.

Infrasonic Observations Test Bed – Technologies would be developed to monitor earthquakes and underground disturbances. The test bed would be used to develop the ability to detect specific signals, characterize the seismic environment, and monitor tests.

Chemical Test Bed – Activities at this test bed would include simulated manufacture and releases of illegal drugs by authorized Federal organizations to develop detection and prevention technologies. An existing facility would be used to train personnel and test sensors and procedures for detection of toxic industrial chemicals.

Biological Simulants Test Bed – Activities at this test bed would include manufacture of biological simulants by authorized Federal organizations for use in detection technology development. Biological simulant releases to the soil, the air, or an NNSS sewer/septic system, would emulate anticipated real-world scenarios. Construction to support these functions would disturb up to 50 acres of land.

A.2.2 Environmental Management Mission

The NNSA Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Under the Expanded Operations Alternative, the Waste Management Program would accept greater volumes of LLW and MLLW from both offsite and onsite sources. As under the No Action Alternative, the Environmental Restoration Program would continue to meet the requirements of the most recent FFACO.

A.2.2.1 Waste Management Program

Waste management operations would support DOE and NNSA research and environmental restoration programs. Under the Expanded Operations Alternative, the waste management objective for the NNSS would continue to be to properly dispose and monitor wastes generated from the NNSS, DoD, and other approved waste generator sites. Approval to ship waste to the NNSS for disposal may be granted only after a waste generator demonstrates that it has a waste characterization and certification program that meets the requirements stated in the NNSS waste acceptance criteria. The process by which NNSA certifies a waste generator, as well as the waste acceptance criteria, is described in greater detail in Chapter 4, Section 4.1.11.1.1.3.

In response to increased levels of operations at NNSA facilities in Nevada under the Expanded Operations Alternative, waste management activities associated with some waste types would increase. In particular, up to approximately 48,000,000 cubic feet of LLW and 4,000,000 cubic feet of MLLW would be disposed at the NNSS. These waste volumes are based on: (1) projections of the respective waste types that are designated for disposal at the NNSS, as well as those without a designated disposal location, as projected in DOE's Waste Information Management System Database as of April 2010, and (2) input from prospective waste generators regarding potential waste streams and/or volumes that are not currently included in the database. Waste estimates include those from West Valley Demonstration Project decontamination and decommissioning, commercial enrichment facilities, Oak Ridge National Laboratory Building 3019 U-233 downblending or direct disposal, disposal of DoD radioisotope thermoelectric generators, and the Global Threat Reduction Initiative.

Table A–6 contains a list of generators of LLW and MLLW under the Expanded Operations Alternative. The quantities shown comprise the inventories currently projected and are used for purposes of analysis. The table is not intended to provide a comprehensive listing of generators that could ship LLW and/or MLLW to the NNSS for disposal or of generator-specific waste volumes that could be disposed in the future. Some of the listed generators may ship larger or smaller quantities than shown based on site-specific determinations. Additionally, some yet-to-be-identified generators may ship LLW and/or

MLLW to the NNSS for disposal. While the quantities from individual generators may vary from those shown in the table, the total volumes would not exceed 48,000,000 cubic feet of LLW or 4,000,000 cubic feet for MLLW. The estimates of LLW and MLLW volumes to be disposed at the NNSS under the Expanded Operations Alternative are based upon conservative estimates from waste-generating facilities, and the aggregated totals reflect this conservatism (i.e., likely overestimate quantities). Additional NEPA review would be conducted if new generators or waste streams were identified.

Table A–6 Waste Generators and Volumes Under the Expanded Operations Alternative [a]

Waste Generators	*Region [b]*	*LLW (cubic feet)*	*MLLW (cubic feet)*
	Out-of-State Generators		
Argonne National Laboratory	Upper Midwest	1,300,000	1,200
Brookhaven National Laboratory	Northeast	120,000	NP
Energy Technology Engineering Center	West	110,000	NP
General Atomics	West	8,400	NP
Idaho National Laboratory	Mountain West	1,000,000	46,000
Lawrence Berkeley Laboratory	West	170,000	96
Lawrence Livermore National Laboratory	West	300,000	580
Los Alamos National Laboratory	Southwest	3,200,000	920,000
Naval Reactor Facility	Mountain West	530	NP
Nuclear Fuel Services	South	430,000	NP
Oak Ridge Reservation	South	2,500,000	370,000
Paducah Gaseous Diffusion Plant	South	5,100,000	1,500,000
Pantex Plant	Southwest	20,000	NP
Portsmouth Gaseous Diffusion Plant	Upper Midwest	14,000,000	58,000
Princeton Plasma Physics Laboratory	Northeast	9,900	NP
Puget Sound Naval Shipyard	Northwest	1,100	NP
Sandia National Laboratories	Southwest	7,800	2,900
Savannah River Site	Southeast	160,000	52,000
SLAC National Accelerator Laboratory	West	570,000	570,000
Separations Project Research Unit	Northeast	NP	2,500
West Valley Demonstration Project	Northeast	6,200,000	750
Waste treatment facilities [c]	Multiple regions	88,000	30,000
Commercial enrichment facilities	Upper Midwest	57,000	NP
U.S. Department of Defense (RTGs)	South (Norfolk, VA)	1,400	NP
Offsite Source Recovery Project	Southwest (San Antonio, TX)	8,500	NP
Total Out-of-State Generators		**36,000,000**	**3,500,000**
	In-State Generators		
Nevada Nuclear Security Site	Not applicable	1,300,000	520,000
North Las Vegas Facility	Not applicable	150	NP
Tonopah Test Range & Nevada Test and Training Range	Not applicable	11,000,000	NP
Total In-State Generators		**12,000,000**	**520,000**
All Generators		***48,000,000***	***4,000,000***

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NP = none projected; RTG = radioisotope thermoelectric generator; SLAC = Stanford Linear Accelerator Center.

[a] Actual individual waste volumes by generator may be more or less than presented in the table, and other yet-to-be-identified generators may ship LLW and/or MLLW to the NNSS for disposal. The quantities shown constitute the inventories currently projected and are used for purposes of analysis only.

[b] Regional location of radioactive waste generators used in the transportation analysis.

[c] Refers to wastes from DOE generators that are sent to the NNSS for disposal after processing at a variety of treatment facilities.

Note: Totals may not equal the sum of individual values because of rounding.

Use of rail-to-truck transloading (i.e., intermodal transportation) would increase, including the use of transloading facilities within Nevada, should commercial vendors establish such a facility. As addressed for the No Action and Reduced Operations Alternatives, final closure of existing operationally closed disposal units would begin in calendar year 2011, and LLW and permitted MLLW disposal would continue elsewhere at the Area 5 RWMC. The Area 3 RWMS may be returned to operation to address, together with the Area 5 RWMC, the volumes of LLW projected for receipt under this alternative. Within the existing Area 5 RWMC and the Area 3 RWMS, new disposal units would be constructed, filled, and closed, as needed, to accommodate the additional waste volumes.

Under the Expanded Operations Alternative, NNSA would treat and store various types of MLLW received from authorized in-state and out-of-state generators. This would require development of one or more MLLW storage facilities similar to the Hazardous Waste Storage Unit. NNSA may modify existing facilities within the Area 5 RWMC or may construct a new facility for MLLW storage. Treatment capacity for both onsite- and offsite-generated MLLW would be developed. Existing facilities would be used to develop treatment facilities for both in-state- and out-of-state-generated MLLW. The treatment technologies that would be developed include macroencapsulation, stabilization/microencapsulation, sorting/segregating, and bench-scale mercury amalgamation. Appropriate permits would be obtained before expanding MLLW storage capacity or implementing any of these treatment technologies. Initially, additional MLLW storage capacity would be developed on the TRU Pad to accommodate MLLW treatment (for either in-state- or out-of-state-generated wastes), pending development of MLLW storage capacity in existing or new facilities at the Area 5 RWMC. To handle the increased volumes and more-frequent shipment receipt rates of LLW and/or MLLW, an additional waste offloading and staging area would be established within the Area 5 RWMC to maintain optimal disposal operations efficiency.

Waste management activities at the NNSS under the Expanded Operations Alternative would additionally include the following:

- Because of the projected increased annual number of experiments at JASPER and other national security activities, somewhat larger quantities of TRU waste would be annually generated (about 1,500 cubic feet per year). As with the No Action Alternative, TRU waste generated by DOE/NNSA activities in Nevada would be safely stored at the TRU Pad pending shipment off site for disposition along with other legacy or newly generated environmental restoration waste.

- Continued treatment by evaporation of liquids containing small concentrations of tritium. Continued management of hazardous waste (about 170,000 cubic feet would be generated by DOE/NNSA activities) in compliance with applicable regulations and permits.

- Continued management of asbestos and PCB wastes, and hydrocarbon-contaminated soil and debris, in compliance with applicable regulations and permits.

- Continued treatment of explosives at the Explosives Ordnance Disposal Unit in Area 11.

- Continued operation of the Area 23 Class II Solid Waste Disposal Site, the Area 6 Class III Solid Waste Disposal Site (Hydrocarbon Landfill), and the U10c Class III Solid Waste Disposal Site. Approximately 9,400,000 cubic feet of sanitary solid waste and construction and demolition debris would be generated by DOE/NNSA activities at the NNSS and disposed in these landfills over the next 10 years. To accommodate the potential increases in solid wastes that may be generated by various operations at the NNSS under the Expanded Operations Alternative, NNSA would seek permits to construct and operate new solid waste disposal facilities as needed. A new sanitary waste landfill would require approximately 15 acres of land. To support environmental restoration work in Area 25, NNSA would obtain appropriate permits to construct and operate a construction/demolition debris landfill that would disturb up to 20 acres in Area 25 of the NNSS. An estimated 9,700,000 cubic feet of sanitary solid waste generated by DOE/NNSA activities would be sent off site to permitted facilities to be recycled.

A.2.2.2 Environmental Restoration Program

Under the Expanded Operations Alternative, the NNSA Environmental Restoration Program would continue in compliance with the FFACO in the form of characterization, monitoring, and, if necessary, remediation of identified contaminated areas, facilities, or environmental media. The NNSA environmental restoration projects that would continue under the Expanded Operations Alternative include the following:

Underground Test Area Project – Activities would continue as identified under the No Action Alternative, but at a potentially accelerated rate.

Soils Project – Activities would continue as identified under the No Action Alternative for the UGTA and Industrial Sites Projects, remediation of Defense Threat Reduction Agency Sites, and Borehole Management Program, but most activities would accelerate. Cleanup standards for Soils Project sites on lands under the jurisdiction of the USAF are subject to agreement among the USAF, NDEP, and DOE. The No Action Alternative addressed cleanup levels consistent with current land uses. However, if more-stringent cleanup standards are adopted than currently planned or additional sites are included under the FFACO, the volumes of waste requiring transport and disposal would increase. For purposes of analysis under the Expanded Operations Alternative, this SWEIS assumes that, at a number of contaminated soil sites on the Nevada Test and Training Range and the TTR (i.e., Clean Slate 2, and 3, Project 57, and Small Boy), a total of about 504 acres would be excavated to a depth of 0.5 feet and the removed soil would be disposed as LLW at either the Area 5 RWMC or the Area 3 RWMS.

Industrial Sites Project – Activities would continue as identified under the No Action Alternative, but some activities would accelerate. The amount of waste that would require transport and disposal may increase if more sites are required to be remediated than currently planned.

Defense Threat Reduction Agency Sites – Activities would remain the same as those under the No Action Alternative for Defense Threat Reduction Agency environmental restoration activities.

Borehole Management Program – Activities would remain the same as those under the No Action Alternative. NNSA would continue to plug unneeded boreholes on the NNSS. Based on the current schedule and known inventory of unneeded boreholes on the NNSS that need to be plugged, the Borehole Management Program should be complete by the end of 2013.

A.2.3 Nondefense Mission

The Nondefense Mission generally includes those activities that are necessary to support mission-related programs, such as construction and maintenance of facilities, provision of supplies and services, warehousing, and similar activities. Activities related to energy supply and conservation, including renewable energy, are considered part of the Nondefense Mission, as are other research and development activities that may occur at NNSA facilities in Nevada, including activities at the Nevada National Environmental Research Park. As described in the following paragraphs, all Nondefense Mission programs would be modified to some extent under the Expanded Operations Alternative.

A.2.3.1 General Site Support and Infrastructure Program

Under the Expanded Operations Alternative, in addition to small projects to maintain the present capabilities of the NNSS, RSL, NLVF, and the TTR, infrastructure-associated activities would include increasing the capacities and capabilities or extending the ranges of facilities and/or services to accommodate new operational programs, projects, and activities.

In addition to accommodating operational requirements and constructing the new facilities described in Sections A.2.1 and A.2.2, the following infrastructure enhancements would be implemented:

- A new security building in Area 23 of the NNSS would be constructed adjacent to existing security facilities. This project would replace outdated facilities (most built in the 1950s and 1960s) and consolidate security facilities (Buildings 1000, 1001, 1002, 114, 701, 1103, 1106, 1107, 1108 and portions of Control Point-41, -111, and -525) and functions into a new, approximately 85,000-square-foot, two-story facility. The facility would include space for administrative offices, computer servers for systems supporting NNSS operations, training, emergency response, locker rooms, restrooms, storage space, armory, technology development, electronic security system engineering and maintenance, and classified work areas. The new building would decrease external exposure to critical security facilities located outside the secure boundaries of the NNSS. The buildings replaced would be evaluated and demolished or used for another purpose. This project is needed in order to provide a safe and secure NNSS to accommodate mandatory training; house new weapons and technology; consolidate protective force operations; provide electronic security system maintenance and testing; provide continuity of operations; and increase exercises per Site Safeguards and Security Plans, Vulnerability Assessments, and protection strategies designed to ensure adequate protective force staffing levels, equipment, facilities, training, management, and administrative support. The proposed project responds to DOE Orders and Federal Codes and Standards, including DOE Order 470.4a, *Safeguards and Security Program*; DOE Order 226.1a, *Implementation of Department of Energy Oversight Policy*; and 10 CFR Part 851, "Worker Safety and Health; Defense Nuclear Security Program; Master Security Plan; DOE Security Strategic Plan; NNSA Defense Nuclear Security Strategic Framework; and Graded Security Protection Policy."

- About 38.5 miles of the existing NNSS 138-kilovolt electrical transmission system would be replaced between Mercury Switching Center in Area 23 and Valley Substation in Area 2. The replacement transmission line would be constructed using steel towers on a right-of-way generally paralleling the existing system. Sufficient separation would be imposed between the existing transmission and new line to ensure electrical safety during construction of the new line and demolition of the old line. Where terrain or other factors dictate, sections of the new line may require a new alignment. The new transmission line would include under-built fiber optic cable and all necessary hardware, including conductors and insulators, to complete a fully operational system. This project would require some new access road construction. The transmission line replacement project would occur in three distinct and separately operable stages: (1) Mercury Switching Center to Frenchman Flat Substation in Area 5, with a loop tap at Mercury Distribution Substation (approximately 15 miles); (2) Frenchman Flat Substation to Tweezer Substation in Area 6 (approximately 9.5 miles); and (3) Tweezer Substation to Valley Substation (approximately 14 miles). The replacement transmission line would increase the capacity of the system from the current level of about 40 megawatts to 100 megawatts and improve the efficiency of the system, but would not increase the system operating voltage. Due to the isolation, unreliability, and failure rate of the existing transmission line, replacement is a high priority. The existing line is part of a multi-utility corridor that contains power, communication fiber optics, supervisory control and data acquisitions, and relay protection. Failure of the power line would cause interruption of communication, supervisory control and data acquisitions, and relay protection.

- The telecommunication system on the NNSS would be upgraded. This project would replace the existing wired telephone switch with a new one that would seamlessly transition between the older and newer technologies. The wireless elements of the trunked radio infrastructure would be upgraded to interface with the packet switched technology. This project would transition the subscriber units (telephones, radios, Blackberry devices, and cellular phones) in a time-phased, replacement program to blend all elements of the wired and wireless systems into an integrated telecommunications hierarchy. Elements of the NNSA/NSO telecommunication/information backbone infrastructure are suffering from technological obsolescence, limited capacity, and inability to provide overall enterprise architecture for current and emerging NNSA/NSO mission imperatives. The existing telecommunications system technology for the present generation of telephone plant is approaching 40 years since its first design release and the wireless elements have also reached the end of their service life. The replacement parts for hardware, software, and spare parts are becoming scarce and exceedingly expensive to acquire as time passes. Replacement of the wired telephone switch with one that can seamlessly transition between the older and new technologies is necessary to allow for interaction with computerized features, video sessions, wireless mobile phone applications, and continued safety of full site coverage.

- Buildings in Mercury are typically 30 to 50 years old. To maintain an efficient and effective operation in support of national security activities, it is necessary to replace most of these facilities and supporting infrastructure due to their lack of energy efficiencies and deteriorating condition. The redevelopment would provide an optimization of square footage by reducing operational costs and consolidating operations. The NNSS, as part of the nuclear weapons complex, is a national asset that supports experimentation, testing, training, and demonstration for defense systems and advances in high hazard operations. If no action is taken, the requirements to provide a more energy-efficient, modern infrastructure and more-efficient operational site will affect programmatic requirements as operational costs increase. Mercury would be reconfigured to provide the modern facilities and infrastructure needed to support advanced experimentation and production at the NNSS. This proposed project would: (1) demolish facilities that are no longer needed or are not economically salvageable; (2) identify functional zones to facilitate groupings of similar activities; (3) replace obsolete buildings that are needed to support NNSS activities; and (4) rebuild/remodel selected facilities and infrastructure to extend their useful lives to accommodate existing and future support requirements. Because the reconfiguration of Mercury is conceptual in nature, an appropriate level of NEPA analysis and documentation would be required before it could be implemented.

These projects would contribute to meeting NNSA Strategic Goal 2.1: Transform the Nation's nuclear weapons stockpile and supporting infrastructure to be more responsive to the threats of the twenty-first century.

In addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain Repository. NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain Repository.

As noted under the No Action Alternative, although considered infrastructure, characterization and monitoring wells developed under the UGTA Project are addressed as part of the Environmental Management Program rather than the General Site Support and Infrastructure Program.

A.2.3.2 Conservation and Renewable Energy Program

Under the Expanded Operations Alternative, NNSA would continue to identify and implement energy conservation measures and renewable energy projects, in compliance with DOE Order 430.2B, *Department of Energy, Renewable Energy and Transportation Management Requirements*; Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*; and Transformational Energy Action Management objectives, as described under the No Action Alternative. In addition, NNSA would pursue renewable energy projects, including geothermal and solar projects.

NNSS Photovoltaic Power Project – Under the Expanded Operations Alternative, NNSA proposes to build a 5-megawatt photovoltaic solar power system near the Area 6 Construction Facilities. The 5-megawatt photovoltaic system would require about 50 acres of land, based on a similar project at Nellis Air Force Base (USAF 2006). Construction of this photovoltaic power project would require grading of the entire 50-acre site and erection of either fixed or tracking (one- or two-axis) photovoltaic arrays on most of the graded area. The photovoltaic arrays would be mounted on concrete foundations embedded in the ground. The balance of the graded area would be covered by electrical switchgear, such as inverters to convert the direct current electricity generated by the photovoltaic arrays into alternating current and transformers to raise the voltage of the photovoltaic-generated power to 34.5 kilovolts. A control building would also be erected on the site, along with a small parking area for workers. The facility would be constructed near to and interconnected with the NNSS 34.5-kilovolt electrical distribution system.

Commercial Solar Power Generation – Under the Expanded Operations Alternative, NNSA would allow development of one or more full-scale commercial solar power generation plants in Area 25 of the NNSS. As shown in Figure 3–2, the solar power generation plants would be located within an area of about 39,600 acres in the southwestern part of the NNSS. The reasons for NNSA's consideration of commercial solar power development only in Area 25 and decision to assess the concentrating solar power parabolic trough technology in this *NNSS SWEIS* are addressed under the No Action Alternative in Section A.1.3.2. The facility(ies) could use a variety of solar power-generating technologies (i.e., parabolic trough, power tower, dish engine, photovoltaic) with a combined generating capability of up to 1,000 megawatts. Approximately 10 miles of new 500-kilovolt electrical transmission line (outside of the NNSS) would be required to integrate the electricity generated into the regional system. The existing regional electrical transmission system does not have sufficient capacity to accommodate an additional 1,000 megawatts of power. Development of the solar power generation plants in Area 25 would require construction of additional transmission infrastructure in the region. Independent of, and unrelated to, the commercial solar power generation facilities considered in this *NNSS SWEIS*, NV Energy, a commercial electrical energy company, and Renewable Energy Transmission Company are planning new large capacity transmission line projects that would accommodate the additional electrical generation (see Chapter 6, Section 6.2.4.4, for additional information). The analysis in this SWEIS is based on assumptions for a representative commercial solar project (West 2010). Because there is no specific proposal for a commercial solar power generation project, additional NEPA analysis would be required to evaluate any such proposals in the future.

Geothermal electrical generation – The NNSS would be evaluated to determine the feasibility of demonstrating an enhanced geothermal system for generating electricity that is applicable to a much broader global geographic area than current 'hot spot' geothermal systems. The primary objective would be to demonstrate the viable recovery of practical operating level energy (5 to 50 megawatts) from rock that is hot (greater than 356 degrees Fahrenheit) but does not contain mobile water. The size of an electrical power plant would be unique to each site's geothermal characteristics and would be based on the optimal balance of temperature, rock reservoir size, heat exchange rate, water pressure, flow rate, etc. If feasible, this system would be developed as a laboratory for use both to improve similar systems and to supply power to the NNSS.

Modular geothermal power plants have a relatively small surface footprint. However, initial project support activities are estimated to require about 30 to 50 acres, including space for an excavated, lined sump to store water during drilling and reservoir development. To achieve the desired temperature (greater than 356 degrees Fahrenheit), several boreholes may be drilled up to 20,000 feet deep. Up to 20 acre-feet of water would be required for initial priming of the system (including the boreholes and underground rock reservoir). Based on the experience of LANL at Fenton Hill, New Mexico, water loss from an enhanced geothermal system was found to be relatively low (Brown 2009) and dependent on flow volume and pressure, which are directly related to electrical output of the power plant. A continuously operating 50-megawatt power plant would require an estimated 50 acre-feet of water per year.

There are a number of locations on the NNSS that have enhanced geothermal system potential, as shown by the red and blue circles depicted in **Figure A–3**. Although Figure A–3 includes areas of geothermal energy potential in areas outside of the NNSS, NNSA is not considering any activities associated with the offsite areas. A decision regarding the best location for a geothermal electrical generation facility would depend on a combination of the enhanced geothermal system's potential, use restrictions, environmental and economic considerations, and other factors. Because there are no specific proposals for geothermal exploration or development on the NNSS at this time, additional NEPA analysis would be required before such work could be conducted.

As a separate but related project, a geothermal research center may be established in Mercury. New construction is not expected to be required for a geothermal research center because existing unused or underused facilities would be employed for this purpose.

A.2.3.3 Other Research and Development Programs

Under the Expanded Operations Alternative, NNSA would continue to host existing environmental research projects at the NNSS and would actively promote and expand the National Environmental Research Park Program. NNSA would consider new environmental or other proposed research and/or development projects not related to the DOE or NNSA National Security/Defense or Environmental Management Missions on a case-by-case basis; however, no research and development projects are proposed at this time that would fall within this category.

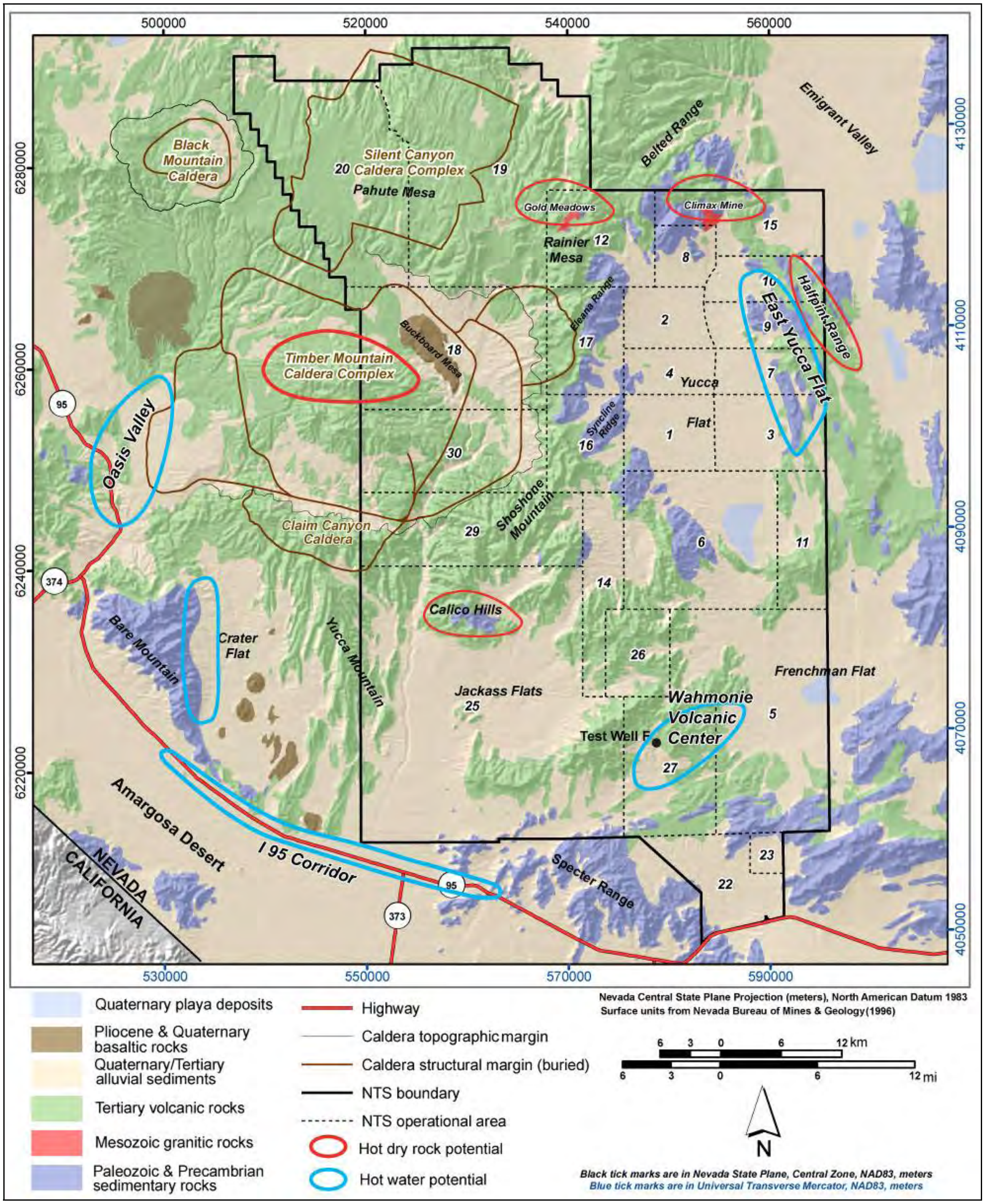


Figure A–3 Potential Locations on the Nevada National Security Site and Surrounding Area for Geothermal Energy Development

A.3 Reduced Operations Alternative

The Reduced Operations Alternative addressed in this SWEIS includes all of the types of activities considered under the No Action Alternative; however, for many programs, the levels of operations would be reduced. The Reduced Operations Alternative, compared to the No Action Alternative, includes diminished activity levels, additional decommissioned facilities, and limited activities in various areas at the NNSS and other NNSA-managed sites in Nevada. Perhaps the most significant changes from the No Action Alternative would be cessation of all activities other than environmental restoration, environmental monitoring, site security operations, and military training and exercises, and changing the land use zone designation to Limited Operations Zone in the northwestern portion of the NNSS (Areas 18, 19, 20, 29, and 30). Under this land use zone change, maintenance of Pahute Mesa, Stockade Wash, and Buckboard Mesa Roads would be terminated and operation of Pahute Mesa Airstrip would be limited to those activities necessary to provide access for the noted activities in these areas. The electrical transmission/distribution system beyond the Echo Peak Substation in Areas 19 and 20 would be de-energized. Ceasing all activities other than those mentioned in Areas 18, 19, 20, 29, and 30 would reduce NNSA's maintenance requirements at the NNSS and allow scarce resources to be focused on the more used areas of the NNSS. It may also reduce impacts on some resources, relative to the No Action and Expanded Operations Alternatives. **Figure A–4** illustrates the configuration of the NNSS under the Reduced Operations Alternative.

The following descriptions of missions, programs, projects, and activities that would be conducted under the Reduced Operations Alternative primarily address only this alternative's differences from the No Action Alternative; that is, those projects and activities that would be conducted at a lower level of intensity or not at all. Because activities under the Reduced Operations Alternative are similar to those under the No Action Alternative, detailed descriptions of the kinds of activities addressed below may be found in Section A.1 of this appendix.

A.3.1 National Security/Defense Mission

Under the Reduced Operations Alternative, NNSA would continue to pursue activities associated with the Stockpile Stewardship and Management, Nuclear Emergency Response, Nonproliferation, Counterterrorism, and Work for Others Programs.

A.3.1.1 Stockpile Stewardship and Management Program

Under the Reduced Operations Alternative, stockpile stewardship and management operations would continue at NNSA facilities in Nevada, particularly at the NNSS, under the conditions of the ongoing nuclear testing moratorium. As under the No Action Alternative, NNSA would continue to maintain its readiness to conduct an underground nuclear weapon test, if so directed by the President.

Under the Reduced Operations Alternative, there would be no change from the No Action Alternative for the following projects and activities associated with the Stockpile Stewardship and Management Program:

- Shock physics experiments at the Large-Bore Powder Gun
- Criticality experiments at DAF
- Disposition of damaged nuclear weapons
- Storage and staging of nuclear devices
- Staging of SNM, including pits
- Readiness-related training and exercises using various kinds of nuclear weapon simulators

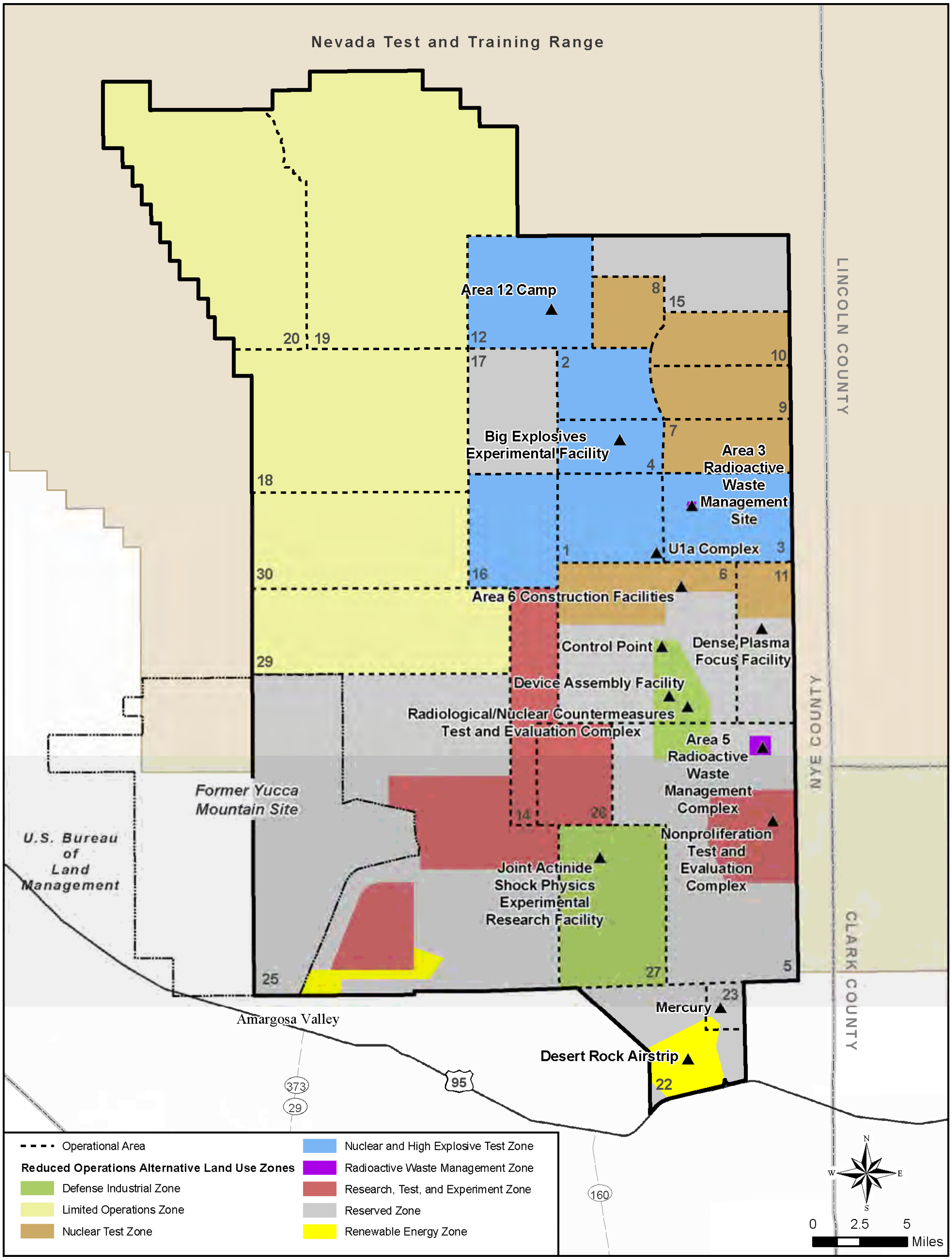


Figure A–4 Nevada National Security Site Land Use Zones and Major Facilities Under the Reduced Operations Alternative

In addition to maintaining these activities, under the Reduced Operations Alternative, the following changes in stockpile stewardship and management activities at NNSA facilities in Nevada would occur:

Dynamic experiments, dynamic plutonium experiments (including subcritical experiments), and hydrodynamic tests – NNSA would annually conduct no more than six of these tests over about a 10-year period. No dynamic or dynamic plutonium experiments or hydrodynamic tests would be conducted in Areas 19 or 20 of the NNSS. Over the next 10 years, a total of five dynamic experiments would be conducted in emplacement holes with each such experiment causing an estimated 20 acres of new land disturbance.

Conventional explosives tests – NNSA would annually conduct up to 10 conventional explosives experiments in the Nuclear and High Explosives Test Zone to directly support the Stockpile Stewardship and Management Program. No other explosives experiments would be conducted.

Shock physics experiments – No more than six shock physics experiments with SNM would be annually conducted at JASPER.

Pulsed-power experiments at the Atlas Facility – The Atlas Facility would be decommissioned and dispositioned.

Fusion experiments at the NNSS and NLVF – NNSA would conduct up to 375 plasma physics and fusion experiments per year: 350 at the Dense Plasma Focus Machine at NLVF, and 25 at the Dense Plasma Focus Machine in Area 11.

Support for Office of Secure Transportation Training – The number of times per year that Office of Secure Transportation training and exercises would be supported would be reduced to four.

Stockpile stewardship and management activities at the TTR – NNSA would not conduct ground- or air-launched rocket or missile operations or fuel-air explosives operations at the TTR.

A.3.1.2 Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs

There would be no change from the No Action Alternative for activities associated with the Nuclear Emergency Response, Nonproliferation, or Counterterrorism Programs. See Section A.1.1.2 for a detailed description of these activities.

A.3.1.3 Work for Others Program

The Work for Others Program is hosted by NNSA and includes the shared use of certain facilities and resources at the NNSS, RSL, NLVF, and the TTR. Under the Reduced Operations Alternative, NNSA would continue to host the projects and activities of other Federal agencies, such as DoD and DHS, as well as state and local governments and nongovernmental organizations; however, certain activities, such as large-scale explosives tests and experiments, would not be conducted. NNSA also would no longer support the following Work for Others Program activities, which are associated with nonproliferation projects and counterproliferation research and development:

- Conventional weapons effects tests, including live-drop and static explosives detonations using up to 30,000-pound-class bombs
- Development and demonstration of capabilities and technologies to attack and defeat military targets protected in tunnels and other deeply buried hardened facilities

- Conduct experiments using explosives and other explosives operations
- Tests and experiments requiring explosive releases of chemical and biological simulants

No Work for Others Program activities, except military training and exercises, would be conducted in Areas 18, 19, 20, 29, or 30 of the NNSS under the Reduced Operations Alternative. The reason for this exception is that military training and exercises are currently conducted primarily in the western half of the NNSS to ensure adequate separation and to avoid interference with other DOE/NNSA activities. This separation would need to be continued for safety and security considerations.

A.3.2 Environmental Management Mission

The NNSA Environmental Management Mission includes the Waste Management and Environmental Restoration Programs. Under the Reduced Operations Alternative, activities for both of these programs would be the same as under the No Action Alternative, except that less TRU waste would be annually generated (about 250 cubic feet per year) because of the projected reduced annual number of experiments at JASPER and other national security activities. As with the No Action Alternative, waste would be safely stored at the TRU Pad pending shipment off site for disposition along with other legacy or newly generated environmental restoration waste. DOE/NNSA activities would generate an estimated 170,000 cubic feet of hazardous waste, which would be sent off site to permitted treatment, storage, and disposal facilities. Smaller annual quantities of solid wastes (about 3,600,000 cubic feet) are also projected compared to the No Action Alternative because of reduced employment and construction activities.

A.3.3 Nondefense Mission

The Nondefense Mission generally includes those activities necessary to support NNSA-related programs, such as construction and maintenance of facilities, provision of supplies and services, warehousing, and similar activities. Activities related to supply and conservation of energy, including renewable energy and other research and development, are also considered under the Nondefense Mission. Activities under the Reduced Operations Alternative would be the same as those under the No Action Alternative, but at a lower level of effort, reflective of operational levels and establishment of the “Limited Operations Zone.”

In addition to maintaining and repairing its infrastructure at the NNSS, RSL, NLVF, and the TTR, NNSA would maintain the existing infrastructure, provide site security, and manage all applicable existing permits and agreements for the former Yucca Mountain Repository. NNSA would perform these functions pending decisions on the disposition of the former Yucca Mountain Repository.

A.3.3.1 General Site Support and Infrastructure Program

Under the Reduced Operations Alternative, infrastructure-associated activities would include repairs, replacements, and projects to maintain the reduced capabilities of the NNSS. Increasing the capacities and capabilities or extending the ranges of facilities and/or services is not proposed under the Reduced Operations Alternative. NNSA would maintain only critical infrastructure within Areas 18, 19, 20, 29, and 30, including the Echo Peak, Motorola, and Shoshone communications facilities; the Echo Peak, Castle Rock, and Stockade Wash Substations; electrical transmission lines interconnecting these substations; and Well 8. Roads within Areas 18, 19, 20, 29, and 30 would only be minimally maintained to provide the basic access necessary to maintain the noted infrastructure.

A.3.3.2 Conservation and Renewable Energy Program

Under the Reduced Operations Alternative, NNSA would allow development of a 100-megawatt commercial solar power generation plant within the Area 25 Renewable Energy Zone, as proposed in the *1996 NTS EIS*, in which it was called the Solar Enterprise Zone. For purposes of the analysis in this SWEIS, NNSA assumed that the commercial solar power generation project would use a dry-cooled concentrating solar power technology, including parabolic troughs similar to the Amargosa Farm Road Solar Energy Project (BLM 2010). Potential impacts of commercial solar power generation at the NNSS would be scaled from the Amargosa Farm Road Solar Energy Project. In addition to a solar power generation plant, additional electrical transmission capacity would be required to integrate the electricity generated onto the regional system. Because no commercial solar power generation project is proposed at the NNSS at this time, additional NEPA analysis would be required before any such project could be implemented.

A.3.3.3 Other Research and Development Programs

Under the Reduced Operations Alternative, NNSA would continue to host existing environmental research projects at the NNSS. NNSA would consider any new environmental or other proposed research and/or development projects not related to the DOE or NNSA National Security/Defense or Environmental Management Missions on a case-by-case basis; however, no research and development projects that would fall within this category are proposed at this time.

A.4 References

AAAS (American Physical Society and American Association for the Advancement of Science), 2008, *Nuclear Forensics, Role, State of the Art, and Program Needs* (accessed January 7, 2010, https://cstps.aaas.org/files/complete.pdf).

BLM (Bureau of Land Management), 2010, *Final Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project* (DOI No. FES 10-53), Pahrump Field Office, Pahrump, Nevada, October.

BLM/DOE (Bureau of Land Management/U.S. Department of Energy), 2010, *Draft Programmatic Environmental Impact Statement for Solar Energy Development in Six Southwestern States* (DES10-59, DOE/EIS-0403). Washington, DC, December.

Brown, 2009, *Hot Dry Rock Geothermal Energy: Important Lessons from Fenton Hill*, Proceedings, Thirty-Fourth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 9–11.

DOE (U.S. Department of Energy), 1996, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Washington, DC, October.

DOE (U.S. Department of Energy), 2002, *Hazardous Materials Testing At the Hazardous Materials Spill Center*, *Nevada Test Site, Environmental Assessment*, DOE/EA-0864, National Nuclear Security Administration, Nevada Operations Office, Las Vegas, Nevada, September.

DOE (U.S. Department of Energy), 2004a, *Final Environmental Assessment for Activities Using Biological Simulants and Releases of Chemicals at the Nevada Test Site,* DOE/EA-1494, National Nuclear Security Administration Nevada Site Office, Las Vegas, Nevada, June.

DOE (U.S. Department of Energy), 2004b, *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site, Final Environmental Assessment*, DOE/EA-1499, National Nuclear Security Administration, Nevada Site Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 2006, *Stockpile Stewardship Plan Overview Fiscal Year 2007-2011*, DOE/NA-0014, National Nuclear Security Administration, Washington, DC, November 13.

DOE/NV (U.S. Department of Energy, Nevada), 2009, *Nevada Test Site Environmental Report 2008*, DOE/NV/25946-790, Nevada Site Office, Las Vegas, Nevada, September.

Mason, Y., 2009, Facility and Infrastructure Planning, Personal communication (email) to D. Starrett, Las Vegas, Nevada, "Data on building square footage by function for NTS, RSL, NLVF," November 24.

NDEP (Nevada Division of Environmental Protection), 2005, Water Pollution Control General Permit GNEV93001, issued for the U.S. Department of Energy, National Nuclear Security Agency, Nevada Site Office, August 5.

NNSA (National Nuclear Security Administration), 2001, *Atlas Relocation and Operation at the Nevada Test Site Final Environmental Assessment*, DOE/EA-1381, Nevada Site Office, Las Vegas, Nevada, May 30.

NNSA (National Nuclear Security Administration), 2004, *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site, Final Environmental Assessment*, DOE/EA-1499, Nevada Site Office, Las Vegas, Nevada, September 2.

NSTec (National Securities Technologies, LLC), 2008, *FY 2009 NNSA/NSO Energy Executable Plan*, Las Vegas, Nevada, December.

Pozzi, S., n.d., Abstract: *Improved Fission Neutron Data Base for Active Interrogation of Actinides* (Project No. 09-414), University of Michigan, Ann Arbor, Michigan.

Townsend, 2009, NTS SWEIS – Borehole Management Plan, Email to M. Skougard, November 19.

USAF (U.S. Air Force), 2006, *Final Environmental Assessment for Leasing Nellis Air Force Base Land for Construction and Operation of a Solar Photovoltaic System, Clark County, Nevada*, 99 CES/CEVN, Nellis Air Force Base, Las Vegas, Nevada, August.

West, M., 2010, Potomac-Hudson Engineering, "NTS SWEIS – Concept and Baseline Data Reference Sheet for Solar Power Plant," Las Vegas, Nevada, July.

Code of Federal Regulations

10 CFR Part 61, U.S. Nuclear Regulatory Commission, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 835, U.S. Department of Energy, "Occupational Radiation Protection."

10 CFR Part 851, "Worker Safety and Health; Defense Nuclear Security Program; Master Security Plan; DOE Security Strategic Plan; NNSA Defense Nuclear Security Strategic Framework; and Graded Security Protection Policy."

40 CFR Part 761, U.S. Environmental Protection Agency, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions."

Executive Orders

Executive Order 13327, " Federal Real Property Asset Management."

Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management."

Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance."

Federal Register Notices

61 FR 65551, U.S. Department of Energy, 1996, "Record of Decision: Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada," December 13.

67 FR 79906, U.S. Department of Energy, National Nuclear Security Administration, 2002, "Record of Decision for the Final Environmental Impact Statement for the Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory," December 31.

U.S. Department of Energy Orders and Manuals

DOE Order 226.1a, *Implementation of Department of Energy Oversight Policy*.

DOE Order 430.2B, *Renewable Energy and Transportation Management Requirements*.

DOE Manual 440.1-1A, *DOE Explosives Safety Manual*.

DOE Order 470.4A, *Safeguards and Security Program*.

APPENDIX B
FEDERAL REGISTER NOTICES

DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Intent To Prepare an Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada Test Site and Off-Site Locations in the State of Nevada

AGENCY: U.S. Department of Energy's National Nuclear Security Administration.

ACTION: Notice of intent to prepare an environmental impact statement and conduct public scoping meetings.

SUMMARY: Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality (CEQ) and the U.S. Department of Energy (DOE) regulations implementing NEPA (40 CFR Parts 1500–1508 and 10 CFR Part 1021, respectively), the National Nuclear Security Administration (NNSA), a semi-autonomous agency within DOE, announces its intention to prepare a site-wide environmental impact statement (SWEIS) (DOE/EIS–0426) for the continued operation of DOE/NNSA activities at the Nevada Test Site (NTS) and certain off-site locations (the Remote Sensing Laboratory at Nellis Air Force Base, Las Vegas, Nevada, the DOE/NNSA campus in North Las Vegas, and the Nevada Test and Training Range (NTTR) including activities at the Tonopah Test Range (TTR)) in the State of Nevada. The purpose of this notice is to invite individuals, organizations, and government agencies and entities to participate in developing the scope of the SWEIS.

The new SWEIS will consider a No Action Alternative, which is to continue current operations through implementation of the 1996 Record of Decision (ROD) (61 FR 65551; 12/13/96), and subsequent decisions. Three action alternatives proposed for consideration in the SWEIS would be compared to the No Action Alternative. The three action alternatives would differ by either their type or level of on-going operations and may include proposals for new operations or the reduction or elimination of certain operations.

DATES: NNSA invites comments on the scope of this SWEIS. The public scoping period starts with the publication of this notice in the **Federal Register** and will continue through October 16, 2009. NNSA will consider all comments defining the scope of the SWEIS received or postmarked by this date. Comments received or postmarked after this date will be considered to the extent practicable. NNSA will conduct public scoping meetings in Las Vegas, Tonopah and Pahrump, Nevada and St. George, Utah scheduled as follows:

- Thursday, September 10, 2009—2–4 p.m. and 6–8 p.m.
  Frank H. Rogers Science & Technology Building, Desert Research Institute, 755 East Flamingo Road, Las Vegas, NV.
- Monday, September 14, 2009—5:30–7:30 p.m.
  Bob Ruud Community Center, 150 North Highway 160, Pahrump, NV.
- Wednesday, September 16, 2009—5:30–7:30 p.m.
  Tonopah Convention Center, 301 Brougher Ave., Tonopah, NV.
- Friday, September 18, 2009—5:30–7:30 p.m.
  Holiday Inn Conference Center, 850 South Bluff Street, St. George, Utah.

These scoping meetings will provide the public with an opportunity to present comments, ask questions, and discuss issues with NNSA officials regarding the SWEIS. Preparation of the SWEIS will require participation of other Federal agencies. As bordering land managers, the USAF and BLM have an inherent interest in activities at the Nevada Test Site (NTS). The DHS and DTRA are tenant organizations with ongoing and future operations at the NTS: Therefore requests for cooperating agency participation will be extended to the DOE, Department of Defense, U.S. Air Force (USAF) and the Defense Threat Reduction Agency (DTRA), the Department of Homeland Security (DHS), and the Department of the Interior, Bureau of Land Management (BLM.)

ADDRESSES: To submit comments on the scope of the SWEIS, questions about the document or scoping meetings, or to be included on the document distribution list, please contact: Linda M. Cohn, NNSA Nevada Site Office, SWEIS Document Manager, P.O. Box 98518, Las Vegas, Nevada 89193–8518; telephone (702) 295–0077; fax (702) 295–5300; or e-mail address: *nepa@nv.doe.gov.*

FOR FURTHER INFORMATION CONTACT: For general information about the DOE NEPA process, please contact: Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance (GC–20), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585; e-mail: *askNEPA@hq.doe.gov*; telephone: 202–586–4600, or leave a message at 1–800–472–2756; or fax: 202–586–7031. Please note that U.S. Postal Service deliveries to the Washington, DC office may be delayed by security screening. Additional information regarding DOE NEPA activities is available on the Internet through the NEPA Web site at *http://www.gc.energy.gov/nepa.*

SUPPLEMENTARY INFORMATION:

Background

The NTS occupies about 1,375 square miles (3,561 square kilometers) in southern Nevada, and is surrounded on three sides by the U.S. Air Force Nevada Test and Training Range (NTTR) (formerly the Nellis Air Force Range) and the Desert National Wildlife Refuge. The fourth boundary is shared with the Bureau of Land Management. The Nevada Site Office (NSO) operations are managed and performed for DOE/NNSA under contract by a management and operating contractor (currently National Security Technologies, LLC) which teams with personnel from Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories as well as other governmental entities to perform NTS mission-related activities. NTS is a multi-disciplinary, multi-purpose facility primarily engaged in work that supports national security, homeland security initiatives, waste management, environmental restoration, and defense and non-defense research and development programs (R&D) for DOE/NNSA and other government entities. Historically, the primary DOE/NNSA mission work conducted at NTS was nuclear weapons testing. Since the moratorium on nuclear testing began in October 1992, NTS has been maintained in a state of readiness to conduct underground nuclear tests, if so directed by the President. It also conducts high-hazard experiments involving nuclear material and high explosives (HE); provides the capability to process and dispose of a damaged nuclear weapon or improvised nuclear device; and conducts non-nuclear experiments, hydrodynamic testing, and HE testing. Nuclear stockpile stewardship activities at the NTS include conducting dynamic plutonium experiments that provide technical information to maintain the safety and reliability of the U.S. nuclear weapons stockpile, and conducting research and training on nuclear safeguards, criticality safety, and emergency response. Special Nuclear Materials are also stored at the NTS. Also, in accordance with the amended 1996 *NTS EIS (DOE/EIS–0243)* ROD, NNSA continues to receive low-level and mixed low-level radioactive waste for disposal at NTS. Sandia National Laboratories, a DOE/NNSA contractor, operates the Tonopah Test Range (TTR) near Tonopah, Nevada for flight testing of gravity weapons (including R&D and testing of nuclear weapons components and delivery systems) in support of DOE/NNSA mission requirements.

The 1996 NTS EIS examined existing and potential impacts to the environment from ongoing and anticipated future DOE/NNSA operations conducted over approximately a 10-year period of time at NTS and at off-site locations in the State of Nevada, such as portions of the NTTR including the TTR. NSO's remediation efforts have been completed at Project Shoal and the Central Nevada Test Area.

The four alternatives analyzed in the 1996 NTS EIS were: (1) The No Action Alternative, to continue to operate at the level maintained in the previous 5 years; (2) Discontinue Operations; (3) Expanded Use, and (4) Alternative Use of Withdrawn Lands. DOE's ROD implemented Alternative 3, Expanded Use, plus the public educational activities of Alternative 4, Alternative Use of Withdrawn Lands. This ROD also selected the continuation of low-level and mixed low-level waste management activities as described in the No Action Alternative until decisions on the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (Waste Management PEIS) (DOE/EIS–0200) could be made. DOE issued its decisions on the Waste Management PEIS in a February 2000 ROD that included an amendment to the 1996 NTS EIS ROD. That February 2000 ROD announced DOE's decision to implement low-level and mixed low-level waste management activities in accordance with the Expanded Use Alternative of the 1996 NTS EIS.

In July 2002, DOE/NNSA completed a 5-year review of the 1996 NTS EIS with the preparation of a Supplement Analysis (SA) (DOE/EIS–0243–SA–01), pursuant to DOE's regulatory requirement to evaluate site-wide NEPA documents at least every 5 years (10 CFR 1021.330) to determine the adequacy of an existing EIS. Based on the 2002 *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/EIS–0243–SA–01), DOE/NNSA determined that there were no substantial changes to the actions or impacts evaluated in the NTS EIS, and there were no significant new circumstances or information relevant to environmental concerns. Thus, the existing NTS EIS was adequate and neither a supplemental EIS or a new EIS was required.

In 2003, NNSA prepared a Supplement Analysis entitled *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada to Address the Increase in Activities Associated with the National Center for Combating Terrorism & Counterterrorism Training & Related Activities* (DOE–EIS–0243–SA–02) to determine whether an anticipated increase in national security projects after the terrorist attacks of September 11, 2001, required further NEPA analysis. This analysis covered military training/exercises, and testing, evaluation, and development of technology for multiple Federal government agencies. Based upon this review, DOE/NNSA determined that the proposed increase in activities would not result in substantial changes to the NTS EIS or the ROD, and there were no significant new circumstances or information relevant to environmental concerns. Thus, neither a supplemental EIS nor a new EIS was required.

More recently, in 2007, DOE/NNSA initiated its second comprehensive 5-year review of the 1996 NTS EIS and prepared a SA entitled *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE–EIS–0243–SA–03) which evaluated whether the 1996 NTS EIS continued to remain adequate for ongoing and reasonably foreseeable activities. This document was issued for public review and comment in April 2008. Based upon consideration of comments received on this draft SA regarding potential changes to the NTS program work scope, the DOE/NNSA decided to prepare a new SWEIS for the Continued Operation of the NTS and Off-Site Locations in the State of Nevada for the 10-year period commencing 2010.

Purpose and Need

The purpose and need for agency action is to continue the operation of NTS to provide support for DOE's core missions as directed by the Congress and the President. NTS has a long history of supporting national security objectives through the conduct of underground nuclear tests and other nuclear and non-nuclear activities. Since October 1992, there has been a moratorium on underground nuclear testing. Thus, the present mission of the DOE at NTS is to maintain a readiness to conduct tests. In addition, NTS supports DOE national security related research, development, and testing programs, and DOE's waste management/disposal activities. NTS also provides opportunities for various environmental research projects.

Alternatives for the SWEIS

In accordance with applicable DOE and CEQ NEPA regulations, the No Action Alternative will be analyzed in the SWEIS and will form the baseline for the action alternatives analyzed in the document. In this case, the No Action Alternative will be the continued implementation of the 1996 NTS EIS ROD, and the amendment to the ROD for the NTS (65 FR 10061 at 10065) at DOE/NNSA sites in Nevada over the next 10 years. Additionally, the No Action Alternative will also include the implementation of other decisions supported by separate NEPA analyses completed since the issuance of the final 1996 NTS EIS, including: the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at Los Alamos National Laboratory* (DOE/EIS–319) and ROD (67 FR 79906); and the *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement* (DOE/EIS–0235–S4) and its RODs (73 FR 77644 and 73 FR 77656) and the *Waste Management PEIS* and ROD (65 FR 10061). The No Action Alternative will also include actions analyzed in eight environmental assessments and their associated Findings of No Significant Impacts, as well as actions categorically excluded from the need for preparation of either an EA or an EIS. These various documents are identified in the 2008 draft SA. Copies of these documents can be reviewed at the DOE/NNSA Public Reading Rooms at 755 E. Flamingo, Las Vegas, Nevada, and 100 North Stewart Street, Carson City, Nevada, and public libraries in St. George, Utah; and Tonopah and Pahrump, Nevada; and on the internet at: *http://www.gc.energy.gov/nepa.*

Three action alternatives will be considered in the SWEIS: Expanded Operations, Reduced Operations, and Renewable Energy Operations. All three of these alternatives will be compared to the No Action Alternative level of operations. The Expanded Operations Alternative will consider a greater proportion of reasonably foreseeable new work from other Federal organizations as identified by cooperating agencies. This work will relate to nonproliferation and counterterrorism, experiments, research, development and testing. Such expansion could include developing test beds for concept testing of sensors, mitigation strategies and weapons effectiveness. The Reduced Operations alternative will consider an overall reduction in the level of operations and closure of specific buildings and structures. The Renewable Energy Operations Alternative will consider renewable energy R&D and the potential deployment of those technologies on the NTS. Any new facilities/activities, regardless of which alternative they are associated with, will be included in the analysis if they are reasonably foreseeable (*i.e.,* proposed within the next 10 years).

This SWEIS will analyze potential impacts resulting from reasonably foreseeable operations and compare these impacts to those projected in the No-Action Alternative. The SWEIS will analyze projected impacts anticipated from operating the NTS and certain off-site locations in the State of Nevada at the current level with some modified work now being proposed at certain facilities, such as the Radiological and Nuclear Test Evaluation Center and the Non-Proliferation Test and Evaluation Center. Examples of newly proposed actions at NTS include development of enhanced national security programs to include increased homeland security activities in sensor development and testing, and chemical and biological simulant releases, as well as stockpile stewardship activities.

Direct and indirect, as well as unavoidable and irreversible and irretrievable impacts to the environment of the NTS and off-site locations in the State of Nevada will be identified and analyzed in the SWEIS. In addition, updated modeling and analysis will be conducted of potential migration of contaminants in the groundwater from historic nuclear testing on the NTS. Where appropriate, mitigation strategies will also be analyzed in the SWEIS. Further, an updated evaluation of NTS operational and transportation accident analyses, and a new assessment of cumulative impacts of DOE/NNSA operations in Nevada will also be included. DOE/NNSA plans to prepare the SWEIS as an unclassified document with a classified appendix. The classified information will not be available for public review; however, it will be considered in the decision-making process of the SWEIS. DOE/NNSA intends to re-evaluate the range of reasonable alternatives following public scoping.

Preliminary Identification of Environmental Issues

DOE/NNSA proposes to address the issues listed below when considering the potential impacts of each alternative. This list is presented to facilitate public comment during the scoping period and will be revisited as DOE/NNSA considers all scoping comments. It is not intended to be comprehensive, nor to imply any predetermination of impacts.

- Potential effects on the public health from exposure to hazardous materials under routine and credible accident scenarios;
- Impacts on surface and groundwater, and on water use and quality;
- Impacts on air quality and noise;
- Impacts on plants and animals, and their habitats, including species that are Federal- or state-listed as threatened or endangered, or of special concern;
- Impacts on geology and soil;
- Impacts on cultural resources such as Native American sites, historic mining and ranching, and Cold War structures;
- Socioeconomic impacts on potentially affected communities and disproportionately high and adverse impacts to minority and low-income populations;
- Potential impacts on land use.
- Pollution prevention and waste management practices and activities;
- Unavoidable adverse impacts and irreversible and irretrievable commitments of resources;
- Potential cumulative environmental effects of past, present, and reasonably foreseeable future actions;
- Potential impacts of intentional destructive acts, including sabotage and terrorism.

SWEIS Process and Invitation To Comment

The SWEIS scoping process provides an opportunity for the public to assist the DOE/NNSA in determining issues. Four public scoping meetings will be held as noted under DATES in this Notice. The purpose of scoping meetings is to provide attendees an opportunity to present comments, ask questions, and discuss concerns regarding the SWEIS with DOE/NNSA officials. Comments and recommendations can also be mailed to Linda M. Cohn as noted in this Notice under ADDRESSES. The SWEIS scoping meetings will use a format to facilitate dialogue between DOE/NNSA and the public and will provide individuals the opportunity to give written or oral statements. DOE/NNSA welcomes specific comments or suggestions on the SWEIS process. The SWEIS will describe the potential environmental impacts of each alternative by using available data where possible and obtaining additional data where necessary. Copies of written comments and transcripts of oral comments provided to DOE/NNSA during the scoping period will be available at the DOE Public Reading Room at 755 E. Flamingo, Las Vegas, Nevada, and public libraries in St. George, Utah; Tonopah and Pahrump, Nevada; and on the Internet at *http://www.nv.doe.gov/library/publications/environmental.*

After the close of the public scoping period, DOE/NNSA will begin developing the draft SWEIS. DOE/NNSA expects to issue the draft SWEIS for public review in mid-2010. Public comments on the draft SWEIS will be received for at least 60 days following publication of the Environmental Protection Agency's Notice of Availability in the **Federal Register**. The Notice of Availability, along with notices placed in local newspapers, will provide dates and locations for public hearings on the draft SWEIS and the deadline for comments on the draft document. Persons who submit comments with a mailing address during the scoping process will receive a copy of the draft SWEIS. Other persons who would like to receive a copy of the document for review when it is issued should notify Linda M. Cohn at one of the addresses provided previously. DOE/NNSA will include all comments received on the draft SWEIS, and responses to those comments in the final SWEIS. Issuance of the final SWEIS is currently scheduled for mid-2011.

Issued in Washington, DC, this 21st day of July 2009.

Thomas P. D'Agostino,

Administrator, National Nuclear Security Administration.

[FR Doc. E9–17751 Filed 7–23–09; 8:45 am]

BILLING CODE 6450–01–P

APPENDIX C
AMERICAN INDIAN ASSESSMENT OF RESOURCES AND ALTERNATIVES PRESENTED IN THE SWEIS

APPENDIX C
AMERICAN INDIAN ASSESSMENT OF RESOURCES AND ALTERNATIVES PRESENTED IN THE SWEIS

Prepared by the American Indian Writers Subgroup
of the Consolidated Group of Tribes and Organizations

"The land, air, and water are living entities. This is what all indigenous people know, understand, and acknowledge as the foundation and center of our existence. We believe we have been created in these lands. Because of this birth-right and tie to our ancestral land, the CGTO believes we have undeniable rights to interact with its precious resources, and a continuous obligation to protect it. The balance given at Creation involves Indian people, who are charged with interacting in culturally-appropriate ways with the animals, plants, minerals, air, and water. Without Indian people to care for these resources, there can be no balance. These resources cannot achieve the purposes given to them by the Creator.

The opportunity given to the CGTO to contribute our assessment and recommendations to this SWEIS is a highly positive step the DOE has taken toward voicing Indian concerns. As you read our input, you will discover these lands are part of the traditional Holy Lands of the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people (Stoffle et al. 1990). As Indian people, we are obligated to manage the land and its resources for seven generations. This means we evaluate and guide our actions in terms of what they could do for or to the next seven generations. The CGTO takes this obligation very seriously and has provided information in Appendix C so we can continue to fulfill our responsibility to care for these lands.

American Indian Writers Subgroup

Summary

Appendix C contains the American Indian assessment of resources and alternatives presented in the *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (SWEIS). Appendix C has been prepared by the American Indian Writers Subgroup (AIWS) for the Consolidated Group of Tribes and Organizations (CGTO).

Since the beginning of time, the area encompassing the Nevada National Security Site (NNSS) (formerly the Nevada Test Site [NTS]) and the TTR has been a central place in the lives of American Indian tribes. Our land contains resources that are crucial for the continuity of American Indian culture, religion, and society.

In consideration of our strong ties and deep understanding of these lands and their resources, DOE invited the CGTO to participate in the development of the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (1996 NTS FEIS). The CGTO has had a long-standing relationship with DOE, and is comprised of 17 tribes and organizations representing the Southern Paiute, Western Shoshone, and Owens Valley Paiute and Shoshone people. Each of these groups has substantiated cultural and historic ties to the NNSS and the surrounding areas (Steward 1938; Stoffle and Evans 1988).

Our participation in the 1996 NTS FEIS was based on the American Indian Consultation Model[1] for government-to-government interactions among DOE and culturally affiliated American Indian Tribes, which was considered an innovative approach by Federal agencies at that time. Concurrently, the CGTO created Appendix G for the 1996 NTS FEIS and provided italicized text for selected FEIS sections. Building on the success of the CGTO's involvement with the 1996 NTS FEIS, DOE invited the CGTO to assess the alternatives analyzed in the SWEIS and the resources potentially affected.

The CGTO knows American Indian people are charged by the Creator to care for and interact with the environment and its resources in culturally-appropriate ways to maintain balance. American Indian's further believe these lands and their resources contain life-sustaining characteristics that must be properly respected and cared for to ensure harmony. Appendix C contains our assessment and recommendations in an effort to regain balance in the NNSS and TTR area.

C.1 Introduction

Historically, DOE has considered the NNSS to be a safe and isolated place to conduct atomic testing and to dispose of radioactive waste produced at twenty-two other Federal facilities because it is essentially thought to be an empty and ugly wasteland. Conversely, the American Indian people have always believed the NNSS region to be a beautiful holy land filled with special places of power and life-sustaining natural resources.

In response, DOE began long-term research in 1985 concerning the inventory and evaluation of American Indian cultural resources within the NNSS region. This research was designed to comply with the American Indian Religious Freedom Act (AIRFA), which specifically reaffirms the rights of the American Indian people under the First Amendment of the United States Constitution, and to have access to lands

[1] The American Indian Consultation Model was based on the Consultation Model produced for the DoD Legacy Project (Deloria and Stoffle 1994), which was modified and implemented during the development of the 1996 NTS FEIS. This model was again revisited and implemented by the CGTO in the development of the SWEIS, and is presented in Section 10.2.1.

and resources essential in the conduct of our traditional religion. These rights are exercised not only in tribal lands but beyond the boundaries of a reservation (Stoffle et al. 1994b).

These ethnographic studies resulted in several reports that record the regional history of American Indian people and contribute to the understanding of the presence of Indian people in the NNSS area (Stoffle et al. 1990c). They identify properties of cultural and religious significance (Stoffle et al. 1989b, 1990b), provide recommendations for reducing potential adverse effects to cultural resources (Stoffle et al. 1988a), and discuss the consultation process (Stoffle and Evans 1988, 1990; Stoffle et al. 1990b, 1991).

These investigations concluded that the NNSS area is part of the traditional Holy Lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone peoples, who shared them for medicinal purposes, religious ceremonies, food, and places necessary to traditional narratives and religious beliefs.

It also became clear that these lands contain not only archaeological remains left by our ancestors but also natural resources and geologic formations in the region, such as plants, animals, water sources and minerals; natural landforms that mark important locations for keeping our history alive and for teaching our children about our culture. American Indians used traditional sites in the NNSS region to make tools, stone artifacts, and ceremonial objects; many sites are also associated with traditional healing ceremonies and power places.

Several areas in the NNSS region are recognized as traditionally or spiritually important. For example, Fortymile Canyon is an important crossroad where trails from such distant places as Owens Valley, Death Valley, and the Avawatz Mountain come together. Black Cone, in Crater Flats is an important religious site that is considered to be an entry to the underworld (AIWS 2005). Prow Pass continues to be an important ceremonial site and, because of this religious significance, tribal representatives recommend that DOE avoid affecting this area (Stoffle et al. 1988). Oasis Valley was historically an important area for trade, and continues to be a place recognized for ceremonial use. Other areas are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and possible burial sites. Despite the current physical separation of tribes from the NNSS and neighboring lands, American Indians continue to value and recognize the meaningful role of these lands in their culture and continued survival.

The CGTO has consistently expressed its concern about environmental impacts resulting from DOE activities at the NNSS. In response, DOE has routinely used conventional methods in an effort to address these impacts. Although the CGTO has been and continues to be concerned about physical impacts, our deep concerns have also been based in terms of those rooted in spiritual and cultural impacts. One of our key struggles is that DOE and Indian people have largely talked past each other because each uses different cultural definitions of radioactivity and all it has and continues to impact.

The Stoffle and Arnold (2003) study that followed reaffirmed the disconnect among DOE and the tribes and concluded that Indian people expressed three basic ideas – we have been in these lands since Creation, non-Indians have failed to appreciate the importance of these lands, and radioactivity is viewed differently in Indian culture. To scientists, radioactive minerals are well understood with specific measurable physical properties, which if one prepares properly for them, are largely safe for use and disposal in a wasteland like the NNSS. Contrary to this belief, American Indian people explain radioactivity as an angry rock—a spiritual being that has been taken from its home without its permission, used in ways it does not agree with, and is being returned to the land without reducing its anger. The angry rock is alive and as sentient as humans are, because it is both powerful and spiritual. As a powerful spiritual being, the angry rock constitutes a threat that can neither be contained nor controlled by conventional means. It has the power to pollute food, medicine, and places, none of which can be used afterward by Indian people. Spiritual impacts are even more threatening, considering the angry rock would be transported along highways before ultimately being disposed of at the NNSS, thereby affecting animal creation places, access to spiritual beings, and unsung human souls. One of the most troubling conclusions reached by the study is that Indian people believe radioactivity has the potential to be transported along the path to the afterlife (Stoffle and Arnold 2003).

Indian knowledge and use of radioactive minerals in western United States goes back for thousands of years. Areas with high concentrations were called dead zones and placed off limits to average Indian people. Such areas were places of power or energy and could only be visited or the minerals used under the supervision of specially-trained Indian people that are sometimes referred to in the English language as shaman or medicine men. The DOE would benefit from this knowledge.

The CGTO knows that we, as Numic people, are traditional people. Traditional people are those who live a long time in one location and do not destroy the natural environment, themselves, or their way of life. Humans become traditional through a time-intensive process of co-adaptation in which both the people and their environment co-evolve to produce a sustainable way of life. At some level the people and the environment reach unification. As Numic people, we are co-adapted with our traditional lands and these lands are spiritually and physically co-adapted with us. This relationship has been documented through the various studies funded by the DOE. Traditional people are often uniquely threatened by pollution that has the potential of eliminating either our residency in or use of our homeland; thus, we are a special type of people at risk (Stoffle and Arnold, 2003).

Consolidated Group of Tribes and Organizations (CGTO)

In 1994, sixteen tribes and tribal organizations culturally affiliated[2] with the NNSS region formally aligned themselves as the CGTO to reinforce our cultural affiliation rights and to prevent the loss of ancestral ties to the area. The CGTO consists of officially-appointed tribal representatives who are responsible for presenting our respective tribal concerns and perspectives to DOE. Subsequent consultation efforts were expanded to 17 tribal groups and organizations in late 1994 to include the Ely Shoshone Tribe.

Presently, the CGTO consists of the following tribes and official Indian organizations:

- Southern Paiute

  Kaibab Paiute Tribe, Arizona
  Paiute Indian Tribe of Utah
  Moapa Band of Paiutes, Nevada
  Las Vegas Paiute Tribe, Nevada
  Pahrump Paiute Tribe, Nevada
  Chemehuevi Indian Tribe, California
  Colorado River Indian Tribes, Arizona

- Western Shoshone

  Duckwater Shoshone Tribe, Nevada
  Ely Shoshone Tribe, Nevada
  Yomba Shoshone Tribe, Nevada
  Timbisha Shoshone Tribe, California/Nevada

---

[2] *In anthropological terms, the concept of cultural affiliation means that an ethnic group (or groups) has an established history of prior occupancy and use of a region's lands and resources (Stoffle and Arnold, 2003).*

- Owens Valley Paiute and Shoshone

  Benton Paiute Tribe, California
  Bishop Paiute Tribe, California
  Big Pine Paiute Tribe of the Owens Valley, California
  Lone Pine Paiute-Shoshone Tribe, California
  Fort Independence Paiute Tribe, California

- Other

  Las Vegas Indian Center, Inc., Nevada

Of these groups, 15 are Federally recognized tribes[3]. The Pahrump Paiute Indian Tribe, which consists of a group of Southern Paiutes living in Pahrump, Nevada, has applied for Federal tribal recognition but to date has not received it. In addition, the Las Vegas Indian Center is not a Federally recognized tribe. It is an organization that represents urban Native Americans residing in Las Vegas and Clark County, Nevada.

One of the most enduring achievements of the CGTO has been the development of a model for tribal consultation in southern Nevada, and the formation and evolution of the CGTO as a consulting body working on behalf of its tribal members (Stoffle et al. 2001). This model has and continues to serve as the basis for American Indian consultations throughout federal agencies, including but not limited to DOE, the U.S. Fish and Wildlife Service, the National Park Service, and the U.S. Department of Defense.

Another achievement of the CGTO lies in its recommendation for “preservation-in-place.” This CGTO recommendation prompted the DOE to adopt a “preservation-in-place” policy whereby artifacts are avoided and left undisturbed without collection, wherever feasible. In another case, DOE initiated a program based on CGTO’s recommendation whereby American Indian monitors would be employed on archaeological projects to ensure that American Indian sensitivities are considered, especially during artifact collection.

The CGTO convened a subcommittee, called the American Indian Writers Subgroup, whose recognized role and responsibility is to closely follow specific issues and to report back to the CGTO. The CGTO members then report back to their respective tribal governments or Indian organization governing bodies. Official responses from tribal governments and governing boards are then submitted to DOE or additional guidance is provided back to CGTO representatives.

American Indian Writers Subgroup (AIWS)

In 1995, the CGTO convened the AIWS and designated individuals to represent the three main tribal groups to document our viewpoints on the NNSS area. Specifically, the CGTO-sanctioned role and responsibility of the AIWS was to represent the seventeen tribes and Indian organizations in the development of the 1996 FEIS, and to write Appendix G to that document. The purpose and scope of Appendix G was to represent the American Indian perspective of the actions proposed and analyzed by DOE for the NNSS, and to consider and address the resources potentially impacted.

In October 2009, DOE responded to the CGTO recommendation to replicate tribal involvement in the 1996 NTS FEIS and participate in the development of the SWEIS. The AIWS reaffirms the general

[3] *Defined by the U.S. Department of Interior as, “Any tribe, band, nation, or other organized group or community of Indians, including any Alaska Native village…which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.” (25 U.S.C. 3001[7]) A list of Federally recognized tribes is maintained by the Bureau of Indian Affairs for the U.S. Department of Interior.*

concepts presented in Appendix G and the American Indian perspective presented in italics within discrete sections of the 1996 NTS FEIS. In its development of Appendix C to the SWEIS, the AIWS has focused its attention on the alternatives and activities introduced in DOE's Notice of Intent to develop an environmental impact statement, and the information provided in the SWEIS for the proposed activities, alternative actions, and resources impacted.

C.1.1 Purpose, Scope, and Obligation

Appendix C contains the American Indian assessment of resources and alternatives presented in the *Draft Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (SWEIS). Appendix C has been prepared by the AIWS at the direction of the CGTO.

In consideration of our ties to these lands and their resources, DOE asked the CGTO to review the SWEIS, and develop text for Appendix C and throughout the SWEIS to enable DOE to comply with the intent of Executive Order 13127, "*Consultation and Coordination with Indian Tribal Governments*," and DOE Order 144.1, "*Department of Energy American Indian Tribal Government Interactions and Policy*." DOE Order 144.1 outlines seven principles regarding decision making and interaction with Federally recognized tribal governments. It requests that all Departmental elements ensure tribal participation and interaction regarding pertinent decisions that may affect the environmental and cultural resources of tribes.

Consultation between the CGTO and DOE (representing the United States government) was conducted during DOE's development of the 1996 FEIS, and documented in Appendix G and throughout pertinent resource sections within the FEIS. Similar to Appendix G of the 1996 FEIS, the CGTO's participation during current consultation efforts is not limited to the alternatives presented in the SWEIS, but also integrates relevant recommendations made by Indian people for the survival and sustainability of important American Indian resources such as land, water, air, plants and animals.

American Indian people believe these resources contain life-sustaining characteristics that must be respected and cared for to ensure harmony. The CGTO knows that American Indian people have been charged by the Creator to interact with these resources in culturally-appropriate ways to maintain balance. The CGTO takes this responsibility very seriously and has developed Appendix C in an effort to once again achieve this obligation for the NNSS area. Appendix C represents the official views of the tribal governments and governing boards represented by the CGTO.

C.1.2 American Indian Participation in the SWEIS

The American Indian Writers Subgroup was comprised of the following representatives from the CGTO, with assistance from the Desert Research Institute:

Gerald Kane	Bishop Paiute Tribe	Owens Valley Paiute
Richard Wilder	Fort Independence Indian Reservation	Owens Valley Paiute
Betty Cornelius	Colorado River Indian Tribes	Chemehuevi
Lalovi Miller	Moapa Paiute Tribe	Southern Paiute
Maurice Frank-Churchill	Duckwater Shoshone Tribe	Western Shoshone
Jerry Charles	Ely Shoshone Tribe	Western Shoshone
Richard Arnold	Desert Research Institute	Southern Paiute
Brenda Bowlby	Desert Research Institute	

C.1.3 Acknowledgement

Since the early 1980's, DOE has supported systematic American Indian studies representing tribal elders' perspectives about the cultural significance of the lands and the resources of the NNSS. The CGTO and DOE continue to receive praise for their efforts to preserve American Indian culture and protect resources through the NEPA process. American Indian consultation procedures, described further in Section 10.2.1 of this SWEIS, have and continue to serve as a model for involving American Indians in both current and future NEPA efforts. The CGTO believes these efforts, combined with DOE's commitment to include the tribes in the SWEIS, will facilitate other Federal agencies to include Indian tribes and organizations into their NEPA processes, comply with DOE Order 144.1 and EO 13175, and to enable American Indian tribes and organizations to better protect their holy lands, cultural resources, and sustainably-manage American Indian resources.

C.2 American Indian Assessment of Potentially Affected Resources

The following text closely follows the outline of issues and resources as they arise in the body of the SWEIS. However, Indian people think in terms that involve Indian use of resources in the ways that nature intended. Indian use of resources requires balance-keeping strategies whereby both people and nature are sustained by each other. This means that resources must co-exist, and Indian use of these resources are often intertwined. For example, impacts to water resources also impact biological resources, which may in turn, impact geology and soils, and so forth. Because of this holistic view, discussions of these resources often overlap each other and may be repeated in other sections within Appendix C.

C.2.1 Land Use

As discussed in Section C.1, Introduction, the NNSS area is part of the traditional Holy Lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone peoples. The lands were central in the lives of these people and were mutually shared for religious ceremony, resource-use, and social events (Stoffle et al. 1990a and b).

American Indians consider the NNSS lands and the surrounding area to contain not only archaeological remains left by their ancestors but also countless natural resources and geologic formations, such as plants, animals, water sources and minerals; natural landforms that mark important locations for keeping our history alive and for teaching our children about our culture. American Indians rely on these lands for medicinal purposes, religious activities and ceremonies, food, recreational use, and integral places described in traditional narratives and religious ceremonies.

The NNSS area and nearby lands were significant to the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people. For many centuries, the NNSS area has been a central place in the lives of American Indian tribes, continuously used by these tribes from antiquity to contemporary times. Until the mid-1900s, traditional festivals involving religious and secular activities attracted American Indian people to the area from as far as San Bernardino, California. Similarly, groups came to the area from a broad region during the hunting season and used animal and plant resources that were crucial for their survival and cultural practices. As one elder noted, "*Land is to be respected. It sustains us economically, spiritually, and socially.*"

The CGTO maintains we have Creation-based rights to protect, use, and have access to lands of the NNSS and the immediate area. These rights were established at Creation and persist forever. Despite the loss of many traditional lands on the NNSS to pollution and reduced access, Indian people have neither lost our ancestral ties nor have we forgotten our responsibilities in caring for it.

One elder from the Moapa Paiute Tribe in Nevada responded to the potential impacts of radioactive contamination of his traditional land as follows: *"You non-Indians can move if you pollute the land on which you live, but we were created for this place, so we must face whatever happens here. We cannot move and continue to be Paiute people – this is our land – we are this land."* (Stoffle and Arnold 2003) This view is shared by other culturally-affiliated tribes within the CGTO.

During the past decade, representatives of the CGTO have visited portions of the NNSS and have identified places, spiritual trails, and cultural landscapes of traditional and contemporary cultural significance. Because this is a public document, the exact locations of these areas will not be revealed; however, they do include a burial cave, a Native American Graves Protection and Repatriation Act (NAGPRA) reburial area, and a local trail and ceremonial landscape near a large water tank. These actions by DOE are considered positive steps towards facilitating co-stewardship arrangements between DOE and the CGTO to help co-manage important Indian resources of the NNSS and to regain balance.

In order to fulfill the Holy Land use expectations, the CGTO recommends continuing to identify special places, spiritual trails, and landscapes and setting aside these places for unique co-stewardship and ceremonial access. For example, studies have begun regarding the identification of places, spiritual trails and cultural landscapes in the Timber Mountain Caldera. We strongly encourage DOE to pursue these studies. When completed, these will add an American Indian cultural component that will contribute to the currently recognized importance of this National Natural Landmark.

According to tribal elders, *"The CGTO knows that ethnographic studies conducted at the NNSS have assisted DOE in incorporating a cultural component to understand that natural phenomena are dynamic, interacting processes and offer opportunities and limitations to human use. It helps federal land managers understand the cultural component of the land--such as song scapes, story scapes, spiritual trails--and its complexity. Until these ethnographic studies are completed, there will continue to be uncertainty regarding the full extent of this cultural component and the true impacts to the land from DOE's activities at the NNSS."*

C.2.2 Infrastructure and Energy

Although infrastructure and energy are analyzed in the SWEIS, the CGTO does not believe it is necessary to provide our assessment of these resources at this time.

C.2.3 Transportation

Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation arise resulting from NNSS-related activities, including the transportation of hazardous and radioactive waste, it could result in the closure of the main transportation artery to that land. If a major (only) road into a reservation closes, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays or separation from their families or support systems. Delays could also occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use or medical supplies. Emergency medical services en route to or from the reservation, and purchases by patrons of tribal enterprises could be dramatically impeded. Potential investors interested in expanding tribal enterprises, as well as on-going considerations by tribal governments for future or current tribal enterprises, may significantly diminish because of the real and perceived risks from the transportation of hazardous and radioactive waste associated with NNSS-related activities.

Because of these potential transportation impacts relating directly to NNSS activities, the CGTO recommends DOE collaborate with potentially affected tribes to develop emergency response measures regarding transportation.

C.2.4 Socioeconomics

Indian people prefer to live in our traditional homelands. One primary reason for this is because Indian people have special ties to our traditional lands and a unique relationship with each other. When Indian people receive employment near our reservations, we can remain on the reservations while commuting to work. This pattern of employment tends to have positive benefits for both the Indian community and tribal enterprises like housing. The reservation Indian community has the participation of the individual and his (her) financial contribution. The individual payment for housing is tied to income level, so the more a person earns with the job, the more they pay to the tribal housing office, and thus making tribally sponsored housing more economically sustainable and attractive for tribal governments.

When employment opportunities decline on reservations, however, Indian families must often move away from our reservations to seek employment elsewhere. As Indian people move away, Indian culture is threatened because the number of families living on reservations declines. Tribal members who choose to relocate from their reservations impact reservation economies, school, housing, and emergency services. Both schools and economies are impacted because federal funding available to tribes is based on population statistics.

With local employment opportunities such as those offered by the NNSS for eligible tribal representatives, prices of tribal housing rise because they are based on income. If a positive balance between increased income and increased cost of living in tribal reservations is achieved, then both individual members and the tribe benefit from employment opportunities.

Tribal housing programs become jeopardized if vacancies occur in rental properties and dwellings remain unoccupied. If vacancies occur, tribal revenues and federal funding are adversely impacted and making it more difficult to expand housing programs in future years.

Additionally, vacant units require more maintenance. If tribal members are unavailable to occupy a tribal housing unit, then tribes make units available to non-Indians, and this, too, potentially impacts Indian culture. The increased presence of non-Indians on a reservation or in an Indian community reduces the privacy needed for the conduct of certain ceremonies and traditional practices. When non-Indian children are in constant interaction with Indian children, it creates a situation that potentially disrupts the perpetuation of cultural learning opportunities that occur in everyday life.

When Indian people move away from our reservations several dilemmas occur. Typically, Indian people experience a feeling of isolation from their tribe, culture, and family. When an Indian person relocates to an off-reservation area, the individual finds that there are fewer people of their tribe and culture around them. As a result, Indian people must decide on the appropriateness of practicing traditional ceremonies in the presence of non-Indian people. Indian people are continually torn between the decision to stay in the city or return to the reservation to participate in traditional ceremonies and interact with other tribal members. This dilemma occurs on a regular basis and potentially impacts the livelihood and cultural well-being of off-reservation employees and their families. When off-reservation individuals choose to return to our homelands to participate in traditional ceremonies or renew familial ties, they risk losing their jobs or being subjected to disciplinary actions against their children who attend public schools due to excessive absenteeism.

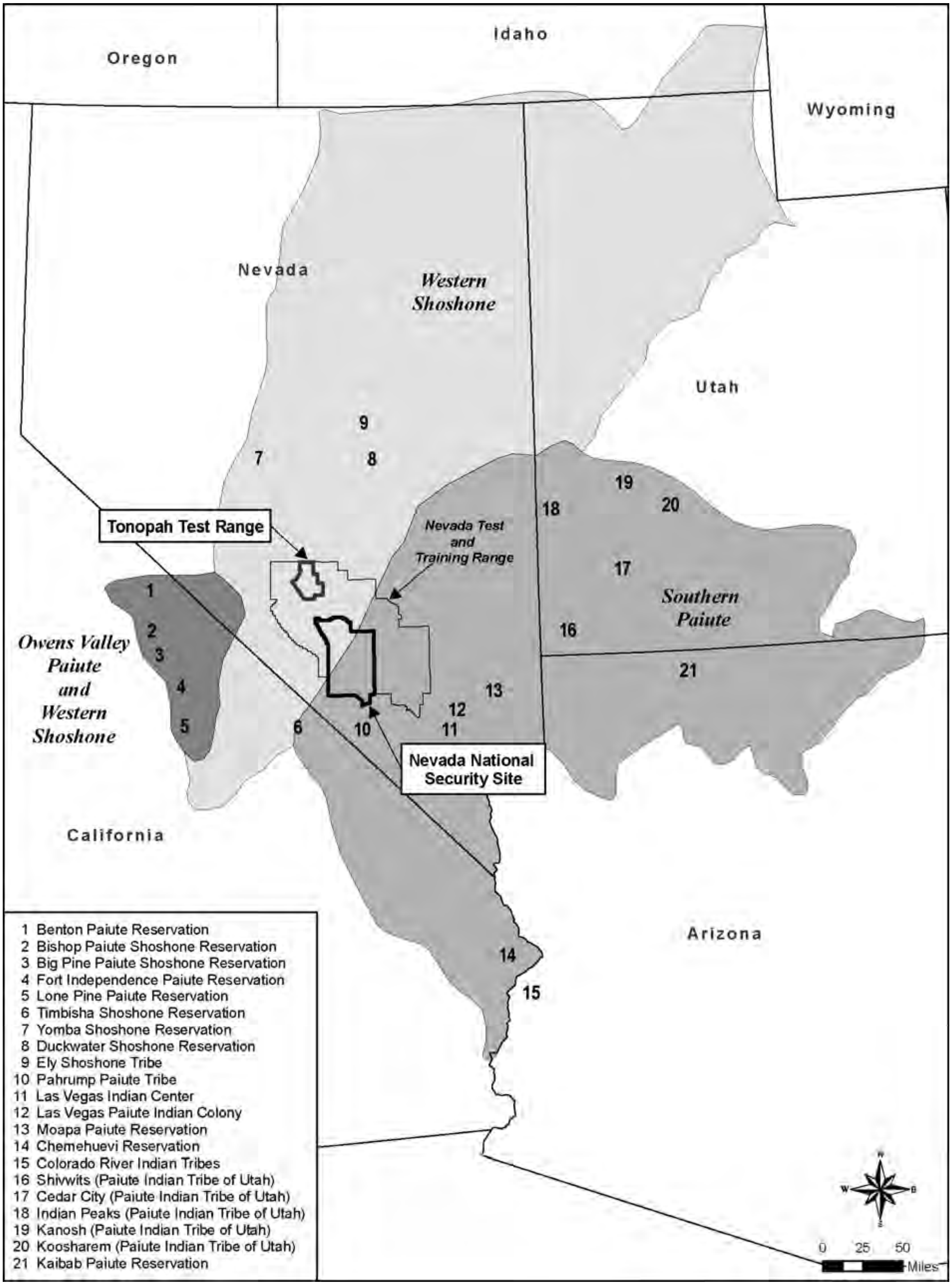


Figure C–1 American Indian Region of Influence for the Nevada National Security Site-Wide Environmental Impact Statement

Under federal and tribal law, American Indian children can be educated in tribally-controlled and federally-certified schools located on Indian reservations (also known as Indian Trust Land). Federal funds are available through the Indian Education Act for the education of Indian children. Compensation from the federal government is provided to any school district that has entered into a cooperative agreement with federally-recognized tribes, whether it be public, private, or an Indian-controlled school.

Small rural Indian reservations must have a sufficient number of people to generate an emergency response capability. The need for emergency services will decline as people move away from the reservation. Tribal members employed in these emergency service occupations may move away because of their marketable skills. Tribal revenues for administration, school, housing, and emergency services will be reduced accordingly, due to a decline in population size.

Many Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation occur resulting from NNSS-related activities, including the transportation of hazardous and radioactive waste, it could result in the closure of the main or only transportation artery to our land. If a major (only) road into a reservation closes, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays. Delays also could occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use. Emergency medical services en route to or from the reservation, and purchases by patrons of tribal enterprises could be dramatically impeded. Potential investors interested in expanding tribal enterprises, as well as on-going considerations by tribal governments for future tribal enterprises, may significantly diminish because of the real and perceived risks from the transportation of hazardous and radioactive waste associated with NNSS-related activities.

Although DOE continues to make strides to diversify their workforce, the CGTO strongly encourages DOE to enhance efforts to hire more Indian people and promote the hiring of Indian-owned businesses to mitigate socioeconomic impacts. We recommend the CGTO serve as a conduit to assist DOE and its contractors in identifying and facilitating employment opportunities for American Indians at the NNSS.

C.2.5 Geology and Soil

When visiting Area 5 of the NNSS in 2009, Indian people observed several traditional use minerals. In particular, Indian people have observed the presence of: (1) Chalcedony, (2) Obsidian, (3) Yellow Chert (otherwise known as Jasper), (4) Black Chert, (5) Pumice, (6) Quartz Crystal, and (7) Rhyolite Tuff. Other traditional use minerals are known to exist in other areas throughout the NNSS.

Minerals are culturally important and have significant roles in many aspects of Indian life. For example, the Chalcedony would have made an attractive offering, which could be acquired here and then left at the vision quest or medicine site located to the north on top of a volcano like Scrugham Peak. Upon return, traditional Indian people would bring offerings back to where we acquired offerings.

Obsidian is a glass-like stone produced by volcanoes. Indian people used a green volcanic glass during curing ceremonies that involved bleeding the patient. Volcanic glass found below Scrugham Peak was used in the first arrow making lessons for young men. Such lessons were held in small rock shelters found along the base of the basalt flow that constitutes Buckboard Mesa. Obsidian flakes were placed before important rock art panels as offering to the spirits that lived on the other side of the passageway provided by the panel. Small obsidian stones, commonly called Apache Tears, have been found on the face of Shoshone Mountain in southern Nevada. This massive deposit of obsidian stones is interpreted by Indian people as being provided by the mountain as both a spiritual backdrop and a location rationale for vision quests (Stoffle et al. 2001).

Volcanic rocks are used in a wide range of ceremonial activities. Indian women enhance the quality of breast milk by squirting it on heated rocks (Stewart 1940; Miller 2004). They are used for medicine society sweat lodge meetings (Zedeno et al. 2001: 146). Indian people call some volcanic rocks "grandfather stones," a designation that reflects reverence as well as wisdom. Such rocks are sought in special places of power and carried over long distances to serve as the heated stones in sweat lodges.

During the evaluation of the 1996 FEIS, the CGTO noted repeated nuclear testing activities had resulted in severe disturbances to the geology and soils, or minerals, in large portions of the NNSS. This seemingly irreparable damage has made certain areas unfit for human use and inaccessible to American Indians who have relied on the earth and rocks for medicine and religious purposes. Sedan Crater, for example, continues to be a dead site; the spirits of the site and resources on it were destroyed in 1962 and the loss can still be felt by members of the CGTO.

The CGTO visited the NNSS in February 2010 and believes the geology and soils are in even poorer condition than they were during the 1996 FEIS due to the continued drought. Drought conditions, ground disturbing site activities, and damage to the soil from previous underground nuclear testing are significantly enhancing erosion. Negative impacts to these resources are long-lasting.

Activities that alter geologic structure also alter hydrologic systems. Such actions result in changes to important geologic and soil features that directly connect the tribes to their homelands in specific, spiritual ways. These changes require spiritual and cultural intervention necessary for restoring balance.

According to tribal elders, *"Bombs have melted the soil. It turned to glass. . . Severe disturbances are still out there. Everything is still suffering from it. . . . All Tribes are in agreement that they want to be here to do what they can to help stop this terrible pressure put on the earth and to sing the songs to help the site and to say prayers. The land has its own songs and when you sing the songs to the land, it'll sing back to you. These songs must be sung to help heal the earth and to restore harmony and balance."*

In the 1996 NTS FEIS and in the 2002 NTS EIS Supplemental Analysis, the CGTO continued to express concerns about the removal of contaminated soils, and reasserted the need for religious leaders to conduct balancing ceremonies and healing prayers at these disturbed locations. The CGTO recommended that tribal representatives provide information about the re-vegetation of a portion of the Double Tracks Site located on the TTR. The CGTO maintains our involvement is still necessary for the Double Tracks site as well as for the Clean Slates site located at TTR; however, we are awaiting DOE's approval to proceed. Because of the long lapse of time since the last visits, the CGTO believes it is necessary to revisit and re-evaluate site conditions.

In general, the mitigation measures proposed by DOE for geology and soils include erosion control through stabilization and re-vegetation. The CGTO is concerned about the unnatural erosion control methods proposed by DOE. In particular, the CGTO struggles with activities that require relocating rocks and soil from where originally placed by the Creator and are being used contrary to the Creator's intention. Indian people know that relocating the soil in a culturally-unacceptable manner can cause adverse impacts to the environment such as the increased potential for noxious weed growth. This could potentially threaten nearby native vegetation and harm Indian people and wildlife that rely on this vegetation for survival.

Therefore, the CGTO recommends DOE implement culturally-appropriate stabilization efforts, and re-vegetation techniques using traditional ecological knowledge. Indian people stabilize our land by offering prayers to explain to the soil why we are removing it, and to thank it for its use. We then remove and protect the topsoil for future use. We replace the soil with dirt and gravel from nearby land only after offering prayers, and re-contour the land out of respect to the visual landscape. Indian people continually re-vegetate our land by offering prayers to bless the seeds and the plants so they will grow strong. We place the seedlings in the direction of the morning sun, and then give thanks for the opportunity to plant them. Our key objective is to protect and restore our ancestral land. We encourage DOE to make provisions for Indian people to participate in its stabilization and re-vegetation to mitigate adverse impacts to geology and soils.

C.2.6 Hydrology

Indian people believe water is a living organism that is fully sentient and willful. The forces of power in the world move along channels and combine into specific nodes or places of power. A common set of these channels follows the path of water. These paths begin at the tops of mountains, especially the highest peaks. Snow and rain falls on these highlands and peaks after being called down by the mountain itself. From this beginning, the water moves downhill in rivulets, washes, and streams. The water often goes underground where it forms similar networks of channels moving in various directions, only somewhat corresponding to what non-native people call hydrologic basins. Water is often attracted to volcanic activity, thus producing significant power places like hot mineral springs.

According to tribal elders, *"Water is life. Water is needed by the plants and animals. Indian people bless themselves with it. It purifies the body. Water is medicine and must be respected. American Indians need it to conduct religious ceremonies. It cleans the earth. It has a vast connection to the underground. Water shouldn't be contaminated or it will die and lose its spirit."*

The CGTO knows we are in a drought because humans have disrespected the earth. It is affecting the balance of our earth's climate. One inevitable implication of the current 100-year drought is that the surface water[4] on the NNSS and immediate areas have diminished and become more sporadic. The modification and availability of surface water has the ability to affect all trophic levels on the NNSS.

Each of the discreet underground water basins, or hydrological basins, has its own origin story. One tribal story tells of a discreet underground water network created by Ocean Woman and where she placed her feet. According to this traditional story, there are points where the water emerges at the surface in springs and seeps. It was here that Ocean Woman placed her medicine staff into the ground and water emerged.

At other points, the surface water in low playa lakes meets the underground water channels. These points are like doorways between the surface world and the underworld.

Rain calling is a basic aspect of American Indian life and culture. Rain ceremonies from the spiritual world help facilitate rain production, and were led by rain callers, often called rain shamans or rain doctors in the English language. The rain caller calls upon the rain by singing songs, and is aided by his spirit helper, which is usually in the form of a mountain sheep. The mountains also had important roles in this activity, and were called up to interact with the clouds and the sky to call down the rain.

Even today, individual traditional Indian people can bring rain. One way this is done is by turning a stinkbug on his back. The rain will come, provided the stinkbug allows a person to tickle his belly with a small stick. As this person prays for rain, he tells the stinkbug why he is asking for rain.

If too much rain fell, certain precautions are taken. For example, the children are not allowed to shake willows that will be used for weaving or to kill frogs as this brings more rain. Hummingbirds were not killed for many reasons, but if they are killed, there will be flooding and lightning storms, with lightning killing the person who killed the hummingbird.

[4] *Surface water is defined here as water available for shallow rooted plants during rainfall, water available during post-rain ponding, runoff, and absorption, and water recharged into near-surface aquifers.*

The Snow Ceremony was performed to ensure a good winter with heavy snow fall. The spiritual leader, often called a weather doctor in the English language, would call the people together and meet at a special place in the mountains, sometimes near a pine nut gathering area. The spiritual leader would sing songs and offer prayers.

According to Indian tradition, the Snow Ceremony is performed during the late fall when the weather becomes cold. A part of this ceremony involves calling on the Snow Fleas. They represent a special category of American Indian environmental knowledge because they are almost invisible and live at the highest elevations on the mountains. The Snow Fleas are the ones that make the snow wet and absorb into the mountain. Without them, the snow is dry and evaporates quickly, and there is less water for the mountains and the valleys below. The Snow Ceremony is conducted in relationship with ceremony of the seeds where young girls dance with seeds in winnowing trays and a spiritual person sings songs to bring whirlwinds, which surround the dancers and scatter the seeds as a gesture of fertilizing the earth. Water is called upon to nourish the soil and the seeds to make them fertile.

Because water is a powerful being it is associated with other powerful beings, such as water babies. Water babies are like the people of the water. They are highly respected by American Indian culture. If water is contaminated, the water babies will move to other areas that are not contaminated. Proof of their existence has been depicted in historic rock drawings throughout Nevada, including one pecked at the volcanic butte at Black Canyon, Pahranagat Valley.

According to a tribal elder, *"Water babies are important to our culture. They are supernatural. They connect everything and you don't want to disrespect them. The springs are all connected and they follow the water flow. Water babies are supernatural beings and are the guardians of the water. They can make sounds like a baby, and you don't want to startle them because they can disturb life. We are taking their native environment away when we drill and contaminate the water. It angers them. When they get mad, there are adverse impacts to wildlife as they can drain you spiritually and physically."*

Other tribal elders noted, *"Water has been disrespected and therefore it is disappearing. It is a medicine—used to heal and used for healing. It is used for ceremonial purposes in prayer. It is alive and must be awakened. It is spiritual--an essential component to begin religious ceremonies, and part of sweat ceremonies. Historically, water was pure and available to those who respected it. Bathing was a ritual. Now we do not trust the purity of the water because it has been disrespected. Hot springs have been affected and are no longer at the temperatures they used to be."*

Playas

The CGTO knows that playas occupy a special place in American Indian culture. Playas are often viewed as empty and meaningless places by western scientists, but to Indian people, playas have a role and often contain special resources that do not occur anywhere else.

The CGTO knows that playas were used in traveling or moving to places where work, hunting, pine cutting, or gathering of other important foods and medicine could be done. One elder remembers crossing over dry lake beds and traveling around but near the edges, and how provisions were left there and at nearby springs by previous travelers at camping spots.

According to tribal elders, who were interviewed during previous NNSS evaluations, *"Indian people left caches in playa areas for people who crossed valleys when water and food was scarce. Frenchman playa is such a place. Indian people took advantage of traveling through this playa as mountains completely surround this area. The CGTO knows that most dry lakes are not known to be completely dry. An example is Soda Lake near Barstow, California. The Mohave River flows into this dry lake and most of* *the year it looks dry but it actually flows underground. . . . Although some people continue to view Frenchman playa [and other playas] as a wasteland, the CGTO knows it is not."*

When humans respect water, it sustains them and life-forms on the surface, but when water is not treated well, it withdraws its life-giving support and returns to the underworld. The CGTO knows that the springs on Pahute and Rainier mesas and near Buckboard Mesa have dried up. Water has returned to the underworld because it has not been treated correctly by the DOE activities. There are places on the NNSS where the rain falls but does not nurture the plants and animals. The CGTO wants to be involved in DOE hydrology studies because if the water continues to be treated in inappropriate ways, it will totally remove itself from the NNSS.

To minimize some adverse impacts to hydrological resources, the CGTO recommends the DOE allow Indian people access to clean the *pohs* and tanks found throughout the NNSS. *Pohs* and tanks are naturally formed geologic features or basins used to bring and gather water from the rain and to nourish the plants and animals. The water within these *pohs* and tanks are central to our ceremonies to restore balance. By supporting the CGTO proposed project to clean the *pohs* and tanks, DOE will help reduce drought conditions. In turn, this project will provide spiritual, cultural, and ecological benefits to the land and the environment, thereby facilitating our obligation of spiritual and ecological rebalancing. Implementation of this process will require Indian people to identify project sites, to inventory and evaluate the conditions, resources, and features of the site, and to design and implement these mitigation measures.

The CGTO also recommends DOE implement mitigation measures for erosion and sediment control through culturally-appropriate stabilization efforts, and re-vegetation techniques using traditional ecological knowledge. Indian people stabilize our land by offering prayers to explain to the soil why we are removing it, and to thank it for its use. We then remove and protect the topsoil for future use. We replace the soil with dirt and gravel from nearby land only after offering prayers, and re-contour the land out of respect to the visual landscape. Indian people revegetate our land by offering prayers to bless the seeds and the plants so they will grow strong. We place the seedlings in the direction of the morning sun, and then give thanks for the opportunity to plant them. Our key objective is to protect and restore our ancestral land. The CGTO encourages DOE to make provisions for Indian people to participate in the stabilization and re-vegetation necessary to mitigate adverse impacts to hydrological resources.

C.2.7 Biological Resources

The CGTO knows the NNSS contains an ancient playa, surrounded by mountain ranges. The runoff from these ranges serves to maintain a healthy desert floor and environment. Animals frequent the area, and there are numerous animal trails. Animals and the places where they live play a significant part in Indian history and lifestyle. The CGTO knows Indian people have lived on these lands since Creation value all plants and animals, yet some of these occupy more cultural significance in our lives. It is widely known that many Indian people still collect and use plants and animals that are found within the NNSS region. We describe these plants, animals, and insects in this section in an effort to demonstrate their importance to our well-being and survival, and their role in maintaining ecological balance to our Holy Land.

The CGTO knows, based on previous DOE-sponsored ethnobotany studies, that there are at least 364 American Indian traditional use plants on the NNSS (see Table C–1). Plants are still used for medicine, food, basketry, tools, homes, clothing, fire, and ceremony – both social and healing. Sage is used for spiritual ceremonies, smudging[5] and medicine. Indian rice grass and wheat grass are used for breads and puddings. Joshua tree is important for hair dye, basketry, foot ware, and rope. Globe mallow had traditional medicine uses, but in recent times is also used for curing European contagious diseases.

[5] *Smudging is a spiritual cleansing involving the use of smoke from certain plants during prayers and ceremonies.*

In order to convey the American Indian meaning of these plants, a series of ethnobotany studies were conducted and the findings used to establish a set of criteria for assessing the cultural importance of each plant and of places where plant communities exist. The CGTO provided these cultural guidelines so that NEPA analyses and other agency decisions could be assessed from an American Indian perspective.

The CGTO knows, based on previous DOE-sponsored ethnofauna studies, there are at least 170 Indian use animals on the NNSS (see Table C–2). All are culturally important to Indian people.

The CGTO knows if they care for the earth and its resources, the Creator will always provide for them. The NNSS area was among the tribes' places to hunt and trap a variety of animals. It is known that special leaders within each tribe would organize large hunts where many Indian people participated. The Indian people would use these animals for many purposes, including food, bones for tool making, fur for warm blankets, ceremonial purposes, and described in traditional winter stories.

Indian people refrain from eating coyote, wolves, and some birds because these animals are fundamental to stories and songs that teach us life lessons to heal, to build character, and to become better people.

The relationships between the animals, the Earth, and Indian people are represented by the respectful roles they play in the stories of our lives then and now. For example, the NNSS contains a valley where an important spiritual journey occurred. It involved Wolf (*Tavats* in Southern Paiute, *Bia esha* in Western Shoshone, *Wi gi no ki* in Owens Valley Paiute) and is considered a Creation story. Out of respect to our traditional teachings, only parts of this story are presented here. When Wolf and Coyote had a battle over who was more powerful, Coyote killed Wolf and felt glorious. Everyone asked Coyote what happened to his brother Wolf. Coyote felt extremely guilty and tried to run and hide but to no avail. Meanwhile, the Creator took Wolf and made him into a beautiful Rainbow (*Paro wa tsu wu nutuvi* in Southern Paiute, *Oh ah podo* in Western Shoshone, *Paduguna* in Owens Valley Paiute). When Coyote saw this special privilege he cried to the Creator in remorse and he too wanted to be a Rainbow. Because Coyote was bad, the Creator put Coyote as a fine, white mist at the bottom of the Rainbow's arch. This story and the spiritual trails discussed in the full version are connected to the Spring Mountains and the large sacred cave in the Pintwater Range as well as to lands now called the NNSS. These areas comprise the home of Wolf, whose spirit is still present and watches over Indian people and our Holy Land.

Both the mountain sheep and the stink bug are traditionally used to call the rain. Rain calling is a basic aspect of American Indian life and culture. Rain ceremonies from the spiritual world help facilitate rain production, and were led by rain callers, often called rain shamans or rain doctors in the English language. The rain caller calls upon the rain by singing songs, and is aided by his spirit helper, which is usually in the form of a mountain sheep. Rain could also be called by turning a stinkbug[6] on his back. The rain will come if the stinkbug allows a person to tickle his belly with a small stick. As this person prays, he tells the stinkbug why he is asking for rain.

Willows, frogs and hummingbirds are also important to Indian people and our respect for the rain. If too much rain fell, certain precautions are taken. For example, the children are not allowed to shake willows that would be used for weaving or to kill frogs as this brings more rain. Hummingbirds are not killed for many reasons, but if they are killed, there will be flooding and lightning storms, with lightning killing the person who killed the hummingbird.

The Snow Fleas are important to Indian people and our Snow Ceremony. The Snow Ceremony is performed in the fall to ensure a good winter with heavy snow fall. The spiritual leader, often called a weather doctor in the English language, calls the Indian people together and meets at a special place in the

[6] *Called "Bee-voos" in Western Shoshone and Wu-who-koo-wechuts in Southern Paiute.*

mountains, sometimes near a pine nut gathering area. The spiritual leader sings songs and offers prayers. A part of this ceremony involves calling on the Snow Fleas. They represent a special category of American Indian environmental knowledge because they are almost invisible and live at the highest elevations on the mountains. The Snow Fleas are the ones that make the snow wet and absorb into the mountain. Without them, the snow is dry and evaporates quickly, and there is less water for the mountains and the valleys below. The Snow Ceremony is conducted in relationship with ceremony of the seeds where young girls dance with seeds in winnowing trays. A spiritual person sings songs to bring whirlwinds, which surround the dancers and scatter the seeds as a gesture of fertilizing the earth. Water is then called upon to nourish the soil and the seeds to make them fertile.

If any of these plants, animals, and insects, continue to be disrespected, then the hydrological systems and weather patterns will remain unbalanced. The CGTO knows this unbalance has resulted in the drought our land and its resources continue to suffer.

The current 100-year drought has increasingly stressed the physical and spiritual nature of the plants and animals on the NNSS. Its environmental impacts are unprecedented in the history of the operation and management of these lands. The CGTO knows the 100-year drought has modified the abundance and distribution of all animals and plants. The quality, quantity, and distribution of indigenous plants, animals, and insects necessary to sustain a healthy environment and to maintain a productive animal habitat are clearly affected.

Water -- both as free flowing springs and absorbed by plants and distributed to animals -- has diminished. Certain springs have dried up making animals travel into other unfamiliar lands. Food foraging becomes difficult and land dries up. Wildlife has less body fat, which results in shorter hibernation cycles. Indian people have observed that ground squirrels are becoming cannibalistic to survive. Other animals are changing their habits as the environment continues to be impacted by this drought. For example, rabbits are now forced to eat unusual foods like Yucca. According to one tribal elder, *"The cries of some birds have changed since the drought began."*

Two discrete efforts in which the CGTO and DOE can work collaboratively to manage biological resources include pine nut harvesting, and the relocation and reintroduction of the big horn sheep and desert tortoise.

Pine Nut Harvesting

Pine nut harvesting areas present a unique opportunity to address significant cultural and ecological problems. In times past, the pine nut trees were cared for by pruning and whipping to encourage production and reduce dead wood. The areas under and around the trees were kept clean by using these materials during routine visits, and other traditional use plants in the area were cared for as well. Ceremonies and cleaning activities occurred in the spring and fall each year. The removal of Indian people from accessing these areas has resulted in limitations to passing on traditional cultural and ecological knowledge, and in unhealthy ecosystems. The contemporary concerns with wildfires and invasive species such as cheat grass in the Great Basin are issues that can be addressed proactively through the reintroduction of traditional pine nut harvesting practices. This project can provide spiritual, cultural, and ecological benefits to the CGTO, DOE, and the environment, consequently fulfilling the primary goal of rebalancing. Implementation of this project will require Indian people to identify project sites, to inventory and evaluate the conditions, resources, and features of the sites, and to design the restoration plan. This project would involve annual activities and monitoring of site conditions so that potential benefits can be measured.

Part of the mitigation measures presented by DOE in Section 7 of the SWEIS includes notifying the U.S. Fish and Wildlife Service (FWS) of incidental taking of desert tortoises. The desert tortoise is culturally-significant to Indian people because of its healing powers, longevity, and wisdom. It is integral to our traditional stories, well-being and perpetuation of our native culture. Incidental taking of this traditionally-important animal is particularly disturbing to native people. Accordingly, the CGTO must be notified concurrently with the FWS so that we may conduct the necessary balancing ceremonies.

According to information presented in the SWEIS, DOE will conduct preactivity surveys for cultural and biological resources prior to project initiation. If biological resources such as the desert tortoise or its habitat are determined to be present at the proposed project site, and avoidance of these is determined by DOE to be impossible, it is the CGTO's understanding from the information presented in the SWEIS that project biologists will relocate and reintroduce these impacted biological resources elsewhere. Over the past 14 years, various initiatives have been undertaken to relocate and reintroduce certain animals without participation from the CGTO. In particular, this has occurred with the desert big horn sheep and the desert tortoise near the southern portion of the NNSS.

Relocation and reintroduction of animals that require their adaptation to unfamiliar habitats are considered highly sensitive religious acts and require oversight by Indian people. Relocating animals from where originally placed by the Creator causes tremendous stress to the animals. They are in a new environment, where food and water sources are unknown. These animals have been improperly removed with disregard for their families and all they know. They must now seek the songs, prayers and voices of the Indian people, as they are no longer in their homeland. They are isolated. This depletes their spirit. Without cultural intervention, relocated animals are unable to reproduce, and often die of premature deaths due to loneliness, thirst and hunger. Therefore, animals should not be relocated unless absolutely necessary.

The desert bighorn sheep and the desert tortoise are both culturally sensitive animals to Indian people. Among their many special qualities, when used ceremonially, they have the ability to bring rain and reduce drought impacts. The reintroduction of desert bighorn sheep is a critical issue for us. For relocation and reintroduction of animals to be successful, it is essential to have tribal representatives involved throughout this process.

In the 2008 Draft NTS EIS Supplemental Analysis, the AIWS presented information regarding the successful reintroduction of a gray wolf in Idaho during the late 1970's, which was a collaborative effort between American Indians and a Federal agency. On the day of release, a Federal liaison unlatched the door of the cage and the animal scrambled out. Waiting for the wolf was an American Indian holy man in traditional regalia, sitting on a horse and watching. The wolf and man gazed at each other and the man spoke words welcoming the wolf back to its new home. The wolf stood for a few more seconds and accepted the holy man's encouragement and blessing. Then the wolf turned and ran into the forest. Everyone present was very moved by the welcoming back ceremony. They knew that was the right thing to do. The CGTO believes collaborative projects such as this underscores the need for American Indian involvement whenever plant or animal species transplanted from other locations are reintroduced to the NNSS area.

Once reintroduced, the desert bighorn sheep and the desert tortoise must be provided all of the resources and considerations necessary to encourage them to remain in their new location. Resources include spiritual and cultural aspects that must be addressed by tribal specialists and cultural experts, and consideration of other species in the area that may be affected negatively by these relocated animals, or may compete with and impede successful rebalancing. This project can provide spiritual, cultural, and ecological benefits to the CGTO, DOE, and the environment, consequently fulfilling the primary goal of rebalancing. Implementation of this project will require the appropriate cultural experts to identify projects sites, to inventory and evaluate the conditions, resources, and features of the sites, and to design the restoration plan including off-site resources necessary to support project sites such as landings or birthing places. This project would involve annual activities and monitoring site conditions.

The CGTO recommends DOE mitigate adverse impacts to biological resources through avoidance, culturally-appropriate re-vegetation efforts, reintroduction of native animals, and traditional plant and animal management methods. Indian people have extensive, traditional ecological knowledge and deep concern for the biological resources of the area and should participate directly with DOE to mitigate adverse impacts and protect these resources.

According to tribal elders, *"Prior to re-vegetation efforts, we talk to the land to let it know what we plan to do and ask the Creator for its help. We choose our seeds from the sweetest and the best plants, and store them for the winter to dry. When the winter is over, we place the seeds in a moist towel or sock and allow the new plant to sprout. We then plant the sprouts into small containers with soil until they are ready to transplant into the ground. This is a long and delicate process, requiring patience and knowledge passed down from our ancestors. If the plants are struggling to grow, we tag them and move them to face the same direction as the sun."*

The DOE would benefit from this knowledge to enhance their re-vegetation efforts. The CGTO knows DOE struggles with the success rates regarding the density and diversity of native plants during their re-vegetation efforts. A co-stewardship approach to this land with the tribes would enable DOE to enhance their re-vegetation efforts, saving time, money, and resources.

C.2.8 Air Quality and Climate

The CGTO knows that the air is alive. The Creator puts life into the air, which is shared by all living things. When a child is born, he pulls in the air to begin its life. The mother watches carefully to make sure that the first breath is natural and that there is no obstruction in the throat. It is believed if the day of birth is a windy day, it is a good day and the child will have a good life.

According to tribal elders' perspectives from Area 5 NNSS activities, *" . . . You can listen to the wind. The wind talks to you. Things happen in nature. Our people had weather watchers, who are kinds of people who will know when crops and things should be done. They watch the different elements in nature and pray to ask the winds to come and talk about these things. Sometimes you ask the north wind to come down and cool the weather. The north wind is asked to blow away the footsteps of the people who have passed on to the afterlife. That kind of wind helps people, it is positive. The wind also brings you songs and messages. Sometimes the messages are about healing people, a sign that the sickness is gone now from the person, or that it is coming to get that sickness to take it away, or it is coming to bring you the strength that you will need to deal with the illness."*

Air can be destroyed, causing pockets of dead air. There is only so much alive air that surrounds the world. If you kill the living air, it is gone forever and cannot be restored.

Dead air lacks the spirituality and life necessary to support other life forms. Airplanes crash when they hit dead air. During a previous CGTO evaluation of the area, one member of the CGTO compared this Indian view of killing air with what happens when a jet flies through the air and consumes all of the oxygen, producing a condition where another jet cannot fly through it.

As one tribal elder noted, *"The spiritual journey of the Southern Paiute Salt Songs are affected as the air quality is not the same as in the days of old. This Salt Singer wonders what is going to happen if the situation isn't corrected. Southern Paiutes need this spiritual journey to ascend their deceased to the next life."*

As people are emitting things into the air that are unnatural, such as radiation from atomic blasts or dust and debris from decontaminating and decommissioning old NNSS buildings, climatic changes such as droughts are occurring because the air is being disrespected. As the air continues to be disrespected, it perpetuates and intensifies imbalance throughout the environment. This impacts many resources, including the land, soil, water, plants, and animals.

Dust devils in various forms and sizes are culturally significant to Indian people and known to bring harm. The CGTO knows the frequency and intensity of dust devils have increased within the NNSS and the surrounding area. Dust devils contain negative energy, and can disperse hazardous and radioactive contaminants from the soil at the NNSS. Their spirits can bring harm if the air is disrespected and if you watch it or allow them to come near or pass through you. If this occurs, a person will become ill and must seek cultural intervention to heal.

Some Indian people who were present during aboveground nuclear tests at the NNSS believe that the sickness they have came from the radiation. To some of these people, the effects of the radiation were in addition to what happened when the air itself was killed. Some tribal elders believe that even when the plants survived the effects of radiation, the dead air killed many of them or made some lose their spiritual power to heal things.

As noted by tribal elders, *"Sheep and other animals are being born out of season, which places them at greater risk from predators and from living full lives. Consequently, their loss adversely impacts our cultural survival, as many of our stories and traditions surround these animals. Weather is out of balance. For example, when it snows, one can also hear thunder. Native people observe the changed nature of the vegetation and blame the atmospheric change on the air quality from the bomb testing on the NNSS."*

The CGTO recognizes that climatic change is occurring and will continue to impact the natural resources of the NNSS and the surrounding region. When rain gauge data are averaged over a decade they can mask the reality that plants and animals are adjusted to regular cycles of rain and snow. Isolated heavy rain events can increase the annual rainfall amounts, but are largely not useful for sustaining life. Plants and animals need the climate to return to its historic, normal annual rainfall that is more evenly dispersed by season.

The CGTO knows that ceremonies have historically helped manage the climate in the NNSS region. Unfortunately, we have not been able to perform these ceremonies since the NNSS area was used for nuclear testing and our Holy Land continues to suffer. To facilitate the healing of this area, DOE must make provisions for the CGTO to access the land and perform these rituals, which are further described below.

Calling the Rain

Rain calling is an important aspect of American Indian life and culture. Rain ceremonies associated with the spiritual world help facilitate rain production, and are led by rain callers, often called rain shamans or rain doctors in the English language. The rain caller calls upon the rain by singing songs, and is aided by his spirit helper, which is usually in the form of a mountain sheep. The mountains also had important roles in this activity, and are called up to interact with the clouds and the sky to call down the rain.

Individual traditional Indian people can also bring rain. This is done by turning a stinkbug[7] on his back. The rain will come, provided the stinkbug allows a person to tickle his belly with a small stick. As this person prays, he tells the stinkbug why he is asking for rain.

If too much rain falls, certain precautions are taken. For example, the children are not allowed to shake willows that would be used for weaving or to kill frogs as this brings more rain. Hummingbirds are not killed for many reasons, but if they are killed, this brings on flooding and lightning storms, with lightning killing the person who killed the hummingbird.

Snow Making Ceremonies

The Snow Ceremony was performed in the fall to ensure a good winter with heavy snow fall. The spiritual leader, often called a weather doctor in the English language, would call the people together and meet at a special place in the mountains, sometimes near a pine nut gathering area. The spiritual leader would sing songs and offer prayers.

According to Indian tradition, the Snow Ceremony is performed during the late fall when the weather becomes cold. A part of this ceremony involves calling on the Snow Fleas. They represent a special category of American Indian environmental knowledge because they are almost invisible and live at the highest elevations on the mountains. The Snow Fleas are the ones that make the snow wet and absorb into the mountain. Without them, the snow is dry and evaporates quickly, and there is less water for the mountains and the valleys below. The Snow Ceremony is conducted in relationship with ceremony of the seeds where young girls dance with seeds in winnowing trays and a spiritual person sings songs to bring whirlwinds, which surround the dancers and scatter the seeds as a gesture of fertilizing the earth. Water is called upon to nourish the soil and the seeds to make them fertile.

Balancing Ceremonies

The earth needs to be rebalanced. The CGTO knows that the air, the climate and all of the Earth's living resources are struggling to adapt and recover from the current drought. As Indian people, we have a responsibility to help them recover and regain balance. According to tribal elders, "*We need to access strategic locations to restore the climate. We need access to conduct balancing ceremonies for the well-being of the people and the well-being of the future—access to the past, the present, and the future. The prayers are far-reaching, and include the environment, people, and everything. The ceremonies and prayers are needed to renew the earth and should be conducted semi-annually by Indian people.*"

We recommend that Indian people perform balancing ceremonies to try to restore the balance to the air, the climate, and the Earth's living resources. Ideally, balancing ceremonies are done in the spring and fall, to pray for good crops and to pray for plentiful harvest, respectively. At a minimum, DOE should make arrangements for Indian people to access the NNSS annually to perform these ceremonies. Renewal ceremonies, or balancing ceremonies, such as these have successfully been conducted with other federal agencies for many years, and we strongly encourage DOE to do the same.

C.2.9 Visual Resources

All landforms within the NNSS have high sensitivity levels for American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is essential for the spiritual interaction between Indian people and our traditional lands.

[7] *Called "Bee-voos" in Western Shoshone and Wu-who-koo-wechuts in Southern Paiute.*

Views from places are an important cultural resource that contributes to the location and performance of American Indian ceremonialism. Views combine with other cultural resources to produce special places where power is sought for medicine and other types of ceremony. Views can be of any landscape, but more central viewscapes are experienced from high places, which are often the tops of mountains and the edges of mesas. Indian viewscapes tend to be panoramic and are made special when they contain highly diverse topography. The viewscape panorama is further enhanced by the presence of volcanic cones and lava flows.

Viewscapes are tied with songscapes and storyscapes especially when the vantage point has a panorama composed of multiple locations described by traditional songs or stories. Our traditional songscapes and storyscapes can be compromised if projects like geothermal energy development are pursued. If geothermal resources are altered, our songs and stories will be impacted and will no longer accurately reflect key traditional aspects of the viewscape.

The CGTO recognizes the cultural significance of viewscapes and have identified a number of these on the NNSS. The Timber Mountain Caldera contains a number of significant vantage points with different panoramas including but not limited to Scrugham Peak, Shoshone Mountain, and Buckboard and Pahute Mesas. The CGTO feels revisiting sites within the viewscapes are essential to Indian people to interact with the land, communicate with the spirits who watch over the land, conduct religious ceremonies with prayers and songs, and monitor each site's condition. Special considerations should be given to tribal elders and youth to provide an educational experience and reinforce positive connections with our culture.

Central to the Indian experience of viewscapes is isolation and serenity in an uncompromised landscape. If construction and operation of the proposed activities proceed in a culturally-inappropriate manner, then visual resources within the NNSS area will be adversely impacted, further perpetuating an unbalanced environment. To restore balance to the environment and it's visual resources, the DOE must provide access for Indian people to conduct religious and cultural ceremonies to fulfill traditional obligations. In this manner, we can restore and preserve our spiritual harmony as a whole.

The CGTO knows many of the activities described under the proposed action and alternatives, such as those associated with facility construction and environmental restoration, will adversely impact visual resources. For Indian people, the adverse impact to visual resources will most certainly impact the spiritual harmony of the environment as a whole. Facility construction and operation will impede visual resources, and affect the solitude and cultural integrity of the land.

Visual resources may be negatively impacted if proposed solar enterprise zones and geothermal projects are pursued. The CGTO must be part of any additional, future discussions of these projects at a minimum as these may impact visual resources and may degrade traditional and cultural ceremonies.

According to the information presented by DOE in the SWEIS regarding the no action alternative, the CGTO knows the NNSS has been selected to pursue the development of the solar enterprise zone within Area 25. We also understand the project schedule presented in the Memorandum of Understanding between DOE and DOI initiates environmental evaluations in July 2010. The CGTO must be part of any additional, future environmental assessments as this proposed activity will adversely impact visual resources and degrade traditional and religious ceremonies. The visual quality of the landscape will lose its integrity and the viewscape will be marred from the introduction of considerable infrastructure directly visible from U.S. 95. For Indian people, an adversely impacted resource will most certainly impact the spiritual harmony as a whole. Therefore, Indian people will need to perform ceremonies, offer prayers, and sing songs in an effort to mitigate these impacts. If construction proceeds, DOE will need to make provisions for Indian monitors to assess the construction footprint and implement traditional techniques that require minimum ground-disturbing actions.

Fundamentally, the CGTO struggles with the idea of pursuing solar energy as a "cleaner" form of energy and the potential impacts to the Sun. According to some tribal elders, *"The Sun is like a big battery. Once you drain its power, will it die? For those spiritually connected to the Sun, we are concerned about unnaturally harnessing it's power. We know the Sun was given only so much energy. If the Sun is drained, how will it be replenished? If the Sun goes away, everything will die. The stories and activities of our ancestors are tied greatly to the Sun. Today, our prayers and ceremonies still travel or rely on its strength."* Because of the complexity and potential implications to the environment, to the cultural and visual landscape, and for our own survival, it is imperative that DOE support an ethnographic study to evaluate the cultural implications of pursuing solar energy on the NNSS. The CGTO also recommends Indian people provide their expertise in the development of the Solar Enterprise Environmental Assessment.

Although DOE proposes to mitigate visual resource impacts by painting structures to reduce visibility, the CGTO knows additional mitigation measures are necessary. The CGTO recommends that landscape modifications, including those associated with environmental restoration activities, be done in consultation with American Indians. Specifically, we recommend DOE make provisions for Indian people to access the land and culturally assess its visual resources. DOE should employ Indian people to participate in annual monitoring of land disturbing activities throughout the duration of the project. The CGTO should also participate in restoring the land, and concealing infrastructure using traditional Indian re-vegetation methods, as we have described in Section C.2.7. Finally, we strongly encourage DOE to make provisions for Indian people to conduct ceremonies, and offer prayers and songs in an effort to re-balance this adversely impacted resource.

C.2.10 Cultural Resources

American Indians consider cultural resources to include not only archaeological remains left by their ancestors but also natural resources and geologic formations in the region, such as plants, animals, water sources, minerals, and natural landforms that mark important locations for keeping their history alive and for teaching their children about their culture.

The NNSS area and nearby lands were significant to the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people. The lands were central in the lives of these people and were mutually shared for religious ceremony, resource use, and social events (Stoffle et al. 1990a and b). When Europeans encroached on these lands, the numbers of Indian people, their relations with one another, and the condition of their traditional lands began to change. European diseases killed many Indian people; European animals replaced Indian animals and disrupted fields of natural plants; Europeans were guided to and then assumed control over Indian minerals; and Europeans took Indian agricultural areas. Indian people believe that the natural state of their traditional lands was what existed before European contact, when Indian people were fully responsible for the continued use and management of these lands.

The withdrawal of Nevada's lands for military purposes in the 1940's, followed by use of the land by the DOE continued the process of Euroamerican encroachment on Indian lands. Land-disturbing activities followed, thus causing some places to become unusable again for Indian people. On the other hand, many places were protected by this land withdrawal because "pothunters" were kept from stealing artifacts from rock shelters and European animals were kept from grazing on Indian plants. The forced removal of Indian people from the land was combined with their involuntary registration and removal to distant reservations in the early 1940s. Indian people were thus removed from lands that had been central to their lives for thousands of years.

The CGTO knows, based upon its collective knowledge of Indian culture and past American Indian studies, that American Indian people view cultural resources as being interconnected. Thus, certain systematic studies of a variety of American Indian cultural resources must be conducted before the cultural significance of a place, area, or region can be fully assessed. The following is a list of studies that are required for a complete American Indian assessment:

1. Ethnoarchaeology – the interpretation of the physical artifacts produced by our Indian ancestors
2. Ethnobotany[8] – the identification and interpretation for the plants used by Indian people
3. Ethnozoology[9] –the identification and interpretation of the animals used by Indian people
4. Rock art – the identification and interpretation of traditional Indian paintings and rock peckings
5. Traditional Cultural Properties – the identification and interpretation of places of central cultural importance to a people, often referred to as "power places" by Indian people
6. Ethnogeography – the identification and interpretation of soil, rocks, water, and air
7. Cultural landscapes – the identification and interpretation of spatial units that are culturally and geographically unique area for American Indian people. Examples of these include songscapes, storyscapes, and spiritual trails.
8. Ethnoastronomy – includes the identification and interpretation of the universe within and beyond the earth's atmosphere, and its influence on American Indians and their environment.

When all of these subjects have been studied, American Indian people assess the information and answer three critical questions: (1) What is the natural condition of this portion of our traditional lands? (2) What has changed due to NNSS activities? And, (3) What impacts will proposed activities have on either furthering existing changes in the natural environment or restoring our traditional lands to their natural condition? Tribal governments and organizations must then have the opportunity to review the recorded thoughts of its elders to determine their support of the conclusions.

DOE has supported several cultural resource studies at the NNSS, most occurring as a result of recommendations made by the CGTO in the 1996 NTS FEIS and commitments made by DOE in the subsequent Record of Decision. Many of these studies are cited throughout Appendix C of the SWEIS. These studies were also designed to comply with various federal laws and executive orders, including AIRFA, Native American Grave Protection and Repatriation Act, and Executive Order 13007, *Indian Sacred Sites*.

Through these studies, the CGTO confirmed that American Indians used traditional sites in the NNSS area to make tools, stone artifacts, and ceremonial objects; many sites are also associated with traditional healing ceremonies and power places. Several areas in the NNSS region are recognized as traditionally or spiritually important. For example, Fortymile Canyon was an important crossroad where trails from such distant places as Owens Valley, Death Valley, and the Avawatz Mountain came together. Black Cone, in Crater Flat, is an important religious site that is considered to be an entry to the underworld. Alice Hill, (refine location with acceptable language) is also regarded as a culturally important place (AIWS 2005). Prow Pass was an important ceremonial site and, because of this religious significance, tribal representatives have recommended that DOE avoid affecting this area (Stoffle et al. 1988). Oasis Valley was another important area for trade and ceremonies. In 1993, tribal members visited a rockshelter site containing perishable basketry and crookneck staff on the NNSS, and recommended that the items be left in place, with annual monitoring to assess their condition. Other areas are considered important based on the abundance of artifacts, traditional-use plants and animals, rock art, and possible burial sites.

[8] *Ethnobotany is sometimes also referred to as ethnoflora.*
[9] *Ethnozoology is sometimes also referred to as enthofauna.*

The CGTO knows the distribution and density of sites has not changed since the 1996 NTS EIS. We know the largest number of recorded cultural resources is in the northwest part of the NNSS, on and around Jackass Flats, Yucca Mountain and Shoshone Mountain. This is because numerous activities were conducted on those portions of the NNSS within the last 14 years, less attention has been directed to these regions, and adverse impacts to these areas have been minimized.

The CGTO recommends tribal visits to monitor the state of cultural sites located within the NNSS and to offer blessings. The CGTO also recommends tribal visits to areas that have been designated for repatriation, such as the Timber Mountain area, and periodic assessments conducted to comply with NAGPRA. According to a tribal elder, *"When Indian people are buried, they are never meant to be disturbed. Laws, such as NAGPRA, are difficult for Indian people to implement because they force us to come up with blessings and methods to address something abnormal and contrary to ceremonial intent."*

C.2.11 Waste Management

We continue to strongly oppose the transportation, storage and disposal of radioactive waste at the NNSS; however, Indian people must continue to fulfill our birth-rite obligation to care for our Holy Land and do what we can to try to restore balance to Area 5 and other contaminated locations.

The CGTO knows the NNSS is used to dispose of low-level radioactive waste and low-level mixed radioactive waste (i.e., containing certain hazardous wastes) in Area 5, and non-hazardous waste and debris. Indian people hold traditional and scientific views of radioactive materials and waste. As an example, the former builds on the view that all resources--including the rocks--are alive. Radioactive rocks are powerful, but they can become "angry rocks" if they are removed without proper ceremony, used in a culturally inappropriate way, disposed of without ceremony, or placed where they do not want to be (Stoffle et al. 1989a and 1990c). The practice of dealing with "bad medicine" or neutralizing negative forces is a part of our traditional culture. Indian knowledge and use of radioactive rocks, or minerals, in the western United States goes back for thousands of years. Areas with high concentrations of these minerals are called dead zones. Such areas contain places of power or energy and can only be visited or certain minerals used under the supervision of specially-trained Indian people, who are sometimes referred to in the English language as a shaman or medicine man (Stoffle and Arnold 2003). Therefore, the DOE would benefit from this knowledge if applied correctly.

A head Salt Song singer and religious leader for the Chemehuevi Paiutes once explained the impacts of radiation as follows:

"Our spirits will paint their faces and become angry because they are disturbed by the presence of angry rocks. When we are out there now, it is still and peaceful; it is like being in a church chamber. Radiation will disturb the harmony . . . It will no longer be the same. It will be violated. All the previous songs stories that have been shared in the area will be disturbed. Once a song is sung it continues to be there. When you sing a song you are on the trail – your spirit is making that trip. You are describing where you are at and what is happening. You tell in the song where you are and what you are doing. When people go to these areas today a person can get a song. Previous songs live in the mountains in the canyons. If you were a gifted person that was meant to be an owner of the song you can actually hear it. . . . There are still areas today where you can go and hear the song. Some people hear the songs and it scares them because they do not know what it is. Young people need to be told what it is they are hearing. The places need to be protected from damage so the songs continue to be there for future generations. It is like a delayed echo that never goes away and can come again and again to new people."

We are very concerned about the tritiated liquids disposed at the NNSS and treated by evaporation into the air from ponds, open tanks, and sewage lagoons. The CGTO is concerned about the ponds drying up and the airborne residue adversely impacting the environment.

According to tribal elders,

"Evaporating tritium like this is not a natural process. The natural environment is altered. The wildlife could drink this contaminated water, birds could land on the ponds, insects and vegetation can become contaminated. This contamination would then adversely impact the food chain. We are concerned the animals will become contaminated or sick if they ingest other contaminated species in the food chain. How can they clean themselves to survive? How can DOE contain this contamination? "

We are also concerned about adverse impacts to the land, animals, plants, water, air, and insects from the waste and noise generated during explosive waste detonation at the Area 11 Explosives Ordnance Disposal Unit. Indian people have witnessed the destructive force of explosive detonations and the resulting destruction to the environment. For example, animals relocate to unfamiliar habitats, which adversely impact their survival rate. Air is adversely impacted, increasing the occurrence of dead air[10]. Noise and vibration from the detonations impact the insects, and disrupt vegetation growth.

Indian people know if the earth and environment are being disrespected, such as in Areas 5 and 11, the spirits that protect and watch over these can become upset and respond negatively. This can result in the characteristics of the environment changing, causing animals to leave their natural habitats, reducing the native vegetation[11], further reducing water resources, and increasing occurrences of perceived mishaps.

The CGTO is also concerned about transporting hazardous and radioactive waste through American Indian homelands and adversely impacting their health and environment. Many of the Indian land within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation resulting from NNSS related activities including the transportation of hazardous and radioactive waste occur, it could result in the closure of a major reservation road. If a major (only) road into a reservation is closed, numerous adverse social and economic impacts could occur. For example, Indian students who have to travel an unusually high number of miles to or from school could realize delays. Delays also could occur for regular deliveries of necessary supplies for inventories needed by tribal enterprises and personal use. Purchases by patrons of tribal enterprises and emergency medical services in route to or from the reservation could be dramatically impeded. Potential investors interested in expanding tribal enterprises and on-going considerations by tribal governments for future tribal developments may significantly diminish because of the perceived risks associated with NNSS related activities including the transportation of radioactive waste.

Finally, the CGTO struggles with the ethics of relocating radioactive waste from other American Indian lands so those people can live without fear of radioactivity. We are greatly concerned about the adverse spiritual, environmental, and health impacts associated with relocating these angry rocks from their current locations to our Holy Land. We believe transporting these to our land perpetuates animosity and discord among tribal governments. We strongly encourage DOE to host a break out session among the culturally affiliated tribes associated with the NNSS and the multi-state waste generator facilities during the 2011 NNSS Generator Workshops to facilitate further discussion and understanding, and each, annual generator workshop thereafter.

---

[10] For additional information on dead air, see Appendix C.2.8.
[11] Reducing the natural vegetation may result in the introduction of noxious weeds.

The CGTO recommends DOE allocate funds and resources for Indian people to conduct systematic ethnographic studies of these waste management programs. If DOE selects the expanded use alternative, the CGTO must conduct a cultural assessment of the Area 3 RWMS prior to new use to mitigate potential impacts.

The CGTO supports DOE's intention to minimize waste within the NNSS area. We encourage the DOE to partner with us to develop and participate in DOE's waste minimization and pollution prevention programs. In particular, the waste minimization efforts described in the SWEIS regarding land commitments must include members of the CGTO to ensure the cultural implications of these decisions are considered prior to implementation.

C.2.12 Human Health

As discussed previously in Section C.2.7, Biological Resources, it is widely known that many tribal representatives still collect and use plants and animals found within the NNSS region. Many of the plants and animals cannot be gathered or found in other places. Consumption patterns of Indian people who still use plants and animals for food, medicine, and other cultural or ceremonial purposes force the CGTO to question if its member tribes are still being exposed to radiation, and possibly hazardous waste located at the NNSS.

The CGTO is aware that, typically, risk assessment models have been used and accepted as a means of mathematically calculating potential risks and assessments to human health and safety. While these models project the potential impacts based on a worst-case scenario, they do not consider the perceived risks which are considered meaningful to Indian people. The lack of knowledge of an unfamiliar concept can lead to a feeling of perceived danger. A perceived danger or hazard associated with something can be very real to Indian people. Indian people view things holistically and believe that everything is interrelated resulting in a cause-and-effect model. This is contrary to scientific models that tend to compartmentalize things from a mathematical point of view, calculating potential risks to health and safety. This viewpoint often does not consider perceived risks, which play an integral role to American Indian cultural beliefs. To address this important issue, DOE listened to the recommendations from our people and commissioned a study in 1998 to evaluate perceived risks of radiation to Indian people. (See C.2.5 for additional information regarding this study.)

Emergency Preparedness

The CGTO knows that some of our member tribes are within close proximity to the NNSS and TTR. These Indian people will be directly, adversely, and potentially irrevocably impacted if an emergency occurs from DOE activities.

Indian reservations within the region of influence are located in remote areas with limited access by standard and substandard roads. Should an emergency situation resulting from NNSS-related activities, including the transportation of hazardous and radioactive waste occur, it could result in the closure of the main transportation artery to that land. If a major (only) road into a reservation closes, access to hospitals and medical facilities could be impeded or cut off entirely. Delays could occur for regular deliveries of necessary supplies, such as food and medicine. Emergency medical services en route to or from the reservation could result in death.

Accordingly, the CGTO recommends DOE collaborate with potentially affected tribes to develop emergency response measures. In particular, we understand DOE has developed the NNSS Emergency Preparedness Plan and an emergency management program. Each tribal government must have a copy of this plan, and participate in the training and implementation of the emergency management program set forth by DOE and its contractors.

Noise and Vibration

Numic people sing the souls of deceased tribal members to the afterlife in a multiple day ceremony called the Cry. The songs sung are called Salt Songs, a name derived from a spiritual journey taken by two sisters. The path of the journey is punctuated by topographically special places, which are reached at the end of various songs or sets of songs. The interactions between songs and places create a songscape (Stoffle, Halmo, and Austin 1997). The CGTO knows Salt Songs follow a spiritual trail. Salt Songs are still sung by Indian people today.

Noise can be a deterrent and a distraction. Noise upsets the spirituality of the area, negatively impacting the ability of salt songs to be heard. Because the thoughts and focus are interrupted, the balance, harmony, and well-being of the community as a whole become affected.

Increased aircraft activities proposed in the SWEIS will increase the noise and vibration throughout the area. According to one tribal elder, "*Noise and vibrations [from the proposed increased air traffic] will cause the animals to migrate from the area. The animals are placed where they are by the Creator. Forcing them to move results in their loss of power, their life span is shortened, and their very existence is endangered. This could disrupt the entire food chain. If these are used culturally and traditionally for medicines, stories, and songs, then harmony is broken. The Creator put them in their area. If you move them outside of their home, then their spirit dies and will cause undo and irreparable stress. They are grounded in the area. If habitats and animals are disturbed, then the benefit of salt songs and stories are diminished and will harm the culture of our people. The mountain needs to hear our songs, to hear our voices, and to still know that we are here. If we are not out there performing these, then the mountain, the wind, the water, and all of the others will continue to be unbalanced. This needs to be part of the Environmental Restoration process. People don't understand harmony. This is our destiny and our responsibility. We are all woven together. The spirits are waiting for the Indian people to come back and to talk to them so that they can heal. We believe it is now time to allow the Indian people to begin the healing process. To do this, we propose balancing ceremonies.*"

The CGTO recommends that DOE work with us to develop a schedule to allow Indian people access to specific areas and perform traditional ceremonies. The CGTO also recommends the DOE establish quiet zones near or on the NNSS where and when Indian people are conducting these ceremonies.

Gold Meadows is extremely important to the Indian people. There are known culturally-sensitive resources in the area that must be protected and undisturbed from noise and human intrusion. Noise pollution becomes a disturbance and a hindrance to the singing of Salt Songs. Therefore, the CGTO recommends this area in particular become a no fly zone.

C.2.13 Environmental Justice

Federal agencies are directed by EO 12898, Environmental Justice, to detect and mitigate potentially disproportionately high and adverse human health or environmental effects of its planned programs, policies, and activities to promote nondiscrimination among various populations in the United States. In the Record of Decision for the 1996 NTS EIS, DOE recognized the need to address environmental justice concerns of the CGTO based on disproportionately high and adverse impacts to their member tribes from DOE NNSS activities. In the 2002 NTS Supplemental Analysis, DOE concluded that the selection and implementation of the Preferred Alternative would impact its member tribes at a disproportionately high and adverse level, perpetuating environmental justice concerns. The CGTO maintains that environmental justice concerns continue to exist.

Of special concern to the CGTO is the potential for holy land violations, cultural survival-access violations, and disproportionately high and adverse human health and environmental impacts to the Indian population. These environmental justice issues need to be addressed in the NNSS SWEIS.

There is no question that the holy lands of Indian people have been, continue to be, and will be impacted by activities at the NNSS. It is also well known that only Indian people have lost cultural traditions because they have been denied free access to many places on the NNSS where ceremonies need to occur, where plants need to be gathered, and where animals need to be hunted in a traditional way. Prior to undertaking or approving activities at the NNSS, the CGTO recommends that DOE comply with EO 12898 and EO 13127 by facilitating tribal access to the NNSS, sponsoring an Indian subsistence consumption study, and sponsoring a study to determine perceived health risks and environmental impacts resulting from NNSS activities to CGTO member tribes.

On February 11, 1994, President Clinton signed EO 12898 which mandated each federal agency to review and achieve environmental justice as part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations in the United States. Specifically, each federal agency is to (1) promote enforcement of all health and environmental statutes in area with minority and low-income populations, (2) ensure greater public participation, (3) improve research and data collection relating to the health and environment of minority and low-income populations, and (4) identify differential patterns of consumption of natural resources among minority and low-income populations. In addition, the environmental justice strategy shall include, where appropriate, a timetable for undertaking identified revisions and consideration of economic and social implications of the revisions.

The EO requires federal agencies such as the DOE to (1) identify an internal administrative process for developing its environmental justice strategy, and inform the Interagency Work Group on Environmental Justice (IWGEJ) within 4 months from the date of the order; (2) provide the IWGEJ with an outline of its proposed environmental justice strategy within 6 months; (3) provide the IWGEJ with the actual environmental justice strategy within 10 months; (4) finalize the strategy and provide a copy and written description of its strategy within 12 months to the IWGEJ including the identity of several specific projects that can be promptly undertaken to address particular concerns; and lastly, (5) report its progress in implementing its agency-wide environmental justice strategy within 24 months to the IWGEJ.

The CGTO has other concerns that fall within the context of EO 12898, such as subsistence consumption. Subsistence consumption requires the DOE to collect, maintain, and analyze information on consumption patterns such as those of Indian populations who rely principally on fish and/or wildlife for existence. Most importantly, the EO mandates each federal agency to apply equally their environmental justice strategy to Native American programs and assume the financial costs necessary for compliance.

To date, DOE has not shared its design and implementation strategy for Environmental Justice with the CGTO, nor has it identified and analyzed subsistence consumption patterns of natural resources by Indian people within the region of influence. Since the EO specifically addresses equity to Indian people and low-income populations, it is critical that the DOE immediately address the concerns of Indian tribes and communities by conducting systematic ethnographic studies and eliciting input necessary for administrative compliance and in the spirit of the DOE American Indian Policy. This policy outlines seven principles in its decision making and interaction with Federally-recognized Tribal governments. It requests that all Departmental elements ensure Tribal participation and interaction regarding pertinent decisions that may affect the environmental and cultural resources of Tribes. Of particular interest within these seven guiding principles is (1) Recognize the Department's trust responsibility. (2) Commit to a government-to-government relationship. (3) Consult with Tribes to assure rights and concerns are considered prior to taking actions, making decisions, or implementing programs. (4) Consult with Tribes about potential impacts of proposed DOE actions on cultural resources or religious concerns that will avoid unnecessary interference with traditional religious practices. (5) The Department will initiate a coordinated effort for technical assistance, economic self determination opportunities and training.

In the Record of Decision for the 1996 NTS EIS, DOE recognized the need to address environmental justice concerns of the CGTO based on disproportionately high and adverse impacts to their member tribes from DOE NNSS activities. In the 2002 NTS Supplemental Analysis, DOE concluded that the selection and implementation of the Preferred Alternative would impact its member tribes at a disproportionately high and adverse level, perpetuating environmental justice concerns. The CGTO maintains that environmental justice concerns continue to exist and include (1) holy land violations, (2) cultural survival-access violations, and (3) disproportionately high and adverse human health and environmental impacts to the Indian population.

C.2.13.1 Holy Land Violations

American Indian people who belong to the CGTO consider the NNSS lands to be as central to their lives today as they have been since the creation of their people. The NNSS lands are part of the holy lands of Western Shoshone, Southern Piute, and Owens Valley Piute, and Shoshone people. The CGTO perceives that the past, present, and future pollution of these holy lands constitutes both Environmental Justice and equity violations. No other people have had their holy lands impacted by NNSS-related activities. Prior to undertaking or approving new activities, the CGTO should be funded to design, conduct, and produce a systematic American Indian Environmental Justice study.

C.2.13.2 Cultural Survival-Access Violations

One of the most detrimental consequences to the survival of American Indian culture, religion, and society has been the denial of free access to their traditional lands and resources. Loss to access to traditional food sources and medicine has greatly contributed to undermining the cultural well-being of Indian people. These Indian people have experienced, and will continue to experience, breakdowns in the process of cultural transmission due to lack of free access to government-controlled lands and resources such as those in the NNSS area. No other people have experienced similar cultural survival impacts due to lack of free access to the NNSS area.

In 1996, President Clinton signed EO 13007, *Indian Sacred Sites*. The EO promotes accommodation of access to American Indian sacred sites by Indian religious practitioners and provides for the protection of the physical integrity of such sites located on federal lands. The CGTO recommends that open access be allowed for American Indians who must conduct their traditional ceremonies and obtain resources within the NNSS study area. Unfortunately, however, land disturbance and irreparable damage of cultural landscapes, potential TCPs, and cultural resources may render certain locations unusable.

C.2.13.3 Disproportionately High and Adverse Human Health and Environmental Impacts to the Indian Population

It is widely known that many tribal representatives still collect and use plants and animals that are found within the NNSS region. Many of the plants and animals cannot be gathered or found in other places. Consumption patterns of Indian people who still use plants and animals for food, medicine, and other cultural or ceremonial purposes and the issues raised in this study force the CGTO to question if its member tribes are still being exposed to radiation, and possibly hazardous waste located at the NNSS.

C.3 American Indian Assessment of Alternatives

Since the early 1990's, DOE provided opportunities for representatives of the CGTO to visit portions of the NNSS and identify important places, spiritual trails, and landscapes of traditional and contemporary cultural significance.[12] These actions by DOE are considered positive steps towards fulfilling its trust responsibility through facilitating co-stewardship and land management strategies between DOE and the CGTO; however, this is an ongoing process.

The CGTO is concerned about culturally-perceived harmful land disturbing DOE actions described in Chapter 3 and Appendix A of this SWEIS. We are concerned because these actions adversely impact the NNSS land and offsite locations, which in turn affect the American Indian cultural landscape. To avert or minimize these impacts, the CGTO recommends DOE and the CGTO develop co-management strategies to help protect the land by implementing the following actions before continuing with these current or proposed activities:

- Identify those areas that have been disrespected and culturally damaged, so that balance can once again be restored
- Avoid further harmful ground-disturbing activities
- Make mitigation or restorable areas a top priority
- Avert or minimize damage to geological formations important to the cultural and ecological landscape
- Implement collaborative environmental restoration techniques that require minimum ground disturbing activities
- Continue to pursue systematic consultations with American Indians so that potentially impacted resources can be readily identified, alternative solutions discussed, and adverse impacts averted
- Provide American Indian people increased access to culturally significant areas so that we can use our knowledge, prayers, and traditions to effectively restore balance to the natural and spiritual harmony of the NNSS area and offsite locations.

In addition, the CGTO recommends DOE and the CGTO continue to hold annual meetings to discuss current and proposed actions in greater depth, to deliberate potential impacts, and to consider and develop mutually acceptable mitigation measures. This is particularly necessary for those actions requiring additional NEPA analysis, including but not limited to solar and geothermal energy development.

We believe we have been created in these lands. Because of this birth-right and tie to our ancestral land, the CGTO believes we have undeniable rights to interact with its precious resources, and a continuous obligation to protect it. The CGTO takes this responsibility very seriously and has developed our input for the alternatives presented throughout Section C.3 so we may fulfill this obligation.

[12] *Because this is a public document, the exact locations of these areas will not be revealed unless determined necessary during government-to-government consultation.*

C.3.1 No Action Alternative

C.3.1.1 National Security/Defense Mission

The CGTO's concerns and perspective regarding the National Security/Defense Mission is presented here, which summarizes our views and applies to all aspects of this mission, including those pertaining to the Stockpile Stewardship and Management Program; the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Program; and the Work for Others Program. According to tribal elders, *"There is always going to be testing. Areas such as U1a support underground testing is where the affects are evaluated. There are programs and facilities where stockpile stewardship and management activities are currently performed. The CGTO knows that DOE maintains and conducts experiments and testing at various locations throughout the NNSS. We continue to be concerned about these activities and their impacts to the cultural landscape. Our involvement is essential to restoring and maintaining the balance to the land and its resources."*

The CGTO understands the National Security Defense Mission includes complying with the nuclear weapons test moratorium of 1992, which precludes new underground nuclear testing. We also understand DOE is required to maintain a state of readiness to resume nuclear tests if so directed by the President. The CGTO continues to be intensely opposed to underground nuclear testing. In consideration of our ancestral ties and proximity to the land, the CGTO must be informed prior to any preparations for testing so we can protect the spiritual and physical health of our people.

The CGTO understands the fundamental intent of the Nonproliferation and Counterterrorism projects is to promote world peace and reduce the need to use the NNSS and its offsite locations for nuclear weapons production, storage, assembly, and testing. However, the CGTO believes these activities may increase the number of weapons stored, disassembled, and disposed. These dangerous conditions may result in the land becoming angry and further contaminated, thereby impeding our ability to access important resources on our ancestral land.

The CGTO knows from past experience, but not formal study, that military training exercises and weaponry tests can adversely impact cultural resources. Military people move across the land on foot and in vehicles without either the time or the purpose to pay attention to the plants that are being disturbed, the animals that are being dislocated, or the archaeological material and other important resources underfoot.

Often geographically distinctive power places or culturally-sensitive areas are targeted without regard or knowledge of the significance to Indian people. Military exercises involving aircraft disrupt the harmony within the cultural landscape. Cultural resources may be damaged when conventional weapons are fired nearby. The environmental setting is disrupted from the noise and vibrations associated with these military operations and overflights. Noise and vibrations upset the spirituality and solitude of the area, negatively impacting songscapes and storyscapes. When the thoughts and focus are interrupted, the balance and well-being of the community as a whole become affected.

C.3.1.2 Environmental Management Mission

The CGTO's concerns and perspective regarding the Environmental Management Mission are presented under the Waste Management Program (Section C.3.1.2.1) and the Environmental Restoration Program (Section C.3.1.2.2), as appropriate.

C.3.1.2.1 Waste Management Program

The CGTO understands that current and proposed waste management activities identified under the Environmental Management Mission include high-hazard experiments involving nuclear material and high explosives, and storing special nuclear materials. The CGTO is aware the NNSS is used to store hazardous waste, and to store and dispose of low-level radioactive waste, low-level mixed radioactive waste (i.e., containing certain hazardous wastes), and non-hazardous waste and debris. After many years, the CGTO continues to be greatly concerned with the ongoing storage and disposal of these wastes at the NNSS, and the transportation of radioactive waste from off-site generators to the NNSS for storage and disposal.

We understand the radioactive and hazardous waste described in this SWEIS are defined in scientific terms and governed by state and federal regulations. Indian people hold both complex traditional and scientific views of these materials and waste. As an example, the former builds on the view that all resources--including the rocks--are alive.

To scientists, radioactive rocks are well understood with specific quantifiable physical properties. Scientists believe if they manage radioactivity in a purely scientifically appropriate manner, they are largely safe for use and disposal at the NNSS, an area often perceived by non-Indian people as a barren wasteland.

American Indian people believe radioactive rocks are powerful. However, contrary to scientific belief, we know that radioactive rocks can become "angry rocks" if they are removed without proper ceremony, used in a culturally inappropriate way, disposed of without ceremony, or placed where they do not want to be (Stoffle et al. 1989; Stoffle et al. 1990). The angry rock constitutes a threat that can neither be contained nor controlled by conventional means. It has the power to pollute food, medicine, and places, none of which can be used afterward by Indian people. Spiritual impacts are even more threatening, considering the angry rock would be transported along highways before ultimately being disposed of at the NNSS, affecting animal creation places, access to spiritual beings, and unsung human souls (Stoffle and Arnold 2003).

Indian knowledge and use of radioactive rocks, or minerals, in the western United States goes back for thousands of years. The DOE would benefit from this knowledge. Areas with high concentrations of these minerals were called dead zones and placed off limits to average Indian people. Such areas were places of power or energy and could only be visited or the minerals used under the supervision of specially-trained Indian people that are sometimes referred to in the English language as shaman or medicine men.

According to tribal elders, *"We are not sure how long Nellis and the NNSS have been facilities, and how much waste has been created, stored, and transported. This information is necessary for the CGTO to fully understand how significant the people and our resources may have been affected, and to prepare ceremonies, prayers, and culturally appropriate mitigation measures to attempt to restore balance. For example, Sunrise Mountain is a very significant mountain. Behind this mountain is a significant cave, Gypsum Cave, which some Indian people fear. There are traditional stories surrounding this area. The mountain and the cave are both culturally significant. Caves are supposed to hold much power. They are supposed to react with your mind. When you leave a cave, you are much more powerful."* Gypsum Cave, which is protected and monitored by culturally affiliated tribes and the BLM, is a potential Traditional Cultural Property that may be impacted by the transportation of the waste.

C.3.1.2.2 Environmental Restoration Program

According to tribal elders, *"The Creator placed everything—the land, the rocks, the plants and animals-where they are for a purpose. However, now that the NNSS land is disturbed, we must come up with the appropriate prayers and ceremonies to rebalance the land and its resources."*

The CGTO views environmental restoration activities attributed to the Environmental Management Mission as a positive effort to rebalance the world. Everything is connected. Individual restoration projects are insufficient alone but are starting points and should be considered as stages or steps in a comprehensive spiritual and ecological restoration program. The CGTO's view is ideally suited to the spirit of holistic ecosystem management subscribed by the public and many Federal agencies.

Although the CGTO is supportive of restoring the environment, we are concerned about the future plans to decontaminate and decommission (D&D) some buildings that may have asbestos and other contamination, which will be released during the process. Specifically, the CGTO is concerned about potential impacts to the air, water, plants and animals. In addition, nearby tribes may be performing ceremonies and prayers and need to be notified so the D&D process does not negatively impact these important religious and traditional events through elevated noise and vibration levels.

We recommend conducting ethnographic studies involving the CGTO to better understand sites such as, but not limited to, Water Bottle Canyon, Timber Mountain, Shoshone Mountain, and other sites identified by the CGTO. Spiritual and ecological restoration assessments and projects require traditional management practices, and the involvement of tribal cultural experts to be successful. These specialists are needed to conduct initial assessments and site inventories, and to make recommendations for the next steps of the restoration effort. This strategy will result in the identification of resources, features, and other site aspects both tangible and intangible, that are in need of healing and restoration using culturally appropriate steps necessary to achieve restoration and balance.

Members of the CGTO have unique and extensive experience in collaborative spiritual and ecological restoration. We have many examples of successful collaboration among our tribal members and federal agencies. For example, the Big Warm Spring near the Duckwater Shoshone Tribe has been used throughout history for spiritual cleansing and healing. Young men are taken there during the "coming of age" to wash and cleanse themselves. In 2005, in collaboration with the U.S. Fish and Wildlife Service, the Duckwater Shoshone Tribe restored the Big Warm Spring to its original size and removed the non-native fish species. In 2007, during the final phase of the project, tribal members reintroduced the Railroad Valley Spring Fish to the Big Warm Spring in a culturally appropriate manner, successfully completing the spiritual and ecological restoration for this collaborative effort.

There are many potential spiritual and ecological restoration projects on the NNSS in need of attention, all with the goal of balancing the spiritual, cultural and ecological inner-workings of the project places. Based on CGTO experience with environmental restoration projects, we suggest a more aggressive collaborative environmental restoration program. Potential projects for which proposals have been or are being developed for the protection of wildlife, plant resources, and geological features, including the following:

Restoration of Water Bottle Canyon

Water Bottle Canyon is a natural water tank area and an exceptional cultural site. Cultural resources include *pohs*, tanks, rock rings, tonal rocks, and traditional use plants (Stoffle et al. 2006). Any activities in or impacts to a side canyon or to Water Bottle Canyon affect the rest of the canyon system, which is connected through physical and spiritual flows. Presently, the spiritual aspects of Water Bottle Canyon are out of balance and require cultural interactions to bring the canyon back into balance. The cleaning of the *pohs* and tanks in this canyon system is one of several cultural practices needed to begin spiritual and ecological restoration. This project can reduce drought conditions, and provide spiritual, cultural, and ecological benefits to the CGTO, DOE, and the environment, consequently fulfilling the primary goal of spiritual and ecological rebalancing. Implementation of this project will require the appropriate cultural experts to identify project sites, to inventory and evaluate the conditions, resources, and features of the sites, and to design the restoration plan. The Project would involve overnight camping, annual activities, and monitoring of site conditions.

Evaluation of Traditional Cultural Property

During the DOE Annual Tribal Meeting with the CGTO, held September 1-2, 2009, the CGTO recommended the DOE support the nomination of a Traditional Cultural Property, previously identified as *Wunjikuda*. The CGTO recommended expanding the studies to enhance previously collected ethnographic information, and determining an appropriate title using knowledgeable tribal elders identified by the CGTO. The CGTO also recommended the DOE sponsor overnight camping activities at this site to elicit additional information from knowledgeable tribal representatives for the submittal of the nomination.

Cleaning Pohs and Tanks

The *pohs* and tanks found throughout the NNSS require cultural practices to function effectively. The *pohs* and tanks at Water Bottle Canyon and Ammonia Tanks, for example, are interrelated and tie each location to each other. Both sites are used to bring water from the rain that is needed and used for ceremonial use to restore balance. American Indian people have Rain Shaman who have the ability to talk to all of the elements responsible for bringing water or rain to the land, people and animals. According to tribal elders, *"When the water arrives, it is approached with great respect and awakened very carefully when prayed upon. In appreciation and in honor of the water's return, the animals come back, the plants will grow and people will continue to pray--all ultimately leading to balance and restoration of the area."* Customarily, Indian people cleaned the *pohs* and tanks through the use of songs, stories and prayers. The women cleaned the *pohs* and tanks and were followed by the Rain Shaman who called the rains.

By supporting the CGTO proposed project to clean the *pohs* and tanks, DOE will reduce drought conditions and restore balance to the area. It will provide spiritual, cultural, and ecological benefits to the CGTO, DOE, and the environment, thereby facilitating our obligation of spiritual and ecological rebalancing. Implementation of this project will require the appropriate cultural experts to identify project sites, to inventory and evaluate the conditions, resources, and features of the site, and to design a culturally appropriate restoration plan.

C.3.1.3 Nondefense Mission

There are a variety of current and proposed actions considered under the Nondefense Mission. Many of these are related to the NNSS Environmental Research Park, which allows universities and other federal agencies to conduct research. Other projects involve solar and geothermal energy development, and constructing the Nevada Desert Free-Air Carbon Dioxide Enrichment and the Mojave Global Change facilities proposed in Area 5. The CGTO's concerns and perspective regarding the Nondefense Mission, including activities associated with the Infrastructure, Conservation and Renewable Energy, and Other Research and Development Programs, are summarized here.

Indian people view each proposed project under the Nondefense Mission as potentially impacting cultural resources. Non-Indian people unfamiliar with the importance of leaving cultural resources untouched may find and collect artifacts or remove plants that are significant to American Indian people. Construction of the proposed solar generating facility in Area 25 involves draining the Sun of its power unnaturally and making it week. Construction also involves scraping the land, generating dust emissions, facilitating erosion, and impeding visual resources.

All landforms within the NNSS have high sensitivity levels for American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is central to the spiritual interaction between Indian people and their traditional lands. Visual resources may be negatively impacted if proposed solar and geothermal projects are pursued. The CGTO must be part of any future discussions of these projects due to potential impacts to visual resources that may impede traditional and cultural ceremonies.

Only Indian people know which places are appropriate for visits by non-Indian people and how to collect plants, animals, and soil samples so that these activities do not disrupt the land and its associated spirituality. Because of the potential affects to the environment and its resources from Nondefense Mission projects, the CGTO must become an integral part of site-specific studies and develop culturally-appropriate text for future NEPA analyses, including environmental assessments and mitigation plans.

C.3.2 Expanded Use Alternative

The CGTO's concerns and perspective regarding the Expanded Use Alternative include those discussed previously. Under the Expanded Use Alternative, DOE would pursue geothermal electrical generation in a variety of locations depicted in SWEIS Figure A.2.3-1, and solar energy systems and facilities in Areas 6 and 25, respectively.

According to the information presented by DOE in the SWEIS, the CGTO knows the NNSS has been selected to pursue the development of the solar enterprise zone within Area 25. We also understand the project schedule presented in the Memorandum of Understanding between DOE and DOI initiates environmental evaluations in July 2010. The CGTO must be part of any additional, future environmental assessments as this proposed activity will adversely impact visual resources and degrade traditional and religious ceremonies. The visual quality of the landscape will lose its integrity and the viewscape will be marred from the introduction of considerable infrastructure directly visible from U.S. 95. For Indian people, an adversely impacted resource will most certainly impact the spiritual harmony as a whole. Therefore, Indian people will need to perform ceremonies, offer prayers, and sing songs in an effort to mitigate these impacts. If construction proceeds, DOE will need to make provisions for Indian monitors to assess the construction footprint and implement traditional techniques that require minimum ground-disturbing actions.

The CGTO understands DOE is proposing to construct modular geothermal power plants that have a relatively small surface footprint. However, the initial project support activities will reportedly impact 30 to 50 acres. The CGTO also understands that DOE may pursue solar power by constructing a 5-megawatt photovoltaic system, and commercial solar power generating facilities. These proposed solar power electrical generation projects would impact approximately 50 acres and 39,600 acres of land, respectively. The CGTO is particularly concerned with the land and resources potentially impacted by these projects.

Fundamentally, the CGTO struggles with the idea of pursuing solar energy as a "cleaner" form of energy and the potential impacts to the Sun. According to some tribal elders, *"The Sun is like a big battery. Once you drain its power, will it die? For those spiritually connected to the Sun, we are concerned about unnaturally harnessing it's power. We know the Sun was given only so much energy. If the Sun is drained, how will it be replenished? If the Sun goes away, everything will die. The stories and activities of our ancestors are tied greatly to the Sun. Today, our prayers and ceremonies still travel or rely on its strength."* Because of the complexity and potential implications to the environment, to the cultural and visual landscape, and for our own survival, it is imperative that DOE support an ethnographic study to evaluate the cultural implications of pursuing solar energy on the NNSS. The CGTO also recommends Indian people provide their expertise in the development of the Solar Enterprise Environmental Assessment.

Construction of the solar power electrical generation system and facilities, and the geothermal electrical generation facility will involve scraping the land, irreparably destroying the land and vegetation. Facility construction will facilitate erosion, impede visual resources, and will emit dust and other potentially hazardous pollutants into the air. This will, in turn, impact the land, water, air, plants, animals, and cultural resources, and will affect the solitude of the land.

The CGTO is concerned that DOE's proposed activities unnaturally harnesses the earth's power without understanding the implications of these actions or all that is necessary to begin to prepare the earth and its resources. Numic people have a complex understanding of *power* and believe it is special force that was placed in all things at the time the world was created. It is that spark which keeps the world going and all of its elements thinking, talking, moving, and interacting. This special *power* moves and has the ability to move down hill, often concentrating or pooling in certain places like mineral outcrops, cliffs, and caves. It has characteristics similar to water, and can be understood as having the ability to return to the sky to become like rain and snow, which are called down from the sky by the highest mountains. This special *power* has a rotation of movement similar to the hydrological cycle and has the ability to impact all things (Carroll et al. 2006).

According to information presented throughout the SWEIS, the proposed geothermal electrical generation facilities would use the power of rocks that are hot. Rocks, or minerals, are culturally important and have significant roles in many aspects of Indian life. For example, the Chalcedony would have made an attractive offering acquired and then left at the vision quest or medicine site located to the north on top of a volcano like Scrugham Peak. In particular, Indian people have observed the presence of the following minerals at the NNSS: (1) Obsidian, (2) Chalcedony, (3) Yellow Chert (otherwise known as Jasper), (4) Black Chert, (5) Pumice, (6) Quartz Crystal, and (7) Rhyolite Tuff.

Other traditional use minerals are known to exist throughout the NNSS and offsite locations (see C.2.5). In order to document the cultural significance of these areas, additional ethnographic mineral studies are needed to fully understand the location and importance of these minerals at the proposed project site locations prior to any surface disturbing activities. The CGTO is particularly concerned about the potential impacts or use of these minerals relating to proposed geothermal activities.

Some of the locations proposed for geothermal electrical power plants are recognized as traditionally or spiritually important. In particular, the CGTO is concerned about activities that have the potential to impact Oasis Valley, Amargosa River, Timber Mountain Caldera Complex, Black Mountain, Gold Meadows, Cane Springs, Calico Hills area, Crater Flats, Scrugham Peak, Shoshone Mountain, Devil's Hole, Ash Meadows, and Death Valley. The CGTO is concerned about locating the proposed geothermal project along hydrological basins, whose power is derived from volcanic activity.

We know the forces of power in the world move along channels and combine into specific nodes or places of power. A common set of these channels follows the path of water. From this beginning, the water moves downhill in rivulets, washes, and streams. The water often goes underground where it forms similar networks of channels moving in various directions, corresponding to hydrological basins. Water is often attracted to volcanic activity, thus producing power places like hot mineral springs.

The CGTO is concerned that DOE may impact hot springs in their pursuit of geothermal power. According to information obtained by Dr. Richard Stoffle with the University of Arizona and presented in the report *Black Mountain: Traditional Uses of Volcanic Landscapes* (Carroll et al. 2006), hot springs come from the earth where volcanic activity still occurs even if the magma cannot be seen on the surface. Such springs are a combination of water and volcanoes producing a special place where both ceremonial and medicine occur. Indian people from Owens Valley have a single origin story for all of the hot springs in the southern Great Basin and northern Mohave Desert. According to traditional stories, a great ball of fire came from the sky and landed at Coso Hot Springs and then splashed to form at once all of the other hot springs.

Hydrological Impacts

According to information presented in the SWEIS, the proposed solar and geothermal projects will require a tremendous amount of water. A modular geothermal power plant alone will require up to 20-acre-feet to initially prime the system.

Indian people believe water is a living being that is fully sentient and willful. Water is already stressed throughout the region. The CGTO is concerned about the use of this very limited and important resource.

Because water is a powerful being it is associated with other powerful beings, such as water babies, a supernatural being that lives in and protects the water. These beings are like the people of the water. They are highly respected by American Indian culture. If water is contaminated and misused, the water babies may cause harm and move to other areas that are not contaminated.

Air Quality and Climate Impacts

Construction of these proposed facilities will impact large areas of land, potentially emitting dust and contaminants. The CGTO knows the air is alive. The Creator puts life into the air, which is shared by all living things. Air can be destroyed, causing pockets of dead air. There is only so much alive air that surrounds the world. If you kill the living air, it is gone forever and cannot be restored. Dead air lacks the spirituality and life necessary to support other life forms. The CGTO is concerned about emitting things into the air that are unnatural, and the potential health and environmental issues associated with these emissions.

Visual Resource Impacts

All landforms within the NNSS have high sensitivity levels for American Indians. The ability to see the land without obstructions like buildings, towers, cables, roads, and other objects is essential for the spiritual interaction between Indian people and their traditional homelands. Visual resources may be negatively impacted if proposed solar and geothermal projects are pursued. The CGTO must be part of any future discussions as these may impact visual resources and may impede traditional and cultural ceremonies.

C.3.3 Reduced Operations Alternative

The CGTO's concerns and perspective regarding the Reduced Operations Alternative include those discussed previously. The CGTO is supportive of a decrease to culturally-perceived harmful land disturbing activities within the NNSS and TTR areas. To successfully reduce operations and restore environmental balance, it is essential to have tribal representatives involved throughout the process to help guide DOE in conducting culturally appropriate activities.

C.4 Mitigation Measures

Only Indian people have traditional ecological knowledge that tells us how and where to interact with the earth and all of its resources to minimize or avoid impacts to the land while maintaining its spiritual integrity. According to tribal elders, "*Indian people have the conviction that the ecology of the natural environment is all integrated. We have been blessed from the beginning of creation as having a unique understanding of being a good steward, and a clear path to care for the land and its resources. The songs, stories, tradition and customs play a profound development of this conviction. It is like the world is a huge stage and there are many cast members all manipulating their intrinsic ties, using their roles to make possible for a successful event.*"

With this in mind, the CGTO is providing DOE recommendations in Section C.4 in an effort to avert or minimize impacts. We must emphasize that recommendations made by the CGTO do not imply we support the proposed actions and alternatives. These are merely our attempt to restore the harmony and balance to the resources impacted or potentially impacted by DOE activities using the NEPA process.

In 1996 and 2000, the DOE invited the CGTO to participate in the development of the NTS/DOE Resource Management Plan (RMP) in an effort to mitigate impacts to resources. The CGTO provided culturally-appropriate resource management strategies for integration on the NNSS based on traditional Indian perspectives. The CGTO long-term objective is to see our existing government-to-government relationship evolve into co-management of the NNSS land and its resources. The key concept driving the RMP is ecosystem management officially recognized in federal guidelines for land management agencies. This fits well with the traditional Indian views regarding maintaining balance and harmony among the land and its resources. Therefore, the CGTO believes the continued development of a RMP is essential to blending elements of the two worldviews. This promotes implementation of culturally-sensitive strategies for land and resource management, which is mutually beneficial to the DOE and the tribes. The CGTO understands the RMP is a dynamic, living document that requires periodic evaluation and updates, as appropriate. Accordingly, the CGTO recommends DOE hold annual update meetings, which would include current and proposed activities at the NNSS, and discussions regarding the RMP, mitigation measures, and their implementation.

C.4.1 Land Use

The CGTO is concerned with DOE's plans to continue to restrict access and potentially close areas within the NNSS. The NNSS area is part of the traditional Holy Lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone peoples. The lands are central in the lives of our people and mutually shared for religious ceremony, resource use, and social events (Stoffle et al. 1990a and b).

Since the early 1990's, DOE has funded representatives of the CGTO to visit portions of the NNSS. Because of this involvement, we have identified places, spiritual trails, and cultural landscapes of traditional and contemporary cultural significance. CGTO remains committed in our assertion that portions of the NNSS must be set aside for traditional and contemporary ceremonial use.

In order to fulfill the Holy Land use expectations, the CGTO also recommends continuing to identify special places, spiritual trails, and landscapes and setting aside these places for unique co-stewardship and ceremonial access. For example, studies have begun regarding the identification of places, spiritual trails and cultural landscapes in the Timber Mountain Caldera. We strongly encourage DOE to pursue these studies, which, when completed, will add an American Indian cultural component that will contribute to the importance of this National Natural Landmark. The CGTO believes these actions by DOE are considered positive steps for facilitating co-stewardship arrangements between our governments to help co-manage important Indian resources of the NNSS and to regain balance.

The CGTO recommends Gold Meadows continue to be set aside for exclusive Indian use because it contains a concentration of significant cultural resources. Similarly, the CGTO recommends DOE set aside Water Bottle Canyon, Scrugham Peak, Prow Pass, Timber Mountain and select areas within Calico Hills and Shoshone Mountain for exclusive Indian use. Efforts should be made to forego any additional land disturbances within these areas and provide access to Indian people. The CGTO also recommends tribal visits to areas designated for repatriation, such as the Pahute Mesa, and periodic assessments conducted to comply with NAGPRA.

C.4.2 Socioeconomics

Although DOE continues to make strides to diversify their workforce, the CGTO strongly encourages DOE to enhance efforts to hire more Indian people and promote the hiring of Indian-owned businesses to mitigate socioeconomic impacts to our people. To facilitate this effort, the CGTO could serve as a conduit to assist DOE and its contractors in identifying and promoting employment opportunities for American Indians at the NNSS.

C.4.3 Geology and Soils

During the evaluation of the 1996 FEIS, the CGTO noted that repeated nuclear testing had resulted in severe disturbances to the geology and soils, or minerals, in large portions of the NNSS. This seemingly irreparable damage has made certain areas unfit for human use and inaccessible to American Indians who have relied on the earth and rocks for medicine and religious purposes.

In general, the mitigation measures proposed by DOE for geology and soils include erosion control through stabilization and re-vegetation. The CGTO is concerned about the unnatural erosion control methods proposed by DOE. In particular, the CGTO struggles with activities that require relocating rocks and soil from where originally placed by the Creator and are being used contrary to the Creator's intention. Indian people know that relocating the soil in a culturally-unacceptable manner can cause adverse impacts to the environment such as the increased potential for noxious weed growth. This could potentially threaten nearby native vegetation and harm Indian people and wildlife that rely on it for survival.

Therefore, the CGTO recommends DOE implement culturally-appropriate stabilization efforts, and re-vegetation techniques using traditional ecological knowledge. Indian people stabilize our land by offering prayers to explain to the soil why we are removing it, and to thank it for its use. We then remove and protect the topsoil for future use. We replace the soil with dirt and gravel from nearby land only after offering prayers, and re-contour the land out of respect to the visual landscape. Indian people re-vegetate our land by offering prayers to bless the seeds and the plants so they will grow strong. We place the seedlings in the direction of the morning sun, and then give thanks for the opportunity to plant them. Our key objective is to protect and restore our ancestral land. This is our ancestral land and we encourage DOE to make provisions for Indian people to participate in its stabilization and re-vegetation to mitigate adverse impacts to geology and soils.

In the 1996 NTS FEIS and in the 2002 NTS EIS Supplemental Analysis, the CGTO continued to express concerns about the removal of contaminated soils and the need for religious leaders to conduct balancing ceremonies and healing prayers at these disturbed locations. In particular, the CGTO recommended tribal representatives provide information about the re-vegetation of a portion of the Double Tracks Site located on the TTR. The CGTO maintains our involvement is still necessary for the Double Tracks site as well as for the Clean Slates site located at TTR; however, we are awaiting DOE's approval to proceed so we may begin to heal these lands.

C.4.4 Hydrology

When water is respected, it sustains all life forms. When water is mistreated, it withdraws life-giving support and returns to the underworld. The CGTO knows the hydrological systems throughout the NNSS have been impacted from the drought. Drainage patterns have been altered from DOE activities and will continue to be impacted if these proceed. There are places on the NNSS where the rain falls but does not nurture the plants and animals. Therefore, the CGTO must be involved with DOE in mitigating impacts to hydrological resources because if the water is treated inappropriately, it will remove itself from the NNSS.

To minimize some adverse impacts to hydrological resources, the CGTO recommends the DOE allow Indian people access to clean the *pohs* and tanks found throughout the NNSS. *Pohs* and tanks are naturally formed geologic features or basins used to bring and gather water from the rain and to nourish the plants and animals. The water within these *pohs* and tanks are central to our ceremonies to restore balance. By supporting the CGTO proposed project to clean the *pohs* and tanks, DOE will help reduce drought conditions. In turn, this project will provide spiritual, cultural, and ecological benefits to the land and the environment, thereby facilitating our obligation of spiritual and ecological rebalancing. Implementation will require cultural experts to identify sites, to inventory and evaluate the conditions, resources, and features of the site, and to implement culturally-appropriate mitigation measures.

C.4.5 Biological Resources

The mitigation measures presented by DOE in SWEIS Section 7.7 focus on avoidance of biological resources, relocation of animal species, and monitoring plants, animals, and their habitats. The CGTO recommends DOE mitigate adverse impacts to biological resources through avoidance, culturally-appropriate revegetation efforts, reintroduction of native animals, and traditional plant and animal management methods. Indian people have extensive, traditional ecological knowledge and deep concern for the biological resources of the area and should participate directly with DOE to mitigate adverse impacts and protect these resources.

According to tribal elders, *"Prior to re-vegetation efforts, we talk to the land to let it know what we plan to do and ask the Creator for its help. We choose our seeds from the sweetest and the best plants, and store them for the winter to dry. When the winter is over, we place the seeds in a moist towel or sock and allow the new plant to sprout. We then plant the sprouts into small containers with soil until they are ready to transplant into the ground. This is a long and delicate process, requiring patience and knowledge passed down from our ancestors. If the plants are struggling to grow, we tag them and move them to face the same direction as the sun."*

The DOE would benefit from this knowledge to enhance their re-vegetation efforts. The CGTO knows DOE struggles with the success rates regarding the density and diversity of native plants during re-vegetation efforts. A co-stewardship approach with the tribes would enable DOE to enhance their re-vegetation efforts, saving time, money, and resources.

Part of the mitigation measures presented by DOE in this section includes notifying the U.S. Fish and Wildlife Service (FWS) of incidental taking of desert tortoises. The desert tortoise is culturally-significant to Indian people because of its healing powers, longevity, and wisdom. It is integral to our traditional stories, well-being and perpetuation of our native culture. Incidental taking of this traditionally-important animal is particularly disturbing to native people. Accordingly, the CGTO must be notified concurrently with the FWS so prepare our people and the environment for this loss.

Over the past 14 years, various initiatives have been undertaken to restore animal habitats and reintroduce certain animals, such as the desert big horn sheep near the southern portion of the NNSS, without participation from the CGTO. Modification of habitat or the restocking of animals is considered a highly sensitive religious act and requires participation from Indian people. For these activities to be successful and to restore balance, it is essential to have tribal representatives involved throughout this process.

C.4.6 Visual Resources

All landforms within the NNSS have high sensitivity levels for American Indians. The ability to see the land without the distraction of buildings, towers, cables, roads, and other objects is essential for the spiritual connection between Indian people and their traditional lands. Views from places are an important cultural resource that contributes to the location and performance of American Indian ceremonialism. Viewscapes are tied with songscapes and storyscapes especially when the vantage point has a panorama composed of multiple locations from either song or story.

The CGTO knows that many of the activities described under the proposed action and alternatives, such as those associated with facility construction and environmental restoration, will adversely impact visual resources. For Indian people, the adverse impact to visual resources will most certainly impact the spiritual harmony of the environment as a whole. Facility construction and operation will impede visual resources, and affect the solitude and cultural integrity of the land.

Although DOE proposes to mitigate visual resource impacts by painting structures to reduce visibility, the CGTO knows additional mitigation measures are necessary. The CGTO recommends that landscape modifications, including those associated with environmental restoration activities, be done in consultation with American Indians. Specifically, DOE should make provisions for Indian people to access the land and culturally assess its visual resources. DOE should make provisions for Indian people to participate in annual monitoring of land disturbing activities through the duration of the project. The CGTO should also participate in restoring the land, and concealing infrastructure using traditional Indian re-vegetation methods (See Section C.4.5, Biological Resources.) Finally, the CGTO recommends that DOE make provisions for Indian people to conduct ceremonies, and offer prayers and songs in an effort to re-balance this adversely impacted resource.

C.4.7 Cultural Resources

We are concerned about impacts to cultural resources from activities including but not limited to scraping the land; underground testing; drilling; grading; excavation; fencing; subsidence crater development resulting from explosives; live fire; cleanup activities; construction of buildings, roads, firebreaks, and utilities; and building modification, decontamination, or demolition. We are also concerned about proposed improvements to existing roads and facilities associated with new construction activities, and the potential impacts to cultural resources on previously disturbed and undisturbed locations. Finally, we are concerned about vehicular and pedestrian access in areas containing cultural resources and the increased potential for vandalism or unauthorized artifact collection.

The CGTO understands the mitigation measures proposed by DOE to protect cultural resources include avoidance, evaluation and data recovery, and monitoring, as described further under Mitigation Measures 1 through 6 of the NTS Cultural Resource Management Plan (Drollinger and Beck 2010). Accordingly, the CGTO must be an integral part of these mitigation measures so that impacts on American Indian cultural resources can be efficiently minimized or averted. American Indian people know the NNSS landscape in great depth and can help DOE identify and protect plants, animals, geography, archaeological sites, and traditional cultural properties that have been or will be adversely impacted by NNSS programs and activities.

The CGTO recommends that DOE make provisions for Indian people to continue to identify culturally-significant locations so potentially impacted resources can be identified, alternative solutions discussed, and adverse impacts averted. These studies will address and guide DOE in developing culturally-appropriate Best Management Practices to protect cultural resources and more effectively implement Mitigation Measures 1 through 6. To accomplish this, Indian people must be involved with the following actions:

- Assess and determine culturally-appropriate measures to protect geological formations important to the spiritual landscape
- Implement culturally-appropriate environmental restoration techniques that require minimal ground disturbance
- Restore impacted plant and animal species essential to the spiritual and cultural landscape
- Provide American Indian people access to CGTO designated areas so they can contribute their knowledge, conduct purification ceremonies with prayers and offerings to restore the natural and spiritual harmony of the NNSS landscape.
- Complete the TCP nomination process previously recommended by the CGTO in 2009 for Shoshone Mountain and initiated for Water Bottle Canyon.
- Complete the Indian History Project report prepared by the DOE, DOD, and CGTO, which originally began in 2001. Specifically, complete editorial changes to the report (as necessary), publish, and distribute.
- Develop and implement systematic American Indian ethnographic studies to better understand the interconnectedness of the cultural landscape and culturally-appropriate methods to protect the landscape and maintain balance.
- Complete the revegetation effort for the restoration of Clean Slates, which began in 1996.

In addition, the CGTO recommends Gold Meadows continue to be set aside for exclusive Indian use because the area contains a concentration of significant cultural resources. Similarly, the CGTO recommends DOE set aside Water Bottle Canyon, Scrugham Peak, Prow Pass, Timber Mountain and select areas within Calico Hills and Shoshone Mountain for exclusive Indian use. Efforts should be made to forego any additional land disturbances within these areas and provide access to Indian people.

The CGTO agrees with DOE’s mitigation measure regarding site monitoring, and recommends Indian people serve as site monitors. At a minimum, the CGTO recommends annual tribal visits to monitor the state of cultural sites located within the NNSS and to offer blessings. The CGTO also recommends tribal visits to areas designated for repatriation, such as the Pahute Mesa, and periodic assessments conducted to comply with NAGPRA.

C.4.8 Waste Management

We continue to strongly oppose the transportation, storage and disposal of radioactive waste at the NNSS; however, Indian people must continue to fulfill our birth-rite obligation to care for our Holy Land and do what we can to try to restore balance to Area 5 and other contaminated locations. The CGTO recommends DOE allocate funds and resources for Indian people to conduct systematic ethnographic studies of these waste management programs. If DOE selects the expanded use alternative, the CGTO must conduct a cultural assessment of the Area 3 RWMS prior to new use to mitigate potential impacts.

The CGTO supports DOE's intention to minimize waste within the NNSS area. We encourage the DOE to partner with us to develop and participate in DOE's waste minimization and pollution prevention programs. In particular, the waste minimization efforts described in the SWEIS regarding land commitments must include members of the CGTO to ensure the cultural implications of these decisions are considered prior to implementation.

Finally, the CGTO struggles with the ethics of transporting and relocating radioactive waste from other American Indian lands so those people can live without fear of radioactivity. We are greatly concerned about the adverse spiritual, environmental, and health impacts associated with relocating these angry rocks from their current locations to our Holy Land. We believe transporting these to our land perpetuates animosity and discord among tribal governments. Because these decisions adversely impact our land and our relationships with other tribal governments, the CGTO recommends DOE host a break out session for culturally-affiliated tribes associated with the NNSS and the multi-state waste generator facilities during DOE's Annual Waste Generator Conference. These efforts will facilitate further discussion, understanding, and to develop culturally-appropriate mitigation measures.

C.5 Conclusions and Recommendations

Ultimately, the CGTO is concerned about impacts to (1) tribal members and the people they represent; (2) tribal economies and enterprises; (3) flora and fauna which are considered vital to cultural survival; (4) important resources which may be damaged from ground-disturbing activities; and (5) shipments and storage of waste through the traditional Holy Lands of the Western Shoshone, Southern Paiute, and Owens Valley Paiute and Shoshone people.

Indian people have a unique understanding based on traditional ecological knowledge which tells us how and where to interact with plants and animals, water sources, and collect soil samples to minimize impacts to the land while maintaining its spiritual integrity. Because of the potential affects to our ancestral land and its delicate resources, the CGTO must be an integral part of NNSS and TTR activities.

The CGTO has provided recommendations to DOE throughout Appendix C and within our text boxes throughout the SWEIS. In addition to these, the CGTO recommends DOE and the CGTO continue to hold annual meetings to discuss current and proposed actions in greater depth, to deliberate potential impacts, and to consider and develop mutually acceptable mitigation measures. This is particularly necessary for those actions requiring additional NEPA analysis, including but not limited to solar and geothermal energy development.

The CGTO strongly encourages DOE to evaluate the cultural impacts of pursuing solar and geothermal energy because of the complexity and the potential implications to the environment, cultural landscape, and our survival. The CGTO recommends developing culturally-appropriate text for future NEPA analyses, including the environmental assessments and mitigation plans required for these proposed undertakings.

In conclusion, the CGTO must continue to fulfill our obligation to care for our Holy Land. We must gain access and opportunity to conduct ceremonies, and to care for the NNSS and TTR land as the Creator intended and in ways only known by Indian people.

Table C–1 American Indian Traditional-Use Plants Present at the Nevada National Security Site

Scientific Name	*Common Name*	*GC/UTTR*	*YM*	*PM/RM*
1. *Ambrosia dumosa*	White bursage	X		
2. *Amelanchier utahensis*	serviceberry		X	
3. *Amsinckia tesselata*	fiddleneck		X	
4. *Anemopsis californica*	yerba mansa		X	
5. *Arabis pulchra*	wild mustard		X	
6. *Artemisia ludoviciana*	sagebrush, wormwood	X	X	
7. *Artemisia nova*	black sagebrush	X		X
8. *Artemisia tridentata*	big sagebrush		X	X
9. *Atriplex canescens*	four-winged saltbush	X		
10. *Atriplex confertifolia*	Shadscale		X	
11. *Brodiaea pulchella*	desert hyacinth		X	
12. *Calochortus bruneaunis*	sego lily			X
13. *Calochortus flexuosus*	mariposa lily		X	
14. *Carex spp.*	sedge	X		
15. *Castilleja chromosa*	Indian paintbrush		X	
16. *Castilleja martinii*	narrowleaf paintbrush			X
17. *Ceratoides lanata*	winterfat			X
18. *Chenopodium fremontii*	Fremont goosefoot			X
19. *Chrysothamnus nauseosus*	rabbitbrush	X	X	X
20. *Cirsium mohavense*	desert thistle		X	
21. *Coleogyne ramosissima*	black brush		X	
22. *Coryphantha vivipara var.*	fishhook cactus	X	X	
23. *Coryphantha vivipara var.*	foxtail cactus			X
24. *Datura meteloides*	jimsonweed	X	X	
25. *Descurainia pinnata*	tansy mustard		X	
26. *Distichlis spicata*	salt grass		X	
27. *Echinocactus polycephalus*	cotton-top cactus		X	
28. *Echinocereus englemannii*	hedge hog cactus	X	X	
29. *Eleocharis palustris*	Spikerush			X
30. *Elymus elymoides*	squirrel tail			X
31. *Encelia virginensis var.*	brittlebush		X	
32. *Ephedra nevadensis*	Indian tea	X	X	X
33. *Ephedra viridis*	Indian tea		X	X
34. *Eriastrum eremicum*	desert eriastrum			X
35. *Eriogonum inflatum*	desert trumpet		X	
36. *Erodium cicutarium*	herringbill			X
37. *Euphorbia albomarginata*	rattlesnake weed		X	X
38. *Geastrum spp.*	earthstar		X	
39. *Gilia inconspicua*	gilia			X
40. *Grayia spinosa*	spiny hop sage			X
41. *Gutierrezia microcephala*	matchweed	X	X	
42. *Juncus mexicanus*	wire grass		X	
43. *Juniperus osteosperma*	juniper, cedar	X	X	X
44. *Krameria parvifolia*	range ratany		X	
45. *Larrea tridentata*	creosote bush	X	X	
46. *Lewisia rediviva*	bitter root			X
47. *Lycium andersonii*	wolfberry	X	X	
48. *Lichen*	lichen		X	X

Scientific Name	Common Name	GC/UTTR	YM	PM/RM
49. *Lycium pallidum*	wolfberry		X	
50. *Menodora spinescens*	spiny menodora		X	
51. *Mentzelia albicaulis*	desert corsage		X	X
52. *Mirabilis multiflora*	four o'clock	X		X
53. *Nicotiana attenuata*	coyote tobacco			X
54. *Nicotiana trigonophylla*	Indian tobacco	X	X	
55. *Opuntia basilaris*	beavertail cactus	X	X	
56. *Opuntia echinocarpa*	golden cholla cactus		X	
57. *Opuntia erinacea*	Mojave prickly pear	X	X	
58. *Opuntia polycantha*	grizzly bear cactus			X
59. *Orobanche corymbosa*	broomrape, wild			X
60. *Oryzopsis (Stipa) hymenoides*	Indian ricegrass	X	X	X
61. *Penstemon floridus*	Panamint beard tongue			X
62. *Penstemon pahutensis*	Pahute beard tongue			X
63. *Peraphyllum ramosissimum*	squawapple		X	
64. *Phragmites australis*	cane, reed	X	X	
65. *Pinus monophylla*	pinyon pine		X	X
66. *Prosopis glandulosa*	mesquite	X	X	
67. *Prosopis pubescens*	screwbean		X	
68. *Psorothamnus polydenius*	dotted dalea		X	
69. *Purshia glandulosa*	buckbrush		X	
70. *Purshia mexicana*	cliffrose			X
71. *Purshia tridentata*	buckbrush			X
72. *Quercus gambelii*	scrub oak		X	X
73. *Rhus aromatica*	skunkbush, sumac			X
74. *Rhus trilobata var. anisophylla*	squawbush		X	
75. *Rhus trilobata var. simplicifolia*	squawbush	X	X	
76. *Ribes cereum*	white squaw currant			X
77. *Ribes velutinum*	desert gooseberry			X
78. *Rosa woodsii*	woods rose			X
79. *Rumex crispus*	curly dock, wild rhubarb		X	
80. *Salix exigua*	willow	X	X	
81. *Salix gooddingii*	black willow	X	X	
82. *Salsola iberica*	Russian thistle	X		X
83. *Salvia columbariae*	chia sage		X	
84. *Salvia dorrii*	purple sage, Indian	X		
85. *Sarcobatus vermiculatus*	greasewood	X		
86. *Sisymbrium altissimum*	tumbling mustard			X
87. *Sphaeralcea ambigua*	globe mallow	X	X	X
88. *Stanleya pinnata*	Indian spinach	X	X	X
89. *Stephanomeria sp. spinosa*	spiny wire lettuce, gum	X	X	
90. *Stipa speciosa*	bunchgrass			
91. *Streptanthella longirostris*	wild mustard		X	
92. *Streptanthus cordatus*	wild mustard		X	
93. *Suaeda torreyana*	seepweed		X	
94. *Symphoricarpos longiflorus*	snowberry		X	
95. *Symphoricarpos spp.*	snowberry			
96. *Tessaria sericeae*	arrowweed	X	X	
97. *Thamnosma montana*	turpentine bush	X	X	
98. *Thelypodium integrifolium*	wild cabbage		X	

Scientific Name	***Common Name***	***GC/UTTR***	***YM***	***PM/RM***
99. *Typha domingensis*	cattail		X	
100. *Typha latifolia*	cattail	X	X	
101. *Veronica anagallis-aquatica*	speedwell		X	
102. *Vitis arizonica*	wild grape	X	X	
103. *Xylorhiza tortifolia*	desert aster		X	
104. *Yucca baccata*	banana yucca	X	X	X
105. *Yucca brevifolia*	Joshua tree		X	
106. *Yucca spp.*	yucca		X	
107. *Yucca schidigera*	Mojave yucca, Spanish		X	

NOTE: American Indian traditional-use plants present in the NNSS area are identified in the project reports entitled *Native American Plant Resources in the Yucca Mountain Area, Nevada* (YM) (Stoffle et al. 1989b) *and Native American Cultural Resources on Pahute and Rainier Mesas, Nevada Test Site* (PM/RM) (Stoffle et al. 1994b). This table includes traditional-use plants identified in the Colorado River Corridor Study (GC) and in the Utah Test and Training Range Study (UTTR) that are also present at the NNSS (see 1996 NTS EIS, Table 4-38).

Table C–2 American Indian Traditional-Use Animals Present at the Nevada National Security Site

Scientific Name	***Common Name***
Alectoris chukar	chukar
Ammospermophilus leucurus	white-tailed antelope squirrel
Amphispiza bilienata	black-throated sparrow
Aquila chrysaetos	golden eagle
Buteo jamaicensis	red-tailed hawk
Callipepla gambelii	Gambel’s quail
Canis latrans	coyote
Cicadidae spp.	cicada
Cnemidophorus tigris	western whiptail lizard
Canis latrans	coyote
Colaptes auratus	northern flicker
Crotalus spp.	rattlesnake
Eutamias dorsalis	cliff chipmunk
Felis concolor	mountain lion
Felis rufus	bobcat
Formicidae formicinae	mound-building ant (red and black ant)
Gopherus agassizii	desert tortoise
Haliaeetus leucocephalus	bald eagle
Odocoileus hemionus	mule deer
Ovis canadensis	bighorn sheep
Sauromalus obesus	chuckwalla
Spizella breweri	Brewer’s sparrow
Stagmomantis spp.	praying mantis
Sylvilagus spp.	cottontail
Vulpes velox	kit fox
Zanaida macroura	mourning dove

NOTE: American Indian traditional-use animals are identified in the project report entitled *Native American Cultural Resources on Pahute and Rainier Mesas, Nevada Test Site* (Stoffle et al. 1994b). This table presents only a partial list of traditional-use animals present at the NNSS (see NTS EIS, Table 4-39). To date, no systematic or extensive animal studies have been conducted at the NNSS.

C.6 References

AIWS (American Indian Writers Subgroup), 1998, *American Indian Perspectives on the Yucca Mountain Site Characterization Project and the Repository Environmental Impact Statement*, Las Vegas: Consolidated Group of Tribes and Organizations, Report submitted to U.S. Department of Energy, Las Vegas.

AIWS (American Indian Writers Subgroup), 2005, *American Indian Perspectives on the Pro-posed Rail Alignment Environmental Impact Statement for the U.S. Department of Energy's Yucca Mountain Project*, Las Vegas: Consolidated Group of Tribes and Organizations, Report submitted to U.S. Department of Energy, Las Vegas.

Carroll , A. K., R.W. Stoffle, K. Van Vlack, R. Arnold, R. Toupal, H. Fauland, A. Haverland, 2006, *Black Mountain: Traditional Uses of Volcanic Landscape*, University of Arizona, Tucson, Arizona (pp. 14 and 21).

D'Azevedo, W. L., 1986, Great Basin, Volume II, Smithsonian Institution, Washington, DC.

DOE (U.S. Department of Energy, Yucca Mountain Project), 1991, NNWSI Project Environmental Field Activity Plan for Cultural Resources: Native American Component.

Stoffle, R. W., 1987, *Native Americans and Nuclear Waste Storage at Yucca Mountain, Nevada: Potential Impacts of Site Characterization Activities,* Ann Arbor: University of Michigan, Institute for Social Research.

Stoffle, R. W., and M. J. Evans, 1988, American Indians and Nuclear Waste Storage: the Debate at Yucca Mountain, Nevada, *Policy Studies Journal* 16(4):751-767.

Stoffle, R. W., and M. J. Evans, 1990, Holistic Conservation and Cultural Triage: American Indian Perspectives on Cultural Resources, *Human Organization* 49(2):91-99.

Stoffle, R. W., M. J. Evans, and D. B. Halmo, 1988a, Recommended Actions for Reducing Potential Adverse Effects on Native American Cultural Resources Caused by Site Characterization Activities, Report prepared for Science Applications International Corp. and the U.S. Department of Energy Nevada Operations Office, Ann Arbor: Institute for Social Research, University of Michigan.

Stoffle, R. W., M. J. Evans, D. B. Halmo, and J. E. Olmsted, 1988b, Annual Report, Native American Cultural Resource Studies, Yucca Mountain, Nevada, Report prepared for Science Applications International Corp. and the U.S. Department of Energy Nevada Operations Office, Ann Arbor: Institute for Social Research, University of Michigan.

Stoffle, R. W., M. J. Evans, D. B. Halmo, W. E. Niles, and J. T. O'Farrell, 1989a, *Native American Plant Resources in the Yucca Mountain Area, Nevada, Interim Report*, DOE/NV-10576-19, Washington, DC: U.S. Department of Energy.

Stoffle, R. W., M. J. Evans, and C. Harshbarger, 1989b, *Native American Interpretation of Cultural Resources in the Area of Yucca Mountain*, *Nevada*, DOE/NV-10576-17, Las Vegas: U.S. Department of Energy, Nevada Operations Office.

Stoffle, R. W., D. B. Halmo, M. J. Evans, and J. E. Olmsted, 1990a, Calculating the Cultural Significance of American Indian Plants: Paiute and Shoshone Ethnobotany at Yucca Mountain, Nevada, *American Anthropologist* 92:416-432.

Stoffle, R. W., D. B. Halmo, J. E. Olmsted, and M. J. Evans, 1990b, *Native American Cultural Resource Studies at Yucca Mountain, Nevada*, Ann Arbor: Institute for Social Research, University of Michigan.

Stoffle, R. W., J. E. Olmsted, and M. J. Evans, 1990c, *Literature Review and Ethnohistory of Native American Occupancy and Use of the Yucca Mountain Area*, DOE/NV-10576-21, Las Vegas: U.S. Department of Energy, Nevada Operations Office.

Stoffle, R. W., D. B. Halmo, and R. Arnold, 1991, The Native American Consultation Process, In Complying with AIRFA: A Literature Review and Evaluation (L. Pippin, ed.), pp. 15-22, Reno: Desert Research Institute, Prepared for U.S. Department of Energy, Nevada Operations Office.

Stoffle, R. W., D. B. Halmo, and M. J. Evans, 1999, Puchuxwavaats Uapi (To Know About Plants): Traditional Knowledge and the Cultural Significance of Southern Paiute Plants, *Human Organization* 58(4):416-429.

Stoffle, R. W., M. N. Zedeño, and D. B. Halmo (eds.), 2001, *American Indians and the Nevada Test Site: A Model for Research and Consultation*, DOE/NV/13046-2001/001, U.S. Government Printing Office, Washington, DC.

Stoffle, R.W., and R. Arnold, 2003, Confronting the Angry Rock: American Indian's Situated Risks from Radioactivity, *Ethnos* 68:2.

Stoffle, R.W., K. Van Vlack, and R. Arnold, 2006, *Paa'oatsa Hunuvi Water Bottle Canyon Traditional Cultural Property Study*, Bureau of Applied Research in Anthropology, University of Arizona, Tucson, Arizona.

Zedeño, M., J. Schrag-James, and R. Basaldu, 2001, *Overview and Inventory of Ethnographic Resources for Petrified Forest National Park, El Malpais National Monument, and National Conservation Area, and El Morro National Monument*, Bureau of Applied Research in Anthropology, the University of Arizona, Tucson, Arizona (p. 146).

APPENDIX D
AIR QUALITY AND CLIMATE

APPENDIX D
AIR QUALITY AND CLIMATE

D.1 Affected Environment

D.1.1 Nevada National Security Site

D.1.1.1 Meteorology

This section provides further details on the meteorology discussion presented in Chapter 4, Section 4.1.8.1, of this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada (NNSS SWEIS)*. **Table D–1** shows the meteorological data used in the climate and air quality analysis. The use of different data in the various analyses reflects the availability of historical data collection efforts and consistency in the methodology used in the data collection.

Table D–1 Summary of Meteorological Data Used in the Nevada National Security Site Air Quality Analysis

Years	*Meteorological Parameter*	*Reference*
Climatological Data		
1983-2002	Temperature	NOAA (2006)
1983-2002	Snowfall	NOAA (2006)
1983-2002	Thunderstorms	NOAA (2006)
1966-2005	Precipitation	DOE (2008f), NOAA (2006)
1954-1983	Tornado Frequency	NRC (1986)
1973-1977	Mixing Heights – Yucca Flat	NOAA (2006)
2004-2008	Wind Roses MEDA Stations	NOAA (2010)
Dispersion Modeling		
2003-2007	Desert Rock Upper-Air – wind and temperature	DOE (2009b)
2003-2007	Desert Rock Surface – wind, temperature, cloud cover	DOE (2009b)

Temperature. Temperatures, especially daily maximum temperatures, have been trending upward over at least the last 25 years. The average annual maximum temperature at most Nevada National Security Site (NNSS) locations have increased about 4 degrees Fahrenheit (°F) from 1983 through 2002, while average annual minimum temperature trends ranged from about -2 °F to +3.3 °F between NNSS locations, with an average increase of about +1 °F (NOAA 2006).

Precipitation. Much of the 1980s and 1990s were wetter than normal. The rain gauge network within the NNSS, however, reflects local variations and tends to show precipitation amounts over the last 10 years being nearly equal or slightly greater than in the last 40 years (DOE 2008f).

Snowfall varies widely within the NNSS, but is generally confined to elevations above about 6,000 feet and is infrequent below about 4,000 feet. An estimated annual average of about 60 inches of snow might fall on the highest point in the NNSS (Rainier Mesa at 7,490 feet). At Desert Rock (southeastern NNSS, 3,251 feet), the average annual measured snowfall is about 3 inches (NOAA 2006).

Thunderstorms occur primarily during two time periods – in spring due to cold front passages and in middle to late summer due to convection from daytime heating. The two thunderstorm recording stations (Yucca Flat in east–central NNSS and Desert Rock in extreme southeastern NNSS) both report about 15 thunderstorm days per year, with multiple peaks in activity between early July and early September. Thunderstorms are more frequent and begin earlier in the afternoon on the mesas compared with lower elevations. Thunderstorm activity tends to reach a maximum in the early afternoon in the northern NNSS and in the later afternoon in the southern NNSS. Some thunderstorms move into the southern NNSS after midnight after forming earlier in the day over the Spring Mountain Range located to the south of the NNSS (NOAA 2006).

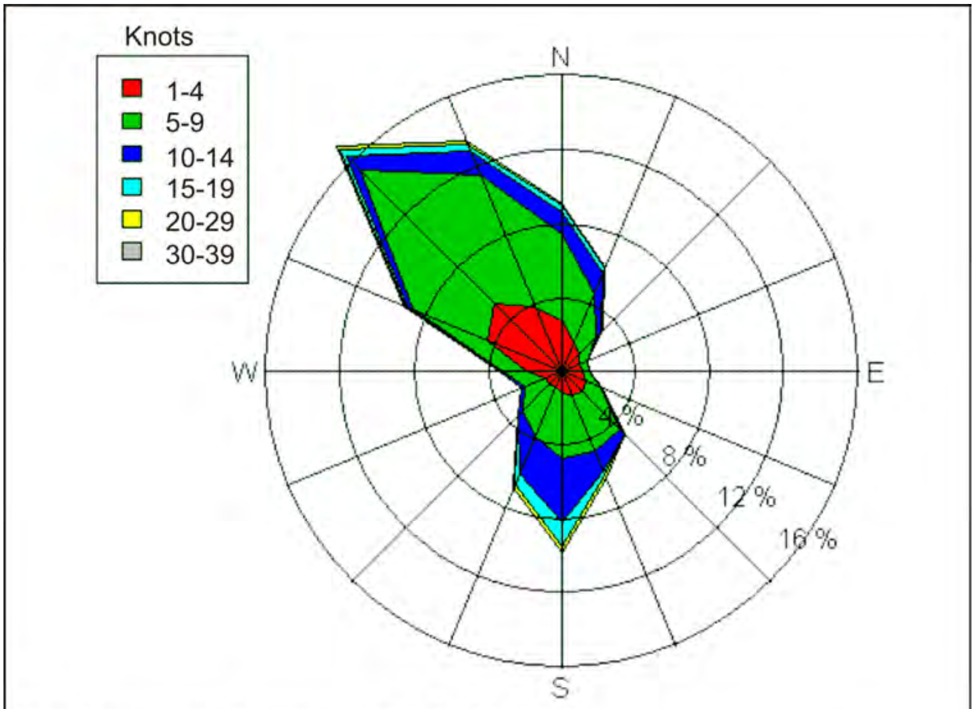
It is rare for a thunderstorm to produce more than about 0.5 inches of rain at a given location, so flooding is rarely a problem on the NNSS. Thunderstorms in the NNSS can be severe at times, with strong surface wind gusts and intense cloud-to-ground lightning, but hail is infrequent and hail size is small (less than about 0.5 inches in diameter). Cloud-to-ground lightning activity tends to maximize over higher elevations particularly during July through September (NOAA 2006). Tornadoes are very rare in Nevada as a whole, with a 1954 to 1983 tornado climatology indicating a statewide tornado strike probability of three per year (NRC 1986).

Wind Flow Patterns. Since nighttime low clouds are infrequent and nighttime mixing heights tend to be less than 700 feet (according to measurements taken at the Yucca Flat station during the period of record from 1973–1977), localized terrain gradients are the dominant nighttime wind flow modifier. In summer months, daytime heating is sufficient to generate uneven heating over the varying terrain, which creates up-slope (southerly) winds during the day. In the winter, daytime winds tend to be down-slope (northerly) (NOAA 2006).

Near the Big Explosives Experimental Facility (BEEF) (see **Figure D–1**), the dominant flow is northwesterly, with a secondary peak from the south. The most significant nearby elevated terrain runs north–south about 6 miles west of BEEF and curves towards the east about 9 miles north of BEEF, which may explain the down-slope preference from the northeast and the up-slope preference towards the north. The maximum observed peak wind speed during the period from 2004–2008 was 100 miles per hour, but the more typical annual maximum wind speed was around 70 miles per hour (not shown).

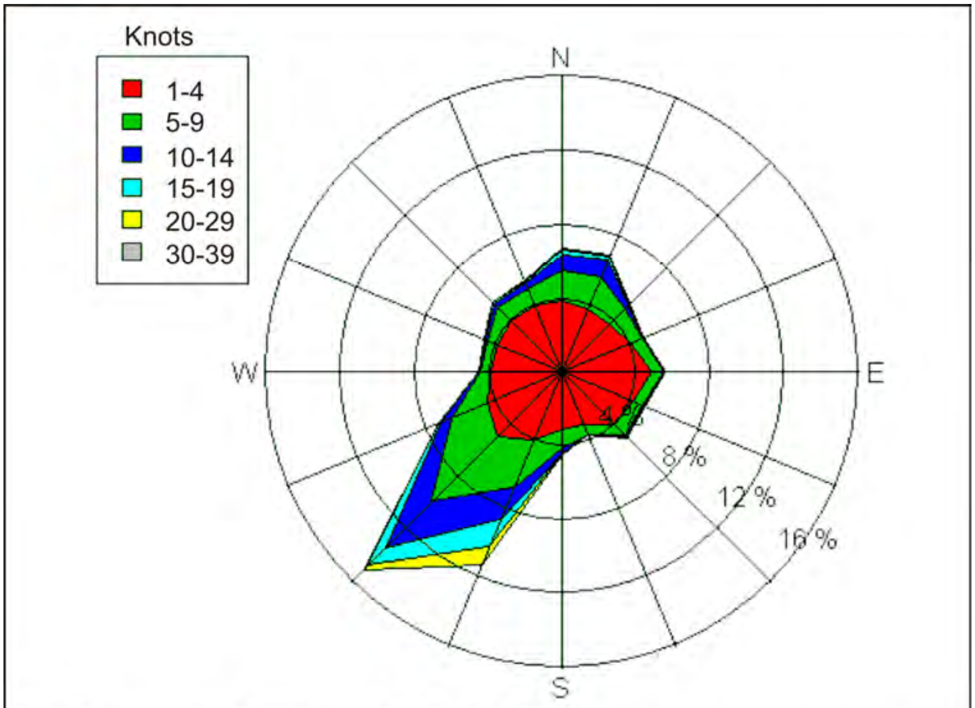
Near the Nonproliferation Test and Evaluation Complex (NPTEC) (**Figure D–2**), the dominant flow is south-southwesterly, with a minor peak from the north. The nearby terrain is fairly uniform in most directions, though the elevation steadily increases for about 4 miles northward and decreases for about 3 miles southward, which may explain the southerly and northerly up-slope and down-slope directions, respectively. The maximum observed wind speed during the period from 2004–2008 was about 90 miles per hour, but the more typical annual maximum wind speed was around 55 miles per hour.

Near Test Cell C (see **Figure D–3**), the dominant flow is northeasterly, with a secondary peak from the southwest. The most significant nearby elevated terrain is about 4 miles southeast and about 4 miles northeast of the station. Since the elevated terrain to the southeast faces west, away from the rising sun, it may not provide the uneven heating necessary to create slope flows. Instead, the terrain to the northeast may dominate up-slope and down-slope effects, perhaps leading to the northeasterly and southwesterly flow preferences. The maximum observed wind speed during the period from 2004–2008 was about 78 miles per hour, but the more typical annual maximum wind speed was around 56 miles per hour (not shown).



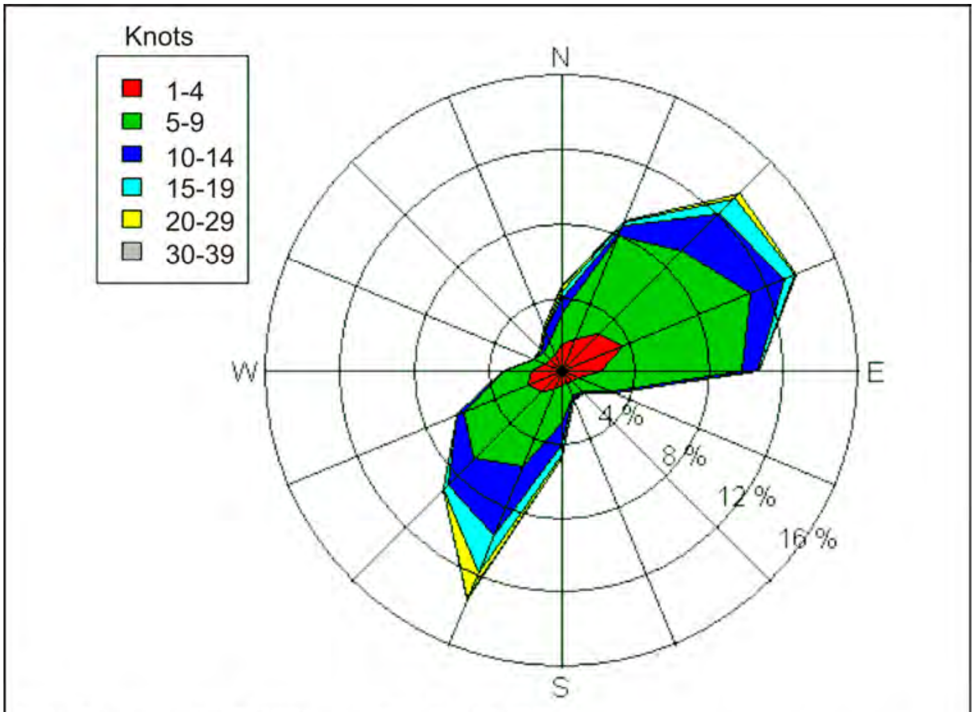
Note: Encompassing 2004 through 2008 (NOAA 2006).
To convert knots to ms^{-1}, multiply by 0.5144. To convert knots to mph, multiply by 1.151.

Figure D–1 Annual Average Wind Rose for Meteorological Data Acquisition Station 49 near the Big Explosives Experimental Facility



Note: Encompassing 2004 through 2008 (NOAA 2006).
To convert knots to ms^{-1}, multiply by 0.5144. To convert knots to mph, multiply by 1.151.

Figure D–2 Annual Average Wind Rose for Meteorological Data Acquisition Station 13 near the Nonproliferation Test and Evaluation Complex



Note: Encompassing 2004 through 2008 (NOAA 2006).
To convert knots to ms^{-1}, multiply by 0.5144. To convert knots to mph, multiply by 1.151.

Figure D–3 Annual Average Wind Rose for Meteorological Data Acquisition Station 26 near Test Cell C

Calm winds are infrequent at the NNSS. For example, at the stations near BEEF (see Figure D–1), NPTEC (see Figure D–2), and Test Cell C (see Figure D–3), the percentage of observations that showed wind speeds of less than 1 knot were between 1 and 2 percent. Locations in basins such as the dry lake beds in the Yucca and Frenchman Flats tend to have the lightest winds (i.e., average annual wind speeds of about 5 to 10 miles per hour). Mesa locations tend to have slightly stronger winds (i.e., average annual wind speeds of about 11 miles per hour) because they tend to reflect the larger-scale wind flow and have less surface roughness. Mountaintop locations tend to have the fastest winds (i.e., average annual wind speeds of about 13 to 20 miles per hour) because they are strongly influenced by upper-level winds. Locations with steep elevation gradients also tend to have higher wind speeds due to stronger up-slope and down-slope wind flows. Seasonally, winds tend to be strongest at all locations on the NNSS during the spring due to more-frequent frontal passages and weakest in the fall. Wind gusts in excess of 55 miles per hour can be observed during springtime frontal passages and during summertime convective thunderstorms (NOAA 2006). When unaccompanied by rainfall, stronger springtime wind speeds can commonly lead to dust storms.

D.1.1.2 Ambient Air Quality on and near the Nevada National Security Site

This section expands the ambient air quality discussion presented in Chapter 4, Section 4.1.8.2, of this *NNSS SWEIS*.

D.1.1.2.1 Existing Air Quality

Emissions from Stationary Sources. Title V of the Clean Air Act gives states the authority to use air quality permits to regulate stationary source emissions of criteria pollutants. At the NNSS, there is one Class II Air Quality Permit. Class II permits are issued for "minor" sources where the following emissions limits are in effect: (1) annual emissions of any one criteria pollutant must not exceed 100 tons; (2) annual emissions of any one hazardous air pollutant (HAP) must not exceed 10 tons (including lead); or (3) annual emissions of any combination of HAPs must not exceed 25 tons (including lead). The emissions limits with associated with the NNSS permit are occasionally re-evaluated and reissued—most recently in 2009. The NNSS facilities regulated by this permit include the following (DOE 2009d, 2009e):

- Over 15 facilities and 185 pieces of equipment in Areas 1, 3, 5, 6, 12, 23, and 27
- NPTEC (in Area 5)
- Sitewide chemical release areas
- BEEF in Area 4
- Explosives Ordnance Disposal Unit in Area 11
- Explosive pads at the HEST [High Explosive Simulation Technique] test range in Area 14,
- Test Cell C in Area 25, and Port Gaston in Area 26

A summary of the historical stationary source emissions and the maximum permitted emission rates are shown in **Table D–2** based on reports submitted to the Nevada Division of Environmental Protection. The actual annual emissions of individual criteria pollutants have been well below the permitted levels over the past 11 years. Most of these emissions are associated with emissions from diesel generators (DOE 2009d). The Class II permit also requires that the best practical method be used to limit the resuspension of soil dust into the air during various site activities. At the NNSS, the main method of dust control is the use of water sprays. Observations of fugitive dust tests conducted during 2008 showed no excessive fugitive dust events on the NNSS (DOE 2009d).

Table D–3 shows the 2008 onsite emissions of criteria pollutants and HAPs associated with permitted onsite stationary sources. Emissions from the current construction and associated surface disturbance activities were much smaller relative to the stationary sources and the other mobile sources and were not explicitly calculated. Levels of particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$) for stationary sources have not been explicitly reported by the NNSS, so the $PM_{2.5}$ levels were conservatively assumed to be equal to emission rates of particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}).

Onsite stationary sources emitted approximately 5.18 tons of criteria pollutants in 2008, the bulk of which was attributable to diesel generators. The stationary sources emitted 0.09 tons of HAPs in 2008, most of which was attributable to chemical spill tests at NPTEC.

Table D–2 Calculated Emissions and Annual Permitted Amounts of Criteria Pollutants and Hazardous Air Pollutants from Nevada National Security Site Stationary Sources, 1998–2008 (tons per year)

Pollutant	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*Annual Permitted Amount*
PM_{10}	1.11	1.7	1.46	2.05	3.61	2.39	0.94	0.84	0.69	0.54	0.22	*25.59*
CO	1.85	1.87	2.76	4.84	4.6	1.79	0.24	0.15	0.43	0.51	0.94	*9.57*
NO_x	7.57	8.07	12.75	22.23	21.09	8.11	1.01	0.69	2.02	1.21	3.36	*28.53*
SO_2	0.37	0.42	0.98	1.68	1.62	0.76	0.12	0.04	0.03	0.01	0.06	*3.49*
VOCs	11.76	1.99	1.89	2.01	2.1	1.21	4.6	1.94	1.4	1.14	0.6	*14.91*
HAPs	NR [a]	NR [a]	0.01	0.03	0.01	0	0.41	0.05	1.87	0.02	0.09 [b]	*N/A*
Criteria pollutant total [c]	22.66	14.05	19.85	32.84	33.03	14.26	7.32	3.71	6.44	3.43	5.18	*N/A*

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NO_x = nitrogen oxides; NR = not reported; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] HAPs may have been released in 1998 and 1999 but were not reported.

[b] In 2008, 95 percent of HAPs were emitted during chemical spill tests at the Nonproliferation Test and Evaluation Complex.

[c] This total includes all displayed pollutants except HAPs.

Source: DOE 2009d.

Table D–3 Calculated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Nevada National Security Site Stationary Sources, 2008 (tons per year)

Pollutant	*BEEF*	*NPTEC*	*Storage Tanks*	*Other Sources* [a]	*TOTAL (all programs)*	*Reference*
PM_{10}	0.01	0	0	0.212	*0.22*	DOE 2009d, pages 3-22 and 3-23
$PM_{2.5}$	0.01	0	0	0.212	*0.22*	DOE 2009d, pages 3-22 and 3-23
CO	0.17	0.01	0	0.76	*0.94*	DOE 2009d, pages 3-22 and 3-23
NO_x	0	0.001	0	3.36	*3.36*	DOE 2009d, pages 3-22 and 3-23
SO_2	0	0	0	0.06	*0.06*	DOE 2009d, pages 3-22 and 3-23
VOCs	0.001	0.12	0.35	0.13	*0.60*	DOE 2009d, pages 3-22 and 3-23
Lead	N/A	N/A	N/A	N/A	*0.0023*	DOE 2009d, Table 10.2, page 10-3
HAPs	N/A	N/A	<0.09	N/A	*0.09*	DOE 2009d, pages 3-22 and 3-23

< = less than; BEEF = Big Explosives Experimental Facility; CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NO_x = nitrogen oxides; NPTEC = Nonproliferation Test and Evaluation Complex; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Note: Activities are partitioned by source type.

[a] Other sources include diesel-fired generators, aggregate and concrete handling, cement services equipment, and portable bins.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 [Motor Vehicle Emission Simulator 2010] (Version 20091221; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the NNSS. Onsite government-owned mobile source activity data were derived from the onsite vehicle counts in the *Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways, Nevada Test Site* (referred to hereafter as the "1999 NTS road renovation study") (BN 1999). **Table D–4** and the discussion that follows contain further details on the activity and vehicle data used. See Chapter 4, Section 4.1.3, for more details.

Table D–4 Vehicle Activity Data Used to Model Emissions from Onsite Government Vehicles at the Nevada National Security Site

Vehicle Type Observed [a]	*MOVES2010 Vehicle Type*	*MOBILE6 Vehicle Type*	*Count*	*Annual VMT*	*Percentage Annual VMT Occurring on Weekdays*	*Fuel Types Used*	*Average Vehicle Age (model year)*	*Vehicle Fuel Economy (miles per gallon)*	*VMT per Applicable Fuel Type*	*Annual Lead Emissions (pounds)*
Single-unit trucks (2 to 3 axles)	Single-unit, short-haul trucks	Light-duty trucks, 6,001–8,500	141	715,842	98	Biodiesel (B-20) and No. 2 diesel	11 years (1997)	11.2	61,247 No. 2 diesel 324,195 B-20	0.007
Cars/light trucks	Light-duty passenger vehicles	Light-duty passenger vehicles, all	1,007	4,191,978	95	E85 (assumed to be E10 for MOVES modeling) and unleaded gasoline	9 years (1999)	24.1	2,974,970 Unleaded gasoline 1,258,657 E10	0.021
Cars/light trucks	Light-duty trucks	Light-duty trucks, 0–6,000	1,007	5,556,808	95	E85 (assumed to be E10 for MOVES modeling) and unleaded gasoline	9 years (1999)	18.5	3,875,501 Unleaded gasoline 1,639,656 E10	0.02
Buses	Transit buses	Heavy-duty transit buses, all	70	90,228	95	Biodiesel (B-20) and No. 2 diesel	9 years (1999)	4.4	77,933 No. 2 diesel 412,522 B-20	0.0087

MOBILE6 = Mobile Source Emission Factor Model; MOVES2010 = Motor Vehicle Emission Simulator 2010; VMT = vehicle miles traveled.

[a] Vehicle types observed in Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways, Nevada National Security Site (BN 1999).

Note: Modeling performed using MOVES2010.

Onsite government vehicle data used for emissions modeling are discussed below (see Chapter 4, Section 4.1.3, for more details):

- **Onsite government vehicle types.** The vehicle types observed in the 1999 NTS road renovation study (BN 1999) were linked to MOVES vehicle types, as shown in Table D–3. Note that the light-duty vehicles and light-duty passenger trucks were not separated in the road renovation study, so vehicle data derived from that study were split equally among light-duty vehicles and light-duty passenger trucks for the purposes of MOVES modeling.
- **Vehicle counts.** The vehicle counts in Table D–4 were derived from those observed in the 1999 NTS road renovation study (BN 1999), which were scaled to reflect the change in NNSS employment since that study.
- **Vehicle miles traveled (VMTs).** The VMTs in Table D–4 were derived from the vehicle counts observed in the 1999 NTS road renovation study (BN 1999) and from assumed vehicle destinations.
- **Vehicle age.** The average national default age was used Table D–4 for each vehicle type since this information was not provided in the the 1999 study.
- **Fuel types.** The National Nuclear Security Administration (NNSA) provided fuel usage amounts of unleaded gasoline (435,000 gallons), E85 (184,000 gallons), biodiesel (343,191 gallons), and No. 2 diesel (644,844 gallons) by onsite government vehicles for fiscal year 2009. These fuel usage amounts were assumed to be similar to usage in calendar year 2008. Fuel amounts are not directly used in MOVES; rather, fuel fraction and fuel supply market share were incorporated into the model in the following way:
  - **Fuel types to vehicles.** Unleaded gasoline and E85 was allocated only to light-duty passenger trucks and light-duty vehicles. Buses and single-unit, short-haul heavy-duty trucks were assigned No. 2 diesel and biodiesel. E85 ethanol or B-100 biodiesel are not included in MOVES. As a conservative assumption, the fuel properties for E10 were used in place of E85 and B-20 in place of B-100.
  - **Market shares of each fuel.** The MOVES default fuel supply market share for Nye County includes only one formulation of diesel and two formulations of gasoline (due mostly to changes in Reid vapor pressure) with a seasonal split of 0.286 and 0.714. However, these default formulations do not include ethanol or biodiesel, which are used at the NNSS. The NNSS fuel usage numbers have an ethanol-to-(gasoline+ethanol) fuel usage ratio of 0.297. The corresponding gasoline market share was then adjusted as follows: (1 - 0.297) = 0.703. Multiplying this gasoline market share by the MOVES default market shares of gasoline formulations results in a 0.201 and 0.502 split between the two types of unleaded gasoline. For biodiesel and No.2 diesel, the NNSS fuel usage is 0.159, so the No. 2 diesel market share was set to 0.841.
- **Lead emissions per vehicle and fuel types.** The U.S. Environmental Protection Agency's (EPA) *Air Quality Criteria for Lead* (EPA 2006) was used to estimate the lead emissions factors for mobile sources. The reference has lead-mass-per-mile factors for gasoline, for No. 2 diesel consumed by trucks, and for No. 2 diesel consumed by buses. The reference contains no lead emission factors for ethanol or biodiesel, so it was conservatively assumed that the same factors apply for unleaded gasoline and No. 2 diesel, respectively. The results are shown in Table D–4.
- **Monthly and hourly distributions of VMT.** MOVES default data were used.
- **Road types.** All Nye County roads are assumed to be rural roads with unrestricted access.

- **Meteorology and road speed distributions.** MOVES default data for Nye County were used.
- **Emissions Types.** Only emissions from running exhaust, evbrake wear, and tire wear were modeled.

Table D–5 shows the modeled current (approximately 2008) onsite mobile emissions of criteria pollutants and HAPs associated with NNSS government-owned vehicles. Total onsite emissions from stationary sources (shown in more detail in Table D–2) are also provided in Table D–4 to show the total onsite emissions from both stationary sources and government-owned vehicle mobile sources.

The mobile source criteria pollutant emissions were dominated by carbon monoxide (39.6 tons) and, to a lesser extent, nitrogen oxides (13.9 tons). Light-duty passenger trucks were the largest onsite mobile source emitters (65 percent of onsite government-owned vehicle emissions), followed by light-duty vehicles (21 percent).

Table D–5 Estimated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Nevada National Security Site Stationary Sources and Government-Owned Mobile Sources, 2008 (tons per year)

	Nye County						
	On NNSS						
	Government-Owned Mobile Source Type (Modeled)						
Pollutant	***Light-Duty Vehicles***	***Light-Duty Passenger Trucks***	***Buses***	***Single-Unit, Short-Haul Trucks***	***Total***	***Stationary Source Type (calculated)***	***Total***
PM_{10}	0.11	0.20	0.11	0.40	0.82	*0.22*	*1.0*
$PM_{2.5}$	0.066	0.12	0.10	0.37	0.66	*0.22*	*0.88*
CO	9.3	28.1	0.55	1.6	39.6	*0.94*	*40.5*
NO_x	2.1	6.9	1.3	3.6	13.9	*3.36*	*17.3*
SO_2	0.026	0.048	0.00035	0.0014	0.076	*0.06*	*0.14*
VOCs	0.10	0.60	0.013	0.084	0.80	*0.6*	*1.4*
Lead	0.0000050	0.000010	0.0000035	0.0000035	0.000022	*0.0023*	*0.0023*
HAPs	0.0098	0.046	0.00029	0.0018	0.058	*0.09*	*0.15*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.
Note: Government-owned mobile source activities are partitioned by source type. The source type partitioning of stationary source activities is shown in Table D–3.

Emissions from Commuter Vehicles. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic from employees commuting to the NNSS using personal vehicles. **Table D–6** and the following discussion contain further details on the activity and vehicle data that were used. Chapter 4, Section 4.1.3, of this *NNSS SWEIS* contains information regarding the origin of these activity numbers.

Private-vehicle commuter activity data were based on employment numbers and residence information. Half of the commuter vehicles were assumed to be light-duty vehicles and the other half, light-duty passenger trucks. To estimate the personal-vehicle emissions in various locations, it was assumed that all personal-vehicle commuters enter the NNSS via Mercury Highway and park at Entry Gate 100. This commuting pattern results in about 4 miles round trip on site per commuter traveling by personal vehicle at the NNSS. It was also assumed that all personal-vehicle commuters coming from Clark County use

U.S. Route 95, which results in about 12 miles round trip per commuter traveling by personal vehicle within Nye County and outside of the NNSS. For Clark County roads, GIS [geographic information system] was used to estimate the total length of various road types; roads outside and inside of the Las Vegas spaghetti bowl correspond to rural and urban roads, respectively. For the Clark County portion of travel, the following fractions were used: 0.176 rural restricted, 0.595 rural unrestricted, 0.058 urban restricted, and 0.171 urban unrestricted.

Table D–6 Vehicle Activity Data Used to Model Emissions from Commuting to and from the Nevada National Security Site

MOVES2010 Vehicle Type	*Count Originating in Clark County*	*Count Originating in Nye County*	*Annual VMT Within Clark County*	*Annual VMT Within Nye County but Outside the NNSS*	*Annual VMT Within Nye County and Inside the NNSS*	*Percentage Annual Clark County VMT Occurring on Weekdays*	*Percentage Annual Nye County VMT Outside the NNSS Occurring on Weekdays*	*Percentage Annual Nye County VMT Inside the NNSS Occurring on Weekdays*	*Fuel Type Used*
Light-duty vehicles	328	97	9,868,361	2,808,808	430,088	85	90	87	Unleaded gasoline
Light-duty passenger trucks	327	98	9,868,361	2,808,808	430,088				
Transit buses	11	0	420,347	19,667	147,576	89	89	89	No. 2 diesel

MOVES2010 = Motor Vehicle Emission Simulator 2010; NNSS = Nevada National Security Site; VMT = vehicle miles traveled.
Note: Modeling performed using MOVES2010.

The default MOVES fuel market shares, meteorology, vehicle speed distributions, and monthly and hourly VMT distributions were used in the analysis. Only emissions associated with vehicle exhaust, brake wear, and tire wear were modeled. As was done for onsite government vehicles, light-duty vehicles and light-duty passenger trucks were conservatively assumed to have an average age of 9 years.

Emissions from transit buses were not modeled using MOVES2010. Instead, emissions from the NNSS bus fleet were modeled using the age of the current bus fleet (all 2003 model year buses) all meeting the 1998 EPA heavy-duty emissions standards. These emissions standards include the following: 72.5 grams per mile of carbon monoxide; 18.7 grams per mile of nitrogen oxides; and 0.468 grams per mile for particulate matter, conservatively assumed to be entirely $PM_{2.5}$. Sulfur dioxide emissions were calculated using Equation 39 from the PART5 Model, Appendix A (EPA 1995b), and using the standard fuel economy of transit buses from MOBILE6 [Mobile Source Emission Factor Model] (EPA 2003). These emissions standards were combined with the bus fleet annual VMT to arrive at annual emissions. The onsite government bus counts derived from the 1999 NTS *Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways* (BN 1999) were used for the spatial allocation. All buses were assumed to make round trips between Clark County and the NNSS, spending 8 round-trip miles inside Nye County.

Table D–7 shows the modeled current (approximately 2008) mobile emissions of criteria pollutants and HAPs associated with onsite employees commuting to the NNSS. Light-duty passenger vehicles contributed about 21 percent of the criteria pollutant total, while light-duty passenger trucks contributed 46 percent and commuter buses, 33 percent. Carbon monoxide was emitted in the largest amounts (136.5 tons) among the criteria pollutants. Commuting activities related to the NNSS emitted approximately 0.14 tons of HAPs in 2008. The majority (71 percent) of emissions related to commuting to the NNSS took place in Clark County, while about 16 percent took place in the portion of Nye County that is outside of the NNSS, and the remaining 13 percent took place on the NNSS.

Table D–7 Estimated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Nevada National Security Site, 2008 (tons per year)

	Light-Duty Vehicles (Modeled)			*Light-Duty Passenger Tucks (Modeled)*			*Transit Buses (calculated)*			*Total*			
		Nye County			*Nye County*			*Nye County*			*Nye County*		
Pollutant	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.25	0.076	0.025	0.37	0.11	0.036	0.22	0.010	0.076	*0.83*	*0.19*	*0.14*	*1.2*
$PM_{2.5}$	0.14	0.044	0.015	0.2	0.058	0.02	0.22	0.010	0.076	*0.56*	*0.11*	*0.11*	*0.78*
CO	20.9	6.1	2.1	44.5	14	4.9	33.6	1.6	11.8	*97*	*21*	*18.5*	*136.5*
NO_x	4.5	1.5	0.48	11.5	3.6	1.2	8.7	0.41	3.0	*24*	*5.3*	*4.6*	*34*
SO_2	0.073	0.02	0.0064	0.11	0.027	0.0097	0.010	0.00047	0.0035	*0.19*	*0.047*	*0.019*	*0.26*
VOCs	0.24	0.071	0.024	1.1	0.3	0.11	N/A	N/A	N/A	*1.2*	*0.35*	*0.12*	*1.7*
Lead	0.000022	6.2×10^{-6}	9.4×10^{-7}	0.000022	6.2×10^{-6}	9.7×10^{-7}	3.4×10^{-6}	1.6×10^{-7}	1.2×10^{-6}	*0.000048*	*0.000013*	3.1×10^{-6}	*0.000064*
HAPs	0.021	0.0069	0.0023	0.08	0.025	0.0087	N/A	N/A	N/A	*0.095*	*0.03*	*0.01*	*0.14*

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Mobile Sources. The MOVES2010 model was used to estimate emissions due to vehicle traffic from nonradioactive waste transport (commercial vendors). **Table D–8** and the following discussion provide further details on the activity and vehicle data used. See Chapter 4, Section 4.1.3, for more details on the development of these numbers.

Table D–8 Vehicle Activity Data Used to Model Emissions from Commercial Vendors Traveling to and from the Nevada National Security Site

MOVES2010 Vehicle Type	*Count*	*Annual VMT Within Clark County*	*Annual VMT Within Nye County but Outside the NNSS*	*Annual VMT Within Nye County and Inside the NNSS*	*Percentage Annual VMT Occurring on Weekdays*	*Fuel Type Used*
Single-unit, short-haul trucks	17	399,126	55,692	194,922	95	No. 2 diesel

MOVES2010 = Motor Vehicle Emission Simulator 2010; NNSS = Nevada National Security Site; VMT = vehicle miles traveled.
Note: Modeling performed using MOVES2010.

Commercial vendor activity was derived from employee count data and from the 1999 NTS road renovation study (BN 1999). Commercial vendors were assumed to use single-unit trucks fueled by No. 2 diesel. The lead emissions factors for mobile sources in EPA's *Air Quality Criteria for Lead* (EPA 2006) were used to estimate lead emissions for NNSS commercial vendor vehicles.

Commercial vendors were assumed to enter the NNSS via Mercury Highway and go to the Area 5 Radioactive Waste Management Site (RWMS). The RWMS was chosen because nearly all hazardous waste is currently (in 2008) stored at the Pit 3 Mixed Waste Disposal Unit, which is near RWMS (DOE 2009c). Hazardous waste was estimated to travel 84 miles per vehicle trip in Clark County, 12 miles per vehicle trip in Nye County but outside the NNSS, and 40 miles per vehicle trip inside the NNSS. MOVES default fuel supply market shares, meteorology, vehicle speed distribution, and monthly and hourly VMT distributions were used in the analysis. Only running exhaust, brake wear, and tire wear were modeled. As was done for onsite government vehicles, single-unit, short-haul trucks were assumed to have an average age of 11 years old. All Nye County roads were assumed to be rural roads with unrestricted access, and the same Clark County road distribution as used for commuter traffic was used for commercial vendors.

Table D–9 shows the 2008 mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS. Approximately 5.9 tons of criteria pollutants were emitted due to commercial vendor activities related to the NNSS in 2008. Nitrogen oxide emissions comprised the single largest amount (3.4 tons) among the criteria pollutants. About 0.068 tons of HAPs were emitted as a result of commercial vendor activities in 2008. The majority (63 percent) of emissions related to NNSS commercial vendors took place in Clark County, while about 29 percent took place in the portion of Nye County that is outside of the NNSS, and the remaining 8 percent took place on the NNSS.

Emissions from Radioactive Waste Truck Mobile Sources. The MOVES2010 (Version 20091221 for Nye County; Version 20100515 for Clark County; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic from radioactive waste transport. **Table D–10** and the following discussion contain details on the activity and vehicle data that were used in modeling the emissions. See Chapter 4, Section 4.1.3, for more details on the development of the transportation activity levels.

Table D–9 Estimated Emissions of Criteria Pollutants and Hazardous Air Pollutant from Commercial Vendors Traveling to and from the Nevada National Security Site, 2008 (tons per year)

Pollutant	*Single-Unit, Short-Haul Trucks*			
	Clark County	*Nye County*		*Total*
		Off NNSS	*On NNSS*	
PM_{10}	0.24	0.032	0.11	0.38
$PM_{2.5}$	0.22	0.029	0.10	0.35
CO	0.98	0.13	0.46	1.6
NO_x	2.2	0.277494	0.97	3.4
SO_2	0.0041	0.00051	0.0018	0.0064
VOCs	0.32	0.042	0.15	0.51
Lead	3.8×10^{-6}	5.2×10^{-7}	1.8×10^{-6}	6.1×10^{-6}
HAPs	0.042	0.0056	0.020	0.068

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table D–10 Vehicle Activity Data Used to Model Emissions from Radioactive Waste Trucks Traveling to and from the Nevada National Security Site

MOVES2010 Vehicle Type	*Count*	*Annual VMT Within Clark County*	*Annual VMT Within Nye County but Outside the NNSS*	*Annual VMT Within Nye County and Inside the NNSS*	*Percentage Annual VMT Occurring on Weekdays*	*Fuel Type Used*
Combination-unit, short-haul trucks	9 [a]	106,799	328,765	2,915	95	No. 2 diesel

MOVES2010 = Motor Vehicle Emission Simulator 2010; NNSS = Nevada National Security Site; VMT = vehicle miles traveled.

[a] The number of radioactive waste trucks was unknown. The number of multiple-axle trucks used by commercial vendors was used as a surrogate.

Note: Modeling performed using MOVES2010.

Radioactive waste transport activity was derived from the average number of transports in 2007 and 2008 and assumed origin-to-NNSS distances. After rounding to the nearest 100,000 miles to account for other special shipments that may not have been accounted for, this activity calculation resulted in an estimated 5.3 million miles driven annually within Nevada due to these transports. An estimated 0.55 percent of this mileage took place on the NNSS. A map of the seasonal routes taken by these transports was used to estimate the mileage percentages within Nye County (62 percent) and Clark County (20 percent). Radioactive waste was transported only by combination-unit trucks, and all of these trucks were assumed to use only No. 2 diesel. The lead emissions factors for mobile sources in EPA's *Air Quality Criteria for Lead* (EPA 2006) were used for estimating lead emissions for NNSS radioactive waste transport vehicles.

Radiological trucks were assumed to travel the preferred transportation routes through Nevada when transporting radioactive waste. MOVES default fuel supply market shares, meteorology, vehicle speed distribution, and monthly and hourly VMT distributions were used in estimating emissions. Only running exhaust, brake wear, and tire wear were modeled. As was done for onsite government vehicles and commercial vendors, combination-unit, short-haul trucks were assumed to have an average age of 11 years. All Clark County and Nye County roads on the seasonal routes taken by these transports were assumed to be rural roads with unrestricted access.

Table D–11 shows the modeled current (approximately 2008) mobile emissions of criteria pollutants and HAPs associated with radioactive waste transport to and from the NNSS. Approximately 13.4 tons of criteria pollutants were emitted due to radioactive waste truck activities related to the NNSS in 2008. Nitrogen oxides were the largest single pollutant at (9.6 tons). Approximately 0.058 tons of HAPs were emitted as a result of radioactive waste truck activities related to the NNSS in 2008. The majority (75 percent) of emissions related to NNSS radioactive waste trucks took place in the portion of Nye County that is outside of the NNSS, while about 25 percent took place in Clark County, and the remaining percentage (less than 1 percent) took place on the NNSS.

Table D–11 Estimated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the Nevada National Security Site, 2008 (tons per year)

	Combination-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.17	0.51	0.0046	*0.68*
$PM_{2.5}$	0.16	0.48	0.0042	*0.64*
CO	0.67	2	0.018	*2.7*
NO_x	2.3	7.2	0.064	*9.6*
SO_2	0.0033	0.01	0.000088	*0.013*
VOCs	0.11	0.33	0.0029	*0.44*
Lead	2.2×10^{-6}	1.9×10^{-6}	1.7×10^{-9}	4.1×10^{-6}
HAPs	0.014	0.044	0.00038	*0.058*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Measurements of Ambient Air Concentrations on the NNSS. The monitored concentrations cannot be directly compared with the standards because the standards use calendar years and some of the standards use other statistics and time periods as part of their calculation. However, given that the monitored concentrations presented in Chapter 4, Table 4–38, are maximum observed concentrations for their respective time periods, and given that none of them exceeded the ambient air quality standards, these monitored concentrations demonstrate that the area is attaining the air quality standards. Listed below are summary concentration statistics from the YMP1 station for the period from October 1991 through September 1995, compared directly with the standard concentration values (ignoring the above comparison issues):

- The maximum 1-hour carbon monoxide concentration was 0.2 parts per million, which is less than 1 percent of the National Ambient Air Quality Standards (NAAQS) value (35 parts per million).

- The maximum 8-hour carbon monoxide concentration was 0.2 parts per million, which is 2 percent of the Nevada standard value for elevations below 5,000 feet (9 parts per million; the YMP1 monitoring station is about 4,000 feet above mean sea level).

- The maximum October-to-September annual nitrogen dioxide concentration was 0.00214 parts per million, which is 4 percent of the NAAQS value (0.053 parts per million).

- The maximum 1-hour ozone concentration was 0.096 parts per million, which is 80 percent of the NAAQS value (0.120 parts per million; this NAAQS is no longer in effect).

- The maximum 3-hour, 24-hour, and September-to-October annual concentrations of sulfur dioxide were all 0.002 parts per million, which are less than 1 percent, 1 percent, and 7 percent of the 3-hour, 24-hour, and annual NAAQS values (0.5, 0.14, and 0.03 parts per million), respectively.

Ozone was the only gaseous criteria pollutant to routinely register ambient levels above the instrument threshold. Ozone levels never exceeded the regulatory limit for the 1-hour average standard (0.12 parts per million by volume). The 1-hour average standard was withdrawn in 2005, and has now been replaced with an 8-hour average standard (0.075 parts per million). Ozone is formed in the atmosphere under the presence of sunlight, nitrogen oxides, and volatile organic compounds. Ozone typically has the highest concentrations during warm weather because strong sunlight and high temperatures are more conducive to higher ambient concentrations. Approximately 90 percent of the warm-season hours had concentrations between 0.020 and 0.060 parts per million; only 44 hours had concentrations in excess of 0.080 parts per million.

No ambient monitoring data were available for lead. However, the U.S. Department of Energy (DOE) expects concentrations of lead to be far below the regulatory standard because there are no industrial sources in the region of influence (or near enough to transport this contaminant into the region of influence), and lead-based gasoline, previously the principal source of lead in the air, has been phased out.

Some annual statistics on observed ambient PM_{10} concentrations at the YMP1, YMP5, YMP6, and YMP9 monitoring stations from 1989 through 2005 are shown in Chapter 4, Table 4–39. This table also shows the NAAQS or Nevada Ambient Air Quality Standards (whichever one is lower) that were in place at the time of monitoring. Note, however, that the air quality standards are not as restrictive as just the highest concentration. For example, the 24-hour PM_{10} standard is not to be exceeded more than once on average over 3 years and the annual PM_{10} standard is the 3-year weighted average PM_{10} concentration. However, these observed concentrations in Table 4–39 do demonstrate compliance with the current 24-hour PM_{10} standard as none of these concentrations exceed the ambient air quality standards. Listed below are some summary concentration statistics from these monitoring stations for the period from 1989 through 2005, compared directly with the air quality standard concentration values (ignoring the above comparison issues):

- The largest 24-hour averaged value observed across these 17 years and 4 monitoring stations was 67 micrograms per cubic meter (at the YMP5 station in 1995), or 45 percent of the NAAQS value (150 micrograms per cubic meter).
- Across the observations for these 17 years and 4 monitoring stations, 41 percent of the annual largest 24-hour averaged values were less than 20 percent of the NAAQS value (150 micrograms per cubic meter).
- The largest annual averaged value observed was 13 micrograms per cubic meter (at the YMP5 station in 1989), or 26 percent of the Nevada Ambient Air Quality Standard value.
- Across the observations for these 17 years and 4 monitoring stations, 54 percent of the annual averaged values were less than 20 percent of the Nevada Ambient Air Quality Standard value for PM_{10}.

No ambient monitoring data were available for $PM_{2.5}$; however, because $PM_{2.5}$ is a subset of PM_{10}, $PM_{2.5}$ can be estimated from measurements of ambient PM_{10}. In the region of influence, most of the PM_{10}

would be generated from the resuspension of surface-level soil and mineral materials with some additional PM_{10} from fuel combustion. A U.S. Department of Agriculture study on wind erosion in the western United States found that over all soils, the fraction of PM_{10} as $PM_{2.5}$ was about 15 percent, ranging from 10 to 30 percent (Hagen 2001). To be conservative, DOE applied the upper end of this range (30 percent) to the ambient PM_{10} data collected in Area 25 (the YMP1, YMP5, and YMP9 stations) over the past 8 years (1998 through 2005), and the resulting data indicated the highest expected 24-hour concentration of $PM_{2.5}$ would be 16 micrograms per cubic meter, and the highest expected annual average concentration would be 4 micrograms per cubic meter. These numbers are 46 and 26 percent of the ambient air quality standards for $PM_{2.5}$.

Modeling of Ambient Air Concentrations on and near the NNSS. Because the NNSS covers some 1,360 square miles, ambient air quality monitoring on the prevailing upwind side of the NNSS (Area 25) may not capture emission impacts from onsite sources. The majority of routine emission sources is concentrated in Areas 6 and 23 and is associated with sand and aggregate processing and fuel-burning, as shown in Table D–3. Impacts from those emissions are small and will likely have little effect on the ambient air quality. However, emissions from other sources (e.g., explosives testing) occur infrequently, but produce high concentrations for short periods. **Figure D–4** shows the locations of the emissions associated with these open detonations: Areas 4 (BEEF), 5 (NPTEC), 11 (EODU [Explosives Ordnance Disposal Unit]), 14 (HEST [High Explosive Simulation Technique] test range), 25 (Test Cell C), and 26 (Port Gaston).

Modeling Methodology. As part of an environmental evaluation for the NNSS Class II Air Quality Operating Permit AP9711-0549.01 (DOE 2009b), dispersion modeling was conducted in 2009 to estimate the air quality impacts from non-explosive emission sources and from explosives testing at the NNSS. Two EPA-approved models – AERMOD and OBODM [Open Burn/Open Detonation Model] – were used to model the non-explosive sources and the detonation activities, respectively.

For the NNSS Class II Air Quality Operating Permit modeling support study, AERMOD was run with many non-explosive stationary sources throughout the NNSS, including industrial sources and storage tanks. AERMOD was run without deposition to conservatively model the air concentration. The AERMOD modeling used 3,785 receptors surrounding the NNSS boundary, forming a 1.5-mile buffer around the NNSS boundary at a spacing of about 0.31 miles (500 meters). The receptors are shown in Figure D–4, but the non-explosive stationary sources are not shown.

OBODM was run for six explosive test sites in the NNSS. The OBODM modeling for the Permit used 1,203 receptors – some were placed at discrete locations along the NNSS boundary, and some were placed east of the NNSS boundary out to a distance of about 3.7 miles at a spacing of about 0.31 miles (500 meters). These eastern receptors were chosen because they are predominantly downwind from the detonation operations.

For this site-wide environmental impact statement (SWEIS), several supplementary OBODM model runs were performed to estimate particulate matter concentrations (not done in the permit support study) at locations accessible to the public (i.e., the Nevada Test and Training Range boundary downwind from the detonation operations) for the baseline affected environment conditions and for the future environmental consequences conditions. The public has access to areas along the southern border of the NNSS. Otherwise, the public's closest approach is along the border of the Nevada Test and Training Range. The Nevada Test and Training Range effectively creates a public access buffer zone of up to 30 miles beyond the northern, western, and eastern NNSS boundaries. The receptors used in the OBODM runs are shown in Figure D–4.

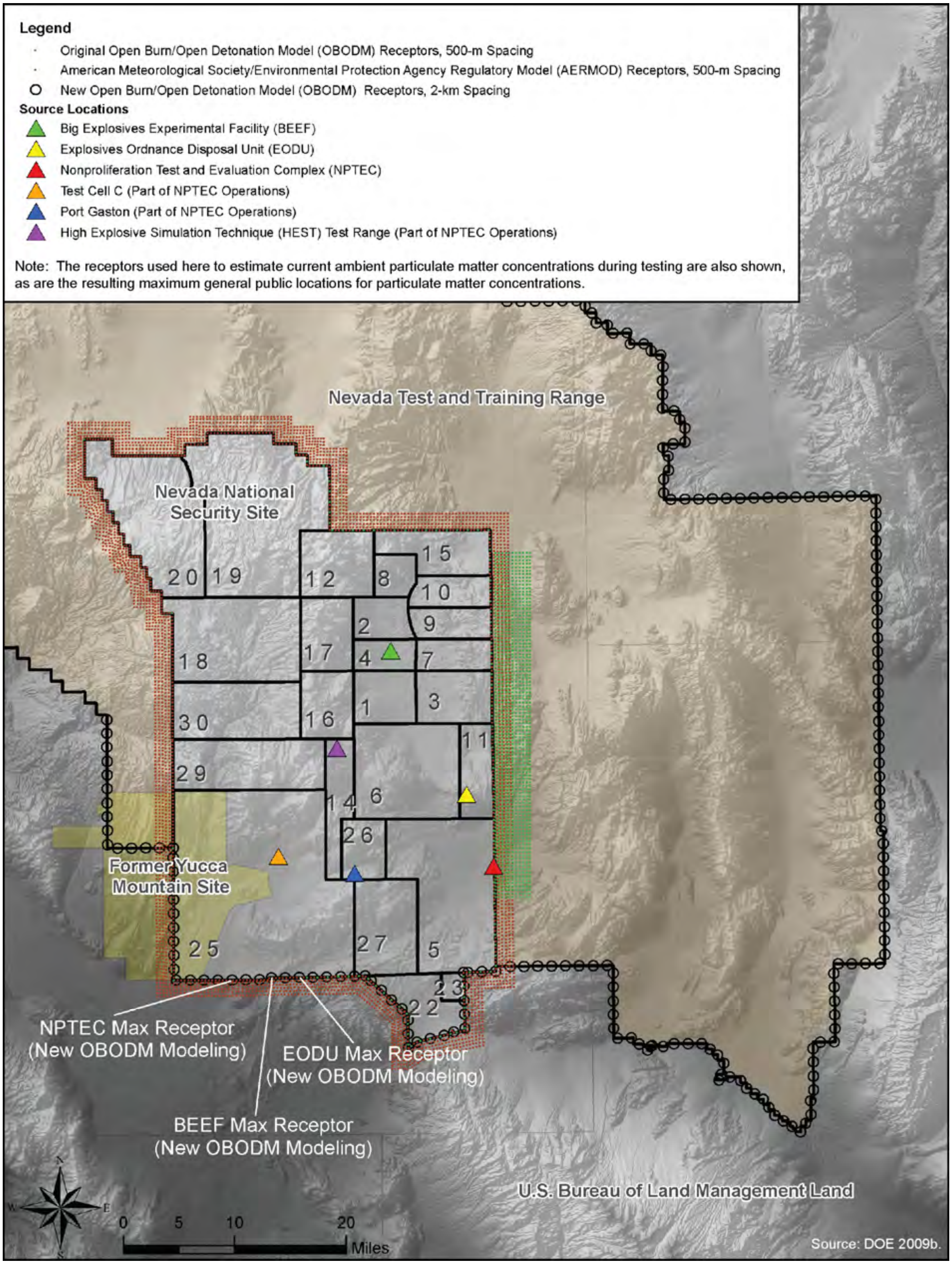


Figure D–4 Locations of the Open-Air Detonation Locations Modeled for the Nevada National Security Site Class II Air Quality Operating Permit (AP9711-0549.01)

AERMOD and OBODM use a suite of hourly meteorological data for years 2003-2007 to simulate dispersion of emissions in the atmosphere. The most complete set of hourly meteorological data is collected at the first order weather station at Desert Rock located on the southern side of the NNSS at 36.6241 degrees north, 116.0192, degrees west, and 3,300 feet (1,000 m) elevation above mean sea level. Both surface and upper air meteorological data are collected at the site and are consistent with the requirements for both models. The surface meteorological dataset contains wind direction and wind speed, temperature and sky cover. Surface temperature data are collected at 6.6 feet (2 meters) above ground level, and surface wind data are collected at 32.8 feet (10 meters). Very little surface data were missing or invalid. For OBODM modeling, wind speeds exceeding 34.4 feet per second (10.5 meters per second) were set to 0 feet per second because detonations would not take place during such high wind speeds and OBODM does not calculate concentrations during calm hours (i.e., when wind speeds are 0). For upper-air data, beginning in early 2005, upper-air data was not collected on weekends and holidays due to budget constraints, and no data substitutions were made because the next closest upper-air station was too far away. In regards to the surface data some differences are found in surface wind patterns within the NNSS (Figure 4-18, Soule, 2006) however, the nature of these elevated releases tend to minimize the differences particularly for the relatively long transport distances to the nearest off-site receptors.

The modeling analysis for the BEEF assumed a maximum emission rate that occurred once daily, that is, one detonation of 21.5 tons of explosives at 9 a.m. daily and then repeated each day. This same approach was used in the Nevada National Security Site Class II Air Quality Operating Permit AP9711-0549.01. This modeling was performed daily over the five year of meteorological data (2003-2007) to determine the maximum downwind concentration. These maximum concentrations are the explosive source result reported in **Table D–12**. For detonations at EODU, hourly detonations of 100 pounds of explosives were modeled to occur from 0800 LT through 1500 LT as long as the wind speed remained below 23.5 miles per hour. For the NPTEC the modeling analysis assumed a worst-case scenario that is a single detonation of 1 ton of explosives per day at 9 a.m.

Table D–12 Particle Mass Distribution per Particle Size Used in Open Burn/Open Detonation Modeling

Permit Modeling		***New Modeling for This SWEIS***	
Particle Diameter Interval (micrometers)	***Mass Fraction of Total PM_{10} Mass***	***Particle Diameter Interval (micrometers)***	***Mass Fraction of Total PM_{10} Mass (Mass Fraction of Total $PM_{2.5}$ Mass)***
4 to 5	0.033	0.21 to 0.24	0.00001 (0.00011)
5 to 6	0.126	0.24 to 0.33	0.00007 (0.00075)
6 to 7	0.341	0.33 to 0.46	0.00026 (0.00298)
7 to 8	0.341	0.46 to 0.64	0.00098 (0.01111)
8 to 9	0.126	0.64 to 0.89	0.00309 (0.03507)
9 to 10	0.033	0.89 to 1.23	0.00846 (0.09596)
		1.23 to 1.72	0.02066 (0.23442)
		1.72 to 2.28	0.03582 (0.40643)
		2.28 to 2.50	0.01879 (0.21317)
		2.50 to 2.65	0.01091 (N/A)
		2.65 to 3.34	0.10200 (N/A)
		3.34 to 4.66	0.14923 (N/A)
		4.66 to 6.49	0.22742 (N/A)
		6.49 to 8.76	0.27830 (N/A)
		8.76 to 10	0.14400 (N/A)

N/A = not applicable; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers.
Source: DoD 2004; Pinnick et al. 1983.

Listed below are other important parameter settings used in the OBODM modeling. Some details about the environmental consequences scenarios are also shown. Note that the OBODM modeling for the Air Quality Permit study only modeled PM_{10}. For the supplementary OBODM modeling performed for this SWEIS, $PM_{2.5}$ was also modeled. Some details about the $PM_{2.5}$ modeling are shown in the list below, and $PM_{2.5}$ is discussed further in the text following the list.

- No depletion from gravitational deposition
- Final cloud-rise height used for all calculations
- Flat terrain, where receptor heights greater than zero are treated as flag poles
- Use both stable and adiabatic plume rise
- Let OBODM calculate: particulate matter settling velocity, reflection coefficient, source effective release height above ground, diameter of initial source material immediately after detonation, wind speed power law, lateral turbulence intensity, vertical turbulence intensity, alongwind turbulence intensity, vertical potential temperature gradients, wind speed shear, and pasquill stability category calculated by OBODM
- Standard deviations of wind direction angle and wind elevation angle calculated by OBODM using internal lookups and defaults at 600-s measuring time
- Calm wind or missing hours have no dispersion or deposition
- If short term wind averages have less than 75 percent valid (non-calm non-missing) hours, use EPA guideline of 75 percent of the possible hours rounded up to the nearest integer
- 24-hour concentration averaging time
- Fuel Heat Content 1000 cal/g
- Fuel Burn Time 2.5s
- Particulate Matter Molecular Weight 90.68 g/g-mol
- Particulate Matter Density of Species 2.05 g/cm^3
- BEEF:
  - 1 instantaneous volume source
  - PBXN-110 Propellant
  - X Coordinate (UTM 11N): 580601 meters, Y Coordinate (UTM 11N): 4105930 meters, Flagpole: 106.6 feet (35.2 meters)
  - Fraction of exhaust cloud constituting pollutant/species: PM_{10} = 0.49, $PM_{2.5}$ = 0.043169
- EODU:
  - 1 instantaneous volume source
  - 0.38 Special Cartridges
  - X Coordinate (UTM 11N): 591532 meters, Y Coordinate (UTM 11N): 4085260 meters, Flagpole 15.4 feet (4.7 meters)
  - Fraction of exhaust cloud constituting pollutant/species: PM_{10} = 0.057, $PM_{2.5}$ = 0.005016

- NPTEC:
  - 4 instantaneous volume sources
  - C-4 Demo Charges
  - 1. NPTEC: X Coordinate (UTM 11N): 595470 meters, Y Coordinate (UTM 11N): 4074879 meters, Flagpole 41.7 feet (12.7 meters)
  - 2. Test Cell C: X Coordinate (UTM 11N): 564419 meters, Y Coordinate (UTM 11N): 4076329 meters, Flagpole 41.7 feet (12.7 meters)
  - 3. Port Gaston: X Coordinate (UTM 11N): 575407 meters, Y Coordinate (UTM 11N): 4073895 meters, Flagpole 41.7 feet (12.7 meters)
  - 4. HEST: X Coordinate (UTM 11N): 572869 meters, Y Coordinate (UTM 11N): 4091869 meters, Flagpole 41.7 feet (12.7 meters)
  - Fraction of exhaust cloud constituting pollutant/species: $PM_{10} = 0.021$, $PM_{2.5} = 0.001848$

The particle mass size distribution used in the Permit modeling (shown in Table D–12) was not used in this analysis because the earlier modeling had assumed none of the particles had a mean aerodynamic diameter smaller than 4 micrometers since the permitting was focused only on PM_{10}. A study by Pinnick et al. (1983) examined several different types of high explosives detonated in a variety of soil types, including sand to silty sand soil as found at the NNSS. The study found that the post explosion particles ranged in mean particle diameter from 0.2 micrometers to larger than 200 micrometers. The study found that the particulate size mass distributions were similar across explosive material and soil types, and that the distributions were both bimodal and lognormal. Based on this information (Pinnick et al. 1983), an equation of two lognormal probability density functions was developed to describe the mass fraction as a function of mean particle diameter (DoD 2004) with the characteristic bimodal distribution. Integrating this equation across the particulate diameters yields the particulate mass fractions as shown in Table D–12 for PM_{10} and $PM_{2.5}$. Note that $PM_{2.5}$ makes up only 8.8 percent of PM_{10} by mass.

Other conservative modeling assumptions include the following: (1) 100 percent of nitric oxide was assumed to be converted into nitrogen dioxide in AERMOD modeling and (2) total pollutant concentrations attributable to NNSS sources were evaluated by adding together the highest calculated concentrations from AERMOD and OBODM, without coupling the concentrations in either time or space.

For this SWEIS, the background concentrations used in the Permit were updated to be based on the Area 25 monitoring data. Measurements taken at the YMP9 and YMP1 stations from 1998 through 2005 (DOE 2008d) show that the PM_{10} 24-hour average background concentration is 39 micrograms per cubic meter using the second highest high PM_{10} concentration, which approximates the PM_{10} exceedance-based standard, which allows no more than one exceedance per year on average across 3 years. The carbon monoxide, sulfur dioxide, and nitrogen dioxide background concentrations were the largest monitored concentrations shown in Chapter 4, Table 4–38.

Results of Permit Modeling. Table D–11 presents these maximum modeled concentrations of carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}. These concentrations are only from the Permit modeling (does not include the supplementary OBODM runs made for this SWEIS), and they include the above update to background concentrations. **Table D–13** also shows the current (2009) NAAQS and Nevada Ambient Air Quality Standards. As shown in Table D–13, all of the maximum modeled concentrations of carbon monoxide, nitrogen dioxide, and sulfur dioxide were significantly smaller than the ambient air quality standards. Due to the explosives detonations, the maximum modeled PM_{10} concentration exceeded the ambient air quality PM_{10} standard by a large margin in areas beyond the eastern border of the NNSS. The maximum distance beyond the eastern border of the NNSS at which the PM_{10} standard was exceeded was 4.3 miles. However, this location is entirely within the non-public access area (Nevada Test and Training Range) of the Desert National Wildlife Refuge.

Table D–13 Dispersion Modeling Results from all Nevada National Security Site Stationary, Fugitive, and Detonation Sources (micrograms per cubic meter)

					Nonexplosive Sources	*Explosive Sources*	
Pollutant	***Averaging Period***	***NAAQS*** [a]	***Nevada AAQS*** [a]	***Background Concentration*** [a]	***Maximum Concentration*** [a]	***Maximum Concentration*** [a]	***Total Maximum Concentration*** [a] ***(percentage of NAAQS, percentage of Nevada AAQS)***
CO	1-hour	40,000 [b]	40,500 [b]	229	41	< 1,007	< 1,277 (<3.2%, <3.2%)
	8-hour	10,000 [b]	10,500 [b,c]	229	10	< 137	< 376 (<3.8%, <3.6%)
NO_2	Annual	100 [d]	100 [d]	4.0	16 [e]	< 3.0 [e]	< 23 [e] (<23%, <23%)
PM_{10}	24-hour	150 [f]	150 [f]	39	5	< 4,013	< 4,057 (<2,163%, <2,163%)
SO_2 [g]	3-hour	1,300 [b]	N/A	5.2	6.3	< 6.4	< 17.9 (<1.4%, N/A)
	24-hour	365 [b]	365 [b]	5.2	1.1	< 0.66	< 7.0 (<1.9%, <1.9%)
	Annual	80 [d]	80 [d]	5.2	1.1 [e]	< 0.66 [e]	< 7.0 [e] (<8.8%, <8.8%)

< = less than; AAQS = Ambient Air Quality Standards; CO = carbon monoxide; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 micrometers; SO_2 = sulfur dioxide.

[a] Concentration units are micrograms per cubic meter. To convert micrograms per cubic meter to parts per million, multiply micrograms per cubic meter by 0.024465 and divide by the molecular weight at 760 millimeters mercury and 25 degrees Centigrade).

[b] Not to be exceeded more than once per year.

[c] For locations below 5,000 feet above mean sea level.

[d] Not to be exceeded.

[e] Maximum 24-hour average.

[f] Not to be exceeded more than once per year on average over 3 years.

[g] There is no 3-hour SO_2 Nevada Ambient Air Quality Standard.

Source: Based on data from DOE 2009b: App. 7, Table 7-1.

Results of Supplementary OBODOM Modeling Performed for This SWEIS: For areas where the public has access, worst-case activities at BEEF activities produced the highest modeled PM_{10} concentrations, but these concentrations were below the PM_{10} NAAQS value. The maximum modeled 24-hour average PM_{10} concentration was 62 micrograms per cubic meter (April 12, 2007; along southern border of Area 25 – see Figure D–4; X Coordinate (UTM 11N): 563420 meters, Y Coordinate (UTM 11N): 4058840 meters), which, even when combined with the maximum background concentration of 39 micrograms per cubic meter, is well below the Nevada Ambient Air Quality Standards value of 150 micrograms per cubic meter. The maximum modeled 24-hour average PM_{10} concentration associated with activities at NPTEC was about 8 micrograms per cubic meter (April 12, 2007; along southern border of Area 25 – see Figure D–4; X Coordinate (UTN 11N): 557729 meters, Y Coordinate (UTM 11N): 4058503 meters); for the Explosives Ordnance Disposal Unit, the corresponding concentration was less than 1 microgram per cubic meter(February 11, 2005; along southern border of Area 25 – See Figure D–4; X Coordinate (UTM 11N): 567419 meters, Y Coordinate (UTM 11N): 4058854 meters).

For areas where the public has access, worst-case BEEF activities produced the highest modeled $PM_{2.5}$ concentrations, but these concentrations were also below the NAAQS values. The maximum modeled

24-hour average $PM_{2.5}$ concentration was 11 micrograms per cubic meter (same date and location as with PM_{10} above), which, when combined with a maximum background concentration of 12 micrograms per cubic meter, is below the NAAQS value of 35 micrograms per cubic meter. The maximum modeled 24-hour average $PM_{2.5}$ concentrations due to worst case NPTEC and Explosives Ordnance Disposal Unit activities were each less than 1 microgram per cubic meter (same dates and locations as with PM_{10} above). Even if all three activities took place at the same time, their combined concentration would be less than the $PM_{2.5}$ NAAQS value of 35 micrograms per cubic meter. The maximum modeled annual average $PM_{2.5}$ concentration was less than 1 microgram per cubic meter, which adds little to the $PM_{2.5}$ annual background concentration of 3.6 micrograms per cubic meter. The $PM_{2.5}$ annual average NAAQS value is 15 micrograms per cubic meter.

Ozone was not modeled as part of the air permit evaluation for this *NNSS SWEIS*, but it is generally recognized as a regional-scale air quality problem. Ozone is formed in the atmosphere under the presence of sunlight, nitrogen oxides, and volatile organic compounds. The emissions of nitrogen oxides (a precursor to ozone formation) and volatile organic compounds at the NNSS are less than 50 tons per year (see Table D–3) and are small relative to the existing regional emissions of nitrogen oxides and volatile organic compounds. Further, these emissions are considerably less than the conformity emission threshold levels of 100 tons per year for nitrogen oxides and volatile organic compounds. These threshold emission levels were set small enough as to not create a measurable impact on ozone levels. Thus, current emissions at the NNSS are not anticipated to increase downwind ozone concentrations beyond the measured ozone concentrations, which are well below the ozone air quality standard.

D.1.1.2.2 Radiological Air Quality

This section expands the radiological air quality discussion presented in Chapter 4, Section 4.1.8.3, of this SWEIS.

The locations of the ambient radiological monitoring stations on and surrounding the NNSS are discussed in Section D.1.1.3.1. The locations of potential radiation emissions on the NNSS and the types of activities that might produce them are discussed in Section D.1.1.3.2. The recent radiation concentrations and exposure levels are discussed in Section D.1.1.3.3.

D.1.1.2.2.1 Ambient Radiological Monitoring on and near the Nevada National Security Site

On the NNSS, six of the 16 monitoring stations established by DOE that monitor ambient tritium (hydrogen-3) levels are considered "critical receptors." These "critical receptors" are approved to monitor levels of various radionuclides for National Emission Standards for Hazardous Air Pollutants (NESHAPs) compliance. The radiological monitoring network overall indicates that levels of americium-241; plutonium-238, -239, and -240; cesium-137; strontium-90; and tritium on the NNSS have been well below the NESHAPs concentration levels since the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)*. More details about radiation detected at NNSS locations are provided in Section D.1.1.3.3.

The Desert Research Institute of the Nevada System of Higher Education runs the Community Environmental Monitoring Program (CEMP), which constitutes an offsite nonregulatory network of environmental air and radiation monitoring stations across southern Nevada, southeastern California, and southwestern Utah. These monitoring stations measure penetrating gamma radiation using thermoluminescent dosimeters, gamma radiation exposure rates using pressurized ion chamber detectors, gross alpha and beta radioactivity in airborne particulates using low-volume particulate air samplers, and meteorological data (DOE 2009b). Alpha and beta particles and gamma rays all occur naturally, but they can be proxies for manmade nuclear activity when detected above certain levels. Alpha particles are usually emitted by decaying uranium isotopes, beta particles are usually emitted as atomic decay products of nuclear fission, and gamma rays occur with alpha and beta particle emissions when certain radionuclides transition to a lower energy state (DOE 2009b, 2009d). More details about the radiation detected at CEMP locations are provided in Section D.1.1.3.3.

D.1.1.2.2.2 Sources of Radiation on the Nevada National Security Site

Between 1951 and 1992, 100 atmospheric and 828 underground nuclear tests were conducted on the NNSS (DOE 2009d). Nuclear testing ended in 1992; since then, the NNSS radiation monitoring has focused on detecting airborne radionuclides from historically contaminated soils. Other than soil resuspension and evapotranspiration of historical radionuclides, as discussed in the main body of the SWEIS, some activities on and near the NNSS still involve radioactive materials. Some special research projects, analytical laboratory operations, Environmental Restoration Program projects, and Borehole Management projects may involve radioactive materials and may result in measurable air emissions of radionuclides. More-specific activities on the NNSS that involve radioactive materials and possible air releases of radionuclides in recent years include the following (DOE 2009d):

- Disposal of tritium-contaminated water removed from the sump well below Building A-1 of the offsite North Las Vegas Facility (NLVF) on the NNSS
- Underground Testing Area Project pumping of tritium-contaminated water to the surface from wells used to characterize the aquifers at the sites of past underground nuclear tests
- Pulsed neutron generator activities that can release tritium at the Dense Plasma Focus Facility (in Area 11)
- Dynamic experiments and hydrodynamic tests that may release tritium and depleted uranium at BEEF (in Area 4)
- Radioactive waste management, including the Area 3 RWMS and Area 5 Radioactive Waste Management Complex, from which measurable tritium releases have been detected
- Operations at the Radiological/Nuclear Countermeasures Test and Evaluation Complex (in Area 6)
- Subcritical experiments at the U1a Complex (in Area 1)
- Handling, transport, storage, and assembly of radioactive targets for the Joint Actinide Shock Physics Experiment Research gas gun (in Area 27)

Accidental or unplanned air releases of radiation are infrequent on the NNSS. Since 1997, such releases have only occurred on the NNSS in 2008, when contaminated debris was carried beyond two control boundaries. In one case, the contaminated area was blocked off, contaminated debris was recovered, and a corrective policy was implemented to ensure that highly contaminated waste is only generated when it can be immediately disposed of. In the other case, the debris was marked and the original contamination area was extended to include the debris (DOE 2009d).

D.1.1.2.2.3 Radiation Levels on and near the Nevada National Security Site

Table D–14 presents the estimated air emissions of radionuclides on the NNSS for the period from 1997 through 2008. The 1993 estimates that were cited in the *1996 NTS EIS* are also shown. These estimates are presented in each year's NNSS environmental report and are used in estimations of equivalent exposure. The methods used to estimate these air emissions included the use of annual field and water monitoring data, historical soil inventory data, and accepted soil resuspension and air transport models (DOE 2009d).

Table D–14 Annual Estimated Air Releases of Radionuclides on the Nevada Nuclear Security Site, 1997–2008 (curies) [a,b]

	1993 (presented in the 1996 NTS EIS)	***1997***	***1998***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
Tritium	708	160	297	362.7	431	564	290	314	560	170	245	550	440
Krypton-85 [c]	160	--	--	--	--	--	--	--	0	0	0	0	0
Plutonium (unspecified isotopes)	0.0018	--	--	--	--	--	--	--	--	--	--	--	--
Plutonium-238	--	0.0000015	0.0000043	0.0000055	~0	~0	~0	~0	~0	~0	~0	0.054	0.05
Plutonium-239 and -240	--	0.280034	0.240038	0.240048	0.32	0.32	0.29	0.29	0.29	0.29	0.29	0.32	0.29
Strontium-90	--	0.000015	0.000024	0.000032	--	--	~0	~0	0	~0	~0	~0	~0
Cesium-137	--	0.0017	0.0015	0.0041	~0	~0	~0	~0	~0	~0	~0	~0	~0
Americium-241	--	--	--	--	0.049	0.049	0.047	0.047	0.047	0.047	0.047	0.047	0.047
Reference	DOE 1996, page 4-150 (from DOE 1994)	DOE 1998, page 1-11	DOE 1999, page 1-12	DOE 2000, page 1-13	DOE 2001, page 1-11	DOE 2002, page 1-11	DOE 2003, page 1-10	DOE 2004, page ES-14	DOE 2005, page 3-21	DOE 2006, page iii	DOE 2007, page v	DOE 2008c, page v	DOE 2009d, page v

[a] Assumes worst-case point and diffuse source releases, including evaporation from containment ponds. Includes calculated data from air sampling results, postulated loss of laboratory standards, and calculated resuspension of surface deposits.

[b] "~0" indicates that observed concentrations were greater than the minimum detectable concentration only a small number of times or not at all, and/or the concentrations contributed less than 10 percent towards the dose estimated to be received by the maximally exposed public individual. "--" indicates that the air emissions of the radionuclide were not mentioned in the reference as contributing towards the official radionuclide air emissions estimation.

[c] Krypton was no longer monitored on site beginning in 1998 since there are no detectable emissions.

Table D–15 shows maximum observed and maximum annual averaged radionuclide concentrations at the six critical receptors for reporting years 2002 through 2008. Years prior to 2002 are not shown because the six critical receptors were chosen in the middle of 2001. The averaging periods for each radionuclide are also shown; tritium is sampled for 26 2-week periods per year, while the other radionuclides are sampled for 1 1-week period per month. So, for example, the maximum observed concentration of plutonium-238 presented in Table D–15 was one of the 12 1-week average values observed in 2006 at the 3545 Substation, and the maximum annual averaged observed concentration of plutonium-238 was the average of the 12 1-week average values observed in 2008 at the Schooner monitoring station.

Table D–15 Comparison of Observed Concentrations of Radionuclides on the Nevada National Security Site at the Six Critical Receptors Used for NESHAPs Compliance with NESHAPs Concentration Levels, 2002-2008

Radionuclide (averaging period; maximum number of annual samples)	*Maximum Observed Concentration*	*Year and Location of Observation*	*Maximum Annual Average Observed Concentration*	*Percentage of NESHAPs CL*	*Year and Location of Maximum*	*Reference*
Tritium (2 weeks; 26 annual samples)	$1,228 \times 10^{-6}$ pCi/mL	2006, Schooner (in Area 20)	434×10^{-6} pCi/mL	29	2002, Schooner (in Area 20)	DOE 2007, page 3-13; DOE 2003, page 2-14
Plutonium-238 (1 week; 12 annual samples)	32×10^{-18} µCi/mL	2006, 3545 Substation (in Area 16)	5×10^{-18} µCi/mL	<1	2008, Schooner (in Area 20)	DOE 2007, page 3-8; DOE 2009d, page 3-8
Plutonium-239 and -240 (1 week; 12 annual samples)	640×10^{-18} µCi/mL	2007, Gate 700 S (in Area 10)	59×10^{-18} µCi/mL	3 [a]	2007, Gate 700 S (in Area 10)	DOE 2008b, page 3-9
Cesium-137 (1 week; 12 annual samples)	48×10^{-16} µCi/mL	2004, Mercury Track (in Area 23)	9×10^{-16} µCi/mL	5	2004, Mercury Track (in Area 23)	DOE 2005, page 3-8
Americium-241 (1 week; 12 annual samples)	106×10^{-18} µCi/mL	2007, Gate 700 S (in Area 10)	12×10^{-18} µCi/mL	<1	2007, Gate 700 S (in Area 10)	DOE 2008b, page 3-6

< = less than; µCi/mL = microcuries per milliliter; CL = concentration level; NESHAPs = National Emission Standards for Hazardous Air Pollutants; pCi/mL = picocuries per milliliter.

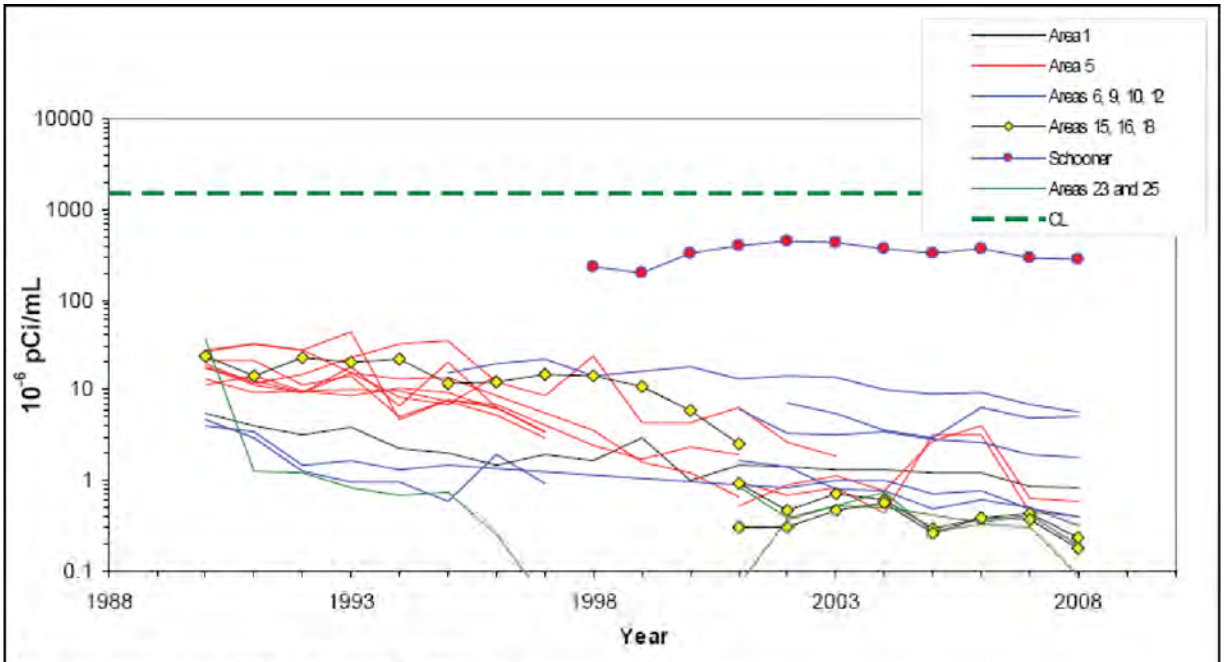
[a] For plutonium-239 and -240, the NESHAPs CL is for plutonium-239 only. Analytical methods cannot distinguish between plutonium-239 and plutonium-240.

Note: The averaging period for each concentration observation is shown in the first column.

As shown in Table D–15, the maximum annual averaged tritium concentration among the six critical receptors from 2002 through 2008 was about 434×10^{-6} picocuries per milliliter, which was 29 percent of the NESHAPs concentration level. Although the maximum observed 2-week averaged concentration cannot be compared to the NESHAPs concentration level for regulatory purposes, it is noteworthy that even the maximum concentration ($1,228 \times 10^{-6}$ picocuries per milliliter) was still only 82 percent of the NESHAPs CL. The maximum sampled tritium concentration always occurred at the Schooner monitoring station (in Area 20).

Figure D–5 shows the annual mean concentrations of tritium from 1990 through 2008 measured in many of the NNSS areas with long-term measurement histories. At most locations, tritium levels have been decreasing steadily, with an average rate of decline of 14 percent among all stations except Schooner. At Schooner (in Area 20), the tritium levels seem directly related to temperature and precipitation trends.

The increased tritium levels at Schooner is a result of much higher readings during the dry hot summer months when the movement of relatively deep soil moisture containing high concentrations of tritium migrates to the surface. The data also suggests that seasonal precipitation and recharge from below plays a role in maintaining the higher levels over time. All of these mean tritium concentrations are below the tritium NESHAPs concentration level, which is also shown in the figure.



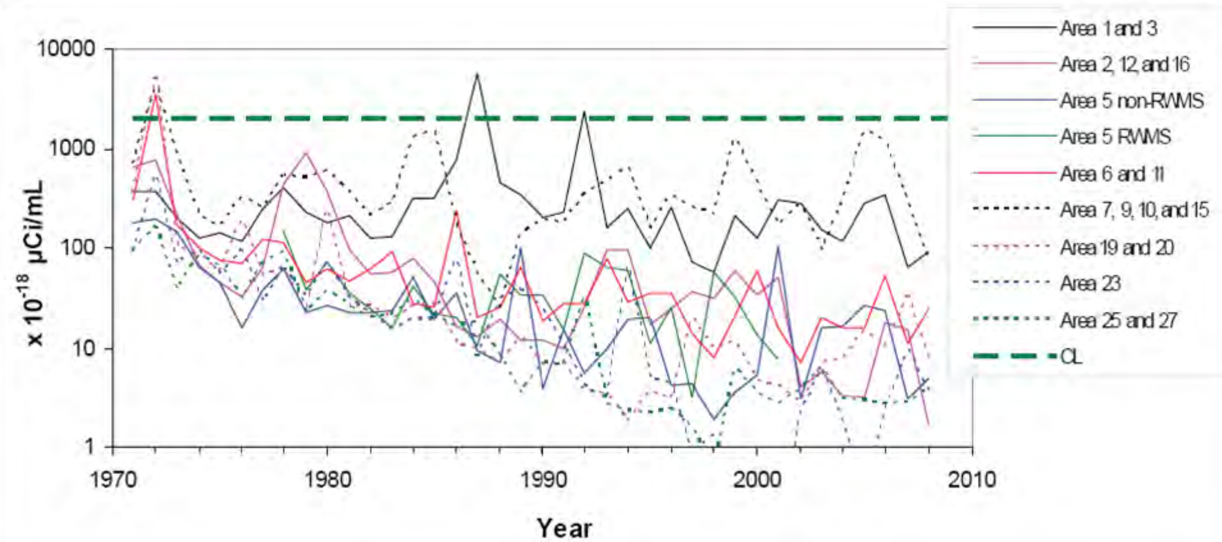
CL = concentration level; pCi/mL = picocuries per milliliter.
Note: Data are presented on a logarithmic scale. Data before 1999 have been adjusted to compensate for sampling method changes. The tritium National Emission Standards for Hazardous Air Pollutants concentration level is also shown (green, dotted line).
Source: DOE 2009d

Figure D–5 Annual Mean Tritium Concentrations in Nevada National Security Site Areas with Long-Term Measurement Histories

As shown in Table D–15, the maximum annual averaged plutonium-238 concentration among the six critical receptors from 2002 through 2008 was about 5×10^{-18} microcuries per milliliter, which is less than 1 percent of the NESHAPs concentration level. Although the maximum observed 1-week averaged concentration cannot be compared to the NESHAPs concentration level for regulatory purposes, it is noteworthy that even the maximum concentration (32×10^{-18} microcuries per milliliter) was still only 2 percent of the NESHAPs concentration level. The maximum annual averaged plutonium-238 concentration usually occurred either at the Yucca station (in Area 6) or the 3545 Substation (in Area 16).

As shown in Table D–15, the maximum annual averaged plutonium-239 and -240 concentration among the six critical receptors measured from 2002 through 2008 was about 59×10^{-18} microcuries per milliliter, which was 3 percent of the NESHAPs CL. Although the maximum observed 1-week averaged concentration cannot be compared to the NESHAPs concentration level for regulatory purposes, it is noteworthy that even the maximum concentration (640×10^{-18} microcuries per milliliter) was still only 32 percent of the NESHAPs concentration level. The maximum annual averaged plutonium-239 and -240 concentration usually occurred either at the Yucca monitor (Area 6) or the Gate 700 S monitor (in Area 10).

Figure D–6 shows the highest annual mean plutonium-239 and -240 concentrations from 1971 through 2008 as observed by stations in NNSS areas. Only stations with at least 15 years of measurement history are included. The average rate of concentration decline ranges from 2.9 percent (in Areas 1 and 3) to 17.7 percent (in Areas 19 and 20). These decline rates are faster than would be expected given the very long half-lives of plutonium-239 and -240, and are attributed to plutonium immobilization in the soil and/or decreases in NNSS activities that would resuspend the plutonium from the soil into the air. All of these maximum mean plutonium-239 and -240 concentrations have been below the plutonium-239 NESHAPs concentration level since 1993. In the period from 1971 through 1992, these maximum mean concentrations exceeded the NESHAPs concentration level three times (in 1972, 1987, and 1992).



µCi/mL = microcuries per milliliter; CL = concentration level; RWMS = Radioactive Waste Management Site.
Note: Data are presented on a logarithmic scale. The plutonium-239 National Emission Standards for Hazardous Air Pollutants concentration level is also shown (green, dotted line).
Source: DOE 2009d

Figure D–6 Highest Annual Mean Plutonium-239 and -240 Concentrations Observed Within Nevada National Security Site Areas with Long-Term Measurement Histories

As shown in Table D–15, the maximum annual averaged cesium-137 concentration among the six critical receptors from 2002 through 2008 was about 9×10^{-16} microcuries per milliliter, which was 5 percent of the NESHAPs concentration level. Although the maximum observed 1-week averaged concentration cannot be compared to the NESHAPs concentration level for regulatory purposes, it is noteworthy that even the maximum concentration (48×10^{-16} microcuries per milliliter) was still only 25 percent of the NESHAPs concentration level. The maximum annual averaged cesium-137 concentration usually occurred either at the Yucca station (in Area 6), the 3545 Substation (in Area 16), or the Mercury Track station (in Area 23).

As shown in Table D–15, the maximum annual averaged americium-241 concentration among the six critical receptors from 2002 through 2008 was about 12×10^{-18} microcuries per milliliter, which was less than 1 percent of the NESHAPs concentration level. Although the maximum observed 1-week averaged concentration cannot be compared to the NESHAPs concentration level for regulatory purposes, it is noteworthy that even the maximum concentration (106×10^{-18} microcuries per milliliter) was still only 6 percent of the NESHAPs concentration level. The maximum annual averaged americium-241 concentration usually occurred either at the Yucca monitoring station (in Area 6), the Gate 700 S station (in Area 10), or the Schooner station (in Area 20).

Since the offsite CEMP stations surrounding the NNSS were upgraded in 1999 (DOE 2009a), the CEMP monitors have not detected radiation that can be attributed to NNSS activities, and the observed radiation levels are well within the background levels typically observed in other parts of the country (DOE 2009d). **Table D–16** presents the maximum monthly average observed gamma radiation readings at some selected stations surrounding the NNSS from late 1999 through 2008 (see Figure D–4 for a map of all CEMP locations). Although these are maximum monthly average values, they are still well within the range of natural background exposures estimated for cities in the United States (see Table D–16).

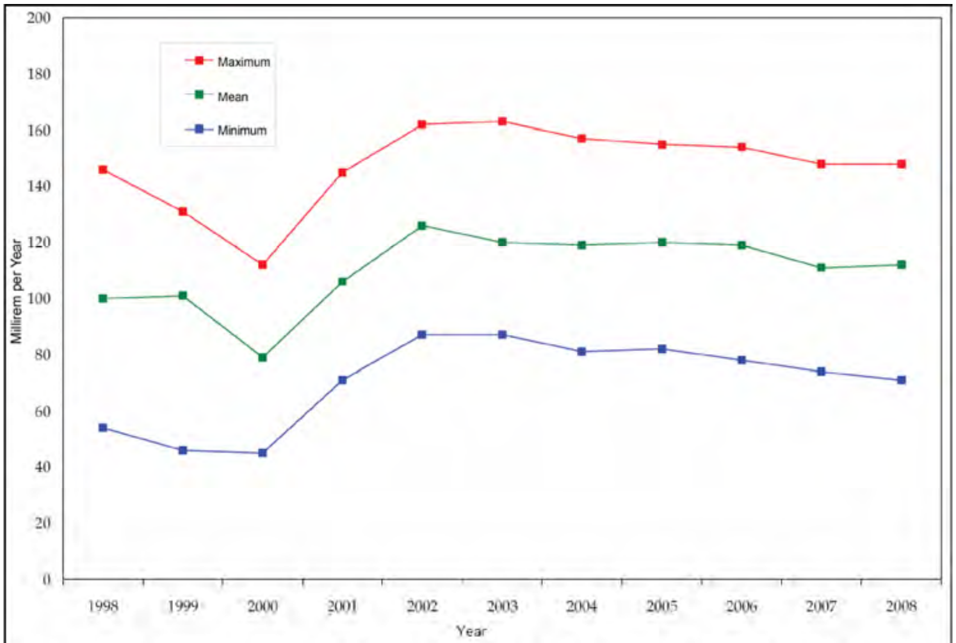
Table D–16 Average Monthly Maximum Gamma Radiation Observations from Select Community Environmental Monitoring Program Stations Surrounding the Nevada National Security Site (millirem per year [a])

	Tonopah	*Goldfield*	*Indian Springs*	*Las Vegas*	*Medlin's Ranch*	*Amargosa Valley*	*Average*
Jan	147	138	104	94	147	110	123
Feb	148	138	102	94	147	110	123
Mar	146	137	101	92	145	110	122
Apr	148	137	101	91	145	112	122
May	146	135	100	91	145	112	121
Jun	146	134	99	90	145	112	121
Jul	145	134	98	91	145	111	121
Aug	145	133	99	91	143	111	120
Sep	148	135	102	91	142	112	122
Oct	149	138	102	92	148	111	123
Nov	149	138	103	94	147	110	124
Dec	150	140	105	95	149	111	125
Period	Oct 1999 – Dec 2008	Oct 1999 – Dec 2008	Sep 1999 – Dec 2008	Jan 2000 – Dec 2008	Nov 1999 – Dec 2008	Oct 1999 – Dec 2008	

[a] Data in the reference source were presented in units of microroentgen per hour; this table presents the data in millirem per year for ease in comparing with the reference level of the National Emission Standards for Hazardous Air Pollutants. The conversion assumed that 1 roentgen gamma exposure from the most common external radionuclides generally produces a dose of 1 rem (DOE 2009d, page 14).

Source: DOE 2009e.

Figure D–7 shows the annual average radiation levels among all CEMP stations from 1998 through 2008, along with annual maximum and minimum values from among the individual stations. These levels were measured by thermoluminescent dosimeters, which measure ionizing radiation from all natural and manmade sources (DOE 2009d).



Note: Radiation levels measured by thermoluminescent dosimeters. The displayed radiation rate unit is milliroentgen per year, which is equivalent to a dose of 0.933 millirem per year, assuming 1 roentgen gamma exposure from the most common external radionuclides generally produces a 1 rem dose.
Source: DOE 2009d

Figure D–7 Annual Average Radiation Levels and Maximum and Minimum Values Among all Community Environmental Monitoring Program Stations, 1999–2008

Table D–17 presents a number of dose estimates resulting from the inhalation of radionuclides on or near the NNSS. From 2003 through 2008, the NNSS environmental reports presented the effective dose equivalent (EDE) (in millirem per year) received by a person residing at the critical receptor that had the largest sum of NESHAPs concentration level fractions (which in all cases was the Schooner receptor in Area 20). For example, in 2008, the Schooner critical receptor had a sum of NESHAPs concentration level fractions of 0.193. This sum of 0.193 indicates that the theoretical person at the receptor experienced an EDE that is 19.3 percent of the NESHAPs level. Since the NESHAPs level is 10 millirem per year, the EDE at the Schooner receptor was 1.93 millirem per year. Although no member of the public has access to areas near these critical receptors, these EDEs can be considered conservative; the EDE experienced by a member of the public off site would be considerably lower. Note that even these EDEs are well below the 10 millirem per year NESHAPs limit for inhalation.

Table D–17 also shows what each year's NNSS environmental report presents as the EDE experienced by the maximally exposed individual (MEI). However, the definition of the MEI changed in 2005, and the method of calculating the EDE changed in 2005 and in 2007. Prior to 2005, the CAP88-PC model (a computer model for estimating dose and risk from radionuclide air emissions) was used with onsite emissions estimates to calculate the EDE experienced by the offsite MEI. Beginning in 2005, CAP88-PC was no longer used for this purpose. In 2005 and 2006, the MEI was still assumed to be off site, but the EDE for the offsite MEI was not directly calculated. Instead, it was assumed to be no greater than 0.2 millirem per year, which was based on the CAP88-PC results from 1992 through 2004. In 2007 and 2008, the MEI was assumed to be located at the critical receptor that had the largest sum of NESHAPs concentration level fractions, and the EDE was estimated directly based on this sum (the sum was multiplied by the NESHAPs level of 10 millirem per year to arrive at the EDE). Compared with using CAP88-PC for an offsite MEI, using direct monitoring results for a critical receptor MEI is very conservative because critical receptors are generally the locations of maximum diffuse radioactive emissions on the NNSS so they likely overstate the radiation dose to the offsite MEI.

Table D–17 Effective Dose Equivalents for Maximally Exposed Individuals by Various Estimation Methods, 1997–2008 (millirem per year)

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
EDE received by an MEI at the critical receptor with the largest sum of NESHAPs CL fractions [a]	--	--	--	--	--	--	2.86	2.45	2.3	2.49	1.9	1.93
EDE to the MEI, as presented in the NNSS environmental reports	0.089 [b]	0.092 [b]	0.12 [b]	0.17 [b]	0.17 [b]	0.11 [b]	0.1 [b]	0.12 [b]	[c]	[c]	[d]	[d]
Reference	DOE 1998, page 7-2	DOE 1999, page 7-2	DOE 2000, page 1-4	DOE 2001, page 1-5	DOE 2002, page 1-5	DOE 2003, page 1-4	DOE 2004, pages 2-19 and 7-3	DOE 2005, pages 3-20 and 8-9	DOE 2006, pages 3-18 and 8-7	DOE 2007, pages 3-18 and 8-5	DOE 2008c, pages 3-18 and 8-5	DOE/NV 2009, pages 3-18 and 8-6

CL = concentration level; EDE = effective dose equivalent; MEI = maximally exposed individual; NESHAPs = National Emission Standards for Hazardous Air Pollutants; NNSS = Nevada National Security Site.

[a] The sum of NESHAP CL fractions was not presented in the NNSS environmental reports from 1997 through 2002. From 2003 through 2008, the critical receptor with the largest sum of NESHAPs CL fractions was the Schooner site in Area 20.

[b] Through 2004, the CAP88-PC model was used with onsite emissions estimates to calculate the EDE to the offsite MEI.

[c] Beginning in 2005, the CAP88-PC model was no longer used to estimate offsite exposure to onsite radioactive emissions. In 2005 and 2006, the EDE to the offsite MEI was estimated to be no more than 0.2 millirem per year based on the CAP88-PC results from 1992 through 2004.

[d] Beginning in 2005, the CAP88-PC model was no longer used to estimate offsite exposure to onsite radioactive emissions. In 2007 and 2008, the MEI was considered to be a person residing at the critical receptor with the largest sum of NESHAPs CL fractions, though the public has had never access to that location.

To put the inhalation radiation dose numbers in Table D–17 into perspective, **Figure D–8** shows a comparison of radiation dose sources received by an offsite MEI. Exposure to radon represents about 59 percent of total radiation exposure to the MEI, while the dose received from NNSS emissions (assumed to be 0.2 millirem per year, based on data in Table D–17) represents less than 1 percent of total radiation exposure to the MEI.

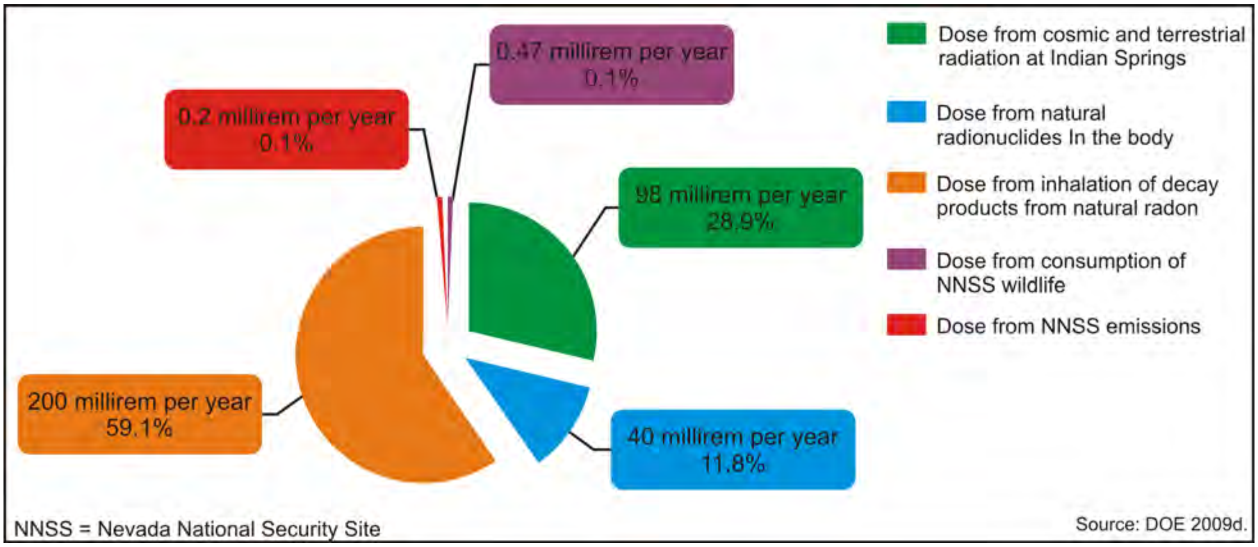


Figure D–8 Comparison of Radiation Doses to the Offsite Maximally Exposed Individual from Natural Background Sources and the Nevada National Security Site

D.1.1.3 Climate Change

Greenhouse gas emissions due to NNSS activities were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010). The electricity consumption by NNSS activities for fiscal year 2009 (45,300,740 kilowatt-hours) was provided by NNSA. This electricity consumption was assumed to be representative of calendar year 2008. The NNSS purchased electricity off of the Arizona-New Mexico (WECC Southwest) eGRID subregion. Greenhouse gas emissions from onsite permitted stationary sources were derived from the amount of red dye diesel used on site (66,433 gallons), as reported by NNSA for fiscal year 2009 and assumed to be representative of calendar year 2008. Emissions from refrigeration and air conditioning (22 pounds HFC-32 [diflouoromethane], 22 pounds HFC-125 [pentafluoroethane], 443 pounds HFC-134a [1,1,1,2-tetrafluoroethane], and 57.7 pounds of SF_6 [sulfur hexafluoride]) were provided by NNSA for fiscal year 2008 and are assumed to be representative of calendar year 2008.

For carbon dioxide emissions by onsite government vehicles, greenhouse gas emissions were estimated using vehicle fuel consumption. Fuel consumption amounts for each vehicle type and fuel type were derived in the same way as VMT amounts for each vehicle type and fuel type were derived (see the discussion in Section D.1.1.2). In short, the estimated fraction of each fuel group (gasoline+ethanol and No. 2 diesel+biodiesel) used by each vehicle type (see Table D–4) was multiplied by the total amount of each fuel type consumed on site (see Section D.1.1.2.1) to arrive at the amount of fuel consumed by each vehicle type and fuel type. For nitrous oxide and methane emissions by onsite government vehicles, and for the greenhouse gas emissions by all other NNSS-related vehicles, the VMT by each vehicle type and each fuel type (see Table D–4) were used. For the purposes of greenhouse gas emissions calculations, ethanol-consuming passenger cars and trucks were considered light-duty vehicles, gasoline-consuming passenger trucks were considered light-duty trucks, and all No. 2 diesel-consuming vehicles were considered heavy-duty vehicles. All other vehicle type and fuel type combinations had obvious matches in the Greenhouse Gas Emissions Calculator.

D.1.2 Remote Sensing Laboratory

D.1.2.1 Meteorology

This section expands on the meteorological characteristics of the Remote Sensing Laboratory (RSL) site presented in Chapter 4, Section 4.2.8.1, of this *NNSS SWEIS*.

The average annual rainfall in the Las Vegas Valley is about 4.5 inches. Rainfall is most common in the late winter and early spring (during Pacific storm passage) and in the late summer (with convective thunderstorms, monsoons, and the occasional tropical storm) (based on climate averages measured at the Las Vegas Weather Service Office Airport from 1971–2000; NCDC 2009). Nevada on the whole has been in a drought most of the last decade, with precipitation amounts far below normal (DOE 2008f), though some recent years (notably 2003 through 2005) were wetter than normal (NWS VEF 2009). Snowfall in the Las Vegas area is rare, with an annual average snowfall total of about 1 inch (based on the measurements taken from 1937–2009 at the Las Vegas Weather Service Office Airport; NCDC 2009). The average annual number of thunderstorm days is about 13, with thunderstorms most frequently occurring in July and August (NWS VEF 2009). Tornadoes in Nevada are exceedingly rare (NRC 1986).

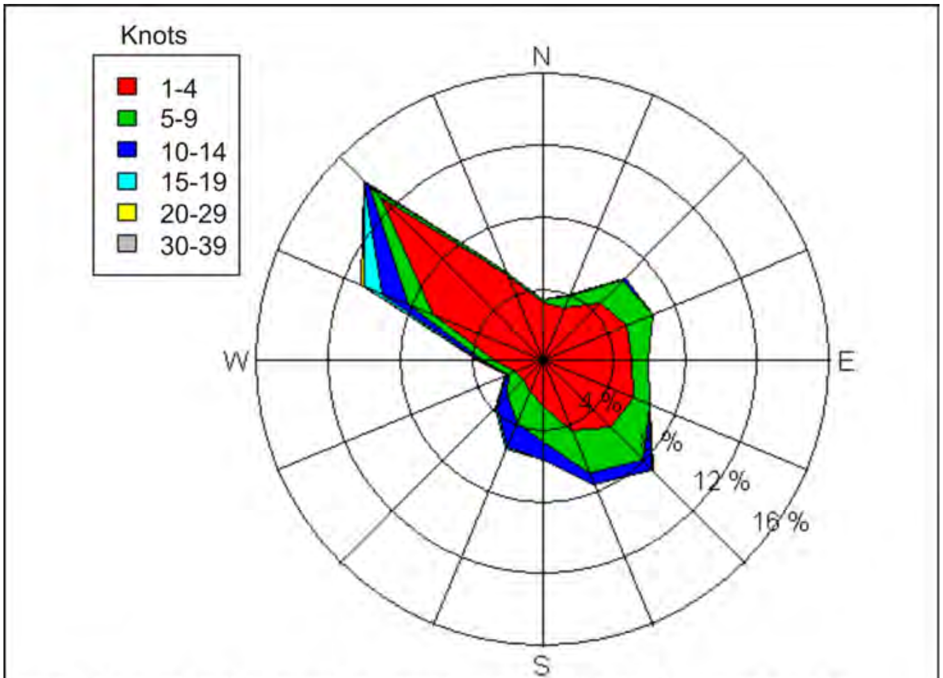
The Clark County Department of Air Quality and Environmental Management (DAQEM) maintains two ambient monitoring sites (the J.D. Smith and E. Craig Road sites) near RSL and NLVF. The annual average (2004–2008) wind roses are shown in **Figures D–9** and **D–10** for these two locations. A review of the timing in these figures shows that during the night, down-slope (northwesterly) drainage winds dominate. During the day, up-slope (southeasterly) winds dominate (Lehrman et al. 2006).

D.1.2.2 Ambient Air Quality on and near the Remote Sensing Laboratory

This section expands the ambient air quality discussion presented in Chapter 4, Section 4.2.8.2, of this SWEIS.

D.1.2.2.1 Existing Air Quality

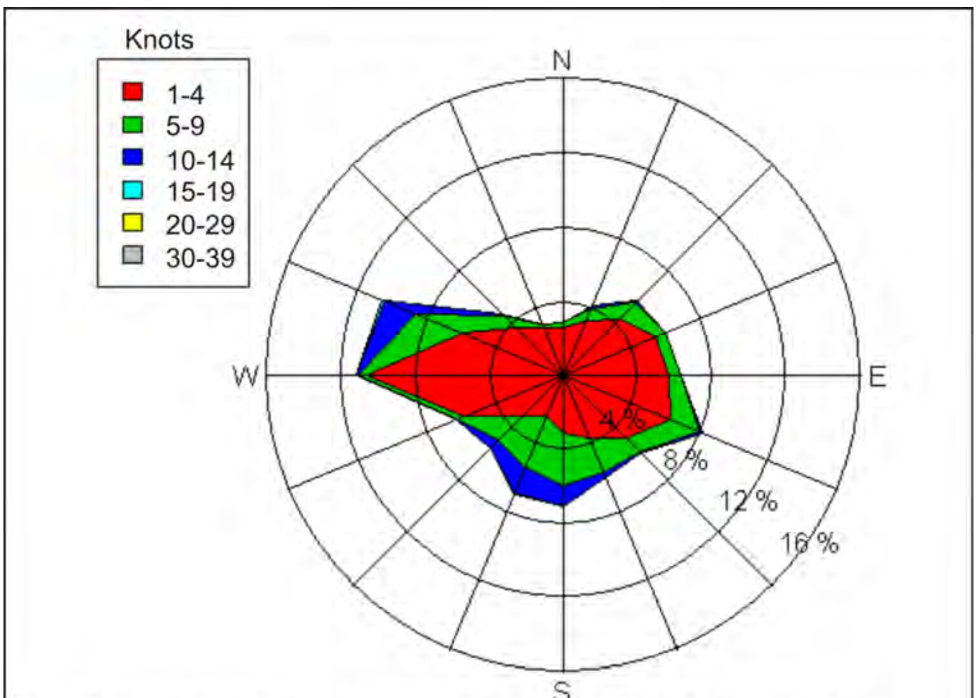
RSL is located about 60 miles southeast of the southern border of the NNSS. The region of influence for air quality and climate for RSL operations is northern Clark County. Historic data on pollutant emissions inventories and compliance status for the State of Nevada are calculated at the resolution of county or hydrographic areas and provide a basis for determining existing air quality in the region of influence and a metric for emissions comparison assessments. See Chapter 4, Section 4.1.8.2.2, for a discussion on the current NAAQS and Nevada Ambient Air Quality Standards.



Note: To convert knots to meters per second, multiply by 0.5144. To convert knots to miles per hour, multiply by 1.121.

Source: Clark County 2010.

Figure D–9 Annual Average Wind Rose for the E. Craig Road DAQEM Site at 4701 Mitchell Street, 2004–2008



Note: To convert knots to meters per second, multiply by 0.5144. To convert knots to miles per hour, multiply by 1.121.

Source: Clark County 2010.

Figure D–10 Annual Average Wind Rose for the J.D. Smith DAQEM Site at 1301 East Tonopah Road, 2004–2008

Emissions from Onsite Stationary and Mobile Sources. The 2008 emissions of onsite permitted stationary sources were from the 2008 NNSS environmental report (DOE 2009d). The amount of natural gas combusted for heating (33,673 therms, or 3,367,300 cubic feet) for fiscal year 2009 was provided by the DOE/NNSA Nevada Site Office (NSO), and the resulting emissions were derived from the EPA AP-42 emissions factors database (EPA 1995a). This natural gas combustion was assumed to be representative of calendar year 2008.

Table D–18 shows the emissions rates and activity times used to estimate emissions from activity related to RSL aircraft. The amount of jet fuel combusted by RSL aircraft (111,030 gallons) for fiscal year 2009 was provided by the DOE NNSA/NSO, and this aircraft fuel combustion was assumed to be representative of calendar year 2008. The number of landings and takeoffs for airplanes (Raytheon Beechcraft Super King Air 200) and helicopters (Bell model) for fiscal years 2005 through 2009 were also provided by DOE NNSA/NSO. Landing and takeoff counts for fiscal year 2006 (260 landings and takeoffs for airplanes, 180 landings and takeoffs for helicopters) were used here because they were the largest of the five years, which creates a more health-conservative calculation of aircraft-related emissions.

Emissions of carbon monoxide, volatile organic compounds, nitrogen oxides, sulfur oxides, PM_{10}, and $PM_{2.5}$ from the airplane activity were derived from EDMS [Emissions and Dispersion Modeling System], v5.1.1 (FAA 2009), where the engine type was PT6A-42, the average mixing depth was 3,000 feet, and the taxi-in and -out times were 4.58 minutes and 30.74 minutes, respectively, across 493.5 total landings and takeoffs. Jet fuel contains no lead.

Appropriate emissions factors for helicopters were not readily available, so the same emission rates used for airplanes (from EDMS, v5.1.1; FAA 2009) were used after scaling them by the generic estimated helicopter activity times compared to the generic estimated turboprop airplane activity times (from EPA 1992). Jet fuel contains no lead.

Emissions of carbon monoxide, volatile organic compounds, nitrogen oxides, sulfur oxides, PM_{10}, and $PM_{2.5}$ from airplane ground support equipment for Raytheon Beechcraft Super King Air 200 airplanes were estimated from the emissions factors in EDMS, v5.1.1 (FAA 2009). The emission rate of lead from ground support equipment was derived from the Health Effects Institute study of mobile source metal emissions (HEI 2006, pages 36 through 48).

Emissions from current construction and surface disturbance activities were much smaller relative to these stationary and other mobile sources and were not explicitly calculated. $PM_{2.5}$ levels were not reported, so the $PM_{2.5}$ levels were conservatively assumed to be equal to the PM_{10} emission rates.

Table D–19 shows the current (approximately 2008) onsite emissions of criteria pollutants and HAPs associated with RSL permitted stationary sources, with heating using natural gas, and with aircraft and aircraft-related operations associated with RSL operations.

Table D–18 Aircraft-Related Emission Rates Used to Calculate Emissions from Aircraft-Related Activities at the Remote Sensing Laboratory

Aircraft	*Engine*	*Mode*	*Time in Mode (minutes)*	*Emissions per Mode per Landing or Takeoff (kilograms)*						
				CO	*VOCs*	*NO_x*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*Lead*
Raytheon Beechcraft Super King Air 200	PT6A-42	Taxi out	19	1.83471084	0.47912844	0.05182179	0.03140373	0	0	0
		Takeoff	0.5	0.0310217	0.00217574	0.00239067	0.00109993	0	0	0
		Climbout	2.5	0.02877526	0.00024815	0.00251907	0.00113136	0	0	0
		Approach	4.5	0.1401291	0.03659423	0.00392481	0.00236548	0	0	0
		Taxi in	7	0.2745547	0.07169902	0.00775485	0.0046994	0	0	0
		Ground support	--	0.2410693	0.00908567	0.02079159	0.00252632	0.00140188	0.00130097	0.00016
Helicopters (Raytheon Beechcraft Super King Air 200 as surrogate)	(PT6A-42 as surrogate)	Taxi out	3.5	0.33797305	0.0882605	0.00954612	0.0057849	0	0	0
		Takeoff	0	0	0	0	0	0	0	0
		Climbout	6.5	0.07481569	0.00064518	0.00654957	0.00294154	0	0	0
		Approach	6.5	0.2024087	0.05285834	0.00566917	0.00341681	0	0	0
		Taxi in	3.5	0.13727735	0.03584951	0.00387743	0.0023497	0	0	0

CO = carbon monoxide; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_x = sulfur oxides; VOC = volatile organic compound.

Table D–19 Calculated Air Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Remote Sensing Laboratory Activities (tons per year)

	Clark County								
	On the Remote Sensing Laboratory								
	Stationary Sources			*Aircraft-Related Sources*					
Pollutant	***Spray Paint Booths, Emergency Generators, Boilers, Cooling Towers, Vapor Degreasers, Water Heaters***	***Natural Gas for Heating***	***Total***	***Airplane LTOs***	***Helicopter LTOs***	***Aircraft Ground Support Equipment***	***Total***	***Total***	***Reference***
PM_{10}	0.025	0.013	*0.038*	0	0	0.00040	*0.00040*	*0.038*	DOE 2009c, page A-10; EPA 1992, page 176; EPA 1995a, pages 1.4-5 to 1.4-6; FAA 2009
$PM_{2.5}$	0.025 [a]	0.013 [a]	*0.038* [a]	0	0	0.00037	*0.00037*	*0.038*	
CO	0.217	0.14	*0.36*	0.66	0.15	0.069	*0.88*	*1.2*	
NO_x	0.426	0.47	*0.90*	0.020	0.0051	0.020	*0.045*	*0.94*	
SO_2	0.009	0.0010	*0.010*	0.012	0.0029	0.00072	*0.016*	*0.026*	
VOCs	0.023	0.0093	*0.032*	0.17	N/A	0.0026	*>0.17*	*>0.20*	
Lead	<0.01 [b]	8.4×10^{-7}	*0.010*	0	0	6.4×10^{-8}	*~0.00040*	*~0.038*	EPA 1995a, pages 1.4-5 to 1.4-6; HEI 2006, pages 36-48
HAPs	0.004	0.0031	*0.0071*	<0.17 [c]	N/A [c]	<0.0026 [c]	*~0.17* [c]	*~0.18*	DOE 2009c, page A-10

~ = approximately; < = less than; CO = carbon monoxide; HAP = hazardous air pollutant; LTOs = landings and takeoffs; N/A = not applicable; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] PM_{10}, as reported in the reference, is conservatively assumed to correspond to $PM_{2.5}$.

[b] Lead emissions are not explicitly reported on site, but they are assumed to be very small.

[c] HAP calculation was unavailable, but HAP emissions should be a factor of VOC emissions, and should be comparatively small.

Note: Activities are partitioned by source type. Stationary permitted source emissions are representative of 2008, while natural gas and aircraft-related sources are representative of fiscal year 2006, which is assumed to be representative of calendar year 2008.

Onsite permitted stationary sources emitted approximately 0.7 tons of criteria pollutants in 2008, the bulk of which (0.426 tons) was nitrogen oxides. Emissions from spray booths and vapor degreasers were nearly 0 (less than 0.001 tons of HAPs from spray booths and less than 0.01 tons of volatile organic compounds from vapor degreasers) (DOE 2008b). So, among the onsite permitted stationary sources, about 54 percent of emissions (about 0.38 tons criteria pollutants, 0 tons HAPs) were from boilers and water heaters and about 46 percent (about 0.32 tons criteria pollutants, 0 tons HAPs) were from diesel generators.

Natural gas used for heating on RSL resulted in about 0.63 tons of criteria pollutant emissions in fiscal year 2009, which is assumed to be representative of calendar year 2008. Most of the criteria pollutant emissions (0.47 tons) were nitrogen oxides. A very small amount (0.0031 tons) of HAPs was emitted.

Airplane landing and takeoff activities at RSL resulted in about 0.86 tons of criteria pollutant emissions in fiscal year 2006, which is assumed to be representative of calendar year 2008. Most of those criteria pollutant emissions (0.66 tons) were carbon monoxide. A very small amount (less than 0.17 tons) of HAPs were emitted. Ground support equipment related to these airplane landings and takeoffs emitted about 0.09 tons of criteria pollutants and less than 0.0026 tons of HAPs. Helicopters emitted about 0.16 tons of criteria pollutants, most of which (0.15 tons) was carbon monoxide. Altogether, aircraft-related activities emitted about 1.1 tons of criteria pollutants (0.88 tons of which was carbon monoxide) and less than 0.2 tons of HAPs.

Overall, onsite stationary source, heating, and aircraft-related sources emitted about 2.4 annual tons of criteria pollutants in 2008, most of which (about 1.2 tons) was carbon monoxide. Most (55 percent) of these onsite criteria pollutant emissions were from stationary sources, while 42 percent were from aircraft and 4 percent were from aircraft-related ground support equipment. A small amount of HAPs (less than 0.2 tons) was emitted on site.

Emissions from Commuter and Commercial Vendor Mobile Sources. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic from employees commuting to the RSL using personal vehicles and from nonradioactive waste trucks (commercial vendors) servicing RSL. **Table D–20** and the following discussion contain further details on the activity and vehicle data that were used. See Chapter 4, Section 4.1.3, for further details on the traffic activity levels. Mobile emissions from onsite activities at RSL are believed to be very small compared to commuter emissions and are not shown.

Table D–20 Vehicle Activity Data Used to Model Emissions from Commuters and Commercial Vendors Traveling to and from the Remote Sensing Laboratory

Activity Type	*MOVES2010 Vehicle Type*	*Count*	*Annual VMT*	*Percentage Annual VMT Occurring on Weekdays*	*Fuel Type Used*
Commuting	Light-duty vehicles	53	471,731	95	Unleaded gasoline
	Light-duty passenger trucks	53	471,731		
Commercial vendors	Single-unit, short-haul trucks	5	72,072	95	No. 2 diesel

MOVES2010 = Motor Vehicle Emission Simulator 2010; VMT = vehicle miles traveled.
Note: Modeling performed using MOVES2010.

Private-vehicle commuter activity data were derived from employee count and residence information. Commercial vendor activity was derived from employee count data and from the 1999 NTS road renovation study (BN 1999). Radioactive waste transport does not usually occur at RSL, and it did not occur in 2008. For personal-vehicle commuters, half were assumed to use light-duty vehicles and the other half were assumed to use light-duty passenger trucks. All personal-vehicle commuters were assumed to use only unleaded gasoline, and all commercial vendors were assumed to use only No. 2 diesel. The lead emissions factors for mobile sources in EPA's *Air Quality Criteria for Lead* (EPA 2006) were used to estimate lead emissions for RSL personal-vehicle commuter vehicles and RSL commercial vendor vehicles.

MOVES default fuel market shares, meteorology, vehicle speed distributions, and monthly and hourly VMT distributions were used. Only running exhaust, brake wear, and tire wear were modeled. As was done for NNSS onsite government vehicles, light-duty vehicles and light-duty passenger trucks were assumed to have an average age of 9 years and single-unit, short-haul trucks were assumed to have an average age of 11 years old. The same Clark County road distribution used for NNSS commuter traffic was used for RSL commuters and commercial vendors (see Section D.1.1.2.1).

Table D–21 shows the modeled current (approximately 2008) ground vehicle emissions of criteria pollutants and HAPs associated with onsite employees commuting to the RSL and with commercial vendors traveling to and from RSL. Mobile source emissions related to RSL commuters and commercial vendors were much larger than stationary source emissions on RSL and were smaller than aircraft landing and takeoff emissions. Mobile source commuter activities emitted about 4 tons of criteria pollutants (3.1 tons of carbon monoxide alone) and about 0.0048 tons of HAPs. Light-duty vehicles contributed about 31 percent towards this criteria pollutant commuter total and about 21 percent towards this HAP commuter total, while light-duty passenger trucks contributed the remainders. Commercial vendors emitted about 0.68 tons of criteria pollutants (0.40 tons of nitrogen oxides alone) and about 0.048 tons of HAPs.

Table D–21 Estimated 2008 Air Emissions of Criteria Pollutants and HAPs from Commuters and Commercial Vendors Traveling to and from the Remote Sensing Laboratory (tons per year)

	Clark County				
	Off the Remote Sensing Laboratory				
	Commuting			***Commercial Vendors***	
Pollutants	***Light-Duty Vehicles***	***Light-Duty Passenger Trucks***	***Total***	***Single-Unit, Short-Haul Trucks***	***Total***
PM_{10}	0.012	0.018	*0.030*	0.043	*0.073*
$PM_{2.5}$	0.0065	0.0097	*0.016*	0.040	*0.056*
CO	0.98	2.1	*3.1*	0.18	*3.3*
NO_x	0.21	0.55	*0.76*	0.40	*1.2*
SO_2	0.0035	0.0049	*0.0084*	0.00074	*0.0091*
VOCs	0.011	0.051	*0.062*	0.058	*0.12*
Lead	1.0×10^{-6}	1.0×10^{-6}	2.0×10^{-6}	6.8×10^{-7}	2.7×10^{-6}
HAPs	0.001	0.0038	*0.0048*	0.0076	*0.012*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

D.1.2.3 Climate Change

This section expands the climate change discussion presented in Chapter 4, Section 4.2.8.4, of this *NNSS SWEIS*.

Greenhouse gas emissions due to RSL activities were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010). About 33 percent of the electricity consumed by RSL was supplied by renewable sources for fiscal year 2009, which is assumed to be representative of calendar year 2008. The resulting nonrenewable electricity consumption by RSL activities (3,250,630 kilowatt-hours) was provided by NNSA. RSL purchased electricity off of the Arizona-New Mexico (WECC Southwest) eGRID subregion. The amount of natural gas consumed by RSL activities (33,673 therms, or 3,367,300 cubic feet) was supplied by NNSA for fiscal year 2009, which is assumed to be representative of calendar year 2008. Greenhouse gas emissions from onsite permitted diesel generators were derived from the amount of amount of red dye diesel used by the generators in 2008 (960 gallons), as reported by DOE (2008b).

The amount of jet fuel used by RSL-related aircraft activities (111,030 gallons) for fiscal year 2009 was provided by NNSA and is assumed to be representative of calendar year 2008. The amount of fuel used by aircraft-related ground support equipment, which are set as heavy-duty vehicles in the Greenhouse Gas Emissions Calculator, was unknown but should be fairly small given the relatively few airplane operations there (an average of 232 annually from fiscal years 2005 through 2009). Ground support equipment was assumed to use 60 gallons of diesel, which was back-calculated from the relationship between the known VMTs by RSL commercial vendors and the ratio of modeled PM_{10} emission rates to estimated fuel consumption based on assumed fuel economy.

VMTs by each vehicle type and each fuel type were used in developing the greenhouse gas emissions attributed to RSL commuter and commercial vendor vehicles. For the purposes of greenhouse gas emissions calculations, gasoline-consuming light-duty passenger trucks were considered light-duty trucks, and all No. 2 diesel-consuming vehicles were considered heavy-duty vehicles. All other vehicle type and fuel type combinations had obvious matches in the Greenhouse Gas Emissions Calculator.

D.1.3 North Las Vegas Facility

D.1.3.1 Meteorology

The meteorological characteristics of the NLVF and RSL sites are based on the same observations due to the close proximity of the locations. Please see Section D.6 for a complete analysis of the meteorological characteristics of the NLVF site.

D.1.3.2 Ambient Air Quality on or near the North Las Vegas Facility

This section expands the meteorology discussion presented in Chapter 4, Section 4.3.8.2, of this *NNSS SWEIS*.

D.1.3.2.1 Existing Air Quality

This section expands the discussion on the methodology used in determining the air emissions for the NLVF.

Emissions from Onsite Stationary Sources. The 2008 emissions of onsite permitted stationary sources were from the 2008 NNSS environmental report (DOE 2009d). The amount of natural gas combusted for heating (25,947 therms, or 2,594,700 cubic feet) for fiscal year 2009 was provided by the DOE NNSA/NSO, and the resulting emissions were derived from the EPA AP-42 emissions factors database (EPA 1995a). This natural gas combustion was assumed to be representative of calendar year 2008. Emissions from current construction and surface disturbance activities were much smaller relative to these stationary and other mobile sources and were not explicitly calculated. $PM_{2.5}$ levels were not reported, so the $PM_{2.5}$ levels were conservatively assumed to be equal to the PM_{10} emission rates.

Onsite permitted stationary sources emitted approximately 0.5 tons of criteria pollutants in 2008, the bulk of which (0.365 tons) was nitrogen oxides. Emissions from sanders, blasters, and paint booths was nearly 0 (about 0.01 tons of PM_{10} from aluminum sanders; DOE 2008e), so among the onsite stationary sources, 98 percent of emissions were from diesel generators.

Natural gas used for heating on NLVF resulted in about 0.49 tons of criteria pollutants in fiscal year 2009, which is assumed to be representative of calendar year 2008. Most of the criteria pollutant emissions (0.36 tons) were nitrogen oxides. A very small amount (0.0024 tons) of HAPs were emitted.

Criteria pollutant and HAP emissions from activities at NLVF are shown in **Table D–22**. Activities are partitioned by source type. Stationary permitted source emissions are representative of 2008; natural gas combustion emissions are representative of fiscal year 2009 (assumed to be representative of calendar year 2008).

Table D–22 Calculated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite North Las Vegas Facility Activities (tons per year)

	Clark County			
	On the North Las Vegas Facility			
Pollutant	***Sanders, Blasters, Spray Paint Booths, Emergency Generators, Boilers, Cooling Towers***	***Natural Gas Consumption***	***TOTAL***	***Reference***
PM_{10}	0.027	0.0099	*0.037*	DOE 2009d, page A-7 and EPA 1995a, pages 1.4-5 to 1.4-6
$PM_{2.5}$	0.027 [a]	0.0099	*0.037*	
CO	0.082	0.11	*0.19*	
NO_x	0.365	0.36	*0.73*	
SO_2	0.016	0.00078	*0.017*	
VOCs	0.021	0.0071	*0.028*	
Lead	<0.01 [b]	6.5×10^{-7}	*<0.01*	EPA 1995a, pages 1.4-5 to 1.4-6
HAPs	0.0002	0.0024	*0.0026*	DOE 2009d, page A-7 and EPA 1995a, pages 1.4-7 to 1.4-8

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] PM_{10}, as reported in the reference, is conservatively assumed to correspond to $PM_{2.5}$.

[b] Lead emissions are not explicitly reported on site, but they are assumed to be very small.

Emissions from Commuter, Commercial Vendor, and Radioactive Waste Transport Mobile Sources. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic to and from the NNSS. **Table D–23** and the following discussion contain further details on the activity and vehicle data that were used. See Chapter 4, Section 4.1.3, for more details.

Table D–23 Vehicle Activity Data Used to Model Emissions from Commuters, Commercial Vendors, and Radioactive Waste Trucks Traveling to and from the North Las Vegas Facility

Activity Type	*MOVES2010 Vehicle Type*	*Count Originating in Clark County*	*Count Originating in Nye County*	*Annual VMT Within Clark County*	*Annual VMT Within Nye County but Outside the NNSS*	*Annual VMT Within Nye County and Inside the NNSS*	*Percentage Annual Clark County VMT Occurring on Weekdays*	*Percentage Annual Nye County VMT Outside the NNSS Occurring on Weekdays*	*Percentage Annual Nye County VMT Inside the NNSS Occurring on Weekdays*	*Fuel Type Used*
Commuting	Light-duty vehicles	567	5	3,864,738	23,435	0	95	95	0	Unleaded gasoline
	Light-duty passenger trucks	566	4	3,864,738	23,435	0	95	95	0	
Commercial vendors	Single-unit, short-haul trucks	23	0	310,565	0	0	95	0	0	No. 2 diesel
Radioactive waste trucks	Combination-unit, short-haul trucks	1	0	3,068	312	208	100	100	100	No. 2 diesel

MOVES2010 = Motor Vehicle Emission Simulator 2010; NNSS = Nevada National Security Site; VMT = vehicle miles traveled.
Note: Modeling performed using MOVES2010.

Private-vehicle commuter activity data were derived from employee count and residence information. Commercial vendor activity was derived from employee count data and from the 1999 NTS road renovation study (BN 1999). Radioactive waste transport activity was derived from the number of transports and the NNSS destination reported as part of the 2009 NESHAPs submission (NSTec 2010), and these 2009 data are assumed to be representative of 2008. Note that these radioactive waste transports are occurring only because of a 1995 tritium contamination in the Building A-1 basement, not due to any other regular activities at NLVF. Mobile emissions from onsite activities at NLVF are believed to be very small compared with commuter emissions and are not shown.

For personal-vehicle commuters, half were assumed to use light-duty vehicles and the other half were assumed to use light-duty passenger trucks. Commercial vendors and radioactive waste transports used combination-unit trucks. All personal-vehicle commuters were assumed to only use unleaded gasoline, and all waste trucks were assumed to only use No. 2 diesel. The lead emissions factors for mobile sources in EPA's *Air Quality Criteria for Lead* (EPA 2006) were used for estimating lead emissions for NLVF personal-vehicle commuter vehicles, NLVF commercial vendor vehicles, and NLVF radioactive waste transport vehicles.

MOVES default fuel market shares, meteorology, vehicle speed distributions, and hourly VMT distributions were used. Only running exhaust, brake wear, and tire wear were modeled. For commuters and commercial vendors, MOVES-default monthly VMT distributions were used. For radioactive waste trucks, transport activity data were available by month, so the monthly VMT distribution was developed from the monthly data. As was done for the NNSS, onsite government vehicles, light-duty vehicles, and light-duty passenger trucks were assumed to be 9 years old, and single-unit, short-haul trucks were assumed to be 11 years old. The same Clark County road distribution used for NNSS commuter traffic was used for NLVF personal-vehicle commuter vehicles, NLVF commercial vendor vehicles, and NLVF radioactive waste transport vehicles (see Section D.1.1.2.1).

Table D–24 shows the modeled current (approximately 2008) ground vehicle emissions of criteria pollutants and HAPs associated with onsite employees commuting to NLVF and with waste transport (commercial vendors and radioactive waste trucks) to and from NLVF.

Mobile source emissions related to NLVF commuting and waste transport were much larger than stationary source emissions on NLVF. Mobile source commuter activities emitted about 31.7 tons of criteria pollutants (24.9 tons of carbon monoxide alone) and about 0.038 tons of HAPs. Light-duty vehicles contributed about 32 percent towards this criteria pollutant commuter total and about 22 percent towards this HAP commuter total, while light-duty passenger trucks contributed the remainders. Over 99 percent of these commuter emissions took place in Clark County, and the remainder took place in Nye County. Commercial vendors emitted about 7.9 tons of criteria pollutants (5.2 tons of nitrogen oxides alone) and about 0.055 tons of HAPs. Single-unit trucks contributed about 37 percent towards this commercial vendor criteria pollutant total and about 60 percent of this commercial vendor HAP total, while combination-unit trucks contributed the remainders. Radioactive waste truck activities related to NLVF emitted approximately 0.11 tons of criteria pollutants and 0.00050 tons of HAPs in 2008. Nitrogen oxides were emitted in by far the largest amounts (0.080 tons) among the criteria pollutants.

Table D–24 Estimated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Ground Vehicle Activity Related to the North Las Vegas Facility, 2008 (tons per year)

	Commuting				Commercial Vendors	Radioactive Waste Transport						
	Light-Duty Vehicles		Light-Duty Passenger Trucks		Single-Unit, Short-Haul Trucks	Combination-Unit, Short-Haul Trucks			Total			
	Clark County	Nye County	Clark County	Nye County	Clark County	Clark County	Nye County		Clark County	Nye County		
Pollutant	Off NLVF	Off NNSS	Off NLVF	Off NNSS	Off NLVF	Off NLVF	On NNSS	Off NNSS	Off NLVF	On NNSS	Off NNSS	Total
PM_{10}	0.10	0.00063	0.15	0.00086	0.19	0.0051	0.00032	0.00048	*0.45*	*0.00032*	*0.002*	*0.45*
$PM_{2.5}$	0.053	0.00037	0.08	0.00049	0.17	0.0048	0.0003	0.00045	*0.31*	*0.00030*	*0.0013*	*0.31*
CO	8.1	0.051	17.4	0.11	0.76	0.020	0.0013	0.0019	*26.3*	*0.0013*	*0.16*	*26.4*
NO_x	1.7	0.012	4.5	0.030	1.7	0.069	0.0045	0.0068	*8.0*	*0.0045*	*0.049*	*8.0*
SO_2	0.029	0.00016	0.040	0.00023	0.0032	0.000098	6.2×10^{-6}	9.4×10^{-6}	*0.072*	6.2×10^{-6}	*0.00040*	*0.073*
VOCs	0.093	0.00060	0.42	0.0026	0.25	0.0033	0.00021	0.00032	*0.77*	*0.00021*	*0.0035*	*0.77*
Lead	8.5×10^{-6}	5.2×10^{-7}	8.5×10^{-6}	5.1×10^{-8}	2.9×10^{-6}	2.9×10^{-8}	2.9×10^{-9}	2.9×10^{-9}	*0.000020*	2.9×10^{-9}	5.7×10^{-7}	*0.000021*
HAPs	0.0082	0.000058	0.032	0.00020	0.033	0.00043	0.000028	0.000042	*0.074*	*0.000028*	*0.00030*	*0.074*

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x= nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

D.1.3.3 Climate Change

This section discusses the basis for estimating the greenhouse gas emissions as presented in Chapter 4, Section 4.3.8.4, of this *NNSS SWEIS*.

The greenhouse gas emissions due to NLVF activities were calculated within the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010). The electricity consumption by NLVF activities for fiscal year 2009 (13,331,050 kilowatt-hours) was provided by NNSA. This electricity consumption was assumed to be representative of calendar year 2008. NLVF purchased electricity off of the Arizona-New Mexico (WECC Southwest) eGRID subregion. The amount of natural gas consumed by NLVF activities (25,947 therms, or 2,594,700 cubic feet) was supplied by NNSA for fiscal year 2009, which is assumed to be representative of calendar year 2008. Greenhouse gas emissions from onsite permitted diesel generators were derived from the amount of amount of red dye diesel used by the generators in 2008 (1,298 gallons), as reported by DOE (2008e). For greenhouse gas emissions by NLVF commuter, commercial vendor, and radioactive waste transport vehicles, the VMT by each vehicle type and each fuel type (see Table D–23) were used. For the purposes of greenhouse gas emissions calculations, gasoline-consuming light-duty passenger trucks were considered light-duty trucks, and all No. 2 diesel-consuming vehicles were considered heavy-duty vehicles. All other vehicle type and fuel type combinations had obvious matches in the Greenhouse Gas Emissions Calculator.

D.1.4 Tonopah Test Range

D.1.4.1 Meteorology

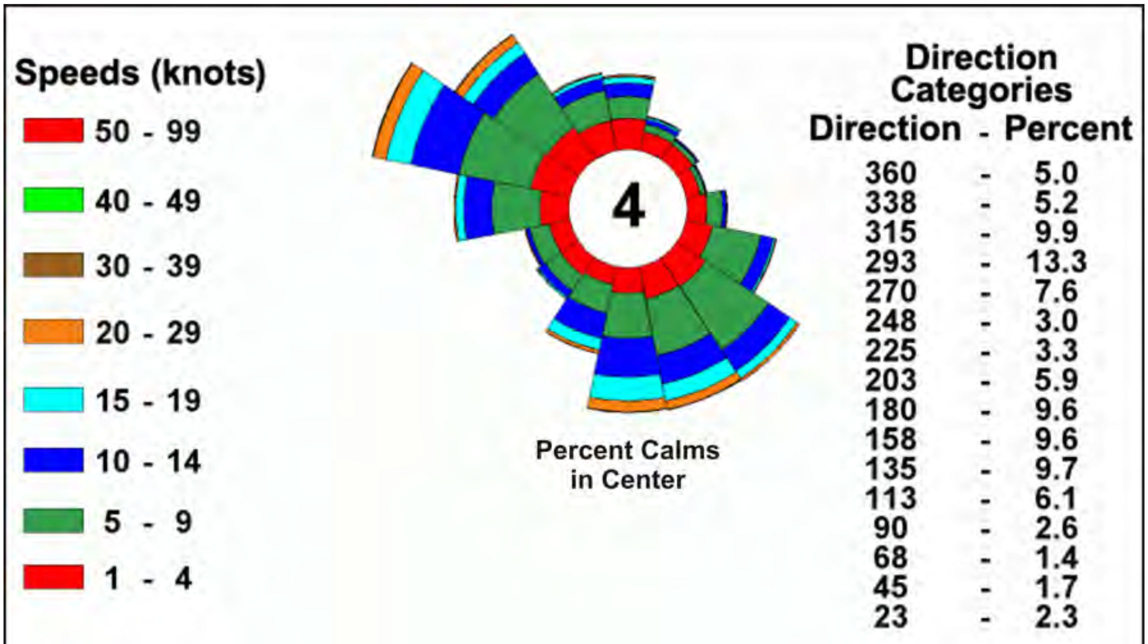
This section expands the meteorology discussion presented in Chapter 4, Section 4.4.8.2, of this *NNSS SWEIS*.

Precipitation. From about 1983 to 1990, the average annual snowfall total at the Tonopah Test Range Airport was about 15 inches (SORD 2002). A 7-year record (1961–1967) at a weather station that existed about 2 miles northeast of the current Tonopah Test Range Airport station recorded an average annual snowfall of about 19 inches (Schaeffer 1968). At the Tonopah Airport (about 25 miles northeast of KTNX at an elevation of about 5,394 feet above mean sea level), the average annual snowfall is about 13 inches (averaged over the period from 1954–2009 Average; NCDC 2009). At the highest elevations, annual snowfall amounts between about 40 and 60 inches are anticipated based on estimates made for Rainier Mesa (about 50 miles southeast of the Tonopah Test Range Airport at an elevation of 7,490 feet above mean sea level; Soulé 2006) and measurements (averaged over the period from 1966–2002) made at Snowball Ranch (90 miles northeast of the Tonopah Test Range Airport; at an elevation of about 7,159 feet above mean sea level; NCDC 2009).

Thunderstorms at the Tonopah Test Range occur primarily in springtime due to frontal passages and in the middle to late summer due to convection from daytime heating (Soulé 2006), and the same is likely true for the Tonopah Test Range (TTR). In a 29-month period (March 1990 through August 1992) at the Tonopah Test Range Airport, the average annual number of days with thunderstorms was 28 (USAF 2003), which is about 13 more than are typically recorded on the NNSS at Yucca Flat (about 68 miles southeast of the Tonopah Test Range Airport at an elevation of 3,921 feet above mean sea level) and at Desert Rock (90 miles southeast of the Tonopah Test Range Airport at an elevation of 3,304 feet above mean sea level). Observations on the NNSS suggest that thunderstorms are more frequent and begin earlier in the afternoon on the mesas compared to lower elevations (Soulé 2006). At the Tonopah Test Range Airport, thunderstorm activity tends to reach a maximum in the middle afternoon, with some summertime thunderstorms existing near and sometimes after midnight (USAF 2003).

On the NNSS, and likely on the TTR as well, it is rare for a thunderstorm to produce more than about 0.5 inches of rain at a given location, so flooding is rarely a problem. Thunderstorms on the NNSS can be severe at times, with strong surface wind gusts and intense cloud-to-ground lightning, but hail is infrequent and hail size is small (less than about 0.5 inches in diameter). Cloud-to-ground lightning activity tends to maximize over higher elevations particularly during the period from July through September (Soulé 2006). Tornadoes are very rare in Nevada as a whole, with a 1954–1983 tornado climatology indicating a tornado strike probability of 3 per year statewide (NRC 1986).

Wind Flow Overview. On the whole, the preferences towards down-slope winds (which tend to be northwesterly) and up-slope winds (which tend to be southerly or southeasterly) are apparent in the Tonopah Test Range Airport annual average wind rose (see **Figure D–11**). Similar wind flows are seen near the town of Tonopah at its CEMP station (see **Figure D–12**), about 31 miles northeast of the Tonopah Test Range Airport at an elevation of about 6,181 feet above mean sea level.



Note: To convert knots to meters per second, multiply by 0.5144. To convert knots to miles per hour, multiply by 1.121.

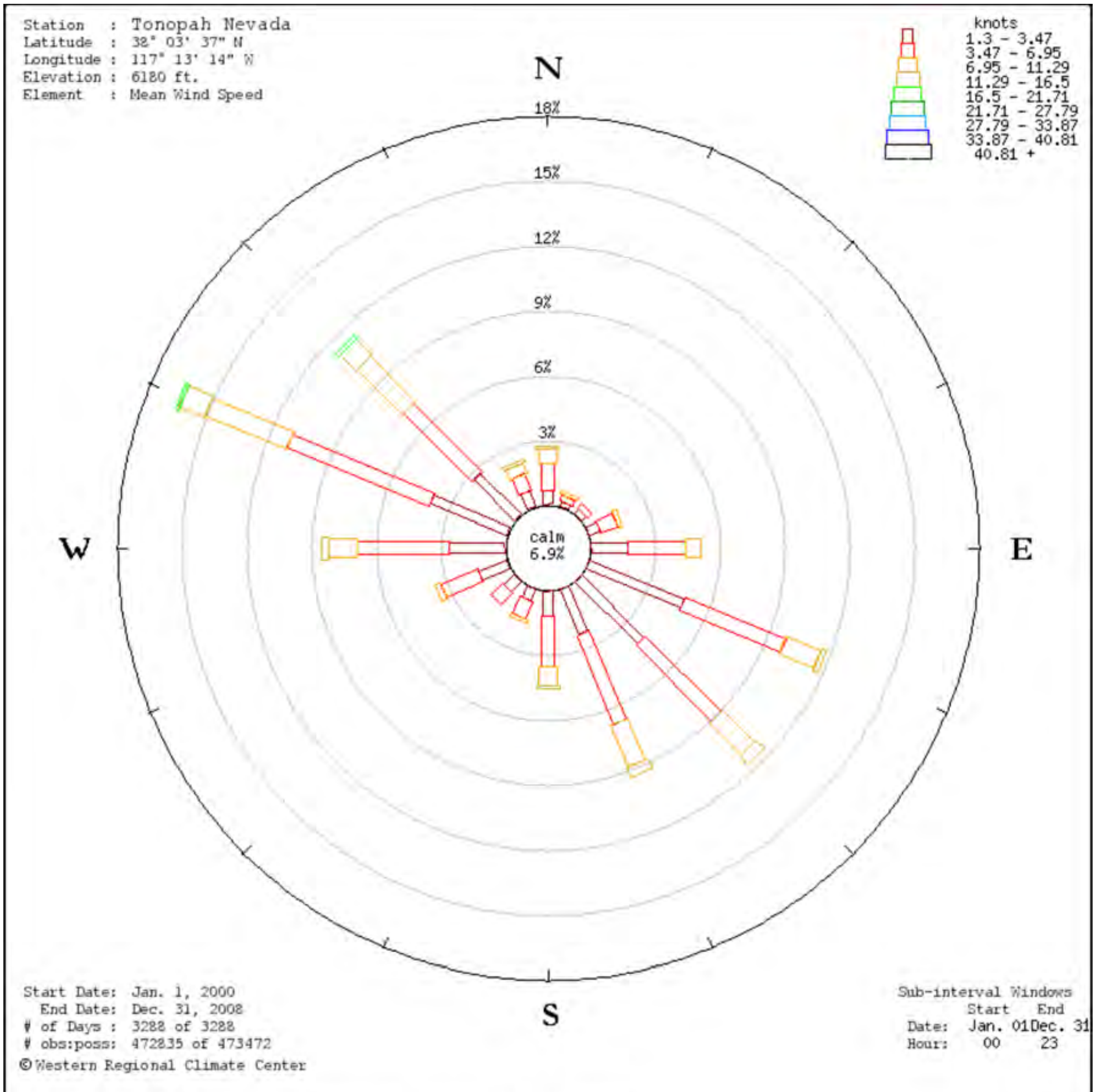
Source: SORD 2005.

Figure D–11 Annual Average Wind Rose for Tonopah Test Range Airport, 1981–2004

Calm winds occur about 4 percent of the hours at the Tonopah Test Range Airport (see Figure D–11) and about 7 percent of the hours at the Tonopah CEMP station (see Figure D–12), with calm conditions more frequent during the winter months and less frequent during the summer. The annual average wind speed at the Tonopah Test Range Airport is about 9 miles per hour (USAF 2003) and at the Tonopah CEMP, about 7 miles per hour (CEMP 2009). Wind speeds along the Cactus and Kawich Mountain Ranges tend to be stronger because they are more influenced by generally stronger upper-level winds. Seasonally, winds tend to be strongest in the spring due to frontal passages and weakest in the fall. Wind gusts in excess of about 55 miles per hour can be observed during springtime frontal passages and during summertime convective thunderstorms (Soulé 2006). Dust storms are common in the spring, when monthly average wind speeds reach about 16 miles per hour (DOE 2009e).

Cloud cover measurements used to estimate atmospheric stability are available from the Desert Rock site located in the southeastern corner of the NNSS, 90 miles southeast of the Tonopah Test Range Airport.

Based on data recorded from 1978 through 2004 at Desert Rock, stable conditions dominate at night, though stronger wind speeds will tend to mix the atmosphere, leading to neutral conditions. Nighttimes tend to be more stable during the summer and fall months because of lighter winds at night relative to the winter and spring periods. Since greater solar radiation leads to greater instability, unstable conditions dominate the daytime hours and the months with the greatest solar radiation (summer) (Soulé 2006). These stability patterns would be slightly modified within the TTR based primarily on wind speed differences and potentially on differences in local cloud cover relative to what occurs at Desert Rock.



Note: To convert knots to meters per second, multiply by 0.5144. To convert knots to miles per hour, multiply by 1.121.

Source: CEMP 2009.

Figure D–12 Annual Average Wind Rose for the Tonopah Test Range Community Environmental Monitoring Program Station, 2000–2008

D.1.4.2 Ambient Air Quality on or near the Tonopah Test Range

This section expands the ambient air quality discussion presented in Chapter 4, Section 4.4.8.2, of this *NNSS SWEIS*.

D.1.4.2.1 Existing Air Quality

Emissions from Onsite Stationary Sources. The emissions from the TTR generators and propane boilers were not explicitly available. However, the horsepower and activity data for the TTR air permit were available for each generator and boiler. This information, in conjunction with the EPA AP-42 emissions factors (EPA 1995a), was used to estimate maximum allowed emissions levels. The emissions from the TTR storage tanks were not explicitly available.

Table D–25 shows the estimated maximum allowed air emissions of criteria pollutants and HAPs from onsite stationary TTR activities. These estimates reflect both permitted facilities operating at maximum permitted capacity and non-permitted facilities operating at peak capacity. The data are approximately representative of 2007, but are assumed to be representative of 2008 as well.

Table D–25 Estimated Maximum Allowed Air Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Stationary Tonopah Test Range Activities (tons per year)

	Nye County						
	On Tonopah Test Range						
Pollutant	*Screening Plant*	*Diesel Generators*	*Gasoline Generators*	*Propane Boilers*	*Storage Tanks*	*TOTAL (all programs)*	*Reference*
PM_{10}	<2.7	<0.95	<0.00072	<0.000031	0	*<3.7*	NDEP 2007, page V-1–V-7 and Appendix; and EPA 1995a, pages 1.5-3 and 3.3-6
$PM_{2.5}$	<2.7	<0.95	<0.00072	<0.000031	0	*<3.7*	
CO	N/A	<2.9	<0.0070	<0.00032	0	*<2.9*	
NO_x	N/A	<13.3	<0.011	<0.00057	0	*<13.3*	
SO_2	N/A	<0.88	<0.00059	<0.033	0	*<0.91*	
VOCs	<0.35	<0.13	<0.13	N/A	<0.35	*<0.96*	
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	*<0.01*	
HAPs	<0.83	<0.21	<0.00049	N/A	<0.09	*<1.1*	NDEP 2007, page V-1–V-7 and Appendix; and EPA 1995a, page 3.3-7

< = less than; CO = carbon monoxide; N/A = not applicable; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to n micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Onsite Government-Owned Vehicle Mobile Sources. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to government vehicle traffic on the TTR. Onsite mobile source activity data were derived from the onsite TTR fleet count from the *1996 NTS EIS* (DOE 1996), the NNSS onsite government-owned vehicle counts in the 1999 NTS road renovation study (BN 1999), the NNSS onsite government-owned fuel usage data (see Section D.1.1.2), the current estimated TTR VMTs (SNL 2010), and the weekday/weekend traffic ratios used for the TTR commuters (see commuter discussion below). The same methodology for estimating lead emissions that was used for onsite government vehicles (see Section D.1.1.2.1) was also used for personal-vehicle commuter vehicles. **Table D–26** contains further details on the activity and vehicle data that were used. See Chapter 4, Section 4.1.3, for more details.

Table D–26 Vehicle Activity Data Used to Model Emissions from Onsite Government Vehicles at the Tonopah Test Range

Vehicle Type Observed [a]	*MOVES2010 Vehicle Type*	*MOBILE6 Vehicle Type*	*Count*	*Annual VMT*	*Percentage Annual VMT Occurring on Weekdays*	*Fuel Types Used*	*Average Vehicle Age (model year)*	*Vehicle Fuel Economy (miles per gallon)*	*VMT per Applicable Fuel Type*	*Annual Lead Emissions (pounds)*
Single-unit trucks (2 to 3 axles)	Single-unit, short-haul trucks	Light-duty trucks 6,001–8,500	6	64,928	97	Biodiesel (assumed to be B-20 for MOVES modeling) and No. 2 diesel	11 years (1997)	11.2	10,317 No. 2 diesel 54,611 B-20	0.0012
Cars/light trucks	Light-duty vehicles	Light-duty trucks All	43	380,216		E85 (assumed to be E10 for MOVES modeling) and unleaded gasoline	9 years (1999)	24.1	267,178 Unleaded gasoline 113,038 E-10	0.0017
Cars/light trucks	Light-duty passenger trucks	Light-duty trucks 0–6,000	42	504,008		E85 (assumed to be E10 for MOVES modeling) and unleaded gasoline	9 years (1999)	18.5	354,166 Unleaded gasoline 149,842 E10	0.0022

MOBILE6 = Mobile Source Emission Factor Model; MOVES2010 = Motor Vehicle Emission Simulator 2010; VMT = vehicle miles traveled.

[a] Vehicle types observed in *Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways, Nevada Test Site* (BN 1999).

Note: Modeling performed using MOVES2010.

Table D–27 shows the modeled current (approximately 2008) onsite mobile emissions of criteria pollutants and HAPs associated with TTR government vehicles. Total onsite emissions from stationary sources (shown in more detail in Table D–25) are also provided in Table D–27 to show the total onsite emissions from both stationary sources and government vehicle mobile sources.

The mobile source criteria pollutant emissions were dominated by carbon monoxide and nitrogen oxide emissions. Light-duty passenger trucks were the largest emitters (3.3 tons of criteria pollutants). Altogether, onsite TTR activities (mobile and stationary) emitted up to 26.5 tons of criteria pollutants and up to 1.1 tons of HAPs in 2008 if stationary sources were operating at maximum allowed levels.

Table D–27 Estimated Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Stationary Tonopah Test Range Sources and Mobile Sources, 2008 (tons per year)

	Nye County					
	On Tonopah Test Range					
	Government-Owned Mobile Source Type (Modeled)					
Pollutant	***Light-Duty Vehicles***	***Light-Duty Passenger Trucks***	***Single-Unit, Short-Haul Trucks***	***Total***	***Stationary Source Type (calculated)***	***Total***
PM_{10}	0.010	0.018	0.037	*0.065*	*<3.7*	<3.8
$PM_{2.5}$	0.0059	0.010	0.034	*0.050*	*<3.7*	<3.8
CO	0.84	2.6	0.15	*3.6*	*<2.9*	<4.5
NO_x	0.024	0.63	0.32	*0.97*	*<13.3*	<14.3
SO_2	0.0023	0.0043	0.00051	*0.0071*	*<0.91*	<0.92
VOCs	0.0095	0.054	0.041	*0.10*	*<0.96*	<1.1
Lead	0.0017	0.0022	0.00096	*0.0049*	*<0.01*	<0.015
HAPs	0.00089	0.0042	0.0046	*0.0097*	*<1.1*	<1.1

< = less than; CO = carbon monoxide; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.
Note: Mobile source activities are partitioned by source type. The source type partitioning of stationary source activities is shown in Table D–24.

Emissions from Commuter Mobile Sources. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic from employees commuting to the TTR using personal vehicles. **Table D–28** and the following discussion contain further details on the activity and vehicle data that were used. See Chapter 4, Section 4.1.3, for more details.

Table D–28 Vehicle Activity Data Used to Model Emissions from Commuting to and from the Tonopah Test Range

MOVES2010 Vehicle Type	***Annual VMT Within Clark County***	***Annual VMT Within Nye County but Outside the TTR***	***Annual VMT Within Nye County and Inside the TTR***	***Percentage Annual Clark County VMT Occurring on Weekdays***	***Percentage Annual Nye County VMT Outside of the TTR Occurring on Weekdays***	***Percentage Annual Nye County VMT Inside the TTR Occurring on Weekdays***	***Fuel Type Used***
Light-duty vehicles	138,902	574,804	16,978	100	97	92	Unleaded gasoline
Light-duty passenger trucks	138,902	574,804	16,978				

MOVES2010 = Motor Vehicle Emission Simulator 2010; TTR = Tonopah Test Range; VMT = vehicle miles traveled.
Note: Modeling performed using MOVES2010.

Private-vehicle commuter activity data were derived from employee count and residence information. For personal vehicle commuters, half were assumed to use light-duty vehicles and the other half were assumed to use light-duty passenger trucks. All personal-vehicle commuters were assumed to use only unleaded gasoline. The lead emissions factors for mobile sources in EPA's *Air Quality Criteria for Lead* (EPA 2006) were used for estimating lead emissions for TTR personal-vehicle commuter vehicles.

To estimate the personal-vehicle emissions taking place in various locations, it was assumed that all personal-vehicle commuters enter the TTR via Route 504 near the Tonopah Test Range Airport. All personal-vehicle commuters coming from Clark County were assumed to use U.S. Route 95, which means that about 75 percent of their commute (about 371 round-trip miles per vehicle) is within Nye County and outside of the TTR and about 24 percent of their commute (about 119 round-trip miles per vehicle) is within Clark County. Roads within Nye County were assumed to be rural roads with unrestricted access. For Clark County roads, the same Clark County road distribution used for NNSS commuter traffic was used for TTR commuters (see Section D.1.1.2.1).

MOVES default fuel market shares, meteorology, vehicle speed distributions, and monthly and hourly VMT distributions were used. Only running exhaust, brake wear, and tire wear were modeled. Average age for onsite government vehicles, light-duty vehicles, and light-duty passenger trucks was assumed to be 9 years old.

Table D–29 shows the modeled current (approximately 2008) mobile emissions of criteria pollutants and HAPs associated with onsite employees commuting to the TTR. Commuting activities included privately owned light-duty vehicles and light-duty passenger trucks. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic from employees commuting to the TTR. Private vehicle mobile source activity data were derived from employee count and residence information. See Chapter 4, Section 4.1.3, for more details on how commuter private vehicle activity data were determined.

Commuting activities related to the TTR emitted approximately 6.5 tons of criteria pollutants in 2008. Light-duty vehicles contributed about 31 percent towards this criteria pollutant total, while light-duty passenger trucks contributed the remainder. Carbon monoxide was emitted in the largest amounts at 5.1 tons. Commuting activities related to the TTR emitted approximately 0.0079 tons of HAPs in 2008. The majority (82 percent) of emissions related to commuting to the TTR took place in Nye County, most of which (98 percent) took place outside of the TTR. The remaining 18 percent of commuting emissions took place in Clark County.

Table D–29 Vehicle Activity Data Used to Model Emissions from Onsite Government Vehicles at the Tonopah Test Range (tons per year)

	Light-Duty Vehicles			***Light-Duty Passenger Trucks***			***Total***			
	Clark County	***Nye County***		***Clark County***	***Nye County***		***Clark County***	***Nye County***		
Pollutant		***Off TTR***	***On TTR***		***Off TTR***	***On TTR***		***Off TTR***	***On TTR***	***Total***
PM_{10}	0.0036	0.016	0.00046	0.0052	0.021	0.00062	*0.0087*	*0.037*	*0.0010*	*0.047*
$PM_{2.5}$	0.0019	0.0090	0.00026	0.0029	0.012	0.00035	*0.0048*	*0.021*	*0.00061*	*0.026*
CO	0.29	1.3	0.037	0.63	2.9	0.0085	*0.91*	*4.1*	*0.047*	*5.1*
NO_x	0.063	0.29	0.0087	0.16	0.73	0.022	*0.22*	*1.0*	*0.030*	*1.2*
SO_2	0.0010	0.0040	0.00012	0.0014	0.0056	0.00016	*0.0024*	*0.0095*	*0.00028*	*0.012*
VOCs	0.0034	0.015	0.00043	0.015	0.062	0.0018	*0.018*	*0.075*	*0.0022*	*0.095*
Lead	6.0×10^{-7}	1.3×10^{-6}	3.7×10^{-8}	6.1×10^{-7}	1.2×10^{-6}	3.7×10^{-8}	1.2×10^{-6}	2.5×10^{-6}	7.4×10^{-8}	3.8×10^{-6}
HAPs	0.00029	0.0014	0.000041	0.0011	0.0051	0.00015	*0.0014*	*0.0063*	*0.00019*	*0.0079*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.
Note: Modeling performed using MOVES2010.

Emissions from Commercial Vendor Mobile Sources. The MOVES2010 (Version 20091221; EPA 2009) mobile source model was used to estimate emissions due to vehicle traffic from nonradioactive waste transport (commercial vendors). **Table D–30** and the following discussion contain further details on the activity and vehicle data that were used. See Chapter 4, Section 4.1.3, for more details on the waste transport activity levels. Radioactive waste transport does not usually occur at the TTR, and it did not occur in 2008.

Table D–30 Vehicle Activity Data Used to Model Emissions from Commercial Vendors Traveling to and from the Tonopah Test Range

MOVES2010 Vehicle Type	*Daily Average Count*	*Annual VMT Within Clark County*	*Annual VMT Within Nye County but Outside the TTR*	*Annual VMT Within Nye County and Inside the TTR*	*Percentage Annual VMT Occurring on Weekdays*	*Fuel Type Used*
Single-unit, short-haul trucks	8	199,093	946,851	11,575	95	No. 2 diesel

MOVES2010 = Motor Vehicle Emission Simulator 2010; TTR = Tonopah Test Range; VMT = vehicle miles traveled.
Note: Modeling performed using MOVES2010.

Commercial vendor activity data were derived from employee count data. To estimate the commercial vendor emissions in various locations, all commercial vehicles (which are combination- and single-unit, short-haul trucks) were assumed to enter the TTR via Route 504.

MOVES default fuel supply market shares, meteorology, vehicle speed distribution, and monthly and hourly VMT distributions were used in the analysis. Only running exhaust, brake wear, and tire wear were modeled. As was done for NNSS onsite government vehicles, combination- and single-unit, short-haul trucks were assumed to have an average age of 11 years. All roads in Nye County were assumed to be rural roads with unrestricted access. For Clark County roads, the same Clark County road distribution used for NNSS commuter traffic was used for TTR commercial vendors (see Section D.1.1.2.1).

Table D–31 shows the modeled current (approximately 2008) mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the TTR. Commercial vendor activities related to the TTR emitted approximately 10.2 tons of criteria pollutants in 2008. Nitrogen oxides were emitted in by far the largest amounts (5.9 tons) among the criteria pollutants. Commercial vendor activities related to the TTR emitted approximately 0.12 tons of HAPs in 2008. The majority (82 percent) of emissions related to TTR commercial vendors took place in Nye County, with most of those emissions (99 percent) taking place outside of the TTR. About 18 percent of TTR-related commercial vendor emissions took place in Clark County.

Table D–31 Estimated Annual Emissions of Criteria Pollutants and HAPs from Commercial Vendors Traveling to and from the Tonopah Test Range, 2008 (tons per year)

	Single-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off TTR, Off NNSS***	***On TTR***	***Total***
PM_{10}	0.12	0.54	0.0066	*0.67*
$PM_{2.5}$	0.11	0.5	0.0061	*0.62*
CO	0.49	2.2	0.027	*2.7*
NO_x	1.1	4.7	0.058	*5.9*
SO_2	0.002	0.0087	0.00011	*0.011*
VOCs	0.16	0.72	0.0088	*0.89*
Lead	1.9×10^{-6}	8.9×10^{-6}	1.1×10^{-7}	*0.000011*
HAPs	0.021	0.095	0.0012	*0.12*

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; NNSS = Nevada National Security Site; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

D.1.4.3 Climate Change

Greenhouse gas emissions due to TTR activities were calculated using the EPA Climate Leaders Simplified Greenhouse Gas Emissions Calculator (EPA 2010). The typical annual electricity consumption by TTR activities (595,000 kilowatt-hours) was provided by DOE (2008g). This electricity consumption was assumed to be representative of calendar year 2008. The TTR purchased electricity off of the Northwest Power Pool (Western Electric Coordinating Council Northwest) eGRID subregion. The permitted stationary sources at the TTR are not associated with combustion and should generate no greenhouse gases. The carbon dioxide emissions from onsite, nonpermitted diesel generators and propane boilers were not calculated using the Greenhouse Gas Emissions Calculator, but rather were calculated using maximum operating hours, maximum horsepower, maximum energy usage (NDEP 2007), and the EPA AP-42 emissions factors database (EPA 1995a).

For carbon dioxide emissions by onsite government vehicles, greenhouse gas emissions were estimated using vehicle fuel consumption. For each vehicle type, given how many VMTs were estimated for each applicable fuel type (see Table D–26), the amount of each fuel type consumed was estimated using those VMTs and the estimated vehicle fuel economies (see Table D–26). For nitrous oxide and methane emissions by onsite government vehicles, and for greenhouse gas emissions by all other NNSS-related vehicles, the VMT by each vehicle type and each fuel type (see Table D–26) were used. For the purposes of greenhouse gas emissions calculations, ethanol-consuming light-duty vehicles and light-duty passenger trucks were considered light-duty vehicles, gasoline-consuming light-duty passenger trucks were considered light-duty trucks, and all No. 2 diesel-consuming vehicles were considered heavy-duty vehicles. All other vehicle type and fuel type combinations had obvious matches in the Greenhouse Gas Emissions Calculator.

D.2 Environmental Consequences

D.2.1 Nevada National Security Site

D.2.1.1 No Action Alternative

D.2.2 Emissions on and near the Nevada National Security Site

Emissions from Construction Activities. Construction emissions for the proposed solar power generation facility were scaled based on the generating capacity of the Amargosa Farm Road Solar Energy Project Environmental Impact Statement (BLM 2010). Emissions for criteria pollutants under construction and operations were scaled based on total energy output of the solar power generation facility.

Emissions from Stationary Sources. No specific changes to the operation of established stationary sources on the NNSS are anticipated under the No Action Alternative. See Chapter 4, Section 4.1.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources. Emissions from stationary sources required for the operation of the proposed solar power generation facility are included with the stationary source emissions in the No Action Alternative. Operation emissions for the solar power generation facility are based on the operation of the auxiliary boiler for startup, weekly diesel generator testing, cooling tower operations, HTF ullage system vent, and maintenance vehicles operated at the site.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the NNSS. Section D.1.1.2.1 describes how onsite government-owned vehicle activity data representative of 2008 were derived. PM_{10} and $PM_{2.5}$ emissions from the diesel fueled vehicles are included in the total PM_{10} and $PM_{2.5}$ throughout the analysis. Actions on efforts to mitigate diesel emissions are discussion in Chapter 7, Section 7.9. For the No Action Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled up 9 percent, corresponding to the increase in NNSS employees (including solar power generation facility contractors) for the No Action Alternative compared to the 2008 baseline. The modeling for the No Action Alternative used 2015 as the midpoint year (relative to 2008 baseline year) and the MOVES national default age distributions for each vehicle type to determine the total mobile source emissions. By 2015, all gasoline-type vehicles in this area of Nevada are assumed by MOVES to be run on ethanol blends, while diesel-type vehicles (buses and short-haul trucks) are operating on the same fraction of No. 2 diesel and biodiesel as in 2008.

Table D–32 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NNSS government-owned vehicles under the No Action Alternative. Total onsite emissions from stationary sources are also provided in Table D–32 to show the total onsite emissions from both stationary sources and government-owned vehicle mobile sources. Despite a 9 percent increase in VMTs, these modeled No Action Alternative emissions are about 30 percent lower overall than the 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–32 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Nevada National Security Site Stationary Sources and Government-Owned Mobile Sources Under the No Action Alternative, 2015 (tons per year)

	Nye County						
	Government-Owned Mobile Source Type (Modeled)						
Pollutant	***Light-Duty Vehicles***	***Light-Duty Passenger Trucks***	***Buses***	***Single-Unit, Short-Haul Trucks***	***Total***	***Stationary Source Type (calculated)***	***Total***
PM_{10}	0.12	0.23	0.097	0.41	0.86	4.0	5.7
$PM_{2.5}$	0.067	0.14	0.092	0.38	0.68	1.4	2.8
CO	9.0	18.6	0.22	1.7	29.5	2.6	61.6
NO_x	0.84	2.5	0.74	3.4	7.5	4.0	19.0
SO_2	0.029	0.05	0.00021	0.0010	0.080	0.21	0.37
VOCs	0.12	0.31	0.0090	0.071	0.51	1.8	2.8
Lead	0.000010	0.000013	7.2×10^{-7}	7.3×10^{-6}	0.000031	<0.03	<0.030
HAPs	0.011	0.028	0.00020	0.0015	0.041	~0.1	~0.18

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Personal Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to NNSS employees and solar power generation facility contract employees traveling to and from the NNSS in personal vehicles. However, the NNSS bus fleet was calculated separately because, by 2015, the fleet will be using buses that meet the 2010 EPA heavy-duty diesel emission standards.

Section D.1.1.2.1 describes how personal commuter vehicle activity data representative of 2008 were derived. For the No Action Alternative, the 2008 personal commuter vehicle activity data (vehicle counts and VMTs) were scaled up 9 percent, corresponding to the increase in NNSS employees (including solar power generation facility contractors) under the No Action Alternative compared to the 2008 baseline. The number of employee transit buses needed under the No Action Alternative was also scaled up 9 percent from the number needed for the 2008 baseline. The total transit bus VMTs under the No Action Alternative were derived based on the 2008 baseline VMT-per-bus ratio. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type (compared to single). By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends

Table D–33 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NNSS employee commuters traveling to and from the NNSS under the No Action Alternative. Despite a 9 percent increase in VMTs, these modeled No Action Alternative emissions are about 37 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–33 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Nevada National Security Site Under the No Action Alternative, 2015 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Transit Buses*			*Total*			
		Nye County			*Nye County*			*Nye County*			*Nye County*		
Pollutant	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Total*
PM_{10}	0.27	0.081	0.012	0.42	0.13	0.020	0.024	0.0011	0.0083	0.71	0.21	0.040	0.97
$PM_{2.5}$	0.14	0.046	0.007	0.23	0.076	0.012	0.024	0.0011	0.0083	0.39	0.12	0.027	0.54
CO	20.8	5.7	0.87	44.3	13.0	2.0	1.2	0.057	0.43	66.3	18.8	3.3	88.4
NO_x	2.9	0.85	0.13	9.0	2.6	0.39	0.47	0.022	0.17	12.4	3.5	0.69	16.5
SO_2	0.071	0.019	0.0029	0.93	0.025	0.0038	0.011	0.00051	0.0039	1.0	0.045	0.011	1.1
VOCs	0.39	0.12	0.019	1.4	0.40	0.62	N/A	N/A	N/A	1.8	0.52	0.64	2.9
Lead	0.000024	6.7×10^{-6}	1.0×10^{-6}	0.000024	6.7×10^{-6}	1.0×10^{-6}	3.7×10^{-6}	1.7×10^{-7}	1.3×10^{-6}	0.000052	0.000014	3.3×10^{-6}	0.000069
HAPs	0.031	0.011	0.0016	0.11	0.032	0.0049	N/A	N/A	N/A	0.14	0.043	0.0065	0.19

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commuter Vehicles Used by Construction Employees. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to construction employees commuting to and from the NNSS in personal vehicles. The 2010 EPA heavy-duty mobile emission standards were used to estimate nitrogen oxides and PM emissions due to commuters using transit buses. The 2010 standard does not specifically improve carbon monoxide emission standards, but the MOVES model suggests that, by 2015, emissions will improve to about 2.4 grams per mile.

These construction employees were assumed to reside in central-west Las Vegas and to commute an average distance of 66 miles each way to and from the NNSS during weekdays only. Similar to regular NNSS employees, half of the construction employees were assumed to commute via personal vehicles, while the remaining half was assumed to use transit buses. Because new construction is anticipated to take place over the next few years, the modeling for the No Action Alternative used 2011 as the modeling year and the MOVES national default age distributions for each vehicle type. The same passenger-to-bus and VMT-to-bus ratios used for the 2008 baseline were used for the No Action Alternative analysis.

Table D–34 shows the modeled 2011 annual onsite mobile emissions of criteria pollutants and HAPs associated with construction employee commuters traveling to and from the NNSS under the No Action Alternative.

Table D–34 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Construction Employees Commuting to and from the Nevada National Security Site Under the No Action Alternative, 2015 (tons per year)

Pollutant	*Light-Duty Vehicles*			*Light-Duty Passenger Trucks*			*Transit Buses*			*Total*			
		Nye County			*Nye County*			*Nye County*			*Nye County*		
	Clark County	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Total*
PM_{10}	0.044	0.0093	0.0031	0.065	0.013	0.0045	0.0059	0.00028	0.0021	0.11	0.023	0.0097	0.15
$PM_{2.5}$	0.023	0.0056	0.0019	0.035	0.0085	0.0028	0.0059	0.00028	0.0021	0.064	0.014	0.0068	0.085
CO	3.7	0.84	0.28	7.2	1.7	0.57	0.30	0.014	0.11	11.2	2.6	0.96	14.7
NO_x	0.73	0.17	0.058	1.5	0.37	0.12	0.12	0.0055	0.042	2.4	0.55	0.22	3.1
SO_2	0.010	0.0022	0.00072	0.014	0.0029	0.00096	0.0027	0.00013	0.00096	0.027	0.0052	0.0026	0.035
VOCs	0.11	0.026	0.0086	0.29	0.061	0.020	N/A	N/A	N/A	0.40	0.087	0.029	0.52
Lead	2.9×10^{-6}	6.9×10^{-7}	2.3×10^{-7}	2.9×10^{-6}	6.9×10^{-7}	2.3×10^{-7}	9.2×10^{-7}	4.3×10^{-8}	3.2×10^{-7}	6.7×10^{-6}	1.4×10^{-6}	7.8×10^{-7}	8.9×10^{-6}
HAPs	0.0083	0.0021	0.00070	0.021	0.0048	0.0016	N/A	N/A	N/A	0.029	0.0069	0.0023	0.039

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from the NNSS. Section D.1.1.2.1 describes how commercial vendor vehicle activity data representative of 2008 were derived. For the No Action Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled up 9 percent, corresponding to the increase in NNSS employees (including solar power generation facility contractors) under the No Action Alternative compared to the 2008 baseline. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks.

Table D–35 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS under the No Action Alternative. Despite a 9 percent increase in VMTs, these modeled No Action Alternative emissions are about 59 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–35 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the Nevada National Security Site Under the No Action Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.096	0.012	0.043	0.15
$PM_{2.5}$	0.078	0.010	0.036	0.12
CO	0.36	0.049	0.17	0.58
NO_x	0.96	0.12	0.43	1.5
SO_2	0.0022	0.00027	0.00095	0.0034
VOCs	0.10	0.014	0.049	0.16
Lead	4.1×10^{-6}	5.6×10^{-7}	2.0×10^{-6}	6.7×10^{-6}
HAPs	0.014	0.0018	0.0064	0.022

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Radioactive Waste Trucks. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to radioactive waste trucks traveling to and from the NNSS. Section D.1.1.2.1 describes how radioactive waste truck activity data representative of 2008 were derived. Based on the anticipated radioactive waste projections under the No Action Alternative, these 2008 VMT data were scaled up about 250 percent. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for combination-unit, short-haul trucks.

Table D–36 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS under the No Action Alternative. Despite about a 250 percent increase in VMTs, these modeled No Action Alternative emissions are about 1 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–36 Estimated 2015 Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the Nevada National Security Site Under the No Action Alternative (tons per year)

Pollutant	*Combination-Unit, Short-Haul Trucks*			
		Nye County		
	Clark County	*Off NNSS*	*On NNSS*	*Total*
PM_{10}	0.20	0.55	0.031	0.78
$PM_{2.5}$	0.17	0.49	0.027	0.68
CO	0.56	1.6	0.088	2.2
NO_x	2.5	7.2	0.40	10.1
SO_2	0.0056	0.016	0.00088	0.022
VOCs	0.11	0.31	0.017	0.44
Lead	3.5×10^{-6}	0.000011	6.1×10^{-7}	0.000015
HAPs	0.014	0.041	0.0023	0.057

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Explosive and Open Detonation Tests. Conventional high-explosives experiments are anticipated under the No Action Alternative. These experiments may be conducted underground or at or above the ground surface. The air emissions from these explosive experiments have been estimated based on actual experiments and their associated emissions conducted at BEEF in 2008 (see Table D–2 for the 2008 BEEF emissions).

Under the No Action Alternative, up to 20 conventional high-explosives experiments may be conducted at BEEF per year and up to 10 per year at other Nuclear and High Explosives Test Zone locations, using up to 70,000 TNT [2,4,6-trinitrotoluene]-equivalent pounds of explosives. **Table D–37** shows the estimated emissions from these explosive tests under the No Action Alternative. These emissions were estimated by scaling the 2008 BEEF emissions (when 2.55 tons of explosives were used) up to a maximum of 70,000 pounds of explosives per 12-month period. All modeled concentrations where the general public may have access were modeled to be below the ambient air quality standards.

Table D–37 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Conventional High-Explosives Experiments Under the No Action Alternative (tons per year) [a]

Pollutant	*Nye County*
	On NNSS
PM_{10}	0.14
$PM_{2.5}$	0.14
CO	2.3
NO_x	0
SO_2	0
VOCs	0.014
Lead	N/A
HAPs	N/A

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] These emissions may be considered maximum, as they are scaled from the amount of TNT-equivalent explosives used at BEEF in 2008 (2.55 tons) up to 35 tons (70,000 pounds) of TNT-equivalent explosives per 12-month period.

D.2.2.1 Expanded Operations Alternative

D.2.2.1.1 Emissions on and near the Nevada National Security Site

Emissions from Construction Activities. New construction activities at the NNSS under the Expanded Operations Alternative are presented in **Table D–38**.

Table D–38 Summary of All New Buildings Under the Expanded Operations Alternative

Building Type	***Location***	***Approximate Size of Building(s) Floor Space (square feet)***	***Years of Construction***
Miscellaneous New Facilities [a]	Area 17	89,000	4
Arms Control Building	TBD	10,000	3
Counterterrorism Building	TBD	10,000	3
Work for Others Program	Counterterrorism	10,000	3
Work for Others Program	Future Counterterrorism	10,000	3
Work for Others Program Aerial Platforms	Desert Rock Airport	200,000	3
Work for Others Program Aerial Platforms	Area 6 Hangar	20,000	3
Work for Others Program Aerial Platforms	Unknown location	5,000	3
Work for Others Program Active Interrogation of Nuclear Materials	Area 12 or 16	10,000	2
Work for Others Program Test Bed Applications - New Facility	TBD	50,000	3
Waste Management Program New Facility	Area 23	5,000	1
Waste Management Program New Facility for Solar Support	Area 25	5,000	1
Total Size (square feet)		424,400	

TBD = to be determined.
[a] Represents the sum of all new facilities under "Conduct Training for Office of Secure Transportation."

Emissions of PM_{10} due to construction activities were calculated using the Western Regional Air Partnership's (*WRAP) Fugitive Dust Handbook* (WGA 2006). A general emission factor of 0.11 tons of PM_{10} per acre-month was used for all construction activities. Due to the scale of each project, it was estimated that only 10 percent of the total site would be disturbed in any 1-month period. Periodic watering of the disturbed areas would reduce the fugitive dust emissions by 74 percent per WRAP guidance. Equation D–1 was used to determine PM_{10} emissions from new construction activities.

Equation D–1. PM_{10} emissions from general construction activities per year.

PM_{10} EmissionsC = EFC x AcrePerMonth x Months x (1-ContEff) / TotalYears

Where:

PM_{10} EmissionsC = Total PM_{10} emissions per year due to new construction activities under the Expanded Operations Alternative

EFC = Emission factor for general construction activities (0.11 tons PM_{10} per acre-month)

AcrePerMonth = Total acres disturbed per month

Months = Total number of months to complete construction on entire sire (assumed to be 10)

ContEff = Control efficiency of daily water application to disturbed site (0.74)

TotalYears = Total length of construction period in years

Road construction was calculated with an average emission factor of 0.42 tons PM_{10} per acre-month following the WRAP handbook. The number of miles disturbed was calculated using local and minor roads ("Group 4") presented in the WRAP handbook. Equation D–2 is the final equation used to determine PM_{10} emissions from new road construction.

Equation D–2. PM_{10} emissions from road construction activities per year

PM_{10} EmissionsR = EFR x AcrePerMonth x Months x (1-ContEff) / TotalYears

Where:

PM_{10} EmissionsR = Total PM_{10} emissions per year due to new road construction activities under the Expanded Operations Alternative

EFR = Emission factor for road construction activities (0.42 tons PM_{10} per acre-month)

AcrePerMonth = Total acres disturbed per month (assumed to be 10 percent of total disturbed site). Total acres were calculated by multiplying total miles of new road (20 miles) by the miles-to-acres conversion factor (7.9 acres per mile) (WGA 2006).

Months = Total number of months to complete construction on entire sire (assumed to be 10)

ContEff = Control efficiency of daily water application to disturbed site (0.74)

TotalYears = Total length of construction period in years

Emissions from construction vehicles during new construction were scaled from the Caliente Rail Corridor Analysis Report (BSC 2007). Emissions for criteria pollutants were scaled based on the building footprint size (number of square feet).

Construction emissions for the proposed solar power generation facility were scaled based on generating capacity from the *Amargosa Farm Road Solar Energy Project Environmental Impact Statement* (BLM 2010). Emissions for criteria pollutants under construction and operations were also scaled based on generating capacity of the solar power generation facility.

Emissions from Stationary Sources. No specific changes to the operation of established stationary sources on the NNSS are anticipated under the Expanded Operations Alternative. See Chapter 4, Section 4.1.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources. Emissions from stationary sources required for the operation of the proposed solar power generation facility are included with the stationary source emissions under the Expanded Operations Alternative. Operation emissions for the solar power generation facility are based on the operation of the auxiliary boiler for start-up, weekly testing of diesel generators, cooling tower operations, HTF ullage system vent, and maintenance vehicles that operate exclusively onsite at the solar power generation facility.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the NNSS. Section D.1.1.2.1 describes how onsite government-owned vehicle activity data representative of 2008 were derived. For the Expanded Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled up 37 percent, corresponding to the increase in NNSS employees (including solar power generation facility contractors) under the Expanded Operations Alternative compared to the 2008 baseline. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type (compared to single, averaged age values for the baseline). By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends, while diesel-type vehicles are assumed to still consume the same fractions of No. 2 diesel and biodiesel that were determined for the 2008 baseline.

Table D–39 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NNSS government-owned vehicles under the Expanded Operations Alternative. Total onsite emissions from stationary sources (shown in more detail in Table D–3) are also shown in Table D–39 to show the total onsite emissions from both stationary sources and government-owned vehicle mobile sources. Despite a 37 percent increase in VMTs, these modeled Expanded Operations Alternative emissions are about 12 percent lower than the 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Emissions from Personal Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to NNSS employees and solar power generation facility contract employees commuting to and from the NNSS in personal vehicles. The 2010 EPA heavy-duty mobile emission standards were used to estimate nitrogen oxides and PM emissions from NNSS transit buses. The current 15 parts per million standard for sulfur dioxide was assumed to still apply. Section D.1.1.2.1 describes how personal commuter vehicle activity data representative of 2008 were derived.

For the Expanded Operations Alternative, the 2008 personal commuter vehicle activity data (vehicle counts and VMTs) were scaled up 37 percent, corresponding to the increase in NNSS employees (including solar power generation facility contractors) under the Expanded Operations Alternative compared to the 2008 baseline. The number of employee transit buses needed under the Expanded Operations Alternative was also scaled up 37 percent from the number needed for the 2008 baseline. The total transit bus VMTs under the Expanded Operations Alternative were derived based on the 2008 baseline VMT-per-bus ratio. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type (compared to single, averaged age values for the baseline). By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends.

Table D–39 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Nevada National Security Site Stationary Sources and Government-Owned Mobile Sources Under the Expanded Operations Alternative, 2015 (tons per year) [a]

Pollutant	*Clark County – On NNSS – Government-Owned Mobile Source Type (Modeled)*: *Light-Duty Vehicles*	*Light-Duty Passenger Trucks*	*Buses*	*Single-Unit, Short-Haul Trucks*	*Total*	*Stationary Source Type (calculated)*	*Total*
PM_{10}	0.15	0.29	0.12	0.51	1.1	16.2	18.4
$PM_{2.5}$	0.084	0.18	0.12	0.48	0.86	5.1	6.8
CO	11.3	23.4	0.28	2.1	37.1	7.9	82.1
NO_x	1.1	3.1	0.93	4.3	9.4	5.8	24.6
SO_2	0.036	0.063	0.00026	0.0013	0.10	0.68	0.88
VOCs	0.15	0.39	0.011	0.089	0.64	5.6	6.9
Lead	0.000013	0.000016	9.0×10^{-7}	9.2×10^{-6}	0.000039	<0.010	~0.010
HAPs	0.014	0.035	0.00025	0.0019	0.051	~0.1	~0.20

< = less than; ~ = approximately; CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] Government-owned mobile source activities are partitioned by source type.

Table D–40 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NNSS employee commuters traveling to and from the NNSS under the Expanded Operations Alternative. Despite a 37 percent increase in VMTs, these modeled Expanded Operations Alternative emissions are about 21 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Emissions from Commuter Vehicles Used by Construction Employees. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to construction employees commuting to and from the NNSS in personal vehicles. The 2010 EPA heavy-duty mobile emission standards were used to estimate nitrogen oxides and PM emissions due to commuters using transit buses. The current 15 parts per million standard for sulfur dioxide was assumed to still apply.

These construction employees were assumed to reside in central-west Las Vegas and to commute an average distance of 66 miles each way to and from the NNSS during weekdays only. Similar to regular NNSS employees, half of the construction employees were assumed to commute via personal vehicles, while the remaining half was assumed to use transit buses. Because new construction is anticipated to take place over the next few years, the modeling for the Expanded Operations Alternative used 2011 as the modeling year and the MOVES national default age distributions for each vehicle type. The same passenger-to-bus and VMT-to-bus ratios used for the 2008 baseline were used for the Expanded Operations Alternative analysis.

Table D–41 shows the modeled 2011 annual onsite mobile emissions of criteria pollutants and HAPs associated with construction employee commuters traveling to and from the NNSS under the Expanded Operations Alternative.

Table D–40 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Nevada National Security Site Under the Expanded Operations Alternative, 2015 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Transit Buses*			*Total*			
		Nye County			*Nye County*			*Nye County*			*Nye County*		
Pollutant	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.34	0.10	0.015	0.53	0.16	0.025	0.030	0.0014	0.010	0.89	0.26	0.050	1.2
$PM_{2.5}$	0.18	0.058	0.0088	0.29	0.096	0.015	0.030	0.0014	0.010	0.49	0.15	0.034	0.68
CO	26.1	7.2	1.1	55.7	16.3	2.5	1.5	0.072	0.54	83.3	23.6	4.1	111.1
NO_x	3.6	1.1	0.16	11.3	3.3	0.49	0.59	0.028	0.21	15.6	4.4	0.87	20.7
SO_2	0.089	0.024	0.0036	1.2	0.031	0.0048	0.014	0.00064	0.0049	1.3	0.057	0.014	1.4
VOCs	0.49	0.15	0.024	1.8	0.50	0.78	N/A	N/A	N/A	2.3	0.65	0.80	3.6
Lead	0.000030	8.4×10^{-6}	1.3×10^{-6}	0.000030	8.4×10^{-6}	1.3×10^{-6}	4.7×10^{-6}	2.1×10^{-7}	1.6×10^{-6}	0.000065	0.000018	4.1×10^{-6}	0.000087
HAPs	0.039	0.014	0.0020	0.14	0.040	0.0062	N/A	N/A	N/A	0.18	0.054	0.0082	0.24

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table D–41 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Construction Employees Commuting to and from the Nevada National Security Site Under the Expanded Operations Alternative, 2011 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Transit Buses*			*Total*			
		Nye County			*Nye County*			*Nye County*			*Nye County*		
Pollutant	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Clark County***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.066	0.014	0.0047	0.098	0.020	0.0068	0.0089	0.00042	0.0032	0.17	0.035	0.015	0.23
$PM_{2.5}$	0.035	0.0084	0.0029	0.053	0.013	0.0042	0.0089	0.00042	0.0032	0.096	0.021	0.010	0.13
CO	5.6	1.3	0.42	10.8	2.6	0.86	0.45	0.021	0.17	16.8	3.9	1.4	22.1
NO_x	1.1	0.26	0.087	2.3	0.56	0.18	0.18	0.0083	0.063	3.6	0.83	0.33	4.7
SO_2	0.015	0.0033	0.0011	0.021	0.0044	0.0014	0.0041	0.00020	0.0014	0.041	0.0078	0.0039	0.053
VOCs	0.17	0.039	0.013	0.44	0.092	0.030	N/A	N/A	N/A	0.60	0.13	0.044	0.78
Lead	4.4×10^{-6}	1.0×10^{-6}	3.5×10^{-7}	4.4×10^{-6}	1.0×10^{-6}	3.6×10^{-7}	1.4×10^{-6}	6.5×10^{-8}	4.8×10^{-7}	0.000010	2.1×10^{-6}	12×10^{-6}	0.000013
HAPs	0.012	0.0032	0.0011	0.032	0.0072	0.0024	N/A	N/A	N/A	0.044	0.010	0.0035	0.059

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from the NNSS. Section D.1.1.2.1 describes how commercial vendor vehicle activity data representative of 2008 were derived. For the Expanded Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled up 37 percent, corresponding to the increase in NNSS employees (including solar power generation facility contractors) for the Expanded Operations Alternative compared to the 2008 baseline. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks (compared to a single, averaged age value for the baseline).

Table D–42 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS under the Expanded Operations Alternative. Despite a 37 percent increase in VMTs, these modeled Expanded Operations Alternative emissions are about 49 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–42 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the Nevada National Security Site Under the Expanded Operations Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	*Clark County*	*Off NNSS*	*On NNSS*	*Total*
PM_{10}	0.12	0.015	0.054	0.19
$PM_{2.5}$	0.098	0.013	0.045	0.16
CO	0.45	0.062	0.21	0.72
NO_x	1.2	0.15	0.54	1.9
SO_2	0.0028	0.00034	0.0012	0.0043
VOCs	0.13	0.018	0.062	0.21
Lead	5.2×10^{-6}	7.0×10^{-7}	2.6×10^{-6}	8.4×10^{-6}
HAPs	0.018	0.0023	0.0080	0.028

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Radioactive Waste Trucks. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to radioactive waste trucks traveling to and from the NNSS. Section D.1.1.2.1 describes how radioactive waste truck activity data representative of 2008 were derived. The same number of trucks (12) was used for both the 2008 baseline and the Expanded Operations Alternative. Based on the anticipated radioactive waste needs under the Expanded Operations Alternative, these 2008 VMT data were scaled up about 550 percent. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to 2008 for the baseline) and the MOVES national default age distributions for combination-unit, short-haul trucks (compared to a single, averaged age value for the baseline).

Table D–43 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS under the Expanded Operations Alternative. Despite about a 550 percent increase in VMTs, these modeled Expanded Operations Alternative emissions increased by 88 percent overall compared to the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–43 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the Nevada National Security Site Under the Expanded Operations Alternative, 2015 (tons per year)

	Combination-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.37	1.0	0.058	1.5
$PM_{2.5}$	0.32	0.91	0.05	1.3
CO	1.0	3.0	0.16	4.1
NO_x	4.6	13.3	0.74	18.8
SO_2	0.010	0.03	0.0016	0.041
VOCs	0.20	0.58	0.032	0.82
Lead	6.5×10^{-6}	0.000020	1.1×10^{-6}	0.000028
HAPs	0.026	0.076	0.0043	0.11

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Explosive and Open Detonation Tests. The dynamic experiments anticipated under the Expanded Operations Alternative would use considerably less explosive material than was used at BEEF in 2008. These experiments also would be underground, with little to no air releases. Thus, air emissions from these dynamic experiments are anticipated to be much less than those from BEEF in 2008 (see Table D–3 for 2008 BEEF emissions).

Up to 100 annual conventional high-explosives tests and experiments may be conducted at Nuclear and High Explosives Test Zone locations, using up to 120,000 TNT-equivalent pounds of explosives (with no more than 70,000 TNT-equivalent pounds of explosives used at BEEF). **Table D–44** shows the estimated emissions from these explosive tests under the Expanded Operations Alternative. These emissions were estimated by scaling the 2008 BEEF emissions (when 2.55 tons of explosives were used) up to a maximum of 120,000 pounds of explosives per 12-month period. The modeled maximum offsite concentrations were: 24-hour average PM_{10} concentration (about 84 micrograms per cubic meter), 24-hour average $PM_{2.5}$ concentration (about 15 micrograms per cubic meter), and annual average $PM_{2.5}$ concentration (less than 1 microgram per cubic meter), all of which would likely occur a few miles east of the Amargosa Valley, but would be well below their respective NAAQS levels (150 micrograms per cubic meter, 35 micrograms per cubic meter, and 15 micrograms per cubic meter, respectively). Even when combined with background concentrations of 39 micrograms per cubic meter, 3.6 micrograms per cubic meter, and 2.0 micrograms per cubic meter, respectively, these offsite concentrations would still be well below NAAQS levels.

Table D–44 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Nevada National Security Site Conventional High-Explosives Tests Under the Expanded Operations Alternatives (tons per year) [a]

Pollutant	*Nye County*
	On NNSS
PM_{10}	0.24
$PM_{2.5}$	0.24
CO	4
NO_x	0
SO_2	0
VOCs	0.024
Lead	Not applicable
HAPs	Not applicable

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] These emissions may be considered "worst-case" because they are scaled from the amount of TNT-equivalent explosives used at BEEF in 2008 (2.55 tons) up to 60 tons (120,000 pounds) of TNT-equivalent explosives per 12-month period.

D.2.2.2 Reduced Operations Alternative

D.2.2.2.1 Emissions on and near the Nevada National Security Site

Emissions from Construction Activities. Construction emissions for the proposed solar power generation facility were scaled from the Amargosa Farm Road Solar Energy Project Environmental Impact Statement (BLM 2010). Emissions for criteria pollutants under construction and operations were scaled based on total energy output of the solar power generation facility.

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on the NNSS are anticipated under the Reduced Operations Alternative. See Chapter 4, Section 4.1.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the NNSS. For the Reduced Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled down by 3 percent, corresponding to the decrease in NNSS employees (including solar power generation facility contractors) for the Reduced Operations Alternative compared to the 2008 baseline. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type (compared to single, averaged age values for the baseline). By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends, while diesel-type vehicles are assumed to still consume the same fractions of No. 2 diesel and biodiesel that were determined for the 2008 baseline.

Table D–45 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NNSS government-owned vehicles under the Reduced Operations Alternative. Total onsite emissions from stationary sources are provided in Table D–45 to show the total onsite emissions from both stationary sources and government-owned vehicle mobile sources. Despite only a 3 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 38 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–45 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Nevada National Security Site Stationary Sources and Government-Owned Mobile Sources Under the Reduced Operations Alternative, 2015 (tons per year) [a]

Pollutant	*Clark County*						
	On NNSS						
	Government-Owned Mobile Source Type (Modeled)					*Stationary Source Type (calculated)*	*Total*
	Light-Duty Vehicles	*Light-Duty Passenger Trucks*	*Buses*	*Single-Unit, Short-Haul Trucks*	*Total*		
PM_{10}	0.11	0.20	0.086	0.36	0.77	0.22	0.98
$PM_{2.5}$	0.060	0.12	0.082	0.34	0.61	0.22	0.82
CO	8.0	16.6	0.20	1.5	26.3	0.94	27.2
NO_x	0.75	2.2	0.66	3.0	6.7	3.36	10.0
SO_2	0.026	0.044	0.00019	0.00089	0.071	0.06	0.13
VOCs	0.11	0.28	0.0080	0.063	0.45	0.60	1.1
Lead	8.9×10^{-6}	0.000012	6.4×10^{-7}	6.5×10^{-6}	0.000028	0.0023	0.0023
HAPs	0.0098	0.025	0.00018	0.0013	0.036	0.09	0.13

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] Government-owned mobile source activities are partitioned by source type. The source type partitioning of stationary source activities is shown in Table D–2.

Emissions from Personal Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to NNSS employees and solar power generation facility contract employees traveling to and from the NNSS in personal commuter vehicles. The 2010 EPA heavy-duty mobile emission standards were used to estimate emissions for commuters using transit buses.

Section D.1.1.2.1 describes how the personal commuter vehicle activity data representative of 2008 were derived. For the Reduced Operations Alternative, the 2008 personal commuter vehicle activity data (vehicle counts and VMTs) were scaled down by 3 percent, corresponding to the decrease in NNSS employees (including solar power generation facility contractors) under the Reduced Operations Alternative compared to the 2008 baseline. The number of employee transit buses needed under the Reduced Operations Alternative was also scaled down by 3 percent from the number needed for the 2008 baseline. The total transit bus VMTs under the Reduced Operations Alternative were derived based on the 2008 baseline VMT-per-bus ratio. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed by MOVES to be run on ethanol blends.

Table D–46 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NNSS employee commuters traveling to and from the NNSS under the Reduced Operations Alternative. Despite only a 3 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 43 percent smaller overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–46 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Nevada National Security Site Under the Reduced Operations Alternative, 2015 (tons per year)

Pollutant	*Light-Duty Vehicles*			*Light-Duty Passenger Trucks*			*Transit Buses*			*Total*			
	Clark County	*Nye County*		*Clark County*	*Nye County*		*Clark County*	*Nye County*		*Clark County*	*Nye County*		*Total*
		Off NNSS	*On NNSS*		*Off NNSS*	*On NNSS*		*Off NNSS*	*On NNSS*		*Off NNSS*	*On NNSS*	
PM_{10}	0.24	0.072	0.011	0.38	0.12	0.018	0.021	0.00098	0.0074	0.64	0.19	0.036	0.87
$PM_{2.5}$	0.13	0.041	0.0063	0.21	0.068	0.011	0.021	0.00098	0.0074	0.35	0.11	0.024	0.48
CO	18.6	5.1	0.78	39.6	11.6	1.8	1.1	0.051	0.38	59.3	16.8	3.0	79.0
NO_x	2.6	0.76	0.12	8.1	2.3	0.35	0.42	0.020	0.15	11.1	3.1	0.62	14.8
SO_2	0.064	0.017	0.0026	0.083	0.022	0.0034	0.0098	0.00046	0.0035	0.16	0.040	0.0098	0.21
VOCs	0.35	0.11	0.017	1.3	0.36	0.55	N/A	N/A	N/A	1.6	0.47	0.57	2.6
Lead	0.000021	6.0×10^{-6}	8.9×10^{-7}	0.000021	6.0×10^{-6}	8.9×10^{-7}	3.3×10^{-6}	1.5×10^{-7}	1.2×10^{-6}	0.000047	0.000013	3.0×10^{-6}	0.000062
HAPs	0.028	0.0098	0.0014	0.098	0.029	0.0044	N/A	N/A	N/A	0.13	0.038	0.0058	0.17

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commuter Vehicles Used by Construction Employees. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to construction employees commuting to and from the NNSS in personal vehicles. It was assumed that the NNSS transit buses would comply with the 2010 EPA heavy-duty diesel mobile emission standards.

The construction employees were assumed to reside in central-west Las Vegas and to commute an average distance of 66 miles each way to and from the NNSS during weekdays only. Similar to regular NNSS employees, half of the construction employees were assumed to commute via personal vehicles, while the remaining half was assumed to use transit buses. Because new construction is anticipated to take place over the next few years, the modeling for the Reduced Operations Alternative used 2011 as the modeling year and the MOVES national default age distributions for each vehicle type. The same passenger-to-bus and VMT-to-bus ratios used for the 2008 baseline were used for the Reduced Operations Alternative analysis.

Table D–47 shows the modeled 2011 annual onsite mobile emissions of criteria pollutants and HAPs associated with construction employee commuters traveling to and from the NNSS under the Reduced Operations Alternative.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from the NNSS. Section D.1.1.2.1 describes how commercial vendor vehicle activity data representative of 2008 were derived. For the Reduced Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled down by 3 percent, corresponding to the decrease in NNSS employees (including solar power generation facility contractors) under the Reduced Operations Alternative compared to the 2008 baseline. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks (compared to a single, averaged age value for the baseline).

Table D–48 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS under the Reduced Operations Alternative. Despite only a 3 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 63 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–47 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Construction Employees Commuting to and from the Nevada National Security Site Under the Reduced Operations Alternative, 2011 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Transit Buses*			*Total*			
		Nye County			*Nye County*			*Nye County*			*Nye County*		
Pollutant	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Clark County*	*Off NNSS*	*On NNSS*	*Total*
PM_{10}	0.035	0.0074	0.0025	0.052	0.010	0.0036	0.0047	0.00022	0.0017	0.088	0.018	0.0078	0.12
$PM_{2.5}$	0.018	0.0045	0.0015	0.028	0.0068	0.0022	0.0047	0.00022	0.0017	0.051	0.011	0.0054	0.068
CO	3.0	0.67	0.22	5.8	1.4	0.46	0.24	0.011	0.088	9.0	2.1	0.77	11.8
NO_x	0.58	0.14	0.046	1.2	0.30	0.096	0.096	0.0044	0.034	1.9	0.44	0.18	2.5
SO_2	0.0080	0.0018	0.00058	0.011	0.0023	0.00077	0.0022	0.00010	0.00077	0.022	0.0042	0.0021	0.028
VOCs	0.088	0.021	0.0069	0.23	0.049	0.016	N/A	N/A	N/A	0.32	0.070	0.023	0.42
Lead	2.3×10^{-6}	5.5×10^{-7}	1.8×10^{-7}	2.3×10^{-6}	5.5×10^{-7}	1.8×10^{-7}	7.4×10^{-7}	3.4×10^{-8}	2.6×10^{-7}	5.4×10^{-6}	1.1×10^{-6}	6.2×10^{-7}	7.1×10^{-6}
HAPs	0.0066	0.0017	0.0056	0.017	0.0038	0.0013	N/A	N/A	N/A	0.023	0.0055	0.0018	0.031

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Table D–48 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the Nevada National Security Site Under the Reduced Operations Alternative, 2015 (tons per year)

Pollutant	*Single-Unit, Short-Haul Trucks*			
	Clark County	*Nye County*		*Total*
		Off NNSS	*On NNSS*	
PM_{10}	0.086	0.011	0.038	0.14
$PM_{2.5}$	0.070	0.0089	0.032	0.11
CO	0.32	0.044	0.15	0.51
NO_x	0.86	0.11	0.38	1.4
SO_2	0.0020	0.00024	0.00085	0.0031
VOCs	0.089	0.013	0.044	0.15
Lead	3.7×10^{-6}	5.0×10^{-7}	1.8×10^{-6}	6.0×10^{-6}
HAPs	0.013	0.0016	0.0057	0.020

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Radioactive Waste Trucks. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to radioactive waste trucks traveling to and from the NNSS. See Section D.1.1.2.1 for more details on how the radioactive waste truck activity data representative of 2008 were derived. The same number of trucks (12) was used for both the 2008 baseline and the Reduced Operations Alternative. Based on the anticipated radioactive waste needs under the Reduced Operations Alternative, these 2008 VMT data were scaled up about 240 percent in Clark County and in the portion of Nye County outside of the NNSS. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for combination-unit, short-haul trucks (compared to a single, averaged age value for the baseline).

Table D–49 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the NNSS under the Reduced Operations Alternative. Despite the 240 percent increase in VMTs, these modeled Reduced Operations Alternative emissions decreased by 2 percent overall compared to the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–49 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the Nevada National Security Site Under the Reduced Operations Alternative, 2015 (tons per year)

Pollutant	*Combination-Unit, Short-Haul Trucks*			
	Clark County	*Nye County*		*Total*
		Off NNSS	*On NNSS*	
PM_{10}	0.19	0.54	0.03	0.76
$PM_{2.5}$	0.17	0.48	0.026	0.67
CO	0.54	1.6	0.088	2.2
NO_x	2.4	7.0	0.39	9.7
SO_2	0.0054	0.016	0.00088	0.022
VOCs	0.11	0.30	0.017	0.42
Lead	3.4×10^{-6}	0.000011	6.1×10^{-7}	0.000015
HAPs	0.014	0.040	0.0023	0.056

CO = carbon monoxide; HAP = hazardous air pollutant; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Explosive and Open Detonation Tests. The dynamic experiments anticipated under the Reduced Operations Alternative would use considerably less explosive material than was used at BEEF in 2008. These experiments also would be underground, with little to no air releases. Thus, air emissions from these dynamic experiments are anticipated to be much less than those from BEEF in 2008 (see Table D–3 for 2008 BEEF emissions).

Up to 10 annual conventional high-explosives tests and experiments may be conducted at Nuclear and High Explosives Test Zone locations, using up to 70,000 TNT-equivalent pounds of explosives. If the full 70,000 TNT-equivalent pounds of explosives were used at BEEF, the limit on total annual explosive tonnage at any one location (32 tons) would be in place. **Table D–50** shows the estimated emissions from these explosive tests under the Reduced Operations Alternative. These emissions were estimated by scaling the 2008 BEEF emissions (when 2.55 tons of explosives were used) up to a maximum of 70,000 pounds of explosives per 12-month period. The same maximum PM_{10} and $PM_{2.5}$ air concentrations modeled for BEEF in Section D.1.1.2 would apply for this Reduced Operations Alternative scenario. All modeled radiation exposures in locations accessible to the public would be well below NAAQS levels.

Table D–50 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from the Nevada National Security Site Conventional High-Explosives Tests (tons per year) [a]

Pollutant	*Nye County* — *On NNSS*
PM_{10}	0.14
$PM_{2.5}$	0.14
CO	2.3
NO_x	0
SO_2	0
VOCs	0.014
Lead	N/A
HAPs	N/A

CO = carbon monoxide; HAP = hazardous air pollutant; N/A = not applicable; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] These emissions may be considered "worst-case," as they are scaled from the amount of TNT-equivalent explosives used at BEEF in 2008 (2.55 tons) up to 35 tons (70,000 pounds) of TNT-equivalent explosives per 12-month period.

D.2.3 Remote Sensing Laboratory

D.2.3.1 No Action Alternative

D.2.3.1.1 Emissions on and near the Remote Sensing Laboratory

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on RSL are anticipated under the No Action Alternative. See Chapter 4, Section 4.2.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Aircraft-Related Sources. No specific changes the operation of aircraft-related sources on RSL are anticipated under the No Action Alternative. See Chapter 4, Section 4.2.8.2.2, of this document for the current (2008) air emissions from aircraft-related sources.

Emissions from Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to RSL employees traveling to and from RSL in personal vehicles.

For the No Action Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were used because no change in the number of employees is anticipated under this alternative. The modeling for the No Action Alternative used 2015 as the midpoint modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends.

Table D–51 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with RSL employee commuters traveling to and from RSL under the No Action Alternative. Even with the same VMT, mobile emissions decrease under the No Action Alternative by about 13 percent overall compared to the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–51 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Remote Sensing Laboratory Under the No Action Alternative, 2015 (tons per year)

Pollutant	*Light-Duty Vehicles*	*Light-Duty Passenger Trucks*	*Total*
	Clark County		
	Off RSL		
PM_{10}	0.012	0.018	0.030
$PM_{2.5}$	0.0061	0.010	0.016
CO	0.91	1.9	2.8
NO_x	0.13	0.4	0.53
SO_2	0.0031	0.0041	0.0072
VOCs	0.017	0.062	0.079
Lead	1.0×10^{-6}	1.0×10^{-6}	2.0×10^{-6}
HAPs	0.0014	0.0046	0.0060

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from RSL.

For the No Action Alternative, these 2008 activity data (vehicle counts and VMTs) were used because no change in the number of employees is anticipated under this alternative. The modeling for the No Action Alternative used 2015 as the midpoint modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks.

Table D–52 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from RSL under the No Action Alternative. Despite the same VMT, these modeled No Action Alternative emissions are about 63 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–52 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from Remote Sensing Laboratory Under the No Action Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks
	Clark County
Pollutant	*Off RSL*
PM_{10}	0.016
$PM_{2.5}$	0.013
CO	0.060
NO_x	0.16
SO_2	0.00036
VOCs	0.017
Lead	6.8×10^{-7}
HAPs	0.0023

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; RSL = Remote Sensing Laboratory; SO_2 = sulfur dioxide; VOC = volatile organic compound.

D.2.4 North Las Vegas Facility

D.2.4.1 No Action Alternative

D.2.4.1.1 Emissions on and near the North Las Vegas Facility

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on NLVF are anticipated under the No Action Alternative. See Chapter 4, Section 4.3.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to NLVF employees traveling to and from NLVF in personal vehicles.

For the No Action Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were scaled up 1 percent, corresponding to the increase in NLVF employees for the No Action Alternative compared to the 2008 baseline. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) and used national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends.

Table D–53 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NLVF employee commuters traveling to and from NLVF under the No Action Alternative. Despite a small increase in VMTs, these modeled No Action Alternative emissions are about 11 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–53 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the North Las Vegas Facility Under the No Action Alternative, 2015 (tons per year)

	Light-Duty Vehicles		*Light-Duty Passenger Trucks*		*Total*		
	Clark County	*Nye County*	*Clark County*	*Nye County*	*Clark County*	*Nye County*	
Pollutant	*Off NLVF*	*Off NNSS*	*Off NLVF*	*Off NNSS*	*Off NLVF*	*Off NNSS*	*Total*
PM_{10}	0.099	0.00063	0.15	0.00097	0.25	0.0016	0.25
$PM_{2.5}$	0.051	0.00036	0.085	0.00059	0.14	0.00095	0.14
CO	7.6	0.044	16.2	0.10	23.8	0.14	23.9
NO_x	1.1	0.0066	3.3	0.020	4.4	0.027	4.4
SO_2	0.026	0.00015	0.034	0.00019	0.060	0.00034	0.060
VOCs	0.14	0.00095	0.52	0.0031	0.66	0.0041	0.66
Lead	8.6×10^{-6}	5.2×10^{-8}	8.6×10^{-6}	5.2×10^{-8}	0.000017	1.0×10^{-7}	0.000017
HAPs	0.011	0.000082	0.038	0.00025	29.2	0.17	0.049

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from NLVF.

See Section D.1.3.2.1 for more details on how the commercial vendor vehicle activity data representative of 2008 were derived. For the No Action Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled up 1 percent, corresponding to the increase in NLVF employees for the No Action Alternative compared to the 2008 baseline. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) using the MOVES model with the national default age distribution.

Table D–54 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from NLVF under the No Action Alternative. Despite a small increase in VMTs, these modeled No Action Alternative emissions are about 62 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–54 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from North Las Vegas Facility Under the No Action Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks
	Clark County
Pollutant	*Off NLVF*
PM_{10}	0.069
$PM_{2.5}$	0.057
CO	0.26
NO_x	0.70
SO_2	0.0016
VOCs	0.076
Lead	3.0×10^{-6}
HAPs	0.01

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Radioactive Waste Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to radioactive waste trucks traveling to and from NLVF.

See Section D.1.3.2.1 for more details on how the radioactive waste truck activity data representative of 2008 were derived. The same number of trucks was used for the 2008 baseline and the No Action Alternative. For the No Action Alternative, the 2008 VMTs were scaled up 1 percent, corresponding to the increase in NLVF employees for the No Action Alternative compared to the 2008 baseline. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions.

Table D–55 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with radioactive waste trucks traveling to and from NLVF under the No Action Alternative. Despite a small increase in VMTs, these modeled No Action Alternative emissions are about 71 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–55 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the North Las Vegas Facility Under the No Action Alternative, 2015 (tons per year)

	Combination-Unit, Short-Haul Trucks			
	Clark County	*Nye County*		
Pollutant	***Off NLVF***	***Off NNSS***	***On NNSS***	***Total***
PM_{10}	0.0017	0.00015	0.00010	0.0020
$PM_{2.5}$	0.0014	0.00013	0.000090	0.0016
CO	0.0046	0.00045	0.00030	0.0054
NO_x	0.021	0.0020	0.0013	0.024
SO_2	0.000046	4.4×10^{-6}	2.0×10^{-6}	0.000053
VOCs	0.00091	0.000086	0.000057	0.0011
Lead	2.9×10^{-8}	3.0×10^{-9}	2.0×10^{-9}	3.4×10^{-8}
HAPs	0.00012	0.000011	0.0000076	0.00014

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NNSS = Nevada National Security Site; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

D.2.4.2 Expanded Operations Alternative

D.2.4.2.1 Emissions on and near the North Las Vegas Facility

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on NLVF are anticipated under the Expanded Operations Alternative. See Chapter 4, Section 4.3.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to NLVF employees traveling to and from NLVF in personal vehicles.

For the Expanded Operations Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were scaled up 27 percent, corresponding to the increase in NLVF employees for the Expanded Operations Alternative compared to the 2008 baseline. The modeling for the Expanded Operations

Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends.

Table D–56 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NLVF employee commuters traveling to and from NLVF under the Expanded Operations Alternative. Despite a 27 percent increase in VMTs, these modeled Expanded Operations Alternative emissions are only 12 percent greater overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–56 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from North Las Vegas Facility Under the Expanded Operations Alternative, 2015 (tons per year)

	Light-Duty Vehicles		*Light-Duty Passenger Trucks*		*Total*		
	Clark County	*Nye County*	*Clark County*	*Nye County*	*Clark County*	*Nye County*	
Pollutant	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Total*
PM_{10}	0.12	0.00079	0.19	0.0012	0.31	0.0020	0.31
$PM_{2.5}$	0.064	0.00045	0.11	0.00074	0.17	0.0020	0.18
CO	9.5	0.055	20.3	0.13	29.8	0.19	29.9
NO_x	1.4	0.0083	4.1	0.025	5.5	0.033	5.5
SO_2	0.033	0.00019	0.043	0.00024	0.076	0.00043	0.075
VOCs	0.18	0.0012	0.65	0.0039	0.83	0.0051	0.83
Lead	0.000011	6.5×10^{-8}	0.000011	6.5×10^{-8}	0.000022	1.3×10^{-7}	0.000021
HAPs	0.014	0.00010	0.048	0.00031	0.062	0.00041	0.061

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from NLVF.

For the Expanded Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled up 27 percent, corresponding to the increase in NLVF employees for the Expanded Operations Alternative compared to the 2008 baseline. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks.

Table D–57 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from NLVF under the Expanded Operations Alternative. Despite a 27 percent increase in VMTs, these modeled Expanded Operations Alternative emissions are about 52 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology resulting from vehicle fleet turnover.

Table D–57 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the North Las Vegas Facility Under the Expanded Operations, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks
	Clark County
Pollutant	***Off NLVF***
PM_{10}	0.086
$PM_{2.5}$	0.071
CO	0.33
NO_x	0.88
SO_2	0.002
VOCs	0.095
Lead	3.8×10^{-6}
HAPs	0.013

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Radioactive Waste Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to radioactive waste trucks traveling to and from NLVF.

For the Expanded Operations Alternative, the 2008 VMTs were scaled up 27 percent, corresponding to the increase in NLVF employees for the Expanded Operations Alternative compared to the 2008 baseline. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for combination-unit, short-haul trucks.

Table D–58 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with radioactive waste trucks traveling to and from NLVF under the Expanded Operations Alternative. Despite about a 27 percent increase in VMTs, these modeled Expanded Operations Alternative emissions are about 64 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–58 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the North Las Vegas Facility Under the Expanded Operations Alternative, 2015 (tons per year)

	Combination-Unit, Short-Haul Trucks			
	Clark County	***Nye County***		
Pollutant	***Off NLVF***	***Off NLVF***	***On NLVF***	***Total***
PM_{10}	0.0021	0.00019	0.00013	0.0025
$PM_{2.5}$	0.0018	0.00016	0.00011	0.0020
CO	0.0058	0.00056	0.00038	0.0068
NOx	0.026	0.0025	0.0016	0.030
SO2	0.000058	5.5×10^{-6}	3.6×10^{-6}	0.000066
VOCs	0.0011	0.00011	0.000071	0.0014
Lead	3.6×10^{-8}	3.8×10^{-9}	2.5×10^{-9}	4.3×10^{-8}
HAPs	0.00015	0.000014	9.5×10^{-6}	0.00018

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

D.2.4.3 Reduced Operations Alternative

D.2.4.3.1 Emissions on and near the North Las Vegas Facility

Emissions from Stationary Sources. No specific changes to the operation of established stationary sources on NLVF are anticipated under the Reduced Operations Alternative. See Chapter 4, Section 4.3.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to NLVF employees traveling to and from NLVF in personal vehicles.

For the Reduced Operations Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were scaled down by 9 percent, corresponding to the decrease in NLVF employees for the Reduced Operations Alternative compared to the 2008 baseline. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends

Table D–59 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with NLVF employee commuters traveling to and from NLVF under the Reduced Operations Alternative. Despite only a 9 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 19 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–59 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the North Las Vegas Facility Under the Reduced Operations Alternative, 2015 (tons per year)

	Light-Duty Vehicles		*Light-Duty Passenger Trucks*		*Total*		
	Clark County	*Nye County*	*Clark County*	*Nye County*	*Clark County*	*Nye County*	
Pollutant	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Off NLVF*	*Total*
PM_{10}	0.089	0.00057	0.14	0.00087	0.23	0.0014	0.23
$PM_{2.5}$	0.046	0.00032	0.077	0.00053	0.12	0.00085	0.13
CO	6.8	0.040	14.6	0.090	21.4	0.13	21.5
NO_x	0.99	0.0059	3.0	0.018	4.0	0.024	4.0
SO_2	0.023	0.00014	0.031	0.00017	0.054	0.00031	0.054
VOCs	0.13	0.00086	0.47	0.0028	0.60	0.0037	0.59
Lead	7.7×10^{-6}	4.7×10^{-8}	7.7×10^{-6}	4.7×10^{-8}	0.000015	9.4×10^{-8}	0.000015
HAPs	0.0099	0.000074	0.034	0.00022	0.044	0.00029	0.044

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from NLVF.

See Section D.1.3.2.1 for more details on how the commercial vendor vehicle activity data representative of 2008 were derived. For the Reduced Operations Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were scaled down by 9 percent, corresponding to the decrease in NLVF employees for the Reduced Operations Alternative compared to the 2008 baseline. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks.

Table D–60 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from NLVF under the Reduced Operations Alternative. Despite only a 9 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions show a 66 percent overall reduction from the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–60 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the North Las Vegas Facility Under the Reduced Operations Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks
	Clark County
Pollutant	***Off NLVF***
PM_{10}	0.062
$PM_{2.5}$	0.051
CO	0.23
NO_x	0.63
SO_2	0.0014
VOCs	0.068
Lead	0.0000027
HAPs	0.0090

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Emissions from Radioactive Waste Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to radioactive waste trucks traveling to and from NLVF.

The same number of trucks was used for the 2008 baseline and the Reduced Operations Alternative. For the Reduced Operations Alternative, the 2008 VMTs were scaled lower by 9 percent, corresponding to the decrease in NLVF employees for the Reduced Operations Alternative compared to the 2008 baseline. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for combination-unit, short-haul trucks.

Table D–61 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with radioactive waste trucks traveling to and from NLVF under the Reduced Operations Alternative. Despite only a 9 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are projected to decrease 74 percent compared to the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–61 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Radioactive Waste Trucks Traveling to and from the North Las Vegas Facility Under the Reduced Operations Alternative, 2015 (tons per year)

	Combination-Unit, Short-Haul Trucks			
	Clark County	*Nye County*		
Pollutant	*Off NLVF*	*Off NLVF*	*On NLVF*	*Total*
PM_{10}	0.0015	0.00013	0.00009	0.0018
$PM_{2.5}$	0.0013	0.00012	0.000081	0.0014
CO	0.0041	0.00041	0.00027	0.0049
NO_x	0.019	0.0018	0.0012	0.022
SO_2	0.000041	4.0×10^{-6}	2.6×10^{-6}	0.000048
VOCs	0.00082	0.000077	0.000051	0.00099
Lead	2.6×10^{-8}	2.7×10^{-9}	1.8×10^{-9}	3.1×10^{-8}
HAPs	0.00011	9.9×10^{-6}	6.8×10^{-6}	0.00013

CO = carbon monoxide; HAP = hazardous air pollutant; NLVF = North Las Vegas Facility; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

D.2.5 Tonopah Test Range

D.2.5.1 No Action Alternative

D.2.5.1.1 Emissions on and near the Tonopah Test Range

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on the TTR are anticipated under the No Action Alternative. See Chapter 4, Section 4.1.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the TTR. See Section D.1.4.2 for more details on how the activity data representative of 2008 were derived. For the No Action Alternative, the 2008 onsite government-owned vehicle activity data (vehicle counts and VMTs) were used because no change in the number of employees is anticipated under this alternative. The modeling for the No Action Alternative used the midpoint year of 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends, while diesel-type vehicles are assumed to still consume the same fractions of No. 2 diesel and biodiesel as used in 2008.

Table D–62 shows the modeled 2015 annual onsite mobile and stationary source emissions of criteria pollutants and HAPs associated with TTR government-owned vehicles and equipment under the No Action Alternative. Despite no change in VMTs, these modeled No Action Alternative emissions are about 33 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–62 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Tonopah Test Range Stationary Sources and Government-Owned Mobile Sources Under the No Action Alternative, 2015 (tons per year) [a]

Pollutant	*Government-Owned Mobile Source Type (modeled)*				*Stationary Source Type (calculated)*	*Total*
	Light-Duty Vehicles	*Light-Duty Passenger Trucks*	*Single-Unit, Short-Haul Trucks*	*Total*		
	Nye County					
	On Tonopah Test Range					
PM_{10}	0.011	0.02	0.036	0.067	<3.7	<3.8
$PM_{2.5}$	0.0059	0.012	0.033	0.051	<3.7	<3.8
CO	0.79	1.6	0.15	2.5	<2.9	<5.4
NO_x	0.073	0.22	0.29	0.58	<13.3	<13.9
SO_2	0.0025	0.0044	0.000087	0.007	<0.91	<0.92
VOCs	0.011	0.027	0.0062	0.044	<0.96	<1.0
Lead	8.9×10^{-7}	1.2×10^{-6}	6.4×10^{-7}	2.7×10^{-6}	<0.01	<0.01
HAPs	0.001	0.0025	0.00013	0.0036	<1.1	<1.1

< = less than; CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; VOC = volatile organic compound.

[a] Government-owned mobile source activities are partitioned by source type. The source type partitioning of stationary source activities is shown in Table D–24.

Emissions from Personal Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to TTR employees traveling to and from the TTR in personal commuter vehicles. Section D.1.1.2.1 describes how personal commuter vehicle activity data representative of 2008 were derived. For the No Action Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were used because no change in the number of employees is anticipated under this alternative. The modeling for the No Action Alternative used the midpoint year of 2015 as the modeling year and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-fueled vehicles in this area of Nevada are assumed to be run on ethanol blends.

Table D–63 shows the modeled 2015 annual mobile emissions of criteria pollutants and HAPs associated with TTR employee commuters traveling to and from the TTR under the No Action Alternative. Despite no change in VMTs, these modeled No Action Alternative emissions are about 15 percent lower overall than the 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–63 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Tonopah Test Range Under the No Action Alternative, 2015 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Total*			
		Nye County			*Nye County*			*Nye County*		
Pollutant	*Clark County*	*Off TTR*	*On TTR*	*Clark County*	*Off TTR*	*On TTR*	*Clark County*	*Off TTR*	*On TTR*	*Total*
PM_{10}	0.0035	0.014	0.0016	0.0064	0.022	0.0024	0.0099	0.036	0.0040	0.05
$PM_{2.5}$	0.0018	0.008	0.00088	0.0030	0.013	0.0015	0.0048	0.021	0.0024	0.028
CO	0.27	1.0	0.11	0.57	2.3	0.25	0.84	3.3	0.36	4.5
NO_x	0.038	0.15	0.016	0.12	0.45	0.049	0.16	0.60	0.065	0.82
SO_2	0.00092	0.0033	0.00036	0.0012	0.0043	0.00048	0.0021	0.0076	0.00084	0.011
VOCs	0.0050	0.021	0.0023	0.018	0.070	0.0077	0.023	0.091	0.010	0.12
Lead	3.1×10^{-7}	1.2×10^{-6}	1.3×10^{-7}	3.1×10^{-7}	1.2×10^{-6}	1.3×10^{-7}	6.2×10^{-7}	2.4×10^{-6}	2.6×10^{-7}	3.3×10^{-6}
HAPs	0.00041	0.0018	0.00020	0.0014	0.0056	0.00062	0.0018	0.0074	0.00082	0.01

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from the TTR. Section D.1.1.2.1 describes how commercial vendor vehicle activity data representative of 2008 were derived. For the No Action Alternative, these 2008 activity data (vehicle counts and VMTs) were used because no change in the number of employees is anticipated under this alternative. The modeling for the No Action Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks.

Table D–64 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the TTR under the No Action Alternative. Despite no change in VMTs, these modeled No Action Alternative emissions are about 62 percent lower overall than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–64 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the Tonopah Test Range Under the No Action Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off TTR***	***On TTR***	***Total***
PM_{10}	0.044	0.19	0.0019	0.24
$PM_{2.5}$	0.036	0.16	0.0016	0.20
CO	0.17	0.77	0.0078	0.95
NO_x	0.44	1.9	0.020	2.4
SO_2	0.00099	0.0042	0.000043	0.0052
VOCs	0.048	0.22	0.0022	0.27
Lead	1.9×10^{-6}	8.9×10^{-6}	9.0×10^{-8}	0.000011
HAPs	0.0063	0.029	0.00029	0.036

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

D.2.5.2 Expanded Operations Alternative

D.2.5.2.1 Emissions on and near the Tonopah Test Range

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on the TTR are anticipated under the Expanded Operations Alternative. See Chapter 4, Section 4.1.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the TTR. For the Expanded Operations Alternative, the 2008 onsite government-owned vehicle activity data (vehicle counts and VMTs) were scaled down by 59 percent, corresponding to the decrease in TTR employees for the Expanded Operations Alternative. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be using ethanol blends, while diesel-type vehicles use the same fractions of No. 2 diesel and biodiesel that used in the 2008 baseline.

Table D–65 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with TTR government-owned vehicles under the Expanded Operations Alternative. Total onsite emissions from stationary sources (shown in more detail in Table D–25) are also provided in Table–65 to show the total onsite emissions from both stationary sources and government-owned vehicle mobile sources. Even with a 59 percent decrease in VMTs, these modeled Expanded Operations Alternative emissions are about 73 percent lower than the modeled 2008 baseline emissions, largely due to improvements in vehicle control technology due to vehicle fleet turnover.

Table D–65 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Tonopah Test Range Stationary Sources and Government-Owned Mobile Sources Under the Expanded Operations Alternative, 2015 (tons per year) [a]

Pollutant	*Government-Owned Mobile Source Type (Modeled)*				*Stationary Source Type (calculated)*	*Total*
	Light-Duty Vehicles	*Light-Duty Passenger Trucks*	*Single-Unit, Short-Haul Trucks*	*Total*		
	Nye County					
	On TTR					
PM_{10}	0.0045	0.0082	0.015	0.027	<3.7	<3.7
$PM_{2.5}$	0.0024	0.0049	0.014	0.021	<3.7	<3.7
CO	0.32	0.66	0.062	1.0	<2.9	<3.9
NO_x	0.030	0.090	0.012	0.24	<13.3	<13.4
SO_2	0.0010	0.0018	0.000036	0.0029	<0.91	<0.91
VOCs	0.0045	0.011	0.0025	0.018	<0.96	<0.98
Lead	3.6×10^{-7}	4.9×10^{-7}	2.6×10^{-7}	1.1×10^{-6}	<0.01	<0.01
HAPs	0.00041	0.0010	0.000053	0.0015	<1.1	<1.1

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

[a] Government-owned mobile source activities are partitioned by source type. The source type partitioning of stationary source activities is shown in Table D–24.

Emissions from Personal Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to TTR employees traveling to and from the TTR in personal commuter vehicles. Section D.1.1.2.1 describes how personal commuter vehicle activity data representative of 2008 were derived. For the Expanded Operations Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were scaled down by 59 percent, corresponding to the decrease in TTR employees for the Expanded Operations Alternative. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blended fuel.

Table D–66 shows the modeled 2015 annual mobile emissions of criteria pollutants and HAPs associated with TTR employee commuters traveling to and from the TTR under the Expanded Operations Alternative. Even with a 59 percent decrease in VMTs, these modeled Expanded Operations Alternative emissions are about 66 percent lower overall than the modeled 2008 baseline emissions, largely due to a combination of reduced vehicle activity and improvements in vehicle control technology due to vehicle fleet turnover.

Table D–66 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Tonopah Test Range Under the Expanded Operations Alternative, 2015 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Total*			
		Nye County			*Nye County*			*Nye County*		
Pollutant	*Clark County*	*Off TTR*	*On TTR*	*Clark County*	*Off TTR*	*On TTR*	*Clark County*	*Off TTR*	*On TTR*	*Total*
PM_{10}	0.0014	0.0057	0.00065	0.0026	0.0089	0.00097	0.0040	0.015	0.0016	0.020
$PM_{2.5}$	0.00073	0.0032	0.00036	0.0012	0.0053	0.00061	0.0019	0.0085	0.00097	0.011
CO	0.11	0.41	0.044	0.23	0.93	0.10	0.34	1.3	0.15	1.8
NO_x	0.015	0.061	0.0065	0.049	0.18	0.020	0.065	0.24	0.026	0.33
SO_2	0.00037	0.0013	0.00015	0.00049	0.0017	0.00019	0.00085	0.0031	0.00034	0.0045
VOCs	0.0020	0.0085	0.00093	0.0073	0.028	0.0031	0.0093	0.037	0.0041	0.049
Lead	1.3×10^{-7}	4.9×10^{-7}	5.3×10^{-8}	1.3×10^{-7}	4.9×10^{-7}	5.3×10^{-8}	2.5×10^{-7}	9.7×10^{-7}	1.1×10^{-7}	1.3×10^{-6}
HAPs	0.00017	0.00073	0.000081	0.00057	0.0023	0.00025	0.00073	0.003	0.00033	0.0041

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from the TTR. Section D.1.1.2.1 describes how commercial vendor vehicle activity data representative of 2008 were derived. For the Expanded Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled down by 59 percent, corresponding to the decrease in TTR employees under the Expanded Operations Alternative. The modeling for the Expanded Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the national default age distributions for single-unit, short-haul trucks.

Table D–67 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the TTR under the Expanded Operations Alternative. Even with a 59 percent decrease in VMTs, these modeled Expanded Operations Alternative emissions are about 85 percent lower than the modeled 2008 baseline emissions, largely due to a combination of reduced vehicle activity and improvements in vehicle control technology due to vehicle fleet turnover.

Table D–67 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the Tonopah Test Range Under the Expanded Operations Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off TTR***	***On TTR***	***Total***
PM_{10}	0.018	0.077	0.00077	0.097
$PM_{2.5}$	0.015	0.065	0.00065	0.081
CO	0.069	0.31	0.0032	0.39
NO_x	0.18	0.77	0.0081	0.97
SO_2	0.00040	0.0017	0.000017	0.0021
VOCs	0.019	0.089	0.00089	0.11
Lead	7.7×10^{-7}	3.6×10^{-6}	3.7×10^{-8}	4.5×10^{-6}
HAPs	0.0026	0.012	0.00012	0.015

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

D.2.5.3 Reduced Operations Alternative

D.2.5.3.1 Emissions on and near the Tonopah Test Range

Emissions from Stationary Sources. No specific changes to the operation of stationary sources on the TTR are anticipated under the Reduced Operations Alternative. See Chapter 4, Section 4.1.8.2.2, of this document for the current (2008) air emissions from onsite stationary sources.

Emissions from Onsite Government-Owned Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to government vehicle traffic on the TTR. See Section D.1.4.2 for more details on how the activity data representative of 2008 were derived. For the Reduced Operations Alternative, the 2008 onsite government-owned vehicle activity data (vehicle counts and VMTs) were scaled down by 63 percent, corresponding to the decrease in TTR employees for the Expanded Operations Alternative. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blends, while diesel-type vehicles are assumed to continue with same fractions of No. 2 diesel and biodiesel that were used in 2008.

Table D–68 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with TTR government-owned vehicles under the Reduced Operations Alternative. Total onsite emissions from stationary sources (shown in more detail in Table D–24) are also provided in Table D–68 to show the total onsite emissions from both stationary sources and government-owned vehicle mobile sources. Even with a 63 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 75 percent lower overall than the modeled 2008 baseline emissions, largely due to a combination of reduced activity and improvements in vehicle emission control technology due to vehicle fleet turnover.

Table D–68 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Onsite Tonopah Test Range Stationary Sources and Government-Owned Mobile Sources Under the Reduced Operations Alternative, 2015 (tons per year) [a]

Pollutant	*Government-Owned Mobile Source Type (Modeled)*				*Stationary Source Type (calculated)*	*Total*
	Light-Duty Vehicles	*Light-Duty Passenger Trucks*	*Single-Unit, Short-Haul Trucks*	*Total*		
	Nye County					
	On TTR					
PM_{10}	0.0041	0.0074	0.013	0.025	<3.7	<3.7
$PM_{2.5}$	0.0022	0.0044	0.012	0.019	<3.7	<3.7
CO	0.29	0.59	0.056	0.93	<2.9	<3.8
NO_x	0.027	0.081	0.11	0.21	<13.3	<13.5
SO_2	0.00093	0.0016	0.000032	0.0026	<0.91	<0.91
VOCs	0.0041	0.010	0.0023	0.016	<0.96	<0.98
Lead	3.3×10^{-7}	4.4×10^{-7}	2.4×10^{-7}	1.0×10^{-6}	<0.01	<0.01
HAPs	0.00037	0.00093	0.000048	0.0013	<1.1	<1.1

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

[a] Government-owned mobile source activities are partitioned by source type. The source type partitioning of stationary source activities is shown in Table D–24.

Emissions from Personal Commuter Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to TTR employees traveling to and from the TTR in personal commuter vehicles. Section D.1.1.2.1 describes how commuting activity data representative of 2008 were derived. For the Reduced Operations Alternative, the 2008 personal vehicle activity data (vehicle counts and VMTs) were scaled down by 63 percent, corresponding to the decrease in TTR employees for the Expanded Operations Alternative. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for each vehicle type. By 2015, all gasoline-type vehicles in this area of Nevada are assumed to be run on ethanol blended gasoline

Table D–69 shows the modeled 2015 annual mobile emissions of criteria pollutants and HAPs associated with TTR employee commuters traveling to and from the TTR under the Reduced Operations Alternative. Even with a 63 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 68 percent lower overall than the modeled 2008 baseline emissions, largely due to a combination of reduced vehicle activity and improvements in vehicle emission control technology due to vehicle fleet turnover.

Table D–69 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commuting to and from the Tonopah Test Range Under the Reduced Operations Alternative, 2015 (tons per year)

	Light-Duty Vehicles			*Light-Duty Passenger Trucks*			*Total*			
		Nye County			*Nye County*		*Clark County*	*Nye County*		
Pollutant	***Clark County***	***Off TTR***	***On TTR***	***Clark County***	***Off TTR***	***On TTR***		***Off TTR***	***On TTR***	***Total***
PM_{10}	0.0013	0.0052	0.00059	0.0024	0.0081	0.00088	0.0036	0.013	0.0015	0.018
$PM_{2.5}$	0.00066	0.0029	0.00032	0.0011	0.0048	0.00055	0.0018	0.0077	0.00088	0.010
CO	0.099	0.37	0.040	0.21	0.85	0.092	0.31	1.2	0.13	1.7
NO_x	0.014	0.055	0.0059	0.044	0.17	0.018	0.059	0.22	0.024	0.30
SO_2	0.00034	0.0012	0.00013	0.00044	0.0016	0.00018	0.00077	0.0028	0.00031	0.0040
VOCs	0.0018	0.0077	0.00085	0.0066	0.026	0.0028	0.0085	0.033	0.0037	0.044
Lead	1.1×10^{-7}	4.4×10^{-7}	4.8×10^{-8}	1.1×10^{-7}	4.4×10^{-7}	4.8×10^{-8}	2.3×10^{-7}	8.8×10^{-7}	9.6×10^{-8}	1.2×10^{-6}
HAPs	0.00015	0.00066	0.000074	0.00052	0.0021	0.00023	0.00066	0.0027	0.00030	0.0037

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

Emissions from Commercial Vendor Vehicles. The MOVES2010 (Version 20100515; EPA 2009) mobile source emissions model was used to estimate annual emission rates due to commercial vendors traveling to and from the TTR. Section D.1.1.2.1 describes how commercial vendor vehicle activity data representative of 2008 were derived. For the Reduced Operations Alternative, these 2008 activity data (vehicle counts and VMTs) were scaled down by 63 percent, corresponding to the decrease in TTR employees for the Expanded Operations Alternative. The modeling for the Reduced Operations Alternative used 2015 as the modeling year (compared to the 2008 baseline) and the MOVES national default age distributions for single-unit, short-haul trucks.

Table D–70 shows the modeled 2015 annual onsite mobile emissions of criteria pollutants and HAPs associated with commercial vendors traveling to and from the TTR under the Reduced Operations Alternative. Even with a 63 percent decrease in VMTs, these modeled Reduced Operations Alternative emissions are about 86 percent lower overall than the modeled 2008 baseline emissions, largely due to a combination of reduced vehicle activity and improvements in vehicle emission control technology due to vehicle fleet turnover.

Table D–70 Estimated Annual Emissions of Criteria Pollutants and Hazardous Air Pollutants from Commercial Vendors Traveling to and from the Tonopah Test Range Under the Reduced Operations Alternative, 2015 (tons per year)

	Single-Unit, Short-Haul Trucks			
		Nye County		
Pollutant	***Clark County***	***Off TTR***	***On TTR***	***Total***
PM_{10}	0.016	0.070	0.00070	0.088
$PM_{2.5}$	0.013	0.059	0.00059	0.073
CO	0.063	0.28	0.0029	0.35
NO_x	0.16	0.70	0.0074	0.88
SO_2	0.00036	0.0015	0.000016	0.0019
VOCs	0.018	0.081	0.00081	0.099
Lead	0.00000070	0.0000033	0.000000033	0.0000041
HAPs	0.0023	0.011	0.00011	0.013

CO = carbon monoxide; HAP = hazardous air pollutant; NO_x = nitrogen oxides; PM_n = particulate matter with an aerodynamic diameter less than or equal to *n* micrometers; SO_2 = sulfur dioxide; TTR = Tonopah Test Range; VOC = volatile organic compound.

D.3 References

BLM (Bureau of Land Management), 2010, *Final Environmental Impact Statement for the Amargosa Farm Road Solar Energy Project* (NVN-084359), DOI No. FES 10-53, U.S. Department of the Interior, Pahrump Field Office, Las Vegas, Nevada, October.

BN (Bechtel Nevada), 1999, *Traffic Study and Cost Benefit Analysis to Renovate Existing Roadways*, Nevada Test Site, PBS&J 511036.00, North Las Vegas, Nevada.

BSC (Bechtel SAIC Company), 2007, *Facilities-Design Analysis Report: Caliente Rail Corridor*, Nevada Rail Line Conceptual Design, Task 10, Revision 2, NRP-R-SYSW-FA-0001-02.

CEMP (Community Environmental Monitoring Program), 2009, Dynamically Created Wind Rose for the Tonopah Station (accessed December 2, 2009, wind rose creator available online at http://cemp.dri.edu/cgi-bin/cemp_stations.pl?stn=tono&prod=11).

Clark County, 2010, Nevada Department of Air Quality and Environmental Management (DAQEM), (accessed 2010, http://www.accessclarkcounty.com/depts/daqem/Pages/index.aspx).

DOD (U.S. Department of Defense), 2004, *Strategic Environmental Research and Development Program (SERDP)/Environmental Security Technology Certification Program*, Source Characterization Model (SCM), A Predictive Capability for the Source Terms of Residual Energetic Materials from Burning and/or Detonating Activities, Final Report, ARI-RR-1384, Billerica, Massachusetts.

DOE (U.S. Department of Energy), 1994, *Nevada Solar Enterprise Zone Development Study*, Nevada Operations Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1996, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1998, *Nevada Test Site Annual Site Environmental Report for Calendar Year 1997*, DOE/NV/11718--231, National Nuclear Security Administration, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1999, *National Nuclear Security Administration Nevada Site, Nevada Test Site Annual Site Environmental Report for Calendar Year 1998*, DOE/NV/11718--361, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2000, *National Nuclear Security Administration Nevada Site, Nevada Test Site Annual Site Environmental Report for Calendar Year 1999*, DOE/NV/11718--463, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2001, *National Nuclear Security Administration Nevada Site, Nevada Test Site Annual Site Environmental Report for Calendar Year 2000*, DOE/NV/11718--605, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2002, *National Nuclear Security Administration Nevada Site, Nevada Test Site Annual Site Environmental Report for Calendar Year 2001*, DOE/NV/11718--747, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2003, *National Nuclear Security Administration Nevada Site, Nevada Test Site Annual Site Environmental Report for Calendar Year 2002*, DOE/NV/11718--842, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2004, *National Nuclear Security Administration Nevada Site Office, Nevada Test Site Environmental Report 2003*, DOE/NV/11718--971, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2005, *National Nuclear Security Administration Nevada Site, Nevada Test Site Environmental Report 2004*, DOE/NV/11718--1080, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2006, *National Nuclear Security Administration Nevada Site Office, Nevada Test Site Environmental Report 2005*, DOE/NV/11718--1214 and DOE/NV/25946--007, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2007, *National Nuclear Security Administration Nevada Site Office, Nevada Test Site Environmental Report 2006*, DOE/NV/25946--259, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008b, *Nellis Air Force Base Remote Sensing Laboratory Emissions Inventory for Calendar Year 2008*, Revision 2, National Nuclear Security Administration Nevada Site Office (NNSA/NSO), Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008c, *National Nuclear Security Administration Nevada Site Office, Nevada Test Site Environmental Report 2007*, DOE/NV/25946--543, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008d, *Final Environmental Impact Statement for a Rail Alignment for the Construction and Operation of a Railroad in Nevada to a Geologic Repository at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0369, Office of Civilian Radioactive Waste Management, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008e, *National Nuclear Security Administration Nevada Site Office, North Las Vegas Facility Emissions Inventory for Calendar Year 2008*, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2008f, *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243-SA-03, National Nuclear Security Administration Nevada Site Office.

DOE (U.S. Department of Energy), 2008g, *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4, National Nuclear Security Administration, Washington, DC, October.

DOE (U.S. Department of Energy), 2009a, and Nevada System of Higher Education Desert Research Institute, *A Brief History of the Community Environmental Monitoring Program* (accessed December 11, 2009, http://www.cemp.dri.edu/cemp/CEMPhist.html).

DOE (U.S. Department of Energy), 2009b, *Nevada Test Site Class II Air Quality Operating Permit AP9711-0549.01*, Appendix 7, Air Quality Impact Modeling, National Nuclear Security Administration/Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2009c, *National Emission Standards for Hazardous Air Pollutants – Radionuclide Emissions Calendar Year 2008*, DOE/NV/25946--742, National Nuclear Security Administration Nevada Site Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 2009d, *Nevada Test Site Environmental Report 2008*, DOE/NV/25946-790, Nevada Site Office, Las Vegas, Nevada, September.

DOE (U.S. Department of Energy), 2009e, and Nevada System of Higher Education Desert Research Institute, Climatological and Gamma Radiation Summary [from Community Environmental Monitoring Program] (accessed December 11, 2009, http://www.cemp.dri.edu/cemp/climate/).

EPA (U.S. Environmental Protection Agency), 1992, *Procedures for Emission Inventory Preparation*, Volume IV: Mobile Sources, EPA420-R-92-009, Office of Air and Radiation.

EPA (U.S. Environmental Protection Agency), 1995a, *Compilation of Air Pollutant Emission Factors*, Volume I: Stationary Point and Area Sources (accessed January 07, 2010, http://www.epa.gov/ttn/chief/ap42/index.html), Office of Air Quality Planning and Standards and Office of Air and Radiation, Research Triangle Park, North Carolina.

EPA (U.S. Environmental Protection Agency), 1995b, *Draft User's Guide to PART5: A Program for Calculating Particle Emissions from Motor Vehicles*, Appendix A, EPA-AA-AQAB-94-2, Office of Mobile Sources, February.

EPA (U.S. Environmental Protection Agency), 2003, *User's Guide to MOBILE6.1 and MOBILE 6.2*, Mobile Source Emission Factor Model, EPA-420-R-03-010, Office of Transportation and Air Quality, August.

EPA (U.S. Environmental Protection Agency), 2006, *Air Quality Criteria for Lead*, Volume I of II – EPA/600/R-05/144aF, Volume II of II – EPA/600/R-05/144bF, National Center for Environmental Assessment, Office of Research and Development, Research Triangle Park, North Carolina, October.

EPA (U.S. Environmental Protection Agency), 2009, *Office of Transportation and Air Quality, Motor Vehicle Emissions Simulator (MOVES) 2010 User Guide*, EPA-420-B-09-041 (accessed on March 2, 2010, http://www.epa.gov/otaq/models/moves/420b09041.pdf), December.

EPA (U.S. Environmental Protection Agency), 2010, *How to Calculate your Carbon Footprint, Simplified GHG Emissions Calculator (v2.8)* (accessed March 22, 2010, http://www.epa.gov/climateleaders/smallbiz/footprint.html).

FAA (Federal Aviation Administration), 2009, *Emissions and Dispersion Modeling System (EDMS) Version 5 Technical Manual*, FAA-AEE-07-7, Office of Environment and Energy, Washington, DC.

Hagen, L., 2001, *Fine Particulates (Pm10 and PM2.5) Generated by Breakage of Mobile Aggregates During Simulated Wind Erosion*, Wind Erosion Research, Manhattan, Kansas, U.S. Department of Agriculture, Agricultural Research Service (available at http://www.ars.usda.gov/research/publications/Publications.htm?seq_no_115=147995).

HEI (Health Effects Institute), 2006, *Characterization of Metals Emitted from Motor Vehicles*, Environmental Chemistry and Technology Program and Wisconsin State, Laboratory of Hygiene, University of Wisconsin, Madison, Wisconsin; and Department of Statistics, Brigham Young University, Provo, Utah, Number 133, March.

Lehrman et al., 2006, *Ozone Characterization Study*, Final Report (P.O. 210324), Environmental Research Associates, Santa Rosa, California.

NCDC (National Climatic Data Center), 2009, U.S. Climate Averages (accessed December 2, 2009, at http://www.wrcc.dri.edu/summary/Climsmnv.html).

NDEP (Nevada Division of Environmental Protection), 2007, Issuance of Repoened Air Quality Operating Permit FIN AA025, AP8733-0680.02 [For Tonopah Test Range], Bureau of Air Pollution Control, Carson City, Nevada.

NOAA (National Oceanic and Atmospheric Administration), 2006, Air Resources Laboratory Special Operations Research Division, Climatology of the Nevada Test Site, SORD 2006-3 (available at http://www.sord.nv.doe.gov/climate/Climatology_of_The_Nevada_Test_Site.Soule.pdf), Las Vegas, Nevada.

NOAA (National Oceanic and Atmospheric Administration), 2010, *Air Resources Laboratory Special Operations Research Division*, Personal communication W. Schalk, Director, March 2 and 5.

NRC (U.S. Nuclear Regulatory Commission), 1986, *Tornado Climatology of the Contiguous United States*, NUREG/CR-4461, Washington, DC.

NSTec (National Security Technologies), 2010, Analysis/Calculation (A/C) Sheet, FRM-2004, Tritium Emissions from Bldg A-1 Source Well Water CY 2009 [for NESHAP 2009 Annual Report for the North Las Vegas Facility], North Las Vegas, Nevada.

NWS VEF (Las Vegas National Weather Service Forecasting Office), 2009, Climate of Las Vegas, Nevada (accessed December 2, 2009, http://www.wrh.noaa.gov/vef/climate/index.php), December 2.

Pinnick, R. G., G. Fernandez, and B. D. Hinds, 1983, "Explosion dust particle size measurements," *Applied Optics*, Vol. 22, No. 1, pp 95-102.

SNL (Sandia National Laboratories), 2010, Tonopah, NV, Personal Communication regarding traffic associated with the NTS and off-site locations, March 11.

Schaeffer, J. R., 1968, Climatology of Tonopah Test Range, 1967, SC-M-68-522, Sandia Laboratories, Albuquerque, New Mexico.

SORD (Special Operations and Research Division), 2002, Meteorological Data Acquisition (MEDA) 1981-2001 Climate Summary for Station 35 (Tonopah Test Range) (accessed December 2, 2009, http://www.sord.nv.doe.gov/products/meda_climate_summaries/cli_sum_35.gif).

SORD (Special Operations and Research Division), 2005: SORD, MEDA 1981-2004 Wind Roses for Station 35 (Tonopah Test Range) (accessed December 2, 2009, at http://www.sord.nv.doe.gov/meda_wind_roses_by_station_numbe.htm).

Soulé, D., 2006, *Climatology of the Nevada Test Site*, SORD 2006-3, Special Operations and Research Division (SORD) of the National Oceanic and Atmospheric Administration Air Resources Laboratory (available at http://www.sord.nv.doe.gov/climate/Climatology_of_The_Nevada_Test_Site.Soule.pdf), Las Vegas, Nevada.

USAF (U.S. Air Force), 2003, *Operational Climatic Data Summary: Tonopah Test Range, Nevada*, Station No. 724844, July.

WGA (Western Governors' Association), 2006, *WRAP Fugitive Dust Handbook*, Western Regional Air Partnership (available at http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_ Rev_06.pdf), May 31.

APPENDIX E
EVALUATION OF HUMAN HEALTH EFFECTS FROM TRANSPORTATION

APPENDIX E
EVALUATION OF HUMAN HEALTH EFFECTS FROM TRANSPORTATION

E.1 Introduction

Transportation of any commodity involves a risk to both transportation crewmembers and the public. This risk results directly from transportation-related accidents and indirectly from increased levels of pollution from vehicle emissions, regardless of the cargo. The transportation of certain materials, such as hazardous or radioactive waste, can pose an additional risk due to the unique nature of the material itself. To permit a complete appraisal of the environmental impacts of the proposed actions and alternatives, the human health risks associated with the transportation of waste (both radioactive and nonradioactive) and radioactive materials on public highways and railroads were assessed.

This appendix provides an overview of the approach used to assess the human health risks that could result from the transportation that would be needed to implement the alternatives considered in this site-wide environmental impact statement (SWEIS). The topics in this appendix include the scope of the assessment, packaging and determination of potential transportation routes, analytical methods used for the risk assessment (e.g., computer models), and important assessment assumptions. In addition, to aid in the understanding and interpretation of the results, specific areas of uncertainty are described with an emphasis on how the uncertainties may affect comparisons of the alternatives.

The risk assessment results are presented in this appendix in terms of "per-shipment" risk factors, as well as the total risk for a given alternative. Per-shipment risk factors provide an estimate of the risk from a single shipment. The total risk for a given alternative is estimated by multiplying the expected number of shipments by the appropriate per-shipment risk factors.

E.2 Scope of Assessment

The scope of the transportation human health risk assessment, including the alternatives, transportation activities, potential radiological and nonradiological impacts, and transportation modes, is described in this section. There are several shipping arrangements for various radioactive wastes that cover all alternatives evaluated in this SWEIS. This evaluation focuses on using public highways and rail systems. Additional details of the assessment are provided in the remaining sections of this appendix.

E.2.1 Transportation-Related Activities

The transportation risk assessment is limited to estimating the human health risks related to transportation under each alternative. The risks to workers or the public during loading, unloading, and handling prior to or after shipment are addressed in Chapter 5, Section 5.1.12, Human Health and Safety, of this SWEIS. The impacts of increased transportation levels on local traffic flow and infrastructure are addressed in Chapter 5, Section 5.2.3.2, Traffic.

E.2.2 Radiological Impacts

For each alternative, radiological risks (i.e., risks resulting from the radioactive nature of the materials) were assessed for both incident-free (i.e., normal) and accident transportation conditions. The radiological risk associated with incident-free transportation conditions would result from the potential exposure of people to external radiation in the vicinity of a shipment. The radiological risk from transportation accidents would result from the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people to that material.

All radiological impacts are calculated in terms of committed dose and associated health effects in the exposed populations. The radiation dose calculated is the total effective dose equivalent (see Title 10 of the *Code of Federal Regulations* [CFR], Part 20), which is the sum of the effective dose equivalent from external radiation exposure and the 50-year committed effective dose equivalent from internal radiation exposure. Radiation doses are presented in units of roentgen equivalent man (rem) for individuals and person-rem for collective populations. The impacts are further expressed as health risks in terms of latent cancer fatalities (LCFs) in exposed populations using the dose-to-risk conversion factors recommended by the U.S. Department of Energy (DOE) Office of National Environmental Policy Act Policy and Compliance, based on guidance from the Interagency Steering Committee on Radiation Standards (DOE 2003).

E.2.3 Nonradiological Impacts

In addition to the radiological risks posed by transportation activities, vehicle-related risks were also assessed for nonradiological causes (i.e., risks related to the transport vehicles rather than the radioactive cargo) for the same transportation routes. The nonradiological transportation risks, which would be incurred by similar shipments of any commodity, were assessed for accident conditions. The nonradiological accident risks are associated with the potential occurrence of transportation accidents that result in fatalities unrelated to the radioactive nature of the cargo.

Nonradiological risks during incident-free transportation conditions could also be caused by potential exposure to increased vehicle exhaust emissions. As explained in Section E.5.2, these emission impacts were not considered.

E.2.4 Transportation Modes

All shipments were assumed to be transported by either dedicated truck or general freight rail. Rail shipments to the Nevada National Security Site (NNSS) would end at a transfer station, where the cargo would be transferred to trucks to complete the trip to the NNSS.

E.2.5 Receptors

Transportation-related risks are calculated and presented separately for workers and members of the general public. The workers considered are truck and rail crewmembers involved in transporting and inspecting the packages and rail-to-truck transfer station workers involved in transferring waste packages between railcars and trucks. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit. Potential risks were estimated for the affected populations and for a hypothetical maximally exposed individual (MEI). When analyzing incident-free transportation conditions, the affected population comprises those individuals living within 0.5 miles of each side of the road or rail line, while the MEI would be a resident living near a highway or rail line that is exposed to all shipments transported on that road or rail line. During accident conditions, the affected population would comprise individuals residing within 50 miles of the accident, and the MEI would be an individual located 330 feet directly downwind from the accident. The risk to the affected population is a measure of the radiological risk posed to society as a whole by the alternative being considered. As such, the impact on the affected population is used as the primary means of comparing various alternatives.

E.3 Packaging and Transportation Regulations

This section provides a high-level summary of regulations for packaging and transporting radioactive materials issued by the U.S. Department of Transportation (DOT) and U.S. Nuclear Regulatory Commission (NRC). Specifics on details on these regulations can be found in 49 CFR Parts 106, 107, and 171–178 (DOT regulations); 10 CFR Parts 20, 61, and 71 (NRC regulations); and 39 CFR Part 121 (U.S. Postal Service regulations). See the cited sections of these regulations for more information, or review the 2008 regulations review document, *Radioactive Material Regulations Review* (RAMREG-12-2008) (DOT 2008), for a comprehensive discussion of radioactive material regulations.

E.3.1 Packaging Regulations

Packaging requirements are an important consideration for transportation risk assessment. The primary regulatory approach to promoting safety from radiological exposure is the specification of standards for the packaging of radioactive materials. Packaging represents the primary barrier between the radioactive material being transported and the public, workers, and the environment. Transportation packaging for radioactive materials must be designed, constructed, and maintained to contain and shield its contents during normal transportation conditions. For highly radioactive material, such as greater-than-Class C waste and certain special nuclear materials, packaging must contain and shield the contents in the event of severe accident conditions. The type of packaging to be used is determined by the total radioactive hazard presented by the material within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Specific requirements for these packages are detailed in 49 CFR Part 173, Subpart I. All packages are designed to protect and retain their contents during incident-free transportation conditions.

Excepted packagings are limited to the transport of materials that have extremely low levels of radioactivity and very low external radiation. Industrial packagings are used to transport materials that present a limited hazard to the public and the environment because of their low concentration of radioactive materials. Type A packagings are designed to protect and retain their contents during incident-free transportation conditions and, because of the higher radioactivity of their contents, must maintain sufficient shielding to limit radiation exposure to handling personnel. Type A packagings, typically 55-gallon drums or standard waste boxes, are commonly used to transport radioactive materials with higher concentrations or amounts of radioactivity than Excepted or Industrial packages. Type B packagings are used to transport material with even higher radioactivity levels and are designed to protect and retain their contents during transportation accident conditions. They are described in more detail in the following sections.

Radioactive materials shipped in Type A packagings or containers, are subject to specific radioactivity limits identified as A1 and A2 values in 49 CFR 173.435, "Table of A1 and A2 Values for Radionuclides." In addition, external radiation limits, as prescribed in 49 CFR 173.441, "Radiation Level Limitations," must be met. If the A1 or A2 limits are exceeded, the material must be shipped in a Type B container unless it can be demonstrated that the material meets the definition of "low specific activity." If the material qualifies as low specific activity, as defined in 10 CFR Part 71 and 49 CFR Part 173, it may be shipped in a shipping container such as Industrial or Type A packaging (49 CFR 173.427); see also RAMREG-001-98, the 1998 *Radioactive Material Regulations Review* (DOT 1998). Type B containers or casks are subject to the radiation limits in 49 CFR 173.441, but no quantity limits are imposed except in the case of fissile materials and plutonium.

Type A packagings are designed to retain their radioactive contents in normal transport. Under normal conditions, a Type A package must withstand the following:

- Operating temperatures ranging from –40 degrees Fahrenheit (°F) to 158 °F
- External pressures ranging from 3.5 to 20 pounds per square inch
- Normal vibration experienced during transportation

- Simulated rainfall of 2 inches per hour for 1 hour
- Free fall from 1 to 4 feet, depending on the package weight
- Water immersion-compression tests
- Impact of a 13-pound steel cylinder with rounded ends dropped from 3.3 feet onto the most vulnerable surface

Type B packagings are designed to retain their radioactive contents during both incident-free and accident conditions. A Type B package must withstand the following during accident conditions in addition to the Type A packaging criteria listed above:

- Free drop from 30 feet onto an unyielding surface in a position most likely to cause damage
- Free drop from 3.3 feet onto the end of a 6-inch-diameter vertical steel bar
- Exposure to a temperature of 1,475 °F for at least 30 minutes
- For all packages, immersion in at least 50 feet of water
- For some packages, immersion in at least 3 feet of water in an orientation most likely to result in leakage
- For some packages, immersion in at least 660 feet of water for 1 hour

Compliance with these requirements is demonstrated by using a combination of simple calculation methods, computer modeling techniques, and scale-model or full-scale testing of transportation packages or casks.

E.3.2 Transportation Regulations

The regulatory standards for packaging and transporting radioactive materials are designed to achieve the following four primary objectives:

- Protect persons and property from radiation emitted from packages during transportation by imposing specific limitations on the allowable radiation levels.
- Contain radioactive material in the package (achieved by packaging design requirements based on performance-oriented packaging integrity tests and environmental criteria).
- Prevent nuclear criticality (an unplanned nuclear chain reaction that could occur as a result of concentrating too much fissile material in one place).
- Provide physical protection against theft and sabotage during transit.

DOT regulates the transportation of hazardous materials in interstate commerce by land, air, and water. DOT specifically regulates the carriers of radioactive materials and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements to reduce transportation impacts. Other DOT regulations specify the maximum dose rate from radioactive material shipments. DOT also regulates the labeling, classification, and marking of radioactive material packagings.

NRC regulates the packaging and transportation of radioactive material for its licensees, including commercial shippers of radioactive materials. In addition, under an agreement with DOT, NRC sets the standards for Type B packagings and packages containing fissile materials.

Through its management directives, orders, and contractual agreements, DOE ensures the protection of public health and safety by imposing transportation activities standards equivalent to those of DOT and NRC. According to 49 CFR 173.7(d), packagings made by or under the direction of DOE may be used for transporting radioactive (Class 7) materials when the packages are evaluated, approved, and certified by DOE against packaging standards equivalent to those specified in 10 CFR Part 71.

The U.S. Department of Homeland Security is responsible for establishing policies for and coordinating civil emergency management, planning, and interaction with Federal Executive agencies that have emergency response functions in the event of a transportation incident. Guidelines for response actions are outlined in the *National Response Framework (NRF)* (DHS 2008a) in the event of a transportation incident involving nuclear material.

The Department of Homeland Security would use the Federal Emergency Management Agency, an organization within the department, to coordinate Federal and state participation in developing emergency response plans and to be responsible for the development and maintenance of the *Nuclear/Radiological Incident Annex* to the *NRF* (DHS 2008b). The *Nuclear/Radiological Incident Annex* describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event.

E.4 Transportation Analysis Impact Methodology

The transportation risk assessment is based on the alternatives described in Chapter 3 of this SWEIS. **Figure E–1** summarizes the transportation risk assessment methodology. After the SWEIS alternatives were identified and the requirements of the shipping campaign were understood, data were collected on material characteristics and accident parameters. The methodology used to conduct the analysis is based on DOE guidance contained in *A Resource Handbook on DOE Transportation Risk Assessment* (DOE 2002b).

Transportation impacts calculated in this SWEIS are presented in two parts: impacts of incident-free (i.e., normal) transportation and impacts of transportation accidents. Impacts of incident-free transportation and transportation accidents were further divided into nonradiological and radiological impacts. Nonradiological impacts could result from transportation accidents in terms of traffic fatalities. Radiological impacts of incident-free transportation include impacts on members of the public and crew from radiation emanating from materials in the shipment. Radiological impacts from accident conditions consider all foreseeable scenarios that could damage transportation packages, leading to releases of radioactive materials to the environment.

The impacts of transportation accidents are expressed in terms of probabilistic risk, which is the probability of an accident multiplied by the consequences of that accident and summed over all reasonably conceivable accident conditions. Hypothetical transportation accident conditions, ranging from low-speed "fender-bender" collisions to high-speed collisions with and without fires, were analyzed. The frequencies of accidents and consequences were evaluated using a method developed by NRC and previously published in NUREG-0170, *Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes* (NRC 1977); NUREG/CR-4829, *Shipping Container Response to Severe Highway and Railway Accident Conditions* (NRC 1987); and NUREG/CR-6672, *Reexamination of Spent Fuel Shipping Risk Estimates* (NRC 2000). Hereafter, these reports are cited as the *Radioactive Material Transportation Study*; *Modal Study*; and *Reexamination Study*, respectively. Radiological accident risk is expressed in terms of additional LCFs, and nonradiological accident risk is expressed in terms of additional immediate (traffic) fatalities. Incident-free risk is also expressed in terms of additional LCFs.

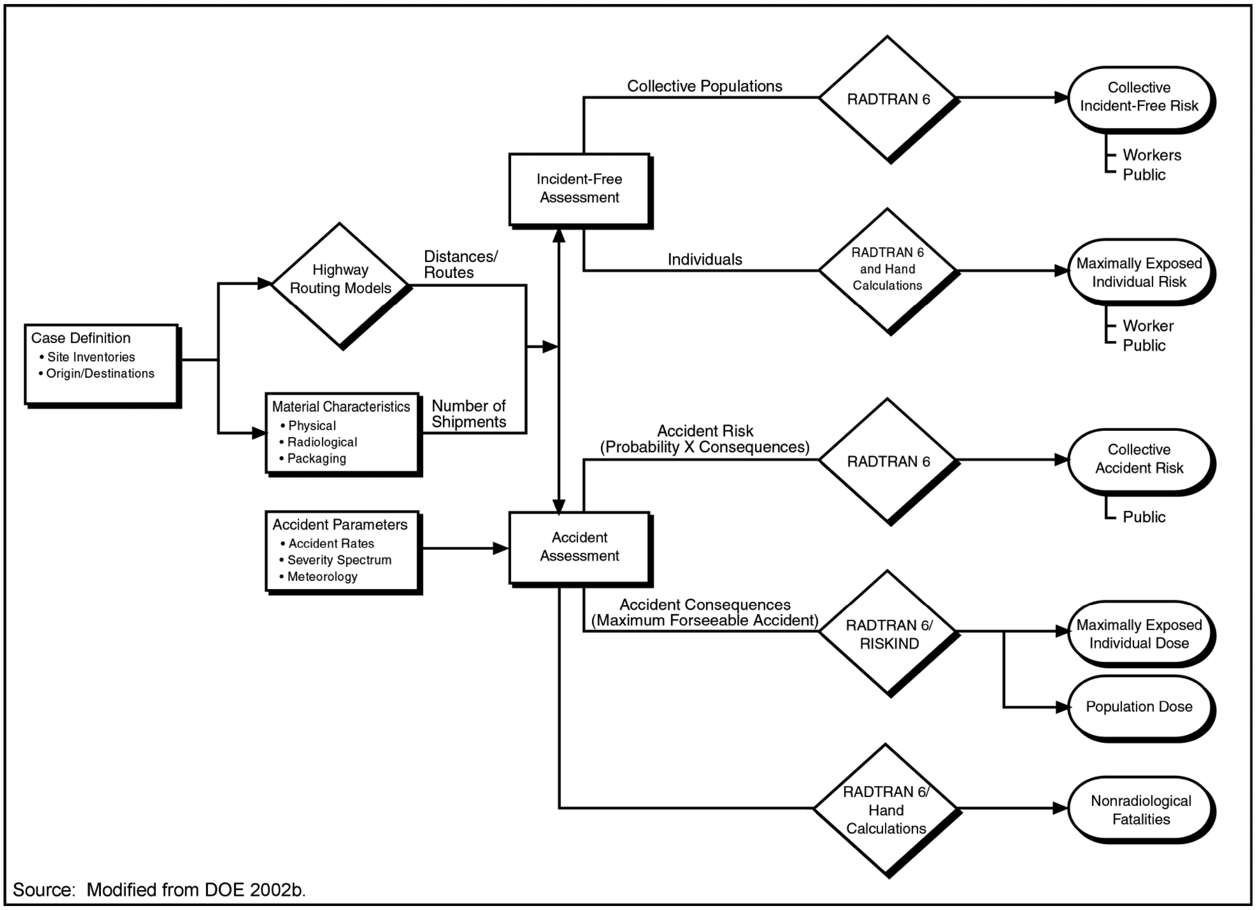


Figure E–1 Transportation Risk Assessment

Transportation-related risks were calculated and are presented separately for workers and members of the general public. The workers considered are truck/rail crewmembers involved in the actual transportation. The general public includes all persons who could be exposed to a shipment while it is moving or stopped during transit.

The first step in the ground transportation analysis was to determine the distances and populations along the routes. The TRAGIS [Transportation Routing Analysis Geographic Information System] computer program (Johnson and Michelhaugh 2003) was used to choose representative truck and rail routes and associated distances and populations. TRAGIS is a geographic information system-based transportation analysis computer program used to identify and select highway, rail, and waterway routes for transporting radioactive materials within the United States. The features in TRAGIS allow users to determine radioactive materials shipment routes that conform to DOT regulations specified in 49 CFR Part 397. Both the road and rail network are 1:100,000-scale databases that were developed from the U.S. Geological Survey digital line graphs and the U.S. Census Bureau Topological Integrated Geographic Encoding and Referencing System. The current version of TRAGIS uses population densities along each route derived from 2000 census data. State-level population data from the 2000 census (the basis for the TRAGIS population densities) and the 2010 census were used to escalate the route-specific population densities to 2016 (Census 2010).

This information, along with the properties of the material being shipped and route-specific accident frequencies, was entered into the RADTRAN 6 [Radioactive Material Transportation] computer code (SNL 2009), which was used to calculate incident-free and accident risks on a per-shipment basis. The risks under each alternative were determined by summing the products of per-shipment risks for each waste type by the number of shipments.

The RADTRAN 6 computer code was used to estimate the impacts of incident-free transportation and transportation accidents on populations and the impacts of incident-free transportation on MEIs. RADTRAN 6 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by a variety of modes, including truck, rail, air, ship, and barge.

The RADTRAN 6 population risk calculations include both the consequences and probabilities of potential exposure events. The RADTRAN 6 code consequence analyses include the following exposure pathways: cloud shine, ground shine, direct radiation (from loss of shielding) inhalation (from dispersed materials), and resuspension (inhalation dose from resuspended materials). The collective population risk is a measure of the total radiological risk posed to society as a whole by the alternative being considered. As such, the collective population risk is used as the primary means of comparing the various alternatives. The RISKIND [Risks and Consequences of Radiological Material Transport] computer code (Yuan et al. 1995) was used to estimate the doses to MEIs and populations for the maximum reasonably foreseeable transportation accident. The RISKIND computer code was developed for DOE’s Office of Civilian Radioactive Waste Management to analyze the exposure of individuals during incident-free transportation and provide a detailed assessment of the consequences for individuals and population subgroups from severe transportation accidents under various environmental settings.

The RISKIND calculations were conducted to supplement the collective risk results calculated with RADTRAN. Whereas the collective risk results provide a measure of the overall risks of each alternative, the RISKIND calculations are meant to address areas of specific concern to individuals and population subgroups. Essentially, the RISKIND analyses are meant to address “What if” questions, such as “What if I live next to a site access road?” or “What if an accident happens near my town?”

E.4.1 Transportation Routes

To conduct the transportation analysis, an origination point and a destination were required for each truck and rail route. The NNSS may receive low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) from many waste generators throughout the United States. Many waste generators are known because of past waste receipts and solid waste forecasts; however, there is uncertainty as to the waste volumes to be received from waste generators, and it is possible that currently unidentified waste generators may transport radioactive waste to the NNSS for disposal. To take into account the uncertainty in waste volumes and possible waste generators, a representative origination point that would provide a conservative estimate of the impacts associated with transporting LLW and MLLW from a location within a region to the NNSS was assumed for eight regions of the United States. **Figure E–2** identifies the regions and representative origination point for each region.

Figure E–2 Regions of the United States Analyzed in this Site-Wide Environmental Impact Statement

Transportation impacts were assessed for two cases, as follows:

Constrained Case: This case constrains the transportation routes that can be used to those that do not travel through Las Vegas or over the bridge downstream of the Hoover Dam. As described in Chapter 4, Section 4.1.3.2.1, Regional Transportation, trucks transporting waste on Interstate 15 from the south avoid traveling through Las Vegas by taking Nevada State Route 160 to its intersection with U.S. Route 95. Radioactive waste being transported to the NNSS from points north of Las Vegas avoids Interstate 15 in Nevada by using Route 6 and then south on U.S. Route 95. In addition, rail transport was analyzed from each region, with shipments going to West Wendover, Nevada (using Tecoma, Nevada, as a proxy), or to Parker, Arizona (using Barstow, California, and Kingman, Arizona, as proxies). It was assumed that only shipments from Idaho National Laboratory would go to West Wendover, while all other shipments would go to Parker. Truck travel from the rail-to-truck transfer stations at these two locations would proceed to the NNSS along the constrained routes. **Figure E–3** shows the constrained truck routes that were analyzed and the rail routes to transfer stations in West Wendover, Nevada, and Parker, Arizona, from each region. **Figure E–4** shows the truck routes from the transfer stations to the NNSS. Note that while the routes shown are meant to represent current transportation activities, other routes can be taken depending on road and weather conditions, logistics, and judgment of the carrier or driver.

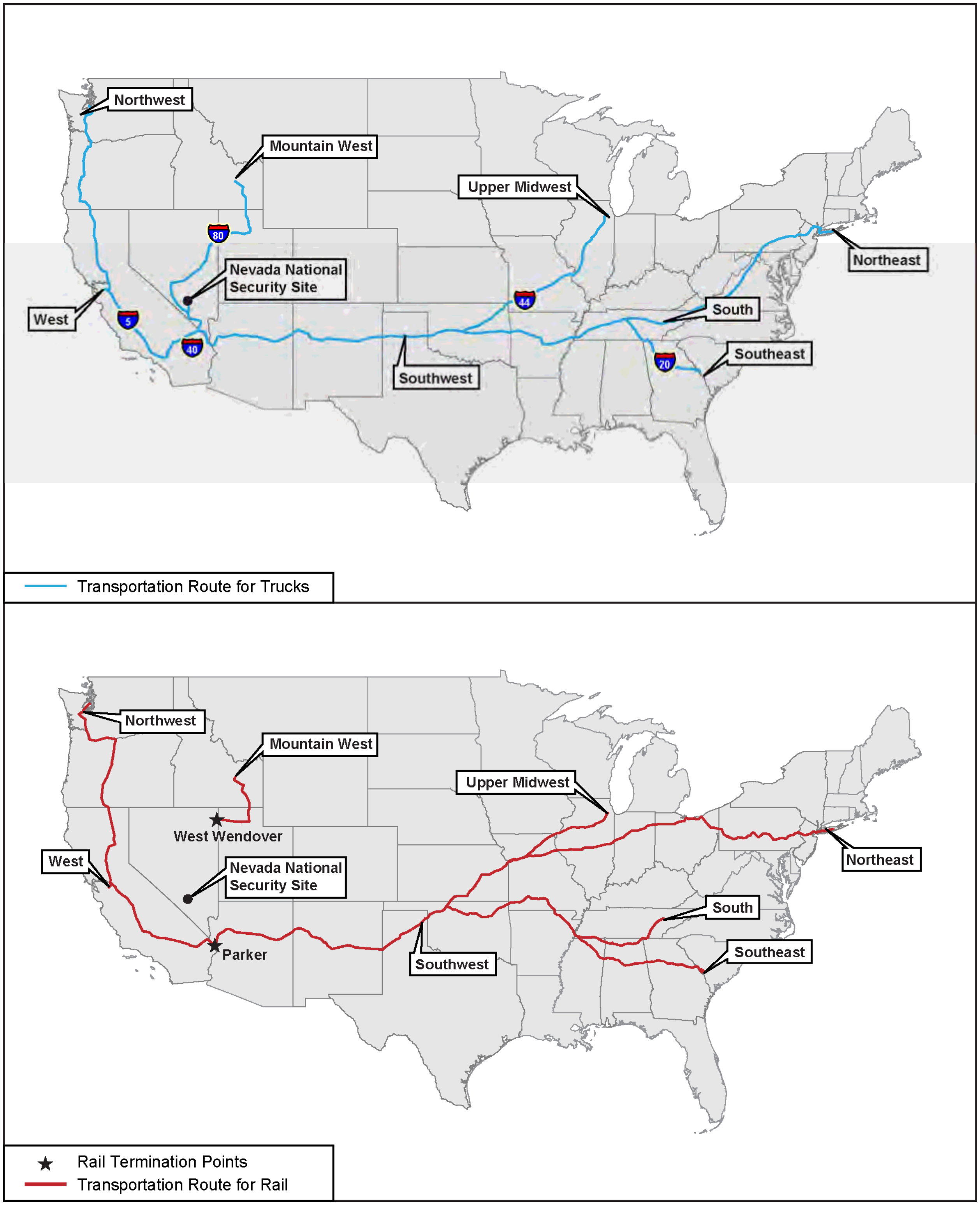


Figure E–3 Constrained Case – Truck Routes to the Nevada National Security Site and Rail Routes to Transfer Stations in West Wendover, Nevada, and Parker, Arizona

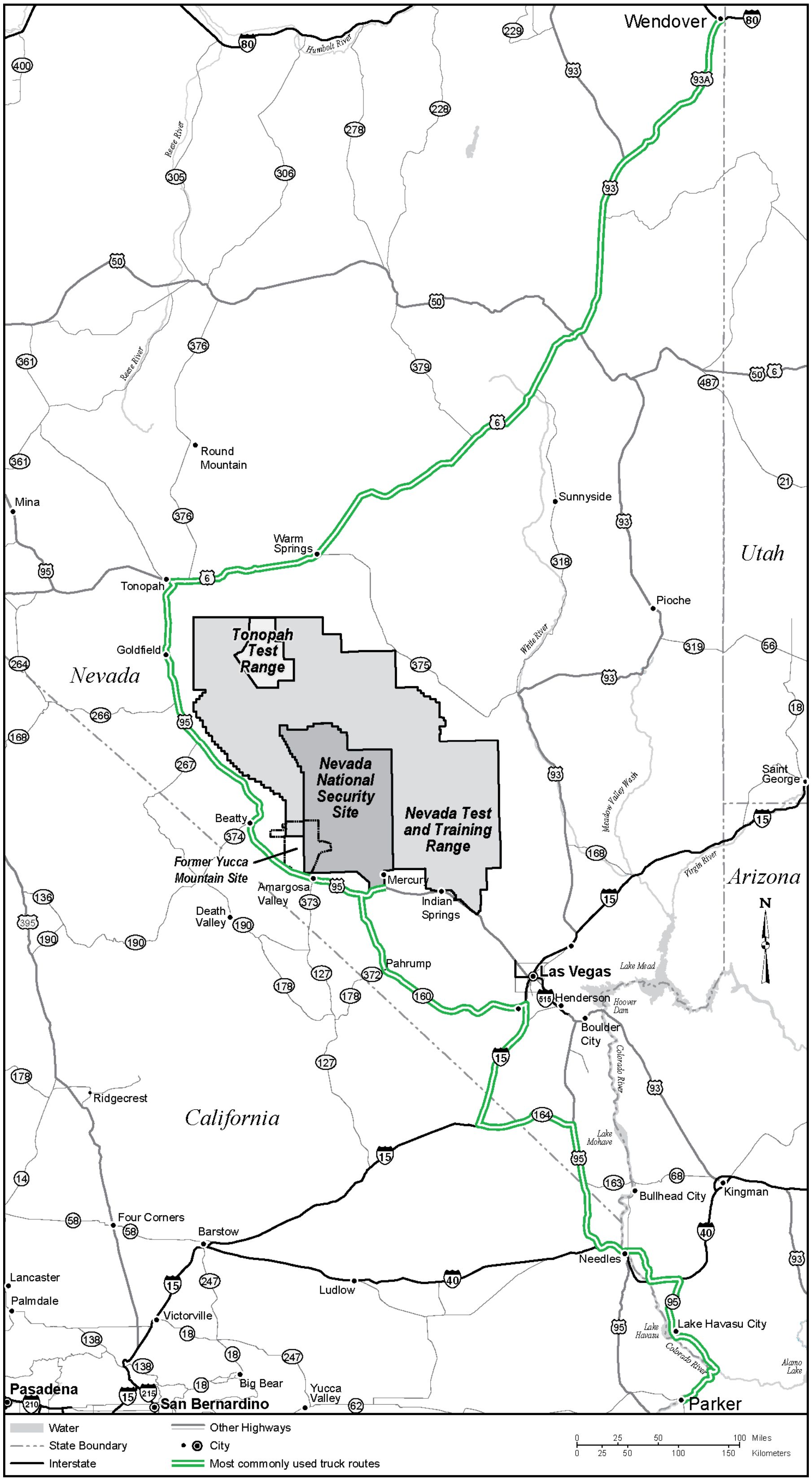


Figure E–4 Constrained Case – Truck Routes from the Transfer Stations to the Nevada National Security Site

Low-Level Radioactive Waste Transportation through the Las Vegas Valley

Historically, the U.S. Department of Energy (DOE) committed to the State of Nevada that it would avoid shipping low-level radioactive waste through the Interstate 15/U.S. 95 interchange in Las Vegas, Nevada. This commitment was made when major highways, such as Interstate 15 and U.S. Route 95, were unable to accommodate increased traffic volumes. The commitment as stated in the Waste Acceptance Criteria for the Nevada National Security Site (NNSS) avoided Hoover Dam and Las Vegas. In compliance with this requirement, commercial carriers of low-level radioactive waste used alternate shipping routes, such as Nevada State Route 160.

Now, the transportation infrastructure throughout metropolitan Las Vegas, such as Interstate 15 and U.S. Route 95, have been expanded and improved. In addition, the 215 Beltway was built to take traffic around the center of Las Vegas. Moreover, highways that continue to be used to transport waste, such as Nevada State Route 160, have experienced increased traffic as the population has grown in that area of the valley.

The National Nuclear Security Administration (NNSA) has analyzed two transportation cases: one that reflects the existing commitment (Constrained Case) and one that permits shipments through the greater metropolitan Las Vegas area (Unconstrained Case). This analysis was undertaken to develop a greater understanding of the potential environmental consequences of shipping such waste through and around metropolitan Las Vegas, and to provide information relevant to consideration of potential highway routing-related revisions to NNSS's waste acceptance criteria. Although an analysis of low-level/mixed low-level waste shipping routes is included in this site-wide environmental impact statement, individual decisions on routing will not be made as part of this National Environmental Policy Act process; such decisions are developed in accordance with NNSA's standard practices, which include consultation with the State of Nevada, and when finalized, become publicly available through publication on the NNSS website.

As part of the Constrained Case, materials and wastes other than LLW and MLLW would be transported to and from the NNSS. Transuranic (TRU) waste would be shipped from the NNSS to Idaho National Laboratory for treatment and certification. The TRU waste would then be shipped from the Idaho National Laboratory to the Waste Isolation Pilot Plant in New Mexico. Truck routes from specific origination and destination sites were analyzed for the transportation of radioisotope thermoelectric generators, special nuclear material, and sealed sources. For nuclear weapons transport, per-shipment risks were calculated for routes from different regions of the United States, and the route with the highest risk was assumed to be used for all transports. Rail transport was not analyzed for TRU waste, special nuclear material, or nuclear weapons.

Unconstrained Case: In the Unconstrained Case, transportation by (a) truck only and (b) a combination of rail and truck were analyzed.

(a) Truck Only: Impacts were analyzed for two route segments. The first segment is from the regional origination point to entry points to Las Vegas (see **Figure E–5**). These entry points are Henderson (at the intersection of Interstate 515 and U.S. Route 95), Apex (on Interstate 15 north of Las Vegas), and Arden (on Interstate 15 just south of the junction of Interstates 15 and 215). Only a portion of the offsite shipments to each entry point was analyzed; with the sum entering all three points being 100 percent of the shipments. This provides a more-realistic analysis, as truck shipments would only enter the Las Vegas area from a direction that makes the most sense (for example, shipments from the West region would not go to Henderson, but would instead enter the Las Vegas area at Arden). The second segment consists of different routes from these entry points to the NNSS. It was assumed that there would be no route limitations in the Las Vegas area; shipments could proceed through or around Las Vegas on several different possible routes, as depicted in **Figure E–6.** Truck routes were analyzed in segments to make it easier to analyze multiple routes (different segments can be added together).

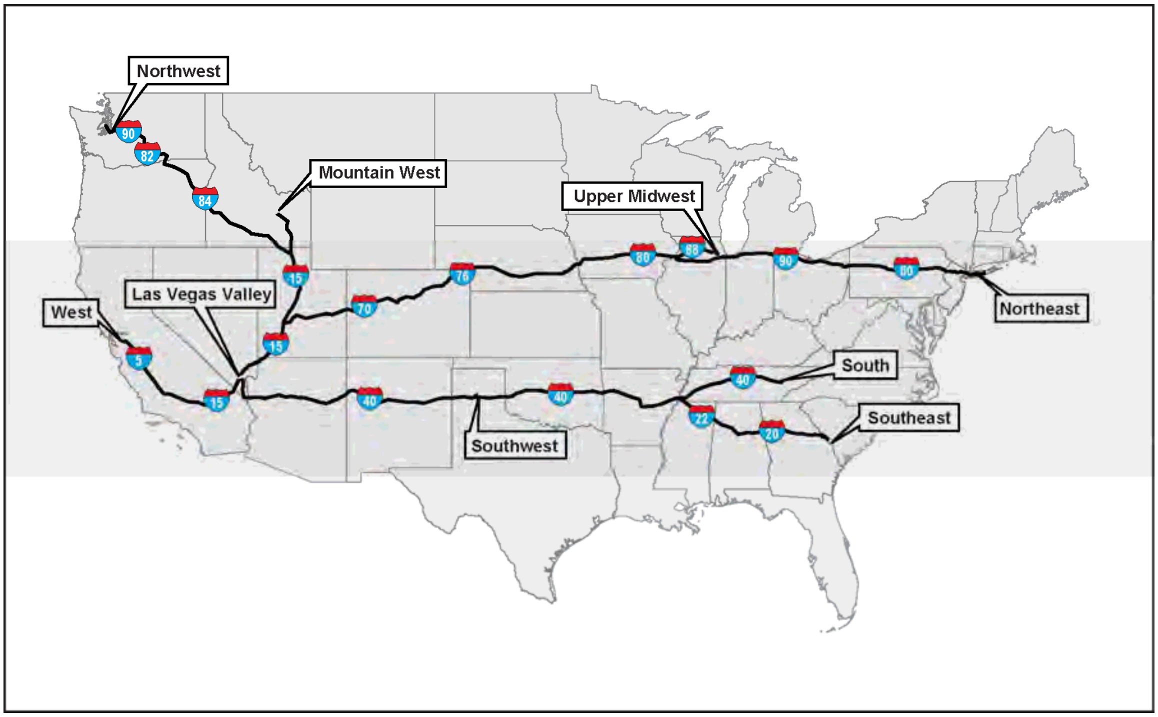


Figure E–5 Unconstrained Case – Truck Routes to Las Vegas Entry Points

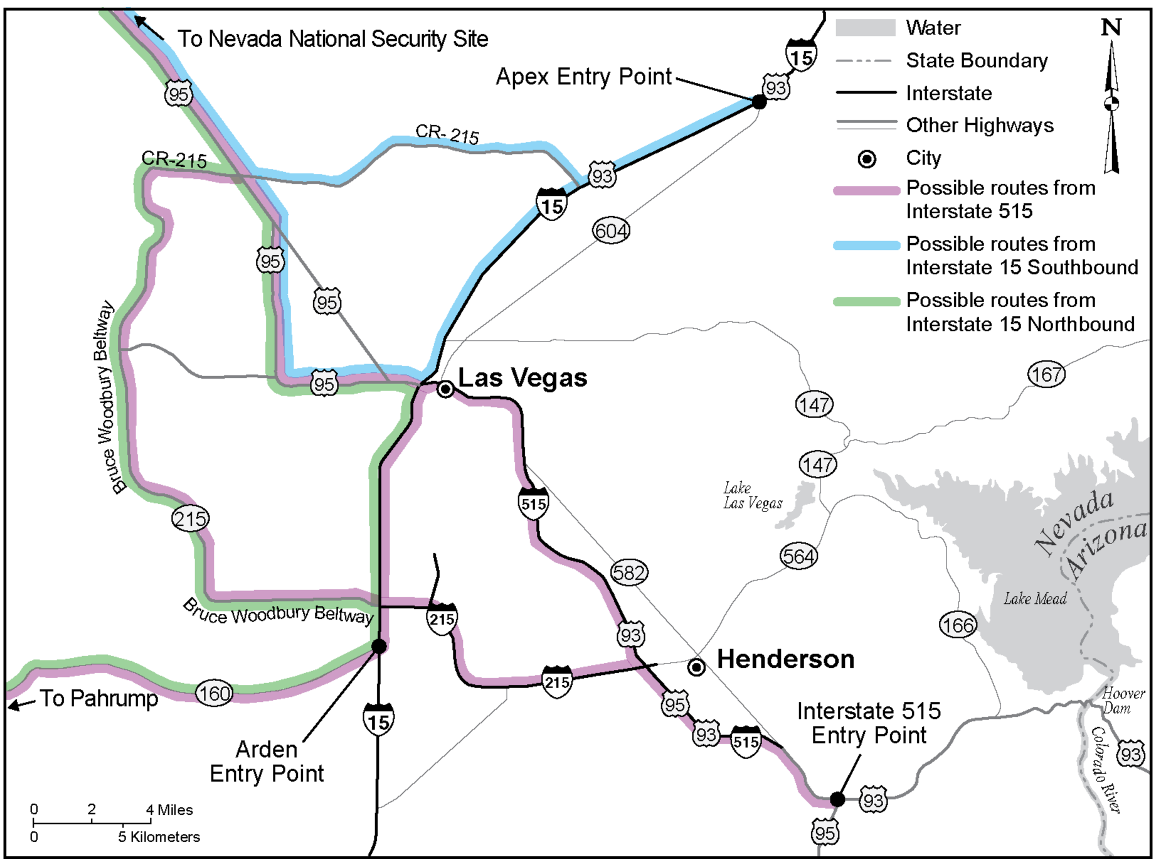


Figure E–6 Unconstrained Case – Truck Routes From Las Vegas Entry Points to the Nevada National Security Site

(b) Multiple routes could be taken from each entry point to the NNSS, as follows (and as shown in Figure E–6):

From Apex to the NNSS:	Interstate 15 to Clark County Route 215 to U.S. Route 95 Interstate 15 to U.S. Route 95
From Arden to the NNSS:	Interstate 15 to U.S. Route 95 Interstate 15 to Interstate 215 to Clark County Route 215 to U.S. Route 95 Interstate 15 to Nevada State Route 160 through Pahrump to U.S. Route 95
From Henderson to the NNSS:	Interstate 515 to U.S. Route 95 Interstate 515 to Interstate 215 to Interstate 15 to U.S. Route 95 Interstate 515 to Interstate 215 to Clark County Route 215 to U.S. Route 95 Interstate 515 to Interstate 215 to Interstate 15 to Nevada State Route 160 through Pahrump to U.S. Route 95

This appendix analyzes and compares all of these potential routes.

(c) Rail-to-Truck: Rail-to-truck transportation impacts were also analyzed by route segment. The first segment is rail transport from each region of the United States to a transfer station located in the Las Vegas region. All of the rail shipments were assumed to be transported to one of five different transfer stations, where they would be transferred to trucks. These five locations are West Wendover, Apex, and Arden, Nevada, and Parker and Kingman, Arizona. [Note: In practice, the location at which shipments would be received would be dependent on arrangements made by the shipper. The actual impacts would fall within the range of results determined in this analysis.] **Figures E–7** and **E–8** show the rail routes to each transfer station.

When analyzing rail-to-truck transportation, truck transport from an analyzed transfer station to a Las Vegas entry point (identified in (a) above) is evaluated as a segment, as shown in **Figure E–9**. Note that the truck segment from the transfer station to the entry point is only applicable to West Wendover, Parker, and Kingman because the transfer stations at Apex and Arden are already located at entry points to Las Vegas. Truck transport from West Wendover would proceed to the Apex entry point; truck transport from Parker would proceed to Henderson via U.S. Route 95; and truck transport from Kingman would proceed to Henderson via U.S. Route 93 over the bridge downstream of the Hoover Dam. The final segment is truck travel from a Las Vegas entry point to the NNSS, as described in (a) above and depicted in Figure E–6.

In addition to analyzing the use of transfer stations in the Las Vegas region, truck-to-rail transfer station locations were analyzed for three different regions of the United States: Southwest region, Northeast region, and West region. This analysis was performed to provide representative impacts associated with transporting LLW and MLLW from generating sites in these regions to a regional transfer station. These regions were selected because there are known LLW/MLLW generating sites in these regions that do not have direct access to rail.

Offsite Route Characteristics

Route characteristics that are important to the radiological risk assessment include the total shipment distance and population distribution along the route. The specific route selected determines both the total potentially exposed population and the expected frequency of transportation-related accidents. Rural, suburban, and urban areas, or zones, are characterized according to the following breakdown:

- Rural population densities range from 0 to 139 persons per square mile.
- Suburban population densities range from 140 to 3,326 persons per square mile.
- Urban population densities include all population densities greater than 3,326 persons per square mile.

The affected population for route characterization and incident-free dose calculation includes all persons living within 0.5 miles of each side of the transportation route.

Table E–1 presents the route characteristics for transporting materials and wastes to and from the NNSS under the Constrained Case. **Table E–2** presents the route characteristics for transporting LLW and MLLW under the Unconstrained Case. Note that the analysis was performed using kilometers, but is presented below in miles.

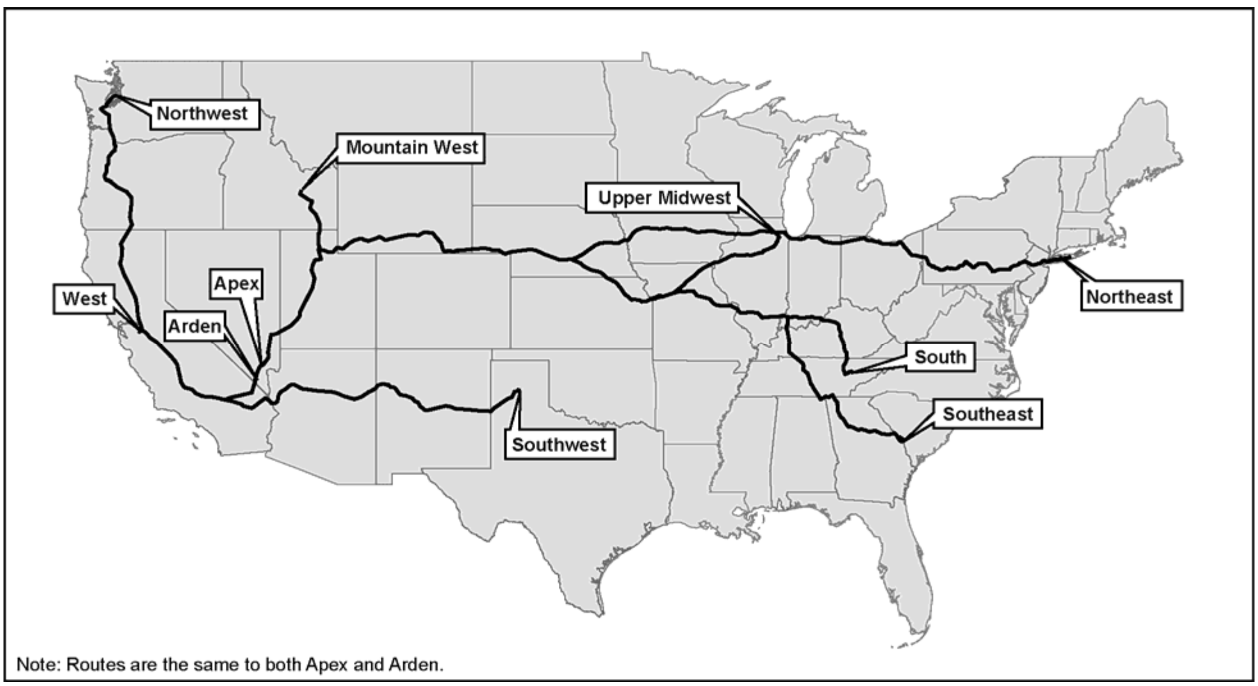


Figure E–7 Unconstrained Case – Rail Routes to Transfer Stations at Apex and Arden, Nevada

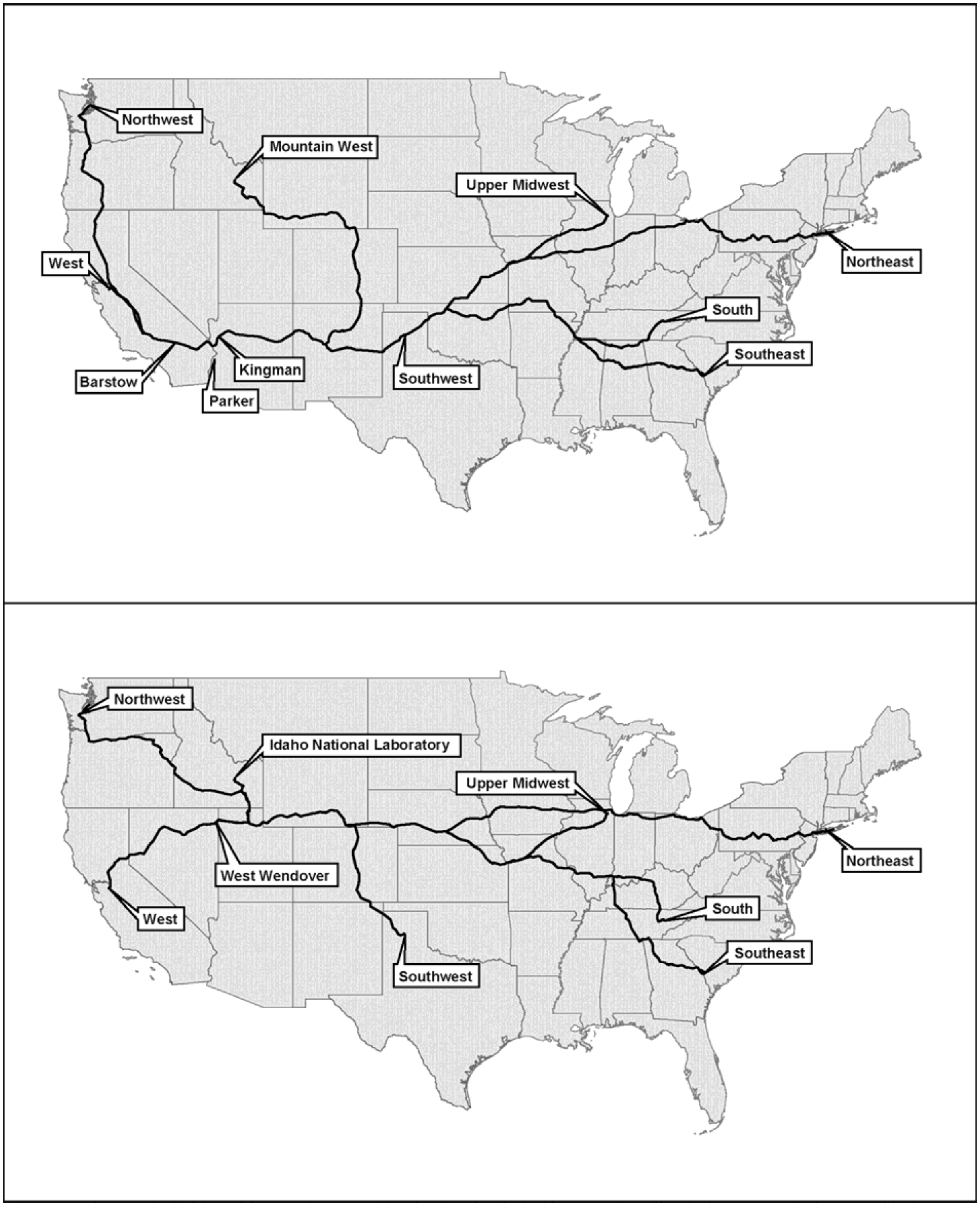


Figure E–8 Rail Routes to Transfer Stations at Parker and Kingman, Arizona, and West Wendover, Nevada

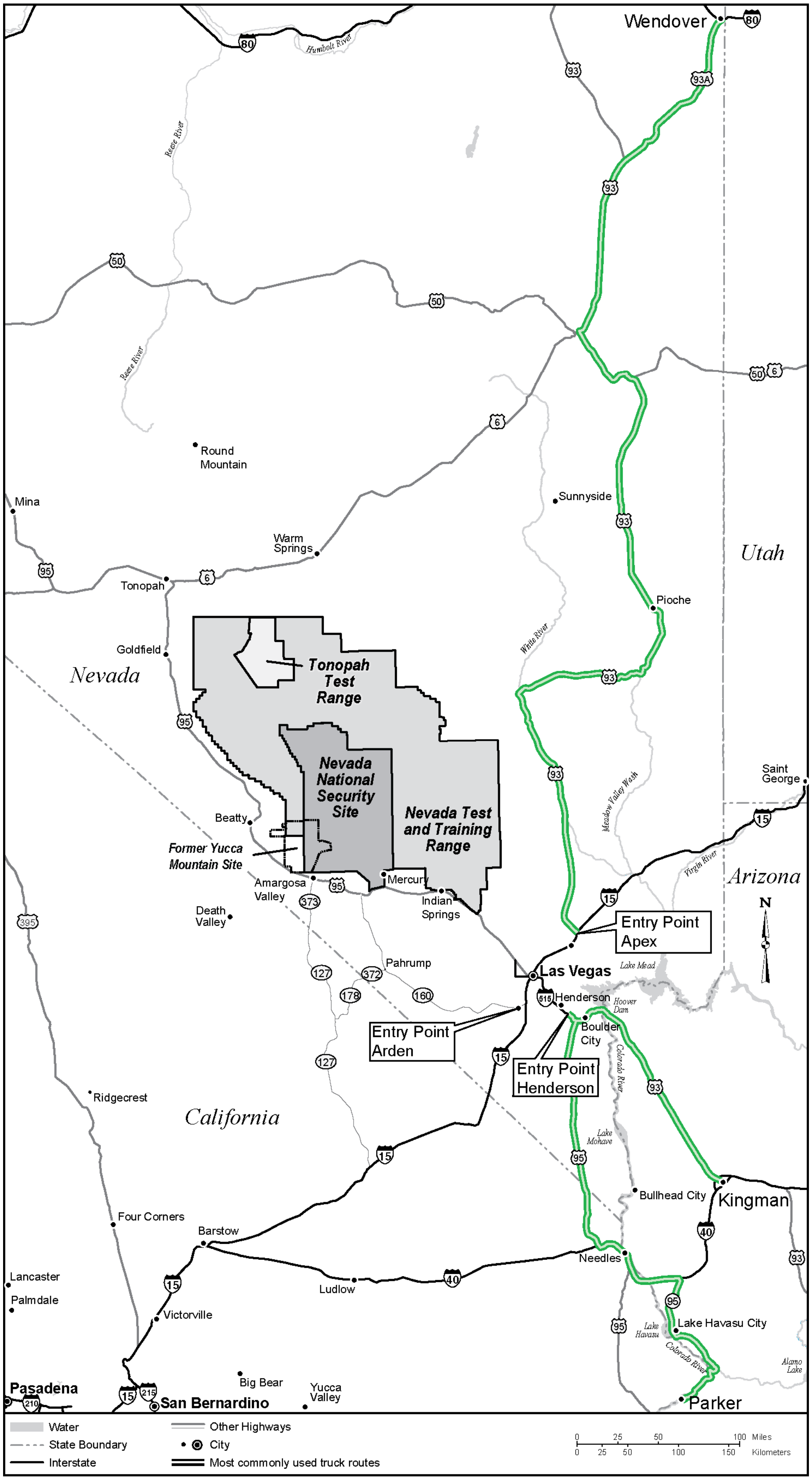


Figure E–9 Truck Routes from Transfer Stations to Las Vegas Entry Points

Table E–1 Constrained Case – Offsite Transport Truck and Rail Route Characteristics

Origin or Destination	*Transport Mode*	*Nominal Distance (miles)*	*Distance Traveled in Zone (miles)*			*Population Density in Zone (persons per square mile)*			*Number of Affected Persons* [a]
			Rural	*Suburban*	*Urban*	*Rural*	*Suburban*	*Urban*	
Radioactive Waste Shipments									
Northeast	Truck	2,990	2130.5	749.7	107.2	36.0	1,009.7	7,179.9	1,594,356
	Rail [b]	3,000	2,314.2	498.3	186.3	23.7	1,235.9	7,377.1	2,033,545
South	Truck	2,170	1,768.5	355.9	42.5	31.2	965.9	7,145.4	698,533
	Rail [b]	2,360	1,985.3	331.4	39.3	25.5	1,216.5	6,643.8	710,887
Southeast	Truck	2,410	1,866.0	477.6	66.2	32.5	1,069.2	7,363.8	1,052,981
	Rail [b]	2,580	2,115.8	406.3	56.4	26.8	1,267.6	7,018.4	962,105
Upper Midwest	Truck	2,090	1,689.6	361.8	37.0	31.7	976.2	6,969.3	660,552
	Rail [b]	2,030	1,827.3	175.5	29.6	17.0	1,221.3	6,897.1	446,896
Southwest	Truck	1,080	971.1	93.8	16.2	23.8	1,126.6	7,746.1	252,527
	Rail [b]	1,090	1,002.9	77.5	10.6	17.1	1,206.4	7,546.2	189,742
Mountain West [c]	Truck	805	725.9	66.1	12.6	15.9	1,294.8	8,635.1	204,866
	Rail [b]	322	285.4	32.2	4.4	25.5	1,123.9	7,976.3	78,183
West	Truck	713	580.7	92.4	40.1	25.8	1,146.6	8,893.4	474,579
	Rail [b]	687	526.4	109.9	50.3	26.3	1,116.9	7,746.5	341,946
Northwest	Truck	1,520	1,030.1	385.6	103.6	35.8	1,157.1	7,995.3	1,304,115
	Rail [b]	1,560	1,260.6	239.0	61.0	22.7	1,147.8	7,559.4	759,834
Parker, AZ	Truck [b]	337	301.8	34.2	1.3	22.5	1,187.3	8,194.9	57,725
West Wendover, NV	Truck [b]	464	457.1	6.6	0.6	7.2	1,570.7	8,660.5	18,457
Norfolk, VA [d]	Truck	2,690	2,040.9	592.7	60.4	35.3	958.3	7,172.6	1,067,067
Special Nuclear Material and Sealed Sources									
INL	Truck	805	725.9	66.1	12.6	15.9	1,294.8	8,635.1	204,866
LLNL	Truck	713	580.7	92.4	40.1	25.8	1,146.6	8,893.4	474,579
LANL	Truck	868	768.6	88.5	10.7	25.8	1,146.6	8,893.4	215,687
Oak Ridge Reservation	Truck	2,170	1,768.5	355.9	42.5	31.2	965.9	7,145.4	698,533
San Antonio, TX	Truck	1,410	1,204.3	157.8	45.9	24.2	1,265.6	9,921.5	688,197
Nuclear Weapons									
Norfolk, VA	Truck	2,690	2,040.9	592.7	60.4	35.3	958.3	7,172.6	1,067,067
Y-12	Truck	2,170	1,768.5	355.9	42.5	31.2	965.9	7,145.4	698,533
Pantex	Truck	1,080	971.1	93.9	16.2	23.8	1,126.6	7,746.1	252,527
LANL	Truck	868	768.6	88.5	10.7	25.8	1,146.6	8,893.4	215,687

INL = Idaho National Laboratory; LANL = Los Alamos National Laboratory; LLNL = Lawrence Livermore National Laboratory; Y-12 = Y-12 National Security Complex.

[a] The estimated number of persons residing within 0.5 miles of the transportation route.

[b] For all alternatives, Barstow, California (for westbound shipments), and Kingman, Arizona (for eastbound shipments), are used as proxy sites for Parker, Arizona, where radioactive materials being shipped by rail are transferred to trucks to complete the trip to the NNSS. Tecoma, Nevada, is used as a proxy site for West Wendover, Nevada. Proxy sites are used because route-specific distance and population data cannot be determined for Parker, Arizona, and West Wendover, Nevada, using TRAGIS.

[c] Transuranic waste originating at the NNSS would be sent to INL for certification.

[d] It was assumed that radioisotope thermoelectric generators unrelated to weapons to be disposed at the NNSS would originate in Norfolk Naval Shipyard, Virginia.

Table E–2 Unconstrained Case – Offsite Transport Truck and Rail Route Characteristics

Mode	To	From	Nominal Distance (miles)	Distance Traveled in Zone (miles)			Population Density in Zone (persons per square mile)			Population Affected [a]
				Rural	Suburban	Urban	Rural	Suburban	Urban	
Truck	Apex	Northeast	2,570	1,911.8	569.2	84.6	32.1	810.4	6,645.2	1,735,418
	Henderson	South	1,960	1,585.9	330.9	39.5	26.2	792.8	5,877.8	857,159
	Henderson	Southeast	2,150	1,676.6	425.6	50.1	28.0	822.3	5,802.1	1,099,911
	Apex	Upper Midwest	1,720	1,438.3	253.0	26.9	27.5	772.9	5,982.1	633,580
	Henderson	Southwest	883	786.7	79.2	16.8	18.9	886.0	6,068.4	299,008
	Apex	Mountain West	630	479.0	122.3	28.2	25.4	941.2	6,334.9	489,541
	Apex	Northwest	1,290	975.6	267.1	44.9	25.1	869.5	6,114.7	849,659
	Arden	West	513	461.9	44.2	6.7	22.0	755.8	6,238.8	136,756
Rail	West Wendover [b]	Northeast	2,530	1,763.0	544.9	219.5	26.7	1,049.0	7,096.6	3,481,698
		South	2,020	1,683.2	292.0	42.3	22.0	988.3	5,700.1	906,468
		Southeast	2,350	1,851.7	420.0	74.1	22.3	1,057.0	5,656.3	1,447,133
		Upper Midwest	1,640	1,489.6	133.0	19.2	14.8	950.5	5,573.7	408,645
		Southwest	1,180	1,023.7	128.1	24.0	11.1	1,021.2	5,900.3	454,613
		Mountain West	322	285.4	32.2	4.4	18.4	814.6	5,837.6	91,552
		Northwest	1,140	967.2	149.9	22.1	20.2	913.5	5,938.4	460,587
		West	637	522.5	81.0	33.7	14.5	1,000.0	6,720.8	504,588
	Arden	Northeast	2,910	2,099.9	575.3	234.2	23.8	1,061.6	7,062.2	3,703,593
		South	2,400	2,020.1	322.4	57.0	19.9	1,017.1	5,919.2	1,128,802
		Southeast	2,730	2,188.7	450.4	88.9	20.2	1,073.0	5,803.9	1,669,214
		Upper Midwest	2,020	1,826.5	163.4	33.9	13.7	1,014.2	5,996.6	630,727
		Southwest	1,240	1,159.5	74.9	10.3	12.2	917.4	5,729.6	226,566
		Mountain West	707	622.7	65.1	19.6	13.5	1,031.6	6,384.1	321,365
		Northwest	1,410	991.8	319.6	96.7	24.9	1,029.0	6,617.5	1,589,398
		West	543	385.8	117.1	39.9	22.8	1,017.1	6,972.0	649,683
	Apex	Northeast	2,880	2,080.2	568.9	230.5	23.8	1,061.9	7,049.0	3,645,804
		South	2,370	2,000.4	316.0	53.4	19.9	1,016.3	5,784.3	1,071,609
		Southeast	2,700	2,168.9	444.0	85.2	20.2	1,073.3	5,714.8	1,611,476
		Upper Midwest	1,990	1,806.8	156.9	30.3	13.5	1,012.7	5,768.5	572,445
		Southwest	1,270	1,179.2	81.4	13.9	12.4	928.3	6,297.1	283,960
		Mountain West	678	602.9	58.6	16.0	13.0	1,028.7	6,040.1	263,270
		Northwest	1,440	1,011.5	326.1	100.4	24.9	1,029.5	6,663.8	1,647,354
		West	573	405.5	123.6	43.5	22.8	1,019.2	7,049.2	706,901

Mode	To	From	Nominal Distance (miles)	Distance Traveled in Zone (miles)			Population Density in Zone (persons per square mile)			Population Affected [a]
				Rural	Suburban	Urban	Rural	Suburban	Urban	
Rail (cont'd)	Kingman	Northeast	2,770	2,095.4	487.4	185.4	22.3	1,128.7	6,927.5	3,009,370
		South	2,130	1,766.6	320.4	38.3	23.1	1,022.3	5,506.6	927,062
		Southeast	2,350	1,897.0	395.3	55.4	23.8	1,044.8	5,658.1	1,234,941
		Upper Midwest	1,800	1,608.5	164.6	28.5	15.0	1,029.3	5,880.6	578,083
		Southwest	860	784.2	66.6	9.6	15.0	917.6	5,779.8	205,714
		Mountain West	1,710	1,506.9	173.7	34.3	14.5	1,051.5	5,960.9	654,300
		Northwest	1,470	1,097.6	289.1	83.5	24.1	1,012.4	6,422.9	1,368,879
		West	598	435.4	122.3	40.5	20.7	1,017.6	6,940.9	663,560
	Parker [b]	Northeast	3,000	2,314.2	498.3	186.3	20.7	1,125.4	6,917.1	3,036,409
		South	2,360	1,985.3	331.4	39.3	21.2	1,020.7	5,493.9	954,395
		Southeast	2,580	2,115.8	406.3	56.4	22.3	1,043.0	5,646.5	1,263,073
		Upper Midwest	2,030	1,827.3	175.5	29.6	14.0	1,025.6	5,851.1	605,846
		Southwest	1,090	1,002.9	77.5	10.6	13.2	925.4	5,707.1	233,040
		Mountain West	1,950	1,725.7	184.6	35.3	13.5	1,047.1	5,933.7	681,560
		Northwest	1,470	1,097.6	289.1	83.5	24.1	1,012.4	6,422.9	1,368,879
		West	598	435.4	122.3	40.5	20.7	1,017.6	6,940.9	663,560
Truck from Rail stop to Las Vegas Valley	Junction I–15/C–215	West Wendover	358	352.9	4.7	0.3	5.7	975.4	4,570.6	12,860
	N/A	Arden	n/a	-	-	-	-	-	-	-
	N/A	Apex	n/a	-	-	-	-	-	-	-
	I–515 Henderson	Kingman	94.3	81.3	10.1	2.9	16.1	1,249.4	5,893.6	49,874
	Lake Havasu	Parker	51.2	41.0	9.8	0.4	18.6	1,101.0	4,570.6	21,590
	I–515 Henderson	Lake Havasu	139	124.5	12.6	1.8	15.3	864.0	6,608.9	39,535
Truck to Las Vegas	NNSS from Henderson	via I–515 to US 95	103	73.9	12.9	16.0	8.5	1,165.5	7,628.3	219,906
		via I–215 to I–15 to US 95	108	76.4	19.0	12.3	9.6	1,138.6	7,448.6	182,322
		via I–215 to C–215 to US 95	111	86.7	19.3	4.4	12.4	784.3	7,029.5	75,594
		through Pahrump	129	108.4	16.2	4.3	11.9	893.3	7,072.8	73,764
	NNSS from Arden	via I–15 to US 95	97.6	75.2	13.9	8.4	8.5	1,054.6	7,529.7	125,576
		via I–215 to C–215 to US 95	100	85.6	14.2	0.6	11.7	576.0	5,344.7	19,492
		through Pahrump	117	106.6	9.9	0.1	10.9	645.7	6,109.8	13,341
	NNSS from Apex	via C–215 to US 95	96.1	91.3	4.6	0.2	9.6	579.4	6,852.4	7,706
		via I–15 to US 95	103	81.4	12.2	9.8	9.3	1,031.9	7,841.2	143,816

Mode	To	From	Nominal Distance (miles)	Distance Traveled in Zone (miles)			Population Density in Zone (persons per square mile)			Population Affected [a]
				Rural	Suburban	Urban	Rural	Suburban	Urban	
Truck to Regional Rail stop	Princeton to Philadelphia	Northeast	33.0	4.7	17.8	10.5	37.3	1,474.0	7,126.4	161,929
	N/A	South	All known waste generators have access to rail at their site.							
	N/A	Southeast	All known waste generators have access to rail at their site.							
	N/A	Upper Midwest	All known waste generators have access to rail at their site.							
	LANL to Albuquerque, NM	Southwest	96.3	71.7	20.3	4.3	20.5		779.8	6,056.5 69,772
	N/A	Mountain West	All known waste generators have access to rail at their site.							
	N/A	Northwest	All known waste generators have access to rail at their site.							
	LBNL to Tracy, CA	West	64.6	27.3	18.3	19.0	34.4		1,264.7	8,009.3 282,257

C = Clark County Route; I = Interstate; LANL = Los Alamos National Laboratory; LBNL = Lawrence Berkeley National Laboratory; N/A = not applicable; US = U.S. Route.

[a] The estimated number of persons residing within 0.5 miles of the transportation route.

[b] For all alternatives, Barstow, California (for westbound shipments), and Kingman, Arizona (for eastbound shipments), are used as proxy sites for Parker, Arizona, where radioactive materials being shipped by rail are transferred to trucks to complete the trip to the Nevada National Security Site. Tecoma, Nevada, is used as a proxy site for West Wendover, Nevada. Proxy sites are used because route-specific distance and population data cannot be determined for Parker, Arizona, and West Wendover, Nevada, using TRAGIS.

E.4.2 Radioactive Material Shipments

All waste types were assumed to be shipped in certified or certified-equivalent packaging on exclusive-use vehicles. Legal-weight, heavy-haul combination trucks are used for highway transportation. Type A packages are transported on common flatbed or covered trailers; Type B packages are generally shipped on trailers designed specifically for the packaging being used. For transportation by truck, the maximum payload weight is considered to be about 48,000 pounds, based on the Federal gross vehicle weight limit of 80,000 pounds. While there are large numbers of multi-trailer combinations (known as longer combination vehicles) with gross weights in excess of the Federal limit in operation on rural roads and turnpikes in some states (FHWA 2003), for evaluation purposes, the load limit for the legal truck is based on the Federal gross vehicle weight. However, the maximum load is often limited by the design load capacity of the cargo container(s), and not the limits on the gross truck weight.

An example of a Type B package is the transuranic waste package transporter II (TRUPACT-II), which is used to transport contact-handled TRU waste (NRC 2009). A new design, the transuranic waste package transporter III (TRUPACT-III), is under licensing review. The TRUPACT-III is a rectangular package that would accommodate waste boxes that are too large for the TRUPACT-II (NEI 2010). Type B packages used to transport special nuclear materials are shipped in specially designed safeguards transporters (SGTs) that contain enhanced structural and security features that are classified. These packages are shipped under operational security procedures and emergency plans that include armed escort, satellite tracking, and advanced communications.

Rail transport can be performed using dedicated and/or general freight trains. For analysis purposes, use of a general freight (manifest) train was assumed. Payload weights for railcars range from 100,000 to 150,000 pounds. A median payload weight of 120,000 pounds was used in this analysis.

The following types of radioactive and nonradioactive wastes and disposal destinations were evaluated for this SWEIS:

- LLW and MLLW, including both contact-handled and remote-handled wastes, would be received for disposal at the NNSS from both onsite and offsite sources. In addition to LLW and MLLW received from DOE facilities, radioisotope thermoelectric generators and sealed sources would also be disposed as LLW.
- TRU waste generated at the NNSS would be transported to Idaho National Laboratory for treatment and certification based on an amended Record of Decision published on March 7, 2008 (73 *Federal Register* [FR] 12401). TRU waste at the NNSS would consist of TRU waste generated by Joint Actinide Shock Physics Experimental Research Facility (JASPER) operations, two 3-foot-diameter steel spheres containing plutonium that were used in subcritical experiments and are now stored at the NNSS, and waste from environmental restoration activities at the Tonopah Test Range (TTR) and the Nevada Test and Training Range. The TRU waste would then be shipped from Idaho National Laboratory to the Waste Isolation Pilot Plant in New Mexico.
- For analytical purposes, hazardous waste generated at the NNSS, TTR, North Las Vegas Facility, and Remote Sensing Laboratory was assumed to be shipped to a treatment, storage, and disposal facility located in Albuquerque, New Mexico, because this location is farther away than the other commonly used facility located in Beatty, Nevada, thereby maximizing the estimated impacts.
- Hazardous and nonhazardous recyclables were assumed to be transported an average of 100 miles one way for disposition.
- Nonradioactive waste, including sanitary solid waste and construction and demolition debris, was assumed to be transported an average of 50 miles one way for disposition.

Special nuclear materials would be received from offsite sources for possible repackaging and temporary storage. Special nuclear material shipments analyzed in this SWEIS include the following:

- 4.4 tons of special nuclear material shipped from Idaho National Laboratory (under the Expanded Operations Alternative only)
- 440 pounds of special nuclear material shipped from Lawrence Livermore National Laboratory (under all alternatives)
- 4.9 pounds of uranium-233 shipped from Los Alamos National Laboratory (under the Expanded Operations Alternative only)
- 1,100 pounds of highly enriched uranium, depleted uranium, and uranium associated with criticality safety experiments shipped from Lawrence Livermore National Laboratory (under all alternatives)
- 880 pounds of plutonium material from Idaho National Laboratory related to Zero Power Plutonium Reactor operations (under the Expanded Operations Alternative only)
- 110 pounds of uranium-233 targets shipped from Oak Ridge National Laboratory (under the Expanded Operations Alternative only)
- Up to 26 pounds of target material, depending on the alternative, shipped from Lawrence Livermore National Laboratory

Sealed sources from the Offsite Source Recovery Program and Global Threat Reduction Initiative would be transported to the NNSS for disposal. For analytical purposes, it was assumed that the sealed sources would originate from the Southwest Research Institute in San Antonio, Texas, as most sealed sources sent to the NNSS would originate from this location.

As part of the Expanded Operations Alternative, nuclear weapons would be transported to the NNSS for component replacement and returned to the U.S. Department of Defense site. Nuclear weapons would be disassembled and the plutonium transported to the Pantex Plant; the canned subassemblies containing enriched uranium would be transported to the Y–12 National Security Complex; milliwatt generators would be transported to Los Alamos National Laboratory; and tritium canisters would be transported to the Savannah River Site (note that this analysis does not evaluate the transportation of tritium because tritium is a beta-emitter and, therefore, would not be a significant source of an external radiation dose).

For the Expanded Operations Alternative, LLW and MLLW volumes from waste generators were determined using data from the Waste Management Information System. These waste volumes were apportioned to containers and numbers of shipments using historical data regarding the types of containers typically received. These waste volumes are shown in **Table E–3** by waste generator. Approval to ship waste to the NNSS for disposal may be granted only after a waste generator demonstrates that it has a waste characterization and certification program that meets the requirements stated in the NNSS waste acceptance criteria. The process by which NNSA certifies a waste generator, as well as the waste acceptance criteria, is described in greater detail in Chapter 4, Section 4.1.11.1.1.3.

The quantities shown in Table E–3 comprise the inventories currently projected and are used for purposes of analysis. The table is not intended to provide a comprehensive listing either of generators that could ship LLW and/or MLLW to the NNSS for disposal or of generator-specific waste volumes that could be disposed in the future. Some of the listed generators may ship larger or smaller quantities than shown based on site-specific determinations. Additionally, some yet-to-be-identified generators may ship LLW and/or MLLW to the NNSS for disposal. While the quantities from individual generators may vary from those shown in the table, the total volume would not exceed 52,000,000 cubic feet of LLW/MLLW. The estimates of LLW and MLLW volumes to be disposed at the NNSS under the Expanded Operations

Alternative are based upon conservative estimates from waste-generating facilities, and the aggregated totals reflect this conservatism (i.e., likely overestimates quantities). Additional National Environmental Policy Act (NEPA) review would be conducted if new generators or waste streams were identified.

Table E–3 Radioactive Waste Generators and Volumes under the Expanded Operations Alternative [a]

Waste Generators	*Region [b]*	*LLW (cubic feet)*	*MLLW (cubic feet)*
Out-of-State Generators			
Argonne National Laboratory	Upper Midwest	1,300,000	1,200
Brookhaven National Laboratory	Northeast	120,000	NP
Energy Technology Engineering Center	West	110,000	NP
General Atomics	West	8,400	NP
Idaho National Laboratory	Mountain West	1,000,000	46,000
Lawrence Berkeley Laboratory	West	170,000	96
Lawrence Livermore National Laboratory	West	300,000	580
Los Alamos National Laboratory	Southwest	3,200,000	920,000
Naval Reactor Facility	Mountain West	530	NP
Nuclear Fuel Services	South	430,000	NP
Oak Ridge Reservation	South	2,500,000	370,000
Paducah Gaseous Diffusion Plant	South	5,100,000	1,500,000
Pantex Plant	Southwest	20,000	NP
Portsmouth Gaseous Diffusion Plant	Upper Midwest	14,000,000	58,000
Princeton Plasma Physics Laboratory	Northeast	9,900	NP
Puget Sound Naval Shipyard	Northwest	1,100	NP
Sandia National Laboratories	Southwest	7,800	2,900
Savannah River Site	Southeast	160,000	52,000
SLAC National Accelerator Laboratory	West	570,000	570,000
Separations Project Research Unit	Northeast	NP	2,500
West Valley Demonstration Project	Northeast	6,200,000	750
Waste treatment facilities [c]	Multiple regions	88,000	30,000
Commercial enrichment facilities	Upper Midwest	57,000	NP
U.S. Department of Defense (RTGs)	South (Norfolk, VA)	1,400	NP
Offsite Source Recovery Project	Southwest (San Antonio, TX)	8,500	NP
Total Out-of-State Generators		**36,000,000**	**3,500,000**
In-State Generators			
Nevada Nuclear Security Site	Not applicable	1,300,000	520,000
North Las Vegas Facility	Not applicable	150	NP
Tonopah Test Range & Nevada Test and Training Range	Not applicable	11,000,000	NP
Total In-State Generators		**12,000,000**	**520,000**
All Generators		***48,000,000***	***4,000,000***

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NP = none projected; RTG = radioisotope thermoelectric generator; SLAC = Stanford Linear Accelerator Center.

[a] Actual individual waste volumes by generator may be more or less than presented in the table, and other yet-to-be-identified generators may ship LLW and/or MLLW to the NNSS for disposal. The quantities shown constitute the inventories currently projected and are used for purposes of analysis only.

[b] Regional location of radioactive waste generators used in the transportation analysis.

[c] Refers to wastes from DOE generators that are sent to the NNSS for disposal after processing at a variety of treatment facilities.

Note: Totals may not equal the sum of individual values because of rounding.

Waste volumes in the table are apportioned to regions of the United States (see Figure E–2) based on the locations of the waste generators. The transportation analysis is based on the regional waste volume totals so that waste generators would not be limited to those obtained from the Waste Management Information System. The total waste volumes by region are assumed to provide conservative estimates of the waste volume to be received from each region of the country.

For the No Action Alternative and Reduced Operations Alternative, it was assumed that the total amount of LLW to be received over a 10-year period, 15,000,000 cubic feet, would be based on the average annual volumes received between FY 1997 and the end of FY 2010. The volume of MLLW analyzed under the No Action and Reduced Operations Alternatives is 900,000 cubic feet, which is based on the permitted volume of Cell 18 at the Area 5 RWMC (the actual permitted volume is 899,996 cubic feet). This volume was apportioned to the waste generators shown in Table E–3 using the percentage of the total volume each waste generator contributed under the Expanded Operations Alternative.

Table E–4 shows the containers assumed to be used for transporting materials and wastes and their physical characteristics. Other containers may be used in addition to, or in lieu of, these containers.

Table E–4 Material or Waste Type and Container Characteristics [a]

Material or Waste Type	*Container*	*Container Volume (cubic feet) [b]*	*Container Mass (pounds) [c]*	*Number of Containers per Shipment*
LLW and MLLW	55-gallon drum	7.35	600	80 per truck 160 per rail
LLW and MLLW	B-12 box	45	10,000	5 per truck 10 per rail
LLW and MLLW	B-25 box	90	10,000	5 per truck 10 per rail
LLW and MLLW	20-foot ISO container	1,360	67,200	1 per truck 2 per rail
Special nuclear material	9975, 9977, B&W 5X22	7.35	300-404	Up to 25 per truck
High-activity LLW and MLLW	High-integrity container	180	20,000	1 per truck 2 per rail
Transuranic waste (JASPER)	Standard waste box	(4) 55-gallon drums	3,633	2 per TRUPACT-II
Transuranic waste	TRUPACT-II	14 drums or 2 standard waste boxes	19,250	3 TRUPACT-IIs per truck 6 TRUPACT-IIs per rail
Special waste [d]	Large box	184	9,500	1 per TRUPACT-III; 3 TRUPACT-IIIs per truck 6 TRUPACT-IIIs per rail
Construction/demolition debris	Roll-on/Roll-off	540	Not applicable	1 per truck
Hazardous	55-gallon drum	7.35	880	60 per truck

ISO = International Organization for Standardization; JASPER = Joint Actinide Shock Physics Experimental Research Facility; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; TRUPACT = transuranic waste package transporter.

[a] Other containers may be used that are not listed in this table.

[b] Container exterior volume. To convert cubic feet to cubic meters, multiply by 0.028317; gallons to liters, by 3.785.

[c] Filled container maximum mass. Container mass includes the mass of the container shell, its internal packaging, and the materials within.

[d] The two 3-foot-diameter steel spheres containing plutonium that were used in subcritical experiments and are now stored at the Nevada National Security Site were assumed to be transported in a TRUPACT-III package.

Note: Hazardous waste would be shipped to an offsite treatment, storage, and disposal facility by truck. Construction debris would be shipped to either an onsite disposal facility or a local offsite location by truck.

Source: CPC 2006; CVSA 2004; Maersk 2010; Certificates of Compliance numbers 9218, 9279, 9250, 9975, 9977.

A shipment is defined as the amount of waste transported on a single truck or a single railcar. In the case of rail transportation, multiple railcars (two or more railcars carrying waste) per train could be used to reduce the number of rail transport shipments. Because the rail accident and fatalities data are per railcar-mile (see Section E.6.2), the transportation analysis presented here is based on one railcar (carrying waste) per transport.

The number of shipping containers per shipment was estimated on the basis of dimensions and weight of the shipping containers, the Transport Index,[1] and the transport vehicle dimensions and weight limits. In general, the various materials and wastes were assumed to be transported on standard truck semi-trailers and railcars in a single stack.

Radioactive waste shipments were assumed to meet the NNSS waste acceptance criteria. This analysis does not specifically account for waste shipments that would be received at the NNSS but returned to the generator because the shipment did not meet the waste acceptance criteria. It is expected that the number of such shipments would be very small compared to the number of shipments received at the NNSS and would not impact the risk results.

This analysis considers transportation of depleted uranium conversion products from the Portsmouth Gaseous Diffusion Plant in Ohio and from the Paducah Gaseous Diffusion Plant in Kentucky to the NNSS under the No Action, Reduced Operations, and Expanded Operations Alternatives. Transportation of these two waste streams to the NNSS for disposal was originally analyzed in the plants' respective environmental impact statements (DOE 2004a, 2004b); however, the analyses for the No Action and Reduced Operations Alternatives use waste volumes and number of shipments analyzed in the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002c), while the analysis for the Expanded Operations Alternative accounts for the estimated number of truck and rail shipments in the plants' environmental impact statements.

The analysis for the Expanded Operations Alternative also considers transportation of radioactive waste from the West Valley Nuclear Service Center in New York as specified in the *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center* (DOE 2010b) and the associated Record of Decision published on April 21, 2010 (75 FR 20582). The analysis also considers operational and decommissioning activities associated with United States Enrichment Corporation fuel enrichment activities; uranium-233 downblending activities at Oak Ridge National Laboratory; and sealed sources from the Offsite Source Recovery Program and Global Threat Reduction Initiative. This analysis incorporates the results from these documents. A smaller number of shipments of sealed sources was analyzed under the No Action and Reduced Operations Alternatives.

Radionuclide Inventories

Radionuclide concentrations for the contact-handled and remote-handled LLW and MLLW were determined using NNSS receipt data from fiscal year 2009 and earlier, as applicable. Many different radioactive waste streams, each with a unique radionuclide inventory, would be transported to the NNSS for disposal. To simplify the analysis and provide conservatism, the largest concentration of each radionuclide across all waste streams was assumed for a shipment. The radionuclide concentration for each radioisotope was proportionally adjusted for each type of container based on container volume. **Table E–5** shows the radionuclide concentrations that were used in the analysis for LLW and MLLW. **Table E–6** shows the radionuclide concentration inventory assumed for TRU waste shipments.

[1] *Transport Index is a dimensionless number (rounded up to the next tenth) placed on a package's label to designate the degree of control to be exercised by the carrier. Its value is equivalent to the maximum radiation level in millirem per hour at 1 meter (3.3 feet) from the package (10 CFR 71.4; 49 CFR 173.403).*

Table E–5 Low-Level and Mixed Low-Level Radioactive Waste Radionuclide Concentrations

Radionuclide	***Curies per Cubic Foot***	***Radioisotope***	***Curies per Cubic Foot***	***Radioisotope***	***Curies per Cubic Foot***
Actinium-227	0.000388	Gadolinium-153	4.81×10^{-15}	Radium-226	0.000175
Antimony-124	9.90×10^{-10}	Hydrogen-3	0.661	Radium-228	3.37×10^{-11}
Antimony-125	1.85×10^{-6}	Iodine-125	2.59×10^{-10}	Ruthenium-106	0.0000314
Americium-241	0.0000657	Iodine-129	2.61×10^{-7}	Samarium-151	1.88×10^{-8}
Americium-242M	9.34×10^{-9}	Iron-55	0.212	Scandium-46	6.14×10^{-13}
Americium-243	7.18×10^{-7}	Iron-59	1.58×10^{-9}	Sodium-22	4.49×10^{-8}
Cadmium-109	7.52×10^{-10}	Krypton-85	2.09×10^{-9}	Strontium-89	1.22×10^{-6}
Cadmium-113M	0.0000145	Lead-210	0.0000658	Strontium-90	1.80
Calcium-45	5.06×10^{-10}	Manganese-54	0.0000333	Tantalum-182	0.000364
Californium-252	4.61×10^{-9}	Neptunium-237	5.09×10^{-7}	Technetium-99	0.00129
Carbon-14	0.000402	Neptunium-239	0.0000141	Thallium-204	6.67×10^{-9}
Cesium-134	3.57×10^{-6}	Nickel-59	0.000972	Thorium-228	0.000388
Cesium-137	0.00359	Nickel-63	0.216	Thorium-229	2.82×10^{-8}
Cesium-144	0.0000462	Niobium-94	3.50×10^{-7}	Thorium-230	1.08×10^{-7}
Cobalt-57	6.93×10^{-9}	Palladium-107	3.13×10^{-11}	Thorium-232	1.49×10^{-6}
Cobalt-58	4.71×10^{-6}	Phosphorus -32	2.58×10^{-7}	Thorium-234	0.00114
Cobalt-60	0.315	Plutonium-236	6.17×10^{-12}	Tin-113	2.59×10^{-11}
Curium-242	1.80×10^{-8}	Plutonium-238	0.0000174	Tin-126	4.11×10^{-8}
Curium -243	2.27×10^{-6}	Plutonium-239	0.0000831	Uranium-232	1.97×10^{-6}
Curium -244	0.00116	Plutonium-240	0.0000264	Uranium-233	1.50×10^{-6}
Curium -245	8.98×10^{-7}	Plutonium-241	0.000591	Uranium-234	0.000563
Curium -246	1.40×10^{-7}	Plutonium-242	5.42×10^{-8}	Uranium-235	0.0000398
Curium -247	9.03×10^{-10}	Plutonium-244	1.78×10^{-12}	Uranium-236	0.0000615
Curium -248	2.74×10^{-9}	Polonium-210	6.26×10^{-9}	Uranium-238	0.00476
Europium-152	1.74×10^{-6}	Promethium-147	0.0000313	Yttrium-90	2.58×10^{-10}
Europium-154	0.174	Protactinium-231	4.85×10^{-7}	Zinc-65	9.97×10^{-6}
Europium-155	0.0561	Radium-224	2.33×10^{-10}	Zirconium-93	5.60×10^{-10}

Table E–6 Transuranic Waste Radionuclide Concentrations

Radionuclide	***Curies per Cubic Foot***	***Radionuclide***	***Curies per Cubic Foot***
Americium-241	0.00382	Plutonium-240	0.00227
Plutonium-238	0.00199	Plutonium-241	0.0694
Plutonium-239	0.00281	–	–

Source: Gordon 2010.

Remote-handled LLW and MLLW would be transported to the NNSS for disposal. **Table E–7** summarizes the inventory assumed for this waste stream.

Table E–7 Remote-Handled Low-Level and Mixed Low-Level Radioactive Waste Radionuclide Concentrations

Radionuclide	*Curies per Cubic Foot*	*Radionuclide*	*Curies per Cubic Foot*	*Radionuclide*	*Curies per Cubic Foot*
Carbon-14	0.0000168	Iron-55	0.459	Nickel-63	0.0184
Cobalt-58	0.689	Manganese-54	0.055	Niobium-94	0.0000138
Cobalt-60	0.497	Nickel-59	0.000122	Tantalum-182	0.176

Source: Gordon 2010.

A shipment of special nuclear material containing uranium-233 would be received at the NNSS from Los Alamos National Laboratory under the Expanded Operations Alternative. **Table E–8** shows the radionuclide inventory for a uranium-233 shipment with a low uranium-232 contamination with progenies decayed over 20 years that is used for the analysis in this SWEIS.

Table E–8 Uranium-233 Shipment Radionuclide Inventory

Radionuclide	*Curies*	*Radionuclide*	*Curies*	*Radionuclide*	*Curies*	*Radionuclide*	*Curies*
Actinium-225	0.0705	Radium-224	0.273	Thorium-228	0.273	Uranium-233	24.99
Lead-212	0.0273	Radium-225	0.0706	Thorium-229	0.0707	Uranium-232	0.266

Source: DOE 2008a.

For sealed sources, it was assumed for analytical purposes that each package would have the same characteristics (i.e., dimensions and dose rate). The maximum inventories per package for cobalt-60 and cesium-137 radioisotopes are 6,000 and 10,000 curies, respectively.

Special nuclear material containing plutonium would be transported to the NNSS from Idaho National Laboratory and Lawrence Livermore National Laboratory. For purposes of analysis, it was assumed that the plutonium would be weapons-grade. **Table E–9** shows the radionuclide inventory assumed for a shipment transported from Oak Ridge Reservation containing uranium-233 plates.

Table E–9 Uranium-233 Plates Radionuclide Inventory for a Shipment

Radionuclide	*Curies*	*Radionuclide*	*Curies*	*Radionuclide*	*Curies*	*Radionuclide*	*Curies*
Uranium-232	0.066	Uranium-234	0.033	Uranium-236	< 0.0001	Plutonium-239	0.0003
Uranium-233	4.38	Uranium-235	< 0.001	Uranium-238	< 0.0001		

< = less than.

E.5 Incident-Free Transportation Risks

E.5.1 Radiological Risk

During incident-free transportation of radioactive materials, a radiation dose results from exposure to the external radiation field that surrounds the shipping containers. The population dose is a function of the number of people exposed, their proximity to the containers, the length of exposure time, and the intensity of the radiation field surrounding the containers.

Radiological impacts were determined for crewmembers and the general population during incident-free transportation. For truck shipments, the crewmembers are the drivers of the shipment vehicle. For rail shipments, the crew consists of workers in close proximity to the shipping containers during inspection or classification of railcars. The general population is composed of persons residing within 0.50 miles of the truck or rail routes (off-link), persons sharing the road or railway (on-link), and persons at stops. Exposures to workers who would load and unload the shipments at generator and disposal sites are not included in this analysis, but are included in the occupational estimates for site workers. Exposures to the inspectors, transfer station workers, and escorts are evaluated and presented separately.

Offsite transportation of the radioactive material has a defined regulatory limit of 10 millirem per hour at 6.6 feet from the conveyance (10 CFR 71.47; 49 CFR 173.441). If a waste container shows an external dose rate that could exceed the DOT limit of 10 millirem per hour at 6.6 feet from the outer, or lateral, edge of the vehicle, it would be transported in a Type A or Type B shielded shipping container. The shielding would reduce the external dose rate to levels within the DOT limits.

Collective doses to the crew and general population were calculated using the RADTRAN 6 computer code (SNL 2009). RADTRAN dose calculations are based on an external dose rate at 3.3 feet from the surface of the waste container. A waste container's dose rate, or its Transport Index, depends on the distribution and quantities of radionuclides, waste density, shielding provided by the packaging, and self-shielding provided by the waste mixture. Wastes were assumed to be in appropriate Type A or Type B shipping packages. For example, contact-handled LLW was assumed to be shipped in containers such as B-25 boxes or 55-gallon drums (Type A containers), and remote-handled LLW in a CNS 10-160B (Type B) cask.

Dose rates of 1 millirem per hour at 3.3 feet and 10 millirem per hour at 3.3 feet were assigned for contact-handled LLW and MLLW and remote-handled LLW and MLLW, respectively. A dose rate of 0.01 millirem per hour at 3.3 feet was assigned for LLW and MLLW from the TTR and the Nevada Test and Training Range. The contact-handled TRU waste package was assigned a dose rate of 4 millirem per hour at 3.3 feet (DOE 1997). A dose rate of 1 millirem per hour at 3.3 feet was assigned to plutonium pits, highly enriched uranium, and uranium-233. A dose rate of 5 millirem per hour at 3.3 feet was assigned to plutonium transported under the Global Threat Reduction Initiative.

For sealed sources, the external dose rate at 3.3 feet from the trailer was assumed to be 10 millirem per hour. The external dose rate for nuclear weapons transport was assumed to be 3 millirem per hour at 3.3 feet. The dose rate for shipments of the milliwatt generators was assumed to be at the regulatory limit of 10 millirem per hour at 6.6 feet from the cask or the outer surface of the vehicle (10 CFR 71.47). The dose rates for plutonium and enriched uranium were assumed to be 1 millirem per hour at 3.3 feet from the outer surface of the vehicle. The tritium gas, which undergoes beta decay and is contained within the canister shielding, does not exhibit any measurable external dose rate and was not analyzed. The dose rates for other special nuclear materials not specified here were assumed to be 1 millirem per hour at 3.3 feet.

To calculate the collective dose, a unit risk factor was developed to estimate the impact of transporting one shipment of radioactive material over a unit distance of travel in a given population density zone. The unit risk factors were combined with routing information, such as the shipment distances in various population density zones, to determine the risk for a single shipment (a shipment risk factor) between a given origin and destination. Unit risk factors were developed on the basis of travel on interstate highways and freeways, as required by 49 CFR Parts 171 through 177 for highway-route-controlled quantities of radioactive material within rural, suburban, and urban population zones by using RADTRAN and its default data. In addition, the analysis assumed that, 10 percent of the time, travel through suburban and urban zones would encounter rush-hour conditions, leading to lower average speed and higher traffic density. The radiological risks from transporting the waste are estimated in terms of the number of LCFs among the crew and the exposed population. A health risk conversion factor of 0.0006 LCFs per person-rem of exposure was used for both the public and workers (DOE 2003).

E.5.2 Nonradiological Risk

The nonradiological (vehicle-related) health risks resulting from incident-free transport may be associated with the generation of air pollutants by transport vehicles during shipment and are independent of the radioactive nature of the shipment. The health endpoint assessed under incident-free transport conditions is the excess latent mortality due to inhalation of vehicle emissions. Unit risk factors for pollutant inhalation in terms of mortality have been generated (Rao et al. 1982); however, the emergence of considerable data regarding threshold values for various chemical constituents of vehicle exhaust has made linear extrapolation to estimate the risks from vehicle/rail emissions untenable (Neuhauser et al. 2000). This calculation has been dropped from RADTRAN in its recent revision (SNL 2009); therefore, no risk factors have been assigned to the vehicle emissions in this SWEIS.

E.5.3 Maximally Exposed Individual Exposure Scenarios

The maximum individual doses for routine offsite transportation were estimated for transportation workers, as well as for members of the general population. For truck shipments, three hypothetical scenarios were evaluated to determine the MEI in the general population. These scenarios are as follows (DOE 2002a):

- A person caught in traffic and located 3.3 feet from the surface of the shipping container for 30 minutes
- A resident living 98 feet from the highway used to transport the shipping container
- A service station worker at a distance of 52 feet from the shipping container for 50 minutes

The hypothetical MEI doses were accumulated over a single year for all transportation shipments. However, for the scenario involving an individual caught in traffic next to a shipping container, the radiological exposures were calculated for only one event because it was considered unlikely that the same individual would be caught in traffic next to all containers for all shipments. For truck shipments, the maximally exposed transportation worker is the driver, who was assumed to have been trained as a radiation worker and to drive shipments for up to 2,000 hours per year, accumulating an exposure of 2 rem per year. For a member of the truck crew who is not trained as a radiation worker, the maximum annual dose rate would be 100 millirem (10 CFR 20.1301).

The following three hypothetical scenarios were also evaluated for railcar shipments:

- A rail yard worker working at a distance of 33 feet from the shipping container for 2 hours
- A resident living 98 feet from the rail line where the shipping container is being transported
- A resident living 656 feet from a rail stop during classification and inspection for 20 hours

The maximally exposed transportation worker (excluding drivers) for both truck and rail shipments is an individual inspecting the cargo at a distance of 3.3 feet from the shipping container for 1 hour.

E.6 Transportation Accident Risks

E.6.1 Methodology

The offsite transportation accident analysis considers the impact of accidents during the transportation of waste by truck or rail. Under accident conditions, human health and environmental impacts could result from the release and dispersal of radioactive material. Transportation accident impacts were assessed using an accident analysis methodology developed by NRC. This section provides an overview of the methodologies; detailed descriptions of various methodologies are found in NUREG-0170, *Radioactive Material Transportation Study*; NUREG/CR-4829, *Modal Study*; and NUREG/CR-6672, *Reexamination Study* (NRC 1977, 1987, 2000). Accidents that could potentially breach the shipping container are represented by a spectrum of accident severities and radioactive release conditions. Historically, most transportation accidents involving radioactive materials have resulted in little or no release of radioactive material from the shipping container. Consequently, the analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents of low severity to hypothetical high-severity accidents that have a correspondingly low probability of occurrence. The accident analysis calculates the probabilities and consequences from this spectrum of accidents.

To provide DOE and the public with a reasonable assessment of radioactive waste transportation accident impacts, two types of analysis were performed. First, an accident risk assessment was performed that takes into account the probabilities and consequences of a spectrum of potential accident severities using a methodology developed by NRC (NRC 1977, 1987, 2000). For the spectrum of accidents considered in the analysis, accident consequences in terms of collective "dose risk" to the population within 50 miles were determined using the RADTRAN 6 computer program (SNL 2009). The RADTRAN code sums the product of consequences and probability over all accident severity categories to obtain a probability-weighted risk value referred to in this appendix as "dose risk," which is expressed in units of person-rem. Second, to represent the maximum reasonably foreseeable impacts on individuals and populations should an accident occur, maximum radiological consequences were calculated in an urban or suburban population zone for an accidental release with a likelihood of occurrence greater than 1 in 10 million per year using the RISKIND computer program (Yuan et al. 1995).

For accidents in which a waste container or the cask shielding is not damaged, population and individual radiation exposures from the waste package were evaluated for the duration of time needed to recover and resume shipment. The collective dose over all segments of transportation routes was evaluated for an affected population up to a distance of 0.5 miles from the accident location. This dose would be an external dose and would be approximately inversely proportional to the square of the distance of the affected population from the accident. Any additional dose to those residing beyond 0.5 miles from the accident would be negligible. The dose to an individual (first responder) was calculated assuming that the individual would be located at 6.6 to 33 feet from the package. For the accidents leading to loss of cask shielding, a method similar to that provided in NUREG/CR-6672, *Reexamination Study* (NRC 2000) and adapted in the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (Yucca Mountain EIS)* was used (DOE 2002a).

E.6.2 Accident Rates

Whenever material is shipped, the possibility exists that a traffic accident could result in vehicular damage, injury, or death. Even when drivers are trained in defensive driving and taking great care, there is a risk of a traffic accident. To date, DOE and its predecessor agencies have a successful 50-year history in transporting radioactive materials. In the years 2004 to 2008, no fatalities related to DOE's transportation of hazardous or radioactive material cargo for the Office of Environmental Management occurred (DOE 2009). DOE Manual 460.2-1A, *Radioactive Material Transportation Practices Manual for Use with DOE Order 460.2A*, contains stipulations that DOE and its shipping contractors follow regarding conditions under which shipments should be made (DOE 2008b).

To calculate the accident risks, vehicle accident and fatality rates were taken from data provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with accident involvement count as the numerator of the fraction and vehicular activity (total travel distance in truck miles) as its denominator. Accident rates were generally determined for a multi-year period. For assessment purposes, the total number of expected accidents or fatalities was calculated by multiplying the total shipment distance for a specific case by the appropriate accident or fatality rate. No reduction in accident or fatality rates was assumed even though radioactive material carrier drivers are better trained and have better-maintained equipment.

For truck transportation, the rates presented are specifically for heavy-haul combination trucks involved in interstate commerce (Saricks and Tompkins 1999). Heavy-haul combination trucks are rigs composed of a separable tractor unit containing the engine and one to three freight trailers connected to each other. Heavy-haul combination trucks are typically used for radioactive material shipments. Truck accident rates were computed for each state based on statistics compiled by the Federal Highway Administration, Office of Motor Carriers, from 1994 to 1996. A fatality caused by an accident is the death of a member of the public who is killed instantly or dies within 30 days due to injuries sustained in the accident. The accident and fatality rates are per truck-mile or railcar-mile.

For offsite transportation, the accident and fatality rates for this SWEIS were based on state-level data provided in the Saricks and Tompkins report (Saricks and Tompkins 1999). The rates in the Saricks and Tompkins report are given in terms of accident and fatality per car-kilometer and railcar-kilometer traveled. Accident and fatality rates for trucks are provided by population zone. This information is used to determine the accident and fatality rate specific to each truck and rail route. For in-state truck transport, Nevada accident and fatality rates were used (Saricks and Tompkins 1999).

A recent review of the truck accidents and fatalities reports by the Federal Carrier Safety Administration indicated that state-level accidents and fatalities were underreported. For the years 1994 through 1996, which were the basis for the analysis in the Saricks and Tompkins report, the review found that accidents were underreported by about 39 percent and fatalities were underreported by about 36 percent (UMTRI 2003). Therefore, truck accident and fatality rates were increased by factors of 1.64 and 1.57, respectively, in this SWEIS to account for the underreporting. Rail accident and fatality rates were increased by a factor of 3.

For each rail shipment, it was assumed that each train would consist of at least three cars: a locomotive, a crew car, and a railcar carrying waste.

For DOE SGTs, the DOE operational experience between 1984 and 1999 was used. The mean probability of an accident requiring towing of a disabled SGT was about 6 per 100 million kilometers (DOE 2000). The number of SGT trailer accidents is too small to support allocating this overall rate among the various types of routes (interstate, primary, others) used in the accident analysis. Therefore, data for the relative rate of accidents on these route types, or influence factor, provided in *Determination of Influence Factor and Accident Rates for Armored Tractor/Safe Secure Trailer* (Phillips, Clauss, and Blower 1994), were used to estimate accident frequencies for rural, urban, and suburban transports. Accident fatalities for SGTs were estimated using the commercial truck transport fatality per accident ratios within each zone.

E.6.3 Accident Severity Categories and Conditional Probabilities

Accident severity categories for potential radioactive waste transportation accidents are described in NUREG-0170, *Radioactive Material Transportation Study* (NRC 1977) (for radioactive waste in general); in NUREG/CR-4829, *Modal Study* (NRC 1987); and in NUREG/CR-6672, *Reexamination Study* (NRC 2000) (for spent nuclear fuel). The methods described in the *Modal Study* and the *Reexamination Study* are applicable to transportation of radioactive materials in a Type B spent fuel cask.

The accident severity categories presented in the *Radioactive Material Transportation Study* would be applicable to all other waste transported off site.

The *Radioactive Material Transportation Study* (NRC 1977) originally was used to estimate conditional probabilities associated with accidents involving transportation of radioactive materials. The *Modal Study* and the *Reexamination Study* (NRC 1987, 2000) are initiatives taken by NRC to refine more precisely the analysis presented in the *Radioactive Material Transportation Study* for spent nuclear fuel shipping casks.

Whereas the *Radioactive Material Transportation Study* (NRC 1977) analysis was primarily performed using best engineering judgments and presumptions concerning cask response, the later studies relied on sophisticated structural and thermal engineering analysis and a probabilistic assessment of the conditions that could be experienced in severe transportation accidents. The latter results are based on representative spent nuclear fuel casks assumed to have been designed, manufactured, operated, and maintained according to national codes and standards. Design parameters of the representative casks were chosen to meet the minimum test criteria specified in 10 CFR Part 71. The study is believed to provide realistic, yet conservative, results for radiological releases during transport accident conditions.

In both the *Modal Study* and the *Reexamination Study*, potential accident damage to a cask is categorized according to the magnitude of the mechanical forces (impact) and thermal forces (fire) to which a cask may be subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a cask is subjected to forces within a certain range of values is assigned to the accident severity region associated with that range. The accident severity scheme is designed to take into account all potential foreseeable transportation accidents, including accidents with low probability but high consequences and those with high probability but low consequences.

As discussed earlier, the accident consequence assessment considers the potential impacts of severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a cask that is released to the environment during the accident. Although accident severity regions span the entire range of mechanical and thermal accident loads, they are grouped into accident categories that can be characterized by a single set of release fractions and are, therefore, considered together in the accident consequence assessment. The accident category severity fraction is the sum of all conditional probabilities in that accident category.

For the accident risk assessment, accident “dose risk” was generically defined as the product of the consequences of an accident and the probability of occurrence of that accident, an approach consistent with the methodology used by the RADTRAN computer code. The RADTRAN code sums the product of consequences and probability over all accident categories to obtain a probability-weighted risk value referred to in this appendix as “dose risk,” which is expressed in units of person-rem.

E.6.4 Atmospheric Conditions

Because it is impossible to predict the specific location of an offsite transportation accident, generic atmospheric conditions were selected for the risk and consequence assessments. On the basis of observations from National Weather Service surface meteorological stations at more than 177 locations in the United States, on an annual average, neutral conditions (Pasquill Stability Classes C and D) occur 58.5 percent of the time, and stable (Pasquill Stability Classes E, F, and G) and unstable (Pasquill Stability Classes A and B) conditions occur 33.5 percent and 8 percent of the time, respectively (DOE 2002a). The neutral weather conditions dominate in each season, but most frequently in the winter (nearly 60 percent of the observations).

Neutral weather conditions (Pasquill Stability Class D) are the most frequently occurring atmospheric stability condition in the United States and are thus most likely to be present in the event of an accident involving a radioactive waste shipment. Neutral weather conditions are typified by moderate windspeeds, vertical mixing within the atmosphere, and good dispersion of atmospheric contaminants. Stable weather conditions are typified by low windspeeds, very little vertical mixing within the atmosphere, and poor dispersion of atmospheric contaminants. The atmospheric condition used in RADTRAN is an average weather condition that corresponds to a stability class spread between Class D (for near distance) and Class E (for farther distance).

The accident consequences for the maximum reasonably foreseeable accident (an accident with a likelihood of occurrence greater than 1 in 10 million per year) were assessed under both stable (Class F with a windspeed of 3.3 feet per second) and neutral (Class D with a windspeed of 13 feet per second) atmospheric conditions. The population dose was evaluated under neutral atmospheric conditions and the MEI dose, under stable atmospheric conditions. The population dose would represent an accident during average weather conditions, while the MEI dose would represent an accident during weather conditions that would yield the greatest impacts (stable conditions, with minimum diffusion and dilution).

E.6.5 Radioactive Release Characteristics

Radiological consequences were calculated by assigning radionuclide release fractions on the basis of the type of waste, the type of shipping container, and the accident severity category. The release fraction is defined as the fraction of the radioactivity in the container that could be released to the atmosphere in a given severity of accident. Release fractions vary according to waste type and the physical or chemical properties of the radioisotopes. Most solid radionuclides are nonvolatile and are, therefore, relatively nondispersible.

Representative release fractions were developed for each waste and container type on the basis of DOE and NRC reports (DOE 1994, 2002b, 2003; NRC 1977, 2000). The severity categories and corresponding release fractions provided in these documents cover a range of accidents from no impact (zero speed) to impacts with speeds in excess of 120 miles per hour onto an unyielding surface. Traffic accidents that could occur at the site would result in minor impacts due to lower local speed, with no release potential.

For radioactive wastes transported in a Type B cask, the particulate release fractions were developed consistent with the models in NUREG/CR-6672, *Reexamination Study* (NRC 2000). For wastes transported in Type A containers (e.g., 55-gallon drums and boxes), the fractions of radioactive material released from the shipping container were based on recommended values from the *Radioactive Material Transportation Study* (NRC 1977) and the *DOE Handbook on Airborne Release and Respirable Fractions* (DOE 1994). For contact-handled and remote-handled TRU waste, the release fractions corresponding to the *Radioactive Material Transportation Study* severity categories, as adapted in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement (WIPP SEIS-II)*, were used (DOE 1997). For wastes transported in high-integrity containers and lift liners in 20-foot International Organization for Standardization (ISO) containers, release fractions were calculated using a method similar to that used in the *WIPP SEIS-II*.

For accidents in which the waste container or cask shielding is not damaged and no radioactive material is released, it was assumed that it would take 12 hours to recover from the accident and resume shipment. During this period, no individual would remain close to the cask. A first responder could stay at a location 6.6 to 33 feet from the package, at a position where the dose rate would be the highest, for 30 minutes in a loss-of-shielding accident and 1 hour for other accidents with no release (DOE 2002b).

E.6.6 Acts of Sabotage or Terrorism

In the aftermath of the tragic events of September 11, 2001, DOE is continuing to assess measures to minimize the risk or potential consequences of radiological sabotage. While it is not possible to determine terrorists' motives and targets with certainty, DOE considers the threat of terrorist attacks to be real and makes all efforts to reduce any vulnerability to this threat. DOE considers, evaluates, and plans for potential terrorist attacks during transportation and storage of special nuclear materials such as plutonium and enriched uranium. These materials would be transported using DOE's safe and secure transport equipment and would be escorted by protective force personnel. DOE has a proven record of protecting these assets; no diversion of any DOE nuclear material has occurred. The details of any postulated terrorist attack, as well as DOE's plans for the security of its facilities and terrorist countermeasures, are classified. A classified appendix has been prepared for this SWEIS that includes impact analyses for intentional acts of destruction related to transportation.

Additionally, DOE has evaluated the impacts of acts of sabotage and terrorism on transportation of spent nuclear fuel and high-level radioactive waste shipments (DOE 1996, 2002a). The spectrum of accidents considered ranges from a direct attack on a cask from afar to hijacking and exploding a shipping cask in an urban area. Both of these actions would result in damaging the cask and its contents and releasing radioactive materials. The fraction of the materials released is dependent on the nature of the attack (type of explosive or weapon used). The sabotage event evaluated in the *Yucca Mountain EIS* (DOE 2002a) was considered as the enveloping analysis for this SWEIS. The event was assumed to involve either a truck-sized or a rail-sized cask containing light-water reactor spent nuclear fuel. The consequences of such an act were calculated to result in an MEI dose (at 460 feet) of 40 to 110 rem for events involving a rail-sized or truck-sized cask, respectively. These events would lead to an increase in the risk of fatal cancer to the MEI by 2 to 7 percent, or 2 chances in 100 to 7 chances in 100 (DOE 2002a). The quantity of radioactive materials transported under all alternatives considered here would be less than that considered in the analysis in the *Yucca Mountain EIS*. Therefore, estimates of risk in the *Yucca Mountain EIS* envelop the risks from an act of sabotage or terrorism involving the radioactive material transported under all alternatives considered in this SWEIS.

E.7 Risk Analysis Results

Per-shipment risk factors have been calculated for the collective populations of exposed persons and for the crew for all anticipated routes and shipment configurations. Radiological risks are presented in doses per shipment for each unique route, material, and container combination. Radiological risk factors per shipment for incident-free transportation and accident conditions for the Constrained Case are presented in **Table E–10**. For incident-free transportation, both dose and LCF risk factors are provided for the crew and the exposed general population. The radiological risks would result from potential exposure of people to external radiation emanating from the packaged waste. The exposed population includes the off-link public (i.e., people living along the route), the on-link public (i.e., pedestrian and car occupants along the route), and the public at rest and fuel stops.

Table E–10 Risk Factors per Shipment of Radioactive Waste and Materials

Region/ Destination/ Origin	Waste or Materials	Container	*Incident-Free Conditions* Crew Dose (person-rem)	Crew Risk (LCF)	Population Dose (person-rem)	Population Risk (LCF)	*Accident Conditions* Radiological Risk (LCF)	Roundtrip Nonradiological Risk (traffic fatalities)
Truck Shipments								
Northeast	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.058	0.000035	0.027	0.000016	1.7×10^{-8}	0.00016
		B-25 box	0.048	0.000029	0.016	9.4×10^{-6}	1.5×10^{-8}	0.00016
		B-12 box	0.042	0.000025	0.016	9.4×10^{-6}	7.6×10^{-9}	0.00016
		20-foot ISO	0.083	0.00005	0.021	0.000013	2.8×10^{-8}	0.00016
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.42	0.00025	0.055	0.000033	3.9×10^{-12}	0.00016
Southeast	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.047	0.000028	0.021	0.000013	1.2×10^{-8}	0.00013
		B-25 box	0.039	0.000023	0.012	7.4×10^{-6}	1.0×10^{-8}	0.00013
		B-12 box	0.034	0.00002	0.012	7.4×10^{-6}	5.1×10^{-9}	0.00013
		20-foot ISO	0.067	0.00004	0.015	9.3×10^{-6}	1.9×10^{-8}	0.00013
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.34	0.0002	0.043	0.000026	2.5×10^{-12}	0.00013
South	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.042	0.000025	0.019	0.000011	8.0×10^{-9}	0.00011
		B-25 box	0.035	0.000021	0.011	6.6×10^{-6}	7.0×10^{-9}	0.00011
		B-12 box	0.03	0.000018	0.011	6.6×10^{-6}	3.5×10^{-9}	0.00011
		20-foot ISO	0.060	0.000036	0.014	8.2×10^{-6}	1.3×10^{-8}	0.00011
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.03	0.00018	0.038	0.000023	1.6×10^{-12}	0.00011
Southwest	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.021	0.000012	0.0090	5.4×10^{-6}	2.8×10^{-9}	0.000052
		B-25 box	0.017	0.00001	0.0053	3.2×10^{-6}	2.4×10^{-9}	0.000052
		B-12 box	0.015	8.9×10^{-6}	0.0053	3.2×10^{-6}	1.2×10^{-9}	0.000052
		20-foot ISO	0.03	0.000018	0.0059	3.5×10^{-6}	4.6×10^{-9}	0.000052
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.15	0.00009	0.019	0.000011	6.2×10^{-13}	0.000052
West	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.014	8.3×10^{-6}	0.0065	3.9×10^{-6}	4.1×10^{-9}	0.000037
		B-25 box	0.011	6.9×10^{-6}	0.0038	2.3×10^{-6}	3.6×10^{-9}	0.000037
		B-12 box	0.0099	5.9×10^{-6}	0.0038	2.3×10^{-6}	1.8×10^{-9}	0.000037
		20-foot ISO	0.02	0.000012	0.0046	2.8×10^{-6}	6.7×10^{-9}	0.000037
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.1	0.00006	0.013	8.0×10^{-6}	1.5×10^{-12}	0.000037

Region/ Destination/ Origin	***Waste or Materials***	***Container***	***Incident-Free Conditions***				***Accident Conditions***	
			Crew Dose (person-rem)	***Crew Risk (LCF)***	***Population Dose (person-rem)***	***Population Risk (LCF)***	***Radiological Risk (LCF)***	***Roundtrip Nonradiological Risk (traffic fatalities)***
Northwest	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.03	0.000018	0.015	8.8×10^{-6}	1.2×10^{-8}	0.000087
		B-25 box	0.025	0.000015	0.0086	5.2×10^{-6}	1.1×10^{-8}	0.000087
		B-12 box	0.021	0.000013	0.0086	5.2×10^{-6}	5.4×10^{-9}	0.000087
		20-foot ISO	0.042	0.000025	0.013	7.9×10^{-6}	2.0×10^{-8}	0.000087
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.22	0.00013	0.030	0.000018	3.6×10^{-12}	0.000087
Mountain West	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.015	9.3×10^{-6}	0.0067	4.0×10^{-6}	2.2×10^{-9}	0.000039
		B-25 box	0.013	7.7×10^{-6}	0.0040	2.4×10^{-6}	1.9×10^{-9}	0.000039
		B-12 box	0.011	6.6×10^{-6}	0.0040	2.4×10^{-6}	9.4×10^{-10}	0.000039
		20-foot ISO	0.022	0.000013	0.0045	2.7×10^{-6}	3.5×10^{-9}	0.000039
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.11	0.000067	0.014	8.3×10^{-6}	5.2×10^{-13}	0.000039
Upper Midwest	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.040	0.000024	0.018	0.000011	7.8×10^{-9}	0.00011
		B-25 box	0.034	0.00002	0.011	6.3×10^{-6}	6.8×10^{-9}	0.00011
		B-12 box	0.029	0.000017	0.011	6.3×10^{-6}	3.4×10^{-9}	0.00011
		20-foot ISO	0.058	0.000035	0.013	8.1×10^{-6}	1.3×10^{-8}	0.00011
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.29	0.00018	0.037	0.000022	1.4×10^{-12}	0.00011
INL	TRU waste [c, g]	55-gallon drum	0.049	0.000029	0.016	9.8×10^{-6}	7.0×10^{-10}	0.000039
Parker	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.0065	3.9×10^{-6}	0.0028	1.7×10^{-6}	7.9×10^{-10}	0.000016
		B-25 box	0.0054	3.2×10^{-6}	0.0016	9.9×10^{-7}	6.9×10^{-10}	0.000016
		B-12 box	0.0046	2.8×10^{-6}	0.0016	9.9×10^{-7}	3.5×10^{-10}	0.000016
		20-foot ISO	0.0092	5.5×10^{-6}	0.0019	1.2×10^{-6}	1.3×10^{-9}	0.000016
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.047	0.000028	0.0057	3.4×10^{-6}	9.7×10^{-14}	0.000016
West Wendover	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.0088	5.3×10^{-6}	0.0037	2.2×10^{-6}	2.5×10^{-10}	0.000021
		B-25 box	0.0073	4.4×10^{-6}	0.0022	1.3×10^{-6}	2.2×10^{-10}	0.000021
		B-12 box	0.0063	3.8×10^{-6}	0.0022	1.3×10^{-6}	1.1×10^{-10}	0.000021
		20-foot ISO	0.013	7.5×10^{-6}	0.0020	1.2×10^{-6}	4.1×10^{-10}	0.000021
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.064	0.000038	0.0076	4.6×10^{-6}	3.4×10^{-14}	0.000021
Transport in Nevada – via southern route (Routes 95 - 160)	CH-LLW/MLLW [a, h]	55-gallon drum (CH)	0.0036	2.2×10^{-6}	0.0016	9.3×10^{-7}	3.8×10^{-10}	0.000021
		B-25 box	0.0030	1.8×10^{-6}	0.00092	5.5×10^{-7}	3.3×10^{-10}	0.000021
		B-12 box	0.0026	1.6×10^{-6}	0.00092	5.5×10^{-7}	1.7×10^{-10}	0.000021
		20-foot ISO	0.0052	3.1×10^{-6}	0.0010	6.0×10^{-7}	6.2×10^{-10}	0.000021
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.026	0.000016	0.0032	1.9×10^{-6}	5.1×10^{-14}	0.000021

Region/ Destination/ Origin	Waste or Materials	Container	Incident-Free Conditions				Accident Conditions	
			Crew Dose (person-rem)	Crew Risk (LCF)	Population Dose (person-rem)	Population Risk (LCF)	Radiological Risk (LCF)	Roundtrip Nonradiological Risk (traffic fatalities)
Transport in Nevada – via northern route (Routes 6 - 95)	CH-LLW/MLLW [a, h]	55-gallon drum (CH)	0.0088	5.3×10^{-6}	0.0037	2.2×10^{-6}	1.4×10^{-10}	0.000021
		B-25 box	0.0073	4.4×10^{-6}	0.0022	1.3×10^{-6}	1.3×10^{-10}	0.000021
		B-12 box	0.0063	3.8×10^{-6}	0.0022	1.3×10^{-6}	6.3×10^{-11}	0.000021
		20-foot ISO	0.013	7.5×10^{-6}	0.0020	1.2×10^{-6}	2.3×10^{-10}	0.000021
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.064	0.000038	0.0076	4.5×10^{-6}	1.8×10^{-14}	0.000021
Truck Shipments for Sealed Sources								
Southwest Research Institute	Cobalt-60	CNS 10-160B	0.14	0.000083	0.036	0.000021	1.8×10^{-15}	0.000036
	Cesium-137	CNS 10-160B	0.14	0.000083	0.036	0.000021	4.0×10^{-13}	0.000036
In Nevada [h]	Cobalt-60	CNS 10-160B	0.018	0.000011	0.0046	2.7×10^{-6}	9.5×10^{-17}	4.3×10^{-6}
	Cesium-137	CNS 10-160B	0.018	0.000011	0.0046	2.7×10^{-6}	6.1×10^{-15}	4.3×10^{-6}
Special Nuclear Material Shipments								
LLNL [d]	SNM/HEU	Drum [e]	0.0022	1.3×10^{-6}	0.0027	1.6×10^{-6}	1.6×10^{-15}	3.3×10^{-6}
LLNL [d]	Plutonium/fuel grade	Drum [e]	0.011	6.6×10^{-6}	0.014	8.1×10^{-6}	2.0×10^{-11}	3.3×10^{-6}
LLNL	Plutonium/target material	Drum	0.00079	4.7×10^{-7}	0.00062	3.7×10^{-7}	4.0×10^{-10}	0.000038
INL [d]	SNM/HEU	Drum [e]	0.0025	1.5×10^{-6}	0.0029	1.7×10^{-6}	1.1×10^{-15}	3.3×10^{-6}
INL	SNM/plutonium plates	Drum [e]	0.0032	1.9×10^{-6}	0.0073	4.4×10^{-6}	1.5×10^{-10}	3.3×10^{-6}
LANL [d]	Uranium-233	Drum [e]	0.020	0.000012	0.030	0.000018	3.2×10^{-12}	3.6×10^{-6}
Oak Ridge Reservation	Uranium-233 plates	Drum	0.0033	2.0×10^{-6}	0.0027	1.6×10^{-6}	5.6×10^{-11}	0.00011
Pantex [d]	SNM/plutonium	Drum [e]	0.0033	2.0×10^{-6}	0.0038	2.3×10^{-6}	3.4×10^{-11}	4.4×10^{-6}
Norfolk, VA	Nuclear Weapon	SGT	0.025	0.000015	0.029	0.000018	5.5×10^{-10}	0.000013
Y-12	Enriched Uranium	ES3100	0.0067	4.0×10^{-6}	0.0078	4.7×10^{-6}	5.7×10^{-15}	9.5×10^{-6}
LANL	Milliwatt Generator	Mound-1KW	0.021	0.000012	0.018	0.000011	4.0×10^{-10}	3.6×10^{-6}
Rail Shipments [f]								
Northeast	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.033	0.000020	0.013	8.0×10^{-6}	6.9×10^{-9}	0.00075
		B-25 box	0.037	0.000022	0.016	9.8×10^{-6}	6.0×10^{-9}	0.00075
		B-12 box	0.037	0.000022	0.016	9.8×10^{-6}	3.0×10^{-9}	0.00075
		20-foot ISO	0.033	0.000020	0.013	8.0×10^{-6}	1.1×10^{-8}	0.00075
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.17	0.00010	0.067	0.000040	8.5×10^{-12}	0.00075

Region/ Destination/ Origin	Waste or Materials	Container	Incident-Free Conditions				Accident Conditions	
			Crew Dose (person-rem)	Crew Risk (LCF)	Population Dose (person-rem)	Population Risk (LCF)	Radiological Risk (LCF)	Roundtrip Nonradiological Risk (traffic fatalities)
Southeast	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.029	0.000018	0.011	6.7×10^{-6}	5.9×10^{-9}	0.00065
		B-25 box	0.032	0.000019	0.014	8.2×10^{-6}	5.2×10^{-9}	0.00065
		B-12 box	0.032	0.000019	0.014	8.2×10^{-6}	2.6×10^{-9}	0.00065
		20-foot ISO	0.029	0.000018	0.011	6.7×10^{-6}	9.6×10^{-9}	0.00065
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.15	0.000088	0.056	0.000033	3.1×10^{-12}	0.00065
South	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.027	0.000016	0.0092	5.5×10^{-6}	4.7×10^{-9}	0.00059
		B-25 box	0.030	0.000018	0.011	6.7×10^{-6}	4.1×10^{-9}	0.00059
		B-12 box	0.030	0.000018	0.0011	6.7×10^{-6}	2.1×10^{-9}	0.00059
		20-foot ISO	0.027	0.000016	0.0092	5.5×10^{-6}	7.7×10^{-9}	0.00059
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.13	0.000081	0.046	0.000028	2.2×10^{-12}	0.00059
Southwest	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.014	8.6×10^{-6}	0.0038	2.3×10^{-6}	1.2×10^{-9}	0.00027
		B-25 box	0.016	9.5×10^{-6}	0.0047	2.8×10^{-6}	1.0×10^{-9}	0.00027
		B-12 box	0.016	9.5×10^{-6}	0.0047	2.8×10^{-6}	5.1×10^{-10}	0.00027
		20-foot ISO	0.014	8.6×10^{-6}	0.0038	2.3×10^{-6}	1.9×10^{-9}	0.00027
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.072	0.000043	0.019	0.000012	6.3×10^{-13}	0.00027
West	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.0097	5.8×10^{-6}	0.0039	2.3×10^{-6}	1.2×10^{-9}	0.00016
		B-25 box	0.011	6.4×10^{-6}	0.0048	2.9×10^{-6}	1.1×10^{-9}	0.00016
		B-12 box	0.011	6.4×10^{-6}	0.0048	2.9×10^{-6}	5.3×10^{-10}	0.00016
		20-foot ISO	0.0097	5.8×10^{-6}	0.0039	2.3×10^{-6}	2.0×10^{-9}	0.00016
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.048	0.000029	0.019	0.000012	1.4×10^{-12}	0.00016
Northwest	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.019	0.000011	0.0069	4.2×10^{-6}	3.1×10^{-9}	0.00039
		B-25 box	0.021	0.000013	0.0085	5.1×10^{-6}	2.7×10^{-9}	0.00039
		B-12 box	0.021	0.000013	0.0085	5.1×10^{-6}	1.4×10^{-9}	0.00039
		20-foot ISO	0.019	0.000011	0.0069	4.2×10^{-6}	5.1×10^{-9}	0.00039
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.095	0.000057	0.035	0.000021	3.0×10^{-12}	0.00039
Mountain West	CH-LLW/MLLW [a]	55-gallon drum (CH)	0.0067	4.0×10^{-6}	0.0026	1.6×10^{-6}	4.6×10^{-10}	0.000081
		B-25 box	0.0074	4.4×10^{-6}	0.0032	1.9×10^{-6}	4.0×10^{-10}	0.000081
		B-12 box	0.0074	4.4×10^{-6}	0.0032	1.9×10^{-6}	2.0×10^{-10}	0.000081
		20-foot ISO	0.0067	4.0×10^{-6}	0.0026	1.6×10^{-6}	7.5×10^{-10}	0.000081
	RH-LLW/MLLW [b]	55-gallon drum (RH)	0.033	0.000020	0.013	7.9×10^{-6}	2.7×10^{-13}	0.000081

Region/ Destination/ Origin	Waste or Materials	Container	Incident-Free Conditions				Accident Conditions	
			Crew Dose (person-rem)	***Crew Risk (LCF)***	***Population Dose (person-rem)***	***Population Risk (LCF)***	***Radiological Risk (LCF)***	***Roundtrip Nonradiological Risk (traffic fatalities)***
Upper Midwest	CH-LLW/MLLW[a]	55-gallon drum (CH)	0.024	0.000014	0.0060	3.6×10^{-6}	2.6×10^{-9}	0.00051
		B-25 box	0.026	0.000016	0.0074	4.4×10^{-6}	2.2×10^{-9}	0.00051
		B-12 box	0.026	0.000016	0.0074	4.4×10^{-6}	1.1×10^{-9}	0.00051
		20-foot ISO	0.024	0.000014	0.0060	3.6×10^{-6}	4.2×10^{-9}	0.00051
	RH-LLW/MLLW[b]	55-gallon drum (RH)	0.12	0.000071	0.030	0.000018	1.5×10^{-12}	0.00051

CH = contact-handled; HEU = highly enriched uranium; INL = Idaho National Laboratory; ISO = International Organization for Standardization; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; LLNL = Lawrence Livermore National Laboratory; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; rem = roentgen equivalent man; RH = remote-handled; SGT = safeguards transporter; SNM = special nuclear material; TRU = transuranic; Y-12 = Y-12 National Security Complex.

[a] LLW and MLLW were assumed to be transported in 55-gallon drums, B-25 boxes, B-12 boxes, and 20-foot ISO (Sealand) containers based on historical information regarding prevalence of use.

[b] RH-LLW and RH-MLLW were assumed to be transported in 55-gallon drums in Type B packages.

[c] TRU waste generated from operation of the Joint Actinide Shock Physics Experimental Research Facility and environmental restoration was assumed to be in standard waste boxes and transported in TRUPACT-II packages. The two 3-foot-diameter steel spheres containing plutonium that were used in subcritical experiments and are now stored at the Nevada National Security Site would be transported in TRUPACT-III packages that have yet to be certified by NRC.

[d] These transports are performed using secured trailers. These transport trailers have different accident and fatality rates from those used for transporting LLW/MLLW.

[e] The special nuclear materials and pits are transported in special Type B packaging that are drum-like containers.

[f] Rail shipments would end in a rail-to-truck transfer station location. These locations would be either Tecoma, Nevada (for West Wendover, Nevada), or Barstow, California, and Kingman, Arizona (for Parker, Arizona). After a rail shipment ends at a transfer station location, the waste would be transported by truck to the Nevada National Security Site. The risk factors for rail transports are based on the assumption of Barstow, California, Kingman, Arizona, and Tecoma, Nevada, as transfer station sites.

[g] No RH-TRU was identified.

[h] The risk factors are the maximum values for transport within Nevada.

During accident conditions, the population would be exposed to radiation from released radioactivity if the package is breached. If the package remains unbreached, the population exposure would be limited to direct radiation emanating from the package. For the accidents with no release, the analysis conservatively assumed that it would take about 12 hours to remove the package and/or vehicle from the accident area (DOE 2002a). Accidents leading to a loss of cask shielding would only be applicable to those shipments that use shielded casks, such as transport of remote-handled Class C and TRU wastes.

LCFs represent the number of additional latent fatal cancers among the exposed population. To calculate the number of LCFs, the incident-free population dose and accident population dose were multiplied by the health risk factor of 0.0006 cancer fatalities per person-rem of exposure. The nonradiological risk factors are nonoccupational traffic fatalities resulting from transportation accidents and are representative of the national mean rates.

Transportation risks were calculated assuming that wastes would be transported using either truck only or a combination of rail and truck. In this latter case, shipments involving both modes of transport would involve workers who would transfer waste containers from railcars to trucks (or vice versa) at a transfer station.

As indicated in Table E–10, all risk factors are less than 1. This means that no LCFs or traffic fatalities are expected to occur during each transport. For example, the risk factors for truck crewmembers and the general population for transporting one shipment of LLW or MLLW in 55-gallon drums from the Northeast region to the NNSS are given as 0.000035 and 0.000016 LCFs, respectively. This risk can also be interpreted as meaning that there is a chance of 1 in 29,000 shipments that an additional LCF could be experienced among the exposed workers from exposure to radiation during one shipment of LLW or MLLW from the Northeast region to the NNSS. Similarly, there is a chance of 1 in 63,000 shipments that an additional LCF could be experienced among the exposed general population residing along the transport route. These are essentially equivalent to zero risk. Note that the maximum allowable dose rate in the truck cabin is less than or equal to 2 millirem per hour, and the maximum annual dose to a commercial truck driver is 100 millirem per year, unless the individual is a trained radiation worker, in which case the administrative annual dose limit would be 2 rem (DOE 1999a). The values could be higher if drivers are radiation workers operating under a federally or state-licensed program (49 CFR 173.441). An individual receiving a dose of 100 millirem would have an expected risk of developing a latent fatal cancer of 0.00006. The same individual is expected to receive a dose of about 620 millirem per year on average from background and other sources of radiation (NCRP 2009).

As discussed in Section E.6.3, the accident dose is called the "dose risk" because the values incorporate the spectrum of accident severity probabilities and associated consequences (e.g., dose). The accident dose risks are very low because accident severity probabilities (i.e., the likelihood of accidents leading to confinement breach of a package or shipping cask and release of its contents) are small, and the content and form of the wastes (such as solid dirt-like contamination) are such that they would lead to nondispersible and mostly noncombustible release. Although persons reside within a 50-mile radius of the transportation route, they are generally quite far from the route. Because RADTRAN uses an assumption of homogeneous population, it would greatly overestimate the actual doses.

Table E–11 provides the estimated numbers of combined LLW and MLLW shipments from each region of the United States and from onsite sources for each alternative for truck transport, by container type (as described in Section E.4.2).

Table E–11 Estimated Number of Truck Shipments of Low-Level Radioactive/Mixed Low-Level Radioactive Waste Under Each Alternative [a]

In-State/Out-of-State Source	*Total Number of Shipments*	*Container Type*				
		Drums	*B-25 Box*	*Sealand [b]*	*B-12 Box*	*Type B Container [c]*
No Action and Reduced Operations Alternatives						
Northeast	140	13	88	39	0	0
South	9,100	520	1,500	3,200	0	3,900
Southeast	120	15	26	75	0	0
Upper Midwest	10,000	480	2,400	7,100	0	7
Southwest	3,100	3,000	9	10	0	0
Mountain West	1,200	1	310	340	470	94
West	1,000	660	120	270	0	0
Northwest	7	1	2	4	0	0
Other Out-of-State Shipments [e]	1,600	N/A	N/A	1,600	N/A	N/A
In-State [g]	2,300	790	0	1,500	0	0
Total – Out-of-State Waste	**26,000**	**4,700**	**4,500**	**13,000**	**470**	**4,000**
Total – All	**29,000**	**5,500**	**4,500**	**14,000**	**470**	**4,000**
Expanded Operations Alternative [d]						
Northeast	290	24	190	80	0	0
South	19,000	50	3,100	7,800	0	8,200
Southeast	310	30	100	180	0	0
Upper Midwest	20,000	1,000	5,100	14,000	0	14
Southwest	7,800	7,800	20	19	0	0
Mountain West	3,100	1	1,200	740	990	190
West	3,000	2,200	250	560	0	0
Northwest	24	4	16	4	0	0
Other Out-of-State Shipments [f]	26,000	N/A	N/A	N/A	N/A	N/A
In-State [g, h]	15,000	100	0	15,000	0	0
Total – Out-of-State Waste	**80,000**	**11,000**	**10,000**	**23,000**	**990**	**8,400**
Total – All	**94,000**	**11,000**	**10,000**	**38,000**	**990**	**8,400**

N/A = not applicable.

Note: Total may not equal the sum of the contributions due to rounding.

[a] Number of rail shipments was assumed to be one-half of the number of truck shipments, except for the number of rail shipments for transporting depleted uranium conversion products (see footnote f).

[b] For purposes of analysis, it was assumed that supersacks would be transported in Sealand containers.

[c] A Type B container is used to transport remote-handled low-level or mixed low-level radioactive waste.

[d] In addition to shipments estimated from the U.S. Department of Energy Waste Management Information System, these numbers include estimated shipments of waste from operation and decontamination and decommissioning of the U.S. Enrichment Corporation lead cascade fuel enrichment facility and operation of the U.S. Enrichment Corporation fuel enrichment full-scale facility.

[e] Includes shipments analyzed in other NEPA documents as follows: 1,026 truck shipments from Paducah in the South region (DOE 2004b) and 553 truck shipments from Portsmouth in the Upper Midwest region (DOE 2004a). These shipments were assumed to consist of Sealand containers transporting depleted uranium conversion products.

[f] Includes shipments analyzed in other NEPA documents as follows: 12,243 truck shipments from the West Valley Demonstration Project in the Northeast region (DOE 2010b); 367 shipments of uranium-233 downblending waste from Oak Ridge National Laboratory in the South region; uranium oxide conversion product consisting of 7,240 truck shipments from Paducah, Kentucky, in the South region (DOE 2004b); and 5,834 truck shipments from Portsmouth, Ohio, in the Upper Midwest region (DOE 2004a). For the uranium oxide conversion products, the number of truck shipments is based on depleted uranium hexafluoride cylinders being filled with uranium oxide conversion product, two cylinders per truck. The numbers of rail shipments required for shipment of uranium oxide conversion products are 5,963 from Paducah (DOE 2004b) and 3,216 from Portsmouth (DOE 2004a). This does not include shipments that would occur after 2020.

[g] Includes radioactive waste generated by environmental restoration activities at the Nevada Test and Training Range and Tonopah Test Range (230 shipments of Sealand containers under the No Action and Reduced Operations Alternatives and 13,000 shipments of Sealand containers under the Expanded Operations Alternative).

[h] Includes shipment of MLLW from the NNSS to the Oak Ridge area for treatment and return to the NNSS.

TRU waste would be generated at the NNSS under all alternatives. The TRU waste projected to be shipped would include waste in storage and TRU waste generated by JASPER operations from 2011 to 2020, the two 3-foot-diameter steel spheres containing plutonium that were used in subcritical experiments and are now stored at the NNSS, and TRU waste from environmental restoration activities at the TTR and Nevada Test and Training Range. **Table E–12** shows the number of shipments of TRU waste, special nuclear material, radioisotope thermoelectric generators, and nuclear weapons under each alternative.

Table E–12 Estimated Number of Shipments of Transuranic Waste, Radioisotope Thermoelectric Generators, Special Nuclear Material, and Nuclear Weapons [a]

Origin or Activity	*Number of Shipments*		
	No Action Alternative	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Transuranic Waste			
JASPER [b]	16	36	11
Environmental Restoration	6	6	6
Radioisotope Thermoelectric Generators			
Norfolk, Virginia	3	10	3
Sealed Sources			
San Antonio, Texas	120	240	120
Special Nuclear Material			
Lawrence Livermore National Laboratory (Global Security SNM)	3	3	3
Lawrence Livermore National Laboratory (highly enriched uranium)	1	1	1
Los Alamos National Laboratory (uranium-233)	0	1	0
Idaho National Laboratory (ZPPR)	0	7	0
Idaho National Laboratory (ZPPR) – plutonium material	0	8	0
Oak Ridge National Laboratory (uranium-233)	0	32	0
Lawrence Livermore National Laboratory (target material for JASPER)	120	240	60
Nuclear Weapons			
Transport to/from the NNSS	0	8,200 [c]	0
Weapon Component Disposition [d]	0	2,010	0

JASPER = Joint Actinide Shock Physics Experimental Research Facility; NNSS = Nevada National Security Site; SNM = special nuclear material; ZPPR = Zero Power Plutonium Reactor.

[a] Number of shipments are for one-way, except for two-way transport of nuclear weapons that would undergo refurbishment at the NNSS.

[b] Includes number of shipments related to transuranic waste in storage.

[c] Includes 100 shipments per year of nuclear weapons to the NNSS for disassembly and 360 shipments per year of nuclear weapons to the NNSS to support component exchange. Includes return shipments of refurbished weapons.

[d] Includes 100 shipments per year of canned subassemblies to the Y-12 National Security Complex and plutonium to the Pantex Plant and 1 shipment per year of milliwatt generators to Los Alamos National Laboratory.

Under the Expanded Operations Alternative, it was assumed there would be 360 shipments of nuclear weapons per year to and from the NNSS for component replacement and 100 shipments per year of nuclear weapons to the NNSS for disassembly. For analytical purposes, it was assumed that each weapon disassembly would result in 1 shipment of plutonium to the Pantex Plant and 1 shipment of enriched uranium to the Y–12 National Security Complex. Disassembly of 100 nuclear weapons would also result in 10 shipments of milliwatt generators to Los Alamos National Laboratory. NNSA would use certified Type B packages and transport these packages using DOE's SGTs.

There would be 124 shipments of special nuclear material under the No Action Alternative, 64 shipments under the Reduced Operations Alternatives, and 292 shipments under the Expanded Operations Alternative. The transport of sealed sources would occur under all alternatives, with twice the number occurring under the Expanded Operations Alternative compared to the other alternatives.

E.7.1 Constrained Case

Tables E–13 and **E–14** show the risks of transporting radioactive waste and radioactive materials, respectively, under each alternative for the Constrained Case. The risks are calculated by multiplying the previously given per-shipment factors by the number of shipments over the duration of the program and, for radiological doses, by the health risk conversion factors. The risks are for the transport of the radioactive wastes over a 10-year period under each alternative.

The values presented in Tables E–13 and E–14 show that the total radiological risks (the product of consequence and frequency) are small under all three alternatives. For truck drivers, about 1 (1.3) LCF could occur under the No Action and Reduced Operations Alternatives, and 3 (3.3) LCFs could occur under the Expanded Operations Alternative, assuming no administrative controls are applied. These results reflect the sum of the risks associated with transport of LLW, MLLW, and other radioactive wastes and materials. For rail workers, less than 1 (0.3) LCF could occur under the No Action and Reduced Operations Alternatives, and 1 (0.6) LCF could occur under the Expanded Operations Alternative, assuming no administrative controls are applied. Note that the maximum annual dose to a transportation worker would be limited to 100 millirem per year, unless the individual is a trained radiation worker, in which case the administrative annual dose limit would be 2 rem (DOE 1999a).[2] The potential for a trained radiation worker to develop a latent fatal cancer from the maximum annual exposure is 0.001; therefore, no individual transportation worker is expected to develop a latent fatal cancer from exposures during activities under all three alternatives.

The risk to the public from incident-free truck transport of all radioactive materials and wastes would be less than 1 (0.2) LCF under the No Action and Expanded Operations Alternatives and about 1 (0.8) LCF under the Expanded Operations Alternative. If rail transport were used to transport LLW and MLLW to the NNSS, then the radiological risk from all rail-to-truck transports would be less than 1 (0.1) LCF under the No Action and Expanded Operations Alternatives, but about 1 (0.5) LCF under the Expanded Operations Alternative.

Nonradiological accident risks (the potential for fatalities as a direct result of traffic accidents) present the greatest risks. The impacts of using only trucks for transporting radioactive materials would range from 2 to 7 traffic fatalities among the alternatives, while using rail-to-truck transport would cause impacts ranging from 6 to 16 traffic fatalities. Considering that the transportation activities analyzed in this SWEIS would occur over a period of 10 years and that the average number of traffic fatalities in the United States is about 40,000 per year (NHTSA 2006), the traffic fatality risk under all alternatives would be small.

[2] *A DOE transportation contractor may choose another dose limit for workers, but this dose is limited to 5 rem per year as set forth in 10 CFR 20.1201.*

Table E–13 Risks of Transporting Radioactive Waste Under Each Alternative – Constrained Case [a]

					Incident-Free Conditions				*Accident Conditions*	
					Crew		*Population*			
Region	***Transport Mode***	***Number of Shipments***	***One-Way Kilometers Traveled (million)***	***One-Way Miles Traveled (million)***	***Dose (person-rem)***	***Risk [b]***	***Dose (person-rem)***	***Risk [b]***	***Radiological Risk [b]***	***Roundtrip Nonradiological Risk [b]***
No Action Alternative										
Northeast	Truck	140	0.67	0.42	8.2	5×10^{-3}	2.6	2×10^{-3}	3×10^{-6}	2×10^{-2}
	Rail only [c]	70	0.34	0.21	2.5	1×10^{-3}	1.1	6×10^{-4}	5×10^{-7}	5×10^{-2}
	Rail/Truck [d]	210	0.41	0.26	3.4	2×10^{-3}	1.6	1×10^{-3}	8×10^{-7}	6×10^{-2}
South	Truck	9,100	31.73	19.72	1400	9×10^{-1}	220	1×10^{-1}	6×10^{-5}	1
	Rail only [c]	4,500	16.84	10.46	330	2×10^{-1}	110	7×10^{-2}	2×10^{-5}	3
	Rail/Truck [d]	13,600	21.78	13.53	550	3×10^{-1}	150	9×10^{-2}	2×10^{-5}	3
Southeast	Truck	120	0.45	0.28	6.7	4×10^{-3}	1.9	1×10^{-3}	2×10^{-6}	1×10^{-2}
	Rail only [c]	60	0.24	0.15	1.8	1×10^{-3}	0.69	4×10^{-4}	5×10^{-7}	4×10^{-2}
	Rail/Truck [d]	180	0.31	0.19	2.7	2×10^{-3}	0.92	6×10^{-4}	6×10^{-7}	2×10^{-3}
Upper Midwest	Truck	10,000	33.77	20.99	510	3×10^{-1}	130	8×10^{-2}	1×10^{-4}	1
	Rail only [c]	5,000	16.44	10.22	120	7×10^{-2}	32	2×10^{-2}	2×10^{-5}	3
	Rail/Truck [d]	15,100	21.90	13.61	200	1×10^{-1}	51	3×10^{-2}	3×10^{-5}	3
Southwest	Truck	3,100	4.28	2.66	64	4×10^{-2}	28	2×10^{-2}	9×10^{-6}	1×10^{-1}
	Rail only [c]	1,500	2.69	1.67	22	1×10^{-2}	5.9	4×10^{-3}	2×10^{-6}	4×10^{-1}
	Rail/Truck [d]	4,600	4.36	2.71	42	3×10^{-2}	14	9×10^{-3}	4×10^{-6}	5×10^{-1}
Mountain West	Truck	1,200	1.58	0.98	27	2×10^{-2}	6.0	4×10^{-3}	2×10^{-6}	5×10^{-2}
	Rail only [c]	610	0.32	0.20	5.6	3×10^{-3}	2.3	1×10^{-3}	2×10^{-7}	5×10^{-2}
	Rail/Truck [d]	1,800	1.23	0.76	21	1×10^{-2}	5.4	3×10^{-3}	5×10^{-7}	7×10^{-2}
West	Truck	1,000	1.20	0.75	16	9×10^{-3}	6.0	4×10^{-3}	5×10^{-6}	4×10^{-2}
	Rail only [c]	530	0.53	0.33	5.1	3×10^{-3}	2.1	1×10^{-3}	7×10^{-7}	8×10^{-2}
	Rail/Truck [d]	1,600	1.10	0.68	13	8×10^{-3}	4.7	3×10^{-3}	2×10^{-6}	1×10^{-1}
Northwest	Truck	7	0.02	0.01	0.25	1×10^{-4}	0.085	5×10^{-5}	1×10^{-7}	6×10^{-4}
	Rail only [c]	4	0.01	0.01	0.08	5×10^{-5}	0.029	2×10^{-5}	2×10^{-8}	2×10^{-3}
	Rail/Truck [d]	10	0.01	0.01	0.13	8×10^{-5}	0.04	3×10^{-5}	2×10^{-8}	2×10^{-3}
Total – Offsite LLW/MLLW from all regions	Truck	24,700	73.7	45.8	2,100	1.2	390	2×10^{-1}	2×10^{-4}	2
	Rail only [c]	12,300	37.4	23.2	490	3×10^{-1}	160	9×10^{-2}	4×10^{-5}	6
	Rail/Truck [d]	37,000	51.1	31.8	840	5×10^{-1}	220	1×10^{-1}	6×10^{-5}	6
Onsite	Truck	2,000	0.05	0.03	4.0	2×10^{-3}	1.5	9×10^{-4}	2×10^{-8}	1×10^{-3}
ER Waste (TTR/Nevada Test and Training Range)	Truck	230	0.09	0.06	0.015	9×10^{-6}	0.0022	1×10^{-6}	4×10^{-13}	2×10^{-3}
TRU waste [e]	Truck	20	0.03	0.02	1.08	6×10^{-4}	0.36	2×10^{-4}	2×10^{-8}	9×10^{-4}
RTGs	Truck	3	0.01	0.01	0.37	2×10^{-4}	0.49	3×10^{-3}	3×10^{-10}	2×10^{-3}
Total – radioactive waste transport	Truck	27,000	73.9	45.9	2,100	1.2	390	2×10^{-1}	2×10^{-4}	2
	Rail/Truck [d]	39,300	51.3	31.9	850	5×10^{-1}	230	1×10^{-1}	6×10^{-5}	6
Transport through Nevada [f]	Truck	24,800	8.12	5.01	200	1×10^{-1}	38	2×10^{-2}	3×10^{-6}	2×10^{-1}

Region	*Transport Mode*	*Number of Shipments*	*One-Way Kilometers Traveled (million)*	*One-Way Miles Traveled (million)*	*Incident-Free Conditions*				*Accident Conditions*	
					Crew		*Population*		*Radiological Risk* [b]	*Roundtrip Nonradiological Risk* [b]
					Dose (person-rem)	*Risk* [b]	*Dose (person-rem)*	*Risk* [b]		
Expanded Operations Alternative										
Northeast	Truck	290	1.40	0.87	17	1×10^{-2}	5.5	3×10^{-3}	6×10^{-6}	5×10^{-2}
	Rail only [c]	150	0.70	0.44	5.2	3×10^{-3}	2.2	1×10^{-3}	1×10^{-6}	1×10^{-1}
	Rail/Truck [d]	440	0.86	0.54	7.1	4×10^{-3}	2.8	2×10^{-3}	1×10^{-6}	1×10^{-1}
South	Truck	19,300	67.32	41.83	3,500	2	460	3×10^{-1}	4×10^{-5}	2
	Rail only [c]	9,600	36.16	22.47	700	4×10^{-1}	240	1×10^{-1}	4×10^{-5}	6
	Rail/Truck [d]	28,900	46.65	28.99	1,200	7×10^{-1}	310	2×10^{-1}	5×10^{-5}	6
Southeast	Truck	310	1.22	0.76	17	1×10^{-2}	5.1	3×10^{-3}	5×10^{-6}	4×10^{-2}
	Rail only [c]	160	0.66	0.41	4.8	3×10^{-3}	1.9	1×10^{-3}	1×10^{-6}	1×10^{-1}
	Rail/Truck [d]	470	0.83	0.51	7.2	4×10^{-3}	2.5	1×10^{-3}	2×10^{-6}	5×10^{-3}
Upper Midwest	Truck	20,100	67.60	42.01	,1000	6×10^{-1}	260	2×10^{-1}	2×10^{-4}	2
	Rail only [c]	10,100	32.90	20.44	250	1×10^{-1}	64	4×10^{-2}	4×10^{-5}	5
	Rail/Truck [d]	30,200	43.82	27.23	410	2×10^{-1}	100	6×10^{-2}	6×10^{-5}	5
Southwest	Truck	7,800	10.91	6.78	160	1×10^{-1}	70	4×10^{-2}	2×10^{-5}	3×10^{-1}
	Rail only [c]	3,900	6.86	4.26	56	3×10^{-2}	15	9×10^{-3}	5×10^{-6}	1
	Rail/Truck [d]	11,700	11.09	6.89	110	6×10^{-2}	37	2×10^{-2}	1×10^{-5}	1
Mountain West	Truck	3,100	4.03	2.50	64	4×10^{-2}	15	9×10^{-3}	6×10^{-6}	1×10^{-1}
	Rail only [c]	1,600	0.81	0.50	14	8×10^{-3}	5.8	3×10^{-3}	6×10^{-7}	1×10^{-1}
	Rail/Truck [d]	4,700	3.14	1.95	50	3×10^{-2}	13	8×10^{-3}	1×10^{-6}	2×10^{-1}
West	Truck	3,000	3.48	2.16	45	3×10^{-2}	18	1×10^{-2}	1×10^{-5}	1×10^{-1}
	Rail only [c]	1,500	1.52	0.95	15	9×10^{-3}	6.0	4×10^{-3}	2×10^{-6}	2×10^{-1}
	Rail/Truck [d]	4,600	3.17	1.97	36	2×10^{-2}	14	8×10^{-3}	5×10^{-6}	3×10^{-1}
Northwest	Truck	24	0.06	0.04	0.68	4×10^{-4}	0.25	1×10^{-4}	3×10^{-7}	2×10^{-3}
	Rail only [c]	12	0.04	0.02	0.24	1×10^{-4}	0.096	6×10^{-5}	4×10^{-8}	5×10^{-3}
	Rail/Truck [d]	36	0.05	0.03	0.39	2×10^{-4}	0.14	8×10^{-5}	6×10^{-8}	5×10^{-3}
Total – Offsite LLW/MLLW from all regions	Truck	5	156	96.9	4,900	2.9	830	5×10^{-1}	3×10^{-4}	5
	Rail only [c]	26,900	79.6	49.5	1,000	6×10^{-1}	340	2×10^{-1}	8×10^{-5}	12
	Rail/Truck [d]	80,900	110	68.4	1,800	1.1	480	3×10^{-1}	1×10^{-4}	13
Onsite	Truck	2,300	0.06	0.04	4.15	2×10^{-3}	1.5	9×10^{-4}	2×10^{-8}	2×10^{-3}
ER Waste (TTR/Nevada Test and Training Range)	Truck	13,100	4.91	3.05	0.82	5×10^{-4}	0.28	2×10^{-4}	2×10^{-11}	1×10^{-1}
TRU waste [e]	Truck	32	0.04	0.03	1.6	9×10^{-4}	0.52	3×10^{-4}	2×10^{-8}	1×10^{-3}
RTGs	Truck	10	0.05	0.03	1.2	7×10^{-4}	1.6	1×10^{-3}	9×10^{-10}	7×10^{-3}
Paducah DUF_6 DOE/EIS-359 [g]	Truck	7,200	20.4	12.7	120	7×10^{-2}	80	5×10^{-2}	3×10^{-3}	5×10^{-1}
	Rail	2,900	9.93	6.19	370	2×10^{-1}	14	8×10^{-3}	2×10^{-3}	2×10^{-1}
Portsmouth DUF_6 DOE/EIS-360 [g]	Truck	5,800	19.6	12.2	11	7×10^{-3}	78	5×10^{-2}	7×10^{-3}	4×10^{-1}
	Rail	2,300	9.37	5.84	330	2×10^{-1}	14	9×10^{-3}	3×10^{-3}	3×10^{-1}

					Incident-Free Conditions				*Accident Conditions*	
					Crew		*Population*			
Region	***Transport Mode***	***Number of Shipments***	***One-Way Kilometers Traveled (million)***	***One-Way Miles Traveled (million)***	***Dose (person-rem)***	***Risk*** [b]	***Dose (person-rem)***	***Risk*** [b]	***Radiological Risk*** [b]	***Roundtrip Nonradiological Risk*** [b]
West Valley DOE/EIS-0226 [g]	Truck	12,000	48.0	29.9	230	1×10^{-1}	64	4×10^{-2}	9×10^{-6}	9×10^{-1}
	Rail	6,100	26.5	16.5	9.3	6×10^{-3}	14	8×10^{-3}	3×10^{-6}	2
ORNL (uranium-233) DOE/EA-1651 [h]	Truck	367	No data	No data	No data	No data	9.5	6×10^{-3}	7×10^{-12}	<1
Total – radioactive waste transport	Truck	94,800	249	155	5,300	3.1	1,100	6×10^{-1}	1×10^{-2}	7
	Rail/Truck [d]	108,000	161	100	2,500	1.5	540	3×10^{-1}	5×10^{-3}	16
Transport through Nevada [f]	Truck	54,100	17.92	11.14	440	3×10^{-1}	82	5×10^{-2}	8×10^{-6}	5×10^{-1}
Reduced Operations Alternative										
All Regions	Truck	See No Action Alternative								
	Rail	See No Action Alternative								
Onsite	Truck	See No Action Alternative								
TRU waste [e]	Truck	17	0.02	0.01	0.83	5×10^{-4}	0.28	2×10^{-4}	1×10^{-8}	7×10^{-4}
Transport through Nevada [f]	Truck	See No Action Alternative								

< = less than; DUF_6 = depleted uranium hexafluoride; ER = Environmental Restoration; ORNL = Oak Ridge National Laboratory; rem = roentgen equivalent man; RTG = radioisotope thermoelectric generator; SGT = safeguards transporter; SNM = special nuclear material; TRU = transuranic; TTR = Tonopah Test Range.

[a] LLW and MLLW were assumed to be transported in 55-gallon drums, B-25 boxes, B-12 boxes, and 20-foot ISO (Sealand) containers based on historical information regarding prevalence of use.

[b] Risk is expressed in terms of LCFs, except for nonradiological risk, where it refers to the number of traffic accident fatalities. Accident dose risk can be calculated by dividing the risk values by 0.0006 (DOE 2003).

[c] These values reflect only the portion of the routes traveled by railcar.

[d] These values reflect the combined use of railcar and truck shipments to transport waste to the NNSS.

[e] Transuranic waste is first transported to Idaho National Laboratory for characterization and then transported back to the NNSS with final disposal at the Waste Isolation Pilot Plant.

[f] The cited risk values are representative of the portion of the routes for transporting LLW and MLLW within Nevada to the NNSS, excluding shipments identified in other NEPA documentation. The stated risks for travel within Nevada are included in the risks for the regional routes shown in the table. The values for the Reduced Operations Alternative are similar to those for the No Action Alternative.

[g] The risks from transporting Paducah and Portsmouth DUF_6 conversion wastes and the West Valley wastes to the NNSS are directly from their respective site EISs (DOE 2004a, 2004b, 2010b), proportionally adjusted for a 10-year period. The rail transport risk values for these analyses consider direct transport to the NNSS; therefore, the risks do not include truck transport from a transfer station. If rail-to-truck transport was used for these shipments, the incident-free risk would be lower, while the accident risk would be slightly higher, given the results of transporting LLW and MLLW. Transportation risks from transporting wastes associated with these waste streams generated beyond this 10-year period are included in the cumulative impacts (Chapter 6).

[h] DOE 2010a.

Note: To convert kilometers to miles, multiply by 0.62137. Total may not equal the sum of the contributions due to rounding. Also due to rounding, the cited risk values are different from multiplication of dose by the dose risk factor of 0.0006 LCFs per person-rem.

Table E–14 Risks of Transporting Radioactive Materials Under Each Alternative – Constrained Case

				Incident-Free Conditions				*Accident Conditions*	
				Crew		*Population*			
Material	***Number of Shipments***	***One-Way Kilometers Traveled (million)***	***One-Way Miles Traveled (million)***	***Dose (person-rem)***	***Risk*** [b]	***Dose (person-rem)***	***Risk*** [a]	***Radiological Risk*** [b]	***Roundtrip Nonradiological Risk*** [a]
No Action Alternative									
Special Nuclear Material	120	0.14	0.088	0.13	8×10^{-5}	0.12	7×10^{-5}	5×10^{-8}	5×10^{-3}
Special Nuclear Material – in Nevada	120	0.04	0.02	0.028	2×10^{-5}	0.023	1×10^{-5}	7×10^{-9}	9×10^{-5}
Sealed Sources	120	0.27	0.17	17	1×10^{-2}	4.3	3×10^{-3}	2×10^{-11}	9×10^{-3}
Sealed Sources – in Nevada	120	0.04	0.02	2.2	1×10^{-3}	0.55	3×10^{-4}	4×10^{-13}	1×10^{-3}
Expanded Operations Alternative									
Special Nuclear Material	290	0.41	0.25	0.39	2×10^{-4}	0.39	2×10^{-4}	1×10^{-7}	1×10^{-2}
Special Nuclear Material – in Nevada	290	0.09	0.06	0.097	6×10^{-5}	0.11	7×10^{-5}	1×10^{-8}	2×10^{-4}
Weapon Component Disposition	2,000	3.49	2.17	10	6×10^{-3}	12	7×10^{-3}	4×10^{-8}	1×10^{-2}
Weapon Component Disposition – in Nevada	2,000	0.71	44.1	1.3	8×10^{-4}	1.5	9×10^{-4}	3×10^{-8}	2×10^{-3}
Weapon Transport	8,200	38.15	23.71	210	1×10^{-1}	240	1×10^{-1}	6×10^{-6}	1×10^{-1}
Weapon Transport – in Nevada	8,200	2.50	1.55	14	9×10^{-3}	16	1×10^{-2}	2×10^{-7}	6×10^{-3}
Sealed Sources	240	0.55	0.34	33	2×10^{-2}	8.5	5×10^{-3}	5.E-11	2×10^{-2}
Sealed Sources – in Nevada	240	0.07	0.05	4.4	3×10^{-3}	1.1	7×10^{-4}	7.E-13	2×10^{-3}
Reduced Operations Alternative									
Special Nuclear Material	60	0.07	0.04	0.083	5×10^{-5}	0.081	5×10^{-5}	2×10^{-8}	5×10^{-3}
Special Nuclear Material – in Nevada	60	0.02	0.01	0.015	9×10^{-6}	0.013	8×10^{-6}	3×10^{-9}	5×10^{-5}
Sealed Sources	See No Action Alternative								
Sealed Sources – in Nevada	See No Action Alternative								

rem = roentgen equivalent man.

[a] Risk is expressed in terms of latent cancer fatalities, except for the nonradiological risk, where it refers to the number of traffic accident fatalities. Accident dose risk can be calculated by dividing the risk values by 0.0006 (DOE 2003).

The risks to various exposed individuals during incident-free transportation conditions have been estimated for hypothetical exposure scenarios identified in Section E.5.3. The estimated doses to workers and the public are presented in **Table E–15**. Doses are presented on a per-event basis (person-rem per event, per exposure, or per shipment), as it is generally unlikely that the same person would be exposed to multiple events. For those individuals that could have multiple exposures, the cumulative dose could be calculated. The maximum dose to a crewmember is based on the same individual being responsible for driving every shipment for the duration of the campaign. Note that the potential exists for larger individual exposures under onetime events of a longer duration. For example, the dose to a person stuck in traffic next to a shipment of Class B or Class C wastes for 30 minutes is calculated to be 0.0097 rem (9.7 millirem). This is generally considered a onetime event for that individual, although this individual may encounter another exposure of a similar or longer duration in his or her lifetime.

A member of the public residing along the route would likely receive multiple exposures from passing shipments. The cumulative dose to this resident can be calculated assuming all shipments pass his or her home. The cumulative dose is calculated assuming that the resident is present for every shipment and is unshielded at a distance of about 98 feet from the route. Therefore, the cumulative dose depends on the number of shipments passing a particular point and is independent of the actual route being considered. If the maximum resident dose provided in Table E–15 is assumed for all waste transport types, then the maximum dose to this resident on a truck route, if all the materials were to be shipped via this route, would be about 10 millirem for the No Action and Reduced Operations Alternatives, and about 20 millirem for the Expanded Operations Alternative (rounded to the nearest 10 millirem). A resident living along a rail route, if exposed to all rail shipments, would receive a dose of about 10 millirem for the No Action and Reduced Operations Alternative, and about 30 millirem for the Expanded Operations Alternative.

Table E–15 Estimated Dose to Maximally Exposed Individuals During Incident Free Transportation Conditions

Receptor	*Dose to Maximally Exposed Individual*
Workers	
Crewmember (truck/rail driver)	2 rem per year [a]
Inspector	0.023 rem per event per hour of inspection
Rail yard worker	0.0011 rem per event
Transfer station worker [b]	0.00034 person-rem per container transfer between rail and truck
Public	
Resident (along the rail route)	6.3×10^{-7} rem per event
Resident (along the truck route)	2.4×10^{-7} rem per event
Person in traffic congestion	0.0097 rem per event per half hour of stop
Resident near the rail yard during classification	0.000065 rem per event
Person at a rest stop/gas station	0.000062 rem per event per hour of stop
Gas station attendant	0.0002 rem per event

rem = roentgen equivalent man.

[a] Maximum administrative dose limit per year for a trained radiation worker (truck/rail crewmember). The value could be higher if drivers are radiation workers operating under a federally or state-licensed program (49 CFR 173.441).

[b] Transfer station worker dose is based on the *NTS Intermodal Study* (DOE 1999b), with a Transport Index of 1.

The accident risk assessment and the impacts shown in Tables E–13 and E–14 consider the entire spectrum of potential accidents, from a fender bender to an extremely severe accident. To provide additional insight into the severity of accidents in terms of the potential dose to an MEI and the public, an accident consequence assessment has been performed for a maximum reasonably foreseeable hypothetical transportation accident with a likelihood of occurrence greater than 1 in 10 million per year. The results, presented in **Table E–16**, include all conceivable accidents, irrespective of their likelihood.

Table E–16 Estimated Dose to the Population and to Maximally Exposed Individuals During Most-Severe Accident Conditions [a]

Alternative/ Transport Mode [b]		*Waste Material in the Accident With the Highest Consequences*	*Likelihood of the Accident (per year)*	*Population [c]*		*Maximally Exposed Individual [d]*	
				Dose (person-rem)	*Risk (LCF)*	*Dose (rem)*	*Risk (LCF)*
No Action and Reduced Operations	Truck	LLW/MLLW in 20-foot ISO container	3.1×10^{-7}	180	0.1	0.034	2×10^{-5}
Expanded Operations	Truck	LLW/MLLW in 20-foot ISO container	6.1×10^{-7}	180	0.1	0.034	2×10^{-5}
Transport within Nevada [e]		LLW/MLLW in 20-foot ISO container	2.4×10^{-6}	27	0.02	0.034	2×10^{-5}

ISO = International Organization for Standardization; LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; rem = roentgen equivalent man.

[a] The likelihood of accidents is based on the annual estimated number of transports from each region to the Nevada National Security Site. The cited likelihood of accidents is the highest calculated value among all transports.

[b] Note that the likelihood of rail accidents is less than 10^{-7} per year and, therefore, rail accident impacts are not shown.

[c] Population extends at a uniform density to a radius of 50 miles. The weather condition was assumed to be Pasquill Stability Class D with a windspeed of 8.8 miles per hour. Unless otherwise noted, the population doses and risks are presented for an urban area on the transportation route.

[d] The maximally exposed individual was assumed to be 330 feet downwind from the accident and exposed to the entire plume of the radioactive release. The weather condition was assumed to be Pasquill Stability Class F with a windspeed of 2.2 miles per hour.

[e] Population dose and risk are for a suburban area along the route. The probability of a maximum foreseeable accident in an urban area along the transportation route is less than 10^{-7} per year. The cited likelihood of an accident is for the Expanded Operations Alternative. The likelihood of accidents under the No Action and Reduced Operations Alternatives is 1.2×10^{-6} per year.

The following assumptions were used to estimate the consequences of maximum reasonably foreseeable offsite transportation accidents:

- The accident is the most severe with the highest release fraction; the highest severity category of accident is a high-impact and high-temperature fire accident.
- The individual is 330 feet downwind from a ground release accident.
- The individual is exposed to airborne contamination for 2 hours and ground contamination for 24 hours with no interdiction or cleanup. A stable weather condition (Pasquill Stability Class F) with a windspeed of 2.2 miles per hour was considered.
- The population is a uniform density within a 50-mile radius, and is exposed to the entire plume passage and 7 days of ground exposure without interdiction and cleanup. A neutral weather condition (Pasquill Stability Class D) with a windspeed of 8.8 miles per hour was considered. As

the consequence would be proportional to the population density, the accident was assumed to occur in an urban[3] area with the highest density (see Table E–1).

- The number of containers involved in the accident is listed in Table E–2. When multiple Type B or shielded Type A shipping casks are transported in a shipment, a single cask was assumed to have failed in the accident. It is unlikely that a severe accident would breach multiple casks.

Table E–16 provides the estimated dose and risk to an individual and population from a maximum foreseeable truck or rail transportation accident with the highest consequences under each alternative and disposal option. The highest consequences for the maximum foreseeable accident are from accidents involving LLW and MLLW in a 20-foot ISO container in a severe impact in conjunction with a long-duration fire. The calculated population doses are based on the maximum population density.

Table E–17 shows the risks of transporting offsite LLW and MLLW waste over a 10-year period (the number of shipments and associated risks do not take into account shipments of LLW and MLLW that have been analyzed in other National Environmental Policy Act documents). Results are presented by segment. For example, for rail-to-truck transport, the first segment shown represents transportation of waste from the U.S. regions by rail to a transfer station. The second segment represents transportation of waste from the transfer station by truck to Las Vegas. The third segment represents transportation of waste from Las Vegas to the NNSS using several possible routes through Las Vegas. Results are presented in this manner to allow the addition of results for a particular route. Note that there are results from transporting waste to Parker and West Wendover under the Constrained Case to allow for comparisons of rail impacts.

Chapter 5, Tables 5–12 and 5–13, summarize the cumulative range of impacts for transporting LLW and MLLW for the total shipping campaign. These impacts are comparable to the impacts associated with constrained transport of these wastes under the Expanded Operations Alternative.

[3] *If the likelihood of accident in an urban area is less than 1 in 10 million per year, then the accident was evaluated for a suburban area.*

Table E–17 Risks of Transporting Radioactive Waste Under Each Alternative – Unconstrained Case [a]

*Transfer Station** or Las Vegas Entry Point (truck)*	*Transport Mode or Route*	*Number of Shipments*	*One-Way Kilometers Traveled (million)*	*One-Way Miles Traveled (million)*	*Incident-Free Conditions*				*Accident Conditions*	
					Crew		*Population*			
					Dose (person-rem)	*Risk [b]*	*Dose (person-rem)*	*Risk (LCF)*	*Radiological Risk (LCF) [b]*	*Roundtrip Nonradiological Risk (fatalities)*
Rail-to-Truck: To Las Vegas										
Apex**	Rail [c]	27,000	81.2	50.5	1,100	0.6	330	0.2	8×10^{-5}	13
	Truck after [d]	footnote e	-	-	-	-	-	-	-	-
Arden**	Rail [c]	27,000	82.0	51.0	1,100	0.6	330	0.2	8×10^{-5}	13
	Truck after [d]	footnote e	-	-	-	-	-	-	-	-
Kingman**	Rail [c]	27,000	74.3	46.2	980	0.6	330	0.2	8×10^{-5}	12
	Truck after [d]	54,000	8.21	5.10	210	0.1	46	0.03	3×10^{-5}	0.3
Parker**	Rail [c]	27,000	83.7	52.0	1,100	0.6	340	0.2	9×10^{-5}	13
	Truck after [d]	54,000	16.5	10.3	420	0.3	86	0.05	2×10^{-5}	0.5
West Wendover**	Rail [c]	27,000	68.6	42.6	920	0.6	250	0.2	6×10^{-5}	11
	Truck after [d]	54,000	31.2	19.4	780	0.5	140	0.08	1×10^{-5}	0.9
Rail-to-Truck: From Las Vegas Entry Points to the NNSS										
Apex to the NNSS	via C-215 to US 95	54,000	8.37	5.20	210	0.1	37	0.02	6×10^{-6}	2×10^{-5}
	via I–15 to US 95	54,000	8.37	5.20	450	0.3	150	0.09	6×10^{-5}	3×10^{-5}
Arden to the NNSS	via I–15 to US 95	54,000	8.75	5.44	220	0.1	52	0.03	6×10^{-5}	2×10^{-5}
	via I–215 to C–215 to US 95	54,000	10.2	6.34	320	0.2	73	0.04	1×10^{-5}	3×10^{-5}
	through Pahrump	54,000	10.2	6.34	370	0.2	80	0.05	1×10^{-5}	3×10^{-5}
Henderson to the NNSS (from Kingman/Parker)	via I–515 to US 95	54,000	8.97	5.57	230	0.1	60	0.04	9×10^{-5}	3×10^{-5}
	via I–215 to I–15 to US 95	54,000	9.40	5.84	350	0.2	110	0.07	9×10^{-5}	3×10^{-5}
	via I–215 to C–215 to US 95	54,000	9.61	5.97	360	0.2	95	0.06	4×10^{-5}	3×10^{-5}
	through Pahrump	54,000	11.2	6.96	420	0.2	110	0.06	4×10^{-5}	3×10^{-5}
Rail-to-Truck Constrained Case: Representing Impacts of Routes from U.S. Regions to the NNSS [f]										
Parker**	Rail	25,000	78.8	49.0	1,000	0.6	330	0.2	8×10^{-5}	12
	Truck after	51,000	27.6	17.1	710	0.4	140	0.08	4×10^{-5}	0.8

Transfer Station** or Las Vegas Entry Point (truck)	Transport Mode or Route	Number of Shipments	One-Way Kilometers Traveled (million)	One-Way Miles Traveled (million)	Incident-Free Conditions				Accident Conditions	
					Crew		Population		Radiological Risk (LCF)[b]	Roundtrip Nonradiological Risk (fatalities)
					Dose (person-rem)	Risk[b]	Dose (person-rem)	Risk (LCF)		
West Wendover**	Rail	1,600	0.81	0.50	14	0.008	5.8	0.003	6×10^{-7}	0.1
	Truck after	3,100	2.33	1.45	37	0.02	7.7	0.005	7×10^{-7}	0.07
Total	Rail	27,000	79.6	49.5	1,000	0.6	340	0.2	8×10^{-5}	13
	Truck after	54,000	30.0	18.6	750	0.4	140	0.09	4×10^{-5}	0.9
Truck Only Transport										
Truck only transport to:	Apex	24,000	60.0	37.3	910	0.5	220	0.1	2×10^{-4}	2
	Arden	3,000	2.51	1.56	32	0.02	12	0.007	4×10^{-6}	0.1
	Henderson	27,000	79.4	49.3	2,900	2	480	0.3	1×10^{-4}	3
Apex to the NNSS	via C–215 to US 95	24,000	3.65	2.27	50	0.03	11	0.007	3×10^{-6}	2×10^{-5}
	via I–15 to US 95	24,000	3.70	2.30	120	0.07	37	0.02	3×10^{-5}	3×10^{-5}
Arden to the NNSS	via I–15 to US 95	3,000	0.49	0.30	6.1	0.004	2.7	0.002	3×10^{-6}	2×10^{-5}
	via I–215 to C–215 to US 95	3,000	0.57	0.35	12	0.007	4.6	0.003	9×10^{-7}	3×10^{-5}
	through Pahrump	3,000	0.57	0.35	14	0.009	5.2	0.003	7×10^{-7}	3×10^{-5}
Henderson to the NNSS	via I–515 to US 95	27,000	4.55	2.83	160	0.1	37	0.02	4×10^{-5}	3×10^{-5}
	via I–215 to I–15 to US 95	27,000	4.77	2.96	220	0.1	59	0.04	3×10^{-5}	3×10^{-5}
	via I–215 to C–215 to US 95	27,000	4.88	3.03	220	0.1	51	0.03	2×10^{-5}	3×10^{-5}
	through Pahrump	27,000	5.71	3.55	260	0.2	57	0.03	2×10^{-5}	3×10^{-5}

C = Clark County Route; I = Interstate; LCF = latent cancer fatality; NNSS = Nevada National Security Site; rem = roentgen equivalent man; US = U.S. Route.

[a] Low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) were assumed to be transported in 55-gallon drums, B-25 boxes, B-12 boxes, and 20-foot International Organization for Standardization (Sealand) containers based on historical information regarding prevalence of use.

[b] Accident dose risk can be calculated by dividing the risk values by 0.0006 (DOE 2003).

[c] These values reflect only the portion of the routes traveled by railcar.

[d] These values reflect the combined use of railcar and truck shipments to transport waste to Las Vegas.

[e] There is no truck transport to Las Vegas from Apex or Arden, based on the defined route segments.

[f] Results of transporting LLW and MLLW by rail-to-truck transport to the NNSS under the Constrained Case are presented so that the two cases can be compared.

Note: To convert kilometers to miles, multiply by 0.62137. Total may not equal the sum of the contributions due to rounding. Also due to rounding, the cited risk values may be different from multiplication of dose by the dose risk factor of 0.0006 LCFs per person-rem.

Table E–18 shows the per-shipment risk factors associated with the routes through Las Vegas. Based on these factors, one shipment of LLW or MLLW through Las Vegas would incur the greatest incident-free impact on the population along the route segment of Interstate 15 south to U.S. Route 95 to the NNSS. The smallest impact would be from Interstate 15 south to Clark County Route 215 to U.S. Route 95 to the NNSS. For accidents, the risk of an LCF from one shipment would be greatest from Arden to Interstate 215 to Clark County Route 215 to U.S. Route 95 to the NNSS. Overall, however, all of these risks are small and, viewed in relation with the overall risks associated with many shipments over the whole transportation route (from Table E–17), would not have a significant impact on these overall risks.

Table E–18 Per-Shipment Risk Factors for Routes Through Las Vegas

From Entry Point to the NNSS	*Route Through Las Vegas*	*Incident-Free Conditions*				*Accident Conditions*	
		Crewmember		*Population*			
		Dose (person -rem)	*Risk (LCF)*	*Dose (person -rem)*	*Risk (LCF)*	*Radiological Risk (LCF)*	*Traffic Fatality (roundtrip)*
Apex	via C–215 to US 95	0.021	1.2×10^{-5}	0.0037	2.2×10^{-6}	4.1×10^{-10}	2.2×10^{-5}
	via I–15 to US 95	0.044	2.7×10^{-5}	0.014	8.6×10^{-6}	4.3×10^{-9}	2.7×10^{-5}
Arden	via I–15 to US 95	0.021	1.3×10^{-5}	0.0049	2.9×10^{-6}	4.0×10^{-9}	2.5×10^{-5}
	via I–215 to C–215 to US 95	0.029	1.8×10^{-5}	0.0066	4.0×10^{-6}	1.0×10^{-9}	2.8×10^{-5}
	through Pahrump	0.034	2.0×10^{-5}	0.0074	4.4×10^{-6}	7.7×10^{-10}	2.8×10^{-5}
Henderson	via I–515 to US 95	0.022	1.3×10^{-5}	0.0056	3.4×10^{-6}	6.4×10^{-9}	3.1×10^{-5}
	via I–215 to I–15 to US 95	0.032	1.9×10^{-5}	0.0095	5.7×10^{-6}	5.8×10^{-9}	3.1×10^{-5}
	via I–215 to C–215 to US 95	0.033	2.0×10^{-5}	0.0082	4.9×10^{-6}	2.8×10^{-9}	2.9×10^{-5}
	through Pahrump	0.038	2.3×10^{-5}	0.0092	5.5×10^{-6}	2.7×10^{-9}	3.3×10^{-5}

C = Clark County Route; I = Interstate; LCF = latent cancer fatality; NNSS = Nevada National Security Site; rem = roentgen equivalent man; US = U.S. Route.

E.8 Impact of Nonradioactive Waste Transport

This section evaluates the impacts of transporting sanitary waste, hazardous wastes, and other wastes and recyclables generated at NNSS facilities to onsite or offsite disposal or reuse facilities. The impacts are evaluated based on the number of truck shipments required for each of the materials and the distances from their point of origin to disposal or reuse facilities. The truck miles for all waste shipments under each alternative were calculated based on forecasted generation rates. The truck accident and fatality rates were assumed to be those that were provided in Section E.6.2. **Table E–19** summarizes the impacts in terms of total number of miles, accidents, and fatalities for all alternatives. The results indicate that there are no large differences in the impacts among all alternatives. Under all alternatives, the expected potential traffic fatalities are very low.

Table E–19 Estimated Impacts of Nonradioactive Waste Transport

Alternative	*Total Distance Traveled (two-way miles)*	*Number of Accidents*	*Number of Fatalities*
No Action	2.0×10^{6}	1.5	0.06
Expanded Operations	3.8×10^{6}	2.8	0.11
Reduced Operations	1.8×10^{6}	1.4	0.05

Note: Includes impacts from transporting nonradioactive waste related to construction and operation of a commercial solar plant.

E.9 Conclusions

Based on the results presented in the previous section, the following conclusions have been reached (see Tables E–13 and E–17):

- It is unlikely that the transportation of radioactive waste would cause an additional fatality among workers as a result of incident-free transportation due to the implementation of administrative controls, as discussed in Section E.7.
- The highest radiological risk to the public would be under the Expanded Operations Alternative, in which about 110,000 truck shipments or 140,000 truck and rail shipments would occur. For incident-free operations, the risk to the public would be less than 1 LCF under the No Action and Reduced Operations Alternatives and about 1 LCF under the Expanded Operations Alternative. The risk of an additional fatal cancer due to an accident would be less than 1 (0.01) LCF.

The nonradiological accident risks (the potential for fatalities as a direct result of traffic or rail accidents) present the greatest risks from transport of radioactive materials and waste. The maximum risks would occur under the Expanded Operations Alternative using rail-to-truck transport. Considering that the transportation activities would occur over a 10-year period and that the average number of traffic fatalities in the United States is about 40,000 per year, the traffic fatality risks under all alternatives are small.

E.10 Long-Term Impacts of Transportation

The *Yucca Mountain EIS* (DOE 2002a) analyzed the cumulative impacts of the transportation of radioactive material, consisting of impacts of historical shipments of radioactive waste and spent nuclear fuel, reasonably foreseeable actions that include transportation of radioactive material, and general radioactive material transportation that is not related to a particular action. The collective dose to the general population and workers was the measure used to quantify cumulative transportation impacts. This measure of impact was chosen because it may be directly related to the LCFs using a cancer risk coefficient. **Table E–20** provides a summary of the total worker and general population collective doses from various transportation activities. The table shows that the impacts incurred by the proposed activities in this *NNSS SWEIS* are small compared with the overall transportation impacts related to transport of DOE-related and commercial radioactive cargoes. The total collective worker dose from all types of shipments (the alternatives in this SWEIS; historical, reasonably foreseeable actions; and general transportation) was estimated to be about 405,000 person-rem (243 LCFs) for the period 1943 through 2073 (131 years). The total general population collective dose was estimated to be about 374,000 person-rem (225 LCFs). The majority of the collective dose for workers and the general population is due to the general transportation of radioactive material. Examples of these activities are shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial LLW to commercial disposal facilities. The total number of LCFs (among the workers and the general population) estimated to result from radioactive material transportation over the period between 1943 and 2073 is about 467, or an average of about 5 LCFs per year. Over this same period (131 years), approximately 73 million people would die from cancer, based on National Center for Health Statistics data. The average annual number of cancer deaths in the United States is about 554,000, with less than 1 percent fluctuation in the number of cancer fatalities in any given year (CDC 2007). The transportation-related LCFs for transporting radioactive cargo would be 0.0009 percent of the total annual number of LCFs; therefore, it is indistinguishable from the natural fluctuation in the total annual death rate from cancer.

Table E–20 Cumulative Transportation Related Radiological Collective Doses and Latent Cancer Fatalities (1943 to 2073)

Category	*Collective Worker Dose (person-rem)*	*Collective General Population Dose (person-rem)*
Transportation Impacts in this SWEIS	5,500 [a]	1,300 [a]
Other Nuclear Material Shipments [b]		
Historical	330	230
Reasonably Foreseeable Actions	24,800	35,000
General Radioactive Material Transport (1943 to 2073)	374,000	338,000
Total Collective Dose (up to 2073)	405,000	374,000
Total LCFs [b, c]	243	225

LCF = latent cancer fatality; rem = roentgen equivalent man; SWEIS = site-wide environmental impact statement.
[a] These maximum impacts are the result of the sum of impacts related to transport of all analyzed radioactive wastes and materials in the Expanded Operations Alternative, Constrained Case.
[b] The values are rounded.
[c] Total LCFs are calculated assuming 0.0006 LCFs per rem of exposure.
Source: DOE 2002a, 2008b, 2010a.

E.11 Uncertainty and Conservatism in Estimated Impacts

The sequence of analyses performed to generate the estimates of radiological risk for transportation includes (1) determination of the inventory and characteristics, (2) estimation of shipment requirements, (3) determination of route characteristics, (4) calculation of radiation doses to exposed individuals (including estimation of environmental transport and uptake of radionuclides), and (5) estimation of health effects. Uncertainties are associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are represented by the computational models; in the data required to exercise the models (due to measurement errors, sampling errors, natural variability, or unknowns caused simply by the future nature of the actions being analyzed); and in the calculations themselves (e.g., approximate algorithms used by the computers).

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result; however, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, the risk analysis is designed to ensure, through uniform and judicious selection of scenarios, models, and input parameters, that relative comparisons of risk among the various alternatives are meaningful. In the transportation risk assessment, this design was accomplished by uniformly applying common input parameters and assumptions to each alternative. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences among the alternatives in a given measure of risk.

In the following sections, areas of uncertainty are discussed for the assessment steps enumerated above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. The reality and conservatism of the assumptions are addressed. Where practical, the parameters that most significantly affect the risk assessment results are identified.

E.11.1 Uncertainties in Material Inventory and Characterization

Waste inventories and the physical and radiological characteristics are important input parameters to the transportation risk assessment. The potential number of shipments under all three alternatives was primarily based on the projected dimensions of package contents, the strength of the radiation field, the heat that must be dissipated, and assumptions concerning shipment capacities. The physical and radiological characteristics are important in determining the material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in the inventory and characterization are reflected in the transportation risk results. If the inventory is overestimated or underestimated, the resulting transportation risk estimates would also be overestimated or underestimated by roughly the same factor. However, the same inventory estimates were used to analyze the transportation impacts of each alternative. Therefore, for comparative purposes, the observed differences in transportation risks among the alternatives, as given in Tables E–13 and E–14, are believed to represent unbiased, reasonably accurate estimates based on current information in terms of relative risk comparisons.

E.11.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

Transportation activities required under each alternative are based in part on assumptions concerning the packaging characteristics and shipment capacities for commercial trucks and railcars. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities such that the projected number of shipments and, consequently, the total transportation risk, would change. However, although the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among the alternatives would remain about the same.

E.11.3 Uncertainties in Route Determination

Analyzed routes have been determined between the origin and destination sites considered in this SWEIS. The route from a given region of the United States with the highest dose risk per shipment was used to calculate cumulative dose risk from that region. The routes have been determined to be consistent with current guidelines, regulations, and practices, but may not be the actual routes that would be used in the future. In reality, the actual routes could differ from the representative ones with regard to distances and total population along the routes. Moreover, because materials could be transported over an extended time starting at some time in the future, the highway infrastructure and the demographics along routes could change. These effects have not been accounted for in the transportation assessment; however, it is not anticipated that these changes would significantly affect relative comparisons of risk among the alternatives considered in this SWEIS. Specific routes for some materials cannot be identified in advance because the routes are classified to protect national security interests.

E.11.4 Uncertainties in the Calculation of Radiation Doses

The models used to calculate radiation doses from transportation activities introduce further uncertainty into the risk assessment process. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the scarcity of data for certain input parameters. Populations (off-link and on-link) along the transportation routes, shipment surface dose rates, and individuals residing near the routes are the most uncertain data in dose calculations. In preparing these data, it was assumed that the off-link population is uniformly distributed; the on-link population is proportional to the traffic density, with an assumed occupancy of two persons per car; the shipment surface dose rate is the maximum allowed dose rate; and the potential exists for an individual to reside at the edge of the highway. It is clear that not all assumptions are accurate. For example, the off-link population is mostly heterogeneous, and the on-link traffic density varies widely within a geographic zone (i.e., urban, suburban, or rural). Finally, added to this complexity are the assumptions regarding the expected distance between the public and the shipment at a traffic stop, rest stop, or traffic jam and the afforded shielding.

Uncertainties associated with the computational models are reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process that are intended to produce conservative results (i.e., to overestimate the calculated dose and radiological risk). Because parameters and assumptions were applied consistently to all alternatives, this model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, the results may not represent risks in an absolute sense.

E.11.5 Uncertainties in Traffic Fatality Rates

Vehicle accident and fatality rates were taken from data provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150 (Saricks and Tompkins 1999). Truck and rail accident rates were computed for each state based on statistics compiled by the Federal Highway Administration, Office of Motor Carriers, and Federal Railroad Administration from 1994 to 1996. The rates are provided per unit car-miles for each state, as well as national, average, and mean values. In this analysis, mean rates were used.

The analysis was based on accident data for the years 1994 through 1996. While these data may be the best available data, subsequent and future accident and fatality rates may change as a result of vehicle and highway improvements. The DOT national accident and fatality statistics for large trucks and buses indicate lower accident and fatality rates for recent years compared with those of 1994 through 1996 and earlier data (DOT 2009).

E.12 References

CDC (Centers for Disease Control and Prevention), 2007, *Total Number of Deaths for 113 Selected Causes, 1999-2004*, National Center for Health Studies, August.

Census (U.S. Census Bureau), 2010, *Census 2010 Apportionment Data, 1910-2010 Total Population, Populations Density, and Population Density Ranking for the Nation, States, the District of Columbia, and Puerto Rico* (accessed at http://2010.census.gov/2010census/data/apportionment-dens-text.php), December 21.

CPC (Container Products Corporation), 2006, *B-25 Waste Containers* (accessed March 2010, www.c-p-c.com/products/B-25. html).

CVSA (Commercial Vehicle Safety Alliance), 2004, "Ready, Set, Drop," *Inspection News*, Volume 11, Issue 4, p. 3, October.

DHS (U.S. Department of Homeland Security), 2008a, *National Response Framework* (accessed at http://www.fema.gov/pdf/emergency/nrf/nrf-core.pdf), Federal Emergency Management Agency, Washington, DC, January.

DHS (U.S. Department of Homeland Security), 2008b, Nuclear/Radiological Incident Annex (accessed at http://www.fema.gov/pdf/emergency/nrf/nrf_nuclearradiologicalincidentannex.pdf), Federal Emergency Management Agency, Washington, DC, June.

DOE (U.S. Department of Energy), 1994, *DOE Handbook – Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facility*, DOE-HDBK-3010-94 (Change Notice No. 1, March 2000), Washington, DC, December.

DOE (U.S. Department of Energy), 1996, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, DOE/EIS-0218, Office of Environmental Management, Washington, DC, February.

DOE (U.S. Department of Energy), 1997, *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*, DOE/EIS-0026-S-2, Carlsbad Area Office, Carlsbad, New Mexico, September.

DOE (U.S. Department of Energy), 1999a, DOE Standard DOE-STD-1098-99, *Radiological Control*, Washington, DC, July.

DOE (U.S. Department of Energy), 1999b, *Life-Cycle Cost and Risk Analysis of Alternative Configurations for Shipping Low-Level Radioactive Waste to the Nevada Test Site*, DOE/CH/CRE-6-1999, Pacific Northwest National Laboratory, Richland, Washington, December.

DOE (U.S. Department of Energy), 2000, *Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility*, DOE/EIS-0310, Office of Nuclear Energy, Science and Technology, Washington, DC, December.

DOE (U.S. Department of Energy), 2002a, *Final Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, DOE/EIS-0250, Office of Civilian Radioactive Waste Management, Washington, DC, February.

DOE (U.S. Department of Energy), 2002b, *A Resource Handbook on DOE Transportation Risk Assessment*, DOE/EM/NTP/HB-01, (accessed at http://nepa.energy.gov/DOETransportation RiskAssessment.pdf), Office of Environmental Management, National Transportation Program, Albuquerque, New Mexico, July.

DOE (U.S. Department of Energy), 2002c, *Final Supplemental Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243-SA, July.

DOE (U.S. Department of Energy), 2003, *Recommended Radiation Risk Factors Updated*, National Environmental Policy Act Lessons Learned, Office of NEPA Policy and Compliance, Quarterly Report, Issue No. 34, Washington, DC, March 3.

DOE (U.S. Department of Energy), 2004a, F*inal Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at Portsmouth, Ohio, Site*, Office of Environmental Management, DOE/EIS-0360, June.

DOE (U.S. Department of Energy), 2004b, *Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site*, DOE/EIS-0360, Office of Environmental Management, June.

DOE (U.S. Department of Energy), 2008a, *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0380, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, May.

DOE (U.S. Department of Energy), 2008b, *Radioactive Material Transportation Practices Manual for Use with DOE O 460.2A*, DOE Manual 460.2-1A, Office of Environmental Management, June 4.

DOE (U.S. Department of Energy), 2009, *Packaging and Transportation* (available at http://www.em.doe.gov/ Pages/Transportation.aspx), Office of Environmental Management, Washington, DC, May 15.

DOE (U.S. Department of Energy), 2010a, *Final Environmental Assessment for U-233 Material Downblending and Disposition Project at the Oak Ridge National Laboratory Oak Ridge, Tennessee*, DOE/EA-1651, January.

DOE (U.S. Department of Energy), 2010b, *Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center*, DOE/EIS-0226, Washington, DC, January.

DOT (U.S. Department of Transportation), 1998, *Radioactive Material Regulations Review*, RAMREG-001-98, Research and Special Programs Administration, Washington, DC.

DOT (U.S. Department of Transportation), 2008, *Radioactive Material Regulations Review*, RAMREG-12-2008, Pipeline and Hazardous Materials Safety Administration, Washington, DC, December.

DOT (U.S. Department of Transportation), 2009, *Large Truck and Bus Crash Facts 2007*, FMCSA-RRA-09-029, Analysis Division, Federal Motor Carrier Safety Administration, Washington, DC, January.

FHWA (Federal Highway Administration), 2003, *Comprehensive Truck Size and Weight Study – Volume I*, Executive Summary (accessed at http://www.fhwa.dot.gov/reports/twstudy/EXECSUM4.htm), May 19.

Gordon, S., National Security Technologies LLC, 2010, Personal communication (email) to M. Skougard, et al., "Isotopic inventory for JASPER TRU waste," May 13.

Johnson, P. E., and R. D. Michelhaugh, 2003, *Transportation Routing Analysis Geographic Information System (TRAGIS) – User's Manual*, ORNL/NTRC-006, Rev. 0 (accessed at http://apps.ntp.doe.gov/tragis/tragis.htm), U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June.

Maersk (A.P. Moller-Maersk Group), 2010, *Container Equipment Guide* (accessed at http://www.maerskline.com/globalfile/?path=/pdf/containerDimensions), March 30.

NCRP (National Council on Radiation Protection and Measurements), 2009, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 160, Bethesda, Maryland.

NEI (Nuclear Engineering International), 2010, Nuclear Road Truckers, (accessed March 1, 2010, http://www.neimagazine.com/storyprint.asp?sc=2055166), January 14.

Neuhauser, S. J., F. L. Kanipe, and R. R. Weiner, 2000, *RADTRAN 5 Technical Manual*, SAND2000-1256 (accessed at http://ttd.sandia.gov/risk/doc_list.htm), Sandia National Laboratories, Albuquerque, New Mexico, May.

NHTSA (National Highway Traffic Safety Administration), 2006, *Traffic Safety Facts 2004 Data*, (accessed at http://www-nrd.nhtsa.dot.gov/ departments/nrd-30/ncsa/), National Center for Statistics and Analysis, Washington, DC, January.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Final Environmental Impact Statement on the Transportation of Radioactive Materials by Air and Other Modes*, NUREG-0170, Washington, DC, December.

NRC (U.S. Nuclear Regulatory Commission), 1987, *Shipping Container Response to Severe Highway and Railway Accident Conditions*, NUREG/CR-4829 (UCID-20733), Washington, DC (accessed at http://ttd.sandia.gov/nrc/docs.htm), February.

NRC (U.S. Nuclear Regulatory Commission), 2000, *Reexamination of Spent Fuel Shipping Risk Estimates*, NUREG/CR-6672 (SAND2000-0234) (accessed at http://ttd.sandia.gov/nrc/docs.htm), Washington, DC, March.

NRC (U.S. Nuclear Regulatory Commission), 2009, Certificate of Compliance No. 9218 for the Model No. TRUPACT-II Package, Rev. 20.

Phillips, J. S., D. B. Clauss, and D. F. Blower, 1994, *Determination of Influence Factors and Accident Rates for the Armored Tractor/Safe Secure Trailer*, SAND93-0111, Sandia National Laboratories, Albuquerque, New Mexico, April.

Rao, R. K., E. L. Wilmot, and R. E. Luna, 1982, *Non-Radiological Impacts of Transporting Radioactive Material*, SAND81-1703, Sandia National Laboratories, Albuquerque, New Mexico, February.

Saricks, C., and M. M. Tompkins, 1999, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150, Center for Transportation Research, Argonne National Laboratory, U.S. Department of Energy, Argonne, Illinois, April.

SNL (Sandia National Laboratories) 2009, RadCat 3.0 Users Guide, SAND2009-5129P, May.

UMTRI (University of Michigan Transportation Research Institute), 2003, "Evaluation of the Motor Carrier Management Information System Crash File, Phase One," UMTRI-2003-06, Center for National Truck Statistics, Ann Arbor, Michigan, March.

Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire, 1995, RISKIND - A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.

APPENDIX F
BIOLOGICAL RESOURCES

APPENDIX F
BIOLOGICAL RESOURCES

This appendix contains detailed information regarding species of plants and animals that inhabit or have been sited at the Nevada National Security Site (NNSS), including a list of sensitive and protected/regulated species. The locations of sensitive plant species on the NNSS are also depicted.

F.1 Sensitive and Protected/Regulated Species of Plants and Animals Known to Occur on or Adjacent to the Nevada National Security Site

Sensitive species of plants and animals are defined as species that are at risk of extinction or serious decline or whose long-term viability has been identified as a concern. They include species on the Nevada Natural Heritage Program Animal and Plant At-Risk Tracking List and bat species ranked as moderate or high in the Nevada Bat Conservation Plan Bat Species Risk Assessment. Protected/regulated species are those that are protected or regulated by Federal or state law. Some species are both sensitive and protected/regulated, such as the desert tortoise (*Gopherus agassizii*). The National Nuclear Security Administration Nevada Site Office (NNSA/NSO) reviews the status or ranking of plants and animals known to occur on the NNSS annually under its Sensitive Plant Monitoring Program and Sensitive and Protected/Regulated Animal Monitoring Program to determine whether any species' status or ranking has changed. Sources that are reviewed include the Nevada Natural Heritage Program Animal and Plant At-Risk Tracking List; *Nevada Administrative Code* 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures," and other sources, such as input from regional biologists. In addition, the results of field surveys and monitoring at the NNSS are used as part of the review process. NNSA/NSO shares the results of field surveys and monitoring with Federal and state agencies and other biologists in the interest of ensuring adequate bases for including/excluding species and providing appropriate protective measures. The most current listing of sensitive and protected/regulated species of plants and animals known to occur on or adjacent to the NNSS and their status are shown in **Table F–1**. Because the list of sensitive and protected/regulated species may change from year to year, the most up-to-date information may be obtained by reviewing the most recent *Ecological Monitoring and Compliance Program Report*, which is available on the NNSA/NSO website at www.nv.doe.gov. The known locations of sensitive plant species populations are shown in **Figure F–1**. It is important to note that these locations may change from year to year. As noted previously, NNSA/NSO annually conducts field surveys and monitoring to maintain and update its sensitive plant database and more effectively provide an appropriate level of protection for sensitive plant species on the NNSS.

Table F–1 Sensitive and Protected/Regulated Species Known to Occur on or Adjacent to the Nevada National Security Site [a]

Common Name	***Scientific Name***	***Status [b]***
Moss Species		
Convex entosthodon moss	*Entosthodon planoconvexus*	S, 5 years
Flowering Plant Species		
Yucca (3 species), Agave (1 species)	Agavaceae	CY
Desert or white bear poppy	*Arctomecon merriamii*	S, 10 years
Beatley milkvetch	*Astragalus beatleyae*	S, 5 years
Black woolypod or Funeral Mountain milkvetch	*Astragalus funereus*	S, 5 years
Clokey's eggvetch	*Astragalus oophorus* var. *clokeyanus*	S, 5 years
Cacti (18 species)	Cactaceae	CY
Cane Spring suncup or largeflower suncup	*Camissonia megalantha*	S, 10 years
Sanicle biscuitroot	*Cymopterus ripleyi* var. *saniculoides*	S, 10 years
Darin buckwheat	*Eriogonum concinnum*	S, 5 years
Clokey's buckwheat	*Eriogonum heermannii* var. *clokeyi*	S, 5 years

Common Name	***Scientific Name***	***Status*** [b]
Pahute green gentian	*Frasera pahutensis*	S, 10 years
Kingston Mountains bedstraw	*Galium hilendiae* ssp. *kingstonense*	S, 10 years
Inyo hulsea	*Hulsea vestita* ssp. *inyoensis*	S, 10 years
Rock purpusia	*Ivesia arizonica* var. *saxosa*	S, 5 years
Juniper, Utah	*Juniperus osteosperma*	CY
Beatley's phacelia or Beatley's scorpionflower	*Phacelia beatleyae*	S, 10 years
Death Valley beardtongue	*Penstemon fruticiformis* ssp. *amargosae*	S, 5 years
Paiute beardtongue	*Penstemon pahutensis*	S, 10 years
Clarke phacelia	*Phacelia filiae*	S, 10 years
Weasel phacelia	*Phacelia mustelina*	S, 10 years
Parish phacelia	*Phacelia parishii*	S, 10 years
Pine, singleleaf pinyon	*Pinus monophylla*	CY
Mollusk Species		
Southeast Nevada springsnail	*Pyrgulopsis turbatrix*	S, A
Reptile Species		
Western red-tailed skink	*Eumeces gilberti* ssp. *rubricaudatus*	S, E
Desert tortoise	*Gopherus agassizii*	LT, S, NPT, IA
Bird Species [c]		
Northern goshawk	*Accipiter gentilis*	S, NPS, IA
Chukar	*Alectoris chukar*	G[d]
Golden eagle	*Aquila chrysaetos*	EA, NP
Western burrowing owl	*Athene cunicularia hypugaea*	NP
Ferruginous hawk	*Buteo regalis*	S, NP, IA
Gambel's quail	*Callipepla gambelii*	G[d]
Mountain plover	*Charadrius montanus*	PT, NP
Western yellow-billed cuckoo	*Coccyzus americanus*	C, S, NPS, IA
Peregrine falcon	*Falco peregrinus*	<LE, S, NPE, IA
Bald eagle	*Haliaeetus leucocephalus*	<LT, EA, S, NPE, IA
Western least bittern	*Ixobrychus exilis* ssp. *hesperis*	S, NP, IA
Loggerhead shrike	*Lanius ludovicianus*	NPS
Sage thrasher	*Oreoscoptes montanus*	NPS
Phainopepla	*Phainopepla nitens*	S, NP, IA
Brewer's sparrow	*Spizella breweri*	NPS
Bendire's thrasher	*Toxostoma bendirei*	S, NP, IA
LeConte's thrasher	*Toxostoma lecontei*	S, NP, IA
Mammal Species		
Pronghorn antelope	*Antilocapra americana*	G
Pallid bat	*Antrozous pallidus*	M, NP, A
Townsend's big-eared bat	*Corynorhinus townsendii*	H, NPS, A
Burro	*Equus asinus*	H&B
Horse, wild	*Equus caballus*	H&B
Elk	*Cervus elaphus*	G
Spotted bat	*Euderma maculatum*	M, NPT, A
Silver-haired bat	*Lasionycteris noctivagans*	M, A
Western red bat	*Lasiurus blossevillii*	H, NPS, A
Hoary bat	*Lasiurus cinereus*	M, A
Bobcat	*Lynx rufus*	F
Dark kangaroo mouse	*Microdipodops megacephalus*	NP
Pale kangaroo mouse	*Microdipodops pallidus*	S, NP, A
California myotis	*Myotis californicus*	M, A
Small-footed myotis	*Myotis ciliolabrum*	M, A

Common Name	***Scientific Name***	***Status*** [b]
Long-eared myotis	*Myotis evotis*	M, A
Fringed myotis	*Myotis thysanodes*	H, NP, A
Yuma myotis	*Myotis yumanensis*	M, A
Desert bighorn sheep	*Ovis canadensis* ssp. *nelsoni*	G
Mule deer	*Odocoileus hemionus*	G
Western pipistrelle	*Pipistrellus hesperus*	M, A
Mountain lion	*Puma (Felis) concolor*	G
Audubon's cottontail	*Sylvilagus audubonii*	G
Nuttall's cottontail	*Sylvilagus nuttallii*	G
Brazilian free-tailed bat	*Tadarida brasiliensis*	NP
Gray fox		F
Kit fox		F

ssp = subspecies; var = variety.

[a] Source: Table 2–1 in *Ecological Monitoring and Compliance Program 2009 Report* (NSTec 2010) with some modifications based on species name changes (plants), status changes, and species inadvertently left off Table 2–1.

[b] Status Codes:

Endangered Species Act (16 U.S.C. 1531 et seq.), U.S. Fish and Wildlife Service
LT – Listed as threatened
PT – Proposed as threatened
C – Candidate for listing
<LE – Formerly listed as an endangered species
<LT – Formerly listed as a threatened species

U.S. Department of the Interior
H&B – Protected under the Wild Free-Roaming Horses and Burros Act (16 U.S.C. 1331 et seq.)
EA – Protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.)

State of Nevada – Plants
S – Nevada Natural Heritage Program – Animal and Plant At-Risk Tracking List (NRS 527.260-.300)
CY – Protected as a cactus, yucca, or Christmas tree (NRS 527.060-.120)

State of Nevada – Animals
S – Nevada Natural Heritage Program – Animal and Plant At-Risk Tracking List and Plant and State Watch List (NRS 501)
NPE – Nevada Protected-Endangered, species protected under *Nevada Administrative Code* (NAC), Chapter 503
NPT – Nevada Protected-Threatened, species protected under NAC 503
NPS – Nevada Protected-Sensitive, species protected under NAC 503
NP – Nevada Protected, species protected under NAC 503
G – Regulated as a game species
F – Regulated as a fur-bearing species

Long-Term Plant Monitoring Status for the Nevada National Security Site
5 years – Monitored at least once every 5 years
10 years – Monitored at least once every 10 years

Long-Term Animal Monitoring Status for the Nevada National Security Site
A – Active
IA – Inactive
E – Evaluate

Nevada Bat Conservation Plan – Bat Species Risk Assessment
H – High risk
M – Moderate risk

[c] All bird species on the Nevada National Security Site are protected by the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.) except chukar, Gambel's quail, English house sparrow, rock dove, and European starling.

[d] Bird species that are considered game species that are also protected under the Migratory Bird Treat Act, such as mourning dove (*Zenaida macroura*) are not included in this table.

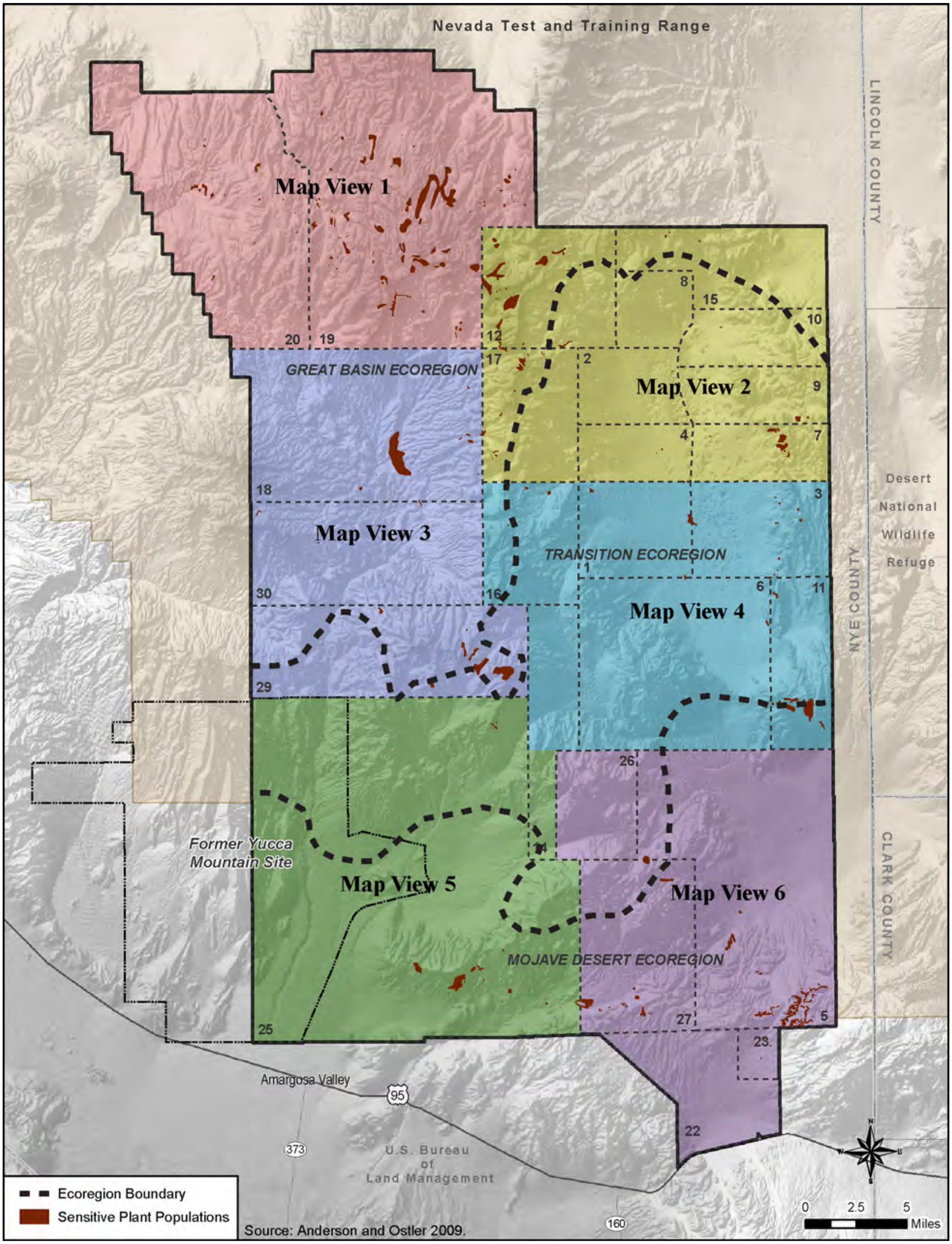


Figure F–1 Sensitive Plant Species on the Nevada National Security Site

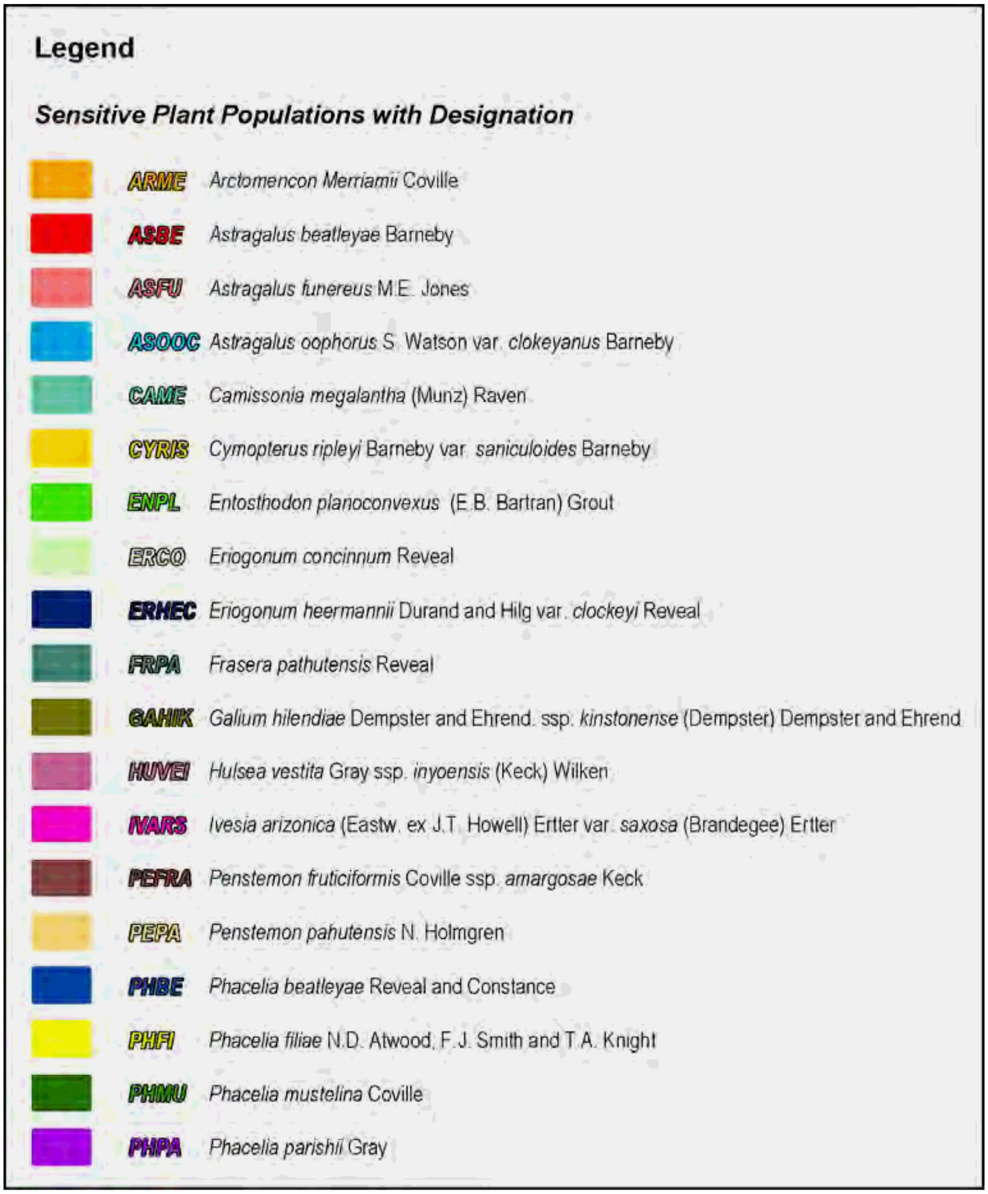


Figure F–1 Sensitive Plant Species on the Nevada National Security Site (cont'd)

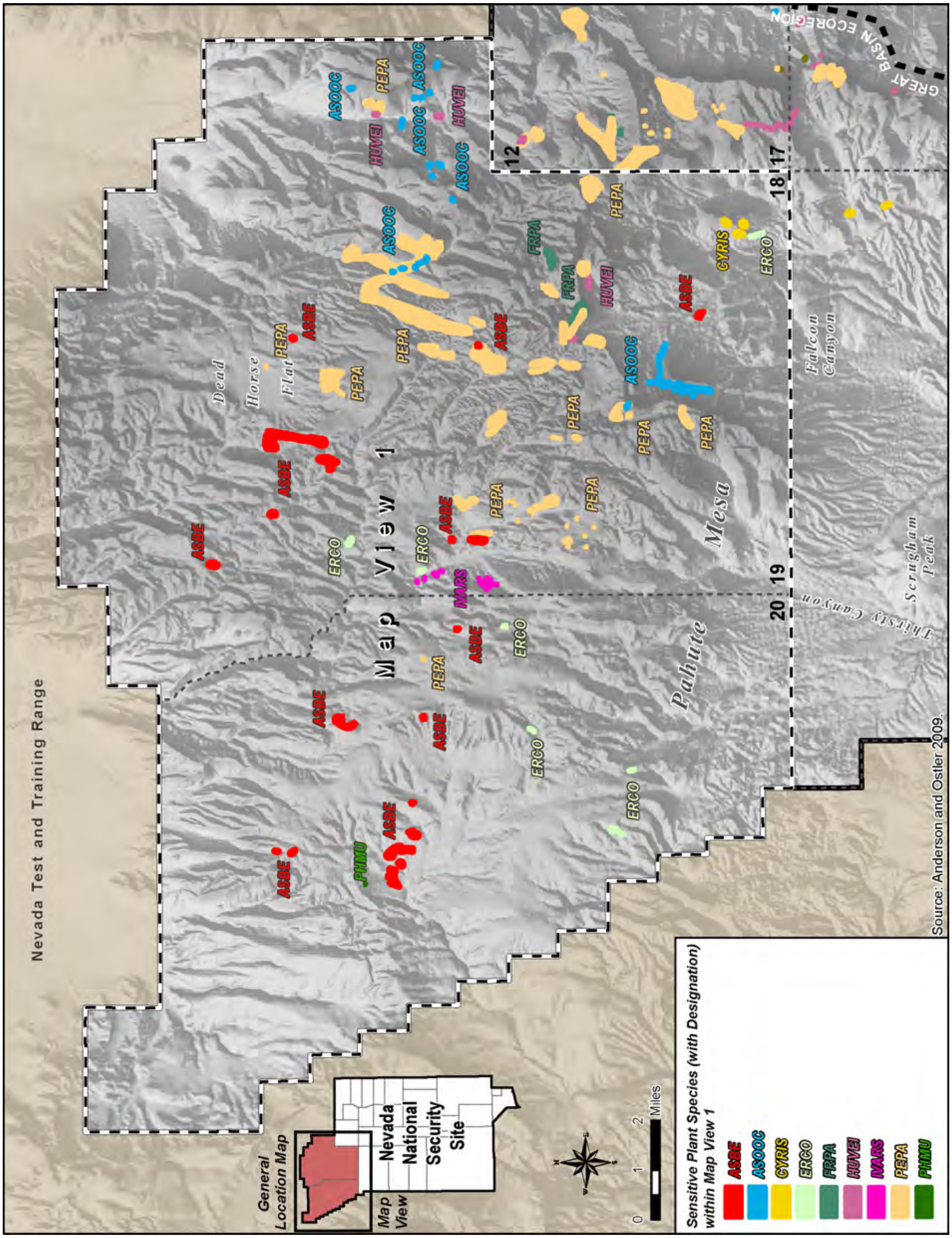


Figure F–1 Sensitive Plant Species on the Nevada National Security Site, Part 1 (cont'd)

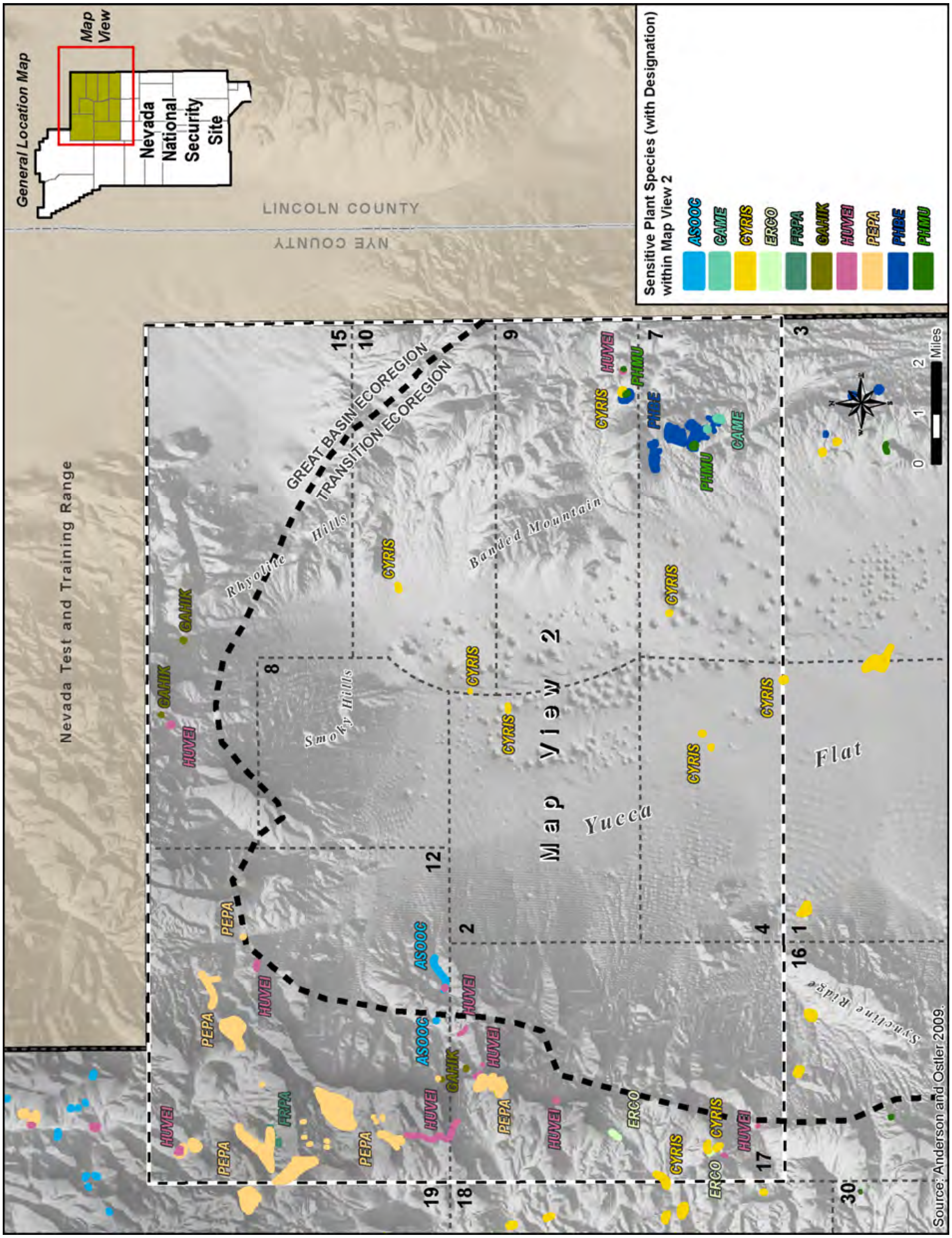


Figure F–1 Sensitive Plant Species on the Nevada National Security Site, Part 2 (cont'd)

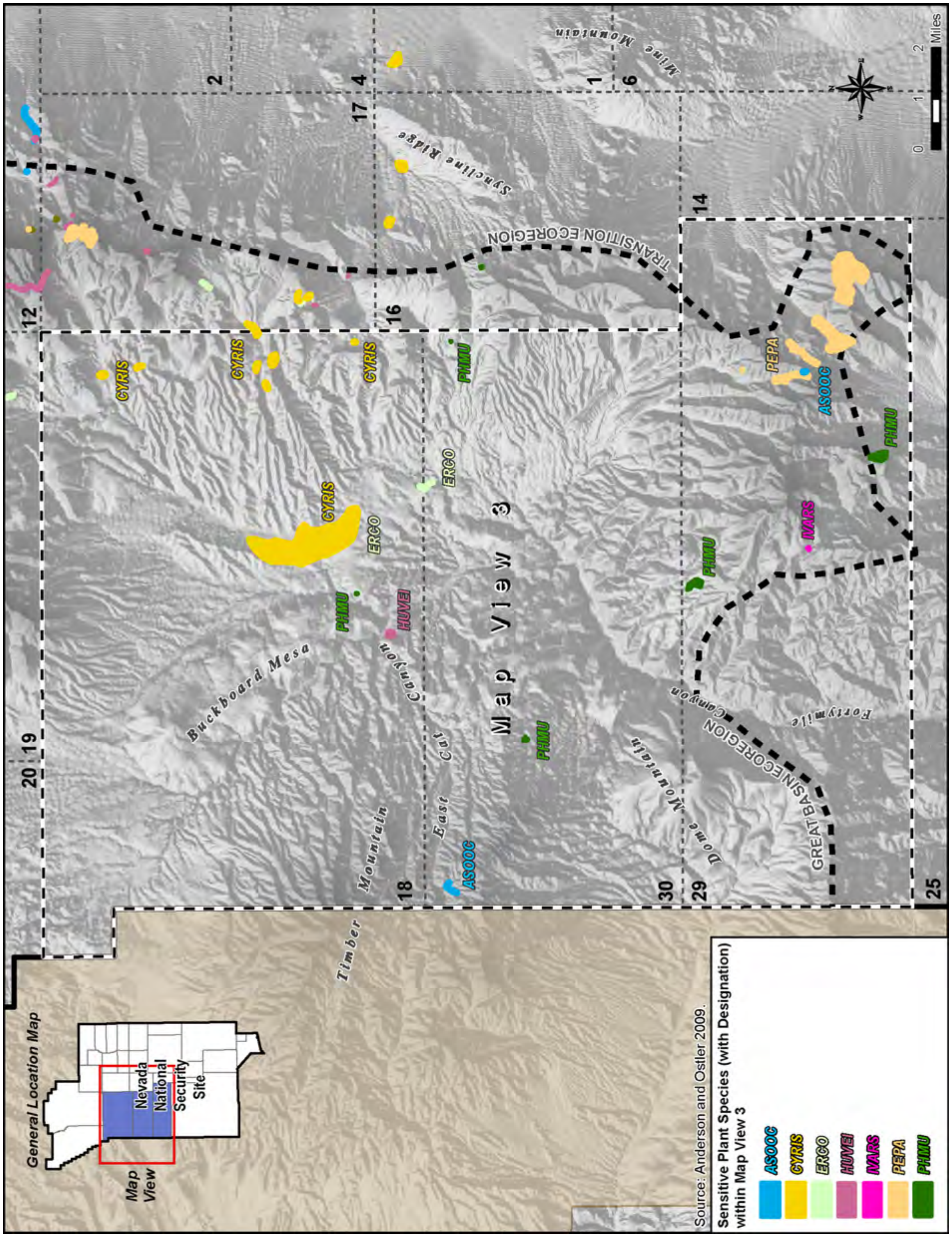


Figure F–1 Sensitive Plant Species on the Nevada National Security Site, Part 3 (cont'd)

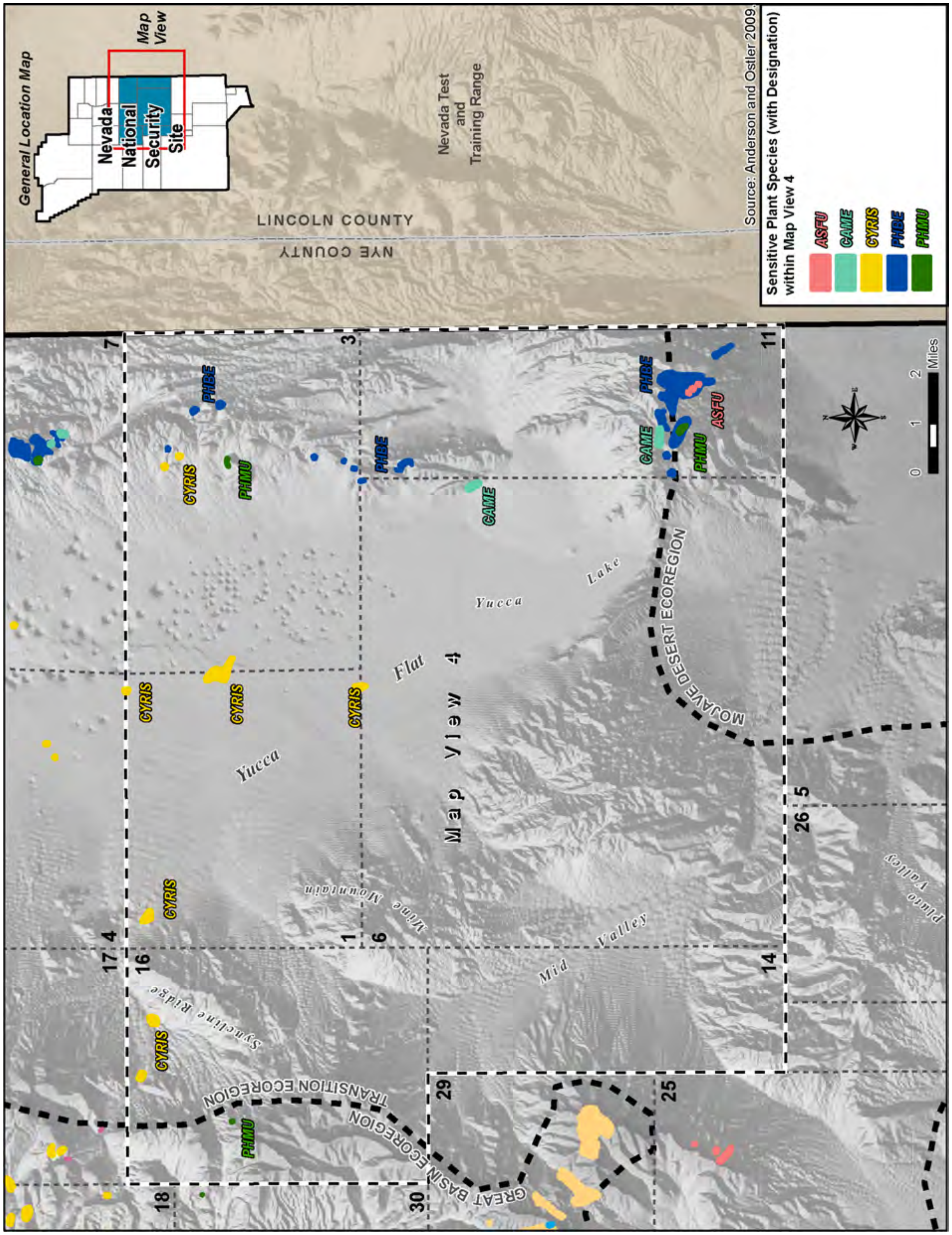


Figure F–1 Sensitive Plant Species on the Nevada National Security Site, Part 4 (cont'd)

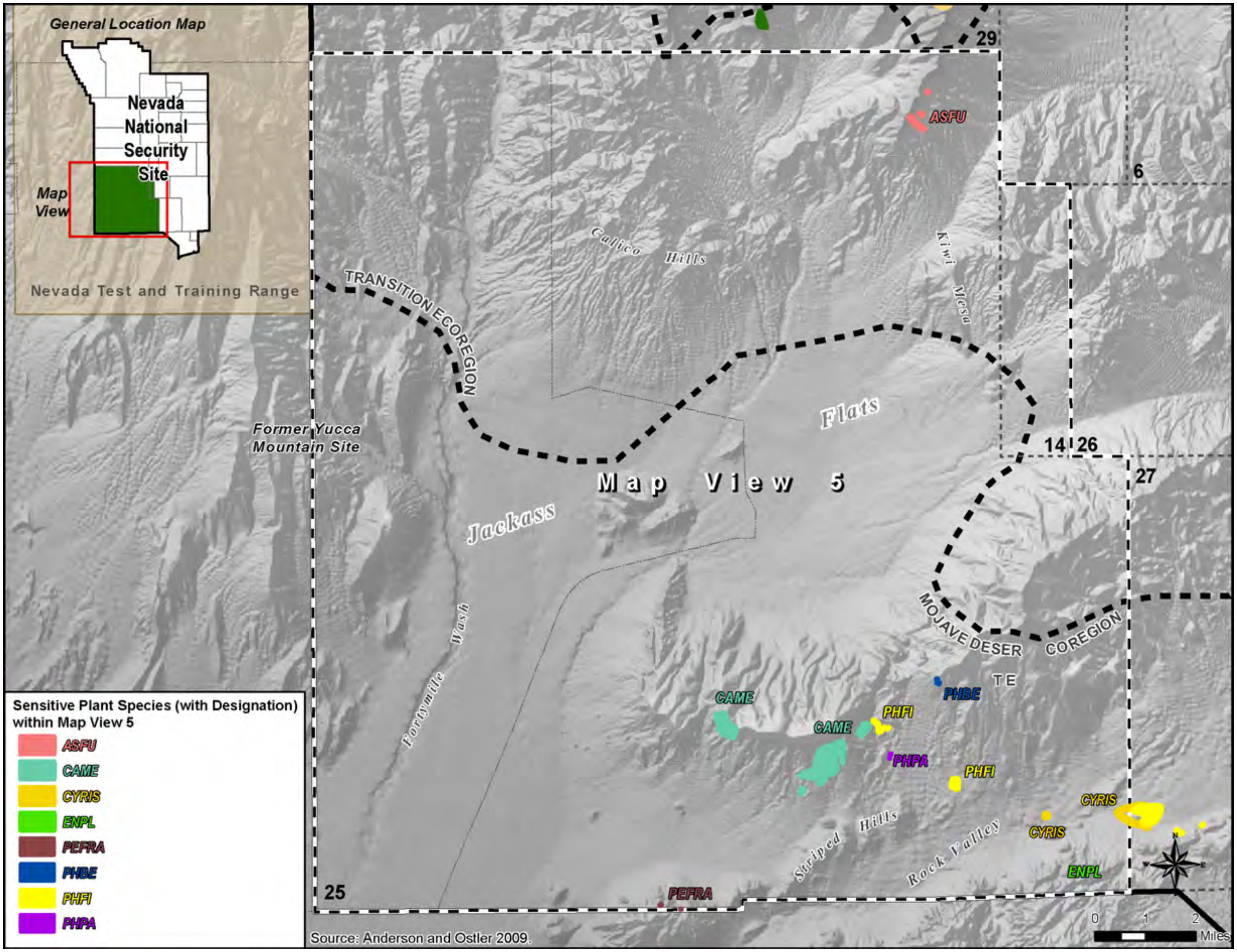


Figure F–1 Sensitive Plant Species on the Nevada National Security Site, Part 5 (cont'd)

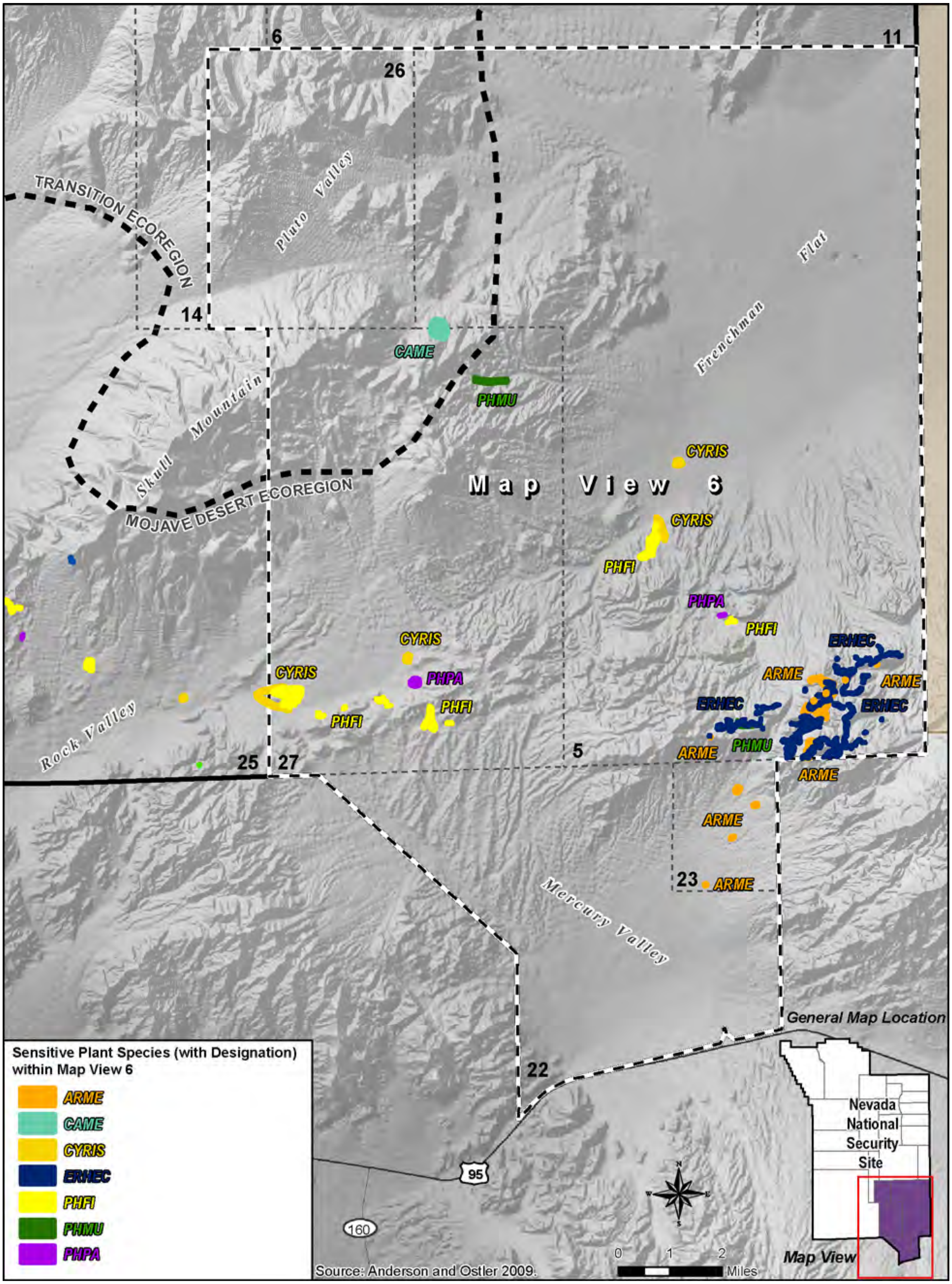


Figure F–1 Sensitive Plant Species on the Nevada National Security Site, Part 6 (cont'd)

Tables F–2 and **F–3** are derived from *Ecology of the Nevada Test Site: An Annotated Bibliography* (Wills and Ostler 2001). The tables list all species of nonvascular and vascular plants, respectively, that have been identified at the NNSS. The species are arranged alphabetically within their respective kingdom and division (for nonvascular plants) and family (for vascular plants) rather than their taxonomic order to help the reader more readily locate particular plant names. The most current genus and species (and variety, where appropriate) names follow (Ostler et al. 2000). The names of species that were not verified in Wills and Ostler 2001 are indicated by an asterisk.

Table F–2 Nonvascular Flora Species of the Nevada National Security Site

KINGDOM FUNGI		
Alternaria tenuissima	*Curvularia* sp. *	*P. granulatum*
Antrodia serialis	*Cylindrocarpon heteronemum* *	*P. janthinellum*
Aspergillus fumigatus	*Fomitopsis pinicola*	*P. lanosum*
A. niger	*F. rosea*	*P. oxalicum*
A. niveus	*Fusarium semitectum*	*P. restrictum*
A. ochraceus	*Geotrichum* sp. *	*P. urtica* *
A. restrictus	*Glipcladium penicilloides* *	*Phoma* sp.
*A. sulfurous**	*G. roseum* *	*Poria carbonica*
A. ustus	*Gloeocladium* sp. *	*P. placenta*
A. versicolor	*Gymnoascus* sp. *	*P. vaillantii*
A. wentii	*Hormiscium* sp. *	*Pullularia pullulans*
Botrytis bassiana *	*Leucogyrophana mollusca* *	*Pythium mammillatum* *
Bourdotia eyrei *	*Mucor* sp.	*Rhizopus stolonifer* *
Cephalosporium sp.	*M. corticolus* *	*Serpula himantioides*
Cephalosporium acremonium	*M. spinescens* *	*Sporotrichum epigaeum* *
C. humicola *	*M. varians* *	*Stachybotrys chartarum*
Chaetomium aureum	*Myrothecium verrucaria* *	*Stemphylium ilicis* *
C. spirale	*Osteina obducta*	*Stysanus medicus* *
Choanephora sp.	*Paecilomyces inflatus* *	*Syncephalastrum racemosum*
Circinella muscae *	*P. terricola* *	*Tetracoccosporium paxianum* *
Cladosporium cladosporioides	*Papularia* sp. *	*Trichoderma harzianum*
C. herbarum	*Papulospora sepedonioides* *	*T. viride*
Coccosporium sp. *	*Paxillus panuoides*	*Tyromyces transmutans* *
Cunninghamella bainieri *	*Penicillium* sp. *	
C. microspora *	*P. avellanea* *	
KINGDOM MONERA		
Division Bacteria (Bacteria)		
Streptomyces sp.		
Division Cyanophycota (Blue-Green Algae)		
Anacystis montana	*Nodularia sphaerocarpa*	*P. autumnale*
Calothrix sp.	*Nostoc* sp.	*Plectonema boryanum*
Coccochloris elabens	*N. commune*	*P. nostocorum*
C. stagnina	*N. enthophytum* *	*Schizothrix accutissima* *
Homoeothrix janthina	*Nostoc humifusum* *	*S. californica* *
Leptolyngbya tenuis	*Oscillatoria* sp.	*S. macbridei* *
Lyngbya sp.	*O. brevis*	*Scytonema hofmannii*
Microcoleus paludosus	*Phormidium* sp.	*Symploca kieneri*
M. vaginatus		

KINGDOM PLANTAE		
Division Bacillariophyta (Diatoms)		
Achnanthes exigua	*Gomphonema parvulum*	*N. gracilis*
A. lanceolata	*Hantzschia* sp.	*N. linearis*
A. minutissima	*Melosira granulata*	*N. palea*
A. saxonica	*Meridion circulare*	*N. tryblionella*
Amphora submontana	*Navicula cryptocephala*	*Pinnularia* sp.
Asterionella formosa	*N. cuspidata* var. *ambigua*	*P. abaujensis* var. *subundulata*
Denticula elegans	*Navicula laevissima*	*P. viridis* var. *minor*
Epithemia adnata var. *proboscidea* *	*N. minima*	*Stauroneis anceps*
E. sorex	*N. rhynchocephala* var. *amphiceras*	*Stephanodiscus niagarae*
Fragilaria sp.	*Nitzschia* sp.	*Surirella ovalis*
F. construens	*N. amphibia*	
Division Chlorophycota (Green Algae)		
Ankistrodesmus falcatus	*Haematococcus lacustris*	*Protosiphon cinnamomeus* *
Bulbochaete sp.	*Microthamnion kuetzingianum*	*Scenedesmus acutus*
Chara sp.	*Oedogonium* sp.	*S. bijuga*
Chlamydomonas sp.	*Oocystis borgei*	*Spirogyra jurgensii*
Chlorella vulgaris	*O. crassa*	*Stigeoclonium* sp.
Closterium turgidum	*Pandorina morum*	*Ulothrix* sp.
Cosmarium sp.	*Protococcus grebillei* *	
Franceia droescheri	*Protoderma viride*	
Division Xanthophyta (Yellow-Green Algae)		
Vaucheria sp.		

sp = species (singular); var = variety.
* Designates species in which the listing was unable to be verified or updated.
Source: Wills and Ostler 2001.

Table F–3 Vascular Flora Species of the Nevada National Security Site

DIVISION CONIFEROPHYTA (CONFIERS)			
Cupressaceae – Cypress Family		**Pinaceae – Pine Family**	
Juniperus osteosperma		*Pinus monophylla*	
DIVISION GNETOPHYTA (GNETOPHYTES)			
Ephedraceae – Mormon-Tea Family			
Ephedra funerea			
E. nevadensis			
E. torreyana			
E. viridis			
DIVISION MAGNOLIOPHYTA (FLOWERING PLANTS)			
Monocotyledons			
Agavaceae – Century-Plant Family	**Liliaceae – Lily Family**	**Poaceae – Grass Family (cont'd)**	**Poaceae – Grass Family (cont'd)**
Agave utahensis var. *eborispina*	*Allium nevadense*	*A. purpurea* var. *fendleriana*	*Echinochloa crusgalli*
Yucca baccata var. *vespertina*	*A. scorodoprasum*	*A. purpurea* var. *longiseta*	*Elymus elymoides* ssp. *elymoides*
Bolboschoenus robustus	*Androstephium breviflorum*	*A. purpurea* var. *nealleyi*	*E. multisetus*
Y. brevifolia	*Calochortus bruneaunis*	*A. purpurea* var. *wrightii*	*Eragrostis barrelieri*
Y. schidigera	*C. flexuosus*	*Avena sativa*	*Erioneuron pilosum*
	Dichelostemma pulchellum	*Blepharidachne kingii*	*E. pulchellum*
Cyperaceae – Sedge Family	*Fritillaria atropurpurea*	*Bouteloua barbata*	*Festuca pratensis*
Carex alma	*Zigadenus paniculatus*	*B. gracilis*	*Hesperostipa comata* ssp. *Comate*
C. douglasii		*B. trifida*	*Hordeum jubatum*
C. occidentalis	**Poaceae – Grass Family**	*Bromus anomalus*	*H. murinum* ssp. *glaucum*
C. praegracilis	*Achnatherum aridum*	*B. berterianus*	*Koeleria macrantha*
Eleocharis macrostachya	*A. coronatum*	*B. carinatus*	*Leptochloa uninervia*
E. parishii	*A. hymenoides*	*B. cartharticus*	*Leymus cinereus*
E. paulustris	*A. parishii*	*B. diandrus*	*L. triticoides*
Schoenoplectus acutus var. *acutus*	*A. parishii* var. *parishii*	*B. japonicus*	*Lolium arundinacea*
	A. pinetorum	*B. rubens*	*L. perenne* ssp. *multiflorum*
Juncaceae – Rush Family	*A. speciosum*	*B. tectorum*	*Monroa squarrosa*
Juncus balticus	*A. thurberianum*	*Chloris virgata*	*Muhlenbergia porteri*
J. longistylis	*Agropyron cristatum*	*Cynodon dactylon*	*M. richardsonis*
J. saximontanus	*Agrostis exarata* var. *monolepis*	*Dactylis glomerata*	*Pascopyrum smithii*
	A. semiverticillata	*Deschampsia caespitosa*	*Piptatherum micrantha*
	Aristida adscensionis	*D. danthonioides*	*Pleuraphis jamesii*
	A. arizonica	*Digitaria sanguinalis*	*P. rigida*
	A. purpurea	*Distichlis spicata*	*Poa annua*

Poaceae – Grass Family (cont'd)
P. bigelovii
P. fendleriana
P. pratensis
P. secunda
Polypogon interruptus
P. monspeliensis

Poaceae – Grass Family (cont'd)
Puccinellia distans
Schismus arabicus
Setaria pumila
Sorghum halepense
Sporobolus cryptandrus

Poaceae – Grass Family (cont'd)
S. flexuosus
Tridens muticus
Vulpia microstachys
V. myuros
V. octoflora

Potamogetonaceae – Pondweeds
Potamogeton pectinatus

Typhaceae - Cattail Family
Typha domingensis
T. latifolia

Dicotyledons

Amaranthaceae – Amaranth Family
Amaranthus albus
A. blitoides
A. californicus
A. fimbriatus

Anacardiaceae – Sumac Family
Rhus trilobata var. *anisophylla*

Apiaceae – Carrot Family
Apium graveolens
Berula erecta
Cymopterus aboriginum
C. gilmanii
C. globosus
C. purpurascens
C. ripleyi
C. ripleyi var. *saniculoides*
Daucus carota
Lomatium foeniculaceum ssp. *fimbriatum*
L. nevadense var. *nevadense*
L. scabrum
Pteryxia hendersonii

Apocynaceae – Dogbane Family
Amsonia tomentosa

Asclepiadaceae – Milkweed Family
Asclepias erosa
Cynanchum utahense

Asteraceae – Aster Family
Acamptopappus shockleyi
Achillea millefolium var. *lanulosa*
Acroptilon repens
Adenophyllum cooperi
Agoseris glauca var. *laciniata*
Ambrosia acanthicarpa
A. dumosa
A. eriocentra
Amphipappus fremontii var. *fremontii*
Anisocoma acaulis
Antennaria dimorpha
A. rosea
Artemisia bigelovii
A. dracunculus
A. ludoviciana
A. ludoviciana ssp. *incompta*
A. nova
A. spinescens
A. tridentata ssp. *tridentata*
Atrichoseris platyphylla
Baccharis emoryi
Baileya multiradiata
B. pleniradiata

Asteraceae – Aster Family (cont'd)
Balsamorhiza hookeri var. *neglecta*
Brickellia arguta
B. atractyloides
B. californica
B. desertorum
B. incana
B. longifolia
B. longifolia var. *multiflora*
B. microphylla var. *scabra*
B. microphylla var. *watsonii*
B. oblongifolia var. *linifolia*
Calycoseris parryi
C. wrightii
Chaenactis carphoclinia
C. douglasii
C. fremontii
C. macrantha
C. stevioides
C. xantiana
Chaetadelphia wheeleri
Chrysothamnus gramineus
C. greenei
C. viscidiflorus ssp. *puberulus*
C. viscidiflorus ssp. *viscidiflorus*
C. v. ssp. *viscidiflorus* var.*stenophyllus*
Cirsium neomexicanum
Conyza canadensis

Asteraceae – Aster Family (cont'd)
Crepis intermedia
C. occidentalis ssp. *occidentalis*
C. runcinata ssp. *hallii*
Encelia virginensis var. *virginensis*
Enceliopsis nudicaulis var. *nudicaulis*
Ericameria cooperi
E. cuneatus
E. linearifolius
E. nanus
E. nauseosa
E. nauseosa ssp. *consimilis* var. *leiosperma*
E. nauseosa ssp. *nauseosa* var. *hololeuca*
E. paniculata
E. parryi var. *nevadensis*
E. teretifolia
E. watsonii
Erigeron aphanactis
E. breweri var. *porphyreticus*
E. concinnus var. *concinnus*
E. divergens
Eriophyllum pringlei
Geraea canescens
Glyptopleura marginata
Gnaphalium palustre
Grindelia squarrosa var. *serrulata*
Gutierrezia microcephala
G. sarothrae

Asteraceae – Aster Family (cont'd)

Hazardia brickellioides
Hecastocleis shockleyi
Helianthus annuus
H. petiolaris ssp. *fallax*
H. petiolaris ssp. *petiolaris*
Heliomeris multiflora var. *nevadensis*
Heterotheca villosa var. *hispida*
Hulsea vestita ssp. *inyoensis*
Hymenoclea salsola
Hymenopappus filifolius var. *megacephalus*
Hymenoxys cooperi var. *cooperi*
Isocoma acradenius var. *eremophilus*
Iva nevadensis
Lactuca serriola
Leucelene ericoides
Lygodesmia dianthopsis
Machaeranthera canescens ssp. *canescens*
M. gooddingii
M. gracilis
Malacothrix coulteri
M. glabrata
M. sonchoides
Monoptilon bellidiforme
M. bellioides
Pectis papposa
Perityle megalocephala var. *intricata**
P. megalocephala var. *megalocephala*
Petradoria pumila
Peucephyllum schottii
Pleurocoronis pluriseta

Asteraceae – Aster Family (cont'd)

Porophyllum gracile
Prenanthella exigua
Psathyrotes annua
P. ramosissima
Pseudognaphalium stramineum
Psilostrophe cooperi
Rafinesquia neomexicana
Senecio integerrimus var. *exaltatus*
S. multilobatus
S. spartioides
Sonchus asper
Stephanomeria exigua ssp. *exigua*
S. parryi
S. pauciflora
S. spinosa
Stylocline micropoides
S. psilocarphoides
Syntrichopappus fremontii
Tetradymia axillaris var. *axillaris*
T. canescens
T. glabrata
Thymphylla pentachaeta var. *belenidium*
Townsendia scapigera
Uropappus linearifolia
Xanthium strumarium var. *canadense*
Xylorhiza tortifolia var. *imberbis*

Boraginaceae – Borage Family

Amsinckia tessellata
Cryptantha ambigua
C. angustifolia
C. barbigera
C. circumscissa
C. confertiflora
C. decipiens
C. dumetorum
C. flavoculata
C. gracilis
C. humilis
C. maritima
C. micrantha
C. nevadensis var. *nevadensis*
C. pterocarya
C. racemosa
C. recurvata
C. scoparia
C. utahensis
C. virginensis
C. watsonii
Lappula occidentalis var. *occidentalis*
Lithospermum ruderale
Pectocarya heterocarpa
P. platycarpa
P. recurvata
P. setosa
Plagiobothrys arizonicus
P. jonesii
P. kingii

Boraginaceae – Borage Family (cont'd)

Tidestromia oblongifolia ssp. *oblongifolia*
Tiquilia canescens var. *canescens*
T. nuttallii
T. plicata

Brassicaceae – Mustard Family

Arabis dispar
A. glaucovalvula
A. holboellii var. *pinetorum*
A. inyoensis
A. pendulina
A. perennans
A. pulchra var. *gracilis*
A. pulchra var. *munciensis*
A. shockleyi
Brassica geniculata
Caulanthus cooperi
C. crassicaulis var. *glaber*
C. pilosus
Descurainia pinnata ssp. *glabra*
D. pinnata ssp. *halictorum*
D. sophia
Draba cuneifolia var. *cuneifolia*
D. cuneifolia var. *integrifolia*
Guillenia lasiophylla
Hirschfeldia incana
Lepidium flavum var. *flavum*
L. fremontii
L. lasiocarpum
L. montanum var. *canescens*

Brassicaceae – Mustard Family (cont'd)

L. perfoliatum
Lesquerella kingii ssp. *kingii*
L. ludoviciana
Malcolmia africana
Physaria chambersii
Sibara rosulata
Sisymbrium altissimum
S. irio
Stanleya elata
S. pinnata var. *pinnata*
Streptanthella longirostris
Streptanthus cordatus var. *cordatus*
Thelypodium laxiflorum
Thysanocarpus curvipes
T. laciniatus

Buddlejaceae – Butterfly-Bush Family

Buddleja utahensis

Cactaceae – Cactus Family

Echinocactus polycephalus
Echinocereus engelmannii
E. engelmannii var. *armatus*
E. engelmannii var. *chysocentrus*
E. engelmannii var. *engelmannii*
E. triglochidiatus var. *melanacanthus*
Escobaria vivipara var. *deserti*
E. vivipara var. *rosea*
Mammillaria tetrancistra
Opuntia basilaris var. *basilaris*
O. echinocarpa var. *echinocarpa*

Cactaceae – Cactus Family (cont'd)

O. erinacea var. *erinacea*
O. erinacea var. *ursina*
O. polyacantha var. *rufispina*
O. pulchella
O. ramosissima
Sclerocactus polyancistrus

Campanulaceae – Bellflower Family

Nemacladus glanduliferus var. *orientalis*
N. rubescens
N. sigmoideus

Capparaceae – Caper Family

Cleome lutea

Caprifoliaceae – Honeysuckle Family

Symphoricarpos longiflorus
S. rotundifolius var. *parishii*

Caryophyllaceae – Pink Family

Arenaria congesta var. *subcongesta*
A. kingii ssp. *compacta*
A. macradenia
A. m. ssp. *macradenia* var. *macradenia*
Scopulophila rixfordii
Silene verecunda ssp. *andersonii*

Celastraceae – Staff-tree Family

Mortonia utahensis

Chenopodiaceae – Goosefoot Family

Atriplex argentea ssp. *expansa*
A. canescens var. *canescens*
A. confertifolia
A. elegans var. *fasciculata*
A. hymenelytra
A. lentiformis ssp. *lentiformis*
A. polycarpa
Bassia hyssopifolia
Chenopodium album
C. album var. *missouriense*
C. atrovirens
C. berlandieri var. *sinuatum*
C. berlandieri var. *zschackei*
C. fremontii
C. incanum
C. leptophyllum
C. pratericola
C. simplex
C. strictum ssp. *glaucophyllum*
Grayia spinosa
Halogeton glomeratus
Kochia americana
K. iranica
K. scoparia
Krascheninnikovia lanata
Monolepis spathulata
Salsola kali ssp. *tragus*
S. paulsenii
Suaeda moquinii

Convolvulaceae – Morning-Glory Family

Convolvulus arvensis

Crossosomataceae – Crossosoma Family

Glossopetalon spinescens var. *aridum*

Cuscutaceae – Dodder Family

Cuscuta denticulata
C. denticulata var. *vetchii*

Euphorbiaceae – Spurge Family

Chamaesyce albomarginata
C. fendleri
C. micromera
C. parishii
C. serpyllifolia ssp. *serpyllifolia*
C. setiloba
Stillingia spinulosa

Fabaceae – Pea Family

Astragalus acutirostris
A. beatleyae
A. beckwithii
A. calycosus var. *calycosus*
A. casei
A. didymocarpus var. *dispermus*
A. funereus
A. layneae
A. lentiginosus var. *fremontii*
A. lentiginosus var. *micans*
A. lentiginosus var. *variabilis*
A. minthorniae var. *villosus*
A. mohavensis var. *mohavensis*
A. newberryi
A. newberryi var. *castoreus*
A. newberryi var. *newberryi*

Fabaceae – Pea Family (cont'd)

A. nyensis
A. oophorus var. *clokeyanus*
A. purshii var. *lectulus*
A. purshii var. *tinctus*
A. tidestromii
Dalea mollissima
D. searlsiae
Lathyrus hitchcockianus
Lotus humistratus
Lupinus argenteus ssp. *artenteus* var. *laxiflorus*
L. aridus
L. brevicaulis
L. caudatus
L. concinnus ssp. *orcuttii*
L. flavoculatus
L. holmgrenanus
L. microcarpus
L. palmeri
L. shockleyi
L. subvexus
L. uncialis
Medicago sativa
Melilotus indicus
M. officinalis
Peteria thompsonae
Prosopis glandulosa var. *torreyana*
Psorothamnus fremontii var. *fremontii*
P. polydenius
Trifolium andersonii

Fagaceae – Beech Family

Quercus gambelii

Gentianaceae – Gentian Family

Frasera albomarginata
F. pahutensis

Geraniaceae – Geranium Family

Erodium cicutarium

Grossulariaceae – Currant Family

Ribes cereum var. *cereum*
R. velutinum var. *velutinum*

Hydrangeaceae – Hydrangea Family

Fendlerella utahensis

Hydrophyllaceae – Waterleaf Family

Eucrypta micrantha
Nama aretioides
N. demissum var. *demissum*
N. densum
N. depressum
N. pusillum
Phacelia affinis
P. ambigua
P. beatleyae
P. bicolor
P. calthifolia
P. crenulata var. *crenulata*
P. cryptantha
P. curvipes
P. distans
P. fremontii
P. lemmonii
P. mustelina

Hydrophyllaceae – Waterleaf Family (cont'd)

P. parishii
P. pedicellata
P. peirsoniana
P. rotundifolia
P. saxicola
P. tetramera
P. vallis-mortae var. *vallis-mortae*
Tricardia watsonii

Krameriaceae – Krameria Family

Krameria erecta

Lamiaceae - Mint Family

Hedeoma nanum ssp. *californicum*
Marrubium vulgare
Monardella glauca
Salazaria mexicana
Salvia columbariae var. *columbariae*
S. dorii ssp. *dorrii* var. *dorrii*

Linaceae – Flax Family

Linum lewisii

Loasaceae – Losa Family

Eucnide urens
Mentzelia albicaulis
M. congesta
M. montana
M. nitens
M. obscura
M. oreophila
M. reflexa
M. veatchiana

Loasaceae – Losa Family (cont'd)

Petalonyx nitidus
P. thurberi ssp. *thurberi*

Malvaceae – Mallow Family

Eremalche exilis
E. rotundifolia
Malva parviflora
Sphaeralcea ambigua ssp. *ambigua*
S. ambigua ssp. *monticola*
S. ambiguua var. *rugosa*
S. emoryi
S. grossulariaefolia ssp. *pedata*
S. parvifolia

Molluginaceae – Carpet-Weed Family

Mollugo cerviana

Nyctaginaceae – Four o'clock Family

Abronia elliptica
A. turbinata
Allionia incarnata
Mirabilis bigelovii
M. bigelovii var. *bigelovii*
M. multiflora var. *glandulosa*
M. pudica
Oxybaphus comatus
Selinocarpus nevadensis
Senecio flaccidus var. *douglasii*

Oleaceae – Olive Family

Forestiera pubescens var. *pubescens*
Fraxinus anomala
F. velutina
Menodora spinescens

Onagraceae – Evening Primrose Family

Camissonia boothii ssp. *condensata*
C. boothii ssp. *intermedia*
C. brevipes ssp. *brevipes*
C. brevipes ssp. *pallidula*
C. californica
C. chamaenerioides
C. claviformis ssp. *integrior*
C. heterochroma
C. kernensis ssp. *gilmanii*
C. megalantha
C. munzii
C. parvula
C. pterosperma
C. pusilla
C. refracta
C. walkeri ssp. *tortilis*
Epilobium ciliatum
E. glaberrimum
Gaura coccinea
Gayophytum decipiens
G. diffusum ssp. *parviflorum*
G. racemosum
G. ramosissimum
Oenothera caespitosa ssp. *marginata*
O. californica spp. avita
O. deltoides ssp. *deltoides*
O. pallida ssp. *pallida*
O. primiveris

Orobanchaceae – Broom-Rape Family

Orobanche cooperi
O. corymbosa
O. fasciculata

Papaveraceae – Poppy Family

Arctomecon merriamii
Argemone corymbosa
A. munita ssp. *rotundata*
Eschscholzia glyptosperma
E. minutiflora
E. multiflora ssp. *covillei*

Plantaginaceae – Plantain Family

Plantago ovata
P. patagonica

Polemoniaceae – Phlox Family

Collomia tenella
Eriastrum eremicum
E. sparsiflorum
E. wilcoxii
Gilia aliquanta ssp. *breviloba*
G. brecciarum ssp. *brecciarum*
G. campanulata
G. cana ssp. *speciformis*
G. cana ssp. *triceps*
G. clokeyi
G. filiformis
G. hutchinsifolia
G. inconspicua
G. latifolia
G. leptomeria
G. malior
G. modocensis

Polemoniaceae – Phlox Family (cont'd)

G. nyensis
G. ophthalmoides
G. ripleyi
G. scopulorum
G. sinuata
G. stellata
G. transmontana
Ipomopsis congesta
I. depressa
I. polycladon
Langloisia setosissima
L. setossima ssp. *punctata*
Leptodactylon pungens
Linanthus arenicola
L. bigelovii
L. demissus
L. dichotomus
L. jonesii
L. nuttallii ssp. *nuttallii*
L. septentrionalis
Loeseliastrum schottii
Navarretia breweri
Phlox gracilis ssp. *humilis*
P. hoodii ssp. *lanata*
P. stansburyi

Polygalaceae – Milkwort Family

Polygala heterorhyncha
P. subspinosa

Polygonaceae – Buckwheat Family

Centrostegia thurberi
Chorizanthe brevicornu var. *brevicornu*
C. brevicornu var. *spathulata*
C. rigida
C. watsonii
Eriogonum baileyi var. *baileyi*
E. brachyanthum
E. brachypodum
E. caespitosum
E. cernuum var. *cernuum*
E. cernuum var. *viminale*
E. concinnum
E. deflexum
E. deflexum var. *baratum*
E. deflexum var. *deflexum*
E. deflexum var. *nevadense*
E. esmeraldense var. *esmeraldense*
E. fasciculatum var. *polifolium*
E. glandulosum
E. heermannii var. *argense*
E. heermannii var. *heermannii*
E. heermannii var. *sulcatum*
E. hookeri
E. howellianum
E. inflatum
E. insigne
E. maculatum
E. microthecum var. *lapidicola*
E. microthecum var. *simpsonii*
E. nidularium
E. nummulare
E. nutans var. *nutans*
E. ovalifolium var. *ovalifolium*
E. palmerianum
E. pusillum

Polygonaceae – Buckwheat Family (cont'd)
- *E. racemosum*
- *E. reniforme*
- *E. saxatile*
- *E. thomasii*
- *E. trichopes*
- *E. umbellatum*
- *E. umbellatum* var. *dichrocephalum*
- *E. umbellatum* var. *subaridum*
- *E. umbellatum* var. *vernum*
- *E. umbellatum* var. *versicolor*
- *E. wrightii* var. *subscaposum*
- *Oxytheca perfoliata*
- *Polygonum argyrocoleon*
- *P. aviculare*
- *P. douglasii* ssp. *johnstonii*
- *P. pensylvanicum*
- *Rumex crispus*
- *R. salicifolius*

Portulacaceae – Purslane Family
- *Cistanthe monandra*
- *C. parryi* var. *nevadense*
- *Claytonia perfoliata* ssp. *perfoliata*
- *Lewisia rediviva* var. *minor*

Ranunculaceae – Buttercup Family
- *Anemone tuberosa*
- *Aquilegia formosa* var. *formosa*
- *Delphinium andersonii*
- *D. parishii* ssp. *parishii*
- *Ranunculus andersonii*

Rhamnaceae – Buckthorn Family
- *Ceanothus greggii* ssp. *vestitus*

Rosaceae – Rose Family
- *Amelanchier pallida*
- *A. utahensis*
- *Cercocarpus intricatus*
- *C. ledifolius* var. *ledifolius*
- *Chamaebatiaria millefolium*
- *Coleogyne ramosissima*
- *Fallugia paradoxa*
- *Holodiscus discolor*
- *Ivesia arizonica* var. *saxosa*
- *I. sabulosa*
- *Peraphyllum ramosissimum*
- *P. caespitosum*
- *Potentilla biennis*
- *Prunus fasciculata*
- *Purshia glandulosa*
- *P. stansburiana*
- *P. tridentata*
- *Rosa woodsii*

Rubiaceae – Madder Family
- *Galium aparine*
- *G. bifolium*
- *G. hilendiae* ssp. *hilendiae*
- *G. hilendiae* ssp. *kingstonense*
- *G. magnifolium*
- *G. stellatum*

Rutaceae – Rue Family
- *Thamnosma montana*

Salicaceae – Willow Family
- *Populus fremontii* ssp. *fremontii*
- *Salix exigua*
- *S. gooddingii*

Saxifragaceae – Saxifrag Family
- *Lithophragma tenellum*

Scrophulariaceae – Figwort Family
- *Castilleja applegatei*
- *C. applegatei* ssp. *martinii*
- *C. linariaefolia*
- *Collinsia parviflora*
- *Keckiella rothrockii* ssp. *rothrockii*
- *Mimetanthe pilosus*
- *M. bigelovii* var. *bigelovii*
- *M. densus*
- *M. guttatus*
- *M. montioides*
- *M. rubellus*
- *M. spissus*
- *M. suksdorfii*
- *Mohavea breviflora*
- *Neogaerrhinum filipes*
- *Penstemon albomarginatus*
- *P. angustifolius* var. *venosus*
- *P. floridus* var. *austinii*
- *P. fruticiformis* ssp. *amargosae*
- *P. humilis* ssp. *humilis*
- *P. pahutensis*
- *Penstemon palmeri*
- *P. petiolatus*
- *P. rostriflorus*
- *P. thurberi*
- *Saircocarpus kingii*
- *Scrophularia desertorum*
- *Veronica americana*
- *V. anagallis-aquatica*
- *V. peregrina* ssp. *xalapensis*

Solanaceae – Potato Family
- *Datura wrightii*
- *Lycium andersonii*
- *L. pallidum* var. *oligospermum*
- *L. shockleyi*
- *Nicotiana attenuata*
- *N. trigonophylla* var. *trigonophylla*
- *Physalis crassifolia*
- *Solanum americanum*

Tamaricaceae – Tamarisk Family
- *Tamarix ramosissima*

Ulmaceae – Elm Family
- *Ulmus minor*
- *U. parvifolia*

Verbenaceae – Verbena Family
- *Verbena bracteata*

Viscaceae – Christmas Mistletoe Family
- *Arceuthobium divaricatum*
- *Phoradendron juniperinum*

Zannichelliaceae – Horned Pondweed Family
- *Zannichellia palustris*

Zygophyllaceae – Creosote-Bush Family
- *Larrea tridentata*
- *Tribulus terrestris*

DIVISION PTERIDOPHYTA (FERNS)
Pteridaceae – Maidenhair Fern Family
Argyrochosma jonesii
Cheilanthes covillei
C. parryi
Pellaea mucronata ssp. *mucronata*
P. truncata
Pentagama triangularis
P. triangularis ssp. *triangularis*

ssp = subspecies; var = variety.
Source: Wills and Ostler 2001.

F.2 Animal Species on the Nevada National Security Site

Tables F–4 and **F–5** are derived from *Ecology of the Nevada Test Site: An Annotated Bibliography* (Wills and Ostler 2001). The tables list all species of invertebrate and vertebrate animals, respectively that have been identified at the NNSS. The listing of vertebrates is not presented in taxonomic order. Instead, phyla are listed alphabetically. Classes, orders, families, and genus/species within a family are each presented in alphabetical order. Common names have been included for all of the vertebrate species since they are used frequently and in general are not locally generally unique. The taxonomy in Tables F–4 and F–5 follows Wills and Ostler 2001 and the names of species that were not verified in that publication are indicated by an asterisk.

Table F–4 Invertebrate Animal Species of the Nevada National Security Site

PHYLUM ANNELIDA (SEGMENTED WORMS)			
Order Haplotaxida – Aquatic Earthworms			
Family Naididae			
Unknown sp.			
PHYLUM ARTHROPODA (ARTHROPODS)			
Subphylum Chelicerata			
Order Acarina – Ticks and Mites			
Family Ameroseiidae *Kleemania* sp.	**Family Dermanyssidae** *Brevisterna utahensis* * *Dermanyssus becki* *Hirstionyssus bisetosus* * *H. carnifix* * *H. hill* * *H. neotomae* * *H. triacanthus* *Ornithonyssus aridus* * *Steatonyssus antrozoi* *	**Family Ixodidae** *Dermacentor albipictus* *D. parumapertus* *Haemaphysalis leporispalustris* *Ixodes angustus* *I. kingi* *I. ochotonae* *I. pacificus* *I. sculptus* *I. spinipalpus*	**Family Listrophoridae** *Listrophorus dipodominus*
Family Argasidae *Argas persicus* *Ornithodoros kelleyi* *O. parkeri* *O. sparnus* *O. talaje* *Otobius lagphilus*	**Family Eremaeidae** *Eremaeus* sp. *	**Family Ixodorhynchidae** *Ixodorhynchus* sp.	**Family Myobiidae** *Lavoimyobia hughesi* *
Family Belbidae *Belba* sp. *Spinibdella* sp.	**Family Erthraeidae** *Hauptmannia* sp. * *Pollux* sp. *	**Family Laelaptidae** *Androlaelaps leviculus* *Eubrachylaelaps circularis* *Eubrachylaelaps debilis* *E. hollisteri* *Haemolaelaps* sp. *H. casalis* *H. glasgowi* *Hypoaspis leviculus*	**Family Nanorchestidae** *Spelorchestes* sp. *
Family Caligonellidae *Molothiognathus* sp. * *Neothrognathus* sp. *	**Family Erythraeidae** *Caeculisoma* sp. *	**Family Linotetranidae** *Linotetrans* sp. *	**Family Neophyllobiidae** *Rhinonyssidae* sp. *
Family Cosmocthoniidae *Cosmochthoniidae* sp.	**Family Gymnodamaeidae** *Joshuella striata* *		**Family Oribatulidae** *Moltoribates* sp.
Family Ctenacaridae *Aphelacarus acarinus* *	**Family Haemogamasidae** *Haemogamasus pontiger* *Ischyropoda armatus*		**Family Passalozetidae** *Passalozetes* sp.
Family Cunaxidae *Cunaxa* sp. *Cunaxoides* sp.			**Family Pterygosomidae** *Geckobiella texana* *Hirstiella* sp.
			Family Teneriffiidae *Tarsolarkus* sp. *Tarsotomus* sp.

Family Trombiculidae
Euschoengastia sp.
E. cordiremus
E. criceticola
E. decipiens
E. fasolla
E. lacerta
E. lanei
E. obesa
E. radfordi

Family Trombiculidae (cont'd)
E. utahensis
Leuwenhoekia americana
Odontacarus arizonensis
O. chiapansis
O. hirsutus
O. linsdalei
O. micheneri
Pseudoschongastia sp. *
Sascarus sp.

Family Trombiculidae (cont'd)
Trombicula 4 spp.
T. arenicola *
T. belkini
T. jessiemae
T. panamensis
T. sola *
Whartonia perplexa
W. whartonia

Family Trombidiidae
Allothrombium sp. *

Family Tuckerellidae
Tuckerella coleogynis

Order Araneae – Spiders

Family Agelenidae
Agelenopsis aperta
Calilena restricta

Family Anyphaenidae
Anyphaena sp.

Family Araneidae
Metepeira gosoga

Family Caponiidae
Orthonops gertschi
Tarsonops sp.

Family Clubionidae
Neoanagraphis chamberlini
N. pearcei

Family Corinnidae
Castianeira descripta
Corinna bicalcarata

Family Cyrtaucheniidae
Aptostichus stanfordianus

Family Dictynidae
Cicurina utahana
Dictyna calcarata
D. personata
D. reticulata
D. tucsona
Mallos mians
M. pallidus

Family Diguetidae
Diguetia canities
D. signata

Family Filistatidae
Kukulcania utahana

Family Gnaphosidae
Callilepis sp.
Cesonia classica
Drassodes saccatus
Herpyllus hesperolus
Drassyllus fractus
D. insularis
D. lamprus
Gnaphosa californica
G. hirsutipes

Family Gnaphosidae (cont'd)
Haplodrassus eunis
Micaria gosiuta
Nodocion utus
Scopoides naturalisticus
Zelotes monachus
Z. nannodes
Z. puritanus

Family Homalonychidae
Homalonychus theologus

Family Linyphiidae
Ceraticelus nesiotes
Disembolus stridulans
Erigone dentosa a
M. fillmorana
M. fratrella
Spirembolus sp.
Tapinocyba sp.
Tennesseellum formic

Family Liocranidae
Piabuna nanna
Phrurotimpus sp.

Family Lycosidae
Alopecosa kochi
Geolycosa rafaelana
Pardosa ramulosa
Schizocosa sp.

Family Mimetidae
Reo eutypus

Family Miturgidae
Syspira eclectica

Family Oxyopidae
Oxyopes tridens

Family Philodromidae
Apollophanes texanus
Ebo dispar
E. merkeli
E. mexicanus
Philodromus histrio

Family Pholcidae
P. infuscatus
Physocyclus tanneri
Psilochorus papago
P. utahensis

Family Plectreuridae	**Family Sicariidae**	**Family Theridiidae**	**Family Thomisidae**
Kibramoa paiuta	*Loxosceles deserta*	*Achaearanea* sp.	*Misumenops deserti*
Plectreurys tristis		*Enoplognatha joshua*	*M. rothi*
	Family Sparassidae	*Euryopis scriptipes*	*Xysticus californicus*
Family Salticidae	*Olios fasciculatus*	*E. spinigera*	*X. iviei*
Habronattus agilis		*Latrodectus hesperus*	*X. lassanus*
H. brunneus	**Family Tetragnathidae**	*L. mactans*	
H. hirsutus	*Tetragnatha laboriosa*	*Steatoda fulva*	**Family Uloboridae**
H. oregonensis		*S. pulchra*	*Uloborus diversus*
Metacyrba arizonensis	**Family Theraphosidae**	*S. washona*	
M. taeniola	*Aphonopelma steindachneri*	*Theridion* sp.	
Metaphidippus sp.			
Peckhamia sp.			
Pellenes limatus			
Phidippus insolens			
P. johnsoni			
P. octopunctatus			
P. workmani			
P. californicus			

Order Opiliones – Harvestmen
Family Phalangiidae
Eurybunus riversi *
Globipes spinulatus *
Leiobunum townsendi *

Order Scorpiones – Scorpions			
Family Iuridae	**Family Superstitionidae**	**Family Vaejovidae**	
Anuroctonus phaiodactylus	*Superstitionia donensis*	*Paruroctonus becki*	
H. spadix		*Paruroctonus boreas*	
Hadrurus arizonensis		*Serradigitus wupatkiensis*	
H. hirsutus		*Vaejovis confusus*	
		V. hirsuticauda	
		V. spinigeris	

Order Solpugida – Sun Spiders

Family Ammotrechidae	**Family Eremobatidae (cont'd)**	**Family Eremobatidae (cont'd)**	**Family Eremobatidae (cont'd)**
Ammontrechula dolabra *	*E. mormonus* *	*H. californica* *	*T. attritus* *
A. lacuna *	*E. scopulatus* *	*Hemerotrecha denticulata* *	*T. bidepressus* *
A. pilosa *	*E. similis* *	*H. fruitana* *	*T. branchi* *
Branchia potens *	*E. vicinus* *	*H. jacintoana* *	*Therobates cameronensis* *
	E. zinni *	*H. proxima* *	*T. flexacus* *
Family Eremobatidae	*Eremorhax pulcher* *	*H. serrata* *	*T. nudus* *
Chanbria sp. *	*E. titania* *	*Horribates* sp. *	*T. plicatus* *
Eremobates ctenidiellus *	*Hemerotrecha branchi* *	*Therobates arcus* *	

Subphylum Crustacea

Order Anostraca – Fairy Shrimp

Family Branchinectidae	**Family Thamnocephalidae**
Branchinecta gigas	*Thamnocephalus platyurus*
B. mackini	

Order Cladocera – Water Fleas

Family Daphniidae
Daphnia sp.

Order Conchostraca – Clam Shrimp

Family Limnadiidae
Eulimnadia antlei

Order Copepoda – Copepods

Family Cyclopidae	**Family Diaptomidae**
Cyclops sp.	*Diaptomus* sp.

Order Decapoda – Decapods

Family Cambaridae
Unknown sp.

Order Isopoda – Isopods

Family Armadillidae	**Family Porcellionidae**
Venezillo arizonicus	*Porcellio laevis*

Order Notostraca – Tadpole Shrimp

Family Lepiduridae
Triops longicaudatus

Order Ostracoda – Seed Shrimp

Family Cypridae
Herpetocypris fretensis

Family Darwinuliidae
Darwinula stevensoni

Subphylum Hexapoda

Class Insecta – Insects

Order Blattodea – Cockroaches

Family Polyphagidae
Arenivaga apacha
A. erractica
Eremoblatta subdiaphana

Order Coleoptera – Beetles

Family Alleculidae
Hymenorus prolixus

Family Anthribidae
Trigonorhinus irregularis

Family Attelabidae
Auletobius sp.
A. humeralis

Family Brentidae
Apion albidulum
A. varicorne

Family Buprestidae
Acmaeodera sp.
A. diffusa
A. immaculata
A. lanata
A. purshiae *
Agrilus felix
Agrilus pubifrons
Anthaxia deleta
Chrysobothris arizonica
C. cuprascens
C. platti

Family Buprestidae (cont'd)
Hippomelas near obliterata
Melanophila piniedulis
Oxypteris consputa

Family Carabidae
Calosoma sp.
Harpalus sp.
Lebia sp.
Pterostichus sp.
Rhadine jejunus
R. myrmecodes

Family Cerambycidae
Moneilema gigas
M. semipunctatum
Prionus californicus

Family Chrysomelidae
Chaetocnema sp.
Chlamisus memnonia *
Diplocapsis sp.
Monoxia sp.
Octatoma sp.
Pachybrachis sp.
Trirhabda sp.

Family Cicindelidae
Cicindela sp.

Family Cleridae
Aulicus reichei *
Caccodes quadrimaculatus
Cymatodera fuchsii
C. latefascia
C. oblita *
C. uniformis
Phyllobaenus pygmaea
P. subfasciata
Priocera inornata
Trichodes ornatus

Family Coccinellidae
Hippodamia apicalis
H. convergens
H. parenthesis
H. quinquesignata
Hyperaspis pleuralis
H. quadrivittata
H. taeniata
Scymnus aridus
S. pallens

Family Curculionidae
Amotus setulosus
Anthonomus cycliferus
A. haematopus
A. hirtus
A. inermis
A near *juniperinus*
A. ochreopilosus
A. ornatulus
A. peninsularis
A. sphaeralciae
A. tenius
Apleurus angularis
Apleurus porosus
Aragnomus sp.
A. hispidulus
A. hispidus
Auleutes sp.
Brachyogmus ornatus
Ceutorhynchus adjunctus
Cimbocera buchanani
C. cazieri
Cleonidius poricollis
C. quadrilineatus
Crocidema californica
Cryptolepidus aridus

Family Curculionidae (cont'd)
- *Cryptolepidus leechi*
- *C. nevadicus*
- *Cylindrocopturus* sp.
- *Eucyllus echinus*
- *E. nevadensis*
- *E. unicolor*
- *E. vagans*
- *Eupagoderes geminatus*
- *E. geminatus*
- *Lepidophorus* sp.
- *Magdalis lecontei*
- *Miloderes mercuryensi*
- *Minyomerus* sp.
- *Myrmex lineatus*
- *Onychobarius near depressa*
- *O. mystica*
- *Ophryastes varius*
- *Orimodema protracta*
- *O. sordidus*
- *Paracimbocera artemisiae*
- *P. atra*
- *Promecotarsus densus*
- *Sirocalodes tescorum*
- *Smicronyx* sp.
- *S. imbricatus*
- *Thricolepis inornata*
- *Tychius prolixus*
- *T. setosa*
- *Yuccaborus frontalis*
- *Zascelis irrorata*

Family Elateridae
- *Horistonotus* sp.

Family Elmidae
- *Elmira* sp. *

Family Gyrinidae
- *Gyrinidae* sp. *

Family Histeridae
- *Saprinus* sp.

Family Leiodidae
- *Ptomaphagus* sp.

Family Meloidae
- *Cysteodemus armatus*
- *Lytta* sp.
- *Saprinus armatus*

Family Melyridae*s*
- *Asydates* sp.
- *Attalus futilis*
- *Collops punctulatu*
- *Eutrichopleurus concinnus*
- *Listrus* sp. *
- *Malachius* sp.
- *Melyrodes* sp.

Family Melyridae*s*
- *Trichochrous varius*

Family Nitidulidae
- *Carpophilus hemipterus*
- *Cybocephalus californicus*

Family Ochodaeidae
- *Ochodaeus sparsus*
- *O. sparsus*

Family Phalacridae
- *Phalacrus* sp.

Family Scarabaeidae
- *Aphodius* sp.
- *A. fucosus*
- *A. militaris*
- *A.* near *talpoidesi*
- *A. nevadensis*
- *Bothynus* sp.
- *Chnaunanthus flavipennis*
- *Cyclocephala longula*
- *Diplotaxis deserta*
- *D. haydenii*
- *D. incuria*
- *D. insignis*
- *D. moerens*
- *D. pacata*
- *D. subangulata*
- *Paracotalpa granicollis*
- *Phyllophaga* sp.
- *P. sociatus*
- *Serica alternata*
- *S. perigonia*

Family Scolytidae
- *Ips confusus*

Family Sulvanidae
- *Oryzaephilus surinamensis*

Family Tenebrionidae
- *Alaephus nevadensis*
- *Anemia californica*
- *Anepsius near brunneus*
- *Asidina semilaevis*
- *A. semilaevis*
- *Auchmobius subboreus*
- *Blapstinus lecontei*
- *B. vandykei*
- *Bothrotes* sp.
- *Centrioptera muricata*
- *Chilometopon abnorme*
- *Coelocnemis punctata*
- *Coniontellus argutus*
- *C. armata*
- *Coniontis lassenica*
- *Craniotus blaisdelli*
- *Cryptoglossa verrucosus*
- *Discodemus* near *knausi*
- *Edrotes ventricosus*
- *Eleodes armata*
- *Eleodes* near *californica*
- *E. carbonaria*
- *E. concinna*
- *E. dissimilis*
- *E. extricata*
- *E. grandicollis*
- *E. hispilabris*
- *E. longicollis*
- *E. longipilosa*
- *E. nevadensis*
- *E. nigrina*
- *E. obscura*
- *E. omissa*
- *E. pimelioides*
- *E. striatipennis*

Family Tenebrionidae (cont'd)	**Family Tenebrionidae (cont'd)**	**Family Tenebrionidae (cont'd)**	**Family Unknown**
E. tenebrosa	*Euschides luctatus*	*Notibius substriatus*	*Neocercopedius* sp. *
Embaphion elongatum	*Helops* sp.	*N. sulcicollis*	
Eschatomoxys wagneri	*H. attenuatus*	*Pelecyphorus actuosus*	**Family Zopheridae**
Eupsophulus castaneus	*Hylocrinus laborans*	*P. pantex*	*Zopherus uteanus*
Eusattus difficilis	*E. brunnipes*	*Philolithus pantex*	
E. dilatatus	*Lobometopon* sp.	*Steriphanus lubricans*	
E. dubius	*Metopoloba bifossiceps*	*Trichiasida acerba*	
E. elongatum	*Metoponium abnorme*	*Triorophus laevis*	
E. muricatus	*M.* near *convexicolle*	*Trogloderus costatus*	
Order Diptera – True Flies			
Family Asilidae	**Family Bombyliidae (cont'd)**	**Family Bombyliidae (cont'd)**	**Family Bombyliidae (cont'd)**
Efferia sp.	*A. parkeri*	*E. labiosus*	*L. melanosus* *
E. benedicti	*A. pavidus*	*E. litus*	*L. nigriventrus* *
E. etaminea *	*A. peodes*	*E. pulvereus*	*L. perplexus*
	A. scalaris	*Eucessia rubens*	*L. pulchrissimus*
Family Bombyliidae	*A. scriptus*	*Exepacmus johnsoni*	*L. singulatus* *
Anastoechus hessei	*A. tardus*	*Exprosopa arenicola*	*L. sororculus*
A. melanohalteralis	*A. timberlakei*	*Exprosopa caliptera*	*L. striatus*
Anthrax albofasciatus	*A. transitus*	*E. divisa*	*Mythicomyia* sp.
A. limatulus	*A. ursula*	*E. dorcadion*	*Oligodranes dolorosus*
A. nidicola	*A. varius*	*E. doris*	*Pantarbes capito*
A. oedipus	*A. vasatus*	*E. sharonae*	*P. pusio*
A. seriepunctata	*A. vittatus*	*E. utahensis*	*P. willistoni*
Aphoebantus abnormis	*A. vulpecula*	*Geminaria canalis*	*Paraconsors humeralis*
A. altercinctus	*Apolysis ater*	*G. pellucida*	*Paracosmus insolens*
A. arenicola	*A. cincturus*	*Geron argutus*	*P. morrisoni*
A. argentifrons *	*A. distinctus*	*Heterostylum robustus*	*Poecilanthrax alpha*
A. borealis	*A. fasciolus*	*H. sackeni* *	*P. apache*
A. brevistylus	*A. mus*	*H. vierecki* *	*P. californicus*
A. desertus	*Aphoebantus pulcher*	*Lepidanthrax agrestis*	*P. moffitti*
A. eremicola	*A. pullatus*	*L. angulus L. hyalinipennis*	*P. poecilogaster*
A. fumosus	*Astrophanes adonis*	*Lordotus abdominalis*	*P. willistonii*
A. interruptus	*Bombylius lancifer*	*L. albidus*	*Toxophora pellucida*
A. marcidus	*Conophorus fenestrata*	*L. apicula*	*T. vasta*
A. marginatus	*Desmatoneura argentifrons*	*L. gibbus*	*T. virgata*
A. mormon	*Dipalta serpentina*	*L. junceus*	*Villa aenea*
A. mus	*Epacmus connectens*	*L. luteolus*	*V. arizonensis* *

Family Bombyliidae (cont'd)	**Family Bombyliidae (cont'd)**	**Family Cecidomyiidae**	**Family Mydidae**
V. atrata *	*V. mira* *	*Asphondylia* sp.	*Pseudonomoneura californica*
V. cautor	*V. morio* *		
V. crocina *	*V. scitula* *	**Family Chironomidae**	**Family Syrphidae**
V. cypris *	*V. sinuosa* *	*Chironomus* sp.	*Pyritis* sp.
V. junctura *	*V. supina*		Unknown sp.
V. lepidota *	*V. utahensis* *	**Family Culicidae**	
		Culiseta sp.	
Order Embioptera – Webspinners			
Family Anisembiidae			
Dactylocerca rubra			
Order Ephemeroptera – Mayflies			
Family Baetidae		**Family Ephemeridae**	
Callibaetis sp.		Unknown sp	
Order Heteroptera – True Bugs			
Family Berytidae	**Family Miridae (cont'd)**	**Family Miridae (cont'd)**	**Family Miridae (cont'd)**
Jalysus wickhami	*Brooksetta chelifer*	*D. nevadensis*	*E. stigmosus*
Neides muticus	*B. nevadensis*	*D. pinicola*	*E. unipuncta*
Pronotacantha annulata	*Ceratocapsus fusiformis*	*D. schwarzii*	*Hadronema picta*
	C. nevadensis	*Dichaetocoris peregrinus*	*H. uhleri*
Family Cynidae	*C. nigrocuneatus*	*Dichrooscytus apicalis*	*Hoplomachidea consors*
Pangaeus congruus	*Chlamydatus associatus*	*D. flavivenosus*	*Largidea nevadensis*
Geocoris pallens	*C. becki*	*D. irroratus*	*Lopidea bullata*
Nysius ericae *	*Chlamydatus monilipes*	*D. junipericola*	*L. fuscosa*
	Clivinema sp.	*D. pinicola*	*Lopidea picta*
Family Miridae	*Coquillettia albella*	*Dicyphus hesperus*	*L. scutata*
Atomoscelis modesta	*C. luteiclava*	*D. ribesi*	*L. ute*
Atractotomus balli	*C. virescens*	*Europiella albipubescens*	*Lygus desertus*
A. pallens	*Daleapidea albescens*	*E. decolor*	*L. elisus*
A. prospidis	D. daleae	*E. grayiae*	*L. hesperus*
Beamerella balius	*Deraeocoris bakeri*	*E. lycii*	*Macrotylus infuscatus*
Beckocoris laticephalus	*D. brevis*	*E. nigricornis*	*M. salviae*
Bolteria juniperi	*D. bullatus*	*E. nigrofemoratus*	*Melanotrichus albocostatus*
B. speciosus	*D. juniperi*	*E. punctipes*	*M. atriplicis*
Brachyceratocoris nevadensis	*D. merinoi*	*Europiella sparsa*	*M. coagulatus*

Family Miridae (cont'd)
M. eurotiae
M. knighti
M. pallens
M. stanleyaea
M. symphoricarpi
Merinocapsus ephedrae
M. pallipes
Microphylellus symphoricarpi
Nevadocoris becki
N. bullatus
N. pallidus
Oncotylus guttulatus
Parthenicus accumulus
P. atriplicis
P. becki
P. brevicornis
P. condensus
P. covilleae
P. cuneotinctus
P. desertus
P. furcatus
P. incurvus
P. merinoi
P. miniopunctatus
P. nevadensis
P. nigripunctus
Parthenicus pictus
P. pilipes
P. pinicola
P. rubrosignatus
P. rufusculus
P. sabulosus
P. tenuis
P. trispinosus
P. utahensis

Family Miridae (cont'd)
Phoenicocoris pini
Phyllopidea hirta
P. picta
Phymatopsallus prosopidis
P. ribesi
Phytocoris albidopictus
P. albidosquamus
P. becki
P. breviatus
P. candidus
P. carnosulus
P. consors
P. cuneotinctus
P. decurvatus
P. *deserticola*
P. geniculatus
P. hirsuticus
P. inops
P. juniperanus
P. longihirtus
P. mellarius
P. minituberculatus
P. nigrolineatus
P. plenus
P. pulchellus
P. pulchricollis
P. ramosus
P. relativus
P. reticulatus
P. rostratus
P. squamosus
P. stitti
P. strigosus
P. tenuis
P. tricinctipes

Family Miridae (cont'd)
P. vanduzeei
P. ventralis
Pilophorus clavicornis
P. tibialis
Plagiognathus salviae
Platylygus vanduzeei
Polymerus relativus
Psallus atriplicis
P. purshiae
Pseudatomoscelis seriatus
Pseudopsallus daleae
Pseudopsallus plagiatus
P. puberus
P. repertus
Rhinacloa forticornis
Semium subglaber
Sericophanes nevadensis
Slaterocoris sp.
S. croceipes
S. longipennis
S. rubrofemoratus
Spanagonicus albofasciata
Stenodema virens *
Stittocapsus franseriae
Trigonotylus americanus

Family Nabidae
Nabis sp.

Family Notonectidae
Unknown sp.

Family Pentatomidae
Banasa euchlora
Brochymena sulcata
Chlorochroa sayi
Dendrocoris sp.
D. contaminatus
Prionosoma podopioides
Tepa rugulosa
Thyanta pallidovirens

Family Phymatidae
Macrocephalus sp.

Family Reduviidae
Reduvius sp.
Zelus sp.

Family Rhopalidae
Arhyssus sp.
A. lateralis
Harmostes angustatus
H. fraterculus
H. reflexulus
Liorhyssus hyalinus

Family Tingidae
Corythucha sp.
C. mollicula
C. sphaeralceae
Dictyla coloradensis
Gargaphia opacula
Teleonemia nigrina

Order Homoptera – Scale Insects			
Family Acanaloniidae	**Family Cicadellidae (cont'd)**	**Family Dictyopharidae**	**Family Issidae**
Acanalonia mollicula	*Dixianus utahnus*	*Scolops* sp.	*Hysteropterum* sp.
	Lycioides loculatus		
Family Cicadellidae	*Scaphytopius nigricollis*	**Family Flatidae**	**Family Membracidae**
Aceratagallia sp.	*S. torridus*	*Melormenis infuscata*	*Centrodontus atlas*
A. cinerea	*Spathanus acuminatus*	*Mistharnophantia sonorana*	*Multareis cornutus*
Ballana sp.	*Stragania* sp.		*Multareoides bifurcatus*
Order Hymenoptera – Ants and Wasps			
Family Andrenidae	**Family Anthophoridae (cont'd)**	**Family Formicidae (cont'd)**	**Family Formicidae (cont'd)**
Andrena sp.	*Xeromelecta californica*	*C. depilis*	*Monomorium minimum*
Calliopsis subalpinus	*Xylocopa californica*	*C. mutans*	*Myrmecocystus* sp.
Perdita sp.		*C. nocturna*	*M. comatus*
P. arcuata	**Family Apidae**	*Formica fusca*	*M. flaviceps*
P. callicerata	*Bombus morrisoni*	*F. integroides*	*M. koso*
P. chloris		*F. lasioides*	*M. lugubris*
P. fallugiae	**Family Bradynobaenidae**	*F. limata*	*M. mendax*
P. nasuta	*Chyphotes melaniceps*	*F. microgyna*	*Myrmecocystus mexicanus*
P. thermophila	*C. petiolatus*	*F. moki*	*M. mimicus*
		F. neogagates	*M. placodops*
Family Anthophoridae	**Family Colletidae**	*F. neorufibarbis*	*M. testaceus*
Anthophora sp.	*Colletes* sp.	*F. obscuripes*	*Myrmica emeryana*
A. californica	*C. eulophi*	*F. obtusipilosa*	*Neivamyrmex minor*
A. hololeuca	*Hylaeus asininus*	*F. subpolita*	*Pheidole bicarinata*
A. phenax		*Iridomyrmex humilis*	*P. desertorum*
A. porterae	**Family Formicidae**	*Lasius crypticus*	*P. inquilina*
A. urbana	*Acanthomyops interjectus*	*L. sitiens*	*P. pilifera*
Centris rhodopus	*A. latipes*	*Leptothorax* sp.	*Pogonomyrmex barbata*
Ceratina nanula	*Aphaenogaster* sp.	*L. andrei*	*P. californicus*
Diadasia australis	*A. boulderensis*	*L. nevadensis*	*P. imberbiculus*
D. diminuta	*A. megommata*	*L. nitens*	*P. magnacanthus*
Diadasia lutzi	*Camponotus hyatti*	*Leptothorax tricarinatus*	*Pogonomyrmex occidentalis*
Epeolus minimus	*C. ocreatus*	*Liometopum luctuosum*	*P. rugosus*
Melissodes subagilis	*C. semitestaceus*	*Messor* sp.	*P. salinus*
M. tristis	*C. vicinus*	*M. lariversi*	*Solenopsis aurea*
Synhalonia 4 spp.	*Conomyrma bicolor*	*M. lobgnathus*	*S. molesta*
S. quadricincta	*C. insana*	*M. pergandei*	
Triepeolus helianthi	*Crematogaster coarctata*	*M. smithi*	

Family Formicidae (cont'd)
S. salina
S. xyloni
Stenama smithi

Family Halictidae
Agapostemon cockerelli
A. texanus
Dufourea 2 spp.
Halictus tripartitus
Lasioglossum 3 spp.
L. albohirtus
L. hyalinus
L. incompletus
L. microlepoides
Lasioglossum nevadensis
L. pruinosus
L. ruficornis
L. sisymbrii
Nomia tetrazonata
Sphecodes eustictus

Family Ichneumonidae
Ophion sp.

Family Megachilidae
Anthidium dammersi
Ashmeadiella aridula
A. australis
A. bigeloviae
A. inyoensis
Ashmeadiella opuntiae
Dianthidium pudicum
D. subparvum
D. ulkei
Dioxys productus
Heriades timberlakei
Lithurge apicalis
Megachile lobatifrons
Osmia sp.
O. titusi
Stelis sp.

Family Melittidae
Hesperapis willmattae

Family Mutillidae
Acanthophotopsis falciformis
Acrophotopsis eurygnathus
Dasymutilla gloriosa
D. klugii
D. paenulata
D. satanas
Dilophotopsis concolor

Family Mutillidae (cont'd)
Odontophotopsis armata
O. clypeatus
O. cookii
O. infelix
O. mamatus
O. microdonta
O. obliquus
O. quadrispinosa
O. sercus
O. setifera
Sphaeropthalma brachyptera
S. acontius
S. amphion
S. angulifera
Sphaeropthalma becki
S. blakeii
S. difficilis
S. ferruginea
S. helicaon
S. macswaini
S. mendica
S. pallida
S. parapenalis
S. sonora
S. yumaella
Family Platygasteridae
Inostemma sp.
Platygaster sp.

Family Tiphiidae
Acanthetropis aequalis
A. noctivaga
Brachycistina acuta
Brachycistis glabrella
B. inaequalis
B. ioachinensis
B. linsleyi
B. triangularis
Colocistis brevis
C. castanea
C. crassa
Colocistis eremi
Quemaya paupercula

Family Vespidae
Vespula pensylvanica

Order Isoptera – Termites

Family Rhinotermitidae
Reticulitiermes basinensis
R. okanaganensis

Family Termitidae
Amitermes sp.

Order Lepiodoptera – Butterflies and Moths

Family Adelidae
Adela punctiferella

Family Arctiidae
Arachnis picta
Pygarctia murina

Family Coleophoridae*
Coleophora sp.

Family Gelechiidae
Malacosoma fragilis

Family Geometridae
Caripeta sp.
Claucina sp. *
Lycia ypsilon
Nacophora sp.
Pero sp.
Semiothisa near *colorata*
S. larreana

Family Heliodinidae
Heliodines near *sexpunctella*

Family Lasiocampidae
Gloveria arizonensis

Family Noctuidae
Conochares near *arizonae*
C. near *hutsoni* *
Grotella sp.
Oxycnemis near *gracillinea*
Phobolosia anfracta
Synedoida sp. *
Triocnemis sp.

Family Oecophoridae
Inga concolorella

Family Pieridae
Pontia protodice

Family Psychidae
Thyridopteryx meadii

Family Putellidae
Plutella maculipennis *

Family Pyralidae
Dichozoma parvipicta
Dioryctria near *gulosella*
Etiella zinckenella
Eumysia mysiella

Family Pyralidae (cont'd)
Heterographis morrisonella
Hulstia undulatella
Loxostege albiceralis
Milgithea sp.
Nephopterix bifasciella
Ommatopteryx texana *
Passadena flavidorsella
Salebriacus odiosella
Sosipatra rileyella
Staudingeria albipenella

Family Saturniidae
Hemileuca nevadensis

Family Satyridae
Cercyonis sp.

Family Scythrididae
Scythris 12 spp.

Family Sphingidae
Celerio lineata *
Hyles lineata
Sphinx dollii

Family Tineidae
Acrolophus 4 spp.
A. laticapitana
A. variabilis
Dyotopasta yumaella
Myrmecozela near *obliquella* *
Tinea sp.

Family Tortricidae
Decodes fragariana
Eucosma bobana
E. near *bolanderana*
Ofatulena duodecemstriata
Pelochrista rorana
Phaneta indagatricana
p. setonana
Platynota labiosana
P. near *yumana*

Family Ypsolophidae
Ypsolopha sp.
Y. near *angelicella*
Y. near *delicatella*
Y. near *flavistrigella*

Order Mantodea – Mantids

Family Mantidae
Litaneutria minor
Stagmomantis californica

Order Odonata – Dragonflies and Damselflies

Suborder Anisoptera – Dragonflies

Family Libellulidae
Unknown sp.

Suborder Zygoptera – Damselflies

Family Coenagrionidae
Argia sp.

Order Orthoptera – Grasshoppers and Crickets			
Family Acrididae	**Family Acrididae (cont'd)**	**Family Acrididae (cont'd)**	**Family Gryllacrididae (cont'd)**
Aeoloplides minor	*Ligurotettix coquilletti*	*T. pallidipennis*	*Stenopelmatus fuscus*
A. tenuipennis	*Melanoplus aridus*	*T. sparsa*	
Ageneotettix sp.	*M. complanatipes*	*Tytthotyle maculatus*	**Family Gryllidae**
A. deorum	*Mestobregma impexum*	*Xanthippus corallipes*	*Cycloptilum comprehendens*
Amphitornus coloradus	*Paraidemona punctatus*		*Gryllus assimilis*
Anconia integra	*Paropomala pallida*	**Family Eumastacidae**	*Myrmecophilus manni*
Arphia conspersa	*Poecilotettix sanguineus*	*Morsea californica*	*Oecanthus californicus*
Cibolacris parviceps	*Psoloessa delicatula*		*O. nigricornis*
Cordillacris occipitalis	*Trimerotropis albescens*	**Family Gryllacrididae**	
Derotmema delicatulum	*T. californica*	*Ceuthophilus lamellipes*	**Family Rhaphidophoridae**
Hesperotettix nevadensis	*T. cyaneipennis*	*Hemiudeopsylla fossor*	*Ceuthophilus deserticola*
H. viridis	*T. fontana*	*H. hesperus*	*C. nevadensis*
Leprus wheeleri	*T. inconspicua*	*Pristoceuthophilus pacificus*	*Gammarotettix bilobatus*
Order Phasmatodea – Walkingsticks			
Family Phasmatidae *Parabacillus hesperus* *Pseudosermyle stramineus*			
Order Siphonaptera – Fleas			
Family Ceratophyllidae	**Family Ctenophthalmidae**	**Family Ctenophthalmidae (cont'd)**	**Family Leptopsyllidae**
Aetheca wagneri	*Anomiopsyllus amphibolus*	*R. sectilis*	*Jordanopsylla allredi*
Dactylopsylla bluei	*A. amphibolus*	*Stenistomera alpina*	*Odontopsyllus dentatus*
Diamanus montanus *	*Callistopsyllus deuterus*	*S. alpina*	*Peromyscopsylla hesperomys*
Eumolpianus eumolpi	*C. deuterus*		
Foxella ignotus	*Carteretta carteri*	**Family Hystrichopsyllidae**	**Family Pulicidae**
Malaraeus euphorbi *	*Catallagia decipiens*	*Atyphloceras echis*	*Echidnophaga gallinaceus*
M. sinomus	*Epitedia wenmanni*		*Hoplopsyllus anomalus*
M. telchimun	*Megarthroglossus procus*	**Family Ichnospyllidae**	*Pulex irritans*
Orchopeas sexdentatus	*Meringis dipodomys*	*Nycteridopsylla vancouverensis*	*Spilopsyllus inaequalis*
Thrassis aridis	*M. hubbardi*		
T. bacchi	*M. parkeri*		
Traubella neotomae	*Rhadinopsylla heiseri*		
Order Thysanoptera – Thrips			
Family Phlaeothripidae *Leptothrips mali*	**Family Thripidae** *Frankliniella minutus*		

		Order Trichoptera – Caddice Flies		
		Family Limnephilidae *Limnephilus* sp.		
		Subphylum Myripoda		
		Class Chilopoda – Centipedes		
Family Gosibiidae *Gosibius arizonensis* *	**Family Lithobiidae** *Oabius mercurialis* *	**Family Schendylidae** *Nyctunguis stenus* *	**Family Scolopendridae** *Scolopendra heros* * *S. michelbacheri*	**Family Tampiyidae** *Abatorus allredi* * *Eremorus becki* *
		Class Diplopoda – Millipedes		
	Family Atopetholidae *Arinolus nevadae* * *A. sequens* * *Orthichelus michelbacheri* *	**Family Leioderidae** *Titsona tida* *		
		PHYLUM MOLLUSCA (MOLLUSKS)		
	Class Bivalvia – Clams		**Class Gastropoda – Snails and Slugs**	
	Family Pisidiidae *Pisidium* sp.		**Family Hydrobiidae** *Pyrgulopsis turbatrix*	
		PHYLUM NEMATA (NEMATODES)		
		Order Dorylaimida – Omnivores		
	Family Leptonchidae *Leptonchus* sp.	**Family Dorylaimidae** *Pungentus* sp.	**Family Qudsianematidae** *Ecumenicus* sp. *Ecumenicus monohystera*	
		Order Rhabditida – Insect-Parasitic		
	Family Cephalobidae *Acrobeles complexus*	**Family Elaphonamatidae** *Elaphonema* sp		
		Order Tylenchida – Plant-Parasitic		
Family Anguinidae *Ditylenchus* sp.	**Family Aphelenchidae** *Aphelenchus avenae*	**Family Aphelenchoididae** *Aphelenchoides* sp.	**Family Belonolaimidae** *Merlinius grandis*	**Family Tylenchina** *Tylenchorhynchus* 3 spp. *Tylenchorhynchus cylindricus*

sp = species (singular); spp = species (plural).
* Designates species for which the listing was unable to be verified or updated.
Source: Wills and Ostler 2001.

Table F–5 Vertebrate Animal Species (Phylum Chordata) of the Nevada National Security Site

Class Actinopterygii: Ray Finned Fish	
Order Cypriniformes – Carps	
Family Cyprinidae	
Carassius auratus	Goldfish
Order Perciformes – Perch-Like	
Family Centrarchidae	
Lepomis machrochirus	
Class Aves: Birds	
Order Anseriformes – Waterfowl	
Family Anatidae	
Aix sponsa	Wood Duck
Anas acuta	Northern Pintail
A. americana American	Wigeon
A. clypeata	Northern Shoveler
A. crecca	Green-winged Teal
A. cyanoptera	Cinnamon Teal
A. discors	Blue-winged Teal
A. platyrhynchos	Mallard
A. strepera	Gadwall
Aythya affinis	Lesser Scaup
A. americana	Redhead
A. collaris	Ring-necked Duck
A. valisineria	Canvasback
Branta Canadensis	Canada Goose
Bucephala albeola	Bufflehead
B. clangula	Common Goldeneye
Chen caerulescens	Snow Goose
Cygnus columbianus	Tundra Swan
Melanitta perspicillata	Surf Scoter
Mergus merganser	Common Merganser
M. serrator	Red-breasted Merganser
Oxyura jamaicensis	Ruddy Duck
Order Apodiformes – Swifts and Hummingbirds	
Family Apodidae	
Aeronautes saxatalis	White-throated Swift
Family Trochilidae	
Archilochus alexandri	Black-chinned Hummingbird
Calypte costae	Costa's Hummingbird
Selasphorus platycercus	Broad-tailed Hummingbird
S. rufus	Rufous Hummingbird
Order Caprimulgiformes – Goatsuckers and Allies	
Family Caprimulgidae	
Chordeiles acutipennis	Lesser Nighthawk
C. minor	Common Nighthawk
Phalaenoptilus nuttallii	Common Poorwill
Order Charadriiformes – Shorebirds, Gulls, and Alcids	
Family Charadriidae	
Charadrius alexandrinus	Snowy Plover
C. montanus	Mountain Plover
C. semipalmatus	Semipalmated Plover
C. vociferus	Killdeer
Pluvialis dominica	American Golden Plover
P. squatarola	Black-bellied Plover
Family Laridae	
Chlidonias niger	Black Tern
Larus argentatus	Herring Gull
L. californicus	California Gull
L. delawarensis	Ring-billed Gull
L. philadelphia	Bonaparte's Gull
L. pipixcan	Franklin's Gull
Sterna caspia	Caspian Tern
S. forsteri	Forster's Tern

Family Recurvirostridae	
Himantopus mexicanus	Black-necked Stilt
Recurvirostra americana	American Avocet
Family Scolopacidae	
Actitis macularia	Spotted Sandpiper
Calidris alpine	Dunlin
C. bairdii	Baird's Sandpiper
C. himantopus	Stilt Sandpiper
C. mauri Western	Sandpiper
C. melanotos	Pectoral Sandpiper
C. minutilla	Least Sandpiper
Catoptrophorus semipalmatus	Willet
Gallinago gallinago	Common Snipe
Limnodromus scolopaceus	Long-billed Dowitcher
Limosa fedoa Marbled	Godwit
Numenius americanus	Long-billed Curlew
Phalaropus lobatus	Red-necked Phalarope
P. tricolor	Wilson's Phalarope
Tringa flavipes	Lesser Yellowlegs
T. melanoleuca	Greater Yellowlegs
T. solitaria	Solitary Sandpiper
Order Ciconiiformes – Herons, Ibises, and Storks	
Family Ardeidae	
Ardea alba egretta	Great Egret
A. Herodias	Great Blue Heron
Botaurus lentiginosus	American Bittern
Bubulcus ibis	Cattle Egret
Butorides striatus *	Green-backed Heron
B. virescens	Green Heron
Egretta thula	Snowy Egret
Ixobrychus exilis	Least Bittern
Nycticorax nycticorax	Black-crowned Night-Heron
Family Ciconiidae	
Cathartes aura	Turkey Vulture
Family Threskiornithidae	
Ajaia ajaja	Roseate Spoonbill
Plegadis chihi	White-faced Ibis
Order Columbiformes – Pigeons and Allies	
Family Columbidae	
Columba livia	Rock Dove
Zenaida macroura	Mourning Dove
Order Coraciiformes – Rollers, Kingfishers, and Allies	
Family Alcedinidae	
Ceryle alcyon	Belted Kingfisher
Order Cuculiformes – Cuckoos and Allies	
Family Cuculidae	
Coccyzus americanus	Yellow-billed Cuckoo
Geococcyx californianus	Greater Roadrunner
Order Falconiformes – Diurnal Birds of Prey	
Family Accipitridae	
Accipiter cooperii	Cooper's Hawk
A. gentilis	Northern Goshawk
A. striatus	Sharp-shinned Hawk
Aquila chrysaetos	Golden Eagle
Buteo jamaicensis	Red-tailed Hawk
B. regalis	Ferruginous Hawk
B. swainsoni	Swainson's Hawk
Circus cyaneus	Northern Harrier
Haliaeetus leucocephalus	Bald Eagle
Pandion haliaetus	Osprey

Family Falconidae	
Falco mexicanus	Prairie Falcon
F. peregrinus	American Peregrine Falcon
F. sparverius	American Kestrel
Order Galliformes – Gallinaceous Birds	
Family Odontophoridae	
Callipepla gambelii	Gambel's Quail
Family Phasianidae	
Alectoris chukar	Chukar
Phasianus colchicus	Ring-necked Pheasant
Order Gaviiformes – Loons	
Family Gaviidae	
Gavia immer	Common Loon
Order Gruiformes – Rails, Cranes, and Allies	
Family Rallidae	
Fulica americana	American Coot
Gallinula chloropus	Common Moorhen
Porzana Carolina	Sora
Order Passeriformes – Perching Birds	
Family Aegithalidae	
Psaltriparus minimus	Bushtit
Family Alaudidae	
Eremophila alpestris	Horned Lark
Family Bombycillidae	
Bombycilla cedrorum	Cedar Waxwing

Family Cardinalidae	
Guiraca caerulea	Blue Grosbeak
Passerina amoena	Lazuli Bunting
P. cyanea	Indigo Bunting
Pheucticus ludovicianus	Rose-breasted Grosbeak
P. melanocephalus	Black-headed Grosbeak
Family Corvidae	
Aphelocoma californica	Western Scrub-Jay
Corvus brachyrhynchos	American Crow
C. corax sinuatus	Common Raven
Cyanocitta stelleri	Steller's Jay
Gymnorhinus cyanocephalus	Pinyon Jay
Nucifraga Columbiana	Clark's Nutcracker
Pica hudsonia	Black-billed Ma gpie
Family Emberizidae	
Amphispiza belli	Sage Sparrow
A. bilineata	Black-throated Sparrow
Calcarius lapponicus	Lapland Longspur
Chondestes grammacus	Lark Sparrow
Junco hyemalis	Dark-eyed Junco
Melospiza lincolnii	Lincoln's Sparrow
M. melodia	Song Sparrow
Passerculus sandwichensis	Savannah Sparrow
Passerella iliaca	Fox Sparrow
Pipilo chlorurus	Green-tailed Towhee
P. maculates	Spotted Towhee
Pooecetes gramineus	Vesper Sparrow
Spizella atrogularis	Black-chinned Sparrow
S. breweri	Brewer's Sparrow
S. passerine	Chipping Sparrow
Zonotrichia atricapilla	Golden-crowned Sparrow
Z. leucophrys	White-crowned Sparrow

Family Fringillidae	
Carduelis pinus pinus	Pine Siskin
C. psaltria	Lesser Goldfinch
C. tristis	American Goldfinch
Carpodacus cassinii	Cassin's Finch
C. mexicanus	House Finch
C. purpureus	Purple Finch
Coccothraustes vespertinus	Evening Grosbeak
Loxia curvirostra	Red Crossbill

Family Hirundinidae	
Hirundo rustica	Barn Swallow
Petrochelidon pyrrhonota	Cliff Swallow
Riparia riparia	Bank Swallow
Stelgidopteryx serripennis	Northern Rough-winged Swallow
Tachycineta bicolor	Tree Swallow
T. thalassina	Violet-green Swallow

Family Icteridae	
Agelaius phoeniceus	Red-winged Blackbird
Euphagus cyanocephalus	Brewer's Blackbird
Icterus bullockii	Bullock's Oriole
I. cucullatus	Hooded Oriole
I. galbula	Baltimore Oriole
I. parisorum	Scott's Oriole
Molothrus ater	Brown-headed Cowbird
Quiscalus mexicanus	Great-tailed Grackle
Q. quiscula *	Common Grackle
Sturnella neglecta	Western Meadowlark
Xanthocephalus xanthocephalus	Yellow-headed Blackbird

Family Laniidae	
Lanius ludovicianus	Loggerhead Shrike

Family Mimidae	
Dumetella carolinensis	Gray Catbird
Mimus polyglottos	Northern Mockingbird
Oreoscoptes montanus	Sage Thrasher
Toxostoma crissale	Crissal Thrasher
T. lecontei	Le Conte's Thrasher
T. rufum	Brown Thrasher

Family Motacillidae	
Anthus rubescens	American Pipit
A. spragueii	Sprague's Pipit

Family Paridae	
Baeolophus inornatus	Oak Titmouse
Poecile gambeli	Mountain Chickadee

Family Parulidae	
Dendroica coronata	Yellow-rumped Warbler
D. nigrescens	Black-throated Gray Warbler
D. pensylvanica	Chestnut-sided Warbler
D. petechia	Yellow Warbler
D. townsendi	Townsend's Warbler
Geothlypis trichas	Common Yellowthroat
Icteria virens	Yellow-breasted Chat
Oporornis tolmiei	MacGillivray's Warbler
Seiurus noveboracensis	Northern Waterthrush
Setophaga ruticilla	American Redstart
Vermivora celata	Orange-crowned Warbler
V. ruficapilla	Nashville Warbler
V. virginiae	Virginia's Warbler
Wilsonia pusilla	Wilson's Warbler

Family Passeridae	
Passer domesticus	House Sparrow

Family Ptilogonatidae	
Phainopepla nitens	Phainopepla
Family Regulidae	
Regulus calendula	Ruby-crowned Kinglet
Family Sittidae	
Sitta canadensis	Red-breasted Nuthatch
S. carolinensis	White-breasted Nuthatch
Family Sturnidae	
Sturnus vulgaris	European Starling
Family Sylviidae	
Polioptila caerulea	Blue-gray Gnatcatcher
P. melanura	Black-tailed Gnatcatcher
Family Thraupidae	
Piranga ludoviciana	Western Tanager
Family Troglodytidae	
Campylorhynchus brunneicapillus	Cactus Wren
Catherpes mexicanus	Canyon Wren
Cistothorus palustris	Marsh Wren
Salpinctes obsoletus	Rock Wren
Thryomanes bewickii	Bewick's Wren
Troglodytes aedon	House Wren
Family Turdidae	
Catharus guttatus	Hermit Thrush
C. ustulatus	Swainson’s Thrush
Ixoreus naevius	Varied Thrush
Myadestes townsendi	Townsend's Solitaire
Sialia currucoides	Mountain Bluebird
S. mexicana	Western Bluebird
Turdus migratorius	American Robin
Family Tyrannidae	
Contopus cooperi	Olive-sided Flycatcher
C. sordidulus	Western Wood Pewee
Empidonax difficilis	Pacific-slope Flycatcher
E. hammondii	Hammond's Flycatcher
E. oberholseri	Dusky Flycatcher
E. wrightii	Gray Flycatcher
Myiarchus cinerascens	Ash-throated Flycatcher
Pyrocephalus rubinus	Vermilion Flycatcher
Sayornis nigricans	Black Phoebe
S. saya	Say's Phoebe
Tyrannus forficatus	Scissor-tailed Flycatcher
T. verticalis	Western Kingbird
T. vociferans	Cassin's Kingbird
Family Vireonidae	
Vireo gilvus	Warbling Vireo
V. solitarius	Blue-headed Vireo
V. vicinior	Gray Vireo
Order Pelecaniformes – Totipalmate Swimmers	
Family Pelecanidae	
Pelecanus erythrorhynchos	American White Pelican
P. occidentalis	Brown Pelican
Family Phalacrocoracidae	
Phalacrocorax auritus	Double-crested Cormorant

Order Piciformes – Woodpeckers and Allies	
Family Picidae	
Colaptes auratus	Northern Flicker
Melanerpes lewis	Lewis's Woodpecker
Picoides scalaris	Ladder-backed Woodpecker
P. villosus	Hairy Woodpecker
Sphyrapicus nuchalis	Red-naped Sapsucker
S. thyroideus	Williamson's Sapsucker
S. varius	Yellow-bellied Sapsucker
Order Podicipediformes – Grebes	
Family Podicipedidae	
Aechmophorus occidentalis	Western Grebe
Podiceps nigricollis	Eared Grebe
Podilymbus podiceps	Pied-billed Grebe
Order Strigiformes – Owls	
Family Strigidae	
Asio flammeus	Short-eared Owl
A. otus	Long-eared Owl
Athene cunicularia	Burrowing Owl
Bubo virginianus	Great Horned Owl
Family Tytonidae	
Tyto alba	Barn-Owl
Class Lissamphibia: Amphibians	
Order Anura – Frogs and Toads	
Family Ranidae	
Rana catesbeiana	Bullfrog
Order Caudata – Salamanders and Newts	
Family Ambystomatidae	
Ambystoma tigrinum	Tiger Salamander
Class Mammalia: Mammals	
Order Artiodactyla – Hoofed Mammals	
Family Antilocapridae	
Antilocapra americana	Pronghorn Antelope
Family Bovidae	
Bos taurus	Cow
Ovis Canadensis nelsoni	Bighorn Sheep
Family Cervidae	
Cervus elaphus	Elk
Odocoileus hemionus	Mule Deer
Order Carnivora – Carnivores	
Family Canidae	
Canis latrans	Coyote
Urocyon cinereoargenteus	Grey Fox
Vulpes macrotis	Kit Fox
Family Felidae	
Felis concolor	Mountain Lion
Lynx rufus	Bobcat
Family Mustelidae	
Mustela frenata	Long-tailed Weasel
Spilogale putorius	Western Spotted Skunk
Taxidea taxus	Badger
Family Procyonidae	
Bassariscus astutus	Ring-tailed Cat

Order Chiroptera – Bats	
Family Molossidae	
Tadarida brasiliensis	Brazilian Free-tailed Bat
Family Vespertilionidae	
Antrozous pallidus	Pallid Bat
Order Rodentia	Rodents
Eptesicus fuscus	Big Brown Bat
Euderma maculatum	Spotted Bat
Lasionycteris noctivagans	Silver-haired Bat
Lasiurus blossevillii	Western Red Bat
L. cinereus	Hoary Bat
Myotis californicus	California Bat
M.Ciliolabrum	Small-footed Myotis
M. evotis	Long-eared Myotis
M. thysanodes	Fringed Myotis
M. volans	Long-legged Myotis
M. yumanensis	Yuma Myotis
Pipistrellus hesperus	Western Pipistrelle Bat
Order Insectivora – Shrews and Moles	
Family Soricidae	
Notiosorex crawfordi	Desert Shrew
Sorex merriami	Merriam's Shrew
S. tenellus	Inyo Shrew
Order Lagomorpha – Pikas, Rabbits and Hares	
Family Leporidae	
Lepus californicus	Black-tailed Jackrabbit
Sylvilagus audubonii	Desert Cottontail
S. nuttallii	Mountain Cottontail
Order Perissodactyla – Horses	
Family Equidae	
Equus asinus	Burro
E. caballus	Horse

Order Rodentia	
Family Cricetidae	
Lagurus curtatus	Sagebrush Vole
Family Erethizontidae	
Erethizon dorsatum	Porcupine
Family Geomyidae	
Thomomys bottae	Botta's Pocket Gopher
T. umbrinus	Pygmy Pocket Gopher
Family Heteromyidae	
Chaetodipus formosus	Longtail Pocket Mouse
Dipodomys deserti	Desert Kangaroo Rat
D. merriami	Merriam's Kangaroo Rat
D. microps	Great Basin Kangaroo Rat
D. ordii	Ord Kangaroo Rat
Microdipodops megacephalus	Dark Kangaroo Mouse
Perognathus longimembris	Little Pocket Mouse
P. parvus	Great Basin Pocket Mouse
Family Muridae	
Neotoma lepida	Desert Woodrat
Onychomys torridus	Southern Grasshopper Mouse
Peromyscus crinitus	Canyon Mouse
P. eremicus	Cactus Mouse
P. maniculatus	Deer Mouse
P. truei	Pinon Mouse
Reithrodontomys megalotis	Western Harvest Mouse
Family Sciuridae	
Ammospermophilus leucurus	White-tailed Antelope-squirrel
Eutamias dorsalis	Cliff Chipmunk
Spermophilus tereticaudus	Round-tailed Ground Squirrel
S. townsendii	Towsend's Ground Squirrel
S. variegatus	Rock Squirrel

Class Reptilia: Lizards, Snakes and Tortoises

Order Squamata – Lizards and Snakes

Suborder Lacertilia Lizards

Family Crotaphytidae	
Crotaphytus insularis	Great Basin Collared Lizard
Gambelia wislizenii	Long-nosed Leopard Lizard
Family Gekkonidae	
Coleonyx variegatus	Desert Banded Gecko
Family Helodermatidae	
Heloderma suspectum *	Banded Gila Monster
Family Iguanidae	
Dipsosaurus dorsalis	Desert Iguana
Sauromalus obesus	Chuckwalla
Family Phrynosomatidae	
Callisaurus draconoides	Common Zebra-tailed Lizard
Phrynosoma platyrhinos	Desert Horned lizard
Sceloporus graciosus	Sagebrush Lizard
S. magister	Yellow-backed Spiny Lizard
S. occidentalis	Western Fence Lizard
Uta stansburiana	Side-blotched Lizard
Family Scincidae	
Eumeces gilberti	Gilbert's Skink
Eumeces gilberti rubricaudatus	Western red-tailed skink
E. skiltonianus	Western Skink
Family Teiidae	
Cnemidophorus tigris	Western Whiptail Lizard
Family Xantusidae	
Xantusia vigilis	Desert Night Lizard

Suborder Serpentes – Snakes

Family Colubridae	
Arizona elegans	Desert Glossy Snake
Chionactis occipitalis	Nevada Shovel-nosed Snake
Diadophis punctatus	Ring-necked Snake
Hypsiglena torquata	Night Snake
Lampropeltis getula	California Kingsnake
Masticophis flagellum	Red Racer
M. taeniatus	Desert Striped Whipsnake
Phyllorhynchus decurtatus	Western Leaf-Nosed Snake
Pituophis catenifer	Great Basin Gopher Snake
Rhinocheilus lecontei	Western Long-nosed Snake
Salvadora hexalepis	Mohave Patch-nosed Snake
Sonora semiannulata	Great Basin Ground Snake
Tantilla hobartsmithi	Southwestern Black-headed Snake
Trimorphodon biscutatus	Western Lyre Snake
Family Leptotyphlopidae	
Leptotyphlops humilis	Western Slender Blind Snake
Family Viperidae	
Crotalus cerastes	Mojave Desert Sidewinder
C. mitchellii	Panamint Rattlesnake

Order Testudines – Turtles and Tortoises

Family Testudinidae	
Gopherus agassizii	Desert Tortoise

Source: Wills and Ostler 2001.

F.3 References

Anderson, D. C., and W. K. Ostler, 2009, *Distribution of Sensitive Plants on the Nevada Test Site*, DOE/NV/25946-631, January.

NSTec (National Security Technologies, LLC), 2010, *Ecological Monitoring and Compliance 2009 Report*, DOE/NV/25946--946, Ecological Services, Las Vegas, Nevada, July.

Ostler, W. K., D. J. Hansen, D. C. Anderson, and D. B. Hall, 2000, *Classification of Vegetation on the Nevada Test Site*, DOE/NV/11718-477, Ecological Services, Bechtel Nevada, Las Vegas, Nevada, December.

Wills, C. A., and W. K. Ostler, 2001, *Ecology of the Nevada Test Site: An Annotated Bibliography*, DOE/NV/11718-594, Ecological Services, Bechtel Nevada, Las Vegas, Nevada, December.

Nevada Administrative Code

NAC 503, "Hunting, Fishing and Trapping: Miscellaneous Protective Measures."

United States Code

16 U.S.C. 668 et seq., Bald and Golden Eagle Protection Act.

16 U.S.C. 703 et seq., Migratory Bird Treaty Act.

16 U.S.C. 1331 et seq., Wild Free-Roaming Horses and Burros Act.

16 U.S.C. 1531 et seq., Endangered Species Act.

APPENDIX G
HUMAN HEALTH IMPACTS

APPENDIX G
HUMAN HEALTH IMPACTS

G.1 Background

G.1.1 Radiation

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* provides the reader with the following information regarding the nature of radiation, the consequences of exposure to radiation, and the basic concepts used to evaluate the health effects resulting from radiation exposure.

Radiation is energy and/or mass transferred in the form of particles or waves. Globally, human beings are exposed constantly to radiation from cosmic sources (outer space); terrestrial sources, such as the Earth's rocks and soils; and radionuclides that are naturally present in the human body. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

All matter in the universe is composed of atoms. Radiation comes from the activity of tiny particles within an atom. An atom consists of a positively charged nucleus (the central part of an atom) and a number of negatively charged electron particles that orbit the nucleus. There are two types of particles in the nucleus: neutrons, which are electrically neutral, and protons, which are positively charged. Atoms with different numbers of protons are known as elements. There are more than 100 natural and manmade elements. An element has equal numbers of electrons and protons. When atoms of an element differ in their number of neutrons, they are called isotopes of that element. All elements have three or more isotopes, some or all of which could be unstable (i.e., change over time).

Unstable isotopes undergo spontaneous change, known as radioactive disintegration or radioactive decay. The process of continuously undergoing spontaneous disintegration is called radioactivity. The radioactivity of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. An isotope's half-life is a measure of its decay rate. For example, an isotope with a half-life of 8 days will lose one-half of its radioactivity in that amount of time. In 8 more days, one-half of the remaining radioactivity will be lost, and so on. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements vary from millionths of a second to millions of years.

As unstable isotopes change into more-stable forms, they emit energy and/or particles (mass). A particle may be an alpha particle (a helium nucleus), a beta particle (an electron), or a neutron, with various levels of kinetic energy. Sometimes these particles are emitted in conjunction with gamma rays. The particles and gamma rays are referred to as "ionizing radiation." Ionizing radiation means that the particles and gamma rays can ionize, or electrically charge, an atom by stripping off one or more of its electrons. Even though gamma rays do not carry an electrical charge, they can ionize atoms by ejecting electrons as they pass through an element, indirectly causing ionization. Ionizing radiation can change the chemical composition of many things, including living tissue (organs), which can affect the way they function.

When a radioactive isotope of an element emits a particle, it changes to an entirely different element or isotope, one that may or may not be radioactive. Eventually, a stable element is formed. This transformation, which may take several steps, is known as a decay chain. For example, radium, a member of the radioactive decay chain of uranium-238, has a half-life of 1,600 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays first to polonium, then through a series of further decay steps to bismuth, and ultimately to a stable isotope of lead. The characteristics of various forms of ionizing radiation are briefly described below.

- Alpha (α) particles – Alpha particles are the heaviest type of ionizing radiation. They can travel only a few centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can be stopped easily by a sheet of paper or by the skin's surface.

- Beta (β) particles – Beta particles are much (7,300 times) lighter than alpha particles. They can travel a longer distance than alpha particles in the air. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

- Gamma (γ) rays – Gamma rays (and x-rays), unlike alpha or beta particles, are a form of electromagnetic radiation, similar to, but more energetic than, visible light. Gamma rays travel at the speed of light. Gamma radiation is very penetrating and requires a large mass, such as a thick wall of concrete, lead, or steel, to stop it.

- Neutrons (n) – Neutrons are particles that contribute to radiation exposure both directly and indirectly. The most prolific source of neutrons is a nuclear reactor. Indirect radiation exposure occurs when gamma rays and alpha particles are emitted following neutron capture in matter. A neutron has about one-quarter the mass of an alpha particle. It will travel in the air until it is absorbed by another element.

G.1.1.1 Radiation Measurement Units

During the early days of radiological experimentation, there was no precise measurement unit for radiation. Therefore, various units were used to identify the amount, type, and intensity of radiation. Amounts of radiation or its effects can be measured in units of curies, radiation absorbed dose (rad), or dose equivalent (roentgen equivalent man, or rem). These units are described below.

- Curie – The curie, named after the scientists Marie and Pierre Curie, describes the "intensity" or activity of a sample of radioactive material. The rate of decay of 1 gram of radium was the basis of this unit of measure. Because the measured decay rate kept changing slightly as measurement techniques became more accurate, 1 curie was subsequently defined as exactly 37 billion disintegrations (decays) per second.

- Rad – The rad is used to measure the physical absorption of radiation. The total energy absorbed per unit quantity of tissue is referred to as the "absorbed dose" (or simply dose). As sunlight heats pavement by giving up an amount of energy to it, radiation similarly gives up energy to objects in its path. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joules of energy per kilogram of absorbing material (a joule is a metric unit of energy, equivalent to 1 watt-second or 0.239 calories of energy per kilogram of absorbing material).

- Rem – The rem is used to measure dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor (the biological effectiveness of a given type of radiation) and possibly other modifying factors. The rem is used to measure the effects of radiation on the body similar to the way degrees Celsius or Fahrenheit (°C or °F) are used to measure the effects of sunlight heating pavement. Thus, 1 rem from one type of radiation is presumed to have the same biological effects as 1 rem from any other kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation. One-thousandth of a rem is called a millirem.

- Person-rem – The person-rem is used to measure collective radiation dose, i.e., the sum of the individual doses received by a population or group from exposure to a specified source of radiation.

The units of measure for radiation in the International System of Units are becquerels (used to measure source intensity [activity]), grays (used to measure absorbed dose), and sieverts (used to measure dose equivalent).

Equivalent Radiation Units in the International System of Units

Traditional Unit	International System Unit
1 curie	3.7×10^{10} becquerels (Bq)
1 rad	0.01 grays (Gy)
1 rem	0.01 sieverts (Sv)

An individual may be exposed to ionizing radiation externally (from a radioactive source outside the body) or internally (from ingesting or inhaling radioactive material). The external dose is different from the internal dose because an external dose is delivered only during the actual time of exposure to the external radiation source, while an internal dose continues to be delivered as long as the radioactive source is in the body. The dose from internal exposure is typically calculated over 50 years following the initial exposure. Both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time.

Doses projected from normal operations and from accidents are reported in terms of total effective dose equivalent, the sum of the effective dose equivalent due to penetrating radiation from sources external to the body and the committed effective dose equivalent from internal deposition of radionuclides. The committed effective dose equivalent is an estimate of the radiation dose to a person resulting from inhalation or ingestion of radioactive material that takes into account the radiation sensitivities of different organs and the time (up to 50 years) a particular substance stays in the body (further discussed in Section G.1.1.3).

G.1.1.2 Sources of Radiation

The average American receives a total dose of approximately 620 millirem per year from all sources of radiation, both natural and manmade (see **Table G–1**); approximately 311 millirem per year of this total are from natural sources (NCRP 2009). The sources of radiation can be divided into six different categories: (1) cosmic radiation, (2) external terrestrial radiation, (3) internal radiation, (4) medical diagnosis and therapy, (5) consumer products, and (6) other sources. These categories are discussed in the following paragraphs.

Table G–1 Ubiquitous Background and Manmade Sources of Radiation Exposure to Individuals Unrelated to the Nevada National Security Site

Source	*Effective Dose (millirem per year)* [a]
Ubiquitous Background	**311**
Cosmic radiation	33
External terrestrial radiation	21
Internal radiation (other than radon)	29
Radon	228
Medical	**300**
Computed tomography	147
Radiography, fluoroscopy	76
Nuclear medicine	77
Consumer	**13**
Other	**less than 1**
Total (rounded)	**620**

[a] Averages for an individual in the U.S. population.
Source: NCRP 2009.

Cosmic radiation. Cosmic radiation is ionizing radiation resulting from the energetic charged particles from space that continuously hit the Earth's atmosphere. These particles, as well as the secondary particles and photons they create, constitute cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with the altitude above sea level. The average dose to a person in the United States from this source is approximately 33 millirem per year.

External terrestrial radiation. External terrestrial radiation is the radiation emitted from the radioactive materials in the Earth's rocks and soils. The average individual dose from external terrestrial radiation is approximately 21 millirem per year.

Internal radiation. Internal radiation results from inhalation or ingestion of natural radioactive material. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon, which contribute approximately 228 millirem per year. The average individual dose from other internal radionuclides is approximately 29 millirem per year.

Medical diagnosis and therapy. Radiation is an important tool for the diagnosis and treatment of medical conditions and illnesses. Diagnostic x-rays, including fluoroscopy and computed tomography, result in an average dose of 223 millirem per year. Nuclear medical procedures result in an average dose of 77 millirem per year.[1]

Consumer products. Consumer products also contain sources of ionizing radiation. In some products, such as smoke detectors and airport x-ray machines, the radiation source is essential to the product's operation. In other products, such as televisions and tobacco, the user is incidentally exposed to radiation as the products function. The average dose from consumer products is approximately 13 millirem per year.

[1] *Exposures from nuclear diagnostic and medical procedures vary over a wide range, depending on the procedure. The reported values are average annual doses in the U.S. population (NCRP 2009).*

Other sources. There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The dose from nuclear fuel cycle facilities (e.g., uranium mines, mills, and fuel processing plants) and nuclear power plants has been estimated to be less than 1 millirem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 millirem per year to the average dose to an individual. Air travel contributes approximately 1 millirem per year to the average dose.

G.1.1.3 Exposure Pathways

As stated earlier, an individual may be exposed to ionizing radiation both externally and internally. The different routes that could lead to radiation exposure are called exposure pathways. Each type of exposure and its associated exposure pathways are discussed separately in the following paragraphs.

External exposure. External exposure results from exposure to radiation outside the body via any of several different pathways, including exposure to a cloud of radiation passing over the receptor (an exposed individual), standing on ground that is contaminated with radioactivity, and swimming or boating in contaminated water. If the receptor departs from the source of radiation exposure, the dose rate will decrease. It was assumed that external exposure occurs uniformly during the year. The appropriate dose measure for external pathways is called the effective dose equivalent.

Internal exposure. Internal exposure results from a radiation source entering the human body through either inhalation of contaminated air or ingestion of contaminated food or water. In contrast to external exposure, once a radiation source enters the body, it remains there for a period of time that varies depending on its biological half-life (the time required for a radioactive material taken in by a living organism to be reduced to half the initial quantity by a combination of biological elimination processes and radioactive decay). The absorbed dose to each organ of the body is calculated for a period of 50 years following the intake. Various organs have different susceptibilities to harm from radiation. The calculated absorbed dose is called the committed dose equivalent; this quantity takes these different susceptibilities into account and provides a broad indicator of the risk to the health of an individual from radiation. The committed effective dose equivalent is a weighted sum of the committed dose equivalent in each major organ or tissue. The concept of committed effective dose equivalent applies only to internal pathways.

G.1.1.4 Radiation Protection Guides

Various organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection (ICRP). The ICRP is responsible for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations that address basic principles of radiation protection, leaving to the various national protection committees the responsibility to prepare detailed technical regulations, recommendations, or codes of practice that are best suited to the needs of their countries.

National Council on Radiation Protection and Measurements. In the United States, this council is the national organization responsible for adapting and providing detailed technical guidelines to implement ICRP recommendations. The council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

National Research Council/National Academy of Sciences. The National Research Council, which functions under the auspices of the National Academy of Sciences, integrates the broad science and technology community with the Academy's mission to further knowledge and advise the Federal Government. The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR Committee) prepares reports to advise the Federal Government on the health consequences of radiation exposure.

U.S. Environmental Protection Agency (EPA). EPA has published a series of documents under the title *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a regulatory benchmark by a number of Federal agencies, including the U.S. Department of Energy (DOE), for the purpose of limiting public and occupational workforce exposures to the greatest extent possible.

U.S. Nuclear Regulatory Commission (NRC). NRC regulates source materials, special nuclear materials, and byproduct materials used by commercial entities, such as nuclear power plants, either directly or through state agreements. NRC has promulgated "Standards for Protection Against Radiation" in Title 10 of the *Code of Federal Regulations* (CFR), Part 20 (10 CFR Part 20), which apply to commercial uses of the materials listed above.

U.S. Department of Energy. DOE establishes requirements for radiological protection at DOE sites in regulations and orders. Requirements for worker protection are included in "Occupational Radiation Protection (10 CFR Part 835). Radiological protection of the public and environment is addressed in *Radiation Protection of the Public and the Environment* (DOE Order 458.1).

G.1.1.5 Radiation Exposure Limits

Radiation exposure limits for members of the public and radiation workers are derived from ICRP recommendations. EPA uses National Council on Radiation Protection and Measurements and ICRP recommendations to set specific annual exposure limits (usually lower than those specified by the ICRP) in its radiation protection guidance to Federal agencies. Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and EPA for radiation workers and members of the public are given in **Table G–2**.

Table G–2 Radiation Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (Organization)	*Public Exposure Limits at the Site Boundary*	*Worker Exposure Limits*
10 CFR Part 835 (DOE)	–	5,000 millirem per year [a]
10 CFR 835.1002 (DOE)	–	1,000 millirem per year [b]
DOE Order 458.1 (DOE) [c]	100 millirem per year (all pathways)	–
40 CFR Part 61, Subpart H (EPA)	10 millirem per year (all air pathways)	–
40 CFR Part 141 (EPA)	4 millirem per year (drinking-water pathway)	–

CFR = *Code of Federal Regulations*; EPA = U.S. Environmental Protection Agency.

[a] Although this measurement is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with as low as reasonably achievable principles. Refer to footnote b.

[b] This measurement is a control level. DOE established this level to assist in achieving its goal of maintaining radiation doses as low as reasonably achievable. DOE recommends that facilities adopt a more-limiting 500-millirem-per-year Administrative Control Level (DOE 2008). Facility operators must make reasonable attempts to maintain individual worker doses below these levels.

[c] Consistent with 10 CFR Part 20. DOE Order 458.1 invokes the requirements of 40 CFR Part 61, Subpart H, and 40 CFR Part 141 for the air pathway and drinking water, respectively.

G.1.1.6 Human Health Effects due to Exposure to Radiation

To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects. Radiation can cause a variety of damaging health effects in humans. The most significant effects are induced cancer fatalities, called latent cancer fatalities (LCFs) because the onset of cancer may take many years to develop after the radiation dose is received. In this site-wide environmental impact statement (SWEIS), LCFs are used to measure the estimated risk due to radiation exposure.

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. Cancer is caused by both external factors (tobacco, infectious organisms, chemicals, and radiation) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). For the U.S. population of about 310 million, the American Cancer Society estimated that, in 2010, about 1,529,560 new cancer cases would be diagnosed and about 569,490 cancer deaths would occur. Approximately one-third of U.S. cancer deaths are estimated to be caused by tobacco use and about one-third are related to overweight or obesity, physical inactivity, and poor nutrition. The average U.S. resident has about 4 chances in 10 of developing an invasive cancer over his or her lifetime (44 percent probability for males, 38 percent for females). Nearly 25 percent of all deaths in the United States are due to cancer (American Cancer Society 2010).

The National Research Council's BEIR Committee has prepared a series of reports to advise the Federal Government on the health consequences of radiation exposure. Based on its 1990 report, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V* (National Research Council 1990), the former Committee on Interagency Radiation Research and Policy Coordination recommended cancer risk factors of 0.0005 per rem for the public and 0.0004 per rem for working-age populations (CIRRPC 1992). In 2002, the Interagency Steering Committee on Radiation Standards (ISCORS) recommended that Federal agencies use conversion factors of 0.0006 fatal cancers per rem for mortality and 0.0008 cancers per rem for morbidity when making qualitative or semi-quantitative estimates of risk from radiation exposure to members of the general public. No separate values were recommended for workers. The DOE Office of Environmental and Policy Guidance subsequently recommended that DOE personnel and contractors use the risk factors recommended by ISCORS, stating that, for most purposes, the value for the general population (0.0006 fatal cancers per rem) could be used for both workers and members of the public in National Environmental Policy Act (NEPA) analyses (DOE 2003).

Recent publications by both the BEIR Committee and the ICRP support the continued use of the ISCORS-recommended risk values. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (National Research Council 2006) reported fatal cancer risk factors of 0.00048 per rem for males and 0.00066 per rem for females in a population with an age distribution similar to that of the entire U.S. population (average value of 0.00057 per rem for a population with equal numbers of males and females). ICRP Publication 103 (Valentin 2007) recommends nominal cancer risk coefficients of 0.00041 and 0.00055 per rem for adults and the general population, respectively, and estimates the risk from heritable effects to be about 3 to 4 percent of the nominal fatal cancer risk (see **Table G–3**).

Accordingly, a risk factor of 0.0006 LCFs per rem was used in this SWEIS to estimate risk due to radiation doses from normal operations and accidents. For high individual doses (greater than or equal to 20 rem), the health risk factor was multiplied by 2 (NCRP 1993).

Using the risk factors discussed above, a calculated dose can be used to estimate the risk of an LCF. For example, if each member of a population of 100,000 people were exposed to a one-time dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem (100,000 persons times 0.1 rem).

Using the risk factor of 0.0006 LCFs per person-rem, this collective dose is expected to cause 6 additional LCFs in this population (10,000 person-rem times 0.0006 LCFs per person-rem).

Table G–3 Nominal Health Risk Estimators Associated with Exposure to Ionizing Radiation [a]

Exposed Population	*Cancer* [b]	*Genetic Effects*	*Total*
Worker (adult) [c]	0.00041	0.00001	0.00042
Whole	0.00055	0.00002	0.00057

[a] Risk per rem (individual dose) or person-rem (population dose). For individual doses equal to or greater than 20 rem, the health risk estimators are multiplied by 2.
[b] Risk of all cancers, adjusted for lethality and quality-of-life impacts.
[c] Ages 18–64 years.
Source: Valentin 2007:Table A.4.4.

Calculations of the number of LCFs sometimes do not yield whole numbers and may yield a number less than 1. For example, if each individual of a population of 100,000 people were to receive an annual dose of 1 millirem (0.001 rem), the collective dose would be 100 person-rem, and the corresponding risk of an LCF would be 0.06 (100,000 persons times 0.001 rem times 0.0006 LCFs per person-rem). A fractional result should be interpreted as a statistical estimate. That is, 0.06 is the average number of LCFs expected if many groups of 100,000 people were to experience the same radiation exposure situation. For most groups, no LCFs would occur; in a few groups, 1 LCF would occur; in a very small number of groups, 2 or more LCFs would occur. The average number of LCFs over all of the groups would be 0.06 (just like the average of 0, 0, 0, and 1 is 1 divided by 4, or 0.25). In the preceding example, the most likely outcome for any single group would be 0 LCFs. In this SWEIS, LCFs calculated for a population are presented as both the rounded whole number, representing the most likely outcome for that population, and the calculated statistical estimate of risk, which is presented in parentheses.

The numerical estimates of LCFs presented in this SWEIS were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality resulting from a dose of 0.1 grays (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of LCFs. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation. However, a comprehensive review of available biological and biophysical data supports a "linear no-threshold" risk model in which the risk of cancer proceeds in a linear fashion at lower doses without a threshold and the smallest dose has the potential to cause a small increase in risk to humans (National Research Council 2006).

G.1.2 Chemicals

The reprocessing of nuclear fuels, the manufacture of nuclear materials, and the processing of fuel cycle waste entail the use of chemicals. Some of the more-hazardous chemicals could pose risks to human health, even to the point of being fatal, if they are accidentally released to the environment or if they come into contact with workers in an occupational setting. The risks from exposure are of two general types: toxic, noncarcinogenic (non-cancer-causing) effects and cancer-inducing effects. In addition, the presence of some chemicals may pose a physical hazard to humans, such as chemical burns of the skin or internal organs, explosions or thermal hazards, displacement of oxygen, or runaway chemical reactions that cause high-energy release events.

G.1.2.1 Toxic or Hazardous Chemical

Nearly every chemical that exists can be detrimental to human health under specific exposure conditions. A large number, both carcinogenic (cancer-causing) and noncarcinogenic, are specifically addressed in Occupational Safety and Health Administration (OSHA) regulations. The exposure limit or guideline for any given substance depends on the basic toxic or hazardous properties of the material; its physical properties (solid, liquid, gas, or vapor); the circumstances of exposure (inhalation, consumption of water or food, or contact with soil or contaminated surfaces); and whether the exposure occurs at a low rate during normal operations or at a high rate as a result of an accident. Occupational exposure limitations and other controls for specific toxic or hazardous chemicals are provided in various sections of the "Occupational Safety and Health Standards" (29 CFR Part 1910). Acute exposure concentration guidelines for more than 3,000 chemicals have been developed by DOE and others for use in hazard analysis and emergency planning and response (DOE 2008).

G.1.2.2 Chemical Usage

Chemical usage categories include process chemicals and nonprocess chemicals that support and maintain waste management operations. Process chemicals are those required in the direct processing of waste. The specific chemicals used depend on the specific processes chosen. The waste being processed, with its various chemical constituents, also falls into the category of process chemicals. Nonprocess chemicals that support and maintain waste management operations are typically cleaning fluids and lubricants.

G.1.2.3 Exposure Pathways

To cause toxic effects on human biological systems, chemicals must make contact with or be introduced into the body. There are three general means of entry into the body: inhalation, ingestion, and dermal (skin) contact. The effects through a particular pathway depend essentially on the properties of the toxic chemical, its concentration in one or more environmental media (air, water, and soil), and human behavior. Exposure may be dominated by contact with chemicals in a single medium or may reflect concurrent contacts with multiple media.

G.1.2.4 Chemical Exposure Limits and Criteria

Exposure to chemicals in occupational settings is limited to levels within applicable OSHA Permissible Exposure Limits (29 CFR Part 1910) or the American Conference of Governmental Industrial Hygienists Threshold Limit Values (ACGIH 2002). Exposures are typically maintained below the levels specified in these references by either engineered controls or the use of protective equipment.

The flammable and explosive hazards associated with chemicals are typically controlled through standards promulgated by OSHA (29 CFR 1910.106). These standards address chemical storage and labeling, as well as the information required to be provided to the worker.

For accidental airborne releases of hazardous chemicals into the environment, DOE has specified criteria to be used as indicators of human health impacts resulting from acute exposures (DOE Guide 151.1–2). For each specific hazardous chemical of concern, criteria are drawn from one of the following systems (listed in order of preference): the Acute Exposure Guideline Levels (AEGLs) promulgated by EPA; the Emergency Response Planning Guidelines (ERPGs), published by the American Industrial Hygiene Association; and the Temporary Emergency Exposure Limits (TEELs), developed by DOE. The system of AEGLs includes values for five exposure periods, ranging from 10 minutes to 8 hours. However, the ERPG and TEEL systems provide values only for exposures of 1 hour. To allow the systems to be used together, DOE has specified that the 1-hour (60-minute) AEGL values are to be used. For the chemicals addressed by each system, three exposure levels (i.e., thresholds), expressed in terms of airborne concentrations, have been developed. Although the specific definitions vary slightly between the systems, the levels of human health impact associated with exposure for 1 hour to each airborne concentration level can be paraphrased as follows: exposures of up to 1 hour at or below level 1 may result in mild, transient, adverse health effects; exposures of up to 1 hour above level 1 and up to level 2 should not result in irreversible or other serious health effects or symptoms that could impair a person's ability to take protective action; exposures of up to 1 hour above level 2 and up to level 3 should not result in an experience or development of life-threatening health effects; and exposures of up to 1 hour above level 3 could result in life-threatening health effects or death. DOE has specified that level 2 is the threshold above which unacceptable human health effects may be experienced. At concentrations above level 2, action should be taken to avoid, reduce, or mitigate human exposure. Level 3 has been identified as the threshold above which severe human health effects are expected.

G.1.2.5 Health Effects of Hazardous Chemical Exposure

Various chemicals invoke different types of damage to human biological systems. The harm may even vary according to the sensitivity of each individual person exposed. Hazardous chemical releases from routine operations generally are expected to result in concentrations below levels that would cause acute toxic health effects. Acute toxic health effects generally result from short-term exposure to relatively high concentrations of the toxic contaminant, such as those resulting from accidental releases. Long-term exposure to lower concentrations can produce adverse chronic health effects, both carcinogenic and noncarcinogenic. Excess incidences of cancer are the endpoint of carcinogenic effects. However, a spectrum of chemical-specific noncancer health effects (e.g., headaches, skin irritation, neurotoxicity, immunotoxicity, reproductive and genetic toxicity, liver/kidney toxicity, and developmental toxicity) could be observed due to exposure to noncarcinogenic compounds.

G.2 Radiological Impacts from Normal Operations

Estimated public radiological impacts from normal operations were determined via two separate modes: (1) the use of established dose information contained in recent documentation, including annual site environmental reports and National Emission Standards for Hazardous Air Pollutants (NESHAPs) reports; and (2) the modeling of additional sources that have not been explicitly analyzed in such reporting mechanisms. Total estimated impacts from these two modes were then summed to provide a high-sided projected aggregate of the impacts that could be incurred by the public from the alternatives analyzed in this SWEIS. The GENII [Hanford Environmental Radiation Dosimetry Software System] Version 2 (GENII-2) computer code (PNNL 2007), described in Section G.6.1, was used to model impacts from normal operations that result in more-chronic emissions. The MACCS2 [MELCOR Accident Consequences Code System] Version 1.13.1 computer code, discussed in Section G.6.2, is usually used to evaluate the impacts of accidents. It was used to assess certain normal operational impacts that are expected from planned activities such as detonations involving depleted uranium at the Big Explosives Experimental Facility (BEEF), as well as tracer experiments (for more information on these activities, see the descriptions provided in Chapter 3 and Appendix A of this SWEIS). Although MACCS2 is not conventionally utilized for modeling normal operational impacts, it was deemed more appropriate for modeling depleted uranium detonation and tracer experiment scenarios than GENII-2 due to the acute nature of the scenarios' associated puff releases.

Radiological impacts of chronic releases during normal operations were calculated using GENII-2 (PNNL 2007). Site-specific input data were used, including location, meteorology, population, and source terms.

G.2.1 GENII-2 Input Data

To perform dose assessments for this SWEIS, different types of data were collected or generated. This section discusses the various data and the assumptions that were made in performing the dose assessments.

Normal operational dose assessments were modeled for members of the general public for the Nevada National Security Site (NNSS) Dense Plasma Focus Facility (DPFF) and the North Las Vegas Facility (NLVF) to determine the incremental doses that would be associated with operations at these facilities under the alternatives addressed in this SWEIS. Incremental doses for members of the public were calculated (via GENII-2) for two different types of receptors:

- Maximally exposed individual (MEI) – The MEI for air releases was assumed to be an individual member of the public located at a position on the site boundary that would yield the highest impacts during normal operations. For a given facility (or point of release), the specific MEI location may be different than the MEI location for another facility. The MEI locations that were used for GENII-2 modeling were 9.1 miles due east of BEEF (Expanded Operations Alternative) and 1.4 miles due east of the Area 5 Radioactive Waste Management Complex (RWMC) (No Action and Reduced Operations Alternatives) for DPFF and 0.06 miles due east of NLVF. (See Section G.2.1.4 for MEI locations.)

- Population – The general population living within 50 miles of DPFF (conservatively modeled from the nearby Area 5 RWMC) and NLVF. (See Section G.2.1.2 for population distributions.)

G.2.1.1 Meteorological Data

The NNSS meteorological data used for modeling normal operational scenarios using GENII-2 were in one of two formats that are compatible with the code: joint frequency distribution format or SAMSON [Solar and Meteorological Surface Observational Network] format (PNNL 2007). The joint frequency distribution files were based on measurements taken over a period of 5 years (2004 to 2008) at the NNSS. The joint frequency distribution data from Meteorological Station 5 (located in Area 5) are presented in **Table G–4**. The data in Table G–4 are provided in terms of percentages, for which each value represents the fraction of time the wind blows in a certain direction, in a certain windspeed category, and within a certain stability class. For modeling emissions from NLVF, hourly data files (in SAMSON format) for the city of Las Vegas were acquired from EPA's website (EPA 2010). The most recently available 5 years of data (1986 to 1990) were used to provide an average representation for Las Vegas meteorology.

Table G–4 Joint Frequency Distribution Data Files Used for Normal Operational Analyses at the Nevada National Security Site

Nevada National Security Site Meteorological Station 5 (2004–2008) Data Collected at a 10-Meter Height																	
Average Windspeed (m/s)	***SC***	***Wind Direction (from)***															
		N	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***	***S***	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***
0.77	A	0.13	0.12	0.1	0.08	0.03	0.06	0.05	0.08	0.13	0.17	0.16	0.19	0.2	0.14	0.14	0.2
	B	0.81	0.66	0.51	0.34	0.29	0.27	0.34	0.32	0.42	0.6	0.74	0.76	0.92	1.01	1	0.88
	C	0.09	0.08	0.1	0.1	0.14	0.08	0.09	0.07	0.1	0.09	0.13	0.13	0.09	0.07	0.11	0.12
	D	0.1	0.11	0.09	0.06	0.1	0.04	0.07	0.07	0.06	0.09	0.09	0.1	0.1	0.13	0.16	0.12
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0.29	0.32	0.32	0.47	0.57	0.49	0.44	0.33	0.26	0.33	0.4	0.3	0.2	0.2	0.28	0.28
	G	1.84	1.84	2.03	2.44	3.18	2.68	2.45	1.76	1.74	1.99	2.54	2.24	1.8	1.69	1.71	1.75
2.57	A	0.03	0.04	0.03	0.02	0.01	0.02	0.02	0.03	0.05	0.16	0.39	0.31	0.06	0.02	0.02	0.03
	B	0.22	0.23	0.18	0.11	0.08	0.06	0.09	0.15	0.15	0.35	0.85	0.53	0.16	0.22	0.4	0.28
	C	0.06	0.08	0.07	0.08	0.07	0.05	0.08	0.07	0.07	0.15	0.15	0.07	0.04	0.04	0.05	0.05
	D	0.28	0.29	0.19	0.12	0.17	0.13	0.16	0.11	0.19	0.4	0.48	0.2	0.17	0.24	0.32	0.27
	E	0.05	0.04	0.08	0.1	0.1	0.06	0.08	0.07	0.11	0.11	0.11	0.07	0.06	0.06	0.06	0.06
	F	0.45	0.47	0.44	0.46	0.51	0.56	0.52	0.4	0.47	0.62	0.67	0.34	0.28	0.28	0.33	0.38
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.37	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.05	0.06	0.04	0.02	0.01	0.02	0.03	0.05	0.06	0.24	0.62	0.3	0.04	0.04	0.09	0.05
	C	0.15	0.15	0.06	0.03	0.06	0.03	0.07	0.04	0.08	0.4	0.84	0.33	0.04	0.03	0.09	0.08
	D	0.33	0.38	0.22	0.07	0.07	0.06	0.11	0.08	0.13	0.52	1	0.29	0.08	0.05	0.14	0.19
	E	0.5	0.63	0.34	0.14	0.1	0.08	0.08	0.07	0.16	0.52	0.77	0.28	0.09	0.1	0.11	0.17
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.95	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.08	0.03	0.02	0	0.01	0.02	0.02	0.01	0.04	0.4	0.57	0.09	0.01	0.02	0.04	0.03
	D	0.77	1.08	0.28	0.07	0.07	0.08	0.14	0.05	0.18	1.96	3.5	0.49	0.07	0.11	0.21	0.29
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Nevada National Security Site Meteorological Station 5 (2004–2008) Data Collected at a 10-Meter Height																	
Average Windspeed (m/s)	***SC***	***Wind Direction (from)***															
		N	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***	***S***	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***
9.77	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.01	0.01	0	0	0	0.01	0.01	0	0	0.05	0.02	0	0	0	0.01	0.01
	D	0.21	0.16	0.04	0	0	0.03	0.05	0.01	0.07	1.54	1	0.05	0.01	0.04	0.08	0.08
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.8	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0.01	0	0	0	0	0	0	0	0.03	0	0	0	0	0.01	0.01
	D	0.04	0.01	0	0.01	0	0.01	0.04	0.01	0.07	0.57	0.13	0	0	0	0.03	0.02
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

m/s = meters per second; SC = stability class.
Note: To convert meters to feet, multiply by 3.2808.

G.2.1.2 Population Data

Population distributions used in the impact assessments were based on U.S. Department of Commerce state population census numbers (DOC 2008; ESRI 2008) and the most recently available U.S. census information (the 2000 U.S. census). The population estimates are projected to the approximate middle year of the 10-year period of operations examined in this SWEIS (year 2016). Population distributions were spatially distributed on a circular grid with 16 directions and 10 radial distances up to 50 miles. Grids were centered at the locations from which radionuclides were assumed to be released. Population distributions centered on each potential release point are provided below in **Table G–5** and were used, as applicable, as input to either GENII-2 or MACCS2 modeling. The population estimates presented in Table G–5 differ from the 50-mile population presented in Chapter 4, Section 4.1.12. Chapter 4 describes the affected environment, and the population of 42,871 cited in Section 4.1.12 represents an estimate of the number of people living within 50 miles of the Area 6 Control Point (DOE/NV 2005).

Table G–5 Population Distribution within 50 Miles of Release Points

Direction	*Distance (miles)*									
	0–1	*1–2*	*2–3*	*3–4*	*4–5*	*5–10*	*10–20*	*20–30*	*30–40*	*40–50*
Big Explosives Experimental Facility										
NNE	0	0	0	0	0	0	0	11	30	50
NE	0	0	0	0	0	0	9	30	42	54
ENE	0	0	0	0	0	0	16	30	42	54
E	0	0	0	0	0	0	17	30	42	54
ESE	0	0	0	0	0	0	15	30	41	60
SE	0	0	0	0	0	0	9	29	38	476
SSE	0	0	0	0	0	0	0	10	588	3,707
S	0	0	0	0	0	0	0	17	908	1,429
SSW	0	0	0	0	0	0	0	0	390	557
SW	0	0	0	0	0	0	0	44	381	343
WSW	0	0	0	0	0	0	0	48	251	275
W	0	0	0	0	0	0	0	11	127	208
WNW	0	0	0	0	0	0	0	0	0	0
NW	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	23
Total	**0**	**0**	**0**	**0**	**0**	**0**	**66**	**290**	**2,880**	**7,290**
50-Mile Total										**10,526**
Device Assembly Facility										
NNE	0	0	0	0	0	0	3	19	38	54
NE	0	0	0	0	0	0	15	30	42	54
ENE	0	0	0	0	0	1	18	30	42	54
E	0	0	0	0	0	2	18	29	41	92
ESE	0	0	0	0	0	1	16	27	38	157
SE	0	0	0	0	0	0	13	247	1,544	824
SSE	0	0	0	0	0	0	141	1,212	2,512	1,554
S	0	0	0	0	0	0	46	760	1,124	27,598
SSW	0	0	0	0	0	0	146	640	665	123
SW	0	0	0	0	0	0	3	224	382	26
WSW	0	0	0	0	0	0	0	200	373	118
W	0	0	0	0	0	0	0	63	254	254
WNW	0	0	0	0	0	0	0	5	89	121
NW	0	0	0	0	0	0	0	0	0	0

Direction	***Distance (miles)***									
	0–1	***1–2***	***2–3***	***3–4***	***4–5***	***5–10***	***10–20***	***20–30***	***30–40***	***40–50***
NNW	0	0	0	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	3
Total	**0**	**0**	**0**	**0**	**0**	**4**	**419**	**3,486**	**7,144**	**31,032**
50-Mile Total										**42,085**
Joint Actinide Shock Physics Experimental Research Facility										
NNE	0	0	0	0	0	0	0	7	26	44
NE	0	0	0	0	0	0	6	30	42	54
ENE	0	0	0	0	0	0	12	30	42	54
E	0	0	0	0	0	0	13	27	38	111
ESE	0	0	0	0	0	0	36	323	634	305
SE	0	0	0	0	0	0	353	2,196	1,436	2,667
SSE	0	0	0	0	0	0	361	1,107	1,737	12,115
S	0	0	0	0	0	53	482	803	18,906	14,829
SSW	0	0	0	0	0	63	413	467	107	26
SW	0	0	0	0	0	5	173	303	28	26
WSW	0	0	0	0	0	0	56	303	132	26
W	0	0	0	0	0	0	39	278	257	133
WNW	0	0	0	0	0	0	3	78	241	239
NW	0	0	0	0	0	0	0	0	5	1
NNW	0	0	0	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**121**	**1,947**	**5,952**	**23,631**	**30,630**
50-Mile Total										**62,281**
Area 5 Radioactive Waste Management Complex										
NNE	0	0	0	0	0	2	17	30	42	54
NE	0	0	0	0	0	4	18	30	42	54
ENE	0	0	0	0	1	4	18	30	42	54
E	0	0	0	0	1	5	17	28	60	120
ESE	0	0	0	0	0	4	16	27	81	182
SE	0	0	0	0	0	4	16	651	750	1,640
SSE	0	0	0	0	0	1	42	2,144	1,471	2,963
S	0	0	0	0	0	0	300	1,037	2,938	31,820
SSW	0	0	0	0	0	0	135	801	951	2,746
SW	0	0	0	0	0	0	97	433	427	59
WSW	0	0	0	0	0	0	0	68	424	219
W	0	0	0	0	0	0	0	35	253	307
WNW	0	0	0	0	0	0	0	0	52	134
NW	0	0	0	0	0	0	0	0	0	0
NNW	0	0	0	0	0	0	0	0	0	0
N	0	0	0	0	0	0	1	6	12	19
Total	**0**	**0**	**0**	**0**	**2**	**24**	**677**	**5,320**	**7,545**	**40,371**
50-Mile Total										**53,939**
Tonopah Test Range										
NNE	0	0	0	0	0	0	12	20	28	36
NE	0	0	0	0	0	0	10	20	28	50
ENE	0	0	0	0	0	0	1	16	28	40
E	0	0	0	0	0	0	0	4	19	31
ESE	0	0	0	0	0	0	0	0	0	2
SE	0	0	0	0	0	0	0	0	0	0

Direction	***Distance (miles)***									
	0–1	***1–2***	***2–3***	***3–4***	***4–5***	***5–10***	***10–20***	***20–30***	***30–40***	***40–50***
SSE	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	159
SSW	0	0	0	0	0	0	0	0	72	202
SW	0	0	0	0	0	0	0	57	81	64
WSW	0	0	0	0	0	0	2	66	50	64
W	0	0	0	0	0	0	2	36	48	60
WNW	0	0	0	0	0	0	1	29	50	60
NW	0	0	0	0	0	0	9	34	3,078	52
NNW	0	0	0	0	0	0	12	20	28	37
N	0	0	0	0	0	1	12	20	28	37
Total	**0**	**0**	**0**	**0**	**0**	**1**	**61**	**322**	**3,538**	**894**
50-Mile Total										**4,816**
North Las Vegas Facility										
NNE	145	333	1,350	2,904	3,774	9,966	61	108	144	164
NE	696	3,218	2,864	4,621	2,029	13,043	142	280	377	3,056
ENE	1,641	6,436	9,684	11,061	6,665	9,180	3,554	385	539	2,853
E	2,307	7,124	7,569	3,399	4,890	24,527	1,359	382	508	424
ESE	2,682	10,581	11,894	16,806	12,754	34,331	5,024	324	397	509
SE	1,571	6,271	12,547	13,587	19,013	89,840	94,433	20,813	337	499
SSE	1,556	6,529	13,129	16,476	15,294	98,239	154,747	11,340	285	366
S	1,492	5,297	9,349	13,003	14,564	83,409	173,530	16,057	2,708	351
SSW	367	3,633	3,771	5,718	10,358	73,040	56,510	11,165	10,148	2,288
SW	479	3,497	6,277	5,795	7,774	105,909	115,422	9,053	14,713	322
WSW	729	3,238	7,524	10,291	15,079	116,209	71,713	1,164	9,718	11,155
W	750	1,821	2,477	6,182	13,803	104,554	41,276	4,787	1,021	25,794
WNW	726	4,251	8,288	9,644	7,874	61,626	35,115	660	1,693	3,025
NW	676	5,243	6,059	10,404	12,670	64,392	27,240	330	983	227
NNW	701	2,798	4,200	11,904	14,816	24,110	235	100	78	57
N	563	1,883	4,235	6,033	6,421	9,502	61	101	141	112
Total	**17,081**	**72,153**	**111,217**	**147,828**	**167,778**	**921,877**	**780,422**	**77,049**	**43,790**	**51,202**
50-Mile Total										**2,390,397**

G.2.1.3 Food Production and Consumption Data

Generic food consumption rates are available as default values in GENII-2. The default values are comparable to those established in NRC Regulatory Guide 1.109 (NRC 1977), which provides guidance for evaluating ingestion doses from consuming contaminated plant and animal food products using a standard set of assumptions for crop and livestock growth and harvesting characteristics.

Food consumption parameters used to evaluate each alternative are presented in **Tables G–6** and **G–7**.

Table G–6 GENII-2 Usage Parameters for Consumption of Plant Food (Normal Operations)

	Agriculture Characteristics		*Maximally Exposed Individual*		*General Population*	
Food Type	*Growing Time (Days)*	*Yield (kilograms per square meter)*	*Holdup Time [a] (days)*	*Consumption Rate (kilograms per year)*	*Holdup Time [a] (days)*	*Consumption Rate (kilograms per year)*
Leafy vegetables	90	1.5	1	30	14	15
Root vegetables	90	4	5	220	14	140
Fruit	90	2	5	330	14	64
Grains/cereals	90	0.8	180	80	180	72

[a] Holdup time is the time between absorption of radionuclides and consumption of a food product.
Note: To convert kilograms to pounds, multiply by 2.2046; square meters to square feet, multiply by 10.764.
Source: NRC 1977; PNNL 2007.

Table G–7 GENII-2 Usage Parameters for Consumption of Animal Products (Normal Operations)

	Stored Feed				*Fresh Forage*			
Food Type	*Diet Fraction*	*Growing Time (days)*	*Yield (kilograms per square meter)*	*Storage Time (days)*	*Diet Fraction*	*Growing Time (days)*	*Yield (kilograms per square meter)*	*Storage Time (days)*
Beef	0.25	90	0.8	180	0.75	45	2	100
Poultry	1	90	0.8	180	–	–	–	–
Milk	0.25	45	2	100	0.75	30	1.5	0
Eggs	1	90	0.8	180	–	–	–	–

	Maximally Exposed Individual		*General Population*	
Food Type	*Consumption Rate (kilograms per year)*	*Holdup Time [a] (days)*	*Consumption Rate (kilograms per year)*	*Holdup Time [a] (days)*
Beef	80	15	70	34
Poultry	18	1	8.5	34
Milk	270	1	230	3
Eggs	30	1	20	18

[a] Holdup time is the time between absorption of radionuclides and consumption of a food product.
Note: To convert kilograms to pounds, multiply by 2.2046; square meters to square feet, multiply by 10.764.
Source: NRC 1977; PNNL 2007.

G.2.1.4 Additional Modeling Parameters

Other key parameters used in GENII-2 modeling include the following:

- Potential MEI locations at the NNSS site boundary were initially evaluated for all 16 compass directions; the MEI was determined to be at the boundary location that yielded the highest total effective dose equivalent for a given release/dispersion scenario. Two locations were ultimately determined and used in the normal operations analysis (9 miles due east of BEEF and 1.4 miles due east of Area 5). These two locations and four additional MEI site boundary locations around the NNSS and the Nevada Test and Training Range (6.6 miles due east of the Device Assembly Facility [DAF], 1 mile due north of the Tonopah Test Range [TTR], 7.2 miles due east of the U1a Complex, and 7 miles south-southwest of the Joint Actinide Shock Physics Experimental Research facility [JASPER]) were ultimately determined and used for the assessment of accidents (see **Figures G–1** and **G–2**).

- Radiological airborne emissions were assumed to be released to the atmosphere at a height of 0 feet (ground level). The emissions from the normal operations activities are not from tall stacks, but occur at or near ground level, given the outdoor/open-air nature of many activities. It is noteworthy that, from a dose-modeling perspective, ground-level releases always maximize impacts on nearby noninvolved workers and typically maximize impacts on MEIs as well, depending upon how far away a site boundary is located. Impacts on offsite populations from ground-level releases (especially at appreciable distances from release locations), however, typically are lower. The primary reason behind this general pattern is that plumes that are released higher in the atmosphere (by a tall stack, buoyancy from heat, or an energetic release) carry contaminants farther before they settle out and are near the ground, where they would affect receptors.

- For GENII-2 normal operations calculations, emission of the plume was assumed to continue throughout the year. In parallel with this assumption, the following scenarios were employed: (1) all public receptors were assumed to breathe effluents from this plume throughout an entire year's time (8,760 hours); (2) the MEI was assumed to be externally exposed to the plume for 0.7 years (6,132 hours); (3) the general population was assumed to be externally exposed to the plume for 0.5 years (4,380 hours); and (4) all public receptors were assumed to be exposed to ground contamination resulting from plume deposition throughout an entire year's time (8,760 hours). Plume and ground deposition exposure parameters used in the GENII-2 model for the exposed offsite individual and the general population are provided in **Table G–8**.

- The exposed individual or population was assumed to have adult human characteristics and habits with respect to food consumption and breathing. As noted in Section G.1.3, the dose-to-risk factors used are appropriate for the age distribution of the U.S. population.

- Members of the population were assumed to spend some time indoors. This is further illustrated in Table G–8.

- A Pasquill-Gifford plume model was used for the air immersion doses.

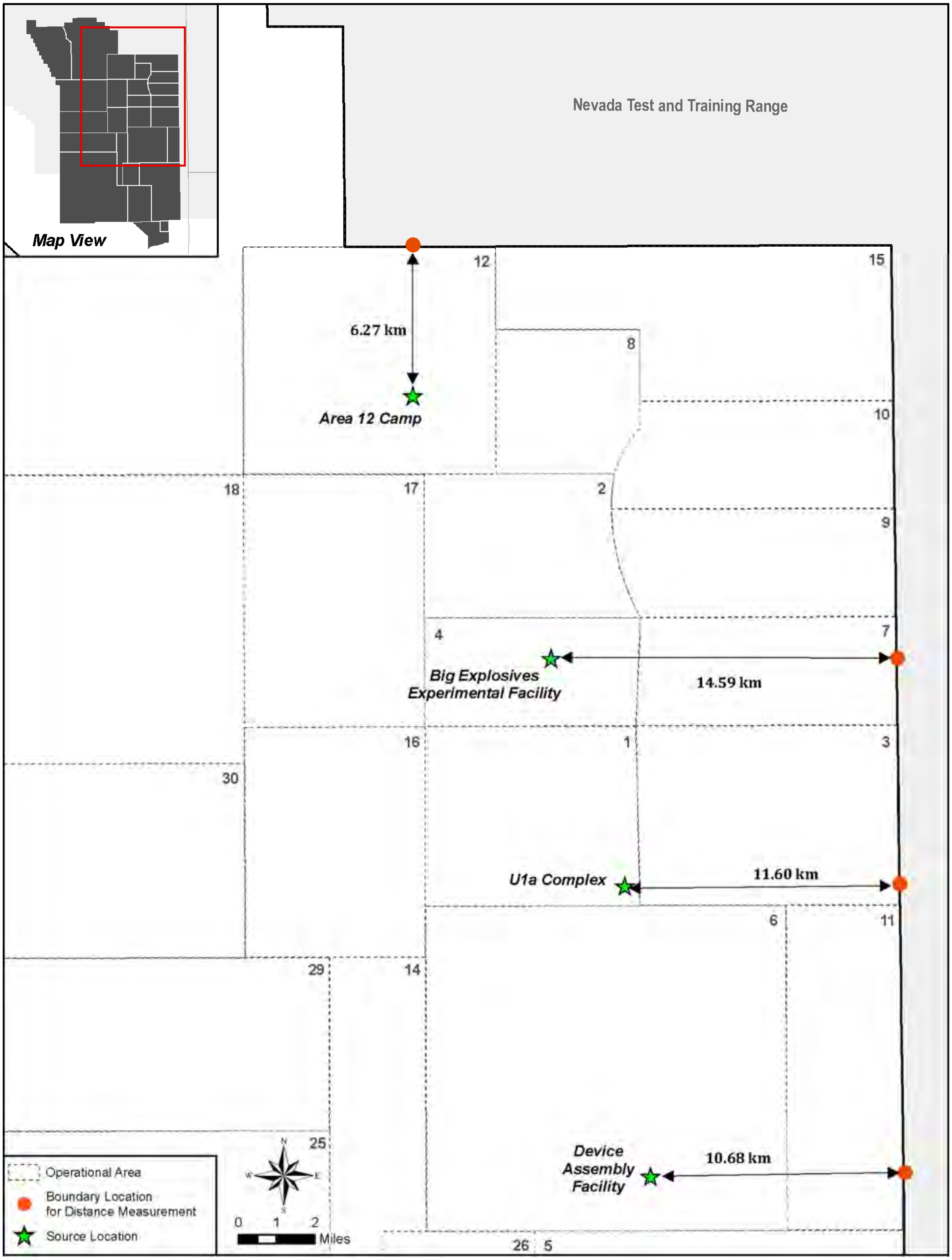


Figure G–1 Potential Source Locations and Distance from the Nevada National Security Site Boundary (North)

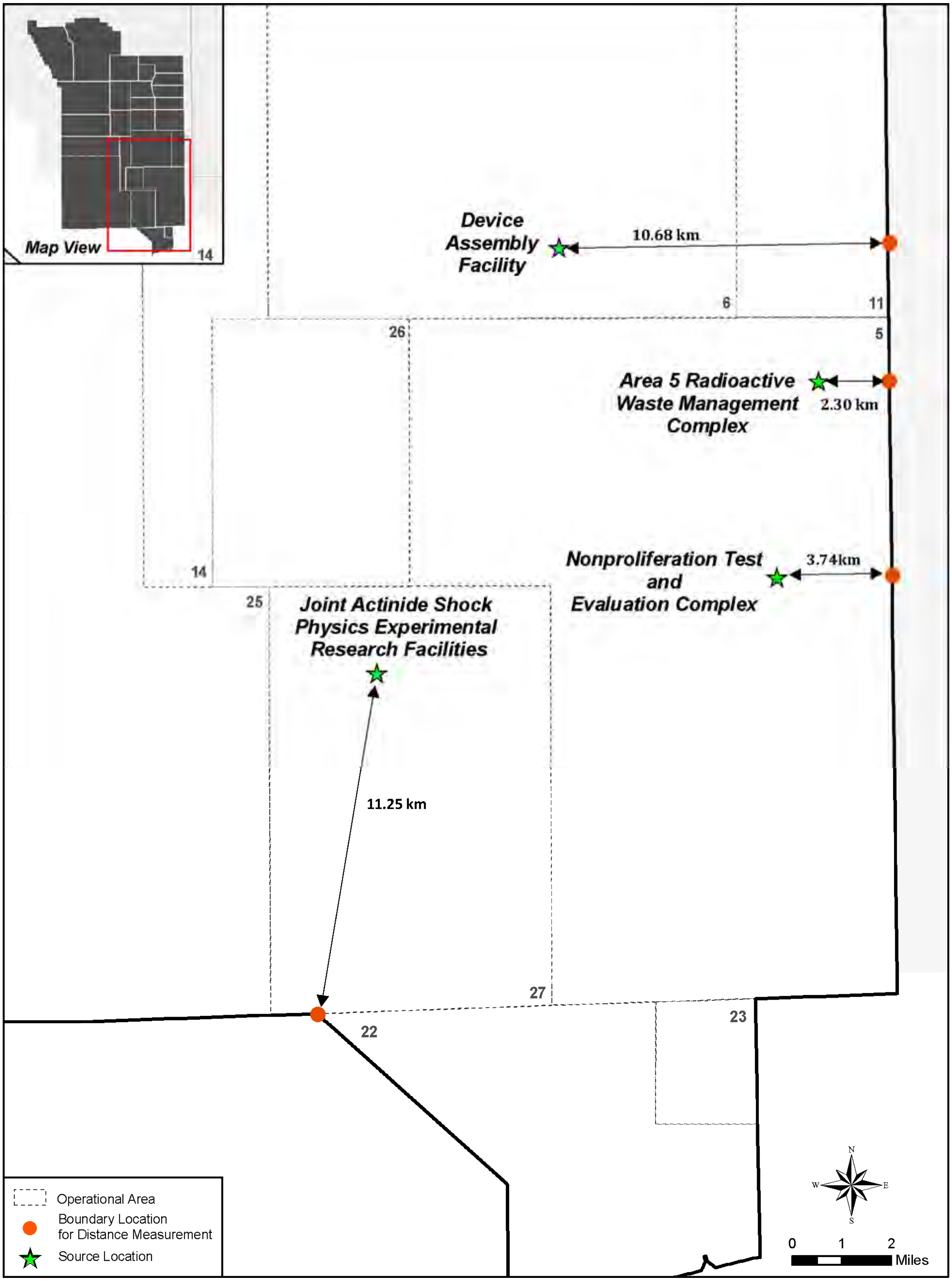


Figure G–2 Potential Source Locations and Distance from the Nevada National Security Site Boundary (South)

Table G–8 GENII-2 Usage Parameters for Exposure to Plumes (Normal Operations)

Maximally Exposed Individual				*General Population*			
External Exposure		*Inhalation of Plume*		*External Exposure*		*Inhalation of Plume*	
Plume (hours) [a]	*Ground Contamination (hours)* [b]	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*	*Plume (hours)* [c]	*Ground Contamination (hours)* [b]	*Exposure Time (hours)*	*Breathing Rate (cubic centimeters per second)*
6,132	8,760	8,760	270	4,380	8,760	8,760	270

[a] Assumes 70 percent of the hours per year are outdoor exposure, with the balance indoors.
[b] Assumes 70 percent reduction in dose due to shielding for time indoors.
[c] Assumes 50 percent of the hours per year are outdoor exposure, with the balance indoors.
Note: To convert cubic centimeters to cubic inches, multiply by 0.061024.
Source: NRC 1977; PNNL 2007.

G.2.2 Source Term Data

Source terms (that is, the quantities of radioactive material released to the environment over a given period) for the No Action Alternative normal operational releases were based on measured annual release quantities of all radionuclides reported in annual site environmental reports from various recent years. These annual site environmental reports identify both airborne and liquid radiological releases; however, the airborne pathway is predominant, given the arid nature of the NNSS and its surrounding areas. Source terms for the two action alternatives (Expanded Operations and Reduced Operations) were developed based on specific implementing activities described in technical reports for these alternatives and their annual estimated airborne releases for risk-dominant radionuclides. GENII-2-modeled airborne radiological releases from normal operations were estimated on an annual basis as the following: No Action at DPFF – 2,000 curies of tritium; Expanded Operations at DPFF – 20,000 curies of tritium; Reduced Operations at DPFF – 1,000 curies of tritium; all alternatives at NLVF, Building A-1 – 0.0111 curies of tritium.

MACCS2-modeled radiological releases used for calculating impacts of two other normal operational scenarios, depleted uranium explosion testing and tracer experiments, as well as postulated accidents, are discussed below in Sections G.2.3.1, G.2.3.2, and G.3, respectively.

G.2.3 Radiological Consequences from Normal Operations

Table G–9 provides the annual dose associated with airborne radiological releases from normal operations to the MEI and the total population, as well as the average dose to a member of the general population for the duration of the implementation of each alternative. Essentially 0 (0.0005) fatal cancers in the surrounding population are expected to result from the maximum annual impacts (0.89 person-rem) anticipated under the Expanded Operations Alternative at the NNSS. Similarly, essentially 0 (2×10^{-7}) fatal cancers in the surrounding population are expected to result from the annual impacts (4.1×10^{-5} person-rem) anticipated under the No Action and Reduced Operations Alternatives at NLVF.

The following sections provide additional details regarding radiological impacts on an MEI and the offsite population resulting from depleted uranium testing and tracer experiment activities. For discussions of expected activities at DPFF and environmental restoration/decontamination and decommissioning, see Chapter 3 and Appendix A of this SWEIS.

Table G–9 Annual Doses to Members of the Population from Airborne Radiological Releases (Normal Operations)

	NNSS								
	No Action			*Expanded Operations*			*Reduced Operations*		
Source	*MEI Dose (millirem per year)*	*Total Population Dose (person-rem)*	*Average Dose to Member of Population (millirem per year)*	*MEI Dose (millirem per year)*	*Total Population Dose (person-rem)*	*Average Dose to Member of Population (millirem per year)*	*MEI Dose (millirem per year)*	*Total Population Dose (person-rem)*	*Average Dose to Member of Population (millirem per year)*
Baseline (site-wide) [a]	2.6	0.47	0.011	2.6	0.47	0.011	2.6	0.47	0.011
BEEF high-explosives experiments [b]	0	0	0	0.62	0.067	0.0064	0	0	0
DPFF [c]	0.14	0.027	5.0×10^{-4}	0.6	0.27	0.0050	0.07	0.013	2.5×10^{-4}
Environmental restoration/ D&D (site-wide) [a]	<0.01	<0.002	$<4.7 \times 10^{-5}$	<0.01	<0.002	$<4.7 \times 10^{-5}$	<0.01	<0.002	$<4.7 \times 10^{-5}$
Tracer experiments [b]	N/A	N/A	N/A	<1	<0.076	<0.0014	N/A	N/A	N/A
TOTAL [d]	**2.8**	**0.5**	**0.012**	**4.8**	**0.89**	**0.024**	**2.7**	**0.48**	**0.011**

	NLVF (All Alternatives)		
Source	*MEI Dose (millirem per year)*	*Total Population Dose (person-rem)*	*Average Dose to Member of Population (millirem per year)*
Building A-1	3.5×10^{-4}	4.1×10^{-5}	1.7×10^{-8}

< = less than; BEEF = Big Explosives Experimental Facility; D&D = decontamination and decommissioning; DPFF = Dense Plasma Focus Facility; MEI = maximally exposed individual; N/A = not applicable; NLVF = North Las Vegas Facility; rem = roentgen equivalent man.

[a] Values based on the NNSS annual site environmental reports and National Emissions Standards for Hazardous Air Pollutants reports.

[b] Values modeled using the MACCS2 [MELCOR Accident Consequences Code System] computer code. For conservatism in modeling population dose impacts, tracer experiments were assumed to be conducted in Area 5 because it is closer to southern population centers than most other areas that might be used. For the MEI calculation, tracer experiments impacts were conservatively assumed to occur at the closest BEEF site boundary location (9 miles east of BEEF).

[c] Values modeled using the GENII-2 [Hanford Environmental Radiation Dosimetry Software System Version 2] computer code and were conservatively assumed to be released from Area 5, which is proximal to DPFF in Area 11. The MEI at the Area 5 site boundary location (east of the Area 5 Radioactive Waste Management Complex) was modeled for No Action and Reduced Operations; the MEI at the BEEF site boundary location (9 miles east of BEEF) was modeled for Expanded Operations.

[d] Totals may not equal the sum of the individual contributing components due to rounding.

Source: DOE/NV 2005, 2006, 2007, 2008, 2009.

G.2.3.1 Normal Radiological Impacts from Detonations of Depleted Uranium at the Big Explosives Experimental Facility

Radiological impacts from expected BEEF operations would be primarily due to detonation of depleted uranium with high explosives. Although amounts of depleted uranium and high explosives may vary by experiment, it was assumed that a typical experiment would involve 200 pounds of depleted uranium and the explosive equivalent of 600 pounds of TNT [2,4,6-trinitrotoluene].

Under the No Action Alternative and the Reduced Operations Alternative, no experiments using depleted uranium would occur at BEEF. Under the Expanded Operations Alternative, the National Nuclear Security Administration (NNSA) assumed 20 experiments using depleted uranium would occur annually at BEEF.

Because these experiments would result in a quick puff-type release of aerosolized depleted uranium with the explosion, the radiological impacts were modeled using the MACCS2 computer code, which is typically used for accident analyses.

It was conservatively assumed that 20 percent of the 200 pounds of depleted uranium would be aerosolized and respirable (DOE 1994). The site boundary location at which the highest potential combined dose would occur from depleted uranium releases at BEEF, releases associated with tracer experiments assumed to be conducted at or near BEEF, and releases from DPFF in Area 11 was determined to be 9 miles east of BEEF. The maximum combined annual dose would be approximately 2.2 millirem from the three sources under the Expanded Operations Alternative (0.62 millirem from depleted uranium, 1 millirem from tracer experiments, and 0.6 millirem from DPFF) operating at their highest expected levels. Under the No Action and Reduced Operations Alternatives, the total estimated dose to the MEI from these three activities would be 0.07 millirem per year.

The projected normal radiological release impacts on the MEI and population solely from depleted uranium experiment activities are presented in **Table G–10** under the Expanded Operations Alternative.

Table G–10 Expanded Operations Alternative Projected Annual Radiological Release Impacts from Depleted Uranium Experiments at the Big Explosives Experimental Facility

Scenario	*Release [a] (pounds of depleted uranium)*	*MEI Dose at 9 Miles East (millirem)*	*MEI LCF Risk*	*Population Dose within 50 Miles (person-rem)*	*Population LCFs [b]*
20 experiments at BEEF	4,000	0.62	4×10^{-7}	0.067	0 (4×10^{-5})

BEEF = Big Explosives Experimental Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.

[a] The 4,000-pound quantity is the total annual inventory. It was conservatively assumed that all of the material would be released and aerosolized. Twenty percent of the released depleted uranium was assumed to be respirable (DOE 1994). The planned usage would be 20 experiments annually, with up to 200 pounds of depleted uranium per experiment, which equates to the 4,000-pound total.

[b] The number of LCFs in the population must be a whole number. The value in parentheses is the result of multiplying the population dose by the factor of 0.0006 LCFs per person-rem.

G.2.3.2 Normal Radiological Impacts from Radioactive Tracer Experiments

Under the Expanded Operations Alternative, up to 3 underground and 12 open-air radioactive tracer experiments per year would be conducted. The highest potential for offsite radiological impacts from typical tracer experiments would be from the underground release of radioactive gases or particulates and their transport to the surface. The underground experiments present the greatest potential impact because of the quantities of radioactive materials that could be used. Of the proposed experiments, the radiological impacts on the aboveground environment and the public would be greater for Experiments 1 and 3.

With Experiment 1, a vessel of radioactive noble gases (up to 27,000 curies each of argon-37, krypton-85, xenon-127, xenon-131m, and xenon-133) would be buried underground with explosive materials, taking advantage of experiments intended for use by the seismic research community. Upon detonation of the explosives, the vessel would rupture, energetically releasing radioactive noble gases underground. These noble gases would be transported to the surface through various physical processes, and atmospheric and soil gas samples would be collected. This experiment may be performed several times in a variety of conditions (burial depth, geomorphology, explosive force, etc.). Explosions from nearly 0 up to 1 kiloton may be warranted to develop models to scale up to nuclear tests.

Experiment 3 involves releasing short-lived radioactive particulates (up to 27,000 curies each of rubidium-86, zirconium-95, technetium-99m, molybdenum-99, ruthenium-103, cesium-136, barium-140, cerium-141, neodymium-147, and samarium-153) from relatively shallow explosions. In this case, some venting to the surface is expected. This experiment may be performed several times in a variety of conditions (burial depth, geomorphology, explosive force, etc.). Explosions from nearly 0 up to 1 kiloton may be used.

Because these experiments are still at the conceptual stage, the actual amounts of radioactive materials that might reach the surface and be available for transport to the public are unknown. One of the purposes of the experiments is to develop a better understanding of the fraction of the various isotopes that would be transported from the underground explosion site to the surface. These fractions are generally expected to be quite small.

As with other NNSS experiments, such as those that occur at the Nonproliferation Test and Evaluation Complex (NPTEC), protocols and safety and environmental criteria would be developed to ensure that the public and environment are protected with each experiment. This is especially important because the specific location and geology for each experiment would likely change to better understand the factors that lead to transport of the radionuclide from the explosion site to the surface. For these experiments, the radiological source inventories would be adjusted such that the levels that reach the surface are detectable to accomplish the goals of the experiment, but are far below the levels that might cause a radiological concern for the public or environment.

For purposes of this SWEIS, it was assumed that the tracer experiments would have safety and environmental goals such that they would not present a substantial risk of causing an exceedance of the overall NNSS NESHAPs airborne radiation limit of 10 millirem per year to the MEI. Individual experiments would be designed to control the combination of explosives, quantities of radionuclides, and medium to meet the goal of 1 millirem per year for all experiments that would be conducted.

To bound the potential population doses that might occur with these releases, as well as the reasonableness of the goal of 1 millirem per year for all experiments, ground-level puff-type releases for the complete inventories of Experiments 1 and 3, assuming a release of the maximum quantity of 27,000 curies of each isotope, were modeled from Area 5 for the general population using the MACCS2 computer code. As discussed in Section G.2.3.1, however, the MEI was modeled (for the Expanded Operations Alternative) at the site boundary location (9 miles due east of BEEF) that would yield the highest combined dose from tracer and depleted uranium experiments and DPFF releases.

The totaled results from modeling a puff release of 27,000 curies of each of the short-lived radioactive particulates (rubidium-86, zirconium-95, technetium-99m, molybdenum-99, ruthenium-103, cesium-136, barium-140, cerium-141, neodymium-147, and samarium-153) and 27,000 curies of each of the radioactive noble gases (argon-37, krypton-85, xenon-127, xenon-131m, and xenon-133) are presented in **Table G–11**.

Table G–11 Projected Normal Radiological Release Impacts from Radioactive Tracer Experiments

Scenario	*Release (curies)*	*Scale Factor to Equal MEI Dose Goal*	*Noninvolved Worker*		*MEI at 9 Miles*		*Population within 50 Miles*	
			Dose (millirem)	*LCFs*	*Dose (millirem)*	*LCF Risk*	*Dose (person-rem)*	*LCFs* [a]
Total Release of All Particulates [b]	2.7×10^5		6.7×10^4	8×10^{-2}	9.9×10^3	6×10^{-3}	1.5×10^3	1 (0.9)
Total Release of All Noble Gases [b]	1.35×10^5		6.5×10^3	4×10^{-3}	1.2×10^3	7×10^{-4}	4.9	0 (3×10^{-3})
MEI Dose Goal for Each Experiment Type					**5.0×10^{-1}**			
Normal Operations Part Release (Particulates) = Dose Goal [c]	13.7	5.06×10^{-5}	3.4	2×10^{-6}	5.0×10^{-1}	3×10^{-7}	7.4×10^{-2}	0 (4×10^{-5})
Normal Operations Gas Release (Noble Gases) = Dose Goal [c]	58	4.30×10^{-4}	2.8	2×10^{-6}	5.0×10^{-1}	3×10^{-7}	2.1×10^{-3}	0 (1×10^{-6})
Total Dose			6.2	4×10^{-6}	1.0	6×10^{-7}	7.6×10^{-2}	0 (5×10^{-5})

LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.
[a] The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population dose by the factor of 0.0006 LCFs per person-rem.
[b] Calculated results are based on the entire inventory being released by the experimental explosion. Controls to limit the release would be imposed.
[c] Based on designing experiments with an annual dose goal of 1 millirem to the MEI, the radionuclide release would be controlled to the levels indicated, resulting in the corresponding doses.
Note: Represented impacts on the MEI and population include dose components from the long-term (chronic) ingestion pathway.

G.2.3.3 Sensitivity Analysis

A sensitivity analysis was performed to determine the differences in the impacts of considering the surrounding population out to a distance of 80 miles (rather than 50 miles) from the release points for both normal operations. Normal operational releases under the Expanded Operations Alternative (e.g., tracer experiments being conducted at Area 5 [the closest modeled release point to the greater Las Vegas metropolitan area]) were considered. The total population increases from about 54,000 (at 50 miles) to about 2.3 million (at 80 miles). The population dose change from about 0.076 person-rem (for the 50-mile population) to about 0.12 person-rem (for the 80-mile population) would be an increase of about 58 percent. The population increase between a 50-mile radius and an 80-mile radius is about 4,000 percent. The average annual dose to an individual living within 50 miles of the release point would be about 0.0014 millirem; the average annual dose to a member of the population living between 50 and 80 miles of the release point would be 2×10^{-5} millirem, or about 1.4 percent of the dose to a member of the population in the first 50 miles. Thus, even though there would be a calculated increase in the population dose when considering an 80-mile radius, the increase would be due to very small incremental individual doses to a large number of people. The increased annual risk of an LCF to an individual from this small dose would be essentially 0 (8×10^{-10}).

G.3 Impacts of Accidents

G.3.1 Introduction to Accident Evaluations

This section provides information and details of the analysis of the impacts of potential facility accidents presented in Chapter 5. It includes, in Section G.3.2, an evaluation of the present applicability of the methodology and accident data that were reported in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (1996 NTS EIS)* (DOE 1996b) to inform the reader of the differences in analyses between that document and this SWEIS.

The occupational and public health and safety evaluations addressed and presented in the *1996 NTS EIS* (DOE 1996b) were based on various ongoing missions, as described for each alternative, with the addition of new activities within each program. As discussed in Chapter 3 of this SWEIS, some activities analyzed in the *1996 NTS EIS* have been either completed or discontinued. Planned or proposed activities at the NNSS (and other offsite locations in Nevada) are described in detail in Chapter 3 of this SWEIS. Available accident scenario, impact, and risk information for the proposed activities was compared to the evaluations presented in the *1996 NTS EIS*. Proposed activities with a potential for accidental release of nuclear and chemical materials are discussed.

Two computer codes were used to analyze the postulated accidents and to estimate their impacts: (1) MACCS2 for radiological releases; and (2) ALOHA [Arial Locations of Hazardous Atmospheres] for chemical releases. These computer codes are described in Section G.6.

G.3.1.1 Accident Scenario Development Methodology

The methodology used to develop accident scenarios and their associated parameters involved several steps. First, other relevant EISs and the *DOE Handbook: Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities (DOE Handbook)* (DOE 1994) were evaluated to develop a list of likely accident scenarios. This evaluation examined the types of structures and equipment at the NNSS and the TTR that are expected to contain any significant residual radioactivity in the form of fixed or mobile chemical or physical forms of radionuclides. Experience from previous EISs involving nonreactor facilities was also used to establish accident scenarios. This first step led to the conclusion that accidents at the NNSS and the TTR could fall into one of the following categories:

- Drops
- Punctures
- Spills
- Leaks
- Fires
- Explosions
- Seismically induced structural failures
- Seismically induced structural failures followed by fires and/or explosions
- Nuclear criticality events
- Chemical reactions

Workers involved in project activities may experience the most severe consequences of the accidents analyzed in this SWEIS. Accidents involving exposure to radiologically contaminated solids, liquids, and volatile compounds could result in minor to significant health impacts due to external exposure, inhalation, and ingestion. Accidents involving seismic events or explosions could result in severe injury or death, most likely from physical injury. This SWEIS does not calculate any specific impacts on workers with regard to such an accident scenario because of the wide range of locations and actions of such workers and the wide range of potential impacts (identified above). All accident consequences and risks were calculated for a noninvolved worker, the MEI, and the offsite population.

G.3.1.2 Radiological Source Term Methodology

The accident source term is the amount of respirable radioactive material released to the air or particles released to the water, in terms of curies or grams, assuming the occurrence of a postulated accident. Exposures via releases to water were not considered reasonable due to the arid climate and the dearth of surface waters that leave NNSA's Nevada sites. The airborne source term is typically estimated by the following equation:

$$\text{Source term} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

where:

MAR = material at risk
DR = damage ratio
ARF = airborne release fraction
RF = respirable fraction
LPF = leak path factor

The MAR is the amount of radionuclides (in curies of activity or grams for each radionuclide) available for release when acted upon by a given physical stress or accident. The MAR is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present, but is that amount of material in the postulated scenario of interest that would be available for release.

The DR is the fraction of material exposed to the effects of the energy, force, or stress generated by the postulated event. For the accident scenarios discussed in this analysis, the DR value varies from 0.1 to 1.0.

The ARF is the fraction of material that becomes airborne due to the accident. In this analysis, ARFs were obtained from the *DOE Handbook* (DOE 1994).

The RF is the fraction of airborne radionuclides that can be transported as particles through air and inhaled into the human respiratory system and is commonly assumed to include particulate matter with an aerodynamic diameter of 10 micrometers or less.

The LPF is the fraction of airborne material that is transported from a source through some confinement mechanism to the environment.

G.3.1.3 Accident Source Terms

After the spectrum of accidents was identified, it was necessary to estimate a release fraction for each of the accidents. Release fraction estimates were developed based on review of available information on facility design and operation, as well as information in the *DOE Handbook* (DOE 1994), relevant EISs (DOE 1995, 1996b, 1998, 1999, 2001, 2002a, 2002b, 2004b, 2004c, 2007a), and various hazards analyses and documented safety analyses developed for the NNSS and TTR facilities (e.g., DOE 1996a, 2010a; LLNL 2005, 2006, 2007; NSTec 2008, 2009a, 2009b, 2009c, 2009d, 2010a; SAIC 1996; SNL 2005). The release fractions selected were also reviewed against each other to ensure that the relative magnitude was considered reasonable.

The release fraction is the fraction of MAR that becomes airborne and could be inhaled by humans, causing a radiation dose. It is calculated by multiplying the four factors, DR, ARF, RF, and LPF.

G.3.1.4 Accident Frequency

The annual frequency of each accident is used to calculate the annual risk of an LCF associated with each accident. The annual accident risk was calculated by multiplying the accident risk of an LCF by the annual frequency of the accident. Each specific accident's annual frequency was determined using data from operational experience or from an analysis of the sequence of events necessary for the accident to occur. In general, accidents with an annual frequency of less than 1×10^{-6} per year or 1 in 1 million are not analyzed in this appendix because they are so unlikely to occur that their risks are extremely small; exceptions to this, however, include scenarios involving (1) aircraft crashes and (2) DAF.

G.3.2 Data and Analysis Changes from the *1996 NTS EIS*

The *1996 NTS EIS* (DOE 1996b) analyzed radiological and chemical accident scenarios for several alternatives, including the Expanded Use Alternative. The accident scenarios for the Expanded Use Alternative were re-evaluated in the *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2002a) and the *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE 2007a).

Since 1996, NNSA has prepared (or updated) and reviewed safety analyses, such as hazards analyses and document safety analyses, or NEPA documents, such as environmental assessments.

For this SWEIS, the accident scenarios and potential source terms from the *1996 NTS EIS* and subsequent supplement analyses were reviewed and evaluated to determine whether changes in operations at the NNSS and offsite locations, as well as changes in accident analysis methodology, indicated a need for a revision of the calculated accident consequences and risks to the public and noninvolved workers. The radiological and chemical accidents addressed in the *1996 NTS EIS* and other NEPA documents considered and evaluated in this SWEIS are presented in **Table G–12**.

Table G–12 Accident Scenarios Involving Release of Radioactive or Chemical Material Considered in the *1996 NTS EIS* (Expanded Use Alternative)

***1996 NTS EIS* Identification Number**	***Scenario Description* [a]**	***Accident Type***	***Scenarios Evaluated since the 1996 NTS EIS* [b]**
NNSS Activities	**National Security/Defense Mission**		
DPR1	P-Tunnel: mechanical release of plutonium during handling	Rad	Considered/Evaluated
DPR2	DAF: explosion involving 55 pounds of high explosives and 5 kilograms of plutonium	Rad	Considered/Evaluated
DPR5	Area 27: explosion in interim-stored nuclear weapons	Rad	Not Applicable
DPR6	Accidental venting from an underground test (fast and slow)	Rad	Not Applicable
WFOR1	BEEF: 100-curie tritium release	Rad	Considered/Evaluated – normal release – not an accident
WFOR2	BEEF: 1,000-curie tritium release	Rad	Considered/Evaluated – normal release – not an accident
WFOH1	BEEF: heavy metal release	Chemical	Considered/Evaluated – normal release – not an accident
WHOH2	BEEF: beryllium and depleted uranium release	Chemical	Considered/Evaluated – normal release – not an accident
NNSS Activities	**Environmental Management Mission**		
WMR1	Area 5: explosion/fire in two TRU waste containers	Rad	Considered/Evaluated
WMR2	Area 5: explosion/fire in multiple TRU waste containers	Rad	Considered/Evaluated
WMR3	Area 5: airplane crash into TRU waste storage unit	Rad	Considered/Evaluated
WMH1	Area 5: explosion/fire in two hazardous waste containers	Chemical	Considered/Evaluated
WMH2	Area 5: explosion/fire in multiple hazardous waste containers	Chemical	Considered/Evaluated
WMH3	Area 5: airplane crash into hazardous waste storage unit	Chemical	Considered/Evaluated
ERR1	Environmental restoration waste spill in plutonium-contaminated soil (evaluated for both the NNSS and the TTR)	Rad	Considered/Evaluated
ERR2	Environmental restoration waste fire in plutonium-contaminated soil (evaluated for both the NNSS and the TTR)	Rad	Considered/Evaluated
ERR3	Airplane crash into environmental restoration site containing plutonium-contaminated soil (evaluated for both the NNSS and the TTR)	Rad	Considered/Evaluated
ERH1	Fire involving one container-equivalent in composite hazardous environmental restoration site at the NNSS	Chemical	Considered/Evaluated
ERH2	Fire involving multiple container-equivalents in composite hazardous environmental restoration site at the NNSS	Chemical	Considered/Evaluated
ERH3	Airplane crash into composite hazardous environmental restoration site at the NNSS	Chemical	Considered/Evaluated
NDRDH1	NPTEC: spill of one container of hazardous chemicals	Chemical	Considered/Evaluated [c]
NDRDH2	NPTEC: tank failure	Chemical	Considered/Evaluated [c]
NDRDH3	NPTEC: airplane crash into tank farm area	Chemical	Considered/Evaluated [c]
TTR Activities	**National Security/Defense Mission**		
DPR3	TTR: mechanical release of plutonium from test assembly	Rad	Not Applicable
DPR4	TTR: failure of artillery fired atomic projectile during firing	Rad	Not Applicable
DPH1	TTR: explosion of rocket test assembly containing depleted uranium and beryllium	Chemical	Not Applicable
DPH2	TTR: rocket propellant storage area fire	Chemical	Not Applicable

***1996 NTS EIS* Identification Number**	***Scenario Description*** [a]	***Accident Type***	***Scenarios Evaluated since the 1996 NTS EIS*** [b]
TTR Activities	**Environmental Management Mission**		
ERR1	Environmental restoration waste spill in plutonium-contaminated soil (evaluated for both the NNSS and the TTR)	Rad	Considered/Evaluated
ERR2	Environmental restoration waste fire in plutonium-contaminated soil (evaluated for both the NNSS and the TTR)	Rad	Considered/Evaluated
ERR3	Airplane crash into environmental restoration site containing plutonium-contaminated soil (evaluated for both the NNSS and the TTR)	Rad	Considered/Evaluated

BEEF = Big Explosives Experimental Facility; DAF = Device Assembly Facility; NNSS = Nevada National Security Site; NPTEC = Nonproliferation Test and Evaluation Complex (originally the Liquefied Gaseous Fuels Spill Test Facility, then the National HAZMAT Spill Center, and now NPTEC); Rad = radiological; TTR = Tonopah Test Range; TRU = transuranic.

[a] Scenarios drawn from DOE 1996b unless otherwise indicated.

[b] Scenarios were considered/evaluated in this SWEIS except for scenarios that are no longer applicable (e.g., activities have ceased or operations have changed) unless otherwise indicated.

[c] Scenarios drawn from DOE 2004b**.**

The evaluation of accidents consisted of three principal steps:

1. Determine whether any changes in operations at the NNSS would result in new accident scenarios or whether the operations evaluated in the *1996 NTS EIS* are no longer applicable.

2. Evaluate the *1996 NTS EIS* accident scenarios to assess whether there have been changes in the assumptions or input parameters that would affect their consequences or risks.

3. Analyze accident consequences and risks, as appropriate, if changes have been noted in Steps 1 or 2.

Radiological accident scenarios from the *1996 NTS EIS* (DOE 1996b) were examined in this SWEIS for determination of their applicability and were evaluated in terms of the factors that affect their calculated radiation doses, LCFs, and annual LCF risk to both the public and noninvolved workers. Accident locations were assumed to be at DAF (Area 6), the TTR, JASPER (Area 27), the Area 5 RWMC, Area 3, and BEEF (Area 4). Similarly, chemical accident scenarios addressed in the *1996 NTS EIS* (Expanded Use Alternative) were reviewed and evaluated.

Several new facilities with the potential for radiological and chemical accidents that might affect the public or noninvolved workers have become operational since the *1996 NTS EIS*. Each of these was considered in this appendix to determine if they might present a risk to the public or the environment.

Accidents analyzed for this SWEIS were categorized by two mission areas served by operations at the facility where the accident was postulated. At the NNSS, these missions are the National Security/Defense Mission and Environmental Management Mission; those associated with the Nondefense Mission were identified, but were not analyzed. Different levels of activity would exist for each of these missions under the three alternatives. The differences in the levels of activities delineated under the three alternatives in Chapter 3 of this SWEIS affect the number of tests or experiments, but not the fact that the same facility operations would occur. Many of the differences in activities among the three alternatives do not affect baseline quantities of radiological or chemical substances (i.e., MAR).

Proposed activities under each of the alternatives were reviewed and compared with the activities identified in the *1996 NTS EIS*, as well as the safety basis and NEPA documents for specific activities and facilities at the NNSS and other Nevada facilities overseen by DOE and NNSA. Accident scenarios analyzed for this SWEIS were developed using the presence of these substances (i.e., the potential MAR for release to the environment from an accident event) and a means for their release to the environment. Accident analyses from the *1996 NTS EIS*, along with updated documents for NNSS facilities and new NNSS operations, formed the basis for selecting accident scenarios for each alternative. **Table G–13** identifies the facilities and locations for which accidents were evaluated under each alternative. Accidents evaluated in prior NEPA documents, as shown in Table G–12, that were carried forward in this SWEIS would occur at one of the facilities or locations listed in Table G–13.

For most facilities, some operations would occur under each of the alternatives and the potential accident scenarios would be similar. The levels of activities would vary among the alternatives, which can potentially influence a quantitative variation in an accident's probability of occurrence. These changes in probability would typically be on the order of less than a factor of 2 in situations where the overall uncertainty in probability is typically plus or minus a factor of 10. Thus, for the majority of cases, the differences in accident types, source terms, consequences, probabilities, and, ultimately, risk do not vary substantially among the alternatives. In this SWEIS, substantial differences in accident types or risks are highlighted as those discriminators that might be important in making decisions among the alternatives.

Table G–13 Accident Scenario Location and Applicability under Each Alternative

Facility or Function	*NNSS Area*	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
NNSS – National Security/Defense Mission				
Device Assembly Facility	6	✓	✓	✓
Criticality Experiments Facility	6	✓	✓	✓
JASPER	27	✓	✓	✓
Tracer experiments	multiple locations	N/A	N/A	✓
Big Explosives Experimental Facility	4 and other locations	N/A	N/A	✓
Radiological/Nuclear Countermeasures Test and Evaluation Complex	6	✓	✓	✓
Nonproliferation Test and Evaluation Complex	5	✓	✓	✓
U1a Complex	1	✓	✓	✓
Atlas Facility	6	✓	✓	✓
Dense Plasma Focus Facility	11	✓	✓	✓
G-Tunnel	12	✓	N/A	✓
NNSS – Environmental Management Mission				
Waste management	3, 5, 6	✓	✓	✓
Environmental restoration	N/A	✓	✓	✓
TTR/NTTR – National Security/Defense Mission				
TTR	TTR	✓	✓	✓
TTR – Environmental Management Mission				
Environmental restoration	TTR/NTTR	✓	✓	✓

JASPER = Joint Actinide Shock Physics Experimental Research Facility; N/A = not applicable; NNSS = Nevada National Security Site; NTTR = Nevada Test and Training Range; TTR = Tonopah Test Range.

After a review of ongoing and planned activities and projects at the NNSS under each of the alternatives, no new accident scenarios with high consequences or risks were identified for this SWEIS. Although the activities at the site have changed since the *1996 NTS EIS*, the potential consequences for the offsite public and onsite workers were found to be dominated by some of the same accidents identified in the *1996 NTS EIS*. Aircraft accidents were initially screened as initiating events in numerous scenarios under all missions for both the *1996 NTS EIS* and this SWEIS. In the final analysis, they were evaluated under the Environmental Management Mission as reasonably foreseeable from a probabilistic basis. However, a number of changes in assumptions and analytical input parameters were identified that affect the calculated radiological and chemical accident public and noninvolved worker consequences and risks. In addition, the computer models used to evaluate radiological and chemical consequences were changed.

An accident's risk (i.e., number of LCFs) is the product of its probability and consequences. Although the risks for some radiological accident scenarios changed for this SWEIS, the absolute magnitude of the risks of the largest accidents remained very small, principally due to the remote location of activities, the low probabilities (frequencies) of such accidents, or both. The aforementioned "largest accidents," although exhibiting high consequences, also have extremely low probabilities, resulting in very small overall risk values.

In general, the chemical accident analysis for this SWEIS resulted in comparable or lower health consequences for an MEI and noninvolved worker than projected in the *1996 NTS EIS*; because of the localized nature of chemical accidents and the remote locations where they might occur, offsite populations would not be affected by chemical accidents.

G.3.3 Nevada National Security Site Radiological and Chemical Accident Scenarios and Source Terms

Current safety basis and NEPA analyses were reviewed for each of the proposed activities under the No Action, Expanded Operations, and Reduced Operations Alternatives to identify the accident scenarios for the NNSS and other Nevada locations. The following sections summarize the findings and identify the consequences- and risk-dominant scenarios for each site.

In cases where there might be substantial differences in accident types or risks among the alternatives, those differences are highlighted as discriminators that may be important in making decisions among the alternatives.

Because of the sensitive nature of some of the work at the NNSS and the supporting safety documents, this section reports the conclusions of the supporting safety documents, but does not report the sensitive details regarding the material inventories or the exact nature of what might be required to propagate the accident identified. Similarly, the material released is often reported in terms of plutonium-239–equivalent masses. In these cases, the isotopic characteristics of the material may be different from plutonium-239, but the radiological impacts can be represented by a dose-equivalent mass of plutonium-239.

G.3.3.1 Nevada National Security Site National Security/Defense Mission

Since the *1996 NTS EIS*, Stockpile Stewardship and Management Program activities at the NNSS have changed substantially, such that some of the activities in the *1996 NTS EIS* that resulted in high-consequence accidents no longer occur. For example, nuclear weapons are no longer stored in the Area 27 storage bunker.

The activities that would result in higher offsite radiological consequences are accidents at DAF that might result in the explosive dispersal of plutonium from the facility. Other experimental activities, such as those at JASPER and BEEF, involve smaller quantities of radioactive material with very limited potential for accidental dispersal to have impacts on people other than involved workers. Many of the activities under the Stockpile Stewardship and Management Program have no reasonably foreseeable accident scenarios that could result in exposure to noninvolved workers or the public. Involved worker impacts were not evaluated for any accident scenarios under this program; safety programs would limit potential impacts on such workers in events where containment or mitigation was possible. In catastrophic accident scenarios, however (i.e., events that would have substantial impacts outside the facility), it was assumed that the involved worker would be subjected to severe injury or fatality from radiation or chemical exposure or physical trauma.

G.3.3.1.1 Device Assembly Facility

Based on the *1996 NTS EIS* and subsequent safety analyses (LLNL 2007; NSTec 2009b), the accidents with the highest potential consequences that are associated with the National Security/Defense Mission at the NNSS are accidents at DAF in Area 6. In these cases, there are larger quantities of both radioactive materials and explosives in close proximity, so there is a potential mechanism to disperse the radioactive material and release it to the atmosphere. Because DAF was designed for these activities, all of the accidents that would result in the release of radioactive material to the environment would require multiple failures of safety systems and are, therefore, extremely unlikely. These accidents would more likely fall in the "beyond extremely unlikely" category because they have probabilities in the range of 10^{-6} to 10^{-7} per year or lower. If one of these explosive dispersal-type accidents were to occur within DAF, 1 to 5 kilograms of plutonium could be released within the building, but would still most likely be largely confined.

A wide range of potential accident scenarios has been evaluated in DAF safety documents (NSTec 2009b), and conservative estimates of their probabilities, MAR, and potential release to the building and the environment have been developed. The operational accident with the highest combined probability and mitigated release to the environment (i.e., highest risk) is an explosion that results in about 1,000 grams of plutonium being released to the environment. The mitigated frequency is conservatively estimated to be 8×10^{-4} per year. A realistic estimate of the probability of a release of this magnitude is likely much lower.

The only credible mechanism that would result in substantial releases would be a severe seismic event that initiates an explosive dispersal event and fails the confinement functions of the building in such a manner that a release to the environment could occur. Regarding a design-basis earthquake with a return interval of about 2,000 years, neither an explosive dispersal within the building or failure of confinement is expected. At some much lower probability, a seismic event could be postulated that initiates both the accident and failure of confinement. This probability is estimated to be much lower than 10^{-6} per year. For purposes of this SWEIS, a beyond-design-basis earthquake was postulated to initiate an explosive dispersal of plutonium within the building, and confinement was postulated to fail in such a manner that 1 to 5 kilograms of plutonium might be released to the environment. The estimated probability range of this seismically induced accident and failure of confinement is estimated to be in the 10^{-6} to 10^{-7} per year or lower range. DAF was specifically designed to isolate activities and potential accidents occurring in one cell or bay from the balance of the facility. Therefore, an accident, such as an explosion in one part of the facility that initiates an explosion in another location in the facility, was not considered a credible accident sequence.

More-severe accidents at DAF have much lower probabilities than explosions that would disperse plutonium. The highest-potential-consequence accident postulated in the DAF safety analyses is an inadvertent nuclear detonation. The physical conditions that would be required to get the plutonium and explosive materials in a configuration that might result in a nuclear yield are extraordinarily unlikely. It is much more likely that accidents involving both high explosives and plutonium would result in explosive dispersal of plutonium with no nuclear yield. An inadvertent nuclear yield accident is considered in the DAF safety analyses as a beyond-design-basis accident, and safety controls are in place to prevent such an accident. The safety controls that prevent the explosive dispersal of plutonium would also prevent the even less likely conditions that might result in an inadvertent detonation. The DAF safety analyses indicate that "this event has a vanishingly small likelihood (i.e., well below 10^{-6} per year)" and is at least two orders of magnitude less likely than a high-explosives dispersal accident (LLNL 2007; NSTec 2009b). When the mitigation controls are considered, the likelihood of an inadvertent nuclear yield occurring as a result of an accident is expected to be far below the 10^{-6} to 10^{-7} per year range and is not considered further in this SWEIS.

G.3.3.1.2 Criticality Experiments Facility located at the Device Assembly Facility

Since the *1996 NTS EIS*, the Criticality Experiments Facility was moved from Los Alamos National Laboratory to DAF. The decision to move this facility was made after completion of the *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory* (DOE 2002b). Operations at the Criticality Experiments Facility have also been the subject of safety analyses (LLNL 2006; NSTec 2010a). The maximum foreseeable accident for the Criticality Experiments Facility is a reactivity-induced accident that could result in a release equivalent to about 2.6 grams of plutonium to the environment. Two beyond-design-basis accidents, with an estimated probability of less than 10^{-6} per year, an unmitigated vault fire and an excess reactivity insertion with the Godiva critical assembly (one of the critical experiment apparatuses employed at DAF), were conservatively estimated to result in releases equivalent to about 130 grams and 250 grams of plutonium, respectively.

G.3.3.1.3 Joint Actinide Shock Physics Experimental Research Criticality Experiments Facility located at the Device Assembly Facility

Since the *1996 NTS EIS*, JASPER was constructed in Area 27 of the NNSS. Prior to operation, hazards analyses were performed for JASPER, a documented safety analysis (LLNL 2005; NSTec 2008) was developed, and controls were identified to prevent or mitigate all hazards based on the DOE risk-based approach. These analyses considered the complete spectrum of hazards and accidents that could result from facility operations or external initiators that would result in potential accident consequences for workers, the public, and the environment. A number of radionuclides (including plutonium-238, plutonium-239, various isotopes of uranium, and, to a lesser degree, other actinides) may be used as target materials in shock physics experiments. These actinides would be impacted by projectiles within a primary target chamber nested inside of a secondary confinement chamber.

The maximum foreseeable accidents identified were a failure of the ultrafast closure valve system that would result in the release of 8.82×10^{-4} grams of plutonium-239 and 4.78×10^{-6} grams of plutonium-238 to the environment, and a target building fire that would potentially release 6×10^{-6} grams of plutonium-239 and 2.1×10^{-7} grams of plutonium-238. The estimated frequency of the ultrafast closure valve system failure accident is 10^{-1} to 10^{-2} per year; the estimated frequency of the target building fire accident is 10^{-4} to 10^{-6} per year. The worst consequence for the environment would be minor local contamination. The risks to the public from JASPER operations would be minimal.

G.3.3.1.4 Tracer Radionuclides Experiments

As discussed in the normal operations section, under the Expanded Operations Alternative, up to 3 underground and 12 open-air radioactive tracer experiments per year would be conducted. These experiments are not included under the No Action and Reduced Operations Alternatives. The details of how these experiments would be conducted and the exact radionuclide inventories to be used have not been established. Under normal operations, the large curie releases of noble gases or particulates would occur underground and only a very small fraction would reach the surface. The exact operational details that would occur under the Expanded Operations Alternative would dictate the actual potential for accidental releases. To bound the potential accident impacts of the proposed tracer radionuclide experiments, an aboveground explosion involving the maximum proposed inventory of each of the short-lived radioactive particulates (up to 27,000 curies each of rubidium-86, zirconium-95, technetium-99m, molybdenum-99, ruthenium-103, cesium-136, barium-140, cerium-141, neodymium-147, and samarium-153) was postulated for initial analysis in this SWEIS. This should be an easily prevented accident; therefore, the accident probability falls into the extremely unlikely category, 10^{-4} to 10^{-6} per year. Even though the configuration of the tracer experiments are not known, it is likely that they would be designed to efficiently aerosolize a measurable quantity of the particulates; therefore, it was assumed that 1 to 10 percent of the particulates would be aerosolized and respirable in a surface accident. For purposes of performing a conservative analysis of the potential impacts of a surface accident, 10 percent of the particulates were assumed to become airborne and respirable.

The impact results, per isotope, from modeling a puff release of 27,000 curies of each of the short-lived radioactive particulates (rubidium-86, zirconium-95, technetium-99m, molybdenum-99, ruthenium-103, cesium-136, barium-140, cerium-141, neodymium-147, and samarium-153) and 27,000 curies of each of the radioactive noble gases (xenon-127, xenon-131m, xenon-133, krypton-85, and argon-37) are presented in **Table G–14**.

Table G–14 Tracer Experiment Full-Scale Results per Isotope

Scenario	*Release (curies)*	*Noninvolved Worker at 110 Yards*		*MEI at 1.4 Miles*		*Population within 50 Miles*	
		Dose (rem)	*LCF Risk*	*Dose (rem)*	*LCF Risk*	*Dose (person-rem)*	*LCFs [a]*
Rubidium-86	2.7×10^{4}	4.4	3×10^{-3}	2.0×10^{-1}	1×10^{-4}	3.7×10^{-1}	0 (2×10^{-4})
Zirconium-95	2.7×10^{4}	21	2×10^{-2}	9.6×10^{-1}	6×10^{-4}	1.7	0 (1×10^{-3})
Technetium-99m	2.7×10^{4}	0.17	1×10^{-4}	8.4×10^{-3}	5×10^{-6}	1.3×10^{-2}	0 (8×10^{-6})
Molybdenum-99	2.7×10^{4}	3.1	2×10^{-3}	1.4×10^{-1}	9×10^{-5}	2.6×10^{-1}	0 (2×10^{-4})
Ruthenium-103	2.7×10^{4}	13	8×10^{-3}	6.0×10^{-1}	4×10^{-4}	1.1	0 (6×10^{-4})
Cesium-136	2.7×10^{4}	8.6	5×10^{-3}	1.8	1×10^{-3}	3.2	0 (2×10^{-3})
Barium-140	2.7×10^{4}	4.8	3×10^{-3}	2.2×10^{-1}	1×10^{-4}	4.0×10^{-1}	0 (2×10^{-4})
Cerium-141	2.7×10^{4}	5.3	3×10^{-3}	2.5×10^{-1}	1×10^{-4}	4.4×10^{-1}	0 (3×10^{-4})
Neodymium-147	2.7×10^{4}	5.2	3×10^{-3}	2.4×10^{-1}	1×10^{-4}	4.3×10^{-1}	0 (3×10^{-4})
Samarium-153	2.7×10^{4}	1.3	8×10^{-4}	6.0×10^{-2}	4×10^{-5}	1.1×10^{-1}	0 (6×10^{-5})
Total Release of All Particulates	**2.7×10^{5}**	**67**	**4×10^{-2}**	**4.5**	**3×10^{-3}**	**8.1**	**0 (5×10^{-3})**
Argon-37	2.7×10^{4}	1.4×10^{-7}	8×10^{-11}	2.3×10^{-8}	1×10^{-11}	6.0×10^{-8}	0 (4×10^{-11})
Krypton-85	2.7×10^{4}	4.5×10^{-2}	3×10^{-5}	1.3×10^{-3}	8×10^{-7}	3.8×10^{-3}	0 (2×10^{-6})
Xenon-127	2.7×10^{4}	5.5	3×10^{-3}	2.5×10^{-1}	2×10^{-4}	4.6×10^{-1}	0 (3×10^{-4})
Xenon-131m	2.7×10^{4}	3.6×10^{-1}	2×10^{-4}	1.7×10^{-2}	1×10^{-5}	3.0×10^{-2}	0 (2×10^{-5})
Xenon-133	2.7×10^{4}	6.5×10^{-1}	4×10^{-4}	3.0×10^{-2}	2×10^{-5}	5.4×10^{-2}	0 (3×10^{-5})
Total Release of All Noble Gases	**1.3×10^{5}**	**6.5**	**4×10^{-3}**	**3.0×10^{-1}**	**2×10^{-4}**	**5.5×10^{-1}**	**0 (3×10^{-4})**

LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.

[a] The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population dose by the factor of 0.0006 LCFs per person-rem.

Note: Impacts for an acute accident release do not include the long-term (chronic) ingestion pathway; actions would be taken to ensure doses from this pathway were a small fraction of the dose from the plume. In contrast, for normal operational tracer experiment impacts presented in Table G–11, the ingestion pathway was included.

Based on the results of this modeling, surface releases of particulates would have greater radiological impacts than releases of comparable quantities of noble gases.

G.3.3.1.5 Big Explosives Experimental Facility

Details of the BEEF analyses are presented in Appendix F of the *1996 NTS EIS*. Since the *1996 NTS EIS*, BEEF has been operational in Area 4 of the NNSS. Prior to operation, hazards analyses were performed for BEEF, a safety analysis was developed, and controls were identified to prevent or mitigate all hazards based on a DOE risk-based approach. These analyses considered the complete spectrum of hazards and accidents that could result from the operations or external initiators that would result in potential accident consequences for workers, the public, and the environment. For these experiments, the releases are intentional and no reasonably foreseeable accidents were identified that would have substantial impacts on noninvolved workers, the public, or the environment.

As discussed above, detonation of depleted uranium was considered for normal operational impacts from explosive operations at BEEF exclusively. For those analyses, it was assumed that a typical experiment would involve 200 pounds of depleted uranium and the explosive equivalent of 600 pounds of TNT.

Results of the analysis for a single BEEF experiment using depleted uranium are shown in **Table G–15**. For the analysis of an accident at BEEF, it was assumed that all of the depleted uranium becomes aerosolized and respirable, rather than only 20 percent, as was assumed for normal operations.

Involved worker impacts were not evaluated under this mission; rather, safety programs are present to limit potential impacts on such workers in the event that containment and/or mitigation are possible. However, in scenarios of catastrophic proportion (i.e., events that would yield extremely high impacts on noninvolved workers), it was assumed that the involved worker would be subjected to prompt fatality from radiation overdose, physical trauma, or another life-threatening episode.

Table G–15 Big Explosives Experimental Facility Experiment with Depleted Uranium

Scenario	*Release [a] (pounds of depleted uranium)*	*Noninvolved Worker at 110 Yards*		*MEI at 1.4 Miles*		*Population within 50 Miles*	
		Dose (rem)	*110-yard LCFs*	*Dose (rem)*	*LCF Risk*	*Dose (person-rem)*	*LCFs [b]*
BEEF (MEI at 9 miles)	200	0.0012	7×10^{-7}	0.00015	9×10^{-8}	0.017	0 (1×10^{-5})

BEEF = Big Explosives Experimental Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man.

[a] For the accident analysis**,** impacts are calculated assuming that all of the depleted uranium becomes airborne and is respirable. Per DOE Handbook 3010 (DOE 1994), the fraction that might be respirable with an explosive release is 20 percent. The 20 percent fraction is applied to the BEEF experiment normal operational values presented in Table G–10.

[b] The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population dose by the factor of 0.0006 LCFs per person-rem.

No accidents were identified that would result in higher radiological releases/impacts than those identified as part of normal operations.

G.3.3.1.6 Radiological/Nuclear Countermeasures Test and Evaluation Complex

The Radiological/Nuclear Countermeasures Test and Evaluation Complex is located near DAF in Area 6. The potential for accidents and public health and safety impacts associated with operation of the facility was considered in the *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site, Final Environmental Assessment* (DOE 2004c), as well as safety basis documents (NSTec 2009c). Because the activities involve nondestructive evaluation and observations of sealed containers and shipping containers, no reasonably foreseeable accidents were identified that would have substantial impacts on noninvolved workers, the public, or the environment.

G.3.3.1.7 Nonproliferation Test and Evaluation Complex

The potential human health impacts of tests and experiments involving the release of biological simulants and low concentrations of chemicals at various locations within the NNSS were evaluated in the 2004 *Final Environmental Assessment for Activities using Biological Simulants and Releases of Chemicals* (DOE 2004b). That environmental assessment stated, "During releases, administrative and access controls, and area monitoring would prevent exposures to involved and non-involved workers and the general public. No impacts to involved or uninvolved workers or the public from injury or illness would be expected…"

For these experiments, the releases are intentional and no reasonably foreseeable accidents were identified that would have substantial impacts on workers or the general public. The evaluations indicate that reasonable controls and safety programs would continue to ensure that any potential human health risks to involved workers, onsite personnel, and the public from accidents would be minimal. Criteria established in the environmental assessment for experimental releases include limiting concentrations of hazardous material beyond controlled areas to acceptable limits.

Future experimental activities could include evaluating the potential impacts of a release of larger quantities of chemicals such as chlorine. Any such proposed experiments would undergo a thorough environmental and safety review prior to authorization of a test involving larger quantities of hazardous materials. In most cases, an accident involving such hazardous materials would release the materials in an unplanned and uncontrolled manner. As such, proper procedures may not be in place, workers may not be properly sheltered, and weather conditions may not be the same as those for planned experiments. Accidents involving hazardous materials have the potential to affect both involved and noninvolved workers and to release the materials at a higher rate than planned in a controlled experiment.

To evaluate the potential environmental impacts of future experiments at the NNSS involving hazardous chemicals, two accident scenarios involving large accidental releases of chlorine gas were postulated in this SWEIS. The first scenario was an accidental release of chlorine gas from a tractor-trailer tank car engaged in transporting the material on site, or a handling accident involving unloading such a tank, either of which results in the release of the contents of a 20-ton tank car. The second scenario was the catastrophic accidental release of the contents of a 90-ton railcar used to store chlorine for experiments at NPTEC. Both of these accidents are in the "extremely unlikely" to "beyond extremely unlikely" frequency categories, i.e., in the 10^{-4} to 10^{-6} per year frequency range or beyond.

G.3.3.1.8 Other Nevada National Security Site National Security/Defense Mission Activities

Other National Security/Defense Mission activities that might occur under each of the alternatives that were also reviewed include the following:

- Pulsed-power experiments at the Atlas Facility
- Plasma physics and fusion experiments
- Stockpile management activities, including:
  - Disposition of damaged U.S. nuclear weapons
  - Staging, disassembly, modification, and maintenance of nuclear weapons

  - Quality assurance testing of weapons components
  - Storage and staging of special nuclear material, including pits

- G-Tunnel operations
- U1a Complex operations

Hazard, safety, and environmental analyses, as appropriate, were performed for each of these operations (e.g., DOE 2001, NSTec 2009d). These analyses showed that any radiological or chemical releases to the environment from normal operations would be small and would be accounted for in the site baseline dose (see Table G–9). No reasonably foreseeable accidents were identified that would have substantial impacts on noninvolved workers, the public, or the environment beyond those already identified. The impacts of accidents involving these activities would be less than or comparable to other activities that were evaluated in more detail in this SWEIS (e.g., potential accident scenarios associated with DAF operations). Existing safety analyses for these activities indicate that reasonable controls are and would continue to be in place to ensure that any potential human health risks to workers, onsite personnel, and the public from accidents would be minimal.

In addition to these existing facilities, development and evaluation of a new, portable high-energy accelerator capable of producing up to 60 megaelectron volt x-rays for active interrogation or radiography of items in support of the U.S. Department of Defense (DOD) and U.S. Department of Homeland Security (DHS) has been proposed. This would be similar to existing accelerators used radiography at the Device Assembly Facility and the Radiological/ Nuclear Countermeasures Test and Evaluation, but would have higher accelerator energy to enable better radiography of items under examination. The DOD and DHS plans call for the active interrogation activities to be conducted in a variety of outdoor locations at the NNSS that are reflective of real-world conditions where the system could be used; that is, using mobile accelerator (x-ray) units using a variety of targets that could be either fixed or mobile. Special nuclear material or other radioactive materials would be used in the process as targets. Initially, the nuclear or radioactive materials would be in either sealed sources or Type B containers, and accelerator energies would be limited to no more than 60 megaelectron volts. As the project progresses, larger energies and other nuclear materials containerization concepts would be considered. Safety controls would be similar to other portable outside radiography activities. The direct beam presents a hazard to anyone within its path, but is easily controlled and managed. Because of the energy of the proposed unit, its range would be longer than some units, so, as with all radiography devices, care would have to be exercised to ensure a clear beam path. The potential for accidents and public health and safety impacts associated with operation of the accelerator are similar to the active interrogation operations that were considered in the *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site, Final Environmental Assessment* (DOE 2004c), as well as safety basis documents for the existing facility (NSTec 2009c) and the new accelerator (NSTec 2010b, 2010c). Because the activities involve nondestructive evaluation and observations of sealed containers and shipping containers, no reasonably foreseeable accidents were identified that would have substantial impacts on noninvolved workers, the public, or the environment (NSTec 2010b, 2010c).

G.3.3.2 Nevada National Security Site Environmental Management Mission

The *1996 NTS EIS* identified maximum reasonably foreseeable accidents for the Environmental Management Mission as an explosion, fires, and aircraft crashes into the Area 5 waste management areas; spills and fires associated with containers of contaminated soils; or an aircraft crash in an area of the NNSS with contaminated soils. Based on more-recent safety analyses, these accidents are still considered the maximum reasonably foreseeable scenarios.

G.3.3.2.1 Radioactive and Hazardous Waste Facilities in Nevada National Security Site Areas 3 and 5

The *1996 NTS EIS* accidents for the Environmental Management Mission were an explosion, fires, and aircraft crashes in the Area 5 waste management areas, identified as accident scenarios WMR1, WMR2, WMR3, WMH1, WMH2, and WMH3. These accident scenarios are still considered relevant. Since the *1996 NTS EIS*, additional safety analyses for the Area 3 and 5 radioactive waste management facilities have been developed, including a documented safety analysis. Activities that have a potential for accidents that might result in high offsite radiological consequences all involve an impact and a subsequent fire involving containers with large quantities of radioactive material. In all cases, these containers are designed and maintained in such a configuration that vehicle impacts are very unlikely, and rupture of a container and subsequent fire are even less likely. All of the accidents that might result in a substantial release of radioactive materials from the container are categorized as "extremely unlikely" or beyond, in the 10^{-4} to 10^{-6} per year or lower probability range. Because wastes are typically stored in containers that would be appropriate for over-the-road transportation, the likelihood that an onsite impact would substantially damage one or more containers is low. Many of the activities under the Waste Management Program have no reasonably foreseeable accident scenarios that could result in exposure to noninvolved workers or the public**.**

Based on recent safety analyses (DOE 2010a), accidents that are extremely unlikely (10^{-4} to 10^{-6} per year), but still credible, include vehicle impacts and fires in containers of low-level radioactive waste or transuranic material, and a design-basis earthquake. Similar events were postulated for the Area 3 hazardous waste storage area. Radiological accidents such as a vehicle impact or fire were postulated to result in a release equivalent to about 24 to 126 grams of plutonium to the environment.

For the Area 3 hazardous waste storage area, the accidents identified in the *1996 NTS EIS* are still considered conservative. Based on current or reasonably foreseeable levels of activity at Area 3, the quantities of hazardous materials assumed in the *1996 NTS EIS* would not be present under the any of the alternatives.

G.3.3.2.2 Nevada National Security Site Environmental Restoration Program

Since the *1996 NTS EIS*, Environmental Restoration Program activities at the NNSS have continued such that the accidents identified in the *1996 NTS EIS* continue to represent maximum reasonably foreseeable accidents for these activities. Because the waste packages and waste handling and storage practices are designed for these activities, all of the accidents that would result in a release of radioactive material to the environment would require multiple failures of safety systems and, therefore, are extremely unlikely. The accidents analyzed involve the release of radioactive material due to a single-container spill, a multiple-container fire, and an aircraft crash into multiple containers. Only small quantities of radiological materials would be involved and potentially released, and there would be extremely low radiological and chemical risks to noninvolved workers and the public.

The *1996 NTS EIS* evaluated three classes of events for Environmental Restoration Program activities for plutonium contamination at the NNSS: an abnormal event (frequency range of 10^{-3} per year or greater), which is represented by the spill of one container of environmental restoration waste; a design-basis event (frequency range of 10^{-6} to 10^{-3} per year), which is represented by a fire involving the contents of three containers (or a front-end loader) of environmental restoration waste; and a beyond-design-basis accident in which a military aircraft crash results in a large fire that involves contaminated soil (i.e., an aircraft crash that is categorized and analyzed as an "initiating event"). Since the *1996 NTS EIS*, annual sortie operations at Nellis Air Force Base have increased from 16,000 to 27,000 per year (USAF 2007), or by a factor of 1.69. Thus, the estimated probability of the aircraft crash, based on the approximately

27,000 sorties per year (USAF 2007) assumed to occur over or near the NNSS, has increased from 7×10^{-7} per year to 1.2×10^{-6} per year.

Review of ongoing and projected environmental restoration activities at the NNSS indicates that these are still reasonable accident types for all of the SWEIS alternatives. The *1996 NTS EIS* assumed maximum soil contamination levels of 2,000 picocuries per gram at the NNSS. Current information indicates that the maximum existing contamination at the TTR is 51,200 picocuries of plutonium-239 per gram of soil at Clean Slate 3 GZ Mound; therefore, the source terms for this SWEIS were increased proportionally.

G.3.4 Remote Sensing Laboratory Radiological and Chemical Accident Scenarios

No credible accidents that would present other than negligible radiological or hazardous chemical impacts on or risks to involved or noninvolved workers, the public, or the environment were identified for the Remote Sensing Laboratory under any of the alternatives.

G.3.5 North Las Vegas Facility Radiological and Chemical Accident Scenarios

Discussions were held with facility personnel at the A-01 building concerning the inventories of radionuclide sources and their typical operational practices. These discussions indicated that all of the sources were "sealed" and packaged in such a manner that they were not vulnerable to the range of operational events, external events, or natural phenomena events. No safety basis or NEPA documents were identified.

A wide range of accidents at NLVF was considered, including accidents involving sealed sources, as well as airplane crashes. All potential scenarios, however, were found to be of such low probability that they were ultimately eliminated (i.e., screened out) from detailed evaluation in this SWEIS. Therefore, it was concluded that no credible accidents that would present other than negligible radiological or hazardous chemical impacts on or risks to the noninvolved worker, the public, or the environment were applicable to NLVF under the any of the alternatives.

G.3.6 Tonopah Test Range Radiological and Chemical Accident Scenarios

G.3.6.1 Tonopah Test Range National Security/Defense Mission

Stockpile Stewardship and Management Program. Since the *1996 NTS EIS*, Stockpile Stewardship and Management Program activities at the TTR have changed substantially such that the activities that resulted in the maximally reasonably foreseeable accidents identified in the *1996 NTS EIS* no longer occur. For example, the activity that resulted in the maximum reasonably foreseeable radiological accident, the failure of an artillery-fired test assembly, no longer occurs or is expected under any of the alternatives evaluated in this SWEIS.

Under each of the alternatives in this SWEIS, the maximum reasonably foreseeable accident involved the release of radioactive and toxic material due to a structural failure, drop, seismic event, fire, explosion, or aircraft impact involving a joint test assembly, which is part of the nuclear explosive-like assembly. Only small quantities of uranium, lithium, and beryllium would be involved and potentially released. Radiological and chemical impacts on noninvolved workers and the public would be minimal (DOE 1996a; SNL 2005).

The TTR safety analysis does consider a range of fire and explosion-type events involving rocket, missiles, and artillery rounds. The most serious events involve the ignition of high explosives or propellants. The mitigated consequences of these events are typically negligible outside of the local area, but could result in worker fatalities. Safety programs are in place to prevent or mitigate these events (SNL 2005).

G.3.6.2 Tonopah Test Range Environmental Management Mission

Since the *1996 NTS EIS*, Environmental Restoration Program activities at the TTR have continued such that the accidents identified in the *1996 NTS EIS* continue to represent those activities proposed under all alternatives in this SWEIS. The accidents involve the release of radioactive material due to a single-container spill, a multiple-container fire, and an aircraft crash into multiple containers. Because the waste packages and waste handling and storage practices are designed to mitigate most of these events, most of the accidents that would result in the release of radioactive material to the environment would require multiple failures of safety systems and, therefore, are extremely unlikely. Only small quantities of radiological materials would be involved and potentially released. The analyzed accident for which waste packages and waste handling and storage practices are not designed involves an aircraft crash followed by a fire, which is an extremely unlikely event. Radiological and chemical risks of these accidents to noninvolved workers and the public would be minimal.

The *1996 NTS EIS* evaluated three classes of events for Environmental Restoration Program activities for plutonium contamination at the TTR: an abnormal event (frequency range of 10^{-3} per year or greater), which is represented by the spill of one container of environmental restoration waste; a design-basis event (frequency range of 10^{-6} to 10^{-3} per year), which is represented by a fire involving the contents of three containers (or a front-end loader) of environmental restoration waste; and a beyond-design-basis accident in which a military aircraft crash results in a large fire that involves contaminated soil. The estimated probability of the aircraft crash, based on the approximately 16,000 sorties per year that occur over the TTR and are also assumed to occur over the NNSS, was 1×10^{-6} per year. Since the *1996 NTS EIS*, the annual sortie operations at Nellis Air Force Base have increased from 16,000 to 27,000 per year (USAF 2007), or by a factor of 1.69. Thus, the estimated probability of the aircraft crash, based on the approximately 27,000 sorties per year assumed to occur over the TTR (USAF 2007), has increased from 1×10^{-6} per year to 1.7×10^{-6} per year.

Review of ongoing and projected environmental restoration activities at the TTR indicates that these are still reasonable accident types for each of the proposed SWEIS alternatives. The *1996 NTS EIS* assumes maximum soil contamination levels of 2,000 picocuries per gram at the NNSS. Current information indicates that the maximum existing contamination at the TTR is 51,200 picocuries of plutonium-239 per gram of soil at Clean Slate 3 GZ Mound; therefore, the source terms for this SWEIS were increased proportionally.

G.3.7 Radiological and Chemical Accident Impacts

Accident consequences and risks are a function of the source term, number, and location of worker and public dose receptors; meteorology; LCF dose-to-risk conversion factor; and annual accident frequency. Source terms, the location of the MEI, and meteorology data were updated from those used in the *1996 NTS EIS* accident assessment scenarios (DOE 1996a); furthermore, the total 50-mile population, dose-to-LCF risk conversion factor, public dose receptor breathing rate, and certain accident frequencies have also changed. The population changed because the *1996 NTS EIS* population was based on the 1990 census, whereas this SWEIS uses an updated population based on the 2000 census that is extrapolated to the year 2016. The dose-to-LCF conversion factor used in this SWEIS (0.0006 fatal cancers per person-rem) changed due to updated information on cancer rates in exposed populations that was evaluated by a U.S. intergovernmental task force and resulted in new recommended factors (DOE 2003). The changes in public breathing rate are based on DOE accident dose calculation methodology recommendations for the MACCS2 computer code (DOE 2004a). The higher aircraft sortie rate from Nellis Air Force Base resulted in higher accident frequencies for three scenarios (USAF 2007).

The mean consequences of accidental radiological releases, given variations in meteorological conditions at the time of the accident, are calculated as radiological doses in terms of rem. The mean consequences, or the expected consequences of the accident, are an appropriate statistic for use in risk estimates. The consequences are also expressed as the additional potential or likelihood of death from cancer for the noninvolved worker and the MEI, as well as the expected number of incremental LCFs among the exposed population. For purposes of this SWEIS, long-term impacts due to ingestion of radioactive materials accidentally released are not reported because it is reasonable to assume that interdiction would occur to minimize any longer-term doses due to accidents.

G.3.7.1 Nevada National Security Site Radiological and Chemical Accident Results

The analysis results for the NNSS accident scenarios are presented in **Table G–16**. The results are presented in terms of the total effective dose equivalent for the 50-mile radius population, the MEI, and a noninvolved worker, as well as the LCF risks associated with these doses. LCF risks were calculated using the risk factor of 0.0006 LCF per rem discussed in Section G.1.1.3. The risk factor was doubled to 0.0012 LCF per rem for doses greater than 20 rem (NCRP 1993).

A large accidental chlorine gas release from NPTEC was postulated to illustrate the maximum credible accident involving hazardous chemicals with future NNSS operations. No other new chemical accident scenarios are expected for this SWEIS. However, a comparison of the ERPG values used in the *1996 NTS EIS* (NIOSH 1990) against those currently recommended by DOE (DOE 2007b) shows that a number of ERPG values have decreased. These lower ERPG values may affect the consequences of chemical accidents; therefore, all chemical accident consequences were re-analyzed using the ALOHA Version 5.2.3 computer code (EPA 2004) (see Section G.6.3).

As discussed above, chemicals were analyzed using the chemical accident scenarios addressed in the *1996 NTS EIS* (Expanded Use Alternative). In general, different source terms, meteorological dispersion parameters, and receptor locations were applied for this SWEIS compared to the *1996 NTS EIS*. The chemical accident scenarios and their acute health effects on the noninvolved worker and MEI are presented for both the *1996 NTS EIS* and this SWEIS in **Table G–17**. Because multiple chemicals are involved in each accident scenario, the ERPG levels indicated in Table G–17 reflect the highest ERPG level for the noninvolved worker and the MEI for any of the chemicals.

Table G–16 Nevada National Security Site Radiological and Chemical Facility Accidents, Source Terms, and Consequences

		Onsite Worker	*Offsite Population*	
Accident	***Source Term***	***Noninvolved Worker at 110 Yards [a, b] (100 meters)***	***Maximally Exposed Individual [b]***	***Population to 50 Miles [c]***
National Security/ Defense Mission				
DAF explosion involving 55 pounds high explosives and release of 1 kilogram plutonium	1,000 grams plutonium equivalent	6.5 rem 0.004 LCF	0.18 rem 0.0001 LCF	23 person-rem 0 (0.01) LCF
DAF design-basis earthquake	5,000 grams plutonium equivalent	2800 rem 1[d] LCF	0.86 rem 0.0005 LCF	113 person-rem 0 (0.07) LCF
Criticality Experiments Facility Godiva-burst reactivity-induced accident	2.6 grams plutonium equivalent	1.5 rem 0.0009 LCF	0.00045 rem 3×10^{-7} LCF	0.059 person-rem 0 (4×10^{-5}) LCF
Criticality Experiments Facility beyond-design-basis vault fire – unmitigated	130 grams plutonium equivalent	74 rem 0.09 LCF	0.022 rem 1×10^{-5} LCF	2.9 person-rem 0 (0.002) LCF
Criticality Experiments Facility beyond-design-basis Godiva excess reactivity insertion	250 grams plutonium equivalent	130 rem 0.2 LCF	0.048 rem 3×10^{-5} LCF	6.3 person-rem 0 (0.004) LCF
JASPER UCVS failure	8.82×10^{-4} grams Pu-239 4.78×10^{-6} grams Pu-238	9.1×10^{-4} rem 5×10^{-7} LCF	2.9×10^{-7} rem 2×10^{-10} LCF	9.9×10^{-5} person-rem 0 (6×10^{-8}) LCF
JASPER target building fire	3.78×10^{-7} curies Pu-239 3.57×10^{-6} curies Pu-238	2.5×10^{-5} rem 2×10^{-8} LCF	8.0×10^{-9} rem 5×10^{-12} LCF	2.8×10^{-6} person-rem 0 (2×10^{-9}) LCF
Bounding tracer radionuclide experiments surface explosion Areas 5, 12, 15, 16, 19, 20 (results for Area 5)	2,700 curies each of Rb-86, Zr-95, Tc-99m, Mo-99, Ru-103, Cs-136, Ba-140, Ce-141, Nd-147, and Sm-153	6.7 rem 0.008 LCF	0.45 rem 3×10^{-4} LCF	0.81 person-rem 0 (5×10^{-4})LCF
NPTEC catastrophic chlorine gas release from 90-ton railcar (chemical accident)	90 tons of chlorine gas	Potential worker fatalities to about 5 miles downwind without evacuation	Chlorine gas concentrations at levels that pose an irritant, but most likely in unoccupied areas	
Environmental Management Mission – Waste Management				
Area 5 transuranic waste container – vehicle impact and fire	23.79 grams plutonium equivalent	7.9 rem 0.005 LCF	0.36 rem 2×10^{-4} LCF	0.65 person-rem 0 (0.0004) LCF
Area 5 – classified transuranic material container - vehicle impact and fire	65.7 grams plutonium equivalent	20.5 rem 0.02 LCF	0.83 rem 5×10^{-4} LCF	1.8 person-rem 0 (0.001) LCF
Area 5 design-basis earthquake	1.58 grams plutonium equivalent	0.49 rem 0.0003 LCF	0.02 rem 1×10^{-5} LCF	0.043 person-rem 0 (3×10^{-5}) LCF
Area 5 TRUPACT Type A container drop, breach, and fire	126 grams plutonium equivalent	39 rem 0.05 LCF	1.6 rem 1×10^{-3} LCF	3.4 person-rem 0 (0.002) LCF

Accident	Source Term	Onsite Worker	Offsite Population	
		Noninvolved Worker at 110 Yards [a, b] ***(100 meters)***	***Maximally Exposed Individual*** [b]	***Population to 50 Miles*** [c]
Environmental Management Mission – Environmental Restoration [e]				
One-container spill	Curies: U-234 1.10×10^{-10} U-235 8.45×10^{-12} U-238 7.94×10^{-10} Pu-238 1.74×10^{-8} Pu-239 1.59×10^{-6} Pu-240 1.54×10^{-7} Pu-241 4.10×10^{-6} Pu-242 3.33×10^{-12} Am-241 1.02×10^{-7}	1.0×10^{-5} rem 6×10^{-9} LCF	4.8×10^{-7} rem 3×10^{-10} LCF	8.7×10^{-7} person-rem 0 (5×10^{-10}) LCF
Three-container fire	Curies: U-234 9.73×10^{-10} U-235 7.68×10^{-11} U-238 7.17×10^{-9} Pu-238 1.54×10^{-7} Pu-239 1.43×10^{-5} Pu-240 1.38×10^{-6} Pu-241 3.58×10^{-5} Pu-242 3.07×10^{-11} Am-241 9.22×10^{-7}	8.8×10^{-5} rem 5×10^{-8} LCF	3.6×10^{-6} rem 2×10^{-9} LCF	7.8×10^{-6} person-rem 0 (5×10^{-9}) LCF
Aircraft crash and fire	Curies: U-234 1.08×10^{-5} U-235 8.19×10^{-7} U-238 7.68×10^{-5} Pu-238 1.69×10^{-3} Pu-239 1.56×10^{-1} Pu-240 1.51×10^{-2} Pu-241 4.10×10^{-1} Pu-242 3.07×10^{-7} Am-241 1.02×10^{-2}	1.0 rem 6×10^{-4} LCF	0.0474 rem 3×10^{-5} LCF	0.090 person-rem 0 (5×10^{-5}) LCF

Ba = barium; Ce = cerium; Cs = cesium; DAF = Device Assembly Facility; JASPER = Joint Actinide Shock Physics Experimental Research; LCF = latent cancer fatality; Mo = molybdenum; Nd = neodymium; NPTEC = Nonproliferation Test and Evaluation Complex; Pu = plutonium; Rb = rubidium; rem = roentgen equivalent man; Ru = ruthenium; Sm = samarium; Tc = technetium; TRUPACT = Transuranic Packaging Transporter; UCVS = ultrafast closure valve system; Zr = zirconium.

[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that no protective action occurs during the period of exposure and that no subsequent medical intervention occurs.

[b] Increased risk of an LCF to an individual, assuming the accident occurs.

[c] Increased number of LCFs for the offsite population, assuming the accident occurs. The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population dose by the factor of 0.0006 LCFs per person-rem.

[d] Because this represents the increased likelihood of an individual developing an LCF, a value of 1 indicates that the person would likely develop a cancer. The value cannot exceed 1.

[e] Environmental restoration activities conservatively assumed to be located at the Area 5 Radioactive Waste Management Complex. This location has the closest proximity to a site boundary (1.4 miles to the east) of all potential environmental restoration areas and is also closest to the bulk of the population centers.

Note: The dose at 110 yards is highly dependent on the modeling assumptions, especially the energy involved and, hence, the effective release height. Very high doses might be expected if the release were mostly at near-ground level. If lots of energy were assumed, the plume might rise to sufficient height that it might pass over the 110-yard location and not reach the ground for several hundred yards. Thus the dose at 110 yards should only be used as an indicator of potential doses.

Table G–17 Comparison of Chemical Accident Health Consequences

Scenario Identification and Location	*Accident Annual Frequency* [a]	*Noninvolved Worker, 1996 NTS EIS* [a]	*Noninvolved Worker, this SWEIS*	*MEI, 1996 NTS EIS* [a]	*MEI, this SWEIS*
DPH1, TTR	6×10^{-6}	ERPG-2	ERPG-3	ERPG-3	ERPG-3
DPH2, TTR	1.6×10^{-6}	ERPG-1	None	ERPG-1	None
WMH1, Area 5	2.96×10^{-2}	ERPG-3	ERPG-3	None	None
WMH2, Area 5	8×10^{-5}	ERPG-3	ERPG-3	None	None
WMH3, Area 5	1×10^{-7} (EIS) 1.7×10^{-7} (SWEIS)	ERPG-3	ERPG-3	ERPG-1	None
ERH1, TTR or NTTR	0.11	ERPG-3	ERPG-3	None	None
ERH2, TTR or NTTR	8×10^{-5}	ERPG-3	ERPG-3	None	None
ERH3, TTR or NTTR	7×10^{-7} (EIS) 1.2×10^{-6} (SWEIS)	ERPG-3	ERPG-3	None	None
NDRDH1, Area 5	1.7×10^{-2}	ERPG-3	ERPG-3	ERPG-1	None
NDRDH2, Area 5	1×10^{-4}	ERPG-3	ERPG-3	ERPG-1	None
NDRDH3, Area 5	1×10^{-7} (EIS) 1.7×10^{-7} (SWEIS)	ERPG-3	ERPG-3	ERPG-2	ERPG-1
WFOH1, Area 4	1×10^{-3} to 1×10^{-2}	ERPG-1	ERPG-2	None	None
WFOH2, Area 4	1×10^{-4} to 1×10^{-3}	ERPG-3	ERPG-3	None	None
Nonproliferation Test and Evaluation Complex	1×10^{-4} to 1×10^{-6} or lower	Not included	ERPG-3	Not included	ERPG-1 possible

EIS = environmental impact statement; MEI = maximally exposed individual; NTTR = Nevada Test and Training Range; SWEIS = site-wide environmental impact statement; TTR = Tonopah Test Range.

[a] Source: DOE 1996a, 1996b; USAF 2007.

ERPG-1 Values: Exposure to airborne concentrations greater than ERPG-1 values for a period greater than 1 hour results in an unacceptable likelihood that a person would experience mild transient adverse health effects or perception of a clearly defined objectionable odor.

ERPG-2 Values: Exposure to airborne concentrations greater than ERPG-2 values for a period greater than 1 hour results in an unacceptable likelihood that a person would experience or develop irreversible or other serious health effects or symptoms that could impair one's ability to take protective action.

ERPG-3 Values: Exposure to airborne concentrations greater than ERPG-3 values for a period greater than 1 hour results in an unacceptable likelihood that a person would experience or develop life-threatening health effects.

The analysis for this SWEIS shows that most of the chemical accidents result in concentrations above ERPG-3 values for the noninvolved worker. The noninvolved worker assumed to be 110 yards from the release is the modeling construct used in accident impact analyses. It is unlikely that there would be noninvolved workers near the postulated accident. The accident scenario with the highest frequency that could result in a noninvolved worker fatality is ERH1 at the TTR or Nevada Test and Training Range, which has an estimated annual frequency of 0.11 (1 chance in 9).

The only accident scenario that exceeds ERPG-3 values for the MEI is DPH1 at the TTR. This accident scenario has an estimated annual frequency of 6×10^{-6} per year, equivalent to 1 chance in 167,000 that this accident would occur. Accident scenario NDRDH3 could result in mild transient adverse health consequences for the MEI. Accident scenario NDRDH3 has an estimated annual frequency of 1.7×10^{-7} per year, equivalent to 1 chance in 5.9 million that it would occur. The NPTEC chlorine accident would also potentially exceed ERPG-3 concentrations for the MEI. The estimated annual frequency of this accident is up to 1×10^{-4} per year, equivalent to 1 chance in 10,000. All other chemical accidents result in no health effects on the MEI. Several accident scenarios (DPH2, WMH3, NRDH1, and NRDH2) that resulted in health consequences for the MEI in the *1996 NTS EIS* were shown to have no health consequences in the analyses performed for this SWEIS. The lower consequences for these accident scenarios are due to the different values used in the analysis of ERPG-1 in this SWEIS for the chemicals involved, as well as the assumption of neutral 50 percent meteorology for the noninvolved worker and

MEI in this SWEIS (the *1996 NTS EIS* assumed stable 95 percent meteorology). The assumption of 50 percent meteorology is consistent with other current DOE NEPA hazardous chemical accident analyses. In general, the chemical accident analysis results in this SWEIS show lower health consequences for the noninvolved worker and MEI than the analysis results in the *1996 NTS EIS.*

Table G–18 shows the facility accident risks to the offsite population, the MEI, and a noninvolved worker after accounting for the estimated frequency of the postulated accidents. The accident presenting the highest risk to the offsite population would be the DAF accident involving about 55 pounds of high explosives and 1 kilogram of plutonium. For the offsite population, there would be an increased risk of 1×10^{-5} (1 in 100,000) per year of operation of a single LCF occurring in the population. The annual risk of an LCF from this accident would be 9×10^{-8} (about 1 in 11 million) for the MEI. The annual risk of an LCF to the noninvolved worker would be about 3×10^{-6} (about 1 in 330,000).

Table G–18 Nevada National Security Site Radiological and Chemical Facility Accident Risks

Accident	Frequency (events per year)	Onsite Worker: Noninvolved Worker at 110 Yards (100 meters) [a]	Offsite Population: Maximally Exposed Individual [a]	Offsite Population: Population to 50 Miles [b]
National Security/ Defense Mission				
DAF explosion involving 55 pounds of high explosives and release of 1 kilogram of plutonium	8×10^{-4} or lower	3×10^{-6}	9×10^{-8}	1×10^{-5}
DAF beyond-design-basis earthquake	$<10^{-6}$ to 10^{-7}	1×10^{-6}	5×10^{-10}	7×10^{-8}
Criticality Experiments Facility Godiva-burst reactivity-induced accident	10^{-2} to 10^{-4}	9×10^{-6}	3×10^{-9}	4×10^{-7}
Criticality Experiments Facility beyond-design-basis vault fire – unmitigated	$<10^{-6}$	9×10^{-8}	1×10^{-11}	2×10^{-9}
Criticality Experiments Facility beyond-design-basis Godiva excess reactivity insertion	$<10^{-6}$	2×10^{-7}	3×10^{-11}	4×10^{-9}
JASPER UCVS Failure	10^{-1} to 10^{-2}	5×10^{-8}	2×10^{-11}	6×10^{-9}
JASPER Target Building Fire	10^{-4} to 10^{-6}	2×10^{-12}	5×10^{-16}	2×10^{-13}
Bounding Tracer Experiment surface explosion of short-lived particulates (Expanded Operations Alternative only)	10^{-4} to 10^{-6}	4×10^{-7}	3×10^{-8}	5×10^{-8}
Environmental Management Mission – Waste Management				
Area 5 transuranic waste container - vehicle impact and fire	10^{-4} to 10^{-6}	5×10^{-7}	2×10^{-8}	4×10^{-8}
Area 5 – Classified transuranic material container – vehicle impact and fire	10^{-4} to 10^{-6}	2×10^{-6}	5×10^{-8}	1×10^{-7}
Area 5 design-basis earthquake	5×10^{-4}	2×10^{-7}	5×10^{-9}	2×10^{-8}
Area 5 TRUPACT Type A container drop, breach and fire	10^{-4} to 10^{-6}	5×10^{-6}	1×10^{-7}	2×10^{-7}
Environmental Management Mission – Environmental Restoration				
One-container spill	3×10^{-2}	2×10^{-10}	9×10^{-12}	2×10^{-11}
Three-container fire	4×10^{-6}	2×10^{-13}	8×10^{-15}	2×10^{-14}
Aircraft crash and fire	1.2×10^{-6}	7×10^{-10}	4×10^{-11}	6×10^{-11}

< = less than; DAF = Device Assembly Facility; JASPER = Joint Actinide Shock Physics Experimental Research; TRUPACT = Transuranic Packaging Transporter; UCVS = ultrafast closure valve system.

[a] Increased risk of an LCF to an individual per year.

[b] Increased number of LCFs for the offsite population per year. The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population risk by the factor of 0.0006 LCFs per person-rem.

Table G–18 shows that the accident with the highest risk to an MEI would be a TRUPACT [Transuranic Packaging Transporter] container drop and breach, followed by a fire. The risk to the MEI would be highest for this accident because it is postulated to occur in Area 5 and the distance to the site boundary is shorter than the distance from DAF to the site boundary. In the analysis, an MEI was assumed to live at the site boundary, 1.4 miles east of the accident location. This is a conservative assumption because the land beyond the site boundary is part of the Nevada Test and Training Range and is closed to the public. For the offsite population, there would be an increased risk of 2×10^{-7} (1 in 5 million) per year of operation of a single LCF occurring in the population. The annual risk of an LCF to the MEI from this accident would be 1×10^{-7} (about 1 in 10 million). The annual risk of an LCF to the noninvolved worker would be about 5×10^{-6} (about 1 in 500,000).

G.3.7.1.1 Nevada National Security Site National Security/Defense Mission

Stockpile Stewardship and Management Program.

The accidents that would result in the highest offsite radiological consequences are those that are postulated to occur at DAF. These include an accident that might result in the explosive dispersal of plutonium from the building or a design-basis earthquake. The other experimental activities, such as those at JASPER, the U1a Complex, and BEEF, involve smaller quantities of radioactive material with very limited potential for accidental dispersal in quantities that would affect persons other than involved workers. Many of the activities under the Stockpile Stewardship and Management Program have no reasonably foreseeable accident scenarios that could result in exposure to the public or noninvolved workers.

The accidents with the highest potential consequences, as shown in Table G–18, are those associated with accidents at DAF. In these cases, there are larger quantities of both radioactive materials and explosives in close proximity, so there is a potential mechanism to disperse the radioactive material and release it to the atmosphere. Because DAF was designed for these activities, all of the accidents that would result in a release of radioactive material to the environment would require multiple failures of safety systems and, therefore, are extremely unlikely. The accident with the highest combined probability and mitigated release to the environment (maximum reasonably foreseeable accident) at DAF is the explosive dispersal of about 1 kilogram of plutonium to the environment. The estimated probability of this type of event is in the range of 8×10^{-4} or lower per year of operation. If the accident were to occur, the MEI would receive a dose of 0.86 rem, which corresponds to an LCF risk of 0.0005 (1 chance in 2,000). The offsite population within 50 miles would receive a dose of 113 person-rem; the calculated number of LCFs associated with this dose is 0.07, implying that the most likely outcome would be no additional LCFs in the exposed population. An involved worker within DAF could be fatally injured in the explosion. A noninvolved worker outside of DAF could receive a dose of 2,800 rem, which would result in an acute fatality due to receipt of a lethal dose. When the annual probability of the accident occurring is taken into account, the increased risk of an LCF to the MEI would be 3×10^{-7} (1 chance in 3.3 million); the increased risk of a single LCF in the exposed population would be 4×10^{-5} (1 chance in 25,000); and the increased risk of an LCF to a noninvolved worker would be 0.0005 (1 chance in 2,000).

More-severe accidents at DAF would have much lower probabilities than the explosions that result in dispersion of plutonium. As discussed in Section G.3.3.1.1, the accident with the highest potential consequences that was postulated in the DAF safety analyses is an inadvertent nuclear detonation. The physical conditions that would be required to get the plutonium and explosive materials in a configuration that might result in a nuclear yield are extraordinarily unlikely. It is much more likely that accidents involving both high explosives and plutonium would result in explosive dispersal of plutonium with no nuclear yield. An inadvertent nuclear yield accident is considered in the DAF safety analyses as a beyond-design-basis accident, and safety controls are in place to prevent such an accident. The safety controls that prevent the explosive dispersal of plutonium would also prevent the even less likely conditions that might result in an inadvertent detonation. The DAF safety analyses indicate that "this event has a vanishingly small likelihood (i.e., well below 10^{-6} per year)" and at least two orders of magnitude less likely than a high-explosives dispersal accident. When the mitigation controls are considered, the likelihood of an inadvertent nuclear yield occurring as a result of an accident is expected to be far below the 10^{-6} to 10^{-7} per year range and is not considered further in this SWEIS.

Nonproliferation Test and Evaluation Complex. A large accidental chlorine gas release from a railcar at NPTEC was postulated to illustrate the maximum credible accident involving hazardous chemicals to be used in future NNSS operations.

Future experimental activities could include evaluating the potential impacts of releases of larger quantities of chemicals such as chlorine. It is anticipated that any such proposed experiments would undergo a thorough environmental and safety review prior to authorization of a test involving larger quantities of hazardous materials. Most experiments at NPTEC are designed to release chemical or biological simulants to the environment. In most cases, an accident involving such hazardous materials would release the materials in an unplanned and uncontrolled manner. As the proper test procedures may not be in place under accident conditions, workers may not be properly sheltered, and weather conditions may not be the same as those for the planned experiments. Therefore, accidents involving hazardous materials have the potential to affect both involved and noninvolved workers and to release the materials at a higher rate than that planned in the controlled experiment.

To evaluate the potential environmental impacts of future experiments at the NNSS involving hazardous chemicals, two accident scenarios involving large accidental releases of chlorine gas were postulated in this SWEIS. The first scenario was an accidental release of chlorine gas from a tractor-trailer tank car engaged in transporting the material on site, or a handling accident involving unloading such a tank, either of which would result in the release of the contents of a 20-ton tank car. The second scenario was the catastrophic accidental release of the contents of a 90-ton railcar used to store chlorine for experiments at NPTEC. Both of these accidents are in the "extremely unlikely" to "beyond extremely unlikely" frequency category, i.e., in the 10^{-4} to 10^{-6} per year frequency range or beyond.

Catastrophic accidents involving a full, 90-ton railcar of chlorine have resulted in fatalities, including a January 6, 2005, accident involving three 90-ton chlorine railcars in Graniteville, South Carolina. In that accident, about 60 tons of chlorine escaped through a fist-sized hole in one of the railcars and nine people were killed (NTSB 2005).

Potential impacts of an accidental chlorine release from a railcar are highly dependent on the specific conditions of the accident because chlorine within the tank car exists as both a liquid and gas. Release rates are highly dependent on the size of the hole in the tank and the vertical height of the hole above the bottom of the tank. If the hole is below the liquid level, typically about a third of the vertical height, releases will be in liquid form. The rate that the released liquid evaporates and forms a heavier-than-air cloud depends on the ambient conditions (wind, temperature, and topography). Emergency response guidance (DOT 2008, page 300) indicates that, for large spills, first responders should isolate the area of the spill in all directions for 200 meters (2000 feet) and then protect persons downwind for 2.2 miles (3.5 kilometers) under daytime conditions and for 5.0 miles (8.0 kilometers) under nighttime conditions. An incident involving a railcar would be considered a potentially very large spill.

The ALOHA modeling results, assuming the release occurs quickly over 1 hour, indicate that potentially fatal concentrations (exceeding EPRG-3 levels) could extend downwind for 5 to 6 miles under typical daytime conditions and for more than 6 miles under typical nighttime conditions. Concentrations that could lead to potentially serious impacts (exceeding EPRG-2) could extend downwind even further, potentially affecting noninvolved workers. Concentrations that could lead to odor and irritation (exceeding EPRG-1) could extend off site. Because of the nature of chlorine and the complexities of trying to model the dispersion of the heavier-than-air gas, substantial uncertainties are associated with these results.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs. No reasonably foreseeable major accident scenarios that could result in exposure to noninvolved workers or the public were identified for the ongoing or near-term activities of the Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs that are proposed under the No Action Alternative. The activities involving radiological materials utilize sealed sources or well-packaged, unopened materials for which substantial radiological accidents are not expected.

If the need arose for the disposition of nuclear and radiological dispersion devices, the impacts of an accident would be comparable to those resulting from an intentional destructive act. Potential impacts of intentional destructive acts were evaluated in a separate, classified appendix to this SWEIS.

Work for Others. No reasonably foreseeable major accident scenarios that could result in exposure to noninvolved workers or the public were identified for the ongoing or near-term Work for Others Program activities hosted by NNSA. Activities at shared facilities, such as BEEF, NPTEC, the Radiological/Nuclear Countermeasures Test and Evaluation Complex, and the T-1 Training Area present minimal risks to noninvolved workers and the public.

G.3.7.1.2 Nevada National Security Site Environmental Management Mission

Waste Management Program. The accident with the highest potential consequences, as shown in Table G–17, would be the drop and breach of a TRUPACT container, followed by a fire. This accident is postulated to result in the dispersal of up to 126 grams of plutonium. The estimated probability of this type of event is in the range of 10^{-4} to 10^{-6} per year of operation. If this accident were to occur, the offsite population within 50 miles would receive a dose of 3.4 person-rem; the calculated number of LCFs associated with this dose is 0.002, implying that the most likely outcome would be no additional LCFs in the exposed population. The MEI would receive a dose of 1.6 rem, which corresponds to an LCF risk of 0.001 (1 chance in 1,000). A noninvolved worker within Area 5 could receive a dose of 39 rem. This dose could result in radiological injury without prompt medical treatment and represents an LCF risk of 0.05 (1 chance in 20). When the probability of the accident occurring is taken into account, the increased annual risk of a single LCF occurring in the offsite population would be 2×10^{-7} (1 chance in 5 million). The annual risk of an LCF to the MEI would be 1×10^{-7} (1 chance in 10 million) and the increased risk of an LCF to a noninvolved worker would be 5×10^{-6} (1 chance in 200,000).

The following section, which evaluates potential accidents involving Environmental Restoration Program activities, includes a scenario in which an airplane crashes into environmental restoration waste containers in Area 5. A similar accident was not evaluated for Waste Management Program activities because other accidents with large releases have a higher estimated frequency (by two orders of magnitude) than an airplane crash.

Environmental Restoration Program. Accidents postulated for Environmental Restoration Program activities involve the release of radioactive material due to a single-container spill, a multiple-container fire, and an aircraft crash into multiple containers. These accidents could happen any place on the NNSS where environmental remediation occurs. For purposes of analysis, these accidents were modeled as occurring at the Area 5 RWMC; because this location is towards the southern end of the site and near the site boundary, the calculated population and MEI doses would be higher than if these accidents were assumed to occur in most other locations at the NNSS. Only small quantities of radiological materials would be involved and potentially released. Radiological and chemical impacts on noninvolved workers and the public would be minimal.

The accident with the highest consequences for Environmental Restoration Program activities at the NNSS would be an aircraft crash and fire. The estimated probability of this type of event is 1.2×10^{-6} (1 chance in 833,000) per year of operation. If this accident were to occur, the offsite population within 50 miles would receive a dose of 0.090 person-rem; the calculated number of LCFs associated with this dose is 5×10^{-5}, implying that the most likely outcome would be no additional LCFs in the exposed population. The MEI would receive a dose of 0.047 rem, with a corresponding LCF risk of 3×10^{-5} (1 chance in 33,000). A noninvolved worker outside the immediate area of the crash could receive a dose of 1.0 rem, with an associated LCF risk of 6×10^{-4} (1 chance in 1,700). When the probability of the accident is taken into consideration, the risk to the offsite public or a noninvolved worker would be essentially 0 (less than 7×10^{-10}, or 1 chance in 1 billion).

Nondefense Mission. No reasonably foreseeable major accident scenarios that could result in exposure to noninvolved workers or the public were identified for the ongoing or near-term Nondefense Mission activities proposed for the NNSS under the No Action Alternative.

G.3.7.2 Tonopah Test Range Radiological Accident Results

The results for TTR accident scenarios are presented in **Table G–19**. Results are presented in terms of the total effective dose equivalent to the 50-mile radius population, the MEI, and a noninvolved worker, as well as the LCF risks associated with these doses. The LCF risks for all accidents were calculated using the risk factor of 0.0006 LCF per rem discussed in Section G.1.1.3.

Table G–20 shows the facility accident risks to the offsite population, the MEI, and a noninvolved worker after accounting for the estimated frequency of the postulated accidents; the risks from all accidents are extremely small. The accident presenting the highest risk would be an aircraft crash into environmental restoration waste containers, followed by a fire. The annual risk of a single LCF occurring in the offsite population as a result of this accident would increase to 1×10^{-11} (1 in 100 billion) per year of operation. The annual risk to the MEI of an LCF would be 3×10^{-13} (1 in 3 trillion). The annual risk of an LCF to a noninvolved worker would be about 2×10^{-9} (1 in 500 million).

Table G–19 Tonopah Test Range Radiological and Chemical Facility Accidents, Probabilities and Consequences

Accident	*Source Term*		*Noninvolved Worker at 110 Yards* [a, b]	*Offsite Population* — *Maximally Exposed Individual* [a, b]	*Offsite Population* — *Population to 50 Miles* [c]
National Security/ Defense Mission					
Joint Test Assembly – radiological		Curies	0.075 rem 5×10^{-5} LCF	1.7×10^{-5} rem 1×10^{-8} LCF	5.9×10^{-4} person-rem 0 (4×10^{-7}) LCF
	Uranium-234	2.48×10^{-2}			
	Uranium-235	7.8×10^{-5}			
Joint Test Assembly – chemical		Grams	Lithium: 0.295 mg/m^3 << 55 mg/m^3 IDLH, but > than 0.025 mg/m^3 OSHA limit	Lithium: ~0 mg/m^3 << 55 mg/m^3 IDLH	–
	Lithium	20	Beryllium: 0.074 mg/m^3 << 10 mg/m^3 IDLH, but >0.002 mg/m^3 OSHA limit	Beryllium: ~0 mg/m^3 << 10 mg/m^3 IDLH	
	Beryllium	5			
Sealed source aircraft impact – fire		Curies	1.2×10^{-5} rem 7×10^{-9} LCF	2.5×10^{-9} rem 2×10^{-12} LCF	1.1×10^{-7} rem 0 (7×10^{-11}) LCF
	Cobalt-60	1.89×10^{-3}			
Environmental Management Mission – Environmental Restoration					
One-container spill		Curies:	1.5×10^{-5} rem 9×10^{-9} LCF	3.4×10^{-9} rem 2×10^{-12} LCF	1.2×10^{-7} person-rem 0 (7×10^{-11}) LCF
	Uranium-234	1.10×10^{-10}			
	Uranium-235	8.45×10^{-12}			
	Uranium-238	7.94×10^{-10}			
	Plutonium-238	1.74×10^{-8}			
	Plutonium-239	1.59×10^{-6}			
	Plutonium-240	1.54×10^{-7}			
	Plutonium-241	4.10×10^{-6}			
	Plutonium-242	3.33×10^{-12}			
	Americium-241	1.02×10^{-7}			
Three-container fire		Curies:	1.2×10^{-4} rem 7×10^{-8} LCF	2.5×10^{-8} rem 2×10^{-11} LCF	1.1×10^{-6} person-rem 0 (7×10^{-10}) LCF
	Uranium-234	9.73×10^{-10}			
	Uranium-235	7.68×10^{-11}			
	Uranium-238	7.17×10^{-9}			
	Plutonium-238	1.54×10^{-7}			
	Plutonium-239	1.43×10^{-5}			
	Plutonium-240	1.38×10^{-6}			
	Plutonium-241	3.58×10^{-5}			
	Plutonium-242	3.07×10^{-11}			
	Americium241	9.22×10^{-7}			
Aircraft crash and fire $25.6 \times$ *1996 NTS EIS* $1 \times 10^5 \times$ single-container spill		Curies:	1.5 rem 9×10^{-4} LCF	0.00034 rem 2×10^{-7} LCF	0.012 person-rem 0 (7×10^{-6}) LCF
	Uranium-234	1.08×10^{-5}			
	Uranium-235	8.19×10^{-7}			
	Uranium-238	7.68×10^{-5}			
	Plutonium-238	1.69×10^{-3}			
	Plutonium-239	1.56×10^{-1}			
	Plutonium-240	1.51×10^{-2}			
	Plutonium-241	4.10×10^{-1}			
	Plutonium-242	3.07×10^{-7}			
	Americium-241	1.02×10^{-2}			

> = greater than; << = much less than; IDLH = Immediate Danger to Life and Health; LCF = latent cancer fatality; mg/m^3 = milligrams per cubic meter; OSHA = Occupational Safety and Health Administration; rem = roentgen equivalent man.

[a] Individual radiation doses in excess of a few hundred rem would result in acute (near-term) health effects or even death from causes other than cancer. In some cases, medical intervention may be effective in reducing the dose, mitigating health impacts, or both. The listed doses are calculated assuming that no protective action occurs during the period of exposure and that no subsequent medical intervention occurs.

[b] Increased risk of an LCF to an individual, assuming the accident occurs.

[c] Increased number of LCFs for the offsite population, assuming the accident occurs. The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population dose by the factor of 0.0006 LCFs per person-rem.

Table G–20 Tonopah Test Range Radiological and Chemical Facility Accident Risks

		Onsite Worker	*Offsite Population*	
Accident	*Frequency (events per year)*	*Noninvolved Worker at 110 Yards* [a]	*Maximally Exposed Individual* [a]	*Population to 50 Miles* [b]
National Security/ Defense Mission				
Joint Test Assembly radiological	6×10^{-6}	3×10^{-10}	6×10^{-14}	2×10^{-12}
Joint Test Assembly chemical	6×10^{-6}	Lithium: 0.295 mg/m^3 << 55 mg/m^3 IDLH, but > than 0.025 mg/m^3 OSHA limit Beryllium: 0.074 mg/m^3 << 10 mg/m^3 IDLH, but > 0.002 mg/m^3 OSHA limit	Lithium: ~0 mg/m^3 << 55 mg/m^3 IDLH Beryllium: ~0 mg/m^3 << 10 mg/m^3 IDLH	–
Sealed source aircraft impact – fire	10^{-4} to 10^{-6}	7×10^{-13}	2×10^{-16}	7×10^{-15}
Environmental Management Mission – Environmental Restoration				
One-container spill 25.6 × *1996 NTS EIS*	3×10^{-2}	3×10^{-10}	6×10^{-14}	2×10^{-12}
Three-container fire 25.6 × *1996 NTS EIS* 9 × single-container spill	4×10^{-6}	3×10^{-13}	8×10^{-17}	3×10^{-15}
Aircraft crash and fire 25.6 × *1996 NTS EIS* 1×10^5 × single-container spill	1.7×10^{-6}	2×10^{-9}	3×10^{-13}	1×10^{-11}

> = greater than; << = much less than; IDLH = Immediate Danger to Life and Health; mg/m^3 = milligrams per cubic meter; OSHA = Occupational Safety and Health Administration.

[a] Increased risk of an LCF to an individual per year.

[b] Increased number of LCFs for the offsite population per year. The number of LCFs in the population would be a whole number. The value in parentheses is the result of multiplying the population risk by the factor of 0.0006 LCFs per person-rem.

G.3.7.2.1 Tonopah Test Range National Security/Defense Mission

Stockpile Stewardship and Management Program. The accident postulated for Stockpile Stewardship and Management Program operations at the TTR involved a release of radioactive and toxic material due to a structural failure, drop, seismic event, fire, explosion, or aircraft impact involving a joint test assembly, which is part of a nuclear explosive-like assembly. Only small quantities of uranium, lithium, and beryllium would be involved and potentially released. If an accident were to occur, the offsite population dose would be 5.9×10^{-4}, which would have the expected result of 0 LCFs (calculated number of 4×10^{-7}). The dose and risk of an LCF to the MEI would be 1.7×10^{-5} rem and 1×10^{-8} (1 chance in 100 million), respectively. The dose and risk of an LCF to the noninvolved worker MEI would respectively be 0.075 rem and 5×10^{-5} (1 chance in 20,000). When the estimated annual frequency of the accident of 6×10^{-6} is considered, the risk to the offsite public and the worker is essentially 0.

G.3.7.2.2 Tonopah Test Range Environmental Management Mission

Waste Management Program. No reasonably foreseeable accident scenarios that could result in exposure to noninvolved workers or the public were identified for the ongoing or near-term Waste Management Program activities at the TTR.

Environmental Restoration Program. Environmental restoration activities at the TTR would involve the cleanup of contaminated surface soil. All of the postulated accidents for environmental restoration activities would result in very low consequences and essentially no risk to the offsite public or a noninvolved worker. Regarding Environmental Restoration Program activities at the TTR, the accident with the greatest impacts would be an aircraft crash and fire. The estimated probability of this type of accident is in the range of 1.7×10^{-6} (1 chance in 590,000) per year of operation. If this accident were to occur, the offsite population within 50 miles would receive a dose of 0.012 person-rem; the calculated number of LCFs associated with this dose is 7×10^{-6}, implying that the most likely outcome would be no additional LCFs in the exposed population. The MEI would receive a dose of 0.00034 rem, with a corresponding LCF risk of 2×10^{-7} (1 chance in 5,000,000). A noninvolved worker outside the immediate area of the crash could receive a dose of 1.5 rem, with an associated LCF risk of 9×10^{-4} (1 chance in 1,100). When the probability of the accident is taken into consideration, the risk to the offsite public or a noninvolved worker would be essentially 0.

G.3.7.2.3 Tonopah Test Range Nondefense Mission

No reasonably foreseeable accident scenarios that could result in exposure to noninvolved workers or the public were identified for the ongoing or near-term Nondefense Mission activities at the TTR.

G.3.8 Accident Radiological and Chemical Impacts Conclusion

As discussed above, radiological analyses of the accidents at the NNSS and TTR for all three alternatives were performed using the MACCS2 computer code. As shown in the prior tables, radiation doses were calculated for the MEI, noninvolved worker, and the population within 50 miles. Doses were converted to LCFs and annual risk, based on 0.0006 LCFs per rem and the annual frequency for each accident scenario. The highest accident consequences and risks to the MEI and population under each alternative are summarized in **Table G–21**. For purposes of comparison, Table G–21 also shows the doses an individual and the population within 50 miles would receive from natural background radiation.

An evaluation of the nature and quantity of toxic chemicals was performed to determine whether a postulated accident could cause a release of these chemicals that could result in a hazard to workers or the public. Although the annual frequency of a postulated accident involving the release of toxic chemicals is equivalent to the radiological release accidents, in most cases, the relatively low quantity and physical characteristics of the toxic chemicals preclude any significant health hazards in the event of an accidental release of toxic liquids or gases. An accident resulting in a large chlorine release was postulated that could result in significant impacts on onsite workers and lesser effects at offsite locations.

Table G–21 Highest Accident Radiological Consequences and Risks to the Public

Receptor/ Accident	*Parameter*	*No Action Alternative*	*Reduced Operations Alternative*	*Expanded Operations Alternative*
MEI/Area 5 TRUPACT Type A container, drop, breach, and fire	dose (rem)	1.6	Same as No Action	Same as No Action
	LCF if the accident occurs	0.001		
	annual risk	3×10^{-7}		
	dose from natural background radiation	0.36		
Population/DAF	dose (person-rem)	113		
	LCF if the accident occurs	0 (0.07)		
	annual risk	3×10^{-5}		
	dose from natural background radiation [a]	15,000		

DAF = Device Assembly Facility; LCF = latent cancer fatality; MEI = maximally exposed individual; rem = roentgen equivalent man; TRUPACT = Transuranic Packaging Transporter.

[a] Based on an annual average natural background dose of 0.355 rem per person (see Table 4–51 of this SWEIS) and a population within 50 miles of DAF of 42,085.

Note: Different accident scenarios can represent the highest consequences (dose and LCFs if accident occurs) and risks (annual risk).

G.4 Industrial Accidents

Annual industrial accidents were projected according to recent U.S. Bureau of Labor Statistics and DOE accident statistics. The fatal occupational injury rate was estimated for the construction activities using a rate of 3.7 fatalities per 100,000 full-time equivalent workers for the commercially constructed solar facility and a rate of 1.1 fatalities per 100,000 full-time equivalent workers for NNSA construction activities (DOE 2010b; DOL 2010a). Accident rates across the DOE complex are lower than those of general industry. Estimates of fatalities are shown in **Table G–22**. **Table G–23** shows the projected total recordable cases (TRCs) and the days away from work, restricted duty, or transferred (DART) cases. The rates used for the solar power facility, based on general industry, are 4.1 TRCs and 2.1 DART cases per 200,000 hours worked (DOL 2010b). The rates used to project incidences for NNSA activities are 1.5 TRCs and 0.7 DART cases per 200,000 hours worked.

Table G–22 Project Annual Incidences of Fatal Industrial Accidents

Location/Activity	*No Action Alternative*	*Expanded Operations Alternative*	*Reduced Operations Alternative*
Nevada National Security Site Construction (per year)	0.0	0.029 [a]	0.0
Commercial Solar Power Generation Facility Construction (per construction project)	0.055 [b]	0.10 [c]	0.041 [d]

[a] Based on 250 full-time equivalent workers per year.
[b] Based on 500 full-time equivalent workers for a 35-month construction period.
[c] Based on 750 full-time equivalent workers for a 42-month construction period.
[d] Based on 400 full-time equivalent workers for a 32-month construction period.
Sources: DOE 2010b; DOL 2010a.

Table G–23 Projected Annual Incidences of Nonfatal Industrial Accidents

Location/Activity	*No Action Alternative*		*Expanded Operations Alternative*		*Reduced Operations Alternative*	
	TRC	DART	TRC	DART	TRC	DART
Nevada National Security Site – Site Operations	26	11	32	14	23	10
Nevada National Security Site – Construction	0	0	3.8	1.7	0	0
Commercial Solar Power Generation Facility – Operations	6.2	3.2	8.3	4.2	5.2	2.7
Commercial Solar Power Generation Facility – Construction (per project duration) [a]	60	31	110	56	44	23
North Las Vegas Facility – Site Operations	22	9.5	27	12	20	8.6
Remote Sensing Laboratory – Site Operations	2.0	0.9	2.0	0.9	2.0	0.9
Tonopah Test Range Industrial – Site Operations	1.6	0.7	0.7	0.3	0.6	0.3

DART=days away, restricted, or transferred; TRC=total recordable cases.
[a] Based on 500 full-time equivalent workers for a 35-month construction period for the No Action Alternative; 750 full-time equivalent workers for a 42-month construction period for the Expanded Operations Alternative; and 400 full-time equivalent workers for a 32-month construction period for the Reduced Operations Alternative.
Sources: DOE 2010b; DOL 2010a.

G.5 Intentional Destructive Acts

NNSA has prepared a separate, classified analysis of the potential impacts of intentional destructive acts related to activities at the NNSS. Intentional destructive acts involving NLVF activities were also considered. There were no intentional destructive acts postulated to occur at the Remote Sensing Laboratory or the TTR that would result in greater impacts than those evaluated for the NNSS and NLVF. NNSA will consider the analysis when developing the Record of Decision for this SWEIS.

G.6 Computer Code Descriptions

G.6.1 GENII-2 Computer Code Description

Radiological impacts of releases during normal operations were calculated using GENII-2 (PNNL 2007). GENII-2 is designed to model atmospheric and liquid releases of radionuclides and their human health consequences. Site-specific input data were used, including location, meteorology, population, and source terms. This section briefly describes GENII-2 and outlines the approach used for normal operations.

The GENII-2 computer model, developed by Pacific Northwest National Laboratory, is an integrated system of computer modules that analyzes environmental contamination resulting from acute or chronic releases to, or initial contamination of, air, water, or soil. The model calculates radiation doses to individuals and populations. The GENII-2 computer model is well documented for assumptions, technical approach, method, and quality assurance issues. The GENII-2 computer model has gone through extensive quality assurance and quality control steps, including comparing results from model computations with those from hand calculations and performing internal and external peer reviews (PNNL 2007).

Available release scenarios include chronic and acute releases to water or to air (ground-level or elevated sources), and initial contamination of soil or surfaces. GENII-2 implements NRC models for surface-water doses that were developed using the LADTAP computer code. Exposure pathways include direct exposure via water (swimming, boating, and fishing), as well as soil, air, inhalation, and ingestion. GENII Version 1.485 implemented dosimetry models recommended by the ICRP in Publications 26, 30, and 48 and approved for use by DOE Order 458.1. GENII-2 implements these models, as well as those of ICRP Publications 56 through 72 and the related risk factors published in Federal Guidance Report No. 13 (EPA 1999). Risk factors in the form of EPA-developed slope factors (a special subset of the Federal Guidance Report No. 13 values) are also included. These dosimetry and risk models are considered state of the art by the international radiation protection community and have been adopted by most national and international organizations as their standard dosimetry methodology (EPA 1999; PNNL 2007).

GENII-2 consists of four independent atmospheric models, one surface water model, three independent environmental accumulation models, one exposure module, and one dose/risk module, each with a specific user interface code. The computer programs are of several types: user interfaces (i.e., interactive, menu-driven programs to assist the user with scenario generation and data input), internal and external dose factor libraries, environmental dosimetry programs, and file-viewing routines. The Framework for Risk Analysis in Multimedia Environmental Systems Program serves as the interface for operating GENII-2. For maximum flexibility, the code has been divided into several interrelated, but separate, exposure and dose calculations (PNNL 2007).

G.6.2 MACCS2 Code Description

The MACCS2 computer code V.1.13.1 (Chanin and Young 1997) was used to estimate the radiological doses and health effects that could result from postulated accidental releases of radioactive materials to the atmosphere. MACCS2 was used to analyze the health impacts of postulated accidents. MACCS2 uses actual hourly meteorological data (i.e., windspeed, wind direction, rainfall, atmospheric dispersion stability) from the site. The use of actual hourly data is more accurate in calculating the probabilistic dose distribution for accident analyses. MACCS2 has the capability to model the effects of population evacuation or relocation during or after an accident. Nevertheless, for the purpose of realistically and conservatively predicting potential population movement in response to an accident, it was assumed that no evacuation or relocation would take place.

The specification of the release characteristics, designated a "source term," can consist of up to four Gaussian plumes that are often referred to simply as "plumes." The radioactive materials released were modeled assuming they would be dispersed into the atmosphere while being transported by the prevailing wind. During transport, particulate material can be modeled as being deposited on the ground. The extent of this deposition can depend on precipitation. If contamination levels exceed a user-specified criterion, mitigating actions can be triggered to limit radiation exposure.

Atmospheric conditions during an accident scenario's release and subsequent plume transport are taken from an annual, hourly meteorological data file. Scenario initiation was assumed to be equally likely during any hour contained in the file's data set, with plume transport governed by the succeeding hours. The model was applied by calculating the exposure to each receptor for accident initiation during each hour of the 8,760-hour data set. The mean results of these samples, which include contributions from all meteorological conditions, are presented in this SWEIS. Data sets from nearby Meteorological Stations 5, 6, 26, and 49 were used in assessing impacts for the various modeled accident locations across the NNSS and the TTR.

Two aspects of the code's structure are important to understanding its calculations: (1) the calculations are divided into modules and phases, and (2) the region surrounding the facility is divided into a polar-coordinate grid. These concepts are described in the following sections.

MACCS2 is divided into three primary modules: ATMOS, EARLY, and CHRONC. The three phases following an accident are defined as the emergency, intermediate, and long-term phases. The relationships among the code's three modules and the three phases of exposure are summarized in the following text. In this SWEIS, the ATMOS and EARLY modules were used to evaluate the potential impacts during the emergency phase of an accident. This is the phase during which a receptor would receive the largest radiation dose.

The ATMOS module performs all of the calculations pertaining to atmospheric transport, dispersion, and deposition, as well as the radioactive decay that occurs before release and while the material is in the atmosphere. It uses a Gaussian plume model with Pasquill-Gifford dispersion parameters. The phenomena treated include building wake effects, buoyant plume rise, plume dispersion during transport, wet and dry deposition, and radioactive decay and in-growth. Local topography is not modeled for calculating atmospheric dispersion, which results in conservatively higher plume concentrations, doses, and risks to the public. The results of the calculations are stored for subsequent use by EARLY and CHRONC. In addition to the air and ground concentrations, ATMOS stores information on wind direction, arrival and departure times, and plume dimensions.

It is noted that dispersion calculations such as those used in MACCS2 are generally recognized to be less applicable within 110 yards (100 meters) of a release than they are to distances further downwind (DOE 2004a); such close-in results frequently overpredict the atmospheric concentrations because they do not account for the initial momentum or size of the release or the impacts of structures and other obstacles on plume dispersion. Most of the results presented in this SWEIS are for distances at least 110 yards (100 meters) downwind from a hypothesized release source.

The EARLY module models the period immediately following a radioactive release. This period is commonly referred to as the "emergency phase." The emergency phase begins at each successive downwind distance point when the first plume of the release arrives. The duration of the emergency phase is specified by the user and can range between 1 and 7 days. The exposure pathways considered during this period are direct external exposure to radioactive material in the plume (cloud shine), exposure from inhalation of radionuclides in the cloud (cloud inhalation), exposure to radioactive material deposited on the ground (ground shine), inhalation of resuspended material (resuspension inhalation), and skin dose from material deposited on the skin. Mitigating actions that can be specified for the emergency phase include evacuation, sheltering, and dose-dependent relocation. However, as a conservative measure, no evacuation or relocation was assumed in any of the accident scenario modeling performed for this SWEIS.

The CHRONC module performs all of the calculations pertaining to the intermediate and long-term phases. CHRONC calculates the individual health effects that result from exposures to radiation via ingestion of contaminated foodstuffs, contact with contaminated ground, and/or inhalation of resuspended materials. The CHRONC module was not utilized in any of the accident scenario modeling of this SWEIS due to the acute high exposures that are expected from a post-accident situation (i.e., direct inhalation and external [cloudshine and cloud immersion] exposure only) as compared to the lower dose long-term exposures. For the accident analyses in this SWEIS, various time segments were employed for the assumed duration(s) of the emergency phase(s), depending on specific accident scenario characteristics, such as whether there was a fire involved, the energy of the incident/plume, or other characteristics that would denote material volatility or dispersal capacity.

The intermediate phase begins at each successive downwind distance point upon conclusion of the emergency phase. The user can configure the calculations with an intermediate phase that has a duration as short as zero or as long as 1 year. In the zero-duration case, there is essentially no intermediate phase, and a long-term phase begins immediately upon conclusion of the emergency phase. Intermediate models are implemented assuming that the radioactive plume has passed and the only exposure sources (ground shine and resuspension inhalation) are from ground-deposited material.

The mitigating action model for the intermediate phase is very simple. If the intermediate phase dose criterion is satisfied, the resident population is assumed to be present and subject to radiation exposure from ground shine and resuspension for the entire intermediate phase. If the intermediate phase exposure exceeds the dose criterion, then the population is assumed to be relocated to uncontaminated areas for the entire intermediate phase.

The long-term phase begins at each successive downwind distance point upon conclusion of the intermediate phase. A number of protective measures, such as decontamination, temporary interdiction, and condemnation, can be modeled in the long-term phase to reduce doses to user-specified levels. As discussed above, however, the food ingestion pathway was not modeled.

The decisions on mitigating action in the long-term phase are based on two sets of independent actions: (1) decisions related to whether land at a specific location and time is suitable for human habitation (habitability), and (2) decisions related to whether land at a specific location and time is suitable for agricultural production (ability to farm). For this SWEIS, mitigation or special protective/remedial measures were assumed for the accident exposure calculations and, hence, the accident doses do not include contributions from long-term ingestion.

All of the calculations of MACCS2 are stored based on a polar-coordinate spatial grid with a treatment that differs somewhat between calculations of the emergency phase and calculations of the intermediate and long-term phases. The region potentially affected by a release is represented with a (r, θ) grid system centered on the location of the release. Downwind distance is represented by the radius "r." The angle, "θ," is the angular offset from the north, going clockwise.

The user specifies the number of radial divisions as well as their endpoint distances. The angular divisions used to define the spatial grid are fixed in the code. They correspond to the 16 points of the compass, each being 22.5 degrees wide. The 16 points of the compass are used in the United States to express wind direction. The compass sectors are referred to as the "coarse grid." Population values are assigned to each of these grid segments in the process of calculating the dose to the surrounding population to a distance that the user specifies. All accidents were modeled out to a distance of 50 miles from all applicable release points; however, as discussed above in the normal operations subsection, a sensitivity analysis for the DAF design-basis earthquake was performed to assess the potential differences in total population doses, given that most of the greater Las Vegas metropolitan area is included within an 80-mile, not a 50-mile, radius of most release points at the NNSS. This accident was chosen because, even though the release location is several miles farther away from the Las Vegas population than Area 5, its dose consequences are several orders of magnitude higher than the largest accident at Area 5. The difference in total population between a 50- and 80-mile radius from DAF is about 2.03 million people (~42,000 out to 50 miles and ~2.07 million out to 80 miles). An expected increase in the population dose of 1,312 person-rem (1,160 percent) occurs, from 113 person-rem to 1,425 person-rem. Because the population dose is divided by a much greater population number, however, there is an associated 77 percent decrease in the average dose to a member of the population (2.7 millirem per person to 0.63 millirem per person).

Because emergency phase calculations use dose-response models for early fatalities and early injuries that can be highly nonlinear, these calculations are performed on a finer grid basis than the calculations of the intermediate and long-term phases. For this reason, the calculations of the emergency phase are performed with the 16 compass sectors divided into 3, 5, or 7 equal angular subdivisions. The subdivided compass sectors are referred to as the "fine grid."

Lifetime doses are the conventional measure of detriment used for radiological protection. These are 50-year dose commitments to a weighted sum of tissue doses defined by the ICRP and referred to as the "effective dose equivalent." Lifetime doses may be used to calculate the stochastic health effect risk resulting from exposure to radiation. The calculated lifetime dose was used in cancer risk calculations.

G.6.3 ALOHA Code Description

Consequences of accidental chemical releases were determined using the ALOHA computer code (EPA 2004). ALOHA is an EPA- and National Oceanic and Atmospheric Administration-sponsored computer code that has been widely used in support of chemical accident responses and also in support of safety and NEPA documentation for DOE facilities. The ALOHA code is a deterministic representation of atmospheric releases of toxic and hazardous chemicals. The code can predict the rate at which chemical vapors escape (such as from puddles or leaking tanks) into the atmosphere; a specified direct release rate is also an option.

ALOHA performs calculations for chemical source terms and resulting downwind concentrations. Source term calculations determine the rate at which the chemical material is released to the atmosphere, the release duration, and the physical form of the chemical upon release.

The term "cloud" is used in this document to refer to the volume that encompasses the chemical emission. In general, the released chemical may be a gas, a vapor, or an aerosol. The aerosol release may consist of either solid (fume, dust) or liquid (fog, mist, spray) particles that are suspended in a gas or vapor medium. Liquid particles are also referred to as "droplets." The analyst specifies the chemical and then characterizes the initial boundary conditions of the chemical with respect to the environment through the source configuration input. The ALOHA code allows the source to be defined in one of four ways (direct source, puddle source, tank source, or pipe source) to model various accident scenarios. The source configuration input is used either to specify the chemical source term or to provide ALOHA with the necessary information and data to calculate transient chemical release rates and the physical state of the chemical upon release. ALOHA calculates time-dependent release rates for up to 150 time steps (EPA 2004). ALOHA then averages the release rates from the individual time steps over one to five averaging periods, each lasting at least 1 minute (EPA 2004). The five averaging periods are selected to accurately portray the peak emissions. The five average release rates are inputs to the ALOHA algorithms for atmospheric transport and dispersion (EPA 2004).

ALOHA tracks the evolution of the mean concentration field of the five separate chemical clouds and calculates the concentration at a given time and location through superimposition. ALOHA limits releases to 1 hour.

Evolution of the mean concentration field of the chemical cloud is calculated through algorithms that model the turbulent flow phenomena of the atmosphere. The prevailing wind flows and associated atmospheric turbulence serve to transport, disperse, and dilute the chemical cloud that initially forms at the source. For an instantaneous or short-duration release, the chemical cloud will travel downwind as a puff. In contrast, a plume will form for a sustained or continuous release.

The wind velocity is a vector term defined by a direction and magnitude (windspeed). The wind direction and speed determine where the puff or plume will go and how long it will take to reach a given downwind location. For sustained or continuous releases, the windspeed has the additional effect of stretching out the plume and establishing its initial dilution. It also determines the relative proportion of ambient air that initially mixes with the chemical source emission. Atmospheric turbulence causes the puff or plume to mix increasingly with ambient air and grow (disperse) in the lateral and vertical direction as it travels downwind. Longitudinal expansion also occurs for a puff. These dispersion effects further enhance the dilution of the puff or plume. The two sources of atmospheric turbulence are mechanical turbulence and buoyant turbulence. Mechanical turbulence is generated from shear forces that result when adjacent parcels of air move at different velocities (either at different speeds or directions). Fixed objects on the ground, such as trees or buildings, increase the ground roughness and enhance mechanical turbulence in proportion to their size. Buoyant turbulence arises from vertical convection and is greatly enhanced by the formation of thermal updrafts that are generated from solar heating of the ground.

The ALOHA code considers two classes of atmospheric transport and dispersion based on the assumed interaction of the released cloud with the atmospheric wind flow.

- For airborne releases in which the initial chemical cloud density is less than or equal to that of the ambient air, ALOHA treats the released chemical as neutrally buoyant. A neutrally buoyant chemical cloud that is released to the atmosphere does not alter the atmospheric wind flow; therefore, the term "passive" is used to describe the phenomenological characteristics associated with its atmospheric transport and dispersion. As a passive contaminant, the released chemical follows the bulk movements and behavior of the atmospheric wind flow.

- Conversely, if the density of the initial chemical cloud is greater than that of the ambient air, then the possibility exists for either a neutrally buoyant or a dense-gas type of atmospheric transport and dispersion. In dense-gas atmospheric transport and dispersion, the dense-gas cloud resists the influences of the hydraulic pressure field associated with the atmospheric wind, and the cloud alters the atmospheric wind field in its vicinity. Dense-gas releases can occur with gases that have a density greater than air due either to a high molecular weight or to being sufficiently cooled. A chemical cloud with sufficient aerosol content can also result in a bulk cloud density that is greater than that of the ambient air. Dense-gas releases undergo what has been described in the literature as "gravitational slumping."

Gravitational slumping is characterized by significantly greater lateral (crosswind) spreading and reduced vertical spreading, compared to the spreading that occurs with a neutrally buoyant release.

In addition to the source term and downwind concentration calculations, ALOHA allows specification of concentration limits for the purpose of consequence assessment (such as assessment of human health risks from contaminant plume exposure). ALOHA refers to these concentration limits as “level-of-concern concentrations.” Safety analysis work uses ERPGs and TEELs for assessing human health effects for both facility workers and the public. While ERPGs and TEELs are not explicitly part of the ALOHA chemical database, ALOHA allows the user to input any value, including an ERPG or TEEL value, as the level-of-concern concentration. The level-of-concern value is superimposed on the ALOHA-generated plot of downwind concentration as a function of time to facilitate comparison. In addition, ALOHA generates a footprint that shows the area (in terms of longitudinal and lateral boundaries) where the ground-level concentration reached or exceeded the level of concern during puff or plume passage (the footprint is most useful for emergency response applications).

The ALOHA code uses a constant set of meteorological conditions (such as windspeed and stability class) to determine the downwind atmospheric concentrations. The sequential meteorological data sets used for the radiological accident analyses were reordered from high to low dispersion by applying a Gaussian dispersion model (such as that used by ALOHA) to a representative downwind distance. The median set of hourly conditions for each site (that is, mean windspeed and mean stability) was used for the analysis; this is roughly equivalent to the conditions corresponding to the mean radiological dose estimates of MACCS2.

ALOHA contains physical and toxicological properties for the chemical spills included in this SWEIS and for approximately 1,000 additional chemicals. The physical properties were used to determine which of the dispersion models and accompanying parameters were applied. The toxicological properties were used to determine the levels of concern. Atmospheric concentrations at which health effects are of concern (that is, ERPG-2 or ERPG-3 levels) are used to define the footprint of concern. Because the meteorological conditions specified do not account for wind direction (that is, it is not known *a priori* in which direction the wind would be blowing in the event of an accident), the areas of concern can be defined by a circle of radius equivalent to the downwind distance at which the concentration decreases to levels less than the level of concern. In addition, the concentration at 110 yards (100 meters) (potential exposure to a noninvolved worker) and at the nearest public access, typically the site boundary distance, (exposure to the MEI) are calculated and presented.

G.7 References

ACGIH (American Conference of Governmental Industrial Hygienists), 2002, 2002 Chemical Substances TLVs and BEIs, Cincinnati, Ohio.

American Cancer Society, 2010, Cancer Facts & Figures 2010, Atlanta, Georgia (accessed at http://nccu.cancer.org/downloads/STT/Cancer_Facts_and_Figures_2010.pdf), August 25.

Chanin, D. and M. L. Young, 1997, *Code Manual for MACCS2: Volume 1, User's Guide*, NUREG/CR-6613, SAND97-0594, Vol. 1, Washington, DC, March.

CIRRPC (Committee on Interagency Radiation Research and Policy Coordination), 1992, *Use of BEIR V and UNSCEAR 1988 in Radiation Risk Assessment, Lifetime Total Cancer Mortality Risk Estimates at Low Doses and Low Dose Rates for Low-LET Radiation*, ORAU 92/F-64, Science Panel Report No. 9, Office of Science and Technology Policy, Executive Office of the President, Washington, DC, December.

DOC (U.S. Department of Commerce), 2008, *Census 2000 Data Releases*, *Summary File 3 (SF 3) – Sample Data*, Bureau of the Census, accessed through http://www.census.gov/Press-Release/www/2002/sumfile3.html, January 9.

DOE (U.S. Department of Energy), 1994, *DOE Handbook: Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, DOE-HDBK-3010-94, Washington, DC, December.

DOE (Department of Energy) 1995, *Final Environmental Assessment for Device Assembly Facility Operations, Nevada Test Site, Nye County, Nevada*, DOE/EA-0971 (available at http://www.osti.gov/bridge/product.biblio.jsp?osti_id=82326), May.

DOE (U.S. Department of Energy), 1996a, *Environmental Impact Statement for the Nevada Test Site and Off-site Locations in the State of Nevada*, Human Health Risk Assessment Phase II, NTS EIS Administrative Record #05.10.01.040, Nevada Operations Office, Las Vegas, Nevada, June.

DOE (U.S. Department of Energy), 1996b, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 1998, *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (DOE/EIS-0277F), Washington, DC, August.

DOE (U.S. Department of Energy), 1999, *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, Appendix G, Section G.3.3, DOE/EIS-0238, Albuquerque, New Mexico, January.

DOE (U.S. Department of Energy), 2001, *Atlas Relocation and Operations at the Nevada Test Site Final Environmental Assessment*, DOE/EA-1381, Nevada Operations Office, Las Vegas, Nevada, May.

DOE (U.S. Department of Energy), 2002a, *Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS/0243-SA-01, Nevada Operations Office, Las Vegas, Nevada, July.

DOE (U.S. Department of Energy), 2002b, *Final Environmental Impact Statement for the Proposed Relocation of Technical Area 18 Capabilities and Materials at the Los Alamos National Laboratory*, DOE/EIS-0319, August.

DOE (U.S. Department of Energy), 2003, *Air, Water, and Radiation Info Brief: Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE)*, ISCORS Technical Report No. 1, Office of Environmental Policy and Guidance, DOE/EH-412/0015/0802, Rev. 1, Washington, DC, January.

DOE (U.S. Department of Energy), 2004a, *MACCS2 Computer Code Application Guidance for Documented Safety Analysis, Final Report,* DOE-EH-4.2.1.4-MACCS2-Code Guidance, Office of Environment, Safety and Health, Washington, DC, June.

DOE (U.S. Department of Energy), 2004b, *Final Environmental Assessment for Activities using Biological Simulants and Releases of Chemicals*, DOE/EA-1494, June.

DOE (U.S. Department of Energy), 2004c, *Radiological/Nuclear Countermeasures Test and Evaluation Complex, Nevada Test Site-Final Environmental Assessment*, DOE/EA-1499, August.

DOE (U.S. Department of Energy), 2007a, *Draft Supplement Analysis for the Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada.*

DOE (U.S. Department of Energy), 2007b, *Protective Action Criteria (PAC) with AEGLs, ERPGs, & TEELs: Rev. 23 for Chemicals of Concern* (available at http://www.hss.energy.gov/HealthSafety/WSHP/chem_safety/teel.html), August

DOE (U.S. Department of Energy), 2008, *DOE Standard - Radiological Control*, DOE-STD-1098-2008, Change Notice 1 (May 2009), Washington, DC, October.

DOE (U.S. Department of Energy), 2010a, *Documented Safety Analysis for the NNSS Area 3&5* Radioactive Waste Facilities, DSA-2151.100 Rev.5, February. **OUO**

DOE (Department of Energy), 2010b, Computerized Accident/Incident Reporting System, "DOE and Contractor Fatality Incident Rates," Office of Health, Safety and Security (available at http://www.hss.doe.gov/csa/analysis/cairs/cairs/summary/oipds094/sum.html).

DOE/NV (U.S. Department of Energy, Nevada Site Office), 2005, *Nevada Test Site Environmental Report 2004*, DOE/NV-11718--1080, Bechtel Nevada, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada Site Office), 2006, *Nevada Test Site Environmental Report 2005*, DOE/NV/11718--1214-ATT A, DOE/NV/25946--007-ATT A, National Security Technologies, Las Vegas, Nevada, October.

DOE/NV (U.S. Department of Energy, Nevada Site Office), 2007, *Nevada Test Site Environmental Report 2006*, DOE/NV/25946--259, National Security Technologies, LLC, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada Site Office), 2008, *Nevada Test Site Environmental Report 2007*, DOE/NV/25946--543, National Security Technologies, LLC, Las Vegas, Nevada, September.

DOE/NV (U.S. Department of Energy, Nevada Site Office), 2009, *Nevada Test Site Environmental Report 2008*, DOE/NV/25946--790, National Security Technologies, LLC, Las Vegas, Nevada, September.

DOL (U.S. Department of Labor), 2010a, "Census of Fatal Occupational Injuries (CFOI) – Current and Revised Data," Bureau of Labor Statistics (accessed at http://www.bls.gov/iif/oshcfoi1.htm), April 21.

DOL (U.S. Department of Labor), 2010b, "Workplace Injuries and Illnesses – 2009," News Release USDL-10-1451, Bureau of Labor Statistics, October 21.

DOT (U.S. Department of Transportation), 2008, *2008 Emergency Response Guidebook*, *A Guidebook for First Responders during the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident* (accessed January 29, 2011 at http://www.tc.gc.ca/media/documents/canutec-eng/erg2008eng.pdf), Pipeline and Hazardous Materials Safety Administration, Washington, DC.

EPA (U.S. Environmental Protection Agency), 1999, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13, EPA 402-R-99-001, Office of Radiation and Indoor Air, Washington, DC, September.

EPA (U.S. Environmental Protection Agency), 2004, *ALOHA – Areal Locations of Hazardous Atmospheres – User's Manual*, Chemical Emergency Preparedness and Prevention Office, Washington, DC, March.

EPA (U.S. Environmental Protection Agency), 2010, *Meteorological Data: Nevada* (available at http://www.epa.gov/ceampubl/tools/metdata/us_met.htm).

ESRI (Environmental Systems Research Institute), 2008, Data & Maps (available at http://www.esri.com/data/data-maps/overview.html), Redlands, California.

LLNL (Lawrence Livermore National Laboratory), 2005, *Jasper Hazards Analysis Report*, Revision 1, UCRL-MI-214719, August. **OUO**

LLNL (Lawrence Livermore National Laboratory), 2006, *Preliminary Documented Safety Analysis for the Criticality Experiments Facility Revision 3*, UCRL-TR-225952, November 13. **UCNI**

LLNL (Lawrence Livermore National Laboratory) 2007, *Nevada Test Site Device Assembly Facility Documented Safety Analysis Revision 2*, UCRL-ID-154613, October. **UCNI**

National Research Council, 1990, *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V, Committee on the Biological Effects of Ionizing Radiation, National Academy Press, Washington, DC.

National Research Council, 2006, *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII–Phase 2*, Committee on the Biological Effects of Ionizing Radiation, National Academy Press, Washington, DC.

NCRP (National Council on Radiation Protection and Measurements), 1993, *Risk Estimates for Radiation Protection*, NCRP Report No. 115, Bethesda, Maryland, December 31.

NCRP (National Council on Radiation Protection and Measurements), 2009, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 160, Bethesda, Maryland.

NIOSH (National Institute for Occupational Safety and Health), 1990, *Pocket Guide to Chemical Hazards*, U.S. Department of Health and Human Services, Centers for Disease Control, June.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*, Regulatory Guide 1.109, Appendix I, Rev. 1, Office of Standards Development, Washington, DC, October.

NSTec (National Security Technologies), 2008, *Documented Safety Analysis, Joint Actinide Shock Physics Experimental Research (JSAPER) Facility*, JAS-DSA-100, Rev. 0, December 1. **OUO**

NSTec (National Security Technologies), 2009a, *Emergency Planning Hazards Assessment for the Area 5 Hazardous Waste Storage Unit and Hazardous Waste Accumulation Area*, EPHA-1002, Revision 4, April 22. **OUO**

NSTec (National Security Technologies), 2009b, *Nevada Test Site Device Assembly Facility Documented Safety Analysis, Change Notice 9*, UCRL-ID-154613, Revision 2, July. **UCNI**

NSTec (National Security Technologies), 2009c, *RNCTEC Operational Safety Analysis*, RNC-OSA-001, Revision 1, February 26. **OUO**

NSTec (National Security Technologies), 2009d, *Documented Safety Analysis for the Barolo Subcritical Experiments*, JNPO-BAR-DSA-001, Rev. 1, May. **OUO**

NSTec (National Security Technologies), 2010a, *Device Assembly Facility Documented Safety Analysis, Addendum for Criticality Experiments Facility Operations, Revision 1 – Input for NSTec, Change Notice 2*, LLNL-MI-407120, February. **UCNI**

NSTec (National Security Technologies), 2010b, *Safety Assessment Strategy (SAS) for High-Energy Accelerator Operations National Nuclear Security Site (NNSS) Active interrogation Evaluations Using Accelerator Devices*, October.

NSTec (National Security Technologies), 2010c, *Safety Assessment Document, High-Energy Accelerator, National Nuclear Security Site*, October.

NTSB (National Transportation Safety Board), 2005, *Railroad Accident Report, Collision of Norfolk Southern Freight Train 192 with Standing Norfolk Southern Local Train P22 with Subsequent Hazardous Materials Release at Graniteville, South Carolina, January 6, 2005*, NTSB/RAR-05/04, (accessed January 29, 2011, http://aristatek.com/newsletter/0601January/RAR0504.pdf), Washington, DC, November.

PNNL (Pacific Northwest National Laboratory), 2007, *GENII Version 2 Users' Guide*, PNNL-14583, Rev. 2, Richland, Washington, March.

SAIC (Science Applications International Corporation), 1996, *Accident Assessments for Nevada Test Site facilities and Off-Site Locations*, NTS EIS Administrative Record 0509.766, June.

SNL (Sandia National Laboratories), 2005, *Tonopah Test Range Safety Assessment*, SF471000 Issue B, July 28. **OUO**

USAF (U.S. Air Force), 2007, *Final Base Realignment and Closure (BRAC) Environmental Assessment for Realignment of Nellis Air Force Base,* Headquarters Air Combat Command and Nellis Air Force Base, Las Vegas, Nevada, March.

Valentin, J., ed., 2007, *Annals of the ICRP: The 2007 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 103, International Commission on Radiological Protection, Elsevier, Amsterdam, The Netherlands, December.

Code of Federal Regulations

10 CFR Part 20, U.S. Nuclear Regulatory Commission, "Standards for Protection Against Radiation."

10 CFR Part 835, U.S. Department of Energy, "Occupational Radiation Protection."

29 CFR Part 1910, Occupational Safety and Health Administration, U.S. Department of Labor, "Occupational Safety and Health Standards."

40 CFR Part 61, Subpart H, U.S. Environmental Protection Agency, "National Emission Standards for Hazardous Air Pollutants," Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities."

40 CFR Part 141, U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations."

U.S. Department of Energy Guides, Handbooks, Orders, and Standards

DOE Guide 151.1-2, *Technical Planning Basis – Emergency Management Guide*, July 11, 2007.

DOE Order 458.1, *Radiation Protection of the Public and the Environment*, February 2011.

APPENDIX H
UNDERGROUND NUCLEAR TESTING

APPENDIX H
UNDERGROUND NUCLEAR TESTING

This appendix provides basic information regarding underground nuclear testing, including the general steps involved in conducting a test in a vertical shaft and the associated major long-term environmental impacts. The U.S. Department of Energy (DOE) and the National Nuclear Security Administration (NNSA) are not proposing to conduct an underground nuclear test as part of this *Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*. However, in accordance with Presidential Decision Directive 15 (November 1993), DOE/NNSA must be able to resume underground nuclear weapons tests within 24 to 36 months if so directed by the President. This capability is maintained by DOE/NNSA at the Nevada National Security Site (NNSS) (formerly the Nevada Test Site).

Because NNSA must maintain its readiness to conduct an underground nuclear test, this appendix provides general information regarding the activities and generalized potential environmental impacts associated with actually conducting such a test. In the event that NNSA is directed by the President to conduct an underground nuclear test, it would be conducted at Pahute Mesa, Rainier Mesa, or Yucca Flat within the Nuclear Test Zone (Areas 7, 8, 9, 10, and 20 and the northern portions of Areas 6 and 11) or at the Nuclear and High Explosives Test Zone (Areas 1, 2, 3, 4, 12, and 16) in the northern and northwestern portions of the NNSS (see Chapter 4, Section 4.1.6.2, Figure 4–13).

The NNSS became the United States' continental nuclear weapons testing site in December 1950, when a 680-square-mile area of land was withdrawn from the 5,000-square-mile Las Vegas Bombing and Gunnery Range (now the Nevada Test and Training Range). The initial nuclear weapon test took place on January 11, 1951, as part of Operation Ranger, and was code-named "Able." Able was an air-dropped test of a small-yield (about 1 kiloton) device (Johnson et al. 2000). Between December 1951 and July 1962, 100 atmospheric nuclear tests were conducted at the NNSS. The first of 828 underground nuclear tests conducted at the NNSS, code-named "Uncle," was detonated on November 29, 1951, in Area 10. The last underground nuclear test to be conducted at the NNSS, code-named "Divider," was on September 23, 1992, in Area 3 (DOE 2000).

The primary purpose of an underground nuclear test is to obtain information related to nuclear weapons. Two basic kinds of underground nuclear tests were conducted at the NNSS: weapon effects tests and weapons development tests. In addition, among the atmospheric and underground nuclear tests that were conducted at the NNSS, 23 were tests associated with the Plowshare Program. The Plowshare tests were part of an effort to develop peaceful uses of nuclear explosions for such purposes as canal and harbor excavation and making petroleum resources more accessible (OTA 1989). In general, underground nuclear tests were conducted in shallow boreholes, deep vertical shafts, and mined tunnels (DOE 1996). Most vertical drill hole tests were conducted for the purpose of developing new weapon systems. Tunnel tests were generally conducted to evaluate the effects (radiation, ground shock, etc.) of various weapons on military hardware and systems (OTA 1989). When the device was detonated at the bottom of a vertical drill hole, data from the test were transmitted through electrical and fiber-optic cables to trailers containing recording equipment placed on the surface near "ground zero." Performance information was also determined from samples of radioactive material recovered by drilling back into the solidified melt created by the explosion (i.e., drillback operations).

Conducting an underground nuclear test is a complex endeavor requiring significant long-term planning and commitment of resources, both natural and economic. A brief, generalized description of underground nuclear testing procedures for a test in a vertical drill hole is included in **Table H–1**.

Table H–1 Underground Nuclear Weapons Testing

Underground Nuclear Weapons Testing (Tests in Vertical Drill Holes)
Step 1 – Site Selection and Drilling. Two subsets of site selection would apply to nuclear tests: (1) selection of an existing drill hole for a specific test or (2) selection of a new drill site within the Nuclear Test Zone or Nuclear and High Explosives Test Zone (see Appendix A, Figure A–1) for a specific test if an existing inventory emplacement hole were not suitable. The goal of site selection would be to optimize the various parameters so that the operational feasibility and successful containment of yields could be attained at a suitably low cost. Many factors would be considered, including: (1) scheduling of field resources; (2) test schedules; (3) the shock sensitivity of a given experiment and possible interactions with other experiments; (4) the depth range required for a suitable device emplacement; (5) geologic structure; (6) geologic material properties; (7) the depth of the water table; (8) potential drilling problems; (9) adjacent expended sites, craters, chimneys, or subsurface collapses; (10) adjacent open emplacement holes or unplugged post-shot or exploratory holes; and (11) non-test program constraints such as groundwater concerns, roads, and power lines (Olsen 1993). If drilling is required after a test location were chosen by the sponsoring national laboratory, a drilling program outlining the requirements of the specific hole would be completed. The selected site would be surveyed, staked, and checked for cultural and biological resources. When these environmental studies are completed, the site would be graded and leveled, and mud pits and a reserve drilling-fluid sump would be constructed to contain drilling fluid and cuttings. A drill rig, usually with its own power source and utilities, would be moved onto the site. Water would be trucked or piped in and mixed with drilling compounds to fill the mud pits. The hole would be drilled using standard Nevada National Security Site (NNSS) big-hole drilling techniques. A normal hole would be from 48 to 120 inches in diameter and from 600 to 2,500 feet deep. During drilling, samples of drill cuttings would be collected at 10-foot intervals and rock cores would be taken as required. After drilling is complete, geophysical logs would be run in the hole to evaluate the condition of the hole and gain a more thorough understanding of the geology. The drill site would be secured by filling the sump and installing specially designed covers over the hole.
Step 2 – Test Site Engineering and Construction. When a hole is selected as a location for a nuclear test, the area around the hole would be surveyed and staked according to the criteria set forth by the sponsoring national laboratory. Cultural and biological surveys would be rerun to determine whether the status of the area has changed. The hole would also be uncovered, and selected geophysical logs rerun in the hole to confirm its condition. Once the environmental clearances are complete, an area would be cleared and leveled for the surface ground-zero equipment and another area close to the selected site would be cleared and leveled for the recording trailer park. This would be a typical earthmoving operation; native materials would be used to top the pads or, if the active native materials are unstable, suitable fill material (Type II base and/or gravel) would be used. Onsite construction would be temporary and would be abandoned after the test is complete. Concrete pads would be placed around the surface ground zero to provide a stable platform for downhole operations, as well as a base for the assembly towers. Equipment would be moved in to emplace the nuclear device in the hole, record the data produced, and provide radiological and seismic monitoring of the site. An extensive grounding system would be used to establish baseline instrumentation grounds, which might include a pit containing saltwater. The equipment to be left in position during the detonation would be protected with an aluminum foil, hex-cell-shaped, shock-mounting material or with dense foam. A circle of radiation detectors would be placed back from the surface ground zero to detect and assess any releases from the experiment. Finally, a perimeter fence would be erected, and access both into and out of the test location would be controlled.
Step 3 – Device Delivery and Assembly. The test article would be delivered to the Device Assembly Facility, any required assembly would be performed, and the test article would be delivered to the test location accompanied by armed convoy. It would then be attached to the diagnostics canister in preparation for emplacement in the hole. Checks would be run and alignment assured. A high state of security would be maintained during all operations involving the nuclear device.
Step 4 – Diagnostic Assembly. A diagnostic canister rack would be assembled off site and transported to the test site. The size of the diagnostic canister would depend on the diameter of the borehole and may be up to almost 12 feet in diameter and 120 feet long and contain all of the instrumentation required to receive data at the time of detonation (real time). The diagnostic canister may contain lead and other materials as shielding for the detectors. After its arrival at the test location, the diagnostic canister would be installed in the assembly tower to be mated with the device on site. Instrumentation cables would be connected to the experiments and the recording trailer park. Slack in the cables would allow the diagnostic canister to be lowered into the hole.

Underground Nuclear Weapons Testing (Tests in Vertical Drill Holes)
Step 5 – Emplacement of the Experiment. The nuclear explosive and special measurement devices would be moved to the hole and lowered to the detonation position; all required diagnostic materials and instrumentation cables would also be lowered into the hole at this time. Downhole operations would be conducted according to a defined checklist and monitored by independent inspectors. The whole assembly would be placed on a set of fracture-safe beams that span the opening. Any auxiliary equipment would then be lowered into the hole, and the area would be secured. Emplacement equipment would be removed from the area, and test runs would be conducted on the downhole experiment. The hole would be stemmed (packed with material) to prevent radioactive materials from escaping during or after the experiment. Stemming materials used to backfill the hole would generally be placed in alternating layers, according to the containment design specification. Sand, gypsum, grout, cold tar, or epoxy plugs are some of the typical stemming materials that may be placed in the hole to provide impenetrable zones. The instrument cables within these zones would be sealed to prevent a radioactive gas path to the surface. Once completed, the area would be cleared of unnecessary equipment. A report would be compiled for the Containment Evaluation Panel to show that the as-built condition reflects the containment design plan.
Step 6 – Test Execution. After the Containment Evaluation Panel accepts the as-built design of the containment and all preliminary tests are successful, the nuclear device would be ready for detonation. Security operations would assure that all non-test-related personnel are evacuated prior to the detonation for security and safety reasons. The explosive would be armed. Radiation monitors would be activated, and aircraft with tracking capability would be prepared for flight in case gas and debris unexpectedly vent to the surface. Weather forecasts and fallout pattern predictions would be reviewed, after which the test device would be detonated. After the test is conducted, the test site would remain secure until it can be assured that the radiological products of the test have been contained. After a suitable time, a reentry crew would be dispatched to the site. Data would be retrieved and the condition of equipment noted. After all is assured to be secure, normal NNSS operations would resume. The site would be roped off, outlining an exclusion zone where there is danger of potential cratering.
Step 7 – Post-shot Operations. After the temperature of the cavity has cooled, a post-shot hole would be drilled into the point of the explosion to retrieve samples of the debris. These highly radioactive samples would provide important information on the test. The post-shot hole would be as small in diameter as possible and drilled at an angle to allow the drill rig to be positioned safely away from the surface ground zero. After drilling and sampling operations are complete, the drill rig and tools would be decontaminated. The site would be cleaned of residual radioactive contamination, and the hole would be plugged back to the surface. This generally completes the test operation.

Source: DOE 1996.

H.1 Disruption of the Physical Environment from Underground Nuclear Testing

Underground nuclear testing at the NNSS was conducted in six main areas: Pahute Mesa, Rainier Mesa, Yucca Flat, Frenchman Flat, Shoshone Mountain, and Buckboard Mesa (Areas 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 18, 19, and 20 of the NNSS) (DOE 1996; DOE/NV 2010). These tests left their mark on the NNSS, both in terms of physical disruption and a subsurface inventory of remaining radioactive isotopes.

The major impacts of an underground nuclear test on the physical environment are ground motion, disruption of the geologic media, surface subsidence, and contamination of the subsurface geologic media and surface soils (DOE 1996). Ground motion is a temporary phenomenon that, with the exception of rockfalls and minor land displacements, has not resulted in permanent effects on the NNSS or offsite areas. Creation of subsidence craters, disruption of underground geologic media, and release of radioactivity into the environment are the most significant and enduring impacts on the physical environment resulting from underground nuclear testing. The following discussion is derived from *The Containment of Underground Nuclear Explosions* (OTA 1989), unless otherwise noted, and describes the events that occur after the moment a nuclear device is detonated.

Figure H–1 shows the sequence of events that occur after an underground detonation (Step 6 in Table H–1). Within a microsecond (one-millionth of a second) of detonation, the billions of atoms involved in a nuclear explosion release their energy. Pressures within the exploding nuclear device reach several million pounds per square inch and temperatures are as high as 100 million degrees Celsius (over 180 million degrees Fahrenheit). A strong shock wave is created by the explosion and moves outward from the point of detonation.

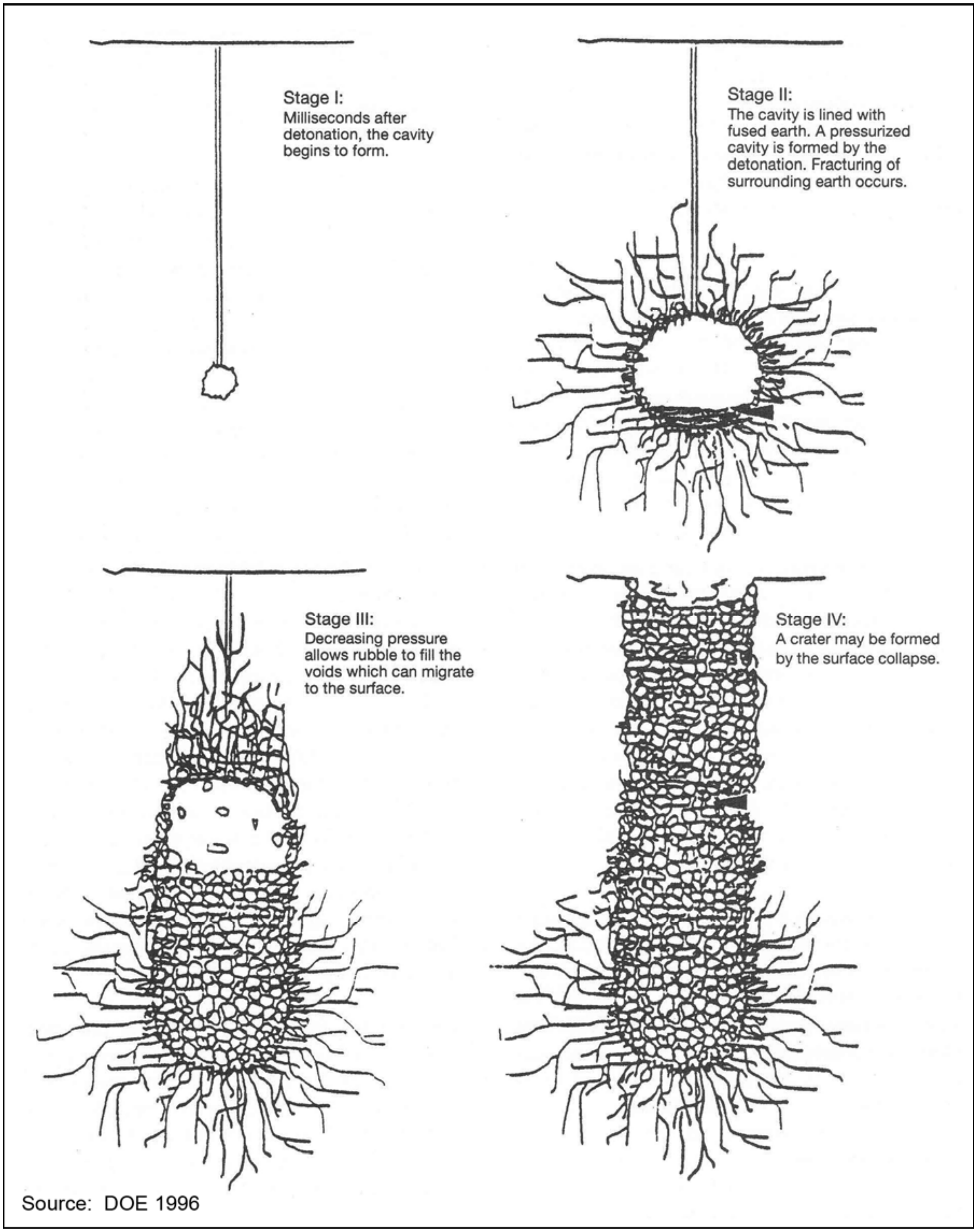


Figure H–1 Formation of an Underground Nuclear Explosive Test Cavity, Rubble Chimney, and Surface Subsidence Crater

Within tens of milliseconds (thousandths of a second) following the detonation, the nuclear device and surrounding rock are vaporized, creating a "bubble" of high-pressure steam and gas. An underground spherical cavity is formed by the pressure of this gas bubble, and the explosive momentum is imparted to the host rock.

As the cavity continues to expand, the pressure decreases and, usually within a few tenths of a second of detonation, equalizes with the pressure from the overlying rock. At this point the cavity reaches its greatest dimensions. Concurrent with this pressure decrease, the shock wave from the detonation travels outward, crushing and fracturing the rock in the near-test environment. Eventually, the shock wave weakens and the rock is no longer crushed, but is merely compressed; it then returns to its original state. This compression and relaxation phase becomes seismic waves that travel through the ground in the same manner as seismic waves formed by an earthquake.

After a few seconds, as the hot gases cool, the molten rock begins to collect and solidify on the cavity sidewalls and in a puddle at the bottom of the cavity. Most of the radioactive products of the explosion would be confined in the solidified rock in this puddle.

When the gases cool, the pressure decreases to the point where it no longer can support the overlying rock and soil and the cavity may collapse, forming a chimney upward from the cavity. The collapse occurs as the overlying rock breaks into rubble and falls into the cavity void. This process continues until either the cavity completely fills with rubble, the chimney reaches a level where the strength of the rock can support the overburden, or, as usually happens, the chimney reaches land surface. When the chimney reaches the surface, the ground sinks, forming a saucer-like subsidence crater. The crater usually forms within a few hours after the detonation, but may take months to form.

Radioactive material produced by a nuclear explosion would remain underground due to the combined effects of the sealing nature of the compressed rock around the cavity, the porosity of the rock, the depth of burial strength of the rock, and the stemming of the emplacement hole.

> Stemming consists of the placement of impenetrable plugs, located at various distances within the emplacement hole, to prevent the emplacement hole from being the path of least resistance for the flow of radioactive materials. It is also designed to prevent gases from traveling up the emplacement hole by forcing them into the surrounding rock, where they are absorbed into the pore spaces.

As noted above, the explosion creates a pressurized cavity filled with gas that is mostly steam. As the cavity pushes outward, the surrounding rock is compressed. Because there is essentially a fixed quantity of gas within the cavity, the pressure decreases as the cavity expands. Eventually, the pressure drops below the level required to deform the surrounding material. Meanwhile, the shock wave imparts outward motion to the material around the cavity. Once the shock wave passes, the material tries to return (rebound) to its original position. The rebound creates a large compressive stress field, called a "stress containment cage," around the cavity. The physics of the stress containment cage are somewhat analogous to how stone archways support themselves. In the case of a stone archway, the weight of each stone pushes against the others and supports the archway. In the case of an underground nuclear detonation, the rebounded rock locks around the cavity, forming a stress field that is stronger than the pressure inside the cavity. The stress containment cage closes any fractures that may have begun and prevents new fractures from forming.

The predominantly steam-filled cavity eventually collapses, forming a chimney. When this collapse occurs, the steam in the cavity is condensed through contact with the cold rock falling into the cavity. The noncondensable gases remain within the lower chimney at low pressure. After the collapse, high-pressure steam is no longer present to drive gases from the cavity region to the surface.

If the test is conducted in porous material, such as alluvium or tuff, the porosity of the medium provides volume to absorb the gases produced by the explosion. For example, all of the steam generated by a 150-kiloton explosion beneath the water table could be contained in a condensed state within the volume of pore space that exists in a hemispherical pile of alluvium 200 to 300 feet high. Although most steam condenses before leaving the cavity region, the porosity of the geologic media helps contain noncondensable gases, such as carbon dioxide and hydrogen. The noncondensable gases diffuse into the interconnected pore space, and the pressure is reduced to a level that is too low to drive the fractures. The deep water table and high porosity of rocks at the NNSS would facilitate this aspect of containment.

Containment also occurs because of the pressure of the overlying rock. The depth of burial provides a stress that limits fracture growth. For example, as a fracture initiated from the cavity grows, gas seeps from the fracture into the surrounding material. Eventually, the pressure within the fracture decreases below the level needed to extend the fracture. At this point, growth of the fracture stops, and the gas simply leaks into the surrounding material.

Rock strength is another important aspect of containment, but only in the sense that an extremely weak rock (such as water-saturated clay) cannot support a stress containment cage. As a result, sites at the NNSS containing large amounts of water-saturated clay would be avoided for any test conducted in the future.

The final aspect of containment is placement of the stemming material into a vertical hole after the nuclear device has been emplaced and before detonation.

How the various containment features perform depends on many variables, including the size of the explosion, the depth of burial, the water content of the rock, and the geologic structure. Problems may occur when the containment cage does not form completely and gas from the cavity flows either through the emplacement hole or the overburden material. When the cavity collapses, the steam condenses and only noncondensable gases, such as carbon dioxide and hydrogen, remain in the cavity. Carbon dioxide forms from the vaporization of carbonate material in the rock; hydrogen forms when water reacts with the iron in the nuclear device and the diagnostics equipment. The carbon dioxide and hydrogen remain in the chimney if there is available pore space. If the quantity of noncondensable gases is large, however, they can act as a driving force to transport radioactivity through the chimney or the overlying rock. Consequently, the amount of carbonate material and water in the rock near the explosion and the amount of iron available for reaction are important considerations when evaluating containment for a particular test.

Historic deep vertical underground testing resulted in the formation of hundreds of craters at the NNSS (DOE 1996). This resulted in the "pockmarked" appearance of Yucca Flat, the location of the majority of underground nuclear tests on the NNSS, as shown in **Figure H–2**. These subsidence craters generally range from 200 to 2,000 feet in diameter and from a few feet to 200 feet deep. The size of the crater is primarily related to the depth of emplacement and the explosive energy of the device that was detonated. Crater formation occurred less frequently with tests conducted on Pahute Mesa because of the greater competency of the rocks in that area and the depths of most tests. The development of craters has been the principal consequence of underground nuclear testing on the terrain of the NNSS.

In addition to the cavity, chimney, and subsidence crater, pressure ridges and small displacement faults occurred at the surface in some cases. Surface fracturing and faulting are the result of the sudden uplift of the earth at the time of detonation and the collapse during the formation of the chimney and crater. Another permanent consequence of testing is vertical displacement along existing geologic faults, particularly along the Yucca and Carpetbagger Faults in Yucca Flat. Vertical displacement of as much as

8 feet occurred along portions of the Carpetbagger Fault (DOE 1996). Fracturing occurred on the top of Rainier Mesa due to the loss of strength in the rocks in that area (DOE 1996).

Figure H–2 Aerial View of a Portion of Yucca Flat, Nevada National Security Site

Although underground nuclear testing had long-term physical consequences on the environment, the effects of the tests were additive, rather than synergistic. That is, the sum of the effects of multiple tests did not produce unexpected consequences or consequences that were greater than the sum of the individual tests (DOE 1996).

Fracturing of the rock in the near-test environment may have resulted in some alteration of the natural permeability of the rocks underlying parts of the NNSS. The shock wave and compressive forces from a test could have increased the permeability of the rock by creating more fractures near the test or may have actually decreased permeability by widening and then closing fractures at greater distances from the test. Post-test measurements of rock samples taken from tunnel complexes generally show that the properties of the host rock are unchanged at a greater distance than three cavity radii from the point of detonation. Beyond that distance, no fracturing occurs from the detonation, but preexisting fractures are widened as the shock wave propagates through the host rock and then are closed after the shock wave has passed. In some instances, the closing of the fractures may reduce the fracture aperture and may result in some permanent reduction in the gross permeability of the rock mass. The implications of the permeability changes in the rock due to underground nuclear testing are discussed in the next section.

H.2 Radioactive Contamination of the Geologic Media and Groundwater

The second major effect of underground nuclear testing, in addition to the impacts on the physical environment, is the formation of pockets of radioactive contamination surrounding each underground test and injection of radionuclides and other contaminants into the groundwater. The total amount of radioactivity released into the underground environment during a test is called the "radionuclide source term." The source term includes numerous isotopes that are both short- and long-lived. For instance, in a 1-kiloton atmospheric detonation, an initial release of about 41 billion curies of radioactivity decays to about 10 million curies in just 12 hours (OTA 1989). All radioactive isotopes decay at specific rates. The decay process is measured in terms of "half-life." The radioactive half-life for a given radioisotope is the time for half the radioactive nuclei in any sample to undergo radioactive decay. The half-lives of radioisotopes vary tremendously. For example, polonium-216 has a half-life of about 0.15 seconds and plutonium-239, a half-life of over 24,000 years; other isotopes may have shorter or longer half-lives. As a simplified example of radioactive decay, the half-life of tritium (radioactive hydrogen) is about 12.3 years. So, beginning with an initial sample of 100 atoms of tritium, after 12.3 years there would be 50 atoms, and after another 12.3 years, about 25 atoms. This decay process continues until there are no radioactive isotopes remaining from the original sample.

In a 2001 report, scientists from Los Alamos National Laboratory and Lawrence Livermore National Laboratory calculated the underground inventory of radionuclides resulting from underground nuclear testing at the NNSS between 1951 and 1992 (Bowen et al. 2001). The radionuclide inventory was divided into six principal geographic test areas where underground nuclear testing was conducted at the NNSS: Frenchman Flat, Pahute Mesa in Area 19, Pahute Mesa in Area 20, Rainier Mesa/Shoshone Mountain, Yucca Flat (above the water table), and Yucca Flat (below the water table). Not all radionuclides produced in an underground nuclear test were included in this inventory. Radionuclides included in the inventory were: (1) residual and unburned fissile fuel and tracer materials, such as isotopes of uranium, plutonium, americium, and curium-244; (2) fission products such as cesium-137 and strontium-90; (3) tritium (a radioactive isotope of hydrogen); and (4) neutron-induced radioisotopes in device parts, external hardware, and the surrounding geologic medium (such as carbon-14, chlorine-36, and calcium-41). Radionuclides that were excluded from the inventory are (1) those with half-lives that are so short (microseconds to hours) that they decay to undetectable levels soon after the test and (2) those that are produced in such low initial abundance that they never exceed levels deemed unsafe or nonpermissible by regulatory agencies. Because no underground nuclear tests have been conducted since 1992, the radionuclide inventory has been decreasing due to the natural decay of radioactive particles.

Table H–2 provides the calculated total radionuclide source terms for the six geographic test areas and for the NNSS overall.

Table H–2 Underground Radionuclide Inventory in the Six Principal Geographic Test Areas at the Nevada National Security Site (in curies; decay corrected to September 23, 1992)

Geographic Test Areas at the NNSS	*Frenchman Flat*	*Pahute Mesa, Area 19*	*Pahute Mesa, Area 20*	*Rainier Mesa/ Shoshone Mountain*	*Yucca Flat (more than 328 feet above the water table)*	*Yucca Flat (less than 328 feet above the water table)*	*Total Inventory*
Radionuclide Inventory	190,000	19,200,000	60,900,000	887,000	15, 800,000	35,200,000	132,000,000

NNSS = Nevada National Security Site.
Note: Numbers are rounded to three significant figures.
Source: Bowen et al. 2001.

The inventory in Table H–2 represents an upper limit of the radionuclides that are potentially available for transport in the groundwater. The portion of the source term that is considered available to the groundwater regime at the NNSS is the radioactive inventory under or within 328 feet of the water table. About 30 percent of underground nuclear tests at the NNSS were conducted beneath the water table (Bowen et al. 2001). In 1996, DOE estimated, based on work by Bryant and Fabryka-Martin (1991) that about 38 percent of the underground nuclear tests at the NNSS were conducted within about 246 feet (75 meters) of the water table. Using that estimate as the basis, a conservative estimate of the potential hydrologic source term for radionuclides underground at the NNSS as of September 1992 is just over 50,000,000 curies. As noted in Bowen et al. 2001, the radionuclide source term will never be transported in its entirety; the hydrologic source term comprises only those radionuclides that are dissolved in or transportable by groundwater. Further, within the hydrologic source term, the mobility of radionuclides is moderated both by chemical kinetics and hydrology.

Most investigators have concluded that, exclusive of tritium, much of the radioactivity released during an underground nuclear test remains confined in the melted and fused rock in the detonation cavity, particularly the refractory isotope species, such as plutonium, rare earth elements, zirconium, and alkaline earth elements. The more volatile nuclides, such as alkali metals, ruthenium, uranium, antimony, tellurium, and iodine, tend to condense on the chimney rubble. The most mobile isotopes are the gaseous species, including argon, krypton, and xenon, that tend to rise through the chimney and may ultimately seep out to the surface (DOE 1996).

The mechanisms by which radionuclides can enter the groundwater include leaching from the melt glass and condensation in the cavity and chimney; injection into fractures outside the cavity during the first milliseconds after the test; and interactions between gaseous species and the groundwater.

Leaching from the rubble chimney is probably an important pathway to the groundwater for radionuclides from tests that were conducted under the water table or in or under perched aquifers. Groundwater within the cavity area was vaporized at detonation of the device, and some portion of that vapor was forced by the shock wave out of the cavity and into the surrounding host rock. With time, groundwater gradually flowed back into the cavity and chimney and came into direct contact with the radionuclides that were condensed onto the chimney rubble. Depending on the solubility of the radionuclides, the groundwater would dissolve the residues until chemical equilibrium was achieved. Once dissolved, the radionuclides would be available for migration through groundwater flow. The impacts of past underground nuclear testing are discussed in Chapter 4, Section 4.1.6.2, and Chapter 6, Section 6.3.6.2.

Leaching of radionuclides from the melt glass and cavity rubble probably has occurred to some degree. According to Borg et al. (1976), studies asserted that (1) less than 1 percent of the radionuclides in the melt glass near the bottom of the chimney would be distributed onto the chimney rubble, and (2) most of the tritium would be mixed with the water in the chimney and cavity at times for about 1 year, while some tritium may be trapped in the melt glass. Leaching of radionuclides from the melt glass probably would occur over extended periods of time, and the leachate would be available for transport through groundwater flow.

Fracture injection is the final pathway for the introduction of radionuclides into the groundwater regime. Water vapor discharged from the cavity immediately following a detonation was seismically “pumped” into the fractures formed by the test and through other fractures that were widened by the shock wave. Following the achievement of equilibrium conditions, radionuclides injected into fractures under the water table became available for transport through groundwater flow.

Tritium is one of the most mobile of the radionuclides resulting from underground nuclear testing present in the subsurface environment surrounding the detonation cavity following an underground nuclear test.

It is also present at higher concentrations (comprising about 95 percent of the total radiological source term as of September 1992 [Bowen et al. 2001]) than other radionuclides for a period of 100 to 200 years following a test, and is generally believed to be present principally as part of a free water molecule, rather than being bound in the puddle glass that contains the large majority of the radionuclides remaining after a test. Tritium is known to migrate when induced by pumping at nearby wells, while many other radionuclides remain in or near the detonation cavity (Bryant 1992). Therefore, tritium represents the radionuclide of greatest concern to users of groundwater for at least the next 100 years because of its mobility and high concentration. For these reasons, in the assessment of impacts from the groundwater pathway, tritium is the primary radionuclide used in the models that have been and are being developed to improve our understanding of the potential movement and risk associated with groundwater beneath the NNSS (see Chapter 6, Section 6.3.6.2). Bowen et al. (2001) calculated the amount of tritium in the overall NNSS radiological source term to be about 125,560,000 curies. Using the 38 percent ratio noted above, it is estimated that about 48,000,000 curies of tritium could be considered to be part of the hydrologic source term, as of September 23, 1992. Based on the radioactive decay rate (half-life) for tritium, the amount of tritium currently available as part of the hydrologic source term is considerably less than 48,000,000 curies.

H.3 References

Borg, I. Y., R. Stone, H. V. Levy, and L. D. Ramspott, 1976, *Information Pertinent to the Migration of Radionuclides in Ground Water at the Nevada Test Site, Part 1: Review and Analysis of Existing Information (UCRL-52078 Pt. 1)*, Lawrence Livermore National Laboratory, Livermore, California, May.

Bowen, S. M., D. L. Finnegan, J. L. Thompson, C. M. Miller, P. L. Baca, L. F. Olivas, C. G. Geoffrion, D. K. Smith, W. Goishi, B. K. Esser, J. W. Meadows, N. Namboodiri, and J. F. Wild, 2001, *Nevada Test Site Radionuclide Inventory, 1951--1992*, LA-13859-MS, Los Alamos National Laboratory, Los Alamos, New Mexico, September.

Bryant, 1992, *The Cambric Migration Experiment, A Summary Report*, LA-12335-MS, Los Alamos National Laboratory, Los Alamos, New Mexico, September.

Bryant, E. A. and J. Fabryka-Martin, 1991, *Survey of Hazardous Material Used in Nuclear Testing*, LA-12014-MS, Los Alamos National Laboratory, Los Alamos, New Mexico, February.

DOE (U.S. Department of Energy), 1996, *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0243, Nevada Operations Office, Las Vegas, Nevada, August.

DOE (U.S. Department of Energy), 2000, *United States Nuclear Tests, July 1945 through September 1992*, DOE/NV-209-Rev 15, Nevada Operations Office, Las Vegas, Nevada, December.

Johnson, W. G., B. A. Holz, and R. J. Johnson, 2000, *A Cold War Battlefield: Frenchman Flat Historic District, Nevada Test Site, Nye County, Nevada*, DE-AC08-00NV13609-01, Division of Earth and Ecosystem Sciences, Desert Research Institute, Las Vegas, Nevada, August.

OTA (Office of Technology Assessment), 1989, *The Containment of Underground Nuclear Explosions*, OTA-ISC-414, U.S. Congress, October.

APPENDIX I
CONTRACTOR DISCLOSURE STATEMENTS

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF A SITE-WIDE EIS FOR THE CONTINUED OPERATION OF THE DEPARTMENT OF ENERGY/ NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA NATIONAL SECURITY SITE AND OFF-SITE LOCATIONS IN THE STATE OF NEVADA

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)," 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

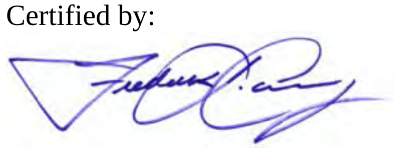
(a) ___X________ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) _____________ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:



Signature

Frederick J. Carey, President
Potomac-Hudson Engineering, Inc.

____
Name

June 28, 2011

____
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF A SITE-WIDE EIS FOR THE CONTINUED OPERATION OF THE DEPARTMENT OF ENERGY/ NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA NATIONAL SECURITY SITE AND OFF-SITE LOCATIONS IN THE STATE OF NEVADA

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)," 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b))

(a) ___X_____ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) __________ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:

Signature [signature]

Gil Olivas
Name
Contracts Manager
SAIC

29 June 2011
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF A SITE-WIDE EIS FOR THE CONTINUED OPERATION OF THE DEPARTMENT OF ENERGY/ NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA NATIONAL SECURITY SITE AND OFF-SITE LOCATIONS IN THE STATE OF NEVADA

CEQ regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project," for the purposes of this disclosure, is defined in the March 23, 1981 guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Question 17a and b.

"Financial or other interest in the outcome of the project 'includes' any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm=s other clients)," 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal)

(a) __X__ Offeror and any proposed subcontractor have no financial interest in the outcome of the project.

(b) ________ Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests:

1.
2.
3.

Certified by:

F. Michael Gray

Signature

F. Michael Gray – Vice President, Director of Contracts
Name

June 30, 2011
Date