DOE–EM/GJ2239

Office of Environmental Management – Grand Junction

UMTRA Project

Moab UMTRA Project
Annual Site Environmental Report for Calendar Year 2016

Revision 0

September 2017

U.S. Department of Energy

Office of Environmental Management

Prepared by the Remedial Action Contractor under contract number DE-EM00005014
for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

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Review and Approval

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Revision History

Revision	Date	Reason for Revision
0	September 2017	Initial issue.

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Acronyms and Abbreviations

ASER	Annual Site Environmental Report
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOE O	DOE Order
EM	Environmental Management
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
IA	interim action
ISMS	Integrated Safety Management System
lb	pounds
LL	Lessons Learned
MEI	maximally exposed individual
mg/L	milligrams per liter
mrem	millirems
pCi/L	picocuries per liter
QA	Quality Assurance
RRM	residual radioactive material
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
US-191	U.S. Highway 191
USC	United States Code
yr	year

Executive Summary

The Annual Site Environmental Report (ASER) serves as the principal document for communicating environmental protection performance information to the public and is the primary mechanism for documenting compliance with U.S. Department of Energy's (DOE's) requirements for radiation protection of the public and environment at its sites.

This ASER presents information pertaining to environmental activities conducted on the DOE Moab Uranium Mill Tailings Remedial Action (UMTRA) Project during calendar year 2016. This report includes Project activities conducted at the Moab site located near Moab, Utah, or the Crescent Junction, Utah, disposal site, located approximately 30 miles north of the Moab site.

There are four major programs for the Project including: Environmental Compliance, Radiological Protection, Ground Water, and Quality Assurance (QA). These programs are discussed in greater detail below.

Environmental Compliance Program
The Project must operate in compliance with various federal environmental statutes, some of which are enforced at the state level through permits. During 2016, the Project remained in compliance with all regulations and permits, and there were no notices of violation. Section 2.0, Compliance Summary, addresses principle regulatory requirements and the status of implementation of each for the Project.

Environmental Radiological Protection Program
The Project monitors radiological emissions and effluents to ensure DOE activities are protective of the public and the environment. The environmental air monitoring network consists of on-site and off-site sampling locations. The Project monitors concentrations of radon and exposure to direct gamma radiation and airborne radioparticulates. Nearly 300 radon and direct gamma samples and more than 700 radioparticulate samples were collected for analysis in 2016. There was one unplanned radiological release, but doses to the public and maximally exposed individuals (MEIs) remained below DOE limits.

Ground Water Program
The Ground Water Program at the Moab site is designed to limit ecological risk from contaminated ground water discharging to the Colorado River. River protection is accomplished through an interim action (IA) ground water remediation system that includes extraction of contaminant mass, primarily ammonia and uranium, near the uranium mill tailings pile and by injection of fresh water closer to the river to protect suitable habitat areas for endangered fish species. Ground water and surface water monitoring measures IA system performance. During 2016, operation and monitoring of the IA system continued.

QA Program
The Project ensures the quality of its environmental data through implementation of contractor QA Plans, which include discussion of validation of site data collection and analysis programs.

Environmental Management System

DOE sites must use an Environmental Management System (EMS) as a platform for site sustainability, implementation, and programs with objectives that contribute to DOE's sustainability goals. The Moab Project's EMS is a structured process for reducing the environmental consequences of Project activities to maximize beneficial use of finite resources and minimize wastes. DOE's EMS integrates key elements into the core functions of the contractors' Integrated Safety Management System (ISMS) to ensure continuous EMS improvement.

Key Initiatives in 2016

The Project shipped nearly 517,000 tons of residual radioactive material (RRM) from the Moab site to the Crescent Junction disposal site during 2016, for a cumulative total through 2016 of more than 8.47 million tons of RRM shipped. DOE reached the halfway mark of 8 million tons shipped in mid-January 2016.

The Project spent considerable effort and resources to refurbish the metal containers used to ship the RRM by rail, due to corrosion on the inside of the containers from the tailings material. Panels were welded on the exterior of the containers, and a protective coating was sprayed on the inside of about 150 containers. In addition, 22 new, pre-lined containers were purchased to augment containers in need of refurbishment.

The evaporation pond on the tailings pile used to store and evaporate contaminated ground water extracted through wells was removed in July 2016. After removal of the pond, the excavation of tailings in that area could be performed from the top down to avoid adversely affecting the pile stability if excavation continued laterally. Extracted ground water is now pumped directly to a storage tank and used by water trucks for dust control on the pile.

Document Availability

This document may be viewed in its entirety on the DOE Moab Project website at *www.gjem.energy.gov/moab* and in the public reading room in the Grand County Library in Moab. Hard copies may be obtained by contacting the Moab Federal Project Director at (970) 257-2115 or at the address below.

U.S. Department of Energy
200 Grand Avenue, Suite 500
Grand Junction, CO 81501

Comments or questions regarding this document may also be directed to the Moab Project at (800) 637-4575. Members of the public who wish to comment on this document or who have questions are encouraged to contact DOE at the above phone number or by email at *moabcomments@gjem.doe.gov*.

1.0 Introduction

1.1 Site Locations

The Moab site is located about 3 miles northwest of Moab in Grand County, Utah (Figure 1). The 480-acre site is bordered on the north and west by sandstone cliffs. U.S. Highway 191 (US-191) parallels the northern site boundary, and State Route 279 transects the western portion of the property. Arches National Park has a common property boundary with the Moab site north of US-191. The Colorado River forms the eastern boundary. The Moab Wash, an ephemeral stream, runs northwest to southeast through the site and joins the Colorado River. The Scott M. Matheson Wetlands Preserve lies directly across the river from the site. Figure 2 shows Moab site features.

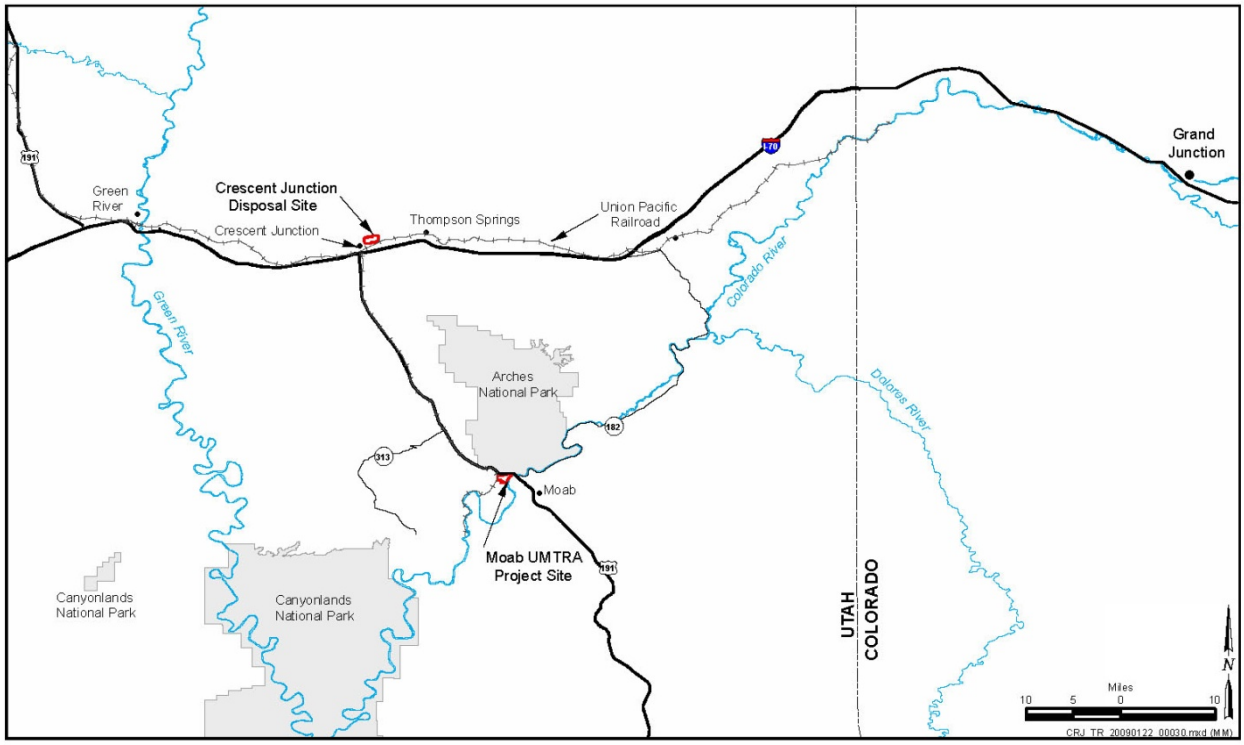

Figure 1. Location of Moab and Crescent Junction Sites

The Crescent Junction site is also located in Grand County, northeast of the junction of Interstate 70 and US-191, approximately 30 miles north of the Moab site (Figure 1), and is the location for disposal of the Moab site RRM. Through a series of temporary withdrawals of public domain land and a permanent land transfer by the Department of the Interior, DOE currently owns 500 acres of land and has another 936 acres in a 20-year (beginning in 2009) withdrawal near Crescent Junction for the disposal cell and surrounding support areas. Figure 3 shows Crescent Junction site features.

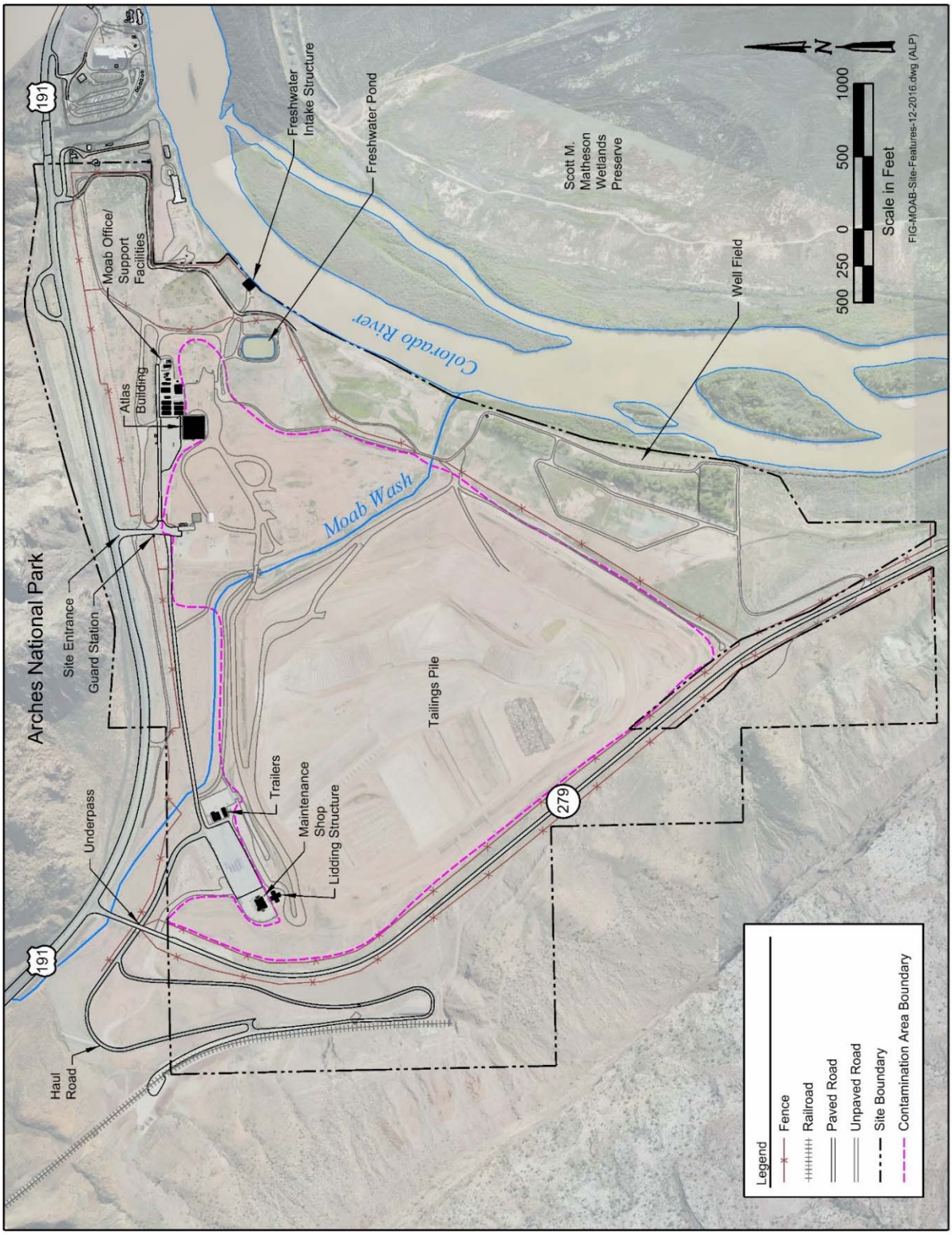

Figure 2. Moab Site Features

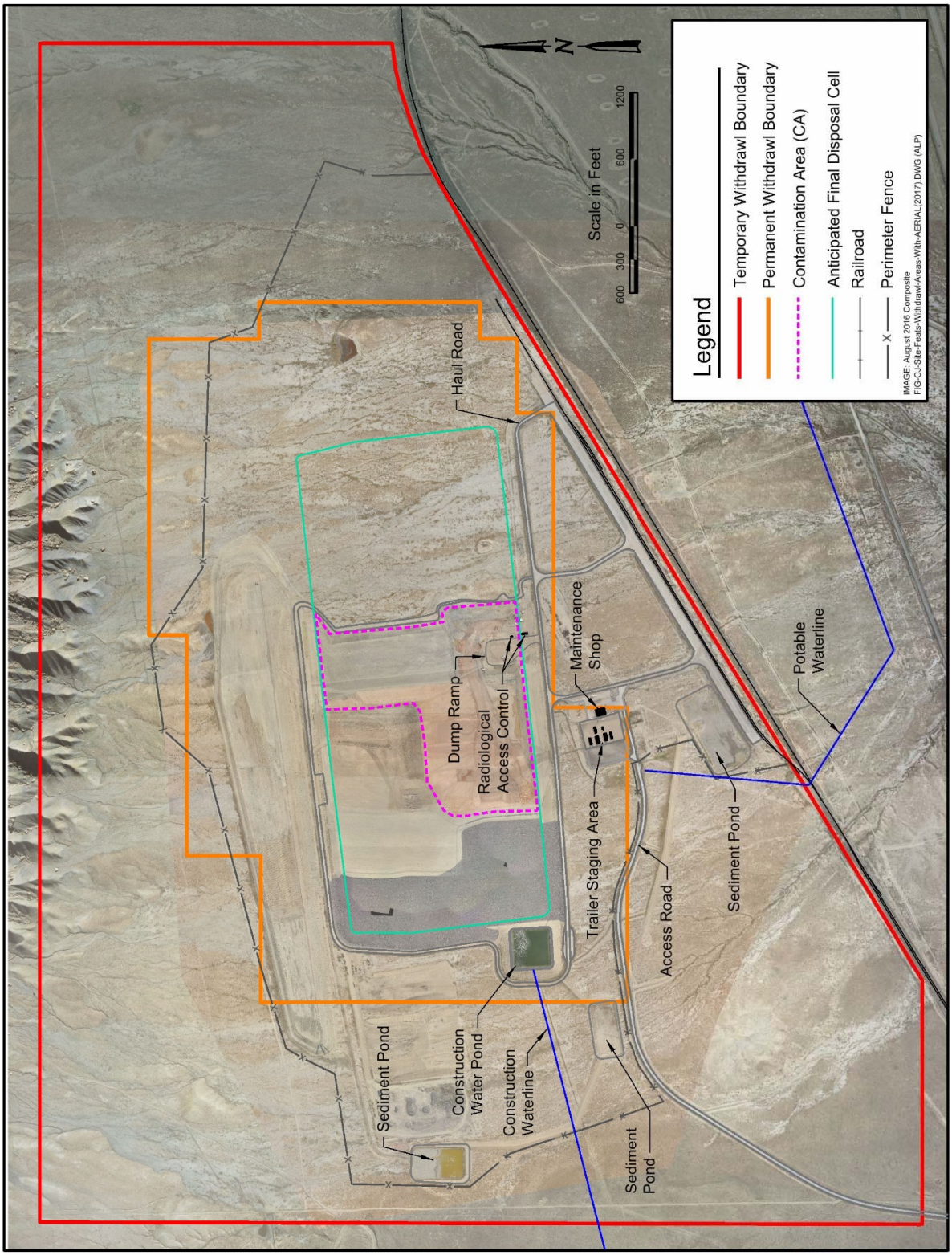

Figure 3. Crescent Junction Site Features

1.2 Site History

The Moab mill operated under various private owners from 1956 through 1984. The tailings created by the milling operations were pumped to an unlined impoundment in the western portion of the property. The tailings accumulated over time, forming a pile up to 90 feet thick; the eastern toe of the pile lies 750 feet from the Colorado River. When processing operations ceased, an estimated 16 million tons (12 million cubic yards) of RRM were present in the pile, which occupied about 130 acres at the site. An interim cover was placed on the pile in 1995.

Congress enacted the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (Public Law 106-398), and in October 2001, ownership and cleanup responsibility for the Moab site were transferred to DOE. The Project is managed by the DOE Office of Environmental Management (EM) located in Grand Junction, Colorado (see Figure 1). The legislation stipulated that the Moab site undergo remediation as a Title I site under Title 42 United States Code Section 7901 (42 USC 7901), the Uranium Mill Tailings Radiation Control Act (UMTRCA).

In July 2005, DOE published the *Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement* (DOE/EIS-0355) (FEIS). The FEIS presented the preferred remediation alternatives. In September 2005, DOE issued the *Record of Decision for the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah* (6450-01-P), which detailed the selection of the preferred alternatives and basis for that decision. The first phase of the disposal cell was constructed in 2008, and RRM shipments to the cell began in April 2009.

1.3 Project Mission

The mission of the Moab Project is to safely relocate uranium mill tailings and other process-related wastes collectively known as RRM from the former uranium ore-processing facility (millsite) and off-site contaminated properties known as vicinity properties in Moab to an engineered disposal cell constructed near Crescent Junction. The RRM is transported primarily by rail. The mission also includes active remediation of contaminated ground water at the Moab site.

1.4 Primary Operations and Project Activities

Primary operations and Project activities at the sites include the following.

- Excavating and conditioning RRM at the Moab site
- Transporting RRM to the Crescent Junction site by rail
- Excavating the Crescent Junction disposal cell
- Placing and compacting RRM from the Moab site and vicinity properties in the cell
- Placing interim and final cell cover layers
- Operating an IA ground water remediation system at the Moab site, including ground water extraction and freshwater injection
- Monitoring radioactive and non-radioactive materials in air, soil, ground water, and surface water

1.5 Environmental Setting

Climate

The climate of the Moab and Crescent Junction sites is semi-arid. Average annual temperature is approximately 57ºF. January is the coldest month, with low temperatures averaging 20ºF, and July is the warmest month, with high temperatures averaging 99ºF. The relative humidity is low, often less than 50 percent during daytime hours. Average annual precipitation ranges from 8 to 10 inches.

Geology and Hydrology

The primary hydrogeologic unit present at the Moab site consists of unconsolidated alluvium on the valley floor flanked by consolidated sandstones and shale on the canyon walls. The Moab site is susceptible to flooding from the Colorado River during runoff of spring snowmelt in the Rocky Mountains and from thunderstorms in the drainage basin of the Moab Wash. The Colorado River generally reaches a maximum flow between late May and early June. Ground water underlying the site moves from north to south, discharging to the Colorado River.

The Crescent Junction site is on a gently south-sloping surface of unconsolidated alluvium underlain by consolidated Mancos Shale. The site lies at the base of the Book Cliffs to the north. Surface drainage flows to ephemeral washes located to the south of the site that ultimately drain to the Green River. Ground water underlying the Crescent Junction site occurs intermittently in sand lenses in the alluvium and in fractures in the Mancos Shale.

1.6 Area Demographics

Moab is the Grand County government seat and the principal city of southeastern Utah. The population of Moab is about 5,242 (U.S. Census Bureau, https://factfinder.census.gov). In addition to Moab, the communities of Crescent Junction and Thompson Springs, also in Grand County, are affected by relocation of RRM to the Crescent Junction site. The population of Grand County is about 9,579 (U.S. Census Bureau). Grand County's major economic base is tourism. Southeastern Utah has the nation's largest concentration of national and state parks, monuments, and recreation areas.

2.0 Compliance Summary

UMTRCA required the promulgation of cleanup standards now codified by the U.S. Environmental Protection Agency (EPA) at Title 40 Code of Federal Regulation (CFR) Part 192 (40 CFR 192), "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," and assigned the U.S. Nuclear Regulatory Commission to oversee the cleanup and issue licenses for the completed disposal cells.

RRM at the Moab site contains contaminants in concentrations that could be hazardous to the environment and public health and that exceed EPA standards. Remediation of the Moab site and disposal at the Crescent Junction site are conducted in compliance with these standards.

RRM, specifically defined at 40 CFR 192.01, "Definitions," is waste that DOE determines is radioactive and related to the milling process. RRM requiring cleanup at the Moab site includes uranium mill tailings, contaminated soil, debris from dismantling the mill buildings and associated structures, equipment, remnants of processing ponds, disposal trenches, and other wastes.

Contaminated ground water beneath the Moab site is also considered RRM. For the purposes of this document, contaminant or contamination refers to RRM unless otherwise specified.

2.1 Compliance Status

The Project is committed to protecting the environment while conducting its mission and operated without any notices of environmental violations during 2016. Table 1 summarizes federal and state environmental regulations and their implementation status on the Project.

2.2 Other Major Environmental Issues and Actions

DOE uses external and internal assessments, surveillances, and management assessments to evaluate environmental compliance and implement corrective actions. The Project QA organization performed and/or coordinated assessments in 2016 to verify system descriptions and compliance with procedures and regulations.

Adapting to Climate Change
The Project actively controls the water level in the Moab freshwater pond and the Crescent Junction construction water pond, reducing the Project's vulnerability during drought conditions. Waste storage areas have been designed in a conservative manner to better withstand beyond-design-basis storms.

Due to the comparatively short-term completion date for the Project, no additional climate change adaptation efforts are currently planned; however, our environmental control plans are reviewed annually and revised as needed based upon changing weather conditions.

2.3 Continuous Release Reporting

Not applicable to the Project.

2.4 Unplanned Releases

No unplanned non-radiological releases occurred in 2016.

Table 1. Principle Regulatory Requirements and Status for the Moab Project

Federal or State Requirement	What it Covers	Implementation Status
Environmental Restoration and Waste Management		
RCRA, FFCA	RCRA governs the generation, storage, handling, and disposal of hazardous wastes. In 1992, RCRA was amended by the FFCA, which required DOE to take a number of actions to manage mixed waste handled at its facilities.	All waste generated within the Moab site CA is considered RRM, the cleanup and management of which is regulated by UMTRCA, not RCRA; however, waste generated outside the CA is considered non-RRM and, therefore, can be regulated by RCRA. During 2016, no RCRA wastes were generated outside the CA. The Project maintains a Conditionally Exempt Small Quantity Generator status.
NEPA	NEPA requires federal agencies to follow a prescribed process to anticipate impacts on the environment of proposed major federal actions and alternatives. DOE codified its implementation of NEPA in 10 CFR 1021, "National Environmental Policy Act Implementing Procedures."	NEPA reviews have been conducted periodically to ensure proposed Project activities are within the original bounds of the FEIS. During 2016, site operations were conducted in accordance with NEPA.
TSCA	TSCA was enacted to regulate the manufacturing and distribution of certain chemical substances and/or mixtures. TSCA specifically addresses the importation, use, and disposal of asbestos, polychlorinated biphenyls, radon, and lead-based paint.	All waste generated within the Moab site CA is considered RRM, the cleanup and management of which is regulated by UMTRCA, not TSCA; however, waste generated outside the CA is considered non-RRM and, therefore, can be regulated by TSCA. During 2016, no TSCA wastes were generated outside the CA. No TSCA wastes exist at the Crescent Junction site.
FIFRA	FIFRA governs the distribution, sale, and use of pesticides. This Act categorizes pesticides as either restricted or general use.	During 2016, general use pesticides were applied at the Moab and Crescent Junction sites.
Radiation Protection		
UMTRCA, Floyd D. Spence Act	Title I of UMTRCA requires DOE to establish a remedial action program and authorizes DOE to stabilize, dispose of, and control RRM, including contaminated ground water, in accordance with cleanup standards promulgated in 40 CFR 192. UMTRCA is the primary law governing site cleanup and disposal for the Project.	During 2016, the Project excavated and disposed of RRM and remediated contaminated ground water in compliance with 40 CFR 192.

Table 1. Principle Regulatory Requirements and Status for the Moab Project (continued)

Federal or State Requirement	What it Covers	Implementation Status
DOE O 458.1 Admin Chg 3, "Radiation Protection of the Public and the Environment"	DOE O 458.1 is the key DOE order for public radiation protection. The order establishes requirements for DOE operations to protect members of the public and the environment from undue risk from radiation.	During 2016, the Project monitored radiological emissions and effluents. Project activities did not result in any dose to the public that exceeded the limits in DOE O 458.1.
DOE O 435.1, "Radioactive Waste Management"	This order was implemented to ensure all DOE radioactive waste is managed in a manner that protects workers, public health and safety, and the environment.	During 2016, the Project managed RRM in compliance with this DOE O 458.1.
AEA	The AEA requires the management, processing, and utilization of radioactive materials in a manner that protects public health and the environment.	UMTRCA directed the cleanup of uranium ore-processing sites to be in accordance with standards prescribed in the AEA.
Air Quality and Protection		
CAA	CAA establishes the requirements for facility air quality and air emissions.	The CAA is enforced at the state level through fugitive dust control plans prepared for the sites.
UAC R307-205-8,"Emission Standards; Fugitive Emissions and Fugitive Dust; Tailings Piles and Ponds"	This state administrative code establishes minimum work practices and emission standards for sources of fugitive emissions and fugitive dust.	During 2016, DOE diligently monitored fugitive dust emissions by individuals certified to EPA Method 9 and implemented the controls outlined in the site fugitive dust control plans to the greatest extent practicable.
40 CFR 61, NESHAP	The CAA establishes emission standards for hazardous air pollutants associated with various industrial processes codified as NESHAP.	The Project is not required to report under the NESHAP program as there are no NESHAP-regulated air emissions associated with the Project sites.
Water Quality and Protection		
33 USC 1251, CWA/NPDES	Under the CWA, the NPDES was designed to regulate and control pollutants from industrial wastewater and storm water discharges, both of which can have negative impacts on the quality of U.S. surface waters. The federal discharge requirements are implemented by UPDES, an equivalent state system.	As required by UPDES Storm Water General Permits (see Table 2), DOE prepared and continues to implement site Storm Water Pollution Prevention Plans. During 2016, no discharges were noted under UPDES.

Table 1. Principle Regulatory Requirements and Status for the Moab Project (continued)

Federal or State Requirement	What it Covers	Implementation Status
Storm Water Management and EISA	Under Section 438 of EISA, federal agencies have requirements to reduce storm water runoff from federal development projects to protect water resources.	During 2016, the Project conducted biweekly inspections to ensure storm water controls were intact and storm water runoff was managed according to the plans.
42 USC 300f, SDWA	The SDWA establishes minimum drinking water standards and monitoring requirements.	The provisions of the SDWA are not directly relevant to the Project sites because neither ground water nor surface water at or near the sites is used as a public drinking water supply. DOE did not engage in any activities that affected drinking water supply sources. Remediation wells are designated as a temporary withdrawal point. During 2016, a Temporary Change Application was received from the Utah Department of Natural Resources, Division of Water Rights (see Table 2).
Other Environmental Statutes		
U.S. DOT Special Permit	Authorizes the transportation in commerce of non-DOT-specification bulk packages containing RRM from the Moab site and vicinity properties to the Crescent Junction disposal cell.	During 2016, the Project remained in compliance with the Special Permit.
DOE O 231.1B Admin Chg 1, "Environmental, Safety and Health Reporting"	DOE O 231.1B requires timely collection, reporting, analysis, and dissemination of data on environmental issues that could adversely affect the health, safety, and security of the public or workers, the environment, DOE operations, or DOE credibility.	This ASER summarizes Project environmental activities and protection performance during 2016.
NHPA	MOA are in place among DOE, the Utah State Historic Preservation Office, the Utah DOT, and the Bureau of Land Management for protection of cultural and historic resources at the Project sites.	In 2016, an annual cultural resource inventory was performed at the Crescent Junction site for Native American art sites, and an annual report was prepared and submitted in accordance with the applicable MOA, documenting no additional impacts or mitigation were noted. The conditions of the Moab site MOA have been previously met.
ESA	The ESA prohibits activities that would jeopardize the continued existence of an endangered or threatened species or cause adverse modification to a critical habitat.	The Project reviewed work activities for potential impacts on threatened or endangered species. Critical fish habitat was protected by interception of contaminated ground water and injection of fresh water in wells near the Colorado River.

Table 1. Principle Regulatory Requirements and Status for the Moab Project (continued)

Federal or State Requirement	What it Covers	Implementation Status
MBTA	The MBTA implements various treaties and conventions among the U.S. and several other countries for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds, their body parts, nests, or eggs is unlawful.	During 2016, no endangered, threatened, or candidate species were noted on the Project sites. The Project provided requested information for the 2016 Council for the Conservation of Migratory Birds Migratory Bird Report to the DOE Headquarters Office of Sustainable Environmental Stewardship.
DOE O 436.1, "Departmental Sustainability"	DOE O 436.1 requires all DOE sites to implement sound stewardship practices protective of the air, water, land, and other natural resources impacted by DOE operations. It also requires DOE sites to cost effectively meet or exceed compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements.	The Project developed an annual Site Sustainability Plan and has implemented an EMS that has been incorporated in contractors' ISMSs to promote sound stewardship practices and to ensure compliance with this DOE order.
42 USC 11001, EPCRA	EPCRA requires facilities with large quantities of hazardous or toxic chemicals, including petroleum products, to prepare emergency plans and report their inventories to EPA, the state, and local emergency planning groups.	The Project operated in accordance with emergency planning and reporting requirements and submitted Tier II Emergency and Hazardous Chemical Inventory Reports for 2016.
EO 11988, "Floodplain Management"	DOE's implementing regulations in 10 CFR 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements," identify the requirements of EO 11988 for actions that may affect floodplains. Portions of the Moab site fall within the 100-year floodplain of the Colorado River.	Activities conducted in the floodplain during 2016 were limited to planting and seeding desirable native species, irrigating, and weed control.
EO 11990, "Protection of Wetlands"	10 CFR 1022 implements the requirements of EO 11990 for actions that may affect wetlands.	Project activities performed in 2016 that could enhance jurisdictional wetlands included storm water controls, revegetation, and erosion control. These activities were authorized under a joint State of Utah Streambank Alteration/USACE 404 permit (see Table 2).

AEA = Atomic Energy Act; CA = Contamination Area; CAA = Clean Air Act; CWA = Clean Water Act; DOT = Department of Transportation; EISA = Energy Independence and Security Act; EO = Executive Order; EPRCA = Emergency Planning and Community Right-to-Know Act; ESA = Endangered Species Act; FFCA = Federal Facilities Compliance Act; FIFRA = Federal Insecticide, Fungicide, and Rodenticide Act; MBTA = Migratory Bird Treaty Act; MOA = memorandum of agreement; NEPA = National Environmental Policy Act; NESHAP = National Emission Standards for Hazardous Air Pollutants; NHPA = National Historic Preservation Act; NPDES = National Pollutant Discharge Elimination System; RCRA = Resource Conservation and Recovery Act; SWDA = Safe Water Drinking Act; TSCA = Toxic Substances Control Act; UAC = Utah Administrative Code; UPDES = Utah Pollutant Discharge Elimination System; USACE = U.S. Army Corps of Engineers

2.5 Summary of Permits

Table 2 shows the permits that were active for the Project during 2016.

Table 2. Active Permits for the Moab Project

Permits	Issuing Agency	No. of Permits
UPDES Storm Water General Permits: Moab UTR359185 Crescent Junction UTR359187	State of Utah, Department of Environmental Quality, Division of Water Quality	2
State of Utah Joint Streambank Alteration/USACE 404 Permit for the Colorado and Green River intake structures and for structures and well field to support the IA ground water remediation system	State of Utah, Department of Natural Resources, Division of Water Rights/USACE	1
Temporary Change Applications to change points of diversion to support ground water actions and a non-use application to extract water from the Colorado River	State of Utah, Department of Natural Resources, Division of Water Rights	2
Highway rights-of-way and encroachment permits for roads, pipelines, and gates	State of Utah, U.S. DOT	8
Special Permit SP-14283 for DOE to transport RRM and party status for the RAC	U.S. DOT	1
Scientific Research and Collecting Permit ARCH-2017-SCI-0006	National Park Service	1
Asbestos Landfill Permit	State of Utah, Department of Environmental Quality, Division of Air Quality	1
Conditional Use Permit	Grand County Council	1

DOT = Department of Transportation; RAC = Remedial Action Contractor; UPDES = Utah Pollutant Discharge Elimination System; USACE = U.S. Army Corps of Engineers

3.0 Environmental Management System

The framework of the Project's EMS is based on the "Plan-Do-Check-Act" cycle of the International Organization for Standardization Standard 14001, "Environmental management systems," to ensure continuous improvement. The Project's EMS is addressed in the first three core functions of ISMS: define the scope of work, analyze the hazards, and develop and implement hazard controls. Once implemented, programs must be assessed and any problems corrected to improve the effectiveness of the management system and to improve environmental, safety, and health performance.

The EMS parallels the process of developing and implementing hazard controls under ISMS where certain hazards (or impacts) are identified. Once implemented, programs must be assessed and any issues corrected to improve the effectiveness of the management system and to improve environmental, safety, and health performance.

In early 2017, an ISMS assessment was performed by an integrated team of Project staff and external assessors. The assessment scope focused on reviewing and evaluating EM Program performance during 2016. Assessment findings were documented, and corrective and preventive actions were defined/documented and on schedule for completion.

As part of its planning process, the Project uses an environmental aspects checklist to consider environmental and human health impacts (adverse or beneficial) of potential new activities. The Project determines the likelihood that each environmental aspect will occur and the consequences if it does. The Project also determines whether the environmental aspect is significant, which are those aspects that have or could have a significant impact on the environment, the Project, or the Project's mission. In 2016, the Project considered environmental aspects of new activities, but none were determined to be significant.

3.1 Environmental Operating Experience and Performance Measurement

Environmental operating experience and performance measurement is an integral component of an EMS. Environmental operating experience and sharing of lessons learned (LL) are consistent with the purpose and objectives of DOE Order (O) 210.2A, "DOE Corporate Operating Experience Program." LL are derived from work activities and events, both positive and negative, which can be used to enhance or improve all aspects of operations. LL are also derived from assessments of Project activities. When lessons are learned at DOE sites, they are documented and shared so that others can learn from them.

Environmental performance is monitored, evaluated, and measured through contractor QA Plans and contractor assurance systems that establish comprehensive and integrated oversight processes to ensure work performance meets applicable requirements for environment, safety, and sustainability. In addition, any opportunities to meet EM and/or Project goals utilizing green and sustainable remediation are evaluated in part based upon a balance of environment, social, and economic factors for a holistic approach.

To implement a comprehensive EMS for the Project in accordance with DOE O 436.1, the EMS provides requirements and responsibilities for managing and achieving sustainability goals. The Project's sustainability goals, performance status, and planned actions toward meeting the goals are included in the annual Site Sustainability Plan.

4.0 Environmental Radiological Protection Program and Dose Assessment

4.1 Radiological Discharges and Doses

This section presents results of the calculated radiation dose to the public from Project operations in 2016. Compliance with DOE O 458.1 may be demonstrated by calculating the dose to the maximally exposed individual (MEI), the representative person or group from the public likely to receive the most radiation dose based on exposure pathways and parameters.

The Project established an MEI for each site. The dose the public receives is calculated based on MEI data. The DOE public dose limit is 100 millirems/year (mrem/yr) above background received through all pathways (i.e., all ways in which a person can be exposed to radiation, such as inhalation, ingestion, and direct radiation). A summary of the 2016 public radiation dose applicable to both the Moab and Crescent Junction sites compared to the DOE public dose limit is shown in Table 3.

Table 3. Moab Project 2016 Public Radiation Dose

Pathway	Maximum Annual Dose to MEIs in mrem (mSv)	% of DOE 100 mrem/yr Limit	Estimated Population Dose in person-rem	Population Within 80 km (~50 miles)	Estimated Bkgd Radiation Population Dose in person-rem
Air	16.4 (0.164)	16.4	175.7	~10,522	918.6
Water	N/A	N/A	N/A	N/A	N/A
Other Pathways	N/A	N/A	N/A	N/A	N/A
All Pathways	16.4 (0.164)	16.4	175.7	~10,522	918.6

bkgd = background; km = kilometers; mSv = millisievert; rem = roentgen equivalent man
Note: Maximum annual dose to the MEI is conservatively based on an assumed occupancy of 24 hours/day for 365 days.

4.2 Clearance of Property Containing RRM

Remediation of Moab site contaminated soils not associated with the RRM pile (off-pile areas) and of vicinity properties is part of the Project scope to reduce potential health and environmental risks from historical uranium ore processing at the site. In 2016, DOE did not perform any off-pile or vicinity property remediation.

4.3 Radiation Protection of Biota

DOE O 458.1 requires protection of populations of aquatic animals and terrestrial plants and animals in local ecosystems from adverse effects due to radiation and radioactive material released from DOE operations. Moab RRM contains low levels of radioactivity, and the chemical composition (salt and pH) of the RRM limits vegetative growth.

The level of Project activities near RRM is not conducive to fauna migratory patterns nor does it promote habitat formation in these areas. The estimated contribution to radiological dose to biota from RRM at the Project sites is indistinguishable from naturally occurring radioactive material found in the surrounding environment; therefore, the Project does not currently monitor the effects of radiological doses to biota and has no plan to monitor these effects.

4.4 Unplanned Radiological Releases

In August 2016, a haul truck carrying a loaded RRM container up to the rail bench turned on its side, spilling some of its contents. The spill was cleaned up quickly and did not result in a radiological dose to the public. No environmental notices of violation were received, and there were no other unplanned radiological releases.

4.5 Environmental Radiological Monitoring

Before tailings removal and disposal operations began, DOE initiated environmental air monitoring at and near the Moab and Crescent Junction sites to collect baseline data and assess the potential for radiation dose to members of the public that could result from site operations. The Project's current air monitoring network measures radon, direct gamma radiation, and airborne radioparticulate matter at on-site and off-site locations. Monitoring locations for Moab are shown in Figures 4 and 5 and for Crescent Junction in Figure 6.

Environmental air monitoring results are used to demonstrate compliance with DOE O 458.1, which states DOE radiological activities must be conducted in a manner that does not cause an annual total effective dose, including gamma radiation and radioparticulates, to the public to exceed 100 mrem above background. DOE O 458.1 also specifies releases of radioactive material to the atmosphere from DOE activities shall not exceed an annual average concentration of 3 picocuries per liter (pCi/L) of radon or its decay products (excluding background) at the site boundary.

Background monitoring locations sufficiently removed from the sites were established to ensure air quality is not influenced by airborne contaminants associated with Project operations. Data from stations 0117 and 0123 collected between 2003 and 2008 were used to establish an average background radon concentration in the Moab area of 0.7 pCi/L, and a background direct gamma radiation effective dose of 82 mrem/yr.

Data collected from monitoring stations in the Crescent Junction area from 2006 to 2009, before tailings shipments began, were used to establish a background radon concentration of 0.9 pCi/L and a background direct gamma radiation effective dose of 92.5 mrem/yr. The effective background dose from inhalation of radioparticulates was not determined for either site.

Environmental air monitoring data are published in quarterly reports that are posted on the DOE Project website at *www.gjem.energy.gov/moab* and available in the public reading room. Monitoring results for 2016 for the Moab site are shown in Table 4 and for Crescent Junction in Table 5.

4.5.1 Radon

DOE O 458.1 established a limit of 3.0 pCi/L above background for radon concentrations at the DOE property boundary. During 2016, radon was measured at 36 locations (20 on site, 14 off site, and two MEIs) using alpha-sensitive detectors (e.g., radon cups). Radon cups were exposed for a period of approximately 3 months. On collection, the radon cups were sent to an off-site laboratory for analysis. As shown in Tables 4 and 5, no annual average concentration exceeded the 3.0 pCi/L plus background annual limit at either site. Based on these data, radon emissions from Project operations are not affecting the public.

4.5.2 Direct Gamma Radiation

As uranium decays, several of the decay products emit gamma radiation. RRM at the Moab site is a source of direct gamma radiation. During 2016, direct gamma radiation was measured at 36 locations (20 on site, 14 off site, and two MEIs) using thermoluminescent dosimeters exposed for approximately 3 months.

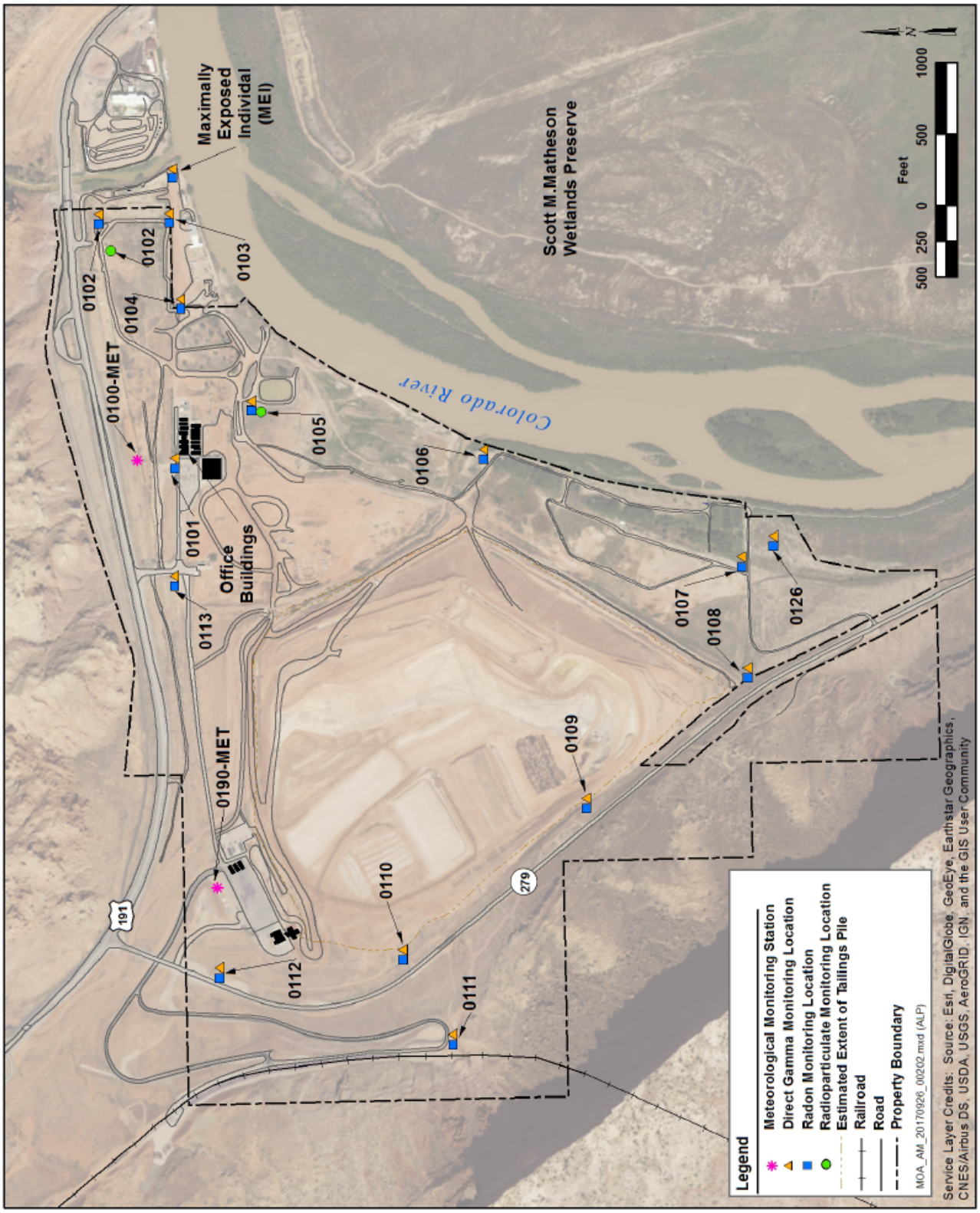

Figure 4. Moab On-site and MEI Environmental Air Monitoring Locations

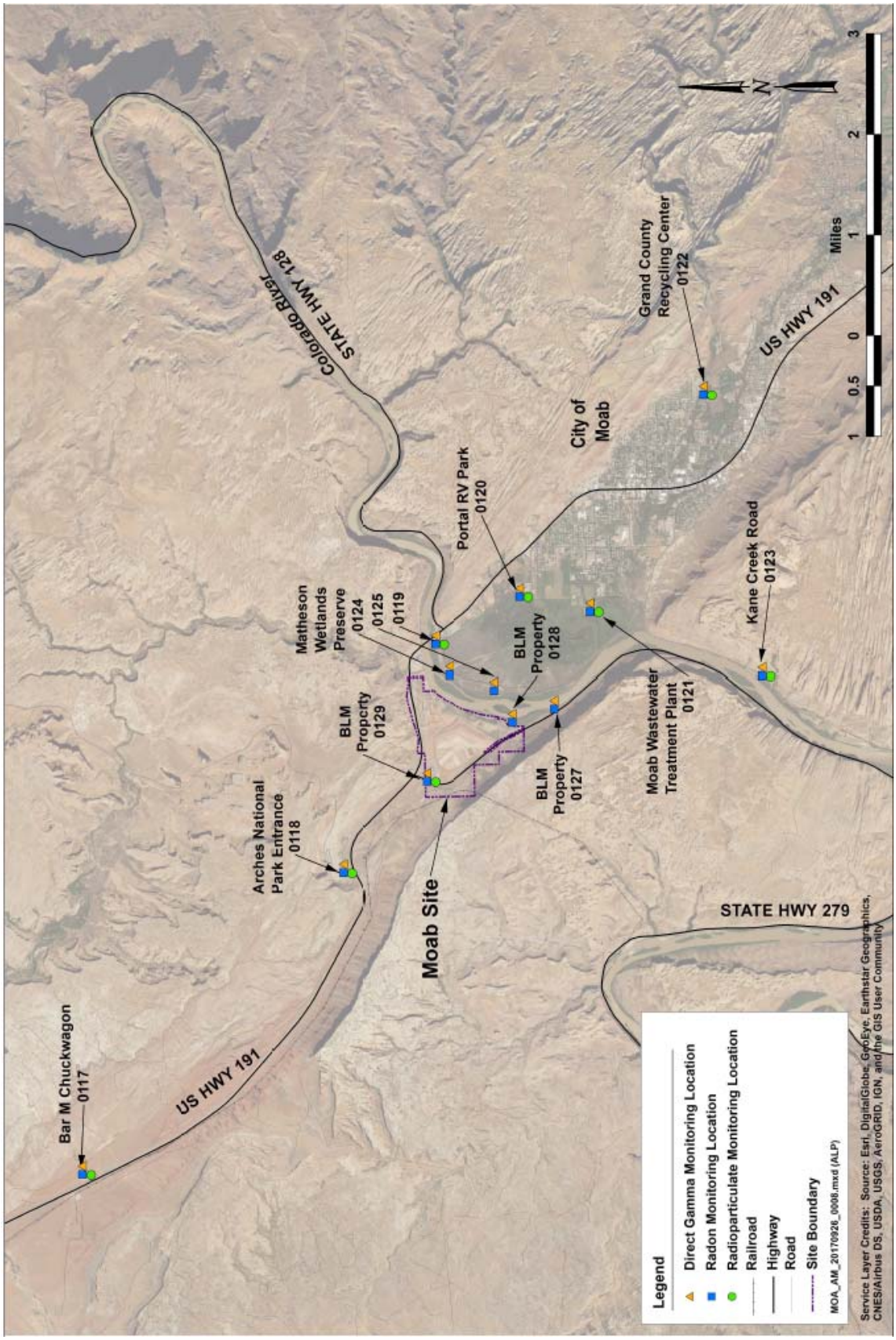

Figure 5. Moab Off-site Environmental Air Monitoring Locations

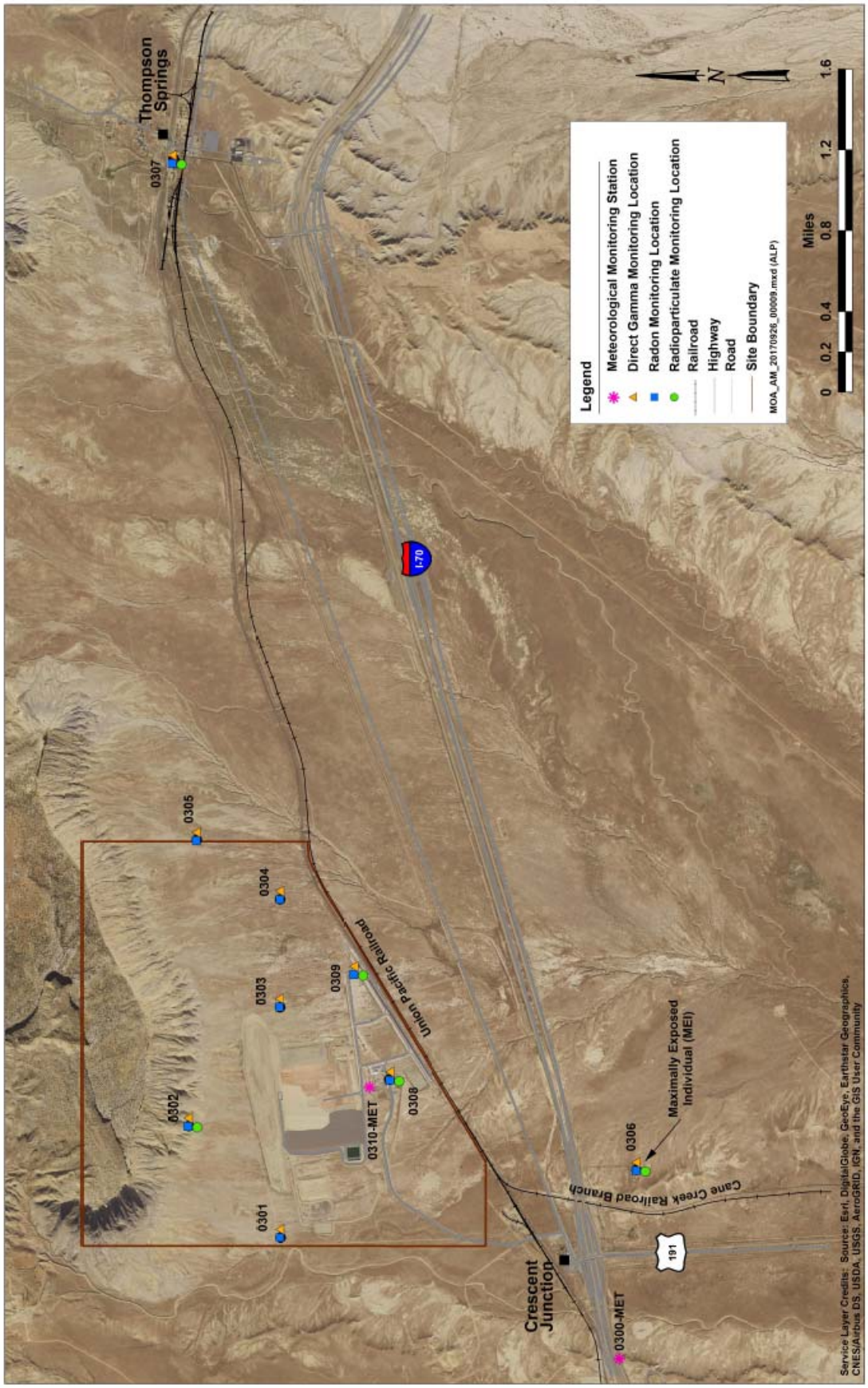

Figure 6. Crescent Junction Site Environmental Air Monitoring Locations

On collection, the dosimeters were sent to an off-site laboratory for analysis. Although several monitoring locations in Table 4 show annual readings greater than the 100 mrem/yr above background limit, no member of the public occupied any of these locations for a sufficient amount of time that would cause the individual to receive a dose in excess of the annual limit. There have been no exceedances at the Crescent Junction site since 2006 when DOE began collecting data.

Table 4. Environmental Air Monitoring Data for the Moab Site

Station Number	Annual Average Radon Concentration (pCi/L)	Annual Direct Gamma Radiation Effective Dose (mrem/yr)	Annual Radioparticulate Effective Dose (mrem/yr)
On-site Locations			
0101	2.4	188.1	NA
0102[1]	1.3	102.1	2.20
0103	1.5	102.7	NA
0104	2.3	106.4	NA
0105	2.4	101.0	2.84
0106	2.8	132.4	NA
0107	2.8	110.4	NA
0108	2.9	182.1	NA
0109	1.9	565.4	NA
0110	1.6	396.5	NA
0111	0.9	168.7	NA
0112	2.2	222.9	NA
0113	3.3	168.7	NA
0126	2.1	111.2	NA
Off-site Locations			
0117	0.5	105.0	1.28
0118	0.6	93.4	2.05
0119	0.8	86.3	1.46
0120	0.5	90.4	1.50
0121	0.6	89.2	1.59
0122	0.4	76.9	1.36
0123	0.4	79.8	1.36
0124	1.1	104.3	NA
0125	1.3	116.6	NA
0127	0.9	102.5	NA
0128	2.4	108.0	NA
0129	2.1	123.9	2.95
MEI	1.3	95.0	NA

NA = Not analyzed
[1]MEI location

Table 5. Environmental Monitoring Data for the Crescent Junction Site

Station Number	Annual Average Radon Concentration (pCi/L)	Annual Direct Gamma Radiation Effective Dose (mrem/yr)	Annual Radioparticulate Effective Dose (mrem/yr)
On-site Locations			
0301	0.5	107.3	NA
0302	0.7	97.6	NA
0303	1.0	122.7	NA
0304	0.7	106	NA
0305	0.7	115	NA
0308	1.5	115.1	2.02
0309	1.0	92.7	2.75
Off-site Locations			
0306[1]	0.6	107.2	1.65
0307	0.6	106.6	1.48

NA = Not analyzed

[1]MEI location

4.5.3 Radioparticulates

Although the milling process recovered about 95 percent of the uranium, the RRM contains several other naturally occurring radioactive elements. In 2016, air samplers measured radioparticulates at 14 locations (four on site, nine off site, and one MEI). Air filters were collected weekly and submitted as a composite sample on a quarterly basis. The filters were then analyzed for specific radionuclides that are common constituents of RRM, including total uranium, thorium-230, radium-226, and polonium-210. Actinium-227 and protactinium-231 were added beginning in the fourth quarter of 2016 to better represent the potential dose associated with airborne emissions.

4.5.4 Total Effective Dose

The Project must ensure the annual effective dose to gamma radiation and radioparticulates from the Project activities at any location does not exceed 100 mrem/yr above background. The annual total effective dose to the Moab MEI was 97.2 mrem/yr and 108.9 mrem/yr for the Crescent Junction MEI. These values are below the annual limit.

5.0 Environmental Non-radiological Program Information

5.1 Non-radiological Environmental Monitoring

The Project manages storm water at the sites through implementation of controls as specified in site-specific Storm Water Pollution Prevention Plans (see Table 1). Opacity is monitored at the sites by Project personnel certified to EPA Method 9. Dust-generating activities are stopped, and dust control is initiated when opacity exceeds 20 percent to minimize fugitive dust.

DOE operates two meteorological monitoring stations at the Moab site and two at or near the Crescent Junction site (see Figures 4 and 6, respectively). These stations enable DOE to monitor site-specific climatic conditions and events, and provide a valuable resource for assessing impacts resulting from any unplanned release of airborne contamination.

Meteorological parameters monitored include air temperature, relative humidity, solar radiation, wind speed, wind direction, and precipitation. Weather conditions in 2016 did not adversely impact site operations significantly.

5.2 Fire Protection Management and Planning

No unplanned wildland fires occurred at the sites during 2016. Dead vegetation, weeds, and windblown materials are cleared near buildings and equipment to minimize fire hazards. Weed control and limited removal of dead vegetation are performed in other areas of the sites.

5.3 Recreational Hunting and Fishing

There is no recreational hunting or fishing allowed on the Project sites.

6.0 Ground Water Protection Program

The ground water beneath the Moab site has been contaminated by former uranium milling operations. The site ground water meets the criteria of limited-use ground water due to the natural salt content; therefore, it is not a current or potential source of drinking water. Ammonia and uranium are the primary contaminants of concern.

The main objectives of the Ground Water Program are to reduce the ammonia and uranium contaminant mass and to protect young-of-year endangered fish species in suitable habitats of the Colorado River from site contaminants. The suitable habitat is protected through ground water extraction near the RRM pile, freshwater injection along the riverbank, and river water diversion directly to the habitat area.

Figure 7 shows the 2016 ammonia and uranium plumes and surface water sampling locations at the site. The ammonia concentration is highest at the toe of the RRM pile, and the uranium concentration is highest at the toe of the RRM pile and near the vicinity of the former uranium mill, just northeast of the pile.

Monitoring results show the extent of contaminant plumes has not changed significantly in the past 5 years. Ground water flow is toward the southeast, discharging to the Colorado River.

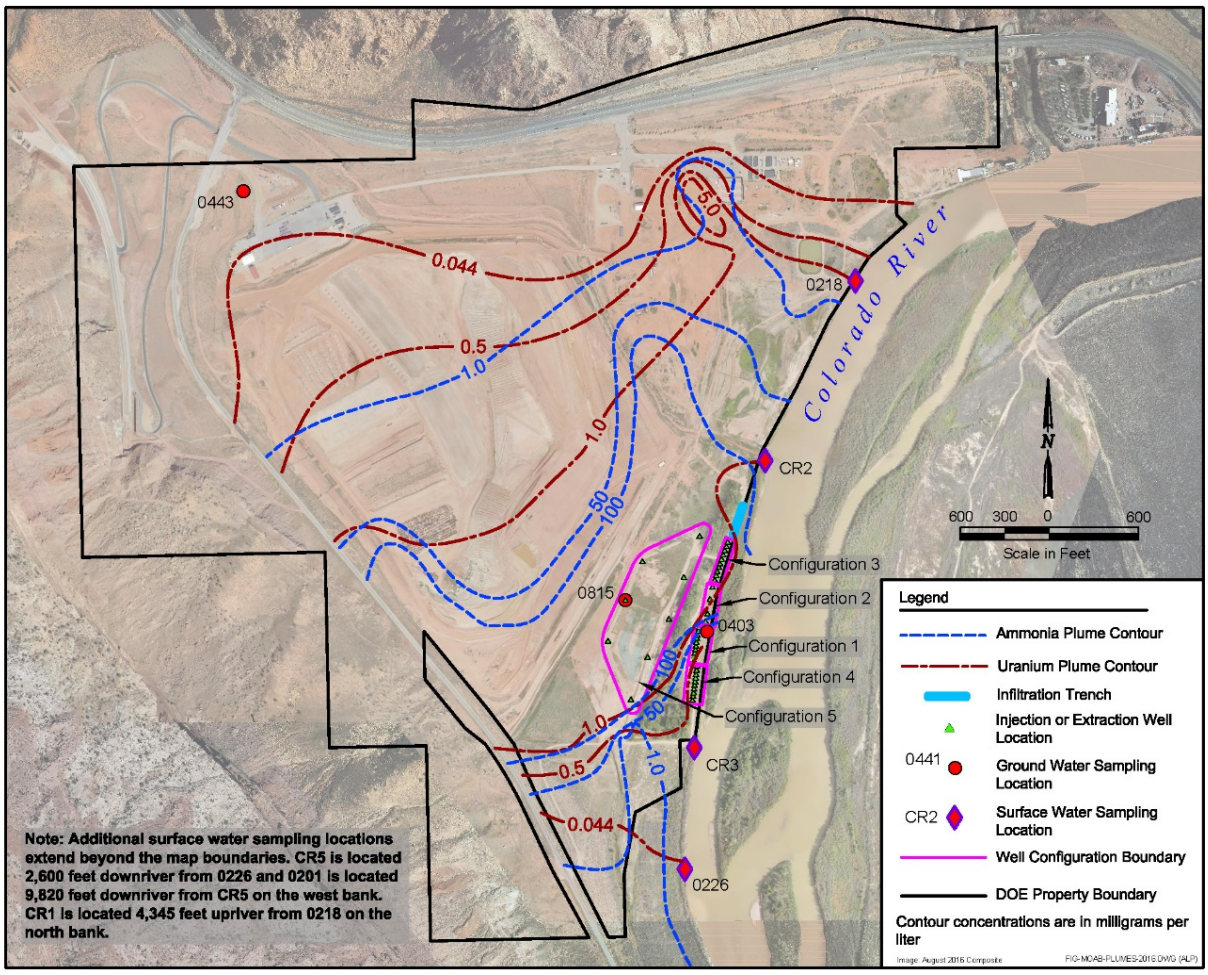

Figure 7. Ammonia and Uranium Plume Contours and Select Sampling Locations

6.1 Ground Water

Eight extraction wells and 10 injection wells were used to minimize contaminant discharge to the Colorado River in 2016. Extracted ground water was pumped to a pond on top of the RRM pile, where it was eliminated through evaporation or stored in a tank for use as dust control on the pile. In fall 2015, extraction was suspended to facilitate evaporation pond removal, which occurred in July 2016. In spring 2016, the water storage tank and associated piping on the RRM pile were relocated away from RRM excavation activities. Extraction of ground water resumed in April 2016 with water pumped directly to the storage tank for use as dust control on the pile.

Samples were collected from the extraction wells to assess IA performance, and site-wide sampling events were initiated in June and December to assess contaminant plumes. Ground water samples were analyzed for ammonia and uranium. Data results from sampling events are available on the Project website at *www.gjem.energy.gov/moab* and in the Moab public reading room.

Table 6 shows the ammonia and uranium concentrations over the past 5 years at representative well locations 0443, an observation well upgradient of the tailings pile; extraction well 0815 is downgradient of the tailings pile; and 0403, an observation well near the riverbank (Figure 7) for well locations). Well 0443 is not affected by contamination in the RRM pile and shows consistent ammonia and uranium results at the detection limit or representative of natural concentrations.

Table 6. Representative Ground Water Well Sampling Results over Past Five Years

Year	Well 0443 (73 ft bgs)		Well 0815 (22 - 52 ft bgs)		Well 0403 (18 ft bgs)	
	Ammonia Total as N (mg/L)	U (mg/L)	Ammonia Total as N (mg/L)	U (mg/L)	Ammonia Total as N (mg/L)	U (mg/L)
2012	NS	NS	190	3.0	69	0.94
2013	0.1*	0.010	270	3.3	26	0.91
2014	0.1*	0.011	350	3.1	24	0.34
2015	0.1*	0.013	190	3.3	56	0.43
2016	0.1*	0.011	250	3.7	73	0.98

bgs = below ground surface; ft = feet; mg/L = milligrams per liter; N = nitrogen; NS = not sampled; U = uranium
* = at detection limit

Well 0815 has been affected by the RRM pile. Ammonia concentrations in this well have fluctuated over the past 5 years. These results indicate the concentration has not decreased during this time; however, this is expected because of the large volume of contaminated ground water. The uranium concentrations in this well are substantially above the water quality standard of 0.044 milligrams per liter (mg/L). Well 0403 is near the Colorado River and shows the effects of IA activities both for ammonia and uranium. The concentrations at this well are fairly consistent over the 5-year period.

Approximately 5.5 million gallons of ground water were extracted in 2016, with about 13,500 pounds (lb) of ammonia and 142 lb of uranium removed. A total of almost 228 million gallons has been extracted since initial implementation of the system through the end of 2016, including more than 875,900 lb of ammonia and 4,635 lb of uranium.

6.2 Surface Water

The Colorado River is the principle surface water feature. Ammonia is of concern because of its toxicity to aquatic life. The purpose of freshwater injection is to create a hydraulic barrier between the RRM pile and river side channels where suitable aquatic habitats can form. Injection occurred almost all year, for a total of about 10.6 million gallons of fresh water injected in 2016.

Surface water samples were collected on site, upriver, and downriver (see Figure 7) for laboratory analysis at near peak flow (June) and base flow (December) conditions in 2016. Fifteen surface water samples were collected during the 2016 sampling events. Table 7 shows the ammonia concentration at each of the locations and the corresponding EPA acute and chronic criteria. Results from all of the sample locations were less than the EPA criteria.

In 2016, no suitable habitat formed adjacent to the Moab site. If one had formed, surface water diversion would have been used to dilute ammonia concentrations exceeding acute or chronic criteria.

Table 7. Ammonia Concentrations in Surface Water Samples Compared to EPA Criteria

Location	Date	Ammonia Total as N (mg/L)	EPA - Acute Total as N (mg/L)[1]	EPA - Chronic Total as N (mg/L)[2]
0201	07/06/16	<0.1	14	0.94
0201	01/03/17	<0.1	3.3	0.80
0218	06/30/16	<0.1	11	0.79
0218	01/03/17	0.2	3.3	0.80
0226	07/05/16	<0.1	11	0.79
0226	01/18/17	0.11	3.3	0.80
CR1	06/30/16	<0.1	31	1.6
CR1	01/03/17	0.11	27	3.8
CR2	06/30/16	<0.1	8.2	0.64
CR2	01/03/17	0.26	3.3	0.80
CR3	07/05/16	<0.1	13	0.79
CR3	01/03/17	0.17	2.3	0.57
CR5	07/06/16	<0.1	9.9	0.74
CR5	01/03/17	<0.1	3.3	0.80
Z	07/06/16	<0.1	7.5	0.60

[1]EPA Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater State (Effective April 2013), Table N.4
[2]Temperature and pH-Dependent Values, Acute Concentration of Total Ammonia as Nitrogen (N) (mg/L)

7.0 Quality Assurance

The Project has a QA Program that provides a structured approach to apply QA principles to work performed on the Project. The quality measures embodied in this Program address requirements in DOE O 414.1D Chg 1, "Quality Assurance." The QA Program is implemented with contractor-specific plans and procedures that ensure environmental data collected are valid and traceable.

7.1 Laboratory Analysis

The Project ensures receipt of analytical data that meet Environmental Air Monitoring Program and Ground Water Program requirements by subcontracting analytical services to qualified laboratories. The subcontracted laboratories are qualified under the DOE EM Consolidated Audit Program, the National Environmental Laboratory Accreditation Program, the Utah Department of Health Environmental Laboratory Certification, and through participation in proficiency testing programs. The quality of the data received from the laboratories is evaluated through a formal data validation process.

7.2 Records Management

All documentation created as a result of compliance with this ASER is considered a Project record and will be managed in accordance with the *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545), which follows DOE orders, policies, and regulations for retention and maintenance of records.

8.0 References

10 CFR 1021 (Code of Federal Regulations), "National Environmental Policy Act Implementing Procedures."

10 CFR 1022 (Code of Federal Regulations), "Compliance with Floodplain and Wetland Environmental Review Requirements."

40 CFR 61 (Code of Federal Regulations), "National Emission Standards for Hazardous Air Pollutants."

40 CFR 192 (Code of Federal Regulations), "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

33 USC 1251 (United States Code), Clean Water Act.

42 USC 300f (United States Code), Safe Drinking Water Act.

42 USC 7901 (United States Code), Uranium Mill Tailings Radiation Control Act.

42 USC 11001 (United States Code), Emergency Planning and Community Right-to-Know Act.

DOE (U.S. Department of Energy), *Moab UMTRA Project Records Management Manual* (DOE-EM/GJ1545).

DOE (U.S. Department of Energy), *Moab UMTRA Project Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact Statement* (DOE/EIS-0355).

DOE (U.S. Department of Energy) Order 210.2A, "DOE Corporate Operating Experience Program."

DOE (U.S. Department of Energy) Order 231.1B Admin Chg 1, "Environment, Safety and Health Reporting."

DOE (U.S. Department of Energy) Order 414.1D Chg 1, "Quality Assurance."

DOE (U.S. Department of Energy) Order 435.1, "Radioactive Waste Management."

DOE (U.S. Department of Energy) Order 436.1, "Departmental Sustainability."

DOE (U.S. Department of Energy) Order 458.1 Admin Chg 3, "Radiation Protection of the Public and the Environment."

DOE (U.S. Department of Energy), *Record of Decision for the Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah* (6450-01-P).

Executive Order 11988, "Floodplain Management."

Executive Order 11990, "Protection of Wetlands."

Public Law 106-398, Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001.

UAC R307-205-8 (Utah Administrative Code), “Emission Standards; Fugitive Emissions and Fugitive Dust; Tailings Piles and Ponds.”

U.S. Census Bureau, https://factfinder.census.gov