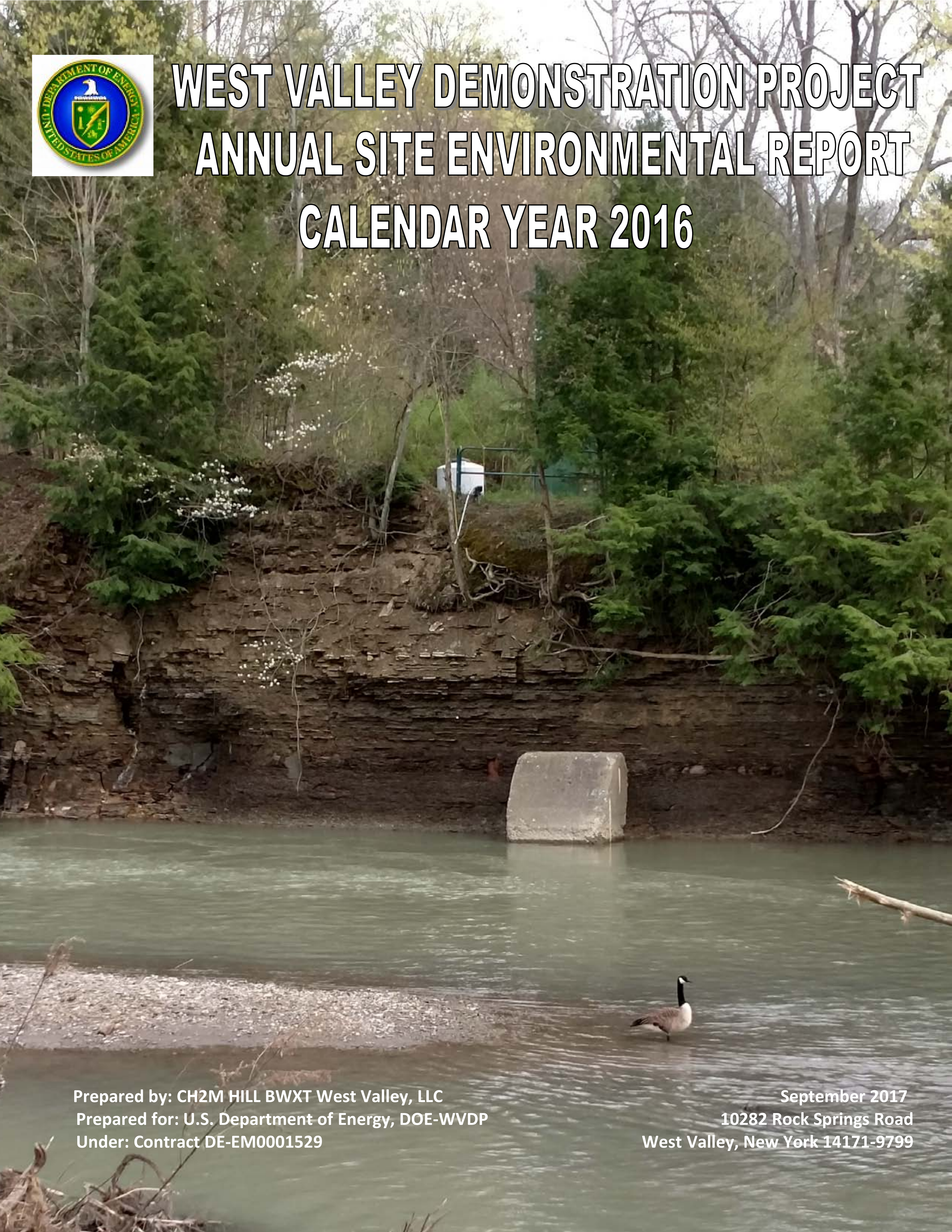

WEST VALLEY DEMONSTRATION PROJECT ANNUAL SITE ENVIRONMENTAL REPORT CALENDAR YEAR 2016

Prepared by: CH2M HILL BWXT West Valley, LLC
Prepared for: U.S. Department of Energy, DOE-WVDP
Under: Contract DE-EM0001529

September 2017

10282 Rock Springs Road
West Valley, New York 14171-9799

Department of Energy
West Valley Demonstration Project
10282 Rock Springs Road
West Valley, NY 14171-9799

To the Reader:

This report, prepared by the United States (U.S.) Department of Energy (DOE) West Valley Demonstration Project (WVDP), represents a single, comprehensive summary of on-site and off-site environmental data collected during calendar year 2016.

CH2M HILL BWXT West Valley, LLC (CHBWV) continued to perform Phase 1 Decommissioning and Facility Disposition activities for DOE during 2016. The term of the Phase 1 Decommissioning and Facility Disposition contract is from August 2011 to March 2020.

Monitoring and surveillance of the WVDP facilities are conducted to verify that public health and safety and the environment are protected. Environmental requirements and pollution prevention are integrated into work planning and execution. The quality assurance requirements applied to the environmental monitoring program by the DOE confirm the validity and accuracy of the monitoring data.

At the WVDP, radiological air emissions are controlled and permitted by the U.S. Environmental Protection Agency (EPA) under National Emission Standards for Hazardous Air Pollutants, Subpart H, regulations. Nonradiological liquid effluent discharges are controlled and permitted through the New York State Pollutant Discharge Elimination System. Generation, storage, and treatment of hazardous and mixed wastes are conducted in accordance with Resource Conservation and Recovery Act interim status regulations and New York State Environmental Conservation Law.

Air, surface water, groundwater, storm water, soil, sediment, and biological samples are collected and analyzed for radiological and nonradiological constituents. The resulting data are evaluated to assess effects of activities at the WVDP on the nearby public and the environment.

The dose to the critical receptor from airborne radiological emissions in 2016 was estimated to be <4.9% of the 10-millirem (mrem) EPA limit. The dose from combined airborne and waterborne radiological releases in 2016 to the same individual was estimated to be <0.50% of the 100-mrem DOE limit, verifying that dose received by off-site residents continues to be minimal.

Safety performance at the WVDP during 2016 continued to be outstanding. In 2016, the employees achieved 2.4 million consecutive safe work hours without a lost-time work injury or illness, while accomplishing complex decontamination, demolition, and waste management activities.

If you have any questions or comments about the information in this report, please contact WVDP Communications at (716) 942-4601 or by e-mail at Cynthia.Dayton@chbwv.com. You may also complete and return the enclosed survey.

Sincerely,

Bryan C. Bower, Director
West Valley Demonstration Project

WVDP Annual Site Environmental Report

Can We Make This Report More Useful to You?

We want to make the *WVDP Annual Site Environmental Report* useful to its readers. Please take a few minutes to let us know if the report meets your needs. You can e-mail or mail this survey, or call WVDP Communications at:

telephone: (716) 942-4601
e-mail: Cynthia.Dayton@chbwv.com
mailing address: WEST VALLEY DEMONSTRATION PROJECT
10282 ROCK SPRINGS ROAD
WEST VALLEY, NY 14171

1. How do you use the *WVDP Annual Site Environmental Report?*

☐ To learn general information about the WVDP
☐ To learn about doses received for the current year
☐ To learn about site compliance information
☐ To gather effluent or environmental surveillance data
☐ Other: ____________________________________

2. Does the *WVDP Annual Site Environmental Report* contain enough:

a. Useful illustrations and graphs? ☐ Yes ☐ No
b. Project background information? ☐ Yes ☐ No
c. Scientific background information? ☐ Yes ☐ No
Comments: ____________________________________

3. Is this report: (please check one)

☐ At appropriate technical level?
☐ Too technical? For example: ____________________________________
☐ Not technical enough? For example: ____________________________________

4. If you could change this report to make it more readable and useful to you, what would you change?

____

5. What is your affiliation?

☐ U.S. DOE
☐ NYSERDA
☐ Other government office/agency
☐ Public interest group
☐ Elected official
☐ Media
☐ Group: ______________________________
☐ Individual: ______________________________

6. To help us identify our audience, please indicate your educational background.

☐ Graduate degree: ☐ Scientific ☐ Nonscientific
☐ Undergraduate degree: ☐ Scientific ☐ Nonscientific
☐ Experience with science outside college setting
☐ Little or no scientific background

West Valley Demonstration Project

Annual Site Environmental Report

for

Calendar Year 2016

Prepared for the U.S. Department of Energy

West Valley Demonstration Project Office

Under: Contract DE-EM0001529

September 2017

CH2M HILL BWXT West Valley, LLC

10282 Rock Springs Road

West Valley, New York 14171-9799

Front Cover: The cover photograph was taken at the Felton Bridge surface water sampling location on Cattaraugus Creek. This is the first point of public access to the creek downstream of the site.

This report and previous Annuals Site Environmental Reports (ASERs) are available on the DOE-WVDP website http://www.wv.doe.gov. Requests for digital copies of the 2016 ASER and questions regarding the report should be referred to:

Cynthia Dayton, WVDP Communications
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West Valley, New York 14171.
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Disclaimer

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EXECUTIVE SUMMARY

Purpose of This Report

The Annual Site Environmental Report for the West Valley Demonstration Project (WVDP or Project) is published to provide information about environmental conditions at the WVDP to members of the public, to the United States (U.S.) Department of Energy (DOE) Headquarters, and to other interested stakeholders. In accordance with DOE Order 231.1B, "Environment, Safety, and Health Reporting," this document summarizes calendar year (CY) 2016 environmental monitoring data, describes the performance of the WVDP's environmental management system (EMS), confirms compliance with environmental standards and regulations, and highlights important environmental monitoring programs. WVDP activities are conducted in cooperation with the New York State Energy Research and Development Authority (NYSERDA).

Project Status

The WVDP is located on the site of a former commercial nuclear fuel reprocessing plant, which shut down in 1976. The WVDP facility lies within a 152 acre fenced area in Western New York. The primary Project facilities include the Main Plant Process Building (MPPB), the Vitrification Facility (VF), four underground storage tanks, four wastewater treatment lagoons, a buried waste disposal facility and waste storage areas. The WVDP is surrounded by the 3,338-acre Western New York Nuclear Service Center (WNYNSC). In 1980, Congress passed Public Law 96-368 (the WVDP Act), included in its entirety in Appendix H. The first responsibility of the WVDP Act, solidification of the high level waste (HLW) stored in the underground tanks by vitrification, was completed in September 2002. Removal of the HLW canisters from the MPPB in 2016 and other activities since 2002 address the remaining requirements of the WVDP Act which include waste disposal, and decontamination and dismantlement of the facilities and tanks.

Record of Decision. In April 2010, DOE released a Record of Decision (ROD) for the Final Environmental Impact Statement (Final EIS or FEIS) for the WVDP and the WNYNSC ("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, issued on January 29, 2010). In the FEIS, DOE and NYSERDA evaluated four alternatives: Site-wide Removal, Site-wide Close-In-Place, Phased Decisionmaking, and No Action. Phased Decisionmaking was identified as the preferred alternative. Under this alternative, decommissioning will be conducted in two phases.

During Phase 1 Site Decommissioning, a number of highly contaminated facilities will be removed under a facilities disposition contract awarded in 2011 (discussed below). Soil remediation actions will be performed under a separate Phase 1 contract following the facilities disposition contract. Phase 1 also includes characterization work and focused studies that will facilitate future decisionmaking for the remaining facilities or areas on the property. The original estimated cost for all of the Phase 1 work was approximately $1.2 billion (FEIS, 2010). The complete FEIS and the ROD can be viewed on-line at the DOE-WVDP website at www.wv.doe.gov.

Phase 2 will address the Waste Tank Farm (WTF), the waste disposal areas, and the non-source area of the groundwater plume. DOE intends to complete any remaining WVDP decisionmaking with its Phase 2 decision (to be made within 10 years of the ROD) in a Supplemental EIS and expects to select either removal or in-place closure, or a combination of those two for the portions of the site for which it has decommissioning responsibility.

Proposals for preparation of the Supplemental EIS and the associated Decommissioning Plan were evaluated throughout 2016. The Supplemental EIS contract was awarded in April 2017.

DOE/NYSERDA Consent Decree. DOE and NYSERDA reached an agreement on the cost sharing for cleanup of the WVDP and the WNYNSC by signing a Consent Decree on August 17, 2010 in the U.S. District Court, Western District of New York. While the Consent Decree defines the cost-sharing agreement, it does not affect in any way what the cleanup will be or the end state of the WVDP and the WNYNSC.

Facilities Disposition Contract. On June 30, 2011, DOE awarded the Phase 1 Decommissioning and Facility Disposition Contract to CH2M HILL • Babcock & Wilcox, West Valley, LLC (CHBWV), made up of CH2M HILL, Babcock & Wilcox Technical Services Group, Inc., and Environmental Chemical Corporation.

The scope of the contract is divided into four primary milestones. The following provides the contract status at the end of CY 2016 for each of these milestones:

Milestone 1 - **Complete relocation of the canisters of vitrified HLW at the WVDP:**

Relocation of the canisters of vitrified HLW was completed in November 2016, with final milestone completion in February 2017, one year ahead of schedule. This milestone involved the use of specialized equipment designed to remotely decontaminate and over-pack the canisters previously stored inside the MPPB into highly shielded Vertical Storage Casks (VSCs). These casks were then moved to the newly constructed outdoor interim storage pad on the WVDP south plateau using custom designed transport vehicles.

The successful and safe loading and relocation of the canisters from inside the MPPB to the on-site HLW Cask Storage Pad was a major accomplishment paving the way for demolition.

All 56 casks were relocated to the interim HLW Cask Storage Pad by November 2016

Milestone 2 - **Processing, shipment and off-site disposal of all legacy waste (waste existing at the WVDP when the Phase 1 Decommissioning and Facility Disposition Contract was issued to CHBWV):**

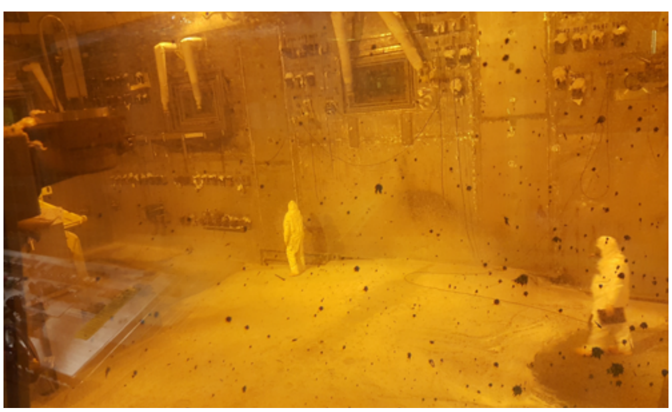
Another major success for the WVDP in 2016 was the shipment of three large low-level radioactive waste (LLW) packages containing components used in the waste vitrification process to a permanent disposal site in Andrews, Texas. This off-site transport and disposal of the waste was safely completed in November 2016. Special packaging and approvals for shipping this waste, mostly by rail, required several years of planning. In addition, the WVDP has packaged and shipped approximately 54% of the legacy LLW that was stored at the site at the beginning of the CHBWV contract.

Shipment of legacy LLW vitrification process components

Burial of legacy LLW components at the permanent disposal site in Andrews, Texas

<u>Milestone 3</u> - **Demolition and removal of the MPPB and the VF:**

Preparations continued in 2016 for demolition of the MPPB and VF including characterization of high-hazard areas, isolation of utility lines, and removal of tanks/vessels, piping, ceiling grids, lighting, equipment, and asbestos. Deactivation of the VF was nearly complete at the end of 2016. The first manned entry since the unit was in operation in 2002 was made possible in 2016. Entry by radiation control technicians was required to complete final characterization and decommissioning tasks.



Manned entry into the Vitrification Facility (VF)

<u>Milestone 4</u> - **Completion of all work described in the Performance Work Statement including disposition of the Balance of Site Facilities:**

The CHBWV milestone 4 contract scope includes continued safe operation of the site through:

- managing and maintaining site infrastructure;
- maintaining the lagoon system;
- conducting environmental monitoring and maintaining compliance with WVDP regulatory and permit requirements; and
- maintaining the WTF, the U.S. Nuclear Regulatory Commission (NRC) licensed-disposal area (NDA), and the north plateau Permeable Treatment Wall (PTW).

The only facility demolished in 2016 was the remainder of the nonradiologically contaminated Test and Storage Building. Considerable progress was made in the removal of asbestos containing material inside various facilities including the utility room attached to the MPPB.

Much of the milestone 4 work performed in 2016 involved planning and design of infrastructure system upgrades for natural gas, electricity, water, and communications.

Major Site Programs

Safety Success. The radiological and hazardous work environment at the WVDP warrants strict adherence to safety procedures. As of December 31, 2016, CHBWV and its subcontractors achieved approximately 2.4 million consecutive work hours without a lost-time work accident or illness. Safety statistics for 2016 place the WVDP among the safest sites in the DOE complex.

Waste Tank Farm (WTF) Tank and Vault Drying System (T&VDS). The T&VDS, designed to reduce the liquid volumes in the tanks, thereby reducing the harmful effects of corrosion, continued to operate effectively during 2016.

Permeable Treatment Wall (PTW) Performance. The full-scale PTW, installed in November 2010, has now been monitored for six years. Performance monitoring data collected to date indicate the ongoing processes within the PTW continue to achieve the remedial action objectives of the PTW defined in the PTW Performance Monitoring Plan.

NRC-Licensed Disposal Area (NDA). Water level data indicate the cap and slurry wall installed in 2008 are causing the weathered Lavery till to become dry in some areas as designed. Reduced water volume extracted from the interceptor trench since the cap and slurry wall were installed also continues to indicate groundwater flow through the NDA is effectively being reduced.

Environmental Management System (EMS)

The WVDP EMS satisfies the requirements of DOE Order 436.1, "Departmental Sustainability," and is a key part of the WVDP Integrated Safety Management System. In 2016, WVDP employees continued to demonstrate their commitment to an all-inclusive approach to safety, coordinating the EMS with other safety management and work planning processes through the integrated environmental, health, and safety management program. CHBWV received a certificate of registration for its EMS under International Organization for Standardization 14001:2004 on July 31, 2012 and was recertified in 2016.

Compliance. Requirements and guidance from applicable state and federal statutes, executive orders, DOE orders, and standards are integrated into the Project's compliance program. WVDP management continued to provide strong support for environmental compliance in 2016.

- There were no New York State Pollutant Discharge Elimination System (SPDES) permit limit noncompliance events in CY 2016.
- No exceedances to the U.S. Environmental Protection Agency's (EPA's) National Emission Standards for Hazardous Air Pollutants (NESHAP) dose standard occurred in 2016.
- No exceedances to the dose standard in DOE Order 458.1 occurred in 2016.
- Inspections by the New York State Department of Environmental Conservation showed continued Project compliance with applicable environmental and health regulations in 2016.
- Requirements of the Emergency Planning and Community Right-to-Know Act were met in 2016 by collecting information about hazardous materials used at the Project and making this information available to the appropriate emergency response organizations.
- Over 46 tons of material was diverted from landfills through the WVDP recycling program in 2016.

Environmental Monitoring - Performance Indicators. As part of the WVDP EMS, environmental monitoring continued on and near the site to detect and evaluate changes in the environment resulting from Project (or pre-Project) activities and to assess the effect of any such changes on the environment or human population. Within the environmental monitoring program, airborne and waterborne effluents were sampled and environmental surveillances of the site and nearby areas were conducted.

Replacement Ventilation System (RVS) for a portion of the MPPB

- Airborne Radiological Releases

  During 2016, radiological releases from the site were measured at six NESHAP permitted emission points and were estimated from one diffuse source.

  Off-site air monitoring continued at the 16 ambient air sampling stations that surround the WNYNSC. This was the fourth complete year of off-site ambient air monitoring with these samplers.

  All measurements demonstrated that airborne releases were within permissible limits.

  There were no unplanned radiological airborne releases at the WVDP during 2016.

- Waterborne Radiological Releases

  Waterborne radiological releases from the site were measured at two natural streams and one controlled outfall.

Off-site surface water was sampled at two downstream locations.

All measurements demonstrated that waterborne releases were within permissible limits.

There were no unplanned releases of waterborne radioactivity in 2016.

- Estimated Dose

In CY 2016, no radioisotopic activity was measured above the method detection limits at the ambient air samplers from potential man-made sources, indicating there was no measurable dose from radioactivity that could have originated at the site.

The estimated maximum potential dose from airborne emissions from the WVDP in 2016 was less than the detection limit of 0.49 millirem (mrem) (<0.0049 millisievert [mSv]) which is well below the 10-mrem (0.1 mSv) limit established by EPA.

The estimated dose from waterborne sources in 2016 was 0.013 mrem (0.00013 mSv).

The total estimated maximum potential dose from both airborne and waterborne sources in 2016 was <0.50 mrem (<0.0050 mSv), which is well below the annual 100-mrem limit established by DOE Order 458.1. In comparison, the average dose to a member of the public from natural background sources is 310 mrem per year.

- Dose to Biota

The dose to biota evaluation for CY 2016 once again concluded that aquatic and terrestrial biota populations (both plants and animals) were not exposed to doses in excess of the DOE biota dose standard of 1 rad/day for aquatic animals and terrestrial plants, and 0.1 rad/day for riparian and terrestrial animals.

- Nonradiological Releases

Nonradiological releases from Project wastewater and storm water monitoring points were within compliance limits throughout 2016.

Quality Assurance (QA). The data presented in this report is validated in accordance with strict QA procedures. The WVDP QA program includes evaluations of the performance of subcontract laboratories and routine assessments of the environmental and regulatory compliance programs. Subcontract laboratories that analyze WVDP environmental samples participated in independent radiological and nonradiological constituent performance evaluation studies. In these studies, environmental test samples with concentrations only known by the testing agency were analyzed by the laboratories. Of 253 performance evaluation analyses conducted for the WVDP, 98.4% were within acceptance limits.

Numerous inspections, audits, assessments, and surveillances of components of the environmental monitoring program were conducted in 2016. Although actions were recommended to improve the program, nothing was found that would compromise the quality of data in this report or the environmental monitoring program in general.

Other Environmental Activities

Phase 1 Studies. During 2016, progress on the Phase 1 Studies included terrain analysis, age dating, and paleoclimate research to recreate the erosion history of the WNYNSC. Phase 1 study work performed in CY 2016 also included completion of updated radionuclide inventory estimates for the State-licensed Disposal Area (SDA), the NDA, and the WTF, as well as a geophysical pilot study at the SDA. Phase 1 Studies reports are available at www.westvalleyphaseonestudies.org.

Aerial Survey. In 2016, NYSERDA evaluated follow-up surface soil samples collected to compare to the September 2014 aerial radiation survey of the WNYNSC and Cattaraugus Creek. The assessed doses in these areas were determined to be below the NRC unrestricted release criteria of 25 mrem/year. No health and safety concerns were identified for these locations. These results are provided in the November 2016 report "Radiological Survey and Dose Assessment Report for the WNYNSC and Off-Site Areas," available at www.nyserda.ny.gov/west-valley.

Preparation for Demolition. In preparation for upcoming demolition activities, DOE and its subcontractors presented a source term calculation methodology to the EPA in February 2016 that estimates the predicted potential airborne release rates based on selected demolition methods. The WVDP received approval to use this methodology to support VF demolition, with the condition that a monitoring study be performed during VF demolition that demonstrates the methodology does not underestimate airborne emissions.

Conclusion

In addition to demonstrating compliance with environmental regulations and directives, evaluation of data collected in 2016 continued to indicate that interim remedial measures are working and WVDP activities pose no threat to public health or safety, or to the environment. All site activities are being completed on or ahead of schedule milestones and work is being performed in a safe and responsible manner.

INTRODUCTION

Site Location

The West Valley Demonstration Project (WVDP or Project) is located in western New York State (NYS), about 30 miles (mi) (50 kilometers [km]) south of Buffalo, New York (Fig. INT-1). The WVDP facilities currently occupy a security-fenced area of about 152 acres (61 hectares [ha]) within the 3,338-acre (1,351 ha) Western New York Nuclear Service Center (WNYNSC or Center) located primarily in the town of Ashford in northern Cattaraugus County. An aerial photo of the WVDP is presented in Figure INT-2.

General Environmental Setting

Climate. Although extremes of 99°F (37°C) and -20°F (-29°C) have been recorded in western New York (NY), the climate is moderate, with an average annual temperature of 46.9°F (8.3°C) (National Oceanic and Atmospheric Administration Climatic Data Center [Official Record] for 1895 to 2016, www.ncdc.noaa.gov/cag and www.weather.gov/buf/BUFRecords). Precipitation is markedly influenced by Lake Erie to the west and, to a lesser extent, by Lake Ontario to the north. Based on data collected at the on-site meteorological tower from 2006 to 2015, the recent 10 year average annual precipitation at the WVDP was 41.4 inches/year. Regional winds are generally from the west and south at about 9 miles per hour (4 meters/second).

Ecology. The WNYNSC lies within the northern deciduous forest biome, and the diversity of its vegetation is typical of the region. Equally divided between forest and open land, the site provides a habitat especially attractive to white-tailed deer and various indigenous and migratory birds, reptiles, and small mammals. No species on the federal endangered species list are known to reside on the WNYNSC.

Geology and Hydrology. The Project lies on NYS's Allegheny Plateau at an elevation of approximately 1,300 to 1,450 feet (ft) (400 to 440 meters [m]) above mean sea level. The underlying geology includes a sequence of glacial sediments above shale bedrock. The Project is drained by three small streams (Franks Creek, Quarry Creek, and Erdman Brook) and is divided by a stream valley (Erdman Brook) into two general areas: the north plateau and the south plateau. Franks Creek, which receives drainage from Erdman Brook and Quarry Creek, flows into Buttermilk Creek, which enters Cattaraugus Creek and flows westward away from the WNYNSC. (See Figures A-1 and A-5.) Cattaraugus Creek ultimately drains into Lake Erie, to the northwest.

Relevant Demographics

Although several roads and a railway approach or pass through the WNYNSC, the public is prohibited from accessing the WNYNSC. A limited public deer hunting program managed by New York State Energy Research and Development Authority (NYSERDA) is conducted on a year-to-year basis in designated areas on the WNYNSC. No unescorted public access is allowed on the WVDP premises.

Land near the WNYNSC is used primarily for agriculture and arboriculture. Downgradient of the WNYNSC, Cattaraugus Creek is used locally for swimming, canoeing, and fishing. Although some water is taken from the creek to irrigate nearby golf course greens and tree farms, no public drinking water is drawn from the creek before it flows into Lake Erie. Water from Lake Erie is used as a public drinking water supply.

The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within approximately 5 mi (8 km) of the Project. Population around the site is sparse with the average population density of Cattaraugus County about 61 persons/mi^2 (24 persons/km^2). No major industries are located within this area.

Historic Timeline of the WNYNSC and the WVDP

The following summary, presented in Table INT-1, depicts a historic timeline for the WNYNSC and the WVDP beginning with the establishment of the WNYNSC as a commercial nuclear fuel reprocessing facility, to the creation of the WVDP, to the current Project mission. The summary includes significant legal directives, major activities, and accomplishments.

FIGURE INT-1
Location of the Western New York Nuclear Service Center (WNYNSC)

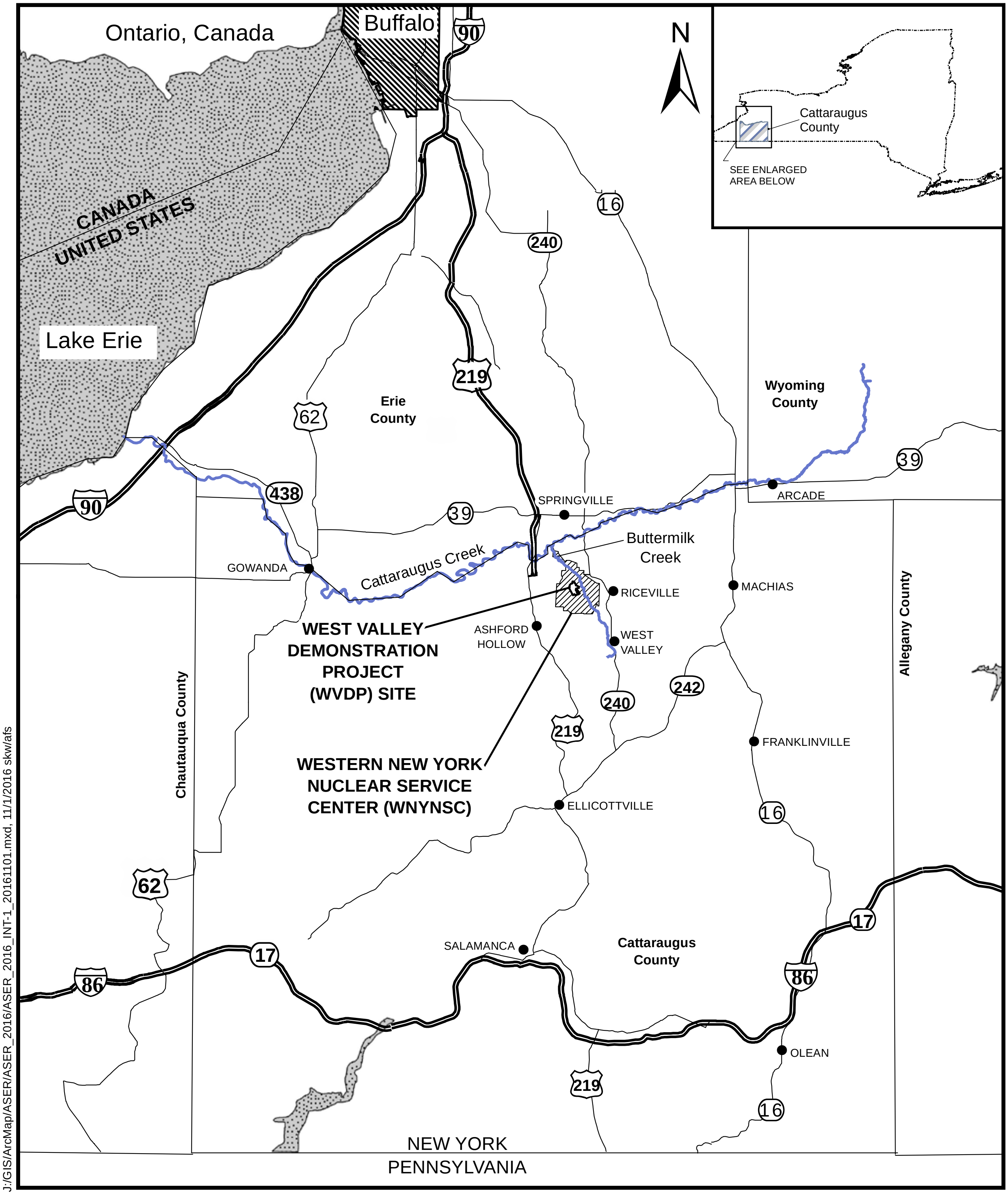


FIGURE INT-2
Aerial Photo of the West Valley Demonstration Project (WVDP)

Overlay showing major site features at the end of CY 2016.
(Underlying aerial survey dated 2015).

TABLE INT-1
Historic Timeline of the WNYNSC and the WVDP

Year	Activity
1954	The Federal Atomic Energy Act (AEA) promoted commercialization of reprocessing spent nuclear fuel.
1959	NYS established the Office of Atomic Development (OAD) to coordinate the atomic industry.
1961	The NYS OAD acquired 3,345 acres (1,354 ha) of land in Cattaraugus County, Town of Ashford (near West Valley), in western New York and established the WNYNSC.
1962	Davison Chemical Company established Nuclear Fuel Services, Inc. (NFS) as a nuclear fuel reprocessing company, and reached an agreement with NYS to lease the WNYNSC (also referred to as "the Center").
1966	NFS constructed and operated the commercial nuclear fuel reprocessing facility at the WNYNSC from 1966 to 1972. NFS processed 640 metric tons (mt) of spent reactor fuel at the facility, generating 660,000 gallons (gal) (2.5 million liters [L]) of highly radioactive liquid waste. A 5-acre landfill, the U.S. Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA) was operated for disposal of waste generated from the reprocessing operations from 1966 until 1986. Also, a 15-acre commercial disposal area, the SDA regulated by NYS agencies, under delegation of authority from the NRC, accepted low-level radioactive waste (LLW) from operations at the WNYNSC and from off-site facilities from 1963 until 1975.
1972	In 1972, while the plant was closed for modifications, more rigorous regulatory requirements were imposed upon fuel reprocessing facilities. NFS determined the costs to meet regulatory requirements of spent nuclear fuel reprocessing were not economically feasible. NFS then notified the NYSERDA, the successor to NYS OAD, in 1976 that they would discontinue reprocessing and would not renew the lease that would expire at the end of 1980.
1975	Water infiltrated into the New York State-Licensed Disposal Area (SDA) trenches and waste burial operations ceased. Between 1975 and 1981, NFS pumped, treated, and released liquids to the adjacent stream. Redesigning the covers reduced, but did not eliminate, water accumulation in the trenches.
1980	The United States (U.S.) Congress passed Public Law 96-368, the West Valley Demonstration Project Act (WVDP Act), requiring the U.S. Department of Energy (DOE) to be responsible for solidifying the liquid high-level radioactive waste (HLW) stored in underground tanks, disposing of the waste that would be generated by solidification, and decontaminating and decommissioning the facilities used during the process. Per the WVDP Act, the DOE entered into a Cooperative Agreement with NYSERDA that established the framework for cooperative implementation of the WVDP Act. Under the agreement, DOE has exclusive use and possession of a portion of the Center (i.e., WNYNSC) known as the Project Premises (approximately 167 acres at that time). A supplement to the Cooperative Agreement (1981 amendment) between the two agencies set forth special provisions for the preparation of a joint Environmental Impact Statement (EIS).
1981	DOE and NRC entered into a Memorandum of Understanding (MOU) that established specific agency responsibilities and arrangements for informal review and consultation by NRC. Because NYSERDA holds the license and title to the WNYNSC, NRC put the technical specifications of the license (CSF-1) in abeyance to allow DOE to carry out the responsibilities of the WVDP Act.
1982	West Valley Nuclear Services (WVNS), a Westinghouse subsidiary, was chosen by DOE to be the management and operating contractor. WVNS commenced operations at the WVDP on February 28, 1982.
1983	Before discontinuing fuel reprocessing operations, NFS had accepted 750 spent fuel assemblies which remained in storage in the on-site fuel receiving and storage (FRS) area. Between 1983 and 1986, 625 of those assemblies were returned to the utilities that owned them. In 1983, NYSERDA assumed management responsibility for the SDA and focused efforts on minimizing infiltration of water into the trenches. In the 1990s, installation of a geomembrane cover over the entire SDA and an underground barrier wall were successful in eliminating increases in trench water levels. The DOE selected the vitrification (VIT) process as the preferred method for solidifying the HLW into glass.
1984	Non-radioactive testing of a full-scale VIT system was conducted from 1984–1989. NFS entered into an agreement with DOE in which DOE assumed ownership of the remaining 125 fuel assemblies in the FRS pool and the responsibility for their removal.

TABLE INT-1 *(continued)*
Historic Timeline of the WNYNSC and the WVDP

Year	*Activity*
1986	A large volume of radioactive, non-HLW would result from WVDP activities. On-site disposal of most of this waste was evaluated in an Environmental Assessment (EA [DOE/EA-0295, April 1986]), and a finding of no significant impact (FONSI) was issued. The Coalition on West Valley Nuclear Waste (The Coalition) and the Radioactive Waste Campaign filed suit contending an EIS should have been prepared. The NYS Department of Environmental Conservation (NYSDEC) was authorized by the U.S. Environmental Protection Agency (EPA) to administer the Resource Conservation and Recovery Act (RCRA) hazardous waste program.
1987	A decision to potentially dispose of LLW at the Project led to a legal disagreement between DOE, The Coalition, and the Radioactive Waste Campaign. The lawsuit was resolved by a Stipulation of Compromise which states that LLW disposal at the site and the potential effects of erosion at the site must be included in a comprehensive EIS.
1988	In December 1988, the DOE and NYSERDA issued a Notice of Intent (NOI) in the Federal Register (FR) to prepare an EIS in accordance with Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 8-0109 of the New York State Environmental Quality Review (SEQR) Act. To prepare for VIT, the integrated radiological waste treatment system was constructed to process liquid supernatant from the underground waste tanks by removing most of the radioactivity in the supernatant, concentrating the liquid, and blending it with cement. The HLW sludge layer was then washed to remove soluble salts. The water containing the salts was also stabilized into cement. About 20,000 drums of cement-stabilized LLW were stored in the aboveground drum cell. The process was completed in 1995.
1990	Organic solvent was observed in a groundwater monitoring well immediately downgradient of the NDA in 1983. Following characterization of the area, an interceptor trench bordering the northeast and northwest boundaries of the NDA and a liquid pretreatment system (LPS) were built in 1990–1991. The trench was designed to collect liquid that might migrate from the NDA and the LPS was designed to recover free organic product (if present) from the recovered liquid. To date, no organic product has been detected in the interceptor trench water; therefore, the water has been pumped and treated through the LLW treatment system. In 1990, NYS was granted the authority to regulate the hazardous waste constituents of radioactive mixed waste. Subsequently, a Title 6 New York State Official Compilation of Codes, Rules, and Regulations (NYCRR) RCRA Part 373-3 (Part A) Permit Application for the WVDP was filed with NYSDEC for storage and treatment of hazardous and mixed wastes.
1992	In 1992, DOE and NYSERDA entered into a RCRA §3008(h) Administrative Order on Consent (Consent Order) with NYSDEC and the EPA. The Consent Order pertained to management of hazardous waste and/or hazardous constituents from solid waste management units (SWMUs) at the WVDP. It also required DOE and NYSERDA to perform a RCRA Facility Investigation (RFI) at the WNYNSC to determine if there had been or if there was potential for a release of RCRA hazardous constituents. Final RFI reports were submitted in 1997, completing the Consent Order investigative activities.
1993	In 1993, gross beta activity in excess of 1.0E-06 microcuries per milliliter (µCi/mL) (the DOE Derived Concentration Guide [DCG] for strontium-90, the applicable guidance at that time) was detected in surface water on the north plateau, in the vicinity of sampling location WNSWAMP. The gross beta radioactivity was determined to be strontium-90.
1994	Extensive subsurface investigations delineated the extent of the strontium-90 plume and determined that the plume originated beneath the southwest corner of the main plant process building (MPPB) during NFS operations and migrated toward the northeast quadrant of the north plateau. A second lobe of contamination was attributed to the area of former lagoon 1, which was backfilled in 1984.
1995	In 1995, a groundwater recovery system consisting of three wells was installed on the north plateau to extract and treat the strontium-90-contaminated groundwater. In 1999, a pilot-scale permeable treatment wall (PTW) was constructed to test this passive in-situ remediation technology. The VIT building shielding was installed in 1991, the slurry-fed ceramic melter was assembled in 1993, and the remaining major components were installed and tested by the end of 1994. In 1995, the Vitrification Facility (VF) was completed, fully tested, and "cold operations" began.

TABLE INT-1 *(continued)*
Historic Timeline of the WNYNSC and the WVDP

Year	*Activity*
1996	The DOE and NYSERDA issued a draft EIS (DEIS) for completion of the WVDP and closure or long-term management of the WNYNSC. Following evaluation of the public comments on the DEIS, the Citizen Task Force was convened to enhance stakeholder understanding and input regarding the WVDP/WNYNSC closure process. VIT operations began in 1996 and continued into 2002, producing 275 ten-foot-tall stainless-steel canisters of hardened radioactive glass containing 16.1 million curies of radioactive material, primarily cesium and strontium, with the radioactivity from daughter products included (decay corrected to January 1, 2014, WVNS-CAL-396). The VIT melter was shut down in September 2002. NYSDEC and DOE entered into an Order on Consent negotiated under the Federal Facilities Compliance Act (FFCA) for handling, storage, and treatment of mixed wastes at the WVDP. The Seneca Nation of Indians Cooperative Agreement was signed in 1996 to foster government-to-government relationships between the Seneca Nation and the U.S. government, as represented by DOE.
1999	VIT expended materials processing was initiated to begin processing unserviceable equipment from the VF. This success helped in developing a remote-handled waste facility (RHWF) to process large-scale, highly contaminated equipment excessed during decontamination and decommissioning (D&D) activities.
2000	Restructuring of the work force and construction of the RHWF began.
2001	The 125 spent fuel assemblies that remained in storage at the WVDP since 1975 were prepared for transport to the Idaho National Engineering and Environmental Laboratory (INEEL). Initial decontamination efforts began in two significantly contaminated areas in the MPPB, the process mechanical cell and the general purpose cell, to place the cells in a safer configuration for future facility decommissioning. DOE published formal notice in 66 FR 16447 to split the EIS process into (1) the WVDP Waste Management EIS, and (2) the Decommissioning and/or Long-Term Stewardship EIS at the WVDP and the WNYNSC.
2002	NRC issued "Decommissioning Criteria for the West Valley Demonstration Project (M-32) at the West Valley Site; Final Policy Statement" (67 FR 5003).
2003	The remaining 125 spent fuel assemblies were shipped to INEEL, allowing for decontamination of the FRS to begin.
2004	The RHWF became operational. Major decontamination efforts continued and site footprint reduction began as 20 office trailers were removed. In December, the 6 NYCRR Part 373-2 Permit Application (i.e., Part B) was submitted to NYSDEC.
2005	In June, the DOE published its final decision on the "WVDP Waste Management Environmental Impact Statement (68 FR 26587)." The DOE implemented the preferred alternative for the management of LLW and mixed LLW. The decision on transuranic (TRU) waste was deferred, and the canisters of vitrified HLW will remain in on-site storage until they can be shipped to a repository. In November, the WVDP was downgraded to a Category 3 nuclear facility, marking the first time in the site's history that it has been designated the least of the three DOE nuclear facility designations. The categorization is based on amounts, types, and configuration of the nuclear materials stored and their potential risks.
2006	An EA (DOE/EA-1552) evaluating the proposed decontamination, demolition, and removal of 36 facilities was issued. By the end of 2006, 11 of the 36 structures were removed. The DOE-WVDP office initiated a collaborative, consensus-based team process, referred to as the "Core Team," that involved DOE, NYSERDA, EPA, the New York State Department of Health (NYSDOH), NRC, NYSDEC, and later West Valley Environmental Services, LLC (WVES). This team brought individuals with decisionmaking authority together to resolve challenging issues surrounding the WVDP EIS process and to make recommendations to move the Project toward an "Interim End-State" prior to issuance of the "Final EIS for the Decommissioning and/or Long-Term Stewardship at the WVDP and the WNYNSC." Shipment of the cement-filled LLW drums was initiated.
2007	Demolition and removal of four more structures identified under DOE/EA-1552 was completed. On June 29, 2007, DOE awarded WVES a four-year contract (Contract DE-AC30-07CC30000) to conduct the next phase of cleanup operations at the WVDP. The remaining drums of cemented LLW in the drum cell were packaged and shipped to the Nevada Test Site for disposal. In the fall of 2007, an Interim Measure (IM) to minimize water infiltration into the NDA was initiated with site surveys and soil borings.

TABLE INT-1 *(continued)*
Historic Timeline of the WNYNSC and the WVDP

Year	*Activity*
2008	During 2008, a trench was excavated along two sides of the NDA, on the south plateau. The trench was backfilled with bentonite and soil to form a slurry wall, a low-permeability subsurface barrier to infiltration. A geomembrane cover was placed over the entire landfill. On the north plateau, additional subsurface soil and groundwater samples were collected in the summer and fall of 2008 to further characterize chemical and radiological constituents within the contaminated groundwater plume beneath and downgradient of the MPPB. The revised DEIS for Decommissioning and/or Long-Term Stewardship at the WVDP and WNYNSC was issued in December for public review, which continued through September 8, 2009. Concurrently, the Proposed Phase 1 Decommissioning Plan (DP) for the WVDP was prepared and submitted to NRC.
2009	Extensive characterization was completed on the north plateau in 2009 to delineate the leading edge of the subsurface strontium-90 groundwater plume and to find a suitable material to capture and retain the contamination.
2010	In January, DOE and NYSERDA issued the final EIS (FEIS) for the WVDP and the WNYNSC (DOE/EIS-0226). The phased decisionmaking alternative was selected as the preferred alternative. The phase 2 decision was deferred for no more than 10 years. In February, NRC issued a Technical Evaluation Report (TER) for the DP, concluding that the DP was consistent with the preferred alternative in the EIS. A SEQR notice of completion for the EIS and its acceptance by NYSERDA was issued on January 27, 2010. On April 14, 2010, DOE issued the Record of Decision (ROD) for the EIS, and on May 12, NYSERDA issued a SEQR Findings Statement, selecting the phased decisionmaking alternative. On August 17, 2010, DOE and NYSERDA reached an agreement and signed a Consent Decree that formally defined the cost sharing for cleanup of the WVDP and the WNYNSC. In September 2010, a revised RCRA Part 373-2 Permit Application was submitted to NYSDEC. An 860-foot-long full-scale PTW near the leading edge of the strontium-90 plume was installed and completed. The Tank and Vault Drying System (T&VDS) was installed to reduce the harmful effects of corrosion on the underground waste tanks. MPPB cell decontamination and deactivation activities continued.
2011	DOE awarded the Phase 1 Decommissioning and Facility Disposition contract to CH2M HILL • B&W West Valley, LLC (CHBWV) on June 29, 2011. The "continuity of contract" period extended to August 29, 2011 during which time work activities were transitioned, environmental monitoring continued, and licenses and permits were transferred to CHBWV. A separate contract was awarded to Safety and Ecology Corporation to implement work associated with the Phase 1 characterization support services, which are requirements of the Phase 1 DP. In September 2011, DOE and NYSERDA jointly awarded a Phase 1 Studies contract to Enviro Compliance Solutions to identify and implement the Phase 1 Studies. The objective of the studies is to use technical experts to conduct scientific studies that will facilitate interagency consensus for decisionmaking in the Phase 2 decommissioning process.
2012	Work continued on the Phase 1 Decommissioning Facilities Disposition Contract, including design of the HLW Canister Interim Storage System, continued legacy waste shipment, preparation for demolition of the MPPB and VF, and demolition of nonradiological Balance of Site Facilities (BOSF). Demolition of the nonradiologically contaminated portions of the 01-14 building began in 2012. DOE issued a final Waste Incidental to Reprocessing (WIR) evaluation for the VIT melter in February 2012, determining that this vessel is LLW incidental to reprocessing and therefore may be managed under DOE's authority in accordance with the requirements of LLW. Phase 1 Studies teams of Subject Matter Experts (SMEs) continued development of recommendations for the identified areas of study. Environmental characterization of surface soils and soil excavations performed in 2012 included characterization of two reference areas, the HLW Canister Interim Storage System area, and two building footprints following demolition.

TABLE INT-1 *(concluded)*
Historic Timeline of the WNYNSC and the WVDP

Year	*Activity*
2013	Demolition of seven buildings was completed in 2013, including demolition of the radiologically contaminated portions of the 01-14 building. The HLW Cask Storage Pad was constructed and eight Vertical Storage Casks (VSCs) were fabricated. The site's existing inventory of legacy LLW and mixed low-level waste (MLLW) was reduced by 50% from the start of the CHBWV contract as a result of off-site shipments. Preparations continued for canister relocation and demolition of the MPPB and VF. A request for EPA approval was prepared for a new MPPB ventilation system. The off-site ambient air monitoring network was in service for a full year in 2013. DOE issued a WIR for the Concentrator Feed Makeup Tank (CFMT) and Melter Feed Hold Tank (MFHT) in February 2013 and began planning for off-site shipment of these vessels and the VIT melter. Phase 1 Studies to support the Phase 2 decision continued in 2013. Environmental characterization activities continued in 2013 and included collection of soil samples and radiological ground surface surveys.
2014	The WVDP was identified as one of DOE's safest sites in 2014 and CHBWV earned the DOE-Voluntary Protection Program (VPP) STAR of Excellence for safe work practices. Preparation for HLW canister relocation continued in 2014, with fabrication of eight additional VSCs, development of a canister decontamination process, procurement of custom designed heavy equipment to move the canister-loaded casks from the MPPB to the HLW Cask Storage Pad, and modifications to the rooms in the MPPB that will be used during the transfer. The Con-Ed and T-FS-04 buildings were demolished. Deactivation and hazard reduction continued inside the MPPB. Debris removal and gross decontamination of the VF was completed in preparation for demolition. The potable water supply system was changed over from a surface water source to a groundwater source. EPA conditionally approved construction of a new MPPB ventilation system in April 2014 (with final approval in March 2015). EPA approved use of the ambient air data to demonstrate compliance with air emissions standards for 2014. A transportation safety analysis report for off-site shipment of the VIT melter was submitted to NRC. Extensive repairs to the lakes and dams were made followed by site restoration.
2015	The first 20 canisters of HLW were safely removed from the MPPB and placed in VSCs. The first four VSCs were relocated to the HLW Cask Storage Pad on the south plateau. Prior to the HLW cask relocation, the final custom designed relocation equipment was received and operation readiness testing was completed. A dose rate cave was procured to obtain dose rates on the non-HLW drums stored in the Chemical Process Cell in order to remove and store the drums safely in preparation for MPPB demolition. A Replacement Ventilation System (RVS) for a portion of the MPPB was constructed, tested and put into operation in August 2015. An erosion control engineering project was completed to reroute the S09 storm water outfall discharge from the lagoon 3 embankment to the bottom of the hill at Franks Creek. The radiologically contaminated High Efficiency Particulate Air (HEPA) filters from the MPPB were shipped off site in 2015, achieving 100% reduction in the legacy MLLW. Deactivation and hazard reduction continued inside the MPPB and VF. The NRC issued a "Special Package Authorization (SPA)" for the VIT melter transportation package in 2015. Personnel were relocated from the Administration Building in order to prepare the building for demolition. Work began on a probabilistic performance assessment to support Phase 2 of the Phased Decisionmaking alternative for the WVDP and WNYNSC.
2016	Removal and relocation of the remaining canisters of HLW from the MPPB was safely completed. The canisters were loaded into a total of 56 VSCs, relocated on site, and safely stored on the WVDP interim HLW Cask Storage Pad by the end of Novermber 2016, approximately one year ahead of schedule. The CFMT, MFHT, and VIT melter were safely shipped to Waste Controls Specialists LLC (WCS), a long-term disposal facility in Andrews, Texas. They were buried in an underground waste cell at WCS before the end of CY 2016. Deactivation and hazard reduction continued inside the MPPB. Deactivation of the VF was nearly complete by the end of the year with planning in progress to begin demolition of the VF in CY 2017. Progress was made in the initial development of a conceptual site model for the probabilistic performance assessment, and additional Phase 1 study work was performed in 2016 to support Phase 2 decisionmaking.

ENVIRONMENTAL COMPLIANCE SUMMARY

Compliance Program

Activities at the WVDP are regulated by various federal and state, public, worker, and environmental protection laws. These laws are administered primarily by the EPA, DOE, NRC, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers (USACE), NYSDEC, NYSDOH, and New York State Department of Labor (NYSDOL) through programs and regulatory requirements for permitting, reporting, inspecting, self-monitoring, and auditing.

Table ECS-1 describes the WVDP's compliance status with applicable environmental statutes, DOE directives, executive orders (EOs), and state laws and regulations applicable to the Project activities.

Table ECS-2 presents a summary of the significant NEPA document history. An update of NEPA activities is provided later in this chapter.

EPA, NYSDEC, and DOE have established standards for effluents that are intended to protect human health, safety, and the environment. DOE applies to EPA for permits to release limited amounts of radiological constituents to the air and applies to NYSDEC for permits to release limited amounts of nonradiological constituents to the air and water, in concentrations determined to be safe for human health and the environment. In general, the permits describe release points, specify management and reporting requirements, list discharge limits on those pollutants likely to be present, and define the sampling and analysis regimen. Releases of radiological constituents in water are subject to the requirements in DOE Orders 458.1 (Radiation Protection of the Public and the Environment, Change 3) and DOE-STD-1196-2011 (Derived Concentration Standards [DCSs]). A summary of the WVDP environmental permits is found in Table ECS-3. (See the compliance tables at the end of this chapter.)

2016 Accomplishments and Highlights

WVDP Phase 1 Decommissioning and Facility Disposition activities began in August 2011. The term of the Phase 1 Decommissioning and Facility Disposition contract is from August 2011 to March 2020 and includes the following scope:

- packaging and relocating canisters of vitrified HLW from the MPPB to a new interim dry storage area;
- processing and shipping legacy waste;
- dismantling and removing the VF and the MPPB;
- removing ancillary facilities; and
- continuing safe operations of the site, including:
  - managing and maintaining site infrastructure;
  - conducting environmental monitoring;
  - maintaining the waste tank farm (WTF), the NDA, and the north plateau PTW; and
  - maintaining the lagoon system.

2016 Major Accomplishments. Major accomplishments towards achieving Phase 1 Decommissioning and Facility Disposition included the following:

- completed relocation of the vitrified HLW to the interim HLW Cask Storage Pad on the WVDP south plateau;

Vertical Storage Casks (VSC) relocation completed

- moved 92 of the remaining 144 containers of non-HLW from the former MPPB Chemical Process Cell (CPC) into alternate storage in 2016 using custom designed highly shielded packaging to prepare the MPPB for demolition;

- packaged and shipped additional waste to reach a 54% reduction in the site legacy LLW in existence at the beginning of the CHBWV contract;

- shipped three large LLW components used in the vitrification process, including the melter, to a permanent disposal site in Andrews, Texas;

- continued decontamination, deactivation and characterization activities in the VF;

Debris removal in the Vitrification Facility (VF)

- continued to perform characterization and hazard reduction activities to prepare the MPPB for demolition including:
  - piping, miscellaneous equipment, and debris removal;
  - liquid removal from three tanks in the Uranium Process Cell (UPC);
  - liquid removal from the last of the nine tanks in the Liquid Waste Cell (LWC);
  - continued asbestos abatement; and
  - filter removal from the Head End Ventilation (HEV) system that was shut down in December 2015 and is now ventilated by a replacement system, and

- operated the off-site ambient air monitoring network for a fourth full year, and used this data to estimate potential dose to the public from the airborne pathway.

Continuing Operations

State Pollutant Discharge Elimination System (SPDES) Permit Noncompliance Events. During calendar year (CY) 2016, all SPDES discharges were within applicable SPDES permit limits.

Permeable Treatment Wall (PTW) Performance. By the end of CY 2016, the full-scale PTW, installed in November 2010, had been monitored for six years. Performance monitoring data collected to date, including the comprehensive data collected in 2016 for the five-year monitoring event, continue to indicate groundwater treatment by ion exchange is occurring, and the ongoing processes within the PTW continue to achieve the remedial action objectives and the functional requirements of the PTW defined in the PTW Performance Monitoring Plan. (Additional discussion of the PTW is provided in Chapter 4 of this report.)

Waste Tank Farm (WTF) and the Tank and Vault Drying System (T&VDS). The T&VDS, installed in 2010 with an ultimate goal of preventing the underground steel tanks from corroding, continued to operate effectively during 2016, maintaining dry conditions in tanks 8D-1, 8D-2 and 8D-3, and reducing the residual liquid in tank 8D-4 by 78 gal (295 L). At the end of CY 2016, 4,542 gal (17,193 L) remained in tank 8D-4. The system also continued to maintain the dry condition of the vaults to below liquid level indicators.

Packaging and Transportation of Radioactive Material. Prior to shipment, an impact limiter was installed on the outside of the VIT melter package to stabilize this 195 ton waste package during transport, which was conducted mostly by rail. Preparation for shipment of the VIT melter and the two additional oversized LLW packages, each containing a large tank from the VIT system, began in 2013.

Vitrification (VIT) component shipment

National Environmental Policy Act (NEPA)

NEPA requires DOE to consider the overall environmental effects of its proposed actions. Evaluations are performed to assess potential environmental effects associated with proposed Project activities. The level of evaluation and documentation depends upon whether the action constitutes a major federal action significantly affecting the quality of the human environment within the meaning of NEPA.

The categories of documentation include categorical exclusion (CX), environmental assessment (EA), and environmental impact statement (EIS). Categorical Exclusions (CXs) describe actions that will not have a significant effect on the environment. EAs are used to evaluate the extent to which a proposed action, not categorically excluded, will affect the environment. Based on the analyses presented in an EA and considering regulatory agency, stakeholder, and public comments, DOE may determine that a proposed action is not a major federal action significantly affecting the quality of the human environment within the meaning of NEPA. Consequently, DOE may issue a notice indicating the finding of no significant impact (FONSI) and therefore would not require the preparation of an EIS.

If a proposed action has potential for significant environmental effects, an EIS would be prepared that describes proposed alternatives to an action and explains the effects of each. Based on the analyses presented, and considering regulatory agency and public input, DOE will determine the preferred alternative and issue a ROD regarding the action.

Since the Project began, a number of proposed site activities have warranted environmental impact evaluations. A summary of the significant NEPA document history is presented in Table ECS-2. WVDP CXs, EAs, and EISs can be found on the DOE-WVDP website under the documents index (www.wv.doe.gov/index.html).

Environmental Impact Statement (EIS) Issued. On April 14, 2010, DOE issued the ROD for the EIS, "Decommissioning and/or Long-Term Stewardship at the WVDP and the WNYNSC" (DOE/EIS-0226), selecting the phased decision-making alternative. Decommissioning the MPPB and the VF, which continued in 2016, is part of the Phase 1 EIS work. DOE will also decommission the RHWF, the wastewater treatment lagoons, and a number of other facilities during Phase 1 (see Figure ECS-1). No decommissioning actions will be taken on the WTF or the NDA, during Phase 1 and the canisters of vitrified HLW will remain safely stored on site. NYSERDA will manage the SDA. Phase 1 was originally estimated to take up to 10 years, during which time DOE will manage the site's remaining facilities in a safe manner.

The EIS ROD indicates that the Phase 2 decision, which involves determining the decommissioning approach for the remaining facilities (e.g., the two inactive radioactive waste disposal facilities on the south plateau and the underground waste storage tanks), will be made within 10 years of issuance of the EIS ROD. DOE and NYSERDA are currently conducting additional scientific studies (i.e., Phase 1 Studies) to facilitate interagency consensus on decommissioning decisions for the remaining facilities.

DOE and NYSERDA have committed to jointly complete the following activities to reach a Phase 2 decommissioning decision by 2020:

- Supplemental EIS (2017-2020);
- Probabilistic Performance Assessment (2016-2018); and
- Phase 1 Studies (2011-2018).

Supplemental Environmental Impact Statement (EIS). In April 2017, DOE awarded a contract to SC&A, Inc. that includes preparation of the Supplemental EIS to support the Phase 2 decisions for the WVDP and WNYNSC including the underground storage tanks, the NDA and SDA disposal areas, and the non-source areas of the strontium-90 plume. Decommissioning Plan (DP) documents that are consistent with the preferred alternative in the Supplemental EIS ROD and NYSERDA Findings Statement will also be prepared under this contract.

Probabilistic Performance Assessment. DOE and NYSERDA awarded a contract to Neptune and Company, Inc. in September 2015 to perform a probabilistic performance assessment. The work performed under the contract includes the following three elements:

- perform sensitivity analyses to provide near-term direction to site data collection activities,

- prepare the long term probabilistic performance assessment to support decision making and meet requirements of NEPA and SEQR, and

- prepare chapters and appendices for the Supplemental EIS as required by the Supplemental EIS contractor.

In 2016, a probabilistic model was still under development. It will be used to evaluate potential decommissioning approaches (e.g. source area removal, engineered barrier designs, etc.) and potential dose from various Phase 2 closure alternative concepts.

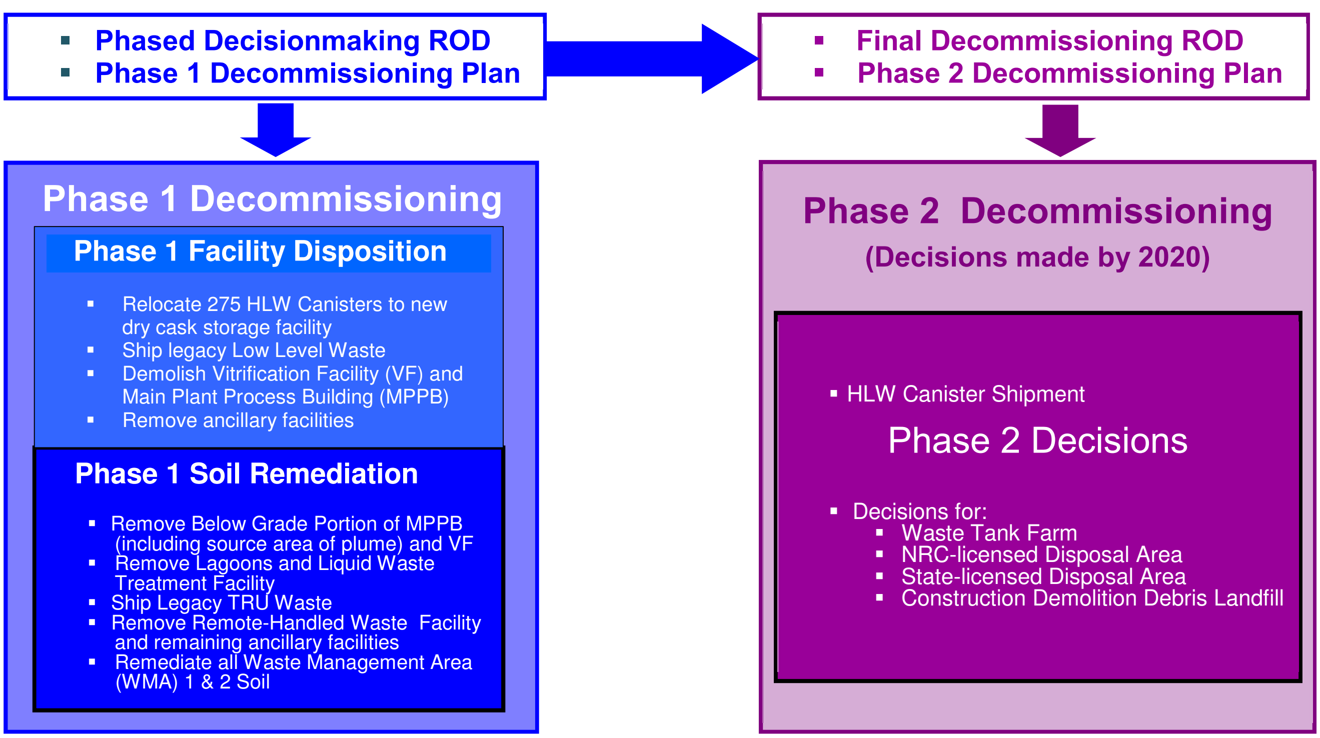
Phase 1 Studies. In September 2011, DOE and NYSERDA jointly awarded the Phase 1 Studies contract to Enviro Compliance Solutions, Inc., an independent, agency-neutral contractor that is jointly funded by DOE and NYSERDA to administer contracts for all Phase 1 Study activities, including contracting with subject matter experts (SMEs), the Independent Scientific Panel (ISP), and contractors performing the study activities. This contract was renewed in March 2013. The purpose of the Phase 1 studies is to enable the agencies to make informed decisions for Phase 2 decommissioning and/or long-term stewardship of the landfills and buried tanks at the WVDP. Future erosion processes and buried waste inventories need to be estimated with sufficient confidence and with sufficient understanding of the uncertainties involved in order to make these decisions.

Significant work was performed under this contract by the Erosion Working Group (EWG) in 2016. Terrain analysis, age dating, paleoclimate, and recent erosion and deposition processes were studied to recreate the erosion history of the WNYNSC since the end of the ice age approximately 14,000 years ago. This information contributes to the confidence factor in the predictive erosion models used to evaluate potential closure alternatives. The Exhumation Working Group (EXWG) published updated radionuclide inventory estimates for the disposal areas and WTF in 2016. The EXWG also completed geophysical field studies of the buried waste to attempt to ascertain the location and depths of wastes and liquid levels in the waste disposal trenches. These studies will be used to evaluate potential future exhumation alternatives at the WVDP and WNYNSC, to evaluate and potentially reduce the associated risk uncertainty, and to assist the agencies in reaching consensus on alternatives eventually selected for the Supplemental EIS analysis.

Phase 1 Decommissioning Plan (DP) for the WVDP. On December 5, 2008, the DOE issued the "Phase 1 Decommissioning Plan for the West Valley Demonstration Project, West Valley, NY" (73 Federal Register 74162) and transmitted it for NRC review. The DP addressed Phase 1 of the proposed two-phased approach for WVDP decommissioning, consistent with the preferred alternative selected in the ROD and the Findings Statement for the WVDP and the WNYNSC. On December 18, 2009, DOE submitted revision 2 of the Phase 1 DP after incorporating responses to NRC's comments.

On February 25, 2010, NRC transmitted to DOE-WVDP the Technical Evaluation Report (TER) for the Phase 1 DP, concluding that the Phase 1 DP was consistent with the preferred alternative in the EIS. NRC also determined that there is reasonable assurance that the proposed Phase 1 actions will meet the decommissioning criteria.

FIGURE ECS-1
Summary of Activities Under Phase 1 and Phase 2



Phase 1 Characterization Sampling and Analysis Plan (CSAP) and the Phase 1 Final Status Survey Plan (FSSP) for the WVDP. The Phase 1 DP required the preparation of two supplemental documents, the CSAP and the FSSP. These two documents provide the specific details of sampling activities to support Phase 1 decommissioning of the WVDP. The CSAP describes the radiological environmental data collection activities (surface and subsurface soils, sediments, and groundwater) that will specifically support the implementation of the Phase 1 decommissioning actions within the WVDP premises as described in the Phase 1 DP.

The FSSP provides the technical basis and sampling protocols to demonstrate that specific portions of the WVDP premises meet the Phase 1 radiological cleanup goals for surface and subsurface soils identified in the Phase 1 DP. The FSSP is consistent with the Multi-Agency Radiation Survey and Site Investigation Manual.

WVDP VF and MPPB Decommissioning and Demolition Plans. The Phase 1 DP required preparation of a work plan for the decommissioning and demolition of the VF and the MPPB. In July 2016, the WVDP transmitted to NRC the VF decommissioning and demolition plan. The NRC provided comments on the plan which the WVDP responded to in January 2017.

Vitrification Facility (VF)

Main Plant Process Building (MPPB)

Resource Conservation and Recovery Act (RCRA)

RCRA and its implementing regulations govern the life cycle of hazardous waste from “cradle-to-grave” and mandate that generators take responsibility for ensuring the proper treatment, storage, and ultimate disposal of their wastes. A hazardous waste permit is required for facilities that store large quantities of hazardous waste for more than 90 days or treat and/or dispose of hazardous waste at the facility.

EPA is responsible for issuing guidelines and regulations for the proper management of solid and hazardous waste (including mixed [radioactive and hazardous] waste). In New York, EPA has delegated the authority to issue permits and enforce these regulations to NYSDEC. In addition, the U.S. Department of Transportation is responsible for issuing guidelines and regulations for labeling, packaging, and spill reporting for hazardous and mixed wastes while in transit.

Hazardous Waste Permitting - RCRA Interim Status Permit Application. In 1984, DOE notified EPA of hazardous waste activities at the WVDP and identified DOE as a hazardous waste generator. In 1990, to comply with 6 NYCRR Part 373-3, a RCRA Part A (i.e., Interim Status or Part A) Permit Application for the WVDP was filed with NYSDEC for storage and treatment of hazardous waste. The WVDP has operated under interim status ever since. RCRA facility operations are limited to those described in the RCRA Part A Permit Application and must comply with the interim status regulations; therefore, the RCRA Part A Permit Application must be revised prior to changes to the Project’s RCRA waste management operations. The latest revisions to the RCRA Part A Permit Application were submitted to NYSDEC on April 27, 2011 and were conditionally approved by NYSDEC on June 9, 2011.

In accordance with the Part A requirements, DOE prepared closure plans for the hazardous waste management units at the WVDP. The closure plans were transmitted to NYSDEC in anticipation of closure activities, and are revised as appropriate to address NYSDEC comments or changes in activities. To complete closure of a RCRA unit, waste is removed, and impacted areas and facilities are decontaminated and/or removed. When specified in the closure plan, confirmatory sampling and analysis are performed, and data are evaluated and presented to NYSDEC in a closure certification report to document completion of closure activities.

During 2016, RCRA closure plans for the VF and for the Interim Status RCRA Treatment and Storage Units located within the MPPB were revised to be consistent with their respective demolition plans and with the Facilities Disposition contract end state.

RCRA Final Status Permit Application. In 2003, NYSDEC officially requested the submittal of a 6 NYCRR Part 373-2 Permit Application (i.e., Part B) for the WVDP. The completed permit application was transmitted to NYSDEC in December 2004. On April 16, 2009, NYSDEC officially requested the submittal of a revised Part B Permit Application for the WVDP. The revised permit application was submitted to NYSDEC on September 30, 2010. Due to the scope and breadth of the permit application, DOE and NYSERDA agreed to NYSDEC's request for an indefinite suspension of NYSDEC's completeness review in January 2011.

On March 22, 2012, NYSDEC notified NYSERDA and DOE that they would suspend further action relative to a Part B Permit. The site will continue to operate according to the 6 NYCRR Part 373-3, Part A (Interim Status) Permit Application and the RCRA 3008(h) Administrative Order on Consent.

RCRA §3008(h) Administrative Order on Consent (Consent Order). Section §3008(h) of RCRA authorizes EPA to issue an order requiring corrective action to protect human health and the environment from a release of hazardous waste or hazardous constituents to the environment from a Solid Waste Management Unit (SWMU). DOE and NYSERDA entered into the Consent Order with NYSDEC and EPA in March 1992. Consent Order activities performed to date are summarized below.

- RCRA Facility Investigation (RFI)

The Consent Order required NYSERDA and DOE's WVDP office to conduct RFIs (unit-specific environmental investigations) at SWMUs to determine if a release occurred or if there was a potential for release of RCRA-regulated hazardous constituents from a SWMU. As many SWMUs are contiguous or close together, most were grouped into larger units, called super SWMUs (SSWMUs), terminology unique to the WVDP. SSWMU descriptions and the individual constituent SWMUs are presented in Table ECS-4. Figures A-9 and A-10 in Appendix A show the WVDP SSWMU locations. Final RFI reports were submitted in 1997, completing the Consent Order investigative activities. No corrective actions were required at that time. Groundwater monitoring, as recommended in the RFI reports and approved by EPA and NYSDEC, continued during 2016 per the Consent Order requirements. The groundwater program and monitoring results at the WVDP are discussed in Chapter 4, "Groundwater Protection Program."

- Current Conditions Report

Per a NYSDEC request, the report entitled "WVDP Solid Waste Management Unit Assessment and Current Conditions Report" was submitted in November 2004. The report summarized the historic activities at each SWMU through the RFI activities and provided environmental monitoring data and information on SWMU activities performed since the RFI reports were submitted.

This document was revised and again submitted to NYSDEC and EPA in September 2010, incorporating operational status changes of each SWMU and providing updated environmental monitoring data.

- Corrective Measures Studies (CMSs)

  In 2004, NYSDEC requested CMSs to be performed on six specific SWMUs at the WVDP. The six SWMUs were:
  - NDA Burial Area (SWMU #2);
  - NDA Interceptor Trench (SWMU #23);
  - Demineralizer Sludge Ponds (SWMU #5);
  - Lagoon 1 (SWMU #3);
  - Construction and Demolition Debris Landfill (CDDL) (SWMU #1); and
  - The Low-Level Waste Treatment Facility (LLWTF) (SWMUs #17, #17a, and #17b).

  The CMS Work Plan was conditionally approved by NYSDEC in October 2006. Draft CMS reports were revised in 2010 to be consistent with the EIS and ROD and provide corrective measures evaluations. The revised documents were submitted to NYSDEC and EPA in September 2010.

- Interim Measures (IMs)

The NDA (SSWMU #9) is regulated under the Consent Order. In 1990, an IM was implemented that involved construction of a trench system through the weathered Lavery till along the northeast and northwest sides of the NDA to intercept and collect groundwater contaminated with a mixture of n-dodecane and tributyl phosphate (TBP). The IM has been effective. No TBP or organic constituents were detected in the groundwater from the NDA interceptor trench in 2016.

NRC-Licensed Disposal Area (NDA)

In 2008 DOE implemented a second IM for the NDA designed to minimize the potential release of impacted groundwater from the NDA, and minimize water infiltration into the NDA until the final disposition of the NDA is determined and can be implemented. An approximately 850 foot long low permeability slurry wall was constructed along the south and western sides of the NDA to limit lateral groundwater migration. In order to meet the IM requirements to ensure a minimum four foot thick earthen cap, the project also involved resurfacing the entire five acre (2 ha) landfill with additional soils, and re-grading, compacting, and applying an impermeable geomembrane cover. As a result of this IM, the volume of water pumped from the NDA interceptor trench has decreased significantly, to 71,611 gal (271,077 L) in CY 2016, compared with pre-IM volumes of several hundred thousand gallons per year. Refer to Chapter 4, "Groundwater Protection Program."

In August 2016, the entire NDA cap was inspected, including storm water basins, walkways, ballast tubes, field seams, pipe penetrations, and the anchor trench. The need for repair of one patch was observed; however, the overall cap condition was good, with no general deterioration of the geomembrane noted. The patch will be repaired in 2017.

- Quarterly Reporting to EPA and NYSDEC

Per the Consent Order, DOE transmits a quarterly progress report to EPA and NYSDEC, summarizing all Consent Order activities at the WVDP for the previous quarter. The report includes progress and accomplishments, contacts with local community interest groups and regulatory agencies pertaining to Consent Order activities at the WVDP, changes to personnel, projected future work activities, and an inventory of mixed waste generated from decontamination activities during the reporting period. The other report submitted quarterly to EPA and NYSDEC under the Consent Order is the groundwater exception report, a summary of RCRA groundwater monitoring results that exceed established trigger levels. The trigger levels are statistically derived from historical results, are based on regulatory criteria, or are based on analytical detection limits. This report includes NDA water level data that demonstrate the performance of the interceptor trench, cap, and slurry wall.

Hazardous Waste Management. Under RCRA, hazardous wastes at the WVDP are managed in accordance with 6 NYCRR Parts 370-374 and 376. Hazardous and mixed waste activities are reported to NYSDEC in the WVDP's Annual Hazardous Waste Report, which specifies the quantities of waste generated, treated, and/or disposed of, and identifies the treatment, storage, and disposal facilities used. The Annual Hazardous Waste Report for 2016 was submitted to NYSDEC in February 2017.

Additional reports are submitted each year to document hazardous waste reduction efforts. Pursuant to Article 27, Section 0908 of New York State Environmental Conservation Law, an update of the WVDP's Hazardous Waste Reduction Plan must be submitted to NYSDEC biennially. An annual status report (an abbreviated version of the biennial update) must be submitted in the interim years. The plan is updated to reflect changes in the types and amounts of hazardous wastes generated at the WVDP. The biennial update for CY 2015 was submitted to NYSDEC in June 2016. The annual status report for the Hazardous Waste Reduction Plan for CY 2016 was submitted to NYSDEC in June 2017.

Mixed Waste Management. Mixed wastes that cannot be treated or disposed of within one year are managed according to the Site Treatment Plan (STP), prepared by the DOE under requirements of the Federal Facilities Compliance Act (FFCA) (an amendment to RCRA), in accordance with a Consent Order agreement. The annually updated plan describes the development of treatment capabilities and technologies for treating mixed waste and updates the mixed waste inventory. The fiscal year (FY) 2016 plan identified two proposed milestones for waste streams managed under the WVDP STP. The first STP milestone involved the treatment and disposal of the liquid MLLW drained from two tanks in the MPPB in 2016. Disposal of this waste is scheduled to be completed by the end of FY 2017. The second milestone required the development of a plan by the end of FY 2017 for disposition of the high activity waste in tank 8D-4.

During 2016, 5,465 pounds (lbs) (2.73 tons) of hazardous and mixed waste were shipped off site for disposal. (See Table ECS-5.)

Nonhazardous, Regulated Waste Management. Nonradioactive, nonhazardous material was also shipped off site to solid waste management facilities in 2016. Certain components of this waste (lead-acid batteries and spent lamps [i.e., universal wastes]) were reclaimed or recycled at off-site, authorized reclamation and recycling facilities. (See Table ECS-5.) Discharge of treated industrial wastewater to Erdman Brook was discontinued in November 2014. With the transfer from surface water to groundwater for a water supply in late September 2014, the generation of several nonradiological wastewater streams was eliminated and routine discharges ceased. Sanitary wastewaters are shipped to the Buffalo Sewer Authority, to the Gowanda Sewage Treatment Plant, or to the Arcade Sewage Treatment Plant for treatment and disposal. (See Table ECS-5.)

Waste Minimization and Pollution Prevention. The annual pollution prevention progress report was submitted to DOE summarizing information for the pollution prevention tracking and reporting system. Reports are submitted to DOE and NYSDEC to document waste reduction efforts.

Construction and Demolition Debris Landfill (CDDL) Activities. The CDDL was closed in 1986 under a NYSDEC-approved closure plan for a nonradioactive solid waste disposal facility. The overall condition of the CDDL grounds were inspected in 2016, with no concerns noted. Over time, the north plateau strontium-90 plume has migrated from the MPPB into the CDDL area and beyond. In 2010, a full-scale PTW was installed south of the CDDL. Construction of the PTW did not impact the CDDL. See "Strontium-90 Plume Remediation Activities" in Chapter 4.

National Emission Standards for Hazardous Air Pollutants (NESHAP) Compliance

NESHAP regulations in Title 40 Code of Federal Regulations (CFR) Part 61, Subpart H allow for use of two alternate methods of demonstrating compliance, either (1) the "measure and model" approach which involves measuring radiological emissions in air released from point sources (such as stack effluents) and using EPA-approved computer models to estimate dose to the maximally exposed off-site individual (MEOSI), or (2) the "environmental measurement" approach which involves measuring environmental concentrations (ambient monitoring) of airborne radionuclides at ambient air monitoring locations. Historically, NESHAP compliance at the WVDP was demonstrated using the "measure and model" approach. Resulting dose estimates for the WVDP using this method have always been far below the 10-millirem (mrem)/year EPA compliance standard. As WVDP facilities continue to be decommissioned or demolished, the alternative approach of using environmental air sampling data to demonstrate compliance has become the more appropriate method.

In the fall of 2012, an ambient air monitoring network was installed surrounding the WVDP consisting of 16 low-volume sampling stations (one for each of the 16 compass sectors) and one high-volume sampler (which can measure lower concentrations) in the sector most often identified as having the maximum estimated dose. Baseline monitoring was performed in October 2012. Routine ambient air network monitoring began in 2013 and continued through 2016. These sampling results are discussed in Chapter 2, "Environmental Monitoring," and are tabulated in Appendix C.

With EPA approval (received July 2015), the method of demonstrating NESHAP compliance was changed to the "environmental measurement" approach for the 2014 annual NESHAP report. The EPA approval was founded on the results of a one-year period of using both the "measure and model" and the "environmental measurement" approach to demonstrate equivalency and confirm compliance in 2013, demonstrating that either method could reliably be used to confirm compliance with air emissions regulations. The ambient air monitoring network data has been used to demonstrate NESHAP compliance since CY 2014. (See additional discussion in Chapter 3, "Dose Assessment.")

In preparation for upcoming WVDP demolition activities, DOE and its subcontractors developed an alternative radiological source term calculation methodology to estimate potential emissions from future planned demolition activities as allowed for by 40 CFR Part 61.96(b). This methodology was presented to EPA in February 2016. The WVDP received conditional approval from EPA in May 2016 for use of this methodology to support VF demolition that requires performing a study during demolition of the VF to demonstrate that the alternate source term calculation methodology does not underestimate airborne emissions.

Environmental Issues

Unplanned Releases. There were no unplanned waterborne or airborne releases of radiological or nonradiological constituents from the WVDP in 2016.

Safety Inspections of the WNYNSC Dams. The two dams located on the WNYNSC property are maintained to provide backup fire-suppression water and SPDES discharge flow augmentation water for the WVDP. The WVDP rail spur and an access roadway are located parallel to the lakes and run along the crest of both dams. A severe rain event in August 2009 caused flood damage to areas of the lakes, dams, and spillway. Since this event, the standard operating procedure for maintenance, inspection, and operation of the dams and spillway was enhanced. Repairs to the Lake 1 spillway and repairs to the Lake 2 dam from the 2009 flood damage were completed during CY 2014. However, new damage to the spillway occurred in 2015 from a significant rainfall over a short time period. Clean-up of the 2015 storm damage and temporary repairs were made in 2016.

In response to a request from the NYSDEC, the WVDP, with support from the USACE, prepared and submitted a proposed long-term plan for the reservoirs, dams, and spillway in February 2016, with revisions in March and July 2016. The overall long-term plan is to phase out the need to withdraw water from the reservoir system. The plan requires the development of an end state for the reservoir system once the reservoirs are no longer needed. DOE will continue to maintain the reservoir system in a safe configuration until the final disposition for the reservoir system has been approved.

Project Assessment Activities in 2016

Throughout CY 2016, assessments were conducted through the Integrated Assessment Program (IAP) at the WVDP. This program effectively complies with applicable DOE directives, regulations, and standards, and Integrated Safety Management System (ISMS) and Environmental Management System (EMS) requirements. The IAP applies to all disciplines including, but not limited to, safety and health, operations, maintenance, environmental protection, quality, decontamination and decommissioning (D&D), HLW activities, emergency management, business processes, and management. Inspections, reviews, and oversight activities are routinely conducted to evaluate performance, reduce risk, and identify improvement opportunities. Overall assessment results reflected continuing, well-managed environmental programs at the WVDP. See "Evaluation of Compliance and Regulatory Requirements" in Chapter 1.

Compliance Summary

In conclusion, all activities performed at the WVDP during 2016 were conducted in full compliance with all federal and state environmental regulations and directives in a manner that was protective of the workers, the health and safety of the public, and of the environment.

TABLE ECS-1
Compliance Status Summary for the WVDP in 2016

Citation	***Environmental Statute, DOE Directive, EO, Agreement***	***WVDP Compliance Status***
42 United States Code (USC) §2011 et seq.	The **AEA** of 1954 was enacted to assure the proper management of source, special nuclear, and by-product materials. The AEA and the statutes that amended it delegate the control of nuclear energy primarily to DOE, NRC, and EPA.	See discussions of the WVDP Act, DOE Orders 435.1, and 458.1
Public Law 96-368	The **WVDP Act** of 1980 authorized DOE to carry out a HLW demonstration project at the WNYNSC (the Center) in West Valley, New York.	DOE is focusing on goals that will lead to completion of responsibilities listed in the WVDP Act.
Cooperative Agreement between DOE and NYSERDA	The **Cooperative Agreement** between DOE and NYSERDA established a cooperative framework for implementing the WVDP Act, effective October 1980, as amended in September 1981. In 1990, the first supplemental agreement was signed by DOE and NYSERDA which set forth specific provisions for preparing a joint EIS. A second supplemental agreement to the Cooperative Agreement was drafted in January 2010 and issued by DOE and NYSERDA in March 2011.	Except as delineated in specific sections of the agreement, DOE was given sole responsibility to carry out the requirements of the WVDP Act. The DOE ROD was issued in April 2010 for the WVDP. There are no current activities being conducted under the 1990 Supplemental Agreement. In accordance with the second supplemental agreement, Phase 1 studies continued in 2016, including field data collection supporting development of predictive erosion models by the EWG. The EXWG completed updating radionuclide inventories for the NDA, SDA and WTF, and continued evaluation of geophysical survey methods and development of soil studies.
WVDP MOU between DOE and NRC	The 1981 **MOU,** mandated by the WVDP Act, established procedures for review and consultation by NRC with respect to activities conducted at the WNYNSC by DOE. The agreement encompassed development, design, construction, operation, and D&D activities associated with the Project as described in the WVDP Act. Under the WVDP Act, and to satisfy commitments made to NRC, DOE was required to prepare a DP for the Project and submit it to NRC for review.	In 2002, NRC issued "Decommissioning Criteria for the WVDP (M-32) at the West Valley Site; Final Policy Statement" (67 FR 5003). The "Phase 1 DP for the West Valley Demonstration Project" was prepared by DOE and submitted to NRC in December 2008, and March and December, 2009. In February 2010, NRC issued a TER on DOE's Phase 1 DP. NRC conducted monitoring visits at the WVDP in March and August 2016. The NRC submitted comments on the WVDP VF decommissioning and demolition plan in September 2016.
DOE Order 231.1B	DOE Order 231.1B, **Environment, Safety, and Health Reporting (updated and approved on June 27, 2011 with Change 1 issued on November 28, 2012),** was issued to ensure that DOE and National Nuclear Security Administration receives timely and accurate information about events that could adversely affect *(continued on next page)*	This WVDP Annual Site Environmental Report (ASER) is prepared and submitted annually to DOE Headquarters (HQ), regulatory agencies, and interested stakeholders in compliance with DOE Order 231.1B.

TABLE ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	***Environmental Statute, DOE Directive, EO, Agreement***	***WVDP Compliance Status***
DOE Order 231.1B *(continued)*	the health, safety, and security of the public or workers, the environment, the operations of DOE facilities, or the credibility of the Department. This is accomplished through timely collection, reporting, analysis, and dissemination of data pertaining to environment, safety, and health issues as required by law or regulations, or in support of U.S. political commitments to the International Atomic Energy Agency (IAEA).	
DOE Order 458.1	DOE Order 458.1, **Radiation Protection of the Public and the Environment** (including Change 3, January 15, 2013), replaced DOE Order 5400.5 and established requirements to protect the public and environment against undue risk from radiation associated with radiological activities conducted under control of DOE pursuant to the AEA, by ensuring that: (1) operations are conducted to limit radiation exposure to members of the public pursuant to limits established in the Order, (2) radiological clearance of DOE real and personal property is controlled, (3) potential radiation exposures to members of the public are as low as reasonably achievable (ALARA), (4) routine and nonroutine releases are monitored and dose to the public is assessed, and (5) the environment is protected from the effects of radiation and radioactive material.	This ASER summarizes radiological estimates of dose to the public and the environment, and compares these values with release and dose standards established by this Order. In 2016, estimated doses from combined airborne and waterborne releases to the MEOSI were <0.50% of the DOE Order 458.1 100-millirem (mrem) standard.
DOE Order 435.1	DOE Order 435.1, **Radioactive Waste Management**, originally issued in 1999, with Change 1 issued in 2001, ensures that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety and the environment, and complies with applicable state, federal, and local laws and regulations. Under the Order, sites that manage radioactive waste are required to develop, document, implement, and maintain a site-wide radioactive waste management program which includes actions to minimize radioactive waste generation.	The WVDP maintains program documentation separately for each waste type. Management of HLW was conducted in accordance with the "WVDP Waste Acceptance Manual;" TRU waste was managed in accordance with the "TRU Waste Management Program Plan;" LLW was managed as summarized in the "LLW Management Program Plan;" and the radioactive component of mixed LLW was managed as summarized in the "Site Treatment Plan (STP) FY 2016 Update."

TABLE ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	***Environmental Statute, DOE Directive, EO, Agreement***	***WVDP Compliance Status***
DOE Order 436.1, and EOs 13423 and 13514	DOE Order 436.1, **Departmental Sustainability**, May 2, 2011 replaced DOE Orders 450.1A and 430.2B. The Order also incorporates the initiatives of EOs 13423 and 13514, which provide requirements and responsibilities for managing sustainability within DOE to (1) ensure the DOE carries out its missions in a sustainable manner that addresses national energy security and global environmental challenges, and advances sustainable, efficient and reliable energy for the future, (2) institute cultural change to factor sustainability and greenhouse gas (GHG) reductions into all DOE decisions, (3) ensure DOE achieves the sustainability goals established in its **Strategic Sustainability Performance Plan (SSPP)** pursuant to applicable laws, regulations, and EOs.	The WVDP supports the objectives of DOE Order 436.1, and has an established culture of environmental stewardship through its EMS. Pollution prevention, waste minimization, and energy efficiency have been incorporated into the culture through standard practices, procedures, training, and encouraging new ideas. In December 2016, DOE-WVDP submitted the "WVDP FY 2017 Site Sustainability Plan" to DOE-HQ, which outlined performance status and planned goals to support DOE's sustainability mission. Refer to Chapter 1, "Environmental Management System." CHBWV, the WVDP Phase 1 decommissioning and facilities disposition contractor, received a Certificate of Registration for the International Organization for Standardization (ISO) 14001:2004 certification of its EMS on July 31, 2012. The EMS was audited in May 2016 and approved for continued certification.
Title 10 CFR Part 830, Subpart A	10 CFR Part 830, **Nuclear Safety Management**, Subpart A, **Quality Assurance Requirements,** and **DOE Order 414.1D, Quality Assurance**, provide the quality assurance (QA) program policies and requirements applicable to WVDP activities.	A QA program that provides a consistent system for collecting, assessing, and documenting data pertaining to radionuclides in the environment continued to be implemented at the WVDP. In 2016, the WVDP updated the QA program to include requirements for Type B and Fissile Material transport packaging.
42 USC §4321 et seq., and 10 CFR Part 1021	The **NEPA** of 1969 and as amended in 1970, established a national policy to ensure that protection of the environment is included in federal planning and decisionmaking. The President's Council on Environmental Quality established a screening system of analyses and documentation that requires each proposed action to be categorized according to the extent of its potential environmental impact.	NEPA documents are prepared at the WVDP to describe potential environmental effects associated with proposed activities. The level of documentation depends upon whether the action constitutes a major federal action significantly affecting the quality of the human environment within the meaning of NEPA. During 2016, NEPA environmental checklists were prepared for construction and operation of a new potable water treatment system and for routine WVDP maintenance activities. It was concluded that none of these activities have a significant impact on the human environment.

TABLE ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	*Environmental Statute, DOE Directive, EO, Agreement*	*WVDP Compliance Status*
Environmental Conservation Law (ECL), 6 NYCRR Part 617 NYS	The NY **SEQR Act** of January 1, 1996, enacted in September 1976 and as amended on June 26, 2000, requires adequate environmental review and assessment of whether a proposed action has the potential to have a significant environmental impact, prior to a decision regarding the action. Where a project involves both NYS and federal approvals, it is preferred to coordinate the SEQR and NEPA processes.	The SEQR process is an action-forcing statute that requires state agencies to incorporate environmental considerations directly into their decisionmaking, and where necessary, to modify that action to mitigate adverse environmental effects. Coordinated efforts were made at the WVDP to effectively utilize information from the federal EIS process to make the required SEQR Findings Statement for the WVDP and WNYNSC, which was issued in May 2010.
42 USC §6901 et seq., and NYS ECL, 6 NYCRR Chapter 4, subchapter B	The **RCRA** of 1976 and the **NYS Solid Waste Disposal Act** (NYS ECL Article 27 [Title 9]) govern the generation, storage, handling, and disposal of hazardous wastes and closure of systems that handle these wastes. RCRA was enacted to ensure that hazardous wastes are managed in a way that protects human health, safety, and the environment.	Generation, storage, handling, treatment, and disposal of hazardous waste, and closure of systems that handle hazardous waste at the WVDP, are conducted in accordance with the RCRA interim status regulations. The WVDP performed a RCRA self-assessment and NYSDEC performed a RCRA inspection in March 2016. No findings, issues, or concerns were identified from either RCRA evaluation. In September 2016, DOE performed a RCRA surveillance of the UPC tanks and a Liquid Waste Treatment System (LWTS) tank. The surveillance resulted in no findings or concerns.
Amendment to 42 USC §6961, NYS ECL, and NYSDEC Administrative Order on Consent with DOE	The **FFCA** of 1992 (an amendment to RCRA) requires DOE facilities to prepare an STP for treating mixed waste inventories to meet land disposal restrictions and to annually update the plan to account for changes in mixed waste inventories, capacities, and treatment technologies. DOE entered into a Consent Order with NYSDEC for the WVDP in 1996.	The FFCA and the FFCA Consent Order requires completing milestones identified in the STP volume. The WVDP STP for FY 2016 update was submitted to NYSDEC in February 2017. Refer to "Mixed Waste Management," earlier in this chapter.
Docket No. II RCRA 3008(h) 92-0202, and NYS ECL	DOE and NYSERDA entered into the **RCRA §3008(h) Administrative Order on Consent** with EPA (lead agency) and NYSDEC in March 1992. The state and federal RCRA regulations authorize the agencies to issue orders requiring RCRA corrective actions associated with the potential releases of hazardous waste and/or hazardous constituents from WVDP SWMUs (under DOE jurisdiction) and WNYNSC SWMUs (under NYSERDA jurisdiction).	Written procedures and site activities are compliant with the Consent Order. In accordance with the Consent Order, DOE submits quarterly reports to EPA and NYSDEC that summarize all RCRA §3008(h) activities and progress conducted at WVDP SWMUs for the representative quarter. A discussion of the current year activities is presented earlier in this chapter.

TABLE ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	***Environmental Statute, DOE Directive, EO, Agreement***	***WVDP Compliance Status***
RCRA 3016 Statute	The **RCRA 3016 Statute** applies to all federal hazardous waste facilities currently owned or operated by the government. It requires that facility hazardous waste information be submitted to EPA and authorized states every two years.	WVDP facility hazardous waste activities are reported biennially to EPA and NYSDEC. The RCRA 3016 Biennial Report for Fiscal Year 2016 was submitted in February 2016.
42 USC §7401 et seq.; 40 CFR 61, Subpart H; and 6 NYCRR Chapter 3, Air Resources	The **Clean Air Act (CAA)** of 1970 and the **NYS ECL** regulate the release of air pollutants through permits and air quality limits. Emissions of radionuclides are regulated by EPA via the NESHAP regulations. On April 5, 1995, DOE and EPA entered into an MOU concerning the Clean Air Act Emission Standards for Radionuclides 40 CFR Part 61 including Subparts H, I, Q, and T. Nonradiological emissions are permitted under 6 NYCRR Part 201-4 (Minor Facility Registrations).	DOE maintained seven NESHAP permits for radiological emissions and one Air Facility Registration Certificate for nonradiological emissions at the WVDP. The CY 2016 annual NESHAP Report summarizing radiological emissions and estimated dose was submitted to the EPA in June 2017. Estimated dose to the critical receptor from radiological air emissions during 2016 was <0.49 mrem, far below the 10-mrem Subpart H standard. Refer to Chapter 3, "Dose Assessment," for discussion.
33 USC §1251 et seq. and NYS ECL and 6 NYCRR Chapter 10	The **Federal Water Pollution Control Act** of 1977 (**Clean Water Act [CWA])** and **NYS ECL** (Article 17 [Title 8]) seek to improve surface water quality by establishing standards and a system of permits. Wastewater and storm water discharges are regulated by NYSDEC through the SPDES permit. Discharges of fill material are regulated through permits issued by the USACE and water quality certifications issued by NYSDEC.	The current SPDES permit was modified in July 2015 to include the relocation of storm water outfall S09. NYSDEC granted an extension to continue operating under this permit after the 2016 expiration date while they conduct a technical review of the current permit. Monthly SPDES Discharge Monitoring Reports (DMRs) are submitted to NYSDEC. SPDES-permitted storm water monitoring was completed during 2016. All SPDES discharge monitoring results and storm water run-off monitoring results were within the effluent limits specified in the SPDES permit.
NYS ECL Article 17, Titles 7 and 8, and ECL Article 70	**NYS ECL Article 17 (Titles 7 and 8), and** ECL **Article 70** regulate storm water discharges related to construction activity.	No construction activities were undertaken in CY 2016 that would require new storm water pollution prevention plans or storm water permits related to construction.

Table ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	*Environmental Statute, DOE Directive, EO, Agreement*	*WVDP Compliance Status*
NYS Navigation Law and NYS ECL	**NYS ECL** Article 17 (Titles 10 and 17), 6 NYCRR 612–614 and Parts 595–599, and 6 NYCRR Subpart 360-14 regulate design, operation, inspection, maintenance, and closure of aboveground and underground petroleum bulk storage (PBS) and chemical bulk storage (CBS) tanks. These laws also regulate spill reporting and cleanup. Under terms of a 1996 agreement, amended in 2005, DOE is not required to report a spill of petroleum product onto an impervious surface if the spill is less than five gal and is cleaned up within two hours of discovery.	The last CBS tank at the WVDP was closed under these regulations in 2006. There remain nine registered PBS tanks (eight aboveground storage tanks [ASTs] and one underground storage tank [UST]) that are periodically inspected and maintained. Spills are reported and cleaned up in accordance with WVDP policies and procedures. In June 2016, there was one immediately reportable spill of 10-15 gallons of hydraulic oil which was immediately contained and cleaned up. There were 3 small petroleum spills (less than five gal each) during CY 2016, which did not require immediate notification to NYSDEC, but were reported in quarterly reports.
EO 11990	EO 11990, **Protection of Wetlands**, directed federal agencies to avoid, where possible, impacts (e.g., destruction, modification, or new construction) that would adversely effect wetlands wherever there is a practical alternative. Activities in wetlands are regulated by the USACE and NYSDEC permits. The wetlands on the WVDP are subject to regulation under Section 404 of the CWA and NYS ECL Articles 24 and 36.	Wetlands are periodically identified and delineated on the WVDP. In March 2006, the USACE approved the 2003 site-wide WVDP wetlands survey. Additional wetlands were delineated in the vicinity of the firing range in October 2006 and in the vicinity of the HLW Cask Storage Pad and north slope of the NDA in May 2013. During 2016, no new wetlands were delineated. A temporary wetland permit was issued in 2016 for roadway upgrades for removal of the three LLW VIT components. This permit will be closed after NYSDEC confirmation that the area was returned to its original condition.
42 USC §9601 et seq.	The **Comprehensive Environmental Response, Compensation, and Liability Act** of 1980 **(CERCLA**, including the **Superfund Amendments and Reauthorization Act** of 1986 **[SARA]**) provided the regulatory framework for remediation of releases of hazardous substances and remediation of inactive hazardous waste disposal sites.	Based on the results of a Preliminary Assessment Report prepared for DOE, it was determined that the WVDP did not qualify for listing on the National Priorities List. Therefore, no further investigation pursuant to CERCLA was warranted. However, if a hazardous substance spill exceeds a reportable quantity, CERCLA reporting requirements would be triggered.
42 USC §11001 et seq.	The **Emergency Planning and Community Right-to-Know Act (EPCRA)** of 1986 (also known as SARA Title III) was designed to create a working partnership between industry, business, state, and local government, and emergency response representatives to help local communities protect public health, safety, and the environment from chemical hazards.	Chemical inventories for the WVDP are reported quarterly under EPCRA, as appropriate. Refer to Tables ECS-7 and ECS-8.

TABLE ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	***Environmental Statute, DOE Directive, EO, Agreement***	***WVDP Compliance Status***
42 USC §300f et seq.	The **Safe Drinking Water Act** of 1974 requires that each federal agency operating or maintaining a public water system must comply with all federal, state, and local requirements regarding safe drinking water. Compliance in NYS is verified by oversight of the NYSDOH, through NYS Public Health Law, and the Cattaraugus County Health Department (CCHD).	The WVDP operates a nontransient, noncommunity public drinking water system serving a population of less than 500. All CY 2016 results from analyses of drinking water were reported within limits to the CCHD. The CCHD routinely performs inspections of the treatment and distribution system. Potable water has been supplied by two groundwater wells since the fall of 2014. In 2016, a design for reconfiguration of the potable water system was submitted to CCHD for approval.
10 CFR Part 851	10 CFR 851 **Worker Safety and Health Program** of 2006 requires DOE contractors to provide workers with a safe and healthful workplace. To accomplish this objective, the rule established program requirements specific to management responsibilities, worker rights, hazard identification and prevention, safety health standards, required training, recordkeeping, and reporting.	Procedures and programs are revised to maintain requirements that comply with 10 CFR 851. Any proposed modification that may invalidate a portion of the worker health and safety program at the WVDP must be approved by DOE-WVDP. The plan was reviewed in July 2016, and it was determined that no major changes to the current plan were necessary.
10 CFR Part 835	10 CFR Part 835, **Occupational Radiation Protection**, amended May 2011, established radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities.	The document "CH2MHILL·B&W West Valley, LLC Documented Radiation Protection Program and Implementation for 10 CFR Part 835, as amended May 2011" (WVDP-477) was last revised in February 2012.
15 USC §2601 et seq., and 12 NYCRR Part 56	The **Toxic Substances Control Act** of 1976 regulates the manufacture, processing, and distribution of chemicals, including asbestos-containing material (ACM) and polychlorinated biphenyls (PCBs). Effective September 2006, the NYSDOL significantly revised the asbestos regulations, cited in 12 NYCRR Part 56. As a result, operating procedures were revised, special training for asbestos workers was conducted, and the WVDP applied for and was granted site-specific variances.	ACM activities were managed in accordance with the site "Asbestos Management Plan" and activities were completed by personnel certified by NYSDOL. Refer to Table ECS-5 for a summary of asbestos waste management activities. PCBs are managed in accordance with the WVDP document "PCB and PCB-Contaminated Material Management Plan." The WVDP maintains an annual document log that details PCB use and changes in storage or disposal status.

TABLE ECS-1 *(continued)*
Compliance Status Summary for the WVDP in 2016

Citation	*Environmental Statute, DOE Directive, EO, Agreement*	*WVDP Compliance Status*
7 USC §136 et seq.	The **Federal Insecticide, Fungicide, and Rodenticide Act** of 1996 and **NYS ECL** provide for EPA and NYSDEC control of pesticide distribution, sale, and use.	Chemical pesticides are applied at the WVDP only after alternative methods are evaluated by trained and NYSDEC-certified professionals and determined to be unfeasible. Herbicides were not used at the WVDP during 2016. Therefore, per the SPDES permit, no analysis for herbicides was required for the storm water outfall samples in 2016.
NYS ECL, Article 15, Title 5, et seq.	**NYS ECL**, Article 15, Title 5, **Protection of Water** regulates the safety of dams and other surface water impounding structures, including construction, inspection, operation, maintenance, and modification of these structures. Revised dam safety regulations became effective on August 19, 2009. The dams maintained by the WVDP, on the WNYNSC property, are classified as Class A - low-hazard dams.	Two surface water impounding dam structures are located on the WNYNSC: NYS Atomic Development Dam #1 (NYSDEC Dam ID #019-3149) and NYS Atomic Development Dam #2 (NYSDEC Dam ID #019-3150). Severe storms in July 2015 caused damage to the 2014 repairs to the Lake 1 spillway. In 2015, short term repairs were made to the toe of the spillway and debris was removed downstream from Buttermilk Creek. Routine inspections continued to be performed in 2016. In response to a NYSDEC request, the DOE submitted a proposed long-term plan for the reservoirs, dams, and spillway in February 2016, and two updates to the plan in March and July 2016.
NYS ECL Article 15, Title 33, Part 675	**NYS ECL,** Article 15, Title 33 **Water Withdrawal Reporting** requires that any person who withdraws or is operating any system or method of withdrawal that has a capacity to withdraw more than 100,000 gal (378,541 L) of groundwater or surface water per day shall file an annual report with NYSDEC. The legislation was enacted to gain more complete information for managing the state's water resources.	A nontransient, noncommunity public water supply system for drinking water and operational purposes is maintained and operated at the WVDP. In compliance with the legislation, the water withdrawal reporting forms for 2016 were submitted to NYSDEC in March 2017. The WVDP withdrew an average of 25,762 gal/day (97,520 L/day) in 2016 from the drinking water wells and from the reservoirs for augmentation water.
49 CFR Part 172, and 6 NYCRR Part 364.9	**6 NYCRR Part 364.9** regulates handling and storage of potentially infectious regulated **medical waste**. 49 CFR Part 172, Subpart H regulates transportation safety and disposal of regulated medical waste at a licensed facility.	The on-site health services office is registered with NYS as a "Small Quantity Generator" of regulated medical waste. Medical services generate potentially infectious medical wastes that are securely stored in approved biohazard containers and are handled and controlled by authorized personnel.

TABLE ECS-1 *(concluded)*
Compliance Status Summary for the WVDP in 2016

Citation	*Environmental Statute, DOE Directive, EO, Agreement*	*WVDP Compliance Status*
16 USC §703 et seq. and EO 13186	The **Migratory Bird Treaty Act** of 1918 implemented various treaties and conventions between the U.S. and foreign countries for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful.	DOE maintains a U.S. Fish and Wildlife Bird Depredation Permit for the WVDP. There were no migratory bird nest depredation activities in 2016.
16 USC §1531 et seq., and 6 NYCRR Part 182	The **Endangered Species Act** of 1973 provided for the conservation of endangered and threatened species of fish, wildlife, and plants. (See also 6 NYCRR Part 182, **Endangered and Threatened Species of Fish and Wildlife; Species of Special Concern**.)	Several ecological surveys of the WNYNSC premises have been conducted. Except for "occasional transient individuals," no plant or animal species protected under the Endangered Species Act are known to reside at the Center.
16 USC §470	The **National Historic Preservation Act** of 1966 established a program for the preservation of historic properties throughout the nation.	Surveys of the WNYNSC have been conducted for historic and archaeological sites. Surveys revealed American Indian and historic homestead artifacts, consistent with the area.
EO 11988	EO 11988, **Floodplain Management**, was issued to avoid adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.	No activities were performed during 2016 at the WVDP that would develop new floodplains or be adversely impacted by the existing 100-year floodplain within the premises.
Stipulation Pursuant to NYS ECL Section 17-0303, and Section 176 of the Navigation Law	In accordance with **Stipulation No. R9-4756-99-03**, dated March 1999, DOE agreed to install a soil bioventing system to remediate petroleum contaminated soils in the warehouse UST site (NYSDEC Spill number 9708617). The remediation plan was to construct a bioventing system, operate it for two years, assess performance, and report to NYSDEC.	The system stimulated in-situ biodegradation of petroleum hydrocarbons in the soil by providing abundant oxygen to existing microorganisms. After reviewing soil and water sampling data and evaluations, NYSDEC determined that no further remediation was required. The system was removed in 2014. A determination regarding the potential need for additional future actions will be made consistent with Phase 2 decisionmaking under the NEPA process.
6 NYCRR Part 360	**NYS ECL Solid Waste Management Facility Regulations** define requirements for closure of nonradioactive solid waste disposal facilities in a manner that protects the environment.	Per a 1986 NYSDEC approved engineering closure plan, the CDDL was closed. As required by the plan, the CDDL cover was inspected in 2016 and all areas were found to be in good condition.

TABLE ECS-2
NEPA Documents Affecting DOE Activities at the WVDP

Year	*Action*	*Outcome*
1982	The FEIS, "Final Environmental Impact Statement: Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the WNYNSC, West Valley (DOE/EIS-0081)" and associated ROD were issued outlining the actions DOE proposed for solidification of the liquid HLW contained in the underground tanks.	The initial period of WVDP Act work activities, completed in September 2002, removed the HLW from the tanks and immobilized it into borosilicate glass through VIT. The canisters of vitrified HLW remain on site in temporary storage inside the VSCs on the south plateau interim HLW Cask Storage Pad.
1988	DOE and NYSERDA published a NOI to prepare the EIS for "Completion of the WVDP and Closure or Long-Term Management of the Facilities at the WNYNSC (the Center)."	The DEIS was issued in 1996.
1996	DOE and NYSERDA issued the "Draft EIS for the Completion of the WVDP and Closure or Long-Term Management of the Facilities at the WNYNSC" (DOE/EIS-0226-D).	The DEIS was issued without a preferred alternative for a six-month review and comment period. After issuing the DEIS, and despite long negotiations, DOE and NYSERDA were unable to reach an agreement on the future course of action for closure at the Center (see Government Accounting Office, 2001).
1997	Following issuance of the 1996 DEIS, NYSERDA and DOE formed a stakeholder advisory group (the West Valley Citizen Task Force) to provide additional input to the public comment process required by the NEPA.	The Citizen Task Force's mission is to provide stakeholder input to decisionmaking for development of a closure option for the WVDP and the WNYNSC.
1997	DOE-HQ issued the "Final Waste Management Programmatic EIS," (WM PEIS [DOE/EIS-0200F]) to evaluate nationwide management and siting alternatives for treatment, storage, and disposal of five types of radioactive and hazardous waste.	The WM PEIS (DOE/EIS-0200F) was issued with the intent to issue a separate ROD for each type of waste generated, stored, or buried over the next 20 years at 54 sites in the DOE complex.
1999	DOE issued a ROD for nationwide management of HLW, Vol. 64, FR, p. 46661 (64 FR 46661).	The ROD specified that WVDP-vitrified HLW will remain in storage on site until it is accepted at a geologic repository
2000	DOE issued a ROD for nationwide management of LLW and mixed LLW (65 FR 10061).	The Hanford site in Washington State and the Nevada National Security Site (previously the Nevada Test Site) were designated as national DOE disposal sites for LLW and mixed LLW.
2001	DOE published an NOI (66 FR 16447) formally announcing its rescoping plan for preparing the waste management EIS for the WVDP. DOE published an Advance NOI (66 FR 56090), announcing in advance, its intention to prepare an EIS for Decommissioning and/or Long-Term Stewardship at the WVDP and the WNYNSC.	The rescoping plan split the scope of the 1996 WVDP DEIS into two phases: (1) near-term waste management decisionmaking and (2) final decommissioning and/or long-term stewardship decisionmaking. The advanced NOI informed interested parties of a pending EIS and provided opportunity for public comments early in the process.

TABLE ECS-2 *(continued)*
NEPA Documents Affecting DOE Activities at the WVDP

Year	*Action*	*Outcome*
2003	DOE issued a notice of availability of the "WVDP Draft Waste Management EIS" (68 FR 26587). DOE, in cooperation with NYSERDA, issued an NOI (68 FR 12044) to issue an EIS for "Decommissioning and/or Long-Term Stewardship at the WVDP and the WNYNSC."	The DEIS presented alternatives for near-term management of WVDP LLW, mixed LLW, TRU waste, and HLW. Based on comments during the scoping process and the complexity of issues relating to long-term agency responsibility, this EIS was delayed (DOE-EIS-0226-R).
2005	DOE issued a ROD, based on alternative A, for the "WVDP Waste Management EIS (WVDP WM EIS-0337)" (70 FR 35073).	The ROD dictated that (1) the canisters of vitrified HLW will remain in storage on site until transfer to a geologic repository, (2) the decision on TRU waste will be deferred until certification is obtained from the Waste Isolation Pilot Plant in Carlsbad, New Mexico, and (3) LLW and mixed LLW will be shipped off site for disposal at commercial or DOE sites.
2005	On August 26, 2005, The Coalition filed a complaint in the U.S. District Court, Western District of New York, against DOE regarding the NEPA process at the WVDP. The Coalition contended that DOE's rescoping plan to split the 1996 WVDP DEIS violated NEPA and the Stipulation of Compromise. The Coalition also sought a declaration that DOE is not empowered to reclassify waste at the WVDP using the "waste incidental to reprocessing" determination.	On September, 28, 2007, the U.S. District Court, Western District of New York ruled to dismiss the complaint in its entirety. Refer to Case 1:05-cv-00614-JTC, Document 41, filed September 28, 2007 for the ruling.
2006	An EA (DOE/EA-1552) evaluated the proposed decontamination, demolition, and removal of select site facilities. A FONSI was issued.	The EA, with the FONSI, cleared the way for removal of 36 facilities that were (or in the next four years would be) no longer required to support WVDP activities.
2007	DOE issued an NOI to prepare an EIS for the disposal of Greater-Than-Class-C (GTCC) LLW (72 FR 40135). In March 2011, DOE issued the DEIS for the disposal of GTCC LLW and GTCC-like waste.	Nine scoping meetings for the EIS were held throughout 2007. On February 25, 2011, a notice of availability for the GTCC draft EIS was issued with the 120-day public comment period ending on June 27, 2011. The final EIS for disposal of GTCC and GTCC-like waste was issued on March 4, 2016 with a review period ending April 4, 2016.
2008	DOE issued a notice of availability for the revised "Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the WVDP and WNYNSC (DOE/EIS-0226-D [Revised])" (73 FR 74160).	The DEIS evaluated the range of reasonable alternatives for decommissioning and/or long-term stewardship of the facilities at the Center. This DEIS is a revision of the 1996 Cleanup and Closure DEIS. This DEIS was distributed December 5, 2008, for a six-month public review period, which was extended through September 8, 2009.

TABLE ECS-2 *(concluded)*
NEPA Documents Affecting DOE Activities at the WVDP

Year	*Action*	*Outcome*
2010	In January 2010, DOE issued the "Final EIS (FEIS) for Decommissioning and/or Long-Term Stewardship at the WVDP and WNYNSC (DOE/EIS-0226 [Revised])". On April 14, 2010, DOE issued the ROD for the FEIS, selecting the phased decisionmaking alternative as the preferred alternative. On May 12, 2010, NYSERDA issued a SEQR Findings Statement selecting the phased decisionmaking alternative as the preferred alternative.	In Phase 1 of the phased decisionmaking preferred alternative, DOE will decommission the MPPB, the VF, RHWF, the wastewater treatment lagoons, and a number of other facilities. The Phase 2 decision will be made within 10 years of the EIS ROD.
2014	In early 2014, DOE and NYSERDA announced that a joint Supplemental EIS would be prepared for the Phase 2 decisions. The integrated approach developed by DOE and NYSERDA for making the Phase 2 decision will incorporate probabilistic performance assessment to support the Phase 2 Decisionmaking Alternative for the WVDP and WNYNSC.	In September 2015, DOE awarded the contract for preparing the probabilistic performance assessment to Neptune and Company, Inc.
2015	In December 2015, DOE issued a request for information seeking feedback from contractors and other interested parties regarding their capabilities and proposed innovative approaches for performance of the Supplemental EIS.	This market research was designed to assist DOE with identifying interested and capable companies to perform the EIS to support Phase 2 decisions for the disposal areas and the underground storage tanks.
2016	In August 2016, DOE issued a final Request For Proposals (RFP) for the Supplemental EIS.	The Supplemental EIS contract was awarded to SC&A, Inc. in April 2017.

TABLE ECS-3
WVDP Environmental Permits

Permit Name and Number	*Agency / Permit Type*	*Description*	*Updates*	*Status*
WVDP RCRA Part A Permit Application (EPA ID #NYD980779540)	NYSDEC Hazardous Waste	Provides interim status under RCRA for treatment and storage of hazardous waste.	DOE is currently operating under the April 2011 RCRA Part A Permit Application. Revisions were submitted to NYSDEC in April 2011, and conditionally approved on June 9, 2011.	On August 29, 2011, the permit was transferred from WVES to CHBWV as co-operator of the WVDP along with DOE.
6 NYCRR Part 373-2 (i.e., Part B) Permit Application (Rev. 1)	NYSDEC Hazardous Waste	Provides final status under RCRA for treatment and storage of hazardous waste.	Submitted a revised application to NYSDEC on September 30, 2010. In January 2011, NYSDEC review was suspended indefinitely.	On March 22, 2012, NYSDEC suspended action relative to the Part B until completion of Phase 1 work.
Air Facility Registration Certificate (9-0422-00005/00099)	NYSDEC / Air Emissions	Certificate caps nitrogen oxide (NO_x) and sulfur oxide (SO_x) emissions from two boilers.	The boilers were taken out of service in January 2014. They were removed from the certificate when the registration was renewed in 2016.	A new registration certificate was issued that is effective from September 1, 2016 to August 31, 2026.
MPPB Ventilation (WVDP-687-01)	EPA / NESHAP	MPPB ventilation radionuclide emissions (originally permitted to ventilate the LWTS).	MPPB stack ventilation is still operating under the original permit. Discharge through the MPPB stack continues from the Ventilation Exhaust Cell (VEC). The original Head End Ventilation (HEV) portion of the MPPB ventilation has been shut down and now exhausts through a new Replacement Ventilation Unit (RVU) emission point that became operable in August 2015. (See RVS permit below.)	Original approval on December 22, 1987. Modified on May 25, 1989 to include the laboratories. Modified February 18, 1997 to include the slurry-fed ceramic melter. No expiration date. In preparation for demolition, the planned path forward for ventilation during deactivation of the MPPB was presented to EPA in February 2016.
Replacement Ventilation System (RVS) (WVDP-RVS-MPPB-New-001)	EPA / NESHAP	Permit to construct a new ventilation and emission system to replace the HEV portion of the MPPB ventilation system.	The RVS is composed of two RVUs discharging through one emission point. The RVS became operational in August 2015.	Application was approved by EPA on March 25, 2015. No expiration date.
VF Heating, Ventilation, and Air-Conditioning (HVAC) System (no permit number)	EPA / NESHAP	VF HVAC system for radionuclide emissions.	Facility being prepared for demolition. Ventilation system was shut down in July 2016.	Approved on February 18, 1997. No expiration date.

Note: Permit and license expiration dates are current as of September 2017.

TABLE ECS-3 *(continued)*
WVDP Environmental Permits

Permit Name and Number	***Agency / Permit Type***	***Description***	***Updates***	***Status***
Contact Size-Reduction Facility (CSRF) (WVDP-287-01)	EPA / NESHAP	Contact size-reduction and decontamination facility radionuclide emissions	Stack ventilation not in service since 2005. A Portable Ventilation Unit (PVU) was used for temporary ventilation of the area during pre-demolition cleanout activities in 2016.	Approved on October 5, 1987. No expiration date. This system is inactive and the building is being prepared for demolition.
Supernatant Treatment System (STS) /PVU (WVDP-387-01)	EPA / NESHAP	STS ventilation for radionuclide emissions	System receives air ventilated from T&VDS.	Original approval on October 5, 1987. Modified on May 4, 1998 for full-time ventilation of WTF. No expiration date.
RHWF (WVDP-RHWF Mod-001)	EPA / NESHAP	RHWF ventilation for radionuclide emissions	Permit issued to allow use of plasma arc cutting techniques in the RHWF.	Approved on April 18, 2012. No expiration date.
Outdoor Ventilated Enclosures/ PVUs (WVDP-587-01)	EPA / NESHAP	Fifteen PVUs for removal of radionuclides.	Since 2007, EPA approval to expand usage of PVUs from 10 to 15. DOE tracks usage on the basis of annual cumulative estimated dose.	Original approved on December 22, 1987. Modified on December 10, 2007 for 15 units. No expiration date.
SPDES (NY0000973)	NYSDEC / Effluent water	Monitors discharges to surface waters from various on-site sources.	An amended SPDES permit was issued by NYSDEC, effective July 1, 2011. The SPDES permit was modified in July 2015 for the relocation of the S09 storm water outfall.	The permit expired on June 30, 2016. Per NYSDEC request, the WVDP submitted a "SPDES Notice/Renewal Application and Questionnaire" to NYSDEC on November 5, 2015 and received a letter from NYSDEC allowing discharges to continue under the existing permit while NYSDEC conducts their technical review of the current permit.
Public Water System ID #NY0417557	CCHD	The WVDP is a nontransient noncommunity public drinking water system.	System was changed from a surface water source to a groundwater source in 2014. A replacement treatment system is scheduled to be built and operational in 2017 to allow for demolition of the utility room.	No permit expiration date.

Note: Permit and license expiration dates are current as of September 2017.

TABLE ECS-3 *(concluded)*
WVDP Environmental Permits

Permit Name and Number	***Agency / Permit Type***	***Description***	***Updates***	***Status***
PBS (#9-008885)	NYSDEC / PBS tank registration	Registration of bulk storage tanks used for petroleum.	Diesel fuel tank FO-D-11 was permanently closed and removed from the license.	License expires September 2, 2021.
Asbestos-Handling License CHBWV #61646	NYSDOL / asbestos-handling and sampling activities	Asbestos contractors license with specific variances for handling and monitoring.	Renewed for CY 2017 in September 2016.	The license was renewed in 2016 and expires on September 30, 2017; each variance has a unique expiration date.
NYS Atomic Development Dam #1 (Reg. ID #019-3149) NYS Atomic Development Dam #2 (Reg. ID #019-3150) USACE Emergency Regional Permit (#99-000-1)	NYSDEC Division of Water, Bureau of Flood Protection and Dam Safety	Two Class A Low-Hazard dams on the WNYNSC property, that supply water for operational purposes, are maintained at the WVDP.	Repair of the 2009 flood damage was completed in 2014. Additional short term repairs of the new damage to the spillway that occurred in 2015 from a significant rainfall over a short time period were completed in 2016.	Activities performed in 2016 under the USACE Emergency Regional Permit are complete. DOE-WVDP is conducting an evaluation of the dams with the support of the USACE. In response to a NYSDEC request, the WVDP submitted a proposed long-term plan for the reservoirs, dams, and spillway in February 2016, and two updates to the plan in March and July 2016.
Underground Injection Control Program Regulation (UICID: 11NY00906001)	EPA Groundwater Compliance Section	EPA regulates injection of tracer solutions into groundwater wells.	Several wells in the north plateau PTW were used to inject sodium bromide tracer solution to estimate groundwater flow velocities.	On November 18, 2010, EPA authorized operation of injection wells.
Bird Depredation Permit (MB747595-0)	U.S. Fish and Wildlife Service	Federal permit for the limited taking of migratory birds and active bird nests.	Permit was renewed for FY 2017.	Renewal application is submitted annually in August. Current permit expires September 30, 2017.

Note: Permit and license expiration dates are current as of September 2017.

TABLE ECS-4
WVDP RCRA SSWMUs and Constituent SWMUs
Identified in the RFI under the RCRA 3008(h) Order on Consent

SSWMU	*SWMU #*	*Constituent SWMUs*
SSWMU #1 – LLWTF	3, 4, 17, 17a, and 17b	Former lagoon 1; LLWTF; lagoons 2, 3, 4, and 5; neutralization pit; and interceptors
SSWMU #2 – Miscellaneous Small Units	5, 6, 7, and 10	Demineralizer sludge ponds and solvent dike; effluent mixing basin; and waste paper incinerator
SSWMU #3 – LWTS	18, 18a, 22, and Sealed Rooms	LWTS; cement solidification system; and specific sealed rooms in the MPPB (per the RFI Workplan and Current Conditions Report)
SSWMU #4 – HLW Storage and Processing Area	12/12a, 13, 19, and 20	WTF; VIT test facility waste storage tanks; STS; and VF
SSWMU #5 – Maintenance Shop Leach Field	8	Maintenance shop leach field
SSWMU #6 – Low-Level Waste Storage Area	9/9a, 15, 16/16a, and 38	Lag storage additions (LSAs) #1 and #2 hardstands; old and new hardstand storage areas; Lag storage building; Lag storage extension; LSAs #3 and #4; and the drum supercompactor
SSWMU #7 – Chemical Process Cell - Waste Storage Area (CPC-WSA)	14	CPC-WSA
SSWMU #8 – CDDL	1	CDDL
SSWMU #9 – NDA	2, 11/11a, 23, 31, and 39	NDA and NDA trench soil container area; kerosene tanks; NDA container storage area; and interceptor trench project and staging area for NDA
SSWMU #10 – Integrated Radwaste Treatment System	21	Integrated radwaste treatment system drum cell
SSWMU #11 – SDA	NA	The SDA is a closed radioactive waste landfill that is contiguous with the Project premises and is owned and managed by NYSERDA. For more information, see their website at www.nyserda.ny.gov.
SSWMU #12 – Hazardous Waste Storage Lockers (HWSLs)	24	HWSLs 1 to 4

Note: The WVDP RCRA SWMUs and SSWMUs are discussed under the section titled "RCRA §3008(h) Administrative Order on Consent." See Figures A-9 and A-10 for location of the SSWMUs.

TABLE ECS-4 *(concluded)*
WVDP RCRA SSWMUs and Constituent SWMUs
Identified in the RFI under the RCRA 3008(h) Order on Consent

WVDP RCRA SWMUs Not Associated with a SSWMU		
Individual SWMUs	25	Inactive scrap metal landfill adjacent to bulk storage warehouse (NYSERDA SWMU)
	26	Subcontractor maintenance area
	27	Fire brigade training area
	28	VIT hardstand
	29	Industrial waste storage area
	30	Cold hardstand area near the CDDL
	32	Old sewage treatment facility
	33	Existing sewage treatment facility
	34	Temporary storage locations for well purge water
	35	Construction and demolition area
	36	Old school house septic system
	37	CSRF
	40	Satellite accumulation areas and 90-day storage areas
	41	Designated roadways
	42	Product storage area
	43	Warehouse extension staging area
	44	Fuel receiving and storage area; high-integrity container and SUREPAK™ staging area
	45	Breach in laundry wastewater line
	46	VIT vault and empty container hardstand
	47	RHWF

Note: The WVDP RCRA SWMUs and SSWMUs are discussed under the section titled "RCRA §3008(h) Administrative Order on Consent." See Figures A-9 and A-10 for location of the SSWMUs.

TABLE ECS-5
Summary of Waste Management Activities at the WVDP During 2016

Waste Description/ Facility	*Type of Project Generating Waste*	*Quantity in 2016*	*Discussion*
LLW	Includes all sources of LLW	12,262 cubic feet (ft^3) (347 cubic meters [m^3])	LLW shipped in 2016.
TRU waste	TRU waste processing	2,558 cubic Feet (ft^3) (72.4 cubic meters [m^3])	TRU waste generated in 2016.
Hazardous and Mixed LLW	Primary source of generation was decomissioning activites and legacy waste shipments	Generated: 58,738.8 lbs (29.37) tons Shipped: 5,465.2 lbs (2.73) tons	Waste generated and shipped during 2016.
Radiological wastewater from the LLWTF (Low Level Waste Treatment Building, LLW2 [WNSP001])	NYSDEC regulates point-source liquid effluent discharges of treated process wastewater through the SPDES permit for the WVDP.	Approximately 3,744,810 gallons (14,175,000 L)	During 2016, two batches of wastewater were processed through the LLW2. This included groundwater pumped from the NDA interceptor trench.
Industrial wastewaters (WNSP007)	All sources of industrial wastewater have been terminated.	No industral wastewaters were discharged through outfall 007 during 2016.	Discharges through outfall 007 were discontinued in November 2014.
Sanitary wastewaters	Waste shipping and disposal	Approximately 1,327,778 gallons (5,026,186 L)	Sanitary wastewaters were authorized for shipment to the Buffalo Sewer Authority, the Gowanda Sewage Treatment Plant, or the Arcade Sewage Treatment Plant for treatment and disposal during 2016.
NDA interceptor trench	Interceptor trench (WNNDATR) and groundwater pre-treatment	Approximately 71,611 gallons (271,077 L)	Groundwater was pumped and transferred to the LLW2. No organics or TBP were encountered in 2016. No pre-treatment was necessary.
Asbestos	Asbestos management and abatement	300 square feet (ft^2) (27.9 square meters [m^2]) of friable tank insulation. 2,582 linear feet (787 meters) of friable pipe insulation	Friable asbestos was removed from the MPPB and Utililty Room as a pre-demolition activitiy during 2016.
Universal waste	Spent bulbs/spent batteries	Bulbs - 287 lbs (0.14 ton) Batteries - 1,796 lbs (0.90 ton)	Waste disposed of as universal waste.

TABLE ECS-6
WVDP 2016 Air Quality Noncompliance Episodes

Permit Type	*Facility*	*Parameter*	*Date(s) Exceeded*	*Description/ Solutions*
EPA, NESHAP	All	All	None	None
NYSDEC Air Permit	All	All	None	None

TABLE ECS-7
Status of EPCRA (SARA Title III) Reporting at the WVDP for 2016

EPCRA Section	*Description of Reporting*	*Submission Required*
EPCRA 302–303	Planning Notification	No
EPCRA 304	Extremely Hazardous Substance Release Notification	No
EPCRA 311	Material Safety Data Sheet	No
EPCRA 312	Hazardous Chemical Inventory	Yes
EPCRA 313	Toxic Chemical Release Inventory Reporting	No

TABLE ECS-8
Reportable Chemicals Above EPCRA 312 (SARA Title III) Threshold Planning Quantities
Stored at the WVDP in 2016

Chemicals Stored at the WVDP Above the Threshold Planning Quantities
Diesel fuel/No. 2 Fuel Oil
Unleaded Gasoline
Oils - various grades
Lead-acid batteries
Sulfuric acid
Ion Exchange Media

TABLE ECS-9
WVDP SPDES[a] Permit Limit Exceedances in 2016

Permit Type	*Outfall(s)*	*Parameter*	*No. of Permit Exceptions*	*No. of Samples Taken*	*No. of Compliant Samples*	*Percent Compliant Samples*
SPDES	All	All	0	655	655	100%

[a] Radionuclides are not regulated under the site's SPDES permit. However, special requirements in the permit specify that the concentration of radionuclides in the discharge is subject to requirements of DOE Order 5400.5, (see letter CHBWV to NYSDEC, January 8, 2013).

Note: The WVDP notified NYSDEC that DOE Order 5400.5 was replaced by DOE Order 458.1. The WVDP is currently executing the requirements of DOE Order 458.1, including its referenced DCSs.

TABLE ECS-10
WVDP Migratory Bird Nest Depredation Activities in 2016

Permit/License Type	***Parameter***	***Permit Limit***	***2016 Total***
U.S. Fish and Wildlife - Bird Depredation Permit	Removal of Active Barn Swallow Nests	20	0
U.S. Fish and Wildlife - Bird Depredation Permit	Removal of Active American Robin Nests	15	0
U.S. Fish and Wildlife - Bird Depredation Permit	Removal of Active Eastern Phoebe Nests	5	0
U.S. Fish and Wildlife - Bird Depredation Permit	Removal of Active Common Grackle Nests	15	0
U.S. Fish and Wildlife - Bird Depredation Permit	Removal of Inactive Migratory Bird Nests	Not limited	0
U.S. Fish and Wildlife - Registration	Oiling of Canada Goose Eggs	NA	0

NA - Not applicable

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CHAPTER 1

ENVIRONMENTAL MANAGEMENT SYSTEM

Environmental Management System (EMS)

The DOE is committed to implementing sound stewardship practices to protect the air, water, land, and other natural and cultural resources that may be affected by activities at the WVDP. The EMS is a program the WVDP utilizes to effectively manage the impacts its operations have on the environment, and to systematically improve its environmental stewardship practices. The WVDP EMS was designed to meet ISO 14001 (the Environmental Management Standard) as required by DOE Order 436.1, "Departmental Sustainability," which describes the requirements and responsibilities for implementing the EMS program. CHBWV, the prime contractor at the WVDP, received a Certificate of Registration for the WVDP EMS under ISO 14001:2004 on July 31, 2012. A third-party ISO 14001 surveillance audit of the EMS was conducted in May 2016. The auditors reported that all core EMS elements were observed to be fully implemented, meeting the ISO 14001 requirements. The EMS was approved for continued certification until July 6, 2018. A plan is currently being developed to transition to the revised ISO 14001:2015 standard. A Certificate of Registration to this new standard is required by July 7, 2018.

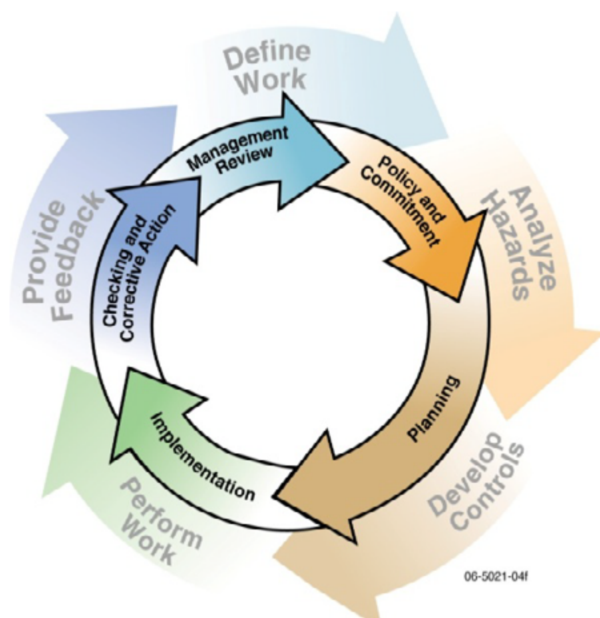
The WVDP EMS is also designed to ensure that DOE-WVDP carries out its mission in a sustainable manner. DOE Order 436.1 requires development and implementation of an annual Site Sustainability Plan (SSP) that identifies the site's contributions toward meeting DOE sustainability goals for national energy security, global environmental challenges, pollution prevention, waste minimization, energy reduction, and water conservation. Sustainability is an essential element of the facility disposition mission at the WVDP. DOE sustainability goals are incorporated into its EMS in all work planning and execution via hazard screens, standard operating procedures, work instruction packages, walk downs, pre-job briefs and ongoing evaluations during job execution.

The EMS is a key component of the Integrated Safety Management System (ISMS). The objective of the ISMS is to perform work in a safe and environmentally sound manner. Together the EMS and ISMS provide a management framework for integrating safety, environmental, and regulatory requirements into all work practices so that work is accomplished while protecting the health and safety of the public, the site workers, and the environment at all levels.

The ISO 14001 EMS model employs a cycle of:

- policy development,
- planning,
- implementation,
- checking and corrective action, and
- management review

to improve resource efficiency, to prevent pollution, and to reduce waste.



ISMS/EMS Integration

The core functions of the EMS shown on the inner circle of the ISMS/EMS integration figure are aligned with the core functions of the ISMS shown in the outer circle: to define work, analyze hazards, develop controls, perform work, and provide feedback. The ultimate goal is to improve performance as the cycle repeats.

Safety is a core value for the work performed at the WVDP. CHBWV again received the Voluntary Protection Program (VPP) Star of Excellence Award, the highest level awarded by DOE for safety and health programs, for their CY 2016 performance. The WVDP first earned DOE VPP Star site certification in 1999 and was recertified as a Star site in 2014 and 2017. Safety performance during 2016 continued to be outstanding, with CHBWV and its subcontractors achieving over 2.4 million consecutive work hours without a job related lost time work injury or illness. Focus on safety not only protects workers but also promotes protection of the environment by reducing the occurrence of accidents. Safe behaviors at the WVDP are continuously reinforced through safety exercises and frequent safety training initiatives.

Policy and Commitment

It is the environmental policy of the WVDP to integrate environmental requirements and pollution prevention into project planning and execution in order to ensure that sound stewardship practices are implemented. The environmental policy requires site personnel:

- comply with all environmental laws and regulations,
- minimize waste generation,
- protect and conserve natural resources, and
- quantify and track environmental objectives with input from all stakeholders, employees and subcontractors.

The environmental policy is posted in many meeting areas across the site, and it is available on the CHBWV website www.chbwv.com/graphics/CHBWV_Environmental_Policy.pdf. Managers are expected to take prompt action to address environmental concerns and to have zero tolerance for noncompliance with the policy.

Program Planning

Incorporating the EMS into planned work activities contributes to successful project outcomes. The EMS directs that the first step in planning work must involve identifying activities with specific regulatory requirements, activities with the potential for significant environmental impacts, and activities that can be performed in a manner that would contribute to DOE sustainability goals.

Regulatory Compliance. Involvement of regulatory support personnel in work planning enables assessment of the applicability of environmental laws and regulations prior to initiation of work to ensure appropriate permits and operating practices are in place. Compliance is also maintained by routine environmental monitoring of air, surface water, drinking water, groundwater, and ambient radiation dose. Required regulatory reports that analyze these data are generated on a regular basis.

Environmental Aspect Analysis. Activities that have regulatory implications or those that have the potential for significant environmental impacts are identified as “significant aspects” through a quantitative ranking process, per the ISO 14001 standard. An “environmental aspect” is any element of an organization’s activities, products, or services that can impact the environment.

Potential significant environmental aspects of site activities planned for 2016 at the WVDP were systematically graded with respect to their likelihood of occurring, the potential magnitude of the impact, the potential regulatory requirements or ramifications, and the anticipated level of community concern. The purpose of grading environmental aspects was to focus management attention on the most important environmental concerns associated with the 2016 scope of work. The most significant potential environmental aspects for 2016 are summarized in Table 1-1.

TABLE 1-1

WVDP Significant Environmental Aspects for 2016[a]

Environmental Aspect:
· Radiological and/or Asbestos Air Emissions
· Discharge of Metals, Organics, or Radiological Constituents to Surface Water
· Generation of Low-level Waste
· Savings in Energy Use
· Potential Accidental Radiological Release (i.e. HEPA filter failure)

[a] Each year all planned work activities are evaluated using a ranking system developed for the EMS that is based on potential environmental and regulatory impacts, community concerns, and likelihood of occurrence. Under this ranking system, aspects with an overall significance of 14 or greater are identified as "significant aspects."

Facility Demolition Planning. EMS practices are currently involved in the development of detailed demolition planning documents for the VF and MPPB. The MPPB was constructed in the 1960s as a commercial nuclear fuel reprocessing facility. The VF was constructed adjacent to the MPPB to vitrify HLW at the site. It housed the ceramic melter and associated components used to solidify the radioactive slurry remaining in the WTF underground storage tanks used during NFS operations. The VF is a 13,000 square foot, steel-reinforced concrete, metal-sided building. Deactivation of the VF in preparation for demolition was nearly complete at the end of CY 2016. Demolition is expected to begin in 2017.

The MPPB is a 40,000 square foot, five-story, steel-reinforced, concrete structure that housed the mechanical and chemical process equipment used to separate uranium and plutonium from spent nuclear fuel. It was used to reprocess nuclear fuel from 1966 to 1972 and portions of the facility were reused to support HLW vitrification. The MPPB is comprised of more than 55 rooms and is contaminated from these activities. To prepare for demolition, thousands of feet of contaminated piping, radiologically contaminated tanks, building components with asbestos containing material, and a variety of specialized equipment that was used for chemical reprocessing of spent nuclear fuel are being removed from the facility. Demolition of the MPPB is planned to follow VF demolition.

For each facility or structure that is considered for demolition, the base environmental aspects are identified and addressed during work planning with the assistance of hazard control specialists. Planning the demolition of the MPPB and VF involves completion of "Demolition Readiness Checklists" that evaluate the relevant environmental aspects that may be encountered during the demolition of each facility.

Demolition planning also involves quantitatively evaluating the methods by which the demolition will be performed with respect to the potential environmental emissions to air and water associated with the selected demolition method. Examples of demolition methods being considered include removal using:

- diamond wire saw cutting,
- hydraulic hammering, and
- mechanical shearing.

The EMS ensures that these evaluations are performed systematically, involve effective internal and external communication, abide by all appropriate regulatory guidance, and include regulatory notifications and approvals, as appropriate.

Activities which have the potential to cause accidental releases to air and water are closely monitored. The EMS is used to ensure appropriate operational procedures and environmental monitoring programs are in place to minimize or eliminate any potential impacts to the environment from this project.

A video that demonstrates how the site EMS helped to ensure worker safety and protection of the environment is available for viewing at:

https://youtu.be/1Jp76nPl2f0 or
http://chbwv.com/video10.htm.

HLW Canister Relocation Planning. The EMS planning process contributed to the safe removal of all of the HLW canisters from the MPPB and successful completion of the transfer of the Vertical Storage Casks (VSCs) containing these canisters from the MPPB to the interim HLW Cask Storage Pad on the south plateau in 2016. The EMS program ensured that this major planning process involved required steps to minimize the potential for

Relocating the last Vertical Storage Cask (VSC) in 2016

56 Vertical Storage Casks (VSCs) safely stored on site

environmental consequences. This included NESHAP evaluations and air monitoring for potential air releases from the welding process, evaluation of potential accidental transport failures, and waste minimization. Extensive dry-runs of the decontamination and relocation process were performed to test processes, infrastructure, and operator readiness. Relocation of the final cask was celebrated in November 2016.

All of the HLW canisters are now stored in the highly shielded VSCs. They were safely and compliantly relocated to the interim HLW Cask Storage Pad on site one year ahead of schedule.

Vertical Storage Cask (VSC) Contents and Construction. During vitrification, 275 stainless steel canisters were filled with vitrified HLW and an additional three canisters were partially filled with vitrified end-of-process materials. Each canister is 2 feet in diameter and 10 feet high. The vitrified HLW canisters were stored in a shielded room in the MPPB. They were relocated to on-site interim storage to enable demolition preparations to proceed inside the MPPB. Canister loading into VSCs began in 2015 and concluded in 2016, with 55 casks containing five canisters each, and the 56th cask containing the three end-of-process canisters and two transport inserts. The VSC package provides safe, shielded, passive storage of the HLW canisters.

As depicted in the diagram below, each VSC is made of a steel-reinforced concrete cylinder with a carbon steel liner. An inner stainless steel overpack holds the five canisters in place inside the cask.

Vertical Storage Cask (VSC) and overpack

The cask walls are 2 feet thick, 4 inches of which is carbon steel and 20 inches is concrete. The casks are 10 feet in diameter and 13 feet high. The cask lids are 14 inches thick, with 4 inches of carbon steel and 10 inches of concrete. There is a 2 inch carbon steel shield plate in the cask base. The casks weigh 87.5 tons when fully loaded. NAC International, the consultant that designed and fabricated the WVDP VSCs and overpacks, received a Certificate of Compliance from NRC approving the WVDP HLW overpack, containing up to five HLW canisters, to be used for future shipment of the canisters.

The process of relocating the canisters involved:

- decontamination of the canisters stored inside the MPPB,
- fabrication of the 56 VSCs,
- loading the canisters into the VSCs in high-risk radioactive areas using remotely controlled cranes and machinery,
- safely welding the overpack lids and bolting the steel and concrete cask covers to complete the shielding of the canisters, and
- transporting the casks to the HLW Cask Storage Pad on the south plateau using custom designed and engineered equipment.

Vertical Cask Transporter (VCT) and tow tractor

Before the canisters of HLW were relocated, a comprehensive readiness assessment was performed. Environmental regulatory personnel were integrated with the HLW relocation project readiness assessment team. A line management assessment was performed for 12 environmental management Lines of Inquiry (LOI) in the Criteria Review Approach Documents. These LOI documented that all environmental and regulatory criteria were achieved for the preparation, construction, and pre-startup testing for relocation of the HLW.

Throughout the HLW cask relocation process, EMS objectives to protect the air, water, land, and other natural resources were considered. A new video of this ground-breaking canister relocation in progress is available to the public at:

https://youtu.be/B6ZLiwYrw74 or
http://www.chbwv.com/video2.htm.

Legacy Low-level Waste Disposal. EMS procedures were used throughout the planning and successful shipment of the three large VF components that were transported off site for disposal at a licensed disposal facility in Texas in 2016. This shipment involved a combination of special truck and rail transport. The complete details of this waste disposal process are also available for viewing at:

https://youtu.be/iy9-falnI0k or
http://www.chbwv.com/video11.htm.

Shipment of legacy LLW off site

EMS Implementation

Objectives. EMS objectives and targets are established in order to quantitatively evaluate progress towards pollution prevention, reduction of environmental hazards, reduction of waste disposal costs, improvements in environmentally safe operations, and overall protection of the public and environment. Objectives and targets are re-aligned annually to support upcoming operations and work activities. The WVDP objectives and targets take into consideration the site mission to demolish buildings and infrastructure. The 2016 EMS objectives and targets included the following:

- reduction in energy use,
- continued scrap metal recycling,
- reduction in the use of potable water,
- reduction in diesel fuel usage and associated NO_x/SO_x emissions, and
- reduction in the amount of waste generated during decommissioning activities.

Progress towards all of these targets was made in 2016. Reduction in required gas heating systems continues as buildings are demolished or prepared for demolition. Scrap metal from nonradiological areas was recycled throughout 2016, and waste minimization objectives continue to be included in the work instructions for decommissioning projects.

DOE Sustainability Goals. Each year, the WVDP updates their sustainability goals to correlate with the planned work scope and to contribute towards nationwide DOE sustainability goals. Achievements in 2016 towards these goals are discussed in the EMS Results section of this chapter.

Training. The "WVDP Worker Safety and Health Plan" describes required safety training and explains how the WVDP complies with 10 CFR 851, the Federal "Worker Safety and Health Program" which has been in effect since 2007. The safety plan is reviewed annually and updated as site conditions change. Based on individual work requirements, employees receive specialized safety training. For example, employees who work in Contamination Areas must first successfully complete RadWorker II training, and those who may work in a confined space take confined space training. Regulatory compliance personnel involved in waste management are required to take Hazardous Waste Operations and Emergency Response training. All employees participate in human performance/behavior-based safety training to help reduce errors and prevent accidents.

Self-assessment activities are also stressed as a mechanism for evaluating, improving, and maintaining worker safety. A lessons-learned program that promotes communication and tracks learning opportunities for safety improvements is managed by the Performance Assurance group.

Any person working at the WVDP who has a personal photo badge allowing unescorted access to administrative areas of the site must successfully complete general employee training that covers health and safety, emergency response, environmental compliance, and other essential topics.

EMS Progress Tracking. The overall success towards reaching the objectives of the EMS program is demonstrated by the excellent safety record achieved at the WVDP in 2016 and by sustained compliance with all environmental laws and regulations. RCRA activity reports, and SPDES, drinking water, surface water, groundwater, and air monitoring reports also demonstrate the WVDP is in compliance with all regulatory requirements.

EMS Results

EMS Performance Metrics for 2016 EMS Scorecard. The EMS Annual Report, submitted to the Federal Facilities Environmental Stewardship and Compliance Assistance Center (www.fedcenter.gov), establishes EMS performance metrics in several categories on which each site is scored. Based on the current status of the site's EMS, the WVDP scored "green" on the scorecard for FY 2016 indicating the site has a compliant and robust environmental management system. Site-specific information for the EMS is provided in the following sections.

Greenhouse Gas (GHG) Emission and Energy Use. Overall GHG emissions from the WVDP decreased approximately 20% from FY 2015 to FY 2016 and decreased over 50% compared to the FY 2008 baseline as shown by Figure 1-1.

Reduction of the environmental footprint of the project by demolition of site facilities results in decreasing energy use. Use of electricity and natural gas decreased from 2015 to 2016, and is below the 2008 baseline as shown by Figure 1-2.

When the natural gas fueled boilers in the MPPB utility room were shutdown in 2014 there was a significant reduction in gas use, however this decrease was offset by an increase in the use of electricity.

Water Use. The volume of water used at the site in 2016 has not changed significantly from previous years. With the exception of backup fire suppression water and augmentation water used during lagoon discharges, all site water has been supplied by two groundwater wells since the fall of 2014. Chlorination, iron filtration, and distribution of the water supply currently takes place in the MPPB utility room which is being prepared for demolition. A new structure and water treatment and distribution system is being planned for construction in 2017 to facilitate deactivation of the MPPB utility room. Backflushing operations will not be required in the new treatment system. It is anticipated this system enhancement should contribute to a reduction in potable water usage.

Vehicle Fleet Fuel Use. Gasoline usage has been reduced by 57% from the FY 2005 baseline as shown by Figure 1-3. There has also been a reduction in the site's motor vehicle fleet size by 23% since the start of the Facilities Disposition Contract in 2011. The use of electric carts obtained from the government surplus list has also reduced the use of gasoline.

FIGURE 1-1
GHG Emissions

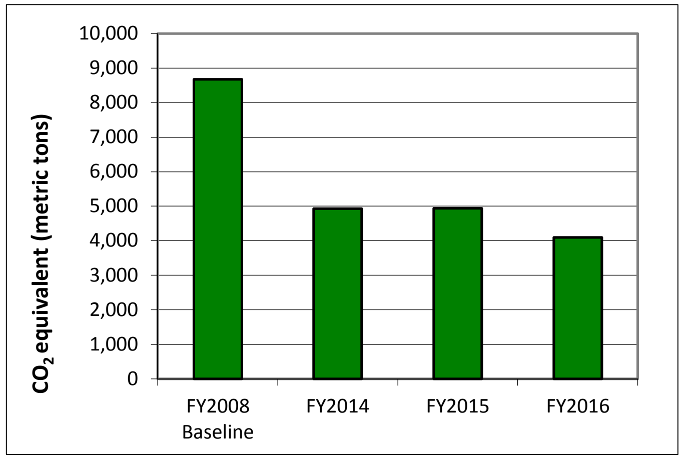


FIGURE 1-2
Energy Use

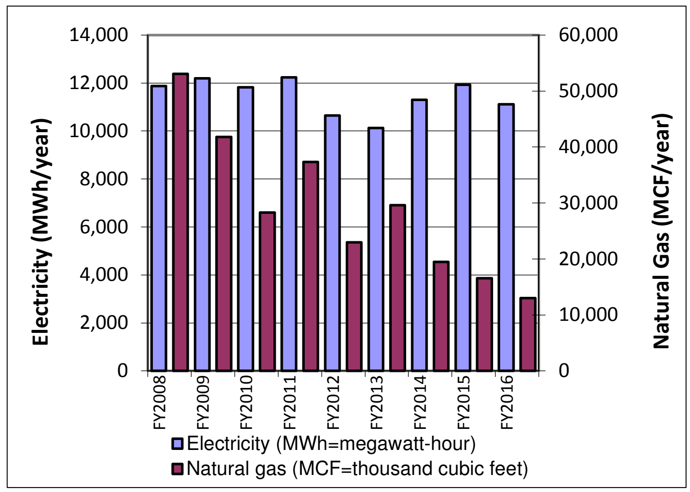
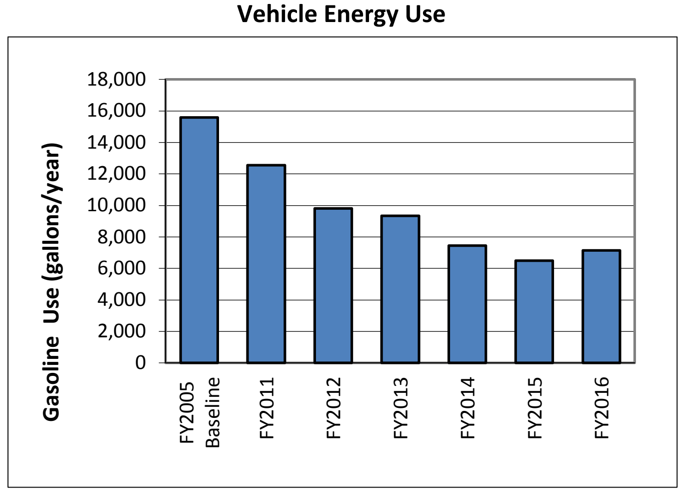


FIGURE 1-3
Vehicle Energy Use



Sustainable Acquisition. In support of DOE sustainability goals, the WVDP continues to purchase products that save energy, conserve water, and reduce health and environmental impacts. Routine activities or projects which require the purchase of chemicals, equipment, and supplies, prompt evaluations for potential purchases of green products. Warehouse stock items are selected through site procedures with objectives to meet recycled and/or bio-based content preferences, such as copy paper with at least 30% post-consumer fiber. Reused material is also considered for major purchases.

In an effort to reduce the procurement of toxic or hazardous materials, all proposed chemical purchases are evaluated to ensure they meet the requirement for utilization of non-toxic or less toxic alternative chemicals. All 2016 construction and custodial subcontracts incorporated sustainability requirements of DOE acquisition regulations.

Pollution Prevention and Waste Reduction. Waste minimization and recycling of non-hazardous, non-radioactive solid waste is maximized through EMS involvement in project planning.

The WVDP's "Waste Minimization and Pollution Prevention Awareness Plan" establishes the strategic framework for integrating waste minimization and pollution prevention into waste generating and reduction activities, and encourages procuring recycled products, reusing existing products, and using methods that conserve energy. The comprehensive program drives continual effort to prevent or minimize pollution, with the overall objective of reducing health and safety risks, and protecting the environment.

Materials have been routinely recycled, reused, or donated by the WVDP for many years. The scrap metal recycling program was re-started in January 2015. A total of approximately 46.3 tons of material was diverted from landfills in FY 2016. The quantity of each type of material recycled/reused or donated is summarized in Table 1-2.

TABLE 1-2
Recycled/Reused/Donated Material in FY 2016

Material	*FY 2016 Quantity (tons)*
Metals	18.2
Mixed paper and corrugated cardboard	14.1
Oil	0.8
Electronics	1.2
Fluorescent bulbs	0.1
Batteries	0.9
Transfers to other DOE sites	2.3
Sales to other government agencies	3.4
Miscellaneous	5.3
Total	46.3

Electronic Stewardship. The site purchased 94% of eligible computer and electronic equipment certified through the Electronic Product Environmental Assessment Tool (EPEAT) program in FY 2016. EPEAT is a global environmental rating system that helps purchasers identify high-performance, environmentally preferable computers and other electronics. Electronic equipment that is no longer needed is sent out for recycling through approved facilities.

Checking and Feedback

Evaluation of Compliance and Regulatory Requirements. Throughout CY 2016, comprehensive evaluations, reviews, audits, assessments, and inspections were performed to evaluate the implementation of EMS elements at the WVDP and to provide objective and independent review of site functions. Many of these evaluations are performed through the QA program to confirm functional compliance with site procedures, applicable local, state, and federal environmental regulations, and applicable DOE directives.

The WVDP's QA program also ensures and documents consistency, precision, and accuracy in collecting and analyzing environmental samples and in interpreting and reporting environmental monitoring data. The integrated QA program incorporates the requirements from the consensus standard "Quality Assurance Program Requirements for Nuclear Facility Applications" (American Society of Mechanical Engineers [ASME] Nuclear Quality Assurance Level 1 [NQA-1-2008/2009a]).

Overall results from the 2016 assessments, audits and inspections indicate that an effective EMS has been implemented at the WVDP. DOE surveillances of the groundwater wells and of management of waste in RCRA storage tanks resulted in no findings or concerns. The external audit of the EMS performed by Orion Registrations in May 2016 identified numerous strengths in the site EMS program, three minor opportunities for improvement, and no nonconformities.

Environmental Quality Assurance (QA) / Quality Control (QC) Program. All environmental laboratories are required to participate in applicable crosscheck programs. Subcontract laboratories at the WVDP are required to have at least 80% of reported results falling within control limits. Crosscheck samples (used to test the accuracy of environmental measurements) contain a constituent of interest at a concentration known to the agency conducting the crosscheck, but unknown to the participating laboratory. Crosscheck results that fall outside of control limits are addressed by formal corrective actions to determine any conditions that could adversely affect sample data and to ensure that actual sample results are reliable.

The WVDP maintains on-site environmental laboratory capabilities to perform limited radiological analysis of air and water samples. These include quick turnaround-time water sample analysis (for gross alpha, gross beta, strontium-90 and gamma emitters) in support of site operations, and analysis of air samples (for gross alpha, gross beta, tritium, select gamma-emitters, and iodine-129) in support of the environmental monitoring program. Analyses requiring NYSDOH Environmental Laboratory Accreditation Program (ELAP) certification are performed by off-site subcontract laboratories. On-site ELAP certification was relinquished in 2012.

TABLE 1-3
Summary of Crosschecks Completed in 2016

Type	Number Reported	Number Within Acceptance Limits	Percent Within Quality Control Limits
Radiological	86	84	97.7%
Nonradiological	167	165	98.8%
All types	253	249	98.4%

In 2016, the WVDP and its subcontract laboratories participated in the DOE Radiological Environmental Sciences Laboratory Mixed Analyte Performance Evaluation Program (MAPEP), which provides performance evaluation samples for both radiological and nonradiological constituents, and in the EPA Discharge Monitoring Report Quality Assurance (DMR-QA) study required of major and select minor SPDES permit holders. As presented in Appendix G and in Table 1-3, 98.4% of the crosschecks performed in 2016 were acceptable.

Best Practices/Lessons Learned. During the ISO 14001 audit that resulted in re-certification, the following EMS program strengths were noted:

- the run plan for the VSC relocation process was described as excellent;
- the cross-functional approach to work planning for waste packaging was identified as a positive process;
- the new walking paths and outside housekeeping show noteworthy improvements since last audit;
- external communications via YouTube video was determined to be an outstanding method to explain the mission and progress;
- the table-top drills and exercises employed for emergency response training were well planned and executed; and
- transition of work spaces from Ground Level Office (GLO) trailers to 4-PLEX and 10-PLEX was identified as a strength.

The EMS auditors commended the WVDP for their routine "effectiveness reviews" used to ensure that enacted solutions have provided permanent resolutions of potential environmental concerns.

Management Review. An internal EMS senior management briefing was conducted at the Executive Safety Review Board (ESRB) meeting on October 12, 2016. The ESRB reviews the site's environmental performance annually to ensure the continuing suitability, adequacy, and effectiveness of the EMS. No findings were identified during this review.

Summary

The benefit of the WVDP's EMS to DOE's mission at the WVDP in 2016 includes an outstanding worker safety record, compliance with all major environmental regulations, reduction of energy and supply water expenses, reduced waste inventory through reuse/recycling and shipping, and safe removal of asbestos.

CHAPTER 2
ENVIRONMENTAL MONITORING

Monitoring Program

The goal of the WVDP environmental monitoring program is to ensure that the public's health and safety and the environment continue to be protected with respect to releases from site activities. To achieve this goal, possible exposure pathways are monitored.

The monitoring program primarily focuses on surface water, air, and groundwater pathways, as these are the principal means by which potential contaminants are transported off site. Water, air, groundwater, and other environmental media samples are collected and measured for radiological and chemical constituents. A description of and schedule for the sampling program at each location and discussion of the environmental monitoring program drivers and rationale, as well as maps showing the 2016 sampling locations, are presented in Appendix A. Groundwater monitoring data are discussed in Chapter 4. Monitoring data for all other media are discussed in this chapter. In accordance with DOE Order 458.1 (Change 3), the monitoring program includes both effluent monitoring and environmental surveillance. There were no monitoring program changes in 2016.

Effluent Monitoring. Liquid effluents and air emissions are monitored by collecting samples at locations on site where radioactivity or chemical constituents are (or might be) released. Release points include discharge outfalls, storm water outfalls, site drainage points, and air ventilation stacks. At some locations, direct measurements (e.g., direct radiation or flow rates) are also collected. The WVDP maintains required permits and/or certificates from regulatory agencies applicable to releases to air and water, as listed in the Environmental Compliance Summary (ECS), Table ECS-3.

Environmental Surveillance. Surface water, drinking water, air, sediment, soil, venison, fish, milk, and food crops are collected at locations where the highest concentrations of transported contaminants might be expected. Samples are also collected at remote locations to provide background data for comparison with data from on-site and near-site samples. This includes samples collected from the ambient air monitors surrounding the WNYNSC. Direct radiation is monitored on site, at the site perimeter, and at a remote background location.

Data Evaluation. Environmental sampling results are assessed to determine whether the constituents of interest are present and, if so, their concentrations. Data from each sampling location are compared with applicable regulatory or guidance limits. The current guidance levels for evaluating radiological constituents in air and water are defined as Derived Concentration Standards (DCSs) and are dictated in DOE-STD-1196-2011. These DCSs are presented in Table UI-4 in the "Useful Information" section of this report, and are used throughout this ASER as comparative standards. Off-site ambient air network results are evaluated against NESHAP Concentration Levels for Environmental Compliance provided in U.S. EPA 40 CFR Part 61. Regulatory limits for chemical constituents in discharges to surface water under the SPDES program, and additional water quality and potable water standards are listed in Appendix B-1. DCSs for air are provided on the tables in Appendix C and groundwater standards are shown in Appendix D-1.

Data from near-site locations are compared with background concentrations using standard statistical methods to assess possible site impacts to the environment. Results from each location are also compared to historical data from that location to determine if any trends, such as increasing constituent concentrations, are occurring. If indicated, follow-up actions are evaluated and implemented as warranted.

Waterborne Effluent Monitoring

The Project is drained by several small streams. Franks Creek enters from the south and receives drainage from the south plateau. As it flows northward, Franks Creek is joined by Erdman Brook, which receives effluent from the LLW2 (through the lagoon system). After leaving the Project at the site security fence, Franks Creek receives drainage from the northeast swamp areas on the north plateau and from Quarry Creek, which receives drainage from the north swamp location WNSW74A. (See Figure A-2.) Franks Creek then flows into Buttermilk Creek, which, after flowing northward through the WNYNSC, enters Cattaraugus Creek and flows westward away from the WNYNSC. Cattaraugus Creek ultimately drains into Lake Erie, to the northwest. (See Figures A-5 and A-14.)

Waterborne Radiological Releases. The primary sources of radionuclide releases from the site to surface waters occur at three locations, the lagoon 3 weir at outfall 001 (WNSP001 shown on Figure A-2), natural drainage from the northeast swamp (monitoring point WNSWAMP shown on Figure A-2), and natural drainage from the north swamp (monitoring point WNSW74A).

Discharge through the lagoon 3 weir at SPDES outfall WNSP001 flows into Erdman Brook. Two batch releases totaling about 3.7 million gal (14.2 million L) were discharged from WNSP001 in 2016. Natural drainage from the WNSWAMP location in CY 2016 was estimated to be approximately 19.2 million gal (72.6 million L). Flow weighted estimates of curies released from these two sources in 2016 and average radionuclide concentrations are summarized in Tables 2-1 and 2-2. Discharge from WNSW74A also contributes a minor amount to the radiological releases from the site and is included in the estimated dose from waterborne releases from the site. Data for WNSW74A is provided in Table B-4B in the Appendix.

Members of the public do not have access to the WVDP and therefore do not have any potential of direct exposure at WNSP001, WNSWAMP, and WNSW74A. The regulatory standard against which surface water is evaluated is the DOE dose limit of 100 mrem (1 millisievert [mSv]) to an off-site individual from all pathways. Dose from the WVDP waterborne pathway is estimated using models and is discussed in Chapter 3.

TABLE 2-1
Total Radioactivity Discharged at Lagoon 3 (WNSP001) in 2016 and Comparison of Discharge Concentrations with DOE DCSs

Isotope [a]	*Discharge Activity* [b]		*Average Concentration*	*DCS* [d]	*Ratio of Average Concentration to DCS*
	(Ci)	*(Becquerels)* [c]	*(µCi/mL)*	*(µCi/mL)*	
Gross Alpha	3.86±0.40E-04	1.43±0.15E+07	2.72±0.28E-08	NA[e]	NA
Gross Beta	5.95±0.07E-03	2.20±0.03E+08	4.20±0.05E-07	NA[e]	NA
H-3	1.18±0.13E-02	4.37±0.50E+08	8.32±0.95E-07	1.9E-03	0.0004
C-14	2.41±2.77E-04	0.89±1.03E+07	1.70±1.96E-08	6.2E-05	<0.0003
K-40	-1.58±3.72E-04	-0.59±1.38E+07	-1.12±2.63E-08	NA[f]	NA
Co-60	0.95±3.87E-05	0.35±1.43E+06	0.67±2.73E-09	7.2E-06	<0.0004
Sr-90	2.30±0.06E-03	8.51±0.21E+07	1.62±0.04E-07	1.1E-06	0.1476
Tc-99	2.18±0.27E-04	8.06±1.01E+06	1.54±0.19E-08	4.4E-05	0.0003
I-129	4.53±1.71E-05	1.68±0.63E+06	3.20±1.21E-09	3.3E-07	0.0097
Cs-137	3.38±0.50E-04	1.25±0.19E+07	2.39±0.36E-08	3.0E-06	0.0080
U-232[g]	1.07±0.07E-04	3.95±0.25E+06	7.53±0.48E-09	9.8E-08	0.0768
U-233/234[g]	8.28±0.67E-05	3.06±0.25E+06	5.84±0.47E-09	6.6E-07[h]	0.0088
U-235/236[g]	4.34±1.54E-06	1.61±0.57E+05	3.06±1.08E-10	7.2E-07	0.0004
U-238[g]	6.78±0.61E-05	2.51±0.22E+06	4.78±0.43E-09	7.5E-07	0.0064
Pu-238	1.53±1.00E-06	5.66±3.69E+04	1.08±0.70E-10	1.5E-07	0.0007
Pu-239/240	2.20±1.14E-06	8.15±4.23E+04	1.55±0.81E-10	1.4E-07	0.0011
Am-241	1.55±0.70E-06	5.75±2.58E+04	1.10±0.49E-10	1.7E-07	0.0006
Sum of Ratios					**0.26**

NA - Not applicable.

[a] Half-lives are listed in Table UI-4.

[b] Total volume released: 1.42E+10 milliliters (mL) (3.74E+06 gal).

[c] 1 curie (Ci) = 3.7E+10 becquerels (Bq): 1Bq = 2.7E-11 Ci; 1 microcurie (µCi) =1E-06 Ci.

[d] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.

[e] DCSs do not exist for indicator parameters gross alpha and gross beta.

[f] The DCS is not applied to potassium-40 (K-40) activity because of its natural origin.

[g] Total uranium (g) = 2.10±0.06E+02; Average uranium (µg/mL) = 1.48±0.04E-02.

[h] The DCS for U-233 is used for this comparison.

TABLE 2-2
Total Radioactivity Released at Northeast Swamp (WNSWAMP) in 2016 and Comparison of Discharge Concentrations with DOE DCSs

Isotope [a]	N	Discharge Activity [b] (Ci)	Discharge Activity [b] (Becquerels) [c]	Average Concentration (µCi/mL)	DCS [d] (µCi/mL)	Ratio of Average Concentration to DCS
Gross Alpha	26	-5.31±6.32E-05	-1.96±2.34E+06	-7.32±8.71E-10	NA[e]	NA
Gross Beta	26	1.68±0.01E-01	6.21±0.02E+09	2.32±0.01E-06	NA[e]	NA
Tritium	26	1.42±2.54E-03	5.27±9.41E+07	1.96±3.51E-08	1.9E-03	< 0.0001
C-14	2	-1.41±1.29E-03	-5.23±4.77E+07	-1.95±1.78E-08	6.2E-05	< 0.0003
Sr-90	12	6.88±0.07E-02	2.55±0.02E+09	9.48±0.09E-07	1.1E-06	0.86
I-129	2	0.82±5.63E-05	0.30±2.08E+06	1.12±7.76E-10	3.3E-07	< 0.0024
Cs-137	12	-8.53±8.92E-05	-3.16±3.30E+06	-1.18±1.23E-09	3.0E-06	< 0.0004
U-232[f]	2	-0.41±2.41E-06	-1.51±8.91E+04	-0.56±3.32E-11	9.8E-08	< 0.0003
U-233/234[f]	2	1.34±0.67E-05	4.98±2.46E+05	1.85±0.92E-10	6.6E-07[g]	0.0003
U-235/236[f]	2	4.21±4.19E-06	1.56±1.55E+05	5.80±5.78E-11	7.2E-07	0.0001
U-238[f]	2	1.01±0.65E-05	3.75±2.39E+05	1.40±0.89E-10	7.5E-07	0.0002
Pu-238	2	0.77±1.99E-06	2.86±7.35E+04	1.07±2.74E-11	1.5E-07	< 0.0002
Pu-239/240	2	1.03±2.18E-06	3.82±8.08E+04	1.42±3.01E-11	1.4E-07	< 0.0002
Am-241	2	0.57±2.47E-06	2.12±9.15E+04	0.79±3.41E-11	1.7E-07	< 0.0002
Sum of Ratios						**0.87**

Notes: Average concentrations represent sample composite concentrations weighted to monthly stream flow.
The average pH at this location was 7.4 Standard Units (SU).
N - Number of samples.
NA - Not applicable.
[a] Half-lives are listed in Table UI-4.
[b] Total estimated volume released: 7.26E+10 mL (1.92+07 gal).
[c] 1 Ci = 3.7E+10 Bq: 1Bq = 2.7E-11 Ci.
[d] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[e] DCSs do not exist for indicator parameters gross alpha and gross beta.
[f] Total Uranium (g) = 2.69±0.14E+01 ; Average Total Uranium (µg/mL) = 3.70±0.19E-04.
[g] The DCS for Uranium-233 is used for this comparison.

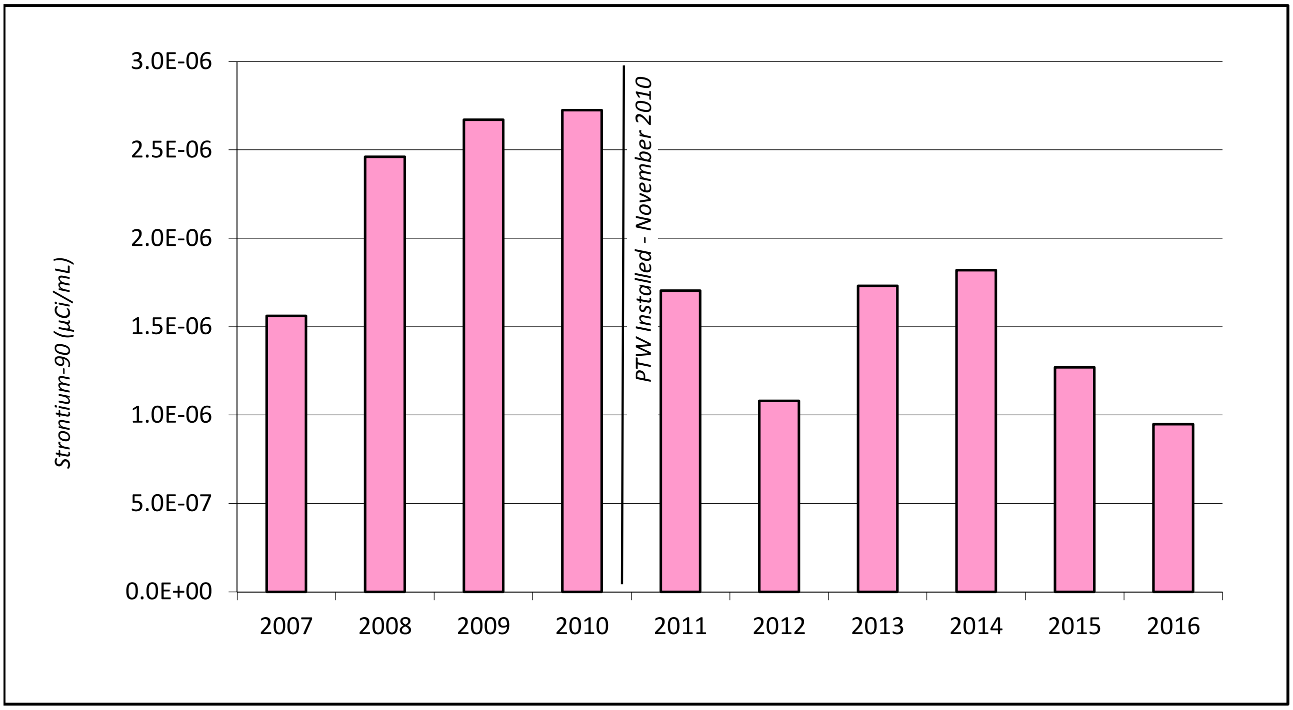
The comparison to DCS values in Tables 2-1 and 2-2 is not a comparison to regulatory criteria, but is included to provide a perspective on the measured on-site concentrations.

DCSs are defined as radionuclide concentrations that, under conditions of continuous exposure for one year by one exposure mode, would result in an effective dose equivalent of 100 mrem). To evaluate each radionuclide released with respect to the DCSs, the annual average radionuclide concentration measured for each nuclide was divided by its respective DCS and the ratios from all nuclides were summed. As a DOE policy, the sum of the ratios (also called the "sum of fractions") should not exceed 1.0, or otherwise expressed as the sum of percentages, should not exceed 100%. Tables 2-1 and 2-2 list the sum of ratios for WNSP001 and WNSWAMP.

The sum of ratios for the release from WNSP001 in 2016 was approximately 0.26, or only approximately 26% of the 1.0 criterion. The sum of ratios from WNSWAMP was 0.87, also below the 1.0 criterion. The maximum sum of ratios calculated at WNSWAMP to date was 2.67 in 2009, prior to installation of the PTW.

As in past years, the sum of ratios at WNSWAMP was almost entirely attributable to strontium-90. Drainage through the WNSWAMP sampling location largely consists of emergent groundwater supplemented by surface water run-off. Elevated gross beta concentrations were first measured at this location in 1993. Subsequent investigations delineated a plume of strontium-90-contaminated groundwater on the north plateau that discharges to the surface water flowing through the WNSWAMP location.

FIGURE 2-1
Flow-Weighted Annual Average Strontium-90 Concentrations at WNSWAMP



In November of 2010, a PTW designed to remove strontium-90 from the groundwater was installed upgradient of the WNSWAMP drainage ditch. A description of the PTW and other remedial measures designed to limit migration of the strontium-90 groundwater plume are discussed in Chapter 4, "Groundwater Protection Program."

For the first time since 2012, the 2016 flow weighted annual average strontium-90 concentration at WNSWAMP (9.48+0.09E-07 µCi/mL) was below the DCS (1.1E-06 µCi/mL]). The strontium-90 concentration at WNSWAMP first exceeded the DCS in 1995. The 2016 annual average strontium-90 concentrations at WNSWAMP are lower than both the 2015 and 10-year annual average concentrations (Figure 2-1).

Waters with elevated strontium-90 concentrations drain from WNSWAMP into Franks Creek, then into Buttermilk Creek, and ultimately into Cattaraugus Creek. Water samples are collected monthly for strontium-90 analysis from Cattaraugus Creek downstream of the WVDP at Felton Bridge (WFFELBR), the first point of public access. The strontium-90 concentrations in CY 2016 at WFFELBR were statistically indistinguishable from background.

State Pollutant Discharge Elimination System (SPDES) Permit-Required Monitoring. Liquid discharges from the WVDP are regulated for chemical constituents under a SPDES permit, as identified in Table ECS-3. The permit identifies compliance points from which liquid effluents are released to Erdman Brook (Figure A-2), and specifies the sampling and analytical requirements for each.

The conditions and requirements of the current SPDES permit are summarized in Appendix B-1. The permit identifies 23 outfalls and compliance points with monitoring requirements and discharge limits. The monitored outfalls include:

- outfall 001 (monitoring point WNSP001), discharge from the LLW2 through the lagoon system;
- outfall 007 (monitoring point WNSP007), discharge from the WWTF, which was discontinued in November 2014 but is still on the SPDES permit;
- outfall 116 (pseudo-monitoring point WNSP116, as noted on the permit), a location in Franks Creek that represents the confluence of outfalls

WNSP001 and WNSP007, as well as storm water runoff, groundwater seepage, and augmentation water. Samples from upstream sources are used to calculate total dissolved solids (TDS) at this location and to demonstrate compliance with the SPDES permit limit for this parameter;

- outfall 01B (monitoring point WNSP01B), an internal monitoring point for the liquid waste treatment system evaporator effluent, which was historically monitored for flow and total mercury. No effluent has been released from this outfall since 2006; and

- nineteen storm water discharge outfalls that receive flow from other minor sources, such as fire hydrant testing and groundwater seepage, monitored on a rotational basis. Requirements of the SPDES permit for monitoring storm water runoff include measurements of:

  (1) the water quality for specific chemical parameters in storm water discharges from specified WVDP locations;
  (2) the amount of rainfall;
  (3) the storm event duration, and
  (4) the resulting flow at the outfalls.

  The 19 WVDP storm water outfalls are grouped into eight representative drainage basins that could potentially be influenced by industrial or construction activity runoff. One representative outfall from each of the eight outfall groups listed in Appendix A must be sampled on a semiannual basis.

The SPDES permit specifies the following conditions for a qualifying storm water event eligible for storm water discharge monitoring:

(1) a total rainfall of more than 0.1 inch;
(2) a period of 72 hours between the monitored event and the previous measurable event of 0.1 inches of precipitation; and
(3) resultant storm water discharge at the outfall.

During CY 2016, two sets of storm water samples were collected from all eight outfall groups. Appendix B-2 presents 2016 process effluent data with SPDES permit limits provided for comparison. Appendix B-3 presents 2016 storm water runoff monitoring data for outfalls designated in the WVDP SPDES permit.

There were no SPDES effluent limit exceedances and no SPDES noncompliance events during 2016.

Airborne Effluent Monitoring

Radiological Air Emissions. Air releases are evaluated and reported to the EPA in the annual NESHAP report. Federal law allows air containing small amounts of radioactivity to be released from plant ventilation stacks during normal operations. The releases must meet dose criteria specified in the NESHAP regulations to ensure that public health and safety and the environment are protected.

During 2016, WVDP radiological releases were measured and/or estimated from six of seven permitted emission points (see Table ECS-3) and from diffuse sources. Sampling locations for point source air emissions are shown on Figure A-6 in Appendix A. The only diffuse source in 2016 was the wastewater storage lagoons that contribute a diffuse radiological release to air at the WVDP by surface water evaporation. Building demolition may be a diffuse source of radiological release to air. However, no radiological facilities were demolished in 2016.

Measured radionuclide concentrations in air at each of the ventilation point sources are compared with DCSs in Appendix C. When only gross alpha and beta measurements are available in WVDP air sample results, activity is assumed to come from plutonium-239/240 and strontium-90, respectively, because the DCSs for these radionuclides are the most limiting for major WVDP particulate emissions.

Ventilation and Emission Systems. Exhaust from each EPA-permitted ventilation system on the WVDP is continuously filtered and the permanent systems are monitored as air is released to the atmosphere. Because radionuclide concentrations in air emissions from the site are quite low, a large volume of facility air must be sampled to measure the radionuclide quantity released.

Emissions are sampled for radioactivity in both particulate (e.g., strontium-90 and plutonium-239/240) and gaseous forms (e.g., tritium and iodine-129). The total release of each radionuclide varies from year to year in response to changing site activities. For instance, releases of iodine-129 dropped sharply after vitrification was completed in 2002.

The Main Plant Process Building (MPPB) Ventilation Stack and Replacement Ventilation System (RVS).
The primary controlled air emission point at the WVDP is the MPPB ventilation stack, ANSTACK, which vents to the atmosphere at a height of 208 ft (63.4 m).

The MPPB stack has historically released ventilation exhaust from several systems, including the HEV system, the Ventilation Exhaust Cell (VEC), the WTF, process off-gas, and off-gas from the former VIT system. Many of these historical contributors to the MPPB stack effluent have been isolated for a number of years and no longer contribute to the stack effluent. During 2016, ventilation through the MPPB stack was only from the VEC system.

The HEV system, which ventilated the rooms in the MPPB that were the most highly contaminated during NFS fuel reprocessing operations, was replaced by the new RVS which began operating in August 2015. The HEV system was shut down in December 2015. The replacement system allowed dismantling of the HEV system and continued decommissioning of the MPPB. The RVS is made up of two Replacement Ventilation Units (RVUs) with a single emission point. The RVS exhausts through its own stack.

Replacement Ventilation System (RVS) for a portion of the MPPB

Ventilation continues to be required in the MPPB while it is being prepared for demolition. Decontamination activities, which are on-going, have been performed in the majority of the MPPB rooms, and debris and vessels have been removed, reducing overall contamination levels. Current emissions from the MPPB through the MPPB stack and the RVS are an order of magnitude lower than the emissions were during VIT operations in 2002.

Total curies released from the MPPB stack in 2016 are listed in Table 2-3, together with annual averages, maxima, and a comparison of average isotopic concentrations with the applicable DCSs. The sum of ratios for radiological concentrations from ANSTACK was 0.017, well below the DOE guideline of 1.0. Airborne concentrations from the stack to the WVDP site boundary are further reduced by dispersion. The total curies released from the RVS in 2016 were a small fraction of the total curies released from ANSTACK in 2016. The RVS results are reported in Table C-2 of Appendix C.

Other On-Site Air Sampling Systems. Sampling systems similar to those of the MPPB are used to monitor airborne effluents from the former VIT heating ventilation and air conditioning system (ANVITSK), the STS/permanent ventilation system stack (ANSTSTK), the Container Sorting and Packaging Facility (CSPF) ventilation stack (ANCSPFK), and the RHWF stack (ANRHWFK). (See Figure A-6.) Ventilation from the Contact Size Reduction Facility (CSRF) ventilation stack (ANCSRFK) was discontinued in 2011, and replaced by a portable ventilation unit (PVU). The CSRF PVU was not operated in 2016. The 01-14 building ventilation stack (ANCSSTK) was demolished with the 01-14 building in 2013. Ventilation from the CSPF in the LSA #4 building was suspended in October 2014 due to lack of repackaging activity. There were no emissions from the CSPF stack in 2016. Operation of the VF heating ventilation and air conditioning system (ANVITSK) was discontinued in July 2016 and replaced by two PVUs.

Permitted outdoor ventilation enclosures (OVEs) for the PVUs are used to provide the ventilation necessary for personnel safety while working with radioactive materials in areas outside permanently ventilated facilities or in areas where permanent ventilation must be augmented. Air samples from PVUs are collected continuously while emission points are discharging, and the data collected are included in annual evaluations of airborne emissions.

Appendix C presents total radioactivity released for specific radionuclides at each on-site air sampling location. No DCSs were exceeded by airborne emissions on an annualized basis during CY 2016. Locations with radiological results statistically greater than background values are summarized in Table 2-4.

Unplanned Radiological Airborne Release. No unplanned radiological airborne releases occurred in 2016.

Nonradiological Air Emissions. Nonradiological air emissions at the WVDP are regulated under an air facility registration certificate that caps (limits) nitrogen and sulfur oxide emissions (NO_X and SO_X, respectively) from the facility at 49.5 tons per year each. (See Table ECS-1.) The certificate primarily applies to two site utility steam boilers, which are the only non-exempted sources of NO_X and SO_X at the site. The boilers were taken out of service in January 2014 and removed from the certificate in 2016.

TABLE 2-3
Total Radioactivity Released at Main Plant Stack (ANSTACK) in 2016 and Comparison of Discharge Concentrations with DOE DCSs

Isotope [a]	*N*	*Total Activity Released* [b] *(Ci)*	*Average Concentration (µCi/mL)*	*Maximum Concentration (µCi/mL)*	*DCS* [c] *(µCi/mL)*	*Ratio of Average Concentration to DCS*
Gross Alpha	26	1.62±0.05E-06	2.19±0.07E-15	2.64E-14	NA[d]	NA
Gross Beta	26	1.07±0.01E-05	1.44±0.02E-14	1.15E-13	NA[d]	NA
H-3	26	7.59±0.61E-04	1.02±0.08E-12	2.26E-12	2.1E-07	<0.0001
Co-60	2	-1.26±3.28E-08	-1.69±4.42E-17	< 7.77E-17	3.6E-10	<0.0001
Sr-90	2	2.55±0.16E-06	3.43±0.22E-15	4.45E-15	1.0E-10	<0.0001
I-129	2	1.07±0.03E-05	1.44±0.05E-14	1.64E-14	1.0E-10	0.0001
Cs-137	2	3.31±0.12E-06	4.46±0.17E-15	4.94E-15	8.8E-10	<0.0001
Eu-154	2	-9.46±9.17E-08	-1.28±1.24E-16	< 2.05E-16	7.5E-11	<0.0001
U-232[e]	2	5.28±5.59E-09	7.11±7.54E-18	1.34E-17	4.7E-13	<0.0001
U-233/234[e]	2	2.83±0.77E-08	3.82±1.03E-17	4.19E-17	1.0E-12[f]	<0.0001
U-235/236[e]	2	1.04±0.54E-08	1.40±0.73E-17	1.50E-17	1.2E-12	<0.0001
U-238[e]	2	2.81±0.73E-08	3.78±0.98E-17	4.19E-17	1.3E-12	<0.0001
Pu-238	2	1.85±0.20E-07	2.49±0.27E-16	3.90E-16	8.8E-14	0.0028
Pu-239/240	2	2.73±0.24E-07	3.68±0.32E-16	4.87E-16	8.1E-14	0.0045
Am-241	2	6.92±0.36E-07	9.33±0.49E-16	1.41E-15	9.7E-14	0.0096
Sum of Ratios						**0.017**

N - Number of samples.
NA - Not applicable.
[a] Half-lives are listed in Table UI-4.
[b] Total volume released at 50,000 cubic feet per minute = 7.42E+14 mL/year.
[c] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[d] DCSs do not exist for indicator parameters gross alpha and gross beta.
[e] Total Uranium = 5.39±0.17E-02 g; average = 7.27±0.23E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[f] DCS for Uranium-233 used for this comparison.

Other units with the potential to emit nonradiological pollutants, such as generators listed in the certificate, are exempted with the understanding that each unit operates less than 500 hours per year. Consequently, there were no reportable NO_X and SO_X emissions in 2016. As of 2016, routine regulatory reporting of nonradiological air emissions is not required. However, the WVDP is currently required by the Air Facility Registration Certificate to demonstrate that only ultra low sulfur diesel fuel is used in the site generators.

Results from the ambient air samplers within a mile of the site boundary have confirmed that WVDP operations have had no discernible effect on off-site air quality, as discussed in the following section.

Environmental Surveillance

Ambient Air. The sixteen ambient air monitoring stations encircling the WVDP have been sampled since October 2012. The first quarter of sampling data was used for operational baselining and equipment testing. CY 2016 represents the fourth full year of routine ambient air monitoring. The ambient air sampling program provides continuous environmental air sampling during all site activities for surveillance and regulatory compliance.

Filter samples are collected biweekly for gross alpha and gross beta screening and charcoal cartridges are collected monthly for iodine-129 screening analysis. Samples collected on a biweekly or monthly basis are composited quarterly and analyzed for radioisotopes known to have

TABLE 2-4
2016 Environmental Monitoring Locations
with Results Greater than Applicable Limits or Background

Sample Type	*Total Number of Sampling Locations and Location Names*	*Locations with Results Greater than Applicable Limits or Screening Levels* [a] *(Constituent)*	*Number of Locations with Results Greater Than Background*	*Locations with Radiological Results Statistically Greater than Background (Constituent)*
Air				***background location=AFGRVAL***
On-site air emission points	6 ANSTACK ANRVEU1 ANSTSTK ANVITSK ANRHWFK OVE/PVUs	**None**	4	**ANSTACK** (gross alpha, H-3, Sr-90, I-129, Cs-137, Pu-238, Pu-239/240, Am-241); **ANRVEU1** (I-129); **ANSTSTK** (H-3, I-129); **ANVITSK** (U-235/236)
Off-site ambient air network	16 AF01_N AF02_NNE AF03_NE AF04_ENE AF05_E AF06_ESE AF07_SE AF08_SSE AF09_S AF10_SSW AF11_SW AF12_WSW AF13_W AF14_WNW AF15_NW AF16_NNW	**None**	0	**None**
Surface water				***background locations = WFBCKBG on Buttermilk Creek and WFBIGBR on Cattaraugus Creek***
On-site surface water effluent and natural drainage	8 WNSP001 WNSP006 WNSP005 WNSWAMP WNSW74A WNNDADR WNERB53 WNFRC67	**WNSWAMP** (Sr-90, Gross beta)	7	**WNSP001** (Gross alpha, Gross beta, H-3, Sr-90, Tc-99, I-129, Cs-137, U-232, U-233/234, U-235/236, U-238, Am-241) **WNSP006** (Gross beta, Sr-90, Cs-137, U-233/234, U-235/236, U-238); **WNSP005** (Gross beta, Sr-90,); **WNSWAMP** (Gross beta, Sr-90, U-235/236, U-238); **WNSW74A** (Gross beta, Sr-90, U-238); **WNNDADR** (Gross beta, H-3, Sr-90); **WNERB53** (Gross beta)
Off-site downstream surface water	2 WFBCTCB WFFELBR	**None**	2	**WFBCTCB** (Gross beta); **WFFELBR** (Gross beta)

[a] Applicable regulatory, guidance, or screening limits are listed in Table UI-4 (radionuclides in air and water), and Appendix B-1 (water).

TABLE 2-4 *(concluded)*
2016 Environmental Monitoring Locations
with Results Greater than Applicable Limits or Background

Sample Type	*Total Number of Sampling Locations and Location Names*	*Locations with Results Greater than Applicable Limits or Screening Levels* [a] *(Constituent)*	*Number of Locations with Results Greater Than Background*	*Locations with Radiolocial Results Statistically Greater than Background* *(Constituent)*
Food				***background locations = BFMCTLS milk and BFDCTRL venison***
Off-site milk samples	1 BFMFLDMN	**None**	0	**None**
Off-site venison samples	3 BFDNEAR BFDNEAR BFDNEAR	**None**	1	**BFDNEAR** (Cs-137)
Environmental radiation				***background location=DNTLD23***
On-site dosimeters near WVDP facilities	11 DNTLD24,28 32,33,34,35 36,38,40,43,44	**None**	3	**DNTLDs #24, 38, 40**
Off-site perimeter dosimeters	17 DFTLD01 to 16 and DFTLD20	**None**	0	**None**

[a] Applicable regulatory, guidance, or screening limits are listed in Table UI-4 (radionuclides in air and water), and Appendix B-1 (water).

been managed on the site. Samples of ambient air will include naturally occurring radioisotopes such as radon decay products which will be detected in the gross radioactivity analyses.

A high-volume sampler is included in the ambient air network located downwind in the prevailing wind direction, which is the direction of the hypothetical critical receptor (the historical MEOSI). This sampler operates at a flow rate more than five times the low-volume samplers and was installed to confirm the results of the lower volume sampling. The low-volume sampling system is able to detect site-managed radioisotopes to approximately 1% of each radioisotope's environmental regulatory compliance level. The high-volume sampler can detect particulate radioisotopes down to approximately 0.1% to 0.2% of the compliance level. (Although the high-volume sampler does not include a sample for iodine-129, the co-located low-volume sampler does measure iodine-129.)

Data collected from the ambient air monitors from January to December 2016 are summarized in Tables C-9, C-10, and C-11 of Appendix C. Gross alpha and gross beta concentrations, measured biweekly, as well as the quarterly composited isotopic results collected in all sixteen ambient air sectors have very similar concentrations as those observed at AFGRVAL, the background ambient air sampler located 18 miles (29 km) south of the site. This location in Great Valley, New York has been monitored for many years (see Figure A-14) and was sampled throughout 2016. This distant background location samples regional air with very low potential to be affected by radiological releases from the WVDP.

None of the 2016 annual average radioisotopic results at the ambient air sampling locations were above the detection limit.

Continuous on-site air sampling is also performed close to the work area during demolition of all radiologically contaminated facilities for health and safety purposes by radiological control technicians. Samples collected from these local samplers are analyzed for gross radioactivity on a daily basis during demolition activities.

Surface Water. On-site surface water drainage is routinely sampled at several points on the north and south plateaus, as shown in Appendix A, Figure A-2. Monitoring points are sited at locations where releases from possible source areas on the north and south plateaus could be detected. Off-site sampling locations are shown on Figure A-5. Appendix B-4 presents data for site surface water drainage and ambient surface water monitoring locations. Also provided for side-by-side comparison with these data are reference values, where available, including background water monitoring data and/or pertinent water quality standards and guidelines.

Radiological and nonradiological results from surface water samples were compared with applicable water quality standards and guidelines. Locations with results exceeding applicable limits and those with results statistically greater than background values are summarized in Table 2-4 and are discussed below.

South Plateau Surface Water. The two inactive underground radioactive waste disposal areas (the NDA, under DOE's control, and the SDA, under NYSERDA's control), the 56 VSCs (stored on the interim HLW Cask Storage Pad), and the drum cell (a building formerly used to store drums of processed LLW), are all located on the south plateau. The drum cell has been empty since 2007, when the waste drums were shipped off site. The disposal sites, the VSCs, and the drum cell are all potential (although not anticipated) contaminant sources to surface water on the south plateau.

Surface water drainage across the south plateau is primarily captured by Erdman Brook and Franks Creek and is monitored downstream of the NDA, SDA, HLW Cask Storage Pad, and drum cell at locations WNNDADR, WNERB53, and WNFRC67. Drainage is directed around the NDA and SDA by storm water drainage pipes, culverts, and drop inlets.

Gross beta and strontium-90 concentrations have historically exceeded background concentrations at both WNNDADR and WNERB53 (see Figure 2-2), and tritium has exceeded background at WNNDADR (see Figure 2-3). Residual soil contamination from past waste burial activities is thought to be the source of this radioactivity. No radionuclide concentrations from these two locations are greater than (or even approach) DCSs. (See Tables B-4E and B-4F.)

A geomembrane cap and slurry wall were constructed at the NDA in 2008 to limit groundwater, surface water, and precipitation infiltration into the NDA. This interim remedial measure has reduced the average gross beta concentrations at WNNDADR and WNERB53 downstream of the NDA by 86% and 62%, respectively and has reduced the strontium-90 concentrations by 85% and 78% respectively. These substantial decreases indicate the IM's effectiveness in reducing surface water infiltration and groundwater migration through the NDA, which affects surface water drainage at these points.

Tritium concentrations at WNNDADR have been decreasing overall since routine monitoring began at this location in 1991. Tritium concentrations at WNNDADR have decreased from a high of 1.79E-05 µCi/mL in 1992 to an annual average concentration of 3.98E-07 µCi/mL in 2016. Since tritium's half-life is only slightly more than 12 years, these observed decreasing tritium concentrations are partly attributable to radioactive decay. Tritium concentrations at WNNDADR, shown on Figure 2-3, remained above the background concentration at Buttermilk Creek of <9.12E-08 uCi/mL but well below the tritium DCS of 1.9E-03 µCi/mL.

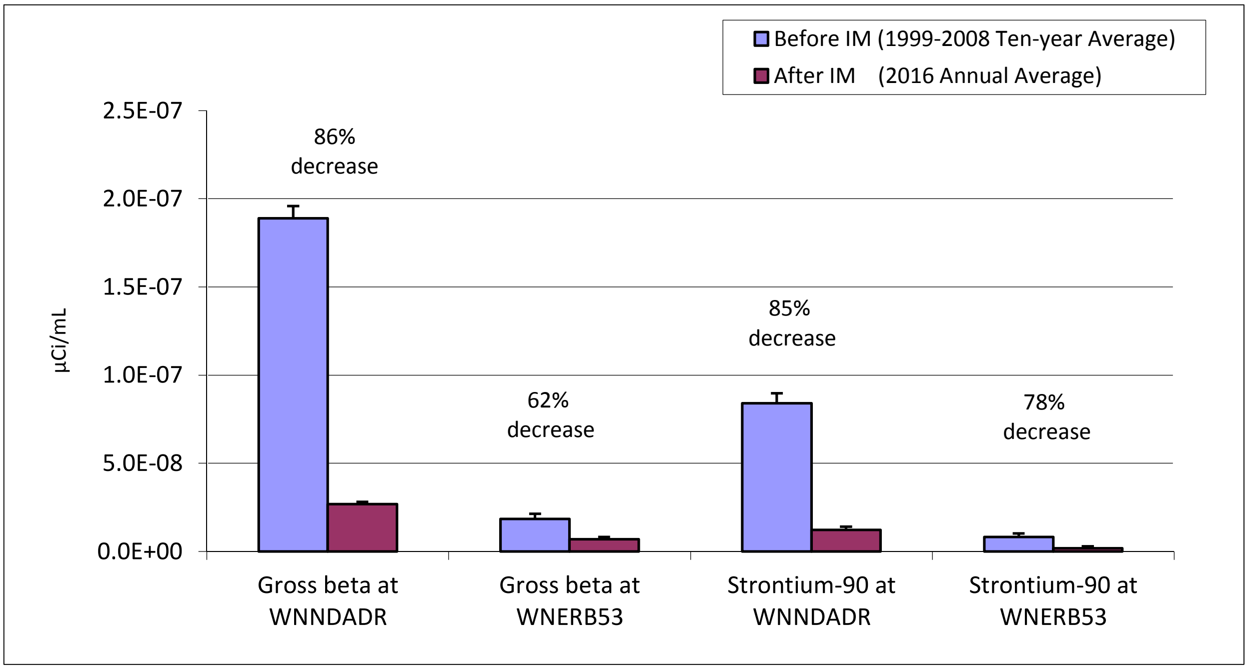
North Plateau Surface Water. On the north plateau, possible contaminant sources that could affect surface water include the WTF, MPPB, the lagoon system associated with the LLW2, waste handling and storage facilities, and seepage from the strontium-90 groundwater plume.

Surface water drainage across the north plateau is captured by Quarry Creek and Franks Creek. North plateau sampling locations include the lagoon 3 discharge (WNSP001), and the two natural drainages (WNSW74A and WNSWAMP), previously discussed, as well as two additional upstream locations, (WNSP005 and WNSP006).

The CY 2016 annual average gross beta and strontium-90 concentrations statistically exceeded background concentrations at WNSP005, located east of the MPPB, but both annual average concentrations were below DCSs.

As in previous years, concentrations at WNSP006, sampled at Franks Creek downgradient of the lagoon 3 outfall, statistically exceeded background for gross beta, strontium-90, cesium-137, uranium-233/234, uranium-235/236 and uranium-238. However, all of the radioisotopic concentrations measured at WNSP006 in 2016 were also well below DCSs.

FIGURE 2-2
Average Gross Beta and Strontium-90 Concentrations in Surface Water on the South Plateau at WNNDADR[a] and WNERB53[b] Before and After the NDA Interim Measure (IM) was Installed

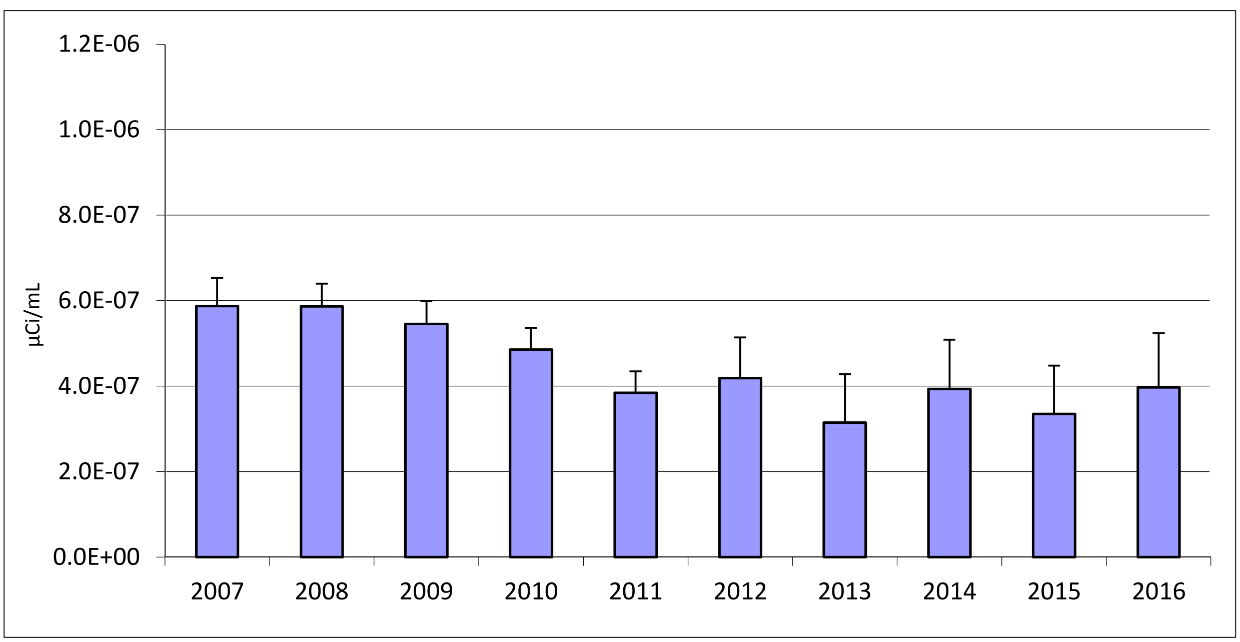


Note: The upper limit of the uncertainty term is indicated with each point. Average gross beta and strontium-90 background concentrations in Buttermilk Creek (WFBCBKG) in CY 2016 were 2.03±0.76E-09 and 4.30±8.00E-10 µCi/mL, respectively.

[a] Sample point WNNDADR is located downstream, immediately north of the NDA.

[b] Sample point WNERB53 is located farther downstream, on Erdman Brook.

FIGURE 2-3
Average Concentration of Tritium in Surface Water at WNNDADR: 2007-2016



Note: The upper limit of the uncertainty term is indicated with each point. Average background tritium concentration in Buttermilk Creek (WFBCBKG) in CY 2016 was <9.12E-08 µCi/mL.

Off-Site Surface Water. Buttermilk Creek receives surface water drainage from the WNYNSC. Buttermilk Creek drains into Cattaraugus Creek which eventually drains into Lake Erie. Surface water samples were collected at three off-site locations in 2016:

- one background location on Buttermilk Creek upstream of the WVDP at Fox Valley Road (WFBCBKG) shown on Figure A-5,
- one downstream location on Buttermilk Creek at Thomas Corners Bridge (WFBCTCB), just before Buttermilk Creek flows into Cattaraugus Creek, shown on the aerial photo below, and
- one further downstream location on Cattaraugus Creek at Felton Bridge (WFFELBR), the first point of public access to surface water downstream of both the WNYNSC and the WVDP, also shown on the aerial photo below.

These locations were sampled for gross alpha, gross beta, tritium, strontium-90, and cesium-137 radioactivity. The strontium-90 and cesium-137 concentrations at both downstream locations WFFELBR and WFBCTCB were statistically indistinguishable from background in CY 2016.

Until discontinuing sampling in 2008, background samples were also collected from another background location on Cattaraugus Creek at Bigelow Bridge on Route 240, upstream of the confluence of Buttermilk Creek and Cattaraugus Creek (WFBIGBR). This location is annotated on Figure A-5. Historical data from this location from 1991 through 2007 have been used to establish upstream background concentrations for Cattaraugus Creek for comparison to samples collected at WFFELBR.

The 2016 annual average strontium-90 concentration at Felton Bridge (WFFELBR), the first point of public access downstream of the site, was a non-detect value of <9.73E-10 µCi/mL. This value is an estimated result below the contract required detection limit for strontium-90. (See Table B4-I).

The annual average strontium-90 concentration at Thomas Corners Bridge (WFBCTCB) was also a non-detect value in 2016 (<1.06E-09 µCi/mL). (See Table B4-H). The maximum strontium-90 concentrations at both of these locations downstream of the site were less than 0.1% of the strontium-90 DCS . Average concentrations of gross alpha, tritium, and cesium-137 were also below detection limits in these downstream sampling locations in 2016.

Surface Water Sampling Locations Downstream of the WVDP on Cattaraugus Creek and Buttermilk Creek

However, gross beta, which is naturally occurring in the environment, is frequently detected in surface water due to minor amounts of sediment in the samples. As in previous years, gross beta was detected in the samples collected at WFFELBR and WFBCTCB. The maximum gross beta concentrations at each of these locations in 2016 was 0.7% of the strontium-90 DCS.

Sediment and Soil. Airborne particulates may be deposited onto soil by wind or precipitation. Particulate matter in streams can adsorb radiological constituents in liquid effluents and settle on the stream bottom as sediment. Soils and sediment may subsequently be eroded or resuspended, especially during periods of high winds or high stream flow. The resuspended particles may provide a pathway for radiological constituents to reach humans either directly via exposure or indirectly through the food pathway.

As part of the monitoring program, on-site sediment/soil samples are collected every five years at three locations on the north plateau where drainage has the potential to be contaminated. On-site soils are collected at SNSP006, SNSWAMP, and SNSW74A (see Figure A-2). Soil samples are also collected at one background location (SFGRVAL, shown on Figure A-14) and three former near-site air sampling locations (SFRSPRD, SFFXVRD, and SFRT240), shown on Figure A-5. Additional off-site sediment samples are collected at one background location on Buttermilk Creek (SFBCSED) and at three downstream locations, one on Buttermilk Creek (SFTCSED) and two on Cattaraugus Creek (SFCCSED and SFSDSED) (see Figure A-5). No sediment or soil samples were collected in 2016. Soil and sediment samples were last collected in 2012 and will next be collected in 2017.

Food. Food samples are collected from locations near the site (Figure A-11) and from remote locations (Figure A-14). Milk and venison samples are collected every year. Fish, apples, beans, and corn are collected every five years, with 2012 being the most recent collection year. Corn, apples, and beans are collected at harvest time. Edible portions are analyzed for radionuclides. Data from 2016 for milk and venison samples are presented in Appendix E. Fish and food crops will be sampled next in 2017.

In 2016, milk and venison data continue to demonstrate that the Project has a minimal effect on local food sources. No radionuclides were detected in milk samples statistically above background in 2016.

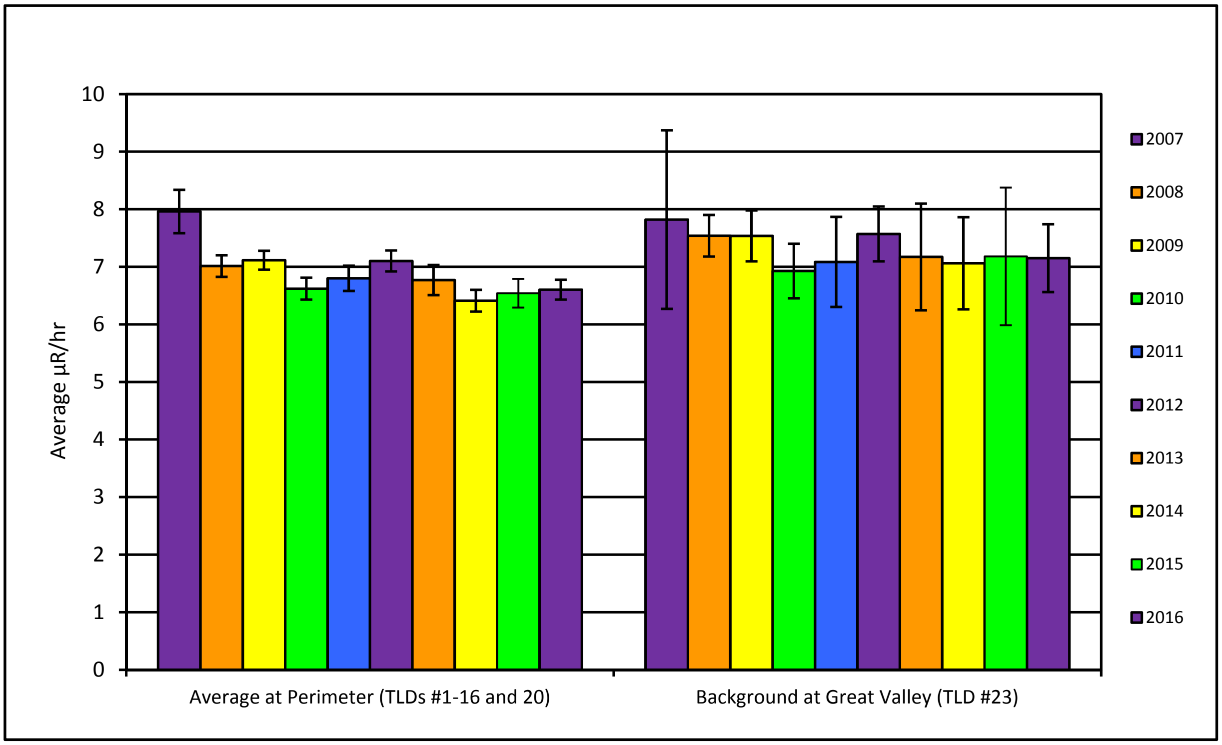
In the 2016 venison samples, the cesium-137 concentration in just one of three near-site deer exceeded the cesium concentrations detected in the background deer collected more than 10 miles (16 km) from the site. As discussed under "Calculated Dose from Food" in Chapter 3, the 2016 conservative dose estimates from consuming maximum quantities of near-site deer, fish, milk, beans, corn, and apples are well below any level of concern and have consistently helped confirm the low dose estimates from the site based on results from air and water monitoring.

Environmental Radiation. Thermoluminescent Dosimeters (TLDs) directly measure radiation in the environment. TLDs are placed on site at waste management units, at the WVDP security fence, around the WNYNSC perimeter and the access road, and at a background location in Great Valley, remote from the WVDP. No changes were made to the location of TLDs in 2016. On-site/near-site TLD locations are shown on Figure A-12 and perimeter TLD locations (off-site) are shown on Figure A-13 in Appendix A.

Figure 2-4 presents a graph of average annual exposure rates (in microroentgen per hour) over the last 10 years at perimeter and background locations. As shown, results at perimeter locations are comparable to background. In addition, no discernible trends over time are evident. TLD data is presented in Appendix F.

Consistent with historical data, the 2016 results from three of the on-site/near-site TLDs (DNTLD24, DNTLD38, and DNTLD40) located near north plateau on-site waste storage facilities were generally higher than background. These locations are within the WNYNSC boundary and are not accessible by the public. On the south plateau, on-site/near-site TLD results remained at background levels.

FIGURE 2-4
10-Year Trends of Environmental Radiation Levels at Perimeter and Background Thermoluminescent Dosimeters (TLDs)



NOTE: The upper and lower limits of the 95% confidence limit of the mean are plotted with each result.

TLD results at the WNYNSC perimeter (TLDs #1-16 and 20) were statistically the same as results from the background TLD (TLD #23), indicating no measurable exposure from Project activities at these locations.

Meteorological Monitoring. Meteorological monitoring at the WVDP provides representative and verifiable data that characterize the local climatology. These data are used to assess potential effects of routine and non-routine releases of airborne radioactivity and to provide input to dispersion models which can be used to calculate dose to off-site residents. The on-site 197-ft (60-m) meteorological tower (Figure A-1) continuously monitors wind speed, wind direction, and temperature at both the 197-ft (60-m) and 33-ft (10-m) elevations. Site barometric pressure is also measured at ground level. Precipitation was monitored east of the main parking lot in 2016.

Total precipitation in 2016 was less than 90% of the 10-year annual average as shown in Table 2-5.

TABLE 2-5
WVDP 2016 Monthly Precipitation Totals Compared with 10-Year Monthly Averages

Month	*2016 Monthly Total (inches)*	*10-Year Monthly Average (2006 through 2015)*
January	2.01	3.07
February	2.75	2.37
March	2.29	2.60
April	1.99	3.55
May	1.85	2.29
June	1.89	3.73
July	1.91	4.97
August	5.31	4.31
September	3.28	4.08
October	5.41	3.64
November	3.10	3.04
December	5.12	3.76
Total (inches)	36.9	41.4
Total (centimeters)	93.8	105.2

The meteorological tower supplies data to the primary digital and analog data acquisition systems on site. The systems are provided with either uninterruptible or standby power backup in the event of site power failures. In 2016, the data recovery rate (the time valid data were logged versus the total elapsed time) was 96.3%. Documentation, such as meteorological system calibration records, site log books, and analog strip charts, are stored in protected archives. "Wind roses" showing the predominant wind direction as measured at the meteorological tower (60-m and 10-m) are shown on Figure 2-5. The wind measurements at the 10-m elevation are influenced by the orientation of the topography around the site. As expected, wind speeds measured at the 10-m elevation were lower than those from the 60-m elevation.

Because dispersive capabilities of the atmosphere are dependent upon wind speed, wind direction, and atmospheric stability (which includes a function of the difference in temperature between two elevations), these parameters are closely monitored and are available to the Emergency Response Organization (ERO) at the WVDP. If an air release occurred, meteorological data would be used to predict the direction of plume migration.

Drinking Water

Project drinking water (potable water) and utility water were drawn from two surface water lakes located within the WNYNSC through September 18, 2014 when the supply source was converted to groundwater. Two bedrock wells were installed in the central area of the site in 2014 capable of satisfying the current and anticipated future potable and process water requirements. Supplemental water needed for emergencies, such as a major fire, and SPDES flow augmentation water, will continue to be supplied by the lakes. Conversion to groundwater as the primary source of potable water was undertaken to allow for closure and demolition of the site utility room attached to the MPPB. A new drinking water treatment and distribution system has been designed to replace the drinking water components that are currently housed in the utility room, such as the chlorinator and iron treatment system.

Drinking water continues to be monitored for both radiological and chemical constituents, with slightly different sampling requirements for the groundwater source. It is monitored at the distribution entry point and at other site tap water locations to verify compliance with EPA, NYSDOH, and Cattaraugus County Health Department regulations. The water supply is also monitored at the groundwater supply wells and at three nearby bedrock wells as part of the source water protection plan. Results from 2016 indicated that the Project's drinking water continued to remain below the local, state, and federal Maximum Contaminant Levels (MCLs) and drinking water standards. Radiological measurements for the supply wells and the nearby bedrock wells were consistent with background levels. The 2016 results for the potable water supply system are presented in Appendix B-5.

Special Projects

Sampling of two on-site ambient air monitors located downwind of the VF began in 2016, as required by EPA, and will continue through completion of VF demolition. The data collected from these samplers during demolition of the VF will be used to validate that the predicted emissions were not underestimated. Results of this VF study will then be used for MPPB demolition planning.

This monitoring is covered in the report "Test Plan for Study of Air Emissions from the Demolition of the Vitrification Facility at West Valley Demonstration Project Compared to Emissions Estimates using Methodology for Radionuclide Source Term Calculations for Air Emissions from Demolition Activities," (Blunt Consulting, LLC, December 2016).

Environmental Monitoring Summary

As in the past, although concentrations of certain radiological constituents from samples collected within the security fence exceeded comparison levels or background concentrations, results from off-site and downstream confirm that the public's health and safety, and the environment continue to be protected. (See Table 2-4.)

Monitoring results from CY 2016 confirm the effectiveness of radiological control measures practiced at the WVDP. A video describing the WVDP environmental monitoring program is available for viewing at:

https://youtu.be/rTXr-COlmEs or
http://www.chbwv.com/video9.htm.

FIGURE 2-5

Wind Frequency and Speed From the Meteorological Tower (10-m and 60-m Elevations)
January 1-December 31, 2016

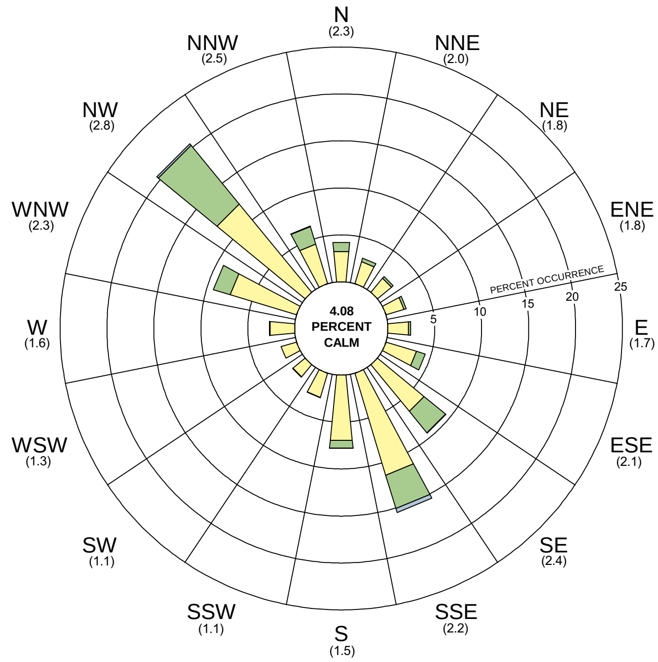
Key:

Numbers indicate sector mean wind speed.

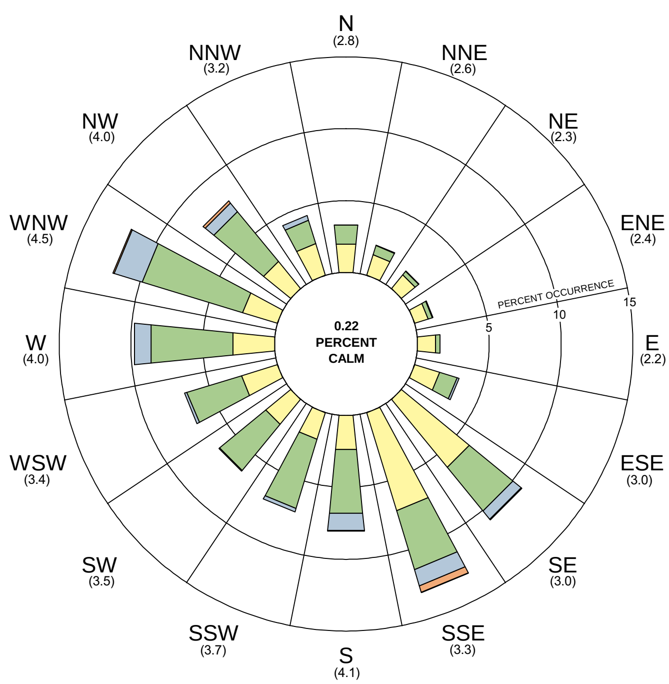
Sectors are directions from which the wind is blowing.

Wind Speed Range (m/sec)

- 0.5-3.0
- 3.0-6.0
- 6.0-9.0
- 9.0-12.0
- >12.0



Meteorological Tower (10-m)



Meteorological Tower (60-m)

CHAPTER 3
DOSE ASSESSMENT

Radiation Sources at the WVDP

Members of the public are routinely exposed to natural and man-made sources of ionizing radiation that can be absorbed by living tissue. (See the inset on page 3-3 for discussions of "Radiation Dose" and "Units of Dose Measurement.") An individual living in the U.S. is estimated to receive an average annual effective dose equivalent (EDE) of about 620 mrem (6.2 mSv) (National Council on Radiation Protection and Measurements [NCRP] Report 160, 2009). NCRP Report No. 160, an update of NCRP Report No. 93 (1987), noted that the average member of the U.S. population was exposed to significantly more radiation from medical procedures than from any other source.

Half of the typical radiation dose to a member of the public, about 310 mrem/year, is from natural background sources such as cosmic radiation (from outer space) and terrestrial radiation and radon (from the subsurface). (See Figure 3-1.) The other half is from man-made sources, such as consumer products and medical diagnostic procedures. (See the "Useful Information" section of this report for discussions of ionizing radiation.)

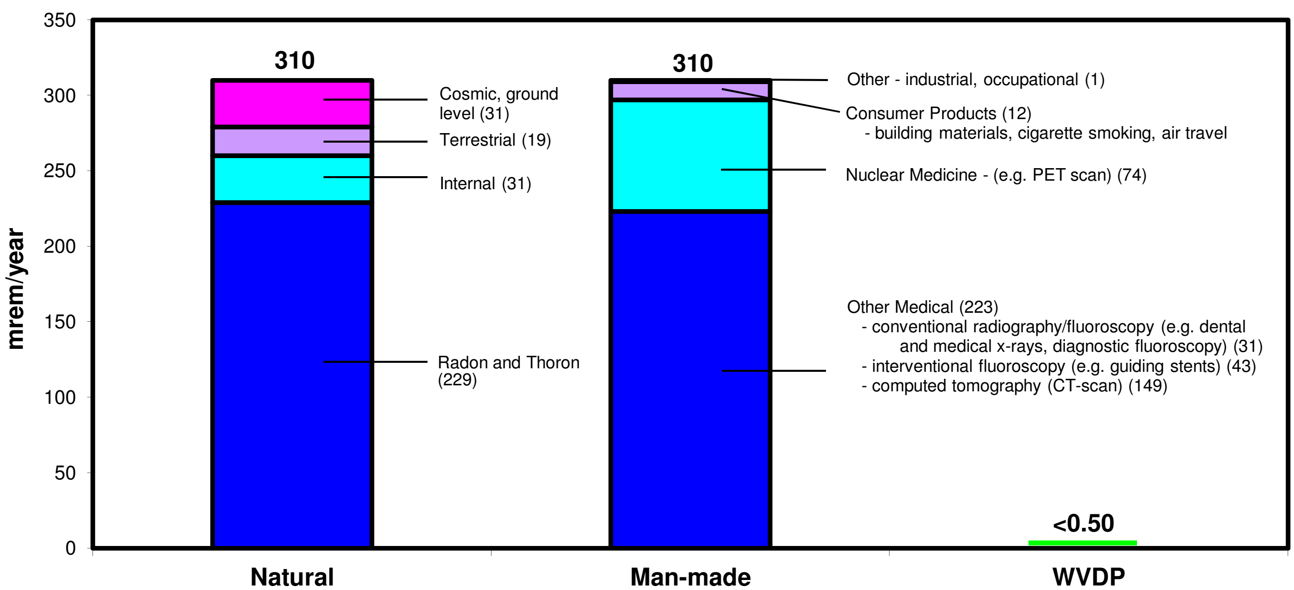
Each year, very small quantities of the radioactive materials remaining at the WVDP are released to the environment. Radioactive materials at the WVDP are residues from the commercial reprocessing of nuclear fuel by NFS in the 1960s and early 1970s. Emissions and effluents are strictly controlled so that release quantities are kept ALARA.

Exposure Pathways

An exposure pathway consists of a route for contamination to be transported by an environmental medium from a source to a receptor. Table 3-1 summarizes the potential exposure pathways to the local off-site population and describes the rationale for including or excluding each pathway when calculating dose from the WVDP.

Potential exposure pathways include: inhalation of gases and particulates, ingestion of locally grown food products and game, and exposure to external penetrating radiation emitted from contaminated materials. Drinking water is not considered a pathway from the WVDP to the public because surveys have determined that no off-site public

FIGURE 3-1
Comparison of Doses From Natural and Man-Made Sources to the Dose From 2016 WVDP Effluents



Reference: NCRP 160 (2009).

TABLE 3-1
Potential Exposure Pathways from the WVDP to the Local Off-Site Population

Exposure Pathway and Transporting Medium	*Reason for Including/Excluding*
Inhalation of gases and particulates in air (included)	Off-site transport of contaminants from stacks, vents, diffuse sources, or resuspended particulates from soil or water.
Ingestion of vegetables, cultivated crops, venison, milk, and fish (included)	Local agricultural products irrigated with potentially contaminated surface or groundwater; airborne deposition on leaves and uptake of deposited contaminants; venison and milk from animals that have inhaled or ingested contaminants; fish that have been exposed to or ingested contaminants in surface water and sediment.
Ingestion of surface and groundwater (excluded)	No documented use of local surface water or downgradient groundwater wells as drinking water by local residents.
External exposure to radiation from particulates and gases directly from air or surface water or indirectly from surface deposition (included)	Transport of air particulates and gases to off-site receptors; transport of contaminants in surface water and direct exposure when swimming, wading, boating, or fishing.

water supplies are drawn from downstream Cattaraugus Creek before Lake Erie or from groundwater in aquifers potentially affected by the WVDP.

Land Use Survey and Population Data

Population information is required when using computer models for annual dose assessments. Periodic surveys of local residents provide information about family size, and sources of food. Population around the WVDP by sector and distance from the CY 2010 census is presented on Figure A-15. These data indicate an estimated 1.62 million people live within 50 mi (80 km) of the site. This total includes approximately 128,000 Canadians (Statistics Canada, 2011). The spatial distribution of population within the 50-mi (80 km) radius of the site may be utilized in both the air and waterborne dose calculations. Information from the most recent land use survey, conducted in early 2002, was used to update the residential locations within 3.1 mi (5 km) of the site. In 2008, a field verification of the residents closest to the site was conducted to confirm the location of the nearest receptor in each sector. Updates to the nearest residents are performed periodically when there are local population changes.

Dose to the Public

Each year an estimate is made of the potential radiological dose to the public that is attributable to WVDP operations and effluents during that calendar year. Estimates are calculated to confirm that no individual could have received a dose that exceeded the limits for protection of the public, as established by DOE or EPA.

Figure 3-1 shows the estimated (all pathway) maximum individual dose from the WVDP in CY 2016 compared with the average annual dose a U.S. resident receives from man-made and natural background sources.

The 2016 estimated dose (<0.50 mrem [<0.0050 mSv]) from the Project to an off-site resident is far below the federal standard of 100 mrem for dose from all pathways allowed from any DOE site operation in a calendar year, confirming that efforts at the WVDP to minimize radiological releases are consistent with the ALARA philosophy of radiation protection.

Dose Assessment Methodology

Dose to the public is evaluated consistent with the requirements of DOE Order 458.1. Measurements (and/or estimates) of radionuclide concentrations in liquid and air released from the Project are summarized for the CY of interest. Ambient and background measurements are also collected. An estimate of the effective dose equivalent (EDE) to the potential maximally exposed member of the general public, and the collective EDE to the population within a 50-mi (80-km) radius of the site is made using these data as input to either EPA- and DOE-approved models, or using comparisons to EPA- and DOE-approved standards. (See the inset on “Radiation Dose” and “Units of Dose Measurement.”)

Radiation Dose

The energy released from a radionuclide is eventually deposited in matter encountered along the path of the radiation. The radiation energy absorbed by a unit mass of material is referred to as the absorbed dose. The absorbing material can be either inanimate matter or living tissue.

Alpha particles leave a dense track of ionization as they travel through tissue and thus deliver the most dose per unit path-length. However, alpha particles are not penetrating and must be taken into the body by inhalation or ingestion to cause harm. Beta and gamma radiation can penetrate the protective dead skin layer of the body from the outside, resulting in exposure of the internal organs to radiation.

Because beta and gamma radiations deposit much less energy in tissue per unit path-length relative to alpha radiation, they produce fewer biological effects for the same absorbed dose. To allow for the different biological effects of different kinds of radiation, the absorbed dose is multiplied by a quality factor to yield a unit called the dose equivalent. A radiation dose expressed as a dose equivalent, rather than as an absorbed dose, permits the risks from different types of radiation exposure to be compared with each other (e.g., exposure to alpha radiation compared with exposure to gamma radiation). For this reason, regulatory agencies limit the dose to individuals in terms of total dose equivalent. Refer to the "Useful Information" section for discussion of ionizing radiation.

Units of Dose Measurement

The unit for dose equivalent in common use in the U.S. is the rem. The international unit of dose equivalent is the sievert (Sv), which is equal to 100 rem. The millirem and millisievert, used more frequently to report the low dose equivalents encountered in environmental exposures, are equal to one-thousandth of a rem or sievert, respectively. Other radioactivity unit conversions are found in the "Useful Information" section at the back of this report.

The effective dose equivalent (EDE), also expressed in units of rem or Sv, provides a means of combining unequal organ and tissue doses into a single "effective" whole body dose that represents a comparable risk probability. The probability that a given dose will result in the induction of a fatal cancer is referred to as the risk associated with that dose. For waterborne releases, the EDE is calculated by multiplying the organ dose equivalent by the organ-weighting factors developed by the International Commission on Radiological Protection (ICRP) in Publications 26 (1977) and 30 (1979). For airborne emissions, the EDE calculation is based upon factors in Federal Guidance Report 13, and National Council on Radiation Protection and Measurements (NCRP) report Number 123. The weighting factor is a ratio of the risk from a specific organ or tissue dose to the total risk resulting from an equal whole body dose. All organ-weighted dose equivalents are then summed, with the dose from internally deposited radionuclides, to obtain the total EDE.

A collective population dose is expressed in units of person-rem or person-sievert because the individual doses are summed over the entire potentially exposed population. The average individual dose can therefore be estimated by dividing the collective dose by the population.

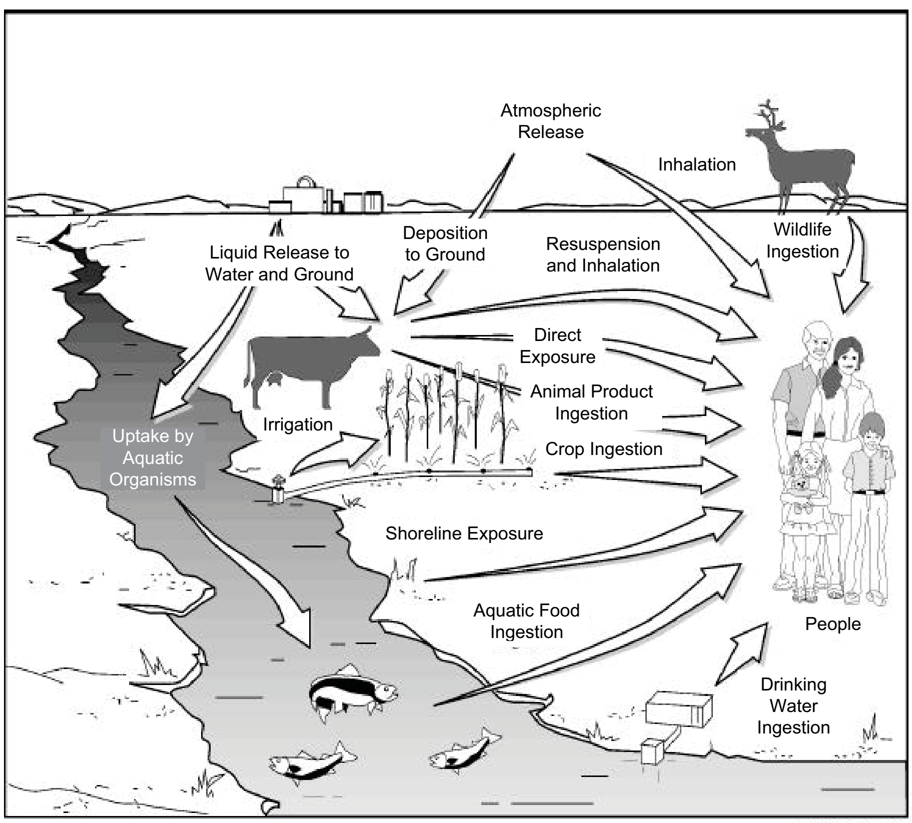
Potential dose to the public is also evaluated from radioactivity measurements in food from locations near the WVDP boundaries to corroborate results from the air and water pathways dose calculations (Figure 3-2). Vegetables, fruit, milk, venison, and fish samples from the WVDP vicinity are collected and analyzed for radiological constituents. (Biological sampling locations are shown on Figures A-11 and A-14.) Radioactivity measurements in food from locations near the site are compared with similar measurements from samples collected at background locations to the WVDP. If any near-site results are higher than background results, dose calculations are performed. These results are used as a conservative, independent confirmation of the dose estimates from all environmental pathways.

Potential dose to near-site residents and the local population from the waterborne pathway was estimated using dose conversion factors that were derived from a site-specific surface water exposure model. Potential dose via the air pathway was estimated by comparing measured ambient air radioactivity with EPA dose standards.

Potential dose via the air pathway historically was estimated using an air dose model with input from measured or estimated emissions from on-site sources. The use of the ambient air monitoring network has become increasingly important as point source discharges are curtailed and work activities at the WVDP progress toward decommissioning and/or facility demolition. Since vitrification was completed in 2002, the primary work performed in the MPPB has been decontamination of the rooms and cells, resulting in very low point source emissions. Consequently, in recent years, diffuse sources, such as radioactivity that is released to the air from natural evaporation from the surface of the lagoon system, have been a significant contributor to the overall airborne dose.

It is not anticipated that planned demolition activities will contribute measureable dose to near-site residents. During demolition of the 01-14 building in 2013, no measured radioactivity increases were observed at either the off-site ambient air monitoring network encircling the site or at the on-site work area air monitors, indicating demolition of the 01-14 building was performed safely. There were no radiologically contaminated structures demolished in 2016.

FIGURE 3-2 Potential Radiation Exposure Pathways to Man



Reference: DOE-HDBK-1216-2015

Dose From Airborne Emissions

Airborne radionuclide emissions are regulated by EPA under the Clean Air Act (CAA) and its implementing regulations. DOE facilities are subject to 40 CFR 61, Subpart H, National Emission Standards for Hazardous Air Pollutants (NESHAP), which contains the national standards for emissions of radionuclides other than radon from DOE facilities. The applicable standard is a maximum of 10 mrem (0.1 mSv) EDE to any member of the public in any year. In July 2015, EPA gave final approval for use of the WVDP ambient air monitoring data to demonstrate compliance with the CAA regulations. Consequently, compliance with the 10-mrem/year NESHAP standard for airborne emissions of radionuclides is now demonstrated annually based on the data collected at the ambient air monitoring stations. Figure A-7 shows the location of these samplers.

There are sixteen low-volume ambient air samplers encircling the WVDP and one high-volume sampler in the north-northwest (NNW) sector, the predominant downwind direction and approximate location of the historically modeled maximally exposed individual. They are located within approximately a mile of the WVDP on NYSERDA or private property near the closest off-site receptor in each compass sector. Ambient air monitoring also continued at the background low-volume air sampler located in Great Valley, New York (AFGRVAL, shown on Figure A-14), 18 miles (29 km) south of the site. Ambient air conditions have been monitored at this background location since 1984. The network of samplers remained more than 98% operational in 2016, the fourth complete year the ambient network was in service.

Low-volume (left) and high-volume (right) samplers located in the historical predominant downwind direction from the site

There were no unplanned releases of airborne radioactivity in 2016. The decommissioning work performed in 2016 was focused on the relocation of the HLW canisters to the south plateau, off-site shipment of the LLW VIT components, and reduction of radioactivity inside the VF and MPPB.

Maximum Dose (Airborne) to an Off-Site Individual. The estimated dose from airborne emissions from the WVDP using the data collected at the ambient air samplers has been below detection limits since 2014 when these samplers were first used to estimate dose for compliance.

The radiological dose that an individual could have received is calculated from the concentrations of radionuclides that are found to be present in the filter media from each ambient air sampler. To determine dose, the annual average radioactivity concentrations from each network perimeter sampler are compared to the concentration levels for environmental compliance to determine a radionuclide specific compliance ratio. This ratio is a value showing what fraction of the limit was measured in the ambient air for each radionuclide of interest.

The standards for environmental compliance (converted to concentration) are the annual average radionuclide concentrations that would result in a 10 mrem/year dose if a person were exposed to that concentration for a full year. A measured concentration that is a fraction of the standard corresponds to an equivalent fraction of the 10 mrem dose. Therefore, the sum of fractions for each sampler location is converted to dose by multiplying the sum by 10 mrem. Compliance with the NESHAP standard is demonstrated when the sum of ratios is less than 1.

Filter media from each ambient air sampler around the WVDP were analyzed throughout 2016 and were used to calculate the average airborne radioactivity measurements for each radionuclide at each sampler location. (See Table C-10.) Measurements at the ambient air samplers are similar to the background sampler at Great Valley. Airborne releases of radionuclides from the WVDP are usually too small for their concentrations to be detected.

The estimated dose using the 2016 ambient air sampling data was based on the compliance ratios shown in the last column of Table C-10 and Table C-11, in Appendix C. When the measurements are below the detection limit of the instruments, a value “<detectable limit” is used to calculate the compliance ratio. The maximum value of the sum of ratios from the ambient air monitoring data was <0.049. Multiplying this sum of fractions by 10 produces a maximum potential dose of <0.49 mrem (<0.0049 mSv), which is below the 10 mrem (0.1 mSv) NESHAP limit established by EPA and mandated by DOE Order 458.1. Therefore the estimated dose, using the measurements from the ambient air monitors, is an upper bound of the potential dose that is based on the detection limits of the samplers.

Continuous Air Effluent Monitoring. The on-site ventilation stacks are monitored continuously while in operation, and will continue to be monitored until building ventilation is terminated. There have been no significant changes in air emissions from the WVDP since vitrification was completed in 2002.

Iodine-129, a long-lived radionuclide, has routinely been found in main stack emissions and continued to be the largest contributor to the estimated dose from airborne emissions through 2013 when the dose was last modeled with CAP88. During the years when the HLW was being vitrified (1996 to 2002), iodine-129 releases increased because gaseous iodine was not as efficiently removed by the VIT process off-gas treatment system as were most other radionuclides. As more HLW was removed from the tanks and converted into glass, less waste was available to emit iodine-129 and the total emitted decreased. In 2016, measured iodine-129 concentrations in main stack emissions remained near pre-VIT levels.

At the WVDP, the maximum contribution to the modeled dose from airborne releases from point source emissions has historically originated from two primary locations, ANSTACK, the MPPB stack, which ventilates the process building, and ANSTSTK, the STS stack, which ventilates the underground HLW tanks. Trend graphs of annual average gross alpha, gross beta and iodine-129 concentrations at ANSTACK and ANSTSTK over the past sixteen years demonstrate that there were no significant changes in the emissions from these primary sources in 2016, as shown on Figure 3-3.

Radon

NESHAP regulations specifically exclude radon from being included in annual total air emission dose calculations. However, a discussion of radon dose in the ASER is required by DOE guidance. Both naturally occurring and man-made radon may be a significant contributor to dose.

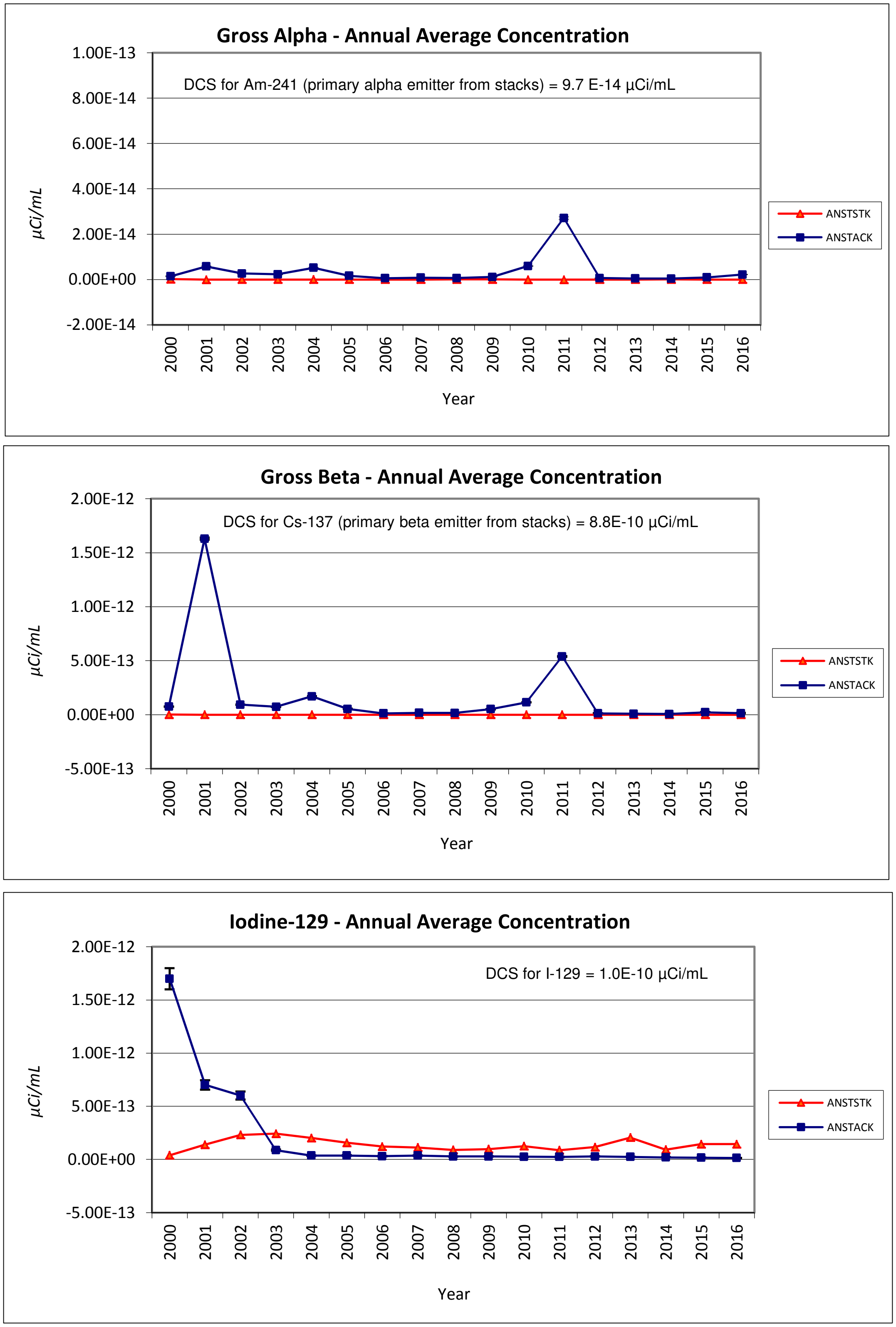
According to the federal report on typical population exposures published by the National Council on Radiation Protection and Measurements (NCRP-160), naturally occurring radon (radon-222) and thoron (radon-220) contribute, on average, an estimated dose of 229 mrem (see Figure 3-1).

Radon-220, also known as thoron, is a naturally occurring gaseous decay product of thorium-232. However, radon-220 has also historically been measured in the airborne emissions from the WVDP due to the thorium reduction extraction (THOREX) process that was performed in the MPPB during NFS operations.

Thoron levels were observed to increase during startup of HLW vitrification in 1996. An average of about 12 curies per day (Ci/day) were assumed to have been released based on an estimate of thoron released during each waste concentration cycle of the VIT process. (Chapter 2 of the 1996 WVDP ASER, (West Valley Nuclear Services Company [WVNSCO] and Dames & Moore, June 1997). With vitrification completed, thoron releases were estimated to return to pre-VIT levels of about 3 Ci/day (conservatively based on thoron radioactivity measured from ANSTACK in the 1990s). Historical CAP88 modeling results indicate the dose from a 3 Ci/day thoron release to a MEOSI located 1.2 miles from the site would have been only 0.094 mrem (0.00094 mSv), significantly below the 10-mrem NESHAP standard. The collective dose to the population within a 50-mi (80-km) radius would have been 4.5 person-rem (0.045 person-Sv).

Monitoring for radon-220 is no longer performed. However, it is likely that the thoron emissions from the MPPB have decreased substantially in recent years due to removal of significant source material during decontamination activities, including removal of some of the MPPB HEPA filters. Thus, the current dose from thoron is likely even less than 0.094 mrem/year.

FIGURE 3-3
Historical Trends in Measured Concentrations from Primary Point Sources



Collective Population Dose (Airborne). Approximately 1.62 million people are estimated to reside in the U.S. and Canada within 50 mi (80 km) of the WVDP. (See Figure A-15.) Historically, the output from CAP88 was used to determine the total EDE from air emissions to the MEOSI and the collective EDE to the population within a 50 mile radius of the site. The model takes into account meteorological data and the spatial distribution of the public surrounding the site to determine the total collective population dose.

The population unit dose conversion factors developed using CAP88 in CY 2015 were used in 2016 together with the estimated total emissions from the site to make a conservative estimate of the collective population dose. The 2016 population dose estimate is <0.42 person-rem (<0.0042 person-Sv) total EDE from radioactive nonradon airborne emissions released from the WVDP. The resulting average EDE per individual within 50 mi (80 km) of the WVDP computes to <0.00026 mrem (<0.0000026 mSv).

Table 3-2 summarizes the dose from both the air and water exposure pathways.

Predicted Dose From Waterborne Releases

There are currently no EPA standards establishing limits on the radiation dose to members of the public from liquid effluents, except as applied in 40 CFR Part 141, National Primary Drinking Water Regulations. Corollary limits for community water supplies are set by the NYSDOH in the New York State Sanitary Code (10 NYCRR 5-1). Radionuclides are not regulated under the site's SPDES permit. However, special requirements in the permit specify that radionuclide concentrations in the discharge are subject to requirements of DOE Order 5400.5 (replaced by DOE Order 458.1, "Radiation Protection of the Public and the Environment," in CY 2011.)

As indicated in Table 3-1, public drinking water does not represent a potential source of exposure to radioactivity from Project activities. Cattaraugus Creek is not used as a drinking water supply; therefore, a comparison of estimated doses from this source with the 4-mrem/year (0.04-mSv/year) EPA and NYSDOH drinking water limits is not appropriate (although values are well below the drinking water limits).

TABLE 3-2
Summary of Annual Total Effective Dose Equivalents (EDEs) to an Individual From WVDP Releases in 2016

Exposure Pathways	*Annual Individual Dose*		
	Critical Receptor/MEOSI [a]	*Comparison to EPA and DOE Standards*	*Comparison to Natural Background Radiation*
Airborne Releases[b]			
Total Airborne Dose (measured at the ambient air ring)	**<0.49 mrem (<0.0049 mSv)**	<4.9% of 10 mrem EPA standard for air (0.1 mSv)	<0.16% of 310 mrem (3.1 mSv) Natural Background Radiation
Waterborne Releases[c]			
Total Waterborne Dose (effluents and natural drainage)	**0.013 mrem (0.00013 mSv)**	*There are no EPA or DOE dose standards for the water only pathway.*	0.0042% of 310 mrem (3.1 mSv) Natural Background Radiation
Total From All Pathways	**<0.50 mrem (<0.0050 mSv)**	<0.50% of 100 mrem DOE standard for air and water combined (1 mSv)	<0.16% of 310 mrem (3.1 mSv) Natural Background Radiation

[a] The critical receptor applies to the airborne dose. The MEOSI applies to the waterborne dose.
[b] Releases are from atmospheric nonradon point and diffuse sources.
[c] Dose calculated according to "Manual for Radiological Assessment of Environmental Releases at the WVDP" (CHBWV, 2012).

The nearest municipal water supplies downstream of the site are located on Lake Erie. Significant surface water dilution occurs between the site and Lake Erie.

Because the Project's liquid effluents eventually reach Cattaraugus Creek, the most important waterborne exposure pathway is the consumption of fish from the creek by local sportsmen and residents. Exposure to external radiation from shoreline contamination or in the water is also considered in the model for estimating radiation dose.

The computer models GENII version 1.485 and LADTAP II were used to calculate site-specific unit dose factors (UDFs) for routine waterborne releases and dispersion of these effluents from the WVDP. These UDFs for water were used to estimate the annual waterborne dose from measured radioactivity in the 2016 water samples.

There are two permitted controlled liquid effluent release points from the WVDP, WNSP001 (lagoon 3) and WNSP007 (the WWTF). However there were no releases from WNSP007 in 2016, because the WWTF has not operated since November 2014. Sanitary waste is now shipped off site for treatment. Controlled discharges from WNSP001 continued in 2016 but the frequency of releases has decreased. Two batches of liquid effluents, totaling about 3.7 million gal (14.2 million L), were released from the lagoon 3 weir WNSP001 (SPDES point 001) during 2016. Measurements of the radioactivity discharged in these effluents were combined with the UDFs to calculate the EDE to the MEOSI and the collective EDE to the population living within a 50-mi (80-km) radius of the WVDP. (See Table 3-2.)

Besides the controlled release point at WNSP001, water from two natural drainage channels on the north plateau originating on the Project premises contain measurable concentrations of radioactivity: the northeast swamp (WNSWAMP) and north swamp (WNSW74A).

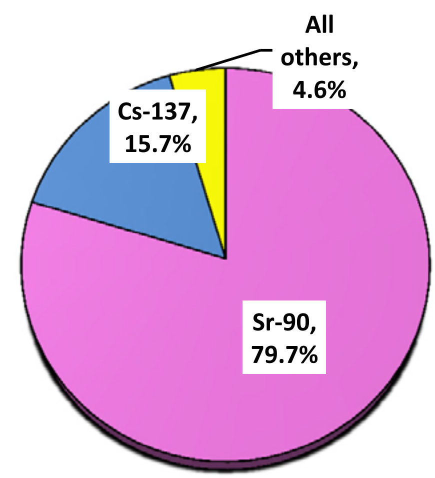
Although releases from WNSWAMP and WNSW74A are not considered "controlled" releases, they are well characterized and are routinely sampled and monitored. Results from these monitoring points are included in the EDE calculations for the MEOSI and the collective population.

There were no unplanned releases of waterborne radioactivity in 2016.

Maximum Dose (Waterborne) to an Off-Site Individual. Contributions to the waterborne dose from controlled releases and from natural drainage are estimated separately. An off-site individual could have received a maximum EDE of 0.0021 mrem (0.000021 mSv) from the radioactivity in liquid effluents discharged from the WVDP (lagoon 3 weir/SPDES point 001) during 2016. (See Table 3-2.) Most of the dose from the lagoon 3 discharge was from cesium-137. An off-site individual could have received a maximum EDE of 0.011 mrem (0.00011 mSv) due to drainage from the north plateau. Most of the north plateau dose was attributable to strontium-90, largely from the WNSWAMP drainage point.

A comparison of dose proportions attributable to specific waterborne radionuclides is shown on the pie chart on Figure 3-4. As presented, strontium-90 (primarily from WNSWAMP) and cesium-137 (primarily from lagoon 3) account for almost all of the estimated waterborne dose in 2016.

FIGURE 3-4
Dose Percent by Radionuclide from Waterborne Releases in 2016



The combined EDE to the MEOSI from liquid effluents and drainage was 0.013 mrem (0.00013 mSv). This annual dose is very small in comparison to the 310-mrem (3.10 mSv) dose that is received by an average member of the U.S. population from natural background radiation.

Collective Population Dose (Waterborne). As a result of radioactivity released in liquid effluents from the WVDP during 2016, the population living within 50 miles

(80 km) of the site received an estimated collective EDE of 0.0040 person-rem (0.000040 person-Sv). The collective dose to the population from the effluents plus the north plateau drainage was 0.067 person-rem (0.00067 person-Sv). The resulting average EDE per individual is 0.000050 mrem (0.00000050 mSv), which is a very small percentage of the dose received by the average person from natural background radiation (310 mrem or 3.1 mSv).

Predicted Dose From All Pathways

The potential dose to the public from both airborne and liquid effluents released from the Project in 2016 is the sum of the individual dose contributions. (See Table 3-2.) The calculated maximum EDE from all pathways to a nearby resident was <0.50 mrem (<0.0050 mSv). This dose is <0.50% of the 100-mrem (1-mSv) annual limit in DOE Order 458.1. As in past years, CY 2016 results continued to demonstrate WVDP compliance with applicable radiation standards for protection of the public and the environment.

Table 3-3 presents the total curies released to air and water from all sources at the WVDP computed from measured air concentrations at the on-site stacks and from estimated diffuse sources, and measured water concentrations from surface water discharges and natural drainage. Table 3-3 shows that in 2016 the total curies released to surface water was greater than the total curies released to the air.

Historically, the largest portion of the total dose has been estimated to be due to waterborne contributions. Numerically, the dose estimated from the airborne pathway is larger than the estimated dose from the water pathway in 2016. However, the dose via the airborne pathway is an upper limit of the potential dose, since no radioisotopic activity was detected at the off-site ambient air samplers in 2016. The dose via the waterborne pathway was modeled mathematically using dose conversion factors, which can result in very low dose estimates.

In CY 2016, the total collective EDE to the population within 50 mi (80 km) of the site was <0.48 person-rem (<0.0048 person-Sv), with an average EDE of <0.00031 mrem (<0.0000031 mSv) per individual.

Radioactivity in the human pathway represented by these data confirms the continued very minor addition to the natural background radiation dose that individuals and the nearby WVDP population receive from Project activities.

Calculated Dose From Food. With the exception of one near-site deer, radionuclide concentrations in near-site milk and venison samples collected in 2016 were statistically indistinguishable from concentrations in background samples collected in the western NY area (sampling locations shown on Figure A-14).

Conservative dose estimates for 2016 due to consuming near-site deer, fish, milk, beans, corn, and apples were estimated using concentrations measured in samples collected over the past five years to be about 0.19 mrem/year (0.0019 mSv/year), which is about 0.031% of the dose received by an average individual due to natural and other man-made sources. (See Figure 3-1, "Comparison of Doses from Natural and Man-Made Sources to the Dose from 2016 WVDP Effluents.") This estimate assumes the individual consumes the maximum quantities of each food item. These independent estimates help confirm the low calculated doses based on air and water effluents, as summarized in Table 3-2.

Risk Assessment

Estimates of cancer risk from ionizing radiation have been presented by the NCRP (1987) and the National Research Council's Committee on Biological Effects of Ionizing Radiation (BEIR 1990 and 2005).

The NCRP estimates that the probability of fatal cancer occurring from exposure to radioactivity is between one and five cancer cases per 10,000 people who are each exposed to one rem (i.e., a risk coefficient of between 0.0001 and 0.0005). The Interagency Steering Committee on Radiation Standards suggests the probability might be slightly higher, or six per 10,000 people (January 2003) and DOE guidance also recommends using a risk factor of 0.0006.

The estimated risk to an individual residing near the WVDP from airborne and waterborne releases can be calculated by multiplying the predicted dose from all pathways (<0.50 mrem or <0.00050 rem in 2016) with the probability of cancer risk (0.0006). In 2016, this risk computes to approximately 30 per 100 million (a risk of 0.00000030). This risk is well below the range of 0.000001 to 0.00001 per year considered by the ICRP to be a reasonable risk for any member of the public (ICRP Report Number 26, 1977).

Over the past several decades the radiation health physics community has conducted considerable research into the biological effects of low dose radiation to develop up-to-date and comprehensive risk estimates for cancer and

TABLE 3-3
WVDP Radiological Dose and Release Summary

Total Annual Dose for Calendar Year CY 2016								
Critical Receptor / MEOSI			Population					
Potential Dose to the Maximally Exposed Off-site Individual (from WVDP Sources)		% of DOE 100-mrem Limit	Population Within 50 Miles[a] of the WVDP (2010 census)	Potential Estimated Population Dose (from WVDP Sources)		Estimated Population Dose (from Natural Sources) (310 mrem/yr x population)		% of Natural Sources
<0.50 (<0.0050)	mrem (mSv)	<0.50%	1,622,050	<0.48 (<0.0048)	person-rem (person-Sv)	502,836 (5,028.36)	person-rem (person-Sv)	<0.000096%

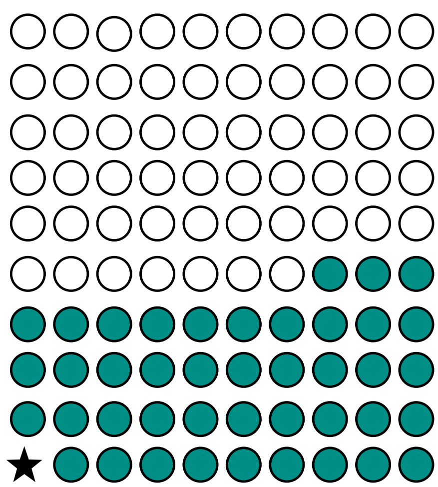
WVDP Radiological Atmospheric Emissions[b] CY 2016 in Curies and Becquerels										
Tritium	Kr-85	Noble Gases ($T_{1/2}$<40 days)	Short-Lived Fission and Activation Products ($T_{1/2}$<3 hr)	Fission and Activation Products ($T_{1/2}$>3 hr)	Total Radio-iodine	Total Radio-strontium	Total Uranium[c]	Total Plutonium	Total Other Actinides	Other (Rn-220)
4.32E-03 (1.60E+08)	NA	NA	NA	8.72E-05 (3.23E+06)	3.28E-05 (1.21E+06)	3.68E-06 (1.36E+05)	2.38E-07 (8.81E+03)	4.64E-07 (1.72E+04)	6.96E-07 (2.57E+04)	1.10E+03 (4.05E+13)

WVDP Liquid Effluent Releases[d] of Radionuclide Material - CY 2016 in Curies and Becquerels						
Tritium	Fission and Activation Products ($T_{1/2}$>3 hr)	Total Radioiodine	Total Radiostrontium	Total Uranium[e]	Total Plutonium	Total Other Actinides
1.46E-02 (5.40E+08)	2.08E-03 (7.70E+07)	6.01E-05 (2.22E+06)	7.13E-02 (2.64E+09)	3.00E-04 (1.11+07)	6.99E-06 (2.59E+05)	2.62E-06 (9.69E+04)

Note: There are no known significant discharges of radioactive constituents from the site other than those reported in this table.
NA - Not applicable
[a] Total population includes the U.S. population from the 2010 census plus the Canadian population residing within a 50-mi (80-km) radius (Statistics Canada, 2011).
[b] Air releases are from point and diffuse sources.
[c] Total uranium (airborne) (g) = 1.21E-01, includes uranium contribution from glass fiber filter matrix.
[d] Water releases are from both controlled liquid effluent releases and from well-characterized site drainages.
[e] Total uranium (waterborne) (g) = 2.48E+02.

other health effects from exposure to "low-level ionizing radiation" (defined as near zero to 10 rem [10,000 mrem]). The most recent BEIR VII report (2005) reviewed all relevant, physical and epidemiological data since the previous committee report in 1990. This included 25 years of new data from the Japanese survivors of the atomic bomb (1945), from recovery workers in Chernobyl (1986), and from a population that has had increased exposure to low level radiation due to medical imaging (i.e., x-rays and CT scans). These data clearly show a correlation between radiation exposure and cancer from high levels of exposure (>10,000 mrem). However, the link between cancer and low dose radiation is not as readily discernible.

FIGURE 3-5
BEIR VII Cancer Risk Study



In a lifetime, approximately 42 of 100 people (solid circles) will be diagnosed with cancer NOT related to radiation exposure. Approximately an additional 1 cancer in 100 people (star) could result from a radiation exposure of 10,000 mrem (defined as low dose). Maximum potential dose from the WVDP in 2016 was <0.50 mrem.

The BEIR VII study put into perspective the risk of developing cancer from radiation relative to the much greater risk of developing cancer from all other causes as shown graphically on Figure 3-5. The BEIR VII lifetime risk model predicts that, assuming a sex and age distribution similar to that of the entire U.S. population, on average approximately 1 person in 100 would be expected to develop cancer from a radiation dose of 10,000 mrem, while approximately 42 of the 100 individuals would be expected to develop cancer from all other causes.

The maximum potential all pathway dose of <0.50 mrem from WVDP operations in 2016 is almost five orders of magnitude lower than 10,000 mrem. The potential risk from <0.50 mrem represents a fraction so small that it could not be seen if plotted as a fraction of the star on the Figure 3-5 graphic.

Release of Materials Containing Residual Radioactivity

In addition to discharges to the environment, the release of property containing residual radioactive materials is considered a potential contributor to dose received by the public, as set forth in DOE Order 458.1.

In 2000, the Secretary of Energy placed a moratorium on the release of volumetrically contaminated metals, and suspended the unrestricted release of metals from radiological areas of DOE facilities for recycling. Although the DOE is currently re-evaluating these policies, no decision has been made based on this re-evaluation to date. Consequently, the moratorium and suspension currently remain in effect and compliance with the Secretary of Energy's suspension of unrestricted release of scrap metal from radiological areas of DOE facilities for recycle continues at the WVDP.

Presently there are no approved criteria for transferring WVDP material to the public that may have been radiologically contaminated in depth or volume; therefore, no unrestricted release of potentially radiologically contaminated scrap metal or other material of this type has occurred. At the WVDP, only scrap metal that has never been stored in a radiologically contaminated area can be recycled. All scrap metal determined recyclable must be accompanied by a "No Radioactivity Added Certification" form that includes the history of the waste storage.

Dose to Biota

Radionuclides from both natural and man-made sources may be found in environmental media such as water, sediments, and soils. In the past, it has been assumed that if radiological controls are sufficient to protect humans, other living things are also likely to be sufficiently protected. This assumption is no longer considered adequate, because plant and animal populations residing in or near these media or taking food or water from these media may be exposed to a greater extent than are humans. DOE has prepared a technical standard that provides methods and guidance to be used to evaluate doses of ionizing radiation to populations of aquatic animals, riparian animals, terrestrial plants, and terrestrial animals.

Methods in this technical standard, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" (DOE-STD-1153-2002, July 2002), were used in 2016 to evaluate radiation doses to aquatic and terrestrial biota within the confines of the WNYNSC, which includes the WVDP. Doses were assessed for compliance with the DOE standard of 1 rad/d for aquatic animals and terrestrial plants and 0.1 rad/d for riparian and terrestrial animals. Note that the absorbed dose unit (rad) is used for biota instead of the units used for indicating human risk (rem).

RESRAD-BIOTA for Windows® (November 2009), a calculation tool provided by DOE for implementing the technical standard, was used to compare existing radionuclide concentration data from environmental sampling with biota concentration guide (BCG) screening values and to estimate upper bounding doses to biota. Data were taken from surface water samples obtained in 2016 and from the most recent sediment samples (2004–2007 and 2012). Soil data from the most recent 10 years for which special on-site surface soil sampling was conducted (1995-2004) and the most recent 10 years of routine on-site surface soil sampling (1999–2007 and 2012) were also used. Differing time periods were used because radionuclide concentrations change more rapidly over time in surface waters than in sediments and soils, as reflected in their sampling frequencies (monthly or quarterly for water, every five years for sediment and surface soil).

The concentration for each radionuclides in each medium is divided by its corresponding BCG to calculate a partial fraction for each nuclide in each medium. Partial fractions for each medium were added to produce a sum of fractions.

Exposures from the aquatic pathway may be assumed to be less than the aquatic dose limit from DOE Order 458.1 if the sum of fractions for the water medium plus that for the sediment medium is less than 1.0. Similarly, exposures from the terrestrial pathway may be assumed to be less than the proposed dose limits for both terrestrial plants and animals if the sum of fractions for the water medium plus that for the soil medium is less than 1.0.

It was found that the isotopes with the highest sums of fractions, the radionuclides that contributed the largest component of both aquatic and terrestrial dose to biota, were strontium-90 and cesium-137. The populations of organisms most sensitive to strontium-90 and cesium-137 in this evaluation; i.e., those most likely to be adversely affected via the aquatic and terrestrial pathways, were determined to be populations of riparian animals (such as the raccoon [aquatic dose]) and terrestrial animals (such as the deer mouse [terrestrial dose]). Populations of both animals are found on the WNYNSC.

A maximum potential biota dose was first modeled using the maximum radionuclide concentrations from surface waters, sediments, and soils. The resulting dose exceeded applicable BCG limits for both aquatic and terrestrial evaluations in 2016.

As recommended in DOE-STD-1153-2002, a more typical dose model was then run using estimates of average radionuclide concentrations derived from measurements in site-wide surface waters, sediments, and soils. These results are summarized in Table 3-4 and explained below.

At the site-specific screening level, the sums of fractions for the aquatic and terrestrial evaluations were 0.16 and 0.45, respectively. The sum of fractions for each assessment was less than 1.0, indicating that applicable BCGs were met for both the aquatic and terrestrial evaluations.

It was therefore concluded that populations of aquatic and terrestrial biota (both plants and animals) on the WNYNSC are not being exposed to doses in excess of the existing DOE dose standard for native aquatic animals (DOE, February 1990) and the international standards for terrestrial organisms (International Atomic Energy Agency [IAEA], 1992).

TABLE 3-4
2016 Evaluation of Dose to Aquatic and Terrestrial Biota

AQUATIC SYSTEM EVALUATION							
Nuclide	***Water BCG [a] (pCi/L)***	***Mean Water Value (pCi/L)***	***Ratio***	***Sediment BCG [a] (pCi/g)***	***Mean Sediment Value (pCi/g)***	***Ratio***	***Water and Sediment Sum of Fractions***
Cesium-137	42.7	2.60	6.17E-02	3,130	5.49	1.76E-03	0.06
Strontium-90	279	20.4	7.31E-02	583	11.7	2.01E-02	0.09
All Others	NA	NA	2.90E-04	NA	NA	4.72E-04	0.00076
Sum of Fractions			1.35E-01			2.23E-02	**0.16**
Estimated upper bounding dose to an aquatic animal = **0.0052 rad/day**; to a riparian animal = **0.016 rad/day**.							

TERRESTRIAL SYSTEM EVALUATION							
Nuclide	***Water BCG [a] (pCi/L)***	***Mean Water Value (pCi/L)***	***Ratio***	***Soil BCG [a] (pCi/g)***	***Mean Soil Value (pCi/g)***	***Ratio***	***Water and Soil Sum of Fractions***
Cesium-137	599,000	2.60	4.40E-06	20.8	4.57	2.20E-01	0.22
Strontium-90	54,500	20.4	3.74E-04	22.5	5.16	2.30E-01	0.23
All Others	NA	NA	1.91E-06	NA	NA	8.15E-04	0.00082
Sum of Fractions			3.80E-04			4.50E-01	**0.45**
Estimated upper bounding dose to a terrestrial plant = **0.0036 rad/day**; to a terrestrial animal = **0.045 rad/day**.							

NA - Not applicable
[a] The biota concentration guides (BCGs) are calculated values. Except for the sums of fractions and dose estimates, which are rounded to two signficant digits, all values are expressed to three signficant digits.

Summary

Tables 3-2, 3-3, and 3-4 summarize radiological dose and release information for CY 2016.

Predictive computer modeling of waterborne releases and measurements of radioactivity at near-site ambient air samplers resulted in estimated doses to the maximally exposed individual that were orders of magnitude below all applicable EPA standards and DOE orders that place limitations on the release of radioactive materials and dose to individual members of the public.

The collective population dose was also assessed and found to be orders of magnitude below the natural background radiation dose. Additionally, estimates indicated that populations of biota at the WVDP are only exposed to a fraction of DOE and IAEA standards for dose to biota.

Based on the overall dose assessment, the WVDP was found to be in compliance with applicable effluent radiological guidelines and standards during CY 2016.

CHAPTER 4
GROUNDWATER PROTECTION PROGRAM

Groundwater Monitoring Program (GMP)

The GMP at the WVDP has been designed to comply with all applicable state and federal regulations and to meet the requirements of DOE Order 458.1, "Radiation Protection of the Public and the Environment," (including Change 3, January 15, 2013) and the RCRA §3008(h) Administrative Order on Consent.

DOE Order 458.1, Section 4.i.2, states that "Groundwater must be protected from radiological contamination to ensure compliance with dose limits in the Order and consistent with ALARA process requirements. To this end, DOE sites must ensure that: baseline conditions of the groundwater quantity and quality are documented; possible sources of, and potential for, radiological contamination are identified and assessed; strategies to control radiological contamination are documented and implemented; monitoring methodologies are documented and implemented; and groundwater monitoring activities are integrated with other environmental monitoring activities." The "WVDP Groundwater Protection Management Program Plan" documents the Project's approach for groundwater protection from site activities.

Compliance with the Consent Order and the conclusions in the RFI reports require routine monitoring of certain analytes at specified groundwater monitoring locations.

The primary objectives of the groundwater monitoring plan are to identify, delineate, and monitor groundwater migration pathways that could transport contaminants off site and to support mitigative actions. To accomplish these goals, the GMP describes a groundwater monitoring well network designed to monitor groundwater conditions in subsurface geologic units that represent potential routes of contaminant migration. For a description of these geologic units refer to "Geology and Hydrogeology" later in this chapter.

Groundwater Use and History. Site groundwater in shallow, unconsolidated geologic units is not used for drinking or operational purposes, nor is WVDP effluent discharged directly to groundwater. In 2014 the site installed two Health Department approved potable water supply wells into bedrock to depths greater than 100 feet beneath the ground surface. Chemical and radiological sampling of these wells was performed as part of the installation and development process. Sampling continues as part of ongoing system operation. These wells are upgradient of site facilities and areas of contamination. Drinking water quality samples are routinely collected with results provided to the Cattaraugus County Health Department.

The majority of site groundwater eventually flows to Cattaraugus Creek and then to Lake Erie. Surveys have determined that no community public water supplies are drawn from groundwater downgradient of the site or from Cattaraugus Creek downstream of the WVDP. However, upgradient of the site, groundwater is used as a public and private drinking water supply by local residents.

Highlights of the site groundwater monitoring history and the evolution of the GMP are summarized in Table 4-1. Groundwater monitoring to evaluate the performance of the full-scale PTW installed in November 2010 on the north plateau is discussed later in this chapter.

Geology and Hydrogeology

The WNYNSC is situated upon a layered sequence of glacial-age sediments that fill a steep-sided bedrock valley composed of interbedded shales and siltstones (Rickard, 1975). (See Figure 4-1.) Erdman Brook bisects the WVDP into the north and south plateaus. The MPPB, WTF, and lagoons are located on the north plateau. The drum cell, NDA, and SDA are located on the south plateau.

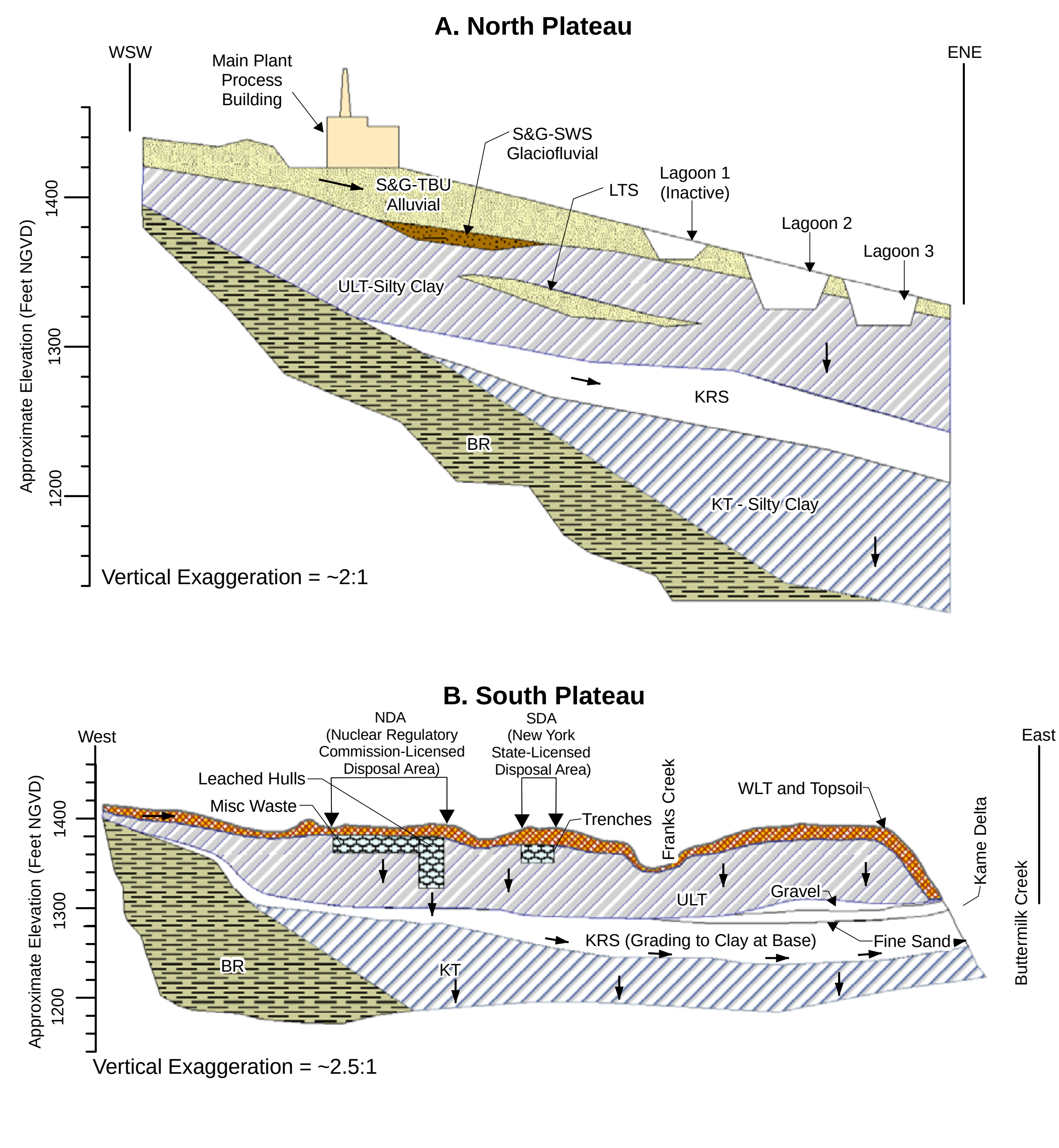
The glacial sediments overlying the bedrock consist of a sequence of three silt- and clay-rich glacial tills of Lavery, Kent, and possibly Olean age. The tills are separated by stratified fluvio-lacustrine deposits (silty or silty/sandy lakebed sediments). The glacial sediments above the Kent till include the Kent recessional sequence (KRS), the weathered Lavery till (WLT) and unweathered Lavery till (ULT), the intra-Lavery till-sand, and the alluvial sand and gravel (S&G) unit. The S&G unit and the WLT are generally regarded as the predominant routes for contaminant migration from the Project via groundwater.

TABLE 4-1
Highlights of Groundwater Monitoring History at the WVDP and the WNYNSC

Year	*Highlight*
1961–1980	From the time the WNYNSC was established in 1961, to passage of the WVDP Act in 1980, groundwater at the WVDP was periodically sampled by NFS, the New York State Geological Survey, and the United States Geological Survey during construction of the MPPB, for spill investigations, and for post-NFS research studies.
1982	Groundwater monitoring at the WVDP began in 1982 under DOE and the site subcontractor, WVNS.
1984	By 1984, 40 wells provided groundwater monitoring coverage near the MPPB and the NDA.
1986	Additional wells were installed to supplement the existing groundwater monitoring network.
1990–1991	Ninety-six wells were installed upgradient and downgradient of the WVDP SWMUs for DOE and RCRA monitoring programs. (The total included wells at the SDA area).
1992	The RCRA §3008(h) Order on Consent was signed.
1993	Elevated gross beta activity was discovered in groundwater from the sand and gravel (S&G) unit on the north plateau. Subsequent investigation delineated a plume of strontium-90-contaminated groundwater originating beneath the MPPB, extending northeast.
1993–1994	An RFI expanded characterization program was conducted to assess potential releases of hazardous constituents from on-site SWMUs. Results from the RFI influenced decisionmaking for the GMP.
1994	A Geoprobe® investigation of groundwater and soil beneath and downgradient of the MPPB was performed to characterize the elevated gross beta activity in the S&G unit. The presumed source was found to be near the southwest corner of the MPPB. The primary isotopes responsible for the beta activity were strontium-90 and its daughter product yttrium-90.
1995	The GMP was evaluated and analytical constituents were tailored to each sampling point for a more focused and cost effective program. The North Plateau Groundwater Recovery System (NPGRS) was installed near the leading edge of the main lobe of the strontium-90 plume to minimize migration, which consisted of three extraction wells to recover groundwater for treatment by ion exchange.
1996	Several groundwater seeps on the northeast edge of the north plateau were added to the monitoring program.
1997	A Geoprobe® soil and groundwater sampling program was conducted to delineate the leading edge of the strontium-90 plume.
1998	In response to recommendations from a 1997 external review of WVDP actions regarding the north plateau, another Geoprobe® soil and groundwater sampling program was carried out to further characterize the core area of the plume. The new radiological data were compared to the 1994 data.
1999	A pilot-scale PTW was installed in the eastern lobe of the plume to test this passive in-situ remediation technology. Well points were installed near the pilot-scale PTW.
2000–2001	Additional wells and well points were installed across the leading edge of the strontium-90 plume to monitor the plume's movement and assess the effectiveness of the pilot PTW.
2003	Four new wells were installed to monitor groundwater upgradient and downgradient of the newly constructed RHWF.
2005	Number of analytes or sampling frequencies were reduced at 14 groundwater monitoring wells.
2007	The GMP was evaluated, considering current site conditions, activities, and environmental exposure pathways. The analytes and sampling frequencies at 20 monitoring points were reduced and sampling at four wells was discontinued. Off-site drinking water sampling was also discontinued after an evaluation of historical data had confirmed that site operations had no impact on off-site downgradient groundwater.
2008	Two replacement wells, and 21 piezometers, were installed near the NDA during installation of a slurry wall and geomembrane cover at the NDA. On the north plateau, three subsurface investigations were performed upgradient, within, and downgradient of the strontium-90 plume.
2010	An approximately 860-ft-long full-scale PTW was installed along the leading edges of the strontium-90 plume. Sixty-six groundwater monitoring wells were installed upgradient, downgradient, and within the PTW to monitor wall performance. Four new wells were installed downgradient of the MPPB to supplement the strontium-90 source area monitoring.
2011-2016	Groundwater monitoring continued from CY 2011 through 2016 per the GMP, the "North Plateau Groundwater Monitoring Plan," and the "North Plateau PTW Performance Monitoring Plan." There were no changes to the monitoring programs, no new groundwater monitoring wells were installed, and no active monitoring wells were decommissioned from 2011 through 2016.

FIGURE 4-1
Geologic Cross Sections of the North and South Plateaus at the WVDP

J:/GIS/ArcMap/ASER/ASER_2010/ASER_2010_Fig4-1_20110602.mxd FJC/skw



Legend

S&G-TBU	Sand and Gravel - Thick-Bedded Unit	KT	Kent Till
S&G-SWS	Sand and Gravel - Slackwater Sequence	BR	Shale Bedrock
LTS	Lavery Till Sand	→	Conceptual Groundwater Flow Direction
WLT	Weathered Lavery Till	ENE	East-Northeast
ULT	Unweathered Lavery Till	WSW	West-Southwest
KRS	Kent Recessional Sequence	*(NGVD - National Geodetic Vertical Datum)*	

The S&G unit consists of two subunits: the thick-bedded unit (TBU) and the slackwater sequence (SWS). It only exists on the Project's north plateau. The ULT and Kent till have relatively low permeability, and groundwater from the S&G and WLT must flow through the ULT to reach the KRS. Therefore, the ULT, Kent till, and KRS do not provide predominant pathways for contaminant movement from the WVDP and are not discussed here. See Figure 4-1 and Table 4-2 for the geographic distribution and additional description of these units.

Routine Groundwater Monitoring

Groundwater Monitoring Network. The WVDP groundwater monitoring network is a vital component of the environmental monitoring performed to meet the requirements of DOE Order 458.1. Groundwater is routinely monitored across the north and south plateaus and in the six geologic units described in Table 4-2. In CY 2016, groundwater samples were collected from 69 on-site, routine groundwater monitoring locations, including 63 monitoring wells and well points, five groundwater seepage points, and one trench sump. (See Figures A-9 and A-10 in Appendix A.) Many of the wells monitor one or more of the SWMUs or SSWMUs per the Consent Order. Table 4-3 lists the monitoring locations in the routine groundwater monitoring network, the geologic units monitored, and the analytes measured in CY 2016. Table 4-4 identifies the analytical parameters defined in each analyte group.

The monitoring frequency and the constituents analyzed under the groundwater monitoring plan are a function of regulatory requirements, historical site activities, current operating practices, and ongoing groundwater data evaluations. Tables 4-5 and 4-6 provide an overview of groundwater monitoring performed during CY 2016, organized by geographic area and monitoring purpose.

Supplemental groundwater monitoring programs are also implemented for evaluation of the PTW and the north plateau strontium-90 groundwater plume discussed later in this chapter.

Groundwater Elevation Monitoring. Groundwater elevations are measured at the monitoring network wells in conjunction with the quarterly analytical sampling. (See Figures A-9 and A-10 in Appendix A.) These data are used to produce maps depicting groundwater flow directions and gradients. Long-term trend graphs are used to illustrate variations in groundwater elevations over time, including seasonal fluctuations or changes resulting from installing water diversions, such as geomembrane covers, trenches, or slurry walls, and groundwater treatment systems (e.g., the North Plateau Groundwater Recovery System [NPGRS] and the full-scale PTW).

Groundwater elevation mapping of the WLT on the south plateau helps evaluate the effectiveness of the NDA interceptor trench, the slurry wall, and geomembrane cover. (See "Groundwater Sampling Observations on the South Plateau including the NRC-Licensed Disposal Area [NDA]".)

Groundwater Trigger Level Evaluation. A computerized data-screening program uses "trigger levels," preset conservative values for chemical and radiological concentrations and groundwater elevation measurements, to promptly identify anomalies in monitoring results that may require further investigation. The trigger levels are statistically derived from historical results, are based on regulatory criteria, or are based on analytical detection limits.

Trigger level exceptions, defined as measurements above an upper trigger level or below a lower trigger level, may be the result of normal seasonal fluctuations, laboratory analytical problems, or changes in groundwater quality. Response actions are identified for each analytical result exceeding a trigger level. After each sampling event, the current trigger level exceptions are compiled, evaluated, and summarized with recommended response actions. RCRA trigger level exceptions are reported to NYSDEC.

Groundwater trigger levels for selected chemical and radiological constituents were last recalculated in September 2015, incorporating data collected through June 2015. Trigger levels in areas that have seen a process change were calculated only on data that was collected after the change occurred. There were no process changes in 2016. A process change may affect the analytical results collected from a monitoring location by altering the underlying physical conditions that are monitored at that sampling point. The upgradient NDA slurry wall and geomembrane cover installed in 2008 is an example of a process change that significantly altered the hydrogeologic conditions at monitoring points located on and downgradient of the NDA. The geomembrane cover and slurry wall have decreased water infiltration and migration into the NDA, which changes water levels in and downgradient of the NDA.

Groundwater Screening Levels (GSLs). In 2009, GSLs were developed during the CMS preparations as a tool to identify the presence of chemical and radiological constituents in groundwater above levels of concern

TABLE 4-2
Summary of Hydrogeology at the WVDP

Geologic Unit	Description	Groundwater Flow Characteristics	Hydraulic Conductivity [a]	Location
S&G; Thick-Bedded Unit (TBU)	Silty sand and gravel layer composed of younger Holocene alluvial deposits	Flow is generally northeast across the plateau toward Franks Creek, with groundwater near the northwestern and southeastern margins flowing radially outward toward Quarry Creek and Erdman Brook.	9 ft/day (3.2E-03 centimeters [cm]/second [sec])	Surficial unit on the north plateau
S&G; Slackwater Sequence (SWS)	Interbedded silty sand and gravel layers composed of Pleistocene-age glaciofluvial deposits partially separated from the S&G-TBU by a discontinuous silty clay interval	Flow is to the northeast along gravel layers toward Franks Creek.	17 ft/day (5.9E-03 cm/sec)	Underlies a portion of the north plateau
Weathered Lavery Till (WLT)	Upper zone of the Lavery till which has been exposed at the ground surface; weathered and fractured to a depth of 3–16 ft (0.9–4.9 m); brown in color due to oxidation; contains numerous desiccation cracks and root tubes	Flow has both horizontal and vertical components allowing groundwater to move laterally across the south plateau before moving downward into the unweathered lavery till or discharging to nearby incised stream channels.	0.07 ft/day (2.4E-05 cm/sec); the highest conductivities are associated with dense fracture zones found within the upper 7 ft (2 m) of the unit	Surficial unit on the south plateau
Unweathered Lavery Till (ULT)	Olive gray silty clay with intermittent lenses of silt and sand; ranges up to 130 ft (40 m) in thickness	Flow is vertically downward at a relatively slow rate; unit is considered an aquitard.	0.002 ft/day (8.1E-07 cm/sec)	Underlies both the north and south plateaus
Lavery Till Sand (LTS)	Thin, sandy unit of limited areal extent and variable thickness within the Lavery till	Flow is to the east-southeast toward Erdman Brook.	0.2 ft/day (8.6E-05 cm/sec)	Primarily beneath the southeastern portion of the north plateau
Kent Recessional Sequence (KRS)	Interbedded clay and silty clay layers locally overlain by coarser-grained sands and gravels; pinches out near the east side of Rock Springs Road	Flow is to the northeast; recharge from the overlying till and from bedrock to the southwest; discharges into Buttermilk Creek.	0.01 ft/day (4.3E-06 cm/sec)	Underlies most of the Project, except areas adjacent to Rock Springs Road

Note: Hydrologic conditions of the site are more fully described in "Environmental Information Document, Volume III: Hydrology, Part 4" (West Valley Nuclear Services Co. [WVNSCO], March 1996) and in the "RCRA Facility Investigation Report (RFI) Vol. 1: Introduction and General Site Overview" (WVNSCO and Dames & Moore, July 1997).

[a] Hydraulic conductivities represent an average of historical testing results.

TABLE 4-3
WVDP Groundwater Monitoring Network Sorted by Geologic Unit

Well ID	*SSWMU*	*Gradient Position*	*Analyte Group (See Table 4-4)*	*Well ID*	*SSWMU*	*Gradient Position*	*Analyte Group (See Table 4-4)*
Sand and Gravel Wells							
103[a]	1, 3	D	I, RI, V	803[a]	8	D	I, RI, SV, V
104	1	C	I, RI	804[a]	8	D	I, RI, V
105	1	C	I, RI	1302[b]	NA	U	I, RI, M,
106	1	D	I, RI	1304[b]	NA	D	I, RI, M, R
111[a]	1	D	I, RI, M, SV, V	8603	8	U	I, RI
116[a]	1, 8	C, U	I, RI, V	8604	1	C	I, RI
205	2	D	I, RI	8605[a]	1, 2	D	I, RI, M, SV, V
301[a]	3	B, U	I, RI	8607[a]	4, 6	D, U	I, RI, V
302	3	U	I, RI	8609[a]	3, 4, 6	D, D, U	I, RI, S, V
401[a]	3, 4	B, U	I, RI, R	8612[a]	8	D	I, RI, SV, V
402	4	U	I, RI	MP-01[a]	3	D	I, RI, M, R-MP, SV, V, T
403	4	U	I, RI	MP-02[a]	3	D	I, RI, M, R-MP, SV, V, T
406[a]	4, 6	D, U	I, RI, R, V	MP-03[a]	3	D	I, RI, M, R-MP, SV, V, T
408[a]	3, 4	D	I, RI, R, V	MP-04[a]	3	D	I, RI, M, R-MP, SV, V, T
501[a]	5	U	I, RI, S, V	WP-A[c]	NA	NA	I, RI
502[a]	5	D	I, RI, S, V	WP-C[c]	NA	NA	I, RI
602A	6	D	I, RI	WP-H[c]	NA	NA	I, RI
604	6	D	I, RI	SP04[d]	NA	NA	RI
605	6	D	I, RI	SP06[d]	NA	NA	RI
706[a]	7	B, D	I, RI, M	SP11[d]	NA	NA	RI
801[a]	6, 8	D, U	I, RI, S, V	SP12[a,d]	8	D	I, RI, V
802	8	D	I, RI, V	GSEEP[a,d]	8	C, D	I, RI, V
Lavery Till Sand Wells							
204[a]	2, 3	D	I, RI	206	2	C	I, RI
Weathered Lavery Till Wells							
906[a]	9	D	I, RI	1005[a]	9, 10	C, U	I, RI
908R[a]	9	U	I, RI	1006[a]	9, 10	C, D	I, RI
909[a]	9	D	I, RI, M, R, SV, V	1008C[a]	9, 10	B, U	I, RI
NDATR[a]	9	D	I, RI, M, R, SV, V				
Unweathered Lavery Till Wells							
107	1	D	I, RI	704	7	D	I, RI
108	1	D	I, RI	707	7	C	I, RI
110[a]	1	D	I, RI, V	910R[a]	9	D	I, RI
405	4	D	I, RI, M	1301[b]	NA	U	I, RI
409	4	D	I, RI	1303[b]	NA	D	I, RI, M
Kent Recessional Sequence Wells							
901[a]	9	U	I, RI	1008B	10	B, U	I, RI
902[a]	9	U	I, RI	8610[a]	9	D	I, RI
903[a]	9	D	I, RI	8611[a]	9	D	I, RI

Gradient Positions: B (background); C (crossgradient); D (downgradient); U (upgradient)

[a] Monitoring for certain parameters is required by the RCRA §3008(h) Consent Order.
[b] Monitor upgradient and downgradient of the RHWF.
[c] Monitor north and east of the MPPB.
[d] Monitor groundwater emanating from seeps along the edge of the north plateau.

TABLE 4-4
WVDP Groundwater Sampling and Analysis Program

Analyte Group	*Description of Parameters*
Indicator Parameters (I)	pH, specific conductance (field measurements)
Radiological Indicator Parameters (RI)	Gross alpha, gross beta, tritium
Volatile Organic Compounds (V)	6 NYCRR Part 373-2 Appendix 33 Volatile Organic Compounds
Semivolatile Organic Compounds (SV)	6 NYCRR Part 373-2 Appendix 33 Semivolatile Organic Compounds and tributyl phosphate
Groundwater Metals (M)	6 NYCRR Part 373-2 Appendix 33 Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, tin, vanadium, zinc)
Radioisotopic Analyses: alpha-, beta-, and gamma-emitters (R)	Carbon-14, strontium-90, technetium-99, iodine-129, cesium-137, radium-226, radium-228, uranium-232, uranium-233/234, uranium-235/236, uranium-238, total uranium
Radioisotopic Analyses MPPB Area (R-MP)	Carbon-14, potassium-40, cobalt-60, strontium-90, technetium-99, iodine-129, cesium-137, europium-154, neptunium-237, plutonium-238, plutonium-239/240, plutonium-241, uranium-232, uranium-233/234, uranium-235/236, uranium-238, americium-241, curium-243/244
Strontium-90 (S)	Strontium-90
Turbidity (T)	Turbidity

TABLE 4-5
2016 Groundwater Monitoring Overview by Geographic Area[a]

Number of…	*Total*	*North Plateau*	*South Plateau*
Monitoring Points Sampled - Analytical	69	55	14
Monitoring Events	4	4	4
Individual Analytical Results	7,079	5,907	1,172
Percent of results below detection limits	84%	83%	87%

[a] Does not include PTW performance monitoring.

TABLE 4-6
2016 Groundwater Monitoring Overview by Monitoring Purpose[a]

Number of…	*Total*	*Regulatory/Waste Management*	*Environmental Surveillance*
Monitoring Points Sampled - Analytical	69	38	31
Monitoring Events	4	4	4
Individual Analytical Results	7,079	6,117	962
Percent of results below detection limits	84%	88%	56%

[a] Does not include PTW performance monitoring.

(e.g., regulatory limits, guidance limits, or background). Methods used to develop the GSLs are discussed in detail in Appendix D. Table 4-8 shows groundwater sampling results for 2016 compared with applicable GSLs and background levels.

North Plateau Strontium-90 Plume

Elevated gross beta has been observed in groundwater from the S&G unit, the shallowest geologic unit on the north plateau, since 1993. (See the highlights for 1993 and for 1994 in Table 4-1.) The routine groundwater monitoring plan network for the S&G unit on the north plateau includes 36 monitoring wells, three well points, and five groundwater seepage locations that delineate this gross beta contamination.

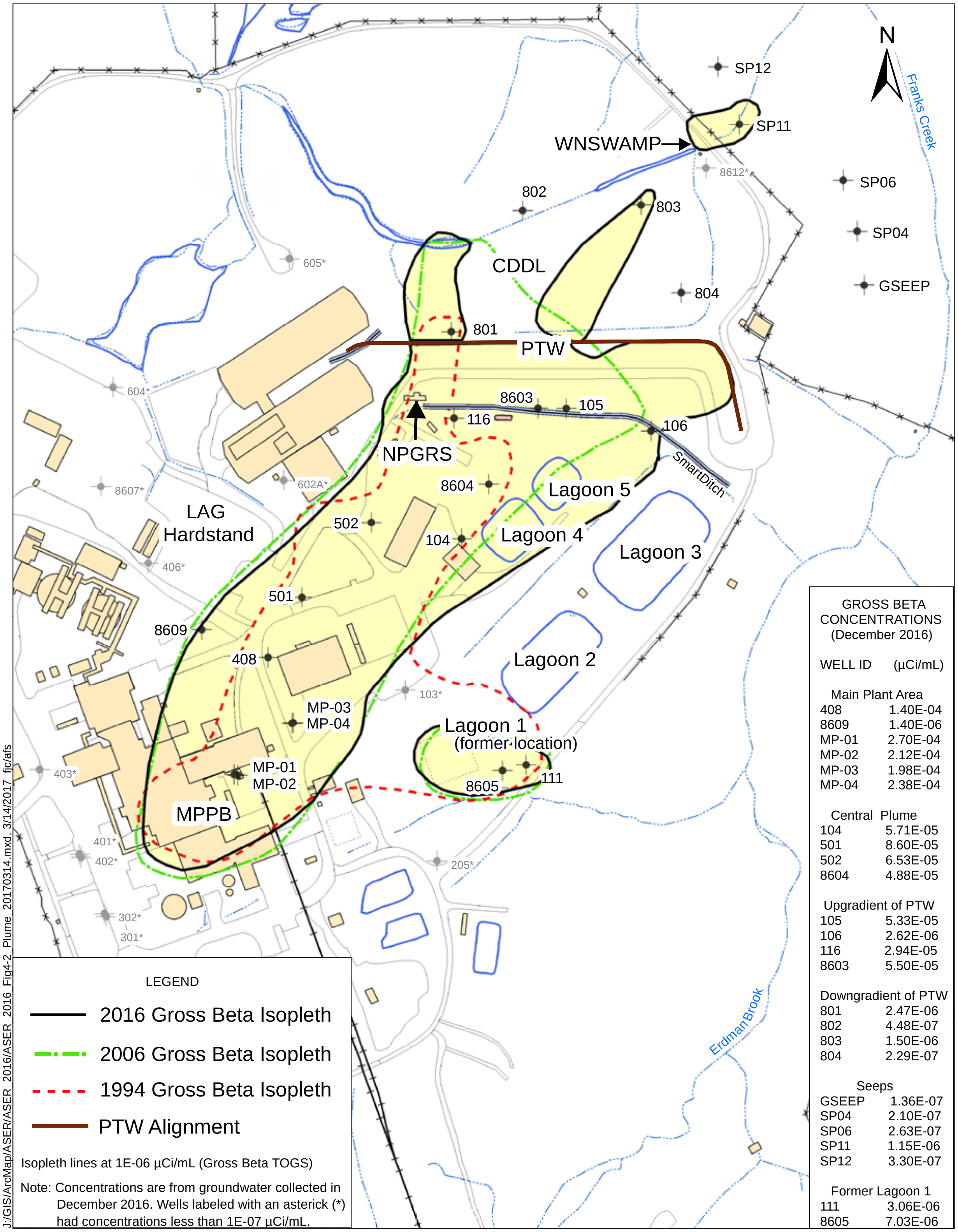
In April 2011, DOE issued a new technical standard (DOE-STD-1196-2011) that established a revised set of Derived Concentration Standards (DCSs) for radiological environmental protection programs at DOE facilities and sites. These DCSs were used to evaluate groundwater data collected in 2016. Because there is no DCS for gross beta in liquid effluents, the strontium-90 DCS (1.1E-06 µCi/mL) is used as a conservative basis for comparison where beta-emitting radionuclides are detected in groundwater. Historical monitoring has established that strontium-90 is the most predominant beta emitter found in site groundwater. The strontium-90 concentrations would be expected to be about one-half of the gross beta result because the beta includes strontium-90 and its daughter product, yttrium-90. Therefore, monitoring wells are routinely sampled for gross beta concentrations, supported by periodic sample measurement at select wells for strontium-90 analysis. For the purpose of the following discussions, the strontium-90 DCS is used for comparison with both gross beta and strontium-90. (See the "Useful Information" section for a discussion of DOE DCSs, and Table UI-4 for a list of the DCSs for radionuclides of interest at the WVDP.)

Figure 4-2 shows the extent of the strontium-90 plume in the S&G unit as defined by the 1.0E-06 µCi/mL gross beta isopleth, at three time intervals spanning 22 years (1994, 2005, and 2016). As shown, the plume's western boundary has remained relatively constant since 1994, but the plume's northern and eastern extents have spread to the northeast and east. The leading edge has divided into three small lobes because of the variable groundwater flow rate across the north plateau due to the heterogeneous nature of the sediments within the S&G unit. The uneven distribution of coarse and fine soils within the S&G unit creates preferential pathways for groundwater flow. The GMP wells that monitor the plume and the measured gross beta concentrations are shown on the figure. Figure 4-2 shows that for 2016 the 1.0E-06 µCi/mL gross beta isopleth in the eastern lobe does not extend beyond the PTW.

Gross beta concentration trends over the last 10 years at monitoring wells located within the plume and near former lagoon 1 are shown on Figures 4-3 through 4-7 and 4-10. These data are plotted on a log scale; therefore, an increase from one gridline to the next represents a 10-fold increase in concentration. The log scale was used so that data from background locations (with concentrations in the 1.0E-09 µCi/mL range) and data from the central plume (with concentrations in the 1.0E-04 µCi/mL range, 100,000 times higher than background) could be plotted on the same graphs.

Groundwater bromide tracer test being performed on one of the PTW wells installed in the zeolite

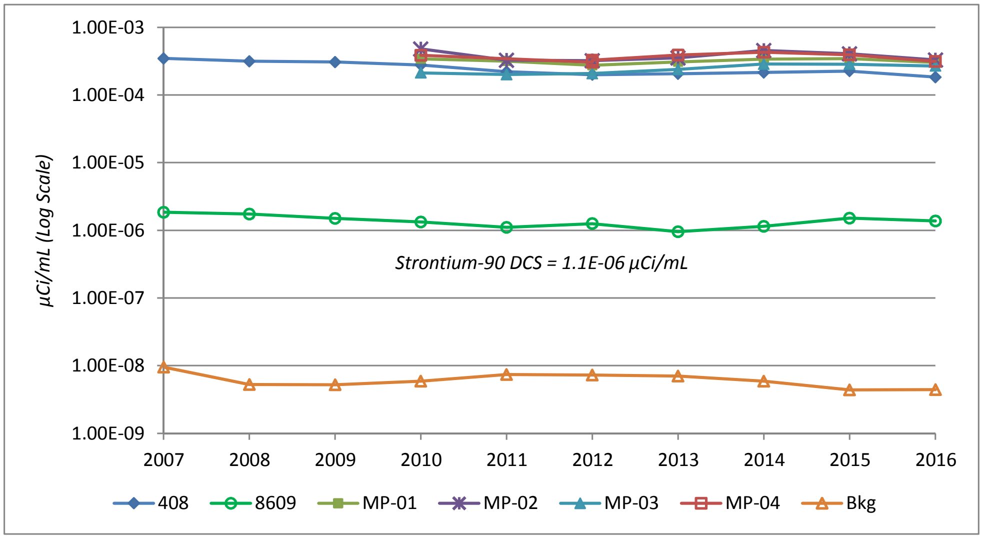
FIGURE 4-2
North Plateau Plume in the S&G Unit



GROSS BETA CONCENTRATIONS (December 2016)

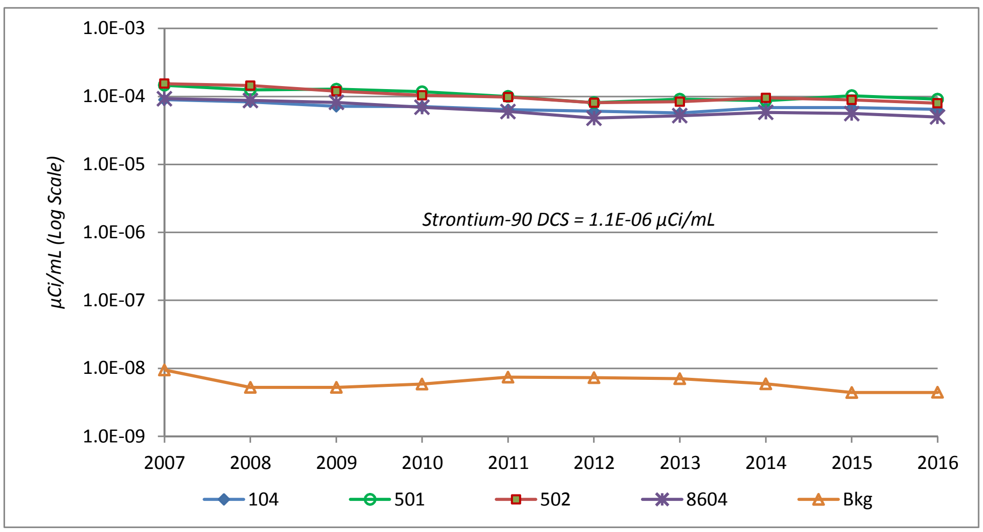
WELL ID	(µCi/mL)
Main Plant Area	
408	1.40E-04
8609	1.40E-06
MP-01	2.70E-04
MP-02	2.12E-04
MP-03	1.98E-04
MP-04	2.38E-04
Central Plume	
104	5.71E-05
501	8.60E-05
502	6.53E-05
8604	4.88E-05
Upgradient of PTW	
105	5.33E-05
106	2.62E-06
116	2.94E-05
8603	5.50E-05
Downgradient of PTW	
801	2.47E-06
802	4.48E-07
803	1.50E-06
804	2.29E-07
Seeps	
GSEEP	1.36E-07
SP04	2.10E-07
SP06	2.63E-07
SP11	1.15E-06
SP12	3.30E-07
Former Lagoon 1	
111	3.06E-06
8605	7.03E-06

FIGURE 4-3
Annual Average Gross Beta Concentrations at Monitoring Wells Downgradient of the North Plateau Strontium-90 Plume Source Area



Note: S&G background (Bkg) wells 301, 401, 706, and 1302 are averaged for this comparison.

FIGURE 4-4
Annual Average Gross Beta Concentrations at Monitoring Wells Centrally Located Within the North Plateau Strontium-90 Plume

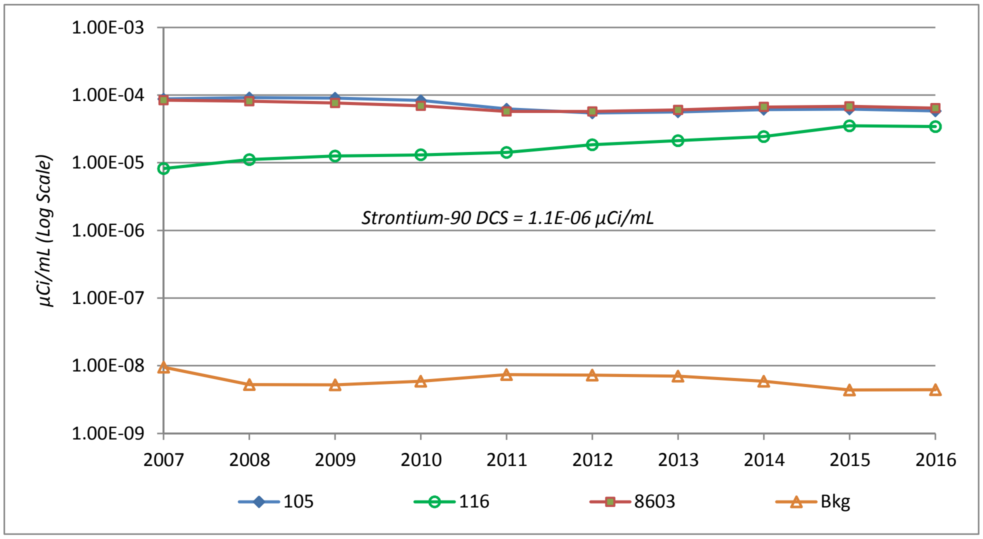


Note: S&G background (Bkg) wells 301, 401, 706, and 1302 are averaged for this comparison.

Figure 4-3 illustrates the gross beta concentrations in groundwater wells located immediately downgradient of the MPPB, the strontium-90 source area, and along the western edge of the plume (at well 8609). Well 408 and the four MPPB wells (MP-01, -02, -03, and -04, installed in CY 2010), located northeast of the MPPB closest to the source area, exhibit the highest gross beta concentrations (up to 5.10E-04 µCi/mL in June 2016, shown in Appendix D-2) of any routinely monitored wells in the GMP. The 2016 gross beta concentrations at these wells remained relatively stable throughout the year and were lower, on average, compared with 2015.

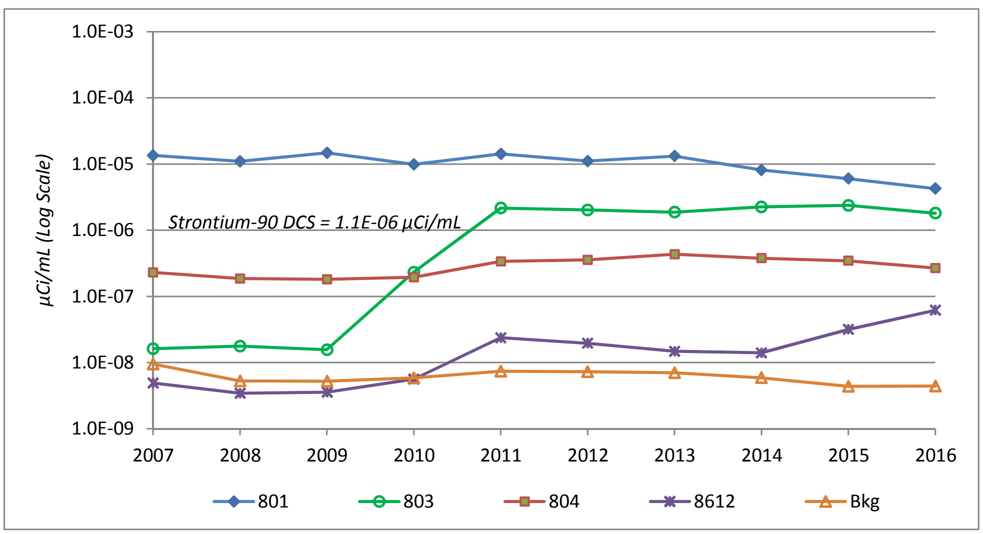
Figure 4-4 illustrates gross beta concentrations in wells 104, 501, 502, and 8604 centrally located within the plume area. Concentration ranges in these wells were generally similar in 2016 as compared with 2015.

FIGURE 4-5
Annual Average Gross Beta at Monitoring Wells Upgradient of the PTW



Note: S&G background (Bkg) wells 301, 401, 706, and 1302 are averaged for this comparison.

FIGURE 4-6
Annual Average Gross Beta at Monitoring Wells Downgradient of the PTW



Note: S&G background (Bkg) wells 301, 401, 706, and 1302 are averaged for this comparison.

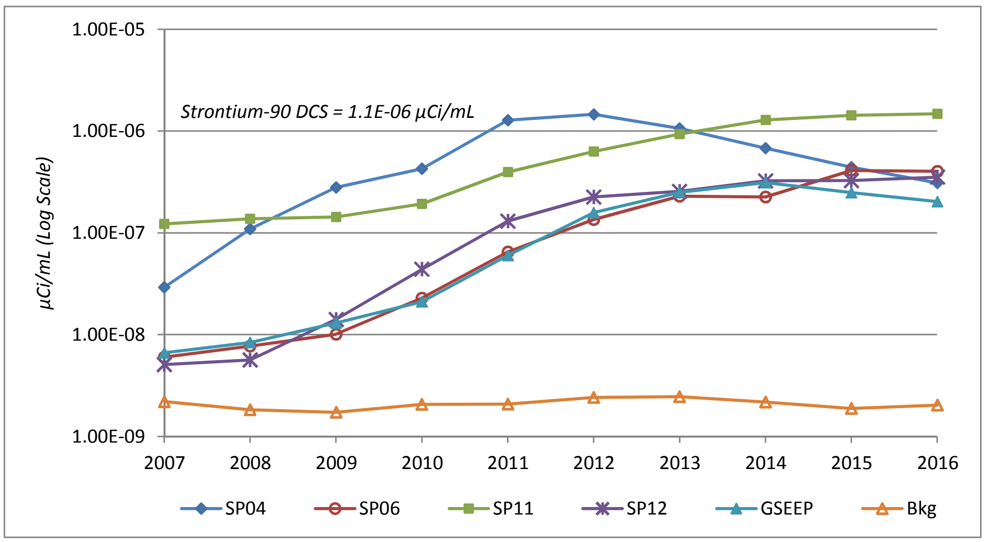
Figure 4-5 illustrates gross beta concentrations at monitoring wells 105, 116, and 8603, upgradient of the PTW. The gross beta concentration at well 116 decreased slightly in 2016 following several years of showing a slowly increasing trend.

Figure 4-6 illustrates gross beta concentrations at monitoring wells 801, 803, 804, and 8612, downgradient of the PTW. The plume's leading edge had migrated past the PTW before it was installed in 2010 as indicated by gross beta levels observed in downgradient wells prior to PTW installation in November 2010. The gross beta concentration increased in well 8612, the furthest downgradient of the PTW, and decreased in the other three wells in 2016. Continued monitoring will determine whether gross beta concentrations decrease over time as more treated groundwater migrates out of the PTW.

Seep monitoring discharge pipe

Maintenance of seep monitoring location

FIGURE 4-7
Annual Average Gross Beta Concentrations at Seeps From the Northeast Edge of the North Plateau

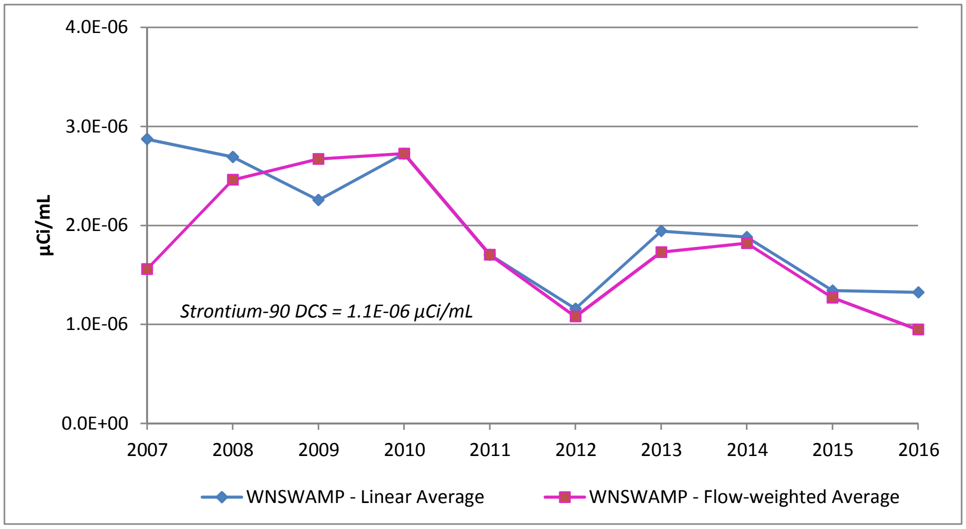


Note: Background (Bkg) from surface water sampling location WFBCBKG at Felton Bridge upgradient of the WVDP.

Monitoring at North Plateau Seeps. Groundwater is also monitored along the northeast edge of the north plateau, where it seeps from the steep banks incised by Erdman Brook and Franks Creek. The downgradient seepage locations (GSEEP, SP04, SP06, SP11, and SP12), located east of the CDDL outside of the WVDP fence line, monitor conditions on the edge of the north plateau where groundwater discharges to the surface. (See Figure 4-2.) Gross beta concentrations began increasing at the seeps several years before the PTW was installed as shown by the ten-year trend graphs of gross beta concentrations at these five seep monitoring points (Figure 4-7). The strontium-90 concentrations in the north plateau plume have been demonstrated to be approximately half of the gross beta concentrations, suggesting the DOE DCSs have not been exceeded at any of the seep locations.

Annual average gross beta concentrations at the seeps were plotted against surface water background values because water from seepage points occasionally may include surface water (i.e., at seepage location SP11). Annual average concentrations at seep locations SP11 and SP12 increased slightly during 2016 as the leading edge of the plume continues to migrate downgradient. The strontium-90 in the groundwater migrates more slowly than the groundwater itself. The strontium-90 adsorbs to the subsurface soils and slowly desorbs back into the groundwater due to chemical processes. The 2016 gross beta concentrations at the three southernmost seeps, SP04, SP06, and GSEEP, decreased compared with 2015, potentially due to PTW treated groundwater reaching this area.

FIGURE 4-8
Annual Average Strontium-90 Concentrations at WNSWAMP



Note: DCSs are used for evaluation only. DCS quantities represent concentrations that would result in a member of the public receiving 100 mrem effective dose following continuous exposure for one year. The WNSWAMP location is not accessible to the public.

Monitoring at the Northeast Swamp Drainage. The western and central lobes of the plume downgradient of the PTW are partially intercepted by the northeast swamp drainage ditch flowing west to east across the plume's leading edge. (See Figure 4-2.)

Totalized flow through the drainage ditch is recorded biweekly. Surface water samples are collected biweekly and analyzed for radiological constituents at sampling location WNSWAMP located at the WVDP project boundary. North plateau plume groundwater seeping into this ditch is believed to be the main source of the strontium-90 activity at WNSWAMP. Approximately 19.2 million gal (72.6 million L) of water flowed through this monitoring point in 2016. (See "Waterborne Effluent Monitoring" in Chapter 2.)

Gross beta and strontium-90 concentrations at WNSWAMP exhibit annual variability, as shown on Figure 4-8. Two methods were used to compute the annual average strontium-90 concentration, a linear average and a flow-weighted average. The flow-weighted average uses the volume of water flowing down the ditch at the time of sampling to proportionally weight the monthly concentrations. Both averages decreased slightly in 2016 and are below the concentrations in 2010, prior to installation of the PTW. The flow-weighted average is noticeably lower than the linear average because of the low precipitation that occurred in the summer of 2016 resulting in relatively low flow volumes during a period of relatively higher strontium-90 concentrations. Annual average strontium-90 concentrations at WNSWAMP have been above the strontium-90 DCS for several years. The flow-weighted annual average was below the DCS in 2016.

The strontium-90 released through WNSWAMP accounted for an annual estimated dose of 1.1E-02 mrem in 2016. (See "Maximum Dose [Waterborne] to an Off-Site Individual" in Chapter 3.)

Monitoring of surface water on Cattaraugus Creek downstream of the seeps and WNSWAMP drainage ditch at the first point of public access, (location WFFELBR), continued to show that strontium-90 concentrations in 2016 were similar to historical concentrations from the Cattaraugus Creek background surface water location at Bigelow Bridge (WFBIGBR). (See Table B-4I.) The annual average strontium-90 concentration at WFFELBR in 2016 was a non-detect.

Strontium-90 Plume Remediation Activities

Full-Scale Permeable Treatment Wall (PTW). In November 2010, an 860-ft-long full-scale PTW was installed to treat the north plateau strontium-90 plume. The PTW has operated now for over six full years. The overall average concentrations of strontium-90 immediately downgradient of the PTW are lower than they were when the wall was installed indicating that the PTW is removing strontium-90 from the groundwater. A map view and cross-section of the PTW installation is shown on Figure 4-9.

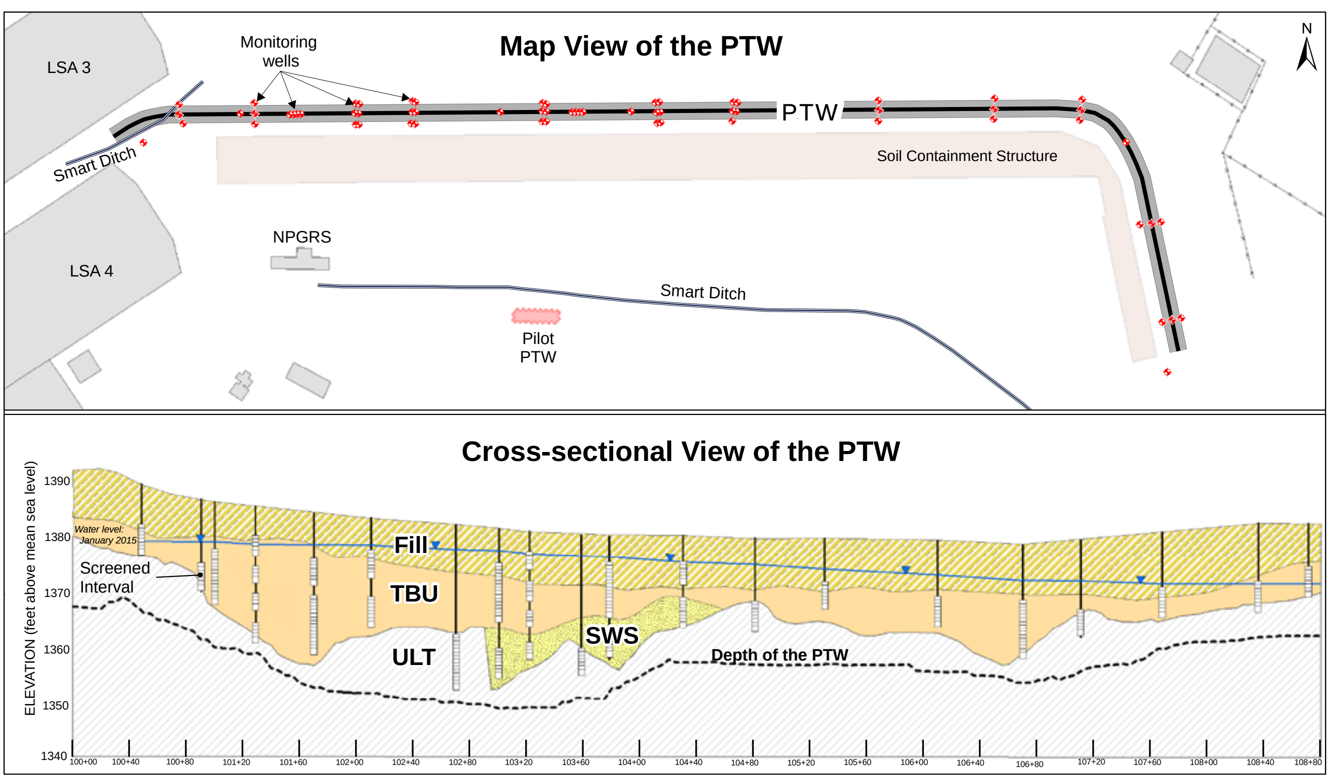
The PTW was installed through the entire thickness of the S&G unit (including the TBU and the SWS, where present), and was keyed into the underlying, low-permeability ULT. Granular clinoptilolite (i.e., zeolite), a natural mineral with a porous structure that traps positively charged ions by ion exchange, including strontium, while allowing the groundwater to pass through, was used as the treatment media in the PTW. A lined storm water drainage ditch (Smart-Ditch™) was also installed in September 2010 south of the PTW to intercept storm water from upland site areas and route it around the PTW to Franks Creek.

The PTW was selected and designed to address three remedial action objectives (RAOs):

- RAO 1: Reduce or eliminate strontium-90 presence in groundwater seepage leaving or potentially exiting the north plateau to ALARA, with a goal to be less than the Derived Concentration Guide (DCG) of 1.0E-06 µCi/mL (the RAOs for the PTW were determined before the DCGs, found in superceded DOE Order 5400.1, were replaced by the DCSs);
- RAO 2: Minimize the future expansion of the strontium-90 plume beyond its current mapped limits; and
- RAO 3: Ensure that a technology selected for current containment of the strontium-90 plume does not preclude any strategies for addressing the plume during site decommissioning.

The PTW placement was chosen to not transect the CDDL and to limit the expansion of groundwater impacted by strontium-90 at or above the 1.0E-05 µCi/mL level, and consequently, by design, did not capture the plume's leading edge as it existed in November 2010. Strontium-90 concentrations that existed downgradient of the PTW prior to the PTW's installation were expected to increase for a period of time, and then eventually decrease when

FIGURE 4-9



J:\GIS\ArMap\ASER\ASER_2015\ASER_2015_Fig4-9_PTW_20151104.mxd, r.1, skw/afs, 5/19/2016 groundwater treated by the PTW begins to reach these downgradient areas. Recent north plateau monitoring shows evidence of treated groundwater exiting the PTW downgradient of the wall.

Removal of the MPPB and excavating subsurface soils in the plume source area are components of DOE's ROD for decommissioning and/or long-term stewardship of the WVDP and the WNYNSC. Long-term strategies for management of the non-source area of the plume, including the PTW, will be evaluated as part of the Phase 2 decision-making process for the WVDP and the WNYNSC.

PTW Performance Monitoring Plan (PTWPMP). Following PTW construction, 66 monitoring wells were installed along the PTW (immediately upgradient, immediately downgradient, and within the PTW itself) in December 2010 to monitor treatment wall performance. The PTWPMP was developed and implemented immediately following the PTW installation. This plan describes the performance monitoring requirements for the PTW. Quarterly sampling and monthly inspections were performed throughout 2016. Collected data was evaluated consistent with the PTWPMP which included the first comprehensive five-year PTW monitoring event performed between April and June 2016. The comprehensive monitoring event included sampling of additional wells and parameters not sampled quarterly and additional hydraulic testing and surveying last performed during the baseline monitoring event which followed PTW installation.

Performance monitoring data collected to date, including data collected for the comprehensive five-year monitoring event, continue to indicate:

- groundwater flow patterns in the PTW area are similar to flow patterns observed prior to PTW construction, indicating that the PTW installation does not substantially alter groundwater flow conditions on the north plateau;

- groundwater treatment by ion exchange is occurring as evidenced by the fact that strontium-90 activity in groundwater inside the PTW typically is either not detected or substantially lower overall than strontium-90 activity levels upgradient of the PTW;

- geochemical differences observed in groundwater that has migrated into or through the zeolite also indicate that ion exchange (i.e., treatment) is occurring;

- the most elevated concentrations of strontium-90 observed inside the PTW occur within relatively narrow zones which are located where plume migration upgradient of the PTW follows preferential groundwater flow paths, such as preferential migration through the SWS;

- strontium-90 activity in groundwater immediately downgradient of the PTW has decreased overall; and

- strontium-90 activity that had already migrated past the PTW prior to its installation is continuing to migrate downgradient. However, strontium-90 concentrations are decreasing in some wells further downgradient of the PTW and are expected to continue to decrease over time as groundwater treated by the PTW flows towards these areas.

During the last 2016 quarterly monitoring conducted in October, there were no detected strontium-90 concentrations greater than 1.0E-05 µCi/mL (10,000 pCi/L) downgradient of the PTW and no detected strontium-90 concentrations above 1.0E-06 µCi/mL (1,000 pCi/L) in the downgradient eastern lobe of the strontium-90 plume.

These observations indicate the ongoing processes within the PTW continue to achieve the RAOs defined in the PTWPMP and shown in the previous section. Monitoring continues to be conducted in accordance with the PTWPMP.

North Plateau Groundwater Monitoring Plan (NPGMP). A supplementary NPGMP was also developed in 2010, in conjunction with completing the full-scale PTW. The primary objective of the NPGMP is to monitor the strontium-90 plume migration in groundwater farther upgradient and downgradient of the PTW than the areas monitored under the PTWPMP. This monitoring program, which includes quarterly gross beta sampling at 26 well locations and water level measurements at 40 well locations, was performed concurrent with the PTWPMP throughout 2016. Data from these wells supports the development of groundwater elevation contours and gross beta isopleths.

PTW Protection and Best Management Plan. The north plateau PTW protection and best management plan describes best management practices implemented to increase the effectiveness and longevity of the PTW. The practices include elimination of road-salt use near the PTW (because the ions will compete with the strontium-90 or removal in the PTW), storm water management via the upgradient Smart-Ditch™, and monthly inspections.

North Plateau Groundwater Recovery System (NPGRS). In 1995, the NPGRS was installed to slow the advance of the strontium-90 plume. (See Figure 4-2.) The NPGRS consists of three wells used to extract contaminated groundwater. Extracted groundwater was transferred to the LLW2 for treatment by ion exchange to remove strontium-90. The treated groundwater was ultimately discharged through the lagoon system to Erdman Brook via the SPDES-permitted outfall 001.

Based on groundwater plume mitigation provided by the PTW, the NPGRS was shut down in April 2013. Closure of the NPGRS will be performed in accordance with SPDES closure requirements.

Pilot-Scale PTW. A pilot-scale PTW was constructed in 1999 with a clinoptilolite selected for its ability to adsorb strontium-90 ions from groundwater. Three wells within the pilot-scale PTW were monitored in 2016 under the NPGMP to support delineation of flow and transport of the plume across the north plateau. The data collected during the testing of the pilot PTW helped determine that the PTW technology was an effective remediation method for strontium-90-contaminated groundwater.

Other Groundwater Sampling Observations on the North Plateau

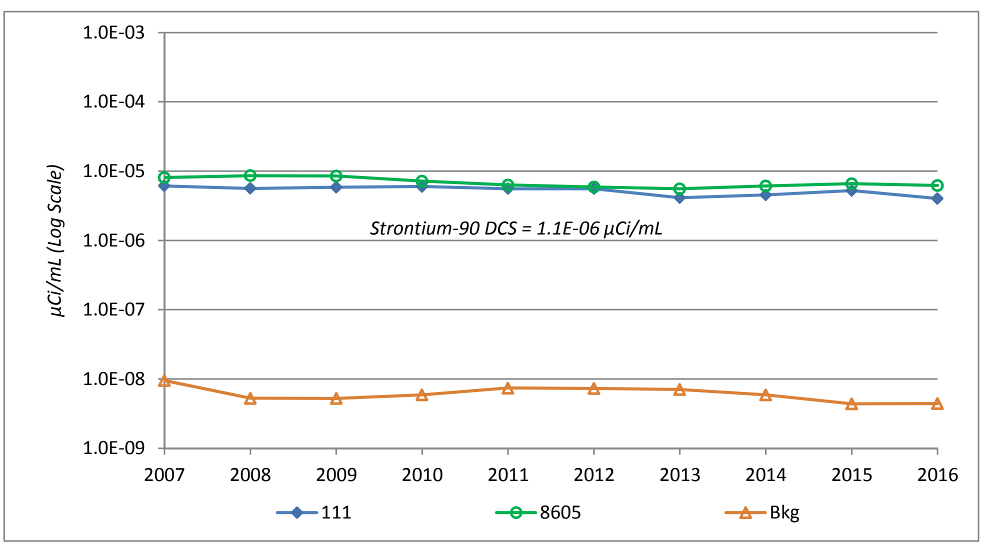
Monitoring Near Former Lagoon 1. Southeast of the strontium-90 plume, elevated gross beta concentrations are documented in groundwater downgradient of former lagoon 1, which was backfilled in 1984. (See Figure 4-2.) Gross beta concentrations in wells 8605 and 111 are consistently above the strontium-90 DCS and are remaining relatively stable from year to year. (See Figure 4-10.) As shown in the 10-year trend graph, the annual average gross beta concentrations at wells 8605 and 111 decreased slightly in 2016 compared with 2015. The gross beta activity source is assumed to be the radiologically contaminated material used as backfill and the residual sediment within former lagoon 1.

Tritium in North Plateau Groundwater. On the north plateau, elevated tritium concentrations have historically been observed downgradient of the MPPB, near the LAG storage hardstand, and adjacent to and downgradient of the lagoon system. Tritium concentrations sitewide have been consistently decreasing. Tritium has a relatively short half-life (about 12.3 years) and dilution from surface water infiltration and groundwater recharge contributes to the decrease. Residual tritium activity is due to former nuclear fuel reprocessing operations.

FIGURE 4-10
Annual Average Gross Beta Concentrations at Monitoring Wells Near Former Lagoon 1

WVDP Treatment Lagoons

Location of former lagoon 1



Note: S&G background (Bkg) wells 301, 401, 706, and 1302 are averaged for this comparison.

As shown in Table 4-7, the maximum tritium concentration measured in groundwater from the north plateau in 2016, 1.28E-05 µCi/mL, occurred at well point WP-C, downgradient of the MPPB. (See Figure A-9 for the well point location.) This concentration was approximately two orders of magnitude below the DCS for tritium of 1.9E-03 µCi/mL.

Radioisotopic Sampling Results on the North Plateau. In addition to being analyzed for gross alpha, gross beta, tritium, and strontium-90, samples from eight groundwater wells in the north plateau S&G unit (401, 406, 408, 1304, and MP-01 through MP-04) were analyzed for specific radionuclides. (See Tables 4-3 and 4-4.) The maximum radionuclide concentrations measured at either the north or south plateau during 2016 are presented in Table 4-7.

The MPPB wells (MP-01, -02, -03, and -04) are analyzed for the following additional radioisotopes to investigate their presence as a result of former MPPB operations: neptunium-237, plutonium-238, plutonium-239/240, plutonium-241, americium-241, and curium-243/244. None of these radioisotopes were detected above their detection limits in the MPPB wells during 2016 (See Appendix D-2, Table D-2G).

Results for Volatile and Semivolatile Organic Compounds (VOCs and SVOCs). Per the 3008(h) Consent Order, select wells within the S&G unit are monitored for VOCs and SVOCs because concentrations of these compounds exceeding NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Class GA Groundwater Quality Standards were detected in some groundwater samples collected during the RFI.

TABLE 4-7

2016 Maximum Concentrations of Radionuclides[a] in Groundwater at the WVDP Compared With WVDP Groundwater Screening Levels[b] (GSLs)

Radionuclide	*Regulatory Compliance*			*Environmental Surveillance*			*GSL (µCi/mL)*
	Well ID With Maximum Concentration	*Flag[c]*	*Maximum Concentration (µCi/mL)*	*Well ID With Maximum Concentration*	*Flag[c]*	*Maximum Concentration (µCi/mL)*	
Tritium	909		**7.60E-07**	WP-C		**1.28E-05**	1.78E-07
Strontium-90	MP-04		**1.08E-04**	–			5.90E-09
Technetium-99	MP-02		**4.72E-08**	–			5.02E-09
Iodine-129	NDATR		**2.29E-08**	–			9.61E-10
Radium-226[d]	408		**1.50E-09**	–			1.33E-09
Radium-228[d]	408	J	**8.22E-09**	1304	J	6.30E-10	2.16E-09
Uranium-233/234[d]	NDATR		**1.59E-09**	1304		4.13E-10	6.24E-10
Uranium-235/236	401	J	**1.47E-10**				8.07E-11
Uranium-238[d]	NDATR		**1.00E-09**	1304	J	1.63E-10	4.97E-10
Total Uranium[d] (µg/mL)	NDATR		**3.27E-03**	1304		4.97E-04	1.34E-03

Note: Bolding indicates that the radionuclide exceeds the GSL.

NE - GSL for this radionuclide not established.

- indicates that none of the regulatory or environmental surveillance wells exhibited positive results for these radionuclides.

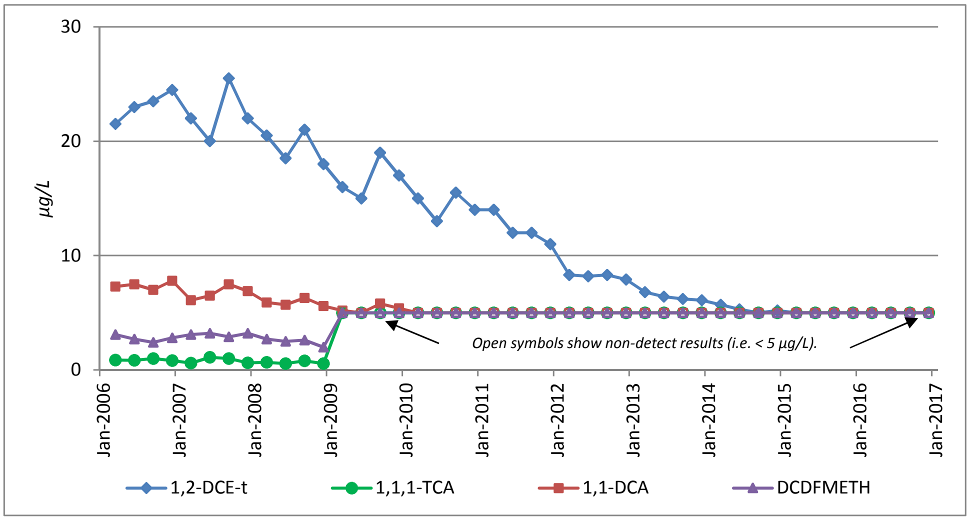
[a] The table presents the maximum concentrations of radioculides that were positively identified in groundwater wells at the WVDP, all other radionuclides were not positively identified, or were not analyzed.

[b] GSLs for radiological constituents are set equal to the larger of the background concentrations or NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Class GA Groundwater Quality Standards (see Table D-1A).

[c] The "J" flag indicates the result is an estimated value.

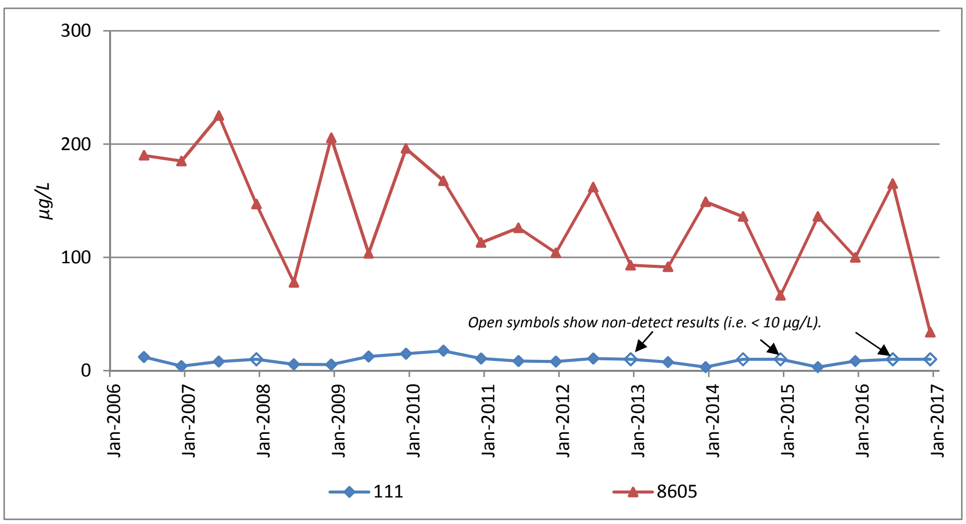
[d] Radium-226, radium-228, uranium-233/234, uranium-238 and total uranium occur naturally in the environment.

FIGURE 4-11
Concentrations of 1,2-DCE-t, 1,1,1-TCA, 1,1-DCA, and DCDFMeth at Well 8612 in the S&G Unit



Note: 1,2-DCE-t = 1,2-Dichloroethylene (total) 1,1-DCA = 1,1-Dichloroethane
1,1,1-TCA = 1,1,1-Trichloroethane DCDFMeth = Dichlorodifluroromethane

FIGURE 4-12
Concentrations of TBP at Monitoring Wells Near Former Lagoon 1 in the S&G Unit



The only S&G unit monitoring location with previously consistent positive VOC detections was well 8612, located northeast and downgradient of the CDDL at the north-east edge of the north plateau. Figure 4-11 illustrates the concentration ranges of four VOCs historically detected at well 8612. None of these VOCs were detected during 2016. The VOCs previously detected in well 8612 are presumed to be from wastes buried in the CDDL.

Tributyl phosphate (TBP), an SVOC, has been continually detected in groundwater from well 8605, downgradient of former lagoon 1 since monitoring at this location began. (See Figure 4-12.) TBP is thought to be residual contamination from liquid waste management activities in the former lagoon 1 area during nuclear fuel reprocessing. The maximum TBP concentration measured in 2016 (165 micrograms per liter [µg/L]) was significantly lower than the historic high of 700 µg/L measured in December 1996. Overall concentrations of TBP at well 8605 are decreasing. A TOGS 1.1.1 water quality standard has not been established for TBP. Historically, TBP has also been detected in well 111, located near well 8605. However, no TBP was detected in well 111 during 2016.

Metals Sampling on the North Plateau. In 2005, 2007, and 2008, select groundwater wells were sampled to evaluate metals concentrations in groundwater impacted by the strontium-90 plume migrating from the MPPB source area. No metals have been determined to be associated with the strontium-90 plume.

During 2016, routine metals sampling continued to be performed, as outlined in the GMP. The sampling results were compared with the established GSLs and background levels. The only metals detected above background in groundwater in 2016 were barium, chromium, and nickel. (See Table 4-8.)

The background concentration of barium was exceeded for three quarters during 2016 at well MP-01 and one quarter at well MP-03. Naturally occurring levels of barium and other metals have been observed in WVDP background monitoring wells. (See Table D-1B in Appendix D-1.) Chromium and nickel were detected at concentrations above background and the GSL in wells 405 and 706. Wells 405 and 706 are stainless steel wells that have historically shown evidence of corrosion. Chromium and nickel can leach from the corroding well screen and adsorb to fine sediments within the well. The elevated chromium and nickel in wells 405 and 706 in 2016 is believed to be due to corrosion of the stainless steel well screens.

Groundwater Sampling Observations on the South Plateau Including the NDA

Interim Measures (IMs). In 1990, a trench system was constructed through the WLT along the northeast and northwest sides of the NDA to intercept and collect potentially contaminated groundwater. Sampling location NDATR is a sump at the lowest point of the interceptor trench. Groundwater is collected at NDATR and transferred to the LLW2 for processing. In 2016, no organic constituents were detected in groundwater from the NDA interceptor trench. Groundwater elevations are monitored quarterly in and around the interceptor trench to ensure that an inward gradient is maintained.

A second IM, to improve the stability of the earthen cap and to limit infiltration of surface water and precipitation into the NDA, was completed in December 2008. This included installing a geosynthetic cap over the NDA, a low-permeability upgradient slurry wall, and surface water drainage diversions. Figure 4-13 shows the reduced water volume extracted from the interceptor trench since the cap and barrier wall were installed, indicating that the IM is effectively reducing flow through the NDA. The total volume pumped from the NDA trench in 2016 (71,611 gal [271,077 L]) was approximately one-sixth of the volume pumped in CY 2007, before the IM.

FIGURE 4-13
Volume of Water Pumped from the NDA Interceptor Trench

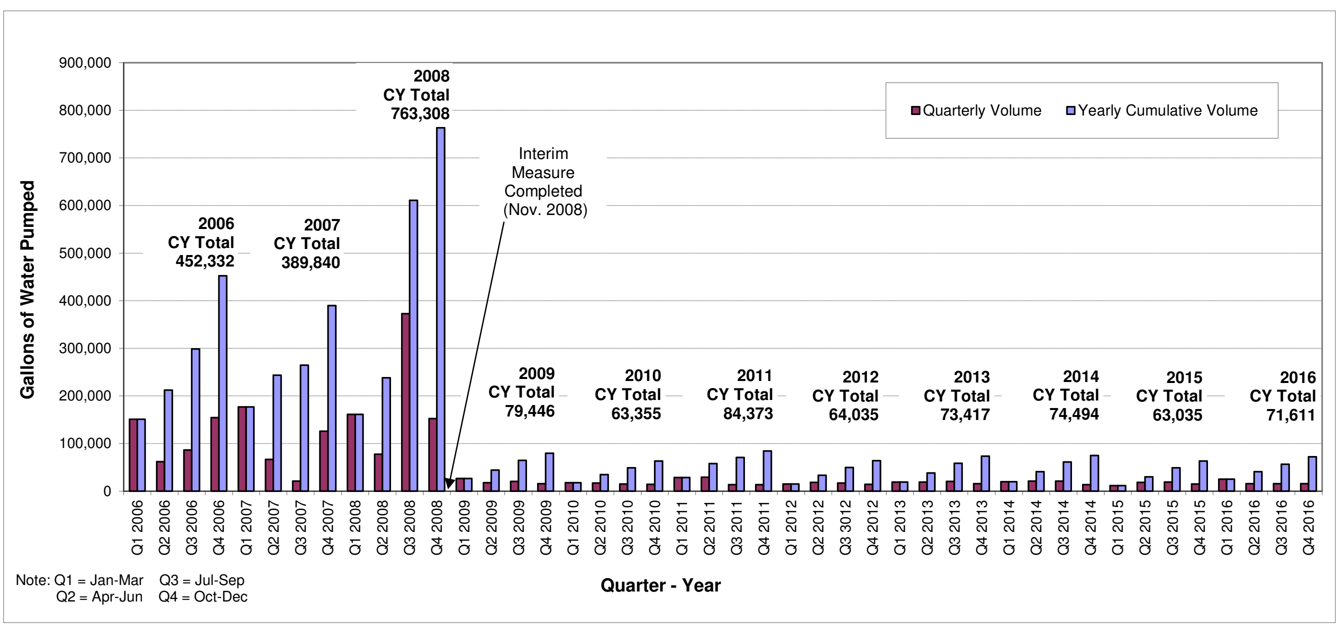


TABLE 4-8
2016 Groundwater Monitoring Results Exceeding GSLs and Background Levels

RADIOLOGICAL PARAMETERS								
Number of Locations exceeding GSLs [a] ***or Background*** [b]		***Geologic Unit (plateau)***	***Groundwater Sampling Location***					
Gross Alpha								
2 > GSL	3 > BKG	S&G (NP)	111	**8605**	**WP-H**			
Gross Beta								
21 > GSL	35 > BKG	S&G (NP)	GSEEP	**104**	**501**	**803**	**8609**	WP-C
			SP04	**105**	**502**	804	8612	**WP-H**
			SP06	**106**	604	**8603**	**MP-01**	
			SP11	**111**	605	**8604**	**MP-02**	
			SP12	**116**	**801**	**8605**	**MP-03**	
			103	**408**	**802**	8607	**MP-04**	
		ULT (NP)	107					
		WLT (SP)	NDATR	909				
Tritium								
10 > GSL	10 > BKG	S&G (NP)	**GSEEP**	**8609**	**WP-A**	**WP-H**		
			106	**8612**	**WP-C**			
		ULT (NP)	**108**	**110**				
		WLT (SP)	**909**					
Strontium-90								
11 > GSL	11 > BKG	S&G (NP)	**408**	**502**	**8609**	**MP-02**	**MP-04**	
			501	**801**	**MP-01**	**MP-03**		
		WLT (SP)	**NDATR**	**909**				
Technetium-99								
5 > GSL	5 > BKG	S&G (NP)	**408**	**MP-01**	**MP-02**	**MP-03**	**MP-04**	
Iodine-129								
2 > GSL	2 > BKG	WLT (SP)	**NDATR**	**909**				
Radium-226								
1 > GSL	1 > BKG	S&G (NP)	**408**					
Radium-228								
1 > GSL	1 > BKG	S&G (NP)	**408**					
Uranium-233/234 [d]								
3 > GSL	3 > BKG	S&G (NP)	**MP-03**	**MP-04**				
		WLT (SP)	**NDATR**					
Uranium-235/236								
5 > GSL	5 > BKG	S&G (NP)	**401**	**408**	**MP-03**	**MP-04**		
		WLT (SP)	**NDATR**					
Uranium-238 [d]								
4 > GSL	4 > BKG	S&G	**MP-03**	**MP-04**				
		WLT (SP)	**NDATR**	**909**				
Total Uranium [d]								
2 > GSL	2 > BKG	WLT (SP)	**NDATR**	**909**				

Note: Bolded wells indicate 2016 results that exceed GSLs. Unbolded wells indicated 2016 results that exceeded background.

TABLE 4-8 (*concluded*)
2016 Groundwater Monitoring Results Exceeding GSLs and Background Levels

METALS				
Number of Locations exceeding GSLs[a] or Background[b]		***Geologic Unit (plateau)***	***Groundwater Sampling Location***	
Barium				
0 > GSL	2 > BKG	S&G (NP)	MP-01	MP-03
Chromium				
2 > GSL	2 > BKG	S&G (NP)	**405**	**706**
Nickel				
2 > GSL	2 > BKG	S&G (NP)	**405**	**706**
ORGANICS				
Tributyl phosphate				
No TOGS[c]	1 > DL	S&G (NP)	8605	

Note: Bolded wells indicate 2016 results that exceed GSLs. Unbolded wells indicated 2016 results that exceeded background.

Key:

BKG - Background
GSL - Groundwater Screening Level
DL - Detection Limit
NP - North
SP - South
S&G - Sand and Gravel
ULT - Unweathered Lavery Till
WLT - Weathered Lavery Till

[a] The site-specific GSLs for radiological constituents were set equal to the larger of the WVDP background concentrations or the NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards as discussed on page D-1 and presented in Table D-1A. The GSLs for metals were set equal to the larger of the background concentration or NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards as presented in Table D-1B. Organic constituents were compared directly with NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards.

[b] The data used for the calculation of background values collected from 1991 through September 2009 were taken from background wells 301, 401, 706, and 1302 in the sand and gravel unit on the north plateau. The background concentration was set to the upper limit of the 95% confidence interval.

[c] No TOGS 1.1.1 standard has been established for tributyl phosphate.

[d] Uranium-233/234, uranium-238 and total uranium occur naturally in the environment.

Water level data from piezometers installed to monitor the effects of the NDA IM indicate that the slurry wall and geomembrane cover are causing the WLT to become dry in some areas. Refer to the Environmental Compliance section titled "RCRA §3008(h) Administrative Order on Consent" for further discussion of the NDA IMs.

Radioisotopic Sampling Results on the South Plateau. Two sampling locations on the south plateau (well 909 and the NDA sump [NDATR]) are analyzed for specific radionuclides. (See Appendix A, Figure A-10.) Results are tabulated in Appendix D-2.

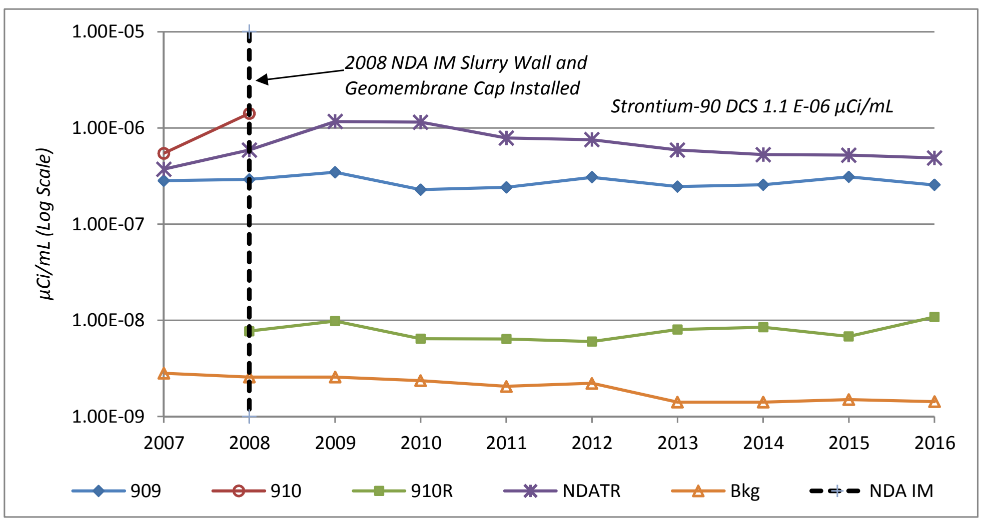
Gross beta, strontium-90, iodine-129, total uranium, and several uranium radioisotope concentrations in groundwater from NDATR continued to be elevated with respect to GSLs or to concentrations in background monitoring locations on the south plateau. (See Table 4-8 and Figure 4-14.) Gross beta concentrations at NDATR have decreased from the maximum observed concentration of 1.75E-06 µCi/L in September 2009 after the 2008 IM to below the gross beta GSL of 1.00E-6 µCi/mL from 2013 through 2016. The increases immediately following the installation of the upgradient slurry wall and cap are believed to be attributable to less dilution of water collected in the trench because groundwater and surface water infiltration into the NDA was significantly reduced. Similar to the north plateau, strontium-90 is the predominant contributing radioisotope to the measured gross beta concentrations in the NDA trench water.

NDATR samples in 2016 exhibited concentrations for iodine-129 that were above background and the GSL similar to the past several years. Elevated iodine-129 concentrations observed since the 2008 IM are believed to be attributable to less dilution of the water that collects within the trench. (See Table 4-7.)

WLT well 909 exhibited elevated tritium, iodine-129, strontium-90, total uranium, and uranium-238 concentrations above their respective GSLs during 2016, consistent with historical values, as shown in Table 4-8 and Appendix D-2.

The radionuclide concentrations in groundwater described above for the NDA sump (NDATR) and from well 909 downgradient of the NDA are presumed to be associated with former waste burial operations.

FIGURE 4-14
Annual Average Gross Beta Concentrations
at Monitoring Wells Downgradient of the NDA and at the NDA Trench



Notes: WLT background well for the south plateau is 1008C. In 2007, well 910 was determined to be damaged such that groundwater samples collected from this well were no longer representative of the ULT. Well 910 was therefore decommissioned in 2008 and replaced with well 910R.

Additional Monitoring and Investigations

Groundwater Monitoring Downgradient of the Waste Tank Farm (WTF). Waste in the underground tanks was removed and solidified through the VIT process from 1996 to 2002. The underground waste tanks are being stabilized by a tank and vault drying system (T&VDS) that began operating in December 2010. Three of the tanks are dry and liquid levels are decreasing in the fourth tank. This system is successfully reducing the liquid volume in the tanks and vaults through evaporation. (See “WTF and the T&VDS” in the Environmental Compliance Summary.) Throughout waste processing activities, groundwater controls have been in place to (1) reduce the upward hydrostatic pressure on the tanks, and (2) to maintain an inward hydraulic gradient toward the tanks, thereby inhibiting potential leaks from the tanks. The natural inward hydraulic gradient is influenced by periodically pumping a dewatering well, located outside the tank vaults, that also controls the hydrostatic pressure near the tanks.

Radioactivity in groundwater near the WTF is routinely monitored and evaluated. Elevated gross beta concentrations from well 8607 have been observed since 1994, with a relatively low maximum concentration of 7.63E-08 µCi/mL measured in 2005. Low levels of gross beta activity have also been observed in the dewatering well and the tank 8D-2 pan. During 2016, gross beta concentrations measured at well 8607 were less than 60 % of the 2005 maximum.

New WVDP Water Supply Wells. As indicated in Chapter 2, in 2014 the WVDP converted its water supply from a surface water source to a groundwater source provided by two newly installed bedrock wells located approximately 700 feet to the southwest of the MPPB. In addition to monitoring the drinking water, three source water protection plan wells are sampled to provide assurance that the bedrock groundwater is free of contamination. Analytical data for 2016 from these three wells, presented on Table B-5H, show that radiological indicator results (gross alpha and gross beta) are within site background concentrations.

Summary

Evaluation of groundwater sampling data from 2016 continues to show that the most widespread area of groundwater contamination at the WVDP is the strontium-90 plume in the S&G unit on the north plateau. Efforts to reduce contaminant levels in the downgradient portions of the north plateau plume included the 2010 installation of the full-scale PTW and installation of the NPGRS in 1995. The NPGRS was determined to no longer be needed after the PTW was installed and has been shut down. Six years of post-installation monitoring results indicate the PTW is removing strontium-90 from the groundwater passing through the wall.

Other localized areas of groundwater contamination have been observed downgradient of former lagoon 1, also on the north plateau, and downgradient of the NDA on the south plateau. Groundwater contaminant concentrations downgradient of Lagoon 1 are remaining stable or decreasing. Measures to reduce and collect water moving through the NDA including the NDA interceptor trench installed in 1990 and the slurry wall and geomembrane cover installed in 2008 are reducing the water level in the NDA and thus the potential for groundwater contamination flowing out of the NDA. The T&VDS is effectively drying out the waste tanks, further reducing the potential for groundwater contamination in the WTF.

As discussed in the ECS, future longer-term measures to reduce potential groundwater contamination as described in Phase 1 of the EIS preferred alternative selected by DOE in the ROD (April 2010), include removing the MPPB, removing the lagoons, and excavating the source area of the north plateau plume.

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USEFUL INFORMATION

This section provides background information that may be useful to the reader in understanding and interpreting the results presented in this ASER. First, it presents brief summaries of concepts pertaining to radiation and radioactivity, including:

- radioactive decay;
- types of ionizing radiation;
- measurement of radioactivity;
- measurement of dose;
- background radiation; and
- potential health effects of radiation.

It describes how data are presented in the ASER, and presents tables of unit prefixes, units of measure, and conversion factors. It discusses limits applicable to air emissions and water effluents, and describes (and presents a table of) the dose-based DOE DCSs. It includes a discussion of CAP88-PC, the computer code that can be used to evaluate compliance with the air dose standard. It also presents discussions of 1) water quality classifications, standards, and limits for ambient water; 2) potable water standards; 3) oil and sediment guidelines; and 4) evaluation of monitoring data with respect to limits.

Radiation and Radioactivity

Radioactivity is a property of atoms with unstable nuclei. The unstable nuclei spontaneously decay by emitting radiation in the form of energy (such as gamma rays) or particles (such as alpha and beta particles) (see inset on following page). If the emitted energy or particle has enough energy to break a chemical bond or to knock an electron loose from another atom, a charged particle (an "ion") may be created. This radiation is known as "ionizing radiation."

As used in this ASER, the term "radiation" refers only to ionizing radiation and does not include nonionizing forms of radiation such as visible light, radio waves, microwaves, infrared light, or ultraviolet light.

Radioactive Decay

An atom is the smallest component of an element having the chemical properties of the element. An atom consists of a central core (the *nucleus*), composed of positively charged particles (*protons*) and particles with no charge (*neutrons*), surrounded by negatively charged particles (*electrons*) that revolve in orbits in the region surrounding the nucleus. The protons and neutrons are much more massive than the electrons; therefore, most of an atom's mass is in the nucleus.

An element is defined by the number of protons in its nucleus, its atomic number. For example, the atomic number of hydrogen is one (one proton), the atomic number of strontium is 38 (38 protons), and the atomic number of cesium is 55 (55 protons).

The mass number of an atom, its *atomic weight*, is equal to the total number of protons and neutrons in its nucleus. For example, although an atom of hydrogen will always have one proton in its nucleus, the number of neutrons may vary. Hydrogen atoms with zero, one, or two neutrons will have atomic weights of one, two, or three, respectively. These atoms are known as *isotopes* (or *nuclides*) of the element hydrogen. Elements may have many isotopes. For instance, the elements strontium and cesium have more than 30 isotopes each.

Isotopes may be stable or unstable. An atom from an unstable isotope will spontaneously change to another atom. The process by which this change occurs, that is, the spontaneous emission from the nucleus of alpha or beta particles, often accompanied by gamma radiation, is known as *radioactive decay*. Depending upon the type of radioactive decay, an atom may be transformed to another isotope of the same element or, if the number of protons in the nucleus has changed, to an isotope of another element.

Isotopes (nuclides) that undergo radioactive decay are called *radioactive* and are known as *radioisotopes* or *radionuclides*. Radionuclides are customarily referred to by their atomic weights. For instance, the radionuclides of hydrogen, strontium, and cesium measured at the WVDP are hydrogen-3 (also known as tritium), strontium-90, and cesium-137. For some radionuclides, such as cesium-137, a short-lived intermediate is formed that decays by gamma emission. This intermediate radionuclide may be designated by the letter "m" (for metastable)

Some Types of Ionizing Radiation

Alpha Particles. An alpha particle is a positively charged particle consisting of two protons and two neutrons. Compared to beta particles, alpha particles are relatively large and heavy and do not travel very far when ejected by a decaying nucleus. Therefore, alpha radiation is easily stopped by a few centimeters of air or a thin layer of material, such as paper or skin. However, if radioactive material is ingested or inhaled, the alpha particles released inside the body can damage soft internal tissues because their energy can be absorbed by tissue cells in the immediate vicinity of the decay. An example of an alpha-emitting radionuclide is the uranium isotope with an atomic weight of 232 (uranium-232). Uranium-232 was in the HLW mixture at the WVDP as a result of a thorium-based nuclear fuel reprocessing campaign conducted by Nuclear Fuel Services, Inc. Uranium-232 has been detected in liquid waste streams.

Beta Particles. A beta particle is an electron emitted during the breakdown of a neutron in a radioactive nucleus. Compared to alpha particles, beta particles are smaller, have less of a charge, travel at a higher speed (close to the speed to light), and can be stopped by wood or a thin sheet of aluminum. If released inside the body, beta particles do much less damage than an equal number of alpha particles because beta particles deposit energy in tissue cells over a larger volume than alpha particles. Strontium-90, a fission product found in the liquids associated with the HLW, is an example of a beta emitting radionuclide.

Gamma Rays. Gamma rays are high-energy “packets” of electromagnetic radiation, called photons, that are emitted from the nucleus. Gamma rays are similar to x-rays, but are generally more energetic. If an alpha or beta particle released by a decaying nucleus does not carry off all the energy generated by the nuclear disintegration, the excess energy may be emitted as gamma rays. If the released energy is high, a very penetrating gamma ray is produced that can be effectively reduced only by shielding consisting of several inches of a dense material, such as lead, or of water or concrete several feet thick. Although large amounts of gamma radiation are dangerous, gamma rays are also used in lifesaving medical procedures. An example of a gamma-emitting radionuclide is barium-137m a short-lived daughter product of cesium-137. Both barium-137m and its precursor, cesium-137, are major constituents of the WVDP HLW.

following the atomic weight. For cesium-137, the intermediate radionuclide is barium-137m, with a half-life of less than three minutes.

The process of radioactive decay will continue until only a stable, nonradioactive isotope remains. Depending on the radionuclide, this process can take anywhere from less than a second to billions of years. The time required for half of the radioactivity to decay is called the radionuclide’s *half-life*. Each radionuclide has a unique half-life. The half-life of hydrogen-3 is slightly more than 12 years, both strontium-90 and cesium-137 have half-lives of approximately 30 years, and plutonium-239 has a half-life of more than 24,000 years.

Knowledge of radionuclide half-lives is often used to estimate past and future inventories of radioactive material. For example, a 1.0 millicurie source of cesium-137 in 2006 would have measured 2.0 millicuries in 1976 and will be 0.5 millicuries in 2036. For a list of half-lives of radionuclides applicable to the WVDP, see Table UI-4.

Measurement of Radioactivity

As they decay, radionuclides emit one or more types of radiation at characteristic energies that can be measured and used to identify the radionuclide. Detection instruments measure the quantity of radiation emitted over a specified time. From this measurement, the number of decay events (nuclear transformations) over a fixed time can be calculated.

Radioactivity is measured in units of curies (Ci) or becquerels (Bq). One Ci (based on the rate of decay of one gram of radium-226) is defined as the “quantity of any radionuclide that undergoes an average transformation rate of 37 billion transformations per second.” In the International System of Units (SI), one Bq is equal to one transformation per second. In this ASER, radioactivity is customarily expressed in units of Ci followed by the equivalent SI unit in parentheses, as follows: 1 Ci (3.7E+10 Bq).

In this report, measurements of radioactivity in a defined volume of an environmental media, such as air or water, are presented in units of concentration. Since levels of radioactivity in the environment are typically very low, concentrations may be expressed in µCi/mL, with SI units (Bq/L) in parentheses. (One microcurie is equal to one millionth of a curie.)

Measurement of Dose

The amount of energy absorbed by a material that receives radiation is measured in rads. A rad is 100 ergs of radiation energy absorbed per gram of material. (An erg is the approximate amount of energy necessary to lift a mosquito one-sixteenth of an inch.) "Dose" is a means of expressing the amount of energy absorbed, taking into account the effects of different kinds of radiation.

Alpha, beta, and gamma radiation affect the body to different degrees. Each type of radiation is given a quality factor that indicates the extent of human cell damage it can cause compared with equal amounts of other ionizing radiation energy. Alpha particles cause 20 times as much damage to internal tissues as x-rays, so alpha radiation has a quality factor of 20, compared to gamma rays, x-rays, or beta particles, each of which have a quality factor of one.

The unit of dose measurement to humans is the *rem*. The number of rem is equal to the number of rads multiplied by the quality factor for each type of radiation. In the SI system, dose is expressed in sieverts. One Sv equals 100 rem. One rem equals 1,000 mrem, the unit used to express standards for dose to man from air and water sources, as applicable to this ASER. This ASER expresses dose in standard units, followed by equivalent SI units in parentheses, as follows: 1 mrem (0.01 millisievert [mSv]).

Background Radiation

Background radiation is always present, and everyone is constantly exposed to low levels of such radiation from both naturally occurring and man-made sources. In the U.S. the average total annual exposure to low-level background radiation is estimated to be about 620 mrem or 6.2 mSv. About one-half of this radiation, approximately 310 mrem (3.1 mSv), comes from natural sources. The other half (about 310 mrem [3.1 mSv]) comes from medical procedures, consumer products, and other man-made sources (NCRP Report Number 160, 2009). (See Figure 3-1 in Chapter 3.)

Background radiation includes cosmic rays; the decay of natural elements, such as potassium, uranium, thorium, and radon; and radiation from sources such as chemical fertilizers, smoke detectors, and cigarettes. Actual doses vary depending on such factors as geographic location, building ventilation, and personal habits.

Potential Health Effects of Radiation

The three primary pathways by which people may be exposed to radiation are (1) direct exposure, (2) inhalation, and (3) ingestion. Exposure from radiation may be from a source outside the body (external exposure) or from radioactive particles that have been taken in by breathing or eating and have become lodged inside the body (internal exposure). Radionuclides that are taken in are not distributed in the same way throughout the body. Radionuclides of strontium, plutonium, and americium concentrate in the skeleton, while radioisotopes of iodine concentrate in the thyroid. Radionuclides such as hydrogen-3 (tritium), carbon-14, or cesium-137, however, will be distributed uniformly throughout the body.

Living tissue in the human body can be damaged by ionizing radiation. The severity of the damage depends upon several factors, among them the amount of exposure (low or high), the duration of the exposure (long-term [*chronic*] or short-term [*acute*]), the type of radiation (alpha, beta, and gamma radiations of various energies), and the sensitivity of the human (or organ) receiving the radiation. The human body has mechanisms that repair damage from exposure to radiation; however, repair processes are not always successful.

Biological effects of exposure to radiation may be either somatic or genetic. *Somatic* effects are limited to the exposed individual. For example, a sufficiently high exposure could cause clouding of the eye lens or a decrease in the number of white blood cells. *Genetic* effects may show up in future generations. Radiation could damage chromosomes, causing them to break or join incorrectly with other chromosomes. Radiation-produced genetic defects and mutations in the offspring of an exposed parent, while not positively identified in humans, have been observed in some animal studies.

Assessing the biological damage from low-level radiation is difficult because other factors can cause the same symptoms as radiation exposure making statistical evaluations difficult. Moreover, the body is able to repair damage caused by exposure to radiation. BEIR VII (2005) concludes that the smallest dose has the potential to cause a small increase in cancer risk to humans. The study determined that the cancer risk from exposure to radiation would continue in a linear fashion without a threshold, and is termed the "linear-no-threshold" model.

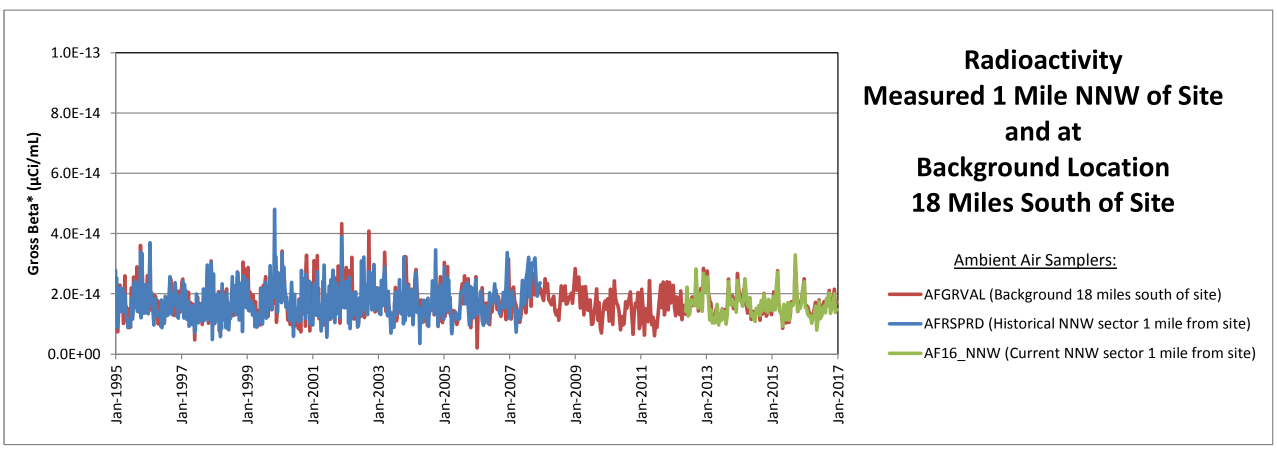
CAP88-PC Computer Modeled Air Dose Estimates Versus Measured Air Dose Estimates

The CAP88-PC model is used regularly for dose and risk evaluation when planning site work activities that have the potential to release airborne radioactivity. To achieve compliance with 40 CFR 61, subpart H, this model estimates human dose for the ingestion, inhalation, air immersion, and ground surface pathways. Version 4.0 of CAP88-PC (Trinity Engineering Associates, Inc., February 2015) is the most recent version approved by EPA for use in demonstrating NESHAP compliance. Dose estimates summarized in the ASER using earlier versions are slightly different than later versions, even if the radioactivity released from the WVDP and the meteorology both remain constant. Any approved version of the code can be used for compliance.

Through CY 2013, airborne radioactive materials released from stacks and diffuse sources on the WVDP property were modeled using CAP88 to demonstrate NESHAP compliance. In 2013 the estimated dose from the air pathway using CAP88 modeling was 0.0032 mrem. The 2013 CAP88 modeled dose estimates were compared with the dose estimated using the 2013 ambient air monitoring data. The 2013 ambient air monitoring measurements resulted in a dose estimate of <0.47 mrem. This dose estimate must be presented as an upper limit of the potential dose from the air pathway (i.e., with a "<") because the 2013 measured average annual concentrations for each ambient air sampler were below the detection limits (therefore considered non-detects). The apparent reduction in the margin of compliance between the measured versus the modeled approach is due to differences in the computational methodologies. EPA reviewed the 2013 comparison of both computational methods and their associated data and granted WVDP final approval to use ambient air monitoring for demonstrating NESHAP compliance at the WVDP. Both dose estimates for 2013 were orders of magnitude lower than the 10 mrem/year NESHAP standard.

The ambient air monitors cannot detect radioactivity down to the low concentrations that can be predicted to reach these areas using a mathematical model. The lowest concentrations the ambient air samplers can detect (i.e. approximately 3E-16 µCi/mL for cesium-137 and strontium-90) are orders of magnitude higher than the model-predicted downwind concentrations from the very low WVDP site emissions. (For example, concentrations of approximately 1.E-20 µCi/mL of cesium-137 and strontium-90 were predicted at the ambient air samplers by the 2013 ASER CAP88 model.

Historical ambient air concentrations at the samplers approximately one mile from the site have not changed and remain similar to concentrations at the background sampler 18 miles away as shown by the graph below.



The effect most often associated with exposure to relatively high levels of radiation appears to be increased risk of cancer. BEIR VII concludes that there will be some risk even at low doses, although the risk is small. (Note that average natural background radiation in the U.S. is about 0.31 rem/year, and estimated annual dose from activities at the WVDP is about three orders of magnitude lower than this dose.)

Data Reporting

In the ASER text, radiological units (e.g., rem, rad, curie) are presented first, followed by the SI equivalent in parentheses. Nonradiological measurements are presented in English units, followed by the metric unit equivalent in parentheses. See Tables UI-1, UI-2, and UI-3 for a summary of unit prefixes, units of measurement, and basic conversion factors used in this ASER.

Where results are very large or very small, scientific notation is used. Numbers greater than 10 are expressed with a positive exponent. To convert the number to its decimal form, the decimal point must be moved to the right by the number of places equal to the exponent. For example, 1.0E+06 would be expressed as 1,000,000 (one million). Numbers smaller than 1 are expressed with a negative exponent. For example, 1.0E-06 would be expressed as 0.000001 (one millionth).

Radiological data are reported as a result plus or minus (±) an associated uncertainty, customarily the 95% confidence interval. The uncertainty is in part due to the random nature of radioactive decay. Generally, the relative uncertainty in a measurement increases as the amount of radioactivity being sampled decreases. For this reason, low-level environmental analyses for radioactivity are especially prone to significant uncertainty in comparison with the result.

TABLE UI-1
Unit Prefixes Used in this ASER

Multiplication factor			
Scientific notation	**Decimal form**	**Prefix**	**Symbol**
1.0E+06	1000000	mega	M
1.0E+03	1000	kilo	k
1.0E-02	0.01	centi	c
1.0E-03	0.001	milli	m
1.0E-06	0.000001	micro	µ
1.0E-09	0.000000001	nano	n
1.0E-12	0.000000000001	pico	p

Radiological data are presented in the following manner:

Example: 1.04±0.54E-09

Where: 1.04 = the result
±0.54 = plus or minus the associated uncertainty
E-09 = times 10 raised to the power -09

Sources of uncertainty may include random components (e.g., radiological counting statistics) or systematic components (e.g., sample collection and handling, measurement sensitivity, or bias). Radiological data in this report include both a result and uncertainty term. The uncertainty term represents only the uncertainty associated with the analytical measurement which for environmental samples is largely due to the random nature of radioactive decay. When such radiological data are used in calculations, such as estimating the total curies released from an air or water effluent point, the other parameter used in the calculation (e.g., air volumes, water volumes), typically do not have an associated uncertainty value available. As such, the uncertainties in this report for such calculated values only reflect the uncertainty associated with the radiological results used in the calculation. The actual (total propagated) uncertainty of such values would be larger if other components of uncertainty were available and included in these estimates.

Radiological results are calculated using both sample counts and background counts. If the background count is greater than the sample count, a negative result term will be reported. The constituent is considered to be detected if the result is larger than the associated uncertainty (i.e., a "positive" detection). Nonradiological data are not reported with an associated uncertainty.

In general, the detection limit is the minimum amount of a constituent that can be detected, or distinguished from background, by an instrument or a measurement technique. If a result is preceded by the symbol "<" (i.e., <5 parts per million [ppm]), the constituent was not measurable below the detection limit (in this example, 5 ppm).

The number of significant digits reported depends on the precision of the measurement technique. Integer counts are reported without rounding. Calculated values are customarily reported to three significant figures. Dose estimates are usually reported to two significant figures. All calculations are completed before values are rounded.

TABLE UI-2
Units of Measure Used in this ASER

Type	Measurement	Symbol	Type	Measurement	Symbol
Length	meter	m	**Dose**	rad (absorbed dose)	rad
	centimeter	cm		rem (dose equivalent)	rem
	kilometer	km		millirem	mrem
	inch	in		sievert	Sv
	foot	ft		millisievert	mSv
	mile	mi		gray	Gy
Volume	gallon	gal	**Exposure**	roentgen	R
	liter	L		milliroentgen	mR
	milliliter	mL		microroentgen	µR
	cubic meter	m^3	**Concentration**	parts per million	ppm
	cubic feet	ft^3		parts per billion	ppb
Area	acre	ac		parts per trillion	ppt
	hectare	ha		milligrams per L (ppm)	mg/L
	square meter	m^2		micrograms per L (ppb)	µg/L
	square foot	ft^2		nanograms per L (ppt)	ng/L
Temperature	degrees Fahrenheit	^{o}F		milligrams per kg (ppm)	mg/kg
	degrees Celsius	^{o}C		micrograms per g (ppm)	µg/g
Mass	gram	g		micrograms per mL (ppm)	µg/mL
	kilogram	kg		milliliters per mL	mL/L
	milligram	mg		microcuries per mL	µCi/mL
	microgram	µg		picocuries per L	pCi/L
	nanogram	ng		microcuries per g	µCi/g
	pound	lb		becquerels per L	Bq/L
	tonne (metric ton)	t		nephelometric turbidity units	NTU
	ton, short	T		standard units (pH)	SU
Radioactivity	curie	Ci	**Flow rate**	gallons per day	gpd
	millicurie	mCi		gallons per minute	gpm
	microcurie	µCi		million gallons per day	mgd
	nanocurie	nCi		cubic feet per minute	cfm
	picocurie	pCi		liters per minute	lpm
	becquerel	Bq		meters per second	m/sec

TABLE UI-3
Conversion Factors Used in this ASER

To convert from	to	Multiply by
miles	kilometers	1.609344
feet	meters	0.3048
inches	centimeters	2.54
acres	hectares	0.4046873
pounds	kilograms	0.45359237
gallons	liters	3.785412
curies	becquerels	3.7E+10
rad	gray	0.01
rem	sievert	0.01

Note: To convert from the units in column two to the units in column one, divide by the conversion factor.

Limits Applicable to Environmental Media

Dose Standards. The two dose standards against which releases at the WVDP are assessed are those established by EPA for air emissions and that established by DOE regarding all exposure modes from DOE activities.

Radiological air emissions other than radon from DOE facilities are regulated by EPA under the NESHAP regulation (40 CFR 61, Subpart H), which establishes a standard of 10 mrem/year effective dose equivalent to any member of the public. Compliance with these regulations can be demonstrated by direct ambient air measurement or by modeling. See “CAP88-PC Computer Code” in inset.

DOE Order 458.1 sets the DOE primary standard of 100 mrem/year effective dose equivalent to members of the public considering all exposure modes from DOE activities. (Currently there are no EPA standards establishing limits on the radiation dose to members of the public from liquid effluents except for drinking water.)

For community water supplies, EPA has established a drinking water limit of 4-mrem/year (0.04-mSv/year) (40 CFR Parts 141, National Primary Drinking Water Regulations). However, there are no community drinking water supplies drawn from groundwater downgradient of the site or from surface waters within the Cattaraugus Creek drainage basin downstream of the WVDP. The WVDP on-site drinking water, currently supplied by a deep bedrock groundwater aquifer, is a non-transient, non-community water supply system that is subject to site-specific drinking water monitoring regulated by the NYSDOH. Applicable Maximum Contaminant Limits (MCLs) for the WVDP permitted drinking water system are set by NYS Sanitary Code (10 NYCRR 5-1). Radiological monitoring requirements are established in the CCHD/NYSDOH approved WVDP drinking water monitoring plan.

DOE DCS. A DCS is defined as the concentration of a radionuclide in air or water that, under conditions of continuous exposure by one exposure mode (i.e., ingestion of water, immersion in air, or inhalation) for one year, would result in an EDE of 100 mrem (1 mSv) to a “reference man” (DOE Order 458.1). DCSs for radionuclides measured at the WVDP are listed in Table UI-4. At the WVDP, DCSs are used as a screening tool for evaluating liquid effluents and airborne emissions. (DCSs are not used to estimate dose.)

SPDES Permit Requirements. On July 1, 2011, a modified SPDES permit became effective for the WVDP, and requirements of the CY 2011 SPDES permit are summarized in Appendix B-1. On July 28, 2015 a modification to the permit was issued for relocation of the S09 storm water outfall. The site’s SPDES permit defines points where sampling must be conducted, sampling frequency, the type of samples to be collected, nonradiological constituents for which samples must be analyzed, and the limits applicable to these constituents. Results are reported monthly to the NYSDEC in DMRs.

Radionuclides are not regulated under the SPDES permit. However, special requirements in the permit specify that the concentration of radionuclides in the discharge is subject to requirements of DOE Order 458.1, “Radiation Protection of the Public and the Environment,” and are reported in the ASER.

Water Quality Classifications, Standards, and Limits for Ambient Water. The objective of the Clean Water Act (CWA) of 1972 is to restore and maintain the integrity of the nation’s waters and ensure that, wherever attainable, waters be made useful for fishing and swimming. To achieve this goal, NYS is delegated with authority under Sections 118, 303, and 510 of the CWA to (1) classify and designate the best uses for receiving waters, such as streams and rivers, within its jurisdiction, and (2) establish and assign water quality standards — goals for achieving the designated best uses for these classified waters.

The definitions for best usage classification of New York’s jurisdictional waters and the water quality standard goals for these classifications are provided in 6 NYCRR Parts 701–704. Mapping of the Cattaraugus Creek drainage basin and assignment of best usage designations and classification to each receiving water segment within this drainage basin are described in 6 NYCRR Part 838.

According to these regulations, Franks Creek, Quarry Creek, and segments of Buttermilk Creek under the influence of water effluents from the WVDP are identified as Class “C” receiving waters with a minimum designated best usage for fishing with conditions suitable for fish propagation and survival.

Cattaraugus Creek, in the immediate downstream vicinity of the WNYNSC, is identified as a Class “B” receiving water with best designated usages for swimming and fishing. All fresh (nonsaline) groundwaters within New York are assigned a “GA” classification with a designated best usage as a potable water supply source.

Refer to Appendix B for a summary of the water quality standards, guidelines, and maximum contaminant levels (MCLs) assigned to these water classifications for those constituents that are included in the WVDP environmental monitoring program for ambient water.

Potable Water Standards. The CWA establishes water quality goals for fishing and swimming. The NYSDOH and EPA have further classified its jurisdictional waters and established ambient water standards, guidelines, and MCLs or MCL goals to achieve the objectives of the Safe Drinking Water Act. Primary drinking water standards, expressed as MCLs or MCL goals, provide for enforceable health based limits. See Appendix B-1 for a summary of these levels.

Soil and Sediment Concentration Guidelines. Contaminants in soil are potential sources for contamination of groundwater, surface water, ambient air, and plants and animals. Routine soil and sediment sampling is performed every five years.

The NRC and the EPA, in a 2002 memorandum of understanding pertaining to decommissioning and decontamination of contaminated sites, agreed upon concentrations of residual radioactivity in soil that would trigger consultation between the two agencies. Consultation "trigger" levels for radioactive contamination for nuclides applicable to the WVDP in both residential and industrial soil are reported in the ASER every fifth year with the soil and sediment sampling results for that year.

In 2006, the NRC, in a decommissioning guidance document (NUREG-1757, Vol. 2, 2006), provided concentration screening values for common radionuclides in soil that could result in a dose of 25 mrem/year.

In 2009, soil cleanup goals were developed from site-specific data for the "Phase 1 Decommissioning Plan for the WVDP," Rev. 2, December 2009. These criteria are presented in Table 5-14 of the DP.

Evaluation of Monitoring Data with Respect to Limits

Monitoring data for this report were evaluated against the limits presented in Table UI-4, and in the Appendices. Those locations with results exceeding the limits are listed in Chapter 2, Table 2-4, and in Chapter 4, Table 4-8.

TABLE UI-4

U.S. Department of Energy Derived Concentration Standards (DCSs) [a]

for Inhaled Air or Ingested Water (µCi/mL)

Radionuclide	Half-life (years)[b]	DCSs in Inhaled Air[c]	DCSs in Ingested Water
Gross Alpha[d]	NA	8.1E-14 (as Pu-239/240)	9.8E-08 (as U-232)
Gross Beta[d]	NA	1.0E-10 (as Sr-90)	1.1E-06 (as Sr-90)
Tritium (H-3)	1.23E+01	2.1E-07[e]	1.9E-03
Carbon-14 (C-14)	5.70E+03	6.1E-07[f]	6.2E-05
Potassium-40 (K-40)	1.25E+09	2.6E-10	4.8E-06
Cobalt-60 (Co-60)	5.27E+00	3.6E-10	7.2E-06
Strontium-90 (Sr-90)	2.89E+01	1.0E-10	1.1E-06
Technetium-99 (Tc-99)	2.11E+05	9.2E-10	4.4E-05
Iodine-129 (I-129)	1.57E+07	1.0E-10	3.3E-07
Cesium-137 (Cs-137)	3.00E+01	8.8E-10	3.0E-06
Europium-154 (Eu-154)	8.59E+00	7.5E-11	1.5E-05
Uranium-232 (U-232)	6.89E+01	4.7E-13	9.8E-08
Uranium-233 (U-233)	1.59E+05	1.0E-12	6.6E-07
Uranium-234 (U-234)	2.46E+05	1.1E-12	6.8E-07
Uranium-235 (U-235)	7.04E+08	1.2E-12	7.2E-07
Uranium-236 (U-236)	2.34E+07	1.2E-12	7.2E-07
Uranium-238 (U-238)	4.47E+09	1.3E-12	7.5E-07
Plutonium-238 (Pu-238)	8.77E+01	8.8E-14	1.5E-07
Plutonium-239 (Pu-239)	2.41E+04	8.1E-14	1.4E-07
Plutonium-240 (Pu-240)	6.56E+03	8.1E-14	1.4E-07
Americium-241 (Am-241)	4.32E+02	9.7E-14	1.7E-07

[a] DCSs are defined as the concentration of a radionuclide that, under conditions of continuous exposure for one year. by one exposure mode, would result in an effective dose equivalent of 100 mrem (1mSv).

[b] Nuclear Wallet Cards. April 2005. National Nuclear Data Center. Brookhaven National Laboratory. Upton, New York.

[c] The DCS selection for air utilized the default type lung absorption rates for each nuclide, based on guidance from ICRP-72 for particulate aerosols when no specific chemical information is available.

[d] Because there are no DCSs for gross alpha and gross beta concentrations, the values for the most restrictive alpha and beta emitters at the WVDP (Pu-239/240 for alpha in air, U-232 for alpha in water, and Sr-90 for both air and water gross beta concentrations) are used as a conservative basis for comparison at locations for which there are no radionuclide-specific data, in which case a more appropriate DCS may be applied.

[e] The DCS for tritium represents the water vapor standard, selected from Table 5, DOE-STD-1196-2011.

[f] The DCS for carbon-14 represents the dioxide chemical form, selected from Table 5, DOE-STD-1196-2011.

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GLOSSARY

A

accuracy - The degree of agreement between a measurement and its true value. The accuracy of a data set is assessed by evaluating results from standards or sample spikes containing known quantities of an analyte.

action plan - An action plan addresses assessment findings and root causes that have been identified in an audit or an assessment report. It is intended to define specific actions that the responsible group will undertake to remedy deficiencies. The plan includes a timetable and resource requirements for implementation of the planned activities.

aquifer - A water-bearing unit of permeable rock or soil that will yield water in usable quantities via wells. Confined aquifers are bounded above and below by less permeable layers. Groundwater in a confined aquifer may be under a pressure greater than the atmospheric pressure. Unconfined aquifers are bounded below by less permeable material, but are not bounded above. The pressure on the groundwater at the surface of an unconfined aquifer is equal to that of the atmosphere.

aquitard - A low-permeability geologic unit that can store groundwater and can transmit groundwater at a very slow rate.

as low as reasonably achievable (ALARA) - An approach to radiation protection that advocates controlling or managing exposures (both individual and collective) to the work force and the general public and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. As used in United States (U.S.) Department of Energy (DOE) Order 458.1, ALARA is not a dose limit but, rather, a process that has as its objective the attainment of dose levels as far below the applicable limits of the order as practicable.

B

background radiation - Natural and man-made radiation such as: cosmic radiation, radiation from naturally radioactive elements, and radiation from commercial sources and medical procedures.

becquerel (Bq) - A unit of radioactivity equal to one nuclear transformation per second.

biweekly - Occurring at a frequency of every two weeks.

C

categorical exclusion (CX) - A proposed action that the DOE has determined does not individually or cumulatively have a significant effect on the human environment. See 10 Code of Federal Regulations (CFR) 1021.410.

Class A, B, C, and Greater-than-Class-C (GTCC) low-level waste (LLW) - Waste classifications from the Nuclear Regulatory Commission's 10 CFR Part 61 rule. Maximum concentration limits are set for specific isotopes. Class A waste disposal is minimally restricted with respect to the form of the waste. Class B waste must meet more rigorous requirements to ensure physical stability after disposal. Higher radionuclide concentration limits are set for Class C waste (the most radioactive), which also must meet physical stability requirements. Moreover, special measures must be taken at the disposal facility to protect against inadvertent intrusion.

Some LLW, referred to by DOE as "Greater-than-Class-C waste," may not be acceptable for near-surface disposal, and may, for example need to be disposed of in a geologic repository.

compliance findings - Conditions that may not satisfy applicable environmental or safety and health regulations, DOE orders and memoranda, enforcement actions, agreements with regulatory agencies, or permit conditions.

confidence interval - The range of values within which some parameter may be expected to lie with a stated degree of confidence. For example, a value of 10 with an uncertainty of 5 calculated at the 95% confidence level (10±5) indicates there is a 95% probability that the true value of that parameter lies between 5 and 15.

consistency - The condition of showing steady conformity to practices. In the environmental monitoring program, approved procedures are in place so that data collection activities are carried out in a uniform manner to minimize variability.

Core Team - The "core team approach" is a formalized, consensus-based process in which those individuals with decision-making authority, including the DOE, the U.S. Environmental Protection Agency (EPA), and State remedial project managers, work together to reach agreement on key remediation decisions (DOE/EH-413-9911, October 1999). In August 2006, the DOE-West Valley Demonstration Project (DOE-WVDP) requested that the New York State Department of Health (NYSDOH), the U.S. Nuclear Regulatory Commission (NRC), the EPA (region 2), the New York State Department of Environmental Conservation (NYSDEC), and the New York State Energy Research and Development Authority (NYSERDA) participate in a collaborative process (i.e., Core Team) to resolve technical issues associated with the "Draft Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center" (DEIS).

critical receptor - An off-site individual who it is estimated would receive the highest radiation dose from a potential air effluent release based on ambient air radioactivity measurements.

cosmic radiation - High-energy subatomic particles from outer space that bombard the earth's atmosphere. Cosmic radiation is part of natural background radiation.

curie (Ci) - A unit of radioactivity equal to 37 billion (3.7 x 10^{10}) nuclear transformations per second.

D

data set - A group of data (e.g., factual information such as measurements or statistics) used as a basis for reasoning, discussion, or calculation.

decay (radioactive) - Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons or by spontaneous fission.

derived concentration standard (DCS) - The concentration of a radionuclide in air and water that, under conditions of continuous human exposure for one year by one exposure mode (i.e., ingestion of water, inhalation, or immersion in a gaseous cloud), would result in an effective dose equivalent of 100 millirem (mrem) (1 millisievert [mSv]). See Table UI-4 in the "Useful Information" section of this report.

detection limit or level (DL) - This term may also be expressed as "method detection limit" (MDL). The smallest amount of a substance that can be distinguished in a sample by a given measurement procedure at a given confidence level. (See *lower limit of detection*.)

dispersion (airborne) - The process whereby particulates or gases are spread and diluted in air as they move away from a source.

dispersion (groundwater) - The process whereby solutes are spread or mixed as they are transported by groundwater as it moves through the subsurface.

dosimeter - A portable device for measuring the total accumulated exposure to ionizing radiation.

downgradient - The direction of water flow from a reference point to a selected point of interest at a lower elevation than the reference point. (See *gradient.*)

E

effective dose - (See *effective dose equivalent* under *radiation dose*.)

effluent - Any treated or untreated air emission or liquid discharge to the environment.

effluent monitoring - Sampling or measuring specific liquid or gaseous effluent streams for the presence of pollutants to determine compliance with applicable standards, permit requirements, and administrative controls.

environmental assessment (EA) - An evaluation that provides sufficient evidence and analysis for determining whether an environmental impact statement is required or a finding of no significant impact should be issued. See 10 CFR 1021.

environmental impact statement (EIS) - A detailed statement that includes the environmental impact of the proposed action, any adverse environmental effects that cannot be avoided should the proposal be implemented, and alternatives to the proposed action. Detailed information may be found in Section 10 CFR 1021.

environmental management system (EMS) - The systematic application of business management practices to environmental issues, including defining the organizational structure, planning for activities, identifying responsibilities, and defining practices, procedures, processes, and resources.

environmental monitoring - The collection and analysis of samples or the direct measurement of environmental media. Environmental monitoring consists of two major activities: effluent monitoring and environmental surveillance.

environmental surveillance - The collection and analysis of samples or the direct measurement of air, water, soil, foodstuff, and biota in the environs of a facility of interest to determine compliance with applicable standards and to detect trends and environmental pollutant transport.

exposure - The subjection of a target (usually living tissue) to radiation.

F

finding - A DOE compliance term. A finding is a statement of fact concerning a condition in the Environmental, Safety, and Health program that was investigated during an appraisal. Findings include best management practice findings, compliance findings, and noteworthy practices. A finding may be a simple statement of proficiency or a description of deficiency (i.e., a variance from procedures or criteria). (See also *self-assessment*.)

fission - The act or process of splitting into parts. A nuclear reaction in which an atomic nucleus splits into fragments (i.e., fission products, usually fragments of comparable mass) with the evolution of approximately 100 million to several hundred million electron volts of energy.

G

gamma isotopic (also *gamma scan*) - An analytical method by which the quantity of several gamma ray-emitting radioactive isotopes may be determined simultaneously. Typical nuclear fuel cycle isotopes determined by this method include, but are not limited to, cobalt-60, zirconium-95, ruthenium-106, silver-110m, antimony-125, cesium-134, cesium-137, and europium-154. Naturally occurring isotopes for which samples may be analyzed are beryllium-7, potassium-40, radium-224, and radium-226.

gradient - Change in value of one variable with respect to another variable, such as a vertical change over a horizontal distance.

groundwater - Subsurface water in the pore spaces and fractures of soil and bedrock units.

H

half-life - The time in which half the atoms of a radionuclide disintegrate into another nuclear form. The half-life may vary from a fraction of a second to billions of years.

hazardous waste - A waste or combination of wastes that because of quantity, concentration, or physical, chemical, or infectious characteristics may: a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

high-level radioactive waste (HLW) - The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations sufficient to require permanent isolation. (See also *transuranic waste*.)

hydraulic conductivity - The ratio of flow velocity to driving force for viscous flow under saturated conditions of a specified liquid in a porous medium; the ratio describing the rate at which water can move through a permeable medium.

I

integrated safety management system (ISMS) - A process that describes the programs, policies, and procedures used at the WVDP to ensure the establishment of a safe workplace for the employees, the public, and the environment. The guiding principles of ISMS are line management responsibility for safety; clear roles and responsibilities; competence commensurate with responsibilities; balanced priorities; identification of safety standards and requirements; hazard controls; and operations authorization.

interim status - The status of any currently existing facility that becomes subject to the requirement to have a Resource Conservation and Recovery Act (RCRA) permit because of a new statutory or regulatory amendment to RCRA.

ion - An atom or group of atoms with an electric charge.

ion exchange - The reversible exchange of ions contained in solution with other ions that are part of the ion-exchange material.

ISO (International Organization for Standardization) - An international network of nongovernmental standards institutes that forms a bridge between the public and private sectors, and is the largest standards organization in the world. ISO enables a consensus to be reached on solutions that meet both the requirements of business and the broader needs of society.

***ISO 14001:2004* -** A standard for an EMS, which requires an organization to:

- Determine the organization's impact on the environment and relevant regulations to the operations of the business;
- Create a plan to control the organization's processes to minimize the environmental impact;
- Monitor the effectiveness of the system at meeting objectives, as well as legal and other; and
- Continually analyze the results and improve the organization's systems.

isotope - Different forms of the same chemical element that are distinguished by having the same number of protons but a different number of neutrons in the nucleus. An element can have many isotopes. For example, the three isotopes of hydrogen are protium, deuterium, and tritium, with one, two, and three neutrons in the nucleus, respectively.

K

knickpoint - A term in geomorphology to describe a location in a river or channel where there is a sharp change in channel slope resulting from differential rates of erosion.

L

land disposal restrictions (LDR) - Regulations promulgated by the EPA (and by NYSDEC in New York State) governing the land disposal of hazardous wastes. The wastes must be treated using the best demonstrated available technology or must meet certain treatment standards before being disposed.

lower limit of detection (LLD) - The lowest limit of a given parameter that an instrument is capable of detecting. A measurement of analytical sensitivity.

low-level radioactive waste (LLW or LLRW) - Radioactive waste not classified as high-level radioactive waste, transuranic waste, spent fuel, or uranium mill tailings. (See *Class A, B, C, and GTCC low-level waste*.)

M

maximally exposed individual (MEI) - An on-site (occupational) or off-site (nonoccupational) individual who, because of realistically assumed proximity, activities, and living habits, would receive the highest radiation dose, taking into account all pathways, from a given event, process, or facility.

maximally exposed off-site individual (MEOSI) - Member of the general off-site public at a known residence who would receive the highest dose from an effluent release.

mean - The average value of a series of measurements.

metric ton - (See *ton, metric*.)

millirem (mrem) - A unit of radiation dose equivalent that is equal to one one-thousandth of a rem. An individual member of the public can receive up to 100 mrem per year according to DOE standards. This limit does not include the roughly 310 mrem, on average, that people in the U.S. receive annually from natural background radiation.

minimum detectable concentration (MDC) or **method detection limit (MDL) -** Depending on the sample medium, the smallest amount or concentration of a radioactive or nonradioactive analyte that can be reliably detected using a specific analytical method. Calculations of the minimum detectable concentrations are based on the lower limit of detection.

mixed waste (MW) - A waste that is both radioactive and RCRA hazardous.

N

n-Dodecane/tributyl phosphate - An organic solution composed of 30% tributyl phosphate (TBP) dissolved in n-dodecane used to first separate the uranium and plutonium from the fission products in dissolved nuclear fuel and then to separate the uranium from the plutonium.

neutron - An electrically neutral subatomic particle in the baryon family with a mass 1,839 times that of an electron, stable when bound in an atomic nucleus, and having a mean lifetime of just under 15 minutes as a free particle.

notice of violation (NOV) - Generally, an official notification from a regulatory agency of noncompliance with permit requirements. (An example would be a letter of notice from a regional water engineer in response to an instance of significant noncompliance with a State Pollutant Discharge Elimination System [SPDES] permit.)

nucleus - The positively-charged central region of an atom, made up of protons and neutrons and containing almost all of the mass of the atom.

O

outfall - The discharge end of a drain or pipe that carries wastewater or other liquid effluents into a ditch, pond, or river.

P

parameter - Any of a set of physical properties whose values determine the characteristics or behavior of something (e.g., temperature, pressure, density of air). In relation to environmental monitoring, a monitoring parameter is a constituent of interest. Statistically, the term "parameter" is a calculated quantity, such as a mean or variance, that describes a statistical population.

particulates - Solid particles and liquid droplets small enough to become airborne.

person-rem - The sum of the individual radiation dose equivalents received by members of a certain group or population. It may be calculated by multiplying the average dose per person by the number of persons exposed. For example, a thousand people each exposed to one millirem would have a collective dose of one person-rem.

plume - The distribution of a pollutant in air or water after being released from a source.

practical quantitation limits (PQLs) - The PQL is the minimum concentration of an analyte that can be measured within specified limits of precision during routine laboratory operations (NYSDEC, 1991).

precision - The degree of reproducibility of a measurement under a given set of conditions. Precision in a data set is assessed by evaluating results from duplicate field or analytical samples.

proton - A stable, positively-charged subatomic particle in the baryon family with a mass 1,836 times that of an electron.

pseudo-monitoring point - A theoretical monitoring location rather than an actual physical location; a calculation based on analytical test results of samples obtained from other associated, tributary, monitored locations. (Point 116 at the WVDP is classified as a "pseudo" monitoring point because samples are not physically collected at that location. Rather, using analytical results from samples collected from "real" upstream outfall locations, compliance with the total dissolved solids limit in the WVDP's SPDES permit is calculated for this theoretical point.)

Q

quality factor (QF) - The extent of tissue damage caused by different types of radiation of the same energy. The greater the damage, the higher the quality factor. More specifically, the factor by which absorbed doses are multiplied to obtain a quantity that indicates the degree of biological damage produced by ionizing radiation. (See radiation dose.) The factor is dependent upon radiation type (alpha, beta, gamma, or x-ray) and exposure (internal or external).

R

rad - Radiation absorbed dose. One hundred ergs of energy absorbed per gram of solid material.

radiation - The process of emitting energy in the form of rays or particles that are thrown off by disintegrating atoms. The rays or particles emitted may consist of alpha, beta, or gamma radiation.

alpha radiation - The least penetrating type of radiation. Alpha radiation (similar to a helium nucleus) can be stopped by a sheet of paper or the outer dead layer of skin.

beta radiation - Electrons emitted from a nucleus during fission and nuclear decay. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.

gamma radiation - A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shielding such as lead, concrete, or steel to be effectively attenuated.

internal radiation - Radiation originating from a source within the body as a result of the inhalation, ingestion, or implantation of natural or man-made radionuclides in body tissues.

radiation dose:

absorbed dose - The amount of energy absorbed per unit mass in any kind of matter from any kind of ionizing radiation. Absorbed dose is measured in rads or grays.

collective dose equivalent - The sum of the dose equivalents for all the individuals comprising a defined population. The per capita dose equivalent is the quotient of the collective dose equivalent divided by the population. The unit of collective dose equivalent is person-rem or person-sievert.

collective effective dose equivalent - The sum of the effective dose equivalents for the individuals comprising a defined population. Units of measurement are person-rem or person-sievert. The per capita effective dose equivalent is obtained by dividing the collective dose equivalent by the population. Units of measurement are rem or sievert.

committed dose equivalent - A measure of internal radiation. The predicted total dose equivalent to a tissue or organ over a 50-year period after a known intake of a radionuclide into the body. It does not include contributions from sources of external penetrating radiation. Committed dose equivalent is measured in rem or sievert.

committed effective dose equivalent - The sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is measured in rem or sievert.

total effective dose equivalent - The summation of the products of the dose equivalent received by specified tissues of the body and the appropriate weighting factors. It includes the dose from radiation sources internal and/or external to the body. The effective dose equivalent is expressed in units of rem or sievert.

radioactivity - A property possessed by some elements (such as uranium) whereby alpha, beta, or gamma rays are spontaneously emitted.

radioisotope - A radioactive isotope of a specified element. Carbon-14 is a radioisotope of carbon. Tritium is a radioisotope of hydrogen. (See *isotope*.)

radionuclide - A radioactive nuclide. Radionuclides are variations (isotopes) of elements. They have the same number of protons and electrons but different numbers of neutrons, resulting in different atomic masses. There are hundreds of known nuclides, both man-made and naturally occurring.

reference man - A hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base.

rem - An acronym for Roentgen Equivalent Man. A unit of radiation exposure that indicates the potential effect of radiation on human cells.

remote-handled waste - At the WVDP, waste that has an external surface dose rate that exceeds 100 millirem per hour or a high level of alpha and/or beta surface contamination and, therefore, must be handled in such a manner that it does not come into physical contact with workers.

roentgen - A unit of exposure to ionizing radiation. It is that quantity of gamma or x-rays required to produce ions carrying one electrostatic unit of electrical charge in one cubic centimeter of dry air under standard conditions. The unit is named after Wilhelm Roentgen, German scientist who discovered x-rays in 1895.

S

self-assessment - Appraisals of work at the WVDP by individuals, groups, or organizations responsible for overseeing and/or performing the work. Self-assessments are intended to provide an internal review of performance to determine that specific functional areas are in programmatic and site-specific compliance with applicable DOE directives, WVDP procedures, and regulations.

finding - A direct and significant violation of applicable DOE, regulatory, or other procedural or programmatic requirements. A finding requires documented corrective action.

observation - A condition that, while not a direct and significant violation of applicable DOE, regulatory, or other procedural or programmatic requirements, could result in a finding if not corrected. An observation may require documented corrective action.

good practice - A statement of proficiency or confirmed excellence worthy of documenting.

sievert - A unit of dose equivalent from the International System of Units (Systeme Internationale). Equal to one joule per kilogram.

solid waste management unit (SWMU) - Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released or created. (See also *super solid waste management unit*.)

spent fuel - Nuclear fuel that has been used in a nuclear reactor; this fuel contains uranium, activation products, fission products, and plutonium.

spill - A spill or release is defined as "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or otherwise disposing of substances from the ordinary containers employed in the normal course of storage, transfer, processing, or use," outside of the intended procedural action.

stakeholder - A person or group that has an investment, share, or interest in something. At the WVDP stakeholders include Project management, scientists, other employees, politicians, regulatory agencies, local and national interest groups, and members of the general public.

standard deviation - An indication of the dispersion of a set of results around their average.

super solid waste management unit (SSWMU) - Individual solid waste management units that have been grouped and ranked into larger units – super solid waste management units – because some individual units are contiguous or so close together as to make monitoring of separate units impractical. This terminology is unique to the WVDP, and is not an official regulatory term. (See also *solid waste management unit*.)

surface water - Water that is exposed to the atmospheric conditions of temperature, pressure, and chemical composition at the surface of the earth.

surveillance - The act of monitoring or observing a process or activity to verify conformance with specified requirements.

T

thermoluminescent dosimeter (TLD) - A device that luminesces upon heating after being exposed to radiation. The amount of light emitted is proportional to the amount of radiation to which the luminescent material has been exposed.

ton, metric (also *tonne*) **-** A unit of mass equal to 1,000 kilograms. (See also Table UI-2, "Units of Measure Used in This ASER.")

ton (*short ton*) **-** A unit of weight equal to 2,000 pounds or 907.1847 kilograms. (See also Table UI-2, "Units of Measure Used in This ASER.)

transuranic (TRU) waste - Waste containing transuranic elements, that is, those elements with an atomic number greater than 92, including neptunium, plutonium, americium, and curium.

U

universal wastes - Wastes subject to special management provisions that are intended to ease the management burden and facilitate recycling of such materials. Four types of waste are currently covered under the universal waste regulations: hazardous waste batteries, hazardous waste pesticides that are either recalled or collected in waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps.

upgradient - Referring to the flow of water or air, "upgradient" is analogous to upstream. Upgradient is a point that is "before" an area of study and that is used as a baseline for comparison with downstream or downgradient data. (See *gradient* and *downgradient*.)

__V______________________________

vitrification - A waste treatment process that encapsulates or immobilizes radioactive wastes in a glassy matrix to prevent them from reacting in disposal sites. Vitrification involves adding chemicals, glass formers, and waste to a heated vessel and melting the mixture into a glass that is then poured into a canister.

__W______________________________

watershed - The area contained within a drainage divide above a specified point on a stream or river.

water table - The upper surface in a body of groundwater; the surface in an unconfined aquifer or confining bed at which the pore water pressure is equal to atmospheric pressure.

well point - A small-diameter well that is hammer-driven rather than placed into a pre-drilled borehole.

__X______________________________

x-ray - Penetrating electromagnetic radiations having wave lengths shorter than those of visible light. They are usually produced by bombarding a metallic target with fast electrons in a high vacuum. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays and those originating in the extranuclear part of the atom as x-rays. These rays are sometimes called Roentgen rays after their discoverer, W.C. Roentgen.

ACRONYMS AND ABBREVIATIONS

Note: For abbreviations of units of measure, see Table UI-2, "Units of Measure Used in This ASER," in the "Useful Information" section.

A

ACM - Asbestos-Containing Material
AEA - Atomic Energy Act
ALARA - As Low As Reasonably Achievable
alpha-BHC - alpha-hexachlorocyclohexane
ASER - Annual Site Environmental Report
ASME - American Society of Mechanical Engineers
AST - Aboveground Storage Tank

B

BCG - Biota Concentration Guide
BEIR - Biological Effects of Ionizing Radiation
BOD_5 - Biological Oxygen Demand (5-day)
BOSF - Balance of Site Facilities
Bq - Becquerels

C

CAA - Clean Air Act
CBS - Chemical Bulk Storage
CCHD - Cattaraugus County Health Department
CD - Compact Disk
CDDL - Construction and Demolition Debris Landfill
CEDE - Committed Effective Dose Equivalent
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CFMT - Concentrator Feed Makeup Tank
CFR - Code of Federal Regulations
CHBWV - CH2M HILL BWXT West Valley, LLC
CMS - Corrective Measures Study
CPC - Chemical Process Cell
CPC-WSA - Chemical Process Cell-Waste Storage Area
CSAP - Characterization Sampling and Analysis Plan
CSPF - Container Sorting and Packaging Facility
CSRF - Contact Size-Reduction Facility
CSS - Cement Solidification System
CWA - Clean Water Act
CX - Categorical Exclusion
CY - Calendar Year

D

D&D - Decontamination and Decommissioning
DCG - Derived Concentration Guide
DCS - Derived Concentration Standard
DEIS - Draft Environmental Impact Statement
DL - Detection Limit
DMR - Discharge Monitoring Report
DO - Dissolved Oxygen
DOE - (U.S.) Department of Energy
DOE-HQ - Department of Energy, Headquarters Office
DOE-WVDP - Department of Energy, West Valley Demonstration Project (title as of June 2006)
DP - Decommissioning Plan

E

EA - Environmental Assessment
ECL - (New York State) Environmental Conservation Law
ECS - Environmental Compliance Summary
EDE - Effective Dose Equivalent
EIS - Environmental Impact Statement
ELAP - Environmental Laboratory Approval Program
EMS - Environmental Management System
EO - Executive Order
EPA - (U.S.) Environmental Protection Agency
EPCRA - Emergency Planning and Community Right-to-Know Act
EPEAT - Electronic Product Environmental Assessment Tool
ERO - Emergency Response Organization
ES - Environmental Services (within Regulatory Strategy Group)
ESRB - Executive Safety Review Board
EWG - Erosion Working Group
EXWG - Exhumation Working Group

F

FEIS - Final Environmental Impact Statement
FFCA - Federal Facilities Compliance Act
FONSI - Finding of No Significant Impact
FR - Federal Register
FRS - Fuel Receiving and Storage
FSSP - Final Status Survey Plan
FY - Fiscal Year

G

GHG - Greenhouse Gas
GLO - Ground Level Office
GMP - Groundwater Monitoring Program
GSL - (Site-Specific) Groundwater Screening Levels
GTCC - Greater Than Class C

H

ha - Hectare
HEPA - High Efficiency Particulate Air (filter)
HEV - Head End Ventilation
HLW - High-Level (radioactive) Waste
HP/BBS - Human Performance/Behavior-Based Safety
HQ - Headquarters
HVAC - Heating, Ventilation, and Air Conditioning
HWSL - Hazardous Waste Storage Locker

I

IAEA - International Atomic Energy Agency
IAP - Integrated Assessment Program
ICRP - International Commission on Radiological Protection
IM - Interim Measure
INEEL - Idaho National Engineering and Environmental Laboratory (1997 to 2005) now known as Idaho National Laboratory
ISMS - Integrated Safety Management System
ISO - International Organization for Standardization
ISP - Independent Scientific Panel

K

KRS - Kent Recessional Sequence
KT - Kent Till

L

LAS - Linear Alkylate Sulfonate
LLW - Low-Level (radioactive) Waste
LLW2 - Low-Level Waste Treatment Building
LLWTF - Low-Level Waste Treatment Facility (SSWMU #1)
LOI - Lines of Inquiry
LPS - Liquid Pretreatment System
LSA - Lag Storage Addition
LTS - Lavery Till Sand
LWC - Liquid Waste Cell
LWTS - Liquid Waste Treatment System

M

MAPEP - Mixed Analyte Performance Evaluation Program
MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
MEOSI - Maximally Exposed Off-Site Individual
MFHT - Melter Feed Hold Tank
MGD - Million Gallons per Day
MLLW - Mixed Low Level Waste
MOU - Memorandum of Understanding
MPPB - Main Plant Process Building

N

NA - Not Applicable
NCRP - National Council on Radiation Protection and Measurements
NDA - Nuclear Regulatory Commission (NRC)-Licensed Disposal Area
NEPA - National Environmental Policy Act
NESHAP - National Emission Standards for Hazardous Air Pollutants
NFS - Nuclear Fuel Services, Inc.
NH_3 - Ammonia
NOI - Notice of Intent
NO_2-N - Nitrite (as N)
NO_3-N - Nitrate (as N)
NO_x - Nitrogen Oxides
NPGMP - North Plateau Groundwater Monitoring Plan
NPGRS - North Plateau Groundwater Recovery System
NPOC - Nonpurgeable Organic Carbon
NQA-1 - Nuclear Quality Assurance, Level 1
NRC - (U.S.) Nuclear Regulatory Commission
NUREG - (U.S.) NRC Regulation
NYCRR - New York State Official Compilation of Codes, Rules, and Regulations
NYS - New York State

NYSDEC - New York State Department of Environmental Conservation
NYSDOH - New York State Department of Health
NYSDOL - New York State Department of Labor
NYSERDA - New York State Energy Research and Development Authority

O

OAD - Office of Atomic Development (historical)
OSTI - Office of Scientific and Technical Information
OVE - Outdoor Ventilation Enclosure

P

PA - Performance Assessment
PBS - Petroleum Bulk Storage
PCB - Polychlorinated Biphenyl
PEA - Programmatic Environmental Assessment
PEIS - Programmatic Environmental Impact Statement
PNL - Pacific Northwest Laboratory
POC - Principal Organic Contaminant
PPA - Probabilistic Performance Assessment
PPM - Parts Per Million
PQL - Practical Quantitation Limit
PTW - Permeable Treatment Wall
PTWPMP - Permeable Treatment Wall Performance Monitoring Plan
PVS - Permanent Ventilation System
PVU - Portable Ventilation Unit

Q

QA - Quality Assurance
QC - Quality Control

R

RAO - Remedial Action Objectives
RCRA - Resource Conservation and Recovery Act
REM - Roentgen Equivalent Man
RFP - Request for Proposal
RFI - RCRA Facility Investigation
RHWF - Remote-Handled Waste Facility
ROD - Record of Decision
RVS - Replacement Ventilation System
RVU - Replacement Ventilation Unit

S

S&G - Sand and Gravel Unit
SARA - Superfund Amendments and Reauthorization Act
SDA - (New York) State-Licensed Disposal Area
SEC - Safety and Ecology Corporation
SEQR - (New York) State Environmental Quality Review Act
SI - Systeme Internationale (International System of Units)
SME - Subject Matter Expert
SOC - Specific Organic Chemicals (NYSDOH). Also referred to as Synthetic Organic Chemicals by EPA.
SO_x - Sulfur Oxides
SPA - Special Package Authorization
SPDES - (New York) State Pollutant Discharge Elimination System
SSP - Site Sustainability Plan
SSPP - Strategic Sustainability Performance Plan
SSWMU - Super Solid Waste Management Unit
STP - Site Treatment Plan
STS - Supernatant Treatment System
SU - Standard Unit
Sv - Sievert
SVOC - Semivolatile Organic Compound
SWMU - Solid Waste Management Unit
SWPPP - Storm Water Pollution Prevention Plan
SWS - Slackwater Sequence

T

T&VDS - Tank and Vault Drying System
TBP - Tributyl Phosphate
TBU - Thick-Bedded Unit
TDS - Total Dissolved Solids
TER - Technical Evaluation Report
TKN - Total Kjeldahl Nitrogen
TLD - Thermoluminescent Dosimeter
TOGS - Technical and Operational Guidance Series
TOX - Total Organic Halides
TRU - Transuranic
TSS - Total Suspended Solids

U

U.S. - United States
UDF - Unit Dose Factor
ULT - Unweathered Lavery Till
UOD - Ultimate Oxygen Demand
UPC - Uranium Product Cell
URS - URS - Energy & Construction Division (historical)

USACE - U.S. Army Corps of Engineers
USC - United States Code
UST - Underground Storage Tank

__V________________________________

VCT - Vertical Cask Transporter
VEC - Ventilation Exhaust Cell
VF - Vitrification Facility
VIT - Vitrification
VOC - Volatile Organic Compound
VPP - Voluntary Protection Program
VSC - Vertical Storage Cask

__W_______________________________

WCS - Waste Control Specialists LLC
WET - Whole Effluent Toxicity
WIR - Waste Incidental to Reprocessing
WLT - Weathered Lavery Till
WMA - Waste Management Area
WNYNSC - Western New York Nuclear Service Center
WTF - Waste Tank Farm
WVDP - West Valley Demonstration Project
WVES - West Valley Environmental Services LLC (historical)
WVNS - West Valley Nuclear Services (historical)
WVNSCO - West Valley Nuclear Services Company (historical)
WWTF - Wastewater Treatment Facility

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APPENDIX A
2016 Environmental Monitoring Program

Environmental Monitoring Program Drivers and Sampling Rationale

The index and tables on the following pages describe the WVDP routine environmental monitoring program for 2016. This program met or exceeded the requirements of DOE Order 458.1, "Radiation Protection of the Public and the Environment," and DOE-HDBK-1216-2015, "DOE Handbook, Environmental Radiological Effluent Monitoring and Environmental Surveillance" (March 2015). Specific methods and monitoring program elements were based on DOE/EP-0096, "A Guide for Effluent Radiological Measurements at DOE Installations," and DOE/EP-0023, "A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations." Additional monitoring was mandated by air and water discharge permits (under the NESHAP regulations in 40 CFR 61, Subpart H, and the SPDES, respectively). Specific groundwater monitoring is required by the RCRA §3008(h) Administrative Order on Consent.

Permits, agreements, and/or programs may require formal reports of monitoring results. Radiological air emissions from the WVDP are reported annually in the NESHAP report to EPA. Nonradiological releases in water effluent and storm water drainage points covered under the SPDES permit are reported monthly to NYSDEC in a DMR. Groundwater monitoring results are reported quarterly to NYSDEC. Annual results from the monitoring program, as a whole, are evaluated and discussed in this ASER, which is prepared as directed in DOE Order 231.1B, "Environment, Safety, and Health Reporting," and associated guidance.

Table A-1 summarizes programmatic drivers and guidance applicable to each environmental medium measured or sampled as part of the WVDP Environmental Monitoring Program.

Sampling Schedule

Sampling locations are assigned a specific identifier, the location code, which is used to schedule sampling, track samples, and trace analytical results. Table A-2 provides the details of the sampling schedule for each location monitored in 2016. Routine sampling locations are shown on Figures A-2 through A-15. Table headings in the sampling program described in Table A-2 are as follows:

- **Sample Location Code**. This code describes the physical location where the sample is collected. The code consists of seven or eight characters: The first character identifies the sample medium as Air, Water, Soil/sediment, Biological, or Direct measurement. The second character specifies oN-site or oFf-site. The remaining characters describe the specific location (e.g., AFGRVAL is Air oFf-site at GReat VALley). Distances noted at sampling locations are as measured in a straight line from the ventilation stack of the MPPB on site. Groundwater and storm water sampling points (e.g., WNW0408, WNNDATR, WNSO04) are often abbreviated in figures or data tables (i.e., "408," "NDATR," "S04").

- **Sampling Type/Medium**. Describes the collection method and the physical characteristics of the medium or sample.

- **Collection Frequency/Total Annual Samples.** Indicates how often the samples are collected or retrieved and the total number of each type of sample processed in one year.

- **Measurements/Analyses**. Notes the type of measurement taken from the sampling medium and/or the constituents of interest, and (in some instances) the type of analysis conducted.

There were no changes to the overall environmental monitoring program in 2016.

Index of Environmental Monitoring Program Sample Points

Sample Location	Description of Monitoring Point	Location shown on Figure
Air Effluent		
ANSTACK	Main Plant Process Building	Figure A-6
ANSTSTK	Supernatant Treatment System	Figure A-6
ANCSRFK (inactive)	Contact Size-Reduction Facility	Figure A-6
ANCSPFK (inactive)	Container Sorting and Packaging Facility	Figure A-6
ANVITSK	Vitrification Heating, Ventilation, and Air Conditioning	Figure A-6
ANRHWFK	Remote-Handled Waste Facility	Figure A-6
ANRVEU1	Main Plant Replacement Ventilation Unit 1	Figure A-6
OVEs/PVUs[a]	Outdoor Ventilated Enclosures/Portable Ventilation Units	not shown
Liquid Effluent and On-Site Water		
WNSP001	Lagoon 3 Weir Point	Figure A-2
WNSP01B[a] (inactive)	Internal Process Monitoring Point	not shown
WNSP116	Pseudo-Monitoring Point Outfall 116	Figure A-2
WNSP007 (inactive)	Sanitary Waste Discharge	Figure A-2
WNURRAW[a]	Augmentation Water (collected in utility room)	not shown
WNSP006	Facility Main Drainage, Franks Creek at Security Fence	Figure A-2
Storm Water Outfalls		
GROUP 1		
S04 (WNSO04)	North Swamp Drainage (WNSW74A)	Figure A-3
GROUP 2		
S06 (WNSO06)	Northeast Swamp Drainage (WNSWAMP)	Figure A-3
S33 (WNSO33)	LAG Storage Drainage	Figure A-3
GROUP 3		
S09 (WNSO09)	Smartditch®	Figure A-3
S12 (WNSO12)	South Facility Drainage (WNSP005)	Figure A-3
GROUP 4		
S34 (WNSO34)	Rail Spur Culvert	Figure A-3
GROUP 5		
S14 (WNSO14)	NDA Service Road Drainage North	Figure A-3
S17 (WNSO17)	NDA Service Road Drainage South	Figure A-3
S28 (WNSO28)	Drum Cell West Road	Figure A-3
GROUP 6		
S36 (WNSO36)	Live-Fire Range Wetland Drainage	Figure A-4
S37 (WNSO37)	Pump House Roadway	Figure A-4
S38 (WNSO38)	Lake Two Roadway North	Figure A-4
S39 (WNSO39)	Lake Two Roadway South	Figure A-4
S41 (WNSO41)	Lake One Roadway	Figure A-4
S42 (WNSO42)	Pre-Railroad Spur Wetland Area (Near WFBCBKG)	Figure A-4
S43 (WNSO43)	Live-Fire Range Drainage East	Figure A-4

[a] *Location not shown on map.*

Index of Environmental Monitoring Program Sample Points *(continued)*

Sample Location	Description of Monitoring Point	Location shown on Figure
Storm Water Outfalls *(continued)*		
GROUP 7		
S20 (WNSO20)	Disposal Area Drainage (WNNDADR)	Figure A-3
GROUP 8		
S27 (WNSO27)	Drum Cell Drainage West	Figure A-3
S35 (WNSO35)	Drum Cell Drainage East	Figure A-3
Storm Water Precipitation pH Measurement Location		
WNSWR01	Near the Site Rain Gauge	Figure A-3
On-Site Surface Water		
WNSWAMP	Northeast Swamp Drainage Point	Figure A-2
WNSW74A	North Swamp Drainage Point	Figure A-2
WNSP005	South Facility Drainage	Figure A-2
WNFRC67	Franks Creek East	Figure A-2
WNERB53	Erdman Brook	Figure A-2
WNNDADR	Disposal Area Drainage	Figure A-2
Off-Site Surface Water		
WFBCBKG	Buttermilk Creek Near Fox Valley, Background	Figure A-5
WFFELBR	Cattaraugus Creek at Felton Bridge	Figure A-5
WFBCTCB	Buttermilk Creek at Thomas Corners	Figure A-5
Soil and Sediment		
On-Site Soil/Sediment		
SNSW74A	Soil/Sediment at North Swamp Drainage Point	Figure A-2
SNSWAMP	Soil/Sediment at Northeast Swamp Drainage Point	Figure A-2
SNSP006	Soil/Sediment at Facility Main Drainage	Figure A-2
Off-Site Soil (collected at historical off-site air sampler locations)		
SFFXVRD	Surface Soil South-Southeast at Fox Valley	Figure A-5
SFRT240	Surface Soil Northeast on Route 240	Figure A-5
SFRSPRD	Surface Soil Northwest on Rock Springs Road	Figure A-5
SFGRVAL	Surface Soil South at Great Valley, Background	Figure A-14
Off-Site Sediment		
SFCCSED	Cattaraugus Creek at Felton Bridge, Sediment	Figure A-5
SFSDSED	Cattaraugus Creek at Springville Dam, Sediment	Figure A-5
SFTCSED	Buttermilk Creek at Thomas Corners, Sediment	Figure A-5
SFBCSED	Buttermilk Creek at Fox Valley Road, Background Sediment	Figure A-5

Index of Environmental Monitoring Program Sample Points *(continued)*

Sample Location	Description of Monitoring Point	Location shown on Figure
On-Site Groundwater and Seeps		
SSWMU #1	LLW2 Wells	Figure A-9
SSWMU #2	Miscellaneous Small Units Wells	Figure A-9
SSWMU #3	Liquid Waste Treatment System Wells	Figure A-9
SSWMU #4	HLW Storage and Processing Tank Wells	Figure A-9
SSWMU #5	Maintenance Shop Leach Field Wells	Figure A-9
SSWMU #6	LLW Storage Area Wells	Figure A-9
SSWMU #7	Chemical Process Cell - Waste Storage Area Wells	Figure A-9
SSWMU #8	CDDL Wells	Figure A-9
SSWMU #9	NDA Unit Wells and NDATR	Figure A-10
SSWMU #10	IRTS Drum Cell Wells	Figure A-10
RHWF	RHWF Wells	Figure A-9
MPPB Wells	MPPB Downgradient Wells	Figure A-9
North Plateau Seeps	Northeastern Edge of North Plateau	Figure A-9
Miscellaneous	Monitoring Locations WP-A, WP-C, WP-H (not associated with a SWMU)	Figure A-9
Surface Elevation	Surface Water Elevation Hubs (i.e., SE009)	Figure A-9
On-Site Potable (Drinking) Water (supplied by groundwater wells)		
WNDWELL1	Drinking Water Well #1	Figure A-8
WNDWELL2	Drinking Water Well #2	Figure A-8
WNDRAW1/2	Raw, Untreated Groundwater (sampled from utility room)	Figure A-8
WNDFIN	Chlorinated, Filtered Groundwater (sampled from utility room)	Figure A-8
WNEHMKE	Bedrock Well South of Main Plant	Figure A-8
WWCOURT	Bedrock Well South of Annex	Figure A-8
WNCT272	Bedrock Well Southeast of Warehouse	Figure A-8
Potable Water Distribution System		
WNDNURSE	Nurse’s Office Sink	Figure A-8
WNDNKMP	Main Plant Shower	Figure A-8
WNDNKRH	RHWF Kitchenette Sink	Figure A-8
WNDNK06	Guardhouse Bathroom Sink	Figure A-8
WNDNK15	Parking Lot Men's Room Sink	Figure A-8
WNDNK23	10-Plex Men’s Room Sink	Figure A-8
WNDNK24	10-Plex Kitchenette Sink	Figure A-8
WNDNK25	RHWF Men’s Room Sink	Figure A-8
WNDNK26	New Women’s Locker Room Sink	Figure A-8
WNDNK27	New Men’s Locker Room Sink - South Extension	Figure A-8
WNDNK28	New Men’s Locker Room Sink - North Extension	Figure A-8

Index of Environmental Monitoring Program Sample Points *(concluded)*

Sample Location	Description of Monitoring Point	Location shown on Figure
Off-Site Ambient Air		
AF01_N	Bond Road	Figure A-7
AF02_NNE	Route 240	Figure A-7
AF03_NE	Route 240	Figure A-7
AF04_ENE	Route 240	Figure A-7
AF05_E	Heinz Road	Figure A-7
AF06_ESE	Buttermilk Road	Figure A-7
AF07_SE	Fox Valley Road	Figure A-7
AF08_SSE	Fox Valley Road	Figure A-7
AF09_S	Rock Springs Road	Figure A-7
AF10_SSW	Dutch Hill Road	Figure A-7
AF11_SW	Dutch Hill Road	Figure A-7
AF12_WSW	Dutch Hill Road	Figure A-7
AF13_W	Dutch Hill Road	Figure A-7
AF14_WNW	Boberg Road	Figure A-7
AF15_NW	Rock Springs Road	Figure A-7
AF16_NNW	Rock Springs Road, historical MEOSI location	Figure A-7
AF16HNNW	Co-located with AF16_NNW, High Volume Sampler	Figure A-7
AFGRVAL	Great Valley Sampler, Background	Figure A-14
Off-Site Biological		
BFMFLDMN	Southeast Milk, Near-Site	Figure A-11
BFMBLSY	Milk, West-Northwest	Figure A-11
BFMSCHT	Milk, South	Figure A-11
BFMCTLS	Milk, Background	Figure A-14
BFDNEAR	Venison, Near-Site	Figure A-11
BFDCTRL	Venison, Background	Figure A-14
BFVNEAR[a]	Produce, Near-Site	Figure A-11
BFVCTRL[a]	Produce, Background	Figure A-14
BFFCATC	Fish, Cattaraugus Creek, Downstream	Figure A-11
BFFCATD	Fish from Cattaraugus Creek, Downstream of Springville Dam	Figure A-11
BFFCTRL	Fish from Cattaraugus Creek, Background	Figure A-14
Direct Measurement Dosimetry (Figures A-12 through A-14)		
DNTLD Series	On-Site/Near-Site Direct Radiation	Figure A-12
DFTLD Series	Off-Site Direct Radiation	Figure A-13
DFTLD23	Background Direct Radiation (more than 5 km from the WVDP)	Figure A-14

[a] Produce samples (corn, apples, and beans) are identified specifically as follows:
Near site: corn = BFVNEAC; apples = BFVNEAAF; beans = BFVNEAB
Background: corn = BFVCTRC; apples = BFVCRA; beans = BFVCTRB.

TABLE A-1
WVDP Environmental Program Drivers and Sampling Rationale

Programmatic Drivers	*Sampling Rationale*
On-Site Air Emissions	
40 CFR 61, Subpart H (radiological air emissions); DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Chapter 4.0 (airborne radiological effluent monitoring and sampling); DOE/EP-0096, Section 3.3 (criteria for effluent measurements)
Ambient Air	
40 CFR 61, Subpart H (radiological air emissions); DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Section 6.7.2 (environmental surveillance, air measurements, sampling locations); DOE/EP-0023, Section 4.2.3 (air sampling locations and measurement techniques)
On-Site Liquid Effluents and Storm Water	
New York State SPDES Permit No. NY 0000973 (nonradiological; specified points only), DOE Order 458.1, Change 3 (radiological)	DOE-HDBK-1216-2015, Section 3.4.4 (liquid effluent monitoring, sampling locations); New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certification for nonpotable water
Surface Water	
DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Section 6.10.1 (environmental surveillance, water sampling locations); NYSDOH ELAP certification for nonpotable water
Potable (Drinking) Water	
DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Section 6.10 (environmental surveillance, water sampling); NYSDOH ELAP certification for potable water
On-Site Groundwater	
RCRA §3008(h) Order on Consent (nonradiological); DOE Order 458.1, Change 3 (radiological)	DOE-HDBK-1216-2015, Section 6.10 (environmental surveillance, water sampling); NYSDOH ELAP certification for nonpotable water
Soil and Sediment	
DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Sections 6.9 (environmental surveillance, basis for sampling soil) and 6.12 (basis for sampling sediment)
Biological	
DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Sections 6.8 (environmental surveillance, sampling of terrestrial foodstuffs) and 6.11 (basis for sampling aquatic foodstuffs)
Direct Radiation	
DOE Order 458.1, Change 3	DOE-HDBK-1216-2015, Section 6.5 (environmental surveillance, external exposure monitoring); DOE/EP-0023, Section 4.6 (external radiation)

TABLE A-2
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
On-Site Air Emissions			
ANSTACK[a] MPPB ventilation exhaust stack **ANSTSTK**[a] STS ventilation exhaust **ANCSRFK**[a,c] (inactive) Contact size-reduction facility exhaust **ANCSPFK**[a] (inactive) Container sorting and packaging facility exhaust **ANVITSK**[a] VIT heating, ventilation, and air conditioning exhaust **ANRHWFK**[a] RHWF exhaust **ANRVEU1**[a,d] MPPB replacement ventilation emission unit exhaust	Continuous on-line air particulate monitors	Continuous measurement of fixed filter; replaced biweekly; held as backup	Real-time monitoring - CAM
	Continuous off-line air particulate filters	Biweekly; 26 each location	Gross alpha/beta, gamma isotopic[b] upon collection, flow
	Composite of biweekly particulate filters	Semiannually; 2 each location	Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic, flow
	Continuous off-line desiccant columns for collection of water vapor	Biweekly; 26 each at ANSTACK and ANSTSTK only	H-3, flow
	Continuous off-line charcoal cartridges	Cartridges collected biweekly and composited into 2 semiannual samples at each location	I-129
OVEs/PVUs[a] Outdoor ventilated enclosures/portable ventilation units	Continuous off-line air particulate filter	Collected as required by project	Gross alpha/beta, gamma isotopic[b] upon collection, flow
	Composite of filters	Semiannually	Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic, flow

[a] Required by 40 CFR 61, Subpart H. Results reported in the Annual NESHAP Report and evaluated in the ASER.
[b] Gamma isotopic analysis done only if gross alpha/beta activity rises significantly.
[c] Operation of the contact size-reduction stack was discontinued in July 2005. The building has been prepared for demolition.
[d] The MPPB replacement ventilation emission unit, went online in August 2015.

TABLE A-2 (*continued*)
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
On-Site Liquid Effluents			
WNSP001[a] Lagoon 3 discharge weir	Continuous	Daily during discharge. Lagoon 3 is discharged 2 to 8 times per year, averaging 6 to 7 days per discharge; 12–56 days per year	Daily flow, hold for flow-weighted composite
	Grab	Twice during discharge; 4–16 per year	Gross alpha/beta, H-3, Sr-90, gamma isotopic
	Flow-weighted composite of daily samples for each discharge	2 to 8 per year	Gross alpha/beta, H-3, C-14, Sr-90, Tc-99, I-129, gamma isotopic, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
	Grab	Twice during discharge; 4–16 per year	Settleable solids, TDS, Dissolved Oxygen (DO)
	24-hour composite	Twice during discharge; 4–16 per year	5-day Biological Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Ammonia (as NH_3), TKN (as N), total Fe
	Grab	Once during discharge; 2–8 per year	Total Hg (method 1631), pH, total recoverable Co, Se, V, total residual chlorine, oil & grease, surfactant (as LAS)
	24-hour composite	Once during discharge; 2–8 per year	Total Al, total recoverable As, dissolved sulfide, NO_3-N, NO_2-N, SO_4
	24-hour composite	Quarterly; 4 per year, every five years[b]	Whole Effluent Toxicity (WET) Testing
	Grab	Semiannually; 2 per year	Cyanide amenable to chlorination, Heptachlor
	24-hour composite	Semiannually; 2 per year	Bromide, B, total Mn, Ni, total recoverable Cu, Cr, Pb, Ti, Zn
	Grab	Annually; 1 per year	Total recoverable Cr+6, Dichlorodifluoromethane, trichlorofluoromethane, 3,3-dichlorobenzidine, tributyl phosphate, xylene, hexachlorobenzene, 2-butanone, alpha-BHC, chloroform
	24-hour composite	Annually; 1 per year	Total Ba, Sb, total recoverable Cd
	Calculated from BOD_5 and TKN	Twice during discharge; 4–16 per year	Ultimate Oxygen Demand (UOD)
WNSP01B[a,c] Internal process monitoring point	Continuous	Recorded when operating	Total flow, elapsed flow time
	Grab liquid	Twice per month when operating; 0–24 per year	Total Hg (method 1631)
WNSP116[a] Pseudo-monitoring point outfall 116	Calculated	Twice per lagoon discharge; 4–16 per year	TDS

[a] Required by SPDES Permit #NY0000973. Results reported in the SPDES DMR and evaluated in the ASER.
[b] WET testing was performed quarterly for the first year in 2012, and will be repeated again in 2017.
[c] WNSP01B is no longer operated.

TABLE A-2 *(continued)*
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
On-Site Liquid Effluents			
WNSP007[a,b] (inactive) Sanitary waste discharge	24-hour composite	Monthly, when discharging	Gross alpha/beta, H-3
	Composite of monthly samples	Annually, if discharged during the year	Sr-90, gamma isotopic
	Grab	2 per month; when discharging	pH, settleable solids, TDS, DO, oil & grease
	24-hour composite	2 per month; when discharging	TSS, BOD_5, ammonia (as NH_3), total Fe
	Grab	Monthly, when discharging	Total residual chlorine, total Hg (method 1631)
	24-hour composite	Monthly, when discharging	TKN (as N), NO_2-N
	24-hour composite	2 per month; when discharging	Flow rate (gpm)
	Calculated from BOD_5 and TKN	Monthly, when discharging	UOD
	24-hour composite	Quarterly; 4 per year , once every 5 years[c]	WET Testing
	Grab	Annually, if discharged during the year	Chloroform
WNURRAW[a] Augmentation water from the reservoirs	Grab	Three per lagoon discharge: pre-discharge, near beginning, at end, 6-24 per year	TDS, flow rate
WNSP006 Franks Creek at the security fence	Timed continuous composite	Biweekly, 26 per year	Gross alpha/beta, H-3
	Composite of biweekly samples	Monthly; 12 per year	Sr-90 and gamma isotopic
	Composite of biweekly samples	Quarterly; 4 per year	C-14, Tc-99, I-129, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
	Grab	Three per lagoon discharge: pre-discharge, near beginning, at end, 6-24 per year	TDS, flow rate
Storm Water Outfalls			
Group 1[a] **WNSO04 (S04)**	First flush grab	Semiannually; 2 per year	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, Cd, Cr, Cr+6, Se, V, TKN (as N), ammonia (as NH_3), NO_3-N, NO_2-N, total nitrogen (as N)
	Flow-weighted composite	Semiannually; 2 per year	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease
Group 2[a] **WNSO06 (S06)** **WNSO33 (S33)**	First flush grab	Semiannually; 2 per year	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, surfactant (as LAS)
	Flow-weighted composite	Semiannually; 2 per year	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease

[a] Required by SPDES Permit #NY0000973. Storm water reports will be appended to the June and December SPDES DMRs.
[b] The waste treatment facility was shutdown in November 2014. WNSP007 is not sampled if there is no discharge.
[c] WET testing at WNSP007 will not be required in 2017 since sanitary and industrial discharges have been discontinued.

TABLE A-2 (*continued*)
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
Storm Water Outfalls			
Group 3[a] **WNSO09 (S09)** **WNSO12 (S12)**	First flush grab	Semiannually; 2 per year	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, Hg (method 1631), total recoverable Cu, Pb, Zn, TKN (as N), ammonia (as NH_3), NO_3-N, NO_2-N, alpha-BHC, total nitrogen (as N)
	Flow-weighted composite	Semiannually; 2 per year	Maximum flow, total flow, plus all of the above constituents (except for pH, oil & grease, and Hg [method 1631])
Group 4[a] **WNSO34 (S34)**	First flush grab	Semiannually; 2 per year	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, surfactant (as LAS)
	Flow-weighted composite	Semiannually; 2 per year	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease
Group 5[a] **WNSO14 (S14)** **WNSO17 (S17)** **WNSO28 (S28)**	First flush grab	Semiannually; 2 per year[b]	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, V, TKN (as N), ammonia (as NH_3), NO_3-N, NO_2-N, surfactant (as LAS), sulfide, settleable solids, total nitrogen (as N)
	Flow-weighted composite	Semiannually; 2 per year[b]	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease
Group 6[a] **WNSO36 (S36)** **WNSO37 (S37)** **WNSO38 (S38)** **WNSO39 (S39)** **WNSO41 (S41)** **WNSO42 (S42)** **WNSO43 (S43)**	First flush grab	Semiannually; 2 per year[b]	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, V, TKN (as N), ammonia (as NH_3), NO_3-N, NO_2-N, surfactant (as LAS), sulfide, settleable solids, total nitrogen (as N)
	S43 only, grab	Semiannually; 2 per year	Total recoverable Pb
	Flow-weighted composite	Semiannually; 2 per year[b]	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease
Group 7[a] **WNSO20 (S20)**	First flush grab	Semiannually; 2 per year	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, TKN (as N), ammonia (as NH_3), NO_3-N, NO_2-N, surfactant (as LAS), sulfide, total nitrogen (as N)
	Flow-weighted composite	Semiannually; 2 per year	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease

[a] Required by SPDES Permit # NY0000973. Storm water reports will be appended to the June and December SPDES DMRs.
[b] For groups containing more than two outfalls, outfalls should be sampled in a rotational sequence until all outfalls in that group have been sampled.

TABLE A-2 (*continued*)
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
		Storm Water Outfalls *(continued)*	
Group 8[a] **WNSO27 (S27)** **WNSO35 (S35)**	First flush grab	Semiannually; 2 per year	pH, oil & grease, BOD_5, TSS, TDS, total P, Al, Fe, total recoverable Cu, Pb, Zn, TKN (as N), ammonia (as NH_3), NO_3-N, NO_2-N, surfactant (as LAS), total nitrogen (as N)
	Flow-weighted composite	Semiannually; 2 per year	Maximum flow, total flow, plus all of the above constituents except for pH and oil & grease
WNSWR01[a] Site rain gauge	Field measurement of precipitation	1 each storm water sampling event	inches of precipitation, pH
		On-Site Surface Water	
WNSWAMP Northeast swamp drainage **WNSW74A** North swamp drainage	Timed continuous composite liquid	Biweekly; 26 per year	Gross alpha/beta, H-3, pH, flow (flow at WNSWAMP only)
	Composite of biweekly samples	Monthly; 12 per year	Sr-90 and gamma isotopic
	Composite of biweekly samples	Semiannually; 2 per year	C-14, I-129, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
WNSP005 Facility yard drainage **WNFRC67** Franks Creek east of SDA **WNERB53** Erdman Brook north of disposal areas	Grab liquid	Quarterly; 4 per year (**WNFRC67** and **WNERB53** collected at same time as **WNNDADR**)	Gross alpha/beta, H-3, pH
	Composite of quarterly samples	Semiannually; 2 per year	Sr-90 and gamma isotopic
WNNDADR Drainage between NDA and SDA	Timed continuous composite liquid	Biweekly; 26 per year	Hold for composite
	Composite of biweekly samples	Monthly; 12 per year	Gross alpha/beta, H-3, gamma isotopic
	Composite of biweekly samples	Semiannually; 2 per year	Sr-90 and I-129

[a] Required by SPDES Permit # NY0000973. Storm water reports will be appended to the June and December DMRs.

TABLE A-2 (*continued*)
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
On-Site Potable (Drinking) Water: Groundwater Supply			
WNDWELL1 and WNDWELL2 Raw water at wellheads	Grab liquid	As needed[d]	Total coliform and E. coli
WNDRAW1, WNDRAW2 Utility room raw water (unfiltered, unchlorinated)	Grab liquid	Monthly; 12 per year	Gross alpha/beta, H-3
		Annually; 1 per year	I-129 and gamma isotopic
WNDFIN Utility room chlorinated potable water (storage tank)	Grab liquid	Daily; 365 per year	Residual chlorine
		Quarterly; up to 4 per year[e]	POCs[e] , SOCs[e] , MTBE[e], vinyl chloride[e]
		Annually; 1 per year (2nd week in August)	Na, NO_3-N, NO_2-N[f]
		Once every 3 years	Ag, As, Ba, Be, Cd, Cr, Hg, Ni, Sb, Se, Tl, cyanide (as free), fluoride
WNDNKMP[g] Main plant shower	Grab liquid	Annually; 1 per year	Gross alpha/beta, H-3
WNDNKRH RHWF drinking water	Grab liquid	Once every 3 years	Total haloacetic acids and total trihalomethanes
Distribution System Sinks: WNDNK06, 15, 23, 24, 25, 26, 27, 28, WNDNKRH and WNDNURSE [a, b, c]	Grab liquid [b,c]	Quarterly[b] ; 4 per year	Total coliform, E. coli, residual chlorine[b]
		Twice a year[c]	Cu and Pb
On-Site Potable (Drinking) Water: Source Water Protection Monitoring for Groundwater Supply			
Bedrock monitoring wells: **WNEHMKE (EHMKE)** South of MPPB **WWCOURT (WWCOURT)** South of Annex **WNCT272 (60CT272)** Southeast of warehouse	Grab liquid	Biweekly; 24 per year	Gross alpha/beta, pH and conductivity

[a] Distribution system sinks in 2016 include: Guard house (WNDNK06), Parking lot men's room (WNDNK15), 10-plex men's room (WNDNK23), 10-plex kitchenette (WNDNK24), RHWF men's room (WNDNK25), New women's locker room (WNDNK26), New men's locker room - south extension (WNDNK27), New men's locker room - north extension (WNDNK28), RHWF kitchenette (WNDNKRH), and Nurse's office (WNDNURSE).

[b] One sample is collected by CCHD for bacteriological sampling from one of four sinks in the distribution system (WNDNK06, WNDNK23, WNDNKRH or WNDNURSE) on a rotational basis each quarter.

[c] Pb and Cu were analyzed for at all ten sinks listed above twice a year in 2016. This was a new change to the drinking water monitoring plan in 2016.

[d] Samples are collected at the wellheads only if bacteriological parameters are detected in the distribution system.

[e] Sampling for Principal Organic Contaminants (POCs) and Specific Organic Chemicals (SOCs) was required only for the first three quarters beginning in 2014. The monitoring waivers from CCHD expire 1/1/2021 for POCs and 12/31/2017 for SOCs.

[f] An initial sample for NO_2-N was collected in 2015. Because the results were less than 50% of the MCL, no additional NO_2-N samples were requried in 2016.

TABLE A-2 (*continued*)
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
On-Site Groundwater			
LLW2: SSWMU #1 (wells 103, 104, 105, 106, 107, 108, 110, 111, 116, 8604, 8605) **Miscellaneous small units:** SSWMU #2 (wells 204, 205, 206) **LWTS:** SSWMU #3 (wells 301, 302) **HLW and processing tank:** SSWMU #4 (wells 401, 402, 403, 405, 406, 408, 409) **Maintenance shop leach field:** SSWMU #5 (wells 501, 502) **LLW storage area:** SSWMU #6 (wells 602A, 604, 605, 8607, 8609) **Chemical process cell waste storage area:** SSWMU #7 (wells 704, 706, 707) **CDDL:** SSWMU #8 (wells 801, 802, 803, 804, 8603, 8612) **NDA:** SSWMU #9 (wells 901, 902, 903, 906, 908, 908R, 909, 910R, 8610, 8611, trench NDATR) **IRTS drum cell**: SSWMU #10 (wells 1005, 1006, 1008B, 1008C) **RHWF** (not in a SSWMU): (wells 1301, 1302, 1303, 1304)	Grab liquid	Quarterly during the fiscal year (generally[a]); 4 per year	Gross alpha/beta, H-3. Select locations for radioisotopic analyses, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), or metals
	Direct field measurement	Twice each sampling event; 8 per year for wells sampled quarterly	Conductivity, pH

[a] Sampling frequency and analyses vary from point to point.

TABLE A-2 *(continued)*
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
On-Site Groundwater			
MPPB downgradient wells (installed in 2010: MP-01, MP-02, MP-03, MP-04)	Grab liquid	Quarterly during the fiscal year; 4 per year	Gross alpha/beta, H-3, Radioisotopic analyses, VOCs, SVOCs, metals, and turbidity
	Direct field measurement	Twice each sampling event; 8 per year	Conductivity, pH
North plateau seeps (not in a SSWMU): (points GSEEP, SP04, SP06, SP11, SP12)	Grab liquid	Semiannually (quarterly at GSEEP); 2 (or 4) per year	Gross alpha/beta, H-3 (also VOCs at GSEEP and SP12)
	Direct field measurement of sampled water	Semiannually at SP12 (quarterly at GSEEP); 2 (or 4) per year	pH, conductivity
PTWPMP wells: (58 PTW platform wells at stations 1-12, installed in 2010 [i.e. PTW-S1A] and 21 pre-existing full network wells [i.e. WP02, MW-5])	Grab liquid	Quarterly (annually at full network wells); 4 (or 1) per year at each location	Strontim-90
	Grab liquid	Annually; 1 per year at each location	Geochemical parameters: Na, K, Ca, Mg, carbonate, bicarbonate, SO_4, Cl
	Direct field measurement	Twice each sampling event; 8 per year (if quarterly), 2 per year (if annually)	Conductivity, pH, temperature, oxidation-reduction potential, dissolved oxygen, and turbidity
NPGMP Wells: (25 north plateau wells)	Grab liquid	Quarterly; 4 per year at each location	Gross beta
Miscellaneous monitoring locations (not in a SSWMU): Well points WP-A, WP-C, WP-H	Grab liquid	Annually; 1 per year	Gross alpha/beta, H-3
	Direct field measurement of sampled water	Annually; 1 per year	pH, conductivity
Surface water elevation points: (SE007, SE008, SE009, SE011)	Direct field measurement	Quarterly; 4 per year at each location	Water level
SDA (SSWMU #11)	Groundwater wells in SSWMU #11 are sampled by NYSERDA under a separate program. For information, see the NYSERDA website at www.nyserda.ny.gov.		
On-Site Soil/Sediment			
SN on-site soil series: SNSW74A (near WNSW74A), **SNSWAMP** (near WNSWAMP), and **SNSP006** (near WNSP006)	Surface plug composite soil/sediment	1 each location every five years (sampled in 2012, will next be sampled in 2017)	Gross alpha/beta, gamma isotopic, Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
Off-Site Soil			
SF off-site soil series (collected at historical air sampling location[s]); **SFFXVRD, SFRT240, SFRSPRD, SFGRVAL**	Surface plug composite soil	1 each location every five years (sampled in 2012, will next be sampled in 2017)	Gross alpha/beta, Sr-90, gamma isotopic, Pu-238, Pu-239/240, Am-241. At nearest site (**SFRSPRD**) and background (**SFGRVAL**), also U-232, U-233/234, U-235/236, U-238, and total U

TABLE A-2 *(continued)*
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
Off-Site Sediment			
SFCCSED Cattaraugus Creek at Felton Bridge **SFSDSED** Cattaraugus Creek at Springville Dam **SFTCSED** Buttermilk Creek at Thomas Corners Road **SFBCSED** Buttermilk Creek at Fox Valley Road (background)	Grab stream sediment	1 each location every five years (sampled in 2012, will next be sampled in 2017)	Gross alpha/beta, gamma isotopic, Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241
Off-Site Surface Water			
WFBCBKG Buttermilk Creek near Fox Valley (background)	Timed continuous composite liquid	Biweekly; 26 per year	Hold for composite
	Composite of biweekly samples	Monthly; 12 per year	Gross alpha/beta, H-3
	Composite of biweekly samples	Semiannually; 2 per year	C-14, Sr-90, Tc-99, I-129, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic
WFFELBR Cattaraugus Creek at Felton Bridge (downstream of confluence with Buttermilk Creek); nearest point of public access to waters receiving WVDP effluents	Timed continuous composite liquid	Biweekly; 26 per year	Gross alpha/beta, H-3, pH, flow
	Flow-weighted composite of biweekly samples	Monthly; 12 per year	Gross alpha/beta, H-3, Sr-90, and gamma isotopic
WFBCTCB Buttermilk Creek at Thomas Corners Road, downstream of WVDP and upstream of confluence with Cattaraugus Creek	Timed continuous composite liquid	Biweekly; 26 per year	Hold for composite
	Composite of biweekly samples	Monthly; 12 per year	Gross alpha/beta, H-3
	Composite of biweekly samples	Semiannually; 2 per year	Sr-90, gamma isotopic

TABLE A-2 *(continued)*
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
Off-Site Ambient Air			
AF01_N North at Bond Road **AF02_NNE** North-northeast at Rt. 240 **AF03_NE** Northeast at Rt. 240 **AF04_ENE** East-northeast at Rt. 240	Glass fiber filters for air particulates	Biweekly; 26 per year	Gross alpha/beta screening, flow; Hold for composite
AF05_E East at Heinz Road **AF06_ESE** East-southeast at Buttermilk Road **AF07_SE** Southeast at Fox Valley Road **AF08_SSE** South-southeast at Fox Valley Road	Charcoal cartridge for iodine	Monthly; 12 per year	I-129 screening, flow; Hold for composite
AF09_S South at Rock Springs Road **AF10_SSW** South-southwest at Dutch Hill Road **AF11_SW** Southwest at Dutch Hill Road **AF12_WSW** West-southwest at Dutch Hill Road	Composite of biweekly glass fiber filters	Quarterly; 4 per year	Sr-90, Cs-137, U-232, Pu-238, Pu-239/240, Am-241, flow
AF13_W West at Dutch Hill Road **AF14_WNW** West-northwest at Boberg Road **AF15_NW** Northwest at Rock Springs Road **AF16_NNW** North-northwest at Rock Springs Road (Low volume sampler at historical MEOSI location)	Composite of monthly charcoal	Quarterly; 4 per year	I-129, flow

TABLE A-2 *(continued)*
2016 Environmental Monitoring Program

Sample Location Code	*Sampling Type/ Medium*	*Collection Frequency/ Total Annual Samples*	*Measurements/Analyses*
Off-Site Ambient Air			
AF16HNNW North-northwest at Rock Springs Road (High volume sampler at historical MEOSI location)	Glass fiber filters for air particulates	Biweekly; 26 per year	Gross alpha/beta screening, flow; Hold for composite
	Composite of biweekly glass fiber filters	Quarterly; 4 per year	Sr-90, Cs-137, U-232, Pu-238, Pu-239/240, Am-241, flow
AFGRVAL 29 km south at Great Valley (background)	Glass fiber filter for air particulates	Biweekly; 26 per year	Gross alpha/beta screening, flow; Hold for composite
	Charcoal cartridge for iodine	Monthly; 12 per year	I-129 screening, flow; Hold for composite
	Composite of monthly charcoal	Quarterly; 4 per year	I-129, flow
	Composite of biweekly glass fiber filters	Quarterly; 4 per year	Sr-90, gamma isotopic, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, flow
Off-Site Biological			
BFMFLDMN Dairy farm 5.1 km southeast of WVDP	Grab milk sample	Annual; 1 per year	Sr-90, I-129, gamma isotopic
BFMCTLS Control location 22 km south (background) **BFMBLSY** Dairy farm 5.5 km west-northwest **BFMSCHT** Dairy farm 4.9 km south	Grab milk sample	Each location and background, once every five years (sampled in 2012, will next be sampled in 2017)	Sr-90, I-129, gamma isotopic
BFDNEAR Deer in the vicinity of the WVDP **BFDCTRL** Control deer 16 km or more from the WVDP	Individual collection of venison samples, usually from deer killed in collisions with vehicles	Six deer collected annually during hunting season (3 near-site, 3 background)	Gamma isotopic and Sr-90 in edible portions of meat, % moisture, H-3 in free moisture
BFVNEAAF (apples), **BFVNEAB** (beans), **BFVNEAC** (corn) Food crops from locations near the WVDP **BFVCTRL** Control food crops (apples, beans, and corn) from locations far from the WVDP	Grab biological	Each food crop and background, once every five years at time of harvest (sampled in 2012, will next be sampled in 2017)	Gamma isotopic and Sr-90 in edible portions, % moisture, H-3 in free moisture

TABLE A-2 *(concluded)*
2016 Environmental Monitoring Program

Sample Location Code	***Sampling Type/ Medium***	***Collection Frequency/ Total Annual Samples***	***Measurements/Analyses***
Off-Site Biological			
BFFCATC Fish from Cattaraugus Creek downstream of its confluence with Buttermilk Creek **BFFCATD** Fish from Cattaraugus Creek downstream of the Springville Dam **BFFCTRL** Control fish sample from nearby stream not affected by WVDP (7 km or more upstream of site effluent point); background	Individual collection of fish	Once every 5 years; 10 fish from each location (sampled in 2012, will next be sampled in 2017)	Gamma isotopic and Sr-90 in edible portions, % moisture
Off-Site Direct Radiation			
DFTLD Series: Off-site environmental thermoluminescent dosimeters (TLDs): **#1 through #16**, at each of 16 compass sectors at nearest accessible perimeter point **#20:** 1,500 m northwest (downwind receptor) **#23:** 29 km south, Great Valley (background)	Integrating TLD	Semiannually; 2 per year at each location	Gamma radiation exposure
On-Site/ Near-Site Direct Radiation			
DNTLD Series: On-site TLDs **#33**: Corner of the SDA **#24, #28, #44**: Security fence around the WVDP **#32, #35, #36**: Drum Cell road and Drum Cell south fence **#38, #40**: Near operational areas on-site **#43**: SDA west perimeter fence	Integrating TLD	Semiannually; 2 per year at each location	Gamma radiation exposure

FIGURE A-1
West Valley Demonstration Project Base Map

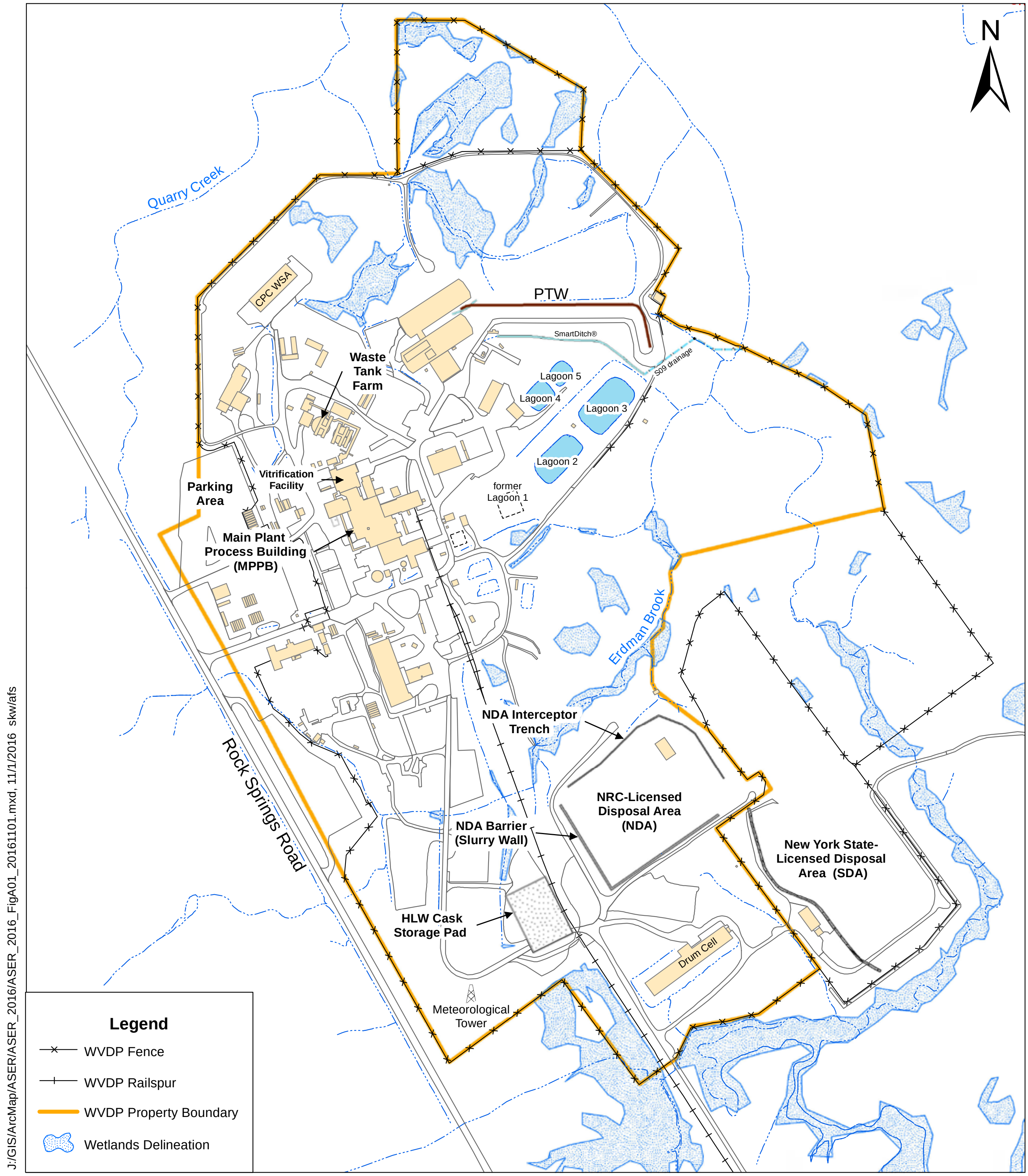
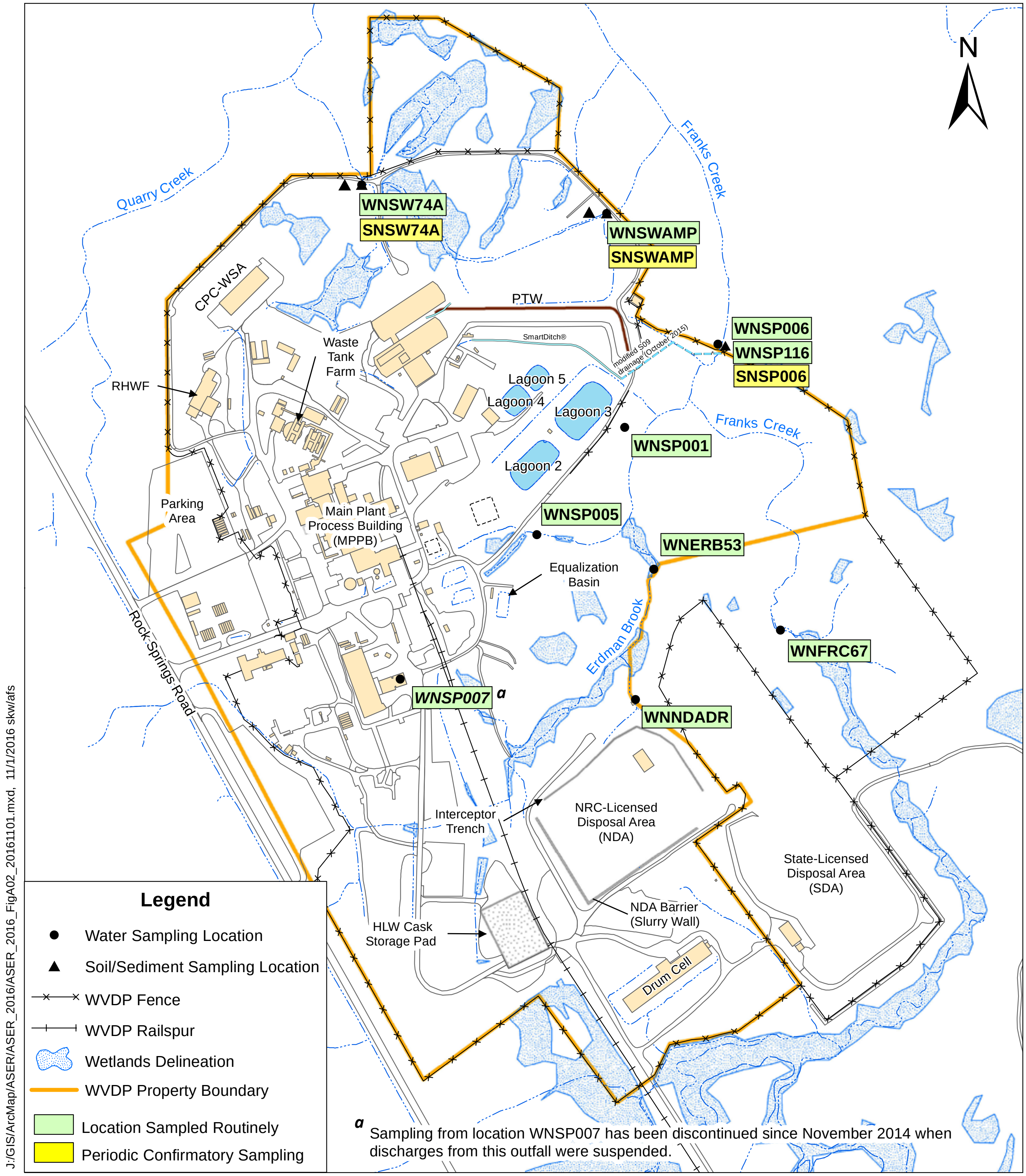
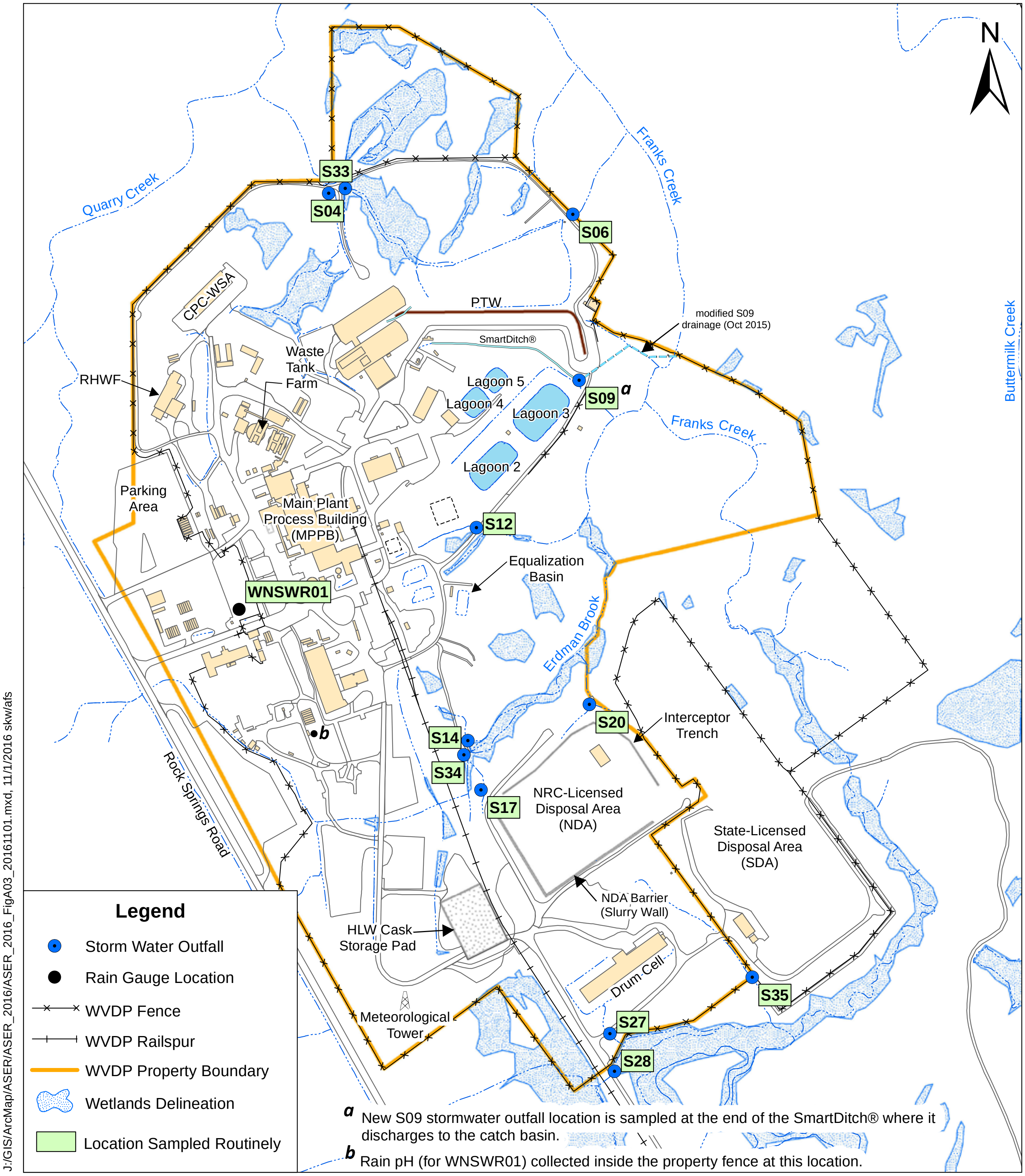


FIGURE A-2
On-Site Liquid Effluent, Surface Water and Soil/Sediment Sampling Locations



[a] Sampling from location WNSP007 has been discontinued since November 2014 when discharges from this outfall were suspended.

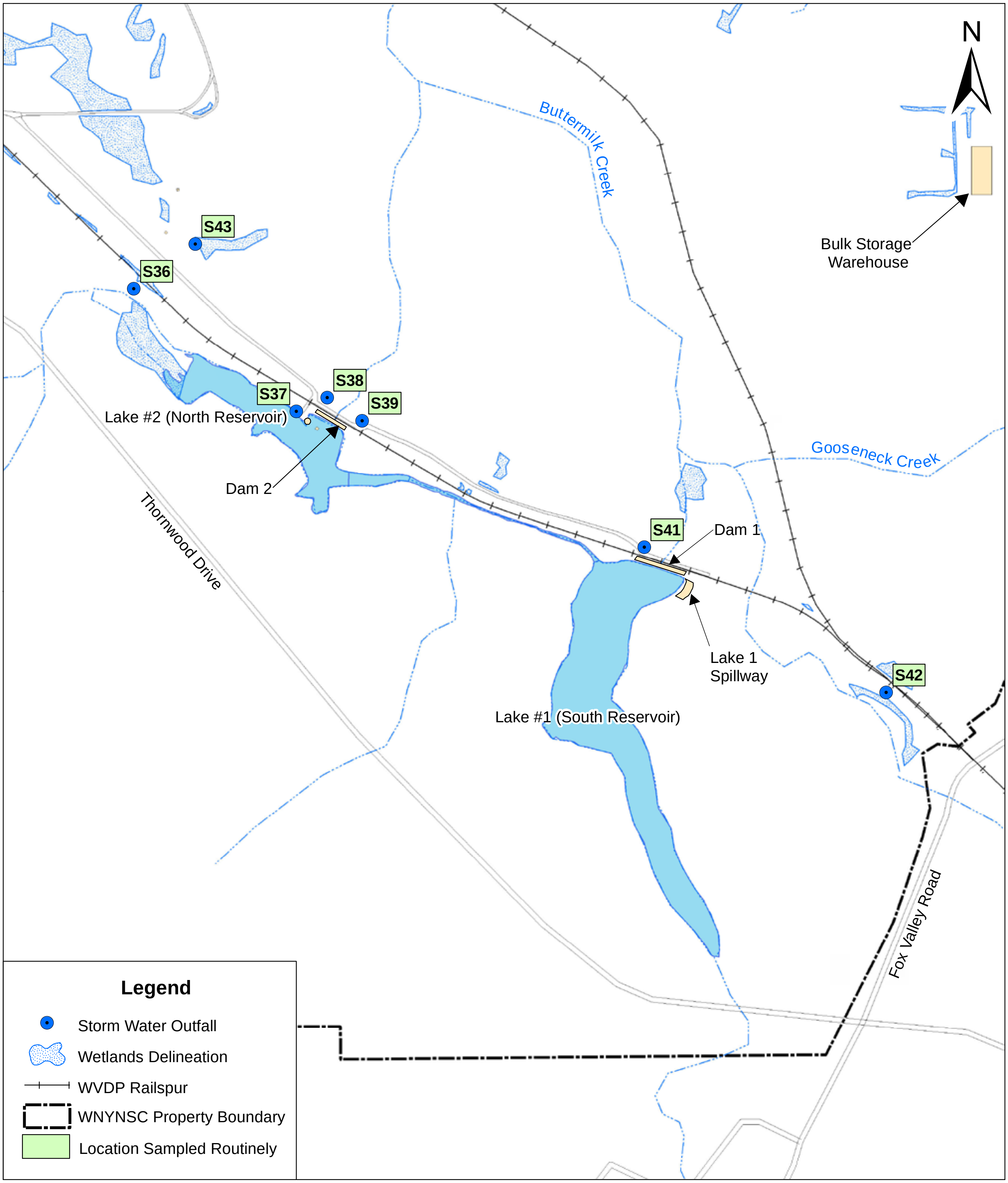
FIGURE A-3
On-Site Storm Water Outfalls



a New S09 stormwater outfall location is sampled at the end of the SmartDitch® where it discharges to the catch basin.

b Rain pH (for WNSWR01) collected inside the property fence at this location.

FIGURE A-4
Rail Spur Storm Water Outfalls



J:/GIS/ArcMap/ASER/ASER_2016/ASER_2016_FigA04_20161101.mxd, 11/1/2016 skw/afs

FIGURE A-5
Off-Site Surface Water and Soil/Sediment Sampling Locations

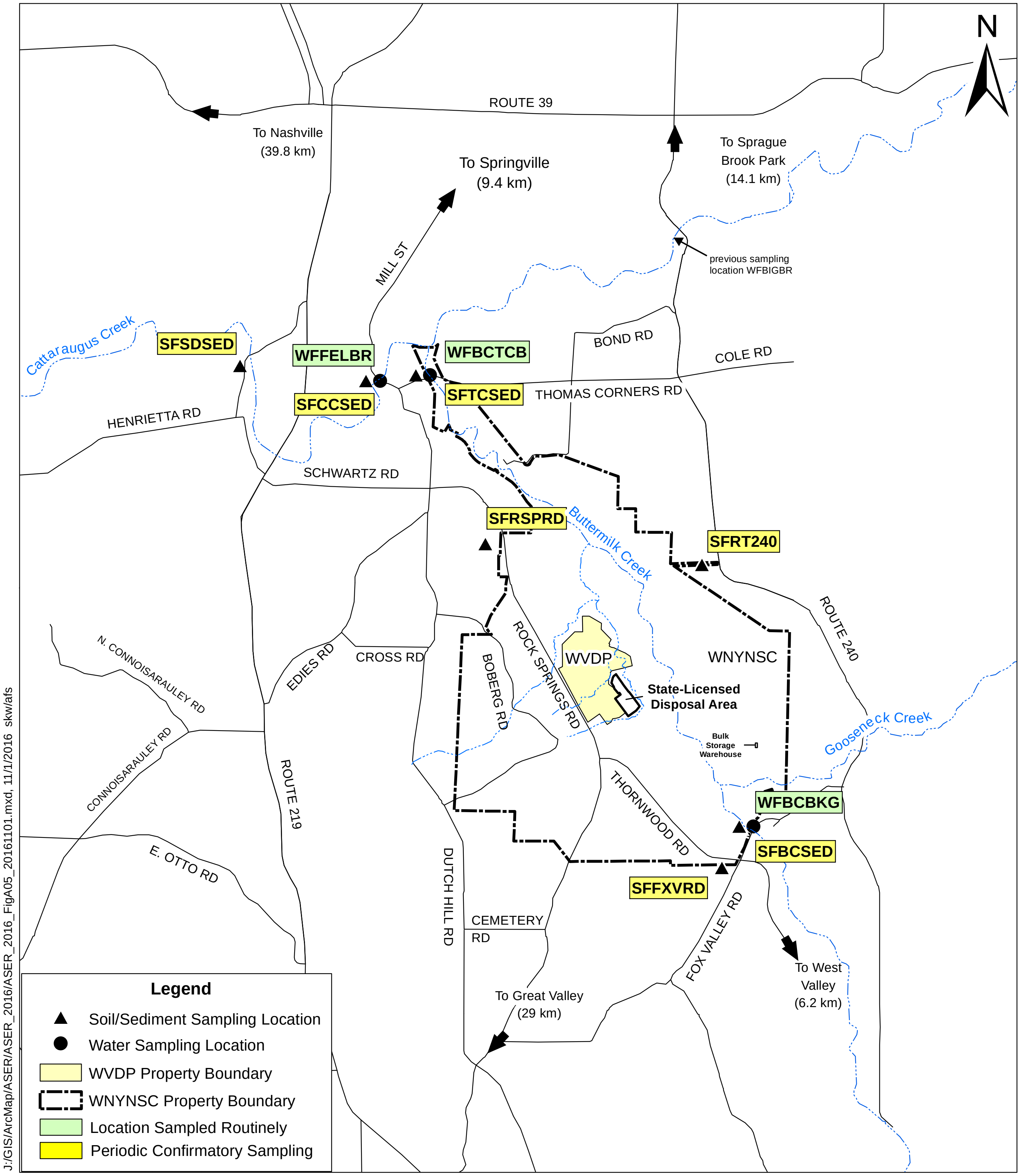


FIGURE A-6
On-Site Air Monitoring and Sampling Locations

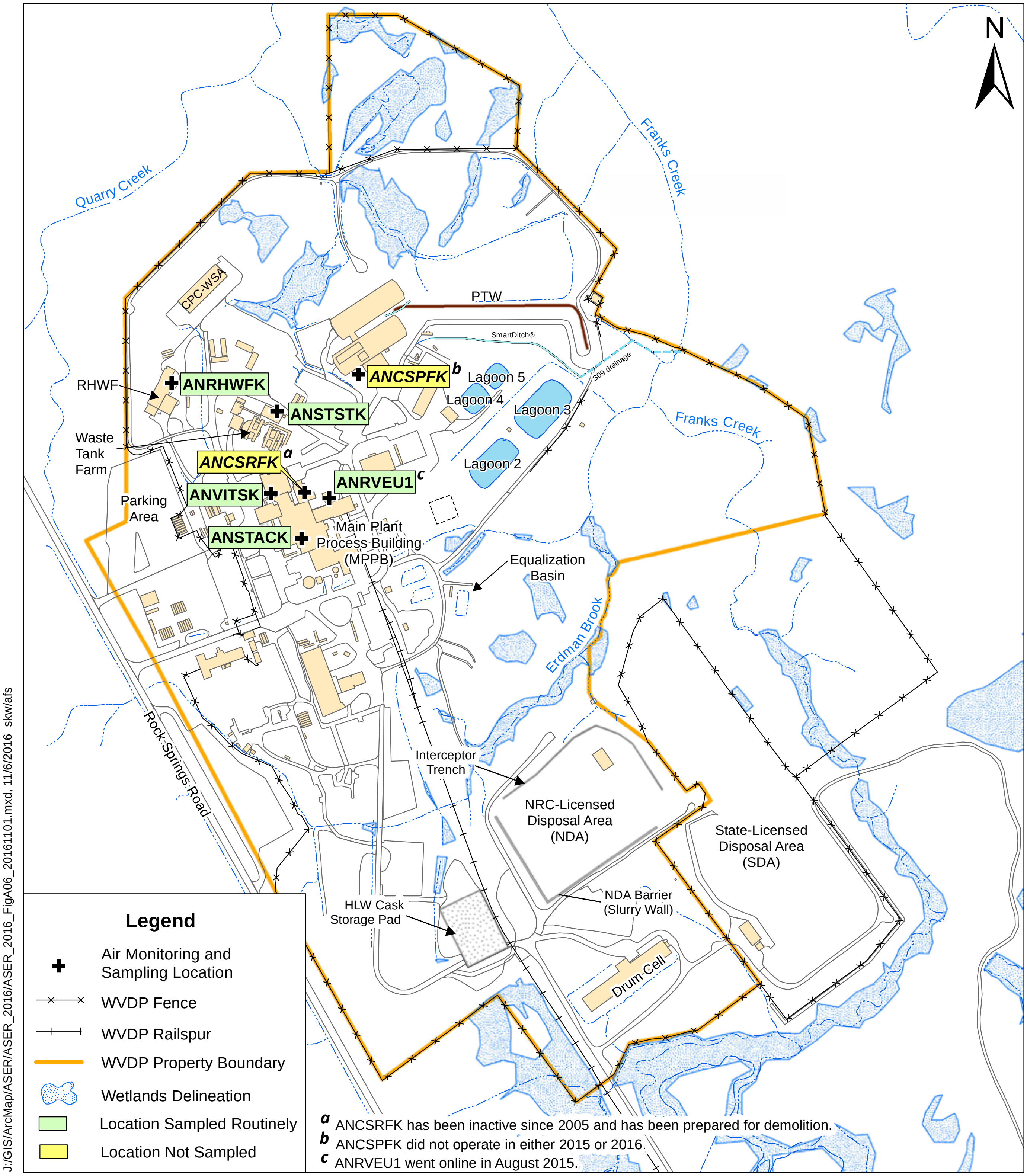


FIGURE A-7
Off-Site Ambient Air Monitoring and Sampling Locations

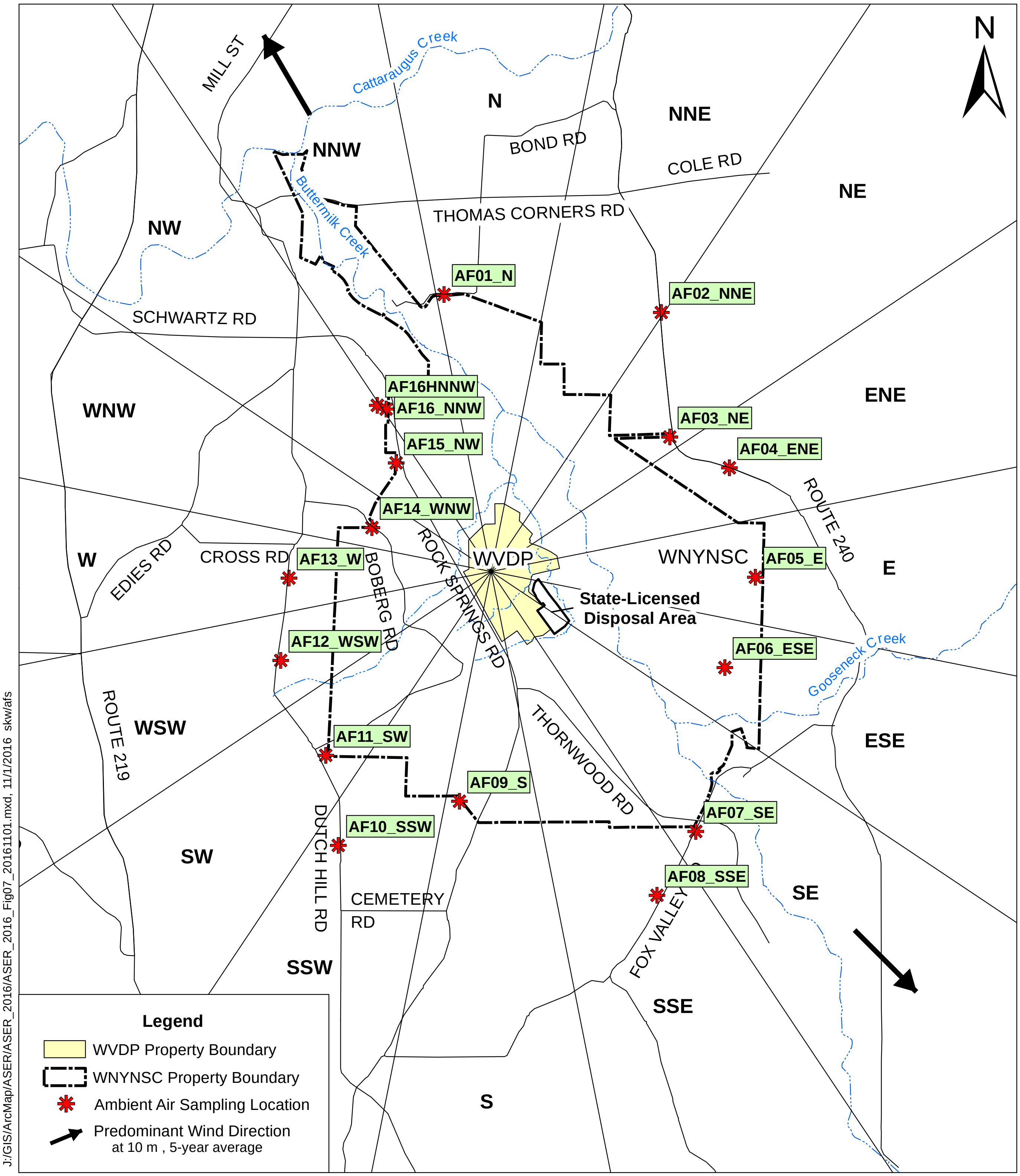


FIGURE A-8
Drinking Water Supply Wells and
Source Water Protection Monitoring Network

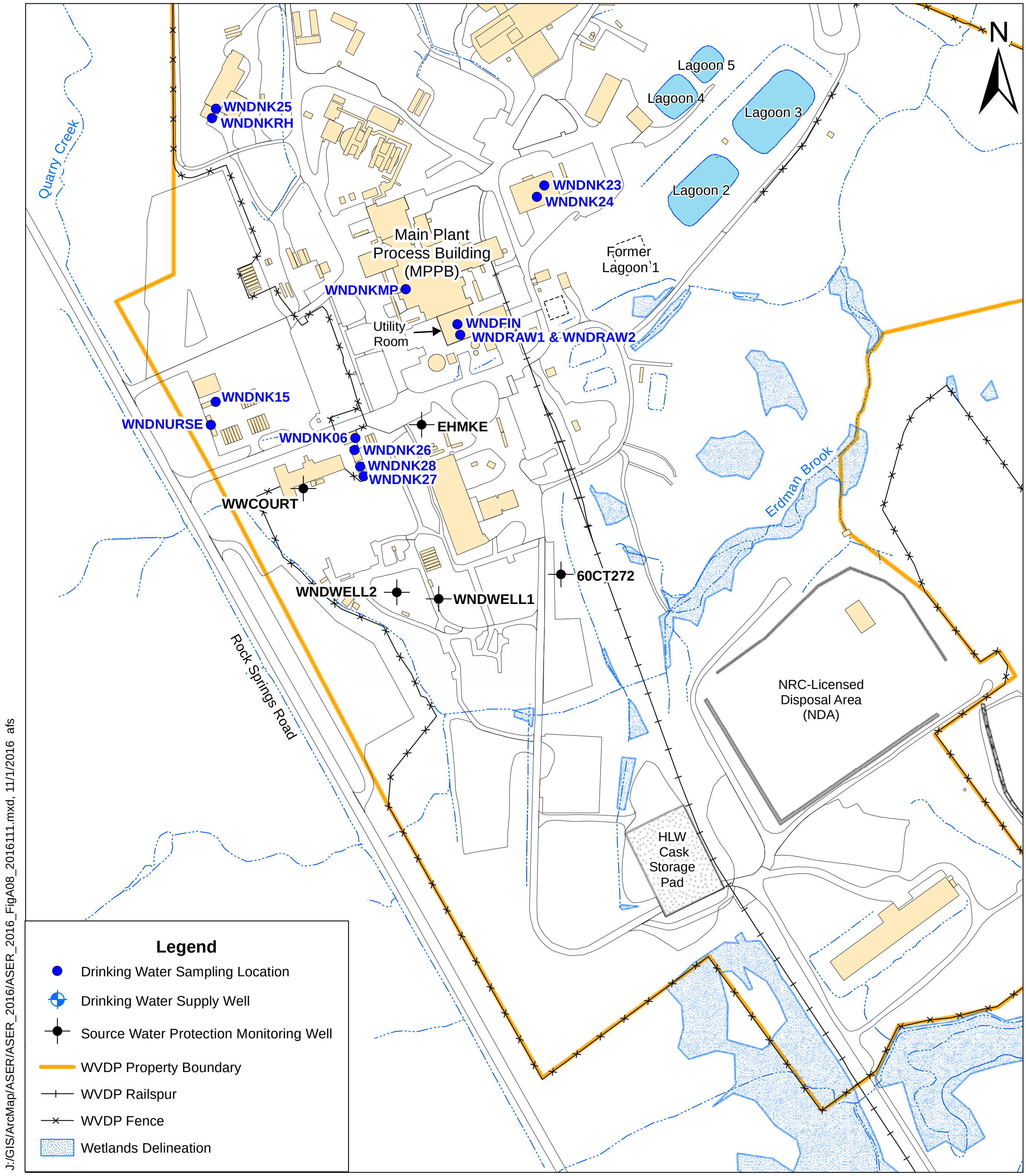


FIGURE A-9
North Plateau Groundwater Monitoring Network

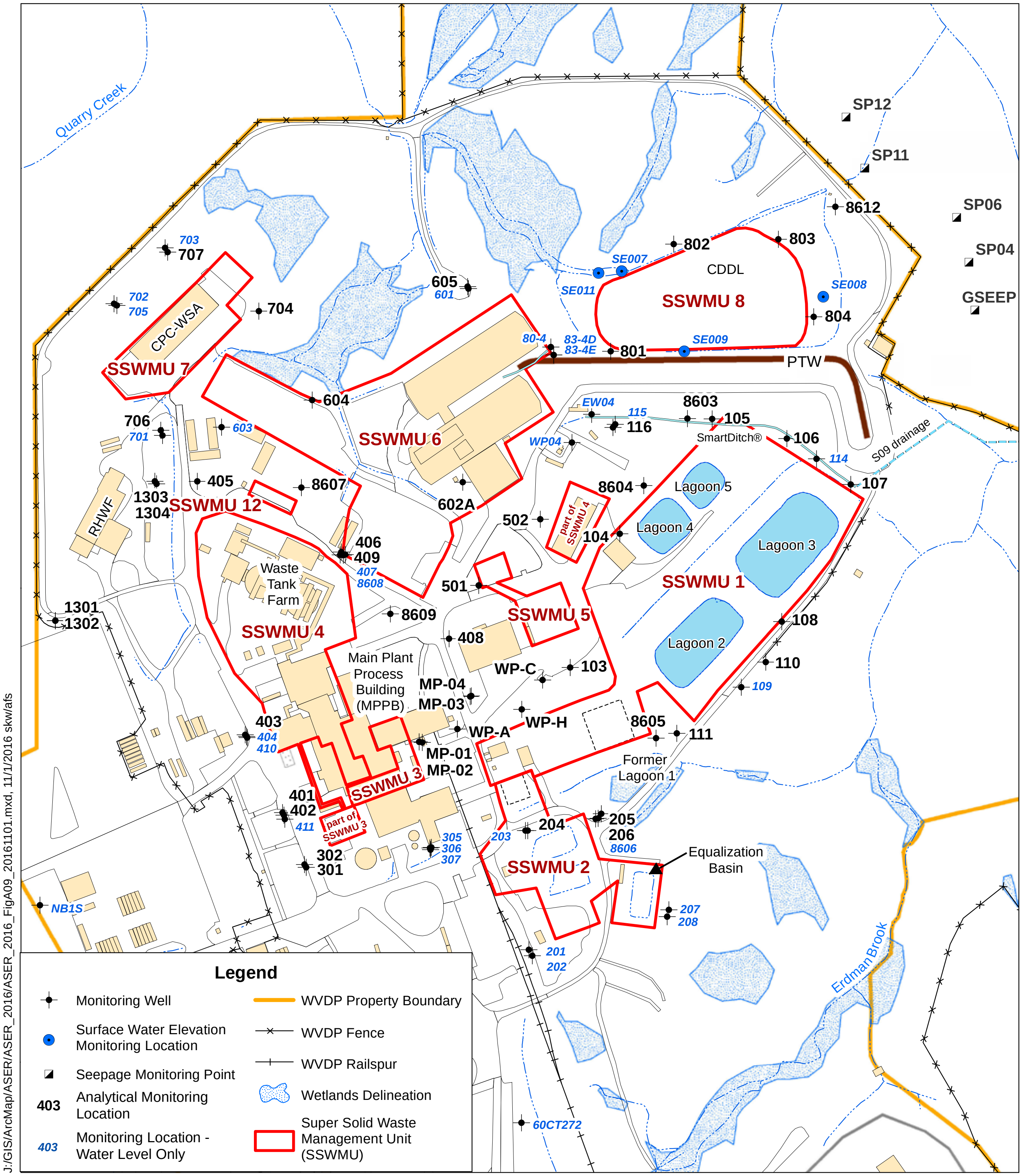
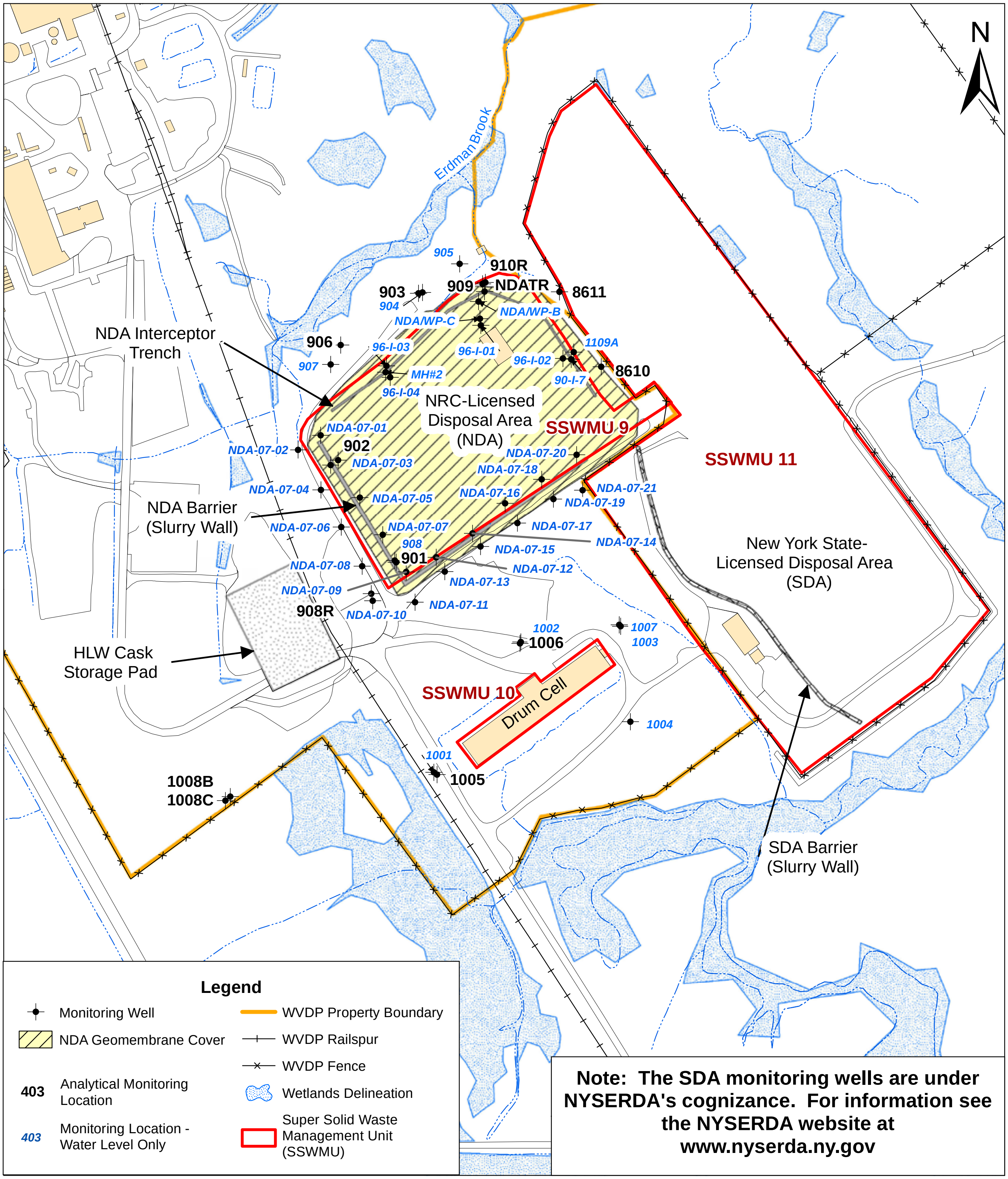


FIGURE A-10
South Plateau Groundwater Monitoring Network



J:/GIS/ArcMap/ASER/ASER_2016/ASER_2016_FigA10_20161101.mxd, 11/1/2016 skw/afs

FIGURE A-11
Biological Sampling Locations

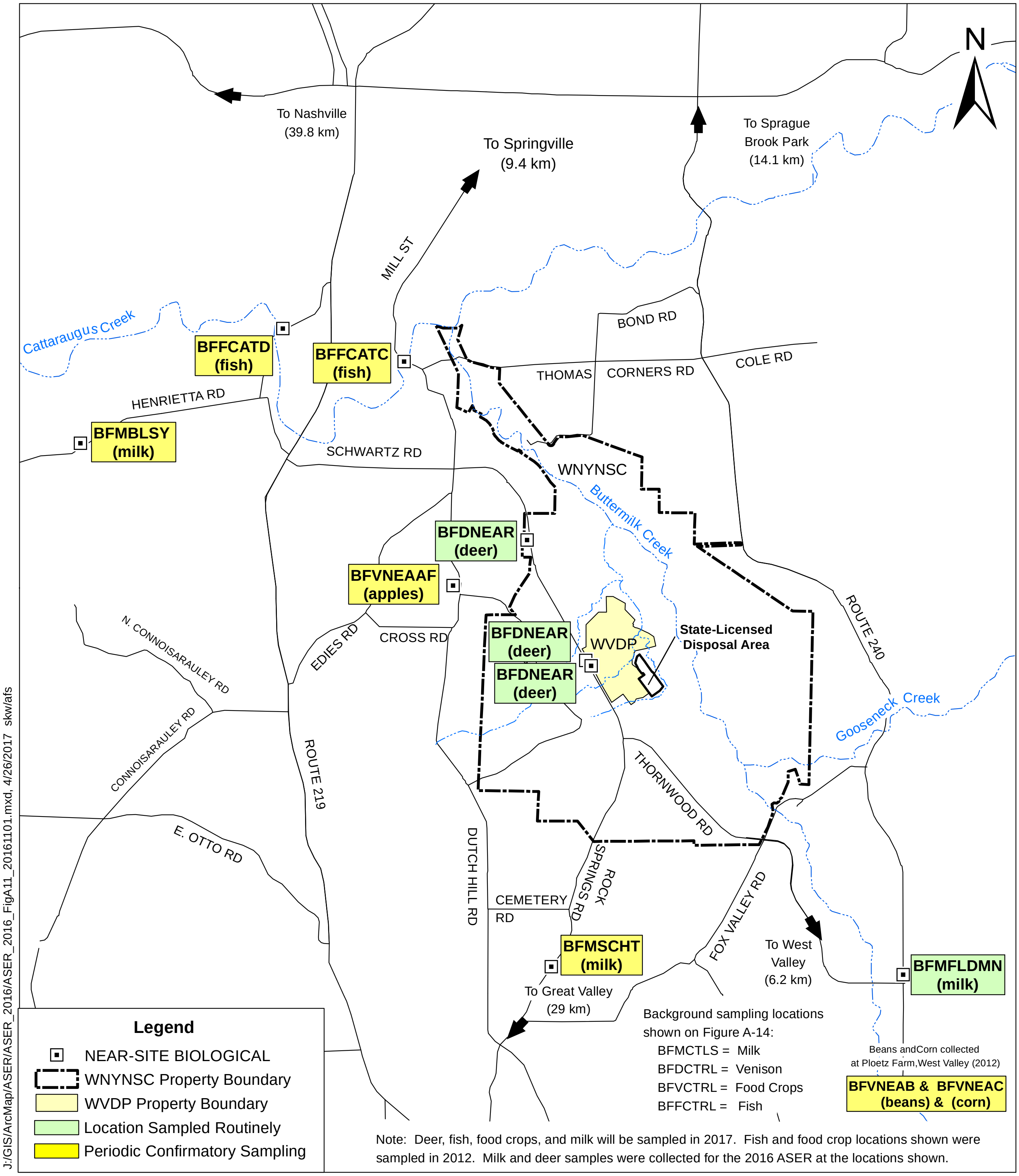


FIGURE A-12
Location of On-Site / Near-Site Thermoluminescent Dosimeters (TLDs)

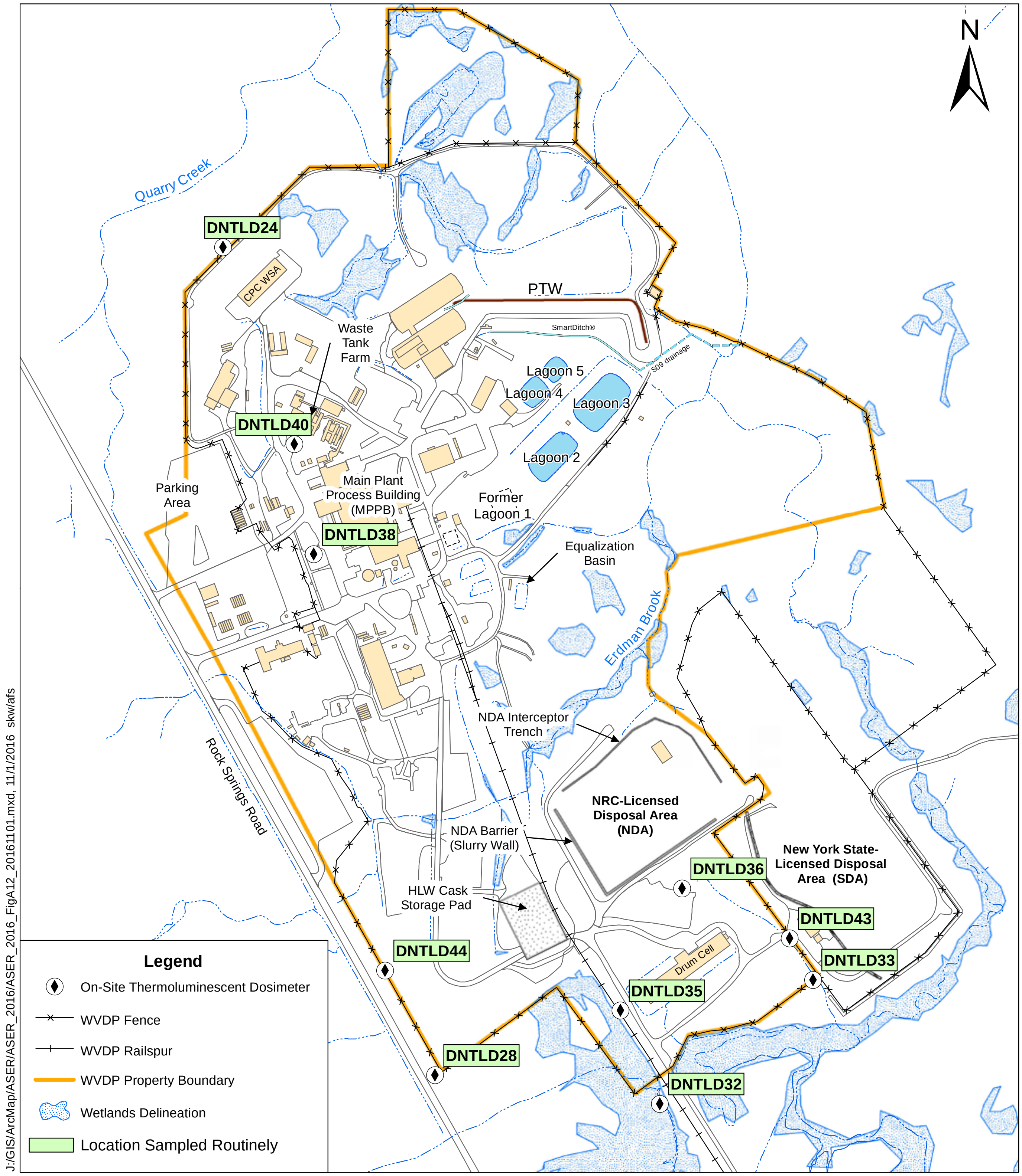
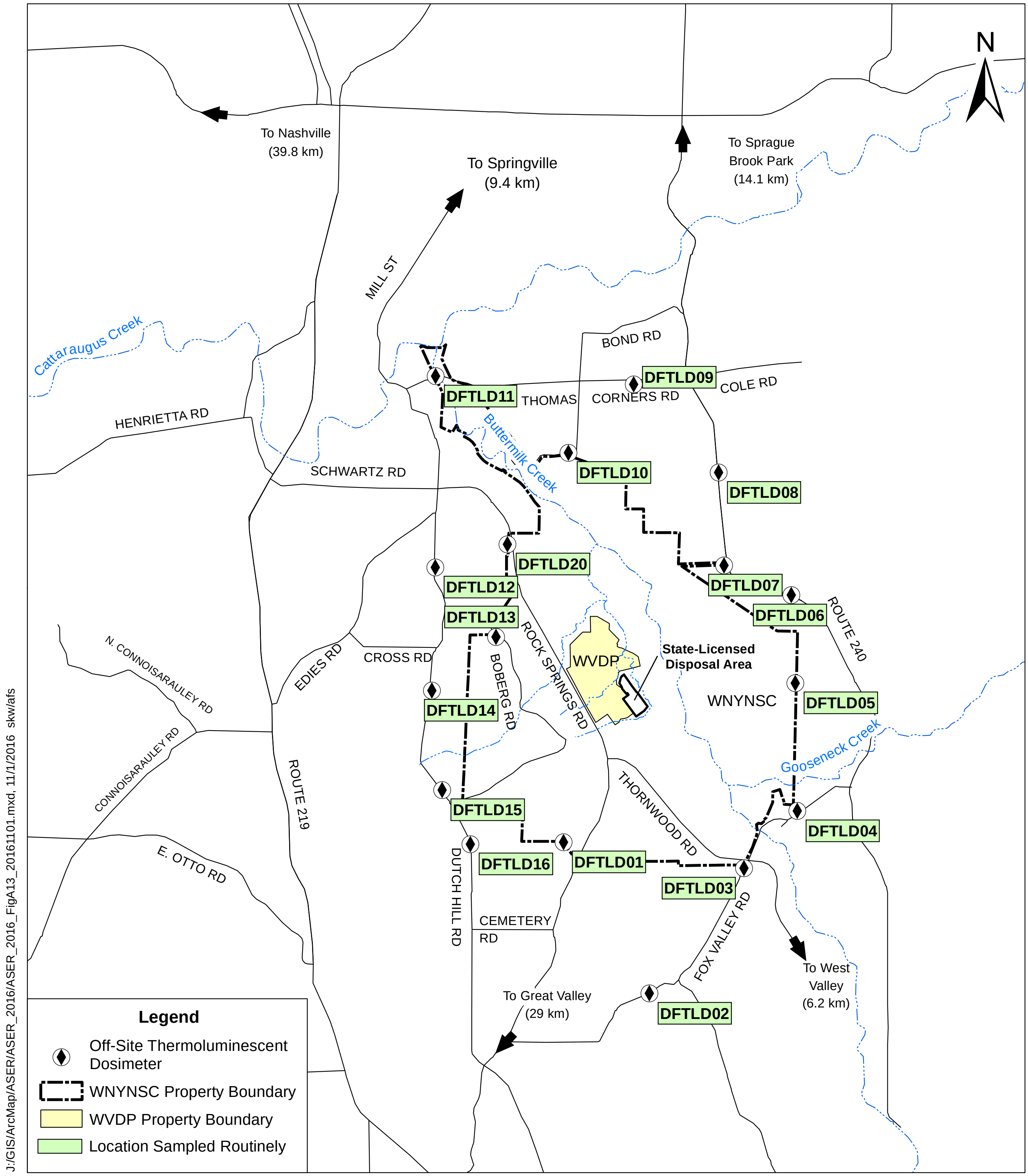


FIGURE A-13
Location of Off-Site Thermoluminescent Dosimeters (TLDs) Within 5 Kilometers of the WVDP



Environmental Sampling Locations More Than 5 Kilometers From the WVDP

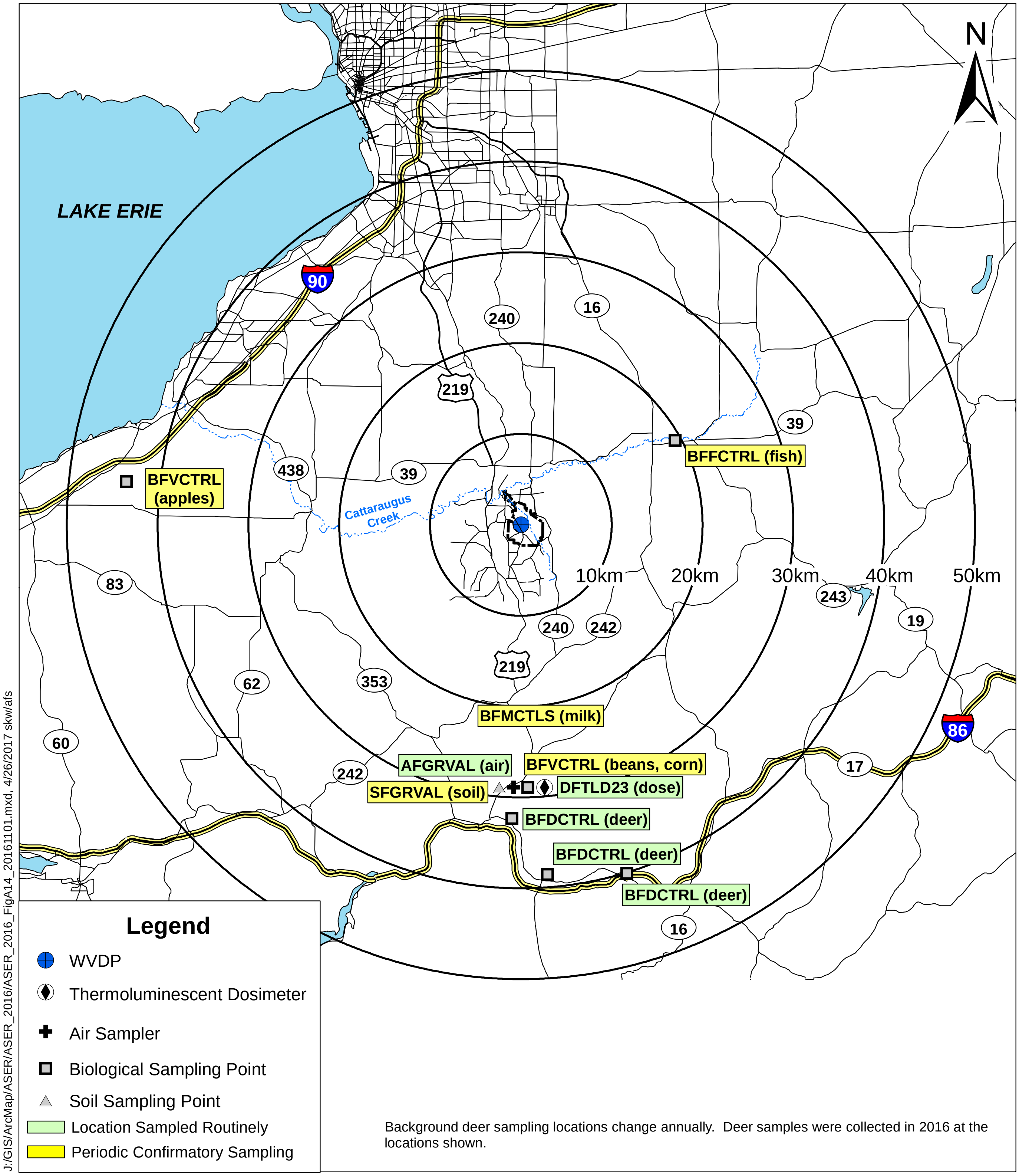
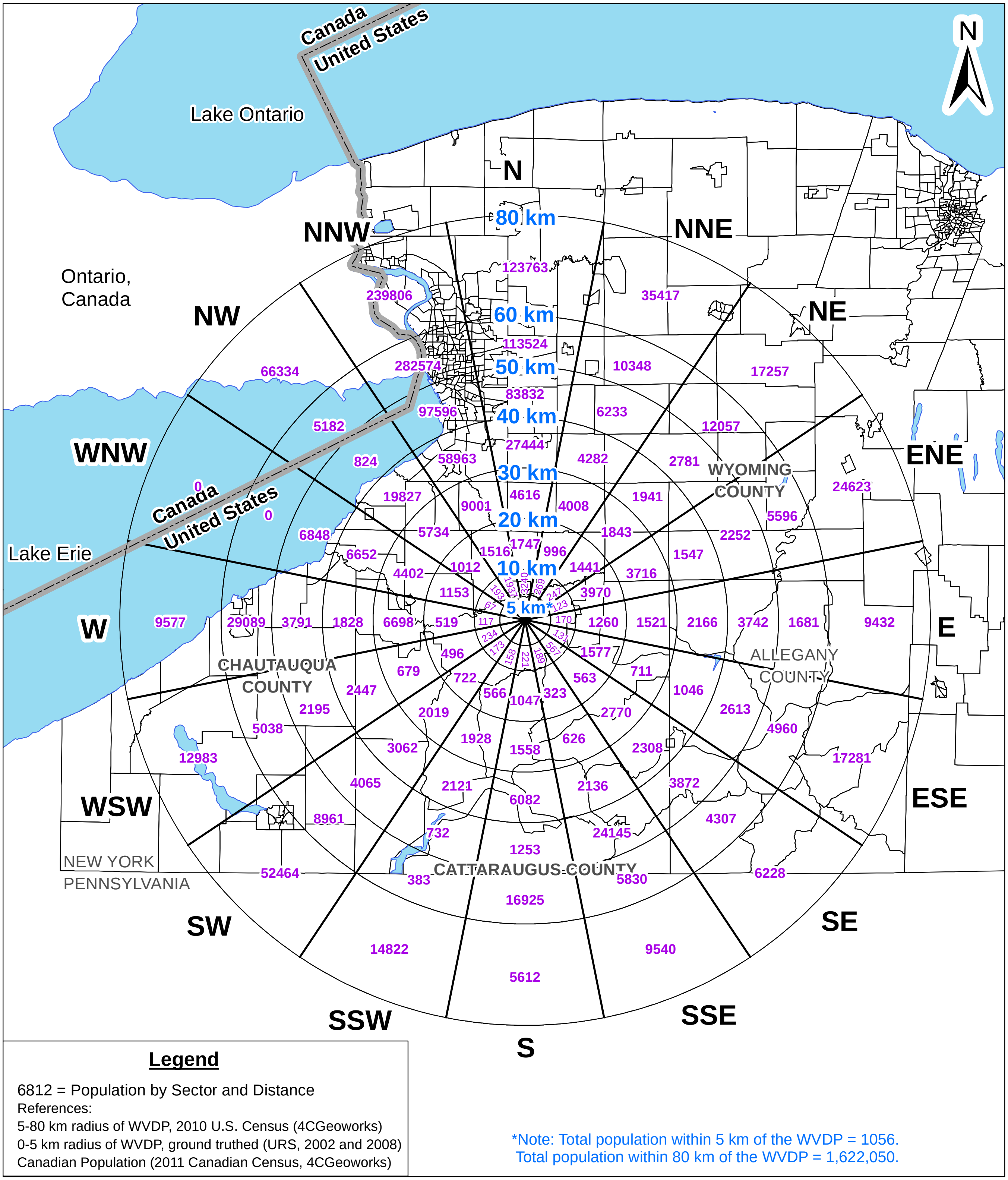


FIGURE A-15
Population by Sector Within 80 Kilometers of the WVDP



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APPENDIX B-1

Summary of Water Limits, Guidelines, and Standards

TABLE B-1A
West Valley Demonstration Project
State Pollutant Discharge Elimination System (SPDES) Sampling Program

Outfall 001	*Parameter*	*Effluent Limit*	*Sample Frequency*
001; Process and Storm Wastewater	Flow	Monitor - MGD	2/batch
	Aluminum	4.0 mg/L	1/batch
	Ammonia as (NH_3)	2.1 mg/L	2/batch
	pH	6.5–8.5 SU	1/batch
	Dissolved Oxygen (DO)	3.0 mg/L (minimum)	2/batch
	Oil and grease	15.0 mg/L	1/batch
	Solids, total suspended	45 mg/L	2/batch
	Solids, Settleable	0.3 ml/L	2/batch
	Solids, Total dissolved	Monitor	2/batch
	BOD_5	10.0 mg/L	2/batch
	TKN (as N)	Monitor	2/batch
	Nitrate (as N)	Monitor	1/batch
	Nitrite (as N)	0.1 mg/L	1/batch
	Ultimate oxygen demand (UOD)	22.0 mg/L	2/batch
	Chlorine, total residual	0.1 mg/L	1/batch
	Arsenic, total recoverable	0.15 mg/L	1/batch
	Cadmium, total recoverable	0.002 mg/L	1/year
	Iron, total	Monitor	2/batch
	Chromium, total recoverable	0.11 mg/L	2/year
	Chromium, hexavalent, total recoverable	0.011 mg/L	1/year
	Copper, total recoverable	0.014 mg/L	2/year
	Cyanide, amenable to chlorination	0.005 mg/L	2/year
	Manganese, total	2.0 mg/L	2/year
	Lead, total recoverable	0.006 mg/L	2/year
	Nickel, total	0.079 mg/L	2/year
	Selenium, total recoverable	0.004 mg/L	1/batch
	Sulfate	Monitor	1/batch
	Sulfide, dissolved	0.4 mg/L	1/batch
	Cobalt, total recoverable	0.005 mg/L	1/batch
	Vanadium, total recoverable	0.014 mg/L	1/batch
	Zinc, total recoverable	0.13 mg/L	2/year
	Dichlorodifluoromethane	0.01 mg/L	1/year
	Trichlorofluoromethane	0.01 mg/L	1/year
	3,3-Dichlorobenzidine	0.01 mg/L	1/year
	Tributylphosphate	0.1 mg/L	1/year
	Heptachlor	0.01 µg/L	2/year
	Surfactant (as LAS)	0.04 mg/L	1/batch
	Xylene	0.05 mg/L	1/year
	2-butanone	0.5 mg/L	1/year
	Hexachlorobenzene	0.2 µg/L	1/year
	Mercury, total	50 ng/L	1/batch
	Alpha - BHC	0.01 µg/L	1/year

TABLE B-1A (*continued*)
West Valley Demonstration Project
State Pollutant Discharge Elimination System (SPDES) Sampling Program

Outfall 001	*Parameter*	*Action Levels*	*Sample Frequency*
001; Process and Storm Wastewater	Antimony	1.0 mg/L	1/year
	Barium	0.5 mg/L	1/year
	Boron	2.0 mg/L	2/year
	Bromide	5.0 mg/L	2/year
	Chloroform	0.3 mg/L	1/year
	Titanium	0.65 mg/L	2/year
	Whole Effluent Toxicity (WET) Testing[a]		
	Parameter	*Action Levels*	*Sample Frequency*
	WET - Acute Invertebrate	0.3 TUa	Quarterly
	WET - Acute Vertebrate	0.3 TUa	Quarterly
	WET - Chronic Invertebrate	1.0 TUc	Quarterly
	WET - Chronic Vertebrate	1.0 TUc	Quarterly

Outfall 007	*Parameter*	*Effluent Limit*	*Sample Frequency*
007[b]; Sanitary and Utility Wastewater	pH	6.5–8.5 SU	2/month
	Dissolved oxygen (DO)	3.0 mg/L (minimum)	2/month
	Flow	Monitor - MGD	1/month
	Oil and Grease	15.0 mg/L	2/month
	Solids, total suspended	45 mg/L	2/month
	Solids, settleable	0.3 ml/L	2/month
	Solids, total dissolved	Monitor	2/month
	BOD_5	10.0 mg/L	2/month
	Ammonia (as NH_3)	2.1 mg/L	2/month
	TKN (as N)	Monitor	Monthly
	Nitrite (as N)	0.1 mg/L	Monthly
	Ultimate oxygen demand (UOD)	22.0 mg/L	Monthly
	Iron, total	Monitor	2/month
	Chlorine, total residual	0.1 mg/L	Monthly
	Mercury, total	50 ng/L	Monthly
	Chloroform	0.20 mg/L	1/year
	Whole Effluent Toxicity (WET) Testing[a]		
	Parameter	*Action Levels*	*Sample Frequency*
	WET - Acute Invertebrate	0.3 TUa	Quarterly
	WET - Acute Vertebrate	0.3 TUa	Quarterly
	WET - Chronic Invertebrate	1.0 Tuc	Quarterly
	WET - Chronic Vertebrate	1.0 TUc	Quarterly

Outfall 01B	*Parameter*	*Effluent Limit*	*Sample Frequency*
01B[b]; Mercury Pre-Treatment Process	Flow	Monitor - GPD	Weekly
	Mercury, total	50 ng/L	2/batch

Sum of Outfalls	*Parameter*	*Effluent Limit*	*Sample Frequency*
001 and 007	Iron, total	1.0 mg/L	Monthly

[a] WET testing is only required every five years. WET testing was performed in 2012 and will be performed again in 2017.
[b] WNSP01B and WNSP007 are no longer in operation.

TABLE B-1A (*concluded*)
West Valley Demonstration Project
State Pollutant Discharge Elimination System (SPDES) Sampling Program

Monitoring Point	*Parameter*	*Effluent Limit*	*Sample Frequency*
116	Solids, total dissolved	500 mg/L	2/discharge event

Monitoring Point	*Parameter*	*Compliance Limit*	*Sample Frequency*
Stormwater Outfalls (All)	Oil & grease	<15 mg/L	1/event
Outfall S43	Lead, total recoverable	0.006 mg/L	1/event

TABLE B-1B

New York State Water Quality Standards and Guidelines[a]

Parameter	Units	Class A	Class B	Class C	Class D	Class GA
Gross Alpha[b]	pCi/L (µCi/mL)	15 (1.5E-08)	--	--	--	15 (1.5E-08)
Gross Beta[c]	pCi/L (µCi/mL)	1,000 (1E-06)	--	--	--	1,000 (1E-06)
Tritium (H-3)	pCi/L (µCi/mL)	20,000 (2E-05)	--	--	--	--
Strontium-90	pCi/L (µCi/mL)	8 (8E-09)	--	--	--	--
Alpha BHC	mg/L	0.000002	0.000002	0.000002	0.000002	0.00001
Aluminum, Ionic	mg/L	0.10	0.10	0.10	--	--
Aluminum, Total	mg/L	--	--	--	--	--
Ammonia, Total as N	mg/L	0.09–2.1	0.09–2.1	0.09–2.1	0.67–29	2.0
Antimony, Total	mg/L	0.003	--	--	--	0.003
Arsenic, Dissolved	mg/L	0.050	0.15	0.15	0.34	--
Arsenic, Total	mg/L	0.050	--	--	--	0.025
Barium, Total	mg/L	1.0	--	--	--	1.0
Beryllium, Total	mg/L	0.003	[d]	[d]	--	0.003
Boron, Total	mg/L	10	10	10	--	1.0
Bromide	mg/L	2.0	--	--	--	2.0
Cadmium, Dissolved[e]	mg/L	--	--	--	--	--
Cadmium, Total	mg/L	0.005	--	--	--	0.005
Calcium, Total	mg/L	--	--	--	--	--
Chloride	mg/L	250	--	--	--	250
Chromium, Dissolved[e]	mg/L	--	--	--	--	--
Chromium, Total	mg/L	0.05	--	--	--	0.05
Cobalt, Total[f]	mg/L	0.005	0.005	0.005	0.11	--
Conductivity	µmhos/cm@25°C	--	--	--	--	--
Copper, Dissolved[e]	mg/L	--	--	--	--	--
Copper, Total	mg/L	0.20	--	--	--	0.20
Cyanide	mg/L	0.0052	0.0052	0.0052	0.022	0.200
Dissolved Oxygen (minimum)	mg/L	4.0	4.0	4.0	3.0	--
Fluoride[e]	mg/L	--	--	--	--	1.5
Hardness	mg/L	--	--	--	--	--
Iron and Manganese (sum)	mg/L	--	--	--	--	0.50
Iron, Total	mg/L	0.30	0.30	0.30	0.30	0.30

-- No applicable guideline or reference standard available.

Note: All water quality and metals standards are presented in mg/L (ppm) to provide consistency in comparisons.

[a] Source: 6 NYCRR Part 702 - 704; The most stringent applicable pathway (e.g.,wildlife, aquatic, human health) values are reported.

[b] Gross alpha standard excludes radon and uranium, however WVDP results include uranium.

[c] Gross beta standard excludes strontium-90 and alpha emitters, however WVDP results include these isotopes.

[d] Beryllium standard for classes "B" and "C" are based on stream hardness values.

[e] Standards for these constituents vary according to stream location hardness values.

[f] Standards for cobalt, thallium, and vanadium are applicable to the acid soluble fraction.

TABLE B-1B *(concluded)*

New York State Water Quality Standards and Guidelines[a]

Parameter	*Units*	*Class A*	*Class B*	*Class C*	*Class D*	*Class GA*
Lead, Dissolved[e]	mg/L	--	--	--	--	--
Lead, Total	mg/L	0.050	--	--	--	0.025
Magnesium, Total	mg/L	35	--	--	--	35
Manganese, Total	mg/L	0.30	--	--	--	0.30
Mercury, Dissolved	mg/L	0.0000007	0.0000007	0.0000007	0.0000007	--
Mercury, Total	mg/L	0.0007	--	--	--	0.0007
Nickel, Dissolved[e]	mg/L	--	--	--	--	--
Nickel, Total	mg/L	0.10	--	--	--	0.10
Nitrate-N	mg/L	10	--	--	--	10
Nitrate + Nitrite	mg/L	10	--	--	--	10
Nitrite-N	mg/L	0.10	0.10	0.10	--	1.0
Oil & Grease	mg/L	No residue nor visible oil film nor globules of grease.				
pH	SU	6.5–8.5	6.5–8.5	6.5–8.5	6.0–9.5	6.5–8.5
Potassium, Total	mg/L	--	--	--	--	--
Selenium, Dissolved	mg/L	0.0046	0.0046	0.0046	--	--
Selenium, Total	mg/L	0.01	--	--	--	0.01
Silver, Total	mg/L	0.05	--	--	--	0.05
Sodium, Total	mg/L	--	--	--	--	20
Solids, Total Dissolved	mg/L	500	500	500	--	500
Solids, Total Suspended	mg/L	None that will cause deposition or impair waters for best usage.				
Sulfate	mg/L	250	--	--	--	250
Sulfide (undissociated form)	mg/L	0.002	0.002	0.002	--	0.050
Surfactants (as LAS)	mg/L	0.04	0.04	0.04	--	--
Thallium, Total[f]	mg/L	0.0005	0.008	0.008	0.020	0.0005
Titanium, Total	mg/L	--	--	--	--	--
Vanadium, Total[f]	mg/L	0.014	0.014	0.014	0.19	--
Zinc, Dissolved[e]	mg/L	--	--	--	--	--
Zinc, Total	mg/L	2.0	--	--	--	2.0

-- No applicable guideline or reference standard available.

Note: All water quality and metals standards are presented in mg/L (ppm) to provide consistency in comparisons.

[a] Source: 6 NYCRR Part 702 - 704; The most stringent applicable pathway (e.g.,wildlife, aquatic, human health) values are reported.

[b] Gross alpha standard excludes radon and uranium, however WVDP results include uranium.

[c] Gross beta standard excludes strontium-90 and alpha emitters, however WVDP results include these isotopes.

[d] Beryllium standard for classes "B" and "C" are based on stream hardness values.

[e] Standards for these constituents vary according to stream location hardness values.

[f] Standards for cobalt, thallium, and vanadium are applicable to the acid soluble fraction.

TABLE B-1C
New York State Department of Health Potable Water MCLs
for a Groundwater Supply

Parameter	*Units*	*NYSDOH MCL* [a]
Inorganic Chemicals (IOCs)		
Metals		
Antimony, Total	mg/L	0.006
Arsenic, Total	mg/L	0.010
Barium, Total	mg/L	2.00
Beryllium, Total	mg/L	0.004
Cadmium, Total	mg/L	0.005
Chromium, Total	mg/L	0.10
Copper, Total	mg/L	1.3 [b]
Lead, Total	mg/L	0.015 [b]
Mercury, Total	mg/L	0.002
Nickel, Total	mg/L	--
Selenium, Total	mg/L	0.05
Silver, Total	mg/L	0.1
Thallium, Total	mg/L	0.002
Other Inorganic Chemicals		
Cyanide (as free cyanide)	mg/L	0.2
Fluoride	mg/L	2.2
Nitrate-N	mg/L	10
Sodium	mg/L	20 / 270 [c]
Organic Chemicals		
POC (Principle Organic Contaminant)	mg/L	0.005
SOC (Specific Organic Chemicals)		
Alachlor	mg/L	0.002
Aldicarb	mg/L	0.003
Aldicarb sulfone	mg/L	0.002
Aldicarb sulfoxide	mg/L	0.004
Atrazine	mg/L	0.003
Carbofuran	mg/L	0.04
Chlordane	mg/L	0.002
Dibromochloropropane(DBCP)	mg/L	0.0002
2,4-D	mg/L	0.05
Dinoseb	mg/L	0.007
Endrin	mg/L	0.002
Ethylene dibromide(EDB)	mg/L	0.00005
Heptachlor	mg/L	0.0004
Heptachlor epoxide	mg/L	0.0002
Hexachlorobenzene	mg/L	0.001
Lindane	mg/L	0.0002

-- No applicable guideline or reference standard available.
MCL - Maximum Contamination Level
[a] MCL - Listed is NYSDOH 10 NYCRR Part 5, Subpart 5-1, Section 5-1.52.
[b] Value shown for copper and lead are the 90th percentile Action Levels.
[c] Although there is no designated limit for sodium, recommended limits are provided for people on severely and moderately sodium restricted diets.

TABLE B-1C *(concluded)*
New York State Department of Health Potable Water MCLs
for a Groundwater Supply

Parameter	*Units*	*NYSDOH MCL* [a]	
Organic Chemicals (continued)			
SOC (Specific Organic Chemicals) ***continued***			
Methoxychlor	mg/L	0.04	
Methyl-tertiary-butyl-ether(MTBE)	mg/L	0.010	
Pentachlorophenol	mg/L	0.001	
Polychlorinated biphenyls(PCBs)	mg/L	0.0005	
Simazine	mg/L	0.004	
Toxaphene	mg/L	0.003	
2,4,5-TP (Silvex)	mg/L	0.01	
2,3,7,8-TCDD (dioxin)	mg/L	0.00000003	
Vinyl chloride	mg/L	0.002	
Parameter	*Units*	*Standard*	
Disinfectant and Disinfection Byproducts			
Free Residual Chlorine	mg/L	0.2 to 4.0	
Haloacetic Acids-Five (5)	mg/L	0.06	
Total Trihalomethanes	mg/L	0.08	
Microbiological Contamination			
E. Coli	NA	no positive samples	
Total Coliform	NA	no positive samples	
SPECIAL WVDP MONITORING: Radiological Parameters			
Parameter	*Units*	*Guidance*	*Groundwater Background* [b]
Gross Alpha	µCi/mL	1.5E-08[c]	7.61E-09
Gross Beta	mrem/year	4[c]	-
Gross Beta (screening level)	µCi/mL	1.5E-08[d]	1.56E-08
Tritium	µCi/mL	2.0E-05[e]	1.78E-07
Cesium-137	µCi/mL	2.0E-07[e]	ND
Iodine-129	µCi/mL	1.0E-09[e]	ND

-- No applicable guideline or reference standard available.
ND - Non-detect
MCL - Maximum Contamination Level

[a] MCL - Listed is NYSDOH 10 NYCRR Part 5, Subpart 5-1, Section 5-1.52.
[b] Background concentrations for groundwater (provided in Table D-1A) are used for screening gross alpha, gross beta and tritium in the groundwater supply and source water protection plan wells.
[c] NYSDOH 10 NYCRR Part 5, Subpart 5-1, Public Water System Table 7 Radiological MCL (applicable to community water systems).
[d] NYSDOH 10 NYCRR Part 5, Subpart 5-1, Public Water System Table 12 Radiological Monitoring Requirements (screening level applicable to community water supply near nuclear facilities).
[e] Standard used for screening radionulides are from the EPA Safe Drinking Water Act Implemention Guidance for Radionuclides (40 CFR Part 141 Subpart F §141.66), applicable to community water systems.

TABLE B-1D
Department of Energy (DOE)
Derived Concentration Standards (DCSs)[a] in Ingested Water

Radionuclide	*Units*	*Concentration in Ingested Water*
Gross Alpha (as U-232)[b]	µCi/mL	9.8E-08
Gross Beta (as Sr-90)[b]	µCi/mL	1.1E-06
Tritium (H-3)	µCi/mL	1.9E-03
Carbon-14 (C-14)	µCi/mL	6.2E-05
Potassium-40 (K-40)	µCi/mL	4.8E-06
Cobalt-60 (Co-60)	µCi/mL	7.2E-06
Strontium-90 (Sr-90)	µCi/mL	1.1E-06
Technetium-99 (Tc-99)	µCi/mL	4.4E-05
Iodine-129 (I-129)	µCi/mL	3.3E-07
Cesium-137 (Cs-137)	µCi/mL	3.0E-06
Europium-154 (Eu-154)	µCi/mL	1.5E-05
Uranium-232 (U-232)	µCi/mL	9.8E-08
Uranium-233 (U-233)	µCi/mL	6.6E-07
Uranium-234 (U-234)	µCi/mL	6.8E-07
Uranium-235 (U-235)	µCi/mL	7.2E-07
Uranium-236 (U-236)	µCi/mL	7.2E-07
Uranium-238 (U-238)	µCi/mL	7.5E-07
Plutonium-238 (Pu-238)	µCi/mL	1.5E-07
Plutonium-239 (Pu-239)	µCi/mL	1.4E-07
Plutonium-240 (Pu-240)	µCi/mL	1.4E-07
Americium-241 (Am-241)	µCi/mL	1.7E-07

[a] DCS: Derived Concentation Standard. DCSs are established in DOE-STD-1196-2011 and are defined as the concentration of a radionuclide that, under conditions of continuous exposure for one year by one exposure mode, would result in an effective dose equivalent of 100 mrem (1mSv).

[b] Because there are no DCSs for gross alpha and gross beta concentrations, the DCSs for the most restrictive alpha and beta emitters in water at the WVDP, uranium-232 and strontium-90 (9.8E-08 and 1.1E-06 uCi/mL, respectively) are used as a conservative basis for comparison at locations for which there are no radionuclide-specific data, in which case a more appropriate DCS may be applied.

APPENDIX B-2

Process Effluent Data

TABLE B-2A
Comparison of 2016 Lagoon 3 (WNSP001) Liquid Effluent Radioactivity Concentrations With U.S. DOE-Derived Conentration Standards (DCSs)

Isotope [a]	*Discharge Activity* [b]		*Average Concentration*	*DCS* [d]	*Ratio of Average Concentration to DCS*
	(Ci)	*(Becquerels)* [c]	*(µCi/mL)*	*(µCi/mL)*	
Gross Alpha	3.86±0.40E-04	1.43±0.15E+07	2.72±0.28E-08	NA[e]	NA
Gross Beta	5.95±0.07E-03	2.20±0.03E+08	4.20±0.05E-07	NA[e]	NA
H-3	1.18±0.13E-02	4.37±0.50E+08	8.32±0.95E-07	1.9E-03	0.0004
C-14	2.41±2.77E-04	0.89±1.03E+07	1.70±1.96E-08	6.2E-05	<0.0003
K-40	-1.58±3.72E-04	-0.59±1.38E+07	-1.12±2.63E-08	NA[f]	NA
Co-60	0.95±3.87E-05	0.35±1.43E+06	0.67±2.73E-09	7.2E-06	<0.0004
Sr-90	2.30±0.06E-03	8.51±0.21E+07	1.62±0.04E-07	1.1E-06	0.1476
Tc-99	2.18±0.27E-04	8.06±1.01E+06	1.54±0.19E-08	4.4E-05	0.0003
I-129	4.53±1.71E-05	1.68±0.63E+06	3.20±1.21E-09	3.3E-07	0.0097
Cs-137	3.38±0.50E-04	1.25±0.19E+07	2.39±0.36E-08	3.0E-06	0.0080
U-232[g]	1.07±0.07E-04	3.95±0.25E+06	7.53±0.48E-09	9.8E-08	0.0768
U-233/234[g]	8.28±0.67E-05	3.06±0.25E+06	5.84±0.47E-09	6.6E-07[h]	0.0088
U-235/236[g]	4.34±1.54E-06	1.61±0.57E+05	3.06±1.08E-10	7.2E-07	0.0004
U-238[g]	6.78±0.61E-05	2.51±0.22E+06	4.78±0.43E-09	7.5E-07	0.0064
Pu-238	1.53±1.00E-06	5.66±3.69E+04	1.08±0.70E-10	1.5E-07	0.0007
Pu-239/240	2.20±1.14E-06	8.15±4.23E+04	1.55±0.81E-10	1.4E-07	0.0011
Am-241	1.55±0.70E-06	5.75±2.58E+04	1.10±0.49E-10	1.7E-07	0.0006
Sum of Ratios					**0.26**

NA - Not applicable.
[a] Half-lives are listed in Table UI-4.
[b] Total volume released: 1.42E+10 milliliters (mL) (3.74E+06 gal).
[c] 1 curie (Ci) = 3.7E+10 becquerels (Bq): 1Bq = 2.7E-11 Ci; 1 microcurie (µCi) =1E-06 Ci.
[d] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[e] DCSs do not exist for indicator parameters gross alpha and gross beta.
[f] The DCS is not applied to potassium-40 (K-40) activity because of its natural origin.
[g] Total uranium (g) = 2.10±0.06E+02; Average uranium (µg/mL) = 1.48±0.04E-02.
[h] The DCS for U-233 is used for this comparison.

TABLE B-2B
2016 SPDES Results for Outfall 001 (WNSP001): Water Quality

Permit Limit	Ammonia (as NH_3) (mg/L)		BOD $_5$ day (mg/L)		Discharge Rate (MGD)		Chlorine, Total Redisual (mg/L)	
	2.1 mg/L daily maximum		10.0 mg/L daily maximum		Monitor		0.1 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January [a]	--	--	--	--	--	--	--	--
February	0.086	0.097	<2.0	<2.0	0.314	0.437	0.04	0.04
March [a]	--	--	--	--	--	--	--	--
April [a]	--	--	--	--	--	--	--	--
May [a]	--	--	--	--	--	--	--	--
June	<0.019	0.028	3.4	4.1	0.196	0.290	0.04	0.04
July [a]	--	--	--	--	--	--	--	--
August [a]	--	--	--	--	--	--	--	--
September [a]	--	--	--	--	--	--	--	--
October [a]	--	--	--	--	--	--	--	--
November [a]	--	--	--	--	--	--	--	--
December [a]	--	--	--	--	--	--	--	--

Permit Limit	Dissolved Oxygen (mg/L)		Nitrogen, total Kjeldahl (as N) (mg/L)		Nitrate (as N) (mg/L)		Nitrite (as N) (mg/L)	
	3.0 mg/L minimum		Monitor		Monitor		0.1 mg/L daily maximum	
Month	**Min**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January [a]	--	--	--	--	--	--	--	--
February	14	15	0.64	0.72	0.091	0.091	<0.02	<0.02
March [a]	--	--	--	--	--	--	--	--
April [a]	--	--	--	--	--	--	--	--
May [a]	--	--	--	--	--	--	--	--
June	6.5	6.7	0.63	0.73	<0.020	<0.020	<0.02	<0.02
July [a]	--	--	--	--	--	--	--	--
August [a]	--	--	--	--	--	--	--	--
September [a]	--	--	--	--	--	--	--	--
October [a]	--	--	--	--	--	--	--	--
November [a]	--	--	--	--	--	--	--	--
December [a]	--	--	--	--	--	--	--	--

Note: No results exceeded the permit limits.
MGD - Million gallons per day.
[a] There was no discharge from outfall 001 during this month in 2016.

TABLE B-2B *(continued)*
2016 SPDES Results for Outfall 001 (WNSP001); Water Quality

Permit Limit	***Oil & Grease (mg/L)***		***pH (standard units)***		***Solids, Settleable (mL/L)***		***Solids, Total Dissolved (mg/L)***	
	15.0 mg/L daily maximum		***6.5 to 8.5***		***0.3 mL/L daily maximum***		***Monitor***	
Month	***Avg***	***Max***	***Min***	***Max***	***Avg***	***Max***	***Avg***	***Max***
January [a]	--	--	--	--	--	--	--	--
February	<1.4	<1.4	8.1	8.1	<0.1	<0.1	705	706
March [a]	--	--	--	--	--	--	--	--
April [a]	--	--	--	--	--	--	--	--
May [a]	--	--	--	--	--	--	--	--
June	<1.4	<1.4	7.5	7.5	<0.1	<0.1	671	676
July [a]	--	--	--	--	--	--	--	--
August [a]	--	--	--	--	--	--	--	--
September [a]	--	--	--	--	--	--	--	--
October [a]	--	--	--	--	--	--	--	--
November [a]	--	--	--	--	--	--	--	--
December [a]	--	--	--	--	--	--	--	--

Permit Limit	***Solids, Total Suspended (mg/L)***		***Sulfate (as S) (mg/L)***		***Sulfide, (as S) Dissolved (mg/L)***		***Surfactant (as LAS) (mg/L)***	
	45 mg/L daily maximum		***Monitor***		***0.4 mg/L daily maximum***		***0.04 mg/L***	
Month	***Avg***	***Max***	***Avg***	***Max***	***Avg***	***Max***	***Avg***	***Max***
January [a]	--	--	--	--	--	--	--	--
February	< 4.0	< 4.0	68	68	<0.05	<0.05	<0.004	<0.004
March [a]	--	--	--	--	--	--	--	--
April [a]	--	--	--	--	--	--	--	--
May [a]	--	--	--	--	--	--	--	--
June	< 4.0	< 4.0	77	77	<0.05	<0.05	0.009	0.009
July [a]	--	--	--	--	--	--	--	--
August [a]	--	--	--	--	--	--	--	--
September [a]	--	--	--	--	--	--	--	--
October [a]	--	--	--	--	--	--	--	--
November [a]	--	--	--	--	--	--	--	--
December [a]	--	--	--	--	--	--	--	--

Note: No results exceeded the permit limits.
LAS - linear alkylbenzene sulfonate.
[a] There was no discharge from outfall 001 during this month in 2016.

Table B-2B *(concluded)*
2016 SPDES Results for Outfall 001 (WNSP001): Water Quality

Permit Limit	***Ultimate Oxygen Demand (UOD) (mg/L)***	
	22.0 mg/L daily maximum	
Month	***Avg***	***Max***
January [a]	--	--
February	< 5.93	< 6.29
March [a]	--	--
April [a]	--	--
May [a]	--	--
June	7.90	9.49
July [a]	--	--
August [a]	--	--
September [a]	--	--
October [a]	--	--
November [a]	--	--
December [a]	--	--

Note: No results exceeded the permit limits.
[a] There was no discharge from outfall 001 during this month in 2016.

TABLE B-2C
2016 SPDES Results for Outfall 001 (WNSP001): Metals

Permit Limit	Aluminum, Total (mg/L)		Arsenic, Total Recoverable (mg/L)		Cobalt, Total Recoverable (mg/L)		Iron, Total (mg/L)	
	4.0 mg/L daily maximum		0.15 mg/L daily maximum		0.005 mg/L daily maximum		Monitor	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January [a]	--	--	--	--	--	--	--	--
February	0.145	0.145	0.00061	0.00061	<0.0006	<0.0006	0.134	0.145
March [a]	--	--	--	--	--	--	--	--
April [a]	--	--	--	--	--	--	--	--
May [a]	--	--	--	--	--	--	--	--
June	0.15	0.15	0.0011	0.0011	<0.0006	<0.0006	0.450	0.494
July [a]	--	--	--	--	--	--	--	--
August [a]	--	--	--	--	--	--	--	--
September [a]	--	--	--	--	--	--	--	--
October [a]	--	--	--	--	--	--	--	--
November [a]	--	--	--	--	--	--	--	--
December [a]	--	--	--	--	--	--	--	--

Permit Limit	Mercury, Total (ng/L)		Selenium, Total Recoverable (mg/L)		Vanadium, Total Recoverable (mg/L)	
	50 ng/L maximum		0.004 mg/L daily maximum		0.014 mg/L daily maximum	
Month	**Avg**	**Max**	**Avg**	**Max**	**Avg**	**Max**
January [a]	--	--	--	--	--	--
February	5.8	5.8	< 0.0004	<0.0004	<0.0015	<0.0015
March [a]	--	--	--	--	--	--
April [a]	--	--	--	--	--	--
May [a]	--	--	--	--	--	--
June	2.4	2.4	< 0.0004	<0.0004	<0.0015	<0.0015
July [a]	--	--	--	--	--	--
August [a]	--	--	--	--	--	--
September [a]	--	--	--	--	--	--
October [a]	--	--	--	--	--	--
November [a]	--	--	--	--	--	--
December [a]	--	--	--	--	--	--

Note: No results exceeded the permit limits.
[a] There was no discharge from outfall 001 during this month in 2016.

TABLE B-2D
2016 SPDES Results for Sum of Outfalls 001 and 007[a] : Water Quality

Permit Limit	***Iron Total Net Effluent Limitation***	
	1.0 mg/L daily maximum	
Month	***Avg***	***Max***
January [b]	--	--
February	0.13	0.13
March [b]	--	--
April [b]	--	--
May [b]	--	--
June	0.45	0.49
July [b]	--	--
August [b]	--	--
September [b]	--	--
October [b]	--	--
November [b]	--	--
December [b]	--	--

Note: No results exceeded the permit limits.
[a] SPDES discharge from 007 was discontinued in November 2014.
[b] There were no discharges from either outfall 001 or 007 during this month in 2016. Therefore, a calculated total iron is not required.

TABLE B-2E
2016 SPDES Results for Sum of Outfalls 001, 007[a] and 116: Water Quality

Permit Limit	***Total Dissolved Solids (mg/L)***	
	500 mg/L daily maximum	
Month	***Avg***	***Max***
January [b]	--	--
February	269	305
March [b]	--	--
April [b]	--	--
May [b]	--	--
June	294	316
July [b]	--	--
August [b]	--	--
September [b]	--	--
October [b]	--	--
November [b]	--	--
December [b]	--	--

Note: No results exceeded the permit limits.
[a] SPDES discharge from 007 was discontinued in November 2014.
[b] There was no discharge from outfall 001 or 007 during this month in 2016. Therefore, a calculated TDS at 116 is not required.

TABLE B-2F
2016 Annual and Semiannual SPDES Results for Outfall 001:
Metals, Water Quality and Organic Compounds

Permit Limit Parameters	*Permit Limit*	*Monitoring Frequency*	*Sample Date*	*Maximum Measured* [a]
2-Butanone	0.5 mg/L daily maximum	Annual	February 2016	<0.002
3,3-Dichlorobenzidine	0.01 mg/L daily maximum	Annual	February 2016	<0.0008
Alpha-BHC	0.01 ug/L daily maximum	Annual	February 2016	<0.006
Cadmium, Total Recoverable	0.002 mg/L daily maximum	Annual	February 2016	0.0002
Chromium VI, Total Recoverable	0.011 mg/L daily maximum	Annual	February 2016	<0.0050
Chromium, Total Recoverable	0.11 mg/L daily maximum	Semiannual[b]	February 2016	0.0013
Copper, Total Recoverable	0.014mg/L daily maximum	Semiannual[b]	February 2016	0.0041
Cyanide, Amenable to chlorination	0.005 mg/L daily maximum	Semiannual[b]	February 2016	<0.005
Dichlorodifluoromethane	0.01 mg/L daily maximum	Annual	February 2016	<0.0003
Heptachlor	0.01 ug/L daily maximum	Semiannual[b]	February 2016	<0.006
Hexachlorobenzene	0.2 ug/L daily maximum	Annual	February 2016	<0.02
Lead, Total Recoverable	0.006 mg/L daily maximum	Semiannual[b]	February 2016	0.0003
Manganese, Total	2.0 mg/L daily maximum	Semiannual[b]	February 2016	0.0093
Nickel, Total	0.079 mg/L daily maximum	Semiannual[b]	February 2016	0.0015
Tributyl phosphate	0.1 mg/L daily maximum	Annual	February 2016	<0.0008
Trichlorofluoromethane	0.01 mg/L daily maximum	Annual	February 2016	<0.0005
Xylene	0.05 mg/L daily maximum	Annual	February 2016	<0.001
Zinc, Total Recoverable	0.13 mg/L daily maximum	Semiannual[b]	February 2016	0.0063

[a] Measured results are reported in the same units as the permit limits shown in this table.
[b] No discharge occurred during the second half of 2016.
Note: No results exceeded the permit limits.

TABLE B-2G
2016 SPDES Action Level Requirement Monitoring Results for Outfalls 001 and 007
Metals and Water Quality

Outfall	*Action Level Parameters*	*Action Level*	*Monitoring Frequency*	*Sampling Date*	*Maximum Measured* [a]
001	**Antimony, Total**	1.0 mg/L daily maximum	Annual	February 2016	< 0.0068
	Barium, Total	0.5 mg/L daily maximum	Annual	February 2016	0.03
	Boron, Total	2.0 mg/L daily maximum	Semiannual[b]	February 2016	0.062
	Bromide, Total	5.0 mg/L daily maximum	Semiannual[b]	February 2016	< 0.073
	Chloroform	0.3 mg/L daily maximum	Annual	February 2016	< 0.0005
	Titanium, Total	0.65 mg/L daily maximum	Semiannual[b]	February 2016	0.0023
007	**Chloroform**	0.20 mg/L daily maximum	There were no discharges through the 007 outfall in 2016 (discontinued in November 2014).		

[a] Measured results are reported in the same units as the permit limits shown in this table.
[b] No discharge occurred during the second half of 2016.
Note: No results exceeded the permit limits.

TABLE B-2H
2016 SPDES Results for Outfall 01B (WNSP01B): Water Quality

Internal process monitoring point did not operate during 2016.

TABLE B-2I
2016 Herbicide Sampling Data

No herbicides were applied at the WVDP during CY 2016.   ***In accordance with the SPDES permit, no sampling for herbicides from storm water outfalls and process effluent was required in 2016.***

TABLE B-2J
2016 Radioactivity Results for Sewage Treatment Outfall (WNSP007)

There were no discharges from the Sewage Treatment Plant in 2016.   **SPDES outfall 007 was discontinued in November 2014.**   ***(The last discharge from outfall 007 occurred at the end of October 2014.)***

APPENDIX B-3

SPDES-Permitted Storm Water Outfall Discharge Data

TABLE B-3A

2016 Storm Water Discharge Monitoring Data for Outfall Group 1

STORM WATER OUTFALL S04

Paramater Group	*Analyte*	*Units*	*First Flush Grab*	*Flow-weighted Composite*
			06/02/16	*06/02/16*
Group A Parameters	BOD_5	mg/L	5.6	2.7
	Oil & Grease[a]	mg/L	< 1.4	NR
	pH	SU	7.8	NR
	Phosphorous, Total	mg/L	0.37	0.085
	Solids, Total Dissolved	mg/L	679	724
	Solids, Total Suspended	mg/L	159	22
Group B Parameters	Aluminum, Total	mg/L	3.5	2.1
	Copper, Total Recoverable	mg/L	0.011	0.0071
	Iron, Total	mg/L	3.8	2.1
	Lead, Total Recoverable	mg/L	0.0046	0.0016
	Zinc, Total Recoverable	mg/L	0.059	0.020
Group C Parameters	Ammonia (as NH_3)	mg/L	0.025	< 0.0090
	Cadmium, Total Recoverable	mg/L	< 0.000071	< 0.000071
	Chromium, Hexavalent, Total Recoverable	mg/L	< 0.0050	< 0.0050
	Chromium, Total Recoverable	mg/L	0.0031	0.0024
	Nitrogen, Nitrate (as N)	mg/L	0.48	0.26
	Nitrogen, Nitrite (as N)	mg/L	0.021	0.030
	Nitrogen, Total (as N)	mg/L	1.7	1.0
	Nitrogen, Total Kjeldahl	mg/L	1.2	0.71
	Selenium, Total Recoverable	mg/L	< 0.00044	< 0.00044
	Vanadium, Total Recoverable	mg/L	0.0013	< 0.0012
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.1	
	Rainfall During Sampling Event	inches	0.20	
Flow	Total Flow During Sampling Event	gallons	40,000	
	Maximum Flow Rate During Sampling Event	gpm	450	

gpm - gallons per minute.

NR - Not required by permit.

[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3A *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 1

STORM WATER OUTFALL S04

Paramater Group	*Analyte*	*Units*	*First Flush Grab*	*Flow-weighted Composite*
			07/25/16	*07/25/16*
Group A Parameters	BOD_5	mg/L	4.7	2.1
	Oil & Grease[a]	mg/L	< 1.6	NR
	pH	SU	7.8	NR
	Phosphorous, Total	mg/L	0.19	0.12
	Solids, Total Dissolved	mg/L	610	560
	Solids, Total Suspended	mg/L	120	82
Group B Parameters	Aluminum, Total	mg/L	3.8	3.6
	Copper, Total Recoverable	mg/L	0.016	0.011
	Iron, Total	mg/L	5.2	4.1
	Lead, Total Recoverable	mg/L	0.0062	0.0038
	Zinc, Total Recoverable	mg/L	0.076	0.043
Group C Parameters	Ammonia (as NH_3)	mg/L	0.022	< 0.0090
	Cadmium, Total Recoverable	mg/L	< 0.000071	< 0.000071
	Chromium, Hexavalent, Total Recoverable	mg/L	0.022 R	0.023 R
	Chromium, Total Recoverable	mg/L	0.0052	0.0037
	Nitrogen, Nitrate (as N)	mg/L	0.43	0.29
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 1.3	< 0.88
	Nitrogen, Total Kjeldahl	mg/L	0.81	0.57
	Selenium, Total Recoverable	mg/L	< 0.00044	< 0.00044
	Vanadium, Total Recoverable	mg/L	0.0047	0.0025
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.23	
Flow	Total Flow During Sampling Event	gallons	140,000	
	Maximum Flow Rate During Sampling Event	gpm	2,200	

gpm - gallons per minute.
NR - Not required by permit.
R - Samples were flagged as unreliable during the data validation process.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3B
2016 Storm Water Discharge Monitoring Data for Outfall Group 2

STORM WATER OUTFALL S06

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			10/20/16	***10/20/16***
Group A Parameters	BOD_5	mg/L	10 R	4.8 R
	Oil & Grease[a]	mg/L	< 1.1	NR
	pH	SU	7.5	NR
	Phosphorous, Total	mg/L	0.089	0.15
	Solids, Total Dissolved	mg/L	570	300
	Solids, Total Suspended	mg/L	7.2	39
Group B Parameters	Aluminum, Total	mg/L	< 0.068	0.49
	Copper, Total Recoverable	mg/L	0.00063	0.0037
	Iron, Total	mg/L	1.1	2.2
	Lead, Total Recoverable	mg/L	< 0.00050	0.0011
	Zinc, Total Recoverable	mg/L	0.0068	0.023
Group C Parameters	Surfactant (as LAS)	mg/L	< 0.0043	0.0097
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.74	
Flow	Total Flow During Sampling Event	gallons	43,000	
	Maximum Flow Rate During Sampling Event	gpm	360	

gpm - gallons per minute.
NR - Not required by permit.
R - Samples were flagged as unreliable during the data validation process.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

NOTE: This oufall was scheduled to be sampled during the first semiannual period, (January to June), but was delayed due to unusually low precipitation rates and storm events that occurred during the weekends or at night.

TABLE B-3B *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 2

STORM WATER OUTFALL S33

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			07/25/16	***07/25/16***
Group A Parameters	BOD_5	mg/L	3.9	4.0
	Oil & Grease[a]	mg/L	< 1.5	NR
	pH	SU	7.3	NR
	Phosphorous, Total	mg/L	0.88	0.31
	Solids, Total Dissolved	mg/L	190	580
	Solids, Total Suspended	mg/L	730	150
Group B Parameters	Aluminum, Total	mg/L	8.4	4.5
	Copper, Total Recoverable	mg/L	0.021	0.0086
	Iron, Total	mg/L	15	7.2
	Lead, Total Recoverable	mg/L	0.037	0.0076
	Zinc, Total Recoverable	mg/L	0.12	0.062
Group C Parameters	Surfactant (as LAS)	mg/L	0.031	0.036
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.86	
Flow	Total Flow During Sampling Event	gallons	24,000	
	Maximum Flow Rate During Sampling Event	gpm	800	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3C
2016 Storm Water Discharge Monitoring Data for Outfall Group 3

STORM WATER OUTFALL S09

Paramater Group	Analyte	Units	First Flush Grab	Flow-weighted Composite
			06/02/16	06/02/16
Group A Parameters	BOD_5	mg/L	> 21	> 21
	Oil & Grease[a]	mg/L	2.0	NR
	pH	SU	8.0	NR
	Phosphorous, Total	mg/L	1.0	0.96
	Solids, Total Dissolved	mg/L	402	255
	Solids, Total Suspended	mg/L	811	606
Group B Parameters	Aluminum, Total	mg/L	9.1	9.7
	Copper, Total Recoverable	mg/L	0.032	0.039
	Iron, Total	mg/L	13	13
	Lead, Total Recoverable	mg/L	0.017	0.019
	Zinc, Total Recoverable	mg/L	0.26	0.33
Group C Parameters	Alpha BHC	mg/L	< 0.000013	< 0.000013
	Ammonia (as NH_3)	mg/L	0.40	0.33
	Mercury, Total[b] (1631E)	ng/L	11.3	NR
	Nitrogen, Nitrate (as N)	mg/L	0.77	0.90
	Nitrogen, Nitrite (as N)	mg/L	0.048	0.036
	Nitrogen, Total (as N)	mg/L	5.0	4.0
	Nitrogen, Total Kjeldahl	mg/L	4.2	3.1
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.1	
	Rainfall During Sampling Event	inches	0.20	
Flow	Total Flow During Sampling Event	gallons	320,000	
	Maximum Flow Rate During Sampling Event	gpm	7,600	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.
[b] The SPDES permit requires that Group 3 outfall grab samples be analyzed for mercury as part of the Mercury Minimization Program.

TABLE B-3C *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 3

STORM WATER OUTFALL S12

Paramater Group	*Analyte*	*Units*	*First Flush Grab*	*Flow-weighted Composite*
			10/20/16	*10/20/16*
Group A Parameters	BOD_5	mg/L	4.8	2.0
	Oil & Grease[a]	mg/L	< 1.4	NR
	pH	SU	7.3	NR
	Phosphorous, Total	mg/L	0.54	0.20
	Solids, Total Dissolved	mg/L	190	150
	Solids, Total Suspended	mg/L	140	120
Group B Parameters	Aluminum, Total	mg/L	5.3	2.8
	Copper, Total Recoverable	mg/L	0.011	0.0058
	Iron, Total	mg/L	7.4	3.1
	Lead, Total Recoverable	mg/L	0.0064	0.0050
	Zinc, Total Recoverable	mg/L	0.057	0.033
Group C Parameters	Alpha BHC	mg/L	<0.0000064	< 0.0000065
	Ammonia (as NH_3)	mg/L	0.019	0.012
	Mercury, Total[b] (1631E)	ng/L	6.0	NR
	Nitrogen, Nitrate (as N)	mg/L	0.20	0.12
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 1.2	< 0.65
	Nitrogen, Total Kjeldahl	mg/L	0.99	0.51
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.74	
Flow	Total Flow During Sampling Event	gallons	180,000	
	Maximum Flow Rate During Sampling Event	gpm	1,700	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.
[b] The SPDES permit requires that Group 3 outfall grab samples be analyzed for mercury as part of the Mercury Minimization Program.

TABLE B-3D
2016 Storm Water Discharge Monitoring Data for Outfall Group 4

STORM WATER OUTFALL S34 / DUPLICATE

Paramater Group	*Analyte*	*Units*	*First Flush Grab*	*Flow-weighted Composite*
			06/02/16	*06/02/16*
Group A Parameters	BOD_5	mg/L	< 2.0 / < 2.0	3.2
	Oil & Grease[a]	mg/L	< 1.4/ < 1.4	NR
	pH	SU	7.7	NR
	Phosphorous, Total	mg/L	0.045 / 0.017	0.026
	Solids, Total Dissolved	mg/L	473 / 465	474
	Solids, Total Suspended	mg/L	26 / 26	45
Group B Parameters	Aluminum, Total	mg/L	0.55 / 0.78	1.3
	Copper, Total Recoverable	mg/L	0.0026 / 0.0026	0.0047
	Iron, Total	mg/L	1.1 / 1.4	1.4
	Lead, Total Recoverable	mg/L	0.0011 / 0.00091	0.0017
	Zinc, Total Recoverable	mg/L	0.023 / 0.022	0.034
Group C Parameters	Surfactant (as LAS)	mg/L	<0.0043/<0.0043	0.0094
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.1	
	Rainfall During Sampling Event	inches	0.20	
Flow	Total Flow During Sampling Event	gallons	300,000	
	Maximum Flow Rate During Sampling Event	gpm	7,600	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

NOTE: The first flush grab samples were collected and analyzed in duplicate.

TABLE B-3D *(concluded)*

2016 Storm Water Discharge Monitoring Data for Outfall Group 4

STORM WATER OUTFALL S34

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			07/25/16	***07/25/16***
Group A Parameters	BOD_5	mg/L	3.2	3.9
	Oil & Grease[a]	mg/L	< 1.5	NR
	pH	SU	7.5	NR
	Phosphorous, Total	mg/L	0.24	0.45
	Solids, Total Dissolved	mg/L	510	420
	Solids, Total Suspended	mg/L	110	220
Group B Parameters	Aluminum, Total	mg/L	3.6	6.2
	Copper, Total Recoverable	mg/L	0.0081	0.017
	Iron, Total	mg/L	5.4	9.1
	Lead, Total Recoverable	mg/L	0.0040	0.0091
	Zinc, Total Recoverable	mg/L	0.068	0.13
Group C Parameters	Surfactant (as LAS)	mg/L	0.087	0.093
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.23	
Flow	Total Flow During Sampling Event	gallons	320,000	
	Maximum Flow Rate During Sampling Event	gpm	7,600	

gpm - gallons per minute.

NR - Not required by permit.

[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3E
2016 Storm Water Discharge Monitoring Data for Outfall Group 5

STORM WATER OUTFALL S14

Paramater Group	*Analyte*	*Units*	*First Flush Grab*	*Flow-weighted Composite*
			10/20/16	*10/20/16*
Group A Parameters	BOD_5	mg/L	2.8	< 2.0
	Oil & Grease[a]	mg/L	< 1.4	NR
	pH	SU	7.1	NR
	Phosphorous, Total	mg/L	0.13	0.079
	Solids, Total Dissolved	mg/L	470	550
	Solids, Total Suspended	mg/L	17	6.0
Group B Parameters	Aluminum, Total	mg/L	0.18	0.12
	Copper, Total Recoverable	mg/L	0.0014	0.0014
	Iron, Total	mg/L	2.5	0.85
	Lead, Total Recoverable	mg/L	0.00050	0.00032
	Zinc, Total Recoverable	mg/L	0.0035	< 0.0026
Group C Parameters	Ammonia (as NH_3)	mg/L	0.013	0.013
	Nitrogen, Nitrate (as N)	mg/L	0.12	0.16
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 1.1	< 1.0
	Nitrogen, Total Kjeldahl	mg/L	1.0	0.83
	Settleable Solids	ml/L	0.2	< 0.1
	Sulfide	mg/L	< 0.050	< 0.050
	Surfactant (as LAS)	mg/L	0.030	0.015
	Vanadium, Total Recoverable	mg/L	< 0.0012	< 0.0012
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.74	
Flow	Total Flow During Sampling Event	gallons	2,000	
	Maximum Flow Rate During Sampling Event	gpm	18	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

NOTE: This oufall was scheduled to be sampled during the first semiannual period, (January to June), but was delayed due to unusually low precipitation rates and storm events that occurred during the weekends or at night.

TABLE B-3E *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 5

STORM WATER OUTFALL S17 / DUPLICATE

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			10/20/16	***10/20/16***
Group A Parameters	BOD_5	mg/L	3.0 / 3.0	2.3
	Oil & Grease[a]	mg/L	< 1.4 / < 1.4	NR
	pH	SU	8.2 / 8.2	NR
	Phosphorous, Total	mg/L	0.27 / 0.28	0.15
	Solids, Total Dissolved	mg/L	240 / 240	150
	Solids, Total Suspended	mg/L	180 / 93	78
Group B Parameters	Aluminum, Total	mg/L	5.0 / 5.5	3.4
	Copper, Total Recoverable	mg/L	0.0075/0.0070	0.0053
	Iron, Total	mg/L	4.7 / 5.1	2.9
	Lead, Total Recoverable	mg/L	0.022 / 0.019	0.0081
	Zinc, Total Recoverable	mg/L	0.045 / 0.042	0.025
Group C Parameters	Ammonia (as NH_3)	mg/L	0.010 / 0.011	< 0.0090
	Nitrogen, Nitrate (as N)	mg/L	0.12 / 0.11	0.068
	Nitrogen, Nitrite (as N)	mg/L	<0.020/<0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	<0.86/< 0.67	< 0.61
	Nitrogen, Total Kjeldahl	mg/L	0.72 / 0.56	0.52
	Settleable Solids	ml/L	0.4 / 0.5	< 0.1
	Sulfide	mg/L	< 0.050 /< 0.050	< 0.050
	Surfactant (as LAS)	mg/L	<0.013/0.020	0.030
	Vanadium, Total Recoverable	mg/L	0.0034 / 0.0030	0.0022
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.74	
Flow	Total Flow During Sampling Event	gallons	78,000	
	Maximum Flow Rate During Sampling Event	gpm	720	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

NOTE: The first flush grab samples were collected and analyzed in duplicate.

TABLE B-3F
2016 Storm Water Discharge Monitoring Data for Outfall Group 6

STORM WATER OUTFALL S38

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			10/20/16	***10/20/16***
Group A Parameters	BOD_5	mg/L	2.2	< 2.0
	Oil & Grease[a]	mg/L	< 1.4	NR
	pH	SU	7.7	NR
	Phosphorous, Total	mg/L	4.6	1.9
	Solids, Total Dissolved	mg/L	330	410
	Solids, Total Suspended	mg/L	2900	1300
Group B Parameters	Aluminum, Total	mg/L	65	40
	Copper, Total Recoverable	mg/L	0.087	0.048
	Iron, Total	mg/L	95	54
	Lead, Total Recoverable	mg/L	0.046	0.023
	Zinc, Total Recoverable	mg/L	0.28	0.14
Group C Parameters	Ammonia (as NH_3)	mg/L	0.040	0.016
	Nitrogen, Nitrate (as N)	mg/L	0.062	0.053
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 4.3	< 2.3
	Nitrogen, Total Kjeldahl	mg/L	4.2	2.2
	Solids, Settleable	ml/L	7.0	3.0
	Sulfide	mg/L	< 0.050	< 0.050
	Surfactant (as LAS)	mg/L	< 0.013	< 0.013
	Vanadium, Total Recoverable	mg/L	0.059	0.041
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.74	
Flow	Total Flow During Sampling Event	gallons	59,000	
	Maximum Flow Rate During Sampling Event	gpm	650	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

NOTE: Storm water samples collected on October 20 and 27, 2017 from outfall S43 in outfall group 6 were also analyzed for total recoverable lead with results of 0.0050 mg/L and 0.0014 mg/L, respectively. (Action Level = 0.006 mg/L).

NOTE: This oufall was scheduled to be sampled during the first semiannual period, (January to June), but was delayed due to unusually low precipitation rates and storm events that occurred during the weekends or at night.

TABLE B-3F *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 6

STORM WATER OUTFALL S39

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			10/20/16	***10/20/16***
Group A Parameters	BOD_5	mg/L	4.3	< 2.0
	Oil & Grease[a]	mg/L	1.8	NR
	pH	SU	7.3	NR
	Phosphorous, Total	mg/L	6.3	2.9
	Solids, Total Dissolved	mg/L	360	290
	Solids, Total Suspended	mg/L	4200	1600
Group B Parameters	Aluminum, Total	mg/L	74	40
	Copper, Total Recoverable	mg/L	0.12	0.053
	Iron, Total	mg/L	110	59
	Lead, Total Recoverable	mg/L	0.067	0.027
	Zinc, Total Recoverable	mg/L	0.40	0.17
Group C Parameters	Ammonia (as NH_3)	mg/L	0.059	0.042
	Nitrogen, Nitrate (as N)	mg/L	0.067	0.021
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 5.5	< 2.7
	Nitrogen, Total Kjeldahl	mg/L	5.4	2.7
	Solids, Settleable	ml/L	1.5	0.5
	Sulfide	mg/L	< 0.050	< 0.050
	Surfactant (as LAS)	mg/L	< 0.13	< 0.013
	Vanadium, Total Recoverable	mg/L	0.082	0.038
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.73	
Flow	Total Flow During Sampling Event	gallons	41,000	
	Maximum Flow Rate During Sampling Event	gpm	370	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3G
2016 Storm Water Discharge Monitoring Data for Outfall Group 7

STORM WATER OUTFALL S20

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			06/02/16	***06/02/16***
Group A Parameters	BOD_5	mg/L	> 21	5.3
	Oil & Grease[a]	mg/L	< 1.5	NR
	pH	SU	7.7	NR
	Phosphorous, Total	mg/L	0.21	0.043
	Solids, Total Dissolved	mg/L	40	35
	Solids, Total Suspended	mg/L	57	13
Group B Parameters	Aluminum, Total	mg/L	2.0	0.59
	Copper, Total Recoverable	mg/L	0.0043	0.0019
	Iron, Total	mg/L	2.5	0.68
	Lead, Total Recoverable	mg/L	0.0019	0.00075
	Zinc, Total Recoverable	mg/L	0.021	0.0077
Group C Parameters	Ammonia (as NH_3)	mg/L	0.62	0.26
	Nitrogen, Nitrate (as N)	mg/L	1.9	0.68
	Nitrogen, Nitrite (as N)	mg/L	0.034	0.032
	Nitrogen, Total (as N)	mg/L	3.8	1.6
	Nitrogen, Total Kjeldahl	mg/L	1.9	0.84
	Sulfide	mg/L	<0.052	< 0.052
	Surfactant (as LAS)	mg/L	< 0.0043	0.0043
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.1	
	Rainfall During Sampling Event	inches	0.20	
Flow	Total Flow During Sampling Event	gallons	64,000	
	Maximum Flow Rate During Sampling Event	gpm	640	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3G *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 7

STORM WATER OUTFALL S20

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			08/31/16	***08/31/16***
Group A Parameters	BOD_5	mg/L	7.1	3.2
	Oil & Grease[a]	mg/L	2.2	NR
	pH	SU	7.3	NR
	Phosphorous, Total	mg/L	0.19	0.11
	Solids, Total Dissolved	mg/L	87	65
	Solids, Total Suspended	mg/L	81	42
Group B Parameters	Aluminum, Total	mg/L	2.8	2.3
	Copper, Total Recoverable	mg/L	0.0027	0.0034
	Iron, Total	mg/L	2.9	2.3
	Lead, Total Recoverable	mg/L	0.0013	0.0010
	Zinc, Total Recoverable	mg/L	0.012	0.011
Group C Parameters	Ammonia (as NH_3)	mg/L	0.30	0.15
	Nitrogen, Nitrate (as N)	mg/L	1.9	1.1
	Nitrogen, Nitrite (as N)	mg/L	0.055	0.046
	Nitrogen, Total (as N)	mg/L	3.5	1.9
	Nitrogen, Total Kjeldahl	mg/L	1.5	0.71
	Sulfide	mg/L	< 0.052	< 0.052
	Surfactant (as LAS)	mg/L	0.033	0.040
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	8.3	
	Rainfall During Sampling Event	inches	0.08	
Flow	Total Flow During Sampling Event	gallons	29,000	
	Maximum Flow Rate During Sampling Event	gpm	360	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

TABLE B-3H
2016 Storm Water Discharge Monitoring Data for Outfall Group 8

STORM WATER OUTFALL S27

Paramater Group	Analyte	Units	First Flush Grab	Flow-weighted Composite
			07/25/16	07/25/16
Group A Parameters	BOD_5	mg/L	2.6	2.4
	Oil & Grease[a]	mg/L	< 1.5	NR
	pH	SU	7.7	NR
	Phosphorous, Total	mg/L	1.1	1.2
	Solids, Total Dissolved	mg/L	160	340
	Solids, Total Suspended	mg/L	460	190
Group B Parameters	Aluminum, Total	mg/L	15	11
	Copper, Total Recoverable	mg/L	0.036	0.014
	Iron, Total	mg/L	17	8.2
	Lead, Total Recoverable	mg/L	0.039	0.011
	Zinc, Total Recoverable	mg/L	0.17	0.051
Group C Parameters	Ammonia (as NH_3)	mg/L	0.086	0.038
	Nitrogen, Nitrate (as N)	mg/L	0.54	0.20
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 2.5	< 1.3
	Nitrogen, Total Kjeldahl	mg/L	1.9	1.1
	Surfactant (as LAS)	mg/L	< 0.013	0.014
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.86	
Flow	Total Flow During Sampling Event	gallons	1,900	
	Maximum Flow Rate During Sampling Event	gpm	37	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

NOTE: This oufall was scheduled to be sampled during the first semiannual period, (January to June), but was delayed due to unusually low precipitation rates and storm events that occurred during the weekends or at night.

TABLE B-3H *(concluded)*
2016 Storm Water Discharge Monitoring Data for Outfall Group 8

STORM WATER OUTFALL S35

Paramater Group	***Analyte***	***Units***	***First Flush Grab***	***Flow-weighted Composite***
			07/25/16	***07/25/16***
Group A Parameters	BOD_5	mg/L	2.7	< 2.0
	Oil & Grease[a]	mg/L	1.4	NR
	pH	SU	8.1	NR
	Phosphorous, Total	mg/L	11	0.30
	Solids, Total Dissolved	mg/L	130	180
	Solids, Total Suspended	mg/L	2400	320
Group B Parameters	Aluminum, Total	mg/L	21	9.9
	Copper, Total Recoverable	mg/L	0.049	0.014
	Iron, Total	mg/L	32	11
	Lead, Total Recoverable	mg/L	0.068	0.013
	Zinc, Total Recoverable	mg/L	0.30	0.15
Group C Parameters	Ammonia (as NH_3)	mg/L	0.12	0.049
	Nitrogen, Nitrate (as N)	mg/L	0.55	0.58
	Nitrogen, Nitrite (as N)	mg/L	< 0.020	< 0.020
	Nitrogen, Total (as N)	mg/L	< 4.0	< 1.6
	Nitrogen, Total Kjeldahl	mg/L	3.4	1.0
	Surfactant (as LAS)	mg/L	< 0.013	< 0.013
Rain Event Summary				
Rainfall	pH of Rainfall During Sampling Event	SU	7.6	
	Rainfall During Sampling Event	inches	0.86	
Flow	Total Flow During Sampling Event	gallons	9,500	
	Maximum Flow Rate During Sampling Event	gpm	75	

gpm - gallons per minute.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

APPENDIX B-4

Surface Water Data

TABLE B-4A

Comparison of 2016 Radioactivity Concentrations in Surface Water at the Northeast Swamp (WNSWAMP) With U.S. DOE-Derived Concentration Standards (DCSs)

Isotope [a]	N	Discharge Activity [b] (Ci)	Discharge Activity [b] (Becquerels) [c]	Average Concentration (µCi/mL)	DCS [d] (µCi/mL)	Ratio of Average Concentration to DCS
Gross Alpha	26	-5.31±6.32E-05	-1.96±2.34E+06	-7.32±8.71E-10	NA[e]	NA
Gross Beta	26	1.68±0.01E-01	6.21±0.02E+09	2.32±0.01E-06	NA[e]	NA
Tritium	26	1.42±2.54E-03	5.27±9.41E+07	1.96±3.51E-08	1.9E-03	< 0.0001
C-14	2	-1.41±1.29E-03	-5.23±4.77E+07	-1.95±1.78E-08	6.2E-05	< 0.0003
Sr-90	12	6.88±0.07E-02	2.55±0.02E+09	9.48±0.09E-07	1.1E-06	0.86
I-129	2	0.82±5.63E-05	0.30±2.08E+06	1.12±7.76E-10	3.3E-07	< 0.0024
Cs-137	12	-8.53±8.92E-05	-3.16±3.30E+06	-1.18±1.23E-09	3.0E-06	< 0.0004
U-232[f]	2	-0.41±2.41E-06	-1.51±8.91E+04	-0.56±3.32E-11	9.8E-08	< 0.0003
U-233/234[f]	2	1.34±0.67E-05	4.98±2.46E+05	1.85±0.92E-10	6.6E-07[g]	0.0003
U-235/236[f]	2	4.21±4.19E-06	1.56±1.55E+05	5.80±5.78E-11	7.2E-07	0.0001
U-238[f]	2	1.01±0.65E-05	3.75±2.39E+05	1.40±0.89E-10	7.5E-07	0.0002
Pu-238	2	0.77±1.99E-06	2.86±7.35E+04	1.07±2.74E-11	1.5E-07	< 0.0002
Pu-239/240	2	1.03±2.18E-06	3.82±8.08E+04	1.42±3.01E-11	1.4E-07	< 0.0002
Am-241	2	0.57±2.47E-06	2.12±9.15E+04	0.79±3.41E-11	1.7E-07	< 0.0002
Sum of Ratios						**0.87**

Notes: Average concentrations represent sample composite concentrations weighted to monthly stream flow.
The average pH at this location was 7.4 Standard Units (SU).

N - Number of samples.

NA - Not applicable.

[a] Half-lives are listed in Table UI-4.

[b] Total estimated volume released: 7.26E+10 mL (1.92+07 gal).

[c] 1 Ci = 3.7E+10 Bq: 1Bq = 2.7E-11 Ci.

[d] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.

[e] DCSs do not exist for indicator parameters gross alpha and gross beta.

[f] Total Uranium (g) = 2.69±0.14E+01 ; Average Total Uranium (µg/mL) = 3.70±0.19E-04.

[g] The DCS for Uranium-233 is used for this comparison.

TABLE B-4B
Comparison of 2016 Radioactivity Concentrations in Surface Water at the North Swamp (WNSW74A) With U.S. DOE-Derived Concentration Standards (DCSs)

Isotope [a]	*N*	*Discharge Activity* [b]		*Average Concentration*	*DCS* [d]	*Ratio of Average Concentration to DCS*
		(Ci)	*(Becquerels)* [c]	*(µCi/mL)*	*(µCi/mL)*	
Gross Alpha	26	-3.17±3.35E-05	-1.17±1.24E+06	-6.78±7.15E-10	NA[e]	NA
Gross Beta	26	4.96±0.30E-04	1.83±0.11E+07	1.06±0.06E-08	NA[e]	NA
Tritium	26	1.38±1.29E-03	5.12±4.78E+07	2.95±2.76E-08	1.9E-03	< 0.0001
C-14	2	-4.01±8.45E-04	-1.48±3.13E+07	-0.86±1.81E-08	6.2E-05	< 0.0003
Sr-90	12	1.49±0.16E-04	5.52±0.59E+06	3.19±0.34E-09	1.1E-06	0.0029
I-129	2	0.17±1.22E-05	0.64±4.50E+05	0.37±2.60E-10	3.3E-07	< 0.0008
Cs-137	12	0.54±4.20E-05	0.20±1.55E+06	1.16±8.97E-10	3.0E-06	< 0.0003
U-232[f]	2	-1.35±8.87E-07	-0.50±3.28E+04	-0.29±1.89E-11	9.8E-08	< 0.0002
U-233/234[f]	2	4.66±1.74E-06	1.72±0.64E+05	9.96±3.72E-11	6.6E-07[g]	0.0002
U-235/236[f]	2	1.23±1.04E-06	4.56±3.85E+04	2.63±2.22E-11	7.2E-07	0.0001
U-238[f]	2	4.84±1.84E-06	1.79±0.68E+05	1.03±0.39E-10	7.5E-07	0.0001
Pu-238	2	0.59±1.05E-06	2.18±3.89E+04	1.26±2.24E-11	1.5E-07	< 0.0001
Pu-239/240	2	0.87±1.16E-06	3.20±4.31E+04	1.85±2.49E-11	1.4E-07	< 0.0002
Am-241	2	-1.97±5.11E-07	-0.73±1.89E+04	-0.42±1.09E-11	1.7E-07	< 0.0001
Sum of Ratios						< **0.0052**

Notes: Average concentrations represent sample composite concentrations weighted to monthly stream flow.
The average pH at this location was 7.6 Standard Units (SU).

N - Number of samples.

NA - Not applicable.

[a] Half-lives are listed in Table UI-4.

[b] Total estimated volume released: 4.68E+10 mL (1.24+07 gal).

[c] 1 Ci = 3.7E+10 Bq: 1Bq = 2.7E-11 Ci.

[d] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.

[e] DCSs do not exist for indicator parameters gross alpha and gross beta.

[f] Total Uranium (g) = 1.16±0.06E+01 ; Average Total Uranium (µg/mL) = 2.49±0.12E-04.

[g] The DCS for Uranium-233 is used for this comparison.

TABLE B-4C
2016 Radioactivity and pH in Surface Water at Facility Yard Drainage (WNSP005)

Analyte	*Units*	*N*	*WNSP005 Concentrations*			*Guideline [a] or Standard [b]*
			Minimum	*Average*	*Maximum*	
Gross Alpha	µCi/mL	4	< 1.28E-09	0.58±2.53E-09	< 3.06E-09	9.8E-08[c]
Gross Beta	µCi/mL	4	1.21E-07	6.78±0.08E-07	1.16E-06	1.1E-06[d]
Tritium	µCi/mL	4	< 8.19E-08	-1.79±9.55E-08	< 1.04E-07	1.9E-03
Sr-90	µCi/mL	2	1.59E-07	2.86±0.09E-07	4.13E-07	1.1E-06
Cs-137	µCi/mL	2	< 2.58E-09	0.88±2.81E-09	< 3.02E-09	3.0E-06
pH	SU	4	Range: 7.4-7.8			6.0–9.5

N - Number of samples.
[a] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[b] New York State Water Quality Standards for Class "D" as a comparative reference for non-radiological results.
[c] Alpha as U-232.
[d] Beta as Sr-90.

TABLE B-4D
2016 Radioactivity of Surface Water Downstream of the WVDP at Franks Creek (WNSP006)

Analyte	*Units*	*N*	*WNSP006 Concentrations*		*N*	*Reference Values*	
			Average	*Maximum*		*WFBCBKG [a] Background Range*	*Guideline [b]*
Gross Alpha	µCi/mL	26	0.43±1.32E-09	4.46E-09	12	< 3.90E-10 - < 1.46E-09	9.8E-08[c]
Gross Beta	µCi/mL	26	4.39±0.18E-08	1.28E-07	12	9.79E-10 - 3.71E-09	1.1E-06[d]
Tritium	µCi/mL	26	5.37±9.52E-08	1.56E-07	12	< 7.10E-08 - 1.41E-07	1.9E-03
C-14	µCi/mL	4	-0.87±2.61E-08	< 2.82E-08	2	< 2.40E-08 - < 2.80E-08	6.2E-05
Sr-90	µCi/mL	12	1.96±0.22E-08	4.43E-08	2	< 7.68E-10 - 9.99E-10	1.1E-06
Tc-99	µCi/mL	4	0.00±2.16E-09	< 2.63E-09	2	< 1.42E-09 - < 1.85E-09	4.4E-05
I-129	µCi/mL	4	-0.05±5.12E-10	< 6.01E-10	2	< 4.52E-10 - < 5.49E-10	3.3E-07
Cs-137	µCi/mL	12	1.67±2.90E-09	5.59E-09	2	< 2.32E-09 - < 2.75E-09	3.0E-06
U-232	µCi/mL	4	1.15±0.67E-10	2.92E-10	2	< 2.56E-11 - < 2.83E-11	9.8E-08
U-233/234	µCi/mL	4	2.76±0.93E-10	4.22E-10	2	1.20E-10 - 2.02E-10	6.6E-07[e]
U-235/236	µCi/mL	4	7.69±5.76E-11	1.16E-10	2	< 4.10E-11 - 5.25E-11	7.2E-07
U-238	µCi/mL	4	2.29±0.89E-10	3.19E-10	2	< 5.45E-11 - 8.00E-11	7.5E-07
Total U	µg/mL	4	7.06±0.34E-04	8.99E-04	2	1.74E-04 - 2.42E-04	--
Pu-238	µCi/mL	4	-0.94±2.89E-11	< 4.13E-11	2	< 1.82E-11 - < 2.28E-11	1.5E-07
Pu-239/240	µCi/mL	4	1.71±3.31E-11	3.47E-11	2	< 2.28E-11 - < 4.01E-11	1.4E-07
Am-241	µCi/mL	4	1.50±3.79E-11	< 5.59E-11	2	< 2.24E-11 - < 2.68E-11	1.7E-07

N - Number of samples.
-- No Guideline or standard available for these analytes.
[a] Background location.
[b] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[c] Alpha as U-232.
[d] Beta as Sr-90.
[e] DCS for U-233 is used for this comparison.

TABLE B-4E
2016 Radioactivity in Surface Water Drainage Between the NDA and SDA (WNNDADR)

Analyte	Units	N	WNNDADR Concentrations			Guideline [a]
			Minimum	Average	Maximum	
Gross Alpha	µCi/mL	12	< 5.30E-10	0.65±1.01E-09	1.89E-09	9.8E-08[b]
Gross Beta	µCi/mL	12	1.85E-08	2.68±0.14E-08	3.72E-08	1.1E-06[c]
Tritium	µCi/mL	12	1.27E-07	3.97±1.26E-07	5.46E-07	1.9E-03
Sr-90	µCi/mL	2	1.09E-08	1.22±0.19E-08	1.35E-08	1.1E-06
I-129	µCi/mL	2	2.95E-10	0.82±3.89E-10	2.95E-10	3.3E-07
Cs-137	µCi/mL	12	< 1.47E-09	0.51±2.96E-09	< 4.03E-09	3.0E-06

N - Number of samples.
[a] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[b] Alpha as U-232.
[c] Beta as Sr-90.

TABLE B-4F
2016 Radioactivity and pH in Surface Water at Erdman Brook (WNERB53)

Analyte	Units	N	WNERB53 Concentrations		N	Reference Values	
						WFBCBKG [a] Background Range	Guideline [b] or Standard [c]
			Average	Maximum			
Gross Alpha	µCi/mL	4	-0.12±1.63E-09	< 1.96E-09	12	< 3.90E-10 - < 1.46E-09	9.8E-08[d]
Gross Beta	µCi/mL	4	7.02±1.28E-09	7.92E-09	12	9.79E-10 - 3.71E-09	1.1E-06[e]
Tritium	µCi/mL	4	3.12±9.96E-08	< 1.05E-07	12	< 7.10E-08 - 1.41E-07	1.9E-03
Sr-90	µCi/mL	2	1.81±1.20E-09	4.11E-09	2	< 7.68E-10 - 9.99E-10	1.1E-06
Cs-137	µCi/mL	2	-0.31±2.89E-09	< 3.21E-09	2	< 2.32E-09 - < 2.75E-09	3.0E-06
pH	SU	4	Range: 7.1-8.1		292	6.4–8.7	6.0–9.5

N - Number of samples.
[a] Background data are from Buttermilk Creek, upstream of the WVDP. Sampling for nonradiological data was discontinued. at this location in 2008. The pH range was calculated from the most recent 10 years of sampling, 1998–2007.
[b] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[c] New York State Water Quality Standards for surface waters Class "D" as a standard for non-radiological results.
[d] Alpha as U-232.
[e] Beta as Sr-90.

TABLE B-4G
2016 Radioactivity and pH in Surface Water at Franks Creek (WNFRC67)

Analyte	Units	N	WNFRC67 Concentrations		N	Reference Values	
			Average	Maximum		WFBCBKG[a] Background Range	Guideline[b] or Standard[c]
Gross Alpha	µCi/mL	4	-6.37±7.81E-10	< 8.86E-10	12	< 3.90E-10 - < 1.46E-09	9.8E-08[d]
Gross Beta	µCi/mL	4	2.00±0.70E-09	5.47E-09	12	9.79E-10 - 3.71E-09	1.1E-06[e]
Tritium	µCi/mL	4	6.70±9.97E-08	< 1.10E-07	12	< 7.10E-08 - 1.41E-07	1.9E-03
Sr-90	µCi/mL	2	1.90±7.14E-10	< 7.65E-10	2	< 7.68E-10 - 9.99E-10	1.1E-06
Cs-137	µCi/mL	2	1.15±2.96E-09	< 3.25E-09	2	< 2.32E-09 - < 2.75E-09	3.0E-06
pH	SU	4	Range: 6.9-8.1		292	6.4–8.7	6.0–9.5

N - Number of samples.
[a] Background data are from Buttermilk Creek, upstream of the WVDP. Sampling for nonradiological data was discontinued. at this location in 2008. The pH range was calculated from the most recent 10 years of sampling, 1998–2007.
[b] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[c] New York State Water Quality Standards for Class "D" surface waters as a standard for non-radiological results.
[d] Alpha as U-232.
[e] Beta as Sr-90.

TABLE B-4H
2016 Water Quality of Surface Water Downstream of the WVDP in Buttermilk Creek at Thomas Corners Bridge (WFBCTCB)

Analyte	Units	N	WFBCTCB Concentrations		N	Reference Values	
			Average	Maximum		WFBCBKG[a] Background Range	Guideline[b]
Gross Alpha	µCi/mL	12	3.05±9.88E-10	2.75E-09	12	< 3.90E-10 - < 1.46E-09	9.8E-08[c]
Gross Beta	µCi/mL	12	6.38±0.92E-09	7.79E-09	12	9.79E-10 - 3.71E-09	1.1E-06[d]
Tritium	µCi/mL	12	3.23±9.29E-08	1.20E-07	12	< 7.10E-08 - 1.41E-07	1.9E-03
Sr-90	µCi/mL	2	0.84±1.06E-09	< 1.08E-09	2	< 7.68E-10 - 9.99E-10	1.1E-06
Cs-137	µCi/mL	2	0.18±2.75E-09	< 2.81E-09	2	< 2.32E-09 - < 2.75E-09	3.0E-06

N - Number of samples.
[a] Background location.
[b] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[c] Alpha as U-232.
[d] Beta as Sr-90.

TABLE B-4I
2016 Radioactivity and pH in Surface Water Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)

Analyte	Units	N	WFFELBR Concentrations [a] Average	WFFELBR Concentrations [a] Maximum	N	Reference Values: WFBIGBR Background Range	Reference Values: Guideline [b] or Standard [c]
Gross Alpha	µCi/mL	12	0.29±1.00E-09	2.00E-09	98	<3.59E-10–4.62E-09	9.8E-08[d]
Gross Beta	µCi/mL	12	3.07±0.81E-09	5.33E-09	98	<9.03E-10–1.37E-08	1.1E-06[e]
Tritium	µCi/mL	12	2.56±9.15E-08	1.10E-07	98	<4.46E-08–2.65E-07	1.9E-03
Sr-90	µCi/mL	12	2.32±9.73E-10	1.62E-09	98	<3.57E-10–1.10E-08	1.1E-06
Cs-137	µCi/mL	12	0.73±3.04E-09	4.57E-09	98	<1.34E-09–5.29E-09	3.0E-06
pH	SU	26	7.2-8.2		98	5.8–8.3	6.5–8.5

Note: Historical background data are from Bigelow Bridge, on Cattaraugus Creek upstream of WFFELBR. Sampling at WFBIGBR was discontinued in 2008. Range was calculated from the most recent 10 years of sampling, 1998-2007.
N - Number of samples.
[a] Except for pH, values represent composite concentrations weighted to monthly stream flow.
[b] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[c] New York Water Quality Standards for Class "B" as a comparative reference for non-radiological results.
[d] Alpha as U-232.
[e] Beta as Sr-90.

TABLE B-4J
Historical Radioactivity and pH in Surface Water at Bigelow Bridge Cattaraugus Creek Background (WFBIGBR)

Analyte	Units	N	WFBIGBR Concentrations Average	WFBIGBR Concentrations Maximum	Reference Values Guideline [a] or Standard [b]
Gross Alpha	µCi/mL	98	0.45±1.05E-09	4.62E-09	9.8E-08[c]
Gross Beta	µCi/mL	98	2.64±1.35E-09	1.37E-08	1.1E-06[d]
Tritium	µCi/mL	98	0.71±7.79E-08	2.65E-07	1.9E-03
Sr-90	µCi/mL	98	1.27±1.46E-09	1.10E-08	1.1E-06
Cs-137	µCi/mL	98	0.59±3.27E-09	5.29E-09	3.0E-06
pH	SU	98	Range: 5.8–8.3		6.5–8.5

Note: Historical background data are from Bigelow Bridge, on Cattaraugus Creek upstream of WFFELBR. Sampling at WFBIGBR was discontinued in 2008. Range was calculated from the most recent 10 years of sampling, 1998-2007.
N - Number of samples.
[a] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[b] The New York Water Quality Standard for Class "B" is provided as a comparative reference for pH
[c] Alpha as U-232.
[d] Beta as Sr-90.

TABLE B-4K
2016 Radioactivity and pH in Surface Water at Fox Valley Road
Buttermilk Creek Background (WFBCBKG)

Analyte	Units	N	WFBCBKG [a] Concentrations Average	WFBCBKG [a] Concentrations Maximum	Reference Values Guideline [b] or Standard [c]
Gross Alpha	µCi/mL	12	-1.17±9.35E-10	< 1.46E-09	9.8E-08[d]
Gross Beta	µCi/mL	12	2.03±0.76E-09	3.71E-09	1.1E-06[e]
Tritium	µCi/mL	12	2.80±9.12E-08	1.41E-07	1.9E-03
C-14	µCi/mL	2	0.38±2.61E-08	< 2.80E-08	6.2E-05
Sr-90	µCi/mL	2	4.30±8.00E-10	9.99E-10	1.1E-06
Tc-99	µCi/mL	2	-0.08±1.65E-09	< 1.85E-09	4.4E-05
I-129	µCi/mL	2	0.45±5.03E-10	< 5.49E-10	3.3E-07
Cs-137	µCi/mL	2	0.06±2.54E-09	< 2.75E-09	3.0E-06
U-232	µCi/mL	2	-0.83±2.70E-11	< 2.83E-11	9.8E-08
U-233/234	µCi/mL	2	1.61±0.85E-10	2.02E-10	6.6E-07[f]
U-235/236	µCi/mL	2	2.49±3.60E-11	5.25E-11	7.2E-07
U-238	µCi/mL	2	5.72±4.59E-11	8.00E-11	7.5E-07
Total U	µg/mL	2	2.08±0.20E-04	2.42E-04	--
Pu-238	µCi/mL	2	-0.44±2.06E-11	< 2.28E-11	1.5E-07
Pu-239/240	µCi/mL	2	1.34±3.26E-11	< 4.01E-11	1.4E-07
Am-241	µCi/mL	2	1.07±2.47E-11	< 2.68E-11	1.7E-07
pH[a]	SU	292	Range: 6.4–8.7		6.0–9.5

N - Number of samples.
-- No Guideline or standard available for these analytes.
[a] Sampling for nonradiological constituents was discontinued in 2008. The pH values represent measurements from the most recent 10 years of sampling, 1998 through 2007.
[b] DOE ingestion-based DCSs for 100 mrem/yr dose limit are provided as a guideline for radiological results.
[c] The New York Water Quality Standard for Class "D" is provided as a comparative reference for pH.
[d] Alpha as U-232.
[e] Beta as Sr-90.
[f] DCS for U-233 used for this comparison.

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APPENDIX B-5

Potable Water (Drinking Water) Data

TABLE B-5A
2016 Water Quality Results in Drinking Water
at Tap Water Locations Inside the MPPB and RHWF

Analyte	Units	N	WNDNKMP [a] (Main Plant)	WNDNKRH (RHWF)	Standard [b]
Gross Alpha	µCi/mL	1	-1.24±0.79E-09	NA	1.5E-08
Gross Beta	µCi/mL	1	3.14±0.76E-09	NA	1.5E-08
Tritium	µCi/mL	1	4.59±6.40E-08	NA	2.0E-05
Disinfection Byproducts					
Haloacetic Acids-Five (5)	mg/L	1	NA	NR[c]	0.060
Total Trihalomethanes	mg/L	1	NA	NR[c]	0.080

N - Number of samples.
NA - Not applicable, constituent not analyzed.
NR - Not required to be sampled in 2016. Will be sampled again in 2018.
[a] Annual sampling for radiological parameters at the MPPB shower continued in 2016 for screening purposes. However, this sampling is not a regulatory requirement under the WVDP drinking water sampling plan.
[b] New York State Department of Health (NYSDOH) MCLs or screening levels for drinking water used as a comparative reference (see Table B-1C).
[c] NYSDOH changed the required sampling frequency for disinfection byproducts in 2016 from annually to once every three years. Disinfection byproducts were last sampled for in August 2015 and will next be sampled for in 2018.

TABLE B-5B
2016 Biological and Chlorine Results in Drinking Water
at Sitewide Tap Water Locations

Analyte	Units	N	Results from Various Site Tap Water Locations	Standard [a]
E. coli[b]	NA	4	0 Positive: 4 Negative	one positive sample
Total Coliform[b]	NA	4	0 Positive: 4 Negative	two or more positive samples
Free Residual Chlorine[b]	mg/L	5	Range: 0.21 - 1.66	greater than 0.2 and less than 4.0

N- Number of samples.
NA - Not applicable.
[a] NYSDOH MCLs for drinking water or EPA MCLGs, whichever is more stringent. Notify health department if exceeded.
[b] Analyzed by Cattaraugus County Health Department (CCHD).

TABLE B-5C
2016 Copper and Lead Results from On-Site Tap Water Locations at the WVDP
(drinking water supplied by groundwater)

Analyte	*Date Collected*	*Units*	*N*	*Range*	*Average*	*90th Percentile* [a]	*Action Level* [a]
Copper, total	6/12/2016	mg/L	10	0.069 - 0.41	0.22	0.33	1.3
Copper, total	12/11/2016	mg/L	10	<0.050 - 0.86	0.30	0.56	1.3
Lead, total	6/12/2016	mg/L	10	<0.0010 - 0.0042	0.0017	0.0023	<0.015
Lead, total	12/11/2016	mg/L	10	<0.0010 - 0.013	0.0025	0.0020	<0.015

N - Number of samples

[a] The 90th percentile calculation is used to evaluate exceedance of the action level.

The ten on-site tap water locations sampled for copper and lead in 2016 included: Guard house (WNDNK06), Parking lot men's room (WNDNK15), 10-plex men's room (WNDNK23), 10-plex kitchenette (WNDNK24), RHWF men's room (WNDNK25), Guard house women's locker room (WNDNK26), Guard house men's locker room - south extension (WNDNK27), Guard house men's locker room - north extension (WNDNK28), RHWF kitchenette (WNDNKRH), and Nurse's office (WNDNURSE).

TABLE B-5D
2016 Metals and Water Quality Results in Treated Potable Water

Analyte	*Units*	*N*	*Average Concentration*	*Standard or Guideline* [a]
Metals [b]				
Sodium, Total[c]	mg/L	1	49	20/270[d]
Water Quality				
Nitrate-N[c]	mg/L	1	<1.0	10
Free Residual Chlorine[e]	mg/L	366	Range: 0.25 - 3.78	0.2 - 4.0

Note: Sample is collected in the utility room at sampling location WNDFIN after chlorination and sequestration, and prior to distribution into the water supply system.

N - Number of samples.
[a] New York State Department of Health (NYSDOH) MCLs for drinking water.
[b] Inorganic chemicals (IOCs) including metals, cyanide and fluoride are analyzed for once every three years. Samples were collected for IOCs in 2015 and will next be sampled for in 2018.
[c] Sodium and Nitrate are analyzed for once every year.
[d] Although there is no designated limit for sodium, recommended limits are provided for people on severely and moderately sodium restricted diets.
[e] Samples of finished water are collected and analyzed for chlorine daily.

TABLE B-5E
2016 Water Quality Results for Organic Parameters in Treated Potable Water

Waivers were received from CCHD such that
Principal Organic Contaminants (POCs) are not required to be sampled again until 2021 and
Specific Organic Contaminants (SOCs) are not required to be sampled again until 2017.

TABLE B-5F
2016 Radiological Indicator Water Quality Results in Raw (Untreated) Potable Water

Location Code	*Date Collected*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Background [a]		*7.61E-09*	*1.56E-08*	*1.78E-07*
Supply Well #1 Pumping				
WNDRAW1	1/14/2016	-0.95±1.60E-09	3.84±0.85E-09	1.05±0.85E-07
WNDRAW1	2/9/2016	1.09±1.51E-09	4.37±1.07E-09	2.07±7.73E-08
WNDRAW1	3/8/2016	1.28±0.75E-09	4.21±0.86E-09	4.73±7.60E-08
WNDRAW1	4/4/2016	-0.48±1.55E-09	4.74±1.03E-09	-7.83±9.31E-08
WNDRAW1	5/5/2016	-0.52±1.78E-09	3.70±1.16E-09	-2.24±7.07E-08
WNDRAW1	6/13/2016	0.27±1.39E-09	4.75±1.24E-09	1.02±1.14E-07
WNDRAW1	7/12/2016	0.00±1.41E-09	1.96±1.05E-09	1.97±9.88E-08
WNDRAW1	8/10/2016	0.00±1.49E-09	2.63±0.70E-09	-6.73±8.45E-08
WNDRAW1	9/7/2016	0.88±1.55E-09	3.70±0.80E-09	-4.38±8.58E-08
WNDRAW1	10/4/2016	1.55±1.44E-09	2.65±0.78E-09	2.12±5.98E-08
WNDRAW1	11/1/2016	0.74±1.04E-09	2.99±0.67E-09	-3.37±9.00E-08
WNDRAW1	12/29/2016	0.81±2.39E-09	3.68±0.73E-09	-4.37±8.97E-08
Supply Well #2 Pumping				
WNDRAW2	1/14/2016	0.42±1.49E-09	4.45±1.30E-09	-0.09±7.58E-08
WNDRAW2	2/9/2016	0.27±2.64E-09	3.10±1.71E-09	-1.96±7.35E-08
WNDRAW2	3/8/2016	-1.37±1.69E-09	5.18±1.57E-09	-1.86±6.82E-08
WNDRAW2	4/4/2016	0.12±1.23E-09	3.92±1.10E-09	2.17±7.22E-08
WNDRAW2	5/5/2016	-0.26±2.36E-09	3.46±1.78E-09	-4.09±6.90E-08
WNDRAW2	6/13/2016	0.88±1.38E-09	4.59±1.26E-09	0.84±1.10E-07
WNDRAW2	7/12/2016	0.07±1.33E-09	2.65±1.14E-09	0.85±9.73E-08
WNDRAW2	8/10/2016	1.73±1.28E-09	2.72±0.70E-09	1.04±0.98E-07
WNDRAW2	9/7/2016	1.35±2.08E-09	4.42±0.96E-09	-2.96±8.64E-08
WNDRAW2	10/4/2016	0.52±1.15E-09	1.74±0.79E-09	4.58±6.14E-08
WNDRAW2	11/1/2016	0.44±1.33E-09	2.69±0.70E-09	3.09±9.49E-08
WNDRAW2	12/29/2016	0.00±1.81E-09	3.82±1.29E-09	-5.43±8.55E-08

[a] Guideline used for screening groundwater supply wells is the background groundwater concentration as shown in Table D-1A, Appendix D, Summary of Groundwater. Potable water has been supplied by two bedrock groundwater wells since the fall of 2014.

TABLE B-5G
2016 RadioisotopIc Results in Raw (Untreated) Potable Water [a]

Location Code	*Date Collected*	*Cesium-137 µCi/mL*	*Iodine-129 µCi/mL*
EPA Standard [b]		*2.00E-07*	*1.00E-09*
Supply Well #1 Pumping			
WNDRAW1	3/8/2016	0.40±2.17E-09	-0.72±7.32E-10
Supply Well #2 Pumping			
WNDRAW2	3/8/2016	-0.58±2.25E-09	-2.56±5.84E-10

[a] Untreated potable water is analyzed for radioisotopes once per year.
[b] Standard used for screening radionulides are from the EPA Safe Drinking Water Act Implemention Guidance for Radionuclides (40 CFR Part 141 Subpart F §141.66).

TABLE B-5H
2016 Radiological Indicator Results from the Source Water Protection Plan Wells

Analyte	*Units*	*N*	*Concentrations*		*Reference Values Guideline [a] or Standard [b]*
			Average	*Maximum*	
WNCT272					
Gross Alpha	µCi/mL	27	0.47±1.06E-10	1.96E-09	7.61E-09
Gross Beta	µCi/mL	27	3.10±0.83E-09	5.66E-09	1.56E-08
Conductivity	µmhos/cm@ 25ºC	27	385	414	NA
pH	SU	27	Range: 6.7-8.2		6.5-8.5
WNEHMKE					
Gross Alpha	µCi/mL	27	0.08±1.25E-09	2.79E-09	7.61E-09
Gross Beta	µCi/mL	27	3.41±0.87E-09	5.40E-09	1.56E-08
Conductivity	µmhos/cm@ 25ºC	27	505	610	NA
pH	SU	27	Range: 6.7-8.0		6.5-8.5
WWCOURT					
Gross Alpha	µCi/mL	27	0.05±1.75E-09	1.64E-09	7.61E-09
Gross Beta	µCi/mL	27	3.46±1.13E-09	5.20E-09	1.56E-08
Conductivity	µmhos/cm@ 25ºC	27	698	1055	NA
pH	SU	27	Range: 6.4-7.9		6.5-8.5

NA - Not applicable.
SU - Standard units.
[a] Guideline used for screening sentinel wells is the background groundwater concentrations as shown in Table D-1A, Appendix D, Summary of Groundwater.
[b] The New York Water Quality Standard for Class "B" is provided as a comparative reference for pH.

APPENDIX C
Summary of Air Monitoring Data

TABLE C-1
Total Radioactivity Released at Main Plant Stack (ANSTACK) in 2016
and Comparison of Discharge Concentrations with U.S. DOE-Derived Concentration Standards (DCSs)

Isotope [a]	*N*	*Total Activity Released* [b] *(Ci)*	*Average Concentration (µCi/mL)*	*Maximum Concentration (µCi/mL)*	*DCS* [c] *(µCi/mL)*	*Ratio of Average Concentration to DCS*
Gross Alpha	26	1.62±0.05E-06	2.19±0.07E-15	2.64E-14	NA[d]	NA
Gross Beta	26	1.07±0.01E-05	1.44±0.02E-14	1.15E-13	NA[d]	NA
H-3	26	7.59±0.61E-04	1.02±0.08E-12	2.26E-12	2.1E-07	<0.0001
Co-60	2	-1.26±3.28E-08	-1.69±4.42E-17	< 7.77E-17	3.6E-10	<0.0001
Sr-90	2	2.55±0.16E-06	3.43±0.22E-15	4.45E-15	1.0E-10	<0.0001
I-129	2	1.07±0.03E-05	1.44±0.05E-14	1.64E-14	1.0E-10	0.0001
Cs-137	2	3.31±0.12E-06	4.46±0.17E-15	4.94E-15	8.8E-10	<0.0001
Eu-154	2	-9.46±9.17E-08	-1.28±1.24E-16	< 2.05E-16	7.5E-11	<0.0001
U-232[e]	2	5.28±5.59E-09	7.11±7.54E-18	1.34E-17	4.7E-13	<0.0001
U-233/234[e]	2	2.83±0.77E-08	3.82±1.03E-17	4.19E-17	1.0E-12[f]	<0.0001
U-235/236[e]	2	1.04±0.54E-08	1.40±0.73E-17	1.50E-17	1.2E-12	<0.0001
U-238[e]	2	2.81±0.73E-08	3.78±0.98E-17	4.19E-17	1.3E-12	<0.0001
Pu-238	2	1.85±0.20E-07	2.49±0.27E-16	3.90E-16	8.8E-14	0.0028
Pu-239/240	2	2.73±0.24E-07	3.68±0.32E-16	4.87E-16	8.1E-14	0.0045
Am-241	2	6.92±0.36E-07	9.33±0.49E-16	1.41E-15	9.7E-14	0.0096
Sum of Ratios						**0.017**

N - Number of samples.
NA - Not applicable.
[a] Half-lives are listed in Table UI-4.
[b] Total volume released at 50,000 cubic feet per minute = 7.42E+14 mL/year.
[c] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[d] DCSs do not exist for indicator parameters gross alpha and gross beta.
[e] Total Uranium = 5.39±0.17E-02 g; average = 7.27±0.23E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[f] DCS for Uranium-233 used for this comparison.

TABLE C-2
2016 Effluent Airborne Radioactivity at Main Plant Replacement Ventilation Emission Unit 1 (ANRVEU1)

Isotope	*N*	*Total Activity Released (Ci)*	*Average Concentration (µCi/mL)*	*Maximum Concentration (µCi/mL)*	*DCS [a] (µCi/mL)*
Gross Alpha	26	5.71±5.76E-09	2.51±2.53E-17	< 2.16E-16	NA[b]
Gross Beta	26	2.73±1.69E-08	1.20±0.74E-16	5.08E-16	NA[b]
Co-60	2	0.70±1.90E-08	3.07±8.36E-17	< 1.19E-16	3.6E-10
Sr-90	2	1.19±1.74E-08	5.22±7.67E-17	1.65E-16	1.0E-10
I-129	2	1.56±0.12E-06	6.87±0.54E-15	7.30E-15	1.0E-10
Cs-137	2	-0.07±1.33E-08	-0.32±5.86E-17	< 9.36E-17	8.8E-10
Eu-154	2	-0.41±4.58E-08	-0.18±2.01E-16	< 3.27E-16	7.5E-11
U-232[c]	2	1.68±1.69E-09	7.39±7.44E-18	< 1.10E-17	4.7E-13
U-233/234[c]	2	1.21±0.25E-08	5.33±1.10E-17	5.40E-17	1.0E-12[d]
U-235/236[c]	2	5.13±1.67E-09	2.26±0.74E-17	2.32E-17	1.2E-12
U-238[c]	2	1.19±0.24E-08	5.24±1.04E-17	5.27E-17	1.3E-12
Pu-238	2	0.57±1.33E-09	2.52±5.87E-18	< 8.71E-18	8.8E-14
Pu-239/240	2	0.65±1.53E-09	2.87±6.74E-18	< 1.06E-17	8.1E-14
Am-241	2	4.18±8.66E-10	1.84±3.81E-18	< 5.77E-18	9.7E-14

N - Number of samples.
NA - Not applicable.
[a] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[b] DCSs do not exist for indicator parameters gross alpha and gross beta.
[c] Total Uranium = 1.91±0.06E-02 g; average = 8.42±0.27E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[d] DCS for Uranium-233 used for this comparison.

TABLE C-3
2016 Effluent Airborne Radioactivity at Vitrification System HVAC (ANVITSK)

Isotope	*N*	*Total Activity Released (Ci)*	*Average Concentration (µCi/mL)*	*Maximum Concentration (µCi/mL)*	*DCS [a] (µCi/mL)*
Gross Alpha	16	1.56±5.90E-09	0.70±2.66E-17	1.19E-16	NA[b]
Gross Beta	16	3.19±1.74E-08	1.44±0.78E-16	3.96E-16	NA[b]
Co-60	2	0.91±1.84E-08	4.09±8.27E-17	< 3.31E-16	3.6E-10
Sr-90	2	3.07±2.82E-08	1.38±1.27E-16	< 5.38E-16	1.0E-10
I-129	2	4.58±4.02E-08	2.06±1.81E-16	2.32E-16	1.0E-10
Cs-137	2	0.63±1.68E-08	2.86±7.55E-17	< 2.54E-16	8.8E-10
Eu-154	2	4.78±4.69E-08	2.15±2.11E-16	8.56E-16	7.5E-11
U-232[c]	2	0.35±2.02E-09	1.59±9.08E-18	< 3.92E-17	4.7E-13
U-233/234[c]	2	9.03±2.91E-09	4.07±1.31E-17	8.40E-17	1.0E-12[d]
U-235/236[c]	2	5.55±2.34E-09	2.50±1.05E-17	9.21E-17	1.2E-12
U-238[c]	2	9.02±2.87E-09	4.06±1.29E-17	7.26E-17	1.3E-12
Pu-238	2	1.19±1.75E-09	5.37±7.87E-18	< 3.37E-17	8.8E-14
Pu-239/240	2	1.50±2.20E-09	6.73±9.92E-18	< 4.18E-17	8.1E-14
Am-241	2	1.37±1.33E-09	6.15±6.00E-18	< 3.06E-17	9.7E-14

Ventilation through the vitrification system HVAC and its stack monitoring system were turned off on July 28, 2016.
N - Number of samples.
NA - Not applicable.
[a] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[b] DCSs do not exist for indicator parameters gross alpha and gross beta.
[c] Total Uranium = 1.69±0.07E-02 g; average = 7.60±0.30E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[d] DCS for Uranium-233 used for this comparison.

TABLE C-4
2016 Effluent Airborne Radioactivity at Supernatant Treatment System (ANSTSTK)

Isotope	N	Total Activity Released (Ci)	Average Concentration (µCi/mL)	Maximum Concentration (µCi/mL)	DCS [a] (µCi/mL)
Gross Alpha	26	0.72±1.44E-09	1.07±2.15E-17	1.08E-16	NA[b]
Gross Beta	26	1.59±0.44E-08	2.38±0.66E-16	3.45E-15	NA[b]
H-3	26	1.97±0.54E-05	2.95±0.80E-13	8.40E-13	2.1E-07
Co-60	2	2.67±3.92E-09	3.99±5.87E-17	< 9.49E-17	3.6E-10
Sr-90	2	0.50±4.60E-09	0.75±6.89E-17	< 1.09E-16	1.0E-10
I-129	2	6.87±0.08E-06	1.03±0.01E-13	1.20E-13	1.0E-10
Cs-137	2	5.87±4.49E-09	8.78±6.73E-17	1.01E-16	8.8E-10
Eu-154	2	-1.15±1.13E-08	-1.72±1.69E-16	< 2.84E-16	7.5E-11
U-232[c]	2	0.32±3.89E-10	0.47±5.82E-18	< 1.00E-17	4.7E-13
U-233/234[c]	2	2.55±0.68E-09	3.81±1.02E-17	4.46E-17	1.0E-12[d]
U-235/236[c]	2	7.35±4.68E-10	1.10±0.70E-17	1.18E-17	1.2E-12
U-238[c]	2	2.17±0.63E-09	3.24±0.95E-17	4.35E-17	1.3E-12
Pu-238	2	0.37±2.61E-10	0.55±3.90E-18	< 6.01E-18	8.8E-14
Pu-239/240	2	1.61±2.91E-10	2.40±4.36E-18	< 6.34E-18	8.1E-14
Am-241	2	3.26±3.16E-10	4.88±4.73E-18	< 8.30E-18	9.7E-14

N - Number of samples.
NA - Not applicable.
[a] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[b] DCSs do not exist for indicator parameters gross alpha and gross beta.
[c] Total Uranium = 4.97±0.16E-03 g; average = 7.43±0.24E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[d] DCS for Uranium-233 used for this comparison.

TABLE C-5
2016 Effluent Airborne Radioactivity at Remote-Handled Waste Facility (ANRHWFK)

Isotope	*N*	*Total Activity Released (Ci)*	*Average Concentration (µCi/mL)*	*Maximum Concentration (µCi/mL)*	*DCS[a] (µCi/mL)*
Gross Alpha	26	5.44±4.26E-09	4.68±3.66E-17	1.84E-16	NA[b]
Gross Beta	26	-1.10±1.20E-08	-0.94±1.03E-16	7.07E-16	NA[b]
Co-60	2	0.10±1.46E-08	0.08±1.25E-16	< 2.16E-16	3.6E-10
Sr-90	2	1.85±1.47E-08	1.59±1.26E-16	3.30E-16	1.0E-10
I-129	2	2.86±3.42E-08	2.45±2.94E-16	< 4.18E-16	1.0E-10
Cs-137	2	0.88±1.19E-08	0.75±1.02E-16	< 1.71E-16	8.8E-10
Eu-154	2	-0.33±4.25E-08	-0.28±3.65E-16	< 5.71E-16	7.5E-11
U-232[c]	2	0.18±1.11E-09	1.58±9.52E-18	< 1.46E-17	4.7E-13
U-233/234[c]	2	8.63±1.70E-09	7.41±1.46E-17	9.07E-17	1.0E-12[d]
U-235/236[c]	2	2.33±1.00E-09	2.00±0.86E-17	2.04E-17	1.2E-12
U-238[c]	2	6.59±1.42E-09	5.66±1.22E-17	6.00E-17	1.3E-12
Pu-238	2	3.66±8.57E-10	3.15±7.36E-18	< 1.07E-17	8.8E-14
Pu-239/240	2	5.29±6.63E-10	4.54±5.70E-18	< 9.37E-18	8.1E-14
Am-241	2	4.66±8.39E-10	4.00±7.20E-18	< 1.08E-17	9.7E-14

N - Number of samples.
NA - Not applicable.
[a] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[b] DCSs do not exist for indicator parameters gross alpha and gross beta.
[c] Total Uranium = 1.54±0.05E-02 g; average = 1.32±0.04E-10 µg/mL, includes uranium contribution from glass fiber filter matrix.
[d] DCS for Uranium-233 used for this comparison.

TABLE C-6
2016 Effluent Airborne Radioactivity at Contact Size-Reduction Facility (ANCSRFK)

Permanent Stack Ventilation Inoperable.[a]

[a] When needed, building air ventilated and monitored with a PVU.

TABLE C-7
2016 Effluent Airborne Radioactivity at Container Sorting and Packaging Facility (ANCSPFK)

Stack Ventilation Off; System Did Not Operate During CY 2016. **No activity requiring ventilation in the CSPF in 2016.**

TABLE C-8
2016 Effluent Airborne Radioactivity at Outdoor Ventilation Enclosures/Portable Ventilation Units (OVE/PVUs)

Isotope	*N*	*Total Activity Released (Ci)*	*Average Concentration (µCi/mL)*	*Maximum Concentration*[a] *(µCi/mL)*	*DCS*[b] *(µCi/mL)*
Gross Alpha	140	5.29±1.67E-09	1.68±0.53E-17	1.53E-16	NA[c]
Gross Beta	140	2.94±0.50E-08	9.34±1.57E-17	4.34E-15	NA[c]
Co-60	2	-0.08±1.96E-09	-0.25±6.21E-18	< 9.11E-18	3.6E-10
Sr-90	2	2.33±2.20E-09	7.40±6.98E-18	< 1.25E-17	1.0E-10
Cs-137	2	1.10±2.33E-09	3.50±7.39E-18	< 1.30E-17	8.8E-10
Eu-154	2	0.64±4.89E-09	0.20±1.55E-17	< 2.20E-17	7.5E-11
U-232[d]	2	0.37±2.59E-10	1.16±8.22E-19	< 1.46E-18	4.7E-13
U-233/234[d]	2	4.48±0.46E-09	1.42±0.15E-17	1.85E-17	1.0E-12[e]
U-235/236[d]	2	7.00±2.98E-10	2.22±0.95E-18	2.61E-18	1.2E-12
U-238[d]	2	4.51±0.46E-09	1.43±0.15E-17	1.83E-17	1.3E-12
Pu-238	2	1.18±1.34E-10	3.76±4.25E-19	6.04E-19	8.8E-14
Pu-239/240	2	1.28±1.52E-10	4.05±4.84E-19	< 7.37E-19	8.1E-14
Am-241	2	1.92±1.65E-10	6.10±5.25E-19	< 9.27E-19	9.7E-14

N - Number of samples.
NA - Not applicable.
[a] Maximum concentrations for gross alpha and gross beta were selected from PVUs that ran long enough to obtain detection limits comparable to continuously operated units.
[b] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.
[c] DCSs do not exist for indicator parameters gross alpha and gross beta.
[d] Total Uranium = 1.02±0.03E-02 g; average = 3.25±0.10E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[e] DCS for Uranium-233 used for this comparison.

TABLE C-9
2016 Gross Alpha and Gross Beta Radioactivity at Nearsite Ambient Air Sampling Locations and at Background Great Valley Location (AFGRVAL)

Monitoring Location	N	Gross Alpha µCi/mL		Gross Beta µCi/mL	
		Average	Maximum	Average	Maximum
AF01_N	26	8.34±1.88E-16	1.38E-15	1.63±0.07E-14	2.15E-14
AF02_NNE	26	7.64±1.76E-16	1.10E-15	1.58±0.07E-14	2.22E-14
AF03_NE	26	7.35±1.65E-16	1.16E-15	1.49±0.06E-14	2.16E-14
AF04_ENE	26	7.81±1.70E-16	1.34E-15	1.52±0.06E-14	2.06E-14
AF05_E	26	8.57±2.05E-16	1.22E-15	1.67±0.07E-14	2.27E-14
AF06_ESE	26	8.14±1.81E-16	1.18E-15	1.55±0.07E-14	2.07E-14
AF07_SE	26	7.86±1.87E-16	1.28E-15	1.47±0.07E-14	2.03E-14
AF08_SSE	26	8.28±1.78E-16	1.16E-15	1.56±0.06E-14	2.07E-14
AF09_S	26	8.62±1.86E-16	1.29E-15	1.62±0.07E-14	2.21E-14
AF10_SSW	26	7.99±1.81E-16	1.35E-15	1.56±0.07E-14	2.21E-14
AF11_SW	26	8.42±1.83E-16	1.42E-15	1.59±0.07E-14	2.20E-14
AF12_WSW	26	8.01±1.74E-16	1.24E-15	1.52±0.06E-14	2.12E-14
AF13_W	26	8.60±2.28E-16	1.26E-15	1.59±0.08E-14	2.27E-14
AF14_WNW	26	8.46±1.84E-16	1.34E-15	1.52±0.07E-14	2.22E-14
AF15_NW	26	8.51±1.83E-16	1.37E-15	1.52±0.06E-14	2.05E-14
AF16_NNW	26	7.87±1.79E-16	1.45E-15	1.44±0.06E-14	2.02E-14
AF16HNNW	26	8.88±1.59E-16	1.48E-15	1.74±0.06E-14	2.48E-14
AFGRVAL	26	8.72±1.81E-16	1.50E-15	1.57±0.06E-14	2.15E-14

N - Number of samples.

TABLE C-10
2016 Ambient Airborne Radioactivity
and Comparison to the NESHAP[a] Concentration Levels for Environmental Compliance

Location	N	Annual Average Concentration (µCi/mL)			
		Sr-90	I-129	Cs-137	U-232
NESHAP Compliance		1.9E-14	9.1E-15	1.9E-14	1.3E-15
AF01_N	4	1.13±1.44E-16	-1.15±7.23E-17	0.08±1.01E-16	0.33±8.92E-18
AF02_NNE	4	0.44±1.31E-16	-1.42±6.34E-17	2.89±7.33E-17	0.51±1.08E-17
AF03_NE	4	-0.21±1.10E-16	-0.46±6.49E-17	-5.60±8.70E-17	2.78±9.50E-18
AF04_ENE	4	0.40±1.27E-16	-1.87±8.02E-17	-1.09±7.80E-17	-0.87±9.21E-18
AF05_E	4	0.15±1.39E-16	0.01±9.30E-17	0.36±1.22E-16	0.74±1.33E-17
AF06_ESE	4	0.73±1.39E-16	0.43±7.49E-17	1.92±9.30E-17	0.44±1.20E-17
AF07_SE	4	-0.52±1.19E-16	-0.16±7.26E-17	0.98±9.81E-17	-1.74±9.53E-18
AF08_SSE	4	0.45±1.37E-16	-2.08±8.57E-17	-0.05±1.11E-16	0.46±1.17E-17
AF09_S	4	-0.37±1.19E-16	-2.32±7.38E-17	1.88±9.55E-17	0.13±1.09E-17
AF10_SSW	4	0.64±1.35E-16	0.13±7.00E-17	0.30±1.06E-16	0.09±1.03E-17
AF11_SW	4	0.27±1.39E-16	-2.61±7.48E-17	-0.23±9.82E-17	0.40±1.06E-17
AF12_WSW	4	0.51±1.22E-16	-2.27±7.95E-17	-0.13±1.18E-16	-3.02±9.81E-18
AF13_W	4	0.50±1.44E-16	0.22±7.04E-17	0.03±1.11E-16	0.15±1.03E-17
AF14_WNW	4	0.13±1.40E-16	-2.43±8.93E-17	-0.21±1.10E-16	0.34±1.17E-17
AF15_NW	4	-0.29±1.17E-16	3.60±8.43E-17	0.04±1.17E-16	-0.12±1.02E-17
AF16_NNW	4	0.34±1.27E-16	-1.89±7.14E-17	0.00±1.07E-16	0.33±9.51E-18
AF16HNNW[c]	4	1.14±2.60E-17	-1.89±7.14E-17[d]	-0.01±3.13E-17	1.30±2.13E-18
AFGRVAL[e]	4	1.20±1.38E-16	4.38±6.70E-17	-0.75±7.37E-17	-1.73±9.72E-18

Location	N	Annual Average Concentration (µCi/mL)			Compliance Ratio (Sum of Ratios)
		Pu-238	Pu-239/240	Am-241	
NESHAP Compliance		2.1E-15	2.0E-15	1.9E-15	
AF01_N	4	3.82±9.73E-18	-0.04±1.00E-17	0.86±8.60E-18	< 0.042
AF02_NNE	4	2.04±9.69E-18	-0.43±8.21E-18	1.65±7.61E-18	< 0.039
AF03_NE	4	-0.43±5.18E-18	-0.28±6.74E-18	3.11±5.88E-18	< 0.034
AF04_ENE	4	2.86±6.96E-18	-1.06±7.37E-18	0.95±8.87E-18	< 0.038
AF05_E	4	-0.90±9.37E-18	1.52±9.55E-18	-0.11±1.05E-17	< **0.049**
AF06_ESE	4	2.02±8.65E-18	1.06±8.41E-18	0.98±6.74E-18	< 0.042
AF07_SE	4	3.65±6.93E-18	0.67±1.06E-17	1.67±6.80E-18	< 0.039
AF08_SSE	4	1.07±7.25E-18	2.74±7.88E-18	1.99±6.70E-18	< 0.042
AF09_S	4	-0.56±8.67E-18	1.55±9.90E-18	1.14±8.02E-18	< 0.041
AF10_SSW	4	0.67±8.60E-18	0.52±1.01E-17	0.81±7.49E-18	< 0.041
AF11_SW	4	1.41±8.80E-18	0.35±1.01E-17	0.45±6.93E-18	< 0.042
AF12_WSW	4	0.09±8.91E-18	3.61±9.52E-18	-0.15±8.53E-18	< 0.042
AF13_W	4	-2.40±8.32E-18	5.52±8.73E-18	1.15±6.98E-18	< 0.041
AF14_WNW	4	2.94±9.16E-18	3.10±7.25E-18	0.46±8.04E-18	< 0.044
AF15_NW	4	1.52±9.59E-18	0.50±8.19E-18	0.11±1.32E-17	< 0.045
AF16_NNW	4	1.90±8.02E-18	1.15±7.96E-18	0.06±1.11E-17	< 0.041
AF16HNNW[c]	4	0.26±1.92E-18	-0.29±1.75E-18	0.77±2.03E-18	< 0.015
AFGRVAL[e]	4	0.81±9.35E-18	0.74±8.88E-18	6.42±9.95E-18	< 0.040

<= Max ratio in 2016.

[a] NESHAP - National Emmissions Standards for Hazardous Air Pollutants, U.S. EPA 40 CFR Part 61.
[b] NESHAP Concentration Levels for Environmental Compliance, 40 CFR Part 61, Appendix E, Table 2.
[c] Location AF16HNNW is the high volume sampler at the same location as AF16_NNW.
[d] The low volume result for I-129 is reported at the high volume sampler in order to calculate an equivalent sum of ratios and estimated dose. I-129 is not measured at the high volume sampler.
[e] AFGRVAL is the background sampling location, approximately 29 km south of the WVDP.

TABLE C-11

2016 Summary of NESHAP[a] Concentration Levels for Environmental Compliance

Location	*Sum of Ratios [b]*	*Notes*
Non-Network Sampler		
AFGRVAL[c]	< 0.040	Background sampling location (2016 Dose < 0.40 mrem/year)
Compliance Network Samplers		
AF01_N	< 0.042	
AF02_NNE	< 0.039	
AF03_NE	< 0.034	
AF04_ENE	< 0.038	
AF05_E	< **0.049**	**Critical Receptor** (for reporting purposes) **(2016 Dose < 0.49 mrem/year)**
AF06_ESE	< 0.042	
AF07_SE	< 0.039	
AF08_SSE	< 0.042	
AF09_S	< 0.041	
AF10_SSW	< 0.041	
AF11_SW	< 0.042	
AF12_WSW	< 0.042	
AF13_W	< 0.041	
AF14_WNW	< 0.044	
AF15_NW	< 0.045	
AF16_NNW	< 0.041	
Non-Network Sampler		
AF16HNNW[d]	< 0.015	High volume sampler

[a] NESHAP - National Emission Standards for Hazardous Air Pollutants, U.S. EPA 40 CFR Part 61.

[b] Sum of ratios = sum of (Average concentration per isotope / NESHAP Concentration Levels for Environmental Compliance, 40 CFR Part 61, Appendix E, Table 2).

[c] AFGRVAL is the background sampling location, approximately 29 km south of the WVDP.

[d] Location AF16HNNW is the high volume sampler at the same location as AF16_NNW.

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APPENDIX D-1

Summary of Groundwater Screening Levels and Practical Quantitation Limits

Groundwater Sampling Methodology

Groundwater samples are collected from monitoring wells using either dedicated Teflon well bailers or bladder pumps. Bailers are used in low-yield wells; bladder pumps are used in wells with good water-yielding characteristics. This sampling equipment is dedicated to an individual well to reduce the likelihood of sample contamination from external materials or cross contamination.

To ensure that only representative groundwater is sampled, three well volumes are removed (purged) from the well before the actual samples are collected. In low-yield wells, pumping or bailing to dryness provides sufficient purging. Conductivity and pH are measured before and after sampling to confirm the geochemical stability of the groundwater during sampling.

The bailer, a tube with a check valve at the bottom, is lowered slowly into the well to minimize agitation of the water column. The bailer containing the groundwater is then withdrawn from the well and emptied into a sample container. Bladder pumps use compressed air to gently squeeze a Teflon bladder that prevents air contact with the groundwater as it is pumped into a sample container with a minimum of agitation and mixing. A check valve ensures that the water flows in only one direction.

Groundwater samples are cooled and preserved, with chemicals if required, to minimize chemical and/or biological changes after sample collection. A strict chain-of-custody protocol is followed for all samples collected by the WVDP.

Groundwater Screening Levels (GSLs) for Radiological Constituents: Background values for radiological constituents in groundwater were derived for the Corrective Measures Studies in 2009 using data from background wells 301, 401, 706, and 1302 in the sand and gravel unit on the north plateau for samples collected from 1991 through September 2009. The 95% upper confidence limit (UCL) was applied in a similar statistical calculation for each radiological constituent. The site-specific GSLs for radiological constituents were set to the greater of the background levels or the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Class GA groundwater quality standard for each radiological constituent. The NYSDEC TOGS standards are only established for gross alpha and gross beta concentrations, consequently most of the screening values for radiological constituents are set to equal the site background values. The GSLs for radiological constituents are listed in Table D-1A.

The site monitoring well radiological concentrations presented in the data tables in Appendix D-2 are compared with these GSLs. Bolding indicates that the measured concentration exceeded the GSL.

Groundwater Screening Levels for Metals: The calculated WVDP GSLs for metals were established in WVDP-494, North Plateau Plume Area Characterization Report. The GSLs for metals were selected as a greater of the NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards or background concentrations in groundwater as documented in Appendix E of WVDP-494. The groundwater background concentrations were derived from a statistical calculation of the mean plus two standard deviations for metals data collected from four background wells (301, 401, 706, and well 1302). Elevated levels of chromium and nickel were identified in site wells constructed with stainless steel (which includes 301, 401, and 706), as presented to NYSDEC in a report entitled Final Report: Evaluation of the Pilot Program to Investigate Chromium & Nickel Concentration in Groundwater in the Sand & Gravel Unit (WVNSCO, 1998). The findings of this report were subsequently accepted by NYSDEC in their memorandum dated September 15, 1998.

Consequently, the majority of the chromium and nickel results from these stainless-steel wells were omitted from the dataset used to establish background, relying primarily on the results from polyvinyl chloride (PVC) well 1302 for these two constituents. The groundwater screening values for metals are listed in Table D-1B.

The site monitoring well metals concentrations presented in the data tables in Appendix D-2 are compared with these GSLs. Bolding indicates that the measured concentration exceeded the GSL.

TABLE D-1A
Groundwater Screening Levels (GSLs) for Radiological Constituents

Radiological Constituent	***Range of Observed Concentrations From Background Monitoring Wells 301, 401, 706, and 1302 [a] (µCi/mL)***	***WVDP 95% UCL Background Groundwater Concentration [a] (µCi/mL)***	***NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards [b] (µCi/mL)***	***WVDP GSLs [c] (µCi/mL)***
Gross alpha	< 7.78E-10 – 1.55E-08	7.61E-09	1.50E-08	1.50E-08
Gross beta	< 2.15E-09 – 2.35E-08	1.56E-08	1.00E-06	1.00E-06
Tritium	< 3.17E-08 – 2.63E-07	1.78E-07	NE	1.78E-07
Carbon-14	< 1.36E-11 – 5.02E-08	2.82E-08	NE	2.82E-08
Cesium-137	5.79E-10 – 1.90E-08	1.03E-08	NE	1.03E-08
Iodine-129	< 2.85E-10 – 1.58E-09	9.61E-10	NE	9.61E-10
Potassium-40	< 5.00E-08 – 3.56E-07	1.99E-07	NE	1.99E-07
Radium-226	< 1.10E-10 – 2.99E-09	1.33E-09	NE	1.33E-09
Radium-228	< 2.23E-10 – 3.20E-09	2.16E-09	NE	2.16E-09
Strontium-90	< 2.41E-10 – 6.40E-09	5.90E-09	NE	5.90E-09
Technetium-99	< 8.21E-10 – 8.61E-09	5.02E-09	NE	5.02E-09
Total Uranium (µg/mL)	< 1.27E-06 – 3.46E-03	1.34E-03	NE	1.34E-03
Uranium-232	< 1.71E-11 – 3.78E-10	1.38E-10	NE	1.38E-10
Uranium-233/234	< 3.85E-11 – 1.53E-09	6.24E-10	NE	6.24E-10
Uranium-235/236	< 1.80E-11 – 1.39E-10	8.07E-11	NE	8.07E-11
Uranium-238	< 1.32E-11 – 1.26E-09	4.97E-10	NE	4.97E-10

NE - No NYSDEC TOGS 1.1.1 groundwater quality standard has been established for this analyte.
[a] The data used for the calculation of background values was taken from background wells 301, 401, 706, and 1302 in the sand and gravel unit on the north plateau for samples collected from 1991 through September 2009. The background was set to the upper limit of the 95% confidence interval.
[b] NYSDEC TOGS 1.1.1 (June 1998/2004 addendum) Class GA groundwater quality standards and guidance values.
[c] The GSLs for radiological constituents were set equal to the larger of the background concentrations or the NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards.

TABLE D-1B
Groundwater Screening Levels for Metals

Analyte [a]	*Range of Observed Concentrations From Background Monitoring Wells 301, 401, 706, and 1302* [a] *(µg/L)*	*Background Groundwater Concentration* [b] *(µg/L)*	*NYSDEC TOGS 1.1.1 Class GA Groundwater Quality Standards (µg/L)*	*WVDP Groundwater Screening Levels (GSLs)* [c] *(µg/L)*
Antimony, total	0.5 – 19.7	15.1	3	15.1
Arsenic, total	1.5 – 34.4	20.9	25	25
Barium, total	71.7 – 499	441	1,000	1,000
Beryllium, total	0.10 – 2.50	1.85	3	3
Cadmium, total	0.30 – 5.30	7.27	5	7.27
Chromium, total[d]	5 – 66	52.3	50	52.3
Cobalt, total	2.05 – 60.9	67.8	NE	67.8
Copper, total	1.4 – 90.5	59.9	200	200
Lead, total	0.5 – 120	42.7	25	42.7
Mercury, total	0.03 – 0.4	0.263	0.7	0.7
Nickel, total[d]	10 – 77.8	59.5	100	100
Selenium, total	1.0 – 25.0	10.1	10	10.1
Silver, total	0.1 – 10	15.5	50	50
Thallium, total	0.3 – 13.1	13.9	0.5	13.9
Tin, total	5.6 – 3,000	4,083	NE	4,083
Vanadium, total	0.6 – 73.1	69.6	NE	69.6
Zinc, total	5.71 – 256	127	2,000	2,000

NE - No TOGS 1.1.1 Class GA Groundwater quality standard has been established for this analyte.

[a] Analytes listed are those identified in the 6 NYCRR Part 373-2 Appendix 33 List.

[b] Data used for the calculation of background values was taken from wells 301, 401, 706, and 1302 in the S&G unit on the north plateau for samples collected from 1991 to December 2008. The background concentration was set equal to the mean plus two standard deviations (as reported in WVDP-494). Ninety-five percent of measurements are expected to fall below this value. Data were rounded to three significant digits or the closest integer.

[c] Metals GSLs were set equal to the larger of the background concentration or the TOGS 1.1.1 Class GA Groundwater Quality Standards.

[d] Elevated chromium and nickel concentrations attributed to well corrosion were noted in wells 301, 401, and 706 over the monitoring period. All results suspected to be affected by corrosion (i.e., all chromium and nickel results for 301 and 401, and all results after May 2004 from 706) were excluded from the background calculation.

TABLE D-1C
Practical Quantitation Limits (PQLs)

6 NYCRR[a] Appendix 33 Volatile Organic Compounds			
Compound	**PQL (µg/L)**	**Compound**	**PQL (µg/L)**
Acetone	10	cis-1,3-Dichloropropene	5
Acetonitrile	100	Ethyl Benzene	5
Acrolein	11	Ethyl methacrylate	5
Acrylonitrile	5	2-Hexanone	10
Allyl chloride	5	Isobutyl alcohol	100
Benzene	5	Methacrylonitrile	5
Bromodichloromethane	5	Methyl ethyl ketone	10
Bromoform (methyl bromide)	5	Methyl iodide	5
Bromomethane	10	Methyl methacrylate	5
Carbon disulfide	10	4-Methyl-2-pentanone (MIBK)	10
Carbon tetrachloride	5	Methylene bromide	10
Chlorobenzene	5	Methylene chloride	5
Chloroethane	10	Pentachloroethane	5
Chloroform	5	Propionitrile	50
Chloromethane (methyl chloride)	10	Styrene	5
Chloroprene	5	1,1,1,2-Tetrachloroethane	5
1,2-Dibromo-3-chloropropane	5	1,1,2,2-Tetrachloroethane	5
Dibromochloromethane	5	Tetrachloroethylene	5
1,2-Dibromoethane	5	Toluene	5
trans-1,4-Dichloro-2-butene	5	1,1,1-Trichloroethane (1,1,1-TCA)	5
1,1-Dichloroethane (1,1-DCA)	5	1,1,2-Trichloroethane (1,1,2-TCA)	5
1,2-Dichloroethane (1,2-DCA)	5	Trichloroethylene (TCE)	5
1,1-Dichloroethylene (1,1-DCE)	5	Trichlorofluoromethane	5
trans-1,2-Dichloroethylene (1,2-DCE[trans])	5	1,2,3-Trichloropropane	5
Dichlorodifluoromethane (DCDF Meth)	5	Vinyl acetate	10
1,2-Dichloropropane	5	Vinyl chloride	10
trans-1,3-Dichloropropene	5	Xylene (total)	5
6 NYCRR[a] Appendix 33 Metals			
Compound	**PQL (µg/L)**	**Compound**	**PQL (µg/L)**
Aluminum[b]	200	Manganese[b]	15
Antimony	10	Mercury	0.2
Arsenic	10	Nickel	40
Barium	200	Selenium	5
Beryllium	1	Silver	10
Cadmium	5	Thallium	2
Chromium	10	Tin	3,000
Cobalt	50	Vanadium	50
Copper	25	Zinc	20
Lead	3		

Note: Specific quantitation limits are highly matrix dependent and may not always be achievable.
[a] Title 6 of the Official Compilation of Codes, Rules, and Regulations of the State of New York.
[b] Not a 6 NYCRR Appendix 33 parameter; sampled for the north plateau early warning program.

TABLE D-1C (*continued*)
Practical Quantitation Limits (PQLs)

6 NYCRR[a] Appendix 33 Semi-Volatile Organic Compounds			
Compound	**PQL (µg/L)**	**Compound**	**PQL (µg/L)**
Acenaphthene	10	2,4-Dinitrotoluene	10
Acenaphthylene	10	2,6-Dinitrotoluene	10
Acetophenone	10	Diphenylamine	10
2-Acetylaminofluorene	10	Ethyl methanesulfonate	10
4-Aminobiphenyl	10	Famphur	10
Analine	10	Fluoranthene	10
Anthracene	10	Fluorene	10
Aramite	10	Hexachlorobenzene	10
Benzo[a]anthracene	10	Hexachlorobutadiene	10
Benzo[a]pyrene	10	Hexachlorocyclopentadiene	10
Benzo[b]fluoranthene	10	Hexachloroethane	10
Benzo[ghi]perylene	10	Hexachlorophene	10
Benzo[k]fluoranthene	10	Hexachloropropene	10
Benzyl alcohol	10	Indeno(1,2,3,-cd)pyrene	10
Bis(2-chloroethyl)ether	10	Isodrin	10
Bis(2-chloroethoxy)methane	10	Isophorone	10
Bis(2-chloroisopropyl)ether	10	Isosafrole	10
Bis(2-ethylhexyl)phthalate	10	Kepone	10
4-Bromophenyl phenyl ether	10	Methapyrilene	10
Butyl benzyl phthalate	10	Methyl methanesulfonate	10
Chlorobenzilate	10	3-Methylcholanthrene	10
2-Chloronaphthalene	10	2-Methylnapthalene	10
2-Chlorophenol	10	1,4-Naphthoquinone	10
4-Chlorophenyl phenyl ether	10	1-Naphthylamine	10
Chrysene	10	2-Naphthylamine	10
Di-n-butyl phthalate	10	Nitrobenzene	10
Di-n-octyl phthalate	10	5-Nitro-o-toluidine	10
Diallate	10	4-Nitroquinoline 1-oxide	40
Dibenz[a,h]anthracine	10	N-Nitrosodi-n-butylamine	10
Dibenzofuran	10	N-Nitrosodiethylamine	10
3,3-Dichlorobenzidine	10	N-Nitrosodimethylamine	10
2,4-Dichlorophenol	10	N-Nitroso-di-n-propylamine	10
2,6-Dichlorophenol	10	N-Nitrosodiphenylamine	10
Diethyl phthalate	10	N-Nitrosomethylethylamine	10
Dimethoate	10	N-Nitrosomorpholine	10
7,12-Dimethylbenz[a]anthracene	10	N-Nitrosopiperidine	10
3,3-Dimethylbenzidine	20	N-Nitrosopyrrolidine	10
2,4-Dimethylphenol	10	Naphthalene	10
Dimethyl phthalate	10	0,0,0-Triethyl phosphorothioate	10
4,6-Dinitro-o-cresol	25	O,O-Diethyl O-2-pyrazinylphosphorothioate	10
2,4-Dinitrophenol	25		

Note: Specific quantitation limits are highly matrix dependent and may not always be achievable.
[a] Title 6 of the Official Compilation of Codes, Rules, and Regulations of the State of New York.

TABLE D-1C (*concluded*)
Practical Quantitation Limits (PQLs)

6 NYCRR[a] Appendix 33 Semi-Volatile Organic Compounds			
Compound	**PQL (µg/L)**	**Compound**	**PQL (µg/L)**
p-(Dimethylamino)azobenzene	10	2,3,4,6-Tetrachlorophenol	10
p-Chloroaniline	10	Tetraethyl dithiopyrophosphate	10
p-Chloro-m-cresol	10	1,2,4-Trichlorobenzene	10
p-Cresol	10	2,4,5-Trichlorophenol	25
p-Dichlorobenzene	10	2,4,6-Trichlorophenol	10
p-Nitroaniline	25	alpha,alpha-Dimethylphenethylamine	50
p-Nitrophenol	25	m-Cresol	10
p-Phenylenediamine	10	m-Dichlorobenzene	10
Parathion	10	m-Dinitrobenzene	10
Pentachlorobenzene	10	m-Nitroanaline	25
Pentachloronitrobenzene	10	o-Cresol	10
Pentachlorophenol	25	o-Dichlorobenzene	10
Phenacetin	10	o-Nitroaniline	25
Phenanthrene	10	o-Nitrophenol	10
Phenol	10	o-Toluidine	10
Pronamide	10	sym-Trinitrobenzene	10
Pyrene	10	2-Picoline	10
Safrole	10	Pyridine	10
1,2,4,5-Tetrachlorobenzene	10	1,4-Dioxane	10
Other Organic Compounds			
Compound	**PQL (µg/L)**		
1,2-Dichloroethylene (Total)	5		
N-Dodecane	60		
Tributyl phosphate	10		

Note: Specific quantitation limits are highly matrix dependent and may not always be achievable.
[a] Title 6 of the Official Compilation of Codes, Rules, and Regulations of the State of New York.

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APPENDIX D-2

Groundwater Monitoring Data

TABLE D-2A
2016 Indicator Results From the Sand and Gravel Unit

Location Code	*Hydraulic Position [a]*	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			***NA***	***NA***	***1.50E-08***	***1.00E-06***	***1.78E-07***
301	UP	Mar-16	6.81	2251	-1.76±4.17E-09	8.62±4.82E-09	7.14±8.33E-08
301	UP	Jun-16	7.42	2934	-4.44±5.81E-09	3.97±3.73E-09	-1.50±8.72E-08
301	UP	Sep-16	6.76	3448	-6.36±7.11E-09	2.75±5.28E-09	0.47±1.03E-07
301	UP	Dec-16	6.85	1629	1.50±3.72E-09	1.86±3.09E-09	-1.94±7.29E-08
302	UP	Jun-16	7.11	5910	0.19±1.23E-08	1.68±1.19E-08	-1.12±8.68E-08
302	UP	Dec-16	6.94	5832	-0.33±1.43E-08	4.79±8.51E-09	0.53±7.48E-08
401	UP	Mar-16	7.13	5009	-0.24±1.28E-08	1.11±0.93E-08	7.71±7.48E-08
401	UP	Jun-16	7.55	4254	-7.13±8.79E-09	7.08±7.75E-09	2.39±9.32E-08
401	UP	Sep-16	6.98	4880	8.24±9.81E-09	-2.48±6.16E-09	-2.18±9.44E-08
401	UP	Dec-16	7.05	5148	**1.54±2.03E-08**	3.81±6.32E-09	-0.97±7.58E-08
402	UP	Jun-16	7.54	6024	-1.69±1.21E-08	1.13±0.96E-08	1.16±9.03E-08
402	UP	Dec-16	7.11	5783	-0.41±1.10E-08	5.68±8.07E-09	-4.29±7.34E-08
403	UP	Jun-16	6.90	2496	-0.24±5.27E-09	1.37±0.36E-08	3.99±7.65E-08
403	UP	Dec-16	7.09	1316	3.89±4.28E-09	4.65±2.62E-09	-1.36±7.60E-08
706	UP	Mar-16	7.12	724	-2.55±2.10E-09	7.70±1.67E-09	7.07±7.37E-08
706	UP	Jun-16	7.12	1062	-1.32±2.20E-09	8.43±2.02E-09	7.35±8.11E-08
706	UP	Sep-16	6.82	1245	-0.23±2.57E-09	6.65±1.86E-09	2.91±9.98E-08
706	UP	Dec-16	7.25	607	-0.31±1.54E-09	6.18±1.23E-09	-1.93±7.70E-08
1302	UP	Dec-16	7.04	492	-0.90±1.26E-09	5.75±9.60E-10	1.10±0.94E-07

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (see Table D-1A).

TABLE D-2A (*continued*)
2016 Indicator Results From the Sand and Gravel Unit

Location Code	*Hydraulic Position [a]*	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
103	DOWN	Mar-16	7.84	4230	-1.53±8.68E-09	1.51±0.13E-07	3.90±6.93E-08
103	DOWN	Jun-16	7.75	4950	-5.97±9.36E-09	1.23±0.11E-07	-1.51±8.95E-08
103	DOWN	Sep-16	7.73	2816	-3.68±5.20E-09	3.13±0.38E-08	0.21±1.13E-07
103	DOWN	Dec-16	7.96	2426	-1.58±5.06E-09	2.75±0.41E-08	-1.75±7.54E-08
104	DOWN	Mar-16	7.08	2032	1.98±2.00E-09	**5.77±0.01E-05**	0.84±1.07E-07
104	DOWN	Jun-16	7.16	2118	-1.54±3.91E-09	**6.57±0.01E-05**	3.77±8.59E-08
104	DOWN	Sep-16	7.09	2486	2.81±5.37E-09	**7.76±0.01E-05**	0.78±1.02E-07
104	DOWN	Dec-16	7.13	2055	-1.19±4.63E-09	**5.71±0.01E-05**	1.16±0.87E-07
105	DOWN	Mar-16	7.2	2574	1.27±3.53E-09	**6.92±0.01E-05**	1.40±1.15E-07
105	DOWN	Jun-16	6.71	2450	-2.59±6.76E-09	**6.17±0.01E-05**	6.45±8.74E-08
105	DOWN	Sep-16	7.12	2500	0.27±4.49E-09	**4.91±0.01E-05**	9.37±9.97E-08
105	DOWN	Dec-16	7.28	2502	-4.11±5.17E-09	**5.33±0.01E-05**	8.53±8.58E-08
106	DOWN	Mar-16	7.06	1994	2.69±2.00E-09	**3.87±0.03E-06**	**4.67±1.41E-07**
106	DOWN	Jun-16	6.56	1818	0.70±4.05E-09	**2.83±0.02E-06**	**6.60±1.24E-07**
106	DOWN	Sep-16	7.11	1830	-5.98±5.12E-09	**2.36±0.02E-06**	**8.03±1.43E-07**
106	DOWN	Dec-16	7.02	1902	3.27±4.64E-09	**2.62±0.02E-06**	**5.27±1.17E-07**
111	DOWN	Mar-16	6.74	484	8.20±1.89E-09	**2.76±0.02E-06**	0.81±1.10E-07
111	DOWN	Jun-16	6.53	909	8.00±3.67E-09	**5.63±0.03E-06**	-6.29±8.11E-08
111	DOWN	Sep-16	6.47	1571	6.47±5.44E-09	**4.63±0.02E-06**	1.40±1.01E-07
111	DOWN	Dec-16	6.43	682	4.74±1.77E-09	**3.06±0.01E-06**	7.23±8.14E-08
116	DOWN	Jun-16	7.3	2622	-7.15±8.36E-09	**3.89±0.01E-05**	5.19±8.98E-08
116	DOWN	Dec-16	7.18	2578	-5.86±5.04E-09	**2.94±0.01E-05**	8.52±9.11E-08
205	DOWN	Jun-16	7.01	4668	-1.43±1.10E-08	4.53±9.26E-09	-5.49±8.55E-08
205	DOWN	Dec-16	7.22	3130	-5.86±6.65E-09	9.64±4.96E-09	1.44±0.97E-07
406	DOWN	Mar-16	7.24	1296	1.61±3.19E-09	8.10±2.29E-09	6.71±7.19E-08
406	DOWN	Jun-16	7.76	970	-1.56±2.01E-09	5.76±1.70E-09	3.26±9.19E-08
406	DOWN	Sep-16	6.94	1061	-1.93±2.00E-09	5.33±1.34E-09	0.90±1.06E-07
406	DOWN	Dec-16	6.92	1352	-1.34±4.18E-09	5.20±1.80E-09	-5.60±7.72E-08

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2A (*continued*)
2016 Indicator Results From the Sand and Gravel Unit

Location Code	*Hydraulic Position* [a]	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
408	DOWN	Mar-16	7.43	4066	5.42±4.14E-09	**1.84±0.01E-04**	0.18±9.87E-08
408	DOWN	Jun-16	7.47	4336	-6.04±9.47E-09	**2.46±0.01E-04**	2.03±8.80E-08
408	DOWN	Sep-16	7.22	4369	-9.61±8.98E-09	**1.63±0.01E-04**	6.77±9.60E-08
408	DOWN	Dec-16	7.28	3709	-2.21±6.07E-09	**1.40±0.01E-04**	-1.30±0.97E-07
501	DOWN	Mar-16	7.46	3320	5.89±7.79E-09	**9.44±0.02E-05**	0.66±1.09E-07
501	DOWN	Jun-16	7.61	3408	-0.13±1.02E-08	**1.04±0.01E-04**	-3.19±8.42E-08
501	DOWN	Sep-16	7.36	3723	-1.54±1.04E-08	**7.99±0.02E-05**	2.14±9.43E-08
501	DOWN	Dec-16	7.36	3093	4.28±7.94E-09	**8.60±0.01E-05**	7.17±7.99E-08
502	DOWN	Mar-16	7.42	3154	-3.14±4.73E-09	**7.56±0.02E-05**	0.48±1.06E-07
502	DOWN	Jun-16	7.48	3026	4.92±5.71E-09	**8.22±0.02E-05**	-3.25±8.64E-08
502	DOWN	Sep-16	7.25	3257	-5.08±8.65E-09	**6.84±0.02E-05**	7.33±9.44E-08
502	DOWN	Dec-16	7.46	3010	-3.59±6.50E-09	**6.53±0.01E-05**	4.04±7.85E-08
602A	DOWN	Jun-16	6.9	1068	-2.29±1.88E-09	1.49±0.18E-08	1.39±0.85E-07
602A	DOWN	Dec-16	6.84	826	-4.02±2.68E-09	1.28±0.17E-08	1.09±0.85E-07
604	DOWN	Jun-16	6.39	1806	1.66±3.92E-09	2.17±0.37E-08	1.79±7.56E-08
604	DOWN	Dec-16	6.66	1800	-2.33±4.08E-09	7.75±3.02E-09	5.41±8.80E-08
605	DOWN	Jun-16	7.14	1081	-0.18±1.70E-09	2.29±0.21E-08	-1.47±8.55E-08
605	DOWN	Dec-16	7.06	804	-1.81±2.24E-09	2.45±0.19E-08	1.22±7.84E-08
801	DOWN	Mar-16	6.72	2141	-1.33±4.46E-09	**4.41±0.03E-06**	-0.20±1.00E-07
801	DOWN	Jun-16	6.61	2486	-5.18±4.94E-09	**6.18±0.04E-06**	0.42±8.93E-08
801	DOWN	Sep-16	6.67	2053	-5.12±4.86E-09	**3.98±0.03E-06**	7.68±9.78E-08
801	DOWN	Dec-16	6.32	1682	-0.77±3.10E-09	**2.47±0.02E-06**	0.89±1.02E-07
802	DOWN	Mar-16	6.93	138	1.34±0.65E-09	3.78±0.20E-08	-3.69±9.75E-08
802	DOWN	Jun-16	6.99	524	-2.19±2.15E-09	3.78±0.06E-07	-5.52±8.12E-08
802	DOWN	Sep-16	6.91	1684	-5.84±3.97E-09	**1.57±0.02E-06**	6.95±9.78E-08
802	DOWN	Dec-16	6.46	620	1.65±1.69E-09	4.48±0.05E-07	3.87±8.71E-08

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2A *(continued)*
2016 Indicator Results From the Sand and Gravel Unit

Location Code	*Hydraulic Position* [a]	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
803	DOWN	Mar-16	7.18	2612	3.92±2.31E-09	**2.00±0.02E-06**	0.69±1.08E-07
803	DOWN	Jun-16	7.00	2669	-1.03±0.73E-08	**2.06±0.02E-06**	3.14±8.84E-08
803	DOWN	Sep-16	6.81	2845	0.28±4.96E-09	**1.69±0.02E-06**	1.10±0.97E-07
803	DOWN	Dec-16	6.82	2615	1.70±7.96E-09	**1.50±0.02E-06**	8.18±8.23E-08
804	DOWN	Mar-16	7.00	1625	-2.66±3.38E-09	2.91±0.08E-07	9.19±7.52E-08
804	DOWN	Jun-16	6.94	1889	2.17±3.29E-09	2.91±0.08E-07	1.33±0.98E-07
804	DOWN	Sep-16	6.75	2571	-1.75±5.29E-09	2.62±0.08E-07	0.86±1.14E-07
804	DOWN	Dec-16	6.87	1925	-3.54±3.89E-09	2.29±0.06E-07	1.13±0.94E-07
1304	DOWN	Mar-16	7.22	2142	1.63±4.62E-09	6.99±4.11E-09	5.84±7.22E-08
1304	DOWN	Jun-16	6.88	3048	3.23±5.67E-09	1.02±0.48E-08	5.57±9.37E-08
1304	DOWN	Sep-16	6.94	2333	-3.44±4.88E-09	1.46±2.87E-09	0.04±1.13E-07
1304	DOWN	Dec-16	7.41	1774	-1.85±5.32E-09	4.18±2.91E-09	0.60±7.73E-08
8603	DOWN	Jun-16	6.66	2497	-1.15±4.76E-09	**7.35±0.01E-05**	4.92±9.13E-08
8603	DOWN	Dec-16	7.29	2552	0.72±7.66E-09	**5.50±0.01E-05**	7.68±8.38E-08
8604	DOWN	Jun-16	7.56	2254	-2.59±0.89E-08	**5.10±0.01E-05**	3.05±9.06E-08
8604	DOWN	Dec-16	7.11	2376	1.17±5.47E-09	**4.88±0.01E-05**	7.13±9.93E-08
8605	DOWN	Mar-16	6.70	604	8.05±2.07E-09	**5.18±0.02E-06**	0.96±1.12E-07
8605	DOWN	Jun-16	6.71	898	3.57±5.01E-09	**7.76±0.03E-06**	1.67±8.81E-08
8605	DOWN	Sep-16	6.84	1715	**1.84±0.59E-08**	**4.93±0.03E-06**	1.25±1.03E-07
8605	DOWN	Dec-16	6.55	772	**2.88±0.44E-08**	**7.03±0.02E-06**	0.51±1.03E-07
8607	DOWN	Mar-16	6.72	1643	-0.96±2.17E-09	4.34±0.34E-08	8.31±7.37E-08
8607	DOWN	Jun-16	6.80	2475	-6.54±4.76E-09	3.38±0.58E-08	9.42±8.24E-08
8607	DOWN	Sep-16	6.60	1270	-1.23±2.81E-09	1.98±0.22E-08	0.26±1.11E-07
8607	DOWN	Dec-16	6.93	1059	-1.60±3.04E-09	1.76±0.21E-08	3.14±8.23E-08
8609	DOWN	Mar-16	7.17	2476	-1.11±2.17E-09	9.30±0.16E-07	1.05±1.13E-07
8609	DOWN	Jun-16	7.29	2823	-3.21±7.06E-09	**1.72±0.02E-06**	9.23±9.20E-08
8609	DOWN	Sep-16	7.02	2936	-2.28±7.32E-09	**1.46±0.02E-06**	**2.00±1.07E-07**
8609	DOWN	Dec-16	7.09	2800	-3.96±4.87E-09	**1.40±0.02E-06**	1.54±0.97E-07

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2A *(continued)*
2016 Indicator Results From the Sand and Gravel Unit

Location Code	*Hydraulic Position* [a]	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
8612	DOWN	Mar-16	7.22	2518	1.12±4.50E-09	5.05±0.49E-08	1.24±0.90E-07
8612	DOWN	Jun-16	7.26	2420	-2.24±4.59E-09	5.60±0.52E-08	1.23±0.97E-07
8612	DOWN	Sep-16	7.02	2539	-4.90±5.08E-09	6.33±0.45E-08	0.88±1.13E-07
8612	DOWN	Dec-16	7.15	2466	-0.69±6.08E-09	7.88±0.52E-08	9.45±9.17E-08
MP-01	DOWN	Mar-16	7.36	4304	4.64±5.53E-09	**3.23±0.01E-04**	0.66±1.10E-07
MP-01	DOWN	Jun-16	7.40	4749	0.00±1.16E-08	**3.71±0.01E-04**	3.67±9.76E-08
MP-01	DOWN	Sep-16	7.23	4456	-1.33±1.14E-08	**2.42±0.01E-04**	4.99±9.68E-08
MP-01	DOWN	Dec-16	7.29	3748	-8.16±6.54E-09	**2.70±0.01E-04**	3.59±7.82E-08
MP-02	DOWN	Mar-16	7.25	3577	1.65±3.24E-09	**3.60±0.01E-04**	0.04±1.04E-07
MP-02	DOWN	Jun-16	7.30	4390	-1.45±1.00E-08	**4.89±0.01E-04**	0.99±1.04E-07
MP-02	DOWN	Sep-16	6.96	3430	-8.60±6.14E-09	**2.58±0.01E-04**	6.72±9.91E-08
MP-02	DOWN	Dec-16	6.96	2335	-9.65±6.37E-09	**2.12±0.01E-04**	8.20±8.34E-08
MP-03	DOWN	Mar-16	7.37	2466	1.92±2.73E-09	**2.24±0.01E-04**	0.65±1.08E-07
MP-03	DOWN	Jun-16	7.38	3468	-7.00±7.53E-09	**4.67±0.01E-04**	3.81±9.58E-08
MP-03	DOWN	Sep-16	7.34	2772	-3.31±6.61E-09	**1.86±0.01E-04**	1.35±1.05E-07
MP-03	DOWN	Dec-16	7.33	2020	-4.01±6.60E-09	**1.98±0.01E-04**	1.30±0.96E-07
MP-04	DOWN	Mar-16	7.57	2987	0.63±4.53E-09	**2.66±0.01E-04**	0.86±1.07E-07
MP-04	DOWN	Jun-16	7.37	3544	-0.81±1.01E-08	**5.10±0.01E-04**	1.02±1.04E-07
MP-04	DOWN	Sep-16	7.27	2817	-5.24±5.43E-09	**2.40±0.01E-04**	1.13±1.04E-07
MP-04	DOWN	Dec-16	7.29	2344	-7.21±4.80E-09	**2.38±0.01E-04**	1.35±0.88E-07
WP-A	DOWN	Sep-16	7.15	138	1.76±9.42E-10	8.02±1.37E-09	**7.31±0.29E-06**
WP-C	DOWN	Sep-16	7.08	1990	3.25±5.12E-09	2.09±0.06E-07	**1.28±0.04E-05**
WP-H	DOWN	Sep-16	6.39	1520	**1.86±0.48E-08**	**8.14±0.03E-06**	**1.61±0.18E-06**
GSEEP	DOWN	Mar-16	7.41	1869	0.00±4.98E-09	2.27±0.07E-07	**2.15±0.85E-07**
GSEEP	DOWN	Jun-16	7.02	2119	3.08±6.55E-09	2.54±0.08E-07	**2.38±0.93E-07**
GSEEP	DOWN	Sep-16	7.07	1829	4.86±3.44E-09	1.95±0.07E-07	**2.74±1.21E-07**
GSEEP	DOWN	Dec-16	7.27	1693	-1.17±4.66E-09	1.36±0.05E-07	**2.21±1.04E-07**

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2A *(concluded)*
2016 Indicator Results From the Sand and Gravel Unit

Location Code	*Hydraulic Position [a]*	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			***NA***	***NA***	***1.50E-08***	***1.00E-06***	***1.78E-07***
SP04	DOWN	Jun-16	NS	NS	0.31±1.03E-08	4.10±0.10E-07	1.32±0.85E-07
SP04	DOWN	Dec-16	NS	NS	0.73±4.38E-09	2.10±0.07E-07	0.45±1.01E-07
SP06	DOWN	Jun-16	NS	NS	-5.63±4.84E-09	5.40±0.11E-07	7.44±8.18E-08
SP06	DOWN	Dec-16	NS	NS	3.44±6.12E-09	2.63±0.07E-07	1.28±0.96E-07
					.		
SP11	DOWN	Jun-16	NS	NS	-5.81±5.07E-09	**1.80±0.02E-06**	6.08±7.86E-08
SP11	DOWN	Dec-16	NS	NS	-4.95±3.92E-09	**1.15±0.01E-06**	9.14±8.37E-08
SP12	DOWN	Jun-16	7.08	2332	-6.66±6.25E-09	3.76±0.10E-07	7.71±8.42E-08
SP12	DOWN	Dec-16	7.22	2392	1.33±0.89E-08	3.30±0.08E-07	5.59±9.65E-08

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

NS - Not sampled.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2B
2016 Indicator Results From the Lavery Till-Sand Unit

Location Code	*Hydraulic Position* [a]	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
204	DOWN	Mar-16	7.47	1928	-0.40±3.61E-09	1.28±3.76E-09	1.44±6.69E-08
204	DOWN	Jun-16	7.33	2046	-0.57±4.28E-09	1.17±3.93E-09	-1.08±8.46E-08
204	DOWN	Sep-16	7.16	2084	-4.47±4.67E-09	-1.09±2.62E-09	-0.58±1.09E-07
204	DOWN	Dec-16	7.50	1888	4.56±3.53E-09	3.82±2.85E-09	7.91±8.99E-08
206	DOWN	Jun-16	7.28	2154	-9.54±6.53E-09	-2.12±3.86E-09	6.01±8.96E-08
206	DOWN	Dec-16	7.38	2066	-2.75±4.12E-09	2.58±2.42E-09	5.09±8.84E-08

NA - Not applicable.
SU - Standard units.
[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.
[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2C
2016 indicator Results From the Weathered Lavery Till Unit

Location Code	*Hydraulic Position* [a]	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
908R	UP	Jun-16	7.20	1489	-4.97±4.53E-09	9.39±3.69E-09	0.77±8.54E-08
908R	UP	Dec-16	7.22	1202	4.22±3.98E-09	8.69±2.34E-09	0.67±9.85E-08
1005	UP	Jun-16	7.27	790	-0.46±2.23E-09	1.45±1.98E-09	0.90±7.67E-08
1005	UP	Dec-16	7.25	740	1.77±2.15E-09	2.63±1.42E-09	1.72±8.38E-08
1008C	UP	Jun-16	7.69	640	-3.82±2.09E-09	0.92±1.62E-09	5.00±8.09E-08
1008C	UP	Dec-16	7.38	560	-0.37±1.77E-09	0.75±1.19E-09	1.08±0.93E-07
906	DOWN	Jun-16	7.45	660	0.18±2.11E-09	4.51±1.53E-09	-0.17±8.35E-08
906	DOWN	Dec-16	7.31	655	0.68±2.41E-09	4.75±1.30E-09	-1.90±9.43E-08
909	DOWN	Jun-16	6.75	1459	1.18±6.52E-09	2.77±0.10E-07	**7.60±1.49E-07**
909	DOWN	Dec-16	6.73	1436	2.65±6.75E-09	2.34±0.07E-07	**6.29±1.43E-07**
1006	DOWN	Jun-16	7.34	1329	1.07±4.32E-09	4.31±4.24E-09	3.82±7.66E-08
1006	DOWN	Dec-16	7.10	1490	-0.44±4.66E-09	3.84±2.53E-09	7.96±8.95E-08
NDATR	DOWN	Mar-16	7.58	804	-0.98±2.11E-09	4.51±0.06E-07	8.96±9.52E-08
NDATR	DOWN	Jun-16	7.75	1028	-1.13±2.14E-09	5.57±0.09E-07	1.18±0.99E-07
NDATR	DOWN	Sep-16	6.93	1060	2.50±1.95E-09	5.70±0.08E-07	5.80±8.56E-08
NDATR	DOWN	Dec-16	6.82	715	-1.28±1.11E-09	3.68±0.04E-07	0.15±1.01E-07

Note: Bolding indicates radiological concentration that exceeds the GSL.
NA - Not applicable.
SU - Standard units.
[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.
[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2D
2016 Indicator Results From the Unweathered Lavery Till

Location Code	*Hydraulic Position [a]*	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			*NA*	*NA*	*1.50E-08*	*1.00E-06*	*1.78E-07*
405	UP	Mar-16	7.71	1689	-5.15±5.16E-09	2.73±3.33E-09	6.78±7.36E-08
405	UP	Jun-16	7.16	1409	-1.01±3.15E-09	4.43±2.44E-09	-0.15±9.10E-08
405	UP	Sep-16	7.25	2016	-5.12±4.84E-09	2.66±2.03E-09	-0.04±1.14E-07
405	UP	Dec-16	7.07	1600	-4.06±4.37E-09	2.84±2.41E-09	1.20±0.95E-07
1303	UP	Mar-16	7.97	253	1.82±1.31E-09	1.88±0.98E-09	-0.02±6.50E-08
1303	UP	Jun-16	7.69	322	-0.56±1.03E-09	1.47±0.78E-09	6.24±8.05E-08
1303	UP	Sep-16	7.71	356	4.54±9.16E-10	1.03±0.69E-09	0.56±1.06E-07
1303	UP	Dec-16	7.84	272	0.91±1.09E-09	9.20±6.68E-10	3.86±8.09E-08
107	DOWN	Mar-16	7.35	818	-0.63±1.73E-09	2.45±0.21E-08	5.21±7.37E-08
107	DOWN	Jun-16	7.73	866	-0.78±2.01E-09	2.10±0.24E-08	2.76±9.30E-08
107	DOWN	Sep-16	7.19	945	-0.91±2.02E-09	2.01±0.17E-08	1.01±1.18E-07
107	DOWN	Dec-16	7.72	652	0.32±1.95E-09	1.65±0.17E-08	1.37±0.94E-07
108	DOWN	Jun-16	7.75	617	-1.93±1.52E-09	2.68±1.32E-09	**2.45±1.02E-07**
108	DOWN	Dec-16	7.67	550	-0.07±1.51E-09	2.34±0.87E-09	**3.15±1.10E-07**
110	DOWN	Mar-16	7.51	576	1.33±1.30E-09	2.80±1.34E-09	**4.88±1.06E-07**
110	DOWN	Jun-16	7.77	574	-3.14±2.05E-09	1.72±1.31E-09	**5.11±1.15E-07**
110	DOWN	Sep-16	7.25	592	-1.15±2.43E-09	1.75±1.04E-09	**5.51±1.37E-07**
110	DOWN	Dec-16	7.51	538	0.32±1.46E-09	2.17±0.84E-09	**4.59±1.02E-07**
409	DOWN	Mar-16	7.98	342	0.16±1.03E-09	2.77±0.85E-09	4.82±7.06E-08
409	DOWN	Jun-16	8.21	344	0.45±1.12E-09	8.17±9.98E-10	-3.22±8.74E-08
409	DOWN	Sep-16	7.89	338	-1.09±0.81E-09	6.52±6.61E-10	0.40±1.15E-07
409	DOWN	Dec-16	7.89	332	0.64±1.05E-09	1.29±0.69E-09	-0.39±7.60E-08
704	DOWN	Mar-16	6.77	976	-1.03±2.24E-09	7.07±2.71E-09	6.57±7.22E-08
704	DOWN	Jun-16	6.84	1034	-1.10±2.74E-09	5.68±2.43E-09	3.15±7.76E-08
704	DOWN	Sep-16	6.47	1104	2.08±2.86E-09	6.21±2.01E-09	0.12±1.15E-07
704	DOWN	Dec-16	6.76	1113	3.77±3.87E-09	4.60±1.76E-09	7.10±8.95E-08
707	DOWN	Jun-16	7.25	618	-0.47±1.53E-09	1.87±1.42E-09	2.27±7.84E-08
707	DOWN	Dec-16	6.95	381	-2.08±8.39E-10	3.77±0.69E-09	8.32±9.10E-08
910R	DOWN	Jun-16	7.17	1384	4.09±3.28E-09	1.38±0.35E-08	-2.37±8.17E-08
910R	DOWN	Dec-16	7.36	1341	2.59±4.83E-09	7.81±2.62E-09	-1.51±9.62E-08

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

SU - Standard units.

[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.

[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2E
2016 Indicator Results From the Kent Recessional Sequence

Location Code	*Hydraulic Position* [a]	*Date Collected*	*pH SU*	*Conductivity µmhos/cm@ 25 ºC*	*Gross Alpha µCi/mL*	*Gross Beta µCi/mL*	*Tritium µCi/mL*
Groundwater Screening Levels [b]			***NA***	***NA***	***1.50E-08***	***1.00E-06***	***1.78E-07***
901	UP	Jun-16	7.20	411	-0.62±1.03E-09	3.13±0.84E-09	-2.82±8.16E-08
901	UP	Dec-16	7.07	385	-3.22±9.18E-10	3.37±0.75E-09	-1.28±9.58E-08
902	UP	Jun-16	7.88	444	-0.16±2.06E-09	3.84±1.27E-09	-4.11±7.99E-08
902	UP	Dec-16	7.98	410	-4.56±8.58E-10	3.07±0.67E-09	-4.06±9.30E-08
1008B	UP	Dec-16	7.82	398	-2.36±1.59E-09	3.47±0.99E-09	5.70±8.63E-08
903	DOWN	Jun-16	7.32	964	-2.27±1.81E-09	3.19±1.39E-09	1.16±8.60E-08
903	DOWN	Dec-16	7.48	898	-0.72±2.50E-09	1.91±1.24E-09	-6.77±9.05E-08
8610	DOWN	Jun-16	7.61	1556	-1.20±3.24E-09	1.29±0.36E-08	-1.36±8.31E-08
8610	DOWN	Dec-16	7.54	1472	0.60±3.52E-09	1.07±0.27E-08	-2.49±9.54E-08
8611	DOWN	Jun-16	7.26	1453	-2.39±2.07E-09	5.64±2.66E-09	-5.66±7.93E-08
8611	DOWN	Dec-16	7.33	1380	1.90±3.49E-09	4.08±1.76E-09	-3.86±9.13E-08

NA - Not applicable.
SU - Standard units.
[a] Hydraulic position is relative to other wells within the same hydrogeologic unit.
[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2F
2016 Results for Metals in Groundwater
Compared With WVDP Groundwater Screening Levels

Location Code	Hydraulic Position	Date Collected	Antimony µg/L	Arsenic µg/L	Barium µg/L	Beryllium µg/L	Cadmium µg/L	Chromium µg/L	Cobalt µg/L	Copper µg/L
Groundwater Screening Levels [a]			***15.1***	***25***	***1,000***	***3***	***7.27***	***52.3***	***67.8***	***200***
Sand and Gravel Unit										
706	UP	Mar-16	<3	<10	<200	<1	<5	**69**	<50	<25
706	UP	Jun-16	<3	<10	<200	<1	<5	41	<50	<25
706	UP	Sep-16	<3	<10	<200	<1	<5	**54**	<50	<25
706	UP	Dec-16	<3	<10	<200	<1	<5	44	<50	<25
1302	UP	Dec-16	<3	<10	<200	<1	<5	<10	<50	<25
111	DOWN	Dec-16	<3	<10	<200	<1	<5	16.1	<50	<25
1304	DOWN	Mar-16	<3	<10	<200	<1	<5	<10	<50	<25
1304	DOWN	Jun-16	<3	<10	<200	<1	<5	<10	<50	<25
1304	DOWN	Sep-16	<3	<10	<200	<1	<5	<10	<50	<25
1304	DOWN	Dec-16	<3	<10	<200	<1	<5	<10	<50	<25
8605	DOWN	Dec-16	<3	<10	<200	<1	<5	<10	<50	<25
MP-01	DOWN	Mar-16	<3	<10	470	<1	<5	<10	<50	<25
MP-01	DOWN	Jun-16	<3	<10	538	<1	<5	<10	<50	<25
MP-01	DOWN	Sep-16	<3	<10	462	<1	<5	10.2	<50	<25
MP-01	DOWN	Dec-16	<3	<10	364	<1	<5	<10	<50	<25
MP-02	DOWN	Mar-16	<3	<10	237	<1	<5	31.5	<50	<25
MP-02	DOWN	Jun-16	<3	<10	335	<1	<5	15.2	<50	<25
MP-02	DOWN	Sep-16	<3	<10	233	<1	<5	33.4	<50	<25
MP-02	DOWN	Dec-16	<3	<10	<200	<1	<5	<10	<50	<25
MP-03	DOWN	Mar-16	<3	<10	299	<1	<5	27.4	<50	<25
MP-03	DOWN	Jun-16	<3	<10	446	<1	<5	25.7	<50	<25
MP-03	DOWN	Sep-16	<3	<10	303	<1	<5	29.7	<50	<25
MP-03	DOWN	Dec-16	<3	<10	272	<1	<5	<10	<50	<25
MP-04	DOWN	Mar-16	<3	<10	314	<1	<5	<10	<50	<25
MP-04	DOWN	Jun-16	<3	<10	368	<1	<5	<10	<50	<25
MP-04	DOWN	Sep-16	<3	<10	259	<1	<5	27.5	<50	<25
MP-04	DOWN	Dec-16	<3	<10	243	<1	<5	<10	<50	<25

Note: Bolding indicates a metal concentration that exceeds the GSL.
NS - Not sampled.

[a] GSLs have been established by selection of the larger of the WVDP background concentration or the 6 NYCRR TOGS 1.1.1 Class GA Groundwater Quality Standards. (See Table D-1B).

TABLE D-2F (*continued*)
2016 Results for Metals in Groundwater
Compared with WVDP Groundwater Screening Levels

Location Code	*Hydraulic Position*	*Date Collected*	*Lead µg/L*	*Mercury µg/L*	*Nickel µg/L*	*Selenium µg/L*	*Silver µg/L*	*Thallium µg/L*	*Tin µg/L*	*Vanadium µg/L*	*Zinc µg/L*
Groundwater Screening Levels [a]			*42.7*	*0.7*	*100*	*10.1*	*50*	*13.9*	*4,083*	*69.6*	*2,000*
Sand and Gravel Unit											
706	UP	Mar-16	<3	<0.2	**260**	<5	<10	<0.5	<3000	<50	<20
706	UP	Jun-16	<3	<0.2	**315**	<5	<10	<0.5	<3000	<50	<20
706	UP	Sep-16	<3	<0.2	**420**	<5	<10	<0.5	<3000	<50	<20
706	UP	Dec-16	<3	<0.2	**230**	<5	<10	<0.5	<3000	<50	<20
1302	UP	Dec-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
111	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
1304	DOWN	Mar-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
1304	DOWN	Jun-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
1304	DOWN	Sep-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
1304	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
8605	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-01	DOWN	Mar-16	<3	<0.2[b]	<40	<5	<10	<2	<3000	<50	<20
MP-01	DOWN	Jun-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-01	DOWN	Sep-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-01	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-02	DOWN	Mar-16	<3	<0.2[b]	<40	<5	<10	<2	<3000	<50	<20
MP-02	DOWN	Jun-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-02	DOWN	Sep-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-02	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-03	DOWN	Mar-16	<3	<0.2[b]	<40	<5	<10	<2	<3000	<50	<20
MP-03	DOWN	Jun-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-03	DOWN	Sep-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	20.4
MP-03	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-04	DOWN	Mar-16	<3	<0.2[b]	<40	<5	<10	<2	<3000	<50	<20
MP-04	DOWN	Jun-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-04	DOWN	Sep-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
MP-04	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20

Note: Bolding indicates a metal concentration that exceeds the GSL.

NS - Not sampled.

[a] GSLs have been established by selection of the larger of the WVDP background concentration or the 6 NYCRR TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1B).

[b] The mercury results for the "MP-" wells reported for the first quarter were from a duplicate sample collected in April 2016 due. Re-sampling was required due to a missed laboratory hold time on the original sample collected in March.

TABLE D-2F (*continued*)
2016 Results for Metals in Groundwater
Compared with WVDP Groundwater Screening Levels

Location Code	*Hydraulic Position*	*Date Collected*	*Antimony µg/L*	*Arsenic µg/L*	*Barium µg/L*	*Beryllium µg/L*	*Cadmium µg/L*	*Chromium µg/L*	*Cobalt µg/L*	*Copper µg/L*
Groundwater Screening Levels [a]			*15.1*	*25*	*1,000*	*3*	*7.27*	*52.3*	*67.8*	*200*
Weathered Lavery Till Unit										
909	DOWN	Dec-16	<3	17	250	<1	<5	<10	<50	<25
NDATR	DOWN	Mar-16	<3	<10	<200	<1	<5	<10	<50	<25
NDATR	DOWN	Jun-16	<3	<10	<200	<1	<5	<10	<50	<25
NDATR	DOWN	Sep-16	<3	<10	<200	<1	<5	<10	<50	<25
NDATR	DOWN	Dec-16	<3	<10	<200	<1	<5	<10	<50	<25
Unweathered Lavery Till Unit										
405	UP	Mar-16	<3	<10	<200	<1	<5	**73**	<50	<25
405	UP	Jun-16	<3	<10	<200	<1	<5	30	<50	<25
405	UP	Sep-16	<3	<10	<200	<1	<5	<10	<50	<25
405	UP	Dec-16	<3	<10	<200	<1	<5	45	<50	<25
1303	UP	Mar-16	<3	<10	<200	<1	<5	<10	<50	<25
1303	UP	Jun-16	<3	<10	<200	<1	<5	<10	<50	<25
1303	UP	Sep-16	<3	<10	<200	<1	<5	<10	<50	<25
1303	UP	Dec-16	<3	<10	<200	<1	<5	<10	<50	<25

[a] GSLs have been established by selection of the larger of the WVDP background concentration or the 6 NYCRR TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1B).

TABLE D-2F (*concluded*)
2016 Results for Metals in Groundwater
Compared with WVDP Groundwater Screening Levels

Location Code	*Hydraulic Position*	*Date Collected*	*Lead µg/L*	*Mercury µg/L*	*Nickel µg/L*	*Selenium µg/L*	*Silver µg/L*	*Thallium µg/L*	*Tin µg/L*	*Vanadium µg/L*	*Zinc µg/L*
Groundwater Screening Levels [a]			*42.7*	*0.7*	*100*	*10.1*	*50*	*13.9*	*4,083*	*69.6*	*2,000*
Weathered Lavery Till Unit											
909	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
NDATR	DOWN	Mar-16	<3	<0.2[b]	<40	<5	<10	<2	<3000	<50	<20
NDATR	DOWN	Jun-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
NDATR	DOWN	Sep-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
NDATR	DOWN	Dec-16	<3	<0.2	<40	<5	<10	<2	<3000	<50	<20
Unweathered Lavery Till Unit											
405	UP	Mar-16	<3	<0.2	**600**	<5	<10	<0.5	<3000	<50	<20
405	UP	Jun-16	<3	<0.2	**500**	<5	<10	<0.5	<3000	<50	<20
405	UP	Sep-16	<3	<0.2	**230**	<5	<10	<0.5	<3000	<50	<20
405	UP	Dec-16	<3	<0.2	**480**	<5	<10	<0.5	<3000	<50	<20
1303	UP	Mar-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
1303	UP	Jun-16	5.2	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
1303	UP	Sep-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20
1303	UP	Dec-16	<3	<0.2	<40	<5	<10	<0.5	<3000	<50	<20

Note: Bolding indicates a metal concentration that exceeds the GSL.

[a] GSLs have been established by selection of the larger of the WVDP background concentration or the 6 NYCRR TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1B).

[b] The mercury results for March 2016 were rejected. The results shown are from a second sample that was collected for mercury analysis only on April 25, 2016.

TABLE D-2G
2016 Radioactivity in Groundwater From Selected Monitoring Locations

Location	Hydraulic Position [a]	Date Collected	C-14 µCi/mL	Sr-90 µCi/mL	Tc-99 µCi/mL	I-129 µCi/mL	Cs-137 µCi/mL	Ra-226 µCi/mL
Groundwater Screening Levels [b]			2.82E-08	5.90E-09	5.02E-09	9.61E-10	1.03E-08	1.33E-09
Sand and Gravel Unit								
401	UP	Dec-16	1.52±2.83E-08	2.35±9.75E-10	1.20±1.88E-09	-0.04±1.96E-10	0.32±3.05E-09	7.15±2.52E-10
406	DOWN	Dec-16	1.88±2.84E-08	1.57±1.23E-09	0.54±1.95E-09	1.24±4.20E-10	-0.49±2.34E-09	0.98±1.76E-10
408	DOWN	Dec-16	-0.82±2.92E-08	**6.45±0.01E-05**	**1.94±0.28E-08**	0.95±1.29E-09	1.05±1.71E-09	**1.50±0.54E-09**
501	DOWN	Dec-16	NS	**3.74±0.01E-05**	NS	NS	NS	NS
502	DOWN	Dec-16	NS	**2.97±0.01E-05**	NS	NS	NS	NS
801	DOWN	Dec-16	NS	**1.28±0.02E-06**	NS	NS	NS	NS
1304	DOWN	Dec-16	-0.05±2.79E-08	1.71±1.19E-09	-1.76±2.30E-09	0.23±2.76E-10	-1.52±3.56E-09	1.80±1.41E-10
8609	DOWN	Dec-16	NS	**6.80±0.13E-07**	NS	NS	NS	NS
MP-01	DOWN	Dec-16	-2.26±2.86E-08	**1.05±0.01E-04**	**4.45±0.31E-08**	-0.27±1.22E-09	-2.25±2.63E-09	NS
MP-02	DOWN	Dec-16	2.08±2.97E-08	**9.49±0.02E-05**	**4.72±0.35E-08**	-0.64±1.22E-09	3.98±2.30E-09	NS
MP-03	DOWN	Dec-16	1.59±3.03E-08	**8.07±0.01E-05**	**3.63±0.29E-08**	1.15±1.14E-09 [c]	-0.30±2.19E-09	NS
MP-04	DOWN	Dec-16	-1.89±2.88E-08	**1.08±0.01E-04**	**3.56±0.29E-08**	0.12±1.45E-09	1.42±2.43E-09	NS
Weathered Lavery Till Unit								
909	DOWN	Dec-16	1.46±2.82E-08	**1.31±0.05E-07**	0.12±1.76E-09	**1.08±0.09E-08**	-1.10±2.73E-09	5.63±2.49E-10
NDATR	DOWN	Jun-16	-2.30±2.66E-08	**1.94±0.07E-07**	0.63±1.92E-09	**1.60±0.31E-08**	0.58±2.52E-09	4.72±1.96E-10
NDATR	DOWN	Dec-16	-0.55±2.94E-08	**1.79±0.07E-07**	-0.67±1.93E-09	**2.29±0.29E-08**	0.79±1.99E-09	3.69±1.71E-10

Note: Bolding indicates radiological concentration that exceeds the GSL.
NS - Not sampled.
[a] Hydraulic position is relative to other wells within the same hydrologic unit.
[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).
[c] This result is not bolded because it was flagged with a "UJ" as not detected above the level of the associated value. The sample quantitation limit is an estimated quantity.

TABLE D-2G (*continued*)
2016 Radioactivity in Groundwater From Selected Monitoring Locations

Location	*Hydraulic Position* [a]	*Date Collected*	*Ra-228 µCi/mL*	*U-232 µCi/mL*	*U-233/234 µCi/mL*	*U-235/236 µCi/mL*	*U-238 µCi/mL*	*Total U µg/mL*
Groundwater Screening Levels [b]			*2.16E-09*	*1.38E-10*	*6.24E-10*	*8.07E-11*	*4.97E-10*	*1.34E-03*
Sand and Gravel Unit								
401	UP	Dec-16	8.33±6.16E-10	0.73±4.69E-11	4.05±1.37E-10	**1.47±0.85E-10**	2.01±0.99E-10	7.13±0.32E-04
406	DOWN	Dec-16	4.08±4.92E-10	-0.75±3.34E-11	3.01±1.38E-10	3.91±6.33E-11	1.19±0.92E-10	4.64±0.22E-04
408	DOWN	Dec-16	**8.22±0.86E-09**	-0.04±5.44E-11	5.61±1.76E-10	**9.73±7.73E-11**	4.16±1.51E-10	1.12±0.05E-03
1304	DOWN	Dec-16	6.30±5.20E-10	-1.39±4.74E-11	4.13±1.49E-10	5.88±6.34E-11	1.63±0.96E-10	4.97±0.22E-04
MP-01	DOWN	Dec-16	NS	6.60±8.42E-11	5.47±1.84E-10	5.72±6.75E-11	4.10±1.61E-10	NS
MP-02	DOWN	Dec-16	NS	6.89±8.45E-11	5.73±1.62E-10	8.01±6.79E-11	2.33±1.08E-10	NS
MP-03	DOWN	Dec-16	NS	-0.85±6.84E-11	**1.12±0.22E-09**	**8.57±6.54E-11**	**7.93±1.85E-10**	NS
MP-04	DOWN	Dec-16	NS	-3.98±5.94E-11	**1.26±0.22E-09**	**1.39±0.78E-10**	**9.86±1.99E-10**	NS
Weathered Lavery Till Unit								
909	DOWN	Dec-16	1.01±4.00E-10	-0.23±3.41E-11	4.63±1.39E-10	5.36±5.75E-11	**5.88±1.53E-10**	**1.46±0.07E-03**
NDATR	DOWN	Jun-16	6.00±3.49E-10	-1.80±7.92E-11	**1.59±0.35E-09**	3.00±6.90E-11	**1.00±0.28E-09**	**3.27±0.16E-03**
NDATR	DOWN	Dec-16	1.90±4.44E-10	5.80±5.65E-11	**1.12±0.16E-09**	**9.31±5.17E-11**	**7.06±1.23E-10**	**2.24±0.09E-03**

Note: Bolding indicates radiological concentration that exceeds the GSL.
NS - Not sampled.
[a] Hydraulic position is relative to other wells within the same hydrologic unit.
[b] The GSLs for radiological constituents are set equal to the larger of the background concentrations or the TOGS 1.1.1 Class GA Groundwater Quality Standards (See Table D-1A).

TABLE D-2G (*concluded)*
2016 Radioactivity in Groundwater From Selected Monitoring Locations

Location	*Hydraulic Position* [a]	*Date Collected*	*Np-237* [b] *µCi/mL*	*Pu-238* [b] *µCi/mL*	*Pu-239/240* [b] *µCi/mL*	*Pu-241* [b] *µCi/mL*	*Am-241* [b] *µCi/mL*	*Cm-243/244* [b] *µCi/mL*
Sand and Gravel Unit								
MP-01	DOWN	Dec-16	4.72±8.98E-11	-0.70±3.08E-11	0.06±4.29E-11	2.44±9.41E-09	-0.53±4.53E-11	-0.52±4.48E-11
MP-02	DOWN	Dec-16	0.99±1.34E-10	-0.70±3.12E-11	-0.35±3.04E-11	-0.03±1.02E-08	-1.69±5.65E-11	-0.61±2.68E-11
MP-03	DOWN	Dec-16	1.78±7.97E-11	0.93±5.15E-11	3.21±7.28E-11	-0.07±1.22E-08	0.05±3.61E-11	0.00±2.43E-11
MP-04	DOWN	Dec-16	-3.78±3.94E-11	0.49±5.13E-11	-1.61±5.45E-11	-0.18±1.16E-08	3.17±5.03E-11	-0.30±2.57E-11

[a] Hydraulic position is relative to other wells within the same hydrologic unit.
[b] Groundwater screening levels have not been established for Np-237, Pu-238, Pu-239/240, Pu-241, Am-241, or Cm-234/244.

APPENDIX E

Summary of Biological Data

TABLE E-1
2016 Radioactivity Concentrations in Milk

Location	*K-40 (µCi/mL)*	*Sr-90 (µCi/mL)*	*I-129 (µCi/mL)*	*Cs-137 (µCi/mL)*
BFMFLDMN Annual	1.45±0.13E-06	0.73±1.04E-09	1.34±3.23E-10	0.84±3.20E-09
BFMCTLS (2012) (Background) Once every five years	1.17±0.16E-06	-5.06±5.98E-10	0.44±1.80E-10	-1.33±3.66E-09

Note: The near-site milk sample (BFMFLDMN) is located 5.1 km southeast of the site. The control milk sample (BFMCTLS) was last sampled in 2012. It will be sampled again in 2017.

TABLE E-2
2016 Radioactivity Concentrations in Venison

Location	*% Moisture*	*H-3 (µCi/mL)*	*K-40 (µCi/g - dry)*	*Sr-90 (µCi/g - dry)*	*Cs-137 (µCi/g - dry)*
Deer Flesh Background (BFDCTRL 10/17/2016)	75.4	1.15±1.03E-07	1.15±0.11E-05	-1.09±2.70E-09	1.22±2.30E-08
Deer Flesh Background (BFDCTRL 10/17/2016)	74.9	4.44±1.28E-07	1.07±0.11E-05	-1.07±2.71E-09	7.46±4.08E-08
Deer Flesh Background (BFDCTRL 11/10/2016)	73.3	1.36±1.05E-07	8.87±0.70E-06	-0.60±2.69E-09	8.60±3.19E-08
Deer Flesh Near-Site (BFDNEAR 1/3/2017)	73.7	1.56±1.08E-07	1.10±0.06E-05	0.04±2.20E-09	2.87±0.30E-07
Deer Flesh Near-Site (BFDNEAR 1/17/2017)	73.9	1.01±0.85E-07	1.11±0.07E-05	-2.09±2.54E-09	4.89±2.57E-08
Deer Flesh Near-Site (BFDNEAR 3/23/2017)	74.9	1.23±1.12E-07	1.13±0.08E-05	-0.41±2.61E-09	1.96±2.74E-08

TABLE E-3
2016 Radioactivity Concentrations in Food Crops

The frequency of sampling of food crops has been decreased from annual to once every five years, consistent with guidance on periodic confirmatory sampling in DOE-HDBK-1216-2015.
Food crops will next be sampled in CY 2017.

TABLE E-4
2016 Radioactivity Concentrations in Edible Portions of Fish

The frequency of sampling fish has been decreased from annual to once every five years, consistent with guidance on periodic confirmatory sampling in DOE-HDBK-1216-2015. .
Fish will next be sampled in CY 2017.

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APPENDIX F

Summary of Direct Radiation Monitoring Data

TABLE F-1

Summary of 2016 Semiannual Averages of Off-Site TLD Measurements [a]

(mR±2 SD/quarter)

Location Number [b]	*1st Half*	*2nd Half*	*Location Average*
DFTLD01	16±1	17±1	16±1
DFTLD02	15±1	16±1	15±1
DFTLD03	13±1	13±1	13±1
DFTLD04	15±1	16±1	15±1
DFTLD05	14±1	15±2	15±1
DFTLD06	14±1	15±1	15±1
DFTLD07	13±1	13±2	13±2
DFTLD08	15±1	16±1	15±1
DFTLD09	15±1	15±1	15±1
DFTLD10	13±1	14±1	13±1
DFTLD11	14±1	14±1	14±1
DFTLD12	14±1	14±1	14±1
DFTLD13	16±1	17±1	16±1
DFTLD14	14±1	15±1	15±1
DFTLD15	14±1	15±1	15±1
DFTLD16	14±1	15±1	14±1
DFTLD20	12±1	13±1	13±1
DFTLD23 (Background)	15±1	16±1	16±1

[a] The frequency of collection at the TLD locations was reduced from quarterly to semiannual in 2008, however data are reported in units of mR per quarter for comparability with historical results.

[b] Off-site locations are shown on Figures A-13 and A-14.

Conversion factor: Milliroentgen (mR) units are used to report exposure rates in air. To convert mR to mrem (dose to humans), a conversion factor of 1.03 must be applied. For example, a reported exposure rate of 18.1mR/quarter would be equivalent to 18.6 mrem/quarter (based upon dose-equivalent phantom calibration using cesium-137).

TABLE F-2

Summary of 2016 Semiannual Averages of On-Site TLD Measurements [a]

(mR±2SD/quarter)

Location Number [b]	***1st Half***	***2nd Half***	***Location Average***
DNTLD24	505±50	518±35	511±43
DNTLD28	16±1	17±1	16±1
DNTLD32	15±1	17±1	16±1
DNTLD33	17±1	19±1	18±1
DNTLD35	16±1	17±1	17±1
DNTLD36	14±1	15±1	15±1
DNTLD38	47±6	53±6	50±6
DNTLD40	107±16	113±10	110±13
DNTLD43	13±1	14±1	14±1
DNTLD44	17±1	18±1	18±1

[a] The frequency of collection at the TLD locations was reduced from quarterly to semiannual in 2008, however data are reported in units of mR per quarter for comparability with historical results.

[b] On-site locations are shown on Figure A-12.

Conversion factor: Milliroentgen (mR) units are used to report exposure rates in air. To convert mR to mrem (dose to humans), a conversion factor of 1.03 must be applied. For example, a reported exposure rate of 18.1mR/quarter would be equivalent to 18.6 mrem/quarter (based upon dose-equivalent phantom calibration using cesium-137).

APPENDIX G

Summary of Quality Assurance Crosscheck Analyses

TABLE G-1

Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 34; March 2016

Analyte	*Matrix*	*Units*	*Reported Value*	*Reference Value*	*Acceptance Range*	*Accept?[b]*	*Analyzed by:*
MAPEP – 16 – GrF34, Air Filter – Gross Alpha/Beta							
Gross alpha	Air Filter	Bq/sample	0.892	1.20	0.36 - 2.04	Yes	ES
Gross beta	Air Filter	Bq/sample	0.781	0.79	0.40 - 1.19	Yes	ES
MAPEP – 16 – RdF34, Air Filter – Radiological							
Am-241	Air Filter	Bq/sample	0.0751	0.0805	0.0564 - 0.1047	Yes	GEL
Cs-137	Air Filter	Bq/sample	2.30	2.30	1.61 - 2.99	Yes	ES
Co-60	Air Filter	Bq/sample	3.98	4.02	2.81 - 5.23	Yes	ES
Cs-137	Air Filter	Bq/sample	2.37	2.30	1.61 - 2.99	Yes	GEL
Co-60	Air Filter	Bq/sample	4.17	4.02	2.81 - 5.23	Yes	GEL
Pu-238	Air Filter	Bq/sample	0.0593	0.0637	0.0446 - 0.0828	Yes	GEL
Pu-239/240	Air Filter	Bq/sample	0.0889	0.099	0.069 - 0.129	Yes	GEL
Sr-90	Air Filter	Bq/sample	1.01	1.38	0.97 - 1.79	W	GEL
U-234/233	Air Filter	Bq/sample	0.170	0.165	0.116 - 0.215	Yes	GEL
U-238	Air Filter	Bq/sample	0.179	0.172	0.120 - 0.224	Yes	GEL
U – total	Air Filter	µg/sample	14.0	13.9	9.7 - 18.1	Yes	GEL
MAPEP – 16 – GrW34, Water – Gross Alpha/Beta							
Gross alpha	Water	Bq/L	0.564	0.673	0.202 - 1.144	Yes	ES
Gross beta	Water	Bq/L	2.35	2.15	1.08 - 3.23	Yes	ES
Gross alpha	Water	Bq/L	0.957	0.673	0.202 - 1.144	Yes	GEL
Gross beta	Water	Bq/L	2.39	2.15	1.08 - 3.23	Yes	GEL
MAPEP – 16 – XaW34, Water – Alkaline							
Iodine-129	Water	Bq/L	4.00	3.85	2.70 - 5.01	Yes	GEL
MAPEP – 16 – MaW34, Water – Radiological							
Cs-137	Water	Bq/L	20.8	21.2	14.8 - 27.6	Yes	ES
Co-60	Water	Bq/L	11.6	11.8	8.3 - 15.3	Yes	ES
H-3	Water	Bq/L	-0.943	[c]	*False Positive Test*[d]	Yes	ES
Sr-90	Water	Bq/L	8.49	8.74	6.12 - 11.36	Yes	ES
Am-241	Water	Bq/L	0.0113	[c]	*False Positive Test*[d]	Yes	GEL
Cs-137	Water	Bq/L	21.8	21.2	14.8 - 27.6	Yes	GEL
Co-60	Water	Bq/L	12.2	11.8	8.3 - 15.3	Yes	GEL
H-3	Water	Bq/L	0.878	[c]	*False Positive Test*[d]	Yes	GEL
Pu-238	Water	Bq/L	1.14	1.244	0.871 - 1.617	Yes	GEL
Pu-239/240	Water	Bq/L	0.586	0.641	0.449 - 0.833	Yes	GEL
Ra-226	Water	Bq/L	1.450	0.718	0.503 - 0.933	No	GEL
Sr-90	Water	Bq/L	7.12	8.74	6.12 - 11.36	Yes	GEL
Tc-99	Water	Bq/L	0.0453	[c]	*False Positive Test*[d]	Yes	GEL
U-234/233	Water	Bq/L	1.370	1.48	1.04 - 1.92	Yes	GEL
U-238	Water	Bq/L	1.43	1.53	1.07 - 1.99	Yes	GEL

Note: This report includes only those matrix/analyte combinations performed in support of the analysis of environmental samples collected as part of the WVDP monitoring program or special investigations.

ES - WVDP Environmental Services. GEL - GEL Laboratories, LLC.

[a] MAPEP monitors performance and requests corrective action as required.

[b] "Yes" - Result acceptable. "W" - Result acceptable with warning 20% < Bias < 30%.

[c] Although no actual reference value or acceptance range was provided, the results were assessed by MAPEP as acceptable.

[d] The false positive test is used to identify laboratory results indicating the presence of an analyte, when, in fact, the analyte is far below the detection limit.

TABLE G-1 (continued)
Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 34; March 2016

Analyte	*Matrix*	*Units*	*Reported Value*	*Reference Value*	*Acceptance Range*	*Accept?[b]*	*Analyzed by:*
MAPEP – 16– MaW34, Water – Inorganic							
Antimony	Water	mg/L	14.0	14.2	9.9 - 18.5	Yes	GEL
Arsenic	Water	mg/L	2.75	2.65	1.86 - 3.45	Yes	GEL
Barium	Water	mg/L	0.052	0.054	*Sensitivity Evaluation[e]*	Yes	GEL
Beryllium	Water	mg/L	4.61	4.78	*3.35 - 6.21*	Yes	GEL
Cadmium	Water	mg/L	0.462	0.470	*0.329 - 0.611*	Yes	GEL
Chromium	Water	mg/L	3.68	3.88	2.72 - 5.04	Yes	GEL
Cobalt	Water	mg/L	-0.00072	[c]	*False Positive Test[d]*	Yes	GEL
Copper	Water	mg/L	16.3	16.6	11.6 - 21.6	Yes	GEL
Lead	Water	mg/L	4.64	4.88	3.42 - 6.34	Yes	GEL
Mercury	Water	mg/L	0.178	0.182	0.127 - 0.237	Yes	GEL
Nickel	Water	mg/L	19.4	19.9	13.9 - 25.9	Yes	GEL
Selenium	Water	mg/L	0.724	0.7669	0.5368 - 0.9970	Yes	GEL
Thallium	Water	mg/L	4.3	4.7	3.3 - 6.1	Yes	GEL
Uranium – total	Water	mg/L	0.133	0.124	0.087 - 0.161	Yes	GEL
Vanadium	Water	mg/L	19.5	19.9	13.9 - 25.9	Yes	GEL
Zinc	Water	mg/L	18.3	19.5	13.7 - 25.4	Yes	GEL
MAPEP – 16 – MaS34, Soil – Inorganic							
Antimony	Soil	mg/kg	130	148.8	104.2 - 193.4	Yes	GEL
Arsenic	Soil	mg/kg	36.4	41	29 - 53	Yes	GEL
Barium	Soil	mg/kg	302	321.8	225.3 - 418.3	Yes	GEL
Beryllium	Soil	mg/kg	37.8	42	29 - 55	Yes	GEL
Cadmium	Soil	mg/kg	0.145	0.163	*Sensitivity Evaluation[e]*	Yes	GEL
Chromium	Soil	mg/kg	93.7	99	69 - 129	Yes	GEL
Cobalt	Soil	mg/kg	172	200	140 - 260	Yes	GEL
Copper	Soil	mg/kg	163	167.6	117.3 - 217.9	Yes	GEL
Lead	Soil	mg/kg	69.8	76.11	53.28 - 98.94	Yes	GEL
Mercury	Soil	mg/kg	0.631	0.636	0.445 - 0.827	Yes	GEL
Nickel	Soil	mg/kg	87.5	87.1	61.0 - 113.2	Yes	GEL
Selenium	Soil	mg/kg	1.87	0.62	*Sensitivity Evaluation[e]*	No	GEL
Silver	Soil	mg/kg	33.6	33.5	23.5 - 43.6	Yes	GEL
Thallium	Soil	mg/kg	74.9	78.6	55.0 - 102.2	Yes	GEL
Uranium – total	Soil	mg/kg	12.6	11.8	8.3 - 15.3	Yes	GEL
Vanadium	Soil	mg/kg	141	149	104 - 194	Yes	GEL
Zinc	Soil	mg/kg	422	471	330 - 612	Yes	GEL

GEL - GEL Laboratories, LLC.
[a] MAPEP monitors performance and requests corrective action as required.
[b] "Yes" - Result acceptable. "W" - Result acceptable with warning 20%<Bias<30%.
[c] Although no actual reference value or acceptance range was provided, the results were assessed by MAPEP as acceptable.
[d] The false positive test is used to identify laboratory results indicating the presence of an analyte, when, in fact, the analyte is far below the detection limit.
[e] A sensistivity evaluation tests the laboratory's ability to measure the analyte near the detection limit.

TABLE G-1 (continued)
Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 34; March 2016

Analyte	*Matrix*	*Units*	*Reported Value*	*Reference Value*	*Acceptance Range*	*Accept?[b]*	*Analyzed by:*
MAPEP – 16– MaS34, Soil – Radiological							
Am-241	Soil	Bq/kg	111	103	72 - 134	Yes	GEL
Cs-137	Soil	Bq/kg	2.57	[c]	*False Positive Test*[d]	Yes	GEL
Co-60	Soil	Bq/kg	1270	1190	833 - 1547	Yes	GEL
Pu-238	Soil	Bq/kg	60.1	63.6	44.5 - 82.7	Yes	GEL
Pu-239/240	Soil	Bq/kg	1.15	0.21	*Sensitivity Evaluation*[e]	Yes	GEL
K-40	Soil	Bq/kg	680	607	425 - 789	Yes	GEL
Sr-90	Soil	Bq/kg	-3.40	[c]	*False Positive Test*[d]	Yes	GEL
Tc-99	Soil	Bq/kg	31.5	[c]	*False Positive Test*[d]	Yes	GEL
U-234/233	Soil	Bq/kg	49.0	45.9	32.1 - 59.7	Yes	GEL
U-238	Soil	Bq/kg	143	146	102 - 190	Yes	GEL
MAPEP – 16 – RdV34, Vegetation – Radiological							
Cs-137	Veg	Bq/sample	5.50	5.62	3.93 - 7.31	Yes	GEL
Co-60	Veg	Bq/sample	-0.0339	[c]	*False Positive Test*[d]	Yes	GEL
Sr-90	Veg	Bq/sample	-0.00648	[c]	*False Positive Test*[d]	Yes	GEL
MAPEP – 16 – OrW34, Water – Organic Compounds							
Heptachlor	Water	µg/L	3.97	4.80	1.99 - 7.60	Yes	GEL
1,2,4-Trichlorobenzene	Water	µg/L	29.8	34.6	7.0 - 62.1	Yes	GEL
1,2-Dichlorobenzene	Water	µg/L	<10	<10	[c]	Yes	GEL
1,3-Dichlorobenzene	Water	µg/L	25.0	29.4	4.5 - 54.4	Yes	GEL
1,4-Dichlorobenzene	Water	µg/L	32.5	36.3	6.5 - 66.1	Yes	GEL
2,4,5-Trichlorophenol	Water	µg/L	46.1	41.8	18.4 - 65.3	Yes	GEL
2,4,6-Trichlorophenol	Water	µg/L	48.6	48.2	22.7 - 73.6	Yes	GEL
2,4-Dichlorophenol	Water	µg/L	24.8	27.8	13.1 - 42.6	Yes	GEL
2,4-Dimethylphenol	Water	µg/L	39.0	42.2	15.8 - 68.6	Yes	GEL
2,4-Dinitrophenol	Water	µg/L	73.1	85	12 - 173	Yes	GEL
2,4-Dinitrotoluene	Water	µg/L	<10	<10	[c]	Yes	GEL
2,6-Dichlorophenol	Water	µg/L	57.4	53.5	22.3 - 84.6	Yes	GEL
2,6-Dinitrotoluene	Water	µg/L	54.5	59.5	30.0 - 89.1	Yes	GEL
2-Chloronaphthalene	Water	µg/L	<1	<10	[c]	Yes	GEL
2-Chlorophenol	Water	µg/L	52.1	55.6	21.7 - 89.4	Yes	GEL
2-Methylnaphthalene	Water	µg/L	<1.0	<10	[c]	Yes	GEL

GEL - GEL Laboratories, LLC.
[a] MAPEP monitors performance and requests corrective action as required.
[b] "Yes" - Result acceptable. "W" - Result acceptable with warning 20% < Bias < 30%.
[c] Although no actual reference value or acceptance range was provided, the results were assessed by MAPEP as acceptable.
[d] The false positive test is used to identify laboratory results indicating the presence of an analyte, when, in fact, the analyte is far below the detection limit.
[e] A sensistivity evaluation tests the laboratory's ability to measure the analyte near the detection limit. This sensitivity evaluation reported a statistically zero result.

TABLE G-1 (concluded)
Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a]; Study 34; March 2016

Analyte	Matrix	Units	Reported Value	Reference Value	Acceptance Range	Accept? [b]	Analyzed by:
MAPEP – 16 – OrW34, Water – Organic Compounds							
2-Methylphenol	Water	µg/L	38.2	41.7	13.5 - 69.9	Yes	GEL
2-Nitrophenol	Water	µg/L	68.6	70.0	28.2 - 111.8	Yes	GEL
4-Methylphenol	Water	µg/L	55.9	56.8	8.4 - 109.5	Yes	GEL
4,6-Dinitro-2-methylphenol	Water	µg/L	31.1	40.4	12.5 - 68.2	Yes	GEL
4-Bromophenyl-phenylether	Water	µg/L	<10	<10	[c]	Yes	GEL
4-Chloro-3-methylphenol	Water	µg/L	31.3	33.2	15.7 - 50.6	Yes	GEL
4-Chlorophenyl-phenylether	Water	µg/L	66.0	82.7	38.3 - 127.2	Yes	GEL
4-Nitrophenol	Water	µg/L	36.5	64	12 - 157	Yes	GEL
Acenaphthene	Water	µg/L	24.9	27.5	12.4 - 42.6	Yes	GEL
Acenaphthylene	Water	µg/L	30.1	32.7	14.1 - 51.3	Yes	GEL
Anthracene	Water	µg/L	26.5	33.9	16.9 - 50.9	Yes	GEL
Benzo(a)anthracene	Water	µg/L	<1.0	<10	[c]	Yes	GEL
Benzo(a)pyrene	Water	µg/L	11.3	19.9	7.8 - 32.0	Yes	GEL
Benzo(b)fluoranthene	Water	µg/L	17.3	28.9	13.1 - 44.7	Yes	GEL
Benzo(g,h,i)perylene	Water	µg/L	<1.0	<10	[c]	Yes	GEL
Benzo(k)fluoranthene	Water	µg/L	20.4	34.8	9.1 - 60.5	Yes	GEL
bis(2-chloroethoxy)methane	Water	µg/L	30.6	31.9	12.4 - 51.3	Yes	GEL
bis(2-chloroethyl)ether	Water	µg/L	65.0	68.7	24.3 - 113.1	Yes	GEL
Bis(2-ethylhexyl)phthalate	Water	µg/L	87.9	113.9	48.0 - 179.7	Yes	GEL
Butylbenzylphthalate	Water	µg/L	<10	<10	[c]	Yes	GEL
Chrysene	Water	µg/L	24.9	37.8	19.6 - 56.1	Yes	GEL
Di-n-butylphthalate	Water	µg/L	109	114.3	49.1 - 179.5	Yes	GEL
Di-n-octylphthalate	Water	µg/L	<10	<10	[c]	Yes	GEL
Dibenzo(a,h)anthracene	Water	µg/L	25.3	34.9	14.2 - 55.7	Yes	GEL
Dibenzofuran	Water	µg/L	<10	<10	[c]	Yes	GEL
Diethylphthalate	Water	µg/L	67.9	79.0	18.3 - 139.8	Yes	GEL
Dimethylphthalate	Water	µg/L	75.2	66.1	9.8 - 142.4	Yes	GEL
Fluoranthene	Water	µg/L	46.7	63.2	34.6 - 91.7	Yes	GEL
Fluorene	Water	µg/L	44.8	51.9	26.7 - 77.1	Yes	GEL
Hexachlorobenzene	Water	µg/L	68.2	91	50 - 133	Yes	GEL
Hexachlorobutadiene	Water	µg/L	42.4	49.5	7.6 - 91.3	Yes	GEL
Hexachlorocyclopentadiene	Water	µg/L	79.6	63	11 - 142	Yes	GEL
Hexachloroethane	Water	µg/L	53.6	57.4	9.7 - 106.8	Yes	GEL
Indeno(1,2,3-c,d)pyrene	Water	µg/L	27.6	36.9	13.4 - 60.4	Yes	GEL
Isophorone	Water	µg/L	53.2	65.3	29.5 - 101.0	Yes	GEL
N-Nitroso-di-n-propylamine	Water	µg/L	<10	<10	[c]	Yes	GEL
N-Nitrosodimethylamine	Water	µg/L	<10	<10	[c]	Yes	GEL
N-Nitrosodiphenylamine	Water	µg/L	<10	<10	[c]	Yes	GEL
Napthalene	Water	µg/L	<1	<10	[c]	Yes	GEL
Nitrobenzene	Water	µg/L	<10	<10	[c]	Yes	GEL
Pentachlorophenol	Water	µg/L	37.4	41.6	13.6 - 69.6	Yes	GEL
Phenanthrene	Water	µg/L	70.5	83	47 - 119	Yes	GEL
Phenol	Water	µg/L	36.4	65	12 - 155	Yes	GEL
Pyrene	Water	µg/L	37.1	50.7	24.3 - 77.0	Yes	GEL

GEL - GEL Laboratories, LLC.
[a] MAPEP monitors performance and requests corrective action as required.
[b] "Yes" - Result acceptable."W" - Result acceptable with warning 20%<Bias<30%.
[c] Although no actual reference value or acceptance range was provided, the results were assessed by MAPEP as acceptable.

TABLE G-2
Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 35; August 2016

Analyte	Matrix	Units	Reported Value	Reference Value	Acceptance Range	Accept?[b]	Analyzed by:
MAPEP – 16 – RdF35, Air Filter – Radiological							
Am-241	Air Filter	Bq/sample	-0.000673	[c]	*False Positive Test*[e]	Yes	GEL
Cs-137	Air Filter	Bq/sample	1.57	1.78	1.25 - 2.31	Yes	ES
Co-60	Air Filter	Bq/sample	3.09	3.26	2.28 - 4.24	Yes	ES
Cs-137	Air Filter	Bq/sample	1.89	1.78	1.25 - 2.31	Yes	GEL
Co-60	Air Filter	Bq/sample	3.3	3.26	2.28 - 4.24	Yes	GEL
Pu-238	Air Filter	Bq/sample	0.0694	0.0693	0.0485 - 0.0901	Yes	GEL
Pu-239/240	Air Filter	Bq/sample	0.0508	0.0535	0.0375 - 0.0696	Yes	GEL
Sr-90	Air Filter	Bq/sample	0.726	1.03	0.72 - 1.34	W	GEL
U-234/233	Air Filter	Bq/sample	0.150	0.150	0.105 - 0.195	Yes	GEL
U-238	Air Filter	Bq/sample	0.152	0.156	0.109 - 0.203	Yes	GEL
U – total	Air Filter	µg/sample	13.6	12.6	8.8 - 16.4	Yes	GEL
MAPEP – 16 – XaW35, Water – Alkaline							
Iodine-129	Water	Bq/L	4.67	*4.54*	3.18 - 5.90	Yes	GEL
MAPEP – 16 – MaW35, Water – Radiological							
Cs-137	Water	Bq/L	0.0636	[c]	*False Positive Test*[e]	Yes	ES
Co-60	Water	Bq/L	0.0174	[c]	*False Positive Test*[e]	Yes	ES
H-3	Water	Bq/L	332	334	234 - 434	Yes	ES
Sr-90	Water	Bq/L	1.91	[c]	*False Positive Test*[e]	No	ES
Am-241	Water	Bq/L	0.725	0.814	0.570 - 1.058	Yes	GEL
Cs-137	Water	Bq/L	-0.089	[c]	*False Positive Test*[e]	Yes	GEL
Co-60	Water	Bq/L	-0.001	[c]	*False Positive Test*[e]	Yes	GEL
H-3	Water	Bq/L	337	334	234 - 434	Yes	GEL
Pu-238	Water	Bq/L	1.09	1.13	0.79 - 1.47	Yes	GEL
Pu-239/240	Water	Bq/L	0.0244	0.013	*Sensitivity Evaluation*[d]	Yes	GEL
Ra-226	Water	Bq/L	1.02	1.33	0.93 - 1.73	Yes	GEL
Sr-90	Water	Bq/L	-0.00289	[c]	*False Positive Test*[e]	Yes	GEL
Tc-99	Water	Bq/L	10.9	11.6	8.1 - 15.1	Yes	GEL
U-234/233	Water	Bq/L	1.85	1.86	1.30 - 2.42	Yes	GEL
U-238	Water	Bq/L	1.89	1.92	1.34 - 2.50	Yes	GEL

Note: This report includes only those matrix/analyte combinations performed in support of the analysis of environmental samples collected as part of the WVDP monitoring program or special investigations.

ES - WVDP Environmental Services. GEL - GEL Laboratories, LLC.

[a] MAPEP monitors performance and requests corrective action as required.

[b] "Yes" - Result acceptable."W" - Result acceptable with warning 20% < bias < 30%.

[c] Although no actual reference value or acceptance range was provided, the results were assessed by MAPEP as acceptable.

[d] A sensistivity evaluation tests the laboratory's ability to measure the analyte near the detection limit. This sensitivity evaluation reported a statistically zero result.

[e] The false positive test is used to identify laboratory results indicating the presence of an analyte, when, in fact, the analyte is far below the detection limit.

TABLE G-2 (continued)
Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 35; August 2016

Analyte	*Matrix*	*Units*	*Reported Value*	*Reference Value*	*Acceptance Range*	*Accept?[b]*	*Analyzed by:*
MAPEP – 16 – MaW35, Water – Inorganic							
Antimony	Water	mg/L	5.38	5.26	3.68 - 6.84	Yes	GEL
Arsenic	Water	mg/L	4.37	4.08	2.86 - 5.30	Yes	GEL
Barium	Water	mg/L	6.30	6.9	4.8 - 9.0	Yes	GEL
Beryllium	Water	mg/L	0.956	1.02	0.71 - 1.33	Yes	GEL
Cadmium	Water	mg/L	0.737	0.762	0.533 - 0.991	Yes	GEL
Chromium	Water	mg/L	2.24	2.35	1.65 - 3.06	Yes	GEL
Cobalt	Water	mg/L	7.20	7.73	5.41 - 10.05	Yes	GEL
Copper	Water	mg/L	10.3	10.6	7.4 - 13.8	Yes	GEL
Lead	Water	mg/L	2.86	3.04	2.13 - 3.95	Yes	GEL
Mercury	Water	mg/L	0.151	0.125	0.088 - 0.163	W	GEL
Nickel	Water	mg/L	12.0	12.5	8.8 - 16.3	Yes	GEL
Selenium	Water	mg/L	0.531	0.563	0.394 - 0.732	Yes	GEL
Thallium	Water	mg/L	1.56	1.84	1.29 - 2.39	Yes	GEL
Uranium – total	Water	mg/L	0.163	0.156	0.109 - 0.203	Yes	GEL
Vanadium	Water	mg/L	3.00	2.91	2.04 - 3.78	Yes	GEL
Zinc	Water	mg/L	11.7	11.8	8.3 - 15.3	Yes	GEL
MAPEP – 16 – MaS35, Soil – Inorganic							
Antimony	Soil	mg/kg	56.8	82	57 - 107	No	GEL
Arsenic	Soil	mg/kg	22.1	25.3	17.7 - 32.9	Yes	GEL
Barium	Soil	mg/kg	149	155	109 - 202	Yes	GEL
Beryllium	Soil	mg/kg	4.13	4.13	2.89 - 5.37	Yes	GEL
Cadmium	Soil	mg/kg	4.23	4.74	3.32 - 6.16	Yes	GEL
Chromium	Soil	mg/kg	72.3	78.6	55.0 - 102.2	Yes	GEL
Cobalt	Soil	mg/kg	75.1	82.2	57.5 - 106.9	Yes	GEL
Copper	Soil	mg/kg	127	123	86 - 160	Yes	GEL
Lead	Soil	mg/kg	33.7	34.4	24.1 - 44.7	Yes	GEL
Mercury	Soil	mg/kg	0.198	0.204	0.143 - 0.265	Yes	GEL
Nickel	Soil	mg/kg	221	236	165 - 307	Yes	GEL
Selenium	Soil	mg/kg	15.4	17.7	12.4 - 23.0	Yes	GEL
Silver	Soil	mg/kg	23.5	23.5	16.5 - 30.6	Yes	GEL
Thallium	Soil	mg/kg	29.8	34.5	24.2 - 44.9	Yes	GEL
Uranium – total	Soil	mg/kg	11.17	9.8	6.9 - 12.7	Yes	GEL
Vanadium	Soil	mg/kg	62.6	65.7	46.0 - 85.4	Yes	GEL
Zinc	Soil	mg/kg	172	198	139 - 257	Yes	GEL

GEL - GEL Laboratories, LLC.
[a] MAPEP monitors performance and requests corrective action as required.
[b] "Yes" - Result acceptable. "W" - Result acceptable with warning 20% < bias < 30%.

TABLE G-2 (continued)
Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 35; August 2016

Analyte	*Matrix*	*Units*	*Reported Value*	*Reference Value*	*Acceptance Range*	*Accept?*[b]	*Analyzed by:*
MAPEP – 16 – MaS35, Soil – Radiological							
Am-241	Soil	Bq/kg	-0.563	[c]	*False Positive Test*[d]	Yes	GEL
Cs-137	Soil	Bq/kg	1180	1067	747 - 1387	Yes	GEL
Co-60	Soil	Bq/kg	889	851	596 - 1106	Yes	GEL
Pu-238	Soil	Bq/kg	69	70.4	49.3 - 91.5	Yes	GEL
Pu-239/240	Soil	Bq/kg	46.8	53.8	37.7 - 69.9	Yes	GEL
K-40	Soil	Bq/kg	619	588	412 - 764	Yes	GEL
Sr-90	Soil	Bq/kg	770	894	626 - 1162	Yes	GEL
Tc-99	Soil	Bq/kg	548	556	389 - 723	Yes	GEL
U-234/233	Soil	Bq/kg	122	122	85 - 159	Yes	GEL
U-238	Soil	Bq/kg	122	121	85 - 157	Yes	GEL
MAPEP – 16 – RdV35, Vegetation – Radiological							
Cs-137	Veg	Bq/sample	5.81	5.54	3.88 - 7.20	Yes	GEL
Co-60	Veg	Bq/sample	4.95	4.86	3.40 - 6.32	Yes	GEL
Sr-90	Veg	Bq/sample	0.575	0.80	0.56 - 1.04	Yes	GEL

GEL - GEL Laboratories, LLC.

[a] MAPEP monitors performance and requests corrective action as required.

[b] "Yes" - Result acceptable. "W" - Result acceptable with warning 20% < bias < 30%.

[c] Although no actual reference value or acceptance range was provided, the results were assessed by MAPEP as acceptable.

[d] The false positive test is used to identify laboratory results indicating the presence of an analyte, when, in fact, the analyte is far below the detection limit.

TABLE G-3
Comparisons of Results From Crosscheck Samples Analyzed for Water Quality Parameters as Part of the EPA's Discharge Monitoring Report - Quality Assurance (DMR-QA) Study 36; (2016) for the National Pollutant Discharge Elimination System (NPDES)

Analyte	*Units*	*Reference Value*	*Reported Value*	*Acceptance Range* [a]	*Accept?* [b]	*Analyzed by:*
Aluminum	µg/L	2,700	2,680	2250 - 3080	Yes	TestAmerica
Aluminum	µg/L	1,770	2,020	1460 - 2030	Yes	GEL
Ammonia (as N)	mg/L	7.93	6.95	6.27 - 9.59	Yes	TestAmerica
Antimony	µg/L	822	757	675 - 944	Yes	TestAmerica
Arsenic (EPA 200.8)	µg/L	552	548	463 - 634	Yes	TestAmerica
Barium	µg/L	160	166	136 - 184	Yes	TestAmerica
Biochemical oxygen demand	mg/L	32.0	27.4	15.5 - 53.3	Yes	TestAmerica
Biochemical oxygen demand	mg/L	61.1	65.4	32.1 - 90.0	Yes	GEL
Cadmium (EPA 200.8)	µg/L	399	402	339 - 459	Yes	TestAmerica
Chlorine (total residual)	µg/L	100	90	40.0 - 160	Yes	WWTF
Chromium (EPA 200.8)	µg/L	164	175	140 - 189	Yes	TestAmerica
Chromium (hexavalent)	µg/L	669	643	562 - 767	Yes	TestAmerica
Cobalt	µg/L	280	269	238 - 322	Yes	TestAmerica
Copper (EPA 200.8)	µg/L	688	658	585 - 792	Yes	TestAmerica
Copper (EPA 200.8)	µg/L	323	333	275 - 371	Yes	GEL
Cyanide, total	mg/L	0.846	0.815	0.550 - 1.14	Yes	TestAmerica
Iron	µg/L	419	426	356 - 482	Yes	TestAmerica
Iron	µg/L	1,780	1,840	1510 - 2050	Yes	GEL
Lead (EPA 200.8)	µg/L	485	437	413 - 558	Yes	TestAmerica
Lead (EPA 200.8)	µg/L	731	731	621 - 841	Yes	GEL
Manganese	µg/L	1,520	1,560	1290 - 1750	Yes	TestAmerica
Mercury (EPA 1631E)	µg/L	7.44	8.06	5.21 - 9.67	Yes	GEL
Nickel	µg/L	556	542	485 - 631	Yes	TestAmerica
Nitrate (as N)	mg/L	12.2	11.3	10.1 - 14.2	Yes	TestAmerica
Nitrite (as N)	mg/L	1.89	2.06	1.60 - 2.18	Yes	TestAmerica
Oil & Grease (Gravimetric)	mg/L	149	139	109 - 170	Yes	TestAmerica
Oil & Grease (Gravimetric)	mg/L	68.0	60.9	46.2 - 80.9	Yes	GEL
pH	SU	7.50	7.52	7.30 - 7.70	Yes	ES
Phosphorus (total, as P)	mg/L	2.66	2.51	2.17 - 3.12	Yes	TestAmerica
Phosphorus (total, as P)	mg/L	9.31	8.96	7.77 - 10.7	Yes	GEL
Selenium (EPA 200.8)	µg/L	383	387	325 - 440	Yes	TestAmerica
Sulfate	mg/L	52.9	46.1	43.6 - 60.6	Yes	TestAmerica
Settleable solids	mL/L	9.4	8.4	6.75 - 12.8	Yes	TestAmerica
Suspended solids (total)	mg/L	33.4	28	24.1 - 39.6	Yes	TestAmerica
Suspended solids (total)	mg/L	35.1	34	25.6 - 41.4	Yes	GEL
Total dissolved solids	mg/L	298	275	253 - 343	Yes	TestAmerica
Total dissolved solids	mg/L	368	331	323 - 413	Yes	GEL
Total Kjeldahl nitrogen (as N)	mg/L	5.45	4.95	3.83 - 7.20	Yes	TestAmerica
Vanadium	µg/L	131	131	112 - 151	Yes	TestAmerica
Zinc	µg/L	1,290	1,330	1090 - 1480	Yes	TestAmerica
Zinc	µg/L	422	414	359 - 485	Yes	GEL

Samples provided by Environmental Resource Associates (ERA) and Phenova.
ES - WVDP Environmental Services
GEL - GEL Laboratories, LLC.
TestAmerica - TestAmerica Laboratories, Inc., Buffalo.
WWTF - WVDP Waste Water Treatment Facility.
[a] Acceptance limits are determined by ERA or Phenova.
[b] "Yes" - Result acceptable; "No" - Result not acceptable.

APPENDIX H

West Valley Demonstration Project Act

(As presented in Exhibit G of the Cooperative Agreement between USDOE and NYSERDA for the WNYNSC at West Valley, New York; effective October 1, 1980 as amended September 18, 1981.)

EXHIBIT G

WEST VALLEY PROJECT DEMONSTRATION ACT

PUBLIC LAW 96–368 [S. 2443]; October 1, 1980

WEST VALLEY DEMONSTRATION PROJECT ACT

For Legislative History of this and other Laws, see Table 1, Public Laws and Legislative History, at end of final volume

An Act to authorize the Department of Energy to carry out a high-level liquid nuclear waste management demonstration project at the Western New York Service Center in West Valley, New York.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

West Valley Demonstration Project Act. 42 USC 2021a note.

SECTION 1. This Act may be cited as the "West Valley Demonstration Project Act".

42 USC 2021a note.

SEC. 2. (a) The Secretary shall carry out, in accordance with this Act, a high level radioactive waste management demonstration project at the Western New York Service Center in West Valley, New York, for the purpose of demonstrating solidification techniques which can be used for preparing high level radioactive waste for disposal. Under the project the Secretary shall carry out the following activities:

Activities.

(1) The Secretary shall solidify, in a form suitable for transportation and disposal, the high level radioactive waste at the Center by vitrification or by such other technology which the Secretary determines to be the most effective for solidification.

(2) The Secretary shall develop containers suitable for the permanent disposal of the high level radioactive waste solidified at the Center.

(3) The Secretary shall, as soon as feasible, transport, in accordance with applicable provisions of law, the waste solidified at the Center to an appropriate Federal repository for permanent disposal.

(4) The Secretary shall, in accordance with applicable licensing requirements, dispose of low level radioactive waste and transuranic waste produced by the solidification of the high level radioactive waste under the project.

(5) The Secretary shall decontaminate and decommission—

(A) the tanks and other facilities of the Center in which the high level radioactive waste solidified under the project was stored,

(B) the facilities used in the solidification of the waste, and

(C) any material and hardware used in connection with the project,

in accordance with such requirements as the Commission may prescribe.

(b) Before undertaking the project and during the fiscal year ending September 30, 1981, the Secretary shall carry out the following:

Hearings.

(1) The Secretary shall hold in the vicinity of the Center public hearings to inform the residents of the area in which the Center is located of the activities proposed to be undertaken under the project and to receive their comments on the project.

(2) The Secretary shall consider the various technologies available for the solidification and handling of high level radioactive waste taking into account the unique characteristics of such waste at the Center.

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(3) The Secretary shall—

(A) undertake detailed engineering and cost estimates for the project,

(B) prepare a plan for the safe removal of the high level radioactive waste at the Center for the purposes of solidification and include in the plan provisions respecting the safe breaching of the tanks in which the waste is stored, operating equipment to accomplish the removal, and sluicing techniques,

(C) conduct appropriate safety analyses of the project, and

(D) prepare required environmental impact analyses of the project.

41 USC 501 note.

(4) The Secretary shall enter into a cooperative agreement with the State in accordance with the Federal Grant and Cooperative Agreement Act of 1977 under which the State will carry out the following:

(A) The State will make available to the Secretary the facilities of the Center and the high level radioactive waste at the Center which are necessary for the completion of the project. The facilities and the waste shall be made available without the transfer of title and for such period as may be required for completion of the project.

(B) The Secretary shall provide technical assistance in securing required license amendments.

State costs, percentage.

(C) The State shall pay 10 per centum of the costs of the project, as determined by the Secretary. In determining the costs of the project, the Secretary shall consider the value of the use of the Center for the project. The State may not use Federal funds to pay its share of the cost of the project, but may use the perpetual care fund to pay such share.

Licensing amendment application.

(D) Submission jointly by the Department of Energy and the State of New York of an application for a licensing amendment as soon as possible with the Nuclear Regulatory Commission providing for the demonstration.

(c) Within one year from the date of the enactment of this Act, the Secretary shall enter into an agreement with the Commission to establish arrangements for review and consultation by the Commission with respect to the project: *Provided*, That review and consultation by the Commission pursuant to this subsection shall be conducted informally by the Commission and shall not include nor require formal procedures or actions by the Commission pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, or any other law. The agreement shall provide for the following:

42 USC 2011 note. 42 USC 5801 note.

(1) The Secretary shall submit to the Commission, for its review and comment, a plan for the solidification of the high level radioactive waste at the Center, the removal of the waste for purposes of its solidification, the preparation of the waste for disposal, and the decontamination of the facilities to be used in solidifying the waste. In preparing its comments on the plan, the Commission shall specify with precision its objections to any provision of the plan. Upon submission of a plan to the Commission, the Secretary shall publish a notice in the Federal Register of the submission of the plan and of its availability for public inspection, and, upon receipt of the comments of the Commission respecting a plan, the Secretary shall publish a notice in the Federal Register of the receipt of the comments and of the availability of the comments for public inspection. If the Secre-

Publications in Federal Register.

tary does not revise the plan to meet objections specified in the comments of the Commission, the Secretary shall publish in the Federal Register a detailed statement for not so revising the plan.

(2) The Secretary shall consult with the Commission with respect to the form in which the high level radioactive waste at the Center shall be solidified and the containers to be used in the permanent disposal of such waste.

(3) The Secretary shall submit to the Commission safety analysis reports and such other information as the Commission may require to identify any danger to the public health and safety which may be presented by the project. Reports and other information to Commission.

(4) The Secretary shall afford the Commission access to the Center to enable the Commission to monitor the activities under the project for the purpose of assuring the public health and safety.

(d) In carrying out the project, the Secretary shall consult with the Administrator of the Environmental Protection Agency, the Secretary of Transportation, the Director of the Geological Survey, and the commercial operator of the Center. Consultation with EPA and others.

SEC. 3. (a) There are authorized to be appropriated to the Secretary for the project not more than $5,000,000 for the fiscal year ending September 30, 1981. Appropriation authorization. 42 USC 2021a note.

(b) The total amount obligated for the project by the Secretary shall be 90 per centum of the costs of the project.

(c) The authority of the Secretary to enter into contracts under this Act shall be effective for any fiscal year only to such extent or in such amounts as are provided in advance by appropriation Acts.

SEC. 4. Not later than February 1, 1981, and on February 1 of each calendar year thereafter during the term of the project, the Secretary shall transmit to the Speaker of the House of Representatives and the President pro tempore of the Senate an up-to-date report containing a detailed description of the activities of the Secretary in carrying out the project, including agreements entered into and the costs incurred during the period reported on and the activities to be undertaken in the next fiscal year and the estimated costs thereof. Report to Speaker of the House and President pro tempore of the Senate. 42 USC 2021a note.

SEC. 5. (a) Other than the costs and responsibilities established by this Act for the project, nothing in this Act shall be construed as affecting any rights, obligations, or liabilities of the commercial operator of the Center, the State, or any person, as is appropriate, arising under the Atomic Energy Act of 1954 or under any other law, contract, or agreement for the operation, maintenance, or decontamination of any facility or property at the Center or for any wastes at the Center. Nothing in this Act shall be construed as affecting any applicable licensing requirement of the Atomic Energy Act of 1954 or the Energy Reorganization Act of 1974. This Act shall not apply or be extended to any facility or property at the Center which is not used in conducting the project. This Act may not be construed to expand or diminish the rights of the Federal Government. 42 USC 2021a note. 42 USC 2011 note. 42 USC 5801 note.

(b) This Act does not authorize the Federal Government to acquire title to any high level radioactive waste at the Center or to the Center or any portion thereof.

SEC. 6. For purposes of this Act: Definitions. 42 USC 2021a note.

(1) The term "Secretary" means the Secretary of Energy.

(2) The term "Commission" means the Nuclear Regulatory Commission.

(3) The term "State" means the State of New York.

(4) The term "high level radioactive waste" means the high level radioactive waste which was produced by the reprocessing at the Center of spent nuclear fuel. Such term includes both liquid wastes which are produced directly in reprocessing, dry solid material derived from such liquid waste, and such other material as the Commission designates as high level radioactive waste for purposes of protecting the public health and safety.

(5) The term "transuranic waste" means material contaminated with elements which have an atomic number greater than 92, including neptunium, plutonium, americium, and curium, and which are in concentrations greater than 10 nanocuries per gram, or in such other concentrations as the Commission may prescribe to protect the public health and safety.

(6) The term "low level radioactive waste" means radioactive waste not classified as high level radioactive waste, transuranic waste, or byproduct material as defined in section 11 e. (2) of the
42 USC 2014. Atomic Energy Act of 1954.

(7) The term "project" means the project prescribed by section 2(a).

(8) The term "Center" means the Western New York Service Center in West Valley, New York.

Approved October 1, 1980.