WEST VALLEY
DEMONSTRATION PROJECT

# Annual Site Environmental Report

CALENDAR YEAR 2021

**PREPARED BY**
CH2M HILL BWXT
West Valley, LLC

**PREPARED FOR**
U.S. Department of Energy
DOE – WVDP

**UNDER CONTRACT**
DE-EM0001529

September 2022
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 2021. Reading this report online will give the reader the ability to navigate to numerous electronic links, which will enhance the overall understanding of the information.

CH2M HILL BWXT West Valley, LLC (CHBWV) continued to perform Phase 1 Decommissioning and Facility Disposition activities for DOE during 2021.

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 CHBWV and the DOE confirm the validity and accuracy of the monitoring data.

At the WVDP, radiological activities are conducted so that public exposure to ionizing radiation will be kept as low as reasonably achievable and not cause a total effective dose exceeding 100 mrem in a year, per DOE Order 458.1, "Radiation Protection of the Public and the Environment." 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. Liquid effluent discharges are controlled and permitted through the New York State Pollutant Discharge Elimination System. Hazardous and mixed wastes are managed 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 as part of a site-wide environmental monitoring program. 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 2021 was estimated to be <5.5% of the 10-millirem (mrem) EPA limit. The dose from combined airborne and waterborne radiological releases in 2021 to the same individual was estimated to be <0.56% of the 100-mrem DOE limit, verifying that dose received by off-site residents continues to be well below regulatory limits.

The WVDP employees achieved 302,129 consecutive safe work hours without a lost-time work injury or illness in 2021, while accomplishing complex decontamination, demolition, and waste management activities. There were 600 hours of lost time attributed to employees not working due to COVID in CY 2021.

If you have any questions or comments about the information in this report, please contact WVDP Communications at (716) 942-4996 or by e-mail at Joseph.Pillittere@chbwv.com. You are also encouraged to 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) 942-4996
e-mail: Joseph.Pillittere@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: ____________________________________
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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?**
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   - ☐ 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 2021

*Prepared for the U.S. Department of Energy*

*West Valley Demonstration Project Office*

*Under: Contract DE-EM0001529*


*by*

*CH2M HILL BWXT West Valley, LLC*

*10282 Rock Springs Road*

*West Valley, New York 14171-9799*


*September 2022*

**Front Cover:** The cover photographs include: a sunset over the Main Plant Process Building (MPPB) before the main stack was removed, the Springville dam downstream of the site on Cattaraugus Creek, a butterfly observed while performing environmental sampling, and concord grapes from a farm overlooking the site. (These photographs were provided by Stephen Wedvik, Martin Regan, and Rebecca Werchowski, CHBWV Regulatory Strategy staff engaged in environmental monitoring at the West Valley Demonstration Project [WVDP].)

This report and previous Annual Site Environmental Reports (ASERs) are available on the DOE-WVDP website http://www.wv.doe.gov. Requests for digital copies of the 2021 ASER and questions regarding the report should be referred to:

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10282 Rock Springs Road,
West Valley, New York 14171.
Telephone: (716) 942-4996
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NOTE: This document includes external hot links to internet web pages as well as internal hot links that allow the reader to readily navigate to a reference within this document. Hot links are underlined and in blue font.

## *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) 2021 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 by DOE in cooperation with the New York State (NYS) Energy Research and Development Authority (NYSERDA).

## Site Location

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 remaining primary Project facilities include the Main Plant Process Building (MPPB), 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).

## Project Status

In 1980, Congress passed Public Law 96-368 (the WVDP Act), included in its entirety in Appendix H. The Act requires DOE to:

1) solidify the high-level radioactive waste (HLW) at the WVDP by vitrification into a form suitable for transportation and disposal,

2) develop containers suitable for the permanent disposal of the HLW,

3) as soon as feasible, transport the solidified HLW to an appropriate federal repository for permanent disposal,

4) dispose of low-level radioactive waste (LLW) and transuranic (TRU) waste produced by the solidification of HLW at the WVDP, and

5) decontaminate and decommission:

    a. the tanks and other facilities where the HLW was stored,
    b. the facilities used in the solidification of the waste, and
    c. any material or hardware used in connection with the project.

As per the WVDP Act requirements, 1) and 2) were completed by September 2002. The remaining requirements of the WVDP Act are or will be addressed consistent with the National Environmental Policy Act (NEPA) process.

**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 selected as the preferred alternative. Under this alternative, decommissioning is being conducted in two phases.

During Phase 1 Site Decommissioning, a number of contaminated facilities are being removed. Phase 1 also includes soil remediation, soil and facility characterization, and focused studies that will facilitate future decisionmaking for the remaining facilities or areas on the property. The complete FEIS and the ROD can be viewed on line at the DOE-WVDP website at:

http://www.wv.doe.gov.

Phase 2 will address the Waste Tank Farm (WTF), the waste disposal areas, the Construction and Demolition Debris Landfill (CDDL), and the nonsource area of the groundwater plume. DOE intends to complete the remaining WVDP decisionmaking with its Phase 2 decision in a Supplemental EIS (SEIS). The SEIS will evaluate a range of alternatives including removal, in-place closure, and a combination of those two.

Phase 1 studies were performed to provide technical evaluations that support preparation of the SEIS. These studies were completed in 2018. The Phase 1 Studies reports are available at:

https://westvalleyphaseonestudies.org

Development of the Probabilistic Performance Assessment (PPA) and preparation of the draft SEIS continued in 2021. DOE and NYSERDA will use the PPA to evaluate the SEIS alternatives. The draft SEIS schedule has been extended due to unanticipated complexities in the PPA modeling. A six-month period for public comment on the SEIS will follow issuance of the draft report. A final SEIS will subsequently be issued followed by the Phase 2 decommissioning ROD and Findings Statement.

## 2021 Major Accomplishments

The majority of the work conducted on the site in 2021 was performed under the Phase 1 Decommissioning and Facility Disposition contract by CH2M HILL BWXT West Valley, LLC (CHBWV). The following is a brief update of the site accomplishments under this work scope through the end of 2021.

**Waste Shipment and Disposal Off Site.** Waste shipping by rail was resumed in 2021 with over 60 successful rail shipments of soil. This project helped the site prepare to use the rail system to ship the large quantity of waste expected from the MPPB demolition.

The majority of the solid waste shipped off site during 2021 was the excavated soil which remained in storage from the installation of the Permeable Treatment Wall (PTW). The majority of the radioactive liquids shipped off site in 2021 were water that had collected in the General Purpose Cell Crane Room (GPC-CR) that was pumped out for disposal.

**Preparations for Demolition of the Main Plant Process Building (MPPB).** Preparation of the MPPB for demolition in 2021 included continued decontamination of the Product Purification Cell - South (PPC-S) using Nitrocision®, a custom designed wall scabbling process performed to remove radioactivity from concrete surfaces using liquid nitrogen; continued removal of radiologically contaminated equipment and ventilation ducts in the Vent Wash Room (VWR); and continued deactivation of below grade cells, including filling these rooms with additional grout to prevent water infiltration and to enable demolition equipment to traverse these areas.

Installation of the MPPB water management system continued with testing commencing in 2021. This system was designed to support collection and treatment of dust suppression water and storm water within the demolition area during MPPB demolition.

Two structures were demolished or partially demolished in 2021: (1) the containment structure used to store the PTW soils, and (2) the Load-In/Load-Out (LILO) structure. At the end of CY 2021, only a portion of the structural frame of the LILO was remaining for removal during MPPB demolition. The LILO was the last ancillary facility (building attached to the MPPB) planned for removal prior to MPPB demolition. A portion of the outer west wall of the MPPB Acid Recovery Cell (ARC) and Off-Gas Aisle (OGA) was also removed in 2021 to provide access for future cutting of the ARC floor.

**Maintenance and Disposition of the Balance of Site Facilities (BOSF)**. The final two BOSF activities in the original Facility Disposition work scope were completed in 2021. These last two tasks were post-demolition restoration of the Chemical Process Cell - Waste Storage Area (CPC-WSA) footprint, and removal of the schoolhouse well and septic system.

**Safety Success.** As of December 31, 2021, CHBWV and its subcontractors achieved 302,129 consecutive work hours without a lost-time work accident or illness. There were 600 hours of lost time attributed to employees not working due to COVID-19 in CY 2021.

**COVID-19 Pandemic Impacts on WVDP Operations**. The WVDP adhered to all federal and DOE specific guidance to protect the safety of the workers and the public throughout 2021 in response to the COVID-19 pandemic that began in March 2020. Examples of activities temporarily delayed by COVID restrictions included decontamination of PPC-S by Nitrocision® and VWR duct removal.

Requirements to adjust the type of work that could be performed under COVID-19 protocols resulted in an expanded scope of work under the current contract.

Several new projects were added to the current contract to include supplemental activities that will continue to prepare the site for the next phases of work.

**Waste Tank Farm (WTF) Tank and Vault Drying System (T&VDS).** The T&VDS was shut down for replacement of the desiccant wheel rollers, belt, and power supply during the second half of 2021. It was returned to service in early 2022. The system continued to reduce the volume of residual liquid in tank 8D-4.

**Permeable Treatment Wall (PTW) Performance.** The full-scale PTW, installed in November 2010, continues to achieve the remedial action objectives involved in mitigating the strontium-90 plume, as defined in the PTW Performance Monitoring Plan.

Strontium-90 concentrations downgradient of the PTW continued to decrease overall in 2021, indicating the PTW is continuing to function as designed. However, recent data suggests strontium-90 treatment performance may be starting to decline in localized areas within the wall. Some changes in groundwater geochemistry were also observed in the monitoring data. Supplemental sampling investigations for cations and anions in the groundwater were performed in 2021 to evaluate whether the nature of these observed changes in the groundwater geochemistry may be affecting PTW performance. This investigation is ongoing.

**Nuclear Regulatory Commission (NRC)-Licensed Disposal Area (NDA).** The enhancements made to the NDA (such as the geomembrane cap and upgradient slurry walls) continue to effectively reduce infiltration of precipitation and groundwater flow through the NDA as evidenced by lowered groundwater levels and reduced water volume required to be pumped from the NDA trench.

## Compliance

The WVDP continued to operate in compliance with all applicable environmental state and federal statutes, executive orders, DOE orders, and standards in 2021.

In 2021 there were:

- no New York State Pollutant Discharge Elimination System (SPDES) permit effluent limit noncompliance events;
- no exceedances of the U.S. Environmental Protection Agency's (EPA's) National Emission Standards for Hazardous Air Pollutants (NESHAP) dose standard; and
- no exceedances of the all pathway dose standard in DOE Order 458.1, "Radiation Protection of the Public and the Environment."

Project assessment activities by state and federal regulators showed continued compliance with all applicable environmental and health regulations.

In collaboration with New York State Department of Environmental Conservation (NYSDEC), the WVDP continued to perform whole effluent toxicity (WET) testing on Lagoon 3 discharges in 2021 as part of the Toxic Inventory/Reduction Evaluation (TI/RE) process.

## 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. Following the third-party remote audit in April 2021, the CHBWV EMS was recommended for continued certification under the EMS standard International Organization for Standardization (ISO) 14001:2015.

## Environmental Monitoring - Performance Indicators

As part of the CHBWV 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. There were no unplanned releases in 2021.

- **Airborne Radiological Releases**

  During 2021, radiological releases from the site were measured at three NESHAP approved emission points (the MPPB, the T&VDS, and the Remote Handled Waste Facility), and at up to 15 portable ventilation units (PVUs) operated periodically.

Off-site ambient air monitoring continued at the 16 ambient air sampling stations that surround the WNYNSC. The ambient air monitors were in operation 98.5% of the time in 2021.

All measurements demonstrated that airborne releases to the environment were within permissible limits.

- **Waterborne Radiological Releases**

Waterborne radiological releases from the site were measured at two natural streams, sampled at locations WNSWAMP and WNSW74A (Figure 2-3, Chapter 2), and one controlled outfall discharging from lagoon 3, sampled at WNSP001. Off-site surface water was sampled at two downstream locations, WFFELBR and WFBCTB. (See Figure 2-7).

All measurements demonstrated that waterborne releases to the environment were within permissible limits.

- **Estimated Dose**

The estimated dose in 2021 from airborne emissions from the WVDP was determined based on the data from the ambient air samplers. The estimated maximum potential dose from airborne emissions based on the annual average radioisotopic concentrations at these off-site samplers was <0.55 millirem (mrem) (<0.0055 millisievert [mSv]) which is well below the 10-mrem (0.1 mSv) limit established by EPA.

The estimated dose from waterborne sources in 2021 was 0.014 mrem (0.00014 mSv) based on measurements of the radioactivity in natural and controlled discharges from the site.

The total estimated maximum potential dose attributable to project emissions from both airborne and waterborne sources in 2021 was <0.56 mrem (<0.0056 mSv), which is well below the annual 100-mrem limit established by DOE Order 458.1. The 2021 total estimated dose was similar to the total estimated dose in 2020 of <0.48 mrem. (See Table 3-2.) 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 2021 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.

## Quality Assurance (QA)

The data presented in this report is validated in accordance with WVDP 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 189 performance evaluation analyses conducted for the WVDP, 96.3% were within acceptance limits.

## Conclusion

The WVDP complies with all environmental regulations and DOE directives intended to ensure the project operates in a safe manner. The data collected and evaluated in 2021 in support of these regulations and directives continues to indicate a program protective of workers, the public and the environment.

# 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 (Figure 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 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 48.8 °F (9.3°C) (The National Weather Service, National Oceanic and Atmospheric Administration [NOAA] average data for 1874 to 2021, https://www.weather.gov).

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 2011 to 2020, the recent 10-year average annual precipitation at the WVDP was 42.5 inches/year. Total precipitation in 2021 was 47.4 inches, 4.9 inches above the 10-year average. Regional winds are generally from the west and south. The WVDP has an on-site meteorological tower that continuously monitors the site-specific wind speed, wind direction, temperature and barometric pressure. This data is accessible in real time to site operations personnel.

**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 in Appendix A.) 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 fishing and for recreational activities (such as swimming and kayaking). 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. Industrial water and noncommunity potable water used for Project activities are supplied by bedrock groundwater wells.

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

**Project History.** A historic timeline describing the significant events impacting the WVDP is provided in the "Useful Information" section of this report.

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

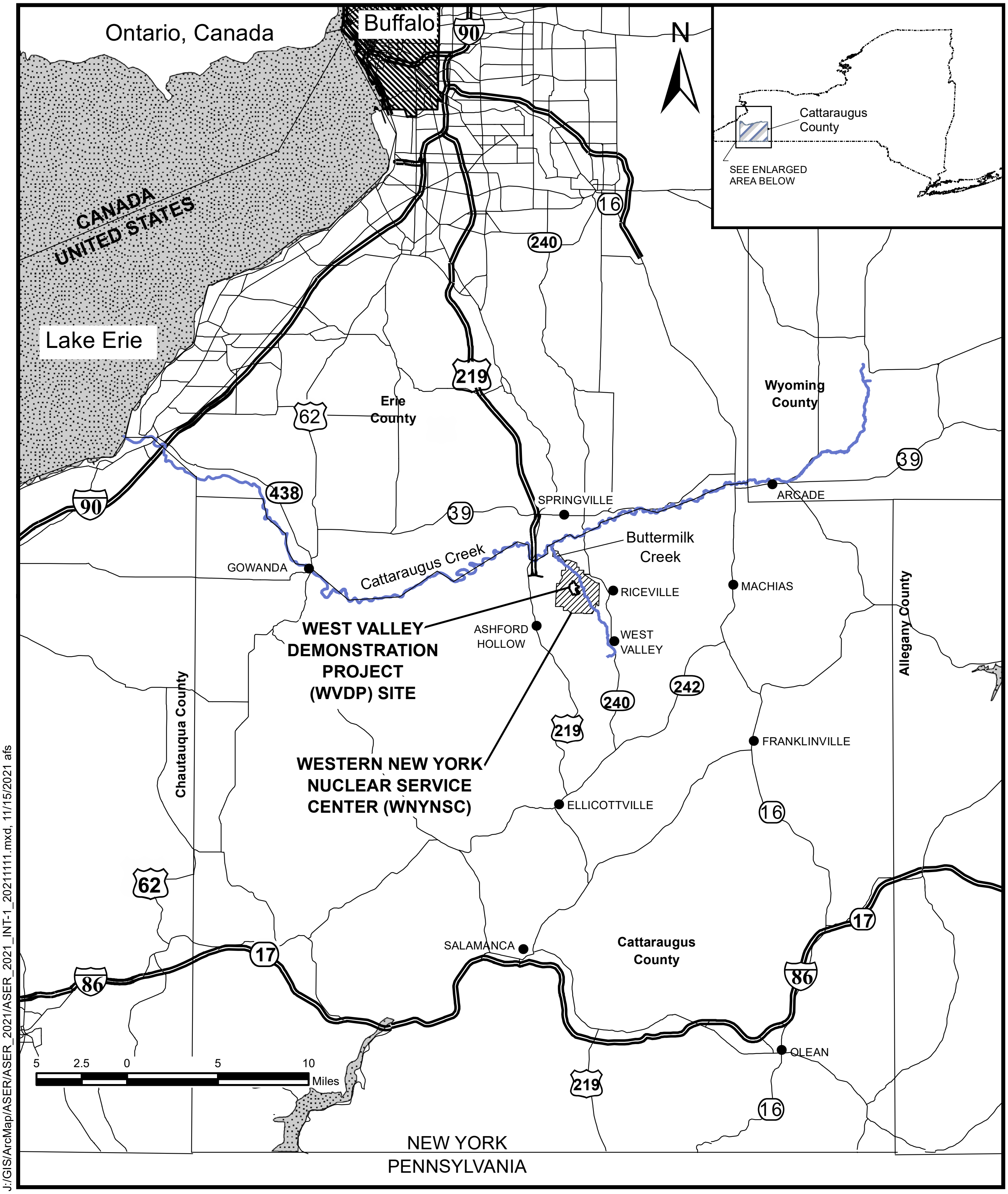
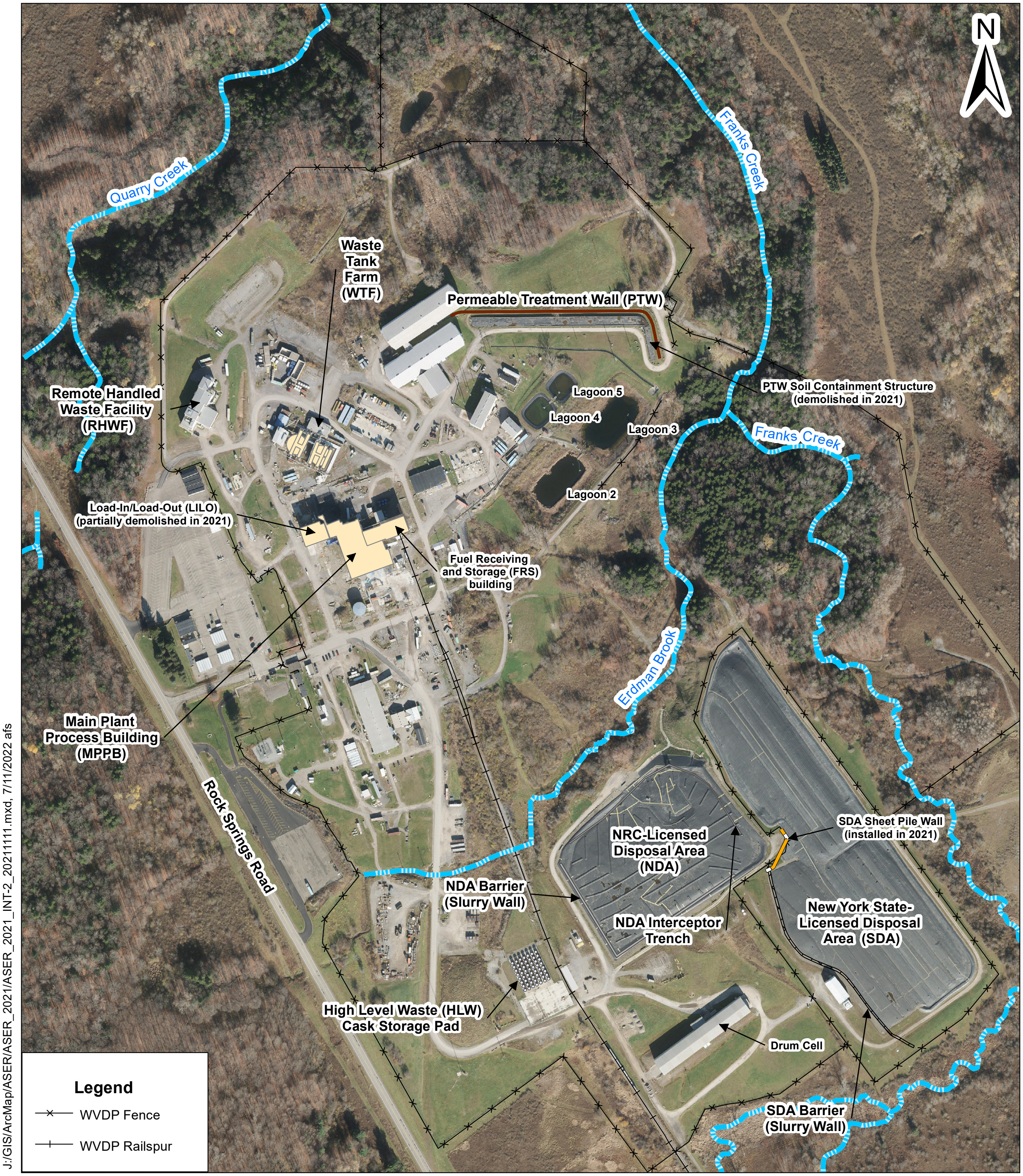


**FIGURE INT-2**
**Aerial Photo of the West Valley Demonstration Project**




*Tan overlay highlights some of the major site features at the end of CY 2021.*
*(Underlying aerial photograph was taken in November 2020).*

## 2021 Accomplishments

The work currently being performed at the WVDP continues to be focused on Phase 1 decommissioning and removal actions as described in the 2010 Decommissioning and/or Long-term Stewardship Record of Decision (ROD) and 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).

WVDP Phase 1 Decommissioning and Facility Disposition activities began in August 2011 with the award of the Phase 1 Decommissioning and Facility Disposition Contract to CH2M HILL BWXT West Valley, LLC (CHBWV).

### Completed in 2021

The following provides the major tasks completed in calendar year (CY) 2021.

Waste shipping by rail was resumed in 2021 with over 60 successful rail shipments. The primary waste disposed of resulted from removal of a containment structure that stored soil excavated during installation of the Permeable Treatment Wall (PTW).

**Off-site shipments by rail**

This accomplishment involved a professional engineering assessment of the rail line prior to use and a thorough readiness review coordinated between the United States (U.S.) Department of Energy (DOE), CHBWV and the Buffalo and Pittsburgh Railroad. This opportunity to ship waste off site by rail provided process improvements that will increase the efficiency of the waste shipping operations during MPPB demolition, which may involve as many as 1,500 intermodal shipments for off-site disposal.

☑ **Off-site waste disposal.**

Approximately 98% of the radiologically contaminated, nonhazardous, low-level waste (LLW) that was generated in 2021 has been shipped off site for disposal.

The solid waste shipped off site during 2021 included:

- soil and debris from disposal of the PTW soil containment structure (over 350 intermodals);
- demolition debris from removal of the Load-In/Load-Out (LILO) facility;
- debris from renovation of the south plateau storage building known as the "drum cell"; and
- debris from removal of the Off-Gas Cell (OGC) trench covers.

The radiologically contaminated liquids shipped off site in 2021 were primarily:

- water that had collected in the General Purpose Cell (GPC), the adjacent GPC Crane Room (GCR), and the GCR Extension (GCRX) that was pumped out for disposal (approximately 11,000 gallons).


**PTW area after removal of the soil containment structure**

The soil that was shipped off site in 2021 was excavated during PTW installation in 2010. It was stored adjacent to the PTW in an aboveground wood and concrete structure made for this purpose. The aerial photograph above shows the area where the PTW soil was previously stored after the containment structure and soils were disposed of and after the ground surface was regraded. The treatment media that makes up the PTW remains in the subsurface, treating the subsurface groundwater that flows across the north plateau down to depths 30 feet below ground.

**First stages of Load-In/Load-Out (LILO) demolition**

**LILO demolition status at the end of December 2021**

☑ **Demolition of ancillary facilities.**

WVDP "ancillary facilities" under the Facility Disposition contract are large structures physically connected to the MPPB. At the beginning of 2021, the only remaining ancillary facility to be removed under the contract was the LILO facility.

The LILO facility was a large steel building attached to the Main Plant Process Building (MPPB) that was previously used to inspect the stainless-steel High-Level Waste (HLW) canisters before they were filled with vitrified glass, and as a work area to weld canister lids. Demolition of the LILO facility began in November 2021 with all interior workspaces and exterior steel walls removed by the end of the calendar year. At the end of CY 2021, a portion of the structural frame of the LILO was remaining for removal during MPPB demolition.

☑ **Preparations for Main Plant Process Building (MPPB) Demolition.**

Demolition of the MPPB is scheduled to begin in 2022. Continued preparation for this work included performing a number of readiness assessments of each process involved in MPPB demolition such as water management, waste processing and work control processes.


**All ancillary structures demolished in preparation for Main Plant Process Building (MPPB) demolition**

Additional accomplishments in 2021 in preparation for MPPB demolition included:

- initial testing of the new MPPB water management system designed to collect, store, and treat the collected water (if needed) during MPPB demolition;
- completion of hazard reduction in the Chemical Process Cell (CPC) by grouting the CPC floor, and by addition of fixatives to the CPC shield door, to the walls above the crane rails, and to the tunnel and walls in the CPC Equipment Decontamination Room (EDR);
- completion of hazard reduction by grouting the below ground portion of the GPC, GCR, GCRX, and General Operating Aisle (GOA) to the level of the surrounding ground to enable demolition equipment to traverse these areas and to prevent future water infiltration into these areas;
- removal of a portion of the west wall of the Acid Recovery Cell (ARC) and Off-Gas Aisle (OGA) to allow future access for precision cutting of the ARC floor using a large custom-designed quarry saw;
- establishing a demolition boundary based upon predictive modeling to maintain worker dose As Low As Reasonably Achievable (ALARA) and well under regulatory limits, with Continuous Air Monitors (CAMs), Fixed Air Samplers (FASs), and deposition plates that collect particles that have settled out of the air placed within and surrounding the demolition area; and
- modification of the 10-plex building to support demolition workers by installing an asbestos shower, locker room, respirator and tool supply storage area, and a pre-job briefing room;

The 2021 accomplishments will help protect both the workers and the public. The engineered approach to deconstructing the MPPB will be carefully performed at a deliberate speed using specialized tools and is planned to require approximately three years to complete.

### ☑ Demolition of Balance of Site Facilities (BOSF)

The two final BOSF activities listed on the original Facility Disposition contract scope of work were completed in 2021. This included removal of the schoolhouse well and septic system and post-demolition restoration of the Chemical Process Cell - Waste Storage Area (CPC-WSA) footprint. The Cattaraugus County Health Department (CCHD) was provided with a brief summary report and photographic documentation of the removal of the schoolhouse well and septic system.

The inactive sewage treatment plant located near the main warehouse was previously listed as a BOSF for removal but currently is not planned to be removed.

### ☑ Upgrades to Site Infrastructure

Major site infrastructure improvements made during 2021 included:

- a rail shipping readiness review followed by minor maintenance of the rail line to allow resumption of waste shipments by rail;
- replacement of a rented diesel generator with a purchased natural gas unit;
- addition of several office and locker room trailers across the site to accommodate COVID-19 social distancing requirements;
- repair and resurfacing the south parking lot for future use; and
- renovations to the former drum cell to support MPPB demolition with upgrades that include installation of a new gas line from the main distribution line, installation of a new roll-up garage door and man-door, refurbishment of the overhead crane, and construction of a new concrete floor and floor ramps;


**Renovations in progress for future use of the drum cell during MPPB demolition**

The drum cell is a large, aluminum-sided storage building on the south plateau that was previously used to temporarily store the cement solidified waste associated with the HLW solidification process in the 1980s. The drum cell is being re-purposed to provide indoor space for waste container preparation and equipment storage during MPPB demolition, particularly during the winter months.

**Wall scabbling using Nitrocision®**

## Continued Progress in 2021

☑ **Continued Preparations for MPPB demolition.**

The most significant continued deactivation and decontamination activities in 2021 in preparation for MPPB demolition included:

- continued aggressive decontamination of the Product Purification Cell - South (PPC-S) using Nitrocision®, a custom designed wall scabbling process performed to remove radioactivity from concrete surfaces using liquid nitrogen with 800 $ft^2$ decontaminated at the end of 2021; and
- continued removal of radiologically contaminated ventilation ducts in the Vent Wash Room (VWR) using a diamond wire saw.

☑ **Transuranic (TRU) waste disposal.**

TRU waste generated during MPPB deactivation is carefully segregated to minimize the amount generated. The stored inventory of on-site TRU waste, for which there is no off-site disposal facility available, decreased slightly in 2021 by 0.5 $m^3$ due to evaporation of liquid waste by the Tank and Vault Drying System (T&VDS). At the end of 2021, there was approximately 798 $m^3$ of TRU waste stored on site.

Although there is no off-site disposal facility available for the TRU waste stored at the WVDP, the U.S. Nuclear Regulatory Commission (NRC) has been evaluating potential final disposal options for several years. The NRC public comment period to ongoing evaluations of potential final disposal options for TRU waste (non-Defense waste, such as that stored at the WVDP) ended in November 2020. A decision on the disposition of WVDP waste is still on hold while the NRC evaluates disposal options and recommendations for a path forward.

☑ **Site Maintenance**

Routine activities performed in 2021 also included safe operation of the site through:

- managing and maintaining site infrastructure;
- maintaining the LLW treatment facility (LLWTF) for processing wastewater managed through the site;
- conducting environmental monitoring, and maintaining compliance with WVDP regulatory and permit requirements; and
- maintaining the Waste Tank Farm (WTF), the NRC-licensed disposal area (NDA), and the north plateau PTW.

## New Work Scope

Due to COVID-19 restrictions that necessitated adjustments to the type of work that could be performed, several new projects were added to the current contract to include supplemental activities that will continue to prepare the site for the next phases of work. This new work scope included the following four major projects:

**Tank Sampling (8D-4).** Planning for the complex task of characterizing the liquid and sludge layer remaining in underground HLW tank 8D-4. Treatment options will be evaluated for the approximately 1,100 gallons of high activity sludge and 2,800 gallons of high activity liquid waste in this tank. This waste must first be sampled and characterized.

**Lagoons 4 and 5 Reroute**. Designing a water management system that will allow Lagoon 3 to be taken out of service for wastewater management. A new engineering subcontract for this work was awarded to Arcadis in 2021, with CHBWV and DOE providing continuous technical support.

**Repackaging of Four Degraded Legacy Chemical Process Cell (CPC) Waste Containers**. Designing and fabricating four specialty shielded containers to replace degrading legacy containers. Container Products Corporation will be fabricating these specialty containers for the WVDP who will repackage this waste prior to off-site disposal.

**New Guard House.** Designing a new guard house and making modification to the site entrance roadway for the anticipated requirements during MPPB demolition and during the next phases of work at the WVDP.

## 2021 Impacts of the COVID-19 Pandemic on WVDP Operations

The COVID-19 pandemic resulted in reduction of work activities at DOE sites across the United States to protect the health and safety of their employees.

Measures to protect our workforce due to the pandemic began in March 2020 and continued throughout 2021. Federal and DOE guidance for sanitizing of workspaces, social distancing, masking, testing, and vaccination programs were implemented by a WVDP COVID response plan that was developed and approved by DOE-headquarters (HQ) to address the evolving requirements associated with the COVID pandemic protocols.

Social distancing requirements and temporary staffing reductions associated with the COVID-19 pandemic affected some work activities at the WVDP during the early months of 2021, including delays in MPPB decontamination by Nitrocision® and VWR duct removal. Pandemic related delays also occurred for delivery of the custom-designed large concrete saw planned to be used for the deconstruction of select floors and walls inside the MPPB.

The DOE and CHBWV adhered to the President's Executive Order (EO) 13991 (January 2021) *Protecting the Federal Workforce and Requiring Mask-Wearing* and EO 14042 (September 2021), *Ensuring COVID Safety Protocols for Federal Contractors*. The WVDP continued to perform work approved under all DOE directed COVID-19 protocols throughout the year, with the health and safety of the workforce as the number one priority.

## WVDP End State Progress

In 2010, DOE and NYSERDA as co-lead preparers issued the "Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center," (DOE/EIS-0226). At that time it was decided to implement the Phased Decisionmaking Alternative.

DOE and NYSERDA are jointly preparing a Supplemental EIS (the SEIS) to implement the next phase of decommissioning/stewardship. The Proposed Action of the SEIS will address the decontamination and decommissioning of the facilities remaining at the West Valley site after completion of Phase 1 decommissioning agreed to in the 2010 FEIS.

The SEIS is being prepared pursuant to the National Environmental Policy Act (NEPA) and New York State Environmental Quality Review Act (SEQR). Phase 2 decisions will be informed by the Phase 1 and other scientific studies being performed at the West Valley site. The Phase 1 studies were completed in 2018. An explanation of the Phase 1 and Phase 2 decommissioning work scope and a more detailed progress update for each of the SEIS study areas is reported in the Environmental Compliance Summary (ECS) of this report.

Work on the long-term probabilistic performance assessment (PPA) for the West Valley site was temporarily paused in 2021 pending the award of a follow-on contract to the contractor preparing the PPA for the West Valley site. NYSERDA and DOE plan on awarding the contract in early 2022. Work on the PPA will continue to evaluate the performance of a range of decommissioning alternatives that will be evaluated in the SEIS.

The SEIS schedule has been extended due to unanticipated complexities in the PPA modeling. Once work on the long-term PPA resumes under the new contract, DOE and NYSERDA will begin to use the PPA to evaluate SEIS alternatives. A six-month period for public comment on the SEIS will follow issuance of the draft report. A final SEIS will subsequently be issued followed by the Phase 2 decommissioning ROD and Findings Statement.

These major accomplishments in 2021 were completed while maintaining the safety of the site employees, and while protecting the public health and safety, and the environment.

# ENVIRONMENTAL COMPLIANCE SUMMARY

Activities at the WVDP are regulated by various federal and state laws. These laws are administered primarily by the Environmental Protection Agency (EPA), DOE, NRC, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers (USACE), New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), and New York State Department of Labor (NYSDOL).

## 2021 Highlights

**Radiation Protection of the Public and the Environment (DOE Order 458.1):** The dose estimated from 2021 air emissions and water discharges containing radionuclides was <0. 56% of the DOE public dose limit of 100 millirem (mrem) per year from all pathways.

**Air Emissions:** The off-site ambient air sampling data indicated the estimated dose based on air emissions in 2021 was <5.5% of the 10 mrem per year EPA compliance limit.

**Water Releases:** There were no exceedances of the State Pollutant Discharge Elimination System (SPDES) permit effluent limits in 2021. In collaboration with NYSDEC, the WVDP continued to perform Whole Effluent Toxicity (WET) testing in 2021 and continued the ongoing investigation into the root cause(s) of the observed sporadic chronic toxicity.

**Waste Management:** In 2021, the waste shipped off site for disposal included demolition debris from the LILO facility, temporarily stored soils from installation of the PTW, the PTW soil containment structure, and radioactive waste liquids. Approximately 1.4 tons of additional Resource Conservation and Recovery Act (RCRA) waste was also shipped off site for treatment and disposal.

**Resource Conservation and Recovery Act (RCRA) Closure Activities**: Closure of RCRA facilities that are no longer in service continued in 2021. NYSDEC responded to public comments on the LAG Storage Area (LSA #2) hardstand closure plan and then provided final approval of the closure plan in June 2021. Closure (sampling) activities were then initiated in late September and early October 2021. The Analytical and Process Chemistry (A&PC) hot cells closure plan has been commented on by the public but is awaiting NYSDEC response to comments and final approval in 2022. The A&PC Hot Cells are RCRA units located inside the MPPB.

**National Environmental Policy Act (NEPA):** Work was temporarily paused on the SEIS for the decommissioning and long-term stewardship of the WVDP and WNYNSC in 2021 pending the award of a follow-on contract to the contractor performing the support work. NYSERDA and DOE plan on awarding the contract in early 2022.

## Compliance Program

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 approval 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.

A summary of the WVDP's current year compliance status with applicable environmental statutes, DOE directives, executive orders (EOs), and state laws and regulations applicable to the Project activities, and a list of the current WVDP environmental permits are included at the end of this chapter.

## Air Emissions

The Clean Air Act (CAA), administered through EPA, requires compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) under Title 40 Code of Federal Regulations (CFR) Part 61, Subpart H.

Sources of radioactive discharges to the atmosphere are regulated directly by the EPA. In NYS, the EPA has delegated to NYSDEC the authority to regulate nonradiological emissions to the atmosphere.

**Radiological Releases.** The NESHAP standard, for which compliance is to be demonstrated at the WVDP, is that no member of the public may receive an Effective Dose Equivalent (EDE) greater than 10 mrem (0.1 millisievert [mSv]) per year resulting from radionuclide emissions to the atmosphere. EPA approval must be obtained before conducting any work where it is expected that the potential to emit will be 1% or more of the 10 mrem standard.

NESHAP regulations allow for the use of two methods of demonstrating compliance, (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 and evaluating dose at the critical receptor. Since 2014, with EPA approval, NESHAP compliance at the WVDP has been demonstrated using the "environmental measurement" approach. This method is more appropriate since the majority of potential emissions from the WVDP have shifted from point to diffuse sources as more facilities are decommissioned or demolished.

Prior to use of the measurement approach, the WVDP first had to demonstrate to EPA's satisfaction that the method would meet EPA compliance requirements. 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.

Routine ambient air network sampling results are discussed in Chapter 2, "Environmental Monitoring," and are tabulated in Appendix C. These data are used to estimate the annual dose from air emissions for NESHAP compliance as described in Chapter 3, "Dose Assessment."

**Nonradiological Releases.** The WVDP currently has an Air Facility Registration Certificate for nonradiological emission sources as required by NYSDEC but does not have any nonradiological sources that require air emissions permits. All potential nonradiological point sources of air emissions are evaluated annually against permitting requirements and in 2021 were determined to be exempt or below permitting release limits.

Asbestos releases are regulated separately from other nonradiological releases under NESHAP and NYSDOL regulations. The asbestos NESHAP regulations require notifications to NYSDOL and EPA before demolition of any structure that could contain asbestos or asbestos-containing material (ACM) in an amount exceeding regulatory thresholds to ensure the safety of the worker and the public. In 2021, no ACM removal from facilities was required.

### Air Quality Compliance Update for 2021

All airborne releases of radiological constituents from the WVDP in 2021 were within permissible EPA and DOE limits. The estimated maximum potential dose to any off-site resident from air emissions in 2021 was <0.55 mrem, significantly less than the 10 mrem NESHAP compliance limit as determined by evaluation of results from the ambient air samplers (the "environmental measurement" method). (See Chapter 3, "Dose Assessment" for more discussion.)

There were no unexpected releases and no releases that were out of compliance with EPA and NYSDEC regulations as summarized in Table ECS-1 below.

**TABLE ECS-1**
**WVDP 2021 Air Quality Noncompliance Episodes**

| *Air Release Type* | *Regulated by* | *Date(s) Exceeded* | *Description/ Solutions* |
|---|---|---|---|
| Radiological | EPA | None | None |
| Nonradiological | NYSDEC, NYSDOL and EPA | None | None |

## Open-Air Demolition: Estimating Predicted Air Emissions using an EPA Approved Alternative Method

NESHAP compliance is demonstrated at the WVDP based on the data collected at the ambient air samplers during the year. To evaluate if formal EPA approval is required for demolition of a facility or a new activity with potential radiological air emissions, the NESHAP regulations require estimating emissions using Appendix D of Title 40 CFR Part 61, or an EPA-approved alternative method. A request for EPA approval of the activity is not required if the off-site annual dose estimated from the activity is less than 0.1 mrem. An alternative method for estimating radionuclide emissions to air was developed by the DOE-WVDP and its subcontractors and was approved by EPA in May 2016 for use to predict emissions during Vitrification Facility (VF) demolition. EPA required that "the Alternative Method" developed by the DOE-WVDP be validated before it could be used to predict emissions for other, future WVDP activities, including MPPB demolition. Validation involved collecting actual emissions data during VF demolition and comparing it to the emissions that were predicted. This comparison, “the validation study,” was performed during demolition of the VF from September 2017 to September 2018. As a result of the study, the WVDP modified the emission factors in the Alternative Methodology to improve the accuracy of the analysis. In July 2019, EPA approved the use of the revised radiological source term estimation methodology to demonstrate compliance with 40 CFR Part 61 Subpart H for other facilities undergoing demolition. The WVDP is using this methodology to estimate airborne emissions predicted for the future demolition of the MPPB.

### <u>Demolition Methods:</u>


**Hammer tool (with dust suppression mister)**

The methodology used for estimating predicted air emissions during demolition uses different air emissions factors for the different tools used to remove or demolish a wall or portion of a building. Most of the MPPB will be removed using the hammer or shear tools. Water will be used with these methods for dust suppression. Emission factors for other demolition techniques such as cutting using a diamond wire saw are also included in the Alternative Methodology used to predict emissions.

The most appropriate method selected to demolish various parts of the building is based on tool functionality (for example, shearing is preferred for pipes and metal objects), the tool's emission factor, and the radiological inventory of the section of the structure being removed.

**Shear tool (misting seen in foreground)**

**Diamond wire saw (used with misting)**

## Surface Water Releases and the WVDP State Pollutant Discharge Elimination System (SPDES) Permit

The Clean Water Act (CWA), administered in NYS by NYSDEC through EPA delegated authority, requires that all process water discharges from the site be compliant with the WVDP SPDES permit. Storm water is also managed under this permit. The current site permit was issued in 2011 and regulates nonradiological liquid discharges through the site's monitored wastewater treatment system outfall and storm water outfalls. Monthly SPDES Discharge Monitoring Reports (DMRs) are submitted to NYSDEC and EPA and are available for public review at:

http://www.chbwv.com/Public_Reading_Room.htm.

Releases of radiological constituents in water effluents are subject to the requirements in DOE Order 458.1 ("Radiation Protection of the Public and the Environment," Change 4) and DOE-STD-1196-2011 ("DOE Standard, Derived Concentration Technical Standard"). DOE Order 458.1 requires environmental monitoring of the air, water, groundwater and biota in order to ensure that the maximum potential public radiation dose from all pathways remains under 100 mrem/year. DOE-STD-1196-2011 established Derived Concentration Standards (DCSs) to be used in the design and conduct of radiological environmental programs at DOE facilities. A new DOE standard with revised DCSs, DOE-STD-1196-2021, was published in 2021. The SPDES permit did not require revision for this new standard in 2021. (See the inset box in Chapter 2 titled Radiological Data Evaluation for additional information on DCSs.)

Compliance with DOE Order 458.1 for process water and non-process waterborne releases to the environment is based on dose and is discussed in Chapter 3, "Dose Assessment."

### Surface Water Compliance Update for 2021

All waterborne releases of radiological constituents from the WVDP in 2021 (from the SPDES 001 outfall and natural surface water effluents such as WNSWAMP) were within permissible limits. The total estimated dose from the waterborne release pathway was well below the DOE 100 mrem/year limit for all pathways.

### SPDES and Storm Water Update for 2021

All SPDES discharges were within applicable SPDES permit limits as shown by the Table ECS-2 below.

The SPDES permit requires whole effluent toxicity (WET) testing every five years. The five-year testing was last performed in 2017. At that time, there were two action level exceedances (one associated with the fathead minnow and one with the water flea). Based on discussions with NYSDEC, the WVDP subsequently performed a Toxic Inventory/Reduction Evaluation (TI/RE). WET testing continued to be conducted in 2021 in support of the ongoing investigation into the root cause(s) of the observed sporadic chronic toxicity.

Storm water was monitored semiannually as required by the SPDES permit. No SPDES exceedances of storm water compliance limits occurred in 2021.

The updated water management system, installed on the site in 2020 and 2021, includes a new pretreatment system consisting of six ion-exchange resin columns to reduce the concentrations of select radionuclides, a series of holding tanks for temporary storage and characterization prior to treatment, and the associated water

**TABLE ECS-2**

**WVDP SPDES[a] Permit Limit Exceedances in 2021**

| *Permit Type* | *Outfall(s)* | *Parameter* | *No. of Permit Exceptions* | *No. of Samples Taken* | *No. of Compliant Samples* | *Percent Compliant Samples* |
|---|---|---|---|---|---|---|
| SPDES | All | All | 0 | 1619 | 1619 | 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.

transfer lines. Testing of the new system began at the end of 2021 and continued into 2022.

The WVDP CWA/SPDES best management practices and storm water pollution prevention plan (SWPPP) was updated in June 2021 to include a detailed approach for managing MPPB demolition water. Water within the bermed demolition area (from dust suppression and precipitation) will be collected, stored in temporary holding tanks and sampled, treated in the Low-Level Waste Treatment Building (LLW2), and will be either shipped off site for disposal or released through the SPDES controlled wastewater discharge system.

## Water Withdrawal

NYS, as one of the participating states in the Great Lakes - St. Lawrence River Basin Water Resources Compact, regulates water withdrawal systems having the capacity to withdraw 100,000 gallons per day (gpd) or more. NYSDEC manages this water withdrawal and reporting program under the NYS Environmental Conservation Law (ECL) Article 15. The WVDP reports the amount of groundwater and reservoir water withdrawn annually to the NYSDEC pursuant to the site water withdrawal permit issued in December 2019 to replace the previous WVDP water withdrawal registration.

Potable and industrial water has been supplied by two groundwater wells located on the site since 2014. Prior to this, water was supplied by two reservoirs immediately south of the site. The reservoirs currently provide SPDES discharge flow augmentation water for the WVDP. The Cattaraugus County Health Department (CCHD) has assigned the WVDP drinking water (potable water) system a NYS tracking number and determines the required sampling for the WVDP drinking water system annually. Additional discussion of the groundwater supply wells is provided in Chapter 4.

### Water Withdrawal Update for 2021

The 2021 WVDP water withdrawal report was submitted to NYSDEC in February 2022. The maximum volume of water withdrawn per day in 2021 was 422,030 gallons per day (gpd). The average daily withdrawal rate in 2021 was 42,401 gpd as compared to 21,667 gpd in 2020. The primary reason for this difference is due to there being three SPDES discharges in 2021 and two in 2020. (The largest water demand occurs during SPDES lagoon discharges.)

Both of the first two controlled lagoon discharges in 2021 were performed at typical release rates of 100 to 300 gallons per minute (gpm). NYSDEC requested that the third discharge, in November 2021, be performed at a lower than usual rate to lessen any potential impacts from the effluent since some toxicity was observed in the predischarge samples from lagoon 3. The November lagoon release was limited to an average release rate of 50 gpm and lasted 19 days.

## 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 reporting spills of hazardous and mixed wastes while in transit.

The WVDP is a hazardous waste generator requiring RCRA permitting, RCRA corrective actions, and routine RCRA reporting of hazardous waste activities to the NYSDEC. An agreement between DOE, NYSERDA, EPA, and NYSDEC (the §3008h Consent Order) directs the implementation of the WVDP RCRA corrective action program. (See the inset box on the following page for additional details.)

## Routine Reporting Required under RCRA

**Quarterly Status Reports, RCRA §3008(h) Consent Order.** Under the Consent Order signed in 1992, DOE transmits two quarterly reports to EPA and NYSDEC:

(1) a progress report summarizing all Consent Order activities at the WVDP for the previous quarter, and

(2) a groundwater exception report, summarizing RCRA groundwater monitoring results that exceed established trigger levels and an update on the performance of the NDA interceptor trench, geomembrane cover, and slurry wall.

## RCRA Permit and §3008(h) Consent Order History at the WVDP

**Hazardous Waste Permitting** - **RCRA Interim Status Permit Application**. In 1984, DOE notified EPA of hazardous waste activities at the WVDP and identified DOE-WVDP as a hazardous waste generator. In 1990, to comply with 6 New York State Official Compilation of Codes, Rules, and Regulations (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 activities associated with 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 unless certain exemptions apply; therefore, the RCRA Part A Permit Application must be revised prior to changes to the Project's RCRA waste management operations. The latest revision to the RCRA Part A Permit Application was submitted to NYSDEC on April 27, 2011 and was conditionally approved by NYSDEC on June 9, 2011.

In accordance with the Part A requirements, DOE prepares closure plans for the hazardous waste management units at the WVDP. The closure plans are transmitted to NYSDEC for approval 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, all wastes are removed and other actions, such as decontamination or removal of structures, are taken as necessary to meet the unit specific RCRA closure requirements. A closure certification report is then prepared for approval by NYSDEC to document closure was performed in accordance with the NYSDEC approved RCRA closure plan.

**RCRA Final Status Permit Application**. In 2003, NYSDEC requested the submittal of a 6 NYCRR Part 373-2 Permit Application (i.e., Final Status or Part B) for the WVDP, which was transmitted to NYSDEC in December 2004. On April 16, 2009, NYSDEC requested the submittal of a revised Part B Permit Application for the WVDP, which was submitted to NYSDEC on September 30, 2010. On March 22, 2012, NYSDEC notified NYSERDA and DOE that they had reassessed the WVDP RCRA regulatory program and that the processing of the September 30, 2010 Part B permit application, including revisions, would be deferred. As a result, the WVDP continues to operate as an interim status facility pursuant to its Part A Permit application.

**RCRA §3008(h) Consent Order** (abbreviated as "Consent Order")**.** Section §3008(h) of RCRA authorizes EPA to issue an order requiring corrective action at RCRA Part A Interim Status facilities 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 a Consent Order with EPA and NYSDEC in March 1992. Consent Order activities performed at the WVDP to date include the following:

- The RCRA Facility Investigation (RFI) evaluated potential releases of RCRA-regulated hazardous constituents from SWMUs. Final RFI reports were submitted in 1997, with no corrective actions required with the exception of groundwater monitoring as outlined in the RFI and approved by EPA and NYSDEC.

- The Solid Waste Management Unit (SWMU) Assessment and Current Conditions Report, originally submitted in 2004 and updated most recently in 2020, summarized the historic activities at each SWMU and provided environmental monitoring data and an update of activities performed since the RFI reports were submitted.

- As a result of reviewing the current conditions report in 2004, NYSDEC requested additional evaluations for six SWMUs (the NDA Burial Area, NDA Interceptor Trench, Demineralizer Sludge Ponds, Lagoon 1, the Construction and Demolition Debris Landfill [CDDL] and the LLWTF) as Corrective Measures Studies (CMSs). These studies, submitted to NYSDEC and EPA in 2010, identified and evaluated potential corrective measures and made recommendations on remedial alternatives.

- The 1990 and 2008 Interim Measures (IMs) for the NDA were implemented, (1) to intercept and collect groundwater within the NDA potentially contaminated with a mixture of n-dodecane and tributyl phosphate (TBP), and (2) to minimize water infiltration into the NDA and groundwater flow through the NDA, thereby minimizing the potential release of impacted groundwater until the final disposition of the NDA is determined. Liquid organic material was never observed. Therefore, with NYSDEC and EPA approval, in 2019 the Liquid Pretreatment System (LPS) building was removed and a geomembrane cover was placed over the building footprint.

The RCRA §3008(h) progress report includes recent activities associated with hazardous waste management, contacts with local community interest groups and regulatory agencies, and an inventory of mixed waste generated from decontamination activities during the reporting period. The groundwater exception report also includes an update on the performance of the NDA interceptor trench, geomembrane cover, and slurry wall.

**Hazardous Waste Management.** Hazardous wastes at the WVDP are managed in accordance with 6 NYCRR and reported to NYSDEC in the WVDP's Annual Hazardous Waste Report. This report specifies the quantities of waste generated, treated, and/or disposed of, and identifies the treatment, storage, and disposal facilities used. Since the WVDP generated less than 25 tons of hazardous waste in 2021, no annual Hazardous Waste Reduction Plan report was required in 2021. (Note: Waste generated from demolition, construction, or spill clean-up is exempt from hazardous waste reduction plans.)

Hazardous and universal waste is shipped off site to RCRA-permitted solid waste management facilities. Some of the universal waste (i.e., lead-acid batteries and spent lamps) are reclaimed or recycled at off-site, authorized reclamation and recycling facilities.

**Mixed Waste Management.** Mixed waste (a waste that is both radioactive and RCRA hazardous) is also shipped off site whenever possible. Mixed wastes that cannot be treated or disposed of within one year are managed according to the Site Treatment Plan (STP), prepared by the WVDP under requirements of the Federal Facilities Compliance Act (FFCA) (an amendment to RCRA), in accordance with the Consent Order. The annually updated plan describes the development of treatment capabilities and technologies for treating mixed waste and updates the mixed waste inventory. Currently, the only wastes covered under the WVDP STP are mixed transuranic (TRU) waste stored in containers and mixed high activity and TRU residual waste remaining in tank 8D-4, for which off-site disposal options are still unavailable and for which on-site treatment is impractical.

**Nonradioactive, Nonhazardous, Regulated Waste Management (Non-RCRA).** Nonradioactive, nonhazardous waste material is also shipped off site to solid waste management facilities. 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. Records are maintained for this waste management, but no routine reporting is required.

## RCRA Update for 2021

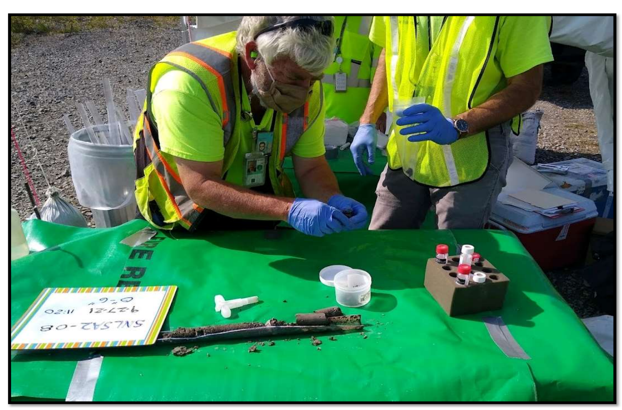
Routine RCRA reporting and RCRA compliant management of hazardous waste continued throughout 2021. The WVDP maintained open communications with NYSDEC and EPA through monthly RCRA teleconferences. The site is continuing to operate according to the 6 NYCRR Part 373-3, Part A (Interim Status) Permit Application and the RCRA §3008(h) Administrative Order on Consent.

Some of the highlights of the RCRA work performed in 2021 are listed below:

- The NDA and the NDA Interim Measures (IMs) continued to perform as designed, helping to contain the buried waste, while minimizing the potential for the release of chemical and radiological contaminants to the environment. The volume of water that is pumped from the NDA interceptor trench has decreased noticeably since the removal of the LPS building and re-covering the area with new geomembrane in May 2019. The volume pumped from the NDA trench in 2021 was 13,097 gallons (gal) (49,578 liters (L), a 15% reduction compared to the volume pumped in 2020 (15,419 gal [58,367 L]). The volume pumped in 2021 is about a 98% decrease compared with pre-IM volumes of over 700,000 gal/year.

- In April and September 2021, the entire NDA cap system was inspected, including storm water basins, walkways, ballast tubes, field seams, pipe penetrations, and the anchor trench. Overall cap condition was good, with no general deterioration of the geomembrane noted.

- NYSDEC provided final approval of the LSA #2 hardstand RCRA closure plan in June 2021. RCRA closure sampling activities for the LSA #2 hardstand were initiated in July 2021 with final setup of the 20-ft by 20-ft sampling grid.



**RCRA soil sampling at the LSA #2 hardstand**

NYSDEC and CHBWV performed a site walk-down of the area in early September 2021 to identify and document the presence of surface stains and/or discoloration for sampling purposes.

Soil sampling under the gravel pad was performed in late September and early October 2021. Soil samples were analyzed for Hazardous Waste Management Unit (HWMU)-specific hazardous waste constituents identified in the approved RCRA closure plan. At the end of CY 2021, the sampling results were being evaluated by NYSDEC to determine follow-up closure sampling activities, if any. The sampling data will be incorporated into the closure certification report that is being prepared for this HWMU.

**Analytical and Process Chemical (A&PC) Hot Cells**

- The A&PC Hot Cells were used to analyze radioactive and RCRA hazardous samples when the MPPB was operational. They are located inside the MPPB on the third floor. They are a RCRA unit whose clean closure will be achieved through removal during the demolition of the MPPB. The closure plan for this unit was conditionally approved by NYSDEC in September 2020 and NYSDEC provided responses to the public comments in January 2022. NYSDEC final approval of this closure plan was pending at the end of 2021.

- The Tank and Vault Drying System (T&VDS), installed in the WTF to maintain the tanks and control corrosion until the final Phase 2 decision is made, continued to operate during the first half of 2021. In late July 2021, the dryer unit desiccant wheel rollers and belt required replacement necessitating temporarily shutting down the system and subsequent ordering of replacement parts. Repairs were completed in early October, but the unit's main power supply breaker was then determined to be inoperable. This obsolete component was replaced in January 2022. The T&VDS began operating again in 2022 after ventilation condensate was removed that was partially blocking the outlet line of tanks 8D-3 and 8D-4. The T&VDS reduced the residual liquid in tank 8D-4 in 2021 by 68 gal (257 L). At the end of 2021, 3,921 gal (14,483 L) remained in tank 8D-4. The T&VDS is operated and monitored as a RCRA hazardous waste treatment system.

- As of September 2021, the effective date of the most recent STP update, there were a total of 56.81 cubic meters ($m^3$) of mixed TRU waste stored in containers and residual waste in tank 8D-4. This is a decrease of 0.44 $m^3$ from the mixed TRU waste in storage at the end of FY 2020 as a result of evaporation in tank 8D-4 and waste segregation and repackaging.

- The Annual Hazardous Waste Report for 2021 waste activities was submitted to NYSDEC in February 2022. The reported quantities generated, treated, and shipped are shown on Table ECS-3. (This table also includes a summary of non-RCRA regulated waste as required to be reported in the Annual Site Environmental Report (ASER) in compliance with DOE Order 435.1, "Radioactive Waste Management.")

- A Hazardous Waste Reduction Plan Annual Status Report was not required by NYSDEC in 2021 because the amount of reportable, nondemolition, hazardous waste generated was less than the 25 ton threshold.

- Per the Consent Order requirements, quarterly progress reports were submitted to EPA and NYSDEC, documenting progress on decontamination activities for Solid Waste Management Units (SWMUs) and waste generation activities.

- Groundwater monitoring, as recommended in the RCRA Facility Investigation (RFI) reports and approved by EPA and NYSDEC, continued during 2021 per the Consent Order requirements. This included submitting the quarterly RCRA groundwater exception reports to EPA and NYSDEC. The groundwater program and monitoring results at the WVDP are discussed in Chapter 4, "Groundwater Protection Program."

- NYSDEC performed their annual RCRA inspection in August 2021. No deficiencies were identified.

**TABLE ECS-3**
**Summary of Waste Generated at the WVDP During 2021**

| *Waste Description/ Facility* | *Type of Project Generating Waste* | *Quantity Generated in 2021* | *Discussion* |
|---|---|---|---|
| TRU waste | TRU waste from decontamination and deactivation activities | 127 cubic feet ($ft^3$)<br>(3.6 cubic meters [$m^3$]) | TRU waste was generated during decommissioning operations. The volume of TRU waste is also reduced each year during recharacterization and repackaging activities. |
| LLW | Includes LLW from all sources, most of which is from deactivation and demolition | 471,274 $ft^3$<br>(4,714 $m^3$) | LLW generated in 2021 includes waste from MPPB deactivation, LILO demolition and PTW soil containment removal. |
| Hazardous and Mixed LLW | Primary source of generation was decommissioning activites and site operations | 6,378 pounds (lbs)<br>(0.051 tons) | The majority of the total hazardous and mixed waste generated in 2021 was lead sheeting previously used for radiological shielding, and debris with metals. |
| Radiological wastewater from the LLWTF<br><br>(outfall 001) | NYSDEC regulates point-source liquid effluent discharges of treated process wastewater through the SPDES permit for the WVDP. | 5,014,520 gallons<br>(18,982,028 L) | During 2021, three batches of processed wastewater were discharged through outfall 001. This wastewater includes groundwater pumped from the NDA interceptor trench. |
| NDA interceptor trench | Interceptor trench (WNNDATR) and groundwater pre-treatment | 13,097 gallons<br>(49,578 L) | Groundwater was pumped and transferred to the LLW treatment building (LLW2). No organics or TBP were encountered in 2021. |
| Asbestos | Asbestos management and abatement | Friable:<br>0 square feet ($ft^2$) (0 $m^2$)<br>and 0 linear feet (0 m)<br>Nonfriable:<br>0 $ft^2$ (0 $m^2$)<br>and 0 linear feet 0 m) | In 2021, no friable or nonfriable asbestos was removed from facilities at the WVDP. |
| ***Waste Description/ Facility*** | ***Type of Project Generating Waste*** | ***Quantity Shipped in 2021*** [1] | ***Discussion*** |
| Sanitary wastewaters | All sanitary wastewaters are containerized and shipped off site. | 956,116 gallons<br>(3,619,293 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 2021. |
| Universal waste | Spent bulbs/spent batteries/mercury | Bulbs - 13 lbs (0.0065 ton)<br>Batteries - 1,392 lbs (0.70 ton)<br>Mercury - 2 lbs (0.0010 ton) | Waste generated in 2021 that was disposed of as universal waste. |

[1] The sanitary wastewaters and universal waste are most accurately measured at the time of shipping. There is one universal waste shipment each year and multiple sanitary waste shipments.

## 2021 Update of NEPA Activities: Phase 1 Decommissioning, Phase 1 Studies, Probabilistic Performance Assessment (PPA), and the Supplemental EIS (SEIS)

The 2010 FEIS provides the blueprint for all activities currently underway at the WVDP. No new major NEPA documents were initiated in 2021. The following is a summary of work activities completed in 2021 consistent with the 2010 FEIS/ROD, Phase 1 Decommissioning Plan (DP), and in support of the SEIS.

**2021 Phase 1 Decommissioning Update.** Deactivation and decontamination of the MPPB continued throughout 2021. Demolition of the LILO facility, located at the west side of the north end of the MPPB, was initiated in November 2021. Removal of the building frame and waste disposal continued into 2022. Final preparations for demolition of the MPPB continued into 2022.

The Phase 1 DP, written in 2010 required preparation of work plans for the decommissioning and demolition of the VF and the MPPB. These plans are used to define the requirements and sequencing of the demolition work. Work Instruction Packages (WIPs) that are based on these decommissioning plans provide the full details needed to complete the demolition of these facilities. Demolition of the MPPB will be performed in compliance with the MPPB decommissioning and demolition plan that was reviewed by the NRC, and by the MPPB demolition WIPs. The most recent revision of the MPPB demolition work plan was sent to the NRC in May 2020. During 2021, the MPPB demolition work plan and supporting documents and information concerning the MPPB dose modeling were reviewed by the NRC followed by several teleconferences. Subsequently, the NRC concluded that the DOE-WVDP had demonstrated adequate planning for open air demolition of the MPPB.

The MPPB demolition WIPs were revised in 2021 to add additional clarification and detail involved in the planned demolition process.

**2021 Phase 1 Studies Update.** The Phase 1 Studies on predicted erosion models and buried waste inventories were published in 2018 and will be used to support evaluation of Phase 2 decommissioning alternatives. The final reports on these studies are available at:

https://westvalleyphaseonestudies.org.

### National Environmental Policy Act (NEPA) Overview

NEPA requires DOE to consider 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 description of the most significant NEPA documents related to Phase 1 decommissioning activities is presented on the following page and a comprehensive summary of the NEPA documents published over the years is included in Table UI-6, in the Useful Information section. WVDP CXs, EAs, and EISs can be found on the DOE-WVDP website under the documents index:

http://www.wv.doe.gov/index.html.

## National Environmental Policy Act (NEPA) Overview *(continued)*

**Final Decommissioning Environmental Impact Statement (FEIS) Issued.** In January 2010, DOE and NYSERDA issued the "Final Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center," DOE/EIS-0226. 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 as shown in Figure ECS-1 below.

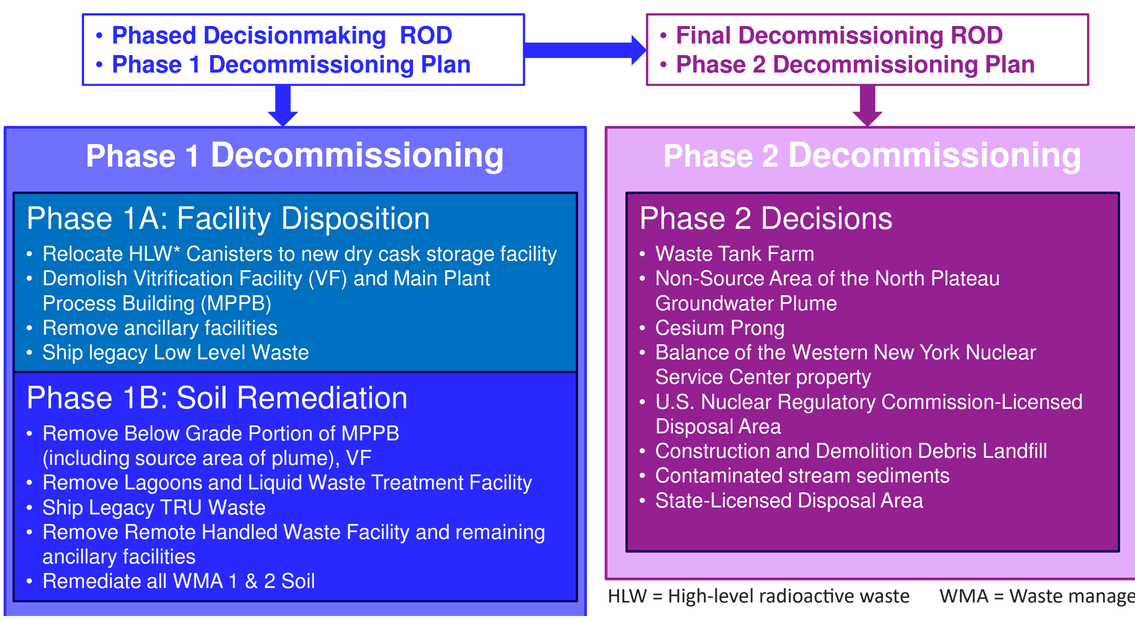
**Record of Decision (ROD).** On April 14, 2010, DOE issued the ROD for the FEIS, selecting the phased decisionmaking alternative. During Phase 1 Site Decommissioning, a number of highly contaminated facilities are being removed under a facilities disposition contract awarded in 2011.

Decommissioning the MPPB and the VF is part of the Phase 1 EIS work. DOE will also decommission the Remote Handled Waste Facility (RHWF), the wastewater treatment lagoons, and a number of other facilities during Phase 1. Phase 1 also includes soil characterization work and focused studies (Phase 1 studies) that will facilitate interagency consensus on decommissioning decisions for the remaining facilities. The original estimated cost for all of the Phase 1 work was approximately $1.2 billion (FEIS, 2010). 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.

**Phase 1 Studies.** Phase 1 studies are scientific studies being conducted to facilitate interagency consensus necessary to complete decommissioning of the remaining facilities following completion of Phase 1. The Phase 1 studies provide technical evaluations supporting the Supplemental EIS (SEIS) preparation.

**Supplemental EIS (SEIS).** The Phase 2 decision, which will be informed by the SEIS, will determine the decommissioning approach for the remaining facilities including the underground storage tanks in the WTF, the NDA and NY State-Licensed Disposal Area (SDA) waste disposal areas, and the nonsource area of the groundwater plume. The SEIS will evaluate a range of alternatives for the remaining facilities for which it has decommissioning responsibility including removal, in-place closure, and a combination of those two. The SEIS is being prepared by SC&A, Inc. under a DOE contract awarded in April 2017.

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




HLW = High-level radioactive waste WMA = Waste management area

Relocate HLW* - The WVDP Act requires the Department of Energy Secretary, as soon as feasible, to transport in accordance with applicable provisions of the law, to an appropriate federal repository for permanent disposal.

## Phase 1 Decommissioning Plan

Decommissioning Plan documents for the NRC are also required under the Phase 1 decommissioning and facility disposition scope of work. These planning documents must be consistent with the preferred alternative in the EIS ROD and NYSERDA Findings Statement.

**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 [FR] 74162) and transmitted it for NRC review. The DP was prepared to meet WVDP obligations to the NRC as directed under the WVDP Act.

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.

**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.

**2021 Probabilistic Performance Assessment (PPA) Update.** Work on the long-term probabilistic performance assessment (PPA) for the West Valley site was temporarily paused in 2021 pending the award of a follow-on contract to the contractor preparing the PPA for the West Valley site. NYSERDA and DOE plan on awarding the contract in early 2022; work on the PPA will continue to evaluate the performance of a range of decommissioning alternatives that will be evaluated in the SEIS.

The new information developed by the PPA and component models will support the Phase 2 decisions.

**2020 Supplemental EIS (SEIS) Update.** The SEIS schedule has been extended due to unanticipated complexities in the PPA modeling. Once work on the long-term PPA resumes under the new contract, DOE and NYSERDA will begin to use the PPA to evaluate SEIS alternatives.

### 2021 Update for Other Final Decommissioning Related Projects

**2021 Permeable Treatment Wall (PTW) Performance Update.** The PTW was installed in November 2010 to mitigate and limit migration of the non-source area of the plume until the final Phase 2 decisions could be made.

Performance monitoring data collected from 2011 through 2021 continues 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.

During 2021, some unexpected higher than usual conductivity and strontium-90 concentrations were observed in the wells completed inside and downgradient of the PTW. Supplemental water quality samples were collected as a result to investigate these anomalies. This included an evaluation of whether the type of material used for deicing across the site that may be impacting the groundwater geochemistry.

**PTW soil containment structure (covered with a black tarp)**

**Demolition and removal of PTW soil containment structure**

When the subsurface treatment wall was installed, the soil that was removed and replaced with zeolite was temporarily stored in a wood and concrete soil containment structure. The soil containment structure was dismantled and the soil and debris shipped off site by rail in 2021.

Additional discussion of the PTW is provided in Chapter 4, "Groundwater Protection Program."

## Other Compliance Related Updates

**Emergency Planning and Community Right-to-Know Act (EPCRA).** The Emergency Planning and Community Right-to-Know Act (EPCRA), also known as Superfund Amendments Reauthorization Act (SARA) Title III, is a federal law passed in 1986 to inform the public of potential environmental and safety hazards posed by the storage and handling of hazardous or toxic chemicals at facilities in their communities.

The WVDP is required to maintain Safety Data Sheets (SDSs) that describe the properties and health effects of all chemicals used and stored on site. Annual reporting requirements are based on the types and quantities of these potentially hazardous or toxic chemicals.

**2021 EPCRA Update.** The WVDP did not use or store any EPCRA listed extremely hazardous substances exceeding their threshold planning quantity in 2021. The WVDP did continue to use and store hazardous chemicals on site.

As shown in Table ECS-4 below, the only report required under SARA Title III in 2021 was the hazardous chemical inventory. The 2021 inventory of chemicals stored at the WVDP is provided in Table ECS-5 below. This chemical inventory was provided to state and local emergency response organizations and the nearby local fire departments.

**TABLE ECS-4**
**Status of EPCRA (SARA Title III) Reporting at the WVDP for 2021**

| *EPCRA Section* | *Description of Reporting* | *Submission Required* |
|---|---|---|
| EPCRA 302–303 | Planning Notification for Extremely Hazardous Substances | No |
| EPCRA 304 | Extremely Hazardous Substance Release Notification | No |
| EPCRA 311 | Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) | No |
| EPCRA 312 | Hazardous Chemical Inventory | Yes |
| EPCRA 313 | Toxic Chemical Release Inventory Reporting | No |

**TABLE ECS-5**
**Reportable Chemicals Above EPCRA 312 (SARA Title III) Threshold Planning Quantities Stored at the WVDP in 2021**

| *Chemicals Stored at the WVDP Above the Threshold Planning Quantities* | |
|---|---|
| Diesel Fuel/No. 2 Fuel Oil | Sulfuric Acid |
| Unleaded Gasoline | Potassium Acetate (Alpine Ice-melt) |
| Lead-acid Batteries | Liquid Nitrogen |

**Migratory Bird Treaty Act.** The Migratory Bird Treaty Act provides for the protection of migratory birds, their nests and their eggs. The DOE maintains a Bird Depredation permit that allows bird nests to be removed from areas where they would be impacted by site operations. Under the Bird Depredation permit, an additional registration is required for the removal or destruction of Canada geese nests and/or goose eggs.

**2021 Migratory Bird Update.** Table ECS-6 summarizes the migratory bird activities conducted during 2021.


**Canada geese**

**TABLE ECS-6**
**WVDP Migratory Bird Nest Depredation Activities in 2021**

| *Permit/License Type* | *Parameter* | *Permit Limit* | *2021 Total* |
|---|---|---|---|
| U.S. Fish and Wildlife - Bird Depredation Permit | Removal of Active Barn Swallow Nests | 20 | 0 |
| | Removal of Active American Robin Nests | 15 | 0 |
| | Removal of Active Eastern Phoebe Nests | 5 | 0 |
| | Removal of Active Common Grackle Nests | 15 | 0 |
| | Removal of Inactive Migratory Bird Nests | Not limited | 0 |
| U.S. Fish and Wildlife - Registration | Canada Goose Egg Nests Destroyed | NA | 0 Nests |

NA - Not applicable

## Project Assessment

Project assessments are 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.

### Project Assessment Activities in 2021

Overall assessment results reflected continuing, well-managed environmental programs at the WVDP.

Project assessment activities related to regulatory compliance conducted in 2021 included:

- one monitoring visit by NRC Region 1 conducted in September 2021 with a focus on preparations for MPPB demolition;
- surveillances by DOE-WVDP of the water management system, operation of the on-site meteorological tower, pre-job planning and other internal communication, fire protection, use of power cords, and housekeeping;
- management workplace visits of major projects by senior CHBWV management;
- an annual RCRA facility assessment by NYSDEC, RCRA surveillances by DOE-WVDP, and RCRA annual inspections of all RCRA units by CHBWV;
- routine inspections of the NDA (discussed under the RCRA section of this chapter), CDDL and PTW;

- safety inspections of the lakes and dams; and
- Regulatory Strategy group self-assessments for NDA operations and maintenance, for groundwater, ambient air, surface water, drinking water, and other environmental monitoring programs, and for sample data management and validation;

**Routine Inspections of the Construction and Demolition Debris Landfill (CDDL) and PTW.** The overall condition of the CDDL grounds were inspected in April and September 2021, with minor cleanup of the area performed in May. The CDDL has been closed since 1986 under a NYSDEC-approved closure plan for a nonradioactive solid waste disposal facility.

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. Routine inspections of the PTW area were also performed in 2021 with no concerns noted. Additional discussion of the PTW is provided in Chapter 4 of this report.

**Safety Inspections of the WNYNSC Lakes and Dams.** The two lakes and dams located on the WNYNSC property are maintained to provide 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.

The lakes, dams, canals and culverts are inspected twice every year by site operations personnel and the spillway is inspected monthly. Repairs of the spillway and dams have occurred several times since the establishment of the WVDP. In 2021, sediment was removed from behind the large concrete blocks at the base of the Lake #1 spillway. Straw bales were placed in these areas to filter out sediment-laden storm water and prevent it from entering the creek.

The engineering evaluation of the railway verifying that it was safe for use to transport waste off site was completed in 2021. The railway was used in 2021 for transport of wastes off site. Routine maintenance and inspections of the railway also continued to be performed in 2021.

The DOE continued to perform routine maintenance of the reservoir system throughout 2021 and will continue to maintain the reservoir system in a safe configuration while the final disposition of the reservoir system is being determined.

## Compliance Summary Tables

Table ECS-7 provides a comprehensive summary of the WVDP's compliance status with environmental statutes, DOE directives, executive orders (EOs), and state laws and regulations applicable to the Project activities.

A summary of the current WVDP environmental permits, approvals, and registrations is provided in Table ECS-8.

**Lake #1 - South Reservoir (used to supply augmentation water for SPDES discharges)**

**TABLE ECS-7**
**Compliance Status Summary for the WVDP in 2021**

| *Citation* | *Environmental Statute, DOE Directive, EO, Agreement* | *WVDP Compliance Status* |
|---|---|---|
| 42 United States Code (USC) §2011 et seq. | The **Atomic Energy Act** (**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 below. |
| 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. | **2021 Update:** DOE work in 2021 continued to focus 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. The DOE ROD for the FEIS was issued in April 2010 for the WVDP.<br><br>**2021 Update:** Work on the SEIS for the West Valley site was temporarily paused in 2021 pending the award of a follow-on contract to the contractor preparing the PPA. |
| WVDP MOU between DOE and NRC | The 1981 **Memorandum of Understanding (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. | **2021 Update:** NRC conducted a site monitoring visit in September 2021. |
| 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 the health, safety, and security of the public or workers, the environment, the operations of DOE facilities, or the credibility of the Department. *(continued)* | 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.<br><br>**2021 Update:** Environmental data for preparing the 2021 ASER was collected throughout the calendar year. The ASER is submitted to DOE-HQ by October 1st of the year following sample collection. |

**TABLE ECS-7 *(continued, page 2 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| ***Citation*** | ***Environmental Statute, DOE Directive, EO, Agreement*** | ***WVDP Compliance Status*** |
|---|---|---|
| DOE Order 231.1B *(continued)* | 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 232.2A | DOE Order 232.2A, **Occurrence Reporting and Processing (ORP) of Operations Information** defines requirements to notify DOE about events that could adversely affect the public, the workers, or the environment. | **2021 Update**: There were five ORP System (ORPS) reports including: (1) slip and fall exiting fork truck with concussion, (2) arm injury while working on piping requiring surgery, (3) high voltage cable severed with weed trimmer, (4) contaminated mud wasp nest, and (5) fire in VWR during diamond wire cutting. |
| DOE Order 458.1 | DOE Order 458.1, **Radiation Protection of the Public and the Environment** 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:<br><br>(1) operations are conducted to limit radiation exposure to members of the public pursuant to limits established in the Order,<br>(2) radiological clearance of DOE real and personal property is controlled,<br>(3) potential radiation exposures to members of the public are as low as reasonably achievable (ALARA),<br>(4) routine and nonroutine releases are monitored and dose to the public is assessed, and<br>(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.<br><br>**2021 Update:** Estimated doses from combined airborne and waterborne releases to the MEOSI were <0.56 % of the DOE Order 458.1 100-millirem (mrem) standard in 2021. |
| DOE Order 435.1 | DOE Order 435.1, **Radioactive Waste Management** 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.<br><br>**2021 Update:** Waste management was conducted in accordance with the following plans in 2021:<br>HLW - "WVDP Waste Acceptance Manual;"<br>TRU - "TRU Waste Management Program Plan;"<br>LLW -"LLW Management Program Plan;" and the radioactive component of mixed LLW - "Site Treatment Plan (STP) FY 2021 Update." |

**TABLE ECS-7** ***(continued, page 3 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| ***Citation*** | ***Environmental Statute, DOE Directive, EO, Agreement*** | ***WVDP Compliance Status*** |
|---|---|---|
| DOE Order 436.1, and EO 13834 | DOE Order 436.1, **Departmental Sustainability** provides requirements and responsibilities for managing sustainability within DOE to<br><br>(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,<br><br>(2) institute cultural change to factor sustainability and greenhouse gas (GHG) reductions into all DOE decisions,<br><br>(3) ensure DOE achieves the sustainability goals established in its **Strategic Sustainability Performance Plan (SSPP)** pursuant to applicable laws, regulations, and EOs. | **2021 Update:** In December 2021, DOE-WVDP submitted the "WVDP Fiscal Year (FY) 2022 Site Sustainability Plan" to DOE-HQ, which outlined performance status and planned goals to support DOE's sustainability mission.<br><br>The WVDP EMS continued to support DOE sustainability objectives in 2021 and was recommended for continued certification under the International Organization for Standardization (ISO) 14001:2015 standard in May 2021 after successful completion of the annual third party EMS audit in April 2021. |
| 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. | The WVDP performs routine assessments of all the laboratories and waste Treatment, Storage, and Disposal Facilities (TSDF) used by the site.<br><br>**2021 Update**: The QA evaluations performed by the Project in 2021 indicated that none of the laboratories or TSDFs utilized by the site had any findings that would compromise the integrity of the environmental data presented in this report or in the disposal services provided. |
| 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.<br><br>**2021 Update:** The CY 2021 Routine Maintenance Checklist concluded that no routine activities would have a significant impact on the human health or the environment. |

**TABLE ECS-7** ***(continued, page 4 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| ***Citation*** | ***Environmental Statute, DOE Directive, EO, Agreement*** | ***WVDP Compliance Status*** |
|---|---|---|
| Environmental Conservation Law (ECL), 6 NYCRR Part 617 NYS | The NY **State Environmental Quality Review** (**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. | 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.<br><br>**2021 Update:** No joint permit applications or short environmental assessment forms for work in wetlands areas were required in 2021. |
| 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.<br><br>**2021 Update:** NYSDEC-performed an inspection of RCRA facilites in August 2021. No findings, issues, or concerns were identified. |
| 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 require completing milestones identified in the STP volume.<br><br>**2021 Update:** The WVDP STP for FY 2021 was submitted to NYSDEC in January 2022. |
| 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). | 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.<br><br>**2021 Update:** Quarterly RCRA §3008(h) reports were submitted to EPA and NYSDEC in 2021. |

**TABLE ECS-7 *(continued, page 5 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| *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 the status of facility hazardous waste activities be reported to EPA and authorized states every two years. | WVDP facility hazardous waste activities are reported biennially to EPA and NYSDEC.<br><br>**2021 Update:** The RCRA 3016 Biennial Report is required every other year. The most recent report was submitted to EPA for CY 2022 in December 2021. |
| 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, approvals, and air quality limits. Emissions of radionuclides are regulated by EPA via the NESHAP regulations.<br><br>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 regulated under 6 NYCRR Part 201-4 (Minor Facility Registrations). | DOE has EPA approval to release radiological emissions from four active stacks and 15 Portable Ventialtion Units (PVUs). DOE also maintains a NYS Air Facility Registration Certificate for nonradiological sources.<br><br>**2021 Update:** The CY 2021 annual NESHAP Report summarizing radiological emissions and estimated dose was submitted to the EPA in June 2022. Estimated dose to the critical receptor from radiological air emissions during 2021 was <0.55 mrem, far below the 10 mrem Subpart H standard. All nonradiological sources have been exempted from reporting requirements. |
| 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. | NYSDEC has granted permission to continue operating under the current SPDES permit that expired in 2016. The project continues to operate under an existing SPDES permit that became affective in July, 2011.<br><br>**2021 Update:** All SPDES discharge monitoring results and storm water run-off monitoring results were within the limits specified in the SPDES permit. SPDES Discharge Monitoring Reports (DMRs) were submitted to NYSDEC monthly and storm water monitoring results were reported with the June and December DMRs. Toxicity evaluations continued in 2021. |
| 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. | **2021 Update:** Modifications were made to WVDP-206, *CWA/SPDES Best Management Practices and SWPPP for the WVDP* in June 2021. |

**TABLE ECS-7** ***(continued, page 6 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| ***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 gallons and is cleaned up within two hours of discovery. Minor petroleum spills that do not meet these conditions are reported quarterly to NYSDEC. Spills of larger significance may have immediate reporting requirements. | The WVDP has five registered PBS tanks (four aboveground storage tanks [ASTs] and one underground storage tank [UST]). They are inspected monthly and maintained. Spills are reported and cleaned up in accordance with WVDP policies and procedures.<br><br>**2021 Update:** The deactivated aboveground 10,000-gal diesel fuel tank was cleaned and permanently closed, and removed from the registration during 2021. There were no immediately reportable spills in 2021. There were eight minor petroleum spills (less than five gallons each) included in the routine NYSDEC quarterly petroleum spill reports in 2021. |
| 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 affect 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. | The most recent site-wide WVDP wetlands survey was performed in 2003 and approved by USACE in March 2006. 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 NDA in May 2013.<br><br>**2021 Update:** No new wetland delineations were performed in 2021. NYSDEC approval was received to work in the 100-ft buffer of NYSDEC Wetland 15 during the 2021 school house well and septic system removal. |
| 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. If a hazardous substance spill exceeds a reportable quantity, CERCLA reporting requirements are triggered. | 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.<br><br>**2021 Update:** There were no CERCLA activities in 2021. |
| 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. | **2021 Update:** Chemical inventories for the WVDP in 2021 were reported quarterly under EPCRA, as appropriate. Refer to Tables ECS-4 and ECS-5. |

**TABLE ECS-7 *(continued, page 7 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| *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, non-community public drinking water system serving a population of less than 500. The CCHD routinely performs inspections of the treatment and distribution system. Potable water has been supplied by two groundwater wells since 2014.<br><br>**2021 Update:** The drinking water supply was sampled and analyzed for Per- and Polyfluoroalkyl Substances (PFAS) in 2021, with results less than detection limits. The current year results from all analyses of drinking water were within limits. |
| 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.<br>**2021 Update:** No program changes were needed in 2021. |
| 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 2017" (WVDP-477) was last revised in February 2021.<br><br>**2021 Update:** The Radiological Controls department updated their procedures in 2021 to follow DOE-STD-1098-2017 for radiation protection (replaces DOE-STD-1098-2008). |
| 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 are managed in accordance with state and federal regulations, as well as site standard operating procedures (SOPs). PCBs are managed in accordance with the site "PCB and PCB-Contaminated Material Management Plan" by personnel certified by NYSDOL.<br><br>**2021 Update:** Table ECS-3 provides a summary of the asbestos quantities managed in 2021. PCB use, storage, and disposal was documented in the 2021 PCB log. |

**TABLE ECS-7** ***(continued, page 8 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| ***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.<br><br>**2021 Update:** Herbicides were used at the WVDP in June and September 2021 to control weed growth. All COVID-19 cleaners and sanitizers were included on the NYSDEC approved list. |
| 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.<br><br>**2021 Update:** Routine inspections of the dams continued to be performed in 2021. These inspections are performed weekly by site operations, monthly by Regulatory Strategy, and semiannually by engineering, as well as after high precipitation (snow or rain) or severe weather events. |
| NYS ECL Article 15, Title 33, Part 675 and Title 15, Part 601 | **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 gallons (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. Modifications to the law that became effective in 2017 require a water withdrawal permit for all water withdrawal systems with a potential to withdraw 100,000 gallons per day or more. | **2021 Update:** NYSDEC issued a water withdrawal permit to the DOE-WVDP in December 2019. The permit is effective through December 2029.<br><br>In 2021, the WVDP withdrew an average of 42,401 gal/day (160,505 L/day) from the groundwater supply wells and reservoirs. The WVDP submitted the 2021 annual water withdrawal report to NYSDEC in March 2022. |
| 49 CFR Part 172, and<br>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. | Medical services generate potentially infectious medical wastes.<br><br>**2021 Update:** All medical waste was securely stored in approved biohazard containers, and handled and controlled by authorized personnel. |

**TABLE ECS-7 *(concluded, page 9 of 9)***
**Compliance Status Summary for the WVDP in 2021**

| *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.<br><br>**2021 Update:** Migratory bird nest depredation activities for the current year are summarized in Table ECS-6. |
| 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.<br><br>**2021 Update:** No known endangered species resided on the WNYNSC or WVDP in 2021. |
| 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.<br><br>**2021 Update:** No protected historical sites were impacted by site activities in 2021. |
| 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. | **2021 Update:** No activities were performed during 2021 at the WVDP that would develop new floodplains or be adversely impacted by the existing 100-year floodplain within the premises. |
| 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.<br><br>**2021 Update:** As required by the plan, the CDDL cover was inspected in April and September 2021, with minor cleanup performed in May. |
| EO 13751 | EO 13751, **Safeguarding the Nation from the Impacts of Invasive Species**, calls on Federal agencies to prevent the introduction, establishment and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. | Environmental staff report invasive species and noxious plants of concern to site maintenance.<br><br>**2021 Update:** Wild parsnip, which can cause burns, was identified along the site's western fenceline and removed again in 2021. Less harmful invasive species seen on site include: multiflora rose, phragmites, nonnative honeysuckle, European starlings, and house sparrows. These will continue to be monitored for potential concerns. |

**TABLE ECS-8**
**WVDP Environmental Permits, Approvals, and Registrations**

| *Permit Description* | Status of Permit, Approval, or Registration and System Updates |
|---|---|
| ***Hazardous Waste Management (NYSDEC)*** | |
| **WVDP RCRA Part A Interim Status Permit Application (EPA ID #NYD980779540)** | |
| RCRA permit that provides interim status for treatment and storage of hazardous waste. | DOE is currently operating under the April 2011 RCRA Part A Permit Application, conditionally approved on June 9, 2011. |
| **RCRA Final Status Permit (6 NYCRR Part 373-2) - *INDEFINITELY SUSPENDED*** | |
| RCRA permit that provides final status for treatment and storage of hazardous waste. | NYSDEC has suspended action relative to the RCRA Final Status permit application until completion of Phase 1 work. |
| ***Effluent Water (NYSDEC)*** | |
| **SPDES (NY0000973)** | |
| Permit to discharge to surface waters from various on-site sources with associated monitoring requirements. | The current SPDES permit was issued by NYSDEC, effective July 1, 2011, modified in July 2015 for the relocation of the S09 storm water outfall, and expired on June 30, 2016. With NYSDEC approval, the WVDP is currently continuing to operate under the terms and conditions of the existing SPDES permit. |
| ***Water Withdrawal (NYSDEC)*** | |
| **Water Withdrawal (NYS ID# 9-0422-00005/00112)** | |
| Permit to withdraw waters from two groundwater supply wells and from the on-site reservoirs. | The WVDP is operating under a NYSDEC approved water withdrawal permit that requires renewal every 10 years. The next renewal is due in 2029. |
| ***Drinking Water (NYSDOH and CCHD)*** | |
| **Public Water System (ID #NY0417557)** | |
| Approval to operate the WVDP nontransient noncommunity public drinking water system under NYSDOH. | The WVDP drinking water system operates with CCHD and NYSDOH approval and is a assigned a NYS drinking water system tracking number by CCHD. |

Note: Permit, approval, and license expiration dates are current as of December 2021.

**TABLE ECS-8** ***(continued, page 2 of 3)***
**WVDP Environmental Permits, Approvals, and Registrations**

| *Permit Description* | Status of Permit, Approval, or Registration and System Updates |
|---|---|
| ***Flood Protection and Dam Safety (NYSDEC)*** | |
| **NYS Atomic Development Dam #1 and Dam #2 (Reg. ID #019-3149 and Reg. ID #019-3150)** | |
| Permit to operate and maintain two Class A Low-Hazard Dams on the WNYNSC property. | Dam permits were issued for operation and routine maintenance of the dams and lakes. The dams create lakes that supply water for SPDES discharge augmentation. The dam permits have no expiration date. |
| ***Air Emissions - Radiological (EPA)*** | |
| **Replacement Ventilation System (RVS) (WVDP-RVS-MPPB-New-001)** | |
| EPA approval for RVS radionuclide emissions. | The RVS is operated under an EPA approval that was obtained in 2015 and has no expiration date. The RVS was isolated from the MPPB in 2021 but continues to be operated. Ventilation of the MPPB in local work areas is provided by Portable Ventilation Units (PVUs). |
| **Supernatant Treatment System (STS)/Permanent Ventilation System (PVS) (WVDP-387-01)** | |
| EPA approval for STS ventilation for radio-nuclide emissions. | The STS ventilation system is operating under an EPA approval that was obtained in 1987 and has no expiration date. |
| **Remote Handled Waste Facility (RHWF) (WVDP-RHWF Mod-001)** | |
| EPA approval for RHWF ventilation for radionuclide emissions. | The RHWF is operating under an EPA approval that was obtained in 2012 that has no expiration date. |
| **Outdoor Ventilated Enclosures/ Potable Ventilation Units (PVUs) (WVDP-587-01)** | |
| EPA approval for 15 PVUs for ventilation and removal of radionuclides. | The PVUs are operating under an EPA approval originally obtained in 1987 for 10 PVUs and expanded in 2007 to allow usage of 15 units. The approval has no expiration date. |

Note: Permit, approval, and license expiration dates are current as of December 2021.

**TABLE ECS-8 *(concluded, page 3 of 3)***
**WVDP Environmental Permits, Approvals, and Registrations**

| Description | Status of Permit, Approval, or Registration and System Updates |
|---|---|
| ***Air Emissions - Nonradiological (NYSDEC and NYSDOL)*** | |
| **Air Facility Registration Certificate (9-0422-00005/00099) - NYSDEC** | |
| Certificate identifies potential sources of nonradiological emissions from the WVDP that do not require a permit. Exempt or trivial emissions are not included. | The WVDP has a NYSDEC approved air facility registration certificate. There are currently no nonradiological emissions sources at the WVDP that require a permit. The air facility registration is renewed as new units are installed or old sources are modified or taken out of service. |
| **Asbestos-Handling License (CHBWV #61646) - NYSDOL** | |
| Asbestos contractor license. | The CHBWV asbestos handling license is renewed annually. |
| ***Petroleum Bulk Storage (PBS) (NYSDEC)*** | |
| **PBS Registration (#9-008885)** | |
| Registration of bulk storage tanks used for petroleum. | The WVDP operates five NYSDEC registered tanks for gasoline and diesel fuel storage under a PBS certificate. The PBS registration certificate requries renewal every five years. The current certificate is valid from 2021 to 2026. |
| ***Wildlife (U.S. Fish and Wildlife Service)*** | |
| **Bird Depredation Permit (MB747595-0)** | |
| Federal permit for the limited taking of migratory birds and active bird nests. | The WVDP has a bird depredation permit that is renewed annually. |
| **Resident Canadian Goose Nest and Egg Registration** | |
| Federal registration for management of goose nests and eggs. | The WVDP has a goose nest and egg registration that is updated annually. |
| ***Groundwater (EPA)*** | |
| **Underground Injection Control Program Regulation (UICID: 11NY00906001)** | |
| Approval to use PTW wells to inject sodium bromide tracer solution to estimate groundwater flow velocities. | EPA authorized operation of injection wells for tracer testing within the PTW at the WVDP in November 2010. This authorization has no expiration. |

Note: Permit, approval, and license expiration dates are current as of December 2021.

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# CHAPTER 1
# ENVIRONMENTAL MANAGEMENT SYSTEM

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 Environmental Management System (EMS) is a program the WVDP utilizes to manage the impacts its operations have on the environment, and to systematically improve its environmental stewardship practices. The WVDP EMS is in conformance with ISO 14001, which is the international standard for an effective EMS.

## 2021 Highlights

The CHBWV EMS was recommended for recertification under the ISO 14001:2015 standard on May 20, 2021, after successful completion of the annual third party EMS recertification audit in April 2021. The WVDP scored 90% (which equates to the highest score of "green") on the federal EMS performance metrics scorecard for 2021 indicating the site has a robust EMS.

The EMS is incorporated into all planned work activities. The 2021 work scope was focused on continued deactivation of the MPPB and preparations for demolition including Nitrocision® in PPC-S, ventilation duct removal in the VWR, and beginning of demolition of the LILO facility. A readiness review was conducted for the initiation of rail shipments from the WVDP for off-site disposal of the PTW soil and its containment structure. Safe and compliant work was performed during 2021 in part due to involvement of EMS trained personnel in hazard screening, in development of project specific work instructions and operating procedures, and in daily pre-job briefs.

CHBWV and its subcontractors achieved over 302,129 consecutive work hours without a job related lost-time work injury or illness during CY 2021.

Much of the effort in 2021 was focused on planning for the demolition of the MPPB. Internal and external assessments were performed of each part of the demolition process including an evaluation of waste management logistics for the large quantities of MPPB waste anticipated and an evaluation of how the environmental radiation protection program might be impacted by this major project. Involvement of EMS trained staff in the MPPB planning will ensure regulatory requirements are addressed and the public and the environment are protected when this work is performed.

The WVDP continues to contribute to DOE sustainability goals for reductions in Greenhouse Gas (GHG) emissions, energy and water use, and for pollution prevention and waste minimization, in large part by reducing energy consumption through removal of site facilities.

The site contributes to renewable energy projects that globally impact GHG emissions through the annual purchase of Renewable Energy Credits (RECs).

## Environmental Management System (EMS)

An EMS is a management practice that allows an organization to conduct work in a systematic manner to minimize the impacts of its operations on the environment. An effective EMS ensures that potential environmental issues are identified, controlled, and monitored, and it provides mechanisms for reinforcing continual improvement in work performance with respect to environmental impacts. 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.

The EMS helps address regulatory requirements in a systematic manner and can reduce the risk of noncompliance as well as improve environmental performance by ensuring that environmental evaluations involve effective communication, abide by all appropriate regulatory guidance, and include regulatory notifications and approvals.

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 each project.

An independent, remote, third-party recertification audit of the EMS for the ISO 14001:2015 standard was conducted in April 2021 by Orion Group. During the audit, CHBWV was commended for the following strengths:

1) senior staff involvement in site activities through a management workplace visit program;
2) environmentally responsible purchasing as a result of a vendor management program;
3) implementation of a very comprehensive communication plan;
4) very knowledgeable staff; and
5) a good document management process.

The auditors concluded that the WVDP ISO 14001:2015 program is mature, well defined and effectively implemented. As a result of the audit, the CHBWV EMS was recommended for recertification under ISO 14001:2015.

**Best Practices.** Improved communication is a key component of the ISO 14001:2015 EMS standard. CHBWV was asked to present a description of WVDP EMS communications practices at the DOE EMS Community of Practice WebEx meeting again in September 2021, after a similar presentation in March 2020. The WVDP was previously showcased for their communication program as a "best practice" at the 2019 Federal Environmental Symposium.

The WVDP communication plan is focused on keeping internal and external stakeholders informed of environmental work and project-related cleanup progress. Some of the best practices in communications commended included routine and frequent communications with regulatory agencies that resulted in timely approvals to support project activities including:

- approval of the NESHAP alternate calculation methodology for estimating air emissions during demolition;
- teleconferences with NYSDEC and EPA on RCRA projects, and periodic RCRA path forward meetings with NYSDEC in Albany;
- quarterly public meetings and quarterly project presentations to the Citizen Task Force (CTF);
- electronic communications such as the WVDP Facebook page of project accomplishments available for viewing at:

https://Bit.Ly//EMWVDP

- and CHBWV YouTube videos featuring site representatives attesting to the rigor of site sampling and oversight:

https://www.youtube.com/watch?v=R0tU4XQ5Irc

and preparations for MPPB demolition:

https://m.youtube.com/watch?v=u1he0p663Ks&feature=youtu.be

CHBWV actively participates in the DOE-HQ Office of Sustainable Environmental Stewardship, an important organization that fosters sharing of EMS best practices.

**Self-Assessments.** At the WVDP, self-assessment activities are stressed as a mechanism for evaluating, improving, and maintaining safety and protection of the public and the environment. These self assessments are coordinated through the site Integrated Assessment Program and involve an annual review of each functional area of the Project.

**Objective Assessments:** Project assessments were performed of each part of the demolition process. The DOE-WVDP, together with an independent external group of demolition waste experts, performed a focused review of the WVDP waste logistics during MPPB demolition. The DOE Headquarters Office of Enterprise Assessments also performed an independent assessment of the WVDP environmental radiation protection program with respect to open-air demolition of the MPPB in order to identify potential opportunities for improvement.

**Lessons Learned.** The WVDP participates in the DOE lessons learned program, providing internal training as well as opportunities for improvements in safety and environmental stewardship.

**Management Review.** The routine annual internal EMS Executive Safety Review Board (ESRB) review was held on March 17, 2021. The ESRB reviews the site's environmental performance annually to ensure the continuing suitability, adequacy, and effectiveness of the EMS. The EMS was determined to be operating effectively during this review.

**Earth Day.** The DOE Office of Sustainable Environmental Stewardship promotes EMS programs during Earth Day, a global annual event that commemorates the beginning of environmental protection awareness. CHBWV hosted an information booth at a local Earth Day event and provided copies of the WVDP ASER, a children's activity book, and reusable totes in 2021.

## Policy and Commitment

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

http://chbwv.com/Safety_and_Environment.htm.

Managers are expected to take prompt action to address environmental concerns and to have zero tolerance for noncompliance with the policy.

## EMS Implementation

The EMS directs that work planning must involve identifying activities with specific regulatory requirements and activities with the potential for significant environmental impacts. In addition, planned work must be performed in a manner that will contribute to DOE sustainability goals.

**Regulatory Compliance.** Assessment of the applicability of environmental laws and regulations prior to initiation of work ensures 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 exposure. Required regulatory reports that analyze these data are generated on a regular basis.

**Environmental Aspect Analysis.** 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, as shown in Table 1-1 below. An "environmental aspect" is any element of an organization's activities, products, or services that can impact the environment.

**TABLE 1-1**

**WVDP Significant Environmental Aspects for 2021[a]**

| ***Environmental Aspect:*** |
|---|
| · Radiological and/or Asbestos Air Emissions |
| · Radiological Waste Generation (low-level waste [LLW], mixed [hazardous radiological] waste, and transuranic [TRU] waste) |
| · Accidental Radiological Release (i.e., High Efficiency Particulate Air [HEPA] filter failure or remote handled TRU waste drum drop) |
| · Toxic Discharge to Surface Water (metals, organics, or radiological constituents) |
| · Savings in Energy Use (positive aspect due to significant reductions and purchase of renewable energy credits [RECs]) |

[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."

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.

Potential significant environmental aspects of site activities 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, the anticipated level of community concern, and the resulting potential realized risk. The purpose of grading environmental aspects is to focus management attention on the most important environmental concerns associated with the 2021 scope of work.

The potential significant environmental aspects identified for 2021 are summarized in Table 1-1. The activities planned for 2021 that were evaluated for their environmental aspects included MPPB demolition preparations, shipments of the PTW soil and its containment structure by rail, processing and repackaging degraded containers, demolition of the LILO facility, and disposition of the waste generated in 2021.

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

Planning for waste shipping by rail included EMS evaluations of potential environmental impacts. The PTW waste soil disposal project provided an opportunity to test all aspects of shipping WVDP waste using the on-site and off-site rail system. A professional engineering study of the rail line was performed before it was approved for use. Shipping the 350 intermodal containers of PTW soil and debris from the containment structure enabled a complete test run of all rail operating procedures. The Project is planning to ship the waste from MPPB demolition off site by rail.

The EMS is reinforced by the Integrated Safety Management System (ISMS). The objective of both the EMS and the ISMS is to conduct work safely, efficiently, and in a manner than ensures protection of the environment. EMS and ISMS guidelines helped to ensure a safe and environmentally sound demolition plan.

**Maintenance work on rail line to ensure it is safe for use**

**Railroad on WVDP property to be used for shipping waste off site**

**Shipping waste soils off site by rail**

**Objectives and Targets**. EMS objectives and targets are established in order to quantitatively evaluate progress towards pollution prevention, reduction of environmental hazards and 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 current site mission to demolish buildings and infrastructure. The 2021 EMS objectives and targets included reducing the potential for contaminants to reach storm water conveyances; improving remote, integrated work capabilities; reducing vehicle emissions by shipping waste by rail instead of by truck; re-purposing existing facilities; reducing potential for fuel leaks to the environment; reducing electricity usage; reducing the inventory of toxic materials, reducing sulfur oxide (SOx), nitrogen oxide (NOx), and particulate matter emissions; limiting Green House Gas (GHG) emissions; purchasing environmentally preferable computers and electronics; and purchasing Renewable Energy Credits (RECs).

The majority of the EMS site-specific objectives and targets were met in 2021. Delays occurred in two of the 2021 EMS objectives for completion: (1) final testing of the MPPB demolition water management system, and (2) reduction of the radiological inventory of PPC-S utilizing Nitrocision®. These objectives and targets will be carried over into 2022. Achievements with respect to the federal sustainability goals are discussed in the "EMS Results and DOE Sustainability Goals" section of this chapter.

**Training.** Employee training demonstrates leadership's commitment to procedure compliance and environmental stewardship, key elements of an effective EMS. 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."

Based on individual work requirements, employees receive specialized safety training. For example, employees who work in environments with airborne hazards must first medically qualify and successfully complete Respiratory Protection training, and those who may work with asbestos removal take asbestos 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.

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.

**Safety.** The WVDP record with respect to worker safety and protection of the public and the environment demonstrates the success of a well implemented ISMS and EMS. CHBWV and its subcontractors had achieved over 302,129 consecutive work hours without a job related lost-time work injury or illness by the end of December 2021. This milestone was achieved while also protecting the public and the environment.

## EMS Results and DOE Sustainability Goals

The WVDP EMS is 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.

**EMS Performance Metrics for 2021 EMS Scorecard.** The EMS Annual Report, submitted to the DOE-HQ Office of Sustainable Environmental Stewardship, establishes EMS performance metrics in several categories on which each site is scored. All sites in the DOE complex and all other federal agencies are required to work towards the nationwide sustainability goals.

Each year, the WVDP updates their site-specific sustainability goals to correlate with the planned work scope, and to contribute towards nationwide DOE sustainability goals outlined in the federal Strategic Sustainability Performance Plan (SSPP). The federal goals are established for a Fiscal Year (FY). Therefore, sustainability data in this chapter is reported by FY. Based on the status of the site's EMS, the WVDP scored 90% (which equates with the highest score of "green") on the federal scorecard for FY 2021 indicating the site has a compliant and robust EMS.

**WVDP Score = Green!**

**Greenhouse Gas (GHG) Emission and Energy Use.** The most significant contribution the WVDP has made towards sustainability is the long-term reduction in energy and water usage that results from removing facilities that are no longer needed. There has been a decrease in GHG emissions attributed to WVDP operations including reductions due to the purchase of renewable energy credits (RECs) of 91% from the FY 2008 baseline. RECs purchased in 2020 had a more significant impact on the GHG emissions in FY 2020 than they did in FY 2021.

The WVDP's overall energy usage continued to decrease between FY 2020 and FY 2021, as shown by Figure 1-2. The electrical supply upgrades that began in 2015 and were completed in 2019 continued to show benefits in 2021. Use of electricity decreased 11% from FY 2020 to FY 2021 and was below the FY 2008 baseline by 46%. Natural Gas usage on site increased by 3% from FY 2020 to FY 2021. Natural gas usage in FY 2020 was below the FY 2008 baseline by 75%.

**Hydrofluorocarbon (HFC) Use**. The only HFC used at the WVDP is a quick cure spray foam used to fill void spaces in radiological waste containers and to seal piping penetrations during deactivation and decontamination activities. Purchase of this has been discontinued and substitute materials are being evaluated.

**Water Use.** All potable and Industrial, Landscaping, and Agricultural (ILA) water is supplied by two groundwater wells except for the augmentation water required during lagoon discharges, which is supplied by the reservoirs. In FY 2021, approximately 63% of the total water used at the WVDP was for potable water and 37% for industrial activities. Water usage decreased between FY 2020 and FY 2021. (See Figure 1-3.) Total water use decreased by 34%, potable water use decreased by 7% and ILA water use decreased 57% in FY 2021 as compared to FY 2020.

**Pollution Prevention and Waste Reduction.** Waste minimization and recycling of nonhazardous, nonradioactive solid waste is maximized through EMS involvement in project planning.

The WVDP "Waste Minimization and Pollution Prevention Awareness Plan" requires that waste minimization objectives be included in the work instructions for all projects, and encourages procurement of recycled products, reusing existing products, and using methods that conserve energy. Material recycling and reuse is tracked under the EMS.

**FIGURE 1-1**
**GHG Emissions**

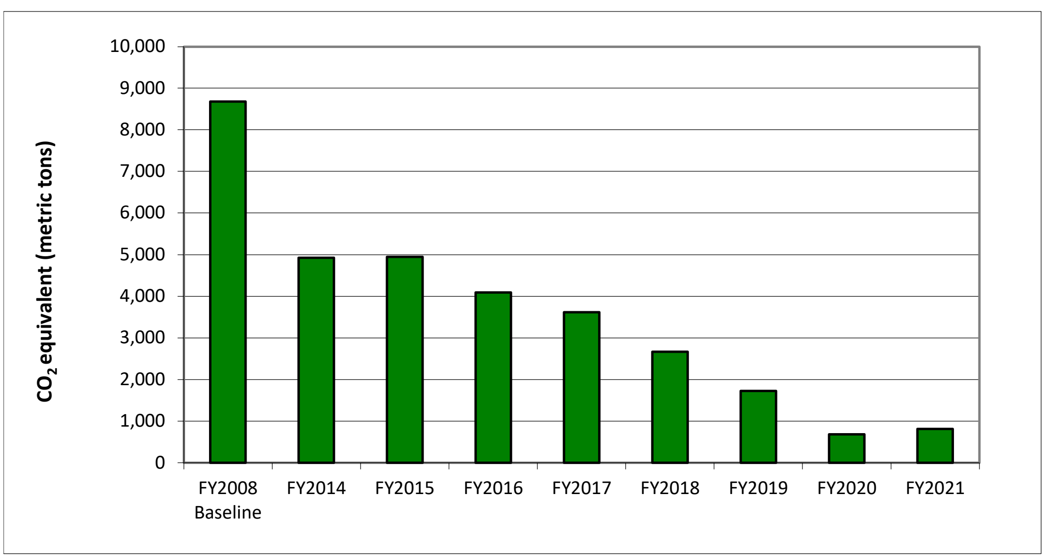


**FIGURE 1-2**
**Energy Use**

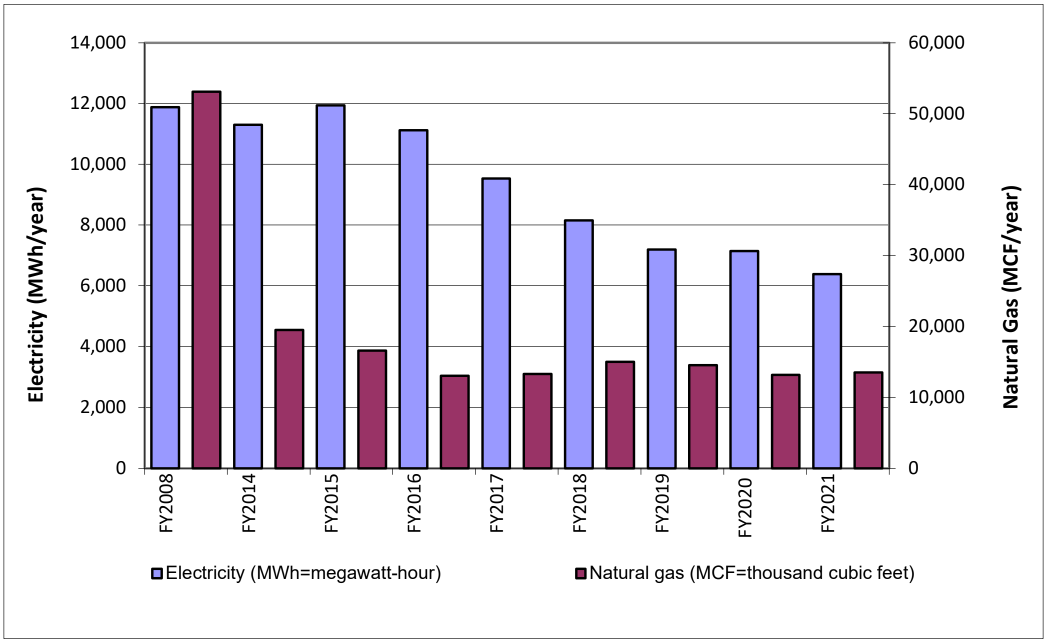
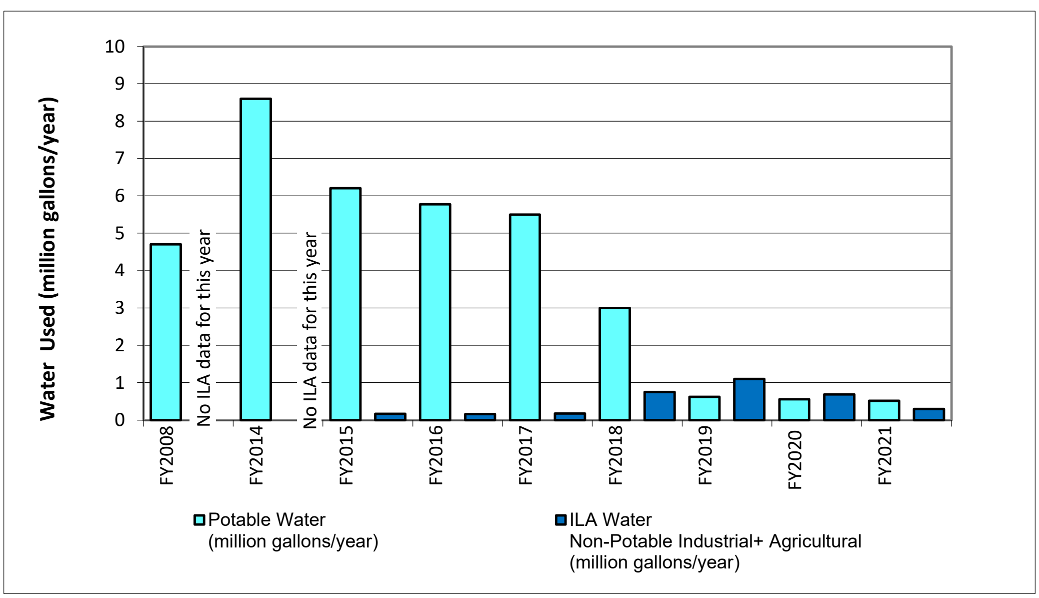


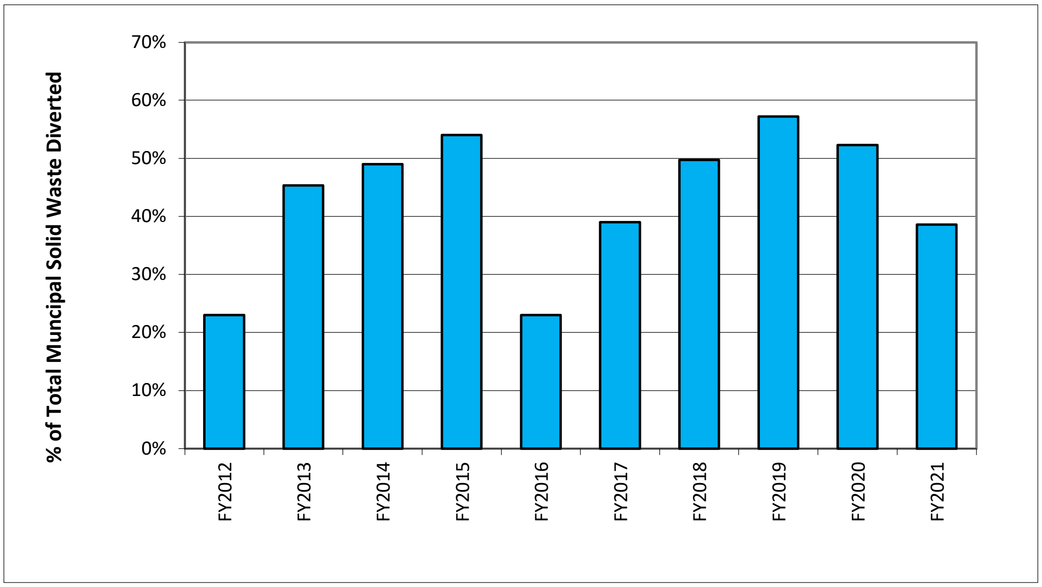

**FIGURE 1-3**
**Water Use**



In FY 2021, the WVDP diverted 38.6% of all nonhazardous municipal solid waste generated away from landfill disposal, as shown on Figure 1-4. (Note: This excludes construction and demolition debris which is frequently radiologically contaminated at the WVDP and cannot be recycled.)

Nonradiologically contaminated solid waste generated in FY 2021 was recycled or reused where practical. This waste diversion included transfers of miscellaneous equipment and parts to other DOE sites and to other non-federal sites. The reused equipment included a fork truck, salt spreader, and multiple totes of Dura-Soil™. These waste diversions for FY 2021 totaled over 38 tons.

**FIGURE 1-4**
**Waste Recycled/Reused/Donated**




A total of approximately 71.8 tons of material was diverted from landfills in FY 2021, including recycling of 20.4 tons of scrap metal. The quantity of each type of material recycled, reused, or donated is summarized in Table 1-2.

**Sustainable Acquisition.** To support 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.

**TABLE 1-2**
**Recycled/Reused/Donated Material**
**in FY 2021**

| *Material* | *FY 2021 Quantity (tons)* |
|---|---|
| Metals | 20.4 |
| Mixed paper and corrugated cardboard | 7.2 |
| Electronics | 2.1 |
| Fluorescent bulbs | 0.1 |
| Batteries | 1.8 |
| Transfers to other DOE sites | 6.8 |
| Transfers to non-federal sites | 32.1 |
| Miscellaneous (oil, bottles, etc.) | 1.3 |
| **Total** | 71.8 |

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 nontoxic or less toxic alternative chemicals. All 2021 construction and custodial subcontracts incorporated sustainability requirements of DOE acquisition regulations.

**Electronic Stewardship.** The site purchased 100% of their eligible computer and electronic equipment through the certified Electronic Product Environmental Assessment Tool (EPEAT) program in FY 2021. CHBWV was recognized with a 2021 EPEAT Purchaser Award by the Global Electronics Council for this accomplishment. 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.

**Renewable Energy Credits (RECs).** One of the DOE SSPP goals is for expanded use of renewable energy generation across the complex. Because the WVDP is deactivating and demolishing facilities, on-site generation of renewable energy is impractical. Instead, renewable energy credits are purchased to support other locations where renewable energy opportunities will contribute to reduced global GHG emissions. The WVDP purchased 2,400 MWh of RECs through the primary contracting agent used by the Department of Defense, Defense Logistics Agency (DLA) in FY 2021, offsetting the site energy usage by 37.6%.

**Climate Resilience.** President Biden issued two new executive orders (EO) relating to climate change in January 2021, EO 13990,“ Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis” and EO 14008, “Tackling the Climate Crisis at Home and Abroad.” EO 13990 is designed to ensure all people have access to clean water and EO 14008 outlines a comprehensive approach to climate change together with other countries across the world.

The WVDP is working with partners to advance the understanding of the earth’s climate system as well as to understand how various options for decommissioning and long-term stewardship of the site may be impacted by climate change. This effort utilizes Probabilistic Performance Assessment (PPA) modeling to analyze climate change impacts to the site such as rain events and erosion. The modeling simulations will be assessed to identify potential remedial strategies for the Supplemental Environmental Impact Statement (SEIS) process that is addressing the final site closure. The SEIS will evaluate erosion issues, reduction of the site footprint, and proactively address radiologically contaminated areas to minimize the spread of contamination as part of the Phase 2 decisionmaking process.

As the DOE mission is to complete the WVDP Act and associated waste management activities, a continued emphasis will be placed on organizational resilience through site security and emergency preparedness procedures. Climate change considerations are being incorporated in final site decommissioning decisions as part of the National Environmental Policy Act (NEPA) process.

## Summary

The benefit of the WVDP’s EMS to DOE’s mission at the WVDP in 2021 includes enhanced worker safety, continued compliance with environmental regulations, reduced energy and water supply use, reduced waste inventory through reuse/recycling and shipping, and safe disposal of hazardous materials.

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# CHAPTER 2

# ENVIRONMENTAL MONITORING

The goal of the WVDP environmental monitoring program is to ensure that the public health and safety and the environment continue to be protected with respect to releases of radiological and chemical contaminants from site activities in accordance with DOE Order 458.1, "Radiation Protection of the Public and the Environment," (Change 4). This chapter describes the environmental monitoring performed and discusses the 2021 results in comparison to background concentrations, permit limits and DOE standards.

The radiological environmental monitoring data is also evaluated each year on the basis of the estimated potential dose to the public and the dose to local biota. The 2021 dose assessment is provided separately in Chapter 3.

## 2021 Highlights

There were no environmental permit discharge limit exceedances in 2021 and no unplanned releases. As in the past, although concentrations of certain radiological constituents from samples collected within the WVDP security fence exceeded background concentrations, results from off site and downstream sampling locations confirm that the health and safety of the public and the environment continue to be protected.

**Air:** Iodine-129 continued to be detected in airborne emissions from on-site point sources during 2021 above background but well below DOE standards. Off site, 2021 radioisotopic results at the ambient air sampling locations encircling the site were below all applicable limits.

**Water:** Gross beta, tritium, strontium-90, cesium-137 and uranium isotopes continued to be detected in surface water above background but well below DOE standards on the WVDP or immediately outside the WVDP property (at WNSP006). Downstream of the WVDP, at the first point of public access, all radioisotopic results were at background levels or nondetectable, except gross beta, which is naturally occurring.

Discharge concentrations from the 001 outfall were similar to previous years. Whole Effluent Toxicity (WET) testing continued to be performed during 2021. The WVDP is continuing to work together with NYSDEC to determine the root cause(s) of sporadic historical toxicity issues in the 001 outfall effluent.

**Drinking Water:** Results from 2021 indicated that the Project's drinking water continued to remain below the local, state, and federal maximum contaminant levels (MCLs) and drinking water standards for chemical contaminants. A group of emerging contaminants of concern, per-and-polyfluoralkyl substances (PFAS), were sampled for in the drinking water supply for the first time in 2021. Recent legislation was enacted to set concentration limits and require monitoring of these contaminants. There were no positive detections for PFAS in the drinking water samples collected in 2021.

**Food Sources:** All radioisotopic concentrations in milk and deer collected in 2021 were below any level of concern and continue to confirm the low dose estimates from the site based on air and water monitoring.

**Direct Radiation Monitoring:** Direct radiation measurements at the WNYNSC perimeter were statistically the same as measured in Great Valley, 18 miles south of the site, indicating no measurable direct radiation exposure from project activities.

## Environmental Monitoring Program

The environmental monitoring program (EMP) includes sampling to evaluate the surface water and air exposure pathways. These are the principal means by which contaminants can be transported off site at the WVDP.

The groundwater monitoring program and potential exposure pathways from the groundwater are discussed separately from the rest of the environmental monitoring program in Chapter 4.

On-site and off-site air, surface water, drinking water, sediment, soil, venison, fish, milk, and food crop samples are collected under the WVDP EMP. These samples are analyzed for radiological and chemical constituents 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.

A description of the sampling schedule at each location in the WVDP environmental monitoring program, a discussion of the program drivers and rationale, as well as maps showing the sampling locations, are presented in Appendix A.

## Quality Assurance (QA) Program

The WVDP implements a comprehensive environmental monitoring QA program that complies with all applicable federal and NYS regulations. This QA program is described in Chapter 5. The QA program requires routine federal audits of the laboratories used, performance evaluation samples (crosscheck programs), and NYSDOH Environmental Laboratory Approval Program (ELAP) certification. Sampling and analysis protocols involve collection and analysis of field and laboratory quality control (QC) samples such as field blanks, duplicates, replicate samples, laboratory standards and spikes (to assess precision and accuracy). QA/QC data are used by both the laboratory and by the Environmental Services (ES) staff at the WVDP to ensure accuracy of the sampling data. The QA program also requires training of personnel, routine calibration and inspection of equipment, and validation and verification of data.

### Airborne Emissions Monitoring Program

**Radiological Air Emissions.** The WVDP currently maintains required EPA approvals for radiological releases from three active air emission points from building ventilation systems (otherwise referred to as “stacks”). This includes the Supernatant Treatment System (STS) stack; the MPPB RVS stack; and the RHWF stack. A fourth low volume stack, the Container Sorting and Packaging Facility (CSPF) stack [that does not require EPA approval] is intermittently operated. The WVDP also has EPA approval for radiological releases from up to 15 portable ventilation units (PVUs) at one time. EPA approvals allow air containing small amounts of radioactivity to be released from plant ventilation stacks during normal operations. Total annual airborne emissions are limited by EPA in the NESHAP regulations to not exceed 10 mrem/year to any member of the public.

Exhaust from each EPA-approved ventilation system at the WVDP is continuously filtered before being released to the atmosphere. Emissions are sampled for radioactivity in both particulate (e.g., strontium-90 and plutonium-239/240) and gaseous forms (e.g., iodine-129) at the building stacks and ambient air samplers. Iodine-129 is not sampled for at portable ventilations units (PVUs).

Radiological emissions also occur from nonpoint diffuse sources. The wastewater storage lagoons contribute a diffuse radiological release to air at the WVDP by surface water evaporation. Building demolition is also a diffuse source of radiological releases to air. Emissions from diffuse sources and point sources are monitored at the air sampling stations encircling the site. (See Figure A-7 in Appendix A.) The dose from radiological air releases are evaluated and reported to the EPA in the annual NESHAP report, and are discussed in Chapter 3, Dose Assessment.

**Nonradiological Air Emissions.** The WVDP maintains an Air Facility Registration Certificate and routinely evaluates new potential sources of nonradiological emissions to determine if any new sources need to be added to the registration, or any new monitoring or permitting is required. All asbestos removal activities are routinely monitored for asbestos emissions. No other nonradiological monitoring or nonradiological air emissions permits are required at the WVDP.

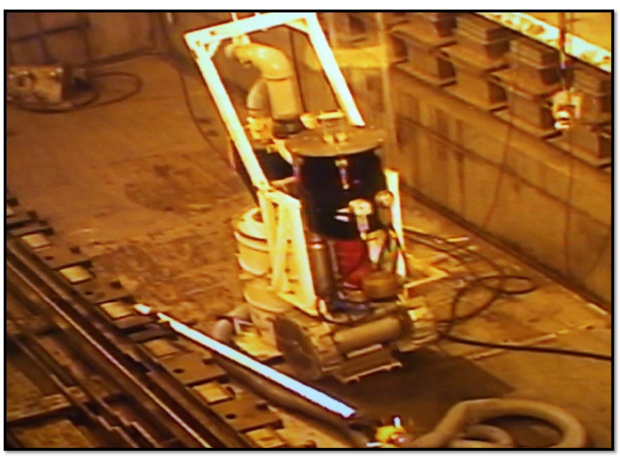
## On-site Active Ventilation and Emissions Systems

**Replacement Ventilation for the MPPB (discontinued in early 2021)**

Replacement Ventilation System (RVS) Stack (ANRVEU1). The MPPB Replacement Ventilation System (RVS) is made up of two Replacement Ventilation Units (RVUs) (shown by the photo above) that exhaust through a single emission point. The original MPPB ventilation stack was removed in 2018. Operation of the RVS for ventilation of the MPPB was discontinued in 2021. (See additional information on the following page.)

**Ventilation of underground HLW tanks by the Tank and Vault Drying System (T&VDS)**

Supernatant Treatment System (STS) Stack (ANSTSTK). Airborne effluents are monitored from the T&VDS that ventilates the below ground HLW tanks (8D-1, 8D-2, 8D-3, and 8D-4), one of which contains STS components. Dry conditions are being maintained by this system in three of the four HLW tanks and residual liquid in the fourth tank is being slowly reduced.



**Vacuum controlled remotely inside the Remote Handled Waste Facility (RHWF)**

Remote Handled Waste Facility (RHWF) Stack (ANRHWFK).
The work areas inside the RHWF where radioactive waste is remotely size-reduced are also ventilated by a permanent stack. The RHWF stack has been in operation since 2004 when construction of the RHWF was completed.

**Container repackaging in the Container Sorting and Packaging Facility (CSPF)**

Container Sorting and Packaging Facility (CSPF) Stack (ANCSPFK). Intermittent ventilation of the CSPF in the LSA #4 storage building also occurs through a permanent stack that is monitored at sampling location ANCSPFK when there is repackaging activity. Repackaging is performed in the CSPF.

**Portable Ventilation Unit (PVU)**

Portable Ventilation Units (PVUs). PVUs are used to provide temporary 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 routinely while work is being performed. The data collected is included in annual evaluations of airborne emissions. The site has been approved to use up to 15 PVUs at a time. Locations of PVUs may change throughout the year depending on operational needs.

## On-Site Air Emissions Update for 2021

Point source emissions to air from the WVDP continued to decrease in 2021 primarily due to continued facility deactivation activities that have significantly reduced the inventory of radioactivity inside the MPPB.

Emissions from diffuse sources, such as from demolition activities and surface water evaporation from the lagoons remain low but are now a larger contributor to air emissions than emissions from the stacks. Two structures were demolished or partially demolished in 2021, the PTW soil containment structure and the LILO facility. (Only a portion of the structural frame of the LILO was remaining for removal during MPPB demolition.) Demolition of these structures resulted in no detections of radioactivity at the ambient air samplers off site.

Appendix C presents total radioactivity released for specific radionuclides at each of the on-site air emission point sources. Low detectable concentrations of radioisotopes at the on-site stacks at levels greater than background are expected. Airborne concentrations on site are naturally reduced by dispersion before they reach the off-site ambient air samplers.

The highest concentration observed at the STS stack in 2021 was iodine-129 at similar concentrations as previous years, well below the DCSs. It has been observed that the concentrations of iodine-129 frequently have increased slightly when the T&VDS is not operating. The T&VDS was down for repairs from the middle of July 2021 through the end of the year to replace the belt and roller wheels on the desiccant dryer. Improvements to the power supply were also later required.

**MPPB emissions (ANRVEU1)**: The concentrations measured in 2021 from the RVU stack were also quite low, with the highest radioactivity also in the form of iodine-129 at concentrations well below DCSs (as shown in Table C-1).

The RVS was installed to allow decontamination work to continue inside the MPPB after the MPPB stack was removed in 2018. Ventilation of the MPPB using the RVUs was discontinued in August 2021. Local work areas inside the building were ventilated with PVUs for the remainder of 2021. The RVS continues to operate in order to maintain negative pressure on the RVUs and air ducts leading to the MPPB.

**T&VDS emissions (ANSTSTK)**: The concentrations measured in 2021 from the STS stack that monitors the T&VDS were very low, as has historically been observed, as evidenced by comparison to respective DCS values.

Table C-2 shows that all radioisotopes measured from the STS stack were three to seven orders of magnitude below DCSs. DCSs are radionuclide specific concentrations intended to provide guidance for the design and conduct of environmental protection programs at DOE facilities to ensure compliance with the public exposure annual dose limit. (For further explanation of how to interpret these results, see "Radiological Data Evaluation" in this chapter.)

**RHWF emissions (ANRHWFK)**: Remote size-reduction to segregate and repackage waste continued in the RHWF throughout 2021. Table C-3 indicates that nearly all of the radioactivity from this unit was below detection limits in 2021.

**CSPF emissions (ANCSPFK)**: No container sorting and packaging was performed in the CSPF in 2021. Therefore, this ventilation system did not operate in 2021.

**PVU emissions**: PVUs were used in 12 locations during 2021, the majority of which were in the MPPB. The sum of the emissions from all of the PVUs used throughout the year was also very low as shown in Table C-5.

The on-site air emission concentrations from the stacks are routinely compared statistically to the background sampling results at Great Valley to provide a perspective on the data reported. These comparisons are summarized in Table 2-5. Only iodine-129 from the ANRVEU1 and ANSTSTK stacks were statistically above background in 2021. The levels released were well below DCSs.

**Diffuse emissions:** Diffuse emissions to air from surface water evaporation off the lagoons, primarily tritium which is a low dose contributor, is estimated each year based on the annual average concentrations of the water in the lagoons.

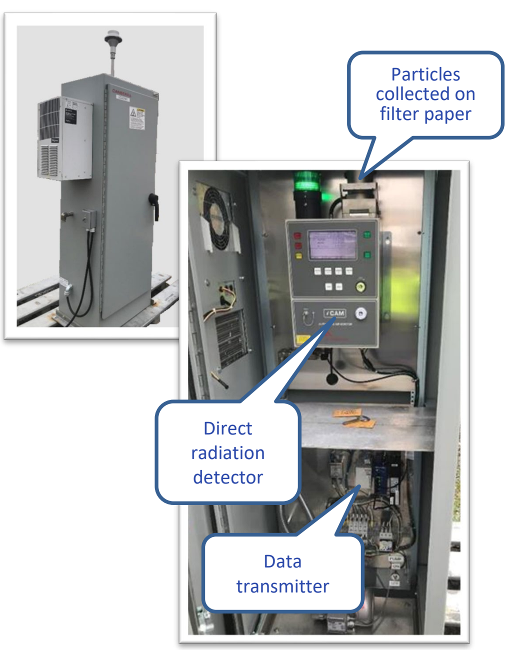
Diffuse emissions from demolition activities are evaluated based on the measured levels of radioactivity within a structure before demolition using calculation methods dictated in the NESHAP regulations. Emissions from demolition activities on site are also measured off site by the ambient air monitoring network.

## Air Monitoring in Demolition Work Areas

Continuous on-site air monitoring is performed close to the work area during demolition of radiologically contaminated facilities to protect the health and safety of the workers. These work area samplers provide early indication of unexpected elevated readings to allow action to be taken, such as pausing demolition operations, before the public could be at risk.

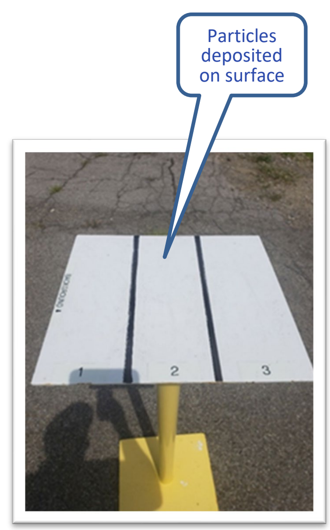
State-of-the-art air monitors and air samplers like the ones shown below are used at many DOE sites during radiological demolition operations. Continuous Air Monitors (CAMs) placed close to the demolition work area will detect elevated levels of radioactivity and provide an early warning if actions need to be taken to adjust or stop demolition activities. Radiation Protection personnel have continuous, direct access to the CAM readings from the operations control room. Samples will be collected from the Fixed Air Samplers (FASs) and analyzed by the on-site laboratory routinely during all worker activities. Radiation Protection personnel will also survey designated surfaces and particle deposition plates for radioactivity many times daily during demolition and waste management activities.

The off-site ambient air samplers, capable of measuring down to very low levels, are discussed in the following section.



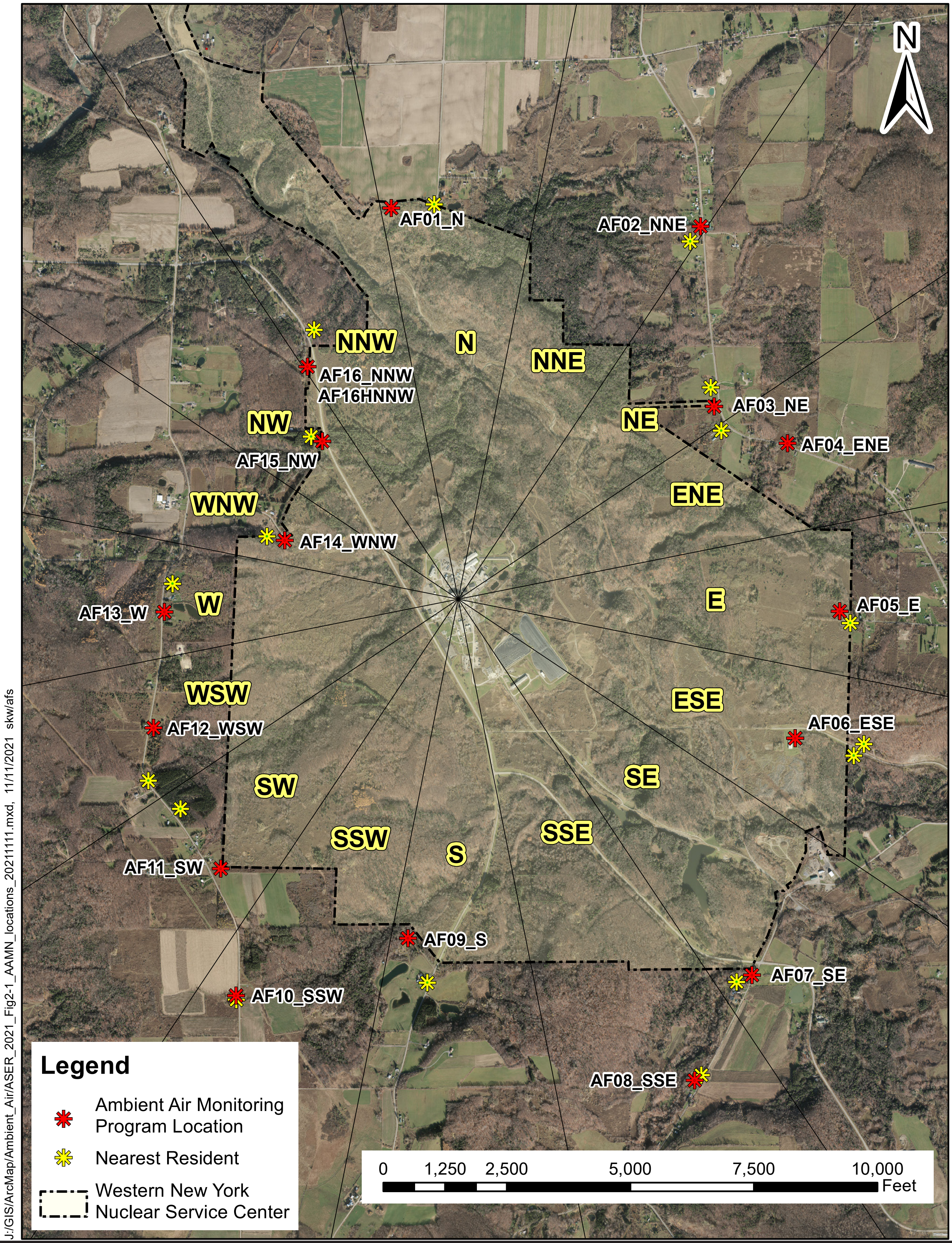

**Continuous Air Monitor (CAM)**


**Fixed Air Sampler (FAS)**




**Particle Deposition Plate**

**FIGURE 2-1**
**Ambient Air Sampling Locations**



## The Ambient Air Monitoring Network

Seventeen ambient air samplers surround the WNYNSC within approximately one mile of the WVDP property boundary as shown on Figure 2-1. One of these is a high-volume sampler (AF16HNNW) located downwind in the prevailing wind direction, which is the direction of the hypothetical maximum potential exposure.

The ambient air off site is sampled throughout the year during all site activities for environmental surveillance (to watch for potential environmental concerns) and to verify regulatory compliance. Samples are collected every two weeks for gross alpha and gross beta screening and monthly for iodine-129 screening analysis. The biweekly and monthly samples are composited quarterly and analyzed for radioisotopes known to have been managed on the site.

The background ambient air sampler (AFGRVAL) is 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.) This distant background location samples regional air with very low potential to be affected by radiological releases from the WVDP and is considered to be a good indicator of background concentrations that may be present at the WVDP. The ambient air network that encircles the WVDP has been sampled since October 2012. The first quarter of sampling data was used for operational baselining and equipment testing. Routine ambient air monitoring at these samplers began in 2013.

The high-volume sampler (AF16HNNW) included in the ambient air network in the prevailing wind direction, operates at a flow rate more than five times the other 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.)

Filter samples are collected biweekly for gross alpha and gross beta screening and charcoal cartridges are collected monthly for iodine-129 screening analysis. These samples collected on a biweekly or monthly basis are composited quarterly and analyzed for stronitum-90, iodine-129, cesium-137, uranium-232, plutonium-238, plutonium-239/240 and americium-241. Samples of ambient air will include background concentrations of naturally occurring radioisotopes such as radon decay products which will be detected in the gross radioactivity analyses.

### Ambient Air Sampling Update for 2021

The radioisotopic data from the ambient air samplers are used to demonstrate compliance with EPA air emissions standards for exposure to the public as discussed in Chapter 3. Results from all of the ambient air samplers have confirmed that emissions from WVDP operations in CY 2021 were below regulatory compliance limits.

Data collected from the ambient air samplers from January to December 2021 are summarized in Tables C-6, C-7, and C-8 of Appendix C. Table C-7 provides the 2021 annual average concentration for each isotope at each ambient air sampling location. Gross alpha, gross beta, and composited isotopic results collected in all 16 ambient air sectors in 2021 had very similar concentrations as those observed at AFGRVAL, the background ambient air sampler located in Great Valley, NY.

All 2021 annual average isotopic results at the ambient air samplers reported in Table C-7 were nondetect (having a result less than the uncertainty).

**Ambient Air Sampler**

The off-site ambient air samplers are routinely visited once a week for inspection and maintenance. A remote power surveillance system was set up in 2017 that monitors the power at the ambient air sampling stations. When power is lost, such as during an electrical storm or when components malfunction, the system automatically sends a text message to the Environmental Services air sampling technician, who will quickly check and repair the sampling system.

The ability to immediately respond to power outages minimizes down time, helping to ensure the ambient air surrounding the site is sampled in all sectors during all site operations. Historically, although the samplers were often checked after storms, other power outages could have resulted in the loss of up to a week of air sampling data. In part due to this enhancement, the ambient air samplers ran 98.5% of the year in 2021.

The annual average air concentrations at each off-site ambient air sampling location is used to determine compliance with the 10 mrem EPA annual dose limit for air emissions. Since the annual average concentrations for each of the isotopes were below the detection limit of the ambient air samples in 2021, the estimated dose is also below detectable levels. (See Chapter 3, for the discussion of the estimated dose using the ambient air samplers.)

**On-site meteorological monitoring tower undergoing inspection with oversight by the full-time on-site meteorological monitoring engineer**

## Meteorological Monitoring

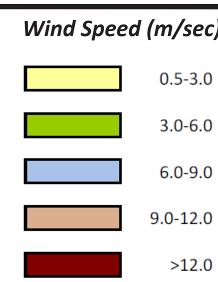
Meteorological monitoring at the WVDP provides representative and verifiable data that characterize the local climatology. These data are used to assess potential effects of routine and nonroutine releases of airborne radioactivity and to provide input to dispersion models which can be used to calculate dose to off-site residents. These data can also be used by the Emergency Response Organization (ERO) at the WVDP to predict the direction of plume migration if an air release occurred. 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 on the meteorological tower at ground level. Precipitation is measured on site.

The meteorological tower sends data to digital and analog data acquisition systems on site. The systems are provided with backup power in the event of site power failures. Documentation, such as meteorological system calibration records, site log books, and analog strip charts, are stored in protected archives. In 2021, the data recovery rate (the percentage of valid recorded data per sampling period) was 92.0%.

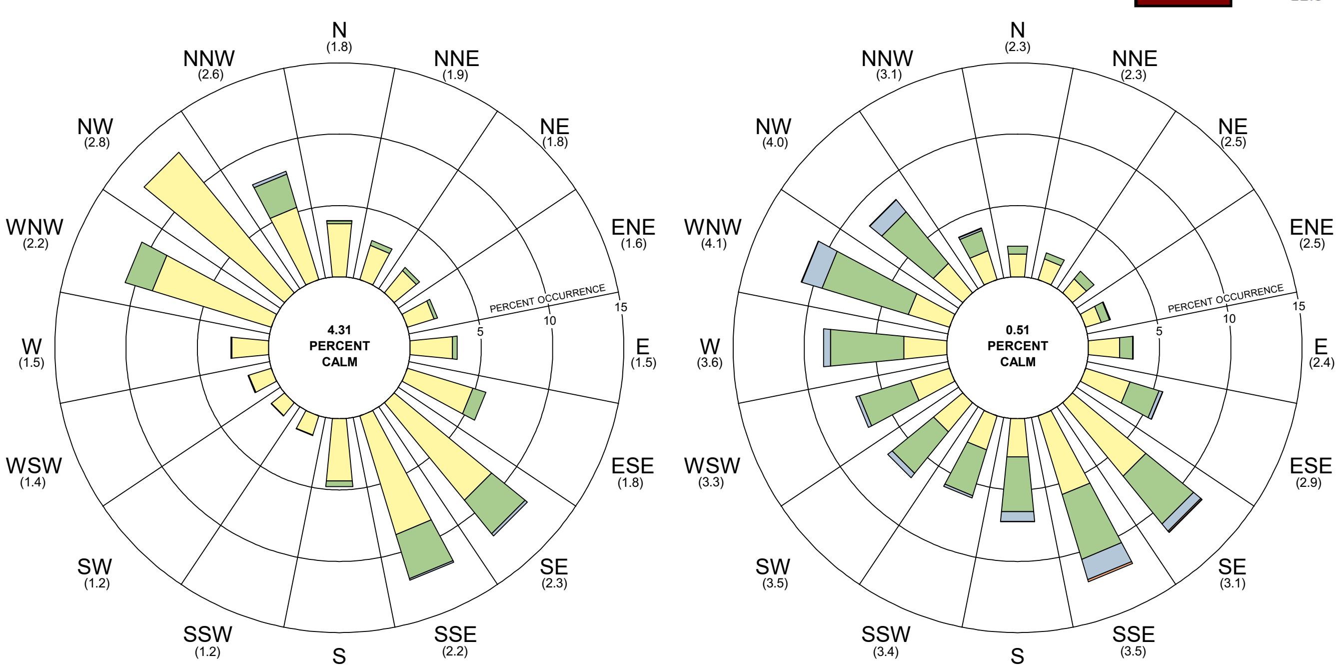
The predominant wind direction measured in 2021 at the meteorological tower (at a height of 10-m and at 60-m) is shown by the “wind roses” on Figure 2-2 below. As expected, wind speeds measured at the 10-m elevation were lower than those from the 60-m elevation. In 2021, the average wind speed at the 10 m elevation was 2.07 m/sec (4.63 mph) and the average wind speed at the 60 m elevation was 3.36 m/sec (7.52 mph). The wind direction at the 10-m elevation is influenced by the topography around the site. The WVDP is located in a northwest-southeast trending valley as evidenced by the direction of the prevailing wind at this elevation. Total precipitation in 2021 was 47.4 inches, 11.5% greater than the 42.5 inch 10-year annual average. (See Table UI-8.)

**FIGURE 2-2**

**Wind Frequency and Speed From the Meteorological Tower (10-m and 60-m Elevations)**
**January 1-December 31, 2021**




Meteorological Tower (10-m) Meteorological Tower (60-m)




Key: Numbers indicate sector mean wind speed (m/sec). Sectors show the direction from which the wind is blowing.

## Radiological Data Evaluation

**Derived Concentration Standards (DCSs).** "DCSs are quantities used in the design and conduct of radiological environmental protection programs at Department of Energy (DOE) facilities and sites. These quantities represent the concentration of a given radionuclide in either water or air that results in a member of the public receiving 1 millisievert (mSv) (100 millirem (mrem)) effective dose following continuous exposure for one year for each of the following pathways: ingestion of water, submersion in air, and inhalation" as defined in DOE-STD-1196-2011. "The intended applications of DCSs are as follows:

- Defining criteria for applying Best Available Technology (BAT) at point of discharge for liquid effluent streams (in accordance with DOE Order 458.1, "Radiation Protection of the Public and the Environment");
- Relative ranking of the importance of radionuclides within a waste stream; and
- Relative ranking of multiple effluent streams to air or water.

The DCSs were developed with consideration of only three exposure modes (ingestion of water, inhalation of air, and air submersion). While they provide relative guidance for the ranking of potential radionuclides in effluent streams released from facilities, they are not intended to be used to infer the dose to members of the public nor to demonstrate compliance with DOE radiation protection dose limits. The DCSs are derived at the point of discharge and do not account for attenuation along the pathway before reaching the receptor. Typically, more complex environmental pathways are involved; thus, a complete pathway analysis is required for calculating public radiation doses resulting from DOE activities." (Quoted from DOE-STD-1196-2011, pages 1 and 11).

DCSs applicable to the radionuclides present at the WVDP are presented in Table UI-4 in the "Useful Information" section of this report. 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. For water effluents, when only gross alpha and beta measurements are available, activity is assumed to come from uranium-232 for gross alpha, and strontium-90 for gross beta, also because their DCSs are the most limiting for major WVDP waterborne exposures.

**Sum of Ratios**. Environmental sampling results at the WVDP are assessed to determine whether the constituents of interest are present and, if so, their concentrations are compared with DCSs as guidelines for controlling potential exposure to the public. To evaluate the radioactivity released from each location 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 are summed. If the sum of the ratios (also called the "sum of fractions") exceeds 1.0, or if expressed as the sum of percentages, exceeds 100%, then the total radioactivity released from that location during the current year exceeds DCSs and further evaluation is required.

This comparison to DCSs is a very conservative method of evaluating the concentration data because it assumes a continuous exposure by drinking the water or inhaling the air, at this concentration, at the point of measurement, which may be at an on-site location where no public exposure is possible and where no water is ingested. DCSs are therefore used as a precaution to ensure releases/emissions are not approaching levels that could cause dose limits to be exceeded off site. The regulatory limit is based on the modeled/measured total annual off-site dose, not this comparison to DCSs.

**Statistical Comparison to Background.** 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.

NOTE: DOE-STD-1196-2011 was used for site operations throughout 2021 and is therefore used for comparison tables for the data collected in 2021. The WVDP plans to transition site operations and data reporting to the new DCSs in DOE standard DOE-STD-1196-2021 (published in July 2021) during 2022.

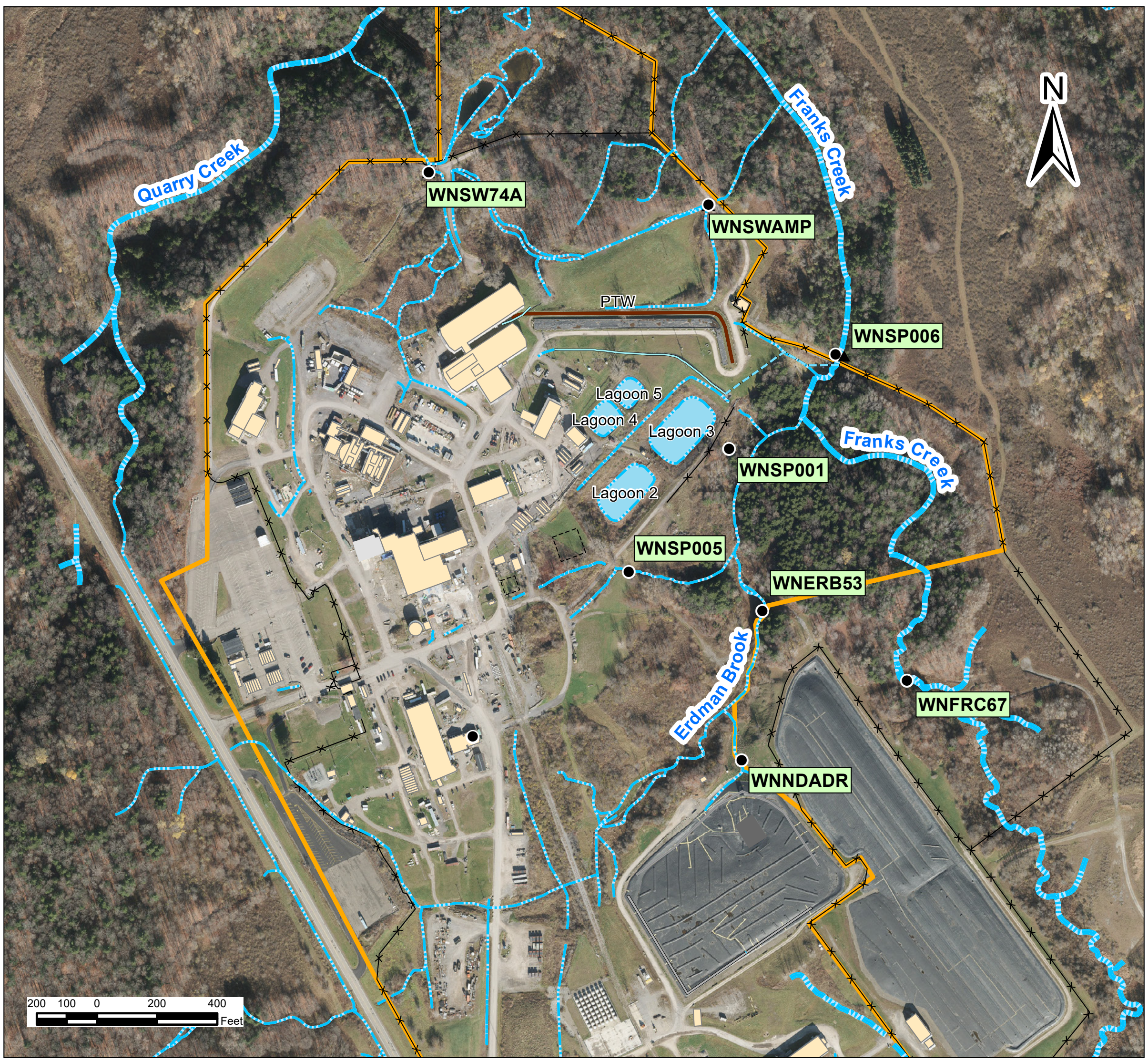
## Water Monitoring Program

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 LLW treatment building (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 2-3 below.) 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 also Figures A-5 and A-14.)

The primary sources of releases from the site to surface waters occur at three locations, the lagoon 3 weir which discharges at outfall 001 (WNSP001), the northeast swamp drainage ditch (WNSWAMP) by natural drainage, and the north swamp drainage ditch (WNSW74A), also by natural drainage. (See Figure 2-3 below.)

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 first point of public access to surface water potentially impacted by the site is on Cattaraugus Creek downstream of the WVDP at Felton Bridge (WFFELBR) shown on Figure 2-7.

**FIGURE 2-3**
**Surface Water Sampling Locations**



## State Pollutant Discharge Elimination System (SPDES) Permit Required Monitoring

Liquid discharges from the WVDP are regulated under a SPDES permit. The permit lists compliance points from which liquid effluents are released to Erdman Brook, and specifies the sampling and analytical requirements for each. The conditions and requirements of the current SPDES permit include monitoring of four wastewater discharge outfalls (only one of which, outfall 001, is an active discharge point) and 19 storm water discharge outfalls.

**Waterborne Nonradiological Releases.** 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.

**Storm Water.** Storm water runoff is generated from rain and snow-melt events that flow over land or impervious surfaces, such as paved streets, parking lots, and building rooftops. The runoff can pick up pollutants like trash, chemicals, oils, and dirt or sediment. This can cause changes in hydrology and water quality, resulting in habitat modification and loss, increased flooding, decreased aquatic biological diversity, and increased sedimentation and erosion. (Definition from: https://epa.gov/npdes/npdes-stormwater-program.)

Requirements of the SPDES permit for monitoring storm water runoff include water quality assessment at specific storm water discharge locations. The amount of rainfall, the storm event duration, volume discharged, and the maximum flow rate must also be reported at each storm water outfall. The storm water sampling results are provided in Appendix B-3. The WVDP storm water outfalls are grouped into eight representative drainage basins that could potentially be influenced by industrial, construction, or demolition activity runoff. One representative outfall from each group must be sampled on a semiannual basis. Storm water samples are not required to be analyzed for radiological parameters under the SPDES permit but are screened for gross alpha and gross beta radioactivity at the WVDP on-site laboratory.

**Whole Effluent Toxicity (WET) Testing.** The SPDES permit also includes periodic special studies such as discharge effluent toxicity testing every five years. This test involves sending samples of the SPDES discharge waters from the site to a bioassay laboratory where vertebrate (fathead minnow) and invertebrate (water flea) freshwater species are tested and evaluated for survival rate, growth rates, and rates of reproduction.

**Waterborne Radiological Releases.** Controlled SPDES discharges from outfall 001 contain radioactivity and must be pre-approved for release by NYSDEC. Pre-discharge radiological data are compared to DOE DCSs and provided to NYSDEC to facilitate this approval, as required by the SPDES permit.

**Radiological Data Evaluation.** The curies released from the 001 outfall, WNSP001, are summarized using flow-weighted mean concentrations (FWMCs). (See the inset box Calculating Flow-Weighted Mean Concentrations.) In order to evaluate these data, the annual average FWMC for each radioisotope is compared to the DCS to determine a ratio. These ratios are then summed. A sum of ratios less than 1.0 indicates the annual average concentration from the water discharged from this location was less than DCSs. (For discussion of DCSs, see the inset box "Radiological Data Evaluation" in this chapter.)

### 2021 Update for SPDES Required Monitoring

**SPDES Outfall Results.** There were no SPDES effluent limit exceedances and no SPDES noncompliance events during 2021.

SPDES Whole Effluent Toxicity (WET) testing for WNSP001 continued to be performed as part of the Toxic Inventory/ Reduction Evaluation (TI/RE) in 2021. The WVDP is continuing to work together with NYSDEC to determine the root cause(s) of historical toxicity testing action level exceedances in site discharges. The November 2021 discharge was authorized by NYSDEC at a reduced flow rate to limit impacts to the stream. (Additional discussion of the 2021 toxicity testing is provided in the ECS chapter of this report.) The 2021 toxicity testing results are reported in Table B-2K in Appendix B.

Appendix B-2 presents 2021 process effluent data with SPDES permit limits provided for comparison.

Appendix B-3 presents 2021 storm water runoff monitoring data for outfalls designated in the WVDP SPDES permit.

**WNSP001 (Lagoon 3).** Three batch releases totaling approximately 5.0 million gallons (19.0 million L) were discharged from WNSP001 in 2021, which is similar to volumes released in the last few years. The sum of ratios for the release from WNSP001 in 2021 was 0.37 (or 37% of the DCSs as shown in Table 2-1 below. This is lower than the 0.49 sum of ratios for WNSP001 in 2020.

The largest contributor to the sum of ratios at WNSP001 in 2021 was strontium-90 (0.32 of the 0.37 total) which is typical. The isotopic distribution released from lagoon 3 in 2021 is also similar to recent years. There were no significant changes to the sources of wastewater processed and discharged through lagoon 3 as compared to previous years.

**Controlled SPDES discharges occur from the lagoon system**

**TABLE 2-1**
**Total Radioactivity Discharged at Lagoon 3 (WNSP001) in 2021 and Comparison of Discharge Concentrations with DOE DCSs**

| *Isotope* [a] | *Discharge Activity* [b] | | *Flow-Weighted Mean Concentration* | *DCS* [d] | *Ratio of Mean Concentration to DCS* |
|---|---|---|---|---|---|
| | *(Ci)* | *(Becquerels)* [c] | *(µCi/mL)* | *(µCi/mL)* | |
| **Gross Alpha** | 1.46±0.39E-04 | 5.42±1.46E+06 | 7.71±2.08E-09 | 9.8E-08[e] | NA |
| **Gross Beta** | 1.49±0.01E-02 | 5.53±0.05E+08 | 7.87±0.06E-07 | 1.1E-06[e] | NA |
| **H-3** | 8.20±1.32E-03 | 3.03±0.49E+08 | 4.32±0.70E-07 | 1.9E-03 | 0.0002 |
| **C-14** | 1.58±3.44E-04 | 0.59±1.27E+07 | 0.83±1.81E-08 | 6.2E-05 | <0.0003 |
| **K-40** | 0.05±4.51E-04 | 0.02±1.67E+07 | 0.02±2.38E-08 | NA[f] | NA |
| **Co-60** | 1.91±2.97E-05 | 0.71±1.10E+06 | 1.01±1.56E-09 | 7.2E-06 | <0.0002 |
| **Sr-90** | 6.71±0.07E-03 | 2.48±0.03E+08 | 3.53±0.04E-07 | 1.1E-06 | 0.3214 |
| **Tc-99** | 7.41±2.18E-05 | 2.74±0.81E+06 | 3.90±1.15E-09 | 4.4E-05 | 0.0001 |
| **I-129** | 3.10±1.41E-05 | 1.15±0.52E+06 | 1.63±0.74E-09 | 3.3E-07 | 0.0049 |
| **Cs-137** | 2.66±0.60E-04 | 9.85±2.22E+06 | 1.40±0.32E-08 | 3.0E-06 | 0.0047 |
| **U-232**[g] | 5.28±0.48E-05 | 1.95±0.18E+06 | 2.78±0.25E-09 | 9.8E-08 | 0.0284 |
| **U-233/234**[g] | 4.13±0.31E-05 | 1.53±0.11E+06 | 2.17±0.16E-09 | 6.6E-07[h] | 0.0033 |
| **U-235/236**[g] | 1.79±0.74E-06 | 6.63±2.75E+04 | 9.45±3.91E-11 | 7.2E-07 | 0.0001 |
| **U-238**[g] | 3.26±0.27E-05 | 1.21±0.10E+06 | 1.72±0.14E-09 | 7.5E-07 | 0.0023 |
| **Pu-238** | 1.76±2.80E-07 | 0.65±1.04E+04 | 0.93±1.48E-11 | 1.5E-07 | <0.0001 |
| **Pu-239/240** | 3.50±3.76E-07 | 1.29±1.39E+04 | 1.84±1.98E-11 | 1.4E-07 | <0.0001 |
| **Am-241** | 6.90±6.16E-07 | 2.55±2.28E+04 | 3.63±3.25E-11 | 1.7E-07 | 0.0002 |
| **Sum of Ratios** | | | | | **0.37** |

NA – Not applicable; ratio calculated from isotopic data.
[a] Half-lives are listed in Table UI-4.
[b] Total volume released: 1.90E+10 milliliters (mL) (5.01E+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] The representative DCS for gross alpha in water shown is for U-232 and for gross beta is for Sr-90 (selected as the most restrictive) since DCSs do not exist for indicator parameters.
[f] The DCS is not applied to potassium-40 (K-40) activity because of its natural origin.
[g] Total uranium (g) = 1.00±0.12E+02; Average uranium (µg/mL) = 5.28±0.65E-03.
[h] The DCS for U-233 is used for this comparison.

## On-Site Surface Water Monitoring

Surface water releases occur from natural drainage as well as from SPDES discharges at the WVDP. Natural surface water drainage to Franks Creek is sampled at WNSWAMP. (See Figure 2-3.) Samples from this location largely consists of emergent groundwater supplemented by surface water runoff. 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. Strontium-90 contaminated surface water from the WNSWAMP drainage ditch flows into Franks Creek, then into Buttermilk Creek, and ultimately into Cattaraugus Creek, where it is sampled at Felton Bridge (WFFELBR), the first point of public access.

Natural surface water drainage to Quarry Creek, on the western side of the north plateau, is sampled at WNSW74A. Concentrations of radionuclides are much lower at this location than at WNSWAMP. Surface water from this drainage has historically contributed a small fraction of the total waterborne dose from the site. The sampling frequency and parameters analyzed for at these and all other EMP sampling locations is provided in Appendix A, Table A-2.

**Other On-Site/Near-Site Surface Water Sampling.** To ensure that the public health and safety and the environment are protected, the near-site surface water drainage is routinely sampled for pH and radiological parameters at several other points on the north and south plateaus. These locations include WNSP005, WNSP006, WNNDADR, WNERB53, and WNFRC67 shown on Figure 2-3 and in Appendix A, on Figure A-2. These monitoring points are sited at locations where releases from other potential source areas on the north and south plateaus could be detected. Samples are collected from these locations at frequencies that vary by parameter as described in Appendix A. This vigilance allows site operations to be modified as needed if anomalous or unexpected concentrations are detected in the near-site surface water.

**Potential Surface Water Contamination Sources on the North Plateau.** On the north plateau, in addition to the planned discharges at the 001 outfall and natural discharges from the strontium-90 plume to surface water, other possible contaminant sources that could affect surface water include the WTF, the MPPB, demolition activities, the lagoon system associated with the LLW2, and waste handling and storage facilities. North plateau surface water sampling locations that monitor these potential sources include locations WNSP005 and WNSP006, in addition to WNSWAMP and WNSW74A.

**Potential Surface Water Contamination Sources on the South Plateau.** On the south plateau, the two inactive underground radioactive waste disposal areas (the NDA and NYS-licensed disposal area (SDA)), the 56 Vertical Storage Casks (VSCs) (stored on the interim HLW Cask Storage Pad), the drum cell (a building formerly used to store drums of processed LLW), and waste management activities are all potential, although not anticipated sources of contamination.

Surface water drainage across the south plateau 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.

**Environmental Compliance Limits for Potential Surface Water Contamination.** The regulatory limit for radioactivity in waterborne releases from DOE facilities is the DOE dose limit of 100 mrem/year (1 millisievert [mSv]/year) to an off-site individual from all pathways, per DOE Order 458.1. This DOE limit includes the contribution from all potential sources including both air and water exposure.

DCSs are radionuclide specific concentrations intended to provide guidance for the design and conduct of environmental protection programs at DOE facilities to ensure compliance with the 100 mrem/year dose limit.

Measured concentrations in the surface water are flow weighted to compute the curies released when measured flow rates are available. (See the inset box Calculating Flow-Weighted Mean Concentrations.) The radioactivity released is estimated using historical flow rates when current measured flow rates are not available.

The annual average FWMC for each radioisotope is compared to the DCS to determine a ratio. These ratios are then summed. A sum of ratios less than 1.0 indicates the annual average concentration from the water discharged from this location was less than DCSs. (For further explanation of how to interpret these results, see "Radiological Data Evaluation".)

**Culvert flowing into surface water sampling location WNSW74A on a tributary of Quarry Creek**
*(See map location on Figure 2-3)*

**Surface water sampling location WNSP005 on a tributary of Erdman Brook**
*(See map location on Figure 2-3)*

## 2021 Update for On-Site Surface Water

In addition to the SPDES outfall sampled at WNSP001 that was discussed in the previous section, surface water is sampled on-site along natural surface water streams and creeks at the seven locations listed below and shown on Figure 2-3. Surface water streams generally flow from south to north across the WVDP. The eight sampling locations and the streams/creeks they monitor are listed below.

On the North Plateau:

- **WNSWAMP** - monitors water discharging to Franks Creek at the farthest north location downstream of the site (a medium volume flow);
- **WNSW74A** - monitors a small tributary of Quarry Creek at the farthest north location downstream of the site (a small volume flow shown in the photograph above);
- **WNSP006** - monitors Franks Creek at the property boundary, downstream of the WNSP001 outfall (a larger volume flow as shown by the photograph on page 2-20);
- **WNSP005** - monitors a small tributary to Erdman Brook, upstream of the WNSP006 sampling point (a small volume flow shown in the photograph above);

On the South Plateau (all small volume streams):

- **WNERB53** - monitors Erdman Brook, a tributary to Franks Creek that separates the north and south plateau;
- **WNNDADR** - monitors surface water draining immediately north of the NDA;
- **WNFRC67** - monitors Franks Creek upstream of the north plateau.

### Calculating Flow-Weighted Mean Concentrations

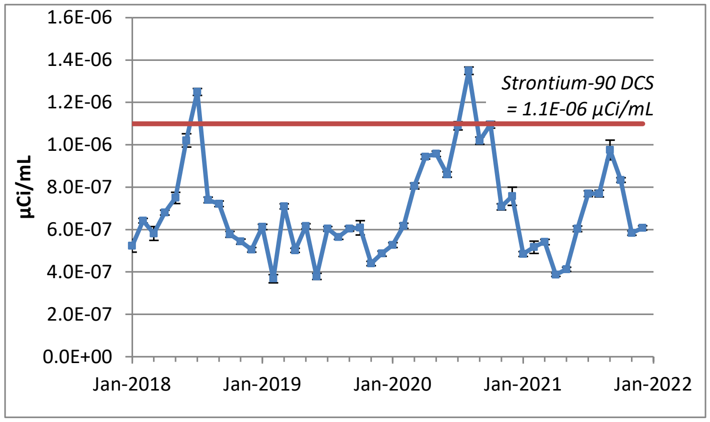
Flow-weighted mean concentrations (FWMC) are concentrations that are adjusted for the variability in stream flow over a given period of time (e.g., monthly or annually). FWMC is useful for estimating the typical concentration of a contaminant adjusting for stream flow. This allows for comparisons between streams with different flows or between years when a stream has different flow volumes.

Flow-weighted mean concentration is defined as = $$\frac{\text{Total Load (kg or Ci)}}{\text{Total Stream Flow Volume (m}^3\text{)}}$$

where the total load (kg or Ci) is divided by the total stream volume ($m^3$) for a given time period (e.g., year or month). By calculating FWMC on a monthly or annual basis, variability due to seasonal and historical sampling frequency fluctuations and missing data can be reduced.

**WNSWAMP.** (*See location on Figure 2-3.*) Natural drainage through the WNSWAMP location in 2021 was measured to be approximately 28.0 million gal (106 million L). The sum of ratios from WNSWAMP was 0.61 (or 61% of DCSs) in 2021 as shown in Table 2-2 below, slightly lower than the 2020 sum of ratios for WNSWAMP of 0.69. 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. The 2021 strontium-90 concentration at WNSWAMP was slightly lower than it was in 2020, potentially due to annually variable flow in the drainage ditch. As shown by the graph at right, the strontium-90 concentration remained below the DCS during 2021.




**Recent strontium-90 concentrations at WNSWAMP**

**TABLE 2-2**
**Total Radioactivity Released at Northeast Swamp (WNSWAMP) in 2021 and Comparison of Discharge Concentrations with DOE DCSs**

| *Isotope* [a] | *N* | *Discharge Activity* [b] (Ci) | *Discharge Activity* [b] (Becquerels) [c] | *Flow-Weighted Mean Concentration (µCi/mL)* | *DCS* [d] *(µCi/mL)* | *Ratio of Mean Concentration to DCS* |
|---|---|---|---|---|---|---|
| **Gross Alpha** | 27 | 1.23±1.35E-04 | 4.55±5.01E+06 | 1.16±1.28E-09 | 9.8E-08[e] | NA |
| **Gross Beta** | 27 | 1.24±0.01E-01 | 4.59±0.02E+09 | 1.17±0.01E-06 | 1.1E-06[e] | NA |
| **Tritium** | 12 | 4.66±2.88E-03 | 1.73±1.07E+08 | 4.40±2.72E-08 | 1.9E-03 | < 0.0001 |
| **C-14** | 2 | 0.80±1.72E-03 | 2.95±6.37E+07 | 0.75±1.62E-08 | 6.2E-05 | < 0.0003 |
| **Sr-90** | 12 | 7.11±0.06E-02 | 2.63±0.02E+09 | 6.70±0.06E-07 | 1.1E-06 | 0.61 |
| **I-129** | 2 | 0.78±3.74E-05 | 0.29±1.38E+06 | 0.74±3.52E-10 | 3.3E-07 | < 0.0011 |
| **Cs-137** | 12 | -3.08±7.22E-05 | -1.14±2.67E+06 | -2.90±6.81E-10 | 3.0E-06 | < 0.0002 |
| **U-232**[f] | 2 | 0.57±1.58E-05 | 2.10±5.86E+05 | 0.54±1.49E-10 | 9.8E-08 | < 0.0015 |
| **U-233/234**[f] | 2 | 1.93±0.94E-05 | 7.13±3.47E+05 | 1.82±0.88E-10 | 6.6E-07[g] | 0.0003 |
| **U-235/236**[f] | 2 | 3.09±5.24E-06 | 1.14±1.94E+05 | 2.91±4.94E-11 | 7.2E-07 | < 0.0001 |
| **U-238**[f] | 2 | 9.52±7.36E-06 | 3.52±2.72E+05 | 8.98±6.94E-11 | 7.5E-07 | 0.0001 |
| **Pu-238** | 2 | 1.71±2.61E-06 | 6.32±9.67E+04 | 1.61±2.47E-11 | 1.5E-07 | < 0.0002 |
| **Pu-239/240** | 2 | 0.94±3.02E-06 | 0.35±1.12E+05 | 0.89±2.85E-11 | 1.4E-07 | < 0.0002 |
| **Am-241** | 2 | 1.26±1.87E-06 | 4.64±6.92E+04 | 1.18±1.76E-11 | 1.7E-07 | < 0.0001 |
| **Sum of Ratios** | | | | | | **0.61** |

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; ratio calculated from isotopic data.

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

[b] Total estimated volume released: 1.06E+11 mL (2.80+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.

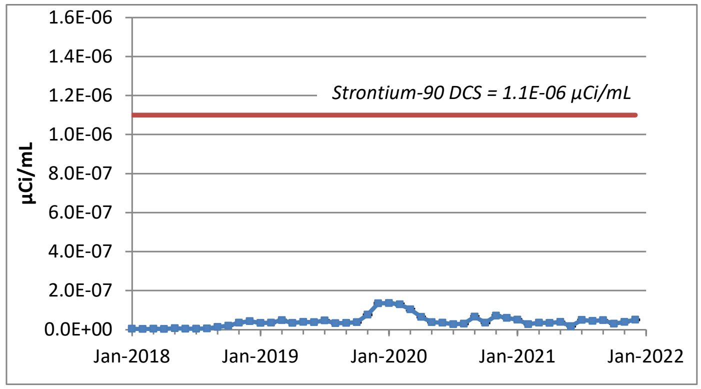
[e] The representative DCS for gross alpha in water shown is for U-232 and for gross beta is for Sr-90 (selected as the most restrictive) since DCSs do not exist for indicator parameters.

[f] Total Uranium (g) = 4.30±0.63E+01; Average Total Uranium (µg/mL) =4.05±0.60E-04.

[g] The DCS for Uranium-233 is used for this comparison.

**WNSW74A.** (*See location on Figure 2-3.*) Natural drainage through the WNSW74A location in 2021 was estimated to be 12.8 million gal (48.6 million L), less than half the volume that flows through WNSWAMP. The sum of ratios from WNSW74A was <0.041 (or <4.1% of DCSs) approximately one tenth of that observed at WNSWAMP as shown by Table 2-3 below.

The majority of the radioactivity at WNSW74A in 2021 was attributable to strontium-90, as it has been historically. Strontium-90 concentrations at WNSW74A increased above background in late 2018 reaching a maximum of 1.36 E-07 µCi/mL in January 2020. Peak concentrations decreased by May 2020 and have remained at approximately the same throughout CY 2021, well below DCSs as shown by the graph at right.




**Recent strontium-90 concentrations at WNSW74A**

**TABLE 2-3**
**Total Radioactivity Released at the North Swamp (WNSW74A) in 2021 and Comparison of Discharge Concentrations with DOE DCSs**

| *Isotope* [a] | *N* | *Discharge Activity* [b] (Ci) | *Discharge Activity* [b] (Becquerels) [c] | *Mean Concentration* (µCi/mL) | *DCS* [d] (µCi/mL) | *Ratio of Average Concentration to DCS* |
|---|---|---|---|---|---|---|
| **Gross Alpha** | 27 | 0.32±1.21E-04 | 1.17±4.49E+06 | 0.65±2.50E-09 | 9.8E-08 [e] | NA |
| **Gross Beta** | 27 | 3.57±0.14E-03 | 1.32±0.05E+08 | 7.34±0.29E-08 | 1.1E-06 [e] | NA |
| **Tritium** | 12 | 2.00±1.12E-03 | 7.40±4.15E+07 | 4.12±2.31E-08 | 1.9E-03 | < 0.0001 |
| **C-14** | 2 | -3.16±8.17E-04 | -1.17±3.02E+07 | -0.65±1.68E-08 | 6.2E-05 | < 0.0003 |
| **Sr-90** | 12 | 1.94±0.04E-03 | 7.19±0.16E+07 | 4.00±0.09E-08 | 1.1E-06 | 0.036 |
| **I-129** | 2 | 1.31±3.06E-05 | 0.49±1.13E+06 | 2.70±6.29E-10 | 3.3E-07 | < 0.0019 |
| **Cs-137** | 12 | 3.43±3.95E-05 | 1.27±1.46E+06 | 7.06±8.13E-10 | 3.0E-06 | < 0.0003 |
| **U-232** [f] | 2 | 0.82±8.34E-06 | 0.30±3.09E+05 | 0.17±1.72E-10 | 9.8E-08 | < 0.0018 |
| **U-233/234** [f] | 2 | 8.13±3.28E-06 | 3.01±1.22E+05 | 1.67±0.68E-10 | 6.6E-07 [g] | 0.0003 |
| **U-235/236** [f] | 2 | 0.53±1.36E-06 | 1.98±5.03E+04 | 1.10±2.79E-11 | 7.2E-07 | < 0.0001 |
| **U-238** [f] | 2 | 5.07±2.76E-06 | 1.88±1.02E+05 | 1.04±0.57E-10 | 7.5E-07 | 0.0001 |
| **Pu-238** | 2 | -1.43±7.91E-07 | -0.53±2.92E+04 | -0.29±1.63E-11 | 1.5E-07 | < 0.0001 |
| **Pu-239/240** | 2 | 0.17±1.15E-06 | 0.62±4.24E+04 | 0.35±2.36E-11 | 1.4E-07 | < 0.0002 |
| **Am-241** | 2 | 4.06±8.40E-07 | 1.50±3.11E+04 | 0.83±1.73E-11 | 1.7E-07 | < 0.0001 |
| **Sum of Ratios** | | | | | | < **0.041** |

Notes: Discharge activity represents the sum of activity released per sampling period. Curies released are based on the estimated monthly 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: 4.86E+10 mL (1.28+07 gal).

[c] 1 Ci = 3.7E+10 Bq: 1Bq = 2.7E-11 Ci.

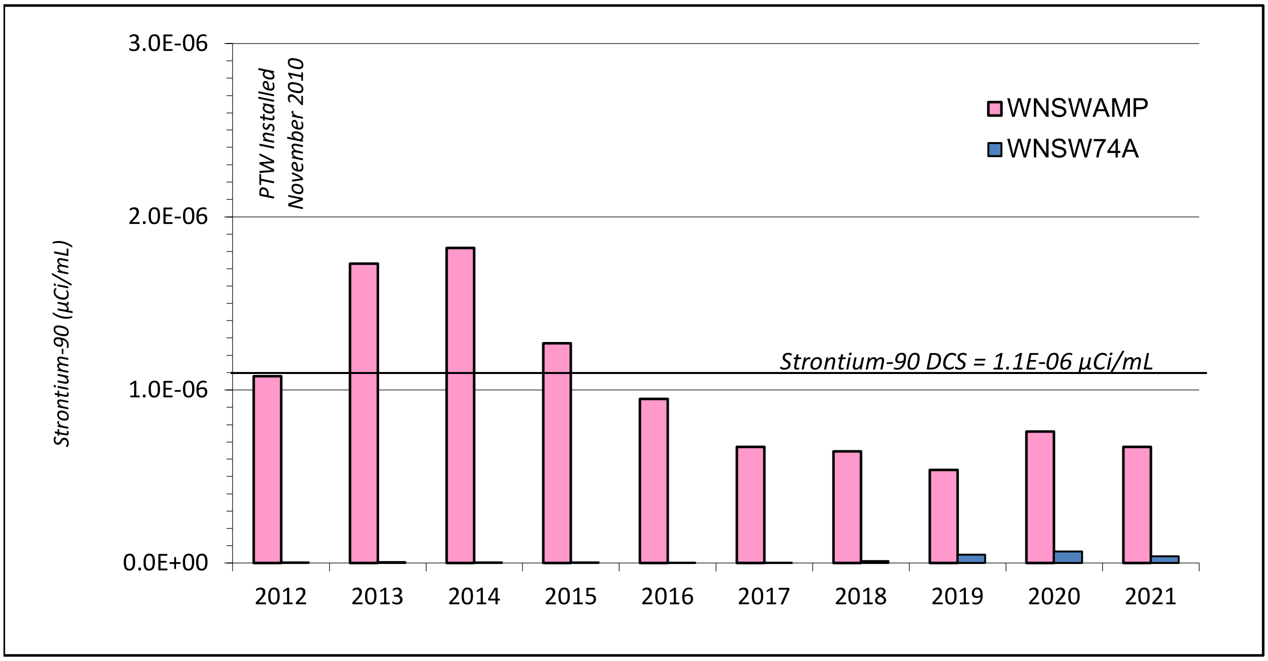
[d] DCSs are used as reference values for the application of best available technology per DOE Order 458.1.

[e] The representative DCS for gross alpha in water shown is for U-232 and for gross beta is for Sr-90 (selected as the most restrictive) since DCSs do not exist for indicator parameters.

[f] Total Uranium (g) = 1.64±0.25E+01 ; Average Total Uranium (µg/mL) = 3.38±0.50E-04.

[g] The DCS for Uranium-233 is used for this comparison.

**FIGURE 2-4**
**Flow-Weighted Annual Average Strontium-90 Concentrations at WNSWAMP and WNSW74A**




Note: The WNSWAMP 10 Year Average = 1.01E-06 µCi/mL. The WNSW74A 10 Year Average = 1.95E-08 µCi/mL.

A historical comparison of the annual average strontium-90 concentrations from the two north plateau drainage areas sampled at WNSWAMP and WNSW74A is shown in Figure 2-4 above. As can be seen from this figure, the concentrations observed at WNSW74A that flows into Quarry Creek are much lower than the concentrations at WNSWAMP that flows into Franks Creek

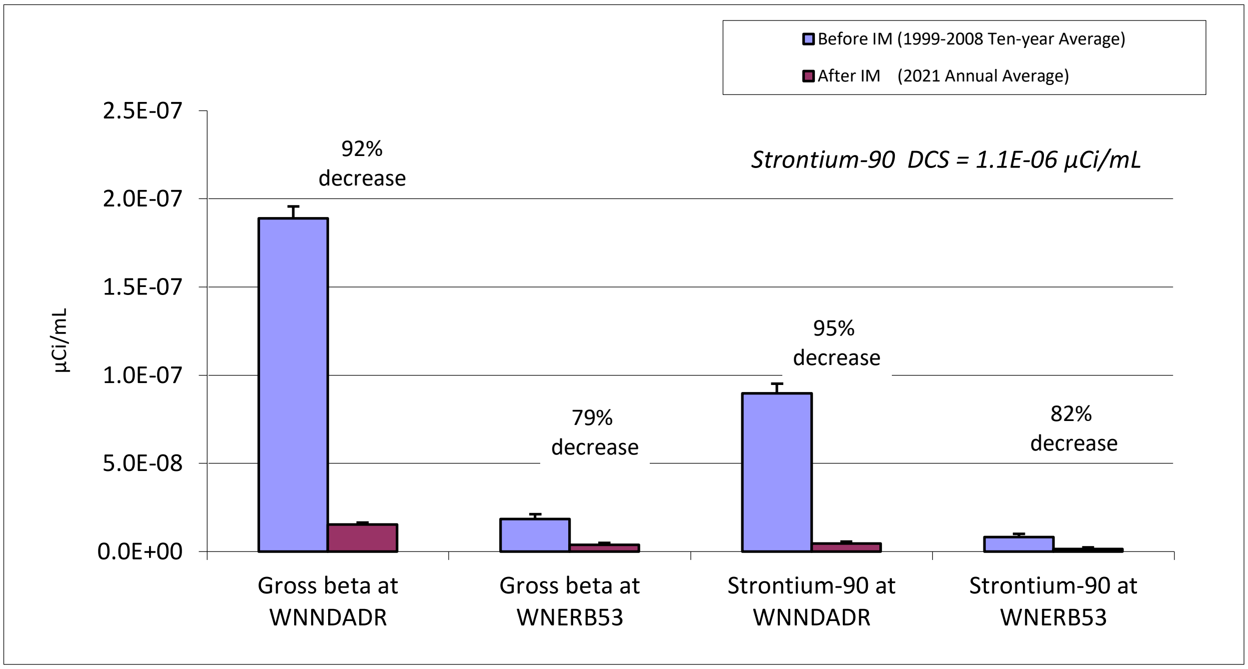
**North Plateau (WNSP005 and WNSP006)**. On site, at sampling location WNSP005, located east of the MPPB, the 2021 annual average strontium-90 concentration were slightly above the strontium-90 DCS. (See Table B-4C.) However, the volume of water flowing into Erdman Brook and then into Franks Creek from this drainage ditch is very small as shown by the photograph on page 2-15. The strontium-90 is believed to be from shallow groundwater intercepted by the drainage ditch. Franks Creek is sampled downstream at WNSP006 at the site boundary. As in previous years, concentrations at WNSP006 for gross beta and strontium-90 in 2021 were two orders of magnitude lower than at WNSP005, well below DCSs, but higher than background as occurs frequently at the WNSP006 sampling location. (See Table B-4D.)

**South Plateau (WNNDADR, WNERB53, and WNFRC67)**. Downgradient of the NDA, annual average gross beta and strontium-90 levels continued to exceed background at WNNDADR and WNERB53, and the annual average tritium continued to exceed background at WNNDADR, but all results remained well below their respective DCSs, as shown by the graphs on the following page. Residual soil contamination from past waste burial activities is thought to be the source of this radioactivity.

Figure 2-5 shows the decrease in the gross beta and strontium concentrations at surface water locations WNNDADR and WNERB53 downstream of the NDA after 2008, when a geomembrane cap and slurry wall were constructed at the NDA to limit groundwater, surface water, and precipitation flowing into the NDA. The average gross beta concentrations at WNNDADR and WNERB53 downstream of the NDA have decreased by 92% and 79% respectively, and the strontium-90 concentrations have decreased by 95% and 82% respectively. The cap and slurry wall surrounding the NDA have effectively reduced surface water infiltration and groundwater migration through the NDA, and have significantly reduced the discharge of gross beta and stronium-90 contaminated groundwater into the surface water drainage downstream of the NDA.

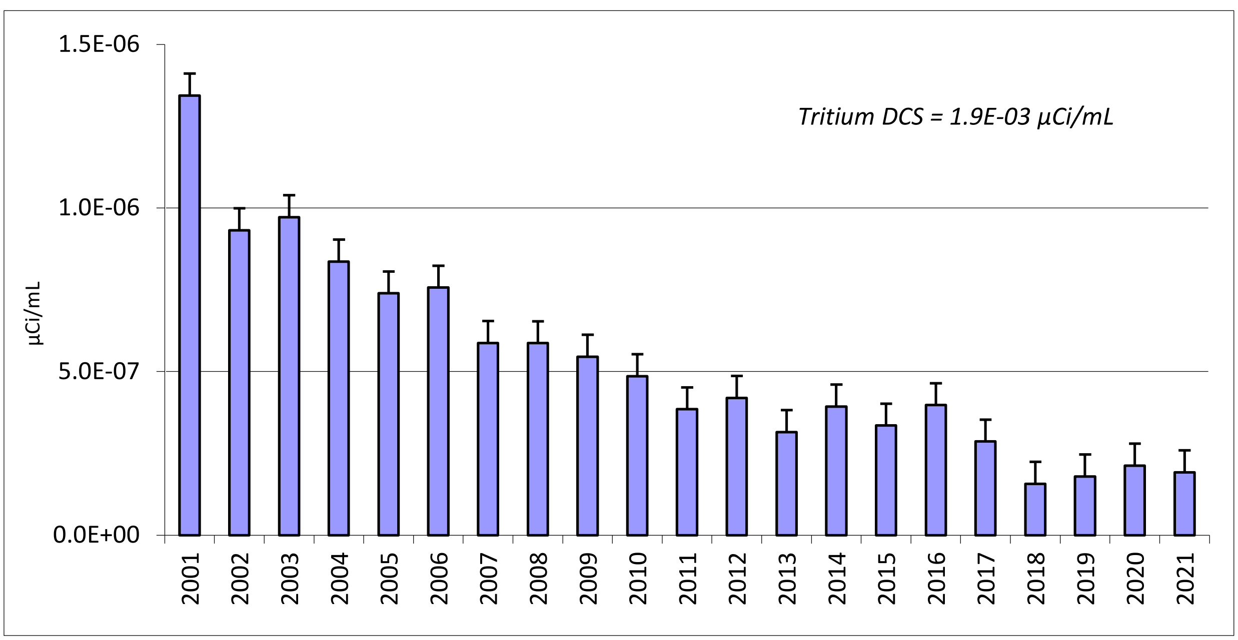
Figure 2-6 shows that the tritium concentrations at WNNDADR have been decreasing overall for the last 20 years with periodic fluctuations. Tritium has decreased from a high of 1.79E-05 µCi/mL in 1992, when routine monitoring began at this location, to an annual average concentration of 1.92E-07 µCi/mL in 2021. The apparent

**FIGURE 2-5**
**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 2021 were 1.89±0.81E-09 and 2.70±8.35E-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 2-6**
**Average Concentration of Tritium in Surface Water at WNNDADR: 2001-2021**




Note: The upper limit of the uncertainty term is indicated with each point. Average background tritium concentration in Buttermilk Creek (WFBCBKG) in CY 2021 was <7.99E-08 µCi/mL.

slight increases since 2019 are within the range of historical fluctuations.

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 remained above the background concentration at Buttermilk Creek of <7.99E-08 µCi/mL but well below the tritium DCS of 1.9E-03 µCi/mL.

All of the radiological results from sampling location WNFRC67 on Franks Creek east of the SDA were below the Minimum Detectable Concentration (MDC) except gross beta which was statistically indistinguishable from background. (See Table B-4G.)

As noted by the table references above, Appendix B-4 presents the 2021 data for the site surface water drainage 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. Locations with results exceeding applicable limits and those with results statistically greater than background values are summarized in Table 2-5.

## MPPB Demolition Water Management Program

Construction of the new water management system, designed for use during demolition of the MPPB, was completed in 2021. The main purpose of the system is to ensure water that comes into contact with potentially contaminated dust or demolition debris is collected, treated as necessary (including filtration of particulate and oil skimming), and released in a controlled fashion via the SPDES outfall. Berms will capture dust suppression water and precipitation in the active demolition area, and drainage controls direct the water to the north interceptor. Storage tanks will contain the water until it is sampled, treated as needed, released through the controlled SPDES outfall, or is shipped off site for treatment and disposal.

Demolition water managed by this new system, as well as storm water outside the bermed demolition area but within the contamination area, will continue to be managed and monitored under the SPDES program. The nearby creeks and streams will also continue to be monitored as they are currently with continuous samplers under the routine environmental monitoring program. This continuous sampling on site will ensure potential contamination that could cause a risk to the environment or the public will be detected and controlled before it can reach surface water accessible to the public downstream of the site.

**Franks Creek during period of high run-off - upstream of WNSP006 sampling location**

## Off-Site Surface Water Monitoring

The aerial photograph of the major creeks downstream of the site (below), shows the northern end of the WNYNSC where Buttermilk Creek, which receives surface water drainage from the site, flows north into Cattaraugus Creek which then flows to the west into Lake Erie. This figure also depicts the two sampling locations downstream of the site.

Surface water samples are collected at three off-site surface water sampling locations:

- one background location on Buttermilk Creek upstream of the WVDP at Fox Valley Road (WFBCBKG) shown on Figure A-5 in Appendix A;

- one downstream location on Buttermilk Creek at Thomas Corners Bridge (shown on Figure 2-7 below as WFBCTCB), just before Buttermilk Creek flows into Cattaraugus Creek, and

- one further downstream location on Cattaraugus Creek at Felton Bridge (shown on Figure 2-7 below as WFFELBR), the first point of public access to surface water downstream of both the WNYNSC and the WVDP,

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

Timed, continuous composite samples from these locations are analyzed for gross alpha, gross beta, tritium, strontium-90, and cesium-137 radioactivity.

**FIGURE 2-7**
**Surface Water Sampling Locations Downstream of the WVDP on Cattaraugus Creek and Buttermilk Creek**

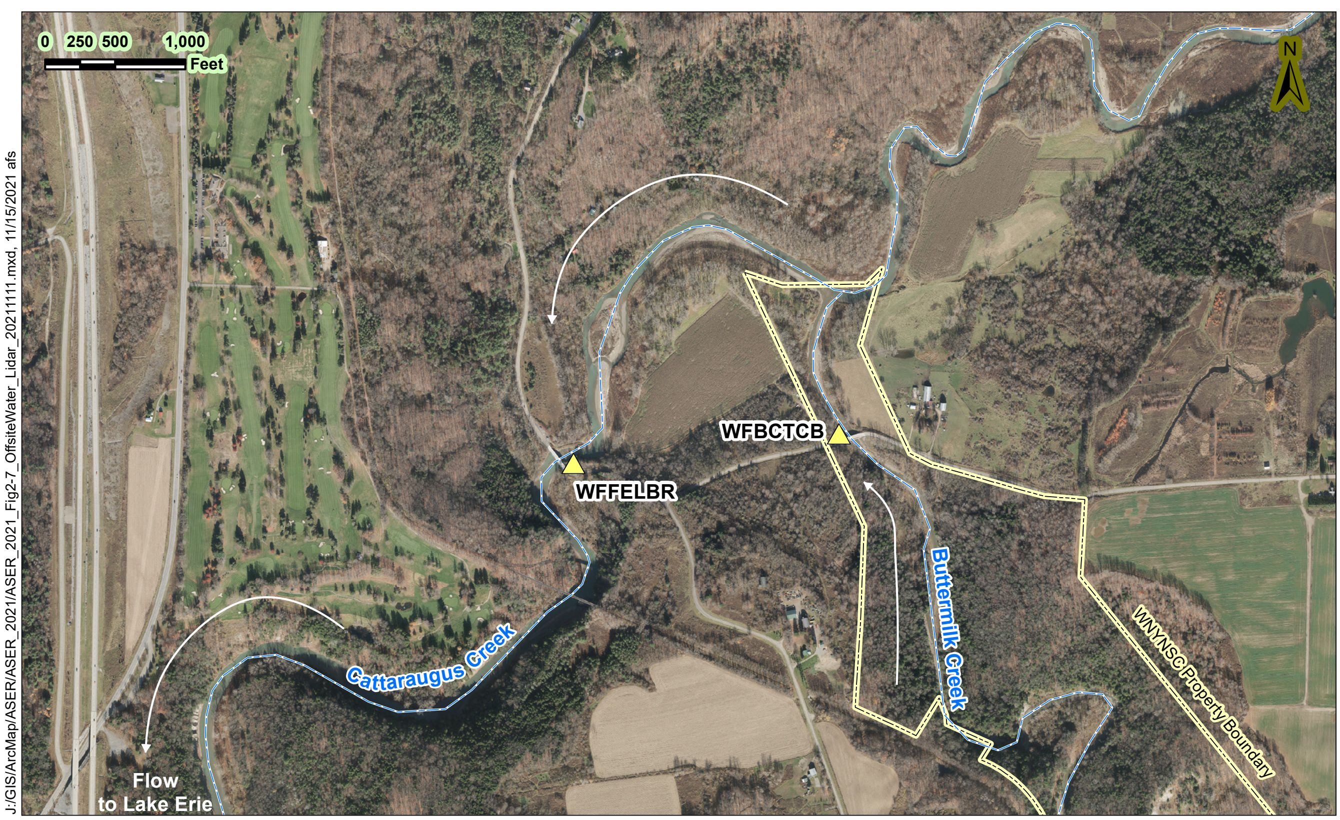


**TABLE 2-4**
**Radioactivity Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)**
**Compared to Upstream / Background Concentrations on Cattaraugus Creek**

| 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 | 0.80±1.13E-09 | 1.14E-09 | 98 | <3.59E-10 - 4.62E-09 | 9.8E-08[d] |
| **Gross Beta** | µCi/mL | 12 | 2.95±0.96E-09 | 4.06E-09 | 98 | <9.03E-10 - 1.37E-08 | 1.1E-06[e] |
| **Tritium** | µCi/mL | 12 | 3.91±8.43E-08 | 8.27E-08 | 98 | <4.46E-08 - 2.65E-07 | 1.9E-03 |
| **Sr-90** | µCi/mL | 12 | 0.67±1.02E-09 | 1.28E-09 | 98 | <3.57E-10 - 1.10E-08 | 1.1E-06 |
| **Cs-137** | µCi/mL | 12 | 0.17±3.20E-09 | < 6.76E-09 | 98 | <1.34E-09 - 5.29E-09 | 3.0E-06 |
| **pH** | SU | 27 | 7.6 - 8.4 | | 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.

## 2021 Update for Off-Site Stream Monitoring

**Felton Bridge (WFFELBR).** Sampling point WFFELBR is the first point of public access to surface water downstream of the WNYNSC and the WVDP, as previously noted. The sampling location is at the bridge south of Springville, and is a favorite kayak launch for paddling Cattaraugus Creek. A composite sampler collects water continuously at this location.

The composite samples collected at WFFELBR in 2021 were analyzed monthly for gross alpha, tritium, strontium-90, and cesium-137. The 2021 results are tabulated on Table 2-4 above. None of radiological sampling results at WFFELBR were statistically greater than the historical concentrations at the Cattaraugus Creek background sampling location (WFBIGBR), with the exception of gross beta as frequently has occurred in previous years. Although the maximum gross beta at WFFELBR in 2021 was within the historical range of gross beta concentrations at background location WFBIGBR, the annual average gross beta at WFFELBR was slightly higher than background. Standard statistical comparisons of these two datasets indicate the 2021 gross beta data was statistically higher than background. This is not a concern however, because gross beta is naturally occurring and is frequently detected in clean areas due to minor amounts of naturally occurring gross beta in the sediment entrained in the samples.

The maximum gross beta concentration seen in 2021 at WFFELBR was 0.4% of the strontium-90 DCS guidance value, and the maximum strontium-90 concentrations was 0.1% of the DCS. (These data are summarized in Table 2-4 above.)

The background location (WFBIGBR) on Cattaraugus Creek is located upstream, east of WFFELBR, where Route 240 crosses Cattaraugus Creek (see Figure A-5).

**Thomas Corners Bridge (WFBCTCB)**. Sampling point WFBCTCB is within the WNYNSC property and downstream of the WVDP on Buttermilk Creek. A composite sampler also collects water continuously at this location.

Similar to the 2021 results at WFFELBR, the gross alpha, strontium-90, and cesium-137 in the samples collected downstream of the WVDP on Buttermilk Creek at Thomas Corners Bridge on Buttermilk Creek were statistically equivalent to the background concentrations on Buttermilk Creek. As in previous years, gross beta was statistically above background but is naturally occurring and is typically detected in samples both upstream and downstream of the WVDP. The maximum gross beta concentration at WFBCTCB was 0.5% of the strontium-90 DCS. (This data is summarized in Appendix B, Table B-4H.)

## Sediment and Soil Monitoring Program

Soil and sediment samples were last collected in 2017 and are scheduled for their next collection in 2022. 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 off site at one background location (SFGRVAL, shown on Figure A-14) and at three near-site air sampling locations (SFRSPRD, SFFXVRD, and SFRT240 - near AF16_NNW, AF07_SE, and AF03_NE, respectively), as 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.) Soil and sediment samples were last collected in 2017 and are scheduled for their next collection in 2022.

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.

## Drinking Water Monitoring Program

The WVDP maintains a nontransient noncommunity drinking water supply that is used only by site employees, primarily for showering. Bottled water is provided for drinking. Project drinking water (potable water) and industrial water are currently supplied by two bedrock wells. Prior to September 2014, potable and industrial water were supplied by two surface water lakes located within the WNYNSC property. Supplemental water needed for SPDES flow augmentation water continues 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. Construction of a new drinking water treatment and distribution system, designed to replace the drinking water components that were housed in the utility room, was completed in 2017 and began being used to supply water to the site in early 2018.

Drinking water continues to be monitored for both radiological and chemical constituents. Drinking water is monitored at the distribution entry point and at several site tap water locations to verify compliance with EPA, NYSDOH, and CCHD 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. In 2021 per- and polyfluoroalkyl substances (PFAS) began being monitored for in the site drinking water per CCHD requirements. Additional details on sampling for PFAS are provided on the following page.

### Drinking Water Update for 2021

Monitoring results from 2021 indicated that the Project's drinking water continued to remain below the local, state, and federal MCLs and drinking water standards for chemical contaminants. Radiological measurements for the supply wells and the nearby bedrock wells were similar to background levels in 2021. The sampling results for the potable water supply system are presented in Appendix B-5.

In addition to other routine analyses, the two drinking water supply wells were sampled for PFAS and 1,4-dioxane in 2021 as required by NYS and the local health department. These data are summarized in Table B-5I. No PFAS or 1,4-dioxane were detected at the site's drinking water.

The inset on the following page describes some of the regulatory history and recent government efforts to control PFAS.

## Per- and Polyfluoroalkyl Substances (PFAS) Sampling

**Preparing drinking water supply samples for off-site laboratory analysis**

A category of man-made chemicals known as per- and polyfluoroalkyl substances (PFAS) have been detected in surface waters and groundwater across the country, and their toxicity and persistence in the environment has led to their designation as emerging contaminants of concern. PFAS include chemicals such as perfluorooctanoic acid (PFOA) which is used to make coatings for items such as water-repellent clothing and heat-resistant nonstick cookware, and perfluorooctane sulfoncic acid (PFOS) used in fire-fighting foam.

**2021 Regulatory Update:** PFAS have received much attention recently because of their widespread presence in common household products. In 2016, EPA issued a lifetime health advisory of 70 parts per trillion (ppt) [nanograms/liter [ng/L]) for long term exposure to PFOA and PFOS in drinking water. In August 2020, NYSDOH adopted a drinking water MCL of 10 ppt for PFOA and PFOS and 1.0 parts per billion (ppb) for 1,4-dioxane and issued requirements that water supply systems begin sampling for these constituents. The CCHD added the requirement to the WVDP to begin monitoring the drinking water supply wells for PFOA, PFOS, and 1,4-dioxane by February 2021. The WVDP began sampling and analysis for these parameters in January 2021. These results are provided in Table B-5I in Appendix B.

In September 2021, the DOE issued a memorandum that provided direction "to assess, contain, reduce and/or remove PFAS contamination and use at DOE sites." Beginning in September 2021, the DOE required all sites to report any new PFAS-containing Aqueous Film-Forming Foam (AFFF, a fire-fighting foam) releases or spills to DOE Headquarters. The DOE is also conducting research at several of its national laboratories to detect, quantify, treat, destroy, and dispose of PFAS.

In October 2021, EPA announced the Agency's "Strategic Roadmap" for addressing PFAS that sets timelines by which EPA plans to take specific actions, includes research plans to better understand PFAS, and promotes statutory actions to minimize PFAS releases to the environment and require remediation of PFAS contamination, holding potential polluters accountable. The EPA is also proposing adding PFAS and other similar substances to the list of RCRA hazardous constituents, and is clarifying the wording of RCRA corrective action regulations so that emerging contaminants such as PFAS can be addressed through RCRA corrective action.

**WVDP Historical:** Historical site information does not suggest that PFOA or PFOS or other recently identified emerging contaminants of concern were used or produced at the WVDP. The fire protection operations have no history of using any substances that may have contained PFOS. Personnel interviews and records searches have shown no operations that could have introduced these chemicals into the WVDP environment. However, the DOE has recently encouraged facilities under their cognizance to further research the potential for historical use of substances potentially containing PFAS and has circulated a questionnaire to help facilities do a thorough investigation of any situations where PFAS could have existed at their sites. The WVDP participated in these DOE complex-wide initiatives in 2021.

Additional information on this topic can be found at the following links:

https://www.epa.gov/pfas.

https://www.dec.ny.gov/chemical/108831.html.

https://health.ny.gov/environmental/investigations/drinkingwaterresponse.

## Monitoring of Food Sources

Milk and venison samples are collected every year and are analyzed for radiological parameters. Fish, apples, beans, and corn are collected every five years, with 2017 being the most recent sampling year in this cycle. The next fish and crop samples will be collected in 2022.

Food samples are collected from locations near the site and from remote locations for comparison purposes. Samples are collected near the site, where plants and animals could potentially be impacted by site activities (at the locations shown on Figure A-11) and far from the site at distant locations where no contamination from the site could occur (at the locations shown on Figure A-14).

Corn, apples, and beans are collected at harvest time. Venison samples are typically collected during the fall when deer are most active and fish may be collected at any time of the year, but are not usually collected during the winter. Only the edible portions of the deer and fish are sampled and analyzed for radionuclides.

**Milk samples are collected annually at a nearby dairy farm**

**Venison samples are collected annually from deer near the site**

### Food Update for 2021

In 2021, venison and milk data continue to demonstrate that the Project has a minimal effect on local food sources. Radionuclides detected in milk and venison samples were statistically indistinguishable from background in 2021.

Low levels of cesium-137 were detected in two of the near-site deer (deer that have been on the site property) and one of the background deer (deer located more than 10 miles from the site) in 2021, as frequently has been observed. Strontium-90 was not detected in either the near site deer or background deer above MDCs.

The near-site deer concentrations for cesium-137 were statistically lower than the 10-year average background deer concentrations as is typical. Because of global fall-out from nuclear weapons testing that remain on the soil, deer frequently have some radiocesium in their bodies. (*Reference: Radiocesium in White-Tailed Deer at the Savannah River Site, University of Georgia, Savannah River Ecology Lab, May 14, 1999.*)

No radioisotopes were detected in the near-site milk samples (except potassium-40 which is naturally occurring). Data from 2021 for milk and venison are provided in Appendix E.

These data and the fish and food crop data collected every five years are used to generate conservative dose estimates from consuming maximum quantities of near-site deer, fish, milk, beans, corn, and apples. As discussed under “Calculated Dose from Food Samples” in Chapter 3, the 2021 estimated dose from food sources was well below any level of concern and has consistently helped confirm the low dose estimates from the site based on results from air and water monitoring.

## Direct Radiation Monitoring

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. 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. No changes were made to the location of TLDs this year.

**Direct radiation measured by TLD on WVDP property fence**

### Direct Radiation Update for 2021

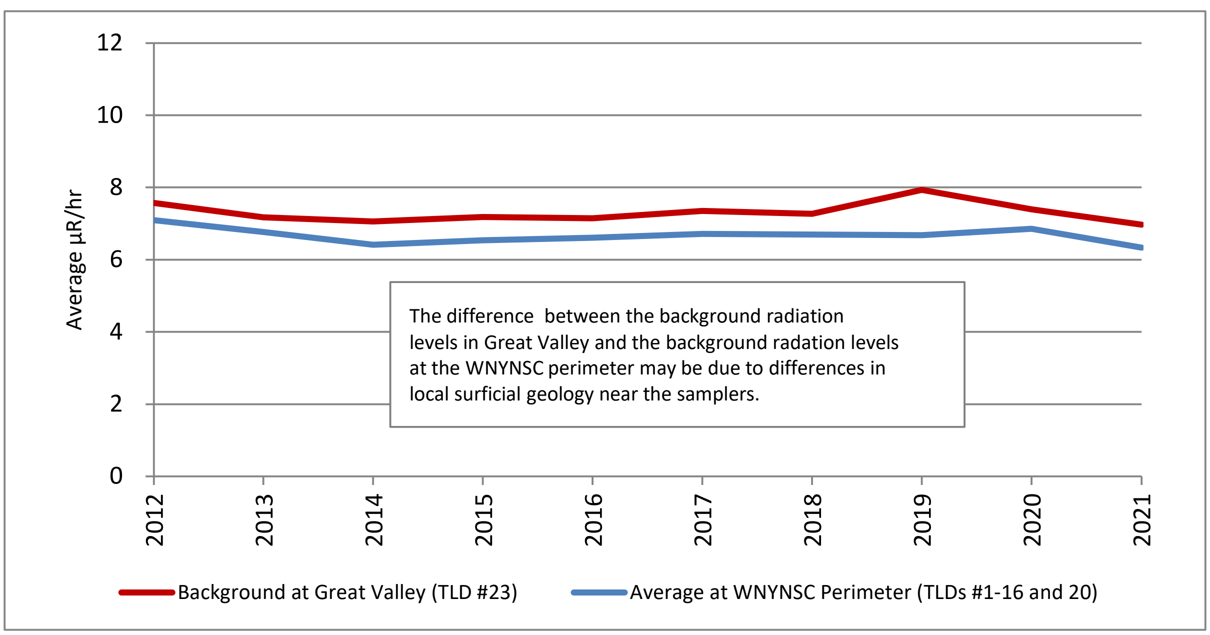
The graph below presents the average annual exposure rates (in microroentgen [μR] per hour) over the last 10 years at off site WNYNSC perimeter and background locations. As shown, results at perimeter locations are comparable to background indicating no radiation from on-site sources resulting in off-site direct radiation exposure.

The average results at the off-site WNYNSC perimeter TLDs (TLDs #1-16 and 20) are nearly equivalent to (although slightly lower than) the background TLD in Great Valley (TLD #23). This dissimilarity may be due to geological characteristics that differ between the perimeter and background locations. No other discernible trends over time are evident. The TLD data is presented in Appendix F in units of milliroentgen (mR)/quarter.

Elevated exposure rates were observed on site at TLD #24, TLD #38 and TLD #40, the same three on-site TLDs on the north plateau that have had elevated rates in previous years.

The average environmental radiation exposure rate near TLD #24 located northwest of the former CPC-WSA in 2021 was 48 mR/quarter, similar to the levels in

**FIGURE 2-8**
**10-Year Trends of Environmental Radiation Levels at Perimeter and Background Thermoluminescent Dosimeters (TLDs)**



2020, but substantially lower than the average rate of 253 mR/quarter in 2018. This decrease is attributed to removal of all radioactive materials stored in the CPC-WSA in 2018, and demolition of the facility in 2019.

The average environmental radiation exposure rate near TLD #38 (located in front of the MPPB) decreased slightly in 2021 compared to 2020 from 100 mR/quarter to 84 mR/quarter. These exposure rates are most likely due to a variety of waste management activities that have occurred over the year in this area as well as proximity to temporary holding tanks of radiologically contaminated water.

The highest on-site radiation exposure rate in 2021 was measured at TLD #40, as it was in 2020. This TLD is located near the STS and the WTF. Its location has not changed since on-site TLD monitoring began in 1995. The exposure rate at this location increased from a historical average of approximately 120 mR/quarter from 1995 to 2019 to over 1,000 mR/quarter in 2020. This TLD appears to be measuring elevated exposure rates due to its proximity to temporary holding tanks of higher radiologically contaminated water placed in this area between July 2019 and January 2020. The annual average environmental radiation exposure rate near TLD #40 decreased between 2020 and 2021, from 1,392 mR/quarter in 2020 to 1,171 mR/quarter in 2021.

Although the results at these three on-site TLDs are higher than background (16 mR/quarter), these locations are not accessible to the public. Radiation areas for workers are posted when the radiation exposure rates are greater than 5 mR/hour. The areas discussed above are well below the limit requiring posting as all are below 1 mR/hour.

On the south plateau, all on-site TLD results were similar to background levels.

## 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 (as shown in summary Table 2-5), results from off site and downstream are comparable to background and confirm that the public health and safety, and the environment continue to be protected from on-site releases.

Monitoring results from CY 2021 demonstrate the effectiveness of radiological and nonradiological contaminant control measures practiced at the WVDP.

A new video created in 2021 describing the WVDP environmental monitoring program is available for viewing at:

https://www.youtube.com/watch?v=R0tU4XQ5Irc

**TABLE 2-5**
**2021 Environmental Monitoring Locations**
**with Results Greater than Applicable Limits or Background**

| ***Sample Type*** | ***Total Number of Sampling Locations and Description*** [b] | | ***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<br>air emission points | 4 | MPPB RVU (ANRVEU1)<br>HLW Tanks (ANSTSTK)<br>RHWF (ANRHWFK)<br>CSPF (ANCSPF) | **None** | 2 | **ANRVEU1** (I-129);<br>**ANSTSTK** (I-129) |
| On-site<br>portable ventilation units (PVUs) | 10 | In 2021, PVUs were used in work areas inside and outside the MPPB, inside LLW2, and inside LSA #4 (in the Waste Packaging Area) | **None** | 0 | **None** |
| Off-site<br>ambient air network | 16 | In each direction on NYSERDA site perimeter and in Great Valley | **None** | 0 | **None** |
| **Surface water** | | | | | ***background locations = WFBCKBG on Buttermilk Creek and WFBIGBR on Cattaraugus Creek*** |
| On-site<br>surface water effluent and natural drainage | 8 | 001 Outfall<br>Franks Creek downstream of 001<br>MPPB Ditch<br>Northeast SWAMP drainage<br>North SWAMP drainage<br>North of the NDA<br>Erdman Brook<br>Franks Creek upstream of 001 | **WNSP005**<br>(Gross beta) | 7 | **WNSP001** (Gross alpha, Gross beta, H-3, Sr-90, Cs-137, U-232, U-233/234, U-238);<br>**WNSP006** (Gross beta, Sr-90);<br>**WNSP005** (Gross beta, Sr-90);<br>**WNSWAMP** (Gross beta, Sr-90);<br>**WNSW74A** (Gross beta, Sr-90);<br>**WNNDADR** (Gross beta, H-3, Sr-90);<br>**WNERB53** (Gross beta) |
| Off-site<br>downstream surface water | 2 | Thomas Corners Bridge<br>Felton Bridge | **None** | 2 | **WFBCTCB** (Gross beta)<br>**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).
[b] Sampling locations shown on Figures A-2 (on-site water), A-5 (off-site water, soil, sediment), A-6 (on-site air), A-7 (off-site air), A-11 (near-site deer, fish, milk, crops), A-12 (on-site Thermoluminescent Dosimeters [TLDs]), A-13 (off-site TLDs), A-14 (samples > 5 km from site).

**TABLE 2-5 *(concluded)***
**2021 Environmental Monitoring Locations**
**with Results Greater than Applicable Limits or Background**

| ***Sample Type*** | ***Total Number of Sampling Locations and Description*** [b] | | ***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)* |
|---|---|---|---|---|---|
| **Food** | | | | | ***background locations = BFMCTLS milk and BFDCTRL venison*** |
| Off-site milk sample | 1 | From a local producer as shown on Figure A-11 | **None** | 0 | **None** |
| Off-site venison samples | 3 | On Route 417 and on Route 242 | **None** | 0 | **None** |
| **Environmental radiation** | | | | | ***background location=DNTLD23*** |
| On-site dosimeters near WVDP facilities | 10 | Near HLW Tanks, MPPB, NDA, SDA, HLW Cask Storage, Drum Cell, and on WVDP property fence | **None** | **3** | **DNTLDs #24, 38, 40** |
| Off-site perimeter dosimeters | 17 | In each direction on NYSERDA site permeter and in Great Valley | **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).
[b] Sampling locations shown on Figures A-2 (on-site water), A-5 (off-site water, soil, sediment), A-6 (on-site air), A-7 (off-site air), A-11 (near-site deer, fish, milk, crops), A-12 on-site TLDs), A-13 (off-site TLDs), A-14 (samples > 5 km from site).

NS - Not sampled

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# CHAPTER 3
# DOSE ASSESSMENT

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. This chapter provides estimates of the maximum potential dose to the public and to plants and animals (biota) from 2021 WVDP activities. A discussion on cancer risk comparing the predicted maximum potential dose estimates to other lifetime cancer risks is included in this chapter as well.

## 2021 Highlights

As in previous years, the estimated maximum potential dose from the WVDP to an off-site individual was orders of magnitude below applicable EPA standards and DOE public dose limits, and a very small fraction of 620 mrem that the public receives annually from natural and man-made sources. There has been negligible change in the estimated annual dose from the WVDP in recent years.

**Total Dose from All Pathways.** The 2021 total estimated dose from the Project to an off-site resident was <0.56 mrem. The DOE annual public dose limit is 100 mrem from all pathways in a calendar year.

**Dose from the Air Pathway.** Annual air emissions of radioactivity are regulated by EPA and limited to 10 mrem per year at the maximally exposed off-site receptor. The total annual dose from airborne emissions in 2021 was <0.55 mrem, well below the 10 mrem annual limit.

**Dose from the Water Pathway**. Dose from the surface water exposure pathway is evaluated by its contribution to the DOE total all pathway dose limit of 100 mrem per year. The total estimated dose from surface water releases from the site was 0.014 mrem, a very small fraction of the 100 mrem DOE dose limit from all pathways. Groundwater is not considered an exposure pathway because no off-site public water supplies are drawn from aquifers potentially affected by the WVDP.

**Dose to Biota**. Biota dose modeling indicates the plants and animals living on or near the WVDP are not being exposed to doses in excess of the DOE biota dose standard.

## Minimizing Potential Dose to the Public and the Environment

DOE Order 458.1, "Radiation Protection of the Public and the Environment," establishes requirements to protect the public and environment against undue risk from radiation. This order ensures DOE operations are conducted in a manner that limits any potential radiation exposures to ***A***s ***L***ow ***A***s ***R***easonably ***A***chievable (ALARA). ALARA is an approach to radiation protection that advocates controlling or managing exposures to as low as technical and practical considerations permit, and as far below the applicable limits of the order as practicable. Deliberate efforts are taken at every level of the work to minimize the time of exposure, to maximize the distance from the potential source, and to utilize shielding whenever possible. ALARA radiological controls protect the worker and, as a result, also protect the public and the environment.

## 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 3-4 for discussions of "Radiation Dose" and "Units of Dose Measurement.") In 2006, an individual living in the U.S. was 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. 184 (2019), an update of the medical exposure section of NCRP Report No. 160, indicates there has been a 15-20% reduction in the non-therapeutic medical radiation dose to the U.S. population in the decade between 2006 and 2016. This reduction effectively reduces the NCRP Report No. 160 estimate to about 540 mrem (5.4 mSv).

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 remainder 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.) Figure 3-1 shows the estimated (all pathway) maximum potential individual dose from the WVDP in 2021 compared with the average annual dose a U.S. resident receives from man-made and natural background sources. The estimated (all pathway) maximum individual dose from the WVDP in 2021 was <0.56 mrem. This is a very small fraction of the average annual dose a U.S. resident receives from natural background sources (310 mrem).

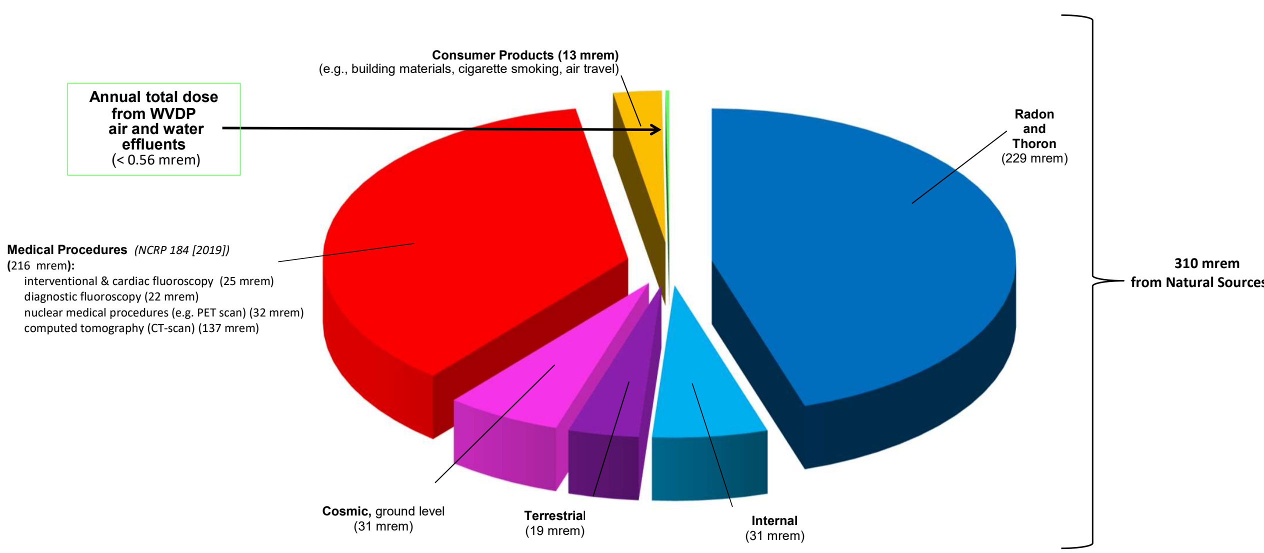
Each year, very small quantities of the radioactive materials remaining at the WVDP are released to the environment. Radioactive materials at the WVDP are residues from the commercial reprocessing of nuclear fuel by Nuclear Fuel Services, Inc. (NFS) in the 1960s and early 1970s. On-site emissions and effluents are strictly controlled so that release quantities are kept ALARA.

## Exposure Pathways

Human beings are exposed to natural radiation and to man-made radiation sources through a variety of exposure pathways. An exposure pathway consists of a route for contamination to be transported by an environmental medium from a source to a receptor. 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, as shown on Figure 3-2.

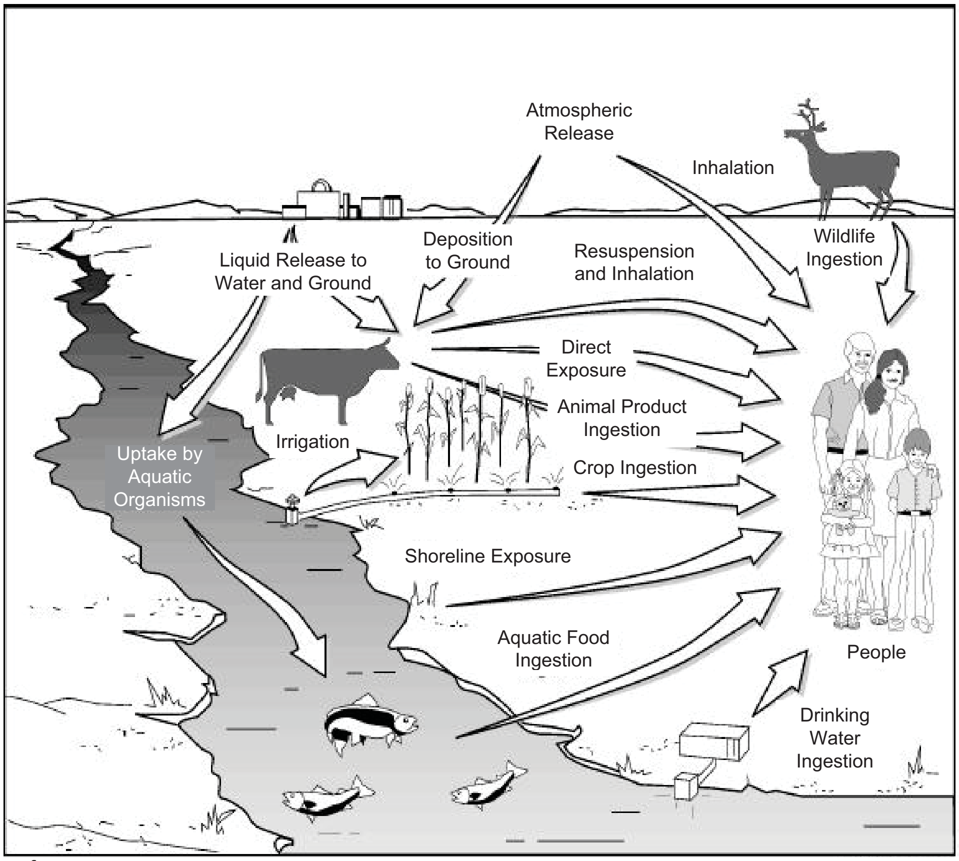
Table 3-1 summarizes the potential exposure pathways to the local off-site population and describes the rationale for including or excluding each pathway when calculating dose from the WVDP. As noted in this table, the WVDP model for the waterborne pathway includes ingestion of milk, crops, meat and fish, and external exposure from waterborne activities like swimming and boating.

**FIGURE 3-1**
**Comparison of Doses from Natural and Man-Made Sources to the Dose from 2021 WVDP Effluents**




*References: NCRP 160 (2009) and NCRP 184 (2019).*

**FIGURE 3-2 Potential Radiation Exposure Pathways to Man**




Reference: DOE-HDBK-1216-2015

**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. |

Note that drinking water is not considered a pathway from the WVDP to the public because surveys have determined that no off-site public water supplies are drawn from downstream Cattaraugus Creek before Lake Erie or from groundwater in aquifers potentially affected by the WVDP.

## 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 both beta radiation and gamma radiation 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 80 km collective dose is the sum of all doses to all individual members of the public within 80 km of the WVDP.

## DOE Ionizing Dose Ranges Chart

The DOE Office of Public Radiation Protection issued a chart that provides an "order of magnitude" reference on a variety of levels of radiation exposure (December 2017). This comprehensive chart provides perspective on the estimated dose from the WVDP compared to other types of radiation dose familiar to the public, such as the dose used for cancer treatments. (See Figure UI-1 in the "Useful Information" section of this report to view the chart.)

## 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.

### Airborne Dose Assessment Methodology

Since 2014, the WVDP dose via the air pathway has been estimated by comparing measured ambient air radioactivity with EPA standards using a sum of the ratios analysis.

Radioactivity samples for estimating off-site dose are collected from 16 low-volume ambient air samplers encircling the WVDP. Samples are also collected from one high-volume sampler co-located with a low volume sampler in the north-northwest (NNW) sector, the predominant downwind direction and approximate location of the historically modeled maximally exposed individual. Figure A-7 shows the location of these samplers. These ambient air samplers 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 is also monitored 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 was 98.5% operational in 2021.

In recent years, diffuse sources, such as releases from demolition combined with low levels of radioactivity released to the air from natural evaporation from the lagoons, have become the largest potential contributors to airborne dose. Currently, the primary work performed on site includes building deactivation and decontamination, demolition of facilities, and waste shipping.

Since the largest contributions to off-site dose are currently from activities that result in diffuse sources (e.g., demolition and waste management), the site transitioned to demonstrating compliance based on off-site ambient air sampling rather than on modeled off-site concentrations from stack emissions.

The method of estimating dose is explained in the inset box "Using the Ambient Air Concentrations and Compliance Ratio to Estimate Airborne Dose". In summary, the estimated annual dose from airborne emissions from the WVDP is calculated by comparing the data collected at the ambient air samplers to EPA limits to compute a "compliance ratio."

The measured radioactivity at the ambient air samplers frequently includes isotopic results that are below detection limits. The estimated dose based on the sum of the dose from each isotope is also below detection and is reported with a "<". This has been the case since the ambient air samplers were first installed.

### 2021 Maximum Airborne Dose to an Off-Site Individual

Based on the results from the ambient air samplers, the estimated maximum potential airborne dose to any off-site individual in 2021 was <0.55 mrem (<0.0055 mSv). This is well below the annual NESHAP compliance limit of 10 mrem. There were no results above the contract laboratory minimum detectable concentrations at the ambient air samplers in 2021.

This low dose was maintained while the WVDP decontaminated additional areas inside the MPPB, demolished the PTW soil containment structure, the LILO facility, and a portion of the outer west wall of the ARC and OGA in the MPPB, and shipped the associated demolition debris and other nondemolition waste.

In general, radioactivity measurements at the ambient air samplers in 2021 were similar to the measurements at the background sampler in Great Valley.

**Demolition of the Load-In/Load-Out (LILO) facility**

## Using Ambient Air Concentrations and the "Compliance Ratio" to Estimate Dose

Filter media and charcoal canisters from each ambient air sampler around the WVDP were analyzed throughout the calendar year and are used to calculate the average airborne radioactivity concentration for each radionuclide at each sampler location. Radionuclides are selected for analysis based on their historical presence at the site and potential dose significance. The ambient air data for the current year are summarized in Table C-7.

The NESHAP regulations include a tabulation of very conservative hypothetical radionuclide concentrations that would result in a 10 mrem/year dose if a person were exposed to that concentration for a full year. The dose estimate methodology involves comparing measured concentrations to the hypothetical concentrations associated with a 10-mrem dose. A measured concentration that is a fraction of the concentration from the EPA standard corresponds to an equivalent fraction of the 10 mrem dose.

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

To determine dose, the measured annual average radioactivity at the ambient air samplers is compared to the concentration levels for NESHAP compliance to determine a radionuclide specific ratio. The ratios for each isotope are summed to generate a "compliance ratio" for each sampling location. This ratio is a value showing what fraction of the limit was measured in the ambient air for each radionuclide of interest. Since the concentrations for NESHAP compliance 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 compliance ratio (the sum of the ratios for each isotope 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 the compliance ratios is less than 1. This correlates to a dose less than 10 mrem. The table below showing data from one of the 16 samplers surrounding the site demonstrates how this compliance ratio is calculated.

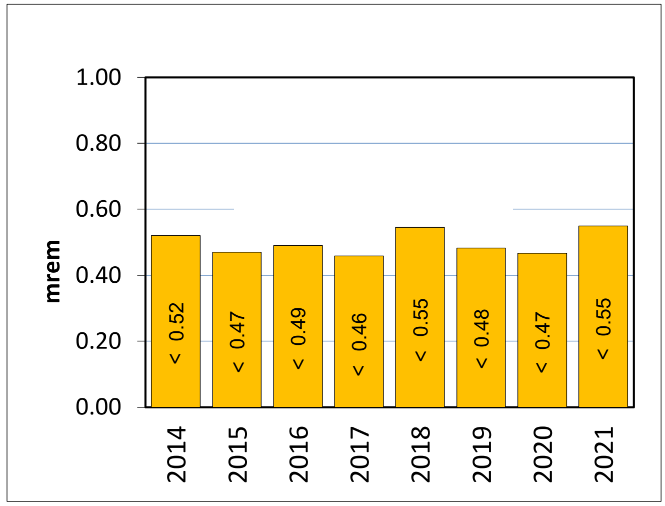
**Compliance Ratio Calculation using 2021 AF10_SSW Data**

| *Isotope* | *Annual Average Concentration* | *NESHAP Compliance Level (Appendix E)* | *Ratio of Average Concentration to Compliance Level* | *Dose (Compliance Ratio x 10 mrem)* | *Dose Isotopic Distribution* |
|---|---|---|---|---|---|
| | *(µCi/mL)* | *(µCi/mL)* | | *(mrem)* | |
| **Sr-90** | < 1.35E-16 | 1.90E-14 | < 0.0071 | < 0.071 | 17% |
| **I-129** | < 8.35E-17 | 9.10E-15 | < 0.0092 | < 0.092 | 21% |
| **Cs-137** | < 1.05E-16 | 1.90E-14 | < 0.0055 | < 0.055 | 13% |
| **U-232** | < 1.05E-17 | 1.30E-15 | < 0.0081 | < 0.081 | 19% |
| **Pu-238** | < 7.59E-18 | 2.10E-15 | < 0.0036 | < 0.036 | 8% |
| **Pu-239/240** | < 7.46E-18 | 2.00E-15 | < 0.0037 | < 0.037 | 9% |
| **Am-241** | < 1.07E-17 | 1.90E-15 | < 0.0056 | < 0.056 | 13% |
| | | **Total =** | **< 0.0428** | **< 0.43 mrem** | |
| | | | "Compliance Ratio" (sum of ratios) | Total Annual Dose to MEOSI | |

The estimated dose from the air pathway has not changed significantly over the last eight years, (since 2014 when the ambient air samplers began to be used for dose estimates), as shown by Figure 3-3. The airborne dose is reported with a "less-than" (<) symbol because it represents a sum that includes nondetects. Nondetects are not interpreted as a zero dose; instead they represent an upper bound of the potential dose that is based on the detection limits of the samplers.

Prior to 2014, the airborne dose was modeled from on-site air effluent concentration measurements. The modeled dose for 2013 was 3.22E-03 mrem and the maximum historical dose was 4.90E-02 mrem/year, both significantly below the dose associated with concentrations that can be measured at the ambient air samplers. Models are able to mathematically calculate a dose from a measured source to any distance off site. If the source is small enough and the distance large enough, the source may disperse (decrease) so much by the time it reaches the off site location that it is below the detection limit of even the best quality air sampler.

**FIGURE 3-3**
**Historical Airborne Dose**
**Based on Ambient Air Monitoring**




## 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. On average, naturally occurring radon (radon-222) and thoron (radon-220) contribute 37% (229 mrem) of the total natural and man-made dose to a member of the public. (See Figure 3-1.)

Radon-220 has 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 vitrification process. (Chapter 2 of the 1996 WVDP ASER, West Valley Nuclear Services Company [WVNSCO] and Dames & Moore, June 1997).

Radon-220 is also a naturally occurring gaseous decay product of thorium-232. When vitrification was completed, thoron releases were estimated to return to their 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 the Maximally Exposed Off-Site Individual (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.

## Population Data

Population information is required when using computer models for annual dose assessments for a community. 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 U.S. census and the 2011 Canadian census is presented on Figure A-15. These data indicate an estimated 1.62 million people live within 50 miles (80 km) of the site. This total includes approximately 128,000 Canadians. Information from the most recent land use survey, conducted for the WVDP in early 2002, was used to update the residential locations within 3.1 miles (5 km) of the site. In 2008, a field verification of the residents closest to the site was conducted. The location of the nearest receptor in each sector is confirmed annually. Updates to the local population distribution are performed periodically. There were no large changes in the local population in 2021, based on information from local fire department representatives.

## Collective Population Dose

The annual collective population dose is the sum of the dose to each individual living within 50 miles (80 km) of the site. This population receives about 503,000 person-rem/yr from natural sources. This is computed by multiplying 310 mrem/yr (the individual annual dose from natural sources as shown on Figure 3-1) by 1.62 million people living within 50 miles of the WVDP. The collective population dose from WVDP activities (to the same 1.62 million people) is estimated using dose assessment models for air and water exposure. The WVDP collective population dose is a very small fraction of that received from natural sources as described in the following sections of this chapter.

**The WVDP is located in a sparsely populated rural area (view of the site from Dutch Hill)**

### 2021 Collective Population Dose (Airborne)

Population unit dose conversion factors developed with the CAP88 model, were used together with the ambient air monitoring data in 2021 to make a conservative estimate of the 2021 collective population dose (dose to the population within 50 miles of the site). CAP88 is an air dispersion model used to demonstrate NESHAP compliance. (See inset on page UI-4 in the "Useful Information" section). 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 computed collective airborne dose using this method was <0.48 person-rem (<0.0048 person-Sv) from radioactive nonradon airborne emissions released from the WVDP. This value means, the sum of the estimated individual doses from each of the 1.62 million residents within 50 miles would total 0.48 rem (at most), a very small fraction of the population dose of 503,000 person-rem from natural sources. (See inset explanation above.)

**Continuous On-Site Air Effluent Sampling.** To monitor for a potential unexpected release, the emissions from the on-site ventilation stacks are sampled continuously while in operation and will continue to be sampled until the stacks are taken out of service. The MPPB stack was removed in 2018. Ventilation of the MPPB during 2021 decommissioning activities was performed by the RVS and by PVUs in select work areas.

Air emissions from the on-site stacks have remained very low, well below the DCS for each radioisotope, over the past 20 years as shown by the Figure 3-4 trend graphs. The STS stack (sampled at ANSTSTK) and RVS stack (sampled at ANRVEU1) were the largest point source (i.e., stack) emitters in 2021. Iodine-129 was the highest contributor of total curies released from the stacks in 2021, primarily from the STS stack which ventilates the HLW tanks, as it has been in recent years. The 2021 annual average iodine-129 concentration at ANSTSTK decreased slightly in 2021 compared to 2020, but remained slightly elevated. The T&VDS was shutdown for maintenance from April to October 2020 and from July 2021 through the end of 2021. Similar T&VDS outages in 2018 and 2019 have also resulted in iodine-129 increases as can be seen in the Figure 3-4 graph on the following page.

There were no detectable increases in off-site radioactivity in any of the ambient air samplers as a result of on site point emissions.

## Dose from Waterborne Releases

DOE Order 458.1, "Radiation Protection of the Public and the Environment," requires DOE facilities to limit annual radiological exposure to less than 100 mrem. The dose to the water pathway is estimated by surface water models at the first point of public access downstream of the site on Cattaraugus Creek.

EPA standards also establish limits on the radiation dose to members of the public from liquid effluents through the National Primary Drinking Water Regulations (40 CFR Part 141). Corollary limits for community water supplies are set by NYSDOH in the New York State Sanitary Code (10 NYCRR 5-1). The EPA and NYSDOH drinking water limit is 4 mrem/year.

Public exposure to drinking water at Cattaraugus Creek is not included as an exposure pathway for the WVDP because Cattaraugus Creek is not used as a public drinking water supply. (Exposure from swimming and fishing in the creek are considered potential exposure pathways.) The nearest municipal drinking water supplies downstream of the site are located on Lake Erie. Surface water in Cattaraugus Creek flows over 30 miles west of the site before reaching Lake Erie.

DOE DCSs for water are used as reference values to help control and evaluate waterborne releases that occur throughout the year and to aid in implementing ALARA objectives. Special requirements in the SPDES permit specify that radionuclide concentrations in the discharge are subject to requirements of DOE Order 458.1. This is implemented by reporting to NYSDEC a comparison of pre-discharge concentrations with the DCS in order to obtain NYSDEC approval to discharge. (For additional discussions of DCSs, see the inset in Chapter 2, "Radiological Data Evaluation".)

### Waterborne Dose Assessment Methodology

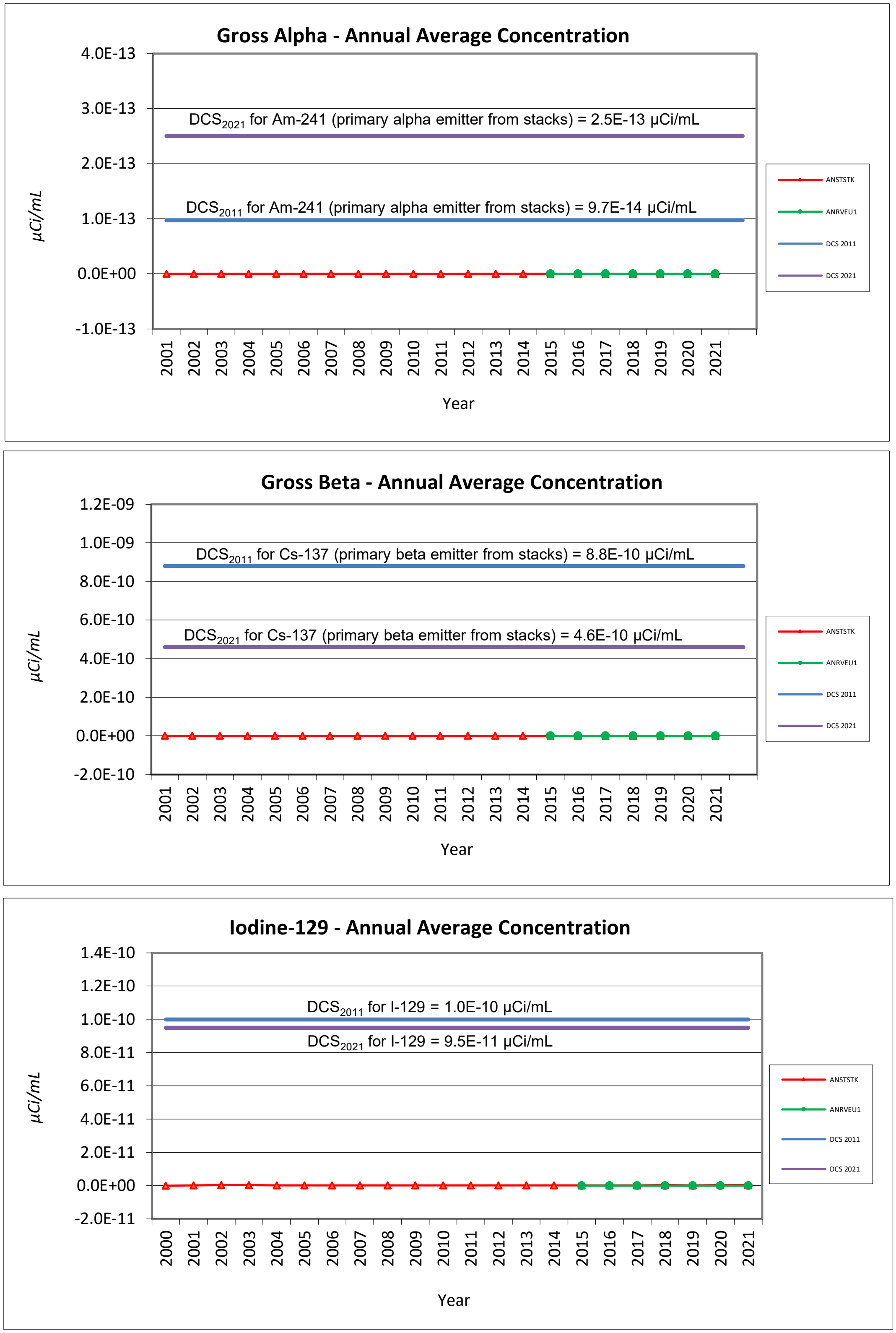
Potential dose to near-site residents and the local population from the waterborne pathway are estimated using site-specific surface water exposure models, GEN II and LADTAP, to simulate the pathways of radiation exposure from source to receptor. These models predict the dose based on site-specific sources, pathways, and exposure scenarios described below.

The primary waterborne sources of potential radioactivity from the WVDP are SPDES outfall 001 (sampling location WNSP001 on lagoon 3), and the two natural drainage channels on the north plateau, the northeast swamp drainage (sampled at WNSWAMP) and north swamp drainage (sampled at WNSW74A). Although releases at WNSWAMP and WNSW74A are not controlled, they are well characterized and are routinely sampled and monitored. Waterborne radioactivity released through these monitoring points is included in the dose calculations for the MEOSI and the collective population.

Felton Bridge on Cattaraugus Creek is the first point of public access to surface water downstream of the WNYNSC property and of the WVDP. Because the Project's liquid effluents eventually reach Cattaraugus Creek, the most important waterborne exposure pathway considered in the dose model is the consumption of fish from the creek by local sportsmen and residents. Exposure to external radiation from shoreline contamination or submersion in the water is also considered in the model for estimating radiation dose.

Additional details about the surface water model are included in the inset box "Using Dose Conversion Factors to Estimate Waterborne Dose".

**FIGURE 3-4**
**Historical Trends in Measured Concentrations from Primary Point Sources**




NOTE: Discussion of these trends is included under "Continuous On-site Air Effluent Sampling" in Chapter 3 and under the "Air Emissions Update for 2021" in Chapter 2.

## 2021 Maximum Waterborne Dose to an Off-Site Individual

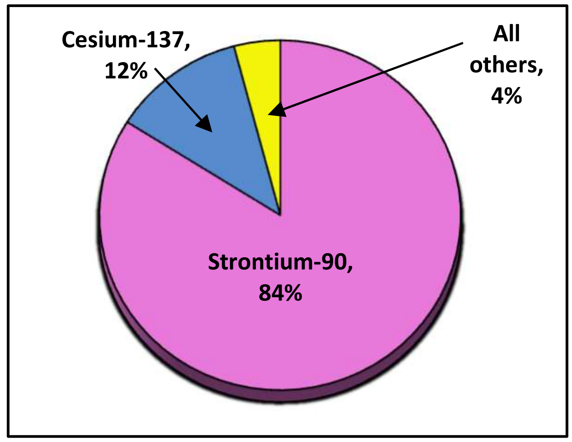
Controlled discharges with low levels of radioactivity from SPDES outfall 001 and surface water discharges of strontium-90 by natural drainage continued in 2021. (Concentrations and flow volumes from these discharges are reported in Chapter 2.) Measurements of the radioactivity discharged in these effluents were combined with the appropriate Unit Dose Factors (UDFs) to calculate the dose to the Maximally Exposed Off-site Individual (MEOSI) and the dose to the population living within a 50-mile (80-km) radius of the WVDP.

Contributions to the waterborne dose from controlled releases and from natural surface water drainage are estimated separately. An off-site individual could have received a maximum dose of 0.0024 mrem (0.000024 mSv) from the radioactivity in controlled liquid effluents discharged from the WVDP (SPDES outfall 001) during 2021. Most of the dose from the lagoon 3 discharge was from cesium-137.

An off-site individual could also have received a maximum dose of 0.012 mrem (0.00012 mSv) due to natural 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 3-5. As presented, strontium-90 (primarily from WNSWAMP) and cesium-137 (primarily from lagoon 3) account for almost all of the estimated waterborne dose in 2021.

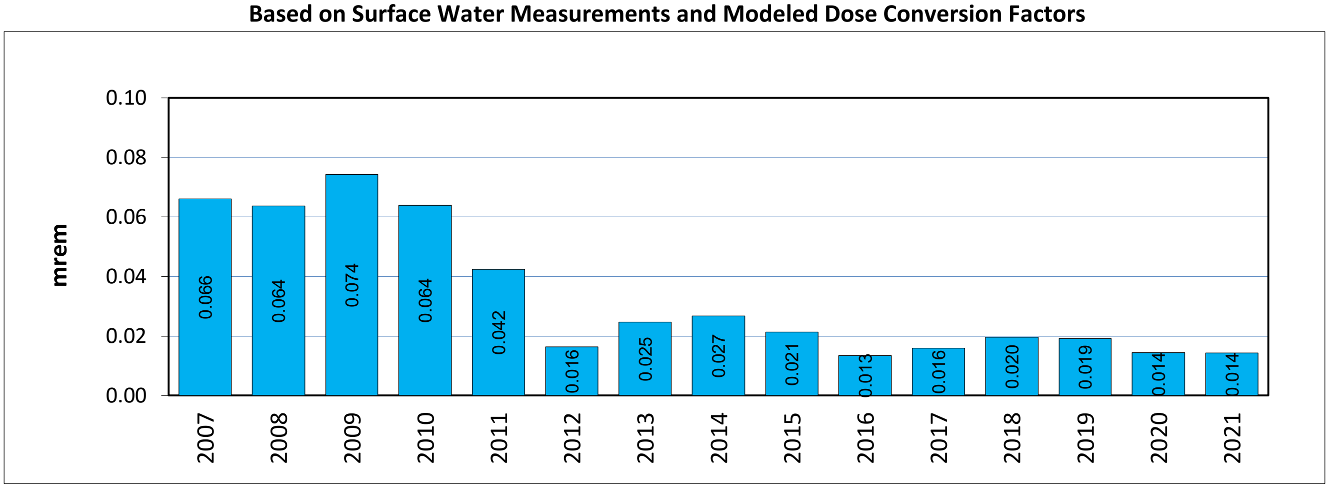
**FIGURE 3-5**
**Dose Percent by Radionuclide from Waterborne Releases in 2021**




The combined dose to the MEOSI from liquid effluents (0.0024 mrem) and natural drainage (0.012 mrem) was 0.014 mrem (0.00014 mSv). This annual dose is very small in comparison to the 100-mrem DOE annual limit from all sources. (These data are summarized on Table 3-2.)

Figure 3-6 shows the model-estimated dose from the water pathway over the past fifteen years. The estimated waterborne dose has decreased as a result of both the reduced volume of industrial process water being discharged from lagoon 3 since approximately 2014 and from decreasing strontium-90 concentrations in the WNSWAMP natural drainage due to installation of the passive groundwater treatment wall in 2010.

**FIGURE 3-6**
**Historical Waterborne Dose**
**Based on Surface Water Measurements and Modeled Dose Conversion Factors**



## Using Dose Conversion Factors To Estimate Waterborne 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 water samples by multiplying the curies of each radioisotope released annually by their respective UDFs, and summing the dose contribution from each isotope.

Radiological impacts were calculated by the models in terms of doses to the MEOSI and to the general population living within an 80-kilometer radius of the WVDP (collective population dose).

Site-specific average surface water flow rates for the potentially impacted streams are included in the input parameters to the model. Liquid effluents are assumed to reach surface waters via travel to Erdman Brook, Franks Creek, Buttermilk Creek, Cattaraugus Creek (the first potential source of off-site dose), and finally Lake Erie, approximately 40 kilometers (25 miles) west of the WVDP. Cattaraugus Creek flows into Lake Erie near its eastern end about 45 kilometers (28 miles) southwest of Buffalo.

Cattaraugus Creek serves as a water recreation area for swimming, canoeing, and fishing. Exposure pathways include consumption of game fish from Cattaraugus Creek, ingestion of meat and plant food products, as well as external exposure to sediment and water from swimming and boating. No potable water is drawn from Cattaraugus Creek downstream of the WVDP before it discharges into Lake Erie and no exposure to drinking water is included in the dose to the MEOSI.

The collective dose to the population within 80 kilometers of the site is estimated for exposure by consumption of fish and potable water from Lake Erie primarily, but also includes exposure from other radiological pathways such as from the use of Lake Erie water for irrigation. Consumption of potable water from Lake Erie is included in the population dose estimate since there is a drinking water exposure pathway from the lake. (Additional details are provided in the “Manual for Radiological Assessment of Environmental Releases at the WVDP,” WVDP-065, revision 7, 2018.)

**Cattaraugus Creek at Felton Bridge - the nearest public access outside the WNYNSC property**

### 2021 Collective Population Dose (Waterborne)

The collective dose to the population living within 50 miles (80 km) of the WVDP from the site effluents plus the north plateau drainage was 0.074 person-rem (0.00074 person-Sv), a very small fraction of the 503,000 person-rem annual collective population dose from natural sources.

## Dose From Air and Water Pathways

The total estimated potential dose from the WVDP in 2021 is a combination of a dose from air exposure based on measurements from the ambient air monitoring network and a modeled dose from water exposure.

### 2021 Total Dose (Air and Water)

Table 3-2 summarizes the dose from both the air and water exposure pathways. The potential dose to the public from both airborne and liquid effluents released from the Project in 2021 was <0.56 mrem (<0.0056 mSv), <0.55 mrem from the air pathway, plus 0.014 mrem from the water pathway. This dose is <0.56% of the 100-mrem (1-mSv) annual limit in DOE Order 458.1.

Table 3-3 presents the total curies released to air and water from all sources at the WVDP. The air total is computed from measured air concentrations at the on-site stacks and from estimated diffuse sources such as the evaporation from the lagoons and facility demolition. The water total is computed from measured concentrations of controlled surface water discharges and natural drainage. Excluding radon (Rn-220), Table 3-3 shows that in 2021 the total curies released to surface water was greater than the total curies released to the air.

In 2021, the total collective dose to the population within 50 miles (80 km) of the site was <0.56 person-rem (<0.0056 person-Sv), <0.48 person-rem from air exposure plus 0.074 person-rem from water exposure.

**TABLE 3-2**
**Summary of Annual Total Effective Dose Equivalents (EDEs) to an Individual and From WVDP Releases in 2021**

| *Exposure Pathways* | *Annual Individual Dose* | | | *Estimated Collective Population Dose* [b] *(1,622,050 people live within 80 km)* |
|---|---|---|---|---|
| | *Critical Receptor/MEOSI* [a] | *Comparison to EPA and DOE Standards* | *Comparison to Natural Background Radiation* | |
| **Airborne Releases**[c] | | | | |
| Total Airborne Dose (measured at the ambient air ring) | **<0.55 mrem** (<0.0055 mSv) | <u><5.5%</u> of 10 mrem EPA standard for air (0.1 mSv) | <u><0.18%</u> of 310 mrem (3.1 mSv) Natural Background Radiation | **<0.48 person-rem** (<0.0048 person-Sv) |
| **Waterborne Releases**[d] | | | | |
| Total Waterborne Dose (effluents and natural drainage) | **0.014 mrem** (0.00014 mSv) | *There are no EPA or DOE dose standards for the water only pathway.* | <u>0.0046%</u> of 310 mrem (3.1 mSv) Natural Background Radiation | **0.074 person-rem** (0.00074 Person-Sv) |
| **Total From All Pathways** | **<0.56 mrem** (<0.0056 mSv) | <u><0.56%</u> of 100 mrem DOE standard for air and water combined (1 mSv) | <u><0.18%</u> of 310 mrem (3.1 mSv) Natural Background Radiation | **<0.56 person-rem** (<0.0056 person-Sv) vs. the Background Population Dose of 503,000 person-rem[e] |

[a] The critical receptor applies to the airborne dose. The MEOSI applies to the waterborne dose.
[b] The 80-km collective dose is the sum of all doses to all indvidual members of the public within 80 km of the WVDP. A population of 1.62 million is estimated to reside in the U.S. and Canada within 50 mi (80 km) of the site.
[c] Releases are from atmospheric nonradon point and diffuse sources.
[d] Dose calculated according to "Manual for Radiological Assessment of Environmental Releases at the WVDP" (CHBWV, 2018).
[e] The background population dose = 1.62 million x 0.310 rem (from natural sources) = approximately 503,000 person-rem.

**TABLE 3-3**
**WVDP Radiological Dose and Release Summary**

| Total Annual Dose for CY 2021 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Critical Receptor / MEOSI | | | Population | | | | | |
| Potential Dose to the Maximally Exposed Off-site Individual (from all WVDP Sources) | | % of DOE 100-mrem Limit | Population Within 50 Miles[a] of the WVDP (2010 census) | Potential Estimated Population Dose (from all WVDP Sources) | | Estimated Population Dose (from Natural Sources) (310 mrem/yr x population) | | % of Natural Sources |
| <0.56 (<0.0056) | mrem (mSv) | <0.56% | 1,622,050 | <0.56 (<0.0056) | person-rem (person-Sv) | 503,000 (5,030) | person-rem (person-Sv) | <0.00011% |

| WVDP Radiological Atmospheric Emissions[b] CY 2021 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) |
| 1.84E-03 (6.80E+07) | NA | NA | NA | 8.16E-05 (3.02E+06) | 3.06E-05 (1.13E+06) | 2.34E-03 (8.66E+07) | 5.07E-06 (1.87E+05) | 1.91E-05 (7.09E+05) | 5.32E-05 (1.97E+06) | 1.10E+03 (4.05E+13) |

| WVDP Liquid Effluent Releases[d] of Radionuclide Material - CY 2021 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 |
| 1.49E-02 (5.50E+08) | 2.31E-03 (8.55E+07) | 5.20E-05 (1.92E+06) | 7.98E-02 (2.95E+09) | 1.81E-04 (6.68E+06) | 6.00E-06 (2.22E+05) | 2.35E-06 (8.70E+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 U.S. census) plus the Canadian population (from the 2011 Canadian census) residing within a 50-mi (80-km) radius.
[b] Air releases are from point and diffuse sources.
[c] Total uranium (airborne) (g) = 2.96E-02, 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) = 1.60E+02.

Radioactivity in the human pathway represented by these data illustrate that the WVDP contributes only a very minor dose to the natural background radiation dose that individuals and the nearby WVDP population receive.

## Calculated Dose from Food Samples

As an independent check of the total dose estimates presented earlier in this chapter, the dose from local food consumption is estimated based on actual food samples collected near the WVDP.

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.) Ingestion Dose Conversion Factors (DCFs) for radionuclides measured in food have been developed by DOE for use at DOE sites to convert measured radioactivity concentrations in food into dose. The ingested radioactivity in food multiplied by these DCFs provides the estimated maximum potential dose from the food only pathway. (Note: The estimated dose from the food pathway for 2021 uses the DCFs from DOE/EH-0071. The DCFs for the radioisotopes used in the food dose provided in DOE/EH-0071 are very similar to, and more conservative than the more recent DCFs for these isotopes for ingested water in DOE-STD-1196-2011 and ingested water and milk in DOE-STD-1196-2021.)

Radioactivity measurements in food from locations near the site are also compared with similar measurements from food samples collected at background locations to the WVDP. Near-site results are statistically compared with background results.

### 2021 Estimated Dose from Food

Radionuclide concentrations in near-site milk and venison samples collected in 2021 were statistically indistinguishable from concentrations in background samples collected in the western New York area (sampling locations shown on Figure A-14).

The conservative dose estimate for 2021 from food is 0.099 mrem/year (0.00099 mSv/year) based on consuming near-site deer, fish, milk, beans, corn, and apples. This estimate assumes the individual consumes the maximum quantities of each food item. This estimate uses concentrations measured in deer and milk samples collected in 2021 and concentrations in fish and vegetables sampled in 2017 (collected every five years). This dose from consuming food raised near the WVDP is a very small fraction of the 620 mrem/year dose received by an average individual due to natural and man-made sources. (See Figure 3-1, "Comparison of Doses from Natural and Man-Made Sources to the Dose from 2021 WVDP Effluents.")

This independent estimate of dose from the food only pathway helps confirm the low calculated doses based on air and water effluents, as summarized in Table 3-2. Both dose estimates are well below the 100 mrem public dose limit.

## Risk Assessment

High doses of radiation are known to cause cancer in humans. There has been considerable research in recent years to evaluate cancer risk due to low doses of radiation. A risk assessment is performed each year in order to determine the cancer risk based on the estimated maximum potential dose from WVDP activities for the current year.

Estimates of cancer risk from ionizing radiation have been presented by the National Council on Radiation Protection and Measurements (NCRP) (1987) and the National Research Council's Committee on Biological Effects of Ionizing Radiation (BEIR 1990 and 2005). (See inset box for the "BEIR VII Cancer Risk Study" on the following page.) The Interagency Steering Committee on Radiation Standards (ISCORS, 2002) and DOE guidance estimate that the probability of fatal cancer occurring from exposure to radioactivity is between one and six cancer cases per 10,000 people who are each exposed to one rem (i.e., a risk coefficient of between 0.0001 and 0.0006).

### 2021 Estimated Cancer Risk

According to the BEIR VII cancer risk study, approximately 42 of 100 people will be diagnosed with cancer not related to radiation exposure in a lifetime. (See additional details on this study on the following page.)

The estimated cancer risk in 2021 to an individual residing near the WVDP from airborne and waterborne releases can be calculated by multiplying the predicted dose from all pathways (<0.56 mrem or <0.00056 rem in 2021) by the probability of fatal cancer from radiation of six persons per 10,000 people per rem. This computes to a cancer risk of 34 cases per 100,000,000. This is more than six orders of magnitude lower than the cancer risk not related to any radiation exposure of 42 cases per 100 people.

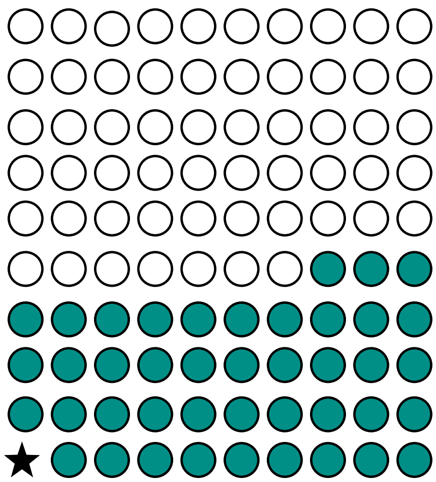
## Biological Effects of Ionizing Radiation (BEIR) VII Cancer Risk Study

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 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 and continues to be debated.

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 in the figure at left. 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 <0.56 mrem from WVDP operations in 2021 is almost five orders of magnitude lower than 10,000 mrem.

The potential risk from <0.56 mrem represents a fraction so small that it could not be seen if plotted as a fraction of the star on the BEIR VII Cancer Risk Study graphic at left.

**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 2021 was <0.56 mrem.

## Dose to Biota

Radionuclides from both natural and man-made sources may be found in environmental media such as water, sediments, and soils. Radiological controls sufficient to protect humans may not adequately protect other living things 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 Order 458.1 requires protection of the local biota from potential adverse effects due to WVDP releases of radioactivity to the environment and has established a methodology and dose rate limits to assist in this evaluation. A description of the biota dose standard is provided in the inset box "Biota Dose Modeling Methodology using RESRAD". The technical standard, DOE-STD-1153-2002, "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota" was streamlined and reissued in early 2019 as DOE-STD-1153-2019, of the same title.

The RESRAD-BIOTA model was run using WVDP site-specific input concentrations of surface water, soil and sediment to output the annual dose to various categories of aquatic and terrestrial animals and plants. The current year's surface water data and multiple years' soil and sediment data are used in the model. The exposure pathways for terrestrial plants and for aquatic, riparian, and terrestrial animals are built into the model.

The model uses Biota Concentration Guides (BCGs) to convert measured concentrations in environmental media to dose to the biota. BCGs are defined as the maximum concentration of a radionuclide in soil, sediment, or water that would not result in an exceedance of the protective dose limit for aquatic and terrestrial biota.

The methodology for estimating dose to biota involves comparing measured radioactivity in the environment with modeled concentrations at which known dose effects have been predicted to specific plants and animals.

Doses were assessed for compliance with the DOE standard presented in DOE-STD-1153-2019, Table 2.2:

1.0 rad/d for aquatic animals;
0.1 rad/d for riparian animals;
1.0 rad/d for terrestrial plants and
0.1 rad/d for terrestrial animals.

(Note that the absorbed dose unit [rad] is used for biota instead of the units used for indicating human risk [rem]).

## 2021 Biota Dose Modeling Results

The WVDP followed the DOE guidance recommended in DOE-STD-1153-2019 for evaluating biota protection using a graded (tiered) approach. The maximum potential biota dose was first modeled using the maximum current year measured radionuclide concentrations from surface waters, sediments, and soils. The resulting dose exceeded applicable limits for both aquatic and terrestrial evaluations in 2021.

The biota dose model was then run using estimates of average measured radionuclide concentrations derived from measurements in site-wide surface waters, sediments, and soils. Average concentrations more closely represent actual environmental conditions. The resulting dose using average concentrations were below limits and are summarized in Table 3-4.

Table 3-4 shows that at the site-specific screening level, the sums of fractions for the aquatic and terrestrial evaluations were 0.26 and 0.56, respectively, with the higher dose occurring in the terrestrial system. The 2021 results are very similar to 2020.

**TABLE 3-4**
**2021 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 | 2.13 | 4.99E-02 | 3,130 | 4.98 | 1.59E-03 | 0.051 |
| **Strontium-90** | 279 | 47.6 | 1.71E-01 | 583 | 19.6 | 3.37E-02 | 0.204 |
| **All Others** | NA | NA | 4.50E-04 | NA | NA | 5.38E-04 | 0.001 |
| **Sum of Fractions** | | | 2.21E-01 | | | 3.58E-02 | **0.26** |
| Estimated upper bounding dose to an aquatic animal = **0.0057 rad/day**; to a riparian animal = **0.026 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 | 2.13 | 3.55E-06 | 20.8 | 4.46 | 2.15E-01 | 0.215 |
| **Strontium-90** | 54,500 | 47.6 | 8.73E-04 | 22.5 | 7.69 | 3.42E-01 | 0.343 |
| **All Others** | NA | NA | 1.63E-06 | NA | NA | 1.48E-04 | 0.00015 |
| **Sum of Fractions** | | | 8.78E-04 | | | 5.57E-01 | **0.56** |
| Estimated upper bounding dose to a terrestrial plant = **0.0042 rad/day**; to a terrestrial animal = **0.056 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.

**This red fox, an example of a terrestrial animal, was observed near the site in 2021.**

Cesium-137 and strontium-90 are shown on Table 3-4 because these two isotopes contribute the largest component of both aquatic and terrestrial dose to biota based on air and water monitoring data at the WVDP.

The populations of organisms most sensitive (most likely adversely affected) to strontium-90 and cesium-137 via the aquatic and terrestrial pathways were riparian animals (such as the raccoon [aquatic dose]) and terrestrial animals (such as the woodchuck [terrestrial dose]). Populations of both animals are found on the WNYNSC.

The sum of fractions for both the aquatic and terrestrial evaluations was less than 1.0, indicating that applicable BCGs were not exceeded, and therefore populations of aquatic and terrestrial biota (both plants and animals) on the WNYNSC are not being exposed to doses in excess of DOE standards.

## Biota Dose Modeling Methodology using RESRAD

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-1153-2019, February 2019), are used to evaluate radiation doses to aquatic and terrestrial biota within the confines of the WNYNSC, which includes the WVDP.

RESRAD-BIOTA® (version 1.8, April 2016), a calculation tool provided by DOE for implementing the technical standard, is 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.

Soil, sediment and surface water concentrations are input to the model. Average and maximum concentrations are needed. Data were taken from surface water samples obtained from the current sampling year. Data for multiple years are used for the soil and sediment. In 2007, the soil and sediment sampling frequency was changed from annually to every five years. Therefore, for 2021, the most recent sediment samples included samples collected from 2005–2007, 2012 and 2017 and the most recent routine on-site surface soil sampling includes samples collected from 1995–2007, 2012 and 2017. Historical on-site surface soil sampling data from several special projects was 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 radionuclide 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-STD-1153-2019 if the sum of fractions for the water medium plus that for the sediment medium is less than 1.0. (Note, this sum of fractions methodology converts a concentration to dose in the same manner as the NESHAP sum of fractions methodology explained earlier in this chapter). 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.

## Dose Assessment Summary

Tables 3-2, 3-3, and 3-4 summarize radiological dose and release information for 2021.

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 well 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 2021 estimated dose (<0.56 mrem [<0.0056 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.

The collective population dose was also assessed and found to be orders of magnitude below the natural background radiation dose.

Biota dose estimates indicated that populations of plants and animals at the WVDP are only exposed to a fraction of DOE standards for dose to biota.

The estimated risk to an individual residing near the WVDP from airborne and waterborne releases is well below the range considered by the ICRP to be a reasonable risk for any member of the public.

Based on the overall dose assessment, the WVDP was found to be in compliance with applicable effluent radiological guidelines and standards during 2021.

### 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.

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. These requirements for scrap metal management remained unchanged at the WVDP in 2021. The moratorium and suspension currently remain in effect and the WVDP remains in compliance with the Secretary of Energy's suspension of unrestricted release of scrap metal from radiological areas of DOE facilities for recycling.

In a March 2021 memorandum, the DOE Associate Under Secretary for Environment, Health, Safety and Security authorized the DOE to use the American National Standard Institute (ANSI)/Health Physics Society (HPS) N13.12-2013, *Surface and Volume Radioactive Standards for Clearance* screening levels as the pre-approved Authorized Limits for Release and Clearance of Volumetric Radioactivity of Personal Property. Pursuant to DOE O 458.1, the DOE Field Element Manager (DOE-WVDP) is the approving authority for use of pre-approved Authorized Limits at a site or for a DOE activity. Any changes to limits approved by the DOE-WVDP must be documented and made available to the public. Currently, the WVDP has not elected to employ this option to make a change to the site requirements for release of potentially contaminated scrap metal.

No unrestricted release of potentially radiologically contaminated scrap metal or other material of this type has occurred from the WVDP.

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# CHAPTER 4

# GROUNDWATER PROTECTION PROGRAM

The primary objectives of the Groundwater Monitoring Program (GMP) are to identify, delineate, and monitor groundwater migration pathways that could transport contaminants off site and to support mitigative actions. 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," (Change 4) and the RCRA §3008(h) Administrative Order on Consent.

## 2021 Highlights

Groundwater sampling data from 2021 continues to show that the most widespread area of groundwater contamination at the WVDP is the well-defined strontium-90 plume on the north plateau. The Permeable Treatment Wall (PTW) installed in 2010 continues to remove strontium-90 from this groundwater plume as it passes through the wall.

On the south plateau, previously identified areas of localized groundwater radiological and chemical contamination continue to be present with concentrations generally decreasing, stable, or increasing slightly as shown by the contaminant concentration trend graphs presented in this chapter. The 2021 monitoring results for the NDA on the south plateau also show that measures implemented to reduce water migrating toward and into the NDA, and to collect groundwater migrating outward from the NDA have proven to be effective, thus reducing the potential for groundwater contamination to move beyond the NDA.

The WVDP GMP currently includes sampling and analysis for analytes that the EPA recently identified as emerging contaminants of concern (e.g., 1,2,3-trichloropropane [TCP] and 1,4-dioxane). There have been no detections of these contaminants since 2007, and all detections prior to 2007 were at estimated concentrations below the method detection limits. No historical records indicate these compounds were used or produced at the WVDP. Sampling for per- and polyfluoroalkyl substances (PFAS) was performed on the drinking water supply wells in 2021. No PFAS were detected. The discussion of PFAS is provided in Chapter 2 under the drinking water program.

No new areas of groundwater contamination were observed in 2021 and no significant changes to the GMP were deemed necessary.

## Groundwater Monitoring Program (GMP) Introduction and Background

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 GMP is structured to meet these requirements.

The GMP is also designed to support the requirements of the RCRA §3008(h) Administrative Order on Consent as well as define the Project's approach for groundwater protection from site activities. The GMP describes a groundwater monitoring well network designed to monitor groundwater conditions in subsurface geologic units that represent potential routes of contaminant migration. The geologic units are described on the following page in the "Geology and Hydrogeology" section of this chapter. Compliance with the Consent Order and the conclusions in the RFI reports require routine monitoring of certain analytes at specified groundwater monitoring locations.

**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.

The S&G unit only exists on the Project's north plateau and consists of two subunits: the thick-bedded unit (TBU) and the slackwater sequence (SWS). 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 4-1 for the geographic distribution and additional description of these units.

**Groundwater Use.** Since 2014, two bedrock water supply wells, WNDWELL 1 and WNDWELL 2, have been used to provide the site's primary water supply. (See Figure A-8.) 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. Samples for drinking water quality parameters are routinely collected with results provided to the Cattaraugus County Health Department (CCHD). Site groundwater in shallow, unconsolidated geologic units is not used for drinking or operational purposes, nor is WVDP effluent discharged directly to groundwater. Drinking water data is discussed in Chapter 2.

The majority of groundwater migrating across the site 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.

## 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 4-1. In CY 2021, groundwater samples were collected from 66 on-site, routine groundwater monitoring locations, including 60 monitoring wells and well points, five groundwater seepage points, and one trench sump (NDATR). (See Figures A-9 and A-10 in Appendix A.) Many of the wells are located to monitor releases from one or more of the SWMUs or Super SWMUs (SSWMUs) on site per the RCRA §3008(h) Consent Order. Table 4-2 lists the monitoring locations in the routine groundwater monitoring network, the geologic units monitored, and the analytes measured in CY 2021. Table 4-3 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 4-4 and 4-5 provide an overview of groundwater monitoring performed during CY 2021, organized by geographic area and monitoring purpose.

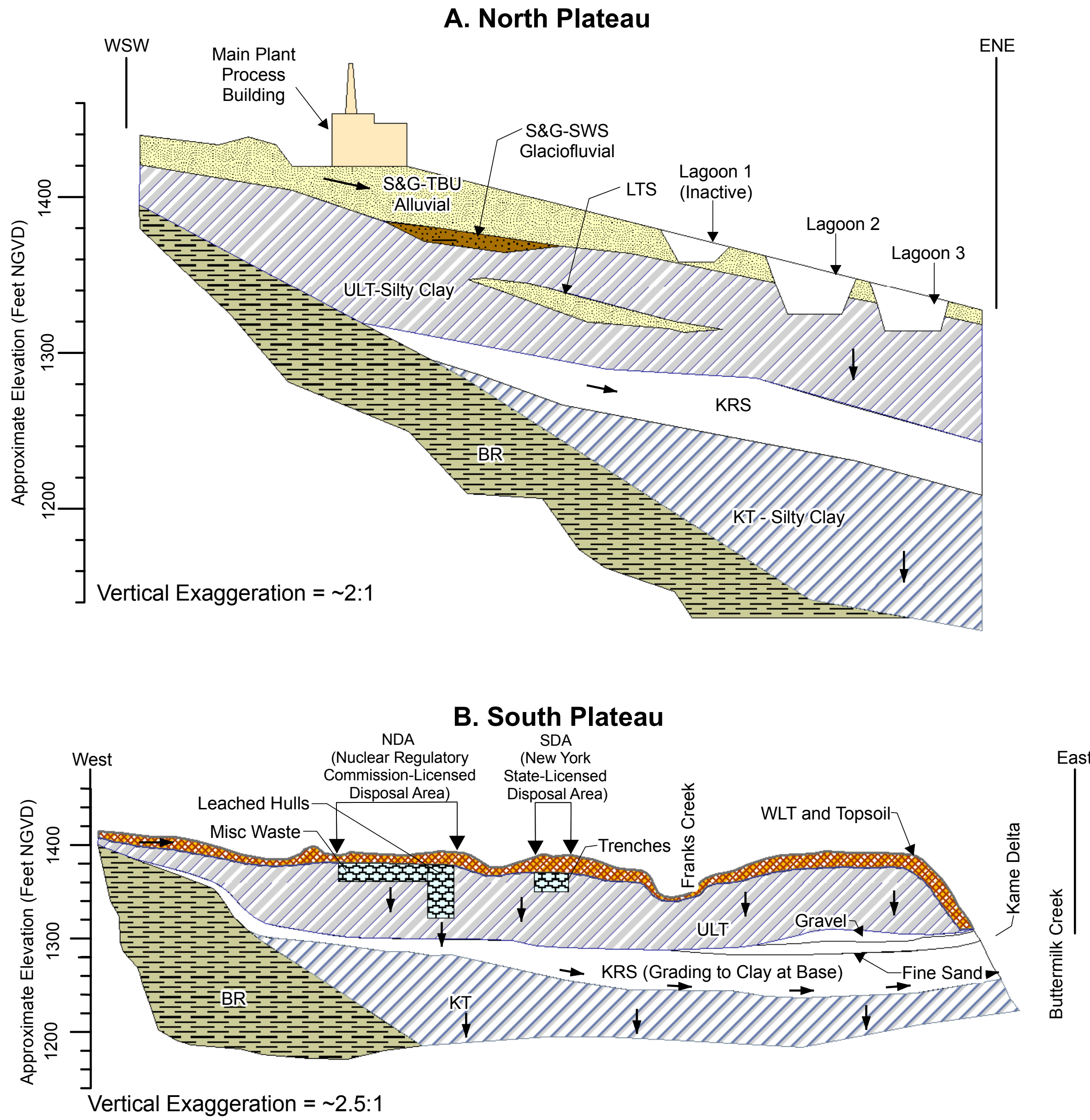
Supplemental groundwater monitoring programs are also implemented for evaluation of the effectiveness of the PTW in treating the north plateau strontium-90 groundwater plume and general plume surveillance discussed later in this chapter. (See inset "Permeable Treatment Wall [PTW] for Strontium-90 Remediation" on Permeable Treatment Wall [PTW] for Strontium-90 Remediation.)

**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 map groundwater flow directions and gradients. Long-term trend graphs are used to evaluate 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 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 NDA.")

**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)* | |

**TABLE 4-1**
**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 | The hydraulic head gradient slopes to the east-southeast. The LTS is a confined unit. | 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 1987 to 2012 conductivity testing results.

**TABLE 4-2**
**WVDP Groundwater Monitoring Network Sorted by Geologic Unit**

| *Well ID* | *SSWMU* | *Gradient Position* | *Analyte Group (See Table 4-3)* | *Well ID* | *SSWMU* | *Gradient Position* | *Analyte Group (See Table 4-3)* |
|---|---|---|---|---|---|---|---|
| **Sand and Gravel Wells** | | | | | | | |
| 103[a] | 1, 3 | D | I, RI, V | 802 | 8 | D | I, RI, V |
| 104 | 1 | C | I, RI | 803[a] | 8 | D | I, RI, SV, V |
| 105 | 1 | C | I, RI | 804[a] | 8 | D | I, RI, V |
| 106 | 1 | D | I, RI | 1302[b] | NA | U | I, RI, M, |
| 111[a] | 1 | D | I, RI, M, SV, V | 1304[b] | NA | D | I, RI, M, R |
| 116[a] | 1, 8 | C, U | I, RI, V | 8603 | 8 | U | I, RI |
| 205 | 2 | D | I, RI | 8604 | 1 | C | I, RI |
| 301[a] | 3 | B, U | I, RI | 8605[a] | 1, 2 | D | I, RI, M, SV, V |
| 302 | 3 | U | I, RI | 8607[a] | 4, 6 | D, U | I, RI, V |
| 401[a] | 3, 4 | B, U | I, RI, R | 8609[a] | 3, 4, 6 | D, D, U | I, RI, S, V |
| 402 | 4 | U | I, RI | 8612[a] | 8 | D | I, RI, SV, V |
| 403 | 4 | U | I, RI | MP-01[a,c] | 3 | D | I, RI, M, R-MP, SV, V, T |
| 406[a] | 4, 6 | D, U | I, RI, R, V | MP-02[a,c] | 3 | D | I, RI, M, R-MP, SV, V, T |
| 408[a] | 3, 4 | D | I, RI, R, V | MP-03[a,c] | 3 | D | I, RI, M, R-MP, SV, V, T |
| 501[a] | 5 | U | I, RI, S, V | MP-04[a,c] | 3 | D | I, RI, M, R-MP, SV, V, T |
| 502[a] | 5 | D | I, RI, S, V | SP04[d] | NA | NA | RI |
| 602A | 6 | D | I, RI | SP06[d] | NA | NA | RI |
| 604 | 6 | D | I, RI | SP11[d] | NA | NA | RI |
| 605 | 6 | D | I, RI | SP12[a,d] | 8 | D | I, RI, V |
| 706[a] | 7 | B, D | I, RI, M | GSEEP[a,d] | 8 | C, D | I, RI, V |
| 801[a] | 6, 8 | D, U | I, RI, S, 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 4-3**
**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 4-4**
**2021 Groundwater Monitoring Overview by Geographic Area** [a]

| *Number of…* | *Total* | *North Plateau* | *South Plateau* |
|---|---|---|---|
| Monitoring Points Sampled - Analytical | 66 | 52 | 14 |
| Monitoring Events | 4 | 4 | 4 |
| Individual Analytical Results | 7,444 | 6,294 | 1,150 |
| Percent of results below detection limits [b] | 88% | 87% | 95% |

[a] Does not include PTW performance monitoring.

[b] Parameters where detection limits are not applicable (i.e., pH, conductivity, and turbidity) were omitted from this statistic.

**TABLE 4-5**
**2021 Groundwater Monitoring Overview by Monitoring Purpose** [a]

| *Number of…* | *Total* | *Regulatory/Waste Management* [c] | *Environmental Surveillance* [c] |
|---|---|---|---|
| Monitoring Points Sampled - Analytical | 66 | 38 | 28 |
| Monitoring Events | 4 | 4 | 4 |
| Individual Analytical Results | 7,444 | 6,546 | 898 |
| Percent of results below detection limits [b] | 88% | 91% | 66% |

[a] Does not include PTW performance monitoring.

[b] Parameters where detection limits are not applicable (i.e., pH, conductivity, and turbidity) were omitted from this statistic.

[c] Regulatory compliance/waste management wells are sampled as directed by the RFI. All other wells are considered environmental surveillance wells.

## Routine Groundwater Data Evaluation Methodology

**Groundwater Trigger Level Evaluation.** A computerized data-screening program uses "trigger levels," which are preset conservative values for chemical and radiological concentrations and groundwater elevation measurements, to promptly identify anomalies (exceptions) in monitoring results that may require further investigation. The trigger levels are statistically derived from historical results at each sampling location. The trigger level evaluation also considers regulatory criteria and 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 in a quarterly trend analysis report with recommended response actions. RCRA trigger level exceptions are reported to NYSDEC.

Trigger levels are periodically updated as more data is collected over time or after a period of time following physical changes (e.g., caps or slurry walls), that can influence the monitoring data. Groundwater trigger levels for selected chemical and radiological constituents were last recalculated in November 2020.

**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 (e.g., regulatory limits, guidance limits, or background). Methods used to develop the GSLs are discussed in detail in Appendix D.

## Routine North Plateau Groundwater Sampling

The monitoring well network on the north plateau provides detection monitoring capabilities for potential and existing chemical and radiological contaminant sources. This includes areas of previously detected contamination such as the CDDL and lagoon 1. The focus of radiological groundwater monitoring is the north plateau strontium-90 plume.

Elevated gross beta activity has been observed in groundwater from the S&G unit, the shallowest geologic unit on the north plateau, since 1993. The routine groundwater monitoring plan network for the S&G unit on the north plateau included 36 monitoring wells, and five groundwater seepage locations that delineate this gross beta contamination.


**Groundwater sampling**

Groundwater sampling data are compared to trigger levels every quarter. Sampling results above or below trigger levels are evaluated for increasing or decreasing trends in concentrations over time. Radiological concentrations in groundwater are also compared to Derived Concentration Standards (DCSs). 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 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.)

## 2021 Update for the North Plateau Groundwater Monitoring

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 (1994, 2010, and 2021) spanning 27 years. The 1994 isopleth shows the results of the subsurface characterization program that defined the outline of the recently discovered gross beta plume. The 2010 isopleth shows the furthest extent of the plume's northward migration prior to the installation of the PTW. The 2021 isopleth shows the current extent of the plume. Groundwater flows from southwest to northeast across the north plateau.

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 plume has migrated toward the PTW, but has not continued to migrate past the wall. Overall, the portion of the plume that is shown downgradient of the PTW is due to gross beta activity that had previously migrated past the location of the PTW prior to its installation. However, in 2021, higher than usual specific conductivity and gross beta concentrations have been observed inside and immediately downgradient of the wall. The leading edge of the plume 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.

Figure 4-2 also shows that for 2021 the 1.0E-06 µCi/mL gross beta isopleth in the eastern lobe no longer extends beyond the PTW. The lobes on the downgradient side of the PTW have been decreasing in overall concentration due to being diluted by lower-activity treated groundwater that exits from the PTW's downgradient side.

Gross beta concentration trends over the last 10 years at monitoring wells located within the plume are shown on Figures 4-3 through 4-6. 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.

Special focused monitoring is performed for the downgradient portion of the plume and for the PTW. A description of the PTW installation and the former North Plateau Groundwater Recovery System (NPGRS) is provided in the insert box titled "Permeable Treatment Wall (PTW) for Strontium-90 Remediation."

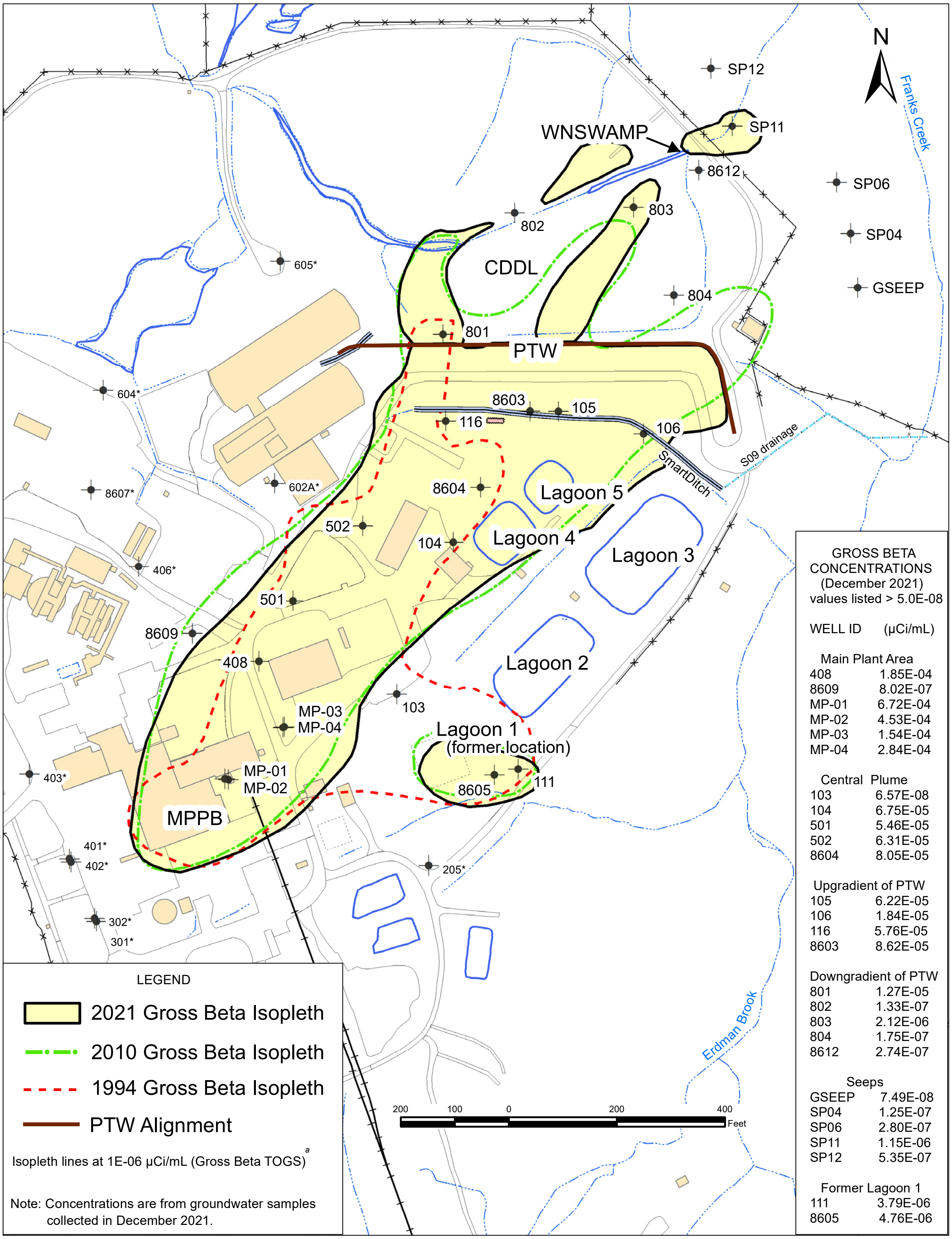
**Groundwater sampling at the WVDP**

## Emerging Contaminants of Concern

In recent years, there has been increasing regulatory interest in emerging contaminants of concern which may be present in the environment, particularly in drinking water supplies. WVDP groundwater and surface water monitoring has included analysis for some of these chemicals, such as 1,2,3-trichloropropane [TCP] and 1,4-dioxane. No detections of either contaminant has been observed since mid-2007. Prior to 2007, there were only a few positive detections of these constituents and all were at estimated concentrations below the contract detection limits.

However, adjacent to the site, 1,4-dioxane is frequently found in SDA trench leachate. This is due to the unique waste buried in the SDA that is not all from waste generated at the Project. Recently, there has been increasing interest in monitoring the environment for PFAS. In 2021, the WVDP groundwater wells that supply the drinking water for the site were sampled for PFAS. The PFAS sampling is discussed in Chapter 2 under the drinking water program.

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

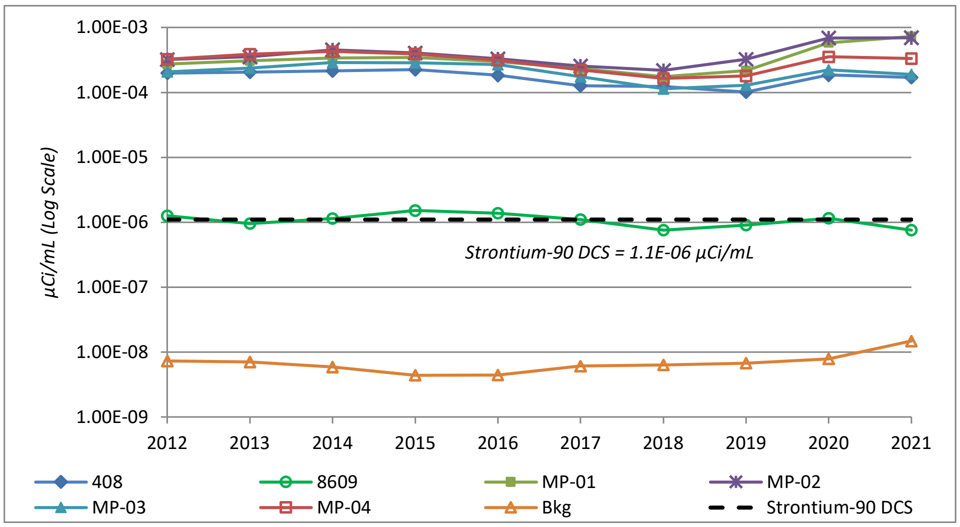



J:/GIS/ArcMap/ASER/ASER_2021/ASER_2021_Fig4-2_Plume_20211111.mxd, 3/7/2022 afs

[a] Gross beta isopleths primarily reflect GMP sampling results supplemented with NPGMP and PTWPMP sampling results. The 2021 data for the GMP wells with higher gross beta concentrations are tabulated on this figure. The 2021 data for all of the GMP wells are provided in Appendix D, including the data for the wells with lower gross beta concentrations that are labeled with an asterisk (*) on the map.

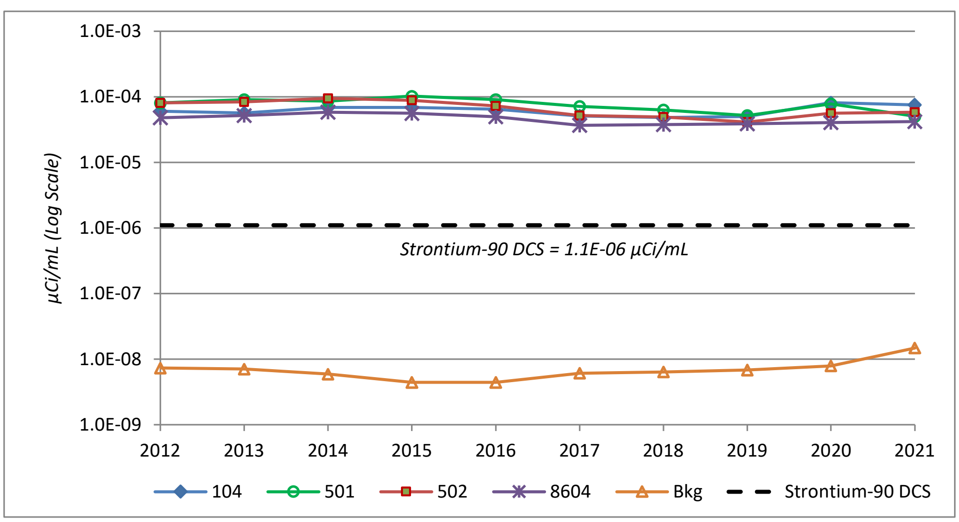
**Monitoring the Central Area of the Plume.** Figure 4-3 illustrates the annual average gross beta concentrations in groundwater wells located immediately downgradient of the MPPB, the strontium-90 source area, and along the western edge of the plume (at well 8609). Well 408 and the four MPPB wells (MP-01, -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 8.93E-04 µCi/mL in September 2021, shown in Appendix D-2) of any routinely monitored wells in the GMP. The 2021 gross beta concentrations at these wells fluctuated over the year. The annual average concentrations in wells MP-01 and MP-02 were higher than in 2020, and those of wells MP-03 and MP-04 were lower than in 2020, as shown by the graph. Well 408 generally increased in concentrations from March through December of 2021, but the overall average concentration was slightly lower than in 2020. Figure 4-4 illustrates gross beta concentrations in wells 104, 501, 502, and 8604 which are centrally located within the plume area. The annual average gross beta concentrations in this area decreased at wells 104 and 501, and increased in wells 502

**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**

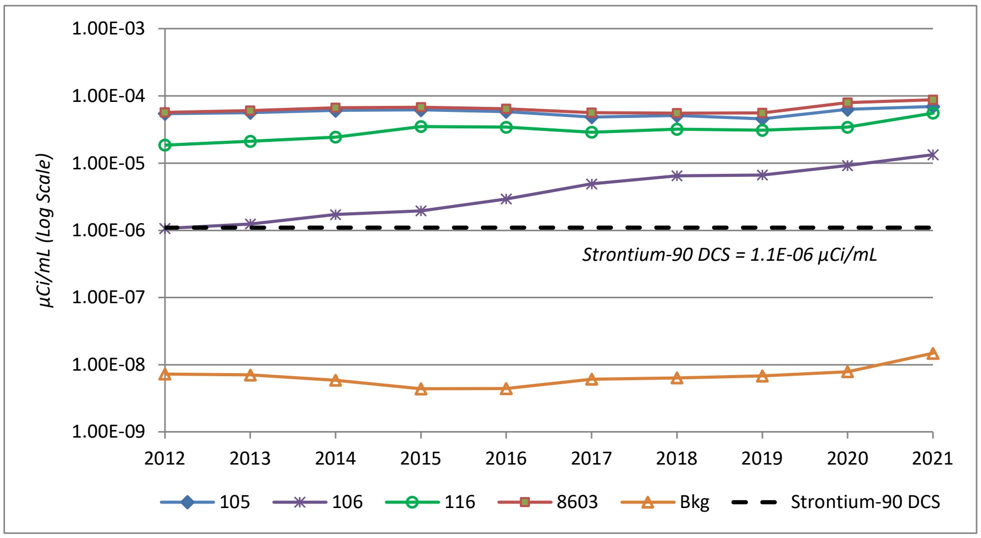



Note: S&G background (Bkg) wells 301, 401, 706, and 1302 are averaged for this comparison.

and 8604, in 2021, when compared with 2020. Historically, gross beta concentrations frequently fluctuate with changes in groundwater elevation and increase as migration from the source area continues. Removal of facilities and changes in groundwater chemistry due to the material used to deice the roads and parking lot may also be affecting the groundwater monitoring results. These and other potential causes for the recent increases in gross beta at these wells are continuing to be evaluated.

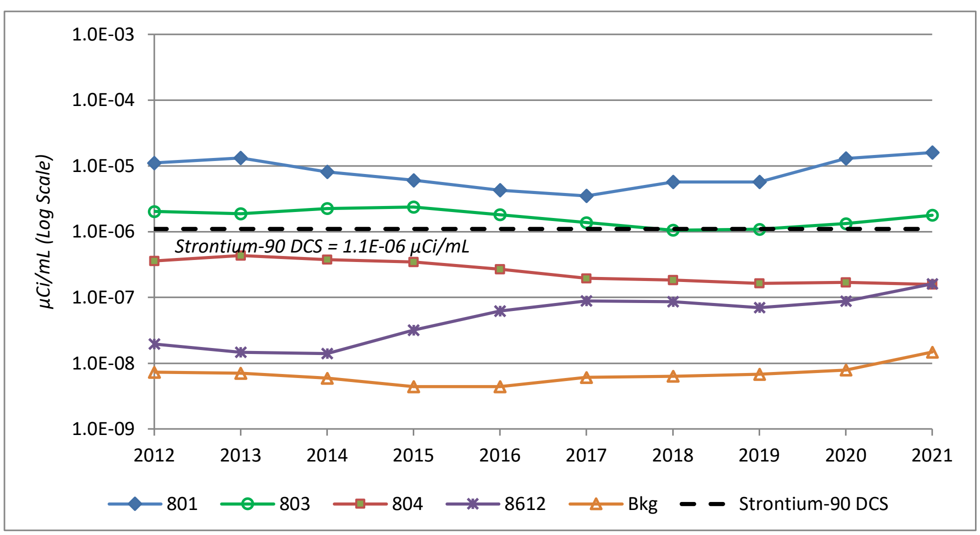
**Monitoring Upgradient and Downgradient of the PTW.** Figure 4-5 illustrates gross beta concentrations at monitoring wells 105, 106, 116, and 8603, upgradient of the PTW. The annual average gross beta concentration at well 106, where the most noticeable migration towards the PTW has occurred over the last several years, showed the second largest increase in 2021. Wells 105 and 8603 had slightly higher average concentrations compared to 2020.

**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.

## Permeable Treatment Wall (PTW) for Strontium-90 Plume Remediation

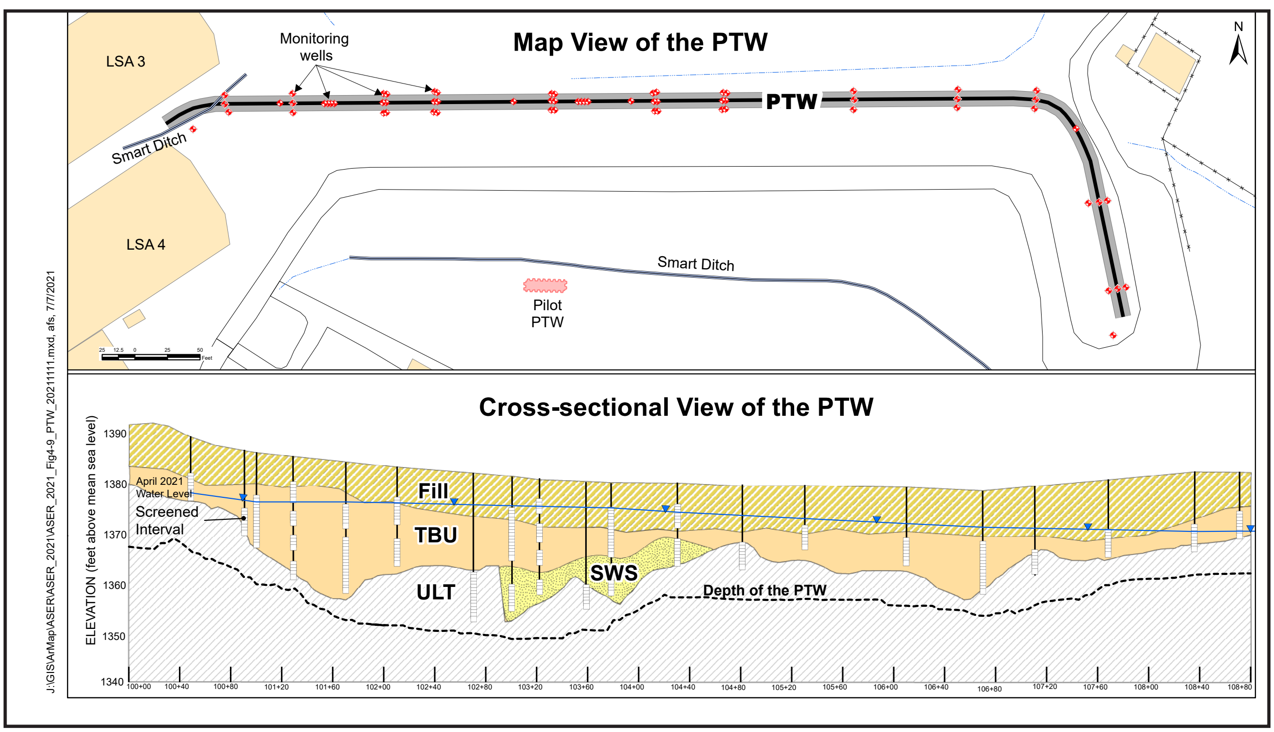
In November 2010, an 860-ft-long full-scale PTW was installed to treat the north plateau strontium-90 plume. The PTW has operated now for over eleven full years. The overall average concentrations of strontium-90 immediately downgradient of the PTW are lower than they were when the wall was installed 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 4-7.

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, including strontium, by ion exchange 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 Derived Concentration Standards (DCSs) found in DOE-STD-1196-2011.);
- 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.

**FIGURE 4-7**



## Permeable Treatment Wall (PTW) for Strontium-90 Plume Remediation *(continued)*

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 groundwater treated by the PTW begins to reach these downgradient areas. North plateau monitoring shows evidence of treated groundwater exiting the PTW downgradient of the wall with significantly lower strontium-90 concentrations than were observed at the time of PTW installation. A pilot-scale PTW, constructed in 1999, helped determine that the PTW technology was an effective remediation method for strontium-90 contaminated groundwater.

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 nonsource area of the plume, including the PTW, will be evaluated as part of the Phase 2 decisionmaking process for the WVDP and the WNYNSC.

In 1995, the NPGRS was installed to slow the advance of the strontium-90 plume. Based on groundwater plume mitigation provided by the PTW, the NPGRS was shut down in April 2013. Closure of the NPGRS was completed in 2018 in accordance with SPDES closure requirements. This included decommissioning the groundwater recovery wells. During the summer of 2021, the PTW soil containment structure was removed. This was a wood containment structure supported by concrete buttresses and steel piling used to store the soils that were excavated during the installation of the PTW. The soils and demolished structure were packaged in railroad cars and shipped off site for disposal in a permitted landfill facility. The area was then graded and reseeded.

**PTW Performance Monitoring Plan (PTWPMP).** Following construction of the full-scale PTW in 2010, 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. The annual monitoring event, performed in April, includes sampling of additional wells and parameters not sampled quarterly.

**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 includes quarterly gross beta sampling at 26 well locations and water level measurements at 40 well locations performed concurrent with the PTWPMP. Data from these wells supports the development of groundwater elevation contour maps and gross beta isopleth maps. The PTWPMP and NPGMP strontium-90 data is used with the GMP data to delineate the plume in Figure 4-2. However, these data are not reported in the ASER.

**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 road-salt ions will compete with the strontium-90 for removal in the PTW), storm water management via the upgradient Smart-Ditch™, and routine inspections.

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 footprint of 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 2021 annual average gross beta concentration increased at wells 801, 803, and 8612, and decreased at well 804. At well 801, immediately downgradient of the PTW, recent data suggests performance may be starting to decline in local areas. Less treated groundwater appears to be exiting the PTW near this well than was observed from 2014 to 2018, resulting in concentrations in this area returning to pre-2012 levels. Some changes in groundwater geochemistry have also been observed, prompting an investigation of deicing material usage. As noted in the previous section, these recent increases are continuing to be evaluated.

Continued monitoring will determine whether gross beta concentrations decrease over time as more treated groundwater migrates out of the PTW.

**PTW Performance.** Performance monitoring data collected to date, including data collected for the 2021 annual monitoring event, indicate the following:

- groundwater flow patterns in the PTW area are similar to flow patterns observed prior to PTW construction, indicating that the PTW installation has not substantially altered groundwater flow.

- the PTW continues to prevent the migration of strontium-90 activities above 10,000 pCi/L past the wall (with the exception of one strontium-90 result in one well during April 2021 with subsequent results in July and October 2021 below 10,000 pCi/L);

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

- increasing concentrations of cations and anions in the groundwater in 2021 may be altering the ionic strength of the groundwater flowing through the PTW and may affect its performance (additional data continues to be collected to help evaluate whether increasing sodium and chloride from road salt may be increasing the solubility of some minerals in groundwater which may compete with strontium-90 for ion exchange sites in the PTW zeolite);

- elevated strontium-90 activity has been detected in zeolite wells that previously were nondetect or at much lower concentrations. These wells are frequently downgradient of wells with elevated strontium-90 concentrations upgradient of the PTW. The levels currently observed inside the PTW suggest that, for some locations, the groundwater needs to migrate further into the zeolite before being sorbed onto a cation exchange site;

- strontium-90 activity in groundwater immediately downgradient of the PTW is overall less than upgradient levels;

- strontium-90 activity that had already migrated past the PTW prior to its installation is continuing to be detected downgradient; and

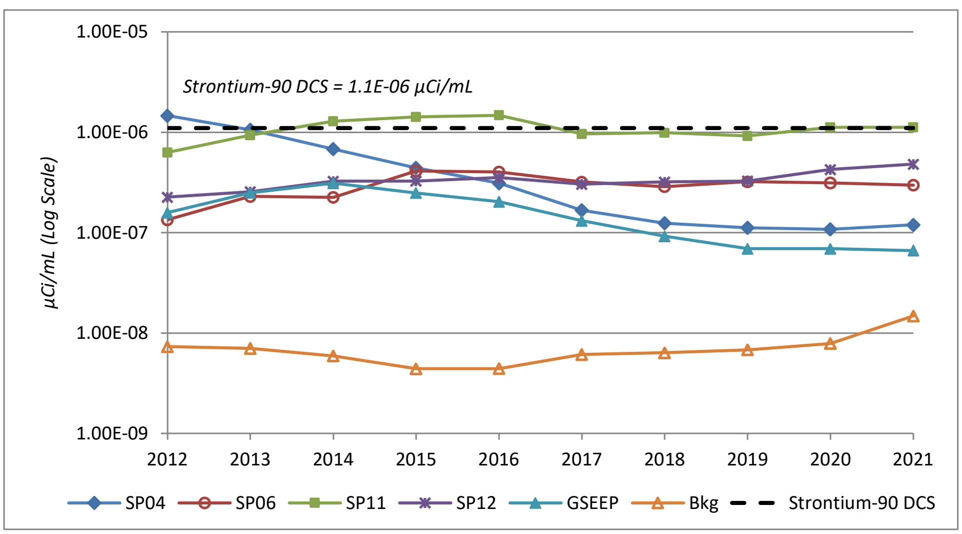
- strontium-90 concentrations in some wells downgradient of the PTW are decreasing as treated groundwater flows towards these areas;

These observations indicate the ongoing processes within the PTW continue to achieve the RAOs defined in the PTWPMP and shown in the previous section. Evaluation of the current performance of the PTW is ongoing to ensure the PTW continues to meet the RAOs.

**Monitoring at the 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. (See Figure 4-8 below.)

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

**FIGURE 4-8**
**Annual Average Gross Beta Concentrations at Seeps From the Northeast Edge of the North Plateau**




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

installed and continued for some time following installation as shown by the ten-year trend graphs of gross beta concentrations at these five seep monitoring points.

The gross beta concentrations in the north plateau plume have been demonstrated to be approximately 50% strontium-90 and 50% its daughter product yttrium-90. Therefore, to compare the gross beta results shown in Figure 4-8 to the strontium-90 DCS, the gross beta values should first be divided by two.

The data show that the strontium-90 DCSs were not exceeded at any of the seep locations in 2021. Annual average concentrations at seeps SP06 and GSEEP, decreased slightly and SP04, SP11, and SP12 increased slightly during 2021 compared with 2020.

**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. These waters ultimately flow into Franks Creek. (See Figure 4-2.)

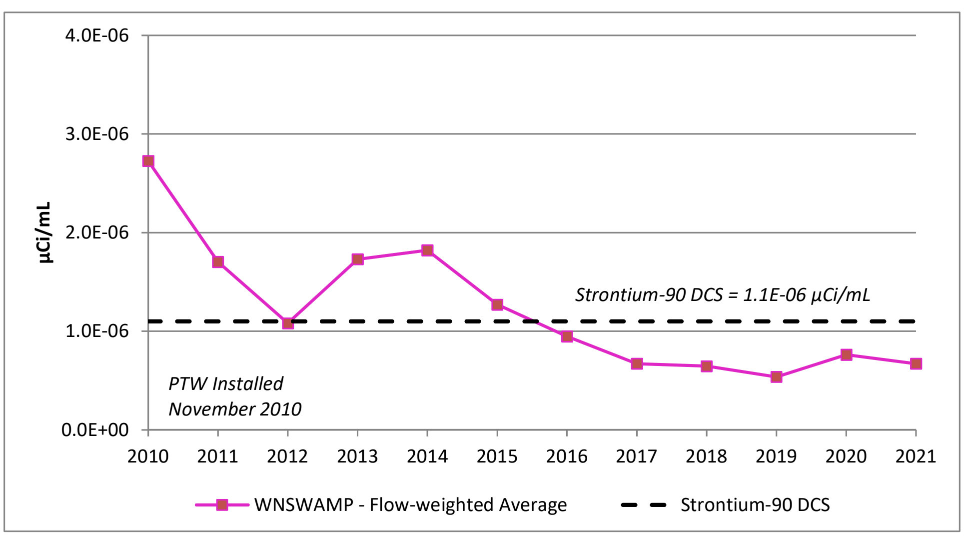
Totalized flow through the drainage ditch is recorded biweekly. Surface water samples are collected biweekly and analyzed for radiological constituents at sampling location WNSWAMP located at the WVDP project boundary. North plateau plume groundwater seeping into this ditch is considered to be the source of the strontium-90 activity at WNSWAMP. Total flow in 2013 and 2014 was lower than usual, ranging from 14 to 16 million gallons per year, resulting in a higher flow weighted average. Approximately 28.0 million gal (106 million L) of water flowed through this monitoring point in 2021, which is closer to the typical annual volume. (See "Water Monitoring Program" in Chapter 2.)

Strontium-90 concentrations at WNSWAMP have been generally decreasing since 2010 when the PTW was installed, with some annual variability, as shown on Figure 4-9. There was a slight decrease in the annual average strontium-90 concentration in 2021.

The flow-weighted annual average plotted on this graph uses the volume of water flowing down the ditch during the month sampled to proportionally weight the measured monthly concentrations. Historically, both the monthly flow volume and the strontium-90 concentrations at WNSWAMP exhibit seasonal fluctuations in response to changes in precipitation and groundwater elevation. The method for computing a flow-weighted annual average is provided in Chapter 2.

The annual average strontium-90 concentrations at WNSWAMP have been below the DCS since 2016. The strontium-90 released through WNSWAMP and WNSW74A accounted for an annual estimated dose of 0.014 mrem in 2021 to an off-site individual on Cattaraugus Creek at Felton Bridge, the first downstream location accessible to the public. (See "2021 Maximum Waterborne Dose to an Off-Site Individual" in Chapter 3.)

**FIGURE 4-9**
**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.

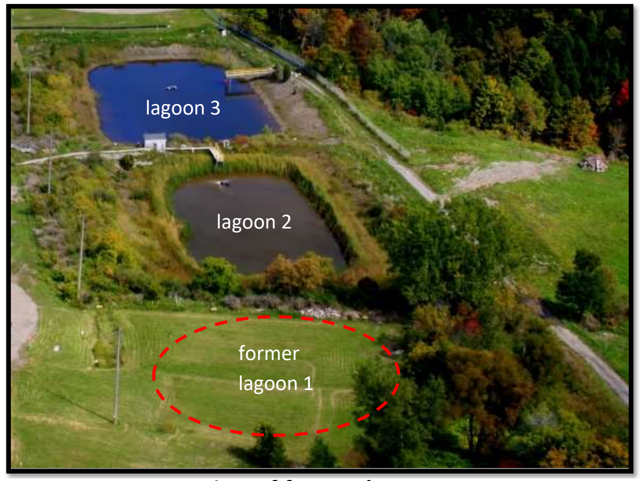
Monitoring of surface water on Cattaraugus Creek downstream of the seeps and WNSWAMP drainage ditch at the first point of public access (sampling location WFFELBR) continued to show that strontium-90 concentrations in 2021 were similar to historical concentrations from the Cattaraugus Creek background surface water sampling location at Bigelow Bridge (WFBIGBR). (See Table B-4I.) The annual average strontium-90 concentration at WFFELBR in 2021 was a nondetect.

**Monitoring Radiological Indicators 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. (The location of lagoon 1 is shown by the aerial photograph at right.)

Gross beta concentrations in wells 8605 and 111 have been consistently above the strontium-90 DCS and are remaining relatively stable from year to year. (See Figure 4-10.)

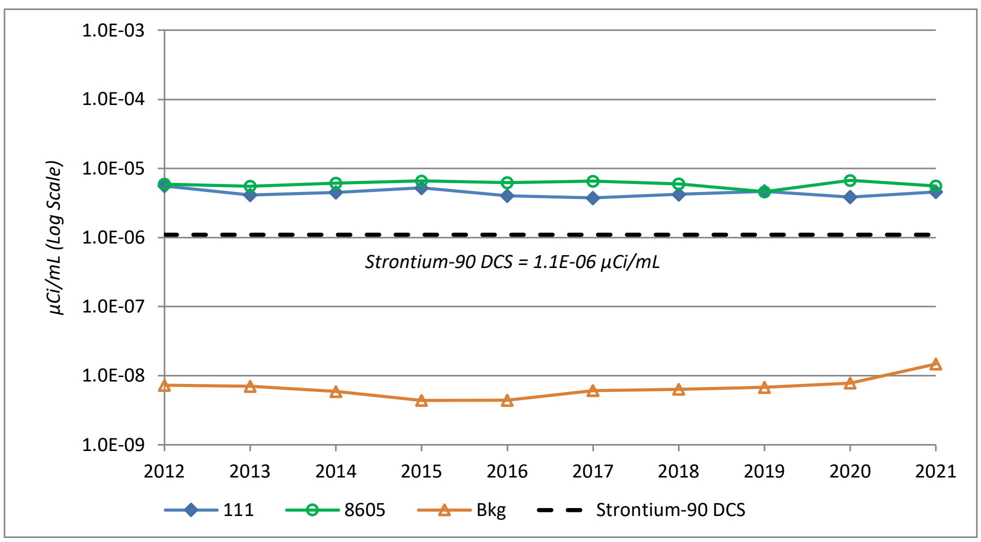
As shown in the 10-year trend graph, the annual average gross beta concentrations at well 111 increased slightly in 2021 compared with 2020 and decreased slightly at well 8605.

The source of the gross beta activity is assumed to be the radiologically contaminated material used as backfill and the residual sediment within former lagoon 1. The former lagoon 1 soils will be removed as part of the lagoon system closure under Phase 1.




**Location of former lagoon 1**

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




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

**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, a fission product of the nuclear power fuel cycle, observed in site groundwater is due to residual tritium in the nuclear fuel that was reprocessed on the site by NFS.

As shown in Table 4-6 below, the maximum tritium concentration measured in groundwater from the north plateau in 2021, 3.86E-07 µCi/mL, occurred at well 106, north of lagoon 3. (See Figure A-9 for the well location.) This concentration was a decrease from the 2020 maximum result and was approximately four orders of magnitude below the DCS for tritium of 1.9E-03 µCi/mL. Overall, the well 106 tritium concentrations have been decreasing for more than 20 years.

**Tritium in South Plateau Groundwater.** Tritium is also observed at relatively low concentrations at well 909, downgradient of the NDA as shown in Table 4-6. The concentrations at this well have not changed significantly in the past few years and remain four orders of magnitude below the DCS for tritium of 1.9E-03 µCi/mL. Further discussion of radiological conditions at the NDA can be found in the section titled Groundwater Sampling on the South Plateau Including the NDA

**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 4-2 and 4-3.) Table 4-6 presents the maximum radionuclide concentrations measured during 2021. (This table includes both north plateau and south plateau wells [discussed in a later section]).

The MPPB wells (MP-01, -02, -03, and -04) are analyzed for the following additional radioisotopes to evaluate their presence in groundwater 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 additional isotopes were detected in the MPPB wells during 2021. (See complete data in Appendix D-2, Table D-2G. Results for wells 909 and NDATR are discussed under the south plateau.)

**TABLE 4-6**

**2021 Maximum Concentrations of Radionuclides [a] in Groundwater at the WVDP Compared With WVDP Groundwater Screening Levels [b] (GSLs)**

| *Radionuclide* | *Regulatory Compliance [c]* | | | *Environmental Surveillance [c]* | | | *GSL (µCi/mL)* |
|---|---|---|---|---|---|---|---|
| | *Well ID With Maximum Concentration* | *Flag [d]* | *Maximum Concentration (µCi/mL)* | *Well ID With Maximum Concentration* | *Flag [d]* | *Maximum Concentration (µCi/mL)* | |
| Tritium | 909 | | **7.17E-07** | 106 | | **3.86E-07** | 1.78E-07 |
| Strontium-90 | MP-01 | | **4.15E-04** | – | | **–** | 5.90E-09 |
| Technetium-99 | MP-03 | | **1.85E-08** | 1304 | | **6.72E-09** | 5.02E-09 |
| Iodine-129 | 909 | | **9.64E-09** | – | | **–** | 9.61E-10 |
| Radium-226[e] | 406 | | **1.94E-09** | 1304 | J | 3.34E-10 | 1.33E-09 |
| Radium-228[e] | 401 | | 1.20E-09 | – | | – | 2.16E-09 |
| Uranium-233/234[e] | NDATR | | **1.66E-09** | – | | – | 6.24E-10 |
| Uranium-235/236 | NDATR | | **1.23E-10** | – | | – | 8.07E-11 |
| Uranium-238[e] | NDATR | | **1.21E-09** | – | | – | 4.97E-10 |
| Total Uranium[e] (µg/mL) | NDATR | | **4.08E-03** | 1304 | | 5.02E-04 | 1.34E-03 |

Note: Bolding indicates that the radionuclide exceeds the GSL.

- indicates that none of the wells in the relevant group (regulatory/environmental) exhibited positive results for these radionuclides.

[a] The table presents the maximum concentrations of radionuclides 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] Regulatory compliance wells are sampled as directed by the RFI. All other wells are considered environmental surveillance wells.

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

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

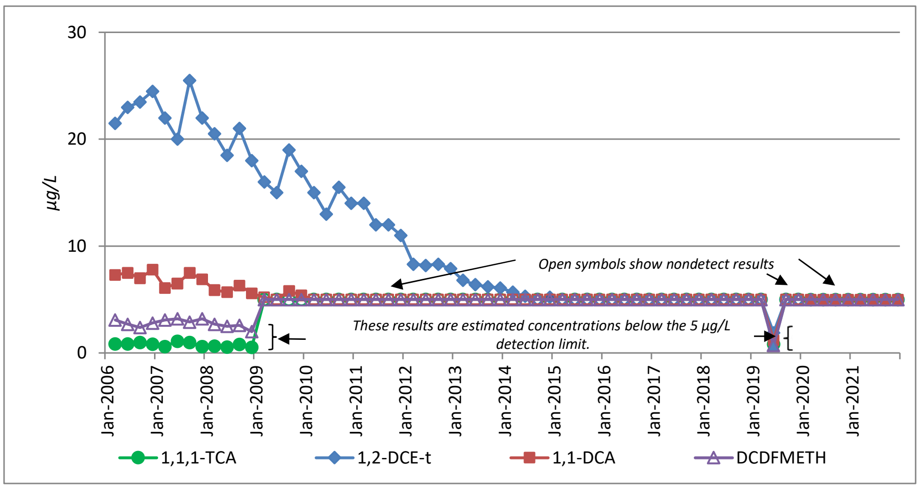
**Results for Volatile and Semivolatile Organic Compounds (VOCs and SVOCs).** Per the 3008(h) Consent Order, select wells within the S&G unit are monitored for VOCs and SVOCs because concentrations of these compounds exceeding NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Class GA Groundwater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

The only S&G unit monitoring location with previously consistent positive VOC detections was well 8612, located northeast and downgradient of the CDDL. Figure 4-11 illustrates the concentration ranges of four VOCs historically detected at well 8612. None of these VOCs have been detected above the Practical Quantitation Limit (PQL) for over six years. 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.) The presence of TBP is thought to be caused by residual contamination from liquid waste management activities in the former lagoon 1 area during nuclear fuel reprocessing. A TOGS 1.1.1 water quality standard has not been established for TBP. There were no other organics above detection limits in 2021.

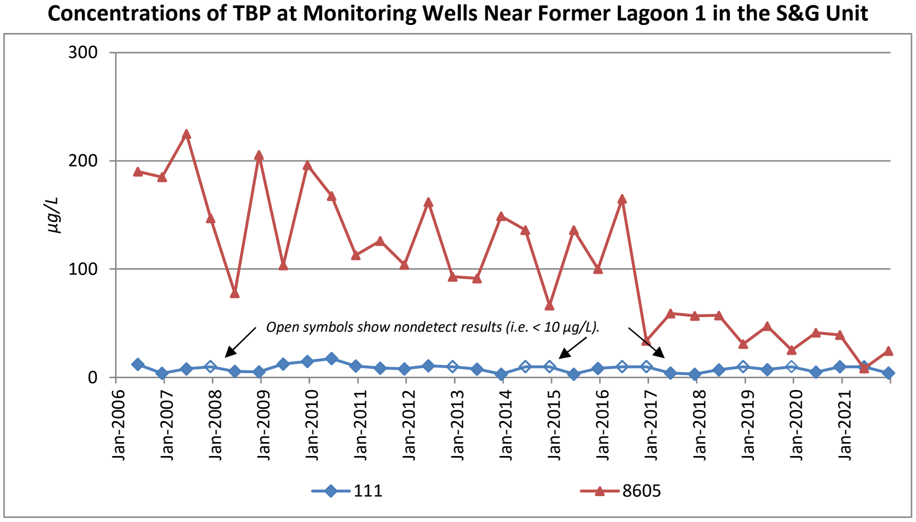
The maximum TBP concentration measured in 2021 (8.3 micrograms per liter [µg/L]) was significantly lower

**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**



than the historic high of 700 µg/L measured at well 8605 in December 1996. Overall concentrations of TBP at well 8605 are decreasing. Historically, TBP has also been detected in well 111, located near well 8605. During 2021, TBP was detected below the PQL (<10.0 µg/L) at well 111.

**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. None of the metals listed in 6 NYCRR 373-2 Appendix 33 have been determined to be associated with the strontium-90 plume.

During 2021, 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 2021 were arsenic, barium, chromium, mercury, and nickel. (See Table 4-7.)

The background concentration and the GSL of arsenic was exceeded by a very slight margin at well 909. The background concentration of barium was exceeded at wells 1304, MP-01, MP-02, and MP-03. These barium concentrations were all below the GSL. 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 GSLs in wells 405 and 706 as has been observed historically. 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 these wells in 2021 is believed to be due to corrosion of the stainless steel well screens. Chromium was also detected at well MP-01 at levels above both background and the GSL and mercury was detected at well MP-02 above both background and the GSL during 2021.

## Groundwater Sampling on the South Plateau Including the NDA

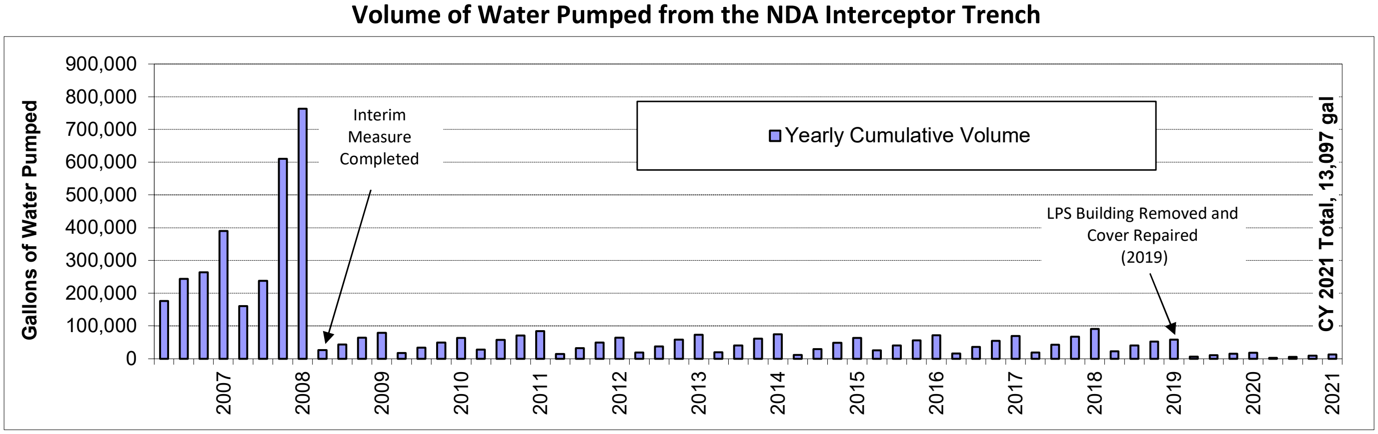
### Interim Measures (IMs)

In accordance with the RCRA §3008(h) Administrative Order on Consent, an IM including a trench system was constructed in 1990 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 LLWTF for processing.

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. In 2019, the Liquid Pretreatment System (LPS) in the north portion of the NDA was deactivated and removed, and a geomembrane patch was applied over the area and attached to the existing geomembrane cover. This improvement to the geomembrane coverage has resulted in a further reduction in the amount of water infiltration into the NDA.

The NDA is located on the south plateau and is adjacent to the SDA, which is owned and managed by NYSERDA. In 2021, NYSERDA installed an additional section of barrier wall, connected to the existing NDA barrier wall, northeast of the NDA, upgradient of SDA Trench 14, and extended their geomembrane cover northwest of SDA Trench 14 to further minimize water infiltration into the SDA.

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



## Update of NDA Interim Measure (IM) Monitoring and Effectiveness

In 2021, no organic constituents were found above detection levels 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.

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 2021 (13,100 gal [49,600 L]) was less than 25% of the volume in 2019, before the geomembrane patch, and less than one percent of the volume pumped in CY 2007, before the IM.

Water level data from piezometers installed to monitor the effects of the NDA IM indicate that the slurry wall and geomembrane cover are limiting the inflow of precipitation and groundwater to the NDA, causing the WLT to become dry in some areas. Refer to the "Environmental Compliance Summary" in this report for further discussion of the NDA IMs.

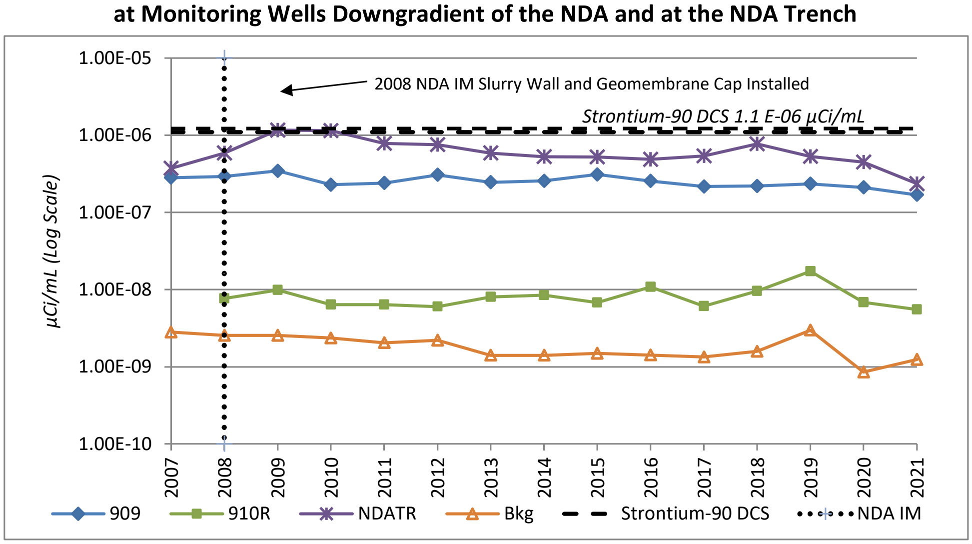
**Radioisotopic Sampling Results on the South Plateau.** Two sampling locations on the south plateau (well 909 and the NDA sump [NDATR]) are analyzed for specific radionuclides. (These sampling locations are shown on Figure A-10. Results are tabulated in Appendix D-2.)

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. Table 4-6 shows NDATR was the groundwater sampling location with the maximum uranium concentrations in 2021

Figure 4-14 shows gross beta concentrations at NDATR have decreased from the maximum observed concentration in September 2009 after the 2008 IM to below the gross beta GSL of 1.0E-06 µCi/L from 2013 through 2021, with the exception of one of the four quarterly gross beta results slightly above the GSL in December 2018. The gross beta 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. Gross beta concentrations have decreased overall since 2009. 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 2021 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 and Figure 4-13.)

**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.

WLT well 909 exhibited elevated gross beta, tritium, iodine-129 and strontium-90 concentrations above their respective GSLs during 2021, consistent with historical values, as shown in Table 4-6, Table 4-7 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.

## Groundwater Monitoring of Other WVDP Facilities and Processes

**Groundwater Monitoring Downgradient of the Waste Tank Farm (WTF).** Radioactive waste in the underground tanks was removed and solidified through the vitrification 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 the "Environmental Compliance Summary" in this report for additional information.) Throughout and subsequent to 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 migration of potential leaks from the tanks. The inward hydraulic gradient is maintained 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, and have typically been relatively low (below 6E-08 µCi/mL), although a few short-term fluctuations with higher gross beta activity have been noted. The maximum concentration of 1.50E-07 µCi/mL was measured in March of 2021, and was followed by three gross beta results that returned to the typical range. Low levels of gross beta activity have also been observed in the dewatering well and the tank 8D-2 pan.

**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. Sample results following installation of these wells in 2014 and subsequent years indicate that the Project's drinking water continues to remain below the local, state, and federal maximum contaminant levels (MCLs) and drinking water standards. In addition to monitoring the drinking water, three additional bedrock wells are sampled under the site's source water protection plan to provide further assurance that the bedrock groundwater is free of contamination. Analytical data for 2021 from these three wells, presented on Table B-5H, show that radiological indicator results (gross alpha and gross beta) are within site background concentrations.

## Groundwater Monitoring History

Highlights of the site groundwater monitoring history and the evolution of the GMP are summarized in Table 4-8 at the end of this chapter.

## Groundwater Protection Program Summary

Evaluation of groundwater sampling data from 2021 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. A full-scale PTW was installed in 2010 to reduce contaminant levels in the downgradient portions of the north plateau plume. Eleven years of post-installation monitoring results continue to indicate the PTW is removing strontium-90 from the groundwater passing through the wall. Although recent data suggests strontium-90 treatment performance may be starting to decline in localized areas, the overall PTW is continuing to function as designed.

Other localized areas of groundwater contamination are 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 relatively stable with minor fluctuations. Measures implemented at the NDA to reduce water infiltration and collect groundwater moving through the subsurface have proven to be effective, thus reducing 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 from 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 beneath the MPPB.

**TABLE 4-7**
**2021 Groundwater Monitoring Results Exceeding GSLs and Background Levels**

| ***Number of Locations exceeding GSLs[a] or Background[b]*** | | ***Geologic Unit (plateau)*** | ***Groundwater Sampling Location*** | | | | | |
|---|---|---|---|---|---|---|---|---|
| **RADIOLOGICAL PARAMETERS** | | | | | | | | |
| **Gross Alpha** | | | | | | | | |
| 2 > GSL | 3 > BKG | S&G (NP) | **111** | **8605** | | | | |
| | | WLT (SP) | NDATR | | | | | |
| **Gross Beta** | | | | | | | | |
| 19 > GSL | 40 > BKG | S&G (NP) | GSEEP | **104** | 302 | 706 | **8603** | **MP-01** |
| | | | SP04 | **105** | 401 | **801** | **8604** | **MP-02** |
| | | | SP06 | **106** | **408** | **802** | **8605** | **MP-03** |
| | | | **SP11** | **111** | **501** | **803** | 8607 | **MP-04** |
| | | | SP12 | **116** | **502** | 804 | 8609 | |
| | | | 103 | 205 | 605 | 1304 | 8612 | |
| | | WLT (SP) | NDATR | 909 | | | | |
| | | ULT (NP + SP) | 107 | 405 | 409 | | | |
| | | KRS (SP) | 902 | | | | | |
| **Tritium** | | | | | | | | |
| 10 > GSL | 10 > BKG | S&G (NP) | **105** | **8609** | **MP-02** | **MP-04** | | |
| | | | **106** | **MP-01** | **MP-03** | | | |
| | | WLT (SP) | **909** | | | | | |
| | | ULT (NP) | **108** | **110** | | | | |
| **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** | | | | | | | | |
| 2 > GSL | 2 > BKG | S&G (NP) | **1304** | **MP-03** | | | | |
| **Iodine-129** | | | | | | | | |
| 2 > GSL | 2 > BKG | WLT (SP) | **NDATR** | **909** | | | | |
| **Radium-226** | | | | | | | | |
| 2 > GSL | 2 > BKG | S&G (NP) | **401** | **406** | | | | |
| **Uranium-233/234[d]** | | | | | | | | |
| 3 > GSL | 3 > BKG | S&G (NP) | **408** | **MP-03** | | | | |
| | | WLT (SP) | **NDATR** | | | | | |
| **Uranium-235/236** | | | | | | | | |
| 1 > GSL | 1 > BKG | WLT (SP) | **NDATR** | | | | | |
| **Uranium-238[d]** | | | | | | | | |
| 2 > GSL | 2 > BKG | S&G (NP) | **MP-03** | | | | | |
| | | WLT (SP) | **NDATR** | | | | | |
| **Total Uranium[d]** | | | | | | | | |
| 5 > GSL | 5 > BKG | S&G (NP) | **408** | **MP-02** | **MP-03** | **MP-04** | | |
| | | WLT (SP) | **NDATR** | | | | | |

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

*(See complete footnotes on the following page.)*

**TABLE 4-7 (*concluded*)**
**2021 Groundwater Monitoring Results Exceeding GSLs and Background Levels**

| *Number of Locations exceeding GSLs [a] or Background [b]* | | *Geologic Unit (plateau)* | *Groundwater Sampling Location* | | | |
|---|---|---|---|---|---|---|
| **METALS** | | | | | | |
| **Arsenic** | | | | | | |
| 1 > GSL | 1 > BKG | WLT (SP) | **909** | | | |
| **Barium** | | | | | | |
| 0 > GSL | 4 > BKG | S&G (NP) | 1304 | MP-01 | MP-02 | MP-03 |
| **Chromium** | | | | | | |
| 3 > GSL | 3 > BKG | S&G (NP) | **706** | **MP-01** | | |
| | | ULT (NP) | **405** | | | |
| **Mercury** | | | | | | |
| 1 > GSL | 1 > BKG | S&G (NP) | **MP-02** | | | |
| **Nickel** | | | | | | |
| 1 > GSL | 2 > BKG | S&G (NP) | 706 | | | |
| | | ULT (NP) | **405** | | | |
| **ORGANICS** | | | | | | |
| **Tributyl phosphate (TBP)** | | | | | | |
| No TOGS[c] | 2 > DL[e] | S&G (NP) | 111 | 8605 | | |

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

Key:

BKG - Background
GSL - Groundwater Screening Level
DL - Detection Limit
NP - North Plateau
SP - South Plateau
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 (S&G) 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.

[e] These compounds were reported as estimated concentrations, below the quantitation limits.

**TABLE 4-8**
**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, West Valley Nuclear Services (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 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 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. |
| 2011-2021 | Groundwater monitoring continued from CY 2011 through 2021 per the GMP, the "North Plateau Groundwater Monitoring Plan," and the "North Plateau PTW Performance Monitoring Plan." There were no significant changes to the monitoring programs, no new groundwater monitoring wells were installed, and no active monitoring wells were decommissioned from 2011 through 2021. The NPGRS was shut down in 2013. The inactive NPGRS pumping wells were decommissioned in 2018. Sampling of WP-A, WP-C, and WP-H was discontinued after 2019. |

# CHAPTER 5
# QUALITY ASSURANCE

The Quality Assurance (QA) program at the WVDP provides for and documents consistency, precision, and accuracy in collecting and analyzing environmental samples and in interpreting and reporting environmental monitoring data.

### 2021 Highlights

Environmental sampling and laboratory analysis were performed in accordance with all applicable regulatory and WVDP site-specific QA/Quality Control (QC) requirements in 2021.

There were no significant audit findings under the DOE Consolidated Audit Program (DOECAP) for the laboratories and treatment, storage, and disposal facilities (TSDFs) that the WVDP contracted with during 2021.

The WVDP and its subcontract laboratories participated in the Mixed Analyte Performance Evaluation Program (MAPEP) and Discharge Monitoring Report Quality Assurance Study (DMR-QA) cross-check programs in 2021, with 97.9% of the results within acceptance limits.

## Environmental Data Quality Assurance (QA)/Quality Control (QC)

The WVDP implements a comprehensive environmental monitoring QA program that complies with all federal and NYS regulations, including:

- 10 CFR Part 830, Subpart A, "Quality Assurance Requirements;"
- DOE Order 414.1D, "Quality Assurance;"
- DOE Order 435.1, "Radioactive Waste Management;" and
- Nuclear Quality Assurance, Level 1 (NQA-1)-2008 with NQA-1a-2009 Addenda, "Quality Assurance Requirements for Nuclear Facility Applications."

### Environmental Sampling QC

**Field QC.** Special field QC samples are collected and analyzed to assess the sampling process. Duplicate field samples are used to assess sample homogeneity and sampling precision. Field and trip blanks (laboratory deionized water in sample containers) are used to detect contamination potentially introduced during sampling or shipping. Environmental background samples (samples of air, water, vegetation, venison, and cow milk taken from locations remote from the WVDP) are collected and analyzed to provide baseline information for comparison with on-site or near-site samples so that site influences can be evaluated.

**Calibration.** Equipment and other items affecting the quality of environmental data must be identified, inspected, calibrated, and tested before use. Calibration status must be clearly indicated and equipment must be re-calibrated on a routine schedule as appropriate.

**Documentation.** Records of all activities must be kept to document what was done and by whom. Records must be clearly traceable to an item or activity. Records such as field data sheets, chain-of-custody forms, requests for analysis, sample shipping documents, sample logs, data packages, training records, and weather measurements, in addition to other records in both paper and electronic form, are maintained as documentation for the environmental monitoring program.

## DOE Consolidated Audit Program (DOECAP)

DOECAP conducts annual qualification audits of analytical environmental laboratories and commercial waste Treatment Storage and Disposal Facilities (TSDFs) in support of DOE facilities using these services. Since 2019, the DOE has recommended the use of third-party accreditation to supplement traditional DOECAP audits where feasible, to provide DOE complex-wide efficiencies. Participation in DOECAP involves regular communications of complex-wide audit findings. Additional audits of laboratories and TSDFs may be performed by individual sites in order to provide the desired level of quality control and oversight.

CHBWV QA conducts a vendor assessment of each of the laboratories the WVDP contracts with by annual evaluations of the DOECAP reports that ensure environmental sample analyses are performed using proven methods, and provide valid, reliable, and defensible data, in accordance with DOE Order 414.D. The WVDP assessment of all the waste disposal facilities used by the site includes an evaluation of the TSDF audit reports generated annually by DOECAP for performing their DOE O 435.1 annual acceptability reviews. Personnel from the CHBWV QA department participate on these audit teams on a rotational basis as do representatives from other DOE facilities thereby providing cost efficiencies by eliminating auditing redundancies.

QA assessments of laboratories for dosimetry and radiobioassay are not performed under the DOECAP accreditation program. Performance standards for these programs are implemented separately under the DOE Laboratory Accreditation Program (DOELAP). To maintain DOELAP accreditation for the CHBWV dosimetry program and for the subcontract laboratory's dosimetry program, audits are performed routinely by CHBWV per the applicable DOELAP standard.

## DOE Mixed Analyte Performance Evaluation Program (MAPEP) and EPA Discharge Monitoring Report Quality Assurance (DMR-QA)

The WVDP and its subcontract laboratories also participate 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.

## 2021 Quality Assurance Update

The WVDP maintained contracts in 2021 with the laboratories and TSDFs listed below. This list includes laboratories that analyze data for the waste management and safety departments as well as the laboratories used for environmental samples.

**Laboratories:**

ALS Environmental
Biotrax (subcontracted)*
Cattaraugus County Laboratory Services
EMSL Analytical, Inc.
Environmental Dosimetry Co. (ED)*
SGS North America, formerly Galson Laboratories
GEL Laboratories, LLC (GEL)*
Landauer, Inc.
New England Bioassay (subcontracted)*
Paradigm Environmental Services
Southwest Research Institute (SwRI)
Eurofins-Test America Laboratories (TA) *
Tri-Air Testing

*Note: The laboratories listed with an * were used in 2021 to analyze the 2021 environmental data.*

**TSDFs:**

Advanced Disposal of Western Pennsylvania
Energy Solutions
Perma Fix Inc.
Perma Fix of Florida
Waste Control Specialists

In 2021, a total of 20 environmental analytical laboratories were assessed under the DOECAP Accreditation Program.

The majority of the environmental samples presented in the ASER were analyzed by GEL, in Charleston, South Carolina, or Eurofins-Test America (TA), in Buffalo, NY. The TLDs were analyzed by Environmental Dosimetry (ED), in Sterling, Massachusetts and the WET testing was performed by New England Bioassay, in Manchester, Connecticut. Biotrax, in Buffalo, NY analyzed for coliform where required in some of the potable water samples.

The WVDP maintains on-site capabilities to perform limited radiological analysis of air and water samples. This capability provides analytical results needed for shipping samples off site and for evaluating anomalies, or investigating unique environmental circumstances. The analyses performed on site include quick turn-around-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, 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.

During 2021, CHBWV QA confirmed that none of the environmental laboratories or TSDFs utilized by the site had any findings reported by the complex-wide DOECAP accreditation program that would compromise the integrity of the environmental data presented in this report or in the disposal services provided.

As part of the WVDP worker protection program, two QA laboratory assessments were performed in November 2021, one internal audit of the CHBWV personnel dosimetry program and one external audit of the GEL radiobioassay program.

The internal audit involved an evaluation of the Landauer, Inc. laboratory for site personnel dosimetry badges. The external audit was a comprehensive triennial assessment of the bioassay program at GEL Laboratories. Both laboratories were approved for continued use.

**Laboratory Proficiency Testing**. The 2021 MAPEP and the DMR-QA study results are presented in Appendix G. These laboratory proficiency tests are summarized in Table 5-1 below, showing that 96.3% of the crosschecks performed in 2021 were acceptable.

**TABLE 5-1**
**Summary of Crosschecks Completed in 2021**

| Type | Number Reported | Number Within Acceptance Limits | Percent Within Quality Control Limits |
|---|---|---|---|
| Radiological | 79 | 76 | 96.2% |
| Nonradiological | 110 | 106 | 96.4% |
| All types | 189 | 182 | 96.3% |

**Equipment, Procedures and Reporting.** Additional integral components of the WVDP environmental monitoring QA program include:

- routine calibration and inspection of equipment and instrumentation;
- environmental procedure audits and self-assessments;
- independent validation of data packages received from the off-site laboratories; and
- peer review and verification of data summaries in all environmental reports.

These QA activities help to ensure the accuracy of the environmental data collected and reported at the WVDP.

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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) soil 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 of 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 approximately 310 mrem (3.1 mSv) from natural sources. (See the DOE dose ranges chart at the end of this chapter.) NCRP Report No. 160 (2009) estimated the average person also receives about 310 mrem [3.1 mSv] from medical procedures, consumer products, and other man-made sources. NCRP Report No. 184 (2019), an update of medical exposure section of NCRP Report No. 160, indicates there has been a 15-20% reduction in the nontherapeutic medical radiation dose to the U.S. population in the decade between 2006 and 2016, lowering the man-made estimate by about by approximately 80 mrem.

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

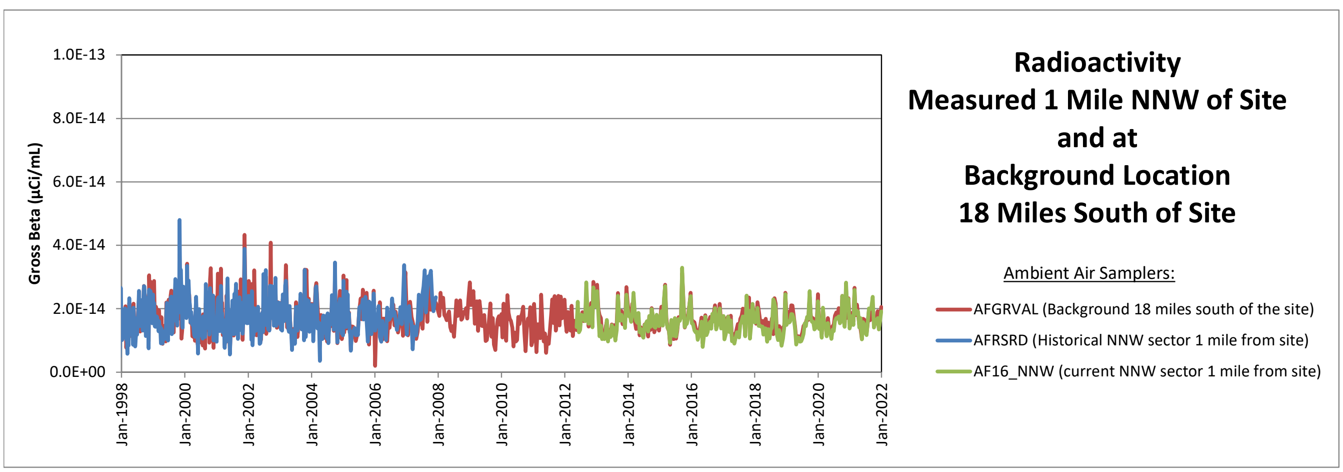
### CAP88-PC Computer Modeled Air Dose Estimates Versus Measured Air Dose Estimates

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 1.0E-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.



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.

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)[a] | mg/L |
| | square meter | $m^2$ | | micrograms per L (ppb)[a] | µg/L |
| | square foot | $ft^2$ | | nanograms per L (ppt)[a] | ng/L |
| **Temperature** | degrees Fahrenheit | $^oF$ | | milligrams per kg (ppm) | mg/kg |
| | degrees Celsius | $^oC$ | | micrograms per g (ppm) | µg/g |
| **Mass** | gram | g | | micrograms per mL (ppm)[a] | 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 |

[a] Equivalency of ppm, ppb, and ppt with the concentrations listed above assumes pure water at standard temperature and pressure.

**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 nontransient, 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, the current SPDES permit for the WVDP became effective. Requirements of the CY 2011 SPDES permit are summarized in Appendix B-1. On July 28, 2015 a modification to the permit was issued to address 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 NYSDOH and EPA have 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 2-5, and in Chapter 4, Table 4-7.

## Historic Timeline of the WNYNSC and the WVDP

Table UI-5, 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.

## Historic Record of NEPA Activities

Table UI-6 provides a history of the significant NEPA activities and NEPA documents since the project began.

## RCRA Units

Table UI-7 provides descriptions of the RCRA SSWMUs and the individual SWMUs identified in the RFI.

## Precipitation

Table UI-8 provides the monthly precipitation data for the current calendar year.

## Ionizing Radiation Dose Ranges Chart

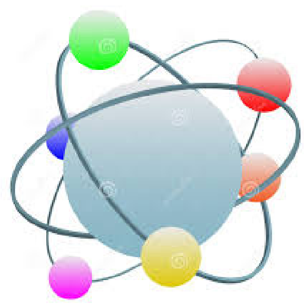


Figure UI-1 is the Ionizing Radiation Dose Ranges Chart developed by the DOE Office of Public Radiation Protection that was published in December 2017.

This chart was constructed with the intention of providing a single, user-friendly, “order-of-magnitude” reference for radiation exposure of interest to scientists, managers, and the general public. It is available on the DOE website shown below, together with an Information Brief that explains the chart for those not completely familiar with the concepts it presents.

https://www.energy.gov/ehss/downloads/doe-ionizing-radiation-dose-ranges-chart

**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 (1 mSv).

[b] Nuclear Wallet Cards. October 2011. 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.

NOTE: DOE-STD-1196-2011 was used for site operations throughout 2021 and is therefore used for comparison tables for the data collected in 2021. The WVDP plans to transition site operations and data reporting to the new DCSs in DOE standard DOE-STD-1196-2021 (published mid-year, in July 2021) during 2022.

**TABLE UI-5**
**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 | Nonradioactive 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 UI-5** ***(continued, page 2 of 6)***
**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. Approximately 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 UI-5 *(continued, page 3 of 6)***
**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). Vitrification of the HLW in the underground tanks was completed in September 2002. |
| 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 UI-5** ***(continued, page 4 of 6)***
**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.<br>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 UI-5** ***(continued, page 5 of 6)***
**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.<br>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 November 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. |

**TABLE UI-5** ***(concluded, page 6 of 6)***
**Historic Timeline of the WNYNSC and the WVDP**

| *Year* | *Activity* |
|---|---|
| 2017 | CHBWV received the DOE VPP Legacy of Stars safety award for 4 consecutive years as a Star site. Deactivation of the VF was completed in 2017. Demolition of the VF began on September 11, 2017. Deactivation and hazard reduction in the MPPB continued in 2017. Shipment of legacy waste was 86% complete by the end of the year of 2017, with completion anticipated ahead of schedule. The remaining non-HLW drums were removed from the MPPB Chemical Process Cell (CPC) in preparation for MPPB demolition. Construction of the new potable water treatment system and communications hub were completed in 2017, and progress was made towards upgrading the electrical supply infrastructure. |
| 2018 | Completed demolition of the VF in September 2018. The Master Slave Manipulator (MSM) Shop, CSRF and a portion of the HEV building were also demolished. Significant progress was made in deactivation and hazard reduction associated with the MPPB including removal of the MPPB stack. Completed shipment of legacy waste in September 2018. Demolition of 28 of 47 BOSF, including the Administration Building, complete by the end of December 2018. Completed natural gas supply upgrade and installed electrical power lines and a new on-site electrical substation to allow replacement of the electrical supply infrastructure in the near future. In February 2018, DOE submitted a Notice of Intent (NOI) to prepare an SEIS and held public scoping meetings in March 2018. The Phase 1 studies were completed in 2018 and progress continued on Probabilistic Performance Assessment (PPA) in support of the SEIS. Request for Information (RFI)/Sources Sought for Phase 1B Decontamination and Decommissioning, and Soil Remediation procurement released by DOE in October 2018. |
| 2019 | The laundry, URE, MPPB office and CVA were all demolished in 2019 leaving only the UR and Load-In/Load-Out (LILO) ancillary facilities attached to the MPPB to remove. In addition, all except two of the 47 BOSF were removed by the end of 2019. Waste management shipped a record volume of materials off site. The remaining VF demolition debris was shipped off site in January 2019. Continued progress was made in deactivation and hazard reduction associated with the MPPB including the beginning of Nitrocision® in PPC-S. Planning for demolition of the MPPB included development of detailed WIPs, a demolition water management plan, and determination of a contamination area (CA) and radiological buffer area (RBA) for MPPB demolition. NYSDEC issued a new water withdrawal permit for the WVDP in December 2019. Progress continued on the PPA in support of the SEIS. |
| 2020 | Facility disposition activities continued in 2020 with demolition of the UR and continued deactivation of the MPPB. On March 20, 2020, the DOE-WVDP implemented a partial stop work order due to the COVID-19 pandemic. Mission critical work continued including compliance inspections, environmental monitoring, mitigation of emergent conditions, and critical preventative maintenance throughout the year. Some work activities, including Nitrocision®, were temporarily suspended. The majority of the waste shipped off site in 2020 was demolition debris from the MPPB office (demolished in 2019) and from the UR. Reduction of the hazards associated with radiologically contaminated areas inside the MPPB continued in 2020 with grouting of the below ground GPC, minicell, and GOA, and approximately three months of wall scabbling by Nitrocision® in PPC-S. A new MPPB water management system was designed and construction initiated to support collection and treatment of dust suppression water and precipitation during MPPB demolition. Progress continued on the PPA in support of the SEIS. |
| 2021 | Facility disposition activities continued in 2021 with continued deactivation of the MPPB and partial demolition of the LILO facility. The COVID-19 pandemic affected some work activities, including Nitrocision® and duct work in the VWR. Waste shipping by rail was resumed in 2021. The majority of the waste shipped off site in 2021 was waste soil and demolition debris from disposal of the PTW soil containment structure and radiologically contaminated water pumped from below ground cells. Preparations for MPPB demolition included internal self-evaluations of MPPB demolition water management, waste processing, and work control processes, as well as continued wall scabbling by Nitrocision® in PPC-S. Installation of the MPPB water management system was completed. Renovations to the drum cell were made for its future use during MPPB demolition. |

**TABLE UI-6**
**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.<br>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 UI-6 *(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).<br><br>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.<br><br>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 UI-6 *(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 (PPA) 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 (SEIS). | 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 SEIS. | The SEIS contract was awarded to SC&A, Inc. in April 2017. |
| 2017 | At the November 2017 quarterly public meeting, the SEIS project team presented an overview of the process for developing the SEIS. | Work continued on the probablistic perfromance assessment to support the SEIS. Work began on development of SEIS alternatives and conceptual engineering designs for disposition of the disposal areas and underground storage tanks. |
| 2018 | Notice of Intent (NOI) to prepare an SEIS was submitted to the *Federal Register* by DOE and to the *State Environmental Notice Bulletin* by NYSERDA in February 2018. Three SEIS public scoping meetings were held in March 2018. | Comments and recommendations from the ninety day public scoping period that ended in May 2018 will be evaluated for the draft report. Work continued in all areas of the draft SEIS preparation as described for year 2017 above. |
| 2019, 2020, and 2021 | Work continued in all areas of the draft preparation of the SEIS and PPA. | DOE and NYSERDA will use the PPA to evaluate SEIS alternatives. The SEIS schedule has been extended due to unanticipated complexities in the PPA modeling. |

**TABLE UI-7**
**WVDP RCRA SSWMUs**
**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;<br>LLWTF;<br>lagoons 2, 3, 4, and 5;<br>neutralization pit; and<br>interceptors |
| SSWMU #2 – Miscellaneous Small Units | 5, 6, 7, and 10 | Demineralizer sludge ponds and solvent dike;<br>effluent mixing basin; and<br>waste paper incinerator |
| SSWMU #3 – LWTS | 18, 18a, 22, and Sealed Rooms | LWTS;<br>cement solidification system; and<br>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;<br>VIT test facility waste storage tanks;<br>STS; and<br>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;<br>old and new hardstand storage areas;<br>Lag storage building;<br>Lag storage extension;<br>LSAs #3 and #4; and<br>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;<br>kerosene tanks;<br>NDA container storage area; and<br>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 on the SDA, go to: |
| https://www.nyserda.ny.gov/Researchers-and-Policymakers/West-Valley/State-Licensed-Disposal-Area | | |
| 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 UI-7 *(concluded)***
**WVDP RCRA SSWMUs**
**Identified in the RFI under the RCRA 3008(h) Order on Consent**

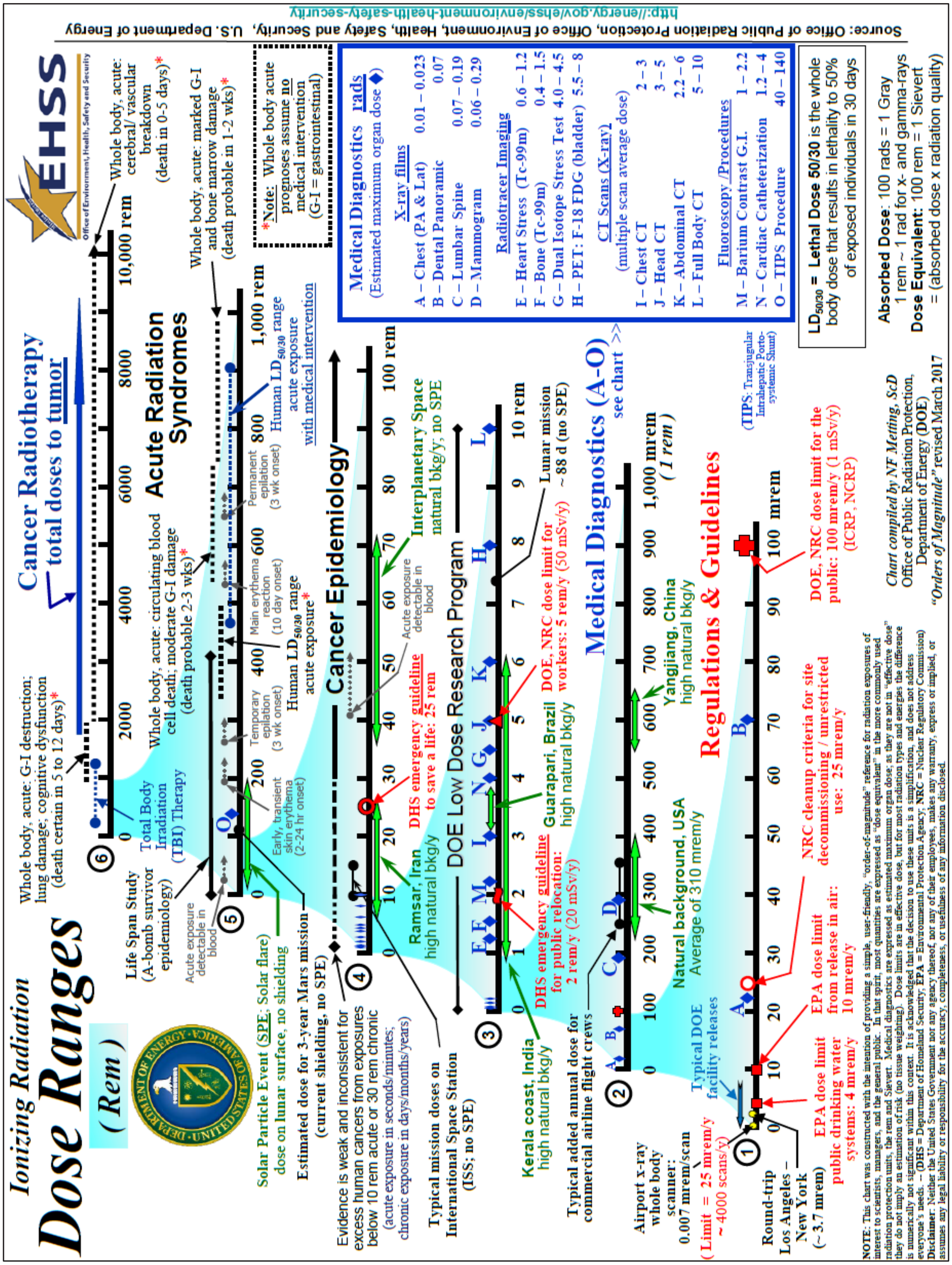
| *SSWMU* | *SWMU #* | *Constituent SWMUs* |
|---|---|---|
| Individual SWMUs (WVDP RCRA SWMUs Not Associated with a SSWMU) | 25 | Inactive scrap metal landfill adjacent to bulk storage warehouse (NYSERDA SWMU) |
| | 26 | Subcontractor maintenance area |
| | 27 | Fire brigade training area |
| | 28 | 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 UI-8**
**WVDP 2021 Monthly Precipitation Totals**

| ***Month*** | ***2021 Monthly Total (inches)*** | ***10-Year Monthly Average (inches)*** *(2011 through 2020)* |
|---|---|---|
| January | 1.72 | 3.15 |
| February | 1.47 | 2.70 |
| March | 1.86 | 2.21 |
| April | 3.22 | 4.59 |
| May | 2.16 | 2.61 |
| June | 5.69 | 3.98 |
| July | 7.46 | 3.97 |
| August | 5.38 | 3.84 |
| September | 3.72 | 4.02 |
| October | 6.64 | 4.82 |
| November | 4.51 | 2.75 |
| December | 3.44 | 3.83 |
| **Total (inches)** | **47.3** | **42.5** |
| Total (centimeters) | 120 | 108 |

**FIGURE UI-1**
**The DOE Ionizing Dose Ranges Chart (December 2017)**



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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 and 2015 -** Standards for an EMS, which require 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

**A&PC -** Analytical and Process Chemistry
**ACM -** Asbestos-Containing Material
**AEA -** Atomic Energy Act
**AFFF -** Aqueous Film-Forming Foam
**ALARA -** As Low As Reasonably Achievable
**alpha-BHC -** alpha-hexachlorocyclohexane
**ANSI -** American National Standards Institute
**AOC -** Ashford Office Complex
**ARC -** Acid Recovery Cell
**ASER -** Annual Site Environmental Report
**ASME -** American Society of Mechanical Engineers
**AST -** Aboveground Storage Tank

## B

**BAT -** Best Available Technology
**BCG -** Biota Concentration Guide
**BEIR -** Biological Effects of Ionizing Radiation
**BKG** - Background
**$BOD_5$ -** Biological Oxygen Demand (5-day)
**BOSF -** Balance of Site Facilities
**BR** - Bedrock

## C

**CA -** Contamination Area
**CAA -** Clean Air Act
**CAM -** Continuous Air Monitor
**CBS -** Chemical Bulk Storage
**CCHD -** Cattaraugus County Health Department
**CD -** Compact Disk
**CDDL -** Construction and Demolition Debris Landfill
**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
**CT-scan -** Computed Tomography scan
**CTF -** Citizen's Task Force
**CVA -** Chemical Viewing Aisle
**CWA -** Clean Water Act
**CX -** Categorical Exclusion
**CY -** Calendar Year

## D

**D&D -** Decontamination and Decommissioning
**DCF -** Dose Conversion Factor
**DCG -** Derived Concentration Guide
**DCS -** Derived Concentration Standard
**DEIS -** Draft Environmental Impact Statement
**DL -** Detection Limit
**DLA -** Defense Logistics Agency
**DMR -** Discharge Monitoring Report
**DO -** Dissolved Oxygen
**DOE -** (U.S.) Department of Energy
**DOE-EM -** Department of Energy, Environmental Management
**DOE-HQ -** Department of Energy, Headquarters Office
**DOELAP -** DOE Laboratory Accreditation Program
**DOE-WVDP -** Department of Energy, West Valley Demonstration Project (title as of June 2006)
**DOECAP -** DOE Consolidated Audit Program
**DP -** Decommissioning Plan

## E

**EA -** Environmental Assessment
**ECL -** (New York State) Environmental Conservation Law
**ECS -** Environmental Compliance Summary

**ED -** Environmental Dosimetry Co.
**EDE -** Effective Dose Equivalent
**EDR -** Equipment Decontamination Room
**EIS -** Environmental Impact Statement
**ELAP -** Environmental Laboratory Approval Program
**EMP -** Environmental Monitoring 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

## F

**FAS -** Fixed Air Sampler
**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
**FWMC -** Flow-Weighted Mean Concentrations
**FY -** Fiscal Year

## G

**GAO -** Government Accounting Office
**GCR -** GPC Crane Room
**GCRE -** GPC Crane Room Enclosure
**GCRX -** GPC Crane Room Extension
**GEL -** General Engineering Lab
**GHG -** Greenhouse Gas
**GMP -** Groundwater Monitoring Program
**GOA -** General Operating Area
**GPC -** General Purpose Cell
**GSL** - (Site-Specific) Groundwater Screening Levels
**GTCC -** Greater Than Class C

## H

**HEPA -** High Efficiency Particulate Air (filter)
**HEV -** Head End Ventilation
**HFC -** Hydrofluorocarbon
**HLW -** High-Level (radioactive) Waste
**HPS -** Health Physics Society
**HQ -** Headquarters
**HVAC -** Heating, Ventilation, and Air Conditioning
**HWMU -** Hazardous Waste Management Unit
**HWSL -** Hazardous Waste Storage Locker

## I

**IAEA -** International Atomic Energy Agency
**IAP -** Integrated Assessment Program
**ICRP -** International Commission on Radiological Protection
**ICSORS -** Interagency Steering Committee on Radiation Standards
**ILA -** Industrial, Landscaping, and Agricultural
**IM -** Interim Measure
**INEEL -** Idaho National Engineering and Environmental Laboratory (1997 to 2005) now known as Idaho National Laboratory
**IRTS -** Integrated Radwaste Treatment System
**ISMS -** Integrated Safety Management System
**ISO -** International Organization for Standardization

## K

**KRS -** Kent Recessional Sequence
**KT -** Kent Till

## L

**LAS -** Linear Alkylate Sulfonate
**LILO -** Load-In/Load-Out
**LLW -** Low-Level (radioactive) Waste
**LLW2 -** Low-Level Waste Treatment Building
**LLWTF -** Low-Level Waste Treatment Facility (SSWMU #1)
**LPS -** Liquid Pretreatment System
**LSA -** Lag Storage Area
**LTS -** Lavery Till Sand
**LWTS -** Liquid Waste Treatment System

## M

**MAPEP -** Mixed Analyte Performance Evaluation Program
**MCF** - One thousand cubic feet
**MCL -** Maximum Contaminant Level
**MCLG -** Maximum Contaminant Level Goal
**MDC -** Minimum Detectable Concentration
**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
**MSDS -** Material Safety Data Sheet
**MSM -** Master Slave Manipulator

## 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.
**NGVD -** National Geodetic Vertical Datum
**$NH_3$ -** Ammonia
**NOAA -** National Oceanic Atmospheric Administration
**NOI -** Notice of Intent
**$NO_2$-N -** Nitrite (as N)
**$NO_3$-N -** Nitrate (as N)
**NOx -** Nitrogen Oxide
**NPDES -** National Pollutant Discharge Elimination System
**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
**NTS -** National Tracking Systems
**NTU -** Nephelometric Turbidity Units
**NUREG -** (U.S.) NRC Regulation
**NYCRR -** New York State Official Compilation of Codes, Rules, and Regulations
**NY -** New York
**NYS -** New York State
**NYS ECL -** New York State Environmental Conservation Law
**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)
**OGA -** Off-Gas Aisle
**OGC -** Off-Gas Cell
**ORP -** Occurrence Reporting and Processing
**ORPS -** Occurrence Reporting and Processing System
**OSTI -** Office of Scientific and Technical Information

## P

**PBS -** Petroleum Bulk Storage
**PCB -** Polychlorinated Biphenyl
**PEIS -** Programmatic Environmental Impact Statement
**PET-scan** - Positron Emission Tomography scan
**PFAS -** Per- and Polyfluoroalkyl Substances
**PFOA -** Perfluoroctanic Acid
**PFOS -** Perfluorooctane Sulfoncic Acid
**PMC -** Process Mechanical Cell
**PNL -** Pacific Northwest Laboratory
**POC -** Principal Organic Contaminant
**PPA -** Probabilistic Performance Assessment
**PPB -** Parts Per Billion
**PPC -** Product Purification Cell
**PPC-S -** Product Purification Cell-South
**PPM -** Parts Per Million
**PPT -** Parts Per Trillion
**PQL -** Practical Quantitation Limit
**PTW -** Permeable Treatment Wall
**PTWPMP -** Permeable Treatment Wall Performance Monitoring Plan
**PVC -** Polyvinyl chloride
**PVS -** Permanent Ventilation System
**PVU -** Portable Ventilation Unit

## Q

**QA -** Quality Assurance
**QC -** Quality Control

## R

**RAO -** Remedial Action Objectives
**RBA -** Radiological Buffer Area
**RCRA -** Resource Conservation and Recovery Act
**REC -** Renewable Energy Credits
**REM -** Roentgen Equivalent Man
**RFI -** RCRA Facility Investigation
**RFP -** Request for Proposal
**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
**SDS -** Safety Data Sheet
**SEIS -** Supplemental Environmental Impact Statement
**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.
**SOP -** Standard Operating Procedure
**SOx -** Sulfur Oxide
**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
**STD -** Standard
**STP -** Site Treatment Plan
**STS -** Supernatant Treatment System
**SU -** Standard Unit
**SVOC -** Semivolatile Organic Compound
**SWMU -** Solid Waste Management Unit
**SWPPP -** Storm Water Pollution Prevention Plan
**SwRI -** Southwest Research Institute
**SWS -** Slackwater Sequence

## T

**T&VDS -** Tank and Vault Drying System
**TA -** Test America Laboratories
**TBP -** Tributyl Phosphate
**TBU -** Thick-Bedded Unit
**TCP -** Trichloropropane
**TDS -** Total Dissolved Solids
**TER -** Technical Evaluation Report
**THOREX -** Thorium Reduction Extraction
**TI/RE -** Toxic Inventory/Reduction Evaluation
**TKN -** Total Kjeldahl Nitrogen
**TLD -** Thermoluminescent Dosimeter
**TOGS -** Technical and Operational Guidance Series
**TRU -** Transuranic
**TSDF -** Treatment Storage and Disposal Facility
**TSS -** Total Suspended Solids

## U

**U.S. -** United States
**UCL -** Upper Confidence Limit
**UDF -** Unit Dose Factor
**ULT -** Unweathered Lavery Till
**UOD -** Ultimate Oxygen Demand
**UPC -** Uranium Product Cell
**UR -** Utility Room
**URE -** Utility Room Extension
**URS -** URS - Energy & Construction Division (historical)
**USACE -** U.S. Army Corps of Engineers
**USC -** United States Code
**UST -** Underground Storage Tank
**UWA -** Upper Warm Aisle

## V

**VEC -** Ventilation Exhaust Cell
**VF -** Vitrification Facility
**VIT -** Vitrification
**VOC -** Volatile Organic Compound
**VPP -** Voluntary Protection Program
**VSC -** Vertical Storage Cask
**VWR -** Vent Washroom

## W

**WCS** - Waste Control Specialists LLC
**WET** - Whole Effluent Toxicity
**WIP -** Work Instruction Package
**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)

## X

**XC -** Extraction Cell

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# APPENDIX A

## 2021 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 2021. The 2021 program meets 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 2021. Routine sampling locations are shown on Figures A-2 through A-14. 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 former ventilation stack of the MPPB (ANSTACK). 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 major changes to the overall environmental monitoring program in 2021. However, there were two minor changes. (1) TI/RE related WET testing continued to be performed in 2021 at the request of NYSDEC as part of an ongoing investigation to understand the performace results. The WVDP SPDES permit requires that WET testing be performed every five years, beginning with year 2012. (2) Sampling of the groundwater wells used for the site drinking water supply for PFAS and 1,4-dioxane analysis was performed for the first time in 2021 under the drinking water monitoring program, per NYSDOH requirements.

# Index of Environmental Monitoring Program Sample Points

| Sample Location | Description of Monitoring Point | Location shown on Figure |
|---|---|---|
| **Air Effluent** | | |
| ANSTSTK | Supernatant Treatment System | Figure A-6 |
| ANCSPFK | Container Sorting and Packaging Facility | 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 | not shown |
| NDA MH#4 | NDA Trench Extraction Point | Figure A-2 |
| **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 |
| WNSP006 | Facility Main Drainage, Franks Creek at Security Fence | 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 |
| **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 |

[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 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 |
| 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 |
| **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 (Franks Creek) | 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)** | | |
| Supply Wells | | |
| WNDWELL1 | Drinking Water Well #1 (at wellhead) | Figure A-8 |
| WNDWELL2 | Drinking Water Well #2 (at wellhead) | Figure A-8 |
| WNDRAW1/2 | Raw, Untreated Groundwater (at water treatment intake) | Figure A-8 |
| Groundwater Treatment System | | |
| WNDFIN | Treated Groundwater (from supply line after treatment) | Figure A-8 |
| Sentinel Monitoring Wells | | |
| WNEHMKE | Bedrock Well South of Main Plant | Figure A-8 |
| WWCOURT | Bedrock Well South of former 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 |
| 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, Hungry Hollow Road, 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 by vegetable/fruit sampled as follows:
Near site: corn = BFVNEA<u>C</u>; apples = BFVNEA<u>A</u>F; beans = BFVNEA<u>B</u>
Background: corn = BFVCTR<u>C</u>; apples = BFVCR<u>A</u>; beans = BFVCTR<u>B</u>.

**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);<br>DOE Order 458.1, Change 4 | DOE-HDBK-1216-2015, Chapter 4.0 (airborne radiological effluent monitoring and sampling);<br>DOE/EP-0096, Section 3.3 (criteria for effluent measurements) |
| **Ambient Air** | |
| 40 CFR 61, Subpart H (radiological air emissions);<br>DOE Order 458.1, Change 4 | DOE-HDBK-1216-2015, Section 6.7.2 (environmental surveillance, air measurements, sampling locations);<br>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),<br>DOE Order 458.1, Change 4 (radiological) | DOE-HDBK-1216-2015, Section 3.4.4 (liquid effluent monitoring, sampling locations);<br>New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certification for nonpotable water |
| **Surface Water** | |
| DOE Order 458.1, Change 4 | DOE-HDBK-1216-2015, Section 6.10.1 (environmental surveillance, water sampling locations);<br>NYSDOH ELAP certification for nonpotable water |
| **Potable (Drinking) Water** | |
| DOE Order 458.1, Change 4 | DOE-HDBK-1216-2015, Section 6.10 (environmental surveillance, water sampling);<br>NYSDOH ELAP certification for potable water |
| **On-Site Groundwater** | |
| RCRA §3008(h) Order on Consent (nonradiological);<br>DOE Order 458.1, Change 4 (radiological) | DOE-HDBK-1216-2015, Section 6.10 (environmental surveillance, water sampling);<br>NYSDOH ELAP certification for nonpotable water |
| **Soil and Sediment** | |
| DOE Order 458.1, Change 4 | 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 4 | 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 4 | DOE-HDBK-1216-2015, Section 6.5 (environmental surveillance, external exposure monitoring);<br>DOE/EP-0023, Section 4.6 (external radiation) |

**TABLE A-2**
**2021 Environmental Monitoring Program**

<table>
<tr><th>Sample Location Code</th><th>Sampling Type/ Medium</th><th>Collection Frequency/ Total Annual Samples</th><th>Measurements/Analyses</th></tr>
<tr><td colspan="4">On-Site Air Emissions</td></tr>
<tr><td rowspan="4">ANSTSTK[a]<br>STS ventilation exhaust<br><br>ANRVEU1[a]<br>MPPB replacement ventilation emission unit exhaust<br><br>ANRHWFK[a]<br>RHWF exhaust<br><br>ANCSPFK[a]<br>Container sorting and packaging facility exhaust</td><td>Continuous on-line air particulate monitors</td><td>Continuous measurement of fixed filter; replaced biweekly; held as backup</td><td>Real-time monitoring - CAM</td></tr>
<tr><td>Continuous off-line air particulate filters</td><td>Biweekly; 26 each location</td><td>Gross alpha/beta, gamma isotopic[b] upon collection, flow</td></tr>
<tr><td>Composite of biweekly particulate filters</td><td>Semiannually; 2 each location</td><td>Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic, flow</td></tr>
<tr><td>Continuous off-line charcoal cartridges</td><td>Cartridges collected biweekly and composited into 2 semiannual samples at each location</td><td>I-129</td></tr>
<tr><td rowspan="2">OVEs/PVUs[a]<br>Outdoor ventilated enclosures/portable ventilation units</td><td>Continuous off-line air particulate filter</td><td>Collected as required by project</td><td>Gross alpha/beta, gamma isotopic[b] upon collection, flow</td></tr>
<tr><td>Composite of filters</td><td>Semiannually</td><td>Sr-90, U-232, U-233/234, U-235/236, U-238, total U, Pu-238, Pu-239/240, Am-241, gamma isotopic, flow</td></tr>
</table>

[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.

**TABLE A-2 (*continued* )**
**2021 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 is performed quarterly every 5 years, beginning with year 2012 in accordance with the SPDES permit. The 2017 quarterly testing was repeated in 2018, 2019, 2020, and 2021 at the request of NYSDEC due to 2017 performance and ongoing investigations to understand the WET testing results.
[c] WNSP01B is no longer operated.

**TABLE A-2 *(continued)***
**2021 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 | TDS, flow rate |
| **WNSP006** Franks Creek at the security fence | Timed continuous composite | Biweekly, 26 per year | Gross alpha/beta |
| | Composite of biweekly samples | Monthly; 12 per year | H-3, 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 is not required since discharges from this location have been discontinued.

**TABLE A-2 (*continued* )**
**2021 Environmental Monitoring Program**

| *Sample Location Code* | *Sampling Type/ Medium* | *Collection Frequency/ Total Annual Samples* | *Measurements/Analyses* |
|---|---|---|---|
| **Storm Water Outfalls** | | | |
| **Group 3**[a]<br>**WNSO09 (S09)**<br>**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]<br>**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]<br>**WNSO14 (S14)**<br>**WNSO17 (S17)**<br>**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]<br>**WNSO36 (S36)**<br>**WNSO37 (S37)**<br>**WNSO38 (S38)**<br>**WNSO39 (S39)**<br>**WNSO41 (S41)**<br>**WNSO42 (S42)**<br>**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]<br>**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* )**
**2021 Environmental Monitoring Program**

| *Sample Location Code* | *Sampling Type/ Medium* | *Collection Frequency/ Total Annual Samples* | *Measurements/Analyses* |
|---|---|---|---|
| **Storm Water Outfalls *(continued)*** | | | |
| **Group 8**[a]<br>**WNSO27 (S27)**<br>**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]<br>Site rain gauge | Field measurement of precipitation | 1 each storm water sampling event | inches of precipitation, pH |
| **On-Site Surface Water** | | | |
| **WNSWAMP**<br>Northeast swamp drainage<br><br>**WNSW74A**<br>North swamp drainage | Timed continuous composite liquid | Biweekly; 26 per year | Gross alpha/beta, pH, flow (flow at WNSWAMP only) |
| | Composite of biweekly samples | Monthly; 12 per year | H-3, 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**<br>Facility yard drainage<br><br>**WNFRC67**<br>Franks Creek east of SDA<br><br>**WNERB53**<br>Erdman Brook north of disposal areas | Grab liquid | Quarterly; 4 per year | Gross alpha/beta, H-3, pH |
| | Composite of quarterly samples | Semiannually; 2 per year | Sr-90 and gamma isotopic |
| **WNNDADR**<br>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 |
| **NDA MH#4**[b]<br>NDA trench water extraction from manhole #4 | Grab liquid | Monthly; 12 per year | Gross alpha/beta, TOC, pH |

[a] Required by SPDES Permit # NY0000973. Storm water reports will be appended to the June and December DMRs.
[b] NDA manhole #4 is also identified as WNNDATR under the groundwater program. EMP sampling at this location began November 9, 2017.

**TABLE A-2 (*continued* )**
**2021 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[a] | Total coliform, E. coli, PFAS, and 1,4-dioxane |
| **WNDRAW1, WNDRAW2** Raw untreated groundwater [*collected in treatment building]* | Grab liquid | Monthly; 12 per year | Gross alpha/beta, H-3 |
| | | Annually; 1 per year | I-129, gamma isotopic, PFAS, and 1,4-dioxane |
| **WNDFIN** Treated potable water *[collected in treatment building]* | Grab liquid | Daily; 365 per year | Residual chlorine |
| | | Quarterly; up to 4 per year[b] | POCs[b] , SOCs[b] , MTBE[b] , vinyl chloride[b] |
| | | Annually; 1 per year | Na, $NO_3$-N[c] |
| | | Once every 3 years | Ag, As, Ba, Be, Cd, Cr, Hg, Ni, Sb, Se, Tl, cyanide (as free), fluoride |
| **WNDNKRH** RHWF drinking water | Grab liquid | Once every 3 years | Total haloacetic acids and total trihalomethanes |
| **Distribution System Sinks: WNDNK06, 23, 27, WNDNKRH and WNDNURSE** [d, e, f] | Grab liquid [e,f] | Quarterly[e] ; 4 per year | Total coliform, E. coli, residual chlorine[e] |
| | | Once every 3 years[f] | Cu and Pb[f] |
| **On-Site Potable (Drinking) Water: Source Water Protection Monitoring for Groundwater Supply** | | | |
| **Bedrock monitoring wells:** **WNEHMKE (EHMKE)** South of MPPB<br>**WWCOURT (WWCOURT)** South of former Annex<br>**WNCT272 (60CT272)** Southeast of warehouse | Grab liquid | Biweekly; 26 per year | Gross alpha/beta, pH and conductivity |

[a] Samples are collected at the wellheads only if bacteriological parameters are detected in the distribution system.

[b] Sampling for Principal Organic Contaminants (POCs) is required every 6 years. POC sampling was performed in May and October 2021 due to one positive detection for bromomethane in 2020. Sampling for Specific Organic Chemicals (SOCs) is requried every 3 years due to recent changes in the CCHD regulations. SOC sampling was performed in 2021 and will be performed again in 2024.

[c] Nitrate ($NO^3$-N) is sampled by CCHD. Sodium is sampled by the WVDP.

[d] Distribution system sinks sampled in this year include: Guard house (WNDNK06), 10-plex men's room sink (WNDNK23), RHWF kitchenette (WNDNKRH), and Nurse's office (WNDNURSE).

[e] One sample is collected by CCHD for bacteriological sampling from one of five sinks in the distribution system (WNDNK06, WNDNK23, WNDNKRH or WNDNURSE) on a rotational basis each quarter.

[f] Copper and lead sampling frequency is every three years. Copper and lead were sampled for in 2021 at locations WNDNK06, WNDNK23, WNDNK27, WNDNKRH, and WNDNURSE.

**TABLE A-2 (*continued* )**
**2021 Environmental Monitoring Program**

| *Sample Location Code* | *Sampling Type/ Medium* | *Collection Frequency/ Total Annual Samples* | *Measurements/Analyses* |
|---|---|---|---|
| **On-Site Groundwater** | | | |
| **LLW2:** SSWMU #1<br>(wells 103, 104, 105, 106, 107, 108, 110, 111, 116, 8604, 8605)<br><br>**Miscellaneous small units:** SSWMU #2<br>(wells 204, 205, 206)<br><br>**LWTS:** SSWMU #3<br>(wells 301, 302)<br><br>**HLW and processing tank:** SSWMU #4<br>(wells 401, 402, 403, 405, 406, 408, 409)<br><br>**Maintenance shop leach field:** SSWMU #5<br>(wells 501, 502)<br><br>**LLW storage area:** SSWMU #6<br>(wells 602A, 604, 605, 8607, 8609)<br><br>**Chemical process cell waste storage area:** SSWMU #7<br>(wells 704, 706, 707)<br><br>**CDDL:** SSWMU #8<br>(wells 801, 802, 803, 804, 8603, 8612)<br><br>**NDA:** SSWMU #9<br>(wells 901, 902, 903, 906, 908R, 909, 910R, 8610, 8611, trench NDATR)<br><br>**IRTS drum cell**: SSWMU #10<br>(wells 1005, 1006, 1008B, 1008C)<br><br>**RHWF** (not in a SSWMU):<br>(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), and/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)***
**2021 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, and metals |
| | Direct field measurement | Twice each sampling event; 8 per year | Conductivity, pH |
| | Direct field measurement | Once each sampling event; 4 per year | Turbidity |
| **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 | Sr-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 |
| **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 (last sampled in 2017, will be sampled in 2022) | 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 (last sampled in 2017, will be sampled in 2022) | 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)***
**2021 Environmental Monitoring Program**

| *Sample Location Code* | *Sampling Type/ Medium* | *Collection Frequency/ Total Annual Samples* | *Measurements/Analyses* |
|---|---|---|---|
| **Off-Site Sediment** | | | |
| **SFCCSED**<br>Cattaraugus Creek at Felton Bridge<br><br>**SFSDSED**<br>Cattaraugus Creek at Springville Dam<br><br>**SFTCSED**<br>Buttermilk Creek at Thomas Corners Road<br><br>**SFBCSED**<br>Buttermilk Creek at Fox Valley Road (background) | Grab stream sediment | 1 each location every five years (last sampled in 2017, will be sampled in 2022) | 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**<br>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**<br>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, pH, flow |
| | Flow-weighted composite of biweekly samples | Monthly; 12 per year | Gross alpha/beta, H-3, Sr-90, and gamma isotopic |
| **WFBCTCB**<br>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)***
**2021 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<br>**AF02_NNE** North-northeast at Rt. 240<br>**AF03_NE** Northeast at Rt. 240<br>**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<br>**AF06_ESE** East-southeast at Buttermilk Road<br>**AF07_SE** Southeast at Fox Valley Road<br>**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<br>**AF10_SSW** South-southwest at Dutch Hill Road<br>**AF11_SW** Southwest at Dutch Hill Road<br>**AF12_WSW** West-southwest at Dutch Hill Road | Composite of biweekly glass fiber filters | Quarterly; 4 per year | Sr-90, gamma isotopic, U-232, Pu-238, Pu-239/240, Am-241, flow |
| **AF13_W** West at Dutch Hill Road<br>**AF14_WNW** West-northwest at Boberg Road<br>**AF15_NW** Northwest at Rock Springs Road<br>**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 |

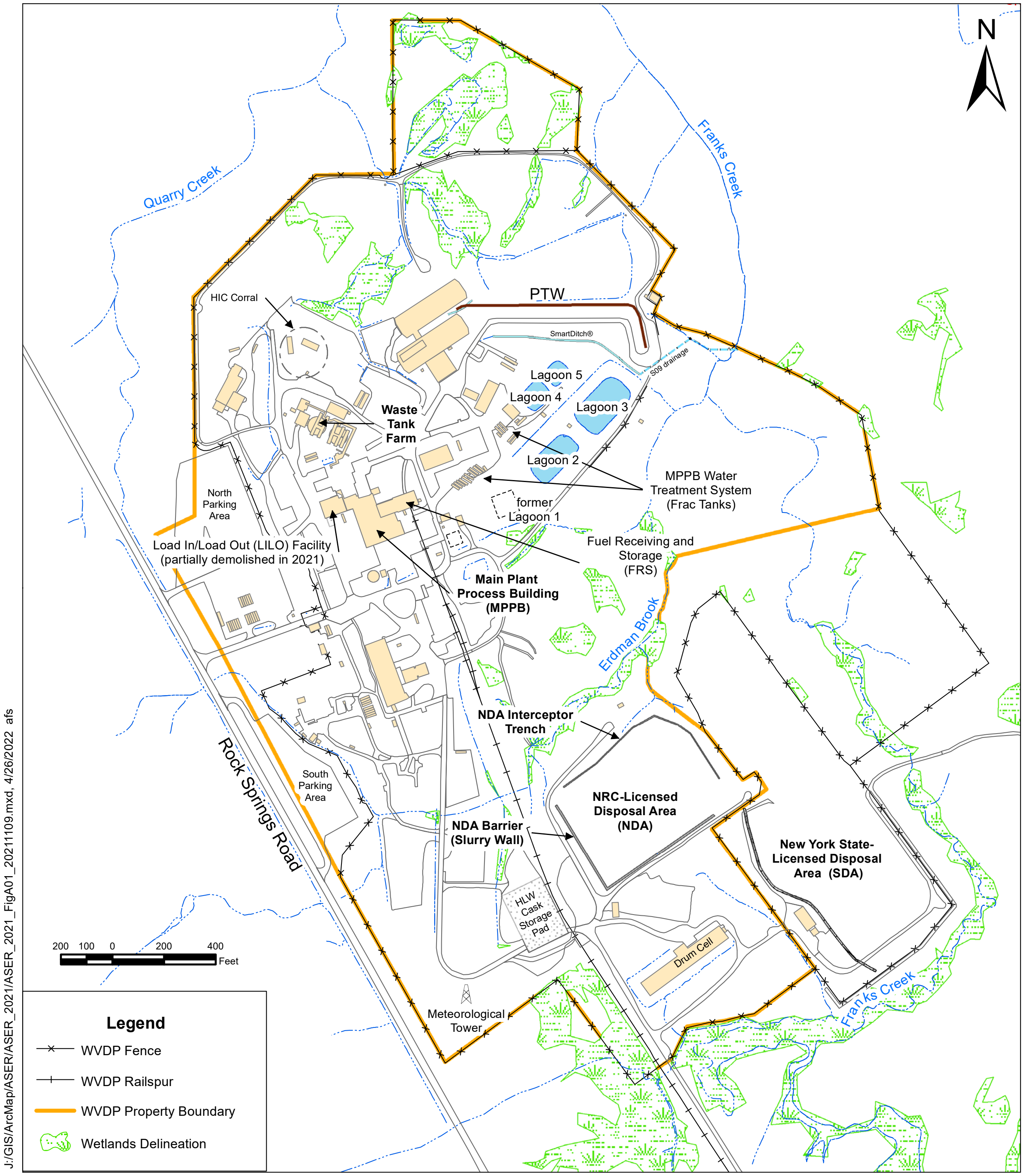
**TABLE A-2 *(continued)***
**2021 Environmental Monitoring Program**

| *Sample Location Code* | *Sampling Type/ Medium* | *Collection Frequency/ Total Annual Samples* | *Measurements/Analyses* |
|---|---|---|---|
| **Off-Site Ambient Air** | | | |
| **AF16HNNW**<br>North-northwest<br>at Rock Springs Road<br>(High volume sampler at historical MEOSI location) | Glass fiber filters for air particulates | Biweekly; 26 per year | Gross alpha/beta screening, flow;<br>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**<br>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;<br>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, Pu-238, Pu-239/240, Am-241, flow |
| **Off-Site Biological** | | | |
| **BFMFLDMN**<br>Dairy farm 5.1 km southeast of WVDP | Grab milk sample | Annual; 1 per year | Sr-90, I-129, gamma isotopic |
| **BFMCTLS**<br>Control location 22 km south (background)<br><br>**BFMBLSY**<br>Dairy farm 5.5 km west-northwest<br><br>**BFMSCHT**<br>Dairy farm 4.9 km south | Grab milk sample | Each location and background, once every five years (sampled in 2017, will next be sampled in 2022) | Sr-90, I-129, gamma isotopic |
| **BFDNEAR**<br>Deer in the vicinity of the WVDP<br><br>**BFDCTRL**<br>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<br>(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)<br>Food crops from locations near the WVDP<br><br>**BFVCTRL**<br>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 2017, will next be sampled in 2022) | Gamma isotopic and Sr-90 in edible portions, % moisture, H-3 in free moisture |

**TABLE A-2 *(concluded)***
**2021 Environmental Monitoring Program**

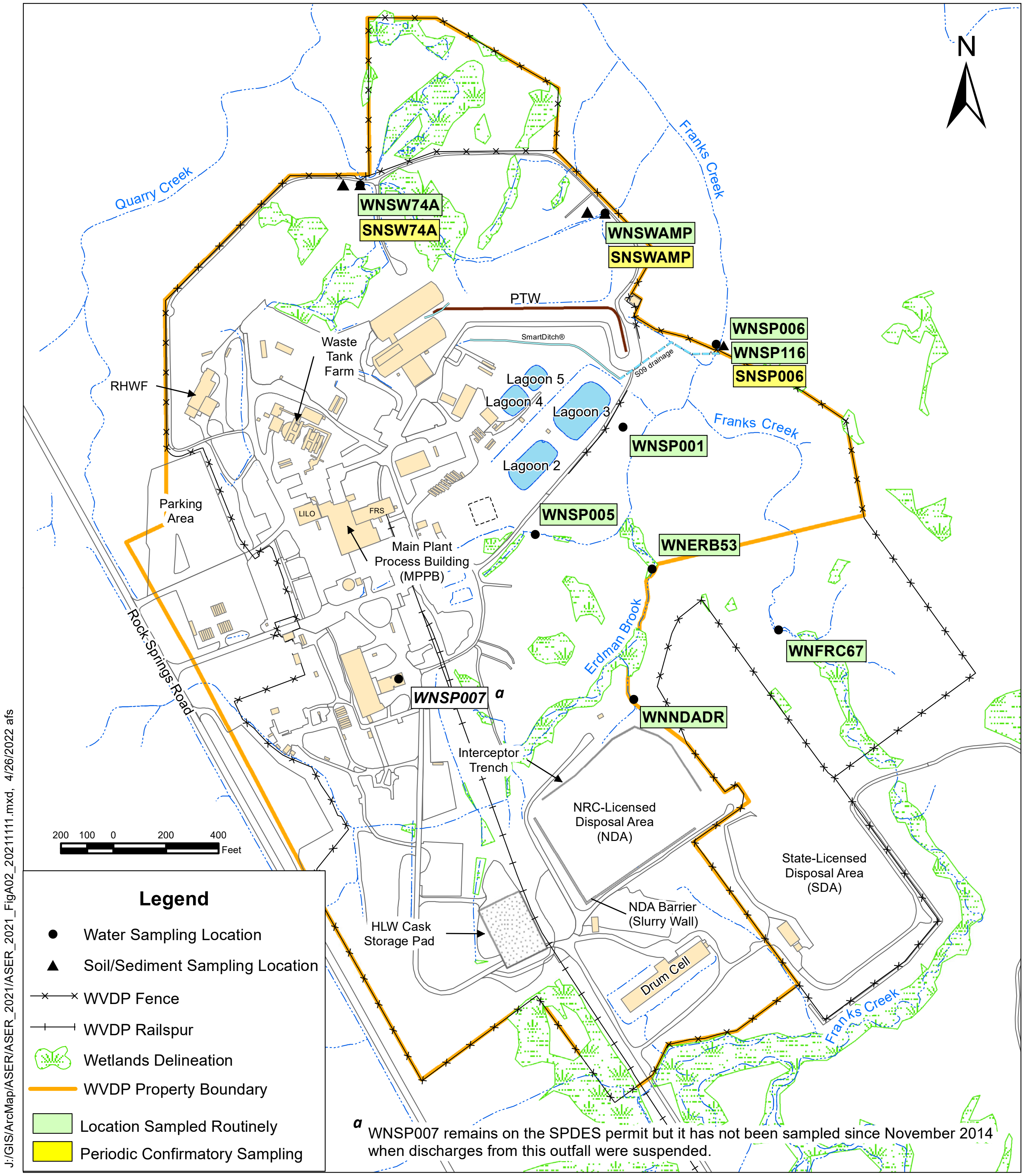
| *Sample Location Code* | *Sampling Type/ Medium* | *Collection Frequency/ Total Annual Samples* | *Measurements/Analyses* |
|---|---|---|---|
| **Off-Site Biological** | | | |
| **BFFCATC**<br>Fish from Cattaraugus Creek downstream of its confluence with Buttermilk Creek<br><br>**BFFCATD**<br>Fish from Cattaraugus Creek downstream of the Springville Dam<br><br>**BFFCTRL**<br>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 (last sampled in 2017, will be sampled in 2022) | 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<br><br>**#20:** 1,500 m northwest (downwind receptor)<br><br>**#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<br><br>**#33**: Corner of the SDA<br><br>**#24, #28, #44**: Security fence around the WVDP<br><br>**#32, #35, #36**: Drum Cell road, Drum Cell south fence, and north of Drum Cell<br><br>**#38, #40**: Near operational areas on-site<br><br>**#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**



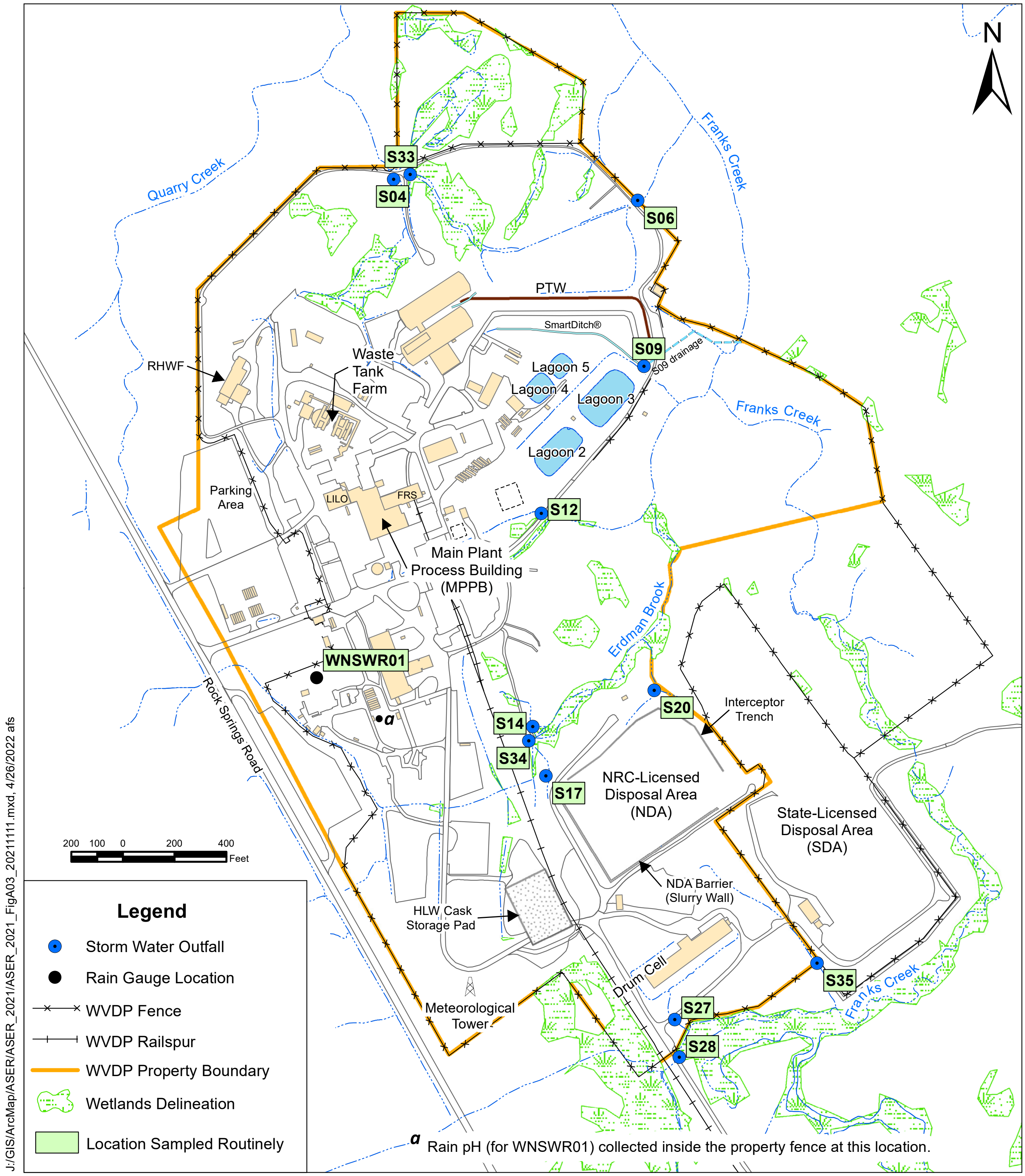

Note: Demolition of the majority of the Load-In/Load-Out (LILO) facility was performed in 2021.

**FIGURE A-2**
**On-Site Liquid Effluent, Surface Water and Soil/Sediment Sampling Locations**




a WNSP007 remains on the SPDES permit but it has not been sampled since November 2014 when discharges from this outfall were suspended.

**FIGURE A-3**
**On-Site Storm Water Outfalls**




*a* Rain pH (for WNSWR01) collected inside the property fence at this location.

**FIGURE A-4**
**Rail Spur Storm Water Outfalls**

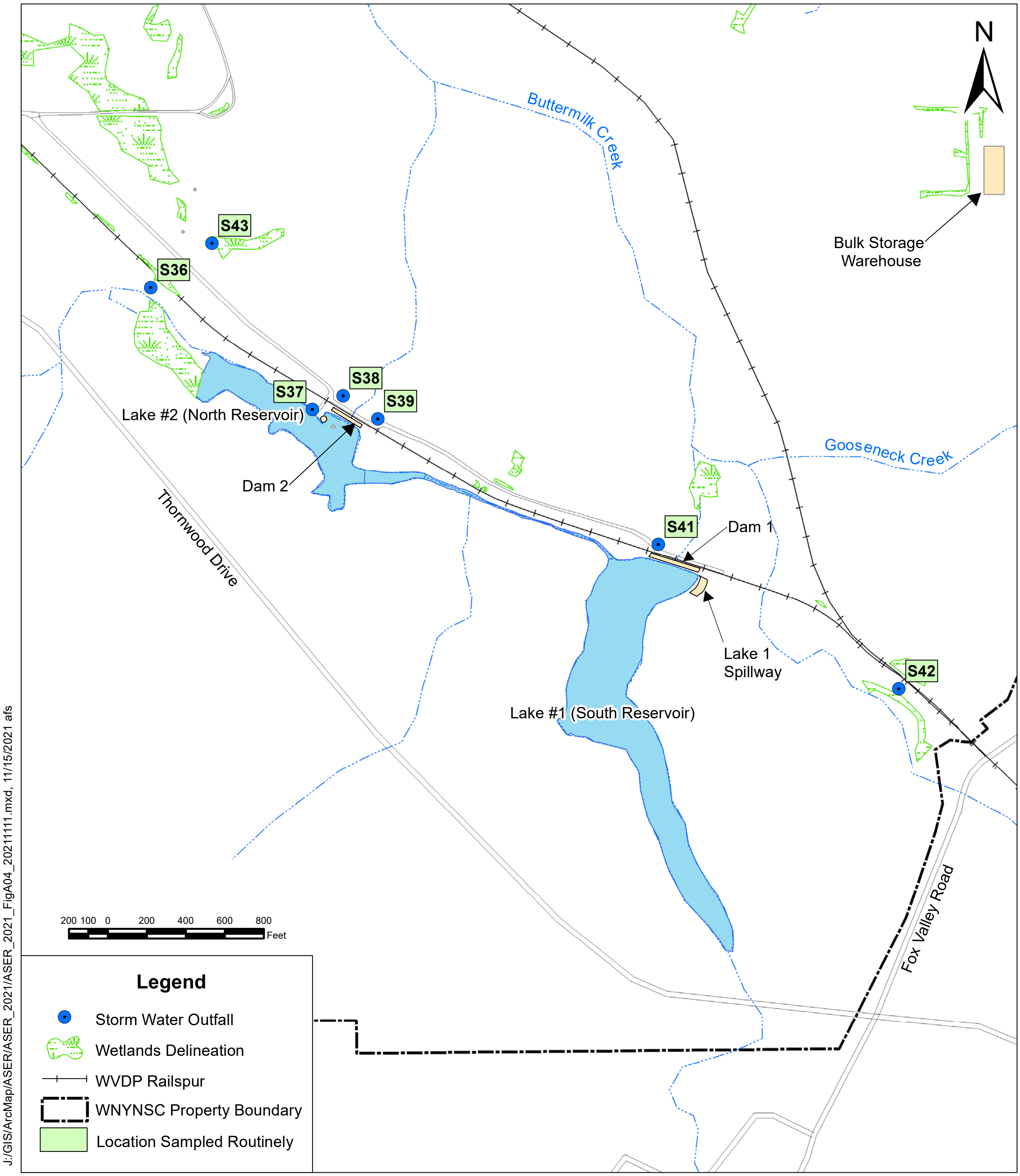


**FIGURE A-5**
**Off-Site Surface Water and Soil/Sediment Sampling Locations**

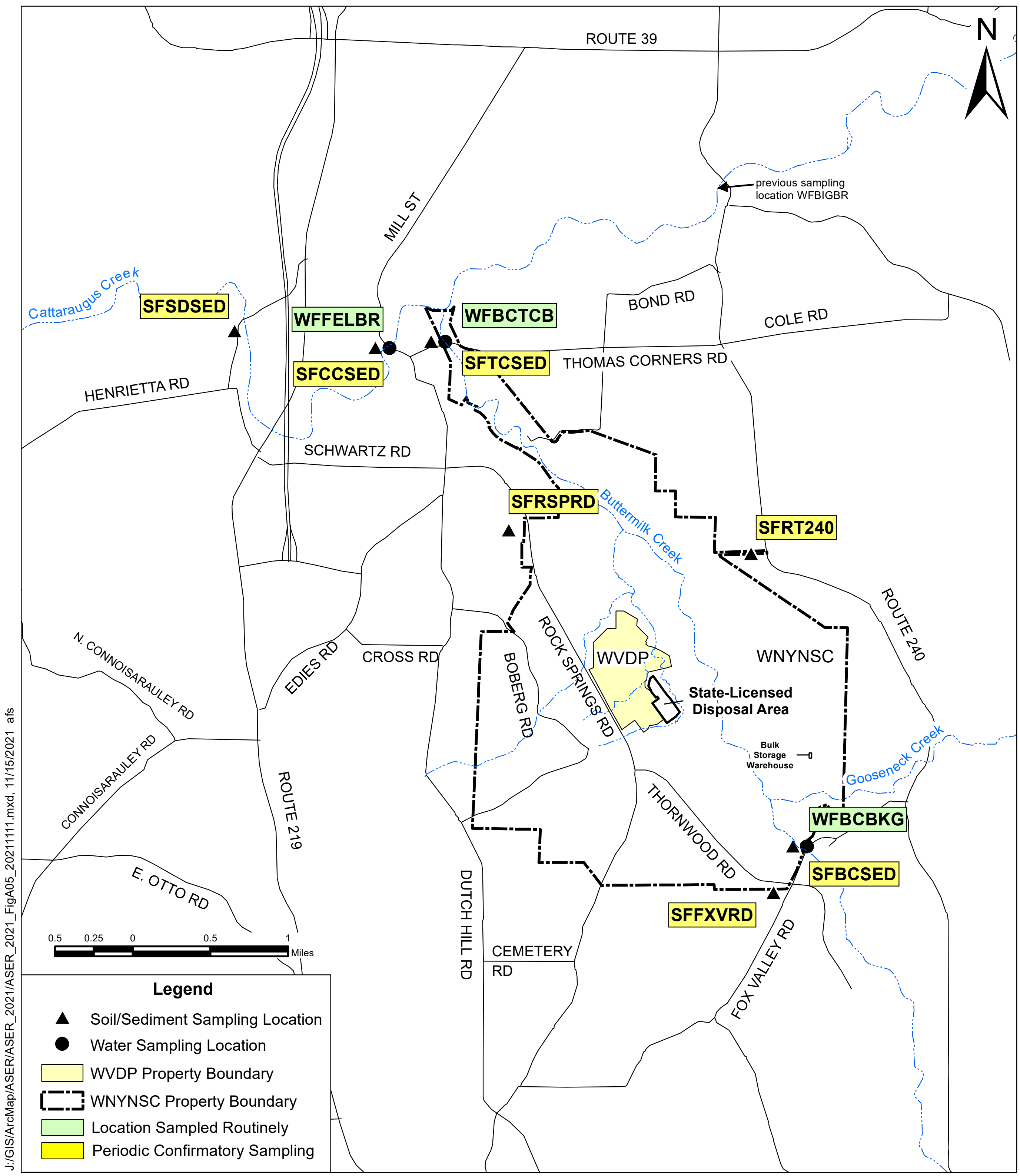
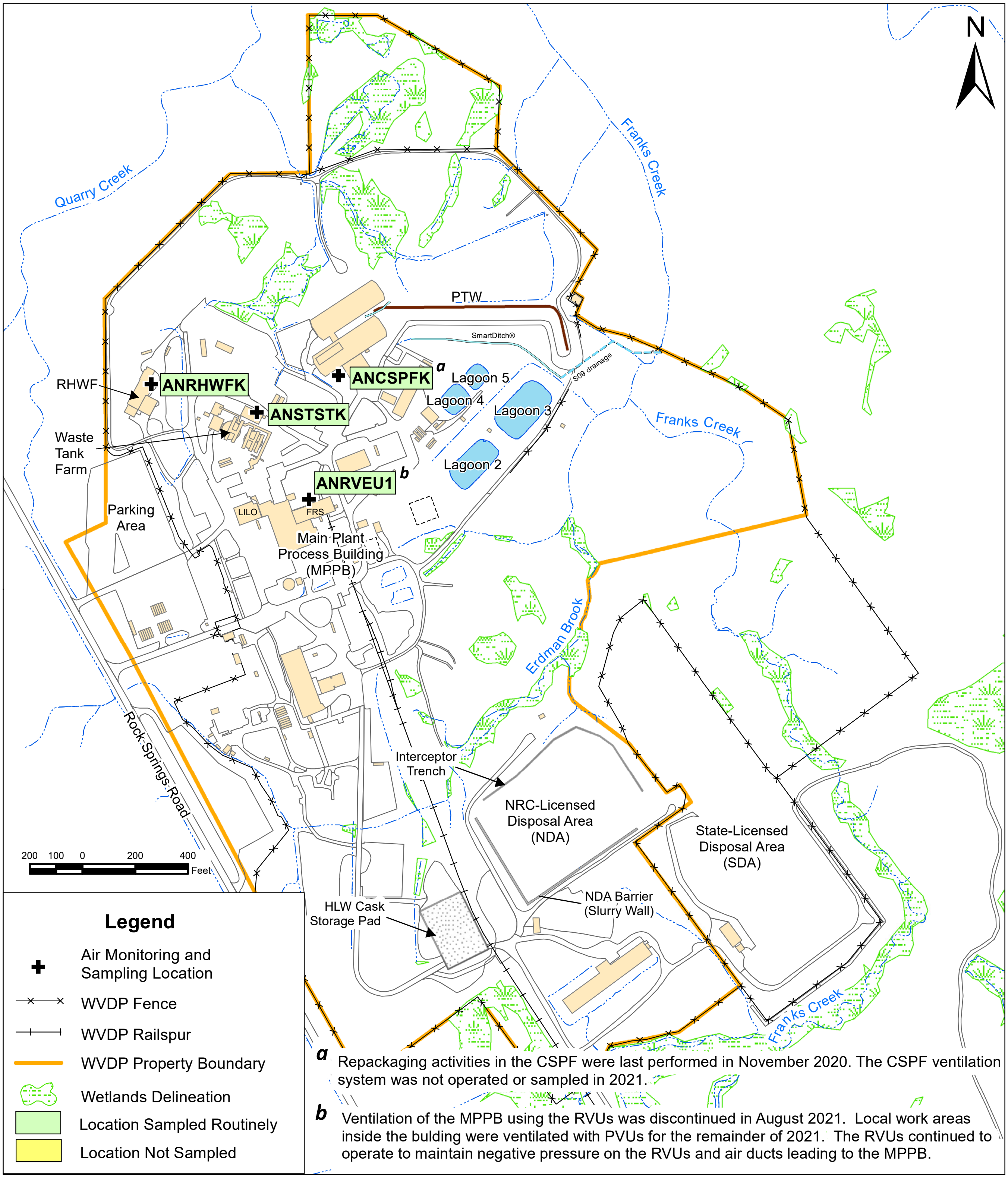


**FIGURE A-6**
**On-Site Air Monitoring and Sampling Locations**




J:/GIS/ArcMap/ASER/ASER_2021/ASER_2021_FigA06_20211111.mxd, 4/26/2022 afs

**FIGURE A-7**
**Off-Site Ambient Air Monitoring and Sampling Locations**

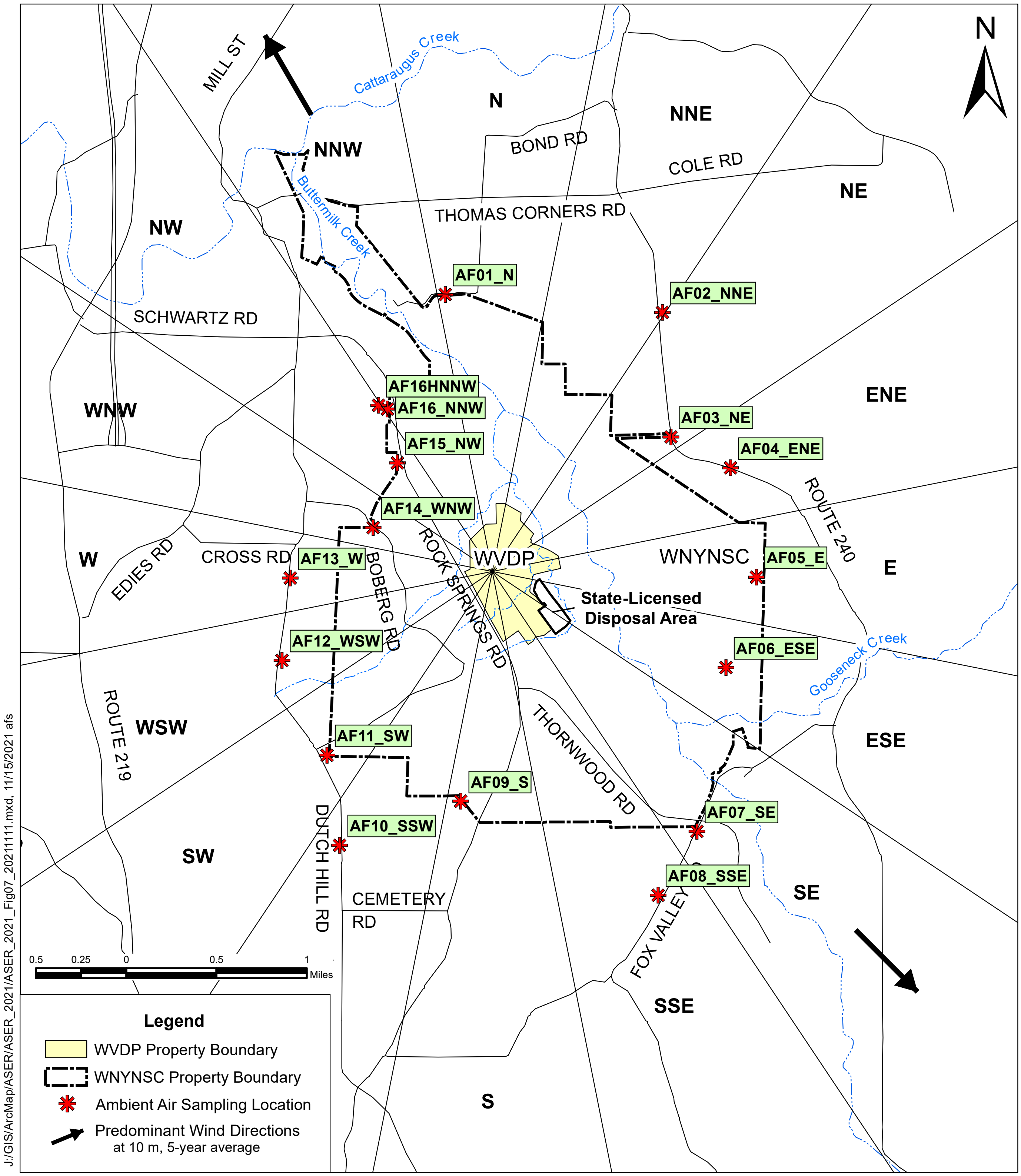
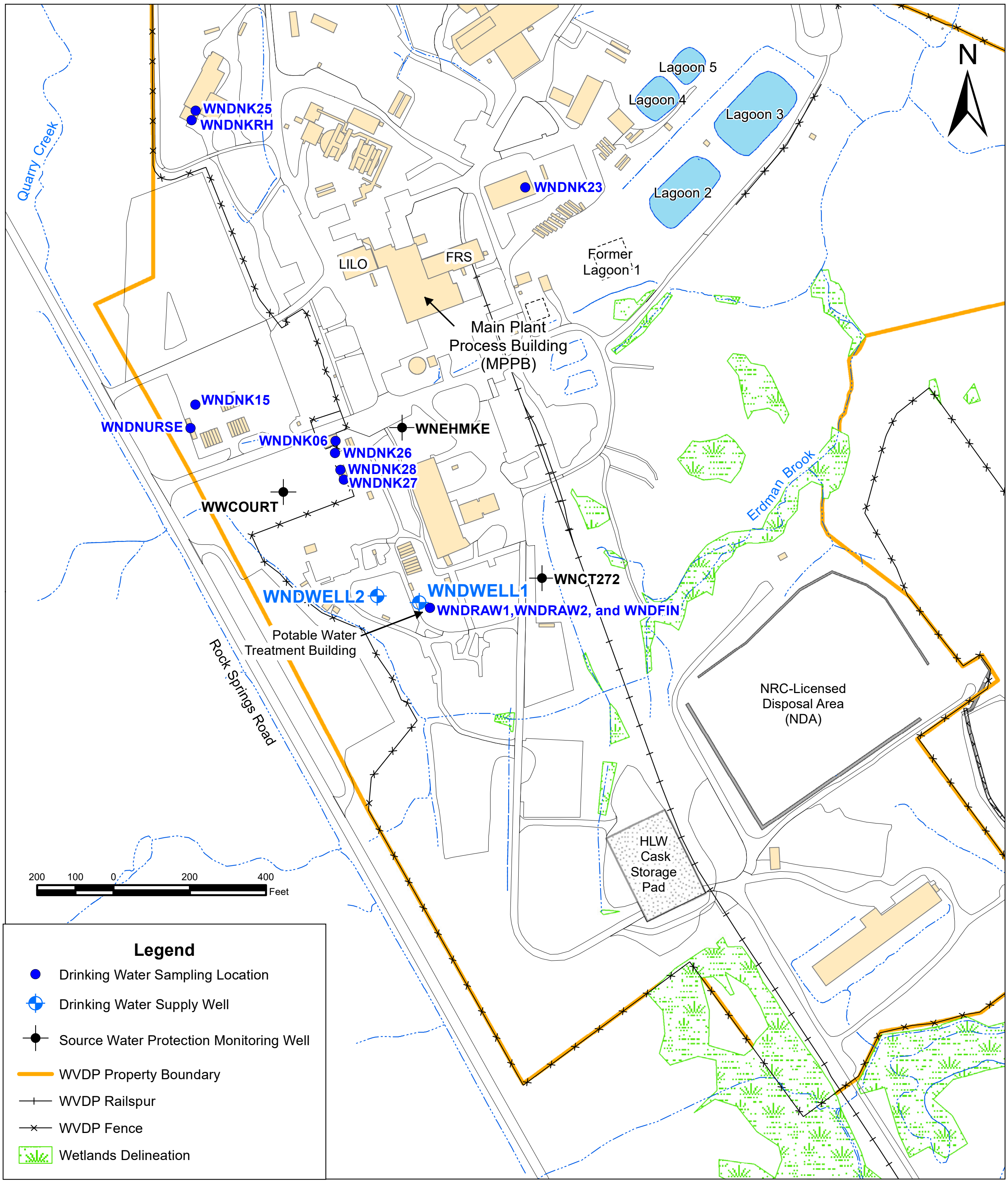


**FIGURE A-8**
**Drinking Water Supply Wells and Source Water Protection Monitoring Network**




J:/GIS/ArcMap/ASER/ASER_2021/ASER_2021_FigA08_20211111.mxd, 7/11/2022 afs

**FIGURE A-9**
**North Plateau Groundwater Monitoring Network**

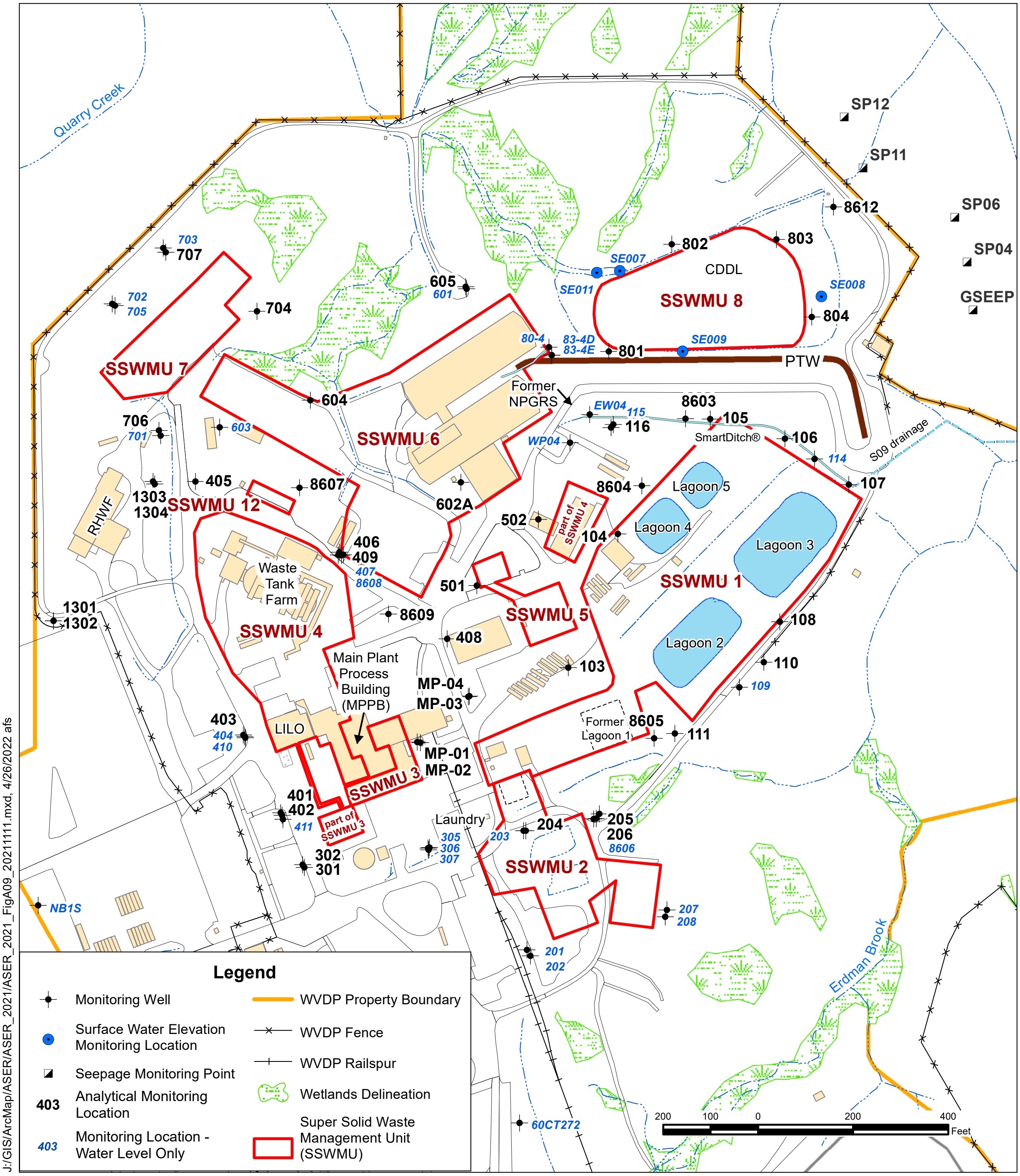


**FIGURE A-10**
**South Plateau Groundwater Monitoring Network**

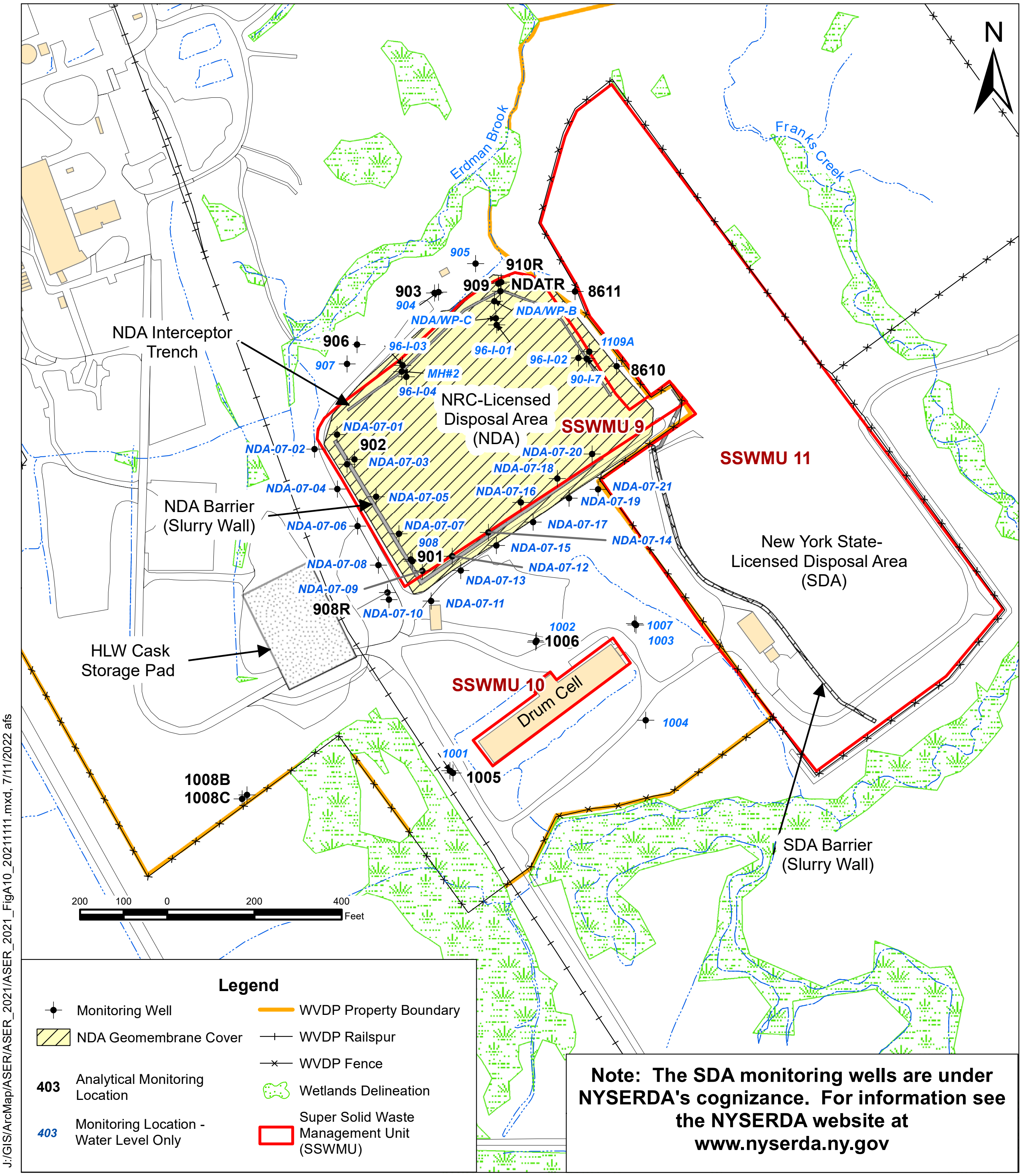
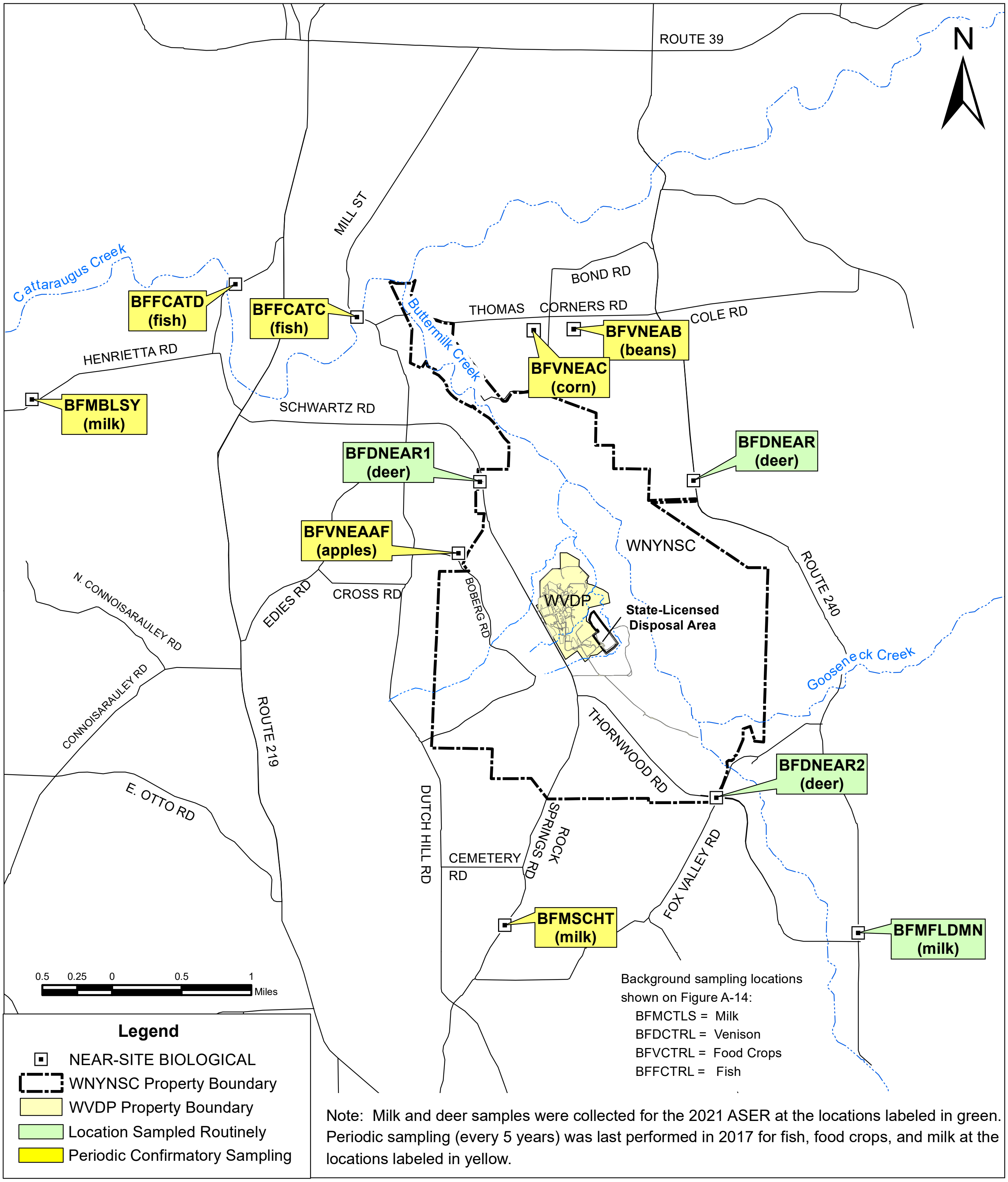


**FIGURE A-11**
**Biological Sampling Locations**




Note: Milk and deer samples were collected for the 2021 ASER at the locations labeled in green. Periodic sampling (every 5 years) was last performed in 2017 for fish, food crops, and milk at the locations labeled in yellow.

J:/GIS/ArcMap/ASER/ASER_2021/ASER_2021_FigA11_20211111.mxd, 4/15/2022 afs

**FIGURE A-12**
**Location of On-Site / Near-Site Thermoluminescent Dosimeters (TLDs)**

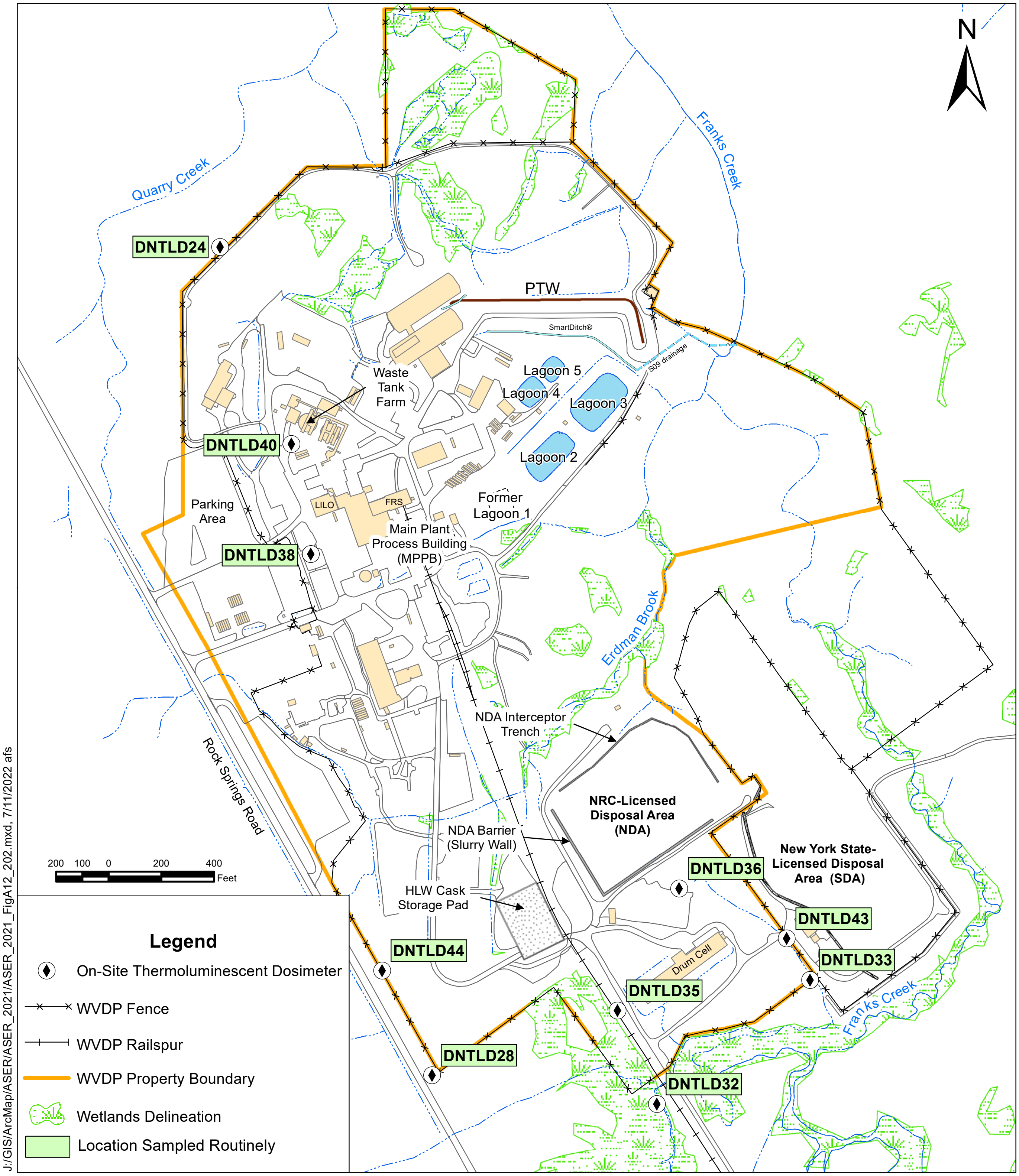
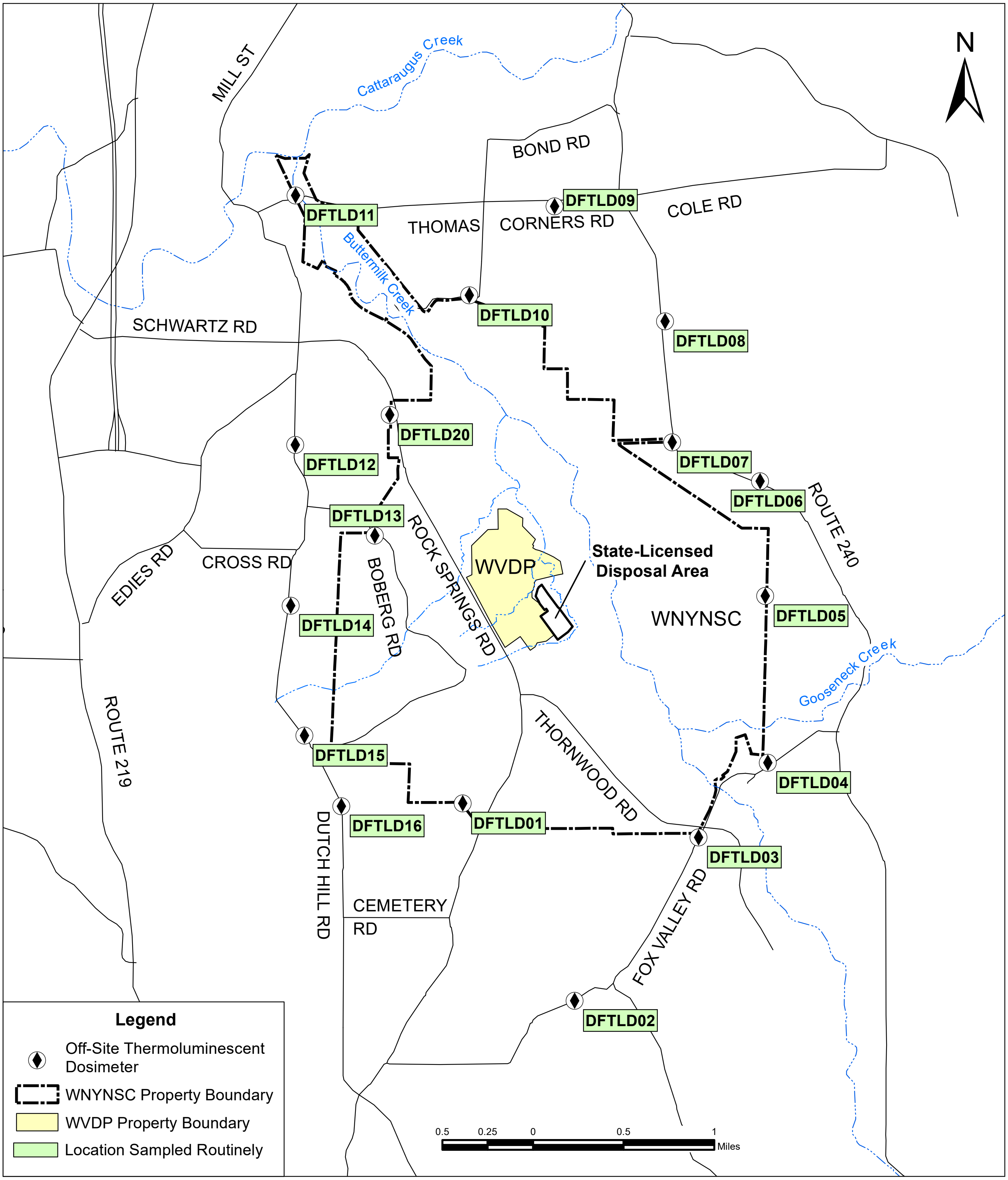
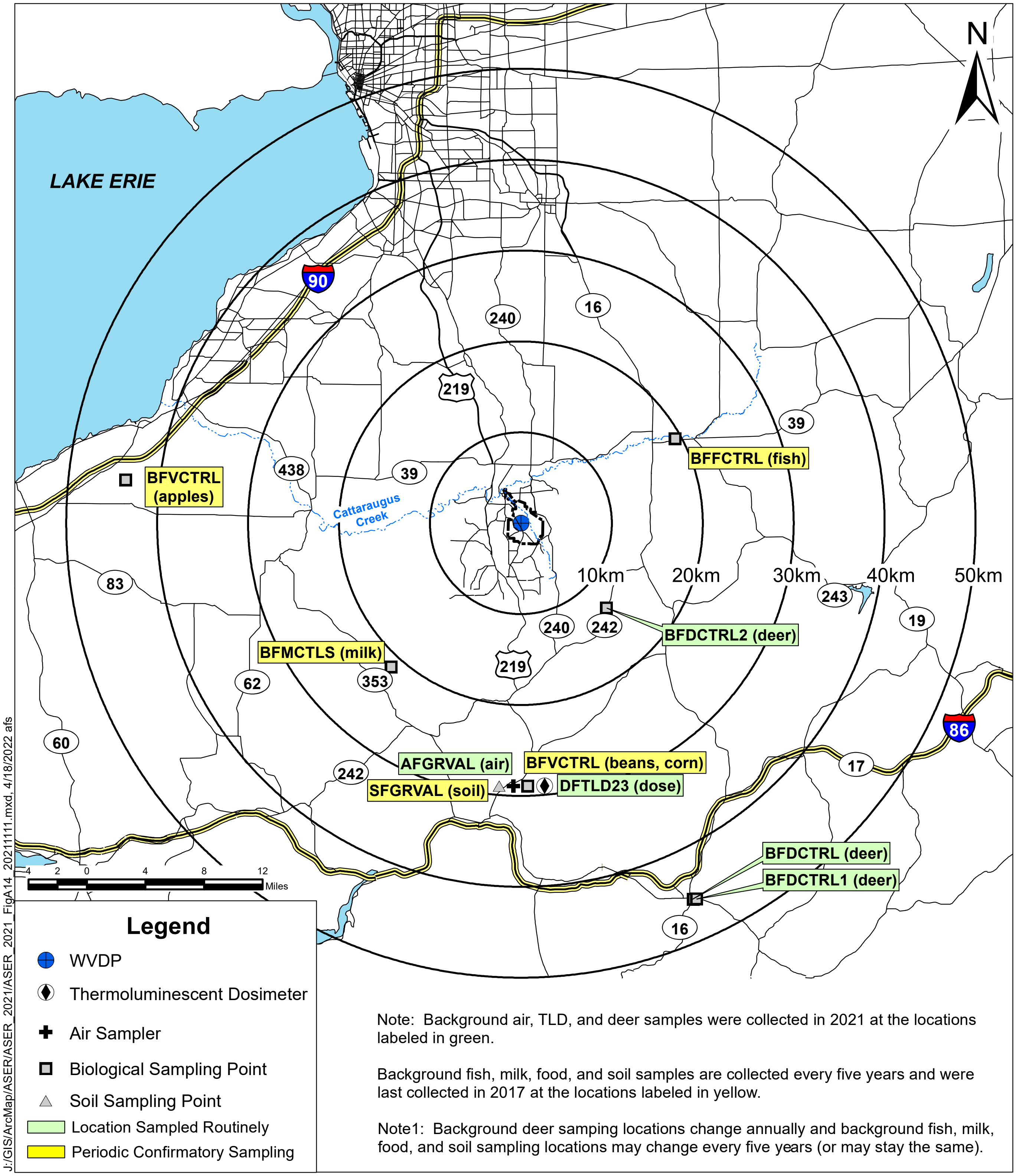


**FIGURE A-13**
**Location of Off-Site Thermoluminescent Dosimeters (TLDs) Within 5 Kilometers of the WVDP**




J:/GIS/ArcMap/ASER/ASER_2021/ASER_2021_FigA13_20211111.mxd, 11/15/2021 ats

**FIGURE A-14**
**Environmental Sampling Locations More Than 5 Kilometers From the WVDP**

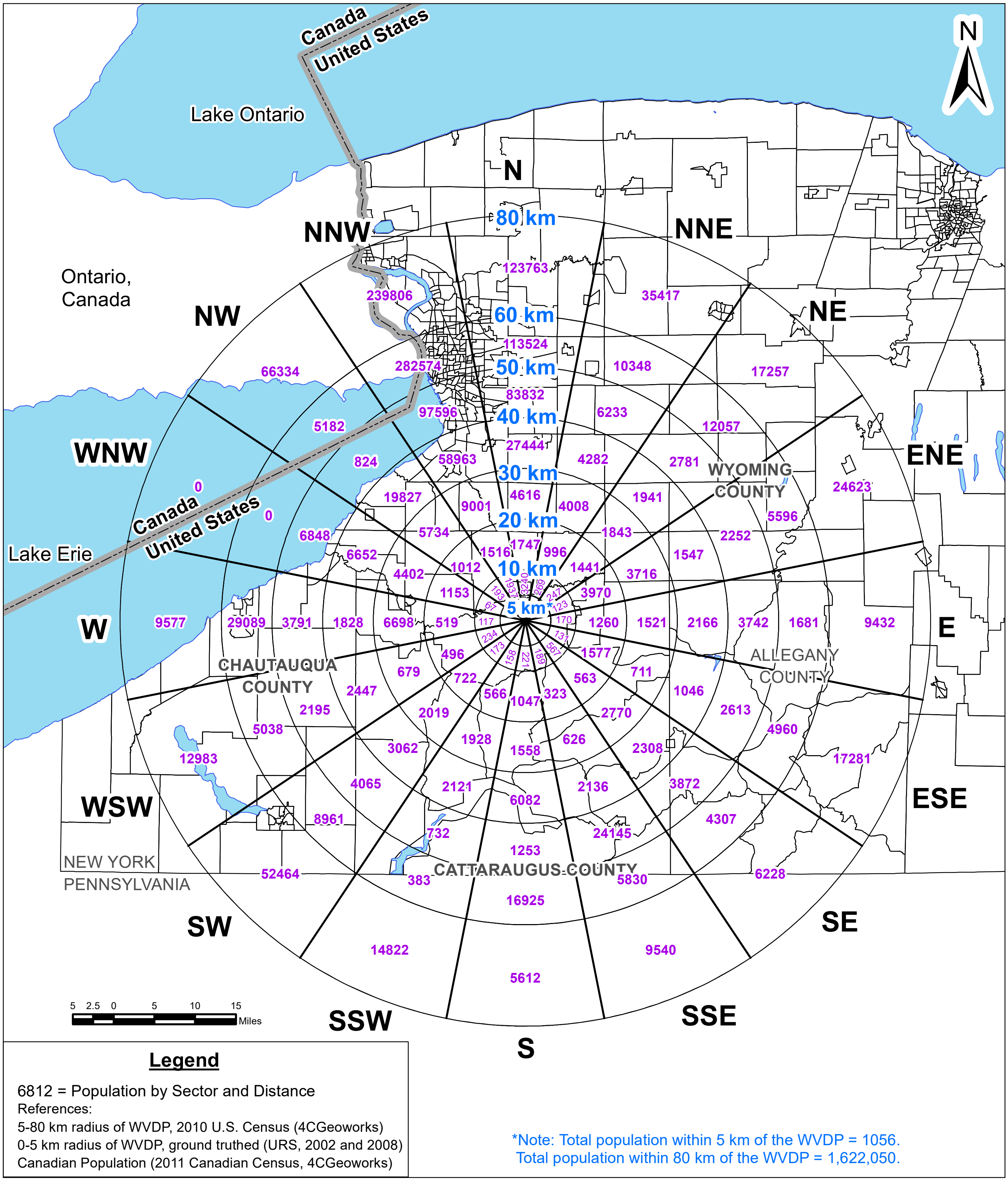



Note: Background air, TLD, and deer samples were collected in 2021 at the locations labeled in green.

Background fish, milk, food, and soil samples are collected every five years and were last collected in 2017 at the locations labeled in yellow.

Note1: Background deer samping locations change annually and background fish, milk, food, and soil sampling locations may change every five years (or may stay the same).

**FIGURE A-15**
**Population by Sector Within 80 Kilometers of the WVDP**




**Legend**

6812 = Population by Sector and Distance
References:
5-80 km radius of WVDP, 2010 U.S. Census (4CGeoworks)
0-5 km radius of WVDP, ground truthed (URS, 2002 and 2008)
Canadian Population (2011 Canadian Census, 4CGeoworks)

*Note: Total population within 5 km of the WVDP = 1056.
Total population within 80 km of the WVDP = 1,622,050.

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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 required every five years unless otherwise directed by NYSDEC.
[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* |
|---|---|---|---|
| **Storm Water 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 (Principal 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 |
| Methoxychlor | mg/L | 0.04 |
| Methyl-tertiary-butyl-ether(MTBE) | mg/L | 0.010 |
| Pentachlorophenol | mg/L | 0.001 |

-- 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*** | | | |
| 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 | |
| **Per-and Polyfluoroalkyl Substances (PFAS) and 1,4-Dioxane** [b] | | | |
| Perfluorooctanoic acid (PFOA) | ng/L | 10 | |
| Perfluorooctanesulfonate (PFOS) | ng/L | 10 | |
| 1,4-Dioxane | µg/L | 1 | |
| ***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*** [c] |
| **Gross Alpha** | µCi/mL | 1.5E-08[d] | 7.61E-09 |
| **Gross Beta** | mrem/year | 4[d] | - |
| **Gross Beta (screening level)** | µCi/mL | 1.5E-08[e] | 1.56E-08 |
| **Tritium** | µCi/mL | 2.0E-05[f] | 1.78E-07 |
| **Cesium-137** | µCi/mL | 2.0E-07[f] | ND |
| **Iodine-129** | µCi/mL | 1.0E-09[f] | ND |

-- No applicable guideline or reference standard available.
ND - Nondetect
MCL - Maximum Contamination Level

[a] MCL - Listed is NYSDOH 10 NYCRR Part 5, Subpart 5-1, Section 5-1.52.
[b] In August 2020, NYS adopted a state drinking water MCL of 10 ppt (10 ng/L) for PFOA and PFOS, and 1 part per billion (ppb) (1 µg/L) for 1,4-dioxane.
[c] 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.
[d] NYSDOH 10 NYCRR Part 5, Subpart 5-1, Public Water System Table 7 Radiological MCL (applicable to community water systems).
[e] Gross beta screening level established in site-specific drinking water monitoring plan. (1.5E-08 µCi/mL is from Table 12 Radiological Monitoring, NYSDOH 10 NYCRR Part 5, Subpart 5-1.)
[f] 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 (1 mSv).

[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 µCi/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 2021 Lagoon 3 (WNSP001) Liquid Effluent Radioactivity Concentrations With U.S. DOE-Derived Conentration Standards (DCSs)**

| Isotope [a] | Discharge Activity [b] | | Flow-Weighted Mean Concentration | DCS [d] | Ratio of Mean Concentration to DCS |
|---|---|---|---|---|---|
| | (Ci) | (Becquerels) [c] | (µCi/mL) | (µCi/mL) | |
| **Gross Alpha** | 1.46±0.39E-04 | 5.42±1.46E+06 | 7.71±2.08E-09 | 9.8E-08[e] | NA |
| **Gross Beta** | 1.49±0.01E-02 | 5.53±0.05E+08 | 7.87±0.06E-07 | 1.1E-06[e] | NA |
| **H-3** | 8.20±1.32E-03 | 3.03±0.49E+08 | 4.32±0.70E-07 | 1.9E-03 | 0.0002 |
| **C-14** | 1.58±3.44E-04 | 0.59±1.27E+07 | 0.83±1.81E-08 | 6.2E-05 | <0.0003 |
| **K-40** | 0.05±4.51E-04 | 0.02±1.67E+07 | 0.02±2.38E-08 | NA[f] | NA |
| **Co-60** | 1.91±2.97E-05 | 0.71±1.10E+06 | 1.01±1.56E-09 | 7.2E-06 | <0.0002 |
| **Sr-90** | 6.71±0.07E-03 | 2.48±0.03E+08 | 3.53±0.04E-07 | 1.1E-06 | 0.3214 |
| **Tc-99** | 7.41±2.18E-05 | 2.74±0.81E+06 | 3.90±1.15E-09 | 4.4E-05 | 0.0001 |
| **I-129** | 3.10±1.41E-05 | 1.15±0.52E+06 | 1.63±0.74E-09 | 3.3E-07 | 0.0049 |
| **Cs-137** | 2.66±0.60E-04 | 9.85±2.22E+06 | 1.40±0.32E-08 | 3.0E-06 | 0.0047 |
| **U-232**[g] | 5.28±0.48E-05 | 1.95±0.18E+06 | 2.78±0.25E-09 | 9.8E-08 | 0.0284 |
| **U-233/234**[g] | 4.13±0.31E-05 | 1.53±0.11E+06 | 2.17±0.16E-09 | 6.6E-07[h] | 0.0033 |
| **U-235/236**[g] | 1.79±0.74E-06 | 6.63±2.75E+04 | 9.45±3.91E-11 | 7.2E-07 | 0.0001 |
| **U-238**[g] | 3.26±0.27E-05 | 1.21±0.10E+06 | 1.72±0.14E-09 | 7.5E-07 | 0.0023 |
| **Pu-238** | 1.76±2.80E-07 | 0.65±1.04E+04 | 0.93±1.48E-11 | 1.5E-07 | <0.0001 |
| **Pu-239/240** | 3.50±3.76E-07 | 1.29±1.39E+04 | 1.84±1.98E-11 | 1.4E-07 | <0.0001 |
| **Am-241** | 6.90±6.16E-07 | 2.55±2.28E+04 | 3.63±3.25E-11 | 1.7E-07 | 0.0002 |
| **Sum of Ratios** | | | | | **0.37** |

NA – Not applicable; ratio calculated from isotopic data.
[a] Half-lives are listed in Table UI-4.
[b] Total volume released: 1.90E+10 milliliters (mL) (5.01E+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] The representative DCS for gross alpha in water shown is for U-232 and for gross beta is for Sr-90 (selected as the most restrictive) since DCSs do not exist for indicator parameters.
[f] The DCS is not applied to potassium-40 (K-40) activity because of its natural origin.
[g] Total uranium (g) = 1.00±0.12E+02; Average uranium (µg/mL) = 5.28±0.65E-03.
[h] The DCS for U-233 is used for this comparison.

**TABLE B-2B**
**2021 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 | <0.009 | <0.009 | <2.0 | <2.0 | 0.271 | 0.365 | 0.04 | 0.04 |
| February [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| March [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| April [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| May [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| June | <0.055 | <0.1 | <2.0 | <2.0 | 0.206 | 0.271 | 0.05 | 0.05 |
| July [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| August [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| September [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| October [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| November | <0.009 | <0.009 | <2.0 | <2.0 | 0.072 | 0.09 | 0.04 | 0.04 |
| 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 | 12.0 | 13.0 | 0.39 | 0.45 | 0.056 | 0.056 | <0.02 | <0.02 |
| February [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| March [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| April [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| May [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| June | 6.4 | 6.9 | 0.45 | 0.51 | <0.02 | <0.02 | 0.04 | 0.04 |
| July [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| August [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| September [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| October [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| November | 8.8 | 11.0 | 0.6 | 0.6 | <0.02 | <0.02 | <0.02 | <0.02 |
| 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 2021.

**TABLE B-2B *(continued)***
**2021 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 | 1.5 | 1.5 | 8.0 | 8.0 | <0.1 | <0.1 | 989 | 1020 |
| February [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| March [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| April [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| May [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| June | <1.5 | <1.5 | 8.0 | 8.0 | <0.1 | <0.1 | 922 | 978 |
| July [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| August [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| September [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| October [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| November | 2.6 | 2.6 | 8.1 | 8.1 | <0.1 | <0.1 | 838 | 868 |
| 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 | < 4.0 | < 4.0 | 50.0 | 50.0 | <0.03 | <0.03 | 0.01 | 0.01 |
| February [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| March [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| April [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| May [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| June | < 5.8 | 7.6 | 69.0 | 69.0 | <0.03 | <0.03 | 0.02 | 0.02 |
| July [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| August [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| September [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| October [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| November | < 4.0 | < 4.0 | 64.0 | 64.0 | <0.03 | <0.03 | 0.01 | 0.01 |
| 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 2021.

**Table B-2B *(concluded)***
**2021 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* | <4.78 | <5.06 |
| *February* [a] | -- | -- |
| *March* [a] | -- | -- |
| *April* [a] | -- | -- |
| *May* [a] | -- | -- |
| *June* | <5.06 | <5.33 |
| *July* [a] | -- | -- |
| *August* [a] | -- | -- |
| *September* [a] | -- | -- |
| *October* [a] | -- | -- |
| *November* | <5.72 | <5.74 |
| *December* [a] | -- | -- |

Note: No results exceeded the permit limits.
[a] There was no discharge from outfall 001 during this month in 2021.

**TABLE B-2C**
**2021 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 | <0.06 | <0.06 | 0.0011 | 0.0011 | <0.0006 | <0.0006 | 0.06 | 0.08 |
| February [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| March [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| April [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| May [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| June | <0.06 | <0.06 | 0.0015 | 0.0015 | <0.0006 | <0.0006 | 0.133 | 0.188 |
| July [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| August [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| September [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| October [a] | -- | -- | -- | -- | -- | -- | -- | -- |
| November | <0.06 | <0.06 | <0.0015 | <0.0015 | <0.0006 | <0.0006 | 0.031 | 0.033 |
| 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 | 1.0 | 1.0 | <0.0004 | <0.0004 | <0.0015 | <0.0015 |
| February [a] | -- | -- | -- | -- | -- | -- |
| March [a] | -- | -- | -- | -- | -- | -- |
| April [a] | -- | -- | -- | -- | -- | -- |
| May [a] | -- | -- | -- | -- | -- | -- |
| June | 1.5 | 1.5 | <0.0004 | <0.0004 | <0.0015 | <0.0015 |
| July [a] | -- | -- | -- | -- | -- | -- |
| August [a] | -- | -- | -- | -- | -- | -- |
| September [a] | -- | -- | -- | -- | -- | -- |
| October [a] | -- | -- | -- | -- | -- | -- |
| November | 0.72 | 0.72 | <0.0006 | <0.0006 | <0.0015 | <0.0015 |
| December [a] | -- | -- | -- | -- | -- | -- |

Note: No results exceeded the permit limits.
[a] There was no discharge from outfall 001 during this month in 2021.

**TABLE B-2D**
**2021 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* | 0.06 | 0.06 |
| *February* [a] | -- | -- |
| *March* [a] | -- | -- |
| *April* [a] | -- | -- |
| *May* [a] | -- | -- |
| *June* | 0.13 | 0.13 |
| *July* [a] | -- | -- |
| *August* [a] | -- | -- |
| *September* [a] | -- | -- |
| *October* [a] | -- | -- |
| *November* | 0.031 | 0.031 |
| *December* [a] | -- | -- |

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 2021. Therefore, a calculated total iron is not required.

**TABLE B-2E**
**2021 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* | 369 | 374 |
| *February* [a] | -- | -- |
| *March* [a] | -- | -- |
| *April* [a] | -- | -- |
| *May* [a] | -- | -- |
| *June* | 388 | 420 |
| *July* [a] | -- | -- |
| *August* [a] | -- | -- |
| *September* [a] | -- | -- |
| *October* [a] | -- | -- |
| *November* | 230 | 262 |
| *December* [a] | -- | -- |

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 2021. Therefore, a calculated TDS at 116 is not required.

**TABLE B-2F**
**2021 Annual and Semiannual SPDES Results for Outfall 001:**
**Metals, Water Quality and Organic Compounds**

| *Permit Limit Parameters* | *Permit Limit* | *Monitoring Frequency* | *Sample Date* | *Annual/ Semiannual Concentrations* [a] |
|---|---|---|---|---|
| **2-Butanone** | 0.5 mg/L daily maximum | Annual | January 2021 | <0.002 |
| **3,3-Dichlorobenzidine** | 0.01 mg/L daily maximum | Annual | January 2021 | <0.0008 |
| **Alpha-BHC** | 0.01 ug/L daily maximum | Annual | January 2021 | <0.006 |
| **Cadmium, Total Recoverable** | 0.002 mg/L daily maximum | Annual | January 2021 | <0.00007 |
| **Chromium VI, Total Recoverable** | 0.011 mg/L daily maximum | Annual | January 2021 | <0.005 |
| **Chromium, Total Recoverable** | 0.11 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | 0.00058<br><0.0016 |
| **Copper, Total Recoverable** | 0.014mg/L daily maximum | Semiannual | January 2021<br>November 2021 | 0.00085<br><0.0017 |
| **Cyanide, Amenable to chlorination** | 0.005 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | <0.005<br><0.002 |
| **Dichlorodifluoromethane** | 0.01 mg/L daily maximum | Annual | January 2021 | <0.0003 |
| **Heptachlor** | 0.01 ug/L daily maximum | Semiannual | January 2021<br>November 2021 | <0.006<br><0.006 |
| **Hexachlorobenzene** | 0.2 ug/L daily maximum | Annual | January 2021 | <0.05 |
| **Lead, Total Recoverable** | 0.006 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | <0.0002<br><0.001 |
| **Manganese, Total** | 2.0 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | 0.007<br>0.014 |
| **Nickel, Total** | 0.079 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | 0.0013<br><0.0013 |
| **Tributyl phosphate** | 0.1 mg/L daily maximum | Annual | January 2021 | <0.0008 |
| **Trichlorofluoromethane** | 0.01 mg/L daily maximum | Annual | January 2021 | <0.0005 |
| **Xylene** | 0.05 mg/L daily maximum | Annual | January 2021 | <0.001 |
| **Zinc, Total Recoverable** | 0.13 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | 0.0035<br><0.0096 |

[a] Measured results are reported in the same units as the permit limits shown in this table.
NS = Not sampled.
Note: No results exceeded the permit limits.

**TABLE B-2G**
**2021 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* | *Annual/ Semiannual Concentrations* [a] |
|---|---|---|---|---|---|
| **001** | **Antimony, Total** | 1.0 mg/L daily maximum | Annual | January 2021 | <0.0068 |
| | **Barium, Total** | 0.5 mg/L daily maximum | Annual | January 2021 | 0.05 |
| | **Boron, Total** | 2.0 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | 0.035<br>0.044 |
| | **Bromide, Total** | 5.0 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | <0.37<br><0.37 |
| | **Chloroform** | 0.3 mg/L daily maximum | Annual | January 2021 | < 0.0005 |
| | **Titanium, Total** | 0.65 mg/L daily maximum | Semiannual | January 2021<br>November 2021 | <0.0011<br><0.011 |

[a] Measured results are reported in the same units as the permit limits shown in this table.
Note: No results exceeded the permit limits.

**TABLE B-2H**
**2021 SPDES Results for Outfall 01B (WNSP01B): Water Quality**

| |
|---|
| **Internal process monitoring point did not operate during 2021.** |

**TABLE B-2I**
**2021 Radioactivity Results for Sewage Treatment Outfall (WNSP007)**

| |
|---|
| **There were no discharges from the Sewage Treatment Plant in 2021.**<br>**SPDES outfall 007 was discontinued in November 2014.** |

**TABLE B-2J**

**2021 Paraquat Dichloride[a] Data in Areas of Herbicide Application**

| *Stormwater Outfalls* | | *Date* | *Units* | *Concentration* |
|---|---|---|---|---|
| Group 1 | S04 | 06/21/21 | mg/L | <0.0004 |
| | S04 | 10/25/21 | mg/L | <0.0003 |
| Group 2 | S06 | 06/21/21 | mg/L | <0.0004 |
| | S06 | 10/25/21 | mg/L | <0.0003 |
| | S33 | 10/25/21 | mg/L | <0.0003 |
| Group 3 | S09 | 06/14/21 | mg/L | <0.0004 |
| | S09 | 10/25/21 | mg/L | <0.0003 |
| | S12 | 06/21/21 | mg/L | <0.0004 |
| | S12 | 10/25/21 | mg/L | <0.0003 |
| Group 5 | S14 | 06/21/21 | mg/L | <0.0004 |
| | S14 | 10/25/21 | mg/L | <0.0003 |
| | S17 | 06/21/21 | mg/L | <0.0004 |
| | S17 | 10/25/21 | mg/L | <0.0003 |
| | S28 | 10/25/21 | mg/L | <0.0003 |
| Group 7 | S20 | 06/21/21 | mg/L | <0.0004 |
| | S20 | 10/25/21 | mg/L | <0.0003 |
| Group 8 | S27 | 10/25/21 | mg/L | <0.0003 |
| Lagoon | 001 | 06/21/21 | mg/L | <0.0004 |

[a] The site applied the herbicide Paraquat Dichloride in 2021. In accordance with the SPDES permit, sampling is required from storm water outfalls and process effluent outfalls within 60 days of herbicide application from the drainage basins potentially affected by the herbicide.

**TABLE B-2K**

**2021 SPDES Whole Effluent Toxicity (WET) Testing[a]**

| *SPDES Outfall* | *Date* | *Species* | *Acute Toxicity Test (survival)* | *Chronic Toxicity Test (survival and reproduction)* | *Interpretation* |
|---|---|---|---|---|---|
| 001 | January 2021 | Invertebrate Water Flea *(Ceriodaphnia dubia)* | 0.3 TUa | 1.0 TUc | WET testing performed in 2021 to support the Toxicity Identification/Reduction Evaluation (TI/RE). |
| 001 | June 2021 | Invertebrate Water Flea *(Ceriodaphnia dubia)* | 0.3 TUa | 1.0 TUc | |
| 001 | November 2021 | Invertebrate Water Flea *(Ceriodaphnia dubia)* | 0.3 TUa | 2.0 TUc | |

TUa = Toxicity Unit acute (Action Level = 0.3 TUa).
TUc = Toxicity Unit chronic (Action Level = 1.0 TUc).

[a] WET testing was performed in compliance with the sites SPDES permit that requires WET testing on a 5-year schedule

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# APPENDIX B-3

## SPDES-Permitted Storm Water Outfall Discharge Data

**TABLE B-3A**

**2021 Storm Water Discharge Monitoring Data for Outfall Group 1**

**STORM WATER OUTFALL S04 / DUPLICATE**

| *Paramater Group* | *Analyte* | *Units* | *First Flush Grab* | *Flow-weighted Composite* |
|---|---|---|---|---|
| | | | *04/29/21* | *04/29/21* |
| Group A Parameters | $BOD_5$ | mg/L | 5.9 / 4.7 | 3.2 |
| | Oil & Grease[a] | mg/L | 2.2 / 2.8 | NR |
| | pH | SU | 7.6 / 7.6 | NR |
| | Phosphorous, Total | mg/L | 0.14 / 0.13 | 0.10 |
| | Solids, Total Dissolved | mg/L | 2600 / 2500 | 1900 |
| | Solids, Total Suspended | mg/L | 75 / 75 | 52 |
| Group B Parameters | Aluminum, Total | mg/L | 1.1 / 1.3 | 1.6 |
| | Copper, Total Recoverable | mg/L | 0.0063/0.0061 | 0.0048 |
| | Iron, Total | mg/L | 1.2 / 1.2 | 1.4 |
| | Lead, Total Recoverable | mg/L | 0.0060/0.0059 | 0.0046 |
| | Zinc, Total Recoverable | mg/L | 0.034 / 0.032 | 0.027 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.28 / 0.30 | 0.19 |
| | Cadmium, Total Recoverable | mg/L | < 0.000071 / < 0.000071 | < 0.000071 |
| | Chromium, Hexavalent, Total Recoverable | mg/L | < 0.0050 / < 0.0050 | < 0.0050 |
| | Chromium, Total Recoverable | mg/L | 0.0034/0.0034 | 0.0030 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.43 / 0.45 | 0.31 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.074 / 0.091 | 0.090 |
| | Nitrogen, Total (as N) | mg/L | 1.5 / 1.8 | 1.3 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 0.95 / 1.3 | 0.93 |
| | Selenium, Total Recoverable | mg/L | < 0.00044 / < 0.00044 | < 0.00044 |
| | Vanadium, Total Recoverable | mg/L | 0.0046/0.0045 | 0.0042 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.6 | |
| | Rainfall During Sampling Event | inches | 0.30 | |
| Flow | Total Flow During Sampling Event | gallons | 210,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 1,500 | |

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)***
**2021 Storm Water Discharge Monitoring Data for Outfall Group 1**

**STORM WATER OUTFALL S04**

| *Paramater Group* | *Analyte* | *Units* | *First Flush Grab* | *Flow-weighted Composite* |
|---|---|---|---|---|
| | | | *08/11/21* | *08/11/21* |
| Group A Parameters | $BOD_5$ | mg/L | 18 | 11 |
| | Oil & Grease[a] | mg/L | 3.7 | NR |
| | pH | SU | 7.8 | NR |
| | Phosphorous, Total | mg/L | 0.19 | 0.13 |
| | Solids, Total Dissolved | mg/L | 540 | 1300 |
| | Solids, Total Suspended | mg/L | 270 | 96 |
| Group B Parameters | Aluminum, Total | mg/L | 4.8 | 3.1 |
| | Copper, Total Recoverable | mg/L | 0.013 | 0.0089 |
| | Iron, Total | mg/L | 7.8 | 3.8 |
| | Lead, Total Recoverable | mg/L | 0.014 | 0.0069 |
| | Zinc, Total Recoverable | mg/L | 0.11 | 0.060 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.047 | 0.12 |
| | Cadmium, Total Recoverable | mg/L | 0.00018 | 0.000082 |
| | Chromium, Hexavalent, Total Recoverable | mg/L | < 0.0050 | < 0.0050 |
| | Chromium, Total Recoverable | mg/L | 0.0076 | 0.0037 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.55 | 0.48 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.033 | 0.027 |
| | Nitrogen, Total (as N) | mg/L | 2.6 | 1.8 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 2.0 | 1.3 |
| | Selenium, Total Recoverable | mg/L | 0.00085 | < 0.00044 |
| | Vanadium, Total Recoverable | mg/L | 0.0063 | 0.0042 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.8 | |
| | Rainfall During Sampling Event | inches | 0.15 | |
| Flow | Total Flow During Sampling Event | gallons | 310,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 8,000 | |

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-3B**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 2**

**STORM WATER OUTFALL S06**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***06/21/21*** | ***06/21/21*** |
| Group A Parameters | $BOD_5$ | mg/L | < 1.0 | < 1.0 |
| | Oil & Grease[a] | mg/L | < 1.5 | NR |
| | pH | SU | 7.2 | NR |
| | Phosphorous, Total | mg/L | < 0.020 | 0.051 |
| | Solids, Total Dissolved | mg/L | 1,200 | 1,100 |
| | Solids, Total Suspended | mg/L | 9.0 | 4.9 |
| Group B Parameters | Aluminum, Total | mg/L | 0.021 | < 0.019 |
| | Copper, Total Recoverable | mg/L | 0.00059 | 0.00040 |
| | Iron, Total | mg/L | 1.1 | 1.3 |
| | Lead, Total Recoverable | mg/L | < 0.00050 | < 0.00050 |
| | Zinc, Total Recoverable | mg/L | 0.012 | 0.0050 |
| Group C Parameters | Surfactant (as LAS) | mg/L | 0.0077 | 0.0077 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 8.0 | |
| | Rainfall During Sampling Event | inches | 1.05 | |
| Flow | Total Flow During Sampling Event | gallons | 9,500 | |
| | Maximum Flow Rate During Sampling Event | gpm | 61 | |

gpm - gallons per minute.
NM - Not measured due to instrument calibration problems.
NR - Not required by permit.
[a] The SPDES permit specifies that oil and grease concentration shall not exceed 15 mg/L.

**TABLE B-3B *(concluded)***
**2021 Storm Water Discharge Monitoring Data for Outfall Group 2**

**STORM WATER OUTFALL S33**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***09/08/21*** | ***09/08/21*** |
| Group A Parameters | $BOD_5$ | mg/L | 4.0 | 7.5 |
| | Oil & Grease[a] | mg/L | 1.9 | NR |
| | pH | SU | 7.3 | NR |
| | Phosphorous, Total | mg/L | 0.74 | 0.85 |
| | Solids, Total Dissolved | mg/L | 1200 | 540 |
| | Solids, Total Suspended | mg/L | 350 | 230 |
| Group B Parameters | Aluminum, Total | mg/L | 4.8 | 1.6 |
| | Copper, Total Recoverable | mg/L | 0.011 | 0.0044 |
| | Iron, Total | mg/L | 27 | 27 |
| | Lead, Total Recoverable | mg/L | 0.021 | 0.0050 |
| | Zinc, Total Recoverable | mg/L | 0.096 | 0.042 |
| Group C Parameters | Surfactant (as LAS) | mg/L | 0.072 | 0.20 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.8 | |
| | Rainfall During Sampling Event | inches | 0.37 | |
| Flow | Total Flow During Sampling Event | gallons | 46,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 320 | |

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**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 3**

**STORM WATER OUTFALL S09**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***06/14/21*** | ***06/14/21*** |
| Group A Parameters | $BOD_5$ | mg/L | 5.2 | 9.5 |
| | Oil & Grease[a] | mg/L | 5.3 | NR |
| | pH | SU | 7.8 | NR |
| | Phosphorous, Total | mg/L | 0.061 | 0.56 |
| | Solids, Total Dissolved | mg/L | 6800 | 1900 |
| | Solids, Total Suspended | mg/L | 77 | 210 |
| Group B Parameters | Aluminum, Total | mg/L | 0.49 | 11 |
| | Copper, Total Recoverable | mg/L | 0.0049 | 0.022 |
| | Iron, Total | mg/L | 0.96 | 13 |
| | Lead, Total Recoverable | mg/L | 0.0022 | 0.030 |
| | Zinc, Total Recoverable | mg/L | 0.020 | 0.19 |
| Group C Parameters | Alpha BHC | mg/L | < 0.0000062 | < 0.0000068 |
| | Ammonia (as $NH_3$) | mg/L | 0.079 | 0.12 |
| | Mercury, Total[b] (1631E) | ng/L | 43 | NR |
| | Nitrogen, Nitrate (as N) | mg/L | 0.084 | 0.43 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.036 | 0.036 |
| | Nitrogen, Total (as N) | mg/L | 1.4 | 2.4 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 1.3 R | 1.9 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 8.1 | |
| | Rainfall During Sampling Event | inches | 0.27 | |
| Flow | Total Flow During Sampling Event | gallons | 20,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 530 | |

gpm - gallons per minute.
NR - Not required by permit.
R - The result was flagged as unreliable.
[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)***
**2021 Storm Water Discharge Monitoring Data for Outfall Group 3**

**STORM WATER OUTFALL S12**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***10/26/21*** | ***10/26/21*** |
| Group A Parameters | $BOD_5$ | mg/L | < 1.0 | 1.2 |
| | Oil & Grease[a] | mg/L | < 1.7 | NR |
| | pH | SU | 6.9 | NR |
| | Phosphorous, Total | mg/L | 0.041 | 0.028 |
| | Solids, Total Dissolved | mg/L | 1300 | 1200 |
| | Solids, Total Suspended | mg/L | 4.0 | 2.2 |
| Group B Parameters | Aluminum, Total | mg/L | 0.12 | 0.076 |
| | Copper, Total Recoverable | mg/L | < 0.0030 | < 0.0030 |
| | Iron, Total | mg/L | 0.40 | 0.26 |
| | Lead, Total Recoverable | mg/L | < 0.0033 | < 0.0033 |
| | Zinc, Total Recoverable | mg/L | 0.012 | 0.011 |
| Group C Parameters | Alpha BHC | mg/L | < 0.0000067 | < 0.0000062 |
| | Ammonia (as $NH_3$) | mg/L | 0.094 | 0.079 |
| | Mercury, Total[b] (1631E) | ng/L | 2.5 | NR |
| | Nitrogen, Nitrate (as N) | mg/L | 0.53 | 0.57 |
| | Nitrogen, Nitrite (as N) | mg/L | < 0.33 | < 0.33 |
| | Nitrogen, Total (as N) | mg/L | < 1.2 | < 1.3 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 0.39 | 0.39 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 5.7 | |
| | Rainfall During Sampling Event | inches | 0.39 | |
| Flow | Total Flow During Sampling Event | gallons | 160,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 970 | |

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**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 4**

**STORM WATER OUTFALL S34**

| *Paramater Group* | *Analyte* | *Units* | *First Flush Grab* | *Flow-weighted Composite* |
|---|---|---|---|---|
| | | | *06/14/21* | *06/14/21* |
| Group A Parameters | $BOD_5$ | mg/L | 7.3 | 6.8 |
| | Oil & Grease[a] | mg/L | 3.6 | NR |
| | pH | SU | 7.3 | NR |
| | Phosphorous, Total | mg/L | 0.14 | 0.50 |
| | Solids, Total Dissolved | mg/L | 1300 | 1400 |
| | Solids, Total Suspended | mg/L | 120 | 210 |
| Group B Parameters | Aluminum, Total | mg/L | 3.7 | 9.9 |
| | Copper, Total Recoverable | mg/L | 0.0069 | 0.017 |
| | Iron, Total | mg/L | 5.5 | 13 |
| | Lead, Total Recoverable | mg/L | 0.010 | 0.041 |
| | Zinc, Total Recoverable | mg/L | 0.060 | 0.18 |
| Group C Parameters | Surfactant (as LAS) | mg/L | 0.14 | 0.14 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 8.1 | |
| | Rainfall During Sampling Event | inches | 0.27 | |
| Flow | Total Flow During Sampling Event | gallons | 210,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 3,070 | |

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-3D *(concluded)***
**2021 Storm Water Discharge Monitoring Data for Outfall Group 4**

**STORM WATER OUTFALL S34**

| *Paramater Group* | *Analyte* | *Units* | *First Flush Grab* | *Flow-weighted Composite* |
|---|---|---|---|---|
| | | | *09/08/21* | *09/08/21* |
| Group A Parameters | $BOD_5$ | mg/L | 3.1 / 2.7 | 2.4 |
| | Oil & Grease[a] | mg/L | 2.7 / 2.4 | NR |
| | pH | SU | 7.2 | NR |
| | Phosphorous, Total | mg/L | 0.57 / 0.74 | 0.31 |
| | Solids, Total Dissolved | mg/L | 290 / 370 | 250 |
| | Solids, Total Suspended | mg/L | 470 / 420 | 350 |
| Group B Parameters | Aluminum, Total | mg/L | 12 / 11 | 7.7 |
| | Copper, Total Recoverable | mg/L | 0.023 / 0.024 | 0.014 |
| | Iron, Total | mg/L | 15 / 16 | 8.2 |
| | Lead, Total Recoverable | mg/L | 0.070 / 0.072 | 0.043 |
| | Zinc, Total Recoverable | mg/L | 0.32 / 0.29 | 0.16 |
| Group C Parameters | Surfactant (as LAS) | mg/L | 0.069 / 0.068 | 0.065 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.8 | |
| | Rainfall During Sampling Event | inches | 0.37 | |
| Flow | Total Flow During Sampling Event | gallons | 120,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 3,000 | |

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-3E**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 5**

**STORM WATER OUTFALL S28**

| Paramater Group | Analyte | Units | First Flush Grab | Flow-weighted Composite |
|---|---|---|---|---|
| | | | 04/29/21 | 04/29/21 |
| Group A Parameters | $BOD_5$ | mg/L | 6.3 | 4.9 |
| | Oil & Grease[a] | mg/L | 2.0 | NR |
| | pH | SU | 7.9 | NR |
| | Phosphorous, Total | mg/L | 0.31 | 0.38 |
| | Solids, Total Dissolved | mg/L | 2600 | 2300 |
| | Solids, Total Suspended | mg/L | 190 | 200 |
| Group B Parameters | Aluminum, Total | mg/L | 6.7 | 5.0 |
| | Copper, Total Recoverable | mg/L | 0.017 | 0.017 |
| | Iron, Total | mg/L | 5.8 | 4.3 |
| | Lead, Total Recoverable | mg/L | 0.014 | 0.025 |
| | Zinc, Total Recoverable | mg/L | 0.036 | 0.051 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.034 | 0.026 |
| | Nitrogen, Nitrate (as N) | mg/L | < 0.020 | < 0.020 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.074 | 0.069 |
| | Nitrogen, Total (as N) | mg/L | < 1.8 | < 1.5 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 1.7 | 1.4 |
| | Settleable Solids | ml/L | 1.0 | 0.4 |
| | Sulfide | mg/L | < 0.67 | < 0.67 |
| | Surfactant (as LAS) | mg/L | < 0.013 | < 0.013 |
| | Vanadium, Total Recoverable | mg/L | 0.0093 | 0.011 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.6 | |
| | Rainfall During Sampling Event | inches | 0.30 | |
| Flow | Total Flow During Sampling Event | gallons | 110,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 814 | |

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 *(concluded)***

**2021 Storm Water Discharge Monitoring Data for Outfall Group 5**

**STORM WATER OUTFALL S14**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***09/15/21*** | ***09/15/21*** |
| Group A Parameters | $BOD_5$ | mg/L | 6.1 | 8.4 |
| | Oil & Grease[a] | mg/L | 2.1 | NR |
| | pH | SU | 7.4 | NR |
| | Phosphorous, Total | mg/L | 0.21 | 0.11 |
| | Solids, Total Dissolved | mg/L | 730 | 650 |
| | Solids, Total Suspended | mg/L | 49 | 25 |
| Group B Parameters | Aluminum, Total | mg/L | 0.43 | 0.74 |
| | Copper, Total Recoverable | mg/L | 0.0016 | 0.0019 |
| | Iron, Total | mg/L | 8.2 | 2.5 |
| | Lead, Total Recoverable | mg/L | 0.0025 | 0.0014 |
| | Zinc, Total Recoverable | mg/L | 0.0083 | 0.0061 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.037 | 0.020 |
| | Nitrogen, Nitrate (as N) | mg/L | < 0.020 | < 0.020 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.027 | 0.035 |
| | Nitrogen, Total (as N) | mg/L | < 2.7 | < 1.7 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 2.7 | 1.6 |
| | Settleable Solids | ml/L | 2.0 | 0.3 |
| | Sulfide | mg/L | < 0.67 | < 0.67 |
| | Surfactant (as LAS) | mg/L | 0.043 | 0.059 |
| | Vanadium, Total Recoverable | mg/L | < 0.0012 | 0.0019 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.9 | |
| | Rainfall During Sampling Event | inches | 0.51 | |
| Flow | Total Flow During Sampling Event | gallons | 1,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 10 | |

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-3F**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 6**

**STORM WATER OUTFALL S42**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***06/21/21*** | ***06/21/21*** |
| Group A Parameters | $BOD_5$ | mg/L | < 2.0 | < 2.0 |
| | Oil & Grease[a] | mg/L | 3.4 | NR |
| | pH | SU | 8.1 | NR |
| | Phosphorous, Total | mg/L | 0.19 | 0.04 |
| | Solids, Total Dissolved | mg/L | 890 | 640 |
| | Solids, Total Suspended | mg/L | 180 | 27 |
| Group B Parameters | Aluminum, Total | mg/L | 4.5 | 0.98 |
| | Copper, Total Recoverable | mg/L | 0.012 | 0.0029 |
| | Iron, Total | mg/L | 11 | 1.6 |
| | Lead, Total Recoverable | mg/L | 0.010 | 0.0014 |
| | Zinc, Total Recoverable | mg/L | 0.033 | 0.0062 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | < 0.10 | < 0.10 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.025 | 0.19 |
| | Nitrogen, Nitrite (as N) | mg/L | < 0.020 | 0.024 |
| | Nitrogen, Total (as N) | mg/L | < 1.5 | 0.55 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 1.2 | 0.34 |
| | Solids, Settleable | ml/L | 1.8 | 0.3 |
| | Sulfide | mg/L | < 0.67 | < 0.67 |
| | Surfactant (as LAS) | mg/L | 0.027 | 0.055 |
| | Vanadium, Total Recoverable | mg/L | 0.0084 | 0.0029 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 8.0 | |
| | Rainfall During Sampling Event | inches | 1.05 | |
| Flow | Total Flow During Sampling Event | gallons | 7,500 | |
| | Maximum Flow Rate During Sampling Event | gpm | 60 | |

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: A storm water sample was collected on June 21, 2021 from outfall S43 in outfall group 6 and analyzed for total recoverable lead with a result of 0.003 mg/L. (Action Level = 0.006 mg/L).

**TABLE B-3F *(concluded)***
**2021 Storm Water Discharge Monitoring Data for Outfall Group 6**

**STORM WATER OUTFALL S36**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***10/26/21*** | ***10/26/21*** |
| Group A Parameters | $BOD_5$ | mg/L | < 2.0 | < 2.0 |
| | Oil & Grease[a] | mg/L | 1.7 | NR |
| | pH | SU | 7.3 | NR |
| | Phosphorous, Total | mg/L | 0.0071 | 0.028 |
| | Solids, Total Dissolved | mg/L | 190 | 160 |
| | Solids, Total Suspended | mg/L | < 4.0 | < 4.0 |
| Group B Parameters | Aluminum, Total | mg/L | < 0.060 | 0.26 |
| | Copper, Total Recoverable | mg/L | 0.00059 | 0.00086 |
| | Iron, Total | mg/L | 0.080 | 0.24 |
| | Lead, Total Recoverable | mg/L | < 0.00017 | 0.00032 |
| | Zinc, Total Recoverable | mg/L | 0.0063 | 0.0065 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | < 0.0090 | < 0.0090 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.089 | 0.092 |
| | Nitrogen, Nitrite (as N) | mg/L | < 0.025 | < 0.025 |
| | Nitrogen, Total (as N) | mg/L | < 0.30 | < 0.31 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | < 0.19 | < 0.19 |
| | Solids, Settleable | ml/L | < 0.1 | < 0.1 |
| | Sulfide | mg/L | < 0.67 | < 0.67 |
| | Surfactant (as LAS) | mg/L | < 0.013 | < 0.013 |
| | Vanadium, Total Recoverable | mg/L | < 0.0012 | < 0.0012 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 5.7 | |
| | Rainfall During Sampling Event | inches | 0.39 | |
| Flow | Total Flow During Sampling Event | gallons | 11,000 | |
| | 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.

NOTE: A storm water sample was collected on October 26, 2021 from outfall S43 in outfall group 6 and analyzed for total recoverable lead with a result of 0.0009 mg/L. (Action Level = 0.006 mg/L).

**TABLE B-3G**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 7**

**STORM WATER OUTFALL S20**

| *Paramater Group* | *Analyte* | *Units* | *First Flush Grab* | *Flow-weighted Composite* |
|---|---|---|---|---|
| | | | *05/25/21* | *05/25/21* |
| Group A Parameters | $BOD_5$ | mg/L | 74 | 17 |
| | Oil & Grease[a] | mg/L | 3.7 | NR |
| | pH | SU | 7.2 | NR |
| | Phosphorous, Total | mg/L | 0.30 | 0.18 |
| | Solids, Total Dissolved | mg/L | 90 | 40 |
| | Solids, Total Suspended | mg/L | 130 | 34 |
| Group B Parameters | Aluminum, Total | mg/L | 2.9 | 0.70 |
| | Copper, Total Recoverable | mg/L | 0.0077 | 0.0036 |
| | Iron, Total | mg/L | 4.8 | 1.5 |
| | Lead, Total Recoverable | mg/L | 0.0086 | 0.0030 |
| | Zinc, Total Recoverable | mg/L | 0.043 | 0.018 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 1.3 | 0.92 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.72 | 0.50 |
| | Nitrogen, Nitrite (as N) | mg/L | < 0.020 | < 0.020 |
| | Nitrogen, Total (as N) | mg/L | < 8.5 | < 3.2 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 7.8 | 2.7 |
| | Sulfide | mg/L | < 0.67 | < 0.67 |
| | Surfactant (as LAS) | mg/L | 0.10 | 0.041 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 5.6 | |
| | Rainfall During Sampling Event | inches | 0.31 | |
| Flow | Total Flow During Sampling Event | gallons | 198,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 4,600 | |

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-3G *(concluded)***
**2021 Storm Water Discharge Monitoring Data for Outfall Group 7**

**STORM WATER OUTFALL S20**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***08/11/21*** | ***08/11/21*** |
| Group A Parameters | $BOD_5$ | mg/L | 13 | 5.7 |
| | Oil & Grease[a] | mg/L | 3.9 | NR |
| | pH | SU | 6.8 | NR |
| | Phosphorous, Total | mg/L | 0.12 | 0.012 |
| | Solids, Total Dissolved | mg/L | 6.0 | < 4.0 |
| | Solids, Total Suspended | mg/L | 52 | 8.4 |
| Group B Parameters | Aluminum, Total | mg/L | 0.60 | 0.15 |
| | Copper, Total Recoverable | mg/L | 0.0026 | 0.0012 |
| | Iron, Total | mg/L | 0.89 | 0.19 |
| | Lead, Total Recoverable | mg/L | 0.0014 | 0.00053 |
| | Zinc, Total Recoverable | mg/L | 0.012 | 0.0049 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.82 | 0.55 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.53 | 0.40 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.029 | 0.046 |
| | Nitrogen, Total (as N) | mg/L | 2.5 | 1.4 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 1.9 | 1.0 |
| | Sulfide | mg/L | < 0.67 | < 0.67 |
| | Surfactant (as LAS) | mg/L | < 0.013 | < 0.013 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.8 | |
| | Rainfall During Sampling Event | inches | 0.15 | |
| Flow | Total Flow During Sampling Event | gallons | 53,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 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.

**TABLE B-3H**
**2021 Storm Water Discharge Monitoring Data for Outfall Group 8**

**STORM WATER OUTFALL S27**

| Paramater Group | Analyte | Units | First Flush Grab | Flow-weighted Composite |
|---|---|---|---|---|
| | | | 04/29/21 | 04/29/21 |
| Group A Parameters | $BOD_5$ | mg/L | 7.5 | 8.2 |
| | Oil & Grease[a] | mg/L | 2.7 | NR |
| | pH | SU | 7.7 | NR |
| | Phosphorous, Total | mg/L | 0.52 | 0.14 |
| | Solids, Total Dissolved | mg/L | 2700 | 1700 |
| | Solids, Total Suspended | mg/L | 210 | 110 |
| Group B Parameters | Aluminum, Total | mg/L | 6.0 | 0.99 |
| | Copper, Total Recoverable | mg/L | 0.012 | 0.0056 |
| | Iron, Total | mg/L | 6.0 | 0.95 |
| | Lead, Total Recoverable | mg/L | 0.034 | 0.0095 |
| | Zinc, Total Recoverable | mg/L | 0.084 | 0.023 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.072 | 0.057 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.16 | 0.084 |
| | Nitrogen, Nitrite (as N) | mg/L | 0.080 | 0.079 |
| | Nitrogen, Total (as N) | mg/L | 2.8 | 2.1 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 2.6 | 1.9 |
| | Surfactant (as LAS) | mg/L | < 0.013 | 0.014 |
| **Rain Event Summary** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 6.6 | |
| | Rainfall During Sampling Event | inches | 0.30 | |
| Flow | Total Flow During Sampling Event | gallons | 4,200 | |
| | 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.

**TABLE B-3H *(concluded)***

**2021 Storm Water Discharge Monitoring Data for Outfall Group 8**

**STORM WATER OUTFALL S35**

| ***Paramater Group*** | ***Analyte*** | ***Units*** | ***First Flush Grab*** | ***Flow-weighted Composite*** |
|---|---|---|---|---|
| | | | ***10/26/21*** | ***10/26/21*** |
| Group A Parameters | $BOD_5$ | mg/L | < 2.0 | < 2.0 |
| | Oil & Grease[a] | mg/L | 1.8 | NR |
| | pH | SU | 6.9 | NR |
| | Phosphorous, Total | mg/L | 0.12 | < 0.0050 |
| | Solids, Total Dissolved | mg/L | 440 | 290 |
| | Solids, Total Suspended | mg/L | 68 | 14 |
| Group B Parameters | Aluminum, Total | mg/L | 3.0 | 1.0 |
| | Copper, Total Recoverable | mg/L | 0.0034 | 0.0019 |
| | Iron, Total | mg/L | 2.7 | 0.62 |
| | Lead, Total Recoverable | mg/L | 0.0062 | 0.0012 |
| | Zinc, Total Recoverable | mg/L | 0.028 | 0.016 |
| Group C Parameters | Ammonia (as $NH_3$) | mg/L | 0.013 | < 0.0090 |
| | Nitrogen, Nitrate (as N) | mg/L | 0.47 | 0.16 |
| | Nitrogen, Nitrite (as N) | mg/L | < 0.025 | < 0.025 |
| | Nitrogen, Total (as N) | mg/L | < 1.5 | < 0.38 |
| | Nitrogen, Total Kjeldahl (as N) | mg/L | 0.97 | < 0.19 |
| | Surfactant (as LAS) | mg/L | < 0.013 | 0.050 |
| ***Rain Event Summary*** | | | | |
| Rainfall | pH of Rainfall During Sampling Event | SU | 5.7 | |
| | Rainfall During Sampling Event | inches | 0.39 | |
| Flow | Total Flow During Sampling Event | gallons | 24,000 | |
| | Maximum Flow Rate During Sampling Event | gpm | 230 | |

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 2021 Radioactivity Concentrations in Surface Water at the Northeast Swamp (WNSWAMP) With U.S. DOE-Derived Concentration Standards (DCSs)**

| Isotope [a] | N | Discharge Activity [b] | | Flow-Weighted Mean Concentration | DCS [d] | Ratio of Mean Concentration to DCS |
|---|---|---|---|---|---|---|
| | | (Ci) | (Becquerels) [c] | (µCi/mL) | (µCi/mL) | |
| **Gross Alpha** | 27 | 1.23±1.35E-04 | 4.55±5.01E+06 | 1.16±1.28E-09 | 9.8E-08[e] | NA |
| **Gross Beta** | 27 | 1.24±0.01E-01 | 4.59±0.02E+09 | 1.17±0.01E-06 | 1.1E-06[e] | NA |
| **Tritium** | 12 | 4.66±2.88E-03 | 1.73±1.07E+08 | 4.40±2.72E-08 | 1.9E-03 | < 0.0001 |
| **C-14** | 2 | 0.80±1.72E-03 | 2.95±6.37E+07 | 0.75±1.62E-08 | 6.2E-05 | < 0.0003 |
| **Sr-90** | 12 | 7.11±0.06E-02 | 2.63±0.02E+09 | 6.70±0.06E-07 | 1.1E-06 | 0.61 |
| **I-129** | 2 | 0.78±3.74E-05 | 0.29±1.38E+06 | 0.74±3.52E-10 | 3.3E-07 | < 0.0011 |
| **Cs-137** | 12 | -3.08±7.22E-05 | -1.14±2.67E+06 | -2.90±6.81E-10 | 3.0E-06 | < 0.0002 |
| **U-232**[f] | 2 | 0.57±1.58E-05 | 2.10±5.86E+05 | 0.54±1.49E-10 | 9.8E-08 | < 0.0015 |
| **U-233/234**[f] | 2 | 1.93±0.94E-05 | 7.13±3.47E+05 | 1.82±0.88E-10 | 6.6E-07[g] | 0.0003 |
| **U-235/236**[f] | 2 | 3.09±5.24E-06 | 1.14±1.94E+05 | 2.91±4.94E-11 | 7.2E-07 | < 0.0001 |
| **U-238**[f] | 2 | 9.52±7.36E-06 | 3.52±2.72E+05 | 8.98±6.94E-11 | 7.5E-07 | 0.0001 |
| **Pu-238** | 2 | 1.71±2.61E-06 | 6.32±9.67E+04 | 1.61±2.47E-11 | 1.5E-07 | < 0.0002 |
| **Pu-239/240** | 2 | 0.94±3.02E-06 | 0.35±1.12E+05 | 0.89±2.85E-11 | 1.4E-07 | < 0.0002 |
| **Am-241** | 2 | 1.26±1.87E-06 | 4.64±6.92E+04 | 1.18±1.76E-11 | 1.7E-07 | < 0.0001 |
| **Sum of Ratios** | | | | | | **0.61** |

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; ratio calculated from isotopic data.

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

[b] Total estimated volume released: 1.06E+11 mL (2.80+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] The representative DCS for gross alpha in water shown is for U-232 and for gross beta is for Sr-90 (selected as the most restrictive) since DCSs do not exist for indicator parameters.

[f] Total Uranium (g) = 4.30±0.63E+01; Average Total Uranium (µg/mL) =4.05±0.60E-04.

[g] The DCS for Uranium-233 is used for this comparison.

**TABLE B-4B**
**Comparison of 2021 Radioactivity Concentrations in Surface Water at the North Swamp (WNSW74A) With U.S. DOE-Derived Concentration Standards (DCSs)**

| Isotope [a] | N | Discharge Activity [b] | | Mean Concentration | DCS [d] | Ratio of Average Concentration to DCS |
|---|---|---|---|---|---|---|
| | | (Ci) | (Becquerels) [c] | (µCi/mL) | (µCi/mL) | |
| **Gross Alpha** | 27 | 0.32±1.21E-04 | 1.17±4.49E+06 | 0.65±2.50E-09 | 9.8E-08[e] | NA |
| **Gross Beta** | 27 | 3.57±0.14E-03 | 1.32±0.05E+08 | 7.34±0.29E-08 | 1.1E-06[e] | NA |
| **Tritium** | 12 | 2.00±1.12E-03 | 7.40±4.15E+07 | 4.12±2.31E-08 | 1.9E-03 | < 0.0001 |
| **C-14** | 2 | -3.16±8.17E-04 | -1.17±3.02E+07 | -0.65±1.68E-08 | 6.2E-05 | < 0.0003 |
| **Sr-90** | 12 | 1.94±0.04E-03 | 7.19±0.16E+07 | 4.00±0.09E-08 | 1.1E-06 | 0.036 |
| **I-129** | 2 | 1.31±3.06E-05 | 0.49±1.13E+06 | 2.70±6.29E-10 | 3.3E-07 | < 0.0019 |
| **Cs-137** | 12 | 3.43±3.95E-05 | 1.27±1.46E+06 | 7.06±8.13E-10 | 3.0E-06 | < 0.0003 |
| **U-232**[f] | 2 | 0.82±8.34E-06 | 0.30±3.09E+05 | 0.17±1.72E-10 | 9.8E-08 | < 0.0018 |
| **U-233/234**[f] | 2 | 8.13±3.28E-06 | 3.01±1.22E+05 | 1.67±0.68E-10 | 6.6E-07[g] | 0.0003 |
| **U-235/236**[f] | 2 | 0.53±1.36E-06 | 1.98±5.03E+04 | 1.10±2.79E-11 | 7.2E-07 | < 0.0001 |
| **U-238**[f] | 2 | 5.07±2.76E-06 | 1.88±1.02E+05 | 1.04±0.57E-10 | 7.5E-07 | 0.0001 |
| **Pu-238** | 2 | -1.43±7.91E-07 | -0.53±2.92E+04 | -0.29±1.63E-11 | 1.5E-07 | < 0.0001 |
| **Pu-239/240** | 2 | 0.17±1.15E-06 | 0.62±4.24E+04 | 0.35±2.36E-11 | 1.4E-07 | < 0.0002 |
| **Am-241** | 2 | 4.06±8.40E-07 | 1.50±3.11E+04 | 0.83±1.73E-11 | 1.7E-07 | < 0.0001 |
| **Sum of Ratios** | | | | | | < **0.041** |

Notes: Discharge activity represents the sum of activity released per sampling period. Curies released are based on the estimated monthly 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: 4.86E+10 mL (1.28+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] The representative DCS for gross alpha in water shown is for U-232 and for gross beta is for Sr-90 (selected as the most restrictive) since DCSs do not exist for indicator parameters.

[f] Total Uranium (g) = 1.64±0.25E+01 ; Average Total Uranium (µg/mL) = 3.38±0.50E-04.

[g] The DCS for Uranium-233 is used for this comparison.

**TABLE B-4C**
**2021 Radioactivity and pH in Surface Water at Facility Yard Drainage (WNSP005)**

| Analyte | Units | N | WNSP005 Concentrations | | Guideline [a] or Standard [b] |
|---|---|---|---|---|---|
| | | | Average | Maximum | |
| **Gross Alpha** | µCi/mL | 4 | 9.61±8.42E-09 | 1.26E-08 | 9.8E-08[c] |
| **Gross Beta** | µCi/mL | 4 | 2.54±0.03E-06 | 3.52E-06 | 1.1E-06[d] |
| **Tritium** | µCi/mL | 4 | 7.43±8.99E-08 | 2.62E-07 | 1.9E-03 |
| **Sr-90** | µCi/mL | 2 | 1.44±0.03E-06 | 1.85E-06 | 1.1E-06 |
| **Cs-137** | µCi/mL | 2 | 0.56±1.36E-09 | < 1.37E-09 | 3.0E-06 |
| **pH** | SU | 4 | 7.0 - 7.4 | | 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 nonradiological results.
[c] Alpha as U-232.
[d] Beta as Sr-90.

**TABLE B-4D**
**2021 Radioactivity of Surface Water Downstream of the WVDP at Franks Creek (WNSP006)**

| Analyte | Units | N | WNSP006 Concentrations | | N | Reference Values | |
|---|---|---|---|---|---|---|---|
| | | | | | | WFBCBKG [a] Background Range | Guideline [b] |
| | | | Average | Maximum | | | |
| **Gross Alpha** | µCi/mL | 27 | 0.32±1.80E-09 | 4.84E-09 | 12 | < 4.85E-10 - 1.38E-09 | 9.8E-08[c] |
| **Gross Beta** | µCi/mL | 27 | 6.68±0.27E-08 | 1.81E-07 | 12 | < 9.59E-10 - 3.24E-09 | 1.1E-06[d] |
| **Tritium** | µCi/mL | 12 | 5.18±7.80E-08 | 1.11E-07 | 12 | < 7.02E-08 - 8.76E-08 | 1.9E-03 |
| **C-14** | µCi/mL | 4 | -1.11±2.61E-08 | < 3.01E-08 | 2 | < 1.90E-08 - < 2.72E-08 | 6.2E-05 |
| **Sr-90** | µCi/mL | 12 | 3.14±0.26E-08 | 6.18E-08 | 2 | < 4.79E-10 - < 1.08E-09 | 1.1E-06 |
| **Tc-99** | µCi/mL | 4 | -0.10±2.30E-09 | < 2.83E-09 | 2 | < 1.90E-09 - < 2.46E-09 | 4.4E-05 |
| **I-129** | µCi/mL | 4 | -0.87±5.84E-10 | < 7.76E-10 | 2 | 8.29E-10 - 8.29E-10 | 3.3E-07 |
| **Cs-137** | µCi/mL | 12 | 0.49±2.71E-09 | 5.88E-09 | 2 | < 2.11E-09 - < 2.27E-09 | 3.0E-06 |
| **U-232** | µCi/mL | 4 | 0.30±1.39E-10 | 1.80E-10 | 2 | < 7.84E-11 - < 3.48E-10 | 9.8E-08 |
| **U-233/234** | µCi/mL | 4 | 2.04±1.03E-10 | 2.38E-10 | 2 | < 7.03E-11 - 1.09E-10 | 6.6E-07[e] |
| **U-235/236** | µCi/mL | 4 | 4.26±5.34E-11 | 9.23E-11 | 2 | < 3.02E-11 - < 6.66E-11 | 7.2E-07 |
| **U-238** | µCi/mL | 4 | 1.31±0.81E-10 | 1.73E-10 | 2 | < 4.88E-11 - < 7.55E-11 | 7.5E-07 |
| **Total U** | µg/mL | 4 | 5.20±1.07E-04 | 7.16E-04 | 2 | 1.31E-04 - 1.59E-04 | -- |
| **Pu-238** | µCi/mL | 4 | 0.59±3.35E-11 | < 3.99E-11 | 2 | < 2.16E-11 - < 2.41E-11 | 1.5E-07 |
| **Pu-239/240** | µCi/mL | 4 | 0.64±3.78E-11 | < 4.55E-11 | 2 | < 3.04E-11 - < 3.31E-11 | 1.4E-07 |
| **Am-241** | µCi/mL | 4 | 1.49±2.70E-11 | < 3.68E-11 | 2 | < 2.48E-11 - 3.32E-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**
**2021 Radioactivity in Surface Water Drainage Between the NDA and SDA (WNNDADR)**

| Analyte | Units | N | WNNDADR Concentrations | | Guideline [a] |
|---|---|---|---|---|---|
| | | | Average | Maximum | |
| **Gross Alpha** | µCi/mL | 12 | 0.89±1.00E-09 | 2.54E-09 | 9.8E-08[b] |
| **Gross Beta** | µCi/mL | 12 | 1.53±0.13E-08 | 3.87E-08 | 1.1E-06[c] |
| **Tritium** | µCi/mL | 12 | 1.92±0.91E-07 | 5.24E-07 | 1.9E-03 |
| **Sr-90** | µCi/mL | 2 | 4.49±1.26E-09 | 5.95E-09 | 1.1E-06 |
| **I-129** | µCi/mL | 2 | 0.24±5.85E-10 | < 7.26E-10 | 3.3E-07 |
| **Cs-137** | µCi/mL | 12 | 0.77±2.50E-09 | 2.17E-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**
**2021 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 | 0.11±1.49E-09 | < 2.47E-09 | 12 | < 4.85E-10 - 1.38E-09 | 9.8E-08[d] |
| **Gross Beta** | µCi/mL | 4 | 3.77±1.19E-09 | 5.92E-09 | 12 | < 9.59E-10 - 3.24E-09 | 1.1E-06[e] |
| **Tritium** | µCi/mL | 4 | 2.84±7.38E-08 | < 7.95E-08 | 12 | < 7.02E-08 - 8.76E-08 | 1.9E-03 |
| **Sr-90** | µCi/mL | 2 | 1.50±1.04E-09 | 1.88E-09 | 2 | < 4.79E-10 - < 1.08E-09 | 1.1E-06 |
| **Cs-137** | µCi/mL | 2 | -0.45±2.21E-09 | < 2.37E-09 | 2 | < 2.11E-09 - < 2.27E-09 | 3.0E-06 |
| **pH** | SU | 4 | 7.7 - 8.0 | | 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 nonradiological results.
[d] Alpha as U-232.
[e] Beta as Sr-90.

**TABLE B-4G**
**2021 Radioactivity and pH in Surface Water at Franks Creek (WNFRC67)**

| Analyte | Units | N | WNFRC67 Concentrations | | N | Reference Values | |
|---|---|---|---|---|---|---|---|
| | | | | | | WFBCBKG [a] Background Range | Guideline [b] or Standard [c] |
| | | | Average | Maximum | | | |
| **Gross Alpha** | µCi/mL | 4 | -2.55±6.91E-10 | < 8.24E-10 | 12 | < 4.85E-10 - 1.38E-09 | 9.8E-08 [d] |
| **Gross Beta** | µCi/mL | 4 | 1.71±0.74E-09 | 2.68E-09 | 12 | < 9.59E-10 - 3.24E-09 | 1.1E-06 [e] |
| **Tritium** | µCi/mL | 4 | 3.26±7.69E-08 | < 8.45E-08 | 12 | < 7.02E-08 - 8.76E-08 | 1.9E-03 |
| **Sr-90** | µCi/mL | 2 | 0.35±1.02E-09 | 1.04E-09 | 2 | < 4.79E-10 - < 1.08E-09 | 1.1E-06 |
| **Cs-137** | µCi/mL | 2 | -0.18±1.54E-09 | < 1.68E-09 | 2 | < 2.11E-09 - < 2.27E-09 | 3.0E-06 |
| **pH** | SU | 4 | 7.1 - 7.5 | | 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 nonradiological results.
[d] Alpha as U-232.
[e] Beta as Sr-90.

**TABLE B-4H**
**2021 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 | |
|---|---|---|---|---|---|---|---|
| | | | | | | WFBCBKG [a] Background Range | Guideline [b] |
| | | | Average | Maximum | | | |
| **Gross Alpha** | µCi/mL | 12 | 7.64±9.52E-10 | 1.48E-09 | 12 | < 4.85E-10 - 1.38E-09 | 9.8E-08 [c] |
| **Gross Beta** | µCi/mL | 12 | 4.53±0.90E-09 | 5.99E-09 | 12 | < 9.59E-10 - 3.24E-09 | 1.1E-06 [d] |
| **Tritium** | µCi/mL | 12 | 1.70±7.57E-08 | < 9.06E-08 | 12 | < 7.02E-08 - 8.76E-08 | 1.9E-03 |
| **Sr-90** | µCi/mL | 2 | 1.32±1.00E-09 | 1.35E-09 | 2 | < 4.79E-10 - < 1.08E-09 | 1.1E-06 |
| **Cs-137** | µCi/mL | 2 | 0.91±2.28E-09 | < 2.44E-09 | 2 | < 2.11E-09 - < 2.27E-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**
**2021 Radioactivity and pH in Surface Water Downstream of the WVDP in Cattaraugus Creek at Felton Bridge (WFFELBR)**

| *Analyte* | *Units* | *N* | *WFFELBR Concentrations* [a] *Average* | *Maximum* | *N* | *Reference Values* *WFBIGBR Background Range* | *Guideline* [b] *or Standard* [c] |
|---|---|---|---|---|---|---|---|
| **Gross Alpha** | µCi/mL | 12 | 0.80±1.13E-09 | 1.14E-09 | 98 | <3.59E-10 - 4.62E-09 | 9.8E-08[d] |
| **Gross Beta** | µCi/mL | 12 | 2.95±0.96E-09 | 4.06E-09 | 98 | <9.03E-10 - 1.37E-08 | 1.1E-06[e] |
| **Tritium** | µCi/mL | 12 | 3.91±8.43E-08 | 8.27E-08 | 98 | <4.46E-08 - 2.65E-07 | 1.9E-03 |
| **Sr-90** | µCi/mL | 12 | 0.67±1.02E-09 | 1.28E-09 | 98 | <3.57E-10 - 1.10E-08 | 1.1E-06 |
| **Cs-137** | µCi/mL | 12 | 0.17±3.20E-09 | < 6.76E-09 | 98 | <1.34E-09 - 5.29E-09 | 3.0E-06 |
| **pH** | SU | 27 | 7.6 - 8.4 | | 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 nonradiological 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* | *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**
**2021 Radioactivity and pH in Surface Water at Fox Valley Road**
**Buttermilk Creek Background (WFBCBKG)**

| *Analyte* | *Units* | *N* | *WFBCBKG [a] Concentrations* | | *Reference Values Guideline [b] or Standard [c]* |
|---|---|---|---|---|---|
| | | | *Average* | *Maximum* | |
| **Gross Alpha** | µCi/mL | 12 | 5.36±7.70E-10 | 1.38E-09 | 9.8E-08[d] |
| **Gross Beta** | µCi/mL | 12 | 1.86±0.81E-09 | 3.24E-09 | 1.1E-06[e] |
| **Tritium** | µCi/mL | 12 | 2.90±7.66E-08 | 8.76E-08 | 1.9E-03 |
| **C-14** | µCi/mL | 2 | -1.23±2.35E-08 | < 2.72E-08 | 6.2E-05 |
| **Sr-90** | µCi/mL | 2 | 2.70±8.35E-10 | < 1.08E-09 | 1.1E-06 |
| **Tc-99** | µCi/mL | 2 | -1.34±2.20E-09 | < 2.46E-09 | 4.4E-05 |
| **I-129** | µCi/mL | 2 | 8.23±8.89E-10 | 8.29E-10 | 3.3E-07 |
| **Cs-137** | µCi/mL | 2 | -0.65±2.19E-09 | < 2.27E-09 | 3.0E-06 |
| **U-232** | µCi/mL | 2 | 0.13±2.52E-10 | < 3.48E-10 | 9.8E-08 |
| **U-233/234** | µCi/mL | 2 | 7.34±7.94E-11 | 1.09E-10 | 6.6E-07[f] |
| **U-235/236** | µCi/mL | 2 | 2.27±5.17E-11 | < 6.66E-11 | 7.2E-07 |
| **U-238** | µCi/mL | 2 | 3.84±6.36E-11 | < 7.55E-11 | 7.5E-07 |
| **Total U** | µg/mL | 2 | 1.45±0.37E-04 | 1.59E-04 | -- |
| **Pu-238** | µCi/mL | 2 | 0.26±2.29E-11 | < 2.41E-11 | 1.5E-07 |
| **Pu-239/240** | µCi/mL | 2 | -0.83±3.18E-11 | < 3.31E-11 | 1.4E-07 |
| **Am-241** | µCi/mL | 2 | 1.92±2.80E-11 | 3.32E-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**
**2021 Water Quality Results in Drinking Water**
**at Tap Water Location Inside the RHWF**

| *Analyte* | *Units* | *N* | *WNDNKRH (RHWF)* | *Standard* [a] |
|---|---|---|---|---|
| *Disinfection Byproducts* [b] | | | | |
| **Haloacetic Acids-Five (5)** | mg/L | 2 | 0.006 | 0.060 |
| **Total Trihalomethanes** | mg/L | 2 | 0.006 | 0.080 |

N - Number of samples.
NA - Not applicable, constituent not analyzed.
[a] New York State Department of Health (NYSDOH) MCLs and EPA or NYSDOH screening levels for drinking water used as comparative references. (See Table B-1C.)
[b] Sampling for disinfection byproducts is required every three years. The result shown in the average of duplicate samples collected in August 2021.

**TABLE B-5B**
**2021 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 | 4 | Range: 0.48 - 1.0 | 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.
[b] Analyzed by Cattaraugus County Health Department (CCHD).

**TABLE B-5C**
**2021 Copper and Lead Results from On-Site Tap Water Locations at the WVDP**

| Analyte | Date Collected | Units | N | Range | Average | 90th Percentile [a] | Action Level [a] |
|---|---|---|---|---|---|---|---|
| Copper, Total | 9/12/2021 | mg/L | 5 | 0.059 - 1.5 | 0.50 | 0.9 | 1.3 |
| Copper, Total[b] | 10/15/2021 | mg/L | 1 | 0.12 | 0.12 | NA | 1.3 |
| Lead, total | 9/12/2021 | mg/L | 5 | <0.00017 - 0.011 | 0.0044 | 0.011 | 0.015 |
| Lead, total | 10/15/2021 | mg/L | 1 | 0.00061 | 0.00061 | NA | 0.015 |

N - Number of samples

[a] The 90th percentile calculation is used to evaluate exceedance of the action level.

[b] The September 2021 copper sampling result exceeded the action level at the nurse's office sink and was therefore resampled in October 2021 after flushing of the tap. The October result was below the action level.

**TABLE B-5D**
**2021 Metals and Water Quality Results in Treated Potable Water**

| Analyte | Date Collected | Units | N | Average Concentration | Standard or Guideline [a] |
|---|---|---|---|---|---|
| *Metals* [b, c] | | | | | |
| Antimony, Total | 4/27/2021 | mg/L | 2 | <0.001 | 0.006 |
| Arsenic, Total | 4/27/2021 | mg/L | 2 | <0.001 | 0.010 |
| Barium, Total | 4/27/2021 | mg/L | 2 | 1.30 | 2.00 |
| Beryllium, Total | 4/27/2021 | mg/L | 2 | <0.002 | 0.004 |
| Cadmium, Total | 4/27/2021 | mg/L | 2 | <0.001 | 0.005 |
| Chromium, Total | 4/27/2021 | mg/L | 2 | <0.007 | 0.10 |
| Mercury, Total | 4/27/2021 | mg/L | 2 | <0.0002 | 0.002 |
| Nickel, Total | 4/27/2021 | mg/L | 2 | <0.005 | -- |
| Selenium, Total | 4/27/2021 | mg/L | 2 | <0.025 | 0.05 |
| Sodium, Total[c] | 4/27/2021 | mg/L | 2 | 38 | 20/270[d] |
| Thallium, Total | 4/27/2021 | mg/L | 2 | <0.0002 | 0.002 |
| *Water Quality* [b,c] | | | | | |
| Cyanide, Total[b] | 4/27/2021 | mg/L | 1 | <0.020 | 0.2 |
| Fluoride[b] | 4/27/2021 | mg/L | 1 | 0.29 | 2.2 |
| Nitrate-N[c] | 4/7/2021 | mg/L | 1 | < 1.0 | 10 |
| Free Residual Chlorine[e] | daily | mg/L | 366 | Range: 0.35 - 3.8 | 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 at WNDNKEP for IOCs in 2021 (last sampled for in 2018).

[c] Sodium and Nitrate are analyzed for once every year. Nitrate sampled by CCDOH.

[d] Although there is no designated limit for sodium, NYSDOH recommended limits are provided for people on severely sodium restricted diets (20 mg/L limit) and moderately sodium restricted diets (270 mg/L limit).

[e] Samples of finished water are collected and analyzed for chlorine daily.

**TABLE B-5E**
**2021 Water Quality Results for Organic Parameters in Treated Potable Water**

| Location Code | Date Collected | Analyte | Results - All Quarters (mg/L) |
|---|---|---|---|
| | | ***Principal Organic Contaminants (POCs)*** | |
| **WNDFIN** | April 2021<br>July 2021<br>October 2021 | 1,1,1,2-Tetrachloroethane | < 0.00050 |
| | | 1,1,1-Trichloroethane | < 0.00050 |
| | | 1,1,2,2-Tetrachloroethane | < 0.00050 |
| | | 1,1,2-Trichloroethane | < 0.00050 |
| | | 1,1-Dichloroethane | < 0.00050 |
| | | 1,1-Dichloroethene | < 0.00050 |
| | | 1,1-Dichloropropene | < 0.00050 |
| | | 1,2,3-Trichlorobenzene | < 0.00050 |
| | | 1,2,3-Trichloropropane | < 0.00050 |
| | | 1,2,4-Trichlorobenzene | < 0.00050 |
| | | 1,2,4-Trimethylbenzene | < 0.00050 |
| | | 1,2-Dichloroethane | < 0.00050 |
| | | 1,2-Dichloropropane | < 0.00050 |
| | | 1,3,5-Trimethylbenzene | < 0.00050 |
| | | 1,3-Dichloropropane | < 0.00050 |
| | | 2,2-Dichloropropane | < 0.00050 |
| | | Benzene | < 0.00050 |
| | | Bromobenzene | < 0.00050 |
| | | Bromochloromethane | < 0.00050 |
| | | Bromomethane | < 0.00050 |
| | | Carbon Tetrachloride | < 0.00050 |
| | | Chlorobenzene | < 0.00050 |
| | | Chloroethane | < 0.00050 |
| | | Chloromethane | <0.00050, 0.00110, 0.00140 |
| | | cis-1,2-Dichloroethene | < 0.00050 |
| | | cis-1,3-Dichloropropene | < 0.00050 |
| | | Dichlorodifluoromethane (DCDFM) | < 0.00050 |
| | | Ethylbenzene | < 0.00050 |
| | | Hexachlorobutadiene | < 0.00050 |
| | | Isopropylbenzene | < 0.00050 |
| | | m-Dichlorobenzene (1,3-Dichlorobenzene) | < 0.00050 |
| | | Methyl-tert butyl-ether (MTBE) | < 0.00050 |
| | | Methylene bromide (Dibromomethane) | < 0.00050 |
| | | Methylene Chloride | < 0.00050 |
| | | N-Butylbenzene | < 0.00050 |
| | | n-Propylbenzene | < 0.00050 |
| | | o-Chlorotoluene (2-Chlorotoluene) | < 0.00050 |
| | | o-Dichlorobenzene (1,2-Dichlorobenzene) | < 0.00050 |
| | | p-Chlorotoluene (4-Chlorotoluene) | < 0.00050 |
| | | p-Dichlorobenzene (1,4-Dichlorobenzene) | < 0.00050 |
| | | p-Isopropyltoluene | < 0.00050 |
| | | Sec-Butylbenzene | < 0.00050 |
| | | Styrene | < 0.00050 |
| | | Tert-Butylbenzene | < 0.00050 |
| | | Tetrachloroethene | < 0.00050 |
| | | Toluene | < 0.00050 |
| | | trans-1,2-Dichloroethene | < 0.00050 |
| | | trans-1,3-Dichloropropene | < 0.00050 |
| | | Trichloroethene | < 0.00050 |
| | | Trichlorofluoromethane | < 0.00050 |
| | | Vinyl chloride | < 0.00050 |
| | | Xylene (m-Xylene and p-Xylene | < 0.00050 |
| | | Xylene (o-Xylene) | < 0.00050 |

**TABLE B-5E *(concluded)***

**2021 Water Quality Results for Organic Parameters in Treated Potable Water**

| Location | Date | Analyte | Results - All Quarters |
|---|---|---|---|
| ***Specific Organic Chemicals (SOCs)*** | | | |
| **WNDFIN** | Decmber 2021 | 2,3,7,8-TCDD (dioxin) | < 0.00000000500 |
| | | 2,4,5-TP (silvex) | < 0.00010 |
| | | 2,4-D | < 0.00010 |
| | | 3-Hydroxycarbofuran | < 0.00050 |
| | | Alachlor | < 0.00010 |
| | | Aldicarb | < 0.00050 |
| | | Aldicarb sulfone | < 0.00070 |
| | | Aldicarb sulfoxide | < 0.00050 |
| | | Aldrin | < 0.00010 |
| | | Atrazine | < 0.00010 |
| | | Benzo(a)pyrene | < 0.000020 |
| | | Butachlor | < 0.00010 |
| | | Carbaryl | < 0.00050 |
| | | Carbofuran | < 0.00090 |
| | | Chlordane | < 0.00010 |
| | | Dalapon | < 0.0010 |
| | | Di(2-ethylhexyl)phthalate | < 0.00060 |
| | | Di(2-ethylhexyl)adipate | < 0.00060 |
| | | Dibromochloropropane (DBCP) | < 0.000010 |
| | | Dicamba | < 0.00010 |
| | | Dieldrin | < 0.00010 |
| | | Dinoseb | < 0.00010 |
| | | Diquat | < 0.00040 |
| | | Endothall | < 0.0050 |
| | | Endrin | < 0.000010 |
| | | Ethylene Dibromide (EDB) | < 0.000010 |
| | | Glyphosate | < 0.0060 |
| | | Heptachlor | < 0.000040 |
| | | Heptachlor epoxide | < 0.000020 |
| | | Hexachlorobenzene | < 0.00010 |
| | | Hexachlorocyclopentadiene | < 0.00010 |
| | | Lindane (gamma BHC) | < 0.000020 |
| | | Methomyl | < 0.00050 |
| | | Methoxychlor | < 0.00010 |
| | | Metolachlor | < 0.00010 |
| | | Metribuzin | < 0.00010 |
| | | Oxymal | < 0.0010 |
| | | PCB-1016 | < 0.000080 |
| | | PCB-1221 | < 0.00019 |
| | | PCB-1232 | < 0.00023 |
| | | PCB-1242 | < 0.00026 |
| | | PCB-1248 | < 0.00010 |
| | | PCB-1254 | < 0.00010 |
| | | PCB-1260 | < 0.00020 |
| | | PCBs, total | < 0.00050 |
| | | Pentachlorophenol | < 0.000040 |
| | | Picloram | < 0.00010 |
| | | Propachlor | < 0.00010 |
| | | Simazine | < 0.000070 |
| | | Toxaphene | < 0.0010 |

Note: Sample is collected after treatment (at sampling location WNDFIN) prior to distribution into the water supply system.

**TABLE B-5F**
**2021 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 | 1/4/2021 | 1.82±1.20E-09 | 4.09±1.24E-09 | 2.33±6.88E-08 |
| WNDRAW1 | 2/1/2021 | 2.05±1.37E-09 | 3.69±0.98E-09 | 4.33±6.91E-08 |
| WNDRAW1 | 3/1/2021 | 1.61±1.60E-09 | 3.99±1.24E-09 | 3.94±7.88E-08 |
| WNDRAW1 | 4/5/2021 | 0.77±1.15E-09 | 2.07±1.01E-09 | 6.52±7.99E-08 |
| WNDRAW1 | 5/3/2021 | 1.16±1.48E-09 | 3.44±1.31E-09 | -2.66±7.32E-08 |
| WNDRAW1 | 6/1/2021 | -0.68±1.63E-09 | 3.06±1.28E-09 | -0.59±6.93E-08 |
| WNDRAW1 | 7/7/2021 | 0.88±1.50E-09 | 2.74±1.22E-09 | 1.84±6.98E-08 |
| WNDRAW1 | 8/2/2021 | 0.19±1.70E-09 | 4.03±1.59E-09 | 3.14±8.02E-08 |
| WNDRAW1 | 9/2/2021 | 1.39±1.58E-09 | 2.69±1.28E-09 | 3.73±6.59E-08 |
| WNDRAW1 | 10/1/2021 | 0.58±1.49E-09 | 2.54±1.47E-09 | 0.12±6.74E-08 |
| WNDRAW1 | 11/1/2021 | 1.28±1.51E-09 | 3.40±1.44E-09 | 6.65±9.72E-08 |
| WNDRAW1 | 12/1/2021 | 2.92±4.12E-09 | 3.33±1.28E-09 | 3.44±9.44E-08 |
| **Supply Well #2 Pumping** | | | | |
| WNDRAW2 | 1/4/2021 | 0.26±1.47E-09 | 3.71±1.16E-09 | 1.45±7.13E-08 |
| WNDRAW2 | 2/1/2021 | 1.30±1.21E-09 | 2.23±0.95E-09 | 3.23±7.44E-08 |
| WNDRAW2 | 3/1/2021 | 1.48±1.14E-09 | 2.86±0.90E-09 | 0.90±7.37E-08 |
| WNDRAW2 | 4/5/2021 | 3.47±2.52E-09 | 3.32±1.06E-09 | 6.82±7.83E-08 |
| WNDRAW2 | 5/3/2021 | 1.02±1.62E-09 | 2.96±0.98E-09 | -2.82±7.56E-08 |
| WNDRAW2 | 6/1/2021 | 0.55±1.30E-09 | 9.31±8.92E-10 | -1.80±6.64E-08 |
| WNDRAW2 | 7/7/2021 | -0.70±3.36E-09 | 3.45±1.19E-09 | 1.71±6.77E-08 |
| WNDRAW2 | 8/2/2021 | -0.13±2.16E-09 | 3.01±1.42E-09 | 5.49±8.24E-08 |
| WNDRAW2 | 9/2/2021 | 0.80±1.57E-09 | 2.47±1.38E-09 | 0.41±6.27E-08 |
| WNDRAW2 | 10/1/2021 | 0.18±1.50E-09 | 1.21±1.21E-09 | 2.56±7.07E-08 |
| WNDRAW2 | 11/1/2021 | -1.19±1.58E-09 | 3.59±1.34E-09 | 3.68±9.36E-08 |
| WNDRAW2 | 12/1/2021 | 1.92±2.79E-09 | 3.32±1.17E-09 | 0.12±8.74E-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**

**2021 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 | 4/5/2021 | 1.66±2.68E-09 | -2.08±2.82E-10 |
| | | | |
| **Supply Well #2 Pumping** | | | |
| WNDRAW2 | 4/5/2021 | 2.21±4.80E-09 | -5.80±5.43E-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**

**2021 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 | 26 | 1.14±1.36E-09 | 3.13E-09 | 7.61E-09 |
| **Gross Beta** | µCi/mL | 26 | 3.78±1.01E-09 | 5.89E-09 | 1.56E-08 |
| **Conductivity** | µmhos/cm@ 25ºC | 26 | 662 | 731 | NA |
| **pH** | SU | 26 | Range: 7.6 - 8.2 | | 6.5-8.5 |
| *WNEHMKE* | | | | | |
| **Gross Alpha** | µCi/mL | 26 | 1.50±1.89E-09 | 4.31E-09 | 7.61E-09 |
| **Gross Beta** | µCi/mL | 26 | 3.92±1.06E-09 | 5.35E-09 | 1.56E-08 |
| **Conductivity** | µmhos/cm@ 25ºC | 26 | 741 | 816 | NA |
| **pH** | SU | 26 | Range: 7.2 - 8.1 | | 6.5-8.5 |
| *WWCOURT* | | | | | |
| **Gross Alpha** | µCi/mL | 26 | 0.88±1.24E-09 | 2.83E-09 | 7.61E-09 |
| **Gross Beta** | µCi/mL | 26 | 2.47±0.91E-09 | 4.92E-09 | 1.56E-08 |
| **Conductivity** | µmhos/cm@ 25ºC | 26 | 519 | 777 | NA |
| **pH** | SU | 26 | Range: 6.9 - 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.

**TABLE B-5I**
**2021 Per-and Polyfluoroalkyl Substances (PFAS) and 1,4-Dioxane in Raw (Untreated) Potable Water[a]**

| Location Code | Date Collected | Perfluorooctanoic acid (PFOA) ng/L | Perfluorooctanesulfonate (PFOS) ng/L | 1,4-Dioxane µg/L |
|---|---|---|---|---|
| NYS DOH MCLs [b] | | 10 ng/L | 10 ng/L | 1 µg/L |
| EPA Health Advisory Limit [b] | | 70 ng/L | 70 ng/L | 200 µg/L |
| **Supply Well #1** | | | | |
| WNDRAW1 | 1/27/2021 | <0.573 | <0.660 | <0.0400 |
| WNDRAW1(dup) | 1/27/2021 | <0.588 | <0.677 | <0.0400 |
| WNDRAW1 | 4/12/2021 | <0.579 | <0.667 | <0.0400 |
| | | | | |
| **Supply Well #2** | | | | |
| WNDRAW2 | 1/27/2021 | <0.588 | <0.677 | <0.0400 |
| WNDRAW2 | 4/12/2021 | <0.573 | <0.660 | <0.0400 |

[a] Untreated potable water was analyzed for PFAS and 1,4-Dioxane in January 2021 for the first time at the WVDP. The CCDOH directed the WVDP that only one quarter of sampling was necessary in 2021 since the results were all nondetect.

[b] In August 2020, NYS adopted a state drinking water MCL of 10 parts per trillion (ppt) (10 ng/L) for PFOA and PFOS, and 1 part per billion (ppb) (1 µg/L) for 1,4-dioxane.

[c] There currently are no federal drinking water MCLs for PFOA, PFOS, or 1,4-Dioxane. However, in 2016, EPA established a lifetime Health Advisory Limit (HAL) of 70 ppt (equal to 70 ng/L) for PFOA and PFOS combined, as well as a HAL for 1,4-Dioxane of 0.2 mg/L (200 µg/L). In May 2021, the federal Agency for Toxic Substances and Disease Registry (ATSDR) finalized a toxilogical profile endorcing much stricter minimal risk levels that assist in decisionmaking but are not regulatory limits.

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# APPENDIX C
## Summary of Air Monitoring Data

**TABLE C-1**
**2021 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** | 27 | -4.65±3.09E-09 | -3.80±2.53E-17 | 2.11E-16 | NA[b] |
| **Gross Beta** | 27 | 0.55±1.06E-08 | 4.46±8.68E-17 | 1.33E-15 | NA[b] |
| **Co-60** | 2 | -0.34±1.28E-08 | -0.28±1.05E-16 | < 1.74E-16 | 3.6E-10 |
| **Sr-90** | 2 | 1.27±1.50E-08 | 1.04±1.23E-16 | < 2.26E-16 | 1.0E-10 |
| **I-129** | 2 | 3.53±0.49E-07 | 2.89±0.40E-15 | 3.51E-15 | 1.0E-10 |
| **Cs-137** | 2 | -0.68±1.01E-08 | -5.58±8.25E-17 | < 1.61E-16 | 8.8E-10 |
| **Eu-154** | 2 | -3.41±3.05E-08 | -2.78±2.50E-16 | < 5.97E-16 | 7.5E-11 |
| **U-232[c]** | 2 | 0.14±1.06E-09 | 1.17±8.69E-18 | < 1.79E-17 | 4.7E-13 |
| **U-233/234[c]** | 2 | 3.35±1.35E-09 | 2.73±1.11E-17 | 3.01E-17 | 1.0E-12[d] |
| **U-235/236[c]** | 2 | 1.56±1.05E-09 | 1.27±0.86E-17 | 1.32E-17 | 1.2E-12 |
| **U-238[c]** | 2 | 2.66±1.22E-09 | 2.17±1.00E-17 | 4.12E-17 | 1.3E-12 |
| **Pu-238** | 2 | 3.53±6.33E-10 | 2.88±5.17E-18 | < 9.84E-18 | 8.8E-14 |
| **Pu-239/240** | 2 | 3.97±8.28E-10 | 3.24±6.77E-18 | < 1.20E-17 | 8.1E-14 |
| **Am-241** | 2 | 1.82±1.46E-09 | 1.48±1.19E-17 | < 2.23E-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 = 8.90±0.21E-03 g; average = 7.27±0.17E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[d] DCS for Uranium-233 used for this comparison.

**TABLE C-2**
**2021 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** | 27 | -1.62±1.08E-09 | -2.33±1.55E-17 | < 1.02E-16 | NA[b] |
| **Gross Beta** | 27 | 2.55±0.39E-08 | 3.67±0.57E-16 | 5.63E-15 | NA[b] |
| **Co-60** | 2 | 1.39±3.38E-09 | 2.01±4.87E-17 | < 8.15E-17 | 3.6E-10 |
| **Sr-90** | 2 | 2.09±5.26E-09 | 3.01±7.59E-17 | < 1.12E-16 | 1.0E-10 |
| **I-129** | 2 | 2.33±0.01E-05 | 3.36±0.02E-13 | 5.06E-13 | 1.0E-10 |
| **Cs-137** | 2 | 1.91±0.57E-08 | 2.75±0.82E-16 | 3.55E-16 | 8.8E-10 |
| **Eu-154** | 2 | 0.80±1.17E-08 | 1.15±1.68E-16 | 1.94E-16 | 7.5E-11 |
| **U-232**[c] | 2 | 1.15±3.90E-10 | 1.66±5.63E-18 | < 8.71E-18 | 4.7E-13 |
| **U-233/234**[c] | 2 | 1.26±0.58E-09 | 1.82±0.84E-17 | 1.96E-17 | 1.0E-12[d] |
| **U-235/236**[c] | 2 | 1.89±3.23E-10 | 2.72±4.66E-18 | < 7.22E-18 | 1.2E-12 |
| **U-238**[c] | 2 | 1.56±0.54E-09 | 2.25±0.78E-17 | 2.90E-17 | 1.3E-12 |
| **Pu-238** | 2 | 2.97±2.95E-10 | 4.29±4.25E-18 | < 6.53E-18 | 8.8E-14 |
| **Pu-239/240** | 2 | 1.64±4.00E-10 | 2.36±5.77E-18 | < 8.97E-18 | 8.1E-14 |
| **Am-241** | 2 | 2.99±5.18E-10 | 4.30±7.48E-18 | < 1.13E-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 = 3.30±0.14E-03 g; average = 4.76±0.19E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.

[d] DCS for Uranium-233 used for this comparison.

**TABLE C-3**
**2021 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** | 27 | -1.33±3.43E-09 | -1.07±2.75E-17 | < 1.77E-16 | NA[b] |
| **Gross Beta** | 27 | 0.03±1.13E-08 | 0.28±9.04E-17 | 6.29E-16 | NA[b] |
| **Co-60** | 2 | 0.86±1.71E-08 | 0.69±1.37E-16 | < 2.32E-16 | 3.6E-10 |
| **Sr-90** | 2 | 0.79±1.60E-08 | 0.64±1.28E-16 | < 1.86E-16 | 1.0E-10 |
| **I-129** | 2 | 0.73±1.93E-08 | 0.58±1.55E-16 | < 2.55E-16 | 1.0E-10 |
| **Cs-137** | 2 | -0.03±1.23E-08 | -0.21±9.88E-17 | < 1.51E-16 | 8.8E-10 |
| **Eu-154** | 2 | 0.27±3.46E-08 | 0.22±2.78E-16 | < 4.40E-16 | 7.5E-11 |
| **U-232[c]** | 2 | -0.56±2.99E-09 | -0.45±2.40E-17 | < 4.73E-17 | 4.7E-13 |
| **U-233/234[c]** | 2 | 2.26±1.35E-09 | 1.82±1.08E-17 | 2.05E-17 | 1.0E-12[d] |
| **U-235/236[c]** | 2 | 9.41±9.47E-10 | 7.55±7.60E-18 | < 1.22E-17 | 1.2E-12 |
| **U-238[c]** | 2 | 3.78±1.51E-09 | 3.03±1.21E-17 | 3.75E-17 | 1.3E-12 |
| **Pu-238** | 2 | 2.85±7.83E-10 | 2.29±6.29E-18 | < 9.23E-18 | 8.8E-14 |
| **Pu-239/240** | 2 | 6.05±8.00E-10 | 4.85±6.42E-18 | < 1.04E-17 | 8.1E-14 |
| **Am-241** | 2 | 0.01±1.25E-09 | 0.01±1.00E-17 | < 1.43E-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 = 9.15±0.26E-03 g; average = 7.34±0.21E-11 µg/mL, includes uranium contribution from glass fiber filter matrix.
[d] DCS for Uranium-233 used for this comparison.

**TABLE C-4**
**2021 Effluent Airborne Radioactivity at Container Sorting and Packaging Facility (ANCSPFK)**

| |
|---|
| **The CSPF did not run during 2021<br>except for HEPA filter testing** |

**TABLE C-5**
**2021 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** | 24 | 2.26±0.41E-08 | 1.01±0.18E-16 | 2.76E-15 | NA[c] |
| **Gross Beta** | 24 | 1.62±0.13E-07 | 7.25±0.60E-16 | 2.56E-14 | NA[c] |
| **Co-60** | 2 | 0.62±1.49E-09 | 2.78±6.65E-18 | < 1.12E-17 | 3.6E-10 |
| **Sr-90** | 2 | 7.50±2.13E-09 | 3.35±0.95E-17 | 7.08E-17 | 1.0E-10 |
| **Cs-137** | 2 | 9.07±2.54E-09 | 4.05±1.14E-17 | 6.56E-17 | 8.8E-10 |
| **Eu-154** | 2 | 1.24±4.51E-09 | 0.55±2.01E-17 | < 2.89E-17 | 7.5E-11 |
| **U-232[d]** | 2 | -0.35±1.46E-10 | -1.57±6.51E-19 | < 1.25E-18 | 4.7E-13 |
| **U-233/234[d]** | 2 | 2.88±1.88E-10 | 1.28±0.84E-18 | 1.40E-18 | 1.0E-12[e] |
| **U-235/236[d]** | 2 | 1.42±1.45E-10 | 6.35±6.50E-19 | 1.16E-18 | 1.2E-12 |
| **U-238[d]** | 2 | 3.51±1.78E-10 | 1.57±0.79E-18 | 1.86E-18 | 1.3E-12 |
| **Pu-238** | 2 | 2.34±1.26E-10 | 1.05±0.56E-18 | 1.53E-18 | 8.8E-14 |
| **Pu-239/240** | 2 | 2.59±1.68E-10 | 1.16±0.75E-18 | 2.43E-18 | 8.1E-14 |
| **Am-241** | 2 | 4.60±2.20E-10 | 2.05±0.98E-18 | 4.22E-18 | 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 = 1.09±0.01E-03 g; average = 4.85±0.06E-12 µg/mL, includes uranium contribution from glass fiber filter matrix.
[e] DCS for Uranium-233 used for this comparison.

**TABLE C-6**
**2021 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** | 27 | 9.09±1.94E-16 | 1.76E-15 | 1.82±0.07E-14 | 2.75E-14 |
| **AF02_NNE** | 27 | 9.04±2.09E-16 | 1.49E-15 | 1.74±0.07E-14 | 2.65E-14 |
| **AF03_NE** | 27 | 8.94±1.87E-16 | 1.67E-15 | 1.81±0.07E-14 | 2.45E-14 |
| **AF04_ENE** | 26 | 8.75±1.77E-16 | 1.66E-15 | 1.74±0.07E-14 | 2.44E-14 |
| **AF05_E** | 27 | 9.39±1.77E-16 | 1.62E-15 | 1.83±0.07E-14 | 2.66E-14 |
| **AF06_ESE** | 27 | 9.12±2.03E-16 | 1.61E-15 | 1.81±0.07E-14 | 2.82E-14 |
| **AF07_SE** | 27 | 8.68±2.13E-16 | 1.45E-15 | 1.74±0.08E-14 | 2.56E-14 |
| **AF08_SSE** | 27 | 9.56±2.27E-16 | 1.69E-15 | 1.78±0.08E-14 | 2.72E-14 |
| **AF09_S** | 27 | 8.99±1.79E-16 | 1.40E-15 | 1.71±0.06E-14 | 2.46E-14 |
| **AF10_SSW** | 27 | 9.29±1.98E-16 | 1.44E-15 | 1.77±0.07E-14 | 2.60E-14 |
| **AF11_SW** | 26 | 8.89±1.64E-16 | 1.50E-15 | 1.75±0.06E-14 | 2.63E-14 |
| **AF12_WSW** | 27 | 9.89±2.08E-16 | 1.55E-15 | 1.86±0.08E-14 | 2.72E-14 |
| **AF13_W** | 27 | 1.01±0.21E-15 | 1.52E-15 | 1.90±0.08E-14 | 2.90E-14 |
| **AF14_WNW** | 27 | 9.20±1.78E-16 | 1.62E-15 | 1.69±0.06E-14 | 2.67E-14 |
| **AF15_NW** | 27 | 8.72±1.72E-16 | 1.24E-15 | 1.70±0.06E-14 | 2.33E-14 |
| **AF16_NNW** | 27 | 9.05±1.81E-16 | 1.56E-15 | 1.68±0.07E-14 | 2.59E-14 |
| **AF16HNNW** | 27 | 7.95±1.39E-16 | 1.42E-15 | 1.56±0.05E-14 | 2.11E-14 |
| **AFGRVAL** | 27 | 8.93±1.74E-16 | 1.36E-15 | 1.71±0.06E-14 | 2.65E-14 |

N - Number of samples.

**TABLE C-7**
**2021 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 Level[b] | | 1.9E-14 | 9.1E-15 | 1.9E-14 | 1.3E-15 |
| AF01_N | 4 | 0.36±1.27E-16 | -0.87±6.03E-17 | 0.03±1.21E-16 | -0.38±1.03E-17 |
| AF02_NNE | 4 | -0.06±1.19E-16 | -2.26±8.07E-17 | 0.21±1.09E-16 | -0.31±1.05E-17 |
| AF03_NE | 4 | -0.03±1.06E-16 | 1.04±6.09E-17 | 2.16±9.98E-17 | -0.84±1.18E-17 |
| AF04_ENE | 4 | 0.04±1.27E-16 | -0.51±6.25E-17 | -0.37±8.53E-17 | -0.13±1.20E-17 |
| AF05_E | 4 | -0.64±9.17E-17 | 0.58±5.59E-17 | 5.09±6.94E-17 | -4.85±8.41E-18 |
| AF06_ESE | 4 | 0.50±1.47E-16 | -0.07±7.20E-17 | -0.41±1.07E-16 | -0.48±1.16E-17 |
| AF07_SE | 4 | 0.75±1.40E-16 | 1.34±7.22E-17 | 0.85±7.66E-17 | -7.75±9.69E-18 |
| AF08_SSE | 4 | -0.28±1.57E-16 | 0.18±1.02E-16 | -0.23±1.17E-16 | -0.24±1.42E-17 |
| AF09_S | 4 | 0.99±1.33E-16 | 0.66±5.55E-17 | 3.44±6.59E-17 | -4.49±8.47E-18 |
| AF10_SSW | 4 | 0.03±1.35E-16 | -2.47±8.35E-17 | 0.54±1.05E-16 | -0.35±1.05E-17 |
| AF11_SW | 4 | 0.13±1.09E-16 | -2.82±6.45E-17 | 1.93±7.41E-17 | -2.42±8.04E-18 |
| AF12_WSW | 4 | 0.36±1.52E-16 | -0.92±7.99E-17 | -4.21±9.70E-17 | -0.14±1.01E-17 |
| AF13_W | 4 | -0.02±1.49E-16 | 0.05±8.27E-17 | 0.61±1.06E-16 | -0.41±1.09E-17 |
| AF14_WNW | 4 | -6.18±9.52E-17 | 4.30±7.10E-17 | 2.37±8.45E-17 | -2.07±9.67E-18 |
| AF15_NW | 4 | -0.37±1.22E-16 | 0.74±5.30E-17 | 0.22±1.02E-16 | -0.80±8.47E-18 |
| AF16_NNW | 4 | 0.79±1.11E-16 | -0.31±6.48E-17 | -1.72±8.84E-17 | 0.05±8.34E-18 |
| AF16HNNW[c] | 4 | -0.40±2.07E-17 | -0.31±6.48E-17[d] | 0.49±2.40E-17 | -1.29±1.74E-18 |
| AFGRVAL[e] | 4 | 0.18±1.06E-16 | 0.93±5.30E-17 | -1.02±8.25E-17 | -0.82±7.64E-18 |

| Location | N | Annual Average Concentration (µCi/mL) | | | Compliance Ratio (Sum of Ratios) |
|---|---|---|---|---|---|
| | | Pu-238 | Pu-239/240 | Am-241 | |
| NESHAP Compliance Level[b] | | 2.1E-15 | 2.0E-15 | 1.9E-15 | |
| AF01_N | 4 | 0.91±7.84E-18 | -0.13±1.01E-17 | 0.29±1.14E-17 | < 0.042 |
| AF02_NNE | 4 | 3.21±9.82E-18 | 0.37±1.01E-17 | 0.78±1.04E-17 | < 0.044 |
| AF03_NE | 4 | 0.30±9.42E-18 | -0.05±1.03E-17 | 0.34±1.27E-17 | < 0.043 |
| AF04_ENE | 4 | 0.69±9.90E-18 | 0.25±1.03E-17 | 0.12±1.13E-17 | < 0.043 |
| AF05_E | 4 | -1.13±6.48E-18 | -1.48±6.76E-18 | 2.62±9.68E-18 | < 0.033 |
| AF06_ESE | 4 | -0.65±8.15E-18 | -0.75±8.09E-18 | 0.28±1.01E-17 | < 0.043 |
| AF07_SE | 4 | -0.05±1.04E-17 | -0.59±7.71E-18 | -0.15±1.04E-17 | < 0.041 |
| AF08_SSE | 4 | 1.05±1.30E-17 | 0.04±1.17E-17 | 0.22±1.20E-17 | < **0.055** |
| AF09_S | 4 | 1.85±6.21E-18 | 0.11±8.95E-18 | 0.63±1.17E-17 | < 0.037 |
| AF10_SSW | 4 | 6.09±7.59E-18 | -0.69±7.46E-18 | -0.13±1.07E-17 | < 0.043 |
| AF11_SW | 4 | -2.15±9.11E-18 | -0.01±1.09E-17 | 0.52±1.04E-17 | < 0.038 |
| AF12_WSW | 4 | 2.80±8.22E-18 | -0.84±9.24E-18 | 0.41±1.36E-17 | < 0.045 |
| AF13_W | 4 | 0.30±1.09E-17 | 0.14±1.03E-17 | 0.41±1.21E-17 | < 0.048 |
| AF14_WNW | 4 | 0.45±7.59E-18 | 0.77±1.08E-17 | 0.55±1.16E-17 | < 0.040 |
| AF15_NW | 4 | -1.39±5.56E-18 | 0.04±6.85E-18 | 0.34±1.06E-17 | < 0.036 |
| AF16_NNW | 4 | 0.55±5.47E-18 | -0.79±6.21E-18 | 0.66±7.48E-18 | < 0.034 |
| AF16HNNW[c] | 4 | 0.71±1.49E-18 | -0.20±1.49E-18 | 0.46±2.27E-18 | < 0.013 |
| AFGRVAL[e] | 4 | 1.42±6.81E-18 | -1.04±8.69E-18 | 4.51±9.55E-18 | < 0.034 |

[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.

Note: All of the above results are nondetects.

**TABLE C-8**

**2021 Summary of NESHAP[a] Concentration Levels for Environmental Compliance**

| *Location* | *Sum of Ratios* [b] If < 1.0, all results are in compliance (< 10 mrem) | *Notes* |
|---|---|---|
| ***Non-Network Sampler*** | | |
| **AFGRVAL**[c] | < 0.034 | Background sampling location (2021 Dose < 0.34 mrem/year) |
| ***Compliance Network Samplers*** | | |
| **AF01_N** | < 0.042 | |
| **AF02_NNE** | < 0.044 | |
| **AF03_NE** | < 0.043 | |
| **AF04_ENE** | < 0.043 | |
| **AF05_E** | < 0.033 | |
| **AF06_ESE** | < 0.043 | |
| **AF07_SE** | < 0.041 | |
| **AF08_SSE** | < 0.055 | **Critical Receptor** (for reporting purposes) **(2021 Dose < 0.55 mrem/year)** |
| **AF09_S** | < 0.037 | |
| **AF10_SSW** | < 0.043 | |
| **AF11_SW** | < 0.038 | |
| **AF12_WSW** | < 0.045 | |
| **AF13_W** | < 0.048 | |
| **AF14_WNW** | < 0.040 | |
| **AF15_NW** | < 0.036 | |
| **AF16_NNW** | < 0.034 | |
| ***Non-Network Sampler*** | | |
| **AF16HNNW**[d] | < 0.013 | 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 representing 10 mrem dose, 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. Groundwater samples collected for analysis of gross alpha and beta activity and radioisotopes under the GMP are filtered prior to analysis, since the presence of sediment or other solid particles can interfere with the measurement of these analytes that are dissolved in the groundwater. Groundwater samples collected for all other analyses under the GMP are not filtered. 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 the 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 and 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 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* [b] *(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)** |
| 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.

**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**
**2021 Indicator Results From the Sand and Gravel Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 6.49 | 5029 | -0.20±1.46E-08 | 6.40±6.98E-09 | 1.42±7.62E-08 |
| 301 | UP | Jun-21 | 6.58 | 5995 | 0.76±8.35E-09 | -7.05±7.86E-09 | 0.22±7.42E-08 |
| 301 | UP | Sep-21 | 6.52 | 4219 | 0.28±1.69E-08 | 9.16±6.77E-09 | 8.30±8.08E-08 |
| 301 | UP | Dec-21 | 6.55 | 2954 | -2.22±6.38E-09 | 7.04±3.29E-09 | 2.33±8.24E-08 |
| | | | | | | | |
| 302 | UP | Jun-21 | 6.74 | 9494 | -1.07±2.71E-08 | 2.57±1.31E-08 | 3.80±8.61E-08 |
| 302 | UP | Dec-21 | 6.81 | 9104 | -0.49±1.28E-08 | 1.42±0.82E-08 | 7.82±8.76E-08 |
| | | | | | | | |
| 401 | UP | Mar-21 | 6.60 | 4970 | 1.09±0.92E-08 | 7.17±0.84E-08 | -4.90±7.43E-08 |
| 401 | UP | Jun-21 | 6.78 | 12160 | -2.32±8.95E-09 | 8.13±8.70E-09 | -0.33±7.53E-08 |
| 401 | UP | Sep-21 | 6.80 | 10527 | 1.34±2.28E-08 | 2.06±1.84E-08 | 2.71±7.82E-08 |
| 401 | UP | Dec-21 | 6.88 | 12680 | -1.88±2.51E-08 | 0.34±1.33E-08 | 2.14±8.77E-08 |
| | | | | | | | |
| 402 | UP | Jun-21 | 6.94 | 8145 | -0.52±1.03E-08 | 1.00±7.99E-09 | 7.16±8.95E-08 |
| 402 | UP | Dec-21 | 7.00 | 9082 | -0.20±1.33E-08 | -0.18±1.27E-08 | -0.31±9.21E-08 |
| | | | | | | | |
| 403 | UP | Jun-21 | 6.90 | 2087 | 3.18±2.65E-09 | 6.33±2.16E-09 | 5.20±8.72E-08 |
| 403 | UP | Dec-21 | 6.77 | 1828 | 0.10±2.81E-09 | 1.16±0.27E-08 | 0.38±8.84E-08 |
| | | | | | | | |
| 706 | UP | Mar-21 | 6.60 | 2289 | 1.01±1.57E-09 | 8.62±0.37E-08 | -5.14±7.25E-08 |
| 706 | UP | Jun-21 | 6.57 | 2902 | 0.17±4.00E-09 | 1.01±0.29E-08 | 6.20±7.79E-08 |
| 706 | UP | Sep-21 | 6.53 | 2520 | 2.71±4.09E-09 | 9.84±3.83E-09 | 1.08±0.92E-07 |
| 706 | UP | Dec-21 | 6.78 | 1049 | -3.48±2.90E-09 | 6.04±3.52E-09 | 7.16±9.56E-08 |
| | | | | | | | |
| 1302 | UP | Dec-21 | 7.06 | 567 | -0.49±1.36E-09 | 1.45±2.71E-09 | 4.23±8.29E-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*)**
**2021 Indicator Results From the Sand and Gravel Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 7.50 | 9642 | 0.31±1.47E-08 | 1.41±0.16E-07 | -5.94±7.22E-08 |
| 103 | DOWN | Jun-21 | 7.86 | 14294 | 0.23±1.72E-08 | 1.32±0.20E-07 | 4.82±7.66E-08 |
| 103 | DOWN | Sep-21 | 7.71 | 12868 | 1.07±1.82E-08 | 1.64±0.22E-07 | 4.53±7.96E-08 |
| 103 | DOWN | Dec-21 | 8.15 | 7564 | 0.69±1.20E-08 | 6.57±1.10E-08 | 7.26±8.60E-08 |
| | | | | | | | |
| 104 | DOWN | Mar-21 | 6.92 | 4004 | 2.81±4.36E-09 | **7.76±0.01E-05** | 1.21±0.85E-07 |
| 104 | DOWN | Jun-21 | 7.04 | 4391 | 1.14±7.90E-09 | **7.74±0.02E-05** | 1.44±0.77E-07 |
| 104 | DOWN | Sep-21 | 6.48 | 4430 | -0.90±1.62E-08 | **7.92±0.02E-05** | 9.27±9.92E-08 |
| 104 | DOWN | Dec-21 | 7.04 | 4008 | 4.07±6.69E-09 | **6.75±0.01E-05** | 5.91±9.00E-08 |
| | | | | | | | |
| 105 | DOWN | Mar-21 | 7.11 | 3898 | -2.72±5.66E-09 | **7.04±0.02E-05** | 1.14±0.89E-07 |
| 105 | DOWN | Jun-21 | 7.17 | 4024 | 1.10±2.07E-08 | **6.72±0.02E-05** | **1.82±0.80E-07** |
| 105 | DOWN | Sep-21 | 6.85 | 4258 | 0.49±7.38E-09 | **7.79±0.02E-05** | 1.27±1.02E-07 |
| 105 | DOWN | Dec-21 | 7.10 | 4260 | -1.96±4.72E-09 | **6.22±0.01E-05** | 1.05±0.76E-07 |
| | | | | | | | |
| 106 | DOWN | Mar-21 | 6.94 | 2431 | 3.76±3.50E-09 | **9.56±0.04E-06** | **3.15±0.99E-07** |
| 106 | DOWN | Jun-21 | 6.92 | 2691 | 1.47±9.22E-09 | **9.85±0.04E-06** | **3.50±0.92E-07** |
| 106 | DOWN | Sep-21 | 6.63 | 3328 | 2.26±4.86E-09 | **1.54±0.01E-05** | **3.86±1.20E-07** |
| 106 | DOWN | Dec-21 | 6.92 | 3788 | -0.72±6.09E-09 | **1.84±0.01E-05** | **3.66±0.97E-07** |
| | | | | | | | |
| 111 | DOWN | Mar-21 | 6.31 | 585 | 0.88±1.64E-09 | **1.90±0.11E-06** | 1.77±7.95E-08 |
| 111 | DOWN | Jun-21 | 6.59 | 1538 | 1.16±1.85E-08 | **6.61±0.07E-06** | 3.81±7.12E-08 |
| 111 | DOWN | Sep-21 | 6.48 | 1944 | **1.99±0.67E-08** | **6.08±0.03E-06** | 1.39±9.50E-08 |
| 111 | DOWN | Dec-21 | 6.49 | 992 | 6.41±2.65E-09 | **3.79±0.02E-06** | 7.57±7.55E-08 |
| | | | | | | | |
| 116 | DOWN | Jun-21 | 7.27 | 3614 | 0.34±1.78E-08 | **5.35±0.01E-05** | 1.44±0.80E-07 |
| 116 | DOWN | Dec-21 | 7.05 | 4136 | -0.39±1.11E-08 | **5.76±0.01E-05** | 8.50±8.82E-08 |
| | | | | | | | |
| 205 | DOWN | Jun-21 | 6.75 | 4822 | 2.66±6.17E-09 | 1.37±0.54E-08 | 4.94±8.61E-08 |
| 205 | DOWN | Dec-21 | 7.13 | 3979 | 4.65±6.08E-09 | 4.14±0.69E-08 | 3.05±9.16E-08 |
| | | | | | | | |
| 406 | DOWN | Mar-21 | 7.27 | 1494 | 2.24±1.90E-09 | 8.22±2.71E-09 | -4.37±7.54E-08 |
| 406 | DOWN | Jun-21 | 6.97 | 1412 | 5.16±6.54E-09 | 5.91±2.16E-09 | 1.87±7.36E-08 |
| 406 | DOWN | Sep-21 | 7.06 | 1330 | 1.21±2.91E-09 | 7.83±3.17E-09 | 8.20±8.13E-08 |
| 406 | DOWN | Dec-21 | 7.09 | 1072 | 1.17±3.34E-09 | 6.35±1.96E-09 | 7.95±8.88E-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*)**
**2021 Indicator Results From the Sand and Gravel Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 7.07 | 5828 | -1.94±1.85E-08 | **1.82±0.01E-04** | 1.44±0.81E-07 |
| 408 | DOWN | Jun-21 | 7.22 | 5966 | 0.93±2.38E-08 | **1.56±0.01E-04** | 1.11±0.74E-07 |
| 408 | DOWN | Sep-21 | 7.21 | 5978 | -0.33±1.13E-08 | **1.59±0.01E-04** | 1.09±1.02E-07 |
| 408 | DOWN | Dec-21 | 7.22 | 5982 | 0.60±1.44E-08 | **1.85±0.01E-04** | 1.07±1.00E-07 |
| | | | | | | | |
| 501 | DOWN | Mar-21 | 7.15 | 3906 | -2.95±6.56E-09 | **4.63±0.01E-05** | 7.95±7.68E-08 |
| 501 | DOWN | Jun-21 | 7.32 | 3980 | -1.18±8.84E-09 | **4.36±0.01E-05** | 1.33±0.77E-07 |
| 501 | DOWN | Sep-21 | 7.10 | 4703 | -1.17±5.37E-09 | **5.70±0.01E-05** | 1.47±1.04E-07 |
| 501 | DOWN | Dec-21 | 7.34 | 4304 | -6.07±9.61E-09 | **5.46±0.01E-05** | 5.80±7.62E-08 |
| | | | | | | | |
| 502 | DOWN | Mar-21 | 7.06 | 3762 | 0.35±1.58E-08 | **5.71±0.01E-05** | 4.97±7.37E-08 |
| 502 | DOWN | Jun-21 | 7.13 | 3554 | -0.52±7.62E-09 | **4.80±0.01E-05** | 1.00±0.74E-07 |
| 502 | DOWN | Sep-21 | 7.06 | 4308 | -2.66±6.85E-09 | **6.48±0.02E-05** | 1.05±0.96E-07 |
| 502 | DOWN | Dec-21 | 7.26 | 4422 | 7.12±7.20E-09 | **6.31±0.01E-05** | 1.04±0.80E-07 |
| | | | | | | | |
| 602A | DOWN | Jun-21 | 6.76 | 2037 | 1.35±3.29E-09 | 1.36±0.41E-08 | 8.14±9.11E-08 |
| 602A | DOWN | Dec-21 | 6.90 | 1632 | 0.18±2.20E-09 | 9.91±1.81E-09 | 8.10±9.75E-08 |
| | | | | | | | |
| 604 | DOWN | Jun-21 | 6.33 | 2558 | 3.47±3.43E-09 | 4.31±2.57E-09 | 1.01±0.84E-07 |
| 604 | DOWN | Dec-21 | 6.32 | 2548 | -2.48±6.17E-09 | 6.09±2.65E-09 | 3.28±8.92E-08 |
| | | | | | | | |
| 605 | DOWN | Jun-21 | 6.77 | 2863 | 1.54±9.80E-09 | 2.57±0.37E-08 | 8.69±8.89E-08 |
| 605 | DOWN | Dec-21 | 6.90 | 1360 | 0.27±1.96E-09 | 1.56±0.20E-08 | 2.32±9.25E-08 |
| | | | | | | | |
| 801 | DOWN | Mar-21 | 6.55 | 3063 | -2.71±5.24E-09 | **1.45±0.01E-05** | 1.02±0.87E-07 |
| 801 | DOWN | Jun-21 | 6.70 | 3886 | -3.97±6.65E-09 | **1.91±0.01E-05** | 8.24±7.06E-08 |
| 801 | DOWN | Sep-21 | 6.52 | 3556 | -1.13±4.74E-09 | **1.74±0.01E-05** | 6.83±9.34E-08 |
| 801 | DOWN | Dec-21 | 6.72 | 2696 | -0.75±3.60E-09 | **1.27±0.01E-05** | 9.45±7.73E-08 |
| | | | | | | | |
| 802 | DOWN | Mar-21 | 6.50 | 146 | 5.51±6.15E-10 | 3.67±0.24E-08 | -3.54±7.54E-08 |
| 802 | DOWN | Jun-21 | 7.08 | 1118 | 0.49±1.50E-09 | 7.80±0.08E-07 | 1.33±0.86E-07 |
| 802 | DOWN | Sep-21 | 6.77 | 1793 | 2.15±3.80E-09 | **1.77±0.02E-06** | 9.15±9.02E-08 |
| 802 | DOWN | Dec-21 | 6.42 | 329 | 6.02±6.72E-10 | 1.33±0.02E-07 | 0.40±7.19E-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*)**
**2021 Indicator Results From the Sand and Gravel Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 7.21 | 3586 | 3.38±5.51E-09 | **1.18±0.09E-06** | 6.22±8.06E-08 |
| 803 | DOWN | Jun-21 | 7.29 | 3836 | 1.34±5.73E-09 | **1.58±0.02E-06** | 5.26±6.92E-08 |
| 803 | DOWN | Sep-21 | 6.96 | 3899 | -3.50±7.94E-09 | **2.23±0.03E-06** | 5.92±9.53E-08 |
| 803 | DOWN | Dec-21 | 7.10 | 3912 | -0.66±5.35E-09 | **2.12±0.02E-06** | 1.03±0.86E-07 |
| | | | | | | | |
| 804 | DOWN | Mar-21 | 6.81 | 2986 | -0.61±3.56E-09 | 3.87±4.10E-09 | -1.80±7.72E-08 |
| 804 | DOWN | Jun-21 | 6.98 | 3164 | 2.82±7.52E-09 | 2.23±0.08E-07 | 1.17±0.85E-07 |
| 804 | DOWN | Sep-21 | 6.62 | 3108 | 1.80±5.15E-09 | 2.30±0.10E-07 | 1.07±0.94E-07 |
| 804 | DOWN | Dec-21 | 6.80 | 2720 | 1.20±4.19E-09 | 1.74±0.07E-07 | 9.32±8.95E-08 |
| | | | | | | | |
| 1304 | DOWN | Mar-21 | 6.90 | 7658 | 0.00±1.43E-08 | 6.26±1.09E-08 | -7.51±7.28E-08 |
| 1304 | DOWN | Jun-21 | 6.80 | 9088 | -0.32±1.01E-08 | -5.17±9.89E-09 | -0.31±7.61E-08 |
| 1304 | DOWN | Sep-21 | 6.90 | 4380 | -0.12±8.18E-09 | 3.76±6.47E-09 | 2.72±8.49E-08 |
| 1304 | DOWN | Dec-21 | 7.10 | 4074 | -4.02±5.45E-09 | 7.53±4.02E-09 | 8.02±8.93E-08 |
| | | | | | | | |
| 8603 | DOWN | Jun-21 | 7.14 | 4436 | 1.53±7.00E-09 | **8.94±0.02E-05** | 1.41±0.79E-07 |
| 8603 | DOWN | Dec-21 | 7.11 | 4468 | 3.53±6.81E-09 | **8.62±0.02E-05** | 1.34±0.90E-07 |
| | | | | | | | |
| 8604 | DOWN | Jun-21 | 7.06 | 4834 | 0.00±8.20E-09 | **7.41±0.02E-05** | 1.07±0.75E-07 |
| 8604 | DOWN | Dec-21 | 6.98 | 4578 | -0.85±1.13E-08 | **8.05±0.02E-05** | 9.71±8.40E-08 |
| | | | | | | | |
| 8605 | DOWN | Mar-21 | 7.02 | 974 | **2.12±0.36E-08** | **5.39±0.03E-06** | 5.87±7.69E-08 |
| 8605 | DOWN | Jun-21 | 6.67 | 1164 | 1.43±0.39E-08 | **6.72±0.03E-06** | 1.26±0.76E-07 |
| 8605 | DOWN | Sep-21 | 6.55 | 2697 | 6.14±7.39E-09 | **5.44±0.04E-06** | 7.60±9.71E-08 |
| 8605 | DOWN | Dec-21 | 6.72 | 874 | **1.60±0.32E-08** | **4.76±0.03E-06** | 1.14±0.88E-07 |
| | | | | | | | |
| 8607 | DOWN | Mar-21 | 6.49 | 4804 | 1.62±5.49E-09 | 1.50±0.10E-07 | -4.16±7.54E-08 |
| 8607 | DOWN | Jun-21 | 6.46 | 8987 | -0.48±1.99E-08 | 6.22±0.95E-08 | 1.07±0.85E-07 |
| 8607 | DOWN | Sep-21 | 6.53 | 2992 | -0.32±3.73E-09 | 2.84±0.43E-08 | 2.28±8.22E-08 |
| 8607 | DOWN | Dec-21 | 6.84 | 1310 | -0.94±3.10E-09 | 1.28±0.64E-08 | 5.67±8.65E-08 |
| | | | | | | | |
| 8609 | DOWN | Mar-21 | 6.98 | 1962 | 3.59±4.93E-09 | 7.58±0.71E-07 | 1.18±0.86E-07 |
| 8609 | DOWN | Jun-21 | 6.87 | 1896 | 0.60±4.56E-09 | 7.46±0.13E-07 | 1.28±0.77E-07 |
| 8609 | DOWN | Sep-21 | 6.87 | 1878 | 1.31±4.62E-09 | 7.37±0.13E-07 | 1.17±1.00E-07 |
| 8609 | DOWN | Dec-21 | 7.04 | 1881 | 1.66±3.78E-09 | 8.02±0.11E-07 | **2.58±0.98E-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)***
**2021 Indicator Results From the Sand and Gravel Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 7.15 | 3220 | 5.49±4.69E-09 | 3.08±4.10E-09 | -2.56±7.63E-08 |
| 8612 | DOWN | Jun-21 | 7.20 | 3413 | -0.42±4.76E-09 | 1.52±0.08E-07 | 9.67±8.15E-08 |
| 8612 | DOWN | Sep-21 | 7.05 | 3416 | 3.61±7.49E-09 | 2.13±0.11E-07 | 1.14±0.93E-07 |
| 8612 | DOWN | Dec-21 | 7.14 | 3524 | 5.19±5.29E-09 | 2.74±0.10E-07 | 1.36±0.91E-07 |
| | | | | | | | |
| MP-01 | DOWN | Mar-21 | 6.96 | 6310 | 5.61±7.83E-09 | **6.14±0.01E-04** | 1.41±0.80E-07 |
| MP-01 | DOWN | Jun-21 | 7.00 | 6748 | 0.38±1.40E-07[c] | **8.15±0.07E-04** | **2.10±0.83E-07** |
| MP-01 | DOWN | Sep-21 | 6.96 | 6778 | -1.44±9.16E-09 | **8.03±0.01E-04** | **2.95±1.15E-07** |
| MP-01 | DOWN | Dec-21 | 7.23 | 6275 | -0.59±1.64E-08 | **6.72±0.01E-04** | -0.87±2.03E-06 |
| | | | | | | | |
| MP-02 | DOWN | Mar-21 | 6.74 | 4014 | 0.76±5.95E-09 | **5.54±0.01E-04** | **1.92±0.84E-07** |
| MP-02 | DOWN | Jun-21 | 6.59 | 5188 | 1.06±3.22E-07[c] | **8.83±0.07E-04** | **2.09±0.80E-07** |
| MP-02 | DOWN | Sep-21 | 6.56 | 5275 | -1.25±0.83E-08 | **8.93±0.01E-04** | **1.84±1.06E-07** |
| MP-02 | DOWN | Dec-21 | 6.88 | 3590 | 0.20±1.69E-08 | **4.53±0.01E-04** | -0.77±2.03E-06 |
| | | | | | | | |
| MP-03 | DOWN | Mar-21 | 6.99 | 4202 | -0.75±5.77E-09 | **2.18±0.01E-04** | 8.52±7.69E-08 |
| MP-03 | DOWN | Jun-21 | 7.11 | 4301 | 3.08±6.51E-09 | **2.17±0.01E-04** | 1.01±0.72E-07 |
| MP-03 | DOWN | Sep-21 | 7.08 | 2831 | 0.23±1.03E-08 | **1.71±0.01E-04** | 1.71±1.03E-07 |
| MP-03 | DOWN | Dec-21 | 7.27 | 2574 | 4.34±4.00E-09 | **1.54±0.01E-04** | **1.80±0.94E-07** |
| | | | | | | | |
| MP-04 | DOWN | Mar-21 | 7.12 | 3848 | 7.87±5.68E-09 | **3.42±0.01E-04** | 1.78±0.84E-07 |
| MP-04 | DOWN | Jun-21 | 7.19 | 3901 | 1.29±2.79E-07[c] | **3.95±0.05E-04** | 1.70±0.80E-07 |
| MP-04 | DOWN | Sep-21 | 7.09 | 3612 | 2.88±7.16E-09 | **3.16±0.01E-04** | **2.40±1.08E-07** |
| MP-04 | DOWN | Dec-21 | 7.27 | 3106 | 1.66±1.86E-08[c] | **2.84±0.01E-04** | 2.22±2.26E-06 |
| | | | | | | | |
| GSEEP | DOWN | Mar-21 | 7.63 | 2326 | -0.77±3.04E-09 | 5.05±0.46E-08 | 3.34±7.94E-08 |
| GSEEP | DOWN | Jun-21 | 7.88 | 3081 | 0.76±1.04E-08 | 6.32±0.46E-08 | 1.42±0.86E-07 |
| GSEEP | DOWN | Sep-21 | 7.68 | 3121 | -1.62±3.95E-09 | 7.65±0.50E-08 | 1.58±0.90E-07 |
| GSEEP | DOWN | Dec-21 | 8.08 | 2970 | -2.21±4.51E-09 | 7.49±0.52E-08 | 1.06±1.00E-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.)
[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-2A *(concluded)***
**2021 Indicator Results From the Sand and Gravel Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | NS | NS | 0.38±5.39E-09 | 1.14±0.06E-07 | 8.24±8.14E-08 |
| SP04 | DOWN | Dec-21 | NS | NS | 3.41±5.28E-09 | 1.25±0.07E-07 | 8.49±9.75E-08 |
| | | | | | | | |
| SP06 | DOWN | Jun-21 | NS | NS | 1.67±3.87E-09 | 3.15±0.08E-07 | 8.49±9.11E-08 |
| SP06 | DOWN | Dec-21 | NS | NS | -1.70±4.37E-09 | 2.80±0.07E-07 | 5.75±9.26E-08 |
| | | | | . | | | |
| SP11 | DOWN | Jun-21 | NS | NS | -2.32±5.06E-09 | **1.09±0.02E-06** | 4.57±7.12E-08 |
| SP11 | DOWN | Dec-21 | NS | NS | 5.23±7.69E-09 | **1.15±0.02E-06** | 1.03±0.88E-07 |
| | | | | | | | |
| SP12 | DOWN | Jun-21 | 7.25 | 3165 | 6.71±6.84E-09 | 4.26±0.11E-07 | 6.48±9.98E-08 |
| SP12 | DOWN | Dec-21 | 7.34 | 3182 | 0.33±4.18E-09 | 5.35±0.10E-07 | 2.58±9.01E-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**
**2021 Indicator Results From the Lavery Till-Sand Unit**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 7.67 | 2061 | 0.20±2.99E-09 | 3.78±2.34E-09 | -6.85±7.36E-08 |
| 204 | DOWN | Jun-21 | 7.47 | 2152 | -2.91±3.70E-09 | 0.87±2.07E-09 | 6.58±8.68E-08 |
| 204 | DOWN | Sep-21 | 7.54 | 2000 | 0.68±2.89E-09 | 2.95±2.30E-09 | 1.08±7.69E-08 |
| 204 | DOWN | Dec-21 | 7.60 | 2020 | -7.88±6.13E-09 | 5.68±4.71E-09 | 5.73±9.65E-08 |
| | | | | | | | |
| 206 | DOWN | Jun-21 | 7.15 | 2594 | 7.12±8.36E-09 | 4.01±2.53E-09 | 8.00±8.84E-08 |
| 206 | DOWN | Dec-21 | 7.31 | 2496 | 0.73±3.71E-09 | 1.27±0.28E-08 | 0.01±8.87E-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**

**2021 indicator Results From the Weathered Lavery Till Unit**

| ***Location Code*** | ***Hydraulic Position [a]*** | ***Date Collected*** | ***pH SU*** | ***Conductivity µmhos/cm @ 25°C*** | ***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-21 | NM | NM | NM | NM | NM |
| 908R | UP | Dec-21 | 7.22 | 1156 | 7.58±2.46E-09 | 6.23±1.67E-09 | 1.38±7.41E-08 |
| | | | | | | | |
| 1005 | UP | Jun-21 | 7.13 | 780 | 1.92±1.43E-09 | 0.05±1.12E-09 | 2.83±8.47E-08 |
| 1005 | UP | Dec-21 | 7.21 | 754 | 1.68±1.42E-09 | 3.02±1.18E-09 | 4.10±8.58E-08 |
| | | | | | | | |
| 1008C | UP | Jun-21 | 7.59 | 413 | 3.25±7.85E-10 | 1.36±0.77E-09 | -0.25±7.96E-08 |
| 1008C | UP | Dec-21 | 7.54 | 561 | -2.73±9.19E-10 | 1.13±0.78E-09 | 4.61±8.74E-08 |
| | | | | | | | |
| 906 | DOWN | Jun-21 | 7.22 | 688 | 1.15±1.81E-09 | 3.60±1.36E-09 | 1.60±6.51E-08 |
| 906 | DOWN | Dec-21 | 7.40 | 719 | 0.39±1.72E-09 | 2.67±1.19E-09 | 3.88±7.77E-08 |
| | | | | | | | |
| 909 | DOWN | Jun-21 | 6.55 | 1376 | 0.40±2.22E-09 | 1.51±0.05E-07 | **7.17±1.14E-07** |
| 909 | DOWN | Dec-21 | 6.71 | 1325 | 2.60±2.77E-09 | 1.86±0.05E-07 | 1.26±0.83E-07 |
| | | | | | | | |
| 1006 | DOWN | Jun-21 | 7.08 | 1487 | 3.90±3.07E-09 | 7.11±2.79E-09 | 7.74±9.11E-08 |
| 1006 | DOWN | Dec-21 | 7.07 | 1470 | 0.86±4.27E-09 | 3.87±2.27E-09 | 6.20±8.81E-08 |
| | | | | | | | |
| NDATR | DOWN | Mar-21 | 7.63 | 1382 | 2.59±2.62E-09 | 2.87±0.07E-07 | 5.68±8.66E-08 |
| NDATR | DOWN | Jun-21 | 7.22 | 1066 | 4.85±3.32E-09 | 1.80±0.04E-07 | 1.28±0.92E-07 |
| NDATR | DOWN | Sep-21 | 7.05 | 1578 | 0.94±1.50E-09 | 2.02±0.04E-07 | 0.98±1.03E-07 |
| NDATR | DOWN | Dec-21 | 7.78 | 1683 | 9.77±4.26E-09 | 2.73±0.07E-07 | 5.59±7.83E-08 |

Note: Bolding indicates radiological concentration that exceeds the GSL.

NA - Not applicable.

NM - Not Measured. Well 908R was dry in June 2021.

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**
**2021 Indicator Results From the Unweathered Lavery Till**

| Location Code | Hydraulic Position [a] | Date Collected | pH SU | Conductivity µmhos/cm @ 25°C | 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-21 | 6.71 | 7439 | -0.54±6.26E-09 | 2.23±0.31E-08 | -0.56±7.69E-08 |
| 405 | UP | Jun-21 | 6.91 | 6608 | -4.54±8.46E-09 | 9.26±5.09E-09 | 5.05±8.43E-08 |
| 405 | UP | Sep-21 | 7.04 | 4004 | 0.39±1.59E-08 | 8.69±6.56E-09 | 4.05±7.84E-08 |
| 405 | UP | Dec-21 | 7.20 | 2542 | -2.32±4.74E-09 | 7.80±4.22E-09 | 3.99±8.45E-08 |
| | | | | | | | |
| 1303 | DOWN | Mar-21 | 7.94 | 378 | 6.22±8.44E-10 | 3.07±9.08E-10 | -3.98±7.32E-08 |
| 1303 | DOWN | Jun-21 | 8.04 | 317 | 9.30±9.98E-10 | 3.22±6.33E-10 | 2.32±8.57E-08 |
| 1303 | DOWN | Sep-21 | 7.35 | 279 | 0.71±2.20E-09 | 2.22±1.87E-09 | 8.54±8.88E-08 |
| 1303 | DOWN | Dec-21 | 8.00 | 272 | -0.47±1.04E-09 | -0.96±5.96E-10 | -3.63±8.55E-08 |
| | | | | | | | |
| 107 | DOWN | Mar-21 | 7.83 | 990 | -0.22±1.55E-09 | 1.08±0.17E-08 | -0.37±7.70E-08 |
| 107 | DOWN | Jun-21 | 7.82 | 912 | -0.06±1.32E-09 | 1.17±0.16E-08 | 1.26±0.94E-07 |
| 107 | DOWN | Sep-21 | 7.47 | 1193 | 0.00±1.92E-09 | 1.79±0.19E-08 | 1.34±0.89E-07 |
| 107 | DOWN | Dec-21 | 7.60 | 1047 | 0.06±1.54E-09 | 1.94±0.16E-08 | 1.01±0.98E-07 |
| | | | | | | | |
| 108 | DOWN | Jun-21 | 7.66 | 686 | 0.93±1.36E-09 | 3.31±0.95E-09 | **2.61±1.06E-07** |
| 108 | DOWN | Dec-21 | 7.59 | 736 | 1.55±1.22E-09 | 3.32±0.88E-09 | **2.91±1.12E-07** |
| | | | | | | | |
| 110 | DOWN | Mar-21 | 7.59 | 575 | 0.60±1.10E-09 | 1.10±0.94E-09 | **2.95±0.97E-07** |
| 110 | DOWN | Jun-21 | 7.52 | 574 | 0.81±1.52E-09 | 1.87±1.08E-09 | **4.11±1.04E-07** |
| 110 | DOWN | Sep-21 | 7.39 | 566 | 0.24±1.25E-09 | -2.33±1.26E-09 | **3.01±0.97E-07** |
| 110 | DOWN | Dec-21 | 7.48 | 556 | 0.77±1.58E-09 | 2.74±1.09E-09 | **3.34±1.09E-07** |
| | | | | | | | |
| 409 | DOWN | Mar-21 | 8.01 | 355 | 1.19±1.20E-09 | 1.44±0.74E-09 | -1.73±7.59E-08 |
| 409 | DOWN | Jun-21 | 7.99 | 341 | -0.96±6.14E-10 | 1.09±0.64E-09 | -3.35±7.11E-08 |
| 409 | DOWN | Sep-21 | 8.24 | 278 | 4.77±9.78E-10 | 2.12±0.78E-09 | 4.00±7.78E-08 |
| 409 | DOWN | Dec-21 | 8.05 | 332 | -3.71±8.37E-09 | 2.00±0.64E-08 | 4.68±9.31E-08 |
| | | | | | | | |
| 704 | DOWN | Mar-21 | 6.66 | 1439 | -2.33±2.24E-09 | 7.12±1.74E-09 | -6.99±7.39E-08 |
| 704 | DOWN | Jun-21 | 6.87 | 1612 | 2.76±4.38E-09 | 3.58±1.76E-09 | 9.44±8.35E-08 |
| 704 | DOWN | Sep-21 | 6.52 | 1272 | -1.00±3.07E-09 | 1.03±0.22E-08 | 6.64±9.43E-08 |
| 704 | DOWN | Dec-21 | 6.96 | 963 | 0.25±2.06E-09 | 1.18±0.19E-08 | -3.65±8.70E-08 |
| | | | | | | | |
| 707 | DOWN | Jun-21 | 7.09 | 656 | 8.43±7.71E-10 | 1.92±0.64E-09 | 0.12±7.17E-08 |
| 707 | DOWN | Dec-21 | 6.75 | 461 | 0.68±1.38E-09 | 4.78±0.89E-09 | 4.39±9.44E-08 |
| | | | | | | | |
| 910R | DOWN | Jun-21 | 7.12 | 1358 | 5.68±4.23E-09 | 3.44±1.26E-09 | 0.64±6.46E-08 |
| 910R | DOWN | Dec-21 | 7.23 | 1399 | 4.51±3.70E-09 | 7.63±2.35E-09 | 7.53±8.25E-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**
**2021 Indicator Results From the Kent Recessional Sequence**

| *Location Code* | *Hydraulic Position* [a] | *Date Collected* | *pH SU* | *Conductivity µmhos/cm @ 25°C* | *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-21 | 7.31 | 400 | 0.09±1.12E-09 | 1.31±0.15E-08 | 0.52±6.61E-08 |
| 901 | UP | Dec-21 | 7.23 | 378 | 9.19±7.38E-10 | 1.87±0.68E-09 | 4.49±8.04E-08 |
| | | | | | | | |
| 902 | UP | Jun-21 | 8.00 | 439 | 2.23±8.38E-10 | 1.61±0.16E-08 | 3.69±6.81E-08 |
| 902 | UP | Dec-21 | 8.05 | 202 | -1.32±6.95E-10 | 2.53±0.66E-09 | 5.83±7.72E-08 |
| | | | | | | | |
| 1008B | UP | Dec-21 | 7.92 | 382 | 7.02±7.94E-10 | 3.08±0.66E-09 | 2.01±8.36E-08 |
| | | | | | | | |
| 903 | DOWN | Jun-21 | 7.45 | 996 | 0.29±1.42E-09 | 3.23±1.42E-09 | 0.55±6.67E-08 |
| 903 | DOWN | Dec-21 | 7.47 | 988 | 1.08±1.55E-09 | 3.31±1.19E-09 | 1.06±0.84E-07 |
| | | | | | | | |
| 8610 | DOWN | Jun-21 | NM | NM | NM | NM | NM |
| 8610 | DOWN | Dec-21 | NM | NM | NM | NM | NM |
| | | | | | | | |
| 8611 | DOWN | Jun-21 | 7.18 | 1569 | -1.43±2.10E-09 | 4.42±2.40E-09 | 0.66±6.51E-08 |
| 8611 | DOWN | Dec-21 | 7.28 | 1616 | 1.05±2.32E-09 | 4.03±1.76E-09 | 1.30±0.84E-07 |

NA - Not applicable.
NM - Not measured. Well 8610 was not able to be sampled due to an obstruction in the well.
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**
**2021 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 | Jun-21 | <3.0 | <10.0 | 280 | <1.0 | <5.0 | **140** | <50.0 | <25.0 |
| 706 | UP | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | **170** | <50.0 | <25.0 |
| | | | | | | | | | | |
| 1302 | UP | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| | | | | | | | | | | |
| 111 | DOWN | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| | | | | | | | | | | |
| 1304 | DOWN | Jun-21 | <3.0 | <10.0 | 780 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| 1304 | DOWN | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| | | | | | | | | | | |
| 8605 | DOWN | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| | | | | | | | | | | |
| MP-01 | DOWN | Mar-21 | <3.0 | <10.0 | 718 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-01 | DOWN | Jun-21 | <3.0 | <10.0 | 800 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-01 | DOWN | Sep-21 | <3.0 | <10.0 | 751 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-01 | DOWN | Dec-21 | <10.0 | <20.0 | 719 | <2.0 | <10.0[b] | **186** | <50.0 | <30.0 |
| | | | | | | | | | | |
| MP-02 | DOWN | Mar-21 | <3.0 | <10.0 | 330 | <1.0 | <5.0 | 48.5 | <50.0 | <25.0 |
| MP-02 | DOWN | Jun-21 | <3.0 | <10.0 | 456 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-02 | DOWN | Sep-21 | <3.0 | <10.0 | 473 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-02 | DOWN | Dec-21 | <10.0 | <20.0 | 319 | <2.0 | <10.0[b] | <10.0 | <50.0 | <30.0 |
| | | | | | | | | | | |
| MP-03 | DOWN | Mar-21 | <3.0 | <10.0 | 519 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-03 | DOWN | Jun-21 | <3.0 | <10.0 | 543 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-03 | DOWN | Sep-21 | <3.0 | <10.0 | 326.5 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-03 | DOWN | Dec-21 | <3.0 | <10.0 | 347 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| | | | | | | | | | | |
| MP-04 | DOWN | Mar-21 | <3.0 | <10.0 | 432 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| MP-04 | DOWN | Jun-21 | <3.0 | <10.0 | 439 | <1.0 | <5.0 | 10.3 | <50.0 | 49.4 |
| MP-04 | DOWN | Sep-21 | <3.0 | <10.0 | 368 | <1.0 | <5.0 | 12.2 | <50.0 | <25.0 |
| MP-04 | DOWN | Dec-21 | <10.0 | <20.0 | 345 | <2.0 | <10.0[b] | <10.0 | <50.0 | <30.0 |

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] Value is a nondetect greater than GSLs. Detection limit is higher than usual due to sample dilution requried for analysis of radiological parameters. Not bolded.

**TABLE D-2F *(continued)***
**2021 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 | Jun-21 | <3.0 | <0.20 | **1100** | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| 706 | UP | Dec-21 | <3.0 | <0.20 | **730** | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| 1302 | UP | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| 111 | DOWN | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| 1304 | DOWN | Jun-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| 1304 | DOWN | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| 8605 | DOWN | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| MP-01 | DOWN | Mar-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-01 | DOWN | Jun-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-01 | DOWN | Sep-21 | <3.0 | <0.20 | <40.0 | <10.0 [b] | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-01 | DOWN | Dec-21 | <5.0 | <0.67 | <40.0 | <15.0 [b] | <10.0 | <6.0 | <3000 | <50.0 | 48.3 |
| | | | | | | | | | | | |
| MP-02 | DOWN | Mar-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-02 | DOWN | Jun-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-02 | DOWN | Sep-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-02 | DOWN | Dec-21 | <5.0 | **0.81** | <40.0 | <15.0 [b] | <10.0 | <6.0 | <3000 | <50.0 | 36.4 |
| | | | | | | | | | | | |
| MP-03 | DOWN | Mar-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-03 | DOWN | Jun-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-03 | DOWN | Sep-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-03 | DOWN | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| MP-04 | DOWN | Mar-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-04 | DOWN | Jun-21 | <3.0 | <0.20 | 52.1 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-04 | DOWN | Sep-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| MP-04 | DOWN | Dec-21 | <5.0 | <0.67 | <40.0 | <15.0 [b] | <10.0 | <6.0 | <3000 | <50.0 | <33.0 |

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] Value is a nondetect greater than GSLs. Detection limit is higher than usual due to sample dilution requried for analysis of radiological parameters. Not bolded.

**TABLE D-2F *(continued)***
**2021 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-21 | <3.0 | **26** | 290 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| | | | | | | | | | | |
| NDATR | DOWN | Mar-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| NDATR | DOWN | Jun-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| NDATR | DOWN | Sep-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| NDATR | DOWN | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| **Unweathered Lavery Till Unit** | | | | | | | | | | |
| 405 | UP | Jun-21 | <3.0 | <10.0 | 355 | <1.0 | <5.0 | **755** | <50.0 | <25.0 |
| 405 | UP | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | **78** | <50.0 | <25.0 |
| | | | | | | | | | | |
| 1303 | DOWN | Jun-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |
| 1303 | DOWN | Dec-21 | <3.0 | <10.0 | <200 | <1.0 | <5.0 | <10.0 | <50.0 | <25.0 |

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.)

**TABLE D-2F (*concluded)***
**2021 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-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| NDATR | DOWN | Mar-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| NDATR | DOWN | Jun-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| NDATR | DOWN | Sep-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| NDATR | DOWN | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <2.0 | <3000 | <50.0 | <20.0 |
| **Unweathered Lavery Till Unit** | | | | | | | | | | | |
| 405 | UP | Jun-21 | <3.0 | <0.20 | **690** | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| 405 | UP | Dec-21 | <3.0 | <0.20 | **160** | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| | | | | | | | | | | | |
| 1303 | DOWN | Jun-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |
| 1303 | DOWN | Dec-21 | <3.0 | <0.20 | <40.0 | <5.0 | <10.0 | <0.50 | <3000 | <50.0 | <20.0 |

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.)

**TABLE D-2G**
**2021 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 | Jun-21 | NS | 1.39±1.11E-09 | NS | NS | -1.77±3.24E-09 | NS |
| 401 | UP | Dec-21 | -1.36±1.99E-08 | 2.35±0.96E-09 | 2.02±1.98E-09 | 1.19±7.85E-10 | -0.97±2.65E-09 | 9.58±3.33E-10 |
| 406 | DOWN | Dec-21 | -1.21±1.90E-08 | 1.87±1.20E-09 | 2.18±1.96E-09 | -1.00±0.90E-09 | 1.15±2.91E-09 | **1.94±0.46E-09** |
| 408 | DOWN | Dec-21 | -0.53±2.02E-08 | **9.50±0.01E-05** | 4.87±1.75E-09 | 0.62±1.12E-09 | 0.51±3.09E-09 | 9.94±3.51E-10 |
| 501 | DOWN | Dec-21 | NS | **2.78±0.01E-05** | NS | NS | NS | NS |
| 502 | DOWN | Dec-21 | NS | **3.27±0.01E-05** | NS | NS | NS | NS |
| 801 | DOWN | Dec-21 | NS | **8.19±0.04E-06** | NS | NS | NS | NS |
| 1304 | DOWN | Jun-21 | NS | 0.93±1.15E-09 | NS | NS | 0.25±3.49E-09 | NS |
| 1304 | DOWN | Dec-21 | -2.30±1.86E-08 | 1.04±0.88E-09 | **6.72±1.17E-09** | 2.34±4.05E-10 | -0.26±3.03E-09 | 3.34±1.85E-10 |
| 8609 | DOWN | Dec-21 | NS | **3.70±0.10E-07** | NS | NS | NS | NS |
| MP-01 | DOWN | Dec-21 | -0.41±1.53E-07 | **4.15±0.02E-04** | -4.81±4.26E-08 [c] | 2.70±5.95E-08 [c] | -2.50±2.29E-08 | NS |
| MP-02 | DOWN | Dec-21 | 0.09±1.57E-07 | **2.74±0.02E-04** | 3.25±3.80E-08 [c] | **2.17±2.04E-08** | -0.64±1.69E-08 | NS |
| MP-03 | DOWN | Dec-21 | -0.72±1.98E-08 | **8.27±0.01E-05** | **1.85±0.34E-08** | 3.01±9.44E-10 [c] | 0.64±2.32E-09 | NS |
| MP-04 | DOWN | Dec-21 | -0.08±1.56E-07 | **1.77±0.01E-04** | -0.10±1.06E-07 [c] | 0.33±4.46E-08 | 0.06±2.52E-08 | NS |
| **Weathered Lavery Till Unit** | | | | | | | | |
| 909 | DOWN | Dec-21 | -1.51±1.90E-08 | **9.88±0.45E-08** | -4.00±8.93E-10 | **9.64±2.55E-09** | 1.37±4.48E-09 | 5.68±2.22E-10 |
| NDATR | DOWN | Jun-21 | 0.90±2.84E-08 | **1.59±0.05E-07** | -0.63±1.23E-09 | **6.55±1.56E-09** | -0.88±6.73E-09 | 2.73±4.41E-10 |
| NDATR | DOWN | Dec-21 | -1.01±1.93E-08 | **1.27±0.06E-07** | -1.61±5.97E-10 | **6.76±2.01E-09** | 1.53±2.12E-09 | 4.09±2.18E-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. It may also be considered a nondetect because the result is less than the uncertainty. The sample quantitation limit is an estimated quantity.

**TABLE D-2G (*continued*)**
**2021 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-21 | 9.38±4.45E-10 | -0.50±1.94E-10 | 4.41±1.67E-10 | 4.27±6.36E-11 | 2.85±1.37E-10 | 7.34±1.50E-04 |
| 406 | DOWN | Dec-21 | 1.46±3.45E-10 | -1.01±2.73E-10 | 1.24±1.03E-10 | 0.00±2.66E-11 | 1.98±1.03E-10 | 3.71±0.78E-04 |
| 408 | DOWN | Dec-21 | 9.34±3.77E-10 [c] | -2.12±1.69E-10 | **6.86±2.45E-10** | 4.71±8.34E-11 | 4.50±2.04E-10 | **1.40±0.28E-03** |
| 1304 | DOWN | Dec-21 | 0.43±3.79E-10 | 0.20±2.26E-10 | -1.26±3.01E-11 | 3.36±5.94E-11 | 0.41±4.30E-11 | 5.02±1.00E-04 |
| MP-01 | DOWN | Dec-21 | NS | 1.19±4.45E-09 [c] | -0.03±2.61E-09 [c] | 1.31±3.68E-09 [c] | 3.60±5.19E-09 [c] | NS |
| MP-02 | DOWN | Dec-21 | NS | 2.69±7.08E-09 [c] | -1.11±6.36E-09 [c] | **7.99±7.60E-09** | 1.15±5.18E-09 [c] | NS |
| MP-03 | DOWN | Dec-21 | NS | 2.25±3.37E-10 [c] | **1.06±0.31E-09** | 1.05±1.07E-10 [c] | **7.29±2.57E-10** | NS |
| MP-04 | DOWN | Dec-21 | NS | -2.36±3.81E-09 | -1.26±4.04E-09 [c] | 2.97±5.84E-09 [c] | 1.28±4.80E-09 [c] | NS |
| **Weathered Lavery Till Unit** | | | | | | | | |
| 909 | DOWN | Dec-21 | 6.99±3.63E-10 | 0.99±2.43E-10 | 3.79±0.98E-10 | 1.01±2.79E-11 | 3.36±0.85E-10 | 9.80±2.00E-04 |
| NDATR | DOWN | Jun-21 | -0.28±3.63E-10 | -0.52±1.86E-10 | **1.62±0.20E-09** | 2.61±3.69E-11 | **1.21±0.18E-09** | **4.08±0.82E-03** |
| NDATR | DOWN | Dec-21 | -0.86±3.29E-10 | 1.45±1.89E-10 [c] | **1.66±0.19E-09** | **1.23±0.56E-10** | **1.21±0.16E-09** | **3.90±0.78E-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.)
[c] This result is not bolded because it was flagged with a "UJ" as not detected. It may also be considered a nondetect because the result is less than the uncertainty. The sample quantitation limit is an estimated quantity.

**TABLE D-2G (*concluded*)**
**2021 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-21 | -1.05±4.75E-09 | 4.82±7.38E-09 | 1.70±5.81E-09 | -3.13±8.35E-07 | 0.52±2.86E-09 | -0.94±2.18E-09 |
| MP-02 | DOWN | Dec-21 | 0.04±2.65E-09 | 0.98±3.20E-09 | 0.00±2.29E-09 | -6.67±8.15E-07 | 0.00±2.16E-09 | 0.00±2.14E-09 |
| MP-03 | DOWN | Dec-21 | 1.35±5.07E-11 | 1.62±3.80E-11 | -0.13±3.88E-11 | 0.39±1.68E-08 | 1.98±3.82E-11 | 1.10±3.38E-11 |
| MP-04 | DOWN | Dec-21 | -0.93±2.16E-09 | 5.25±5.83E-09 | 1.20±3.36E-09 | -3.66±8.30E-07 | 0.00±2.21E-09 | 0.00±2.19E-09 |

[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**
**2021 Radioactivity Concentrations in Milk**

| *Location* | *K-40 (µCi/mL)* | *Sr-90 (µCi/mL)* | *I-129 (µCi/mL)* | *Cs-137 (µCi/mL)* |
|---|---|---|---|---|
| **BFMCTLS (2017)**[a] (Background) Once every five years | 1.32±0.18E-06 | 3.46±6.87E-10 | 0.78±2.88E-10 | -0.12±4.78E-09 |

[a] The background milk sample (BFMCTLS) was collected from a farm located 22 km south of the site. Milk from this location is sampled every five years. It was last sampled in 2017 and will be sampled again in 2022.

| *Location* | *K-40 (µCi/mL)* | *Sr-90 (µCi/mL)* | *I-129 (µCi/mL)* | *Cs-137 (µCi/mL)* |
|---|---|---|---|---|
| **BFMFLDMN**[b] Annual | 1.49±0.11E-06 | -2.69±7.92E-10 | -1.83±4.97E-10 | -0.80±2.18E-09 |

[b] The near-site milk sample (BFMFLDMN) was collected from a farm located 5.1 km southeast of the site. Milk from this location is sampled annually.

**TABLE E-2**
**2021 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)* |
|---|---|---|---|---|---|
| **BFDCTRL** (Background) | 73.0 | 1.95±1.05E-07 | 1.31±0.07E-05 | 2.40±2.91E-09 | 4.91±1.83E-08 |
| **BFDCTRL1** (Background) | 73.4 | -3.53±7.23E-07 | 1.19±0.08E-05 | 2.60±2.82E-09 | -1.06±2.01E-08 |
| **BFDCTRL2** (Background) | 71.6 | 6.05±1.37E-07 | 1.09±0.07E-05 | 4.18±3.02E-09 | 0.71±2.81E-08 |
| **BFDNEAR** (Near-Site) | 73.9 | 3.59±9.07E-08 | 1.28±0.07E-05 | 3.52±2.90E-09 | 0.00±3.04E-08 |
| **BFDNEAR1** (Near-Site) | 74.5 | 7.15±9.54E-08 | 1.21±0.08E-05 | -0.85±2.60E-09 | 6.13±2.70E-08 |
| **BFDNEAR2** (Near-Site) | 72.9 | 1.02±0.16E-06 | 1.10±0.07E-05 | -1.91±2.52E-09 | 2.56±1.82E-08 |

Note: Both near-site and background venison samples are collected annually.

**TABLE E-3**
**2021 Radioactivity Concentrations in Food Crops**

| |
|---|
| **Food crops were sampled in 2017 and will next be sampled in CY 2022.** [a] |

[a] Food crops are sampled every five years, consistent with guidance on periodic confirmatory sampling in DOE-HDBK-1216-2015.

**TABLE E-4**
**2021 Radioactivity Concentrations in Edible Portions of Fish**

| |
|---|
| **Fish were sampled in 2017 and will next be sampled in CY 2022.** [a] |

[a] Fish are sampled every five years, consistent with guidance on periodic confirmatory sampling in DOE-HDBK-1216-2015.

# APPENDIX F
## Summary of Direct Radiation Monitoring Data

**TABLE F-1**

**Summary of 2021 Semiannual Averages of Off-Site TLD Measurements**

**(mR±2 SD/quarter)**

| *Location Number*[a] | *1st Half* | *2nd Half* | *Location Average* | *Background DFTLD23* |
|---|---|---|---|---|
| DFTLD01 | 15±1 | 17±1 | 16±1 | 15±1 |
| DFTLD02 | 14±1 | 16±1 | 15±1 | |
| DFTLD03 | 12±1 | 13±1 | 13±1 | |
| DFTLD04 | 14±1 | 15±1 | 14±1 | |
| DFTLD05 | 14±1 | 15±1 | 14±1 | |
| DFTLD06 | 14±1 | 15±1 | 14±1 | |
| DFTLD07 | 12±1 | 13±1 | 12±1 | |
| DFTLD08[b] | Not measured | 14±1 | 14±1 | |
| DFTLD09 | 13±1 | 14±1 | 14±1 | |
| DFTLD10 | 12±1 | 13±1 | 13±1 | |
| DFTLD11 | 13±1 | 14±1 | 13±1 | |
| DFTLD12 | 14±1 | 15±1 | 14±1 | |
| DFTLD13 | 14±1 | 16±1 | 15±1 | |
| DFTLD14 | 13±1 | 14±1 | 14±1 | |
| DFTLD15 | 13±1 | 14±1 | 14±1 | |
| DFTLD16 | 13±1 | 15±1 | 14±1 | |
| DFTLD20 | 11±1 | 13±1 | 12±1 | |

[a] Off-site locations are shown on Figures A-13 and A-14.

[b] The TLD package for sampling location DFTLD08 was missing upon arriving at the collection in July 2021. The yard was searched and the home owner contacted but it was never found and had to be replaced.

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 18.1 mR/quarter would be equivalent to 18.6 mrem/quarter (based upon dose-equivalent phantom calibration using cesium-137).

**TABLE F-2**

**Summary of 2021 Semiannual Averages of On-Site TLD Measurements[a]**

**(mR±2SD/quarter )**

| *Location Number [a]* | *1st Half* | *2nd Half* | *Location Average* |
|---|---|---|---|
| DNTLD24 | 45±5 | 50±4 | 48±5 |
| DNTLD28 | 15±1 | 16±1 | 16±1 |
| DNTLD32 | 14±1 | 16±2 | 15±1 |
| DNTLD33 | 16±1 | 17±1 | 17±1 |
| DNTLD35 | 15±1 | 16±1 | 16±1 |
| DNTLD36 | 13±1 | 14±1 | 14±1 |
| DNTLD38 | 86±5 | 83±6 | 84±6 |
| DNTLD40 | 1,168±111 | 1,175±93 | 1,171±102 |
| DNTLD43 | 13±1 | 13±1 | 13±1 |
| DNTLD44 | 17±1 | 18±1 | 17±1 |

[a] 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 18.1 mR/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 44; March 2021**

| *Analyte* | *Matrix* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?*[b] | *Analyzed by:* |
|---|---|---|---|---|---|---|---|
| ***MAPEP – 21 – RdF44, Air Filter – Radiological*** | | | | | | | |
| Am-241 | Air Filter | Bq/sample | 0.0385 | 0.037 | 0.026 - 0.048 | Yes | GEL |
| Cs-137 | Air Filter | Bq/sample | -0.00665 | [c] | *False Positive Test*[d] | Yes | ES |
| Co-60 | Air Filter | Bq/sample | 0.00220 | [c] | *False Positive Test*[d] | Yes | ES |
| Cs-137 | Air Filter | Bq/sample | -0.0168 | [c] | *False Positive Test*[d] | Yes | GEL |
| Co-60 | Air Filter | Bq/sample | 0.0325 | [c] | *False Positive Test*[d] | Yes | GEL |
| Pu-238 | Air Filter | Bq/sample | 0.0207 | 0.0228 | 0.0160 - 0.0296 | Yes | GEL |
| Pu-239/240 | Air Filter | Bq/sample | 0.0417 | 0.0453 | 0.0317 - 0.0589 | Yes | GEL |
| Sr-90 | Air Filter | Bq/sample | 0.890 | 0.749 | 0.524 - 0.974 | Yes | GEL |
| U-234 | Air Filter | Bq/sample | 0.063 | 0.060 | 0.04 - 0.08 | Yes | GEL |
| U-238 | Air Filter | Bq/sample | 0.0617 | 0.0630 | 0.044 - 0.082 | Yes | GEL |
| ***MAPEP – 21 – MaW44, Water – Radiological*** | | | | | | | |
| Cs-137 | Water | Bq/L | 7.64 | 7.9 | 5.5 - 10.3 | Yes | ES |
| Co-60 | Water | Bq/L | -0.000574 | [c] | *False Positive Test*[d] | Yes | ES |
| Sr-90 | Water | Bq/L | 4.44 | 4.47 | 3.13 - 5.81 | Yes | ES |
| Am-241 | Water | Bq/L | 0.0145 | [c] | *False Positive Test*[d] | Yes | GEL |
| Cs-137 | Water | Bq/L | 8.54 | 7.9 | 5.5 - 10.3 | Yes | GEL |
| Co-60 | Water | Bq/L | 0.146 | [c] | *False Positive Test*[d] | Yes | GEL |
| H-3 | Water | Bq/L | 2.27 | [c] | *False Positive Test*[d] | Yes | GEL |
| Pu-238 | Water | Bq/L | 0.515 | 0.577 | 0.404 - 0.750 | Yes | GEL |
| Pu-239/240 | Water | Bq/L | 0.564 | 0.649 | 0.454 - 0.844 | Yes | GEL |
| Ra-226 | Water | Bq/L | 0.538 | 0.632 | 0.442 - 0.822 | Yes | GEL |
| Sr-90 | Water | Bq/L | 4.95 | 4.47 | 3.13 - 5.81 | Yes | GEL |
| Tc-99 | Water | Bq/L | 3.69 | 4.01 | 2.81 - 5.21 | Yes | GEL |
| U-234 | Water | Bq/L | 0.884 | 0.85 | 0.60 - 1.11 | Yes | GEL |
| U-238 | Water | Bq/L | 0.913 | 0.86 | 0.60 - 1.12 | 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. "No" - Result not 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 44; March 2021**

| *Analyte* | *Matrix* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?[b]* | *Analyzed by:* |
|---|---|---|---|---|---|---|---|
| ***MAPEP – 21– GrW44, Water – Radiological*** | | | | | | | |
| Gross alpha | Water | Bq/L | 0.782 | 0.87 | 0.26 - 1.48 | Yes | GEL |
| Gross beta | Water | Bq/L | 2.40 | 2.50 | 1.25 - 3.75 | Yes | GEL |
| ***MAPEP – 21– MaW44, Water – Inorganic*** | | | | | | | |
| Antimony | Water | mg/L | 9.08 | 8.63 | 6.04 - 11.22 | Yes | GEL |
| Arsenic | Water | mg/L | 2.06 | 2.06 | 1.44 - 2.68 | Yes | GEL |
| Barium | Water | mg/L | 7.83 | 7.58 | 5.31 - 9.85 | Yes | GEL |
| Beryllium | Water | mg/L | 3.24 | 3.15 | 2.21 - 4.10 | Yes | GEL |
| Cadmium | Water | mg/L | 0.759 | 0.748 | 0.524 - 0.972 | Yes | GEL |
| Chromium | Water | mg/L | 4.09 | 4.01 | 2.81 - 5.21 | Yes | GEL |
| Cobalt | Water | mg/L | 10.6 | 10.3 | 7.2 - 13.4 | Yes | GEL |
| Copper | Water | mg/L | 5.67 | 5.53 | 3.87 - 7.19 | Yes | GEL |
| Lead | Water | mg/L | 2.67 | 2.52 | 1.76 - 3.28 | Yes | GEL |
| Mercury | Water | mg/L | 0.0982 | 0.106 | 0.074 - 0.138 | Yes | GEL |
| Nickel | Water | mg/L | 5.25 | 5.05 | 3.54 - 6.57 | Yes | GEL |
| Selenium | Water | mg/L | 0.708 | 0.676 | 0.473 - 0.879 | Yes | GEL |
| Thallium | Water | mg/L | 2.65 | 2.46 | 1.72 - 3.20 | Yes | GEL |
| Uranium – total | Water | mg/L | 0.073 | 0.07 | 0.049 - 0.091 | Yes | GEL |
| Vanadium | Water | mg/L | 18.3 | 17.4 | 12.2 - 22.6 | Yes | GEL |
| Zinc | Water | mg/L | 15.7 | 15.5 | 10.9 - 20.2 | Yes | GEL |
| ***MAPEP – 21 – MaS44, Soil – Inorganic*** | | | | | | | |
| Antimony | Soil | mg/kg | 27.3 | 78 | 55 - 101 | No | GEL |
| Arsenic | Soil | mg/kg | 45.9 | 45.8 | 32.1 - 59.5 | Yes | GEL |
| Barium | Soil | mg/kg | 222 | 223 | 156 - 290 | Yes | GEL |
| Beryllium | Soil | mg/kg | 58.8 | 60.6 | 42.4 - 78.8 | Yes | GEL |
| Cadmium | Soil | mg/kg | 6.61 | 7.05 | 4.94 - 9.17 | Yes | GEL |
| Chromium | Soil | mg/kg | 48.4 | 49.9 | 34.9 - 64.9 | Yes | GEL |
| Cobalt | Soil | mg/kg | 182 | 194 | 136 - 252 | Yes | GEL |
| Copper | Soil | mg/kg | 37.2 | 37.7 | 26.4 - 49.0 | Yes | GEL |
| Lead | Soil | mg/kg | 26.0 | 28.8 | 20.2 - 37.4 | Yes | GEL |
| Mercury | Soil | mg/kg | 0.992 | *not evaluated* | | | GEL |
| Nickel | Soil | mg/kg | 137 | 148 | 104 - 192 | Yes | GEL |
| Selenium | Soil | mg/kg | 14.8 | 16.9 | 11.8 - 22.0 | Yes | GEL |
| Silver | Soil | mg/kg | 39.4 | 42.5 | 29.8 - 55.3 | Yes | GEL |
| Thallium | Soil | mg/kg | 10.5 | 11.0 | 7.7 - 14.3 | Yes | GEL |
| Uranium - total | Soil | mg/kg | 17.35 | 16.7 | 11.7 - 21.7 | Yes | GEL |
| Vanadium | Soil | mg/kg | 266 | 279 | 195 - 363 | Yes | GEL |
| Zinc | Soil | mg/kg | 350 | 370 | 259 - 481 | Yes | GEL |

GEL - GEL Laboratories, LLC.

[a] MAPEP monitors performance and requests corrective action as required.

[b] "Yes" - Result acceptable. "No" - Result not acceptable. "W" - Result acceptable with warning 20% < bias < 30%.

**TABLE G-1 *(concluded)***
**Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 44; March 2021**

| *Analyte* | *Matrix* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?[b]* | *Analyzed by:* |
|---|---|---|---|---|---|---|---|
| ***MAPEP – 21– MaS44, Soil – Radiological*** | | | | | | | |
| Am-241 | Soil | Bq/kg | 89.6 | 88 | 62 - 114 | Yes | GEL |
| Cs-137 | Soil | Bq/kg | 1590 | 1550 | 1085 - 2015 | Yes | GEL |
| Co-60 | Soil | Bq/kg | 1320 | 1370 | 959 - 1781 | Yes | GEL |
| Pu-238 | Soil | Bq/kg | 51.2 | 49.1 | 34.4 - 63.8 | Yes | GEL |
| Pu-239/240 | Soil | Bq/kg | -0.819 | [c] | *False Positive Test [d]* | Yes | GEL |
| K-40 | Soil | Bq/kg | 618 | 618 | 433 - 803 | Yes | GEL |
| Sr-90 | Soil | Bq/kg | 313 | 272 | 190 - 354 | Yes | GEL |
| Tc-99 | Soil | Bq/kg | 576 | 638 | 447 - 829 | Yes | GEL |
| U-234 | Soil | Bq/kg | 57.1 | 59 | 41 - 77 | Yes | GEL |
| U-238 | Soil | Bq/kg | 194 | 208 | 146 - 270 | Yes | GEL |
| ***MAPEP – 21 – RdV44, Vegetation – Radiological*** | | | | | | | |
| Cs-137 | Veg | Bq/sample | 3.75 | 4.69 | 3.28 - 6.10 | Yes | GEL |
| Co-60 | Veg | Bq/sample | 2.36 | 2.99 | 2.09 - 3.89 | Yes | GEL |
| Sr-90 | Veg | Bq/sample | 0.444 | 0.673 | 0.471 - 0.875 | No | GEL |

GEL - GEL Laboratories, LLC.
[a] MAPEP monitors performance and requests corrective action as required.
[b] "Yes" - Result acceptable. "No" - Result not 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-2**
**Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 45; August 2021**

| *Analyte* | *Matrix* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?* [b] | *Analyzed by:* |
|---|---|---|---|---|---|---|---|
| ***MAPEP – 21 – RdF45, Air Filter – Radiological*** | | | | | | | |
| Am-241 | Air Filter | Bq/sample | 0.109 | 0.119 | 0.083 - 0.155 | Yes | GEL |
| Cs-137 | Air Filter | Bq/sample | 1.16 | 1.28 | 0.90 - 1.66 | Yes | ES |
| Co-60 | Air Filter | Bq/sample | 2.07 | 2.28 | 1.60 - 2.96 | Yes | ES |
| Cs-137 | Air Filter | Bq/sample | 1.31 | 1.28 | 0.90 - 1.66 | Yes | GEL |
| Co-60 | Air Filter | Bq/sample | 2.37 | 2.28 | 1.60 - 2.96 | Yes | GEL |
| Pu-238 | Air Filter | Bq/sample | 0.00232 | 0.0030 | *Sensitivity Evaluation* [e] | Yes | GEL |
| Pu-239/240 | Air Filter | Bq/sample | 0.0574 | 0.0609 | *0.0426 - 0.0792* | Yes | GEL |
| Sr-90 | Air Filter | Bq/sample | 0.195 | 0.273 | 0.191 - 0.355 | W | GEL |
| U-234 | Air Filter | Bq/sample | 0.101 | 0.100 | 0.070 - 0.130 | Yes | GEL |
| U-238 | Air Filter | Bq/sample | 0.107 | 0.104 | 0.073 - 0.135 | Yes | GEL |
| U – total | Air Filter | µg/sample | 8.579 | 8.4 | 5.9 - 10.9 | Yes | GEL |
| ***MAPEP – 21 – MaW45, Water – Radiological*** | | | | | | | |
| Cs-137 | Water | Bq/L | -0.00944 | [c] | *False Positive Test* [d] | Yes | ES |
| Co-60 | Water | Bq/L | 13.8 | 14.0 | 9.8 - 18.2 | Yes | ES |
| Sr-90 | Water | Bq/L | 3.75 | 3.86 | 2.70 - 5.02 | Yes | ES |
| Am-241 | Water | Bq/L | 0.407 | 0.426 | 0.298 - 0.554 | Yes | GEL |
| Cs-137 | Water | Bq/L | -0.0411 | [c] | *False Positive Test* [d] | Yes | GEL |
| Co-60 | Water | Bq/L | 14.5 | 14.0 | 9.8 - 18.2 | Yes | GEL |
| H-3 | Water | Bq/L | 231 | 250 | 175 - 325 | Yes | GEL |
| Pu-238 | Water | Bq/L | -0.00169 | 0.0096 | *Sensitivity Evaluation* [f] | Yes | GEL |
| Pu-239/240 | Water | Bq/L | 0.470 | 0.528 | 0.370 - 0.686 | Yes | GEL |
| Ra-226 | Water | Bq/L | 0.31 | 0.226 | 0.158 - 0.294 | No | GEL |
| Sr-90 | Water | Bq/L | 3.5 | 3.86 | 2.70 - 5.02 | Yes | GEL |
| Tc-99 | Water | Bq/L | 3.79 | 3.71 | 2.60 - 4.82 | Yes | GEL |
| U-234 | Water | Bq/L | 0.0203 | 0.0215 | *Sensitivity Evaluation* [f] | Yes | GEL |
| U-238 | Water | Bq/L | 0.00975 | 0.0123 | *Sensitivity Evaluation* [f] | 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.

[e] A sensistivity evaluation tests the laboratory's ability to measure the analyte near the detection limit.

[f] Sensitivity evaluation with statistically zero result.

**TABLE G-2 *(continued)***
**Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 45; August 2021**

| *Analyte* | *Matrix* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?[b]* | *Analyzed by:* |
|---|---|---|---|---|---|---|---|
| ***MAPEP – 21– GrW45, Water – Radiological*** | | | | | | | |
| Gross alpha | Water | Bq/L | 0.226 | 0.232 | 0.070 - 0.394 | Yes | GEL |
| Gross beta | Water | Bq/L | 2.73 | 2.807 | 1.404 - 4.211 | Yes | GEL |
| ***MAPEP – 21 – MaW45, Water – Inorganic*** | | | | | | | |
| Antimony | Water | mg/L | 6.92 | 7.27 | 5.09 - 9.45 | Yes | GEL |
| Arsenic | Water | mg/L | 2.25 | 2.46 | 1.72 - 3.20 | Yes | GEL |
| Barium | Water | mg/L | 3.02 | 3.18 | 2.23 - 4.13 | Yes | GEL |
| Beryllium | Water | mg/L | 3.82 | 4.03 | 2.82 - 5.24 | Yes | GEL |
| Cadmium | Water | mg/L | 0.426 | 0.468 | 0.328 - 0.608 | Yes | GEL |
| Chromium | Water | mg/L | 2.38 | 2.48 | 1.74 - 3.22 | Yes | GEL |
| Cobalt | Water | mg/L | 5.7 | 6.04 | 4.23 - 7.85 | Yes | GEL |
| Copper | Water | mg/L | 7.93 | 8.29 | 5.80 - 10.78 | Yes | GEL |
| Lead | Water | mg/L | 2.87 | 3.00 | 2.10 - 3.90 | Yes | GEL |
| Mercury | Water | mg/L | 0.107 | 0.128 | *0.090 - 0.166* | Yes | GEL |
| Nickel | Water | mg/L | 0.0004 | 0.00102 | *Sensitivity Evaluation [e]* | Yes | GEL |
| Selenium | Water | mg/L | 0.402 | 0.411 | 0.288 - 0.534 | Yes | GEL |
| Thallium | Water | mg/L | 3.00 | 3.06 | 2.14 - 3.98 | Yes | GEL |
| Uranium – total | Water | mg/L | 0.000959 | 0.001 | 0.00070 - 0.00130 | Yes | GEL |
| Vanadium | Water | mg/L | 9.84 | 10.1 | 7.1 - 13.1 | Yes | GEL |
| Zinc | Water | mg/L | 7.52 | 8.42 | 5.89 - 10.95 | Yes | GEL |
| ***MAPEP – 21 – MaS45, Soil – Inorganic*** | | | | | | | |
| Antimony | Soil | mg/kg | 10.3 | 29.9 | 20.9 - 38.9 | No | GEL |
| Arsenic | Soil | mg/kg | 14.9 | 20.2 | 14.1 - 26.3 | W | GEL |
| Barium | Soil | mg/kg | 131 | 144 | 101 - 187 | Yes | GEL |
| Beryllium | Soil | mg/kg | 19.7 | 20.8 | 14.6 - 27.0 | Yes | GEL |
| Cadmium | Soil | mg/kg | 14.2 | 16.4 | 11.5 - 21.3 | Yes | GEL |
| Chromium | Soil | mg/kg | 46.8 | 53.3 | 37.3 - 69.3 | Yes | GEL |
| Cobalt | Soil | mg/kg | 142 | 149 | 104 - 194 | Yes | GEL |
| Copper | Soil | mg/kg | 178 | 197 | 138 - 256 | Yes | GEL |
| Lead | Soil | mg/kg | 69.9 | 72.0 | 50.4 - 93.6 | Yes | GEL |
| Mercury | Soil | mg/kg | 0.312 | 0.215 | 0.151 - 0.280 | No | GEL |
| Nickel | Soil | mg/kg | 120 | 124 | 87 - 161 | Yes | GEL |
| Selenium | Soil | mg/kg | 11.2 | 13.1 | 9.2 - 17.0 | Yes | GEL |
| Silver | Soil | mg/kg | 53.1 | 59.9 | 41.9 - 77.9 | Yes | GEL |
| Thallium | Soil | mg/kg | 25.9 | 30.1 | 21.1 - 39.1 | Yes | GEL |
| Uranium – total | Soil | mg/kg | 12.34 | 13.6 | 9.5 - 17.7 | Yes | GEL |
| Vanadium | Soil | mg/kg | 177 | 201 | 141 - 261 | Yes | GEL |
| Zinc | Soil | mg/kg | 312 | 317 | 222 - 412 | 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-2 *(concluded)***
**Crosscheck Sample Comparisons From the DOE Mixed Analyte Performance Evaluation Program (MAPEP)[a] ; Study 45; August 2021**

| *Analyte* | *Matrix* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?[b]* | *Analyzed by:* |
|---|---|---|---|---|---|---|---|
| ***MAPEP – 21 – MaS45, Soil – Radiological*** | | | | | | | |
| Am-241 | Soil | Bq/kg | 106 | 98 | 69 - 127 | Yes | GEL |
| Cs-137 | Soil | Bq/kg | 579 | 572 | 400 - 744 | Yes | GEL |
| Co-60 | Soil | Bq/kg | 692 | 722 | 505 - 939 | Yes | GEL |
| Pu-238 | Soil | Bq/kg | 55.9 | 59.8 | 41.9 - 77.7 | Yes | GEL |
| Pu-239/240 | Soil | Bq/kg | 66.3 | 71.3 | 49.9 - 92.7 | Yes | GEL |
| K-40 | Soil | Bq/kg | 612 | 607 | 425 - 789 | Yes | GEL |
| Sr-90 | Soil | Bq/kg | 0.161 | [c] | *False Positive Test [d]* | Yes | GEL |
| Tc-99 | Soil | Bq/kg | 747 | 777 | 544 - 1010 | Yes | GEL |
| U-234 | Soil | Bq/kg | 79.6 | 51.4 | 36.0 - 66.8 | No | GEL |
| U-238 | Soil | Bq/kg | 177 | 168 | 118 - 218 | Yes | GEL |
| ***MAPEP – 21 – RdV45, Vegetation – Radiological*** | | | | | | | |
| Cs-137 | Veg | Bq/sample | 2.28 | 2.21 | 1.55 - 2.87 | Yes | GEL |
| Co-60 | Veg | Bq/sample | 3.44 | 3.51 | 2.46 - 4.56 | Yes | GEL |
| Sr-90 | Veg | Bq/sample | 1.10 | 1.32 | 0.92 - 1.72 | 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 41; 2021; for the National Pollutant Discharge Elimination System (NPDES)**

| *Analyte* | *Units* | *Reference Value* | *Reported Value* | *Acceptance Range* | *Accept?* [a] | *Analyzed by:* |
|---|---|---|---|---|---|---|
| Aluminum | µg/L | 2,360 | 2,390 | 1960 - 2690 | Yes | TestAmerica |
| Aluminum | µg/L | 632 | 635 | 507 - 753 | Yes | GEL |
| Ammonia (as N) | mg/L | 10.5 | 10.2 | 8.38 - 12.6 | Yes | TestAmerica |
| Antimony | µg/L | 274 | 265 | 212 - 326 | Yes | TestAmerica |
| Arsenic (EPA 200.8 ) | µg/L | 420 | 432 | 349 - 487 | Yes | TestAmerica |
| Barium | µg/L | 642 | 675 | 545 - 738 | Yes | TestAmerica |
| Biochemical oxygen demand | mg/L | 75.1 | 56.3 | 38.0 - 125 | Yes | TestAmerica |
| Biochemical oxygen demand | mg/L | 58.5 | 54.2 | 30.7 - 86.3 | Yes | GEL |
| Cadmium (EPA 200.8) | µg/L | 681 | 734 | 579 - 783 | Yes | TestAmerica |
| Chlorine (total residual) | µg/L | 117 | 130 | 57.0 - 177 | Yes | PSO |
| Chromium (EPA 200.8) | µg/L | 736 | 784 | 625 - 846 | Yes | TestAmerica |
| Chromium (hexavalent) | µg/L | 813 | 781 | 685 - 930 | Yes | TestAmerica |
| Cobalt | µg/L | 743 | 710 | 632 - 855 | Yes | TestAmerica |
| Copper (EPA 200.8) | µg/L | 934 | 1,050 | 794 - 1070 | Yes | TestAmerica |
| Copper (EPA 200.8) | µg/L | 516 | 546 | 439 - 593 | Yes | GEL |
| Cyanide, total | mg/L | 0.207 | 0.180 | 0.135 - 0.280 | Yes | TestAmerica |
| Iron | µg/L | 617 | 626 | 524 - 709 | Yes | TestAmerica |
| Iron | µg/L | 368 | 360 | 313 - 423 | Yes | GEL |
| Lead (EPA 200.8) | µg/L | 925 | 980 | 786 - 1060 | Yes | TestAmerica |
| Lead (EPA 200.8) | µg/L | 543 | 584 | 462 - 624 | Yes | GEL |
| Manganese | µg/L | 1,190 | 1,220 | 1010 - 1370 | Yes | TestAmerica |
| Mercury (EPA 1631E) | µg/L | 27.7 | 24.6 | 19.4 - 36.0 | Yes | GEL |
| Nickel | µg/L | 1,520 | 1,450 | 1340 - 1700 | Yes | TestAmerica |
| Nitrate (as N) | mg/L | 10.9 | 11.6 | 8.99 - 12.7 | Yes | TestAmerica |
| Nitrite (as N) | mg/L | 1.86 | 1.92 | 1.57 - 2.14 | Yes | TestAmerica |
| Oil & Grease (Gravimetric) | mg/L | 113 | 103 | 81.1 - 131 | Yes | TestAmerica |
| Oil & Grease (Gravimetric) | mg/L | 135 | 114 | 98.2 - 155 | Yes | GEL |
| pH | SU | 6.69 | 6.76 | 6.49 - 6.89 | Yes | ES |
| Phosphorus (total, as P) | mg/L | 8.79 | 8.76 | 7.33 - 10.2 | Yes | TestAmerica |
| Phosphorus (total, as P) | mg/L | 2.48 | 1.78 | 2.02 - 2.92 | No | GEL |
| Selenium (EPA 200.8) | µg/L | 339 | 372 | 288 - 389 | Yes | TestAmerica |
| Sulfate | mg/L | 8.27 | 7.66 | 5.79 - 10.1 | Yes | TestAmerica |
| Settleable solids | mL/L | 10.1 | 13.0 | 7.38 - 13.7 | Yes | TestAmerica |
| Suspended solids (total) | mg/L | 88.7 | 85.2 | 72.9 - 98.4 | Yes | TestAmerica |
| Suspended solids (total) | mg/L | 55.9 | 53 | 44.0 - 63.5 | Yes | GEL |
| Total dissolved solids | mg/L | 668 | 639 | 601 - 735 | Yes | TestAmerica |
| Total dissolved solids | mg/L | 277 | 271 | 232 - 322 | Yes | GEL |
| Total Kjeldahl nitrogen (as N) | mg/L | 12.3 | 11.6 | 9.05 - 15.2 | Yes | TestAmerica |
| Vanadium | µg/L | 834 | 813 | 709 - 959 | Yes | TestAmerica |
| Zinc (EPA 200.8) | µg/L | 668 | 707 | 568 - 769 | Yes | TestAmerica |
| Zinc | µg/L | 857 | 817 | 728 - 986 | Yes | GEL |

Samples provided by Environmental Resource Associates (ERA) and Phenova.

ES - WVDP Environmental Services

GEL - GEL Laboratories, LLC.

TestAmerica - TestAmerica Laboratories, Inc., Buffalo.

PSO - Plant Systems Operations.

[a] "Yes" - Result acceptable. "No" - Result not acceptable.

**TABLE G-3 (*concluded*)**

**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 41; 2021; for the National Pollutant Discharge Elimination System (NPDES)**

| *Analyte* | *Units* | *Reported Value* | *Reference Value* | *Acceptance Range* | *Accept?* [a] | *Analyzed by:* |
|---|---|---|---|---|---|---|
| ***Toxicity*** | | | | | | |
| Ceriodaphnia Acute MHSF 25° - LC50 | % | 53.7 | 47.2 | 18.4 - 76.0 | Yes | New England Bioassay |
| Ceriodaphnia Chronic MHSF - Survival NOEC | % | 25.0 | 25.0 | 12.5 - 50 | Yes | New England Bioassay |
| Ceriodaphnia Chronic MHSF - Reproduction IC25 | % | 20.0 | 27.7 | 16.2 - 39.2 | Yes | New England Bioassay |
| Ceriodaphnia Chronic MHSF - Reproduction NOEC | % | 12.5 | 25.0 | 12.5 - 50 | Yes | New England Bioassay |

[a] "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,***

SECTION 1. This Act may be cited as the "West Valley Demonstration Project Act". 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: 42 USC 2021a note. 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:

(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. Hearings.

(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.

(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:

41 USC 501 note.

(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.

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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 Atomic Energy Act of 1954. 42 USC 2014.

(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.