



Five-Year Review Report

for

Brookhaven National Laboratory Superfund Site (NY7890008975)

Town of Brookhaven, Hamlet of Upton

Suffolk County, New York

August 2026

PREPARED FOR:

The United States Department of Energy

Office of Science

PREPARED BY:

Environmental Protection Division

Brookhaven National Laboratory

Upton, New York 11973



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2. Inspection Checklists
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4. Technology Assessments and Standards Review Memo (Technical Assessment, Question B Memorandum, HFBR Decay Assessment)
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Executive Summary

The U.S. Department of Energy (DOE) owns the Brookhaven National Laboratory (BNL) site in Upton, New York, and is the lead agency for the Five-Year Review. DOE entered into a Federal Facilities Agreement (also referred to as the Interagency Agreement, or IAG) for the BNL site, along with the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). Brookhaven Science Associates (BSA), under contract with the DOE, manages and operates BNL.

The purpose of this Five-Year Review is to determine whether the remedies implemented at BNL continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews leading to such determinations are documented in *Five-Year Review Reports*. In addition, *Five-Year Review Reports* identify potential problems with the ability of the current remedial actions to meet the cleanup objectives, if any, and provide recommendations to address them.

The remedies for the BNL Superfund site in Upton include excavation and off-site disposal of contaminated soil, sediment, tanks, and structures, capping of landfills and other contaminated soil areas, installation and operation of groundwater treatment systems, groundwater monitoring, and implementation of institutional controls. DOE has invested approximately \$656 million to date to implement the groundwater, soil, Peconic River, and reactor remedies. With the exception of the removal of large, activated components at the High Flux Beam Reactor (HFBR), the remedies selected in nine signed Records of Decision (RODs) and four Explanations of Significant Differences (ESDs) have been constructed and are operational, in long-term monitoring, or have achieved closure.

This is the fifth sitewide Five-Year Review and covers the period from May 1, 2021, through December 31, 2025. This Review includes 11 Operable Units (OUs), as well as the Brookhaven Graphite Research Reactor (BGRR), the HFBR, and the g-2/Brookhaven Linac Isotope Producer (BLIP)/Underground Storage Tanks (USTs) related *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) actions.

Based on a review of closeout reports, annual *BNL Groundwater Status Reports*, monitoring data, site inspections, and regulatory interviews, and implementation of institutional controls, the remedies were implemented in accordance with the RODs and ESDs. The soil cleanup levels have been met and the groundwater remediation systems continue to meet the remedial action objectives identified in each signed ROD.

Since the last Five-Year Review in 2021, significant progress has been made:

Continued optimization of the groundwater remediation systems has been a primary focus during this review period to ensure plume capture, accelerate cleanup, and improve operational efficiency. Optimization efforts included installation of additional extraction wells, modification of pumping rates and operating modes (e.g., pulsed pumping and standby), refinement of groundwater modeling, and targeted source-area treatment.

In the Western South Boundary area, four deeper extraction wells installed in 2019–2020 to address previously unidentified deep VOC contamination have significantly reduced concentrations in the plume core. As concentrations declined, the wells were transitioned to pulsed pumping mode. A petition for shutdown of the Western South Boundary system is anticipated based on sustained low concentrations and demonstrated plume control.

At OU VI, additional characterization and aquifer testing identified deeper ethylene dibromide (EDB) contamination than originally identified. Two new, deeper, extraction wells were installed in 2024 to capture the deeper portions of the leading edge of the plume. Pump testing and monitoring data indicate that these wells are effectively intercepting deeper contamination. The groundwater model will be updated to reassess projected cleanup timeframes, as plume migration has been slower than originally predicted.

At the Building 96 source area, an in-situ chemical treatment program consisting of liquid carbon and zero-valent iron injections was implemented in 2024 to address residual tetrachloroethylene (PCE) contamination

in the vadose zone. Post-injection monitoring demonstrates reduced PCE mobility and declining groundwater concentrations, supporting the effectiveness of this targeted source control optimization.

For the BGRR/WCF and other Sr-90 plumes, pulsed pumping of selected extraction wells continues to manage seasonal water table fluctuations that mobilize residual contamination from the vadose zone. Monitoring data are evaluated routinely to determine whether extraction wells can be placed in standby mode without compromising protectiveness.

Several treatment systems achieved regulatory-approved shutdown or closure during this review period (e.g., LIPA and Industrial Park), reflecting sustained attainment of capture goals and declining plume concentrations. Where systems were placed in standby, monitoring continues to confirm that rebound does not occur and that hydraulic control is maintained.

Groundwater modeling completed in 2025 for the Middle Road and South Boundary systems evaluated hydraulic capture and plume migration within the deeper portions of the Upper Glacial aquifer, including lower-permeability zones of the Upton Unit. The modeling recommended installation of two additional extraction wells at the Middle Road and one at the South Boundary to expedite the cleanup timeframe. Design planning for these wells was initiated in 2025.

In addition, compliance monitoring for recently established New York State Ambient Water Quality Guidance Values for perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA), and 1,4-dioxane has been incorporated into treatment system operations. Where effluent concentrations exceeded discharge guidance values, a *Groundwater Treatment Systems Discharge Compliance Plan* was developed and implemented in 2024 to recommend actions to attain compliance, where necessary, with the new discharge limits on a system-by-system basis.

To support the Peconic River Remedy, supplemental sediment remediation at Area PR-WC-06 was completed in 2017, and federally required vegetation monitoring concluded in 2022. The other areas of the Peconic River Remedy have met their long-term cleanup objectives identified in the ROD. Long-term protectiveness of the Peconic River remedy has been verified and post-cleanup monitoring of the sediment and surface water is complete. Although low water conditions and lack of sufficient biomass limited the frequency of fish sampling over the last five-year period, monitoring for population survey and sampling fish tissue for polychlorinated biphenyls (PCBs) and mercury continues annually under the site environmental surveillance program.

Demolition of the HFBR stack was completed in 2021, and long-term surveillance and maintenance continue for the reactor confinement building. Evaluation of decay rates confirms that the 65-year safe storage period for removal of large activated components remains appropriate.

In 2021, DOE established OU X to address PFOS, PFOA, and 1,4-dioxane. Two Time Critical Removal Action groundwater treatment systems began operation in October 2022 and January 2023 to hydraulically capture and treat high-concentration PFAS plumes associated with the Current and Former Firehouse areas. Characterization of additional PFAS and 1,4-dioxane impacts will be completed under the pending OU X Remedial Investigation/Feasibility Study.

While significant progress has been made, several plume areas — particularly portions of the OU III Middle Road, South Boundary, and Airport VOC plumes, and the OU VI EDB plume—may require extended operation beyond original cleanup timeframe projections due to slower-than-anticipated plume migration in lower-permeability zones. Continued monitoring, modeling updates, and potential system enhancements are planned.

A comprehensive sitewide protectiveness statement is not appropriate at this time because removal of the HFBR reactor vessel and other large, activated components has not yet been completed. However, all implemented remedies are functioning as intended, and short-term protectiveness is achieved. Institutional controls, groundwater monitoring, and ongoing system operations effectively prevent exposure pathways that

could result in unacceptable risks.

The table below provides a summary of each OU's issues and recommendations from the 2026 Five-Year Review. The recommendations are subject to regulatory review, and implementation timing will be based on the availability of funding. These actions focus primarily on continued plume monitoring, groundwater system optimization, evaluation of cleanup timeframes, operation of PFAS treatment systems, and maintenance of property access agreements.

The sixth sitewide Five-Year Review to be conducted within five years of issuance of this report will include all OUs, the BGRR, the HFBR, and the g-2/Brookhaven Linac Isotope Producer and will continue to evaluate the protectiveness and performance of all remedial actions at the site. **Table E-1** below provides a summary of issues and recommendations from the 2026 Five-Year Review. **Table E-2** provides a summary of Other Findings.

Table E-1: Issues/Recommendations

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
HFBR	Explore the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large, activated components earlier.	BNL	DOE, EPA, NYSDEC, SCDHS	Recurring	N	Y
OUs III & VI – Maintain terms of groundwater treatment system property access agreements	Record property access agreements with County Clerk, continue to manage existing access agreements. Renew one expired access agreement.	BNL	DOE, EPA, NYSDEC, SCDHS	Ongoing	N	Y

Notes:

Recommendations are subject to regulatory review; implementation will be based on the availability of funding

Table E-2: Other Findings

Finding	Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date
OU X 1,4-dioxane contamination in OU III Middle Road/South Boundary/Western South Boundary and Airport Treatment System discharge	In accordance with the <i>Treatment Systems Discharge Compliance Plan</i> (BNL, 2024d), complete the 1,4-dioxane treatment systems design documents.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU III Building 96 Source Removal Effectiveness	Monitor plume and source area. Re-evaluate cleanup timeframe based on post-injection monitoring data and report in annual Groundwater Status Report.	BNL	DOE, EPA, NYSDEC, SCDHS	Annual, starting in 2026

Finding	Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date
OU III Middle Road VOC contamination	Prepare design plans for potential installation of additional extraction wells based on 2025 modeling recommendations.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU III South Boundary VOC contamination	Prepare design plans for potential installation of additional extraction well based on 2025 modeling recommendations.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU VI EDB contamination	Continued operation of the new extraction wells. Reevaluate cleanup timeframe based upon new operational data and pump testing performed on the new extraction wells.	BNL	DOE, EPA, NYSDEC, SCDHS	2027
Sr-90 in OU I Former HWMF Groundwater	Continue to track Sr-90 plume attenuation. Enhance monitoring network with temporary and/or permanent wells as necessary. Monitor plume attenuation progress with 2021 groundwater model predictions and report in annual Groundwater Status Report.	BNL	DOE, EPA, NYSDEC, SCDHS	June 2031
OU X Current and Former Firehouse PFAS contamination	Continue full-time operation of the two PFAS treatment systems. Evaluate the easterly shift in segments of the Current Firehouse and Building 170 plumes and design additional extraction well locations as needed.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU X RI/FS	Finalize the draft OU X RI/FS and implement investigation. Completion will be dependent on availability of funding.	BNL	DOE, EPA, NYSDEC, SCDHS	Ongoing
Continuing Sr-90 sources at BGRR, WCF, and Building 801	Monitor plume and continued degradation of source areas. Install temporary wells in WCF areas as necessary. Perform intermittent pulsed pumping of extraction wells. Evaluate during next Five-Year Review.	BNL	DOE, EPA, NYSDEC, SCDHS	June 2031

Finding	Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date
Building 650 Sr-90 contamination	Continue to monitor the 650 Sump Outfall source area and downgradient portions of the plume using the existing well network supplemented by the installation of temporary wells as needed.	BNL	DOE, EPA, NYSDEC, SCDHS	Annual, starting in 2026

Notes:

Follow up actions are subject to regulatory review; implementation will be based on the availability of funding

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN): Brookhaven National Laboratory Superfund Site		
EPA ID (from WasteLAN): NY7890008975		
Region: 2	State: NY	City/County: Upton, Suffolk
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☒ Complete		
Multiple OUs?* ☒ YES ☐ NO	Construction completion date: ____ / ____ / ____	
Are the properties associated with this site in use or are they suitable for reuse? ☒ YES ☐ NO		
REVIEW STATUS		
Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency (DOE)		
Author name: Matthew Barger		
Author title: DOE Site Manager	Author affiliation: U.S. DOE, Upton, NY	
Review period: 1/1/2025 to 5/26/2026		
Date(s) of site inspection: Inspections of remediation systems and associated infrastructure are continuous through O&M; Institutional Control inspections performed semi-annually. Specifically in 2025 inspections were performed on the following dates: May 29, 2025, May 30, 2025, June 3, 2025, June 6, 2025, June 9, 2025, June 11, 2025, June 13, 2025, October 28, 2025, October 30, 2025, November 3, 2025, November 18, 2025, November 20, 2025, November 21, 2025		
Type of review: ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action-site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☐ 2 (second) ☐ 3 (third) ☒ Other (specify) 5 (<u>fifth</u>)		
Triggering action: ☐ Actual RA Onsite Construction at OU I ☐ Actual RA Start at OU# ____ ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date (from WasteLAN): 8/9/2021		
Due date (five years after triggering action date): 8/9/2026		

List of Acronyms

µg/dL	Micrograms per decaliter
µg/L	Micrograms per liter
1,1-DCA	1,1-Dichloroethane
ALARA	As Low As Reasonably Achievable
AOC	Area of Concern
AFFF	Aqueous Film Forming Foam
AGS	Alternating Gradient Synchrotron
msl	mean sea level
AS/SVE	Air Sparging/Soil Vapor Extraction
AWQS	Ambient Water Quality Standards
BGRR	Brookhaven Graphite Research Reactor
BLIP	Brookhaven Linac Isotope Producer
BLL	Blood Lead Level
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CAC	Community Advisory Council
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cs-137	Cesium-137
DER	Division of Environmental Remediation (NYSDEC)
DOE	U.S. Department of Energy
DQO	Data Quality Objective
EDB	ethylene dibromide
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Division
ESD	Explanation of Significant Differences
FS	Feasibility Study
ft	feet
GIS	Geographic Information System
gpm	gallons per minute
HFBR	High Flux Beam Reactor
HWMF	Hazardous Waste Management Facility
IAG	Interagency Agreement

IC	Institutional Control
IRIS	Integrated Risk Information System
Linac	Linear Accelerator
LIPA	Long Island Power Authority
LUCMP	Land Use Controls Management Plan
LUIC	Land Use Institutional Controls
mCi	milliCuries
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MOC	Method of Characteristics
mRem	milliRem
MW	Megawatt
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
ng/g	nanogram per gram
ng/L	nanogram per liter
NPL	National Priorities List
NRMP	Natural Resource Management Plan
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
ORISE	Oak Ridge Institute for Science and Education
OSWER	EPA Office of Solid Waste and Emergency Response
OU	Operable Unit
pCi/L	picocurie(s) per liter
pCi/g	picocurie(s) per gram
PCB	Polychlorinated Biphenyl
PCE	tetrachloroethylene
PFAS	Per- and Polyfluoroalkyl Substances
PFOS	Perfluorooctane Sulfonate
PFOA	Perfluorooctanoic Acid
ppm	part per million
RAO	Remedial Action Objective
RI	Remedial Investigation

ROD	Record of Decision
SCDHS	Suffolk County Department of Health Services
SCGs	Standards, Criteria, and Guidance Values
SCWA	Suffolk County Water Authority
SDWA	Safe Drinking Water Act
SPDES	State Pollutant Discharge Elimination System
Sr-90	Strontium-90
STP	Sewage Treatment Plant
SUSC	Science and User Support Center
SVOC	semi-volatile organic compound
TAGM	Technical and Administrative Guidance Memorandum
TBC	Items “To Be Considered”
TCA	1,1,1-trichloroethane
TCRA	Time Critical Removal Action
TCE	trichloroethene
TVOC	Total Volatile Organic Compound
UCMR	Unregulated Contaminant Monitoring Rule
USACE	U.S. Army Corps of Engineers
UST	Underground Storage Tank
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
WCF	Waste Concentration Facility
WLA	Waste Loading Area
WSB	Western South Boundary
ZVI	Zero Valent Iron

Glossary

Administrative Record: A file that contains the documents, including technical reports, which forms the basis for selection of a final remedy and acts as a vehicle for public participation.

Area of Concern: A geographic area of BNL where there has been a release or the potential for a release of a hazardous substance, pollutant, or other contaminant. There are 34 areas of concern at BNL.

Cleanup Objective: a goal established in the Record of Decision designed to protect human health and the environment.

Capture Goal: target contaminant concentration a groundwater treatment system is designed to actively remediate. Once the capture goal is achieved, individual extraction wells can be shutdown, or shutdown of the system can be petitioned.

Closeout Report: A report that documents the completion of construction of the remedy and how it complies with the requirements of the remedial design plans, specifications, and the ROD. The report includes post-excavation confirmatory sampling results.

Institutional Controls: Measures or restrictions established to prevent exposure of workers or the public to hazards. These may include the establishment of fencing, posting of signs, prevention of unplanned alteration of contaminant plume flow pathways, etc.

Interagency Agreement: A legal binding document established under the *Comprehensive Environmental Response, Compensation, and Liability Act*, that presents the framework for implementing the cleanup activities at a particular site. At BNL, the IAG, also known as a Federal Facilities Agreement (EPA, 1992), was signed in 1992 by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation.

Maximum Contaminant Level: A standard set by the U.S. Environmental Protection Agency and/or the New York State Department of Environmental Conservation for contaminants in drinking water. These standards are the highest level of a contaminant that is allowed in drinking water. NYSDEC standards often apply a safety factor and are more stringent than the Federal standards.

Milestone: A date when a significant point in a project is expected to occur.

Operable Unit: Groups of areas within a site containing the same or similar contamination. The areas within one operable unit are not necessarily adjacent. BNL has eleven operable units.

Other Finding: In the Five-Year Review process, Other Findings are observations made during the review that do not directly affect the current or future protectiveness of the remedy, but are important for operations and maintenance, accelerating site closeout, or improving performance of the remedy.

Picocurie Per Liter: A unit of measure of radioactivity per liter of water.

Record of Decision: Documents the decision by DOE and the regulators on a selected remedial action. It includes the responsiveness summary and a bibliography of documents that were used to reach the remedial decision. When the record of decision is finalized, the remedial design and construction can begin. BNL has nine records of decision.

Time Critical Removal Action (TCRA): This type of interim cleanup action was developed by EPA for initiating early cleanup action or accelerating ongoing cleanup action to abate, mitigate, or reduce risk to human health or the environment at a contaminated waste site. Section 415 of the NCP lists the factors to be considered in determining the appropriateness of a TCRA, including actual or potential contamination of drinking water supplies or sensitive ecosystems. Under the BNL Federal Facilities Agreement, DOE is authorized to perform removal actions in accordance with CERCLA and the NCP. The TCRA will ultimately be evaluated for inclusion as a final action in the subsequent ROD.

Brookhaven National Laboratory

Five-Year Review Report

1.0 Introduction

The purpose of this Five-Year Review is to determine whether the remedies implemented at Brookhaven National Laboratory (BNL) continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews leading to such determinations are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify potential problems, if any, with the ability of the current remedial actions to meet the cleanup objectives and provide recommendations to address them.

The U.S. Department of Energy (DOE) prepared this Five-Year Review Report pursuant to the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) §121 and the *National Contingency Plan* (NCP). CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

DOE interpreted this requirement further in the NCP; 40 *Code of Federal Regulations* (CFR) §300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

Brookhaven Science Associates (BSA), under contract with the DOE, manages and operates BNL. Brookhaven Science Associates' Environmental Protection Division (EPD) conducted this Five-Year Review of the remedial actions implemented at the BNL site under the direction of the DOE Brookhaven Site Office. This report documents the results of the review.

This is the fifth sitewide Five-Year Review for the BNL site and includes all the Operable Units (OUs), the Brookhaven Graphite Research Reactor (BGRR), the High Flux Beam Reactor (HFBR), and the g-2 Tritium Plume and Brookhaven Linear Accelerator (Linac) Isotope Producer (BLIP) Areas of Concern (AOCs). The triggering action for this 2026 sitewide statutory Five-Year Review is the completion of the fourth sitewide review in June 2021. This review is required because hazardous substances, pollutants, or contaminants at the site are above levels that allow for unlimited use and unrestricted exposure. Past Five-Year Reviews were:

- Five-Year Evaluation Reports prepared for the Current and Former Landfills in 2001 and 2002 in accordance with New York State Part 360 requirements (BNL, 2001a) (BNL, 2002).
- A Five-Year Review focused specifically on the OU IV remedy in September 2003 (BNL, 2003a).
- The first sitewide Five-Year Review submitted as draft to the regulators in July 2005, with the final Report issued in August 2006 (BNL, 2006). The triggering action for this review was initiation of the remedial action for OU I contaminated landscape soils in July 2000. This Five-Year Review did not include the g-2/BLIP or HFBR Records of Decision (RODs).
- The second sitewide Five-Year Review was submitted to the regulators in March 2011 (BNL, 2011a),

and the Addendum addressing regulator comments was issued as final in November 2011 (BNL, 2011b). The triggering action for this review was the completion of the last review.

- The third sitewide Five-Year Review was submitted to the regulators in June 2016 (BNL, 2016a), and the Addendum addressing regulator comments was issued as final in February 2017 (BNL, 2017a). The triggering action for this review was the completion of the last review and the United States Environmental Protection Agency's (EPAs) August 2016 concurrence letter.
- The fourth sitewide Five-Year Review was submitted to the regulators in June 2021 (BNL, 2021a), and the Addendum addressing regulator comments was issued as final in June 2022 (BNL, 2022a). The triggering action for this review was the completion of the last review and EPAs August 2021 concurrence letter.

A summary of site background, operable units, and cleanup progress is updated annually by U.S. Environmental Protection Agency (EPA) and posted on their website:

<https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0202841#bkground>.

2.0 Site Chronology

Remedial actions at the BNL site are currently being addressed under RODs for 11 OUs, covering 34 AOCs. In February 2021, DOE identified two new AOCs; AOC 33 for perfluorooctane sulfonate (PFOS)/perfluorooctanoic acid (PFOA) (which are per- and polyfluoroalkyl substances [PFAS]) and AOC 34 for 1,4-dioxane. A new OU, OU X, was established to address AOCs 33 and 34.

In May 2022, a crosswalk was prepared to develop consistency among the BNL OU numbers and descriptions that are used by DOE, EPA, and the New York State Department of Environmental Conservation (NYSDEC). As a result, the following projects were provided OU numbers: g-2/ BLIP/Underground Storage Tanks (USTs) (OU VIII), HFBR (OU IX), PFOS/PFOA/1,4-Dioxane (OU X), and BGRR (OU XI). That crosswalk is provided in **Table 2-1**. The chronology in **Table 2-2** first identifies general site information, and then breaks down each OU by major event. **Table 2-3** presents each OU and Removal Action AOC.

Background information, OU summary, and general site information for cleanup activities completed to date is presented by EPA on their Superfund Site website:

<https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.Cleanup&id=0202841#bkgrouund>

and also presented by BSA on their Environmental Protection Division information website: <https://www.bnl.gov/gpg/reports.php>. The Environmental Protection Division website also contains links to the annual Groundwater Status Reports, which provide additional details and background information.

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3.0 Facility-Wide Background

3.1 Physical Characteristics

The BNL site is located in the hamlet of Upton, Town of Brookhaven, Suffolk County, New York, near the geographic center of Long Island. The BNL property approximates a square, 3 miles on each side, comprising an area of approximately 5,265 acres (about 8 square miles). The boundaries of BNL are either near or adjacent to neighboring communities. The site's terrain is gently rolling, with elevations varying between 40 and 120 feet (ft) above mean sea level (amsl). The land lies on the western rim of the Peconic River watershed, with a tributary of the river rising in marshy areas west of the William Floyd Parkway and in the northern part of the site.

3.2 Geology/Hydrogeology

BNL is underlain by unconsolidated glacial and deltaic deposits that overlie gently southward sloping, relatively impermeable, crystalline bedrock. The deposits are about 2,000 feet thick in central Suffolk County. The aquifer system beneath BNL is comprised of three water-bearing units: the Upper Glacial, the Magothy, and the Lloyd aquifers. These units are hydraulically connected and make up a single zone of saturation with varying physical properties extending from a depth of 5 to 1,500 feet below the land surface. The Long Island Aquifer System is designated as a "sole-source aquifer" by the EPA and serves as the primary source of drinking water for Nassau and Suffolk Counties.

3.3 Land, Resource Use, and Institutional Controls

The site where BNL is located was formerly occupied by the U.S. Army as Camp Upton during World Wars I and II. Between the wars, the Civilian Conservation Corps operated the site. In 1947, the Atomic Energy Commission established BNL. The Laboratory was then transferred to the Energy Research and Development Administration in 1975, and finally to the DOE in 1977. BNL is a federal facility that conducts basic and applied research in high-energy nuclear physics and solid-state physics; fundamental material, structure properties, and the interaction of matter; biomedical and environmental sciences; quantum computing and artificial intelligence; as well as in energy technologies and national security.

The developed region of the site includes the principal BNL facilities which are near the center of the site on relatively high ground. These facilities comprise an area of approximately 1,800 acres, of which 500 acres were originally developed for Army use. Outlying facilities occupy approximately 550 acres and include an apartment area, Sewage Treatment Plant (STP), firebreaks, and former landfill areas. 530 acres of land on the eastern portion of the site has been designated as the Upton Ecological Research Reserve. The reserve has been designated as an area for the protection of sensitive habitats and a place where researchers can study local ecosystems. The Upton Reserve contains wetlands and is largely within the core preservation area of the Long Island Central Pine Barrens. DOE has granted an easement on approximately 200 acres of land in the east and southeast portion of the site for the operation of the Long Island Solar Farm. This 32 megawatt solar photovoltaic power plant was constructed in 2011.

The current land-use designations for the BNL site include industrial/commercial use in the central portion of the site, residential in the southwestern portion of the site, and open space borders. The Science User Support Center (SUSC), a newly constructed gateway to BNL, is located near the site entrance. These land-use settings are projected to remain the same. These include:

- Soil Remediation Complete - Unrestricted Land Use (A)
- Soil Remediation Complete - Restricted Land Use (B)
- Capped/Controlled Contaminated Soils - Restricted Land Use (C)
- Known or Potentially Contaminated Soils, Remediation Pending - Restricted Land Use (D)

- Groundwater Contamination Areas - Restricted Groundwater Use (E)
- Radiological Facility, Decontamination & Demolition Pending - Restricted Land Use (F)
- Sensitive Areas, Biologically/Culturally Sensitive - Restricted Land Use (G)

Institutional Controls (ICs) are administered per the *BNL Land Use Controls Management Plan* (LUCMP) (BNL, 2022b). The LUCs will be maintained for as long as necessary in order to ensure performance of the completed remedies as described and documented in the BNL RODs. The AOC-specific institutional controls are documented on fact sheets stored on the BNL LUC website. This is a secure website and is not open to the general public. The website is BNL's tool for internally managing ICs and consists of an interactive Geographic Information System that is linked to the AOC-specific fact sheets. Planning for any work at the site that may potentially disturb a remediated area requires a review of the website. Institutional Controls are deployed at BNL to prevent exposure to residual environmental contamination and to ensure the long-term effectiveness of the remedies.

The LUCMP is periodically updated by BNL and reviewed by the regulatory agencies in an effort to stay current with evolving management techniques. The LUCMP has been updated six times since its initial issue in 2003, with the latest update published in February 2022 (BNL, 2022b). The LUCs are evaluated from a sitewide standpoint on an annual basis and issues from the last year are summarized in a letter report to the regulatory agencies. A summary of findings from the required annual inspections of AOCs is included in this report. The LUCMP also details notification criteria in the event of a LUC breach or unauthorized change in land use. Specific ICs for each area are detailed in the fact sheets and are summarized by OU in **Section 7.0** of this Report.

Because of the potential for chemical contamination in the Upper Glacial aquifer, DOE provided public water hookups for homes in the area south of BNL in 1996-1997. **Figure 3-1** shows the public water hookup area extent. At the time, ten homeowners within the designated public water hookup area declined the free DOE hookup offer and continued to use their private wells for drinking purposes. By 2024, the number of homeowners was reduced to four. However, after review of the 2024 private well data, in 2025, BNL was contacted by the NYSDEC, in consultation with New York State Department of Health (NYSDOH), to provide an alternate water supply to one of the four residences not connected to public water, along with other potentially responsible parties. Based on the hydrogeologic conditions and the available groundwater characterization data collected in the area of the residence, DOE declined to provide the alternate water supply. The residence was provided an alternate water supply by others, and was connected to public water in 2025. This brings the number of homes not connected to public water to three (one in OU V, and two in OU VI). Annually, DOE formally offers those homeowners free testing of their private drinking water wells. The samples are collected and analyzed for a suite of analyses including volatile organic compounds (VOCs), 1,4-dioxane, metals, and pesticides by the Suffolk County Department of Health Services (SCDHS). However, in an agreement with DOE/BNL and SCDHS, samples collected for PFAS are analyzed by a BNL contract laboratory.

3.4 History of Contamination

Much of the environmental contamination at BNL is associated with past accidental spills and historical storage and disposal of chemical and radiological materials. These past operations, some of which may date back to when the site was an Army training camp, have caused soil and groundwater contamination that can be categorized into four main areas. These areas are 1) groundwater contamination (primarily VOCs, PFOS/PFOA, ethylene dibromide [EDB], strontium-90 [Sr-90], and tritium), 2) soils contamination (primarily polychlorinated biphenyls [PCBs], tetrachloroethylene [PCE], PFOS/PFOA, metals, cesium-137 [Cs-137], Sr-90) and landfills, 3) the Peconic River sediment contamination (primarily metals and PCBs), and 4) the BGR and HFBR facilities (primarily Sr-90 and tritium, respectively). Contamination in the Peconic River, groundwater contamination of VOCs, and PFAS have been found to extend off the BNL property. A significant environmental concern is that BNL lies above an EPA designated sole-source aquifer

system that is used for drinking water purposes both on and off site. Brief descriptions of the nature of contamination associated with each OU, the BGRR, g-2/BLIP/ USTs, and the HFBR covered under this Five-Year Review are as follows:

- OU I – Former landfills, disposal pits, and soils contaminated with metals such as mercury and lead, and radionuclides including Cs-137 and Sr-90; above- and below-ground leaking storage tanks; and Sr-90 and VOC (e.g.: chloroethane and 1,1-dichloroethane) -contaminated groundwater on BNL property.
- OU II/VII – Radiologically contaminated soils on BNL property such as Cs-137 identified as part of aerial radiological surveys. The AOCs in this OU were documented under the OU I and III RODs (except for BLIP [AOC 16K], which was documented in the g-2/BLIP/USTs ROD (BNL, 2007a)).
- OU III – Groundwater contaminated with VOCs such as carbon tetrachloride, 1,1,1-trichloroethane (TCA), and PCE, and radionuclides such as tritium and Sr-90 on BNL property; VOC-contaminated groundwater off of BNL property including PCE, carbon tetrachloride and EDB; and residual PCE soil contamination at one location on BNL property.
- OU IV – Soil and groundwater contaminated with VOCs such as toluene and ethylbenzene, and semi-volatile organic compounds (SVOCs) from a former oil/solvent tank spill on BNL property. Groundwater contaminated with Sr-90 located in central portion of BNL property.
- OU V – Radiological- and metal-contaminated soil at the STP such as Cs-137, mercury, and silver; metal- (mercury, silver, copper) and PCB-contaminated sediment in the Peconic River; and VOC-contaminated groundwater, including trichloroethene (TCE) on and off of BNL property.
- OU VI – EDB-contaminated groundwater off of BNL property.
- OU VIII g-2/BLIP/USTs – Radioactive soil shielding and contaminated groundwater at the former g-2 experiment and BLIP facility areas, and removal of USTs.
- OU IX HFBR – Activated components, contaminated structures, systems, underground pipes/ducts, ancillary buildings, and associated soils. Tritium-contaminated groundwater on the BNL site.
- OU X – PFAS-contaminated groundwater and soil onsite; PFAS-contaminated groundwater offsite. 1,4-Dioxane-contaminated groundwater on- and offsite. PFAS source areas will be investigated and delineated through the Remedial Investigation/Feasibility Study (RI/FS).
- OU XI BGRR – Activated components including the graphite pile and biological shield (both of which have been removed and disposed off-site), radiologically contaminated soils, sumps, ducts, piping, and standing water, including Cs-137 and Sr-90; and Sr-90 in groundwater on the BNL site.

3.5 Initial Response

In 1980, the BNL site was placed on the NYSDEC list of Inactive Hazardous Waste Disposal Sites. In 1989, BNL was also included on the EPA National Priorities List (NPL) because of soil and groundwater contamination. Effective in 1992, EPA, NYSDEC, and DOE entered into a Federal Facilities Agreement (also referred to as the Interagency Agreement, or IAG). While not formal IAG partners, SCDHS and NYSDOH are also actively involved with BNL cleanup decisions. The IAG identified AOCs that were grouped into OUs to be evaluated for response actions and established the framework and schedule for characterizing, assessing, and remediating the site in accordance with the requirements of CERCLA. In February 2021, DOE recommended the addition of AOCs 33 (PFOS and PFOA) and 34 (1,4-dioxane) to the regulators, and in March 2021, OU X was established. There are currently 34 AOCs and 11 OUs at the BNL site.

As noted in **Table 2-2**, prior to the approval of the RODs, DOE used its removal action authority in many situations to help reduce risks to human health and the environment. In most cases, these actions were taken to address source areas of contamination. These activities include the closure/capping of landfills, fencing to restrict access, tank removals, soils remediation, groundwater treatment, public water hookups, STP remediation, Peconic River sediment remediation, and response actions at the BGRR and HFBR. In several cases, the Removal Action ended up being the final remedial action. These actions are documented in the

respective RODs. A Time Critical Removal Action (TCRA) is currently underway to address PFAS groundwater contamination originating from the current and former firehouse facilities.

3.6 Basis for Taking Action

The nature of the contamination, as well as the risks to human health and the environment for each OU, are summarized below.

Operable Unit I: Radioactively contaminated soil is the principal issue. In addition, Removal Actions were conducted to address groundwater and buried waste at several AOCs.

Soils: The former Hazardous Waste Management Facility (HWMF) (AOC 1) contained most of the radioactively contaminated soil at BNL. The predominant radionuclide was Cs-137, which is the primary source of risk from direct exposure. Strontium-90 was also present, and most of the contamination was at or near the surface, although in some locations it extended to 12 feet below grade. The former HWMF Perimeter Area (AOC 1J) soils contained primarily Cs-137. Other contaminated soil areas included the former Waste Concentration Facility (WCF, AOC 10) (which also contained leaking tanks), former Building 650 Sump and Sump Outfall (AOC 6), and several areas throughout the site that were the result of contaminated soils that were unknowingly used for landscaping purposes. The Former (AOC 2), Interim (AOC 2D), and Current (AOC 3) Landfills, as well as the Chemical/Animal Pits and Glass Holes (AOC 2B and 2C), received waste generated at the BNL site from 1918 through 1990. These disposal areas were unlined and had a direct impact on groundwater quality prior to being capped or excavated in the mid-1990s. Contaminants at the Former Landfill Area included VOCs, metals such as mercury, and Sr-90. In addition to the above, based on recent groundwater monitoring results, contaminants at the Current Landfill Area also included PFAS.

The ash pits (AOC 2F), which once received ash and slag from a solid-waste incinerator located on the BNL site, have lead concentrations above cleanup goals. The Upland Recharge/Meadow Marsh Area (AOC 8) contained sediment with levels of pesticides and metals that were below cleanup standards for human health; however, these levels presented an exposure risk to eastern tiger salamanders, an endangered species in New York State.

Groundwater: The groundwater beneath the Former Landfill Area contained VOCs and Sr-90, while groundwater beneath the Current Landfill contains VOCs, PFAS, and metals. Strontium-90 and VOCs have also entered the groundwater from the former HWMF. Volatile organic compound contamination from these areas has migrated beyond the site's boundary.

Operable Unit II/VII: The principal issue is radioactively contaminated soils.

Soils: Cesium-137 is the major radiological contaminant of concern in soil where it can exceed specified risk or radiation dose limits. Cesium-137 was found in the WCF soils as well as several areas identified from the aerial radioactive monitoring system results (e.g., landscaping soils [AOC 16S]). During the remedial investigation (RI), no Cs-137 soil contamination in the landscape soils was found greater than two feet below grade. This soil contamination was included under the OU I project. Strontium-90 soil contamination was found deeper than two feet at the WCF, as was tritium contamination in soil at the BLIP.

Groundwater: The BLIP (AOC 16K) contains an area of soil and groundwater contamination. (See discussion on g-2 and BLIP areas below).

Operable Unit III: Groundwater contamination is the most significant concern; however, there are several soil AOCs.

Soils: Soils contaminated with PCBs above the New York State Technical and Administrative Guidance Memorandum (TAGM) cleanup levels, as well as high concentrations of PCE in soil, were found at the former Building 96 Scrapyard (AOC 26B). Other smaller contaminated soil areas included mercury at Building 464 (AOC 27) and PCBs at Building 479 (AOC 25).

Groundwater: Groundwater contaminated with VOCs extend south from the central portion of the BNL site to off-site to the Brookhaven Airport area, a distance of approximately three miles. The VOC plumes originated from a variety of sources including various small spill areas in the central industrial/research areas of the site, former Building 96 area, the Former Landfill, the Central Steam Facility, Former Building 208 warehouse area, the former Carbon Tetrachloride UST, and maintenance Building 452. The primary contaminants are TCA, PCE, Freon-11, EDB, and carbon tetrachloride. Per- and polyfluoroalkyl substances and 1,4-dioxane detected in the OU III areas will be addressed under OU X. Tritium and Sr-90 are also present above the MCLs on the BNL site. There is no radiological contamination off of BNL property that exceeds MCLs. The potable drinking water wells off of the BNL site are currently not impacted by VOCs or radioactivity, nor are they expected to be impacted from the contamination. Although these plumes were not found to have impacted any off-site private drinking water supply wells, in the 1990s DOE provided public water connections to most of the homes in the designated hook-up area downgradient of the site.

Operable Unit IV: Soil and groundwater contamination are the concerns.

Soil: Volatile organic compounds and SVOCs were present in the soils from a historical oil/solvent spill. Radiological contamination of soils was identified at the Building 650 Sump Outfall. The Building 650 soil contamination was included under the OU I project.

Groundwater: Volatile organic compounds and SVOCs, such as benzene, toluene, and ethylbenzene from a historical oil/solvent spill, contaminated the groundwater at this OU. Per- and polyfluoroalkyl substances and 1,4-dioxane detected in the OU IV area will be addressed under OU X. Strontium-90 was released to groundwater at the Building 650 Sump Outfall and the plume is located in the central portion of the site.

Operable Unit V: Radioactively and metal-contaminated soil, and metal and PCB-contaminated river sediment are the principal issues.

Soil/Sediment: The STP berms soil (AOC 4) presented concern due to potential impacts to future on-site residents from Cs-137 and mercury. In addition, concentrations of mercury and PCBs in fish may have posed a health hazard to people consuming fish taken from certain locations on the Peconic River (AOC 30). Sediment within certain depositional areas of the Peconic River was contaminated with mercury, silver, and copper, and posed a potential ecological concern. Surface sediment in depositional areas up to 1.5 miles downstream of the STP contained the PCB Aroclor-1254. Trace amounts of Cs-137 were co-located in the sediment but did not pose a risk to people or aquatic organisms.

Groundwater: Volatile organic compounds (primarily TCE and TCA) were the primary contaminants in the groundwater both on and off of the BNL site. Low levels of tritium were also found, but at concentrations below the 20,000 picocuries per liter (pCi/L) MCL. In the 1980s, one private well was impacted by site-related VOCs at concentrations exceeding drinking water standards. DOE provided a carbon filtration system to this home and subsequently connected it to the public water supply. Although this action was not performed as part of a CERCLA remedy under the BNL Federal Facilities Agreement, it did help support the basis for investigation of the groundwater in OU V. DOE currently offers free annual testing to one homeowner that continues to use their private well for drinking water purposes in OU V. Per- and polyfluoroalkyl substances and 1,4-dioxane detected in the on- and off-site OU V areas will be addressed under OU X.

Operable Unit VI: Groundwater contamination is the primary issue.

Groundwater: The pesticide EDB is the contaminant of concern (AOC 28). It has been found in groundwater on and off of BNL property significantly above the MCL of 0.05 micrograms per liter (µg/L). The EDB originated from application in the Biology Fields in the 1970s. DOE offers free annual testing to one business and one homeowner that continue to use their private wells for drinking water purposes.

Operable Unit VIII g-2/BLIP/USTs: Radioactively contaminated soil and groundwater is the principal issue.

Structures and Soils: Particle accelerator operations at the former g-2 experiment area (AOC 16T) and BLIP facility (AOC 16K) have resulted in the activation of soil used for shielding. The primary contaminants of concern in the activated soils are tritium and sodium-22. The infiltration of rainwater through the activated soils can leach tritium and sodium-22 from the soils and carry them into the groundwater. To reduce the ability of rainwater to infiltrate the activated soils, a number of stormwater management controls have been implemented. In addition, eight USTs from several locations across the site were removed between 1988 and 1996, and confirmatory soil sampling following the tank removals indicated no environmental impacts.

Groundwater: Groundwater in the vicinity of the former g-2 experiment area (AOC 16T) and BLIP facility (AOC 16K) had been contaminated with tritium at concentrations that exceeded the 20,000 pCi/L MCL. Although sodium-22 concentrations had occasionally exceeded the 400 pCi/L MCL, it was found to naturally attenuate (via decay and dispersion) to nearly non-detectable levels within a short distance from the source areas. There were no groundwater impacts associated with the former USTs.

Operable Unit IX HFBR: Radioactively contaminated groundwater is the principal issue.

Activated Components, Contaminated Structures and Soils: Past operations resulted in the formation of radioactive material (i.e., activation products) within the metal and concrete of the large reactor components (reactor vessel/internals, thermal shield and biological shield). Smaller quantities of radioactive material were also found in ancillary structures (fan houses and stack), underground pipes/ducts, and associated soils.

Groundwater: Groundwater contaminated with tritium, including under OU III, was present beneath the HFBR and had extended several thousand feet to the south at concentrations exceeding the 20,000 pCi/L MCL. The downgradient portion of the plume has attenuated to below the MCL, and tritium has not been detected above the MCL in monitoring wells immediately downgradient of the HFBR since 2020. Tritium from the HFBR was never detected above the MCL beyond the BNL property boundary.

Operable Unit X: Soil and groundwater contamination are the primary concerns.

Soil: To date, only limited sampling of soils for PFAS has been performed. Shallow soil sampling conducted in the Current Firehouse, Building 170, and Former Firehouse aqueous film forming foam (AFFF) training areas have identified PFOA and PFOS above their current New York State Soil Cleanup Guidance (SCGs) values. Two soil borings installed from land surface to the water table in the Current Firehouse former training area identified high concentrations of PFOA, PFOS, and other PFAS compounds in both shallow and deep soils. Sampling conducted at BNL's Recreation Center in the southwest portion of the site identified low levels of PFOS and PFOA in the shallow soils where PFAS had been released. Additional soil sampling at other identified foam release areas will be performed during the RI/FS. To remain protective of human health through direct exposure, the known PFAS soil contamination areas are managed with ICs which minimize and control soil disturbance in these areas.

Groundwater: Past use of AFFF for firefighting training purposes has resulted in PFAS groundwater contamination downgradient of the current firehouse, Building 170, and the former firehouse facilities (AOCs 33D and E, and J) significantly above the New York State MCL of 10 nanograms per liter (ng/L) and the Federal MCL of four ng/L for both PFOA and PFOS, respectively. Active groundwater remediation for the current firehouse and Building 170 plumes began in October 2022 and for the former firehouse plume in January 2023. Groundwater characterization downgradient of these areas indicated that PFAS is migrating offsite.

Lower levels of PFOS and PFOA exceeding the standards have also been identified on BNL property where AFFF was released during training and fire suppression system testing (AOCs 33A, B, C, F, and G). PFAS have also been detected in the groundwater at the STP (AOC 33I) the Current Landfill (AOC 33K) and in several off-site areas. Low levels of 1,4-dioxane exceeding the NYS MCL of 1.0 µg/L have been identified in several on-site and off-site areas (AOC 34). Perfluorooctane sulfonate has been detected in three of BNL's potable drinking water supply wells at concentrations exceeding the 10 ng/L MCL. As a precaution, BNL

potable supply well BNL-4 and BNL-6 were removed from service and carbon treatment was added to BNL-10, -11 and -12.

The Suffolk County Water Authority (SCWA) potable wells west of the site on the west side of William Floyd Parkway may be at risk of impact from relatively low-level PFAS in groundwater originating from the BNL Recreation Center area and other potential off-site sources. Additional groundwater sampling in this area will be performed as part of the RI/FS.

Soil Vapor/Indoor Air: Vapor intrusion investigations may be appropriate in the future for buildings where PFAS contamination is present in shallow groundwater and/or soil beneath occupied buildings (e.g.: Building 599 and Building 725). However, there are currently no standards or guidance values for comparison of sub-slab or indoor air vapor concentrations for PFAS or for evaluating an inhalation exposure risk.

Operable Unit XI BGRR: Radioactively contaminated soil and groundwater is the principal issue.

Structures and Soils: There were several radiologically contaminated and activated structures and components at various locations within the BGRR complex (AOC 9). These include the graphite pile and surrounding biological shield, contaminated concrete within the fuel-handling system's deep pit and fuel canal (AOC 9A), and contaminated steel, concrete, air coolers, and filters within the below-ground ducts (AOC 9B). Additionally, there are isolated pockets of contaminated soils (primarily contaminated with Sr-90) adjacent to the below-ground ducts secondary cooling air bustle and expansion joints, fuel canal outer walls and construction joint, the reactor building pipe trench, and the reactor building drains. Concerns also include rainwater infiltration and subsequent leaching of Sr-90 into the soil/groundwater, as well as the continued release of residual Sr-90 to the groundwater that had previously leached into the deep vadose zone soils beneath the building and underground structures as a result of rainwater infiltration. To reduce the ability of rainwater to infiltrate the contaminated below ground structures and soil, a number of stormwater management controls have been implemented, including an engineered cap. Most non-radiological hazardous materials associated with the BGRR were removed through previous interim stabilization measures. Isolated pockets of non-radiological hazardous material contamination are present within the reactor building pipe trench, and within embedded drain lines. Hazardous materials intrinsic to construction materials, such as floor tiles, paint, and insulating materials, remain within the reactor building.

Groundwater: Groundwater contaminated with Sr-90, included under OU III, is present beneath the BGRR complex at concentrations significantly above the MCL of 8 pCi/L. The Sr-90 contamination in groundwater extends from the BGRR approximately 1,500 feet south. Residual Sr-90 present in the deep vadose zone close to the water table continues to be released to groundwater during periods of seasonal high water table levels.

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4.0 Remedial Actions

4.1 Remedy Selection

To date, nine RODs and four Explanations of Significant Differences (ESDs) have been signed at BNL. The first was signed in 1996 (OU IV ROD) and the last in 2012 (OU III ESD). The nine RODs are:

1. OU I – Radiologically contaminated soils on the BNL site (incorporates OU II/VII AOCs) (BNL, 1999)
2. OU III – Groundwater on and off of the BNL site (BNL, 2000a)
3. OU IV – Soil and groundwater on site (BNL, 1996a)
4. OU V – STP (BNL, 2001b)
5. OU V – Peconic River (BNL, 2004a)
6. OU VI – EDB in groundwater off of the BNL site (BNL, 2000b)
7. OU VIII g-2/BLIP/USTs – Radiologically contaminated soil shielding and groundwater (BNL, 2007a)
8. OU IX HFBR – Radiologically contaminated structures and soil (BNL, 2009a)
9. OU XI BGRR – Radiologically contaminated structures and soil on site (BNL, 2005a)

The four ESDs are:

1. OU III – Magothy and Sr-90 groundwater cleanup, institutional controls (BNL, 2005b)
2. OU III – Building 96 soil and groundwater remedy optimization (BNL, 2009b)
3. OU III – BGRR Biological shield removal changes (BNL, 2012a)
4. OU III – Building 452 Freon-11 groundwater remedy (BNL, 2012b)

Operable Unit X for PFAS and 1,4-dioxane was established in March 2021, and the TCRA for removal of PFAS in groundwater is underway. A ROD will be issued upon completion of the RI/FS. Brief descriptions of the ROD remedial action objectives (RAOs) and the major remedy components are described below.

Operable Unit I ROD, signed August 1999 (BNL, 1999)

- Objectives are to:
 - Prevent or minimize leaching of contaminants (radiological and chemical) from soil into the groundwater.
 - Prevent or minimize migration of contaminants present in surface soil via surface runoff and windblown dust.
 - Prevent or minimize human exposure including direct external exposure, ingestion, inhalation, and dermal contact, and environmental exposure to contaminants in the surface and subsurface soils.
 - Prevent or minimize the uptake of contaminants present in the soil by ecological receptors.
 - For radionuclides in soil, the cleanup goal is based on a total dose of 15 milliRem per year (mRem/yr) above background.
 - The NYSDEC guidance of 10 mRem/yr above background has been adopted as an As Low As Reasonably Achievable (ALARA) goal which will be considered during the design and construction phase.
- OU I Remedy Components:
 - Excavate soils that are radiologically and chemically contaminated above the selected cleanup goals at the former HWMF, WCF, Building 650 Sump and Sump Outfall, and the Chemical/Animal Pits and Glass Holes, and dispose of soil at an approved off-site facility. Reconstruct wetlands at the former HWMF.
 - Remove out-of-service facilities, tanks, piping, and equipment at the former HWMF and WCF.

- Install soil caps to address metal contamination at ash pits.
- Excavate chemically contaminated sediment from the Upland Recharge/Meadow Marsh Area and dispose of sediment at an approved facility off the BNL site. Reconstruct wetlands and monitor. Note: The cleanup values for the primary contaminants of concern were mercury 1.84 milligram per kilogram (mg/kg), lead 15.8 mg/kg, thallium 0.35 mg/kg, zinc 22.4 mg/kg, and copper 25 mg/kg.
- Implement long-term ICs and monitoring to ensure that planned uses are protective of public health.
- All of the previous removal actions that were implemented, such as landfill capping, waste and soil excavation, groundwater pump and treat systems, and groundwater monitoring, were selected as final remedies under the OU I ROD.

Groundwater contamination associated with the Former Landfill Area and off-site groundwater associated with other Operable Unit I AOCs were addressed in the OU III ROD (BNL 2000a). An evaluation of remedial alternatives for contaminated soil and groundwater associated with the BLIP facility (AOC 16K) was completed. The final remedy for contaminated soils and groundwater at BLIP is documented in the g-2/BLIP/USTs ROD (BNL, 2007a).

Operable Unit II/VII Decisions

Remedial actions for the OU II and VII AOCs are documented in the OU I ROD (BNL, 1999), the OU III ROD (BNL, 2000a), and the g-2/BLIP/USTs ROD (BNL, 2007a).

Operable Unit III ROD, signed June 2000 (BNL, 2000a)

- Objectives are to:
 - Meet drinking water standards (i.e., MCLs) for VOCs (5.0 µg/L for most VOCs), Sr-90 (8.0 pCi/L), and tritium (20,000 pCi/L) in groundwater.
 - Complete cleanup of the groundwater in the Upper Glacial aquifer within 30 years (by 2030) or less. [Note: the updated timeframe for Sr-90 is addressed in the 2005 ESD].
 - Prevent or minimize further migration of VOCs, Sr-90, and tritium in groundwater.
- OU III Remedy Components:
 - For VOCs – Install treatment systems at the Long Island Power Authority (LIPA) right-of-way, North Street, Airport, North Street East, Industrial Park East, Middle Road, and Western South Boundary. All of the previously implemented VOC removal actions (including treatment systems at the South Boundary and Industrial Park) were selected as final remedies under the OU III ROD.
 - For tritium (AOC 29) – Institute contingency plans to reactivate the Princeton Avenue pump and recharge system, and low-flow groundwater extraction of high tritium concentrations at the HFBR with approved off-site disposal of the water.
 - For Sr-90 – Install treatment systems using ion exchange at the Chemical Holes and the BGRR/WCF plumes. Prior to implementation, perform a pilot treatability study to evaluate the effectiveness of extraction and treatment, and modify the remedy, if needed.
 - Magothy aquifer – Perform additional characterization and determine the need for a remedy. If a remedy for the Magothy is necessary, either the OU III ROD would be modified or another decision document would establish the selected action (see OU III ESD below).
 - The previous removal action that was implemented for public water hookups was selected as a final remedy under the ROD.
 - Groundwater monitoring program to monitor and verify the cleanup over time.
 - Source Areas – Source removal system at Building 96 for VOCs in groundwater and PCBs in soil, remediation of groundwater at the former Carbon Tetrachloride UST spill area, and removal of Building 830 USTs (AOC 12).

- Deferred Decisions – The final remedy for potential source areas such as the Building 96 geophysical anomalies (AOC 26B) was documented in a subsequent ROD (see OU III ESD below). The final remedy for AOC 9D, the Pile Fan Sump, was documented in the BGRR ROD.

Operable Unit III Explanation of Significant Differences, signed May 2005 (BNL, 2005b)

- OU III Remedy Components:
 - Magothy aquifer – Add two Magothy aquifer extraction wells off of BNL property in addition to the three wells already installed. Meet drinking water standards within 65 years of the signing of the OU III ROD (by 2065).
 - Sr-90 – Continue to operate the “pilot study” remediation facility treatment system at the Chemical Holes and meet the drinking water standards within 40 years (by 2040). Install an ion exchange treatment system for the BGRR/WCF plume and meet the drinking water standards within 70 years (by 2070).
 - Building 96 Scrapyard – No further action for the geophysical anomalies.
 - Implement long-term institutional controls and monitoring to ensure that planned uses are protective of public health.

Operable Unit III Explanation of Significant Differences, signed August 2009 (BNL, 2009b)

- OU III Remedy Components:
 - Building 96 Scrapyard – Changes to the Building 96 groundwater remedy to include excavation and off-site disposal of PCE-contaminated soils. This will optimize the remedy by reducing the number of years of active treatment and enable BNL to achieve the ROD cleanup goal for this groundwater plume (by meeting drinking water standards for VOCs by 2030).

Operable Unit III Explanation of Significant Differences, signed May 2012 (BNL, 2012b)

- OU III Remedy Components:
 - Building 452 Freon-11 Source Area and Groundwater Plume – Following the 2011 discovery of a Freon-11 plume near site maintenance Building 452, a new groundwater treatment system was installed in early 2012. This remedy will enable BNL to achieve the ROD cleanup goal for this groundwater plume (by meeting drinking water standards for VOCs by 2030).

Operable Unit IV ROD, signed March 1996 (BNL, 1996a)

- Objectives are to restore the groundwater quality of the most contaminated portion of the AOC 5 plume to MCLs or background levels, and prevent or minimize:
 - Leaching of contaminants (radiological and chemical) from the soils into the groundwater.
 - Volatilization of contaminants from surface soils into the ambient air.
 - Migration of contaminants present in surface soil via surface runoff and windblown dust.
 - Human exposure including ingestion, inhalation, and dermal contact, and environmental exposure to contaminants in surface soil.
 - Uptake of contaminants present in the soil and/or groundwater by plants and animals.
- OU IV Remedy Components:
 - Treat chemically contaminated soil in the vadose zone of the spill area (AOC 5A) and the fuel unloading area (AOC 5D) using soil vapor extraction (SVE).
 - Treat groundwater at the most contaminated portion of the spill area using SVE and air sparging.
 - Use an engineering enhancement option for the groundwater if AS/SVE alone will not achieve the desired performance levels.

- As an Interim Action, install a fence around the radiologically contaminated soil at Building 650 Sump and Sump Outfall area with institutional controls and monitoring. The final remedy for these soils is documented in the OU I ROD as discussed above.
- Monitor the natural attenuation of Sr-90 contamination in groundwater originating from the former Sump Outfall area.

Operable Unit V Sewage Treatment Plant ROD, signed January 2002 (BNL, 2001b)

- Objectives are to:
 - Protect public health and the sole-source aquifer, continue to monitor the groundwater, and to prevent or minimize:
 - Migration of contaminants present in surface soil via surface runoff and windblown dust.
 - Human and environmental exposure to contaminants in surface and subsurface soil.
 - Potential for uptake of contaminants present in the soil by ecological receptors.
 - Potential for migration of contaminants (radiological and chemical) from the soil to groundwater.
 - Reduce the levels of contamination in the sand filter beds (AOC 4B)/berms and adjacent areas.
- OU V STP Remedy Components:
 - Excavate radiologically and chemically contaminated soil at the sand filter beds and berms, firing range berms, and the sludge drying beds, and dispose of soil at an approved off-site facility.
 - Remove sludge from manholes along a retired section of the sanitary sewer line leading to the STP.
 - Monitor the groundwater for VOCs and tritium.
 - A previously implemented removal action for the Imhoff Tank is selected as the final remedy (AOC 4C).
 - Implement institutional controls on BNL property such as preventing the installation of pumping wells that may interfere with groundwater monitoring.
 - Any sale or transfer of BNL property will meet the requirements of 120(h) of CERCLA to ensure that future users are not exposed to unacceptable levels of contamination.

Operable Unit V Peconic River ROD, signed January 2005 (BNL, 2004a)

- Objectives are to:
 - Reduce site-related contaminants (e.g., mercury) in sediment to levels that are protective of human health.
 - Following cleanup on Laboratory property, the average mercury concentration will be less than 1 part per million (ppm), with a goal that all mercury concentrations in the remediated areas are less than 2 ppm.
 - Following cleanup outside Laboratory property, the average mercury concentration will be less than 0.75 ppm, with a goal that all mercury concentrations in the remediated areas are less than 2 ppm.
 - Reduce or mitigate, to the extent practicable, existing and potential adverse ecological effects of contaminants in the Peconic River.
 - Prevent or reduce, to the extent practical, the migration of contaminants off the BNL property.
- OU V Peconic River Remedy Components:
 - Removal and disposal of mercury-contaminated sediment above agreed upon cleanup levels from designated depositional areas on and off of BNL property.

- Implement a monitoring program to demonstrate the effectiveness of the cleanup. Near-term monitoring results will establish the basis for the long-term monitoring program. The program includes monitoring for methyl mercury in the water column, sediment sampling, and fish sampling on and off of BNL property.
- Conduct an annual review for the first five years after commencement of the remedial action to ensure that the remedies continue to provide adequate protection of human health and the environment.
- Sampling results for each annual review and the formal Five-Year Review will be evaluated with the regulators and appropriate modifications will be made, as necessary, for subsequent sampling.

Operable Unit VI ROD, signed March 2001 (BNL, 2000b)

- Objectives are to:
 - Meet the MCL for EDB in groundwater (0.05 µg/L).
 - Complete cleanup of the groundwater in a timely manner. For the Upper Glacial aquifer, this goal is 30 years (by 2030) or less.
 - Prevent or minimize further migration of EDB in groundwater vertically and horizontally.
- OU VI Remedy Components:
 - Install a treatment system to extract EDB from the groundwater with treatment via activated carbon filtration.
 - The previous removal action that was implemented for public water hookups was selected as a final remedy under the ROD.
 - Develop groundwater monitoring program to monitor and verify the cleanup over time.
 - Implement institutional controls on the BNL property to prevent use of contaminated groundwater in the OU VI area.

Operable Unit VIII g-2/BLIP/USTs ROD, signed May 2007 (BNL, 2007a)

- Objective is to:
 - Prevent additional rainwater infiltration into activated soil shielding at g-2 and BLIP.
- g-2/BLIP/USTs Remedy Components:
 - Inspect and maintain the caps and other stormwater controls at the g-2 and BLIP source areas. Submit an annual certification to NYSDEC that institutional and engineering controls are in place, are unchanged from the previous certification, and nothing has occurred that would impair the ability of the control to protect public health and the environment.
 - Conduct routine groundwater monitoring to verify the effectiveness of the stormwater controls. Monitor the downgradient portion of the g-2 plume until tritium concentrations decrease to below the 20,000 pCi/L MCL.
 - For the former UST areas, no additional remedial actions are required.

Operable Unit IX High Flux Beam Reactor ROD, signed April 2009 (BNL, 2009a)

- Objectives are to control, minimize, or eliminate:
 - All routes of future human and/or environmental exposure to radiologically contaminated facilities or materials.
 - The potential for future release of non-fixed radiological or chemical contamination to the environment.
 - All routes of future human and/or environmental exposure to contaminated soils.
 - The future potential for contaminated soils to impact groundwater.

- HFBR Remedy Components:

The HFBR remedy incorporates many completed interim actions, several near-term actions, and the segmentation, removal, and disposal of the remaining HFBR structures, systems, and components following a safe storage decay period (not to exceed 65 years).

Completed actions:

- The HFBR fuel was removed and sent to an off-site facility.
- The primary coolant was drained and sent to an off-site facility.
- Scientific equipment was removed and is being reused.
- Shielding and chemicals were removed and are being reused at BNL and other facilities.
- The cooling tower superstructure was dismantled and disposed of.
- The confinement structure and spent fuel canal were modified to meet Suffolk County Article 12 requirements.
- The Stack Monitoring Facility (Building 715) was dismantled and disposed of.
- The Cooling Tower Basin and Pump/Switchgear House (Building 707/707A) was dismantled and disposed of.
- The Water Treatment House (Building 707B) was dismantled and disposed of.
- The Cold Neutron Facility (Building 751) contaminated systems were removed and the clean building has been transferred to another organization for re-use.
- The Guard house (Building 753) was dismantled and disposed of.
- Soil excavation and disposal of the former HWMF Waste Loading Area (WLA) was performed.
- Control rod blades and beam plugs were removed and disposed of.
- Removal of ancillary buildings and associated soils.
 - Stack (Building 705) by 2020 – Stack Demo Complete February 2021 (Closeout Report issued fall 2021)
 - Fan houses (Buildings 704 and 802) - Complete
- Removal of contaminated underground pipes and ducts - Complete
- Preparation of Reactor Confinement Building (Building 750) for safe storage - Complete.

Removal after Safe Storage Decay Period:

- Large, activated components (reactor vessel and internals, thermal shield and biological shield).
- Reactor Confinement Building structures, systems and components.
- Cleanup of associated soils.

In addition, the final remedy specifies the requirements for surveillance and maintenance to manage the inventory of radioactive material during the safe storage period. Land use and institutional controls, including periodic certification to EPA and NYSDEC, are also specified.

Operable Unit X (No ROD), Time Critical Removal Action Memo signed August 2021 (BNL, 2021b)

- Includes AOC 33 (PFOS and PFOA) and AOC 34 (1,4-dioxane)
 - Currently, AOC 33 includes 12 sub-AOCs:
 - 33A – Former Bubble Chamber Experiment and Blockhouse Area
 - 33B – Building 924 Area
 - 33C – East of Building 902
 - 33D – Current Firehouse
 - 33E – Former Firehouse
 - 33F – Major Petroleum Facility
 - 33G – Building 526 Area
 - 33H – Recreation Center Area
 - 33I – STP

- 33J – Building 170
 - 33K – Current Landfill
 - 33L – Water Treatment Plant Recharge Basins
- TCRA Objectives are to:
 - Remediate the highest levels of PFAS groundwater contamination that is migrating downgradient of the Current Firehouse and Former Firehouse source areas. The Building 170 former training area was also included as part of the Current Firehouse treatment system following design characterization.
 - Hydraulically capture and treat the highest concentration areas of the plumes and prevent or minimize further PFAS plume migration.
 - Treatment system capture goal of 100 ng/L or greater for PFOS or PFOA.
- OU X TCRA Remedy Components:
 - Installed two groundwater treatment systems (Current Firehouse/Building 170 and the Former Firehouse) to extract PFAS from the groundwater with treatment via activated carbon filtration and discharge to onsite recharge basins.
 - Groundwater monitoring to verify the performance of the systems and cleanup progress over time.
- A Draft RI/FS Work Plan was tentatively approved by the EPA and NYSDEC in March 2024. Future RI characterization will determine the full nature and extent of PFAS and 1,4-dioxane contamination not already addressed by the TCRA. This will include the remaining PFOS and PFOA groundwater and soil areas and 1,4-dioxane in groundwater.
- Each of the OU X AOCs has been incorporated into BNL's LUIC program to prevent or mitigate exposure and/or spreading of potentially PFAS contaminated soil.

Operable Unit XI BGRR ROD, signed March 2005 (BNL, 2005a)

- Objectives are to:
 - Ensure protection of human health and the environment, without undue uncertainties, from the potential hazards posed by the radiological inventory that resides in the BGRR complex.
 - Use the ALARA principle while implementing the remedial action.
 - Following completion of the remedial activities, implement long-term monitoring, maintenance, and institutional controls to manage potential hazards to protect human health and the environment.
- BGRR Remedy Components:
 - Remove the below ground duct filters and primary liner.
 - Remove a portion of the fuel canal outside the structural footprint of the reactor building. Remove accessible subsurface contaminated soil in the vicinity of the fuel canal, below ground duct expansion joint #4, and the secondary cooling air bustle.
 - Isolate the below ground ducts and demolish the instrument house.
 - Install water infiltration control (i.e., engineered cap) and monitoring system (including the installation of groundwater monitoring wells) for remaining structures and subsurface contaminated soil.
 - Remove the graphite pile and biological shield.
 - Complete final status surveys to document that cleanup objectives are met and to document final conditions.
 - Develop and implement land use and institutional controls that include routine inspection and surveillance of the BGRR complex, maintenance and upkeep of Building 701 and surrounding

water infiltration control system, and reporting requirements to ensure that planned uses are protective of public health.

- Submit an annual certification to NYSDEC that institutional and engineering controls are in place, are unchanged from the previous certification, and nothing has occurred that would impair the ability of the control to protect public health and the environment.
- All of the previous removal actions that were implemented prior to the ROD signing, such as removal and disposition of accumulated contaminated water, Pile Fan Sump and soils, above-ground ducts, canal and water treatment house, accessible contaminated soils, and exhaust cooling coils and filters, were selected as final remedies under the ROD.

BGRR Explanation of Significant Differences, signed June 2012 (BNL, 2012a)

- OU III Remedy Components:
 - Biological Shield - Changes to the scope of work for removal of the BGRR biological shield includes the removal of the outer steel walls, the inner steel walls, and the concrete between the inner and outer walls down to the existing floor level, rather than removing the approximately three vertical feet of biological shield embedded below the existing floor.

4.2 Remedy Implementation

With the exception of the decommissioning and decontamination of the remaining HFBR structures (e.g., large activated components including reactor vessel, systems, and confinement building), all soil, groundwater, and decommissioning and decontamination remedies for the nine signed RODs at the site have been implemented. This includes the excavation and approved off-site disposal of all contaminated soil, sediment, and tanks, the installation and operation of all groundwater treatment systems, and Long-Term Surveillance and Maintenance of the BGRR and HFBR. As noted above, a TCRA for the construction of two PFOS/PFOA groundwater treatment systems downgradient of the current and former firehouse facilities was completed and the systems became operational as of October 2022 (Current Firehouse/Building 170) and January 2023 (Former Firehouse). These will ultimately be documented in the OU X ROD. A chronology of the previous removal actions undertaken for each OU, and post-ROD remedial actions, is presented in **Table 2-2** (see **Section 2.0**). A brief summary of the status of remedy implementation since the signing of each ROD is identified below.

Operable Unit I: Excavation and off-site disposal of radiologically contaminated soil was initiated in 2000 with the landscape soil (approximately 2,800 cubic yards), followed by the Building 650 Sump and Sump Outfall (approximately 1,800 cubic yards), and Upland Recharge/Meadow Marsh Area (approximately 500 cubic yards). In 2005, removal of radiologically contaminated soil from the former HWMF (approximately 13,000 cubic yards), Building 811 soil (approximately 4,000 cubic yards), and former Chemical Holes residual surface soil (approximately 4,000 cubic yards) was completed. Of the total contaminated soil volume, approximately 23,600 cubic yards were disposed of at Envirocare of Utah, and 2,500 cubic yards were disposed of at Niagara Falls Landfill Facility. Furthermore, approximately 11,000 cubic yards of soil were excavated from the Chemical/Animal Pits and Glass Holes during 1997 as part of a Removal Action that was conducted prior to the ROD being signed. In 2003, the ash pits were capped with a soil cover to prevent direct contact risks, and removal and disposal of the Building 811 USTs was completed in 2005. The Oak Ridge Institute for Science and Education (ORISE), an independent contractor to DOE, verified that the cleanup effort at these radiologically contaminated soils areas attained the cleanup goals defined in the ROD (ORISE, 2008). Closeout reports were issued for the landscape soil, Building 650 Sump and Sump Outfall, Upland Recharge/Meadow Marsh Area, the former HWMF, and Building 811 soil, and an addendum to the existing Chemical Holes Closeout Report was issued. In March 2007, the decontamination of the Merrimack Holes at the former HWMF was completed. Between 2009 and 2014, three phases of cleanup of the former HWMF Perimeter Soils were performed (approximately 407 cubic yards were excavated). Closeout reports for each phase of the cleanup were issued (BNL, 2010a) (BNL, 2010b) (BNL, 2015a). Starting in 2014 and continuing into 2018, the former Waste Concentration Facility Buildings 810 and 811 were demolished, waste transfer

lines were removed, and excavation of radiologically-contaminated soil was completed (approximately 1,822 cubic yards of waste).

As noted in the *Final Closeout Report for Area of Concern 16 Landscape Soils* (BNL, 2001c), monitoring conducted after calendar year 2000 and the excavation of the landscape soil indicates that the potential exposure to workers and future site residents is less than the 15 mRem/yr above background criteria. This cleanup also met the NYSDEC ALARA goal of less than 10 mRem/yr above background. Landscape soil from the Building 355 area was excavated again in March 2010 as part of construction activities for the new Interdisciplinary Science Building 734. The soil was transferred to the former HWMF to be used as fill. Three confirmatory soil samples identified remaining Cs-137 concentrations below 0.5 picocuries per gram (pCi/g).

The OU I South Boundary Treatment System for groundwater, installed under a Removal Action, began operation in 1997 and was approved for shutdown in 2013 (BNL, 2013a) and closure in 2019 (BNL, 2019b).

Operable Unit III: Fifteen of BNL's 20 groundwater treatment systems are included under OU III. Following the signing of the OU III ROD in June 2000, the groundwater treatment systems were installed between 2000 and 2012 both on and off of the BNL property. Twelve of the treatment systems were installed to address VOC groundwater contamination and two systems were installed to address Sr-90 groundwater contamination. One pump and recharge system was installed to address tritium groundwater contamination. The performance of these systems in meeting the overall groundwater cleanup goals is evaluated in the annual *BNL Groundwater Status Reports*. Through 2024, the OU III treatment systems are responsible for 94 percent of the 7,900 pounds of VOCs removed by all of the BNL groundwater treatment systems.

In accordance with the ROD, several low-flow extraction events were performed between 2000 and 2001 for the high-concentration segments of the HFBR tritium plume. Approximately 100,000 gallons of tritium-contaminated water were pumped from the aquifer and disposed of at an approved off-site facility. In response to the November 2006 triggering of the OU III ROD contingency plan, the HFBR Pump and Recharge system was re-started in December 2007. As part of this action, a new extraction well was constructed to improve control and capture of the plume. This well began operation in November 2007. The treatment system was approved for shutdown in 2013, and later approved for closure in 2019. The extraction wells have remained shut down and in standby mode, while post-closure monitoring continues.

The Building 96 treatment system was originally approved for shutdown in 2005. Between 1999 and 2005, approximately 2,200 cubic yards of PCB-contaminated soil from the former Building 96 Scrapyard area were excavated and disposed of offsite. This was accomplished in accordance with the ROD to reduce the risk of direct contact with contaminated soils in this area. In 2008, the system was turned back on and extraction well RTW-1 was modified from a recirculation well to an extraction well to improve the removal efficiency of VOCs in the source area. Subsequent investigations identified a continuing localized source of VOC contamination within the vadose zone. In accordance with the OU III ESD approved in 2009 (BNL, 2009b), the VOC-contaminated soils were excavated in 2010 and disposed of at an approved off-site facility. Hexavalent chromium was also detected in Building 96 area monitoring wells in 2008 as a byproduct of earlier potassium permanganate injections in the source area that were used to remediate residual VOCs. Well RTW-1 also included treatment for hexavalent chromium from 2008 through 2018. Following the soil removal in 2010, a significant initial decrease in the total VOC concentrations in groundwater was observed, followed by a rebound of PCE concentrations, which indicated the continued presence of residual source material. As recommended in the *2021 Five-Year Review*, implementation of an *in-situ* chemical treatment program was performed in July 2024. The initial post-injection monitoring results indicate the treatment injections were successful at reducing the mobility of PCE from the source area.

In accordance with the OU III ESD approved in 2005 (BNL, 2005b), two additional Magothy aquifer groundwater extraction wells were installed at the Industrial Park treatment system, and one Magothy aquifer extraction well at the LIPA system to address VOC contamination. Between 2007 and 2025, additional extraction wells were installed at the LIPA/Airport, Chemical Holes Sr-90, HFBR Tritium Pump and Recharge, BGRR/WCF Sr-90, South Boundary, Middle Road, Western South Boundary, and the North Street

East systems. These additional extraction wells were necessary to address changing plume conditions identified as part of the long-term groundwater monitoring program.

In accordance with the OU III ESD approved in 2012 (BNL, 2012b), one Upper Glacial aquifer groundwater extraction well was installed to address Freon-11 contamination detected downgradient of site maintenance Building 452. This well began operation in 2012 and was shut down in 2016.

The status of the Petitions for Shutdown and Petitions for Closure of the OU III groundwater treatment systems is as follows:

- Carbon Tetrachloride: Approved for shutdown in 2004. Approved for closure in 2009-2010.
- Industrial Park East: Approved for shutdown in 2009. Approved for closure in 2013. Infrastructure repurposed in 2014 to support deeper Industrial Park extraction wells.
- North Street: Approved for shutdown in 2013; however, it was restarted in 2014 due to rebound of VOCs. Approved for closure in 2020.
- HFBR Tritium Pump and Recharge: Approved for shutdown in 2013. Approved for closure in 2019.
- Industrial Park: Approved for shutdown in 2013, however, it was restarted in 2014 due to rebound of VOCs. Shut down again in 2017. Two additional extraction wells became operational in 2015 to address deep VOCs and were placed in standby mode in 2019. Approved for closure in 2019.
- North Street East: The original VOC treatment system was approved for shutdown in 2014.
- North Street East EDB: Two additional extraction wells were installed at the North Street East system and became operational in 2020 to address a newly identified EDB plume. The system is now referred to as the North Street East EDB treatment system. The system was approved for shutdown in January 2026.
- Building 452 Freon-11: Approved for shutdown in 2016. Approved for closure in 2019.
- Chemical Holes Sr-90: Approved for shutdown in 2018.
- LIPA: LIPA portion of the LIPA/Airport treatment system was approved for closure in 2024.

Operable Unit IV: In accordance with the March 1996 OU IV ROD (BNL, 1996a), a groundwater treatment system was installed in 1997 to remediate VOC and SVOC soil and groundwater contamination at a former oil/solvent spill area. A CERCLA Five-Year Review performed for OU IV in 2003 found that the remedy was highly effective in remediating soil and groundwater contamination (BNL, 2003a). The system met its cleanup objectives and the regulatory agencies approved its decommissioning in 2003.

Operable Unit V: Following issuance of the OU V STP ROD (BNL, 2001b), the contaminated soil at the plant was excavated and disposed of offsite in 2003. A completion report for this effort was issued in 2004 (BNL, 2004b). Following the 2012 regulatory approval of a *Final Petition to Discontinue Operable Unit V Groundwater Monitoring* (BNL, 2012c), natural attenuation monitoring of the low-level VOC groundwater plume that originated from the STP area was completed in 2014.

Prior to issuance of the OU V Peconic River ROD (BNL, 2004a), on- and off-site contaminated sediments were excavated from the river (approximately 21,000 cubic yards) during 2004 and 2005 under the authority of the *Peconic River Removal Action for Sediment on BNL Property* (BNL, 2004c). The closeout report for the Peconic River Phases 1 and 2 was issued in 2005 (Envirocon, 2005c). Based on Peconic River monitoring data (for approximately 1,700 sediment, surface water, and fish samples collected between 2006 and 2011 [(BNL, 2007b; BNL, 2008; BNL, 2009c; BNL, 2010c; BNL, 2011c; BNL, 2012d)), DOE and the regulatory agencies determined that supplemental sediment removal in the river was necessary. In late 2010 through early 2011, an additional 800 cubic yards of contaminated sediment were excavated. The final completion report was issued in 2012 (Terra, 2012). Based on Peconic River annual sediment monitoring data collected between 2011 and 2015 at the three supplemental remediation areas, a small segment of the river was

identified as requiring additional sediment remediation (BNL, 2013b). In 2016, DOE submitted a plan to the regulators for supplemental sediment removal at on-site Area WC-06 (BNL, 2016b). Supplemental sediment removal of 108 cubic yards was performed in 2017 in Area WC-06. The final completion report was issued in December 2017 (Land, 2017). Vegetation monitoring of on-site area WC-06 was completed in 2022.

Operable Unit VI: In 2004, a groundwater treatment system was installed in accordance with the OU VI ROD and began operations to remediate the plume of EDB located beyond the site boundary. In 2024, two new extraction wells were installed to address deeper EDB contamination in the Upper Glacial aquifer. Per the OU III and VI RODs (BNL, 2000a; BNL, 2000b), DOE continues to offer homeowners not connected to public water free annual testing of their private wells.

Operable Unit VIII g-2/BLIP/USTs: BNL routinely inspects and maintains the caps and other stormwater controls at the g-2 and BLIP source areas. Routine groundwater monitoring at the source areas is conducted to verify the effectiveness of the stormwater controls. Following the detection of tritium in groundwater south of Brookhaven Avenue above the 20,000 pCi/L ROD contingency trigger level, BNL initiated additional monitoring in this area (BNL, 2007a). During 2015, the tritium levels were found to have attenuated to below the 20,000 pCi/L MCL in the downgradient portion of the plume. Monitoring of the downgradient plume segment was subsequently discontinued. Monitoring is currently limited to areas directly downgradient of the g-2 and BLIP source areas. The former USTs were removed from the ground between 1988 and 1996 and confirmatory sampling was performed under the requirements of Suffolk County Sanitary Code Article 12. Therefore, the closure work already completed is the final action. No additional remedial actions are required for the former UST areas.

Operable Unit IX HFBR: Prior to the ROD approval in 2009, all of the cleanup actions at the HFBR were performed through removal actions or National Environmental Policy Act (NEPA) categorically excluded actions (BNL, 2009a). Since ROD approval, stabilization of the reactor confinement building for safe storage and the cleanup actions at the HFBR, such as the removal of Buildings 801-811 waste transfer lines (A/B waste lines with co-located piping) and associated soil, were performed as remedial actions under the ROD. Other remedial actions associated with the removal of ancillary structures were also performed and closeout reports issued: Fan houses, confinement building stabilization, underground utilities, soil and stack silencer baffles (BNL, 2011d; BNL, 2011e; BNL, 2011f; BNL, 2012g). Surveillance and maintenance of the HFBR is performed in accordance with the *Long-Term Surveillance and Maintenance Manual for the High Flux Beam Reactor* (BNL, 2023e).

The WLA was part of the former HWMF, AOC 1. It is an area (of about two acres in size) along the eastern boundary of the former HWMF that was left in place so that it could be used as a waste staging and railcar loading area for the BGRR, HFBR and other decommissioning projects. The WLA was transferred to the HFBR scope of work in September 2005 through a modification to the *Remedial Design Implementation Plan* for the former HWMF. In February 2009, AOC 31, comprising the HFBR complex and the WLA, was established. The cleanup of the WLA was performed as a non-time-critical removal action (BNL, 2007c). The cleanup of this area used the same cleanup goals and methodology required for AOC 1 in the OU I ROD. Soil remediation was performed from November 2007 to May 2008, and the cleanup goals for both chemicals and radionuclides were achieved. This work is summarized in the document *High Flux Beam Reactor, Area of Concern 31, Final Completion Report for Waste Loading Area Soil Remediation* (BNL, 2009d). The WLA continues to be used for loading waste into rail cars.

Physical demolition of the stack was completed in February 2021 and structures/soil remediation was completed in May 2021. The *Site Closeout Report for the High Flux Beam Reactor Stack (Building 705) Decommissioning and Demolition* (BNL, 2022c) was submitted to the regulators in March 2022. The reactor vessel is planned for removal in 2072.

Operable Unit X: A final remedy for OU X has not yet been established. The two groundwater treatment systems, Current Firehouse/Building 170 and Former Firehouse, went into operation in October 2022 and

January 2023, respectively, as a TCRA to address PFAS-contaminated groundwater (BNL, 2021b). A ROD will be developed upon completion of the RI/FS.

Operable Unit XI BGRR: All of the cleanup actions performed at the BGRR prior to the ROD approval in 2005 were conducted through removal actions or NEPA categorically excluded actions. Since ROD approval, the cleanup actions at the BGRR (e.g., removal of the graphite pile) were performed as remedial actions under the ROD (BNL, 2005a). Remedial activities associated with the Graphite Pile Removal Project commenced in December 2009 and were completed in May 2010. The scope of these activities included removal and disposal of control rods, removal and disposal of boron shot, removal and disposal of shield plugs, removal and disposal of the upper portion of the air-tight membrane, removal and disposal of Invar rods, and removal and disposal of the Graphite Pile. Installation of the final engineered cap adjacent to Building 701 was completed in 2011 and a final closeout report issued (BNL, 2011g). In 2012, the biological shield was removed in accordance with the ESD (BNL, 2012a) and a final closeout report issued (BNL, 2012e).

Groundwater Monitoring: An essential component of the groundwater remediation program is continued monitoring of the groundwater to ensure the cleanup is progressing as planned and that source controls continue to be effective. An average of 1,250 groundwater sampling events were performed annually between 2021 and 2025. The effectiveness of the groundwater remediation systems' performance is evaluated monthly, quarterly, and annually. Comprehensive summaries of the annual monitoring and evaluations of the systems and plumes are documented in quarterly progress reports and in the annual *BNL Groundwater Status Reports* (Volume II of the *BNL Site Environmental Report*). Recommendations are made on an annual basis for modifications to groundwater monitoring programs and treatment system operations in response to changing plume conditions. These recommendations are developed with regulatory agency input. The treatment systems and monitoring programs are optimized with the goal of meeting drinking water standards within 70 years (2070) for the BGRR/WCF Sr-90 plume, within 65 years (2065) for the Magothy aquifer, within 40 years (2040) for the Chemical Holes Sr-90 plume, and within 30 years (2030) for VOCs in the Upper Glacial aquifer.

Property Access: A total of seven agreements are currently in place with Brookhaven Town, the local electric utility, and private landowners. These agreements enable BSA to perform groundwater remediation activities for contamination that has migrated beyond the property boundary of BNL. The terms of these agreements must be adhered to, such as maintaining adequate liability insurance, and in some cases, making annual monetary payments. A summary of the status of the current agreements is provided below:

- The agreement to access portions of the Industrial Park immediately south of BNL property was renewed in 2023. This agreement requires recording with the Suffolk County Clerk's Office. BNL is currently confirming if this agreement has been properly recorded with the County.
- The agreement with the local electric utility to access the Long Island Power Authority (LIPA) right-of-way expired in 2018. BNL still has permission to access to the right-of-way through LIPA and their operator and maintains the insurances coverage prescribed in the 2018 agreement. The agreement is currently being renegotiated between the parties.
- The former Dowling property which provides access to the Airport treatment system and has several monitoring wells located on it was sold to new ownership in 2025. The lot was subsequently subdivided, and a portion was transferred to the Town of Brookhaven. BNL is in contact with the new ownership and maintains access through the property and to the monitoring wells. BNL also continues to maintain the necessary insurance coverage. BNL is currently working to establish a new agreement with the new ownership entity which will require recording with the Suffolk County Clerk.
- BNL is working to amend the Town of Brookhaven agreement to include the newly deeded parcel from the former Dowling property. The Town of Brookhaven agreement requires recording with the Suffolk County Clerk.

- One agreement with a private entity requires recording with the Suffolk County Clerk. BNL is working to have this agreement properly recorded.
- The remaining two agreements are with private entities and are properly recorded with the Suffolk County Clerk.

4.3 System Operations/Operation and Maintenance

To date, 20 groundwater treatment systems have been constructed. The first system became operational in January 1997, and the last system was placed in service in January 2023 for the treatment of PFAS. The location of each of the treatment systems, the systems' operational status, and the operational status of each of the extraction wells is shown on **Figure 4-1** (note that Brookhaven Airport and LIPA are one treatment system, and North Street East and North Street East EDB are considered two separate treatment systems). The Industrial Park East, OU IV AOC 5, and Carbon Tetrachloride systems met their cleanup goals and were decommissioned, and the OU I South Boundary, North Street, HFBR Tritium Pump and Recharge, Building 452 Freon-11, Industrial Park and LIPA systems were approved for closure. The original North Street East system was approved for shutdown in 2014. The North Street East system was modified in 2020 through installation of two extraction wells to target a previously unidentified EDB plume, and is referred to as the North Street East EDB treatment system. A petition for shutdown of the North Street East EDB treatment system was approved by the regulators in January 2026. A petition for closure of the Industrial Park treatment system was approved by the regulators in 2025. The Chemical Holes Sr-90 system is currently in standby mode. The remaining nine systems (BGRR WCF Sr-90, Building 96, Middle Road, Western South Boundary, OU III South Boundary, OU VI EDB, Brookhaven Airport, Current Firehouse and Former Firehouse) are in active operation. New extraction wells were installed in 2023 and 2024 to address EDB contamination that was detected in the deep portion of the Upper Glacial aquifer at OU VI. These wells became operational in January 2024. As part of a TCRA, two groundwater treatment systems went into operation during 2022/2023 for the high concentration PFOS/PFOA plume segments associated with the Current Firehouse, Building 170, and Former Firehouse PFAS source areas. The requirements for ongoing operation and maintenance (O&M), as well as performance monitoring frequencies of these systems, are identified in the O&M manuals. The O&M manuals are updated as needed to reflect changes to the treatment systems, such as the installation of additional extraction wells. BNL performs routine inspections and maintenance of these systems.

Groundwater has been extracted from the Upper Glacial and Magothy aquifers using 85 wells. As of December 2025, 31 of these wells were in operation, 38 of these wells were in standby mode and 16 were shut down and approved for closure. Five of the wells in operation were in pulsed pumping mode in 2025. Of the systems approved for closure, none of the extraction wells will be decommissioned (i.e., abandoned by sanding and grouting the well in place) until characterization for 1,4-dioxane and PFAS is complete and an assessment made of the potential future need for these wells. Average individual extraction well flow rates range from approximately 5 gallons per minute (gpm) for the Sr-90 systems to up to 200 gpm for some of the VOC systems. Groundwater treatment systems used to remediate VOCs use either air stripping methods or granular activated carbon (GAC) filters. Ion exchange filters are used to treat Sr-90 contaminated groundwater. Granular activated carbon filters are also used to treat PFAS contaminated groundwater. To monitor system performance, the influent, midpoint (if appropriate), and effluent are routinely sampled. Treated water from the systems is returned to the Upper Glacial aquifer via recharge basins, injection wells, or dry wells. These discharges are regulated by New York State Pollutant Discharge Elimination System (SPDES) discharge equivalency permits, and the data are reported monthly.

Table 4-1: Groundwater Treatment System O&M Costs for FY 2021 to 2025

System	(\$ in K)					Comments
	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	
OU I South Boundary	12	24	16	20	21	Air stripping. Closed since 2019.
OU III South Boundary/Middle Road/Western South Boundary	219	262	436	225	141	Air stripping. South Boundary, Middle Road, and Western South Boundary being co-treated at same air-stripping system since 2019. As of 2025, one extraction well operating full-time at South Boundary, two at Middle Road, and four in pulsed pumping mode at Western South Boundary.
OU III Industrial Park	174	339	269	265	318	In-well air stripping with vapor phase carbon treatment. The system was approved for closure with continued groundwater monitoring in 2025.
OU III Building 96	35	32	25	184	115	Air stripping. Source area in-situ chemical treatment completed in 2024. One extraction well is operating in pulsed pumping mode.
OU III North Street	2	3	4	--	--	Liquid phase carbon treatment. System approved for shutdown in 2020. Does not include property access costs.
OU III North Street East EDB	92	100	69	54	118	Liquid phase carbon treatment. The system was approved for shutdown in 2026. Does not include property access costs.
OU III Airport/LIPA	163	246	112	132	231	Liquid phase carbon treatment. The LIPA portion of the system was approved for closure in 2024. Three of the Airport extraction wells are operating full-time. Does not include property access costs.
OU III HFBR Tritium	1	1	--	--	--	Pump and recharge. The System was approved for closure in 2019.
OU III Sr-90 Chemical Holes	23	28	27	22	24	Ion-exchange treatment. The system was placed in standby mode in 2018.
OU III Sr-90 BGRR/WCF	123	106	123	123	137	Ion-exchange treatment. As of 2025, one extraction well is operating full time.
OU VI EDB	314	182	256	360	77	Liquid phase carbon treatment. Two new deep extraction wells were installed and became operational in 2024. The two shallow wells were subsequently placed in standby. Does not include property access costs.
OU X Current Firehouse/Building 170	--	427	228	402	311	Liquid phase carbon treatment. The system became operational in 2022. As of 2026, six

System	(\$ in K)					Comments
	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	
						of the nine extraction wells are operating full time.
OU X Former Firehouse	--	--	93	214	158	Liquid phase carbon treatment. The system became operation in 2023 with three extraction wells operating full time.

The largest components of the annual O&M cost for the treatment systems are electric, system sampling and analysis, maintenance, spent carbon or ion exchange resin disposal, and property access payments (if applicable). The costs above do not reflect the property access costs. These are direct costs of operation and do not include monitoring well sampling and analysis, and project oversight/management.

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5.0 Progress Since the Last Review

This is the fifth sitewide Five-Year Review for the BNL site that covers all of the OUs. The protectiveness statement for each OU, the BGRR, the HFBR, and progress in accomplishing the cleanup goals since the last Five-Year Review (BNL, 2021a) are discussed below.

Operable Unit I: The remedy is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Soil Remediation:

In 2018, an area of surficial radiologically contaminated soil identified along the former WCF north fence line to the adjacent metal storage yard was excavated. This was the final phase of soil cleanup in this area, and no further soil remediation has taken place since the completion. This, along with previous cleanup actions in this area, is expected to further reduce Sr-90 contamination in the soil, thus helping to meet the groundwater cleanup objective.

Groundwater Remediation:

- Meeting the capture goal for the VOC plume was accomplished by operations of the OU I South Boundary treatment system. The off-site segment of the plume is being controlled by the North Street East system (discussed under OU III). The South Boundary treatment system, capping of the Current Landfill, remediation of the former HWMF, and natural attenuation have all contributed to a significant reduction in the overall extent and concentrations of the VOC plume, as shown on **Figure 5-1**. As a result, the regulators approved the Petition for Closure of the treatment system in 2019 (BNL, 2019a). Post-closure monitoring indicates that total VOC (TVOC) concentrations in groundwater have remained below the system capture goal of 50 µg/L since 2013. As a result, the ROD cleanup goals of meeting MCLs by 2030 are expected to be achieved.
- Since 2015, the annual installation of temporary wells has been used to track the movement of higher concentration Sr-90 plume segments downgradient of the former HWMF. During 2019-2020, three new monitoring wells were installed for improved monitoring of the high concentration plume segments and three additional wells were installed near the leading edge of the plume. A total of 25 permanent monitoring wells were used in 2025 to monitor the Sr-90 contamination emanating from the former HWMF. Groundwater monitored natural attenuation simulations were updated in 2021. The simulation evaluated Sr-90 concentrations of 1,000 pCi/L and 750 pCi/L which predicted that Sr-90 at estimated concentrations slightly above the MCL could reach the site boundary by 2080. The concentrations observed over the last five-year period are significantly lower than the conservative concentrations used in the model, indicating that Sr-90 should continue to attenuate to below the MCL before reaching the southern site boundary. Continued monitoring of the plume will be used to evaluate the Sr-90 groundwater plume extent and the potential for off-site migration. The results are further summarized in **Section 7.1**.
- The groundwater quality downgradient of the capped landfills continues to improve. Volatile organic compounds were not detected above MCLs at the Former Landfill from 1998 to 2021. Based on the data collected over the last two decades, it was recommended that groundwater monitoring be discontinued at the Former Landfill in the *2020 Environmental Monitoring Report, Current and Former Landfill Areas* (BNL, 2021c). The report was accepted by the regulators, and the changes were implemented in 2021. Volatile organic compounds continue to be periodically detected at levels slightly above MCLs at the Current Landfill. Although low level VOCs continue to be detected, the cap has been effective at improving the groundwater quality downgradient of the Current Landfill, and VOCs are expected to attenuate to below MCLs over time. In 2023, PFAS and 1,4-dioxane were added to the analytical list for Current Landfill monitoring wells. The results of the 2025 samples showed PFOS, PFOA, and 1,4-dioxane in groundwater above the New York State Ambient Water Quality Guidance Values (AWQGVs) in program monitoring wells. The presence of PFAS and 1,4-

dioxane at the Current Landfill will continue to be evaluated through the OU X RI/FS.

Operable Unit III: The remedy is expected to be protective of human health and the environment upon meeting groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The extent of the high-concentration segments of the OU III VOC plumes have decreased both on and off site as the result of groundwater remediation system operations and the effects of natural attenuation (see **Figure 5-1**).
- Changes to the treatment systems' status since 2021 are as follows:
 - The Industrial Park system recirculation wells were placed in standby mode in 2017. The two additional extraction wells that became operational in 2015 to address deeper VOC contamination were placed in standby mode in 2019 due to low VOC concentrations. The system has remained shutdown, in standby mode since 2019. A petition for closure for this system was approved by the regulators in 2025 (BNL, 2025a).
 - The North Street East VOC system was approved for shutdown in 2014 (BNL, 2014a). Although the original North Street East VOC system met its cleanup goal, the system was modified to add two extraction wells, which were installed during 2020, to address an EDB plume that was identified in this area. The new extraction wells became operational in mid-2020 as part of the North Street East EDB treatment system. The extraction wells were placed in pulsed pumping mode in May 2024 due to low concentrations of EDB observed. A petition for shutdown of the North Street East EDB treatment system approved by the regulators in January 2026 (BNL, 2025f).
 - The LIPA portion of the LIPA/Airport treatment system was approved for closure in 2024 (BNL, 2024a). The Airport portion of the system continues to operate full time.
 - The OU III South Boundary, Middle Road, and Airport treatment systems are continuing to treat elevated concentrations of VOCs. However, the concentrations are not declining at a rate that will definitively meet the 2030 cleanup goal in the Upper Glacial aquifer. This is further discussed in **Section 7.3**.
- **Figure 4-1** provides the operational status of each of the treatment systems including extraction wells that were shut down and placed in standby mode, and wells that are in pulsed pumping mode.
- In June 2019, to increase the capture zone of Building 96 extraction well RTW-1, the flow was increased to 60 gpm. The water was being treated at the nearby Building 452 Freon-11 treatment system due to the larger capacity of that air stripping system, and reported under the Building 452 Freon-11 system's SPDES Equivalency Permit. Effective March of 2022 the discharge from RTW-1 is being reported under the revised SDPES Equivalency permit for the Building 96 treatment system. Extraction well RTW-1 operated full time until May 2022 when it began pulsed pumping one month on, one month off. This schedule continued until May 2024 when it was placed in standby mode to facilitate chemical treatment injections as part of the Building 96 Source Area Optimization work. This work was completed in 2024 with the objective to reduce the mobility of PCE and enhance its degradation. The work included an in-situ chemical injection program consisting of liquid carbon and zero-valent iron, and is summarized in the *Building 96 Source Area Optimization Report* (P.W.Grosser, 2024). Extraction well RTW-1 was returned to pulsed pumping mode in March 2025, after the injection work was completed. Post-injection monitoring of the well network and the treatment system indicates the injection work was successful. However, additional monitoring is needed to reassess the cleanup timeframe.
- Although the BGRR building and engineered impermeable cap are effectively preventing stormwater infiltration through the contaminated soils, elevated concentrations of Sr-90 are still periodically

detected in the BGRR source area monitoring wells. Strontium-90 contamination below the facility structures in the vadose zone is periodically mobilized to the aquifer when the water table rises, intersecting contaminated soil in the unsaturated zone. This water table flushing process has been observed with periodic increases in tritium concentrations at several other BNL source areas (at the HFBR and at the former g-2 experiment). Due to a rise in the water table in 2024, Sr-90 concentrations in one well immediately downgradient of the BGRR increased significantly above the MCL. As a result, SR-3 was restarted in October 2024. The downgradient migration of the Sr-90 plume is controlled by extraction well SR-3. Water table elevations decreased in 2025, and subsequently the Sr-90 concentrations in downgradient monitoring wells decreased to below the MCL. Extraction well SR-3 was returned to standby mode in March 2025. Monitoring will continue in this area until the inventory of Sr-90 in the unsaturated zone beneath Building 701 and the below ground ducts has been depleted and flushing of Sr-90 (due to water table elevation increases) no longer results in significant concentrations in groundwater.

- The 2015-2016 demolition of the former WCF and removal of nearby impermeable surfaces may have allowed for the leaching of residual Sr-90 from the underlying soils to the groundwater. Concentrations of Sr-90 in the source area have varied from 2023 to 2025 ranging from 13 pCi/L to 54 pCi/L. It is expected that these concentrations will attenuate over time, and the downgradient migration of Sr-90 from the source area will be controlled by extraction well SR-1 and SR-2.
- The Chemical Holes system has effectively remediated Sr-90 contaminated groundwater downgradient of this former waste disposal area. Following regulatory approval of the Petition for Shutdown (BNL, 2018a), the system was placed in standby mode in July 2018. There has been no observed rebound in contaminant concentrations since the system was shut down.
- The HFBR tritium plume has continued to significantly attenuate over the last five years. The groundwater monitoring program has been reduced over time to sampling from 10 wells located immediately downgradient of the HFBR twice per year. The areas further downgradient of the HFBR are no longer monitored because tritium concentrations in these areas have declined to below the 20,000 pCi/L MCL. Tritium exceeding the MCL is observed intermittently in individual wells immediately downgradient of the HFBR. The maximum tritium concentration detected over the last six years was 35,900 pCi/L in late 2019. The HFBR Tritium Pump and Recharge System was approved for closure in 2019.
- At the Middle Road and South Boundary systems, three additional monitoring wells were installed in 2023 to monitor a high-concentration portion of the VOC plume in the deep Upper Glacial aquifer, as recommended in the *2022 Groundwater Status Report* (BNL, 2023a). Concentrations of VOCs in this area, and at this depth, are not declining at a rate that will definitively meet the ROD cleanup goal of MCLs by 2030. Per the 2021 CERCLA Five-Year Review Report (BNL, 2021a) recommendations, groundwater modeling simulations were performed in 2025 to evaluate the performance of the existing Middle Road/South Boundary treatment systems and make recommendations for the enhancements of the treatment system to expedite aquifer cleanup efforts. The report recommended installation of three additional extraction wells to expedite the cleanup timeframe. Further technical evaluation and development of preliminary designs and cost estimates is planned for 2026, as described in **Section 7.3**.

Operable Unit IV: The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- Post-closure groundwater monitoring was completed in 2011 for the OU IV air sparging/soil vapor extraction (AS/SVE) system.
- Monitoring continues for a plume of Sr-90 which originated from the Building 650 Sump Outfall and

is entirely located within the central portion of the site. Temporary wells installed in 2019 confirmed a shift in the position of the plume to the southeast. The shift was likely due to reductions in the amount of water discharged to recharge basins HO and RA V, thereby lessening the hydraulic impact of those basins on flow directions. A shift back to the southwest is probably due to the increased discharge to the RA V basin. Additional wells have been incorporated into the program to address the shift in groundwater flow direction.

Operable Unit V: The cleanup goals have been met for OU V, therefore the remedy currently protects human health and the environment. The Completion Report for the 2017 Peconic River supplemental remediation was approved by the regulators in April 2018 (Land, 2017). The OU V cleanup areas are depicted on **Figure 5-2**.

Vegetation monitoring of remediated area PR-WC-06 was completed in accordance with the State wetland equivalency permit requirements, and was discontinued in 2022 when the federal monitoring duration requirements were met.

- Groundwater monitoring requirements under the ROD were met in 2014. Groundwater quality at the STP is currently monitored under the SPDES program.
- In accordance with the federal monitoring requirements, the vegetation monitoring of remediated area PR-WC-06 continued semi-annually through 2022. The inspections showed sufficient vegetation was established across the area. Monitoring of PR-WC-06 was discontinued in 2022. Semi-annual inspections of the Peconic are still performed through the LUIC program.
- In response to the *Peconic River Monitoring Report* (BNL, 2019e), it was requested by NYSDEC to continue fish monitoring. Fish sampling has been discontinued under CERCLA however, it was agreed to by DOE, BSA, and NYSDEC to continue sampling fish for mercury and PCBs in on-site portions of the Peconic River as part of the site environmental surveillance monitoring program, as conditions allow. Fish sampling would be limited to times, as determined by BNL and BHSO, when river conditions allow adequate size, number, and fish mobility to ensure results accurately represent risk levels to human health and the environment. Fish sampling results since 2021 have been documented in the annual Site Environmental Reports (BNL, 2022d; BNL, 2023a; BNL, 2024c; BNL, 2025c) and are summarized below. Survey and sampling areas A through D are shown on **Figure 5-2**.

- In 2021, a population assessment was conducted at the end of May and resulted in the capture of nine chain pickerel. The largest fish caught had a length of 80 mm, or a little over three inches. The average length of fish was 58 mm. Since there were no fish of significant size, no samples were taken.
- The fish population supported sampling in 2022. However, no individual fish were large enough to meet all of the analysis requirements requested of the analytical laboratory and were therefore sent with several fish making up composite whole-body samples. The laboratory misunderstood the analysis request and removed individual fish from samples for the various analysis requested. Not knowing which fish was associated with each analytical result required invalidating all results. Analysis for radionuclides supports calculation for a dose to biota and dose to the maximally exposed off site individual. Because all results had to be invalidated, there were no results for calculating dose to biota or dose to the maximally exposed off site individual in 2022. In 2022, a population assessment was conducted at the end of May and resulted in the capture of 37 pumpkinseed sunfish. The largest fish caught had a length of 140 millimeters, or a little over five and half inches.
- In 2023, a population assessment was conducted at the end of May and resulted in the capture of nine pumpkinseed sunfish. The largest fish caught had a length of 101 mm, or a little over four inches. The fish population supported sampling in 2023. However, no individual fish

were large enough to meet all of the analysis requirements requested of the analytical laboratory and were therefore sent with several fish making up composite whole-body samples. Two samples were sent for analysis and analyzed for Cs-137, polychlorinated biphenyls (PCBs), and mercury. Both samples were below detection limits for Cs-137 and mercury, and had detections for the PCBs Aroclor-1254 (14.6 and 28 µg/kg) and Aroclor 1260 in one sample with estimated value of 11.2 µg/kg. Both Aroclor-1254 and 1260 were historically used at BNL and known to be present at low levels within Peconic River sediments.

- In 2024, a population assessment was conducted in early June and resulted in no captures of any fish.
- In 2025, insufficient water levels did not allow for a population assessment to be conducted.

Operable Unit VI: The remedy is expected to be protective of human health and the environment upon attainment of the groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The EDB treatment system continues to effectively remediate the EDB contaminated groundwater, and reduce plume size and further migration (see **Figure 6-15**). Groundwater characterization and geologic data obtained in 2020 and 2021 identified that the plume is deeper in the Upper Glacial aquifer than originally observed. In December 2023, the system was modified with two new extraction wells installed at greater depths than the two existing extraction wells to capture the deeper portions of the EDB plume observed. The new extraction wells became operational in January 2024, and based on monitoring data, the wells are effectively capturing the remaining EDB plume in the deep Upper Glacial aquifer.

Operable Unit VIII g-2/BLIP/USTs: The remedy is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- Groundwater monitoring has demonstrated that tritium levels in the areas downgradient of the Alternating Gradient Synchrotron (AGS) facility have attenuated to below the MCL of 20,000 pCi/L. Although the engineered cap over the source area is being maintained and is effectively preventing stormwater infiltration to the activated soil shielding, periodic tritium concentrations immediately downgradient of the source area continue to slightly exceed the standard. The periodic increases in tritium concentrations appear to be correlated to seasonal rises in the water table, which can release residual tritium from the deep vadose zone soils.

Operable Unit IX HFBR: The HFBR ROD was finalized in April 2009 (BNL, 2009a). The final remedy incorporates many completed interim actions, several near-term actions, and the long-term segmentation, removal, and disposal of the remaining HFBR structures, systems, and components, including the reactor vessel. The near-term actions included dismantling the remaining ancillary buildings, removing contaminated underground utilities, and preparing the reactor confinement building for safe storage. The ROD required that these near-term actions be completed no later than 2020. Activities completed for the HFBR stack include:

- An Updated Remedial Design/Remedial Action Work Plan was submitted to the regulators in October 2019.
- The U.S. Army Corps of Engineers (USACE) awarded the stack demolition contract in February 2020.
- Following NYSDEC and EPA review of the draft Quality Assurance Project Plan, Field Sampling Plan, Demolition Plan, and Community Air Monitoring Plan for the stack demolition, final plans were submitted to the regulators in August 2020.
- The demolition contractor collected premobilization characterization samples in June 2020.

- The demolition contractor mobilized to the site in August 2020 to begin the exterior coating abatement. The abatement was completed in early November 2020.
- Mobilization of the demolition equipment to the site was performed late November, and the contractor initiated demolition in early December 2020.
- DOE submitted a milestone extension request to EPA in August 2020 to extend the administrative closeout until July 2021 due to contractor mobilization delays associated with COVID-19.
- Physical demolition of the stack was completed in February 2021, followed by soil and structure removal in May/June 2021. A final status survey by the contractor and verification by ORISE was performed in mid-2021.
- Following completion of waste disposal, the Closeout Report was submitted to the regulators and is dated March 2022 (Olgoonik FPM, 2022).

Long-term surveillance and maintenance activities are conducted to ensure effectiveness of the remedy. The activities included routine environmental health and safety monitoring, secure access via locked doors, periodic structural inspections of Building 750, water intrusion monitoring, preventive maintenance of Building 750 and the infiltration management system, and groundwater monitoring. Over the last five years, repairs were made: to the east exterior periphery wall to prevent water intrusion into the building; to the roof over the machine shop; and to the cracks and holes above the generator room door to prevent water, and wildlife intrusion; several minor repairs to insulation on piping in the confinement dome were made; and several small areas of asbestos cleaned up. Minor water intrusion into the generator room has been an ongoing issue. An update to the long-term Surveillance and Maintenance Manual for the HFBR was issued in September 2023 (BNL, 2023e).

The WLA was used for the stack demolition waste rail car loading.

The ROD also lays out a plan for the long-term segmentation, removal, and disposal of the remaining HFBR structures, systems, and components (including the reactor vessel and thermal and biological shields). These long-term actions will be conducted following a safe storage period (not to exceed 65 years) to allow for the natural reduction of high radiation levels to a point where conventional demolition techniques can be used to dismantle these reactor components. Land-use and institutional controls and groundwater monitoring in accordance with the Operable Unit III ROD are also part of the final remedy. The completed remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Operable Unit X: Operable Unit X was recommended by DOE in February 2021 to document the two new AOCs (33 and 34) for PFAS and 1,4-dioxane, respectively. No ROD has been signed. The TCRA Memo was approved and implemented in 2021 (BNL, 2021b). The TCRA consists of two groundwater treatment systems to remove PFAS in groundwater from the highest concentration areas of each of the two identified plumes. In 2023, a draft OU X RI/FS was prepared for regulatory agency review. The draft RI/FS was revised and resubmitted in March 2024. In December 2024, a *Groundwater Treatment Systems Discharge Compliance Plan* (BNL, 2024b) was approved by the regulators to implement a monitoring program of the treatment systems discharge which have detected concentrations of PFAS or 1,4-dioxane. The draft OU X RI/FS and the implementation of components of the *Groundwater Treatment Systems Discharge Compliance Plan* have been deferred until funding becomes available.

Operable Unit XI BGRR: The BGRR ROD was finalized in March 2005 (BNL, 2005a). The removal and disposal of the Graphite Pile was completed in 2010. The remaining work required under the ROD, including installation of an engineered cap and removal of the biological shield, were completed in 2011 and 2012, respectively (BNL, 2011g). Land-use and institutional controls were implemented, and groundwater monitoring is underway in accordance with the Operable Unit III ROD, and as part of the final remedy. The remedy is protective of human health and the environment, and exposure pathways that could result in

unacceptable risks are being controlled. Long-term surveillance and maintenance activities are conducted to ensure effectiveness of the remedy. The activities included periodic structural inspections of Building 701, water intrusion monitoring, preventive maintenance of Building 701 and the infiltration management system, groundwater monitoring, annual inspections of the below-ground ducts, and periodic maintenance and repairs as identified during the inspections. Recent maintenance actions performed since 2021 include: improvements to roof access, sealing of precipitation infiltration areas, and minor repairs to the cap. An update to the Long-Term Surveillance and Maintenance Manual for the BGRR was issued in September 2023 (BNL, 2023b).

Table 5-1 shows the status of the actions recommended in the 2021 Five-Year Review.

Table 5-1: Follow-Up Actions to the 2021 Five-Year Review Recommendations

Issue	Recommended Actions	Milestone Date	Current Status
Sr-90 in OU I Former HWMF Groundwater	Continue to track Sr-90 plume attenuation. Enhance monitoring network with temporary and/or permanent wells as necessary. Monitor plume attenuation progress with 2021 groundwater model predictions and report in annual Groundwater Status Report.	June 2026	A total of 25 permanent monitoring wells, supplemented by temporary wells, are used to monitor the Sr-90 contamination. Groundwater modeling results continue to suggest that Sr-90 will attenuate to near MCLs by the time the plume segments reach the site boundary, predicted in 2080. The continued groundwater monitoring of this plume will be used to evaluate the concentrations, and if needed, additional modeling will be performed to evaluate concentrations as they near the site boundary.
OU III Building 96 Source Removal Effectiveness	Monitor plume and source area. Evaluate and/or implement a liquid carbon in-situ treatment for the source area soils if groundwater concentrations do not decline to below the system capture goal.	October 2023	Chemical treatment injections were performed in 2024 to reduce the mobility of PCE and enhance its degradation. Post-injection monitoring of the well network and the treatment system indicates the injection work was successful.
OU III Middle Road and South Boundary VOC contamination	Conduct a pre-design characterization of VOCs in groundwater between monitoring well 104-37 and the site boundary by installing several temporary vertical profile wells. Install new extraction well(s) based on data and groundwater modeling.	October 2024	The OU III Middle Road and South Boundary VOC contamination were evaluated and addressed together. Since 2021, installation of vertical profile borings to further characterize groundwater and hydrogeologic conditions, performed down-hole nuclear magnetic resonance (NMR) imaging with the United States Geologic Survey and slug-testing to obtain improved hydraulic conductivity values for the Upton Unit, updated the groundwater model hydrogeologic framework with the new data, and performed modeling and simulations to determine whether modifications to the treatment systems would optimize the treatment of VOCs within the Upton Unit. Groundwater modeling was completed in 2025 which recommended two additional extraction wells at the Middle Road and one additional extraction well at South Boundary. The preparation of a design plan for the additional extraction wells was initiated in 2025.

Issue	Recommended Actions	Milestone Date	Current Status
OU VI EDB contamination	Update the groundwater model framework based on latest geologic and groundwater quality data. Modify the system to meet ROD cleanup goals and ensure capture of deeper EDB.	October 2024	The system was modified with two new extraction wells installed at greater depths than the two existing extraction wells to better capture the deeper portions of the EDB plume observed. The new extraction wells became operational in January 2024, and based on monitoring data, the wells are effectively capturing the remaining EDB plume in the deep Upper Glacial aquifer.
OU X PFAS	Begin operation of the TCRA groundwater treatment systems for current and former firehouses' PFAS plumes.	2022	The Time Critical Removal Action Memo was approved and implemented in 2021. The TCRA consists of two groundwater treatment systems to remove PFAS in groundwater from the highest concentration areas of each of the two identified plumes. Both systems became operational in 2022 and 2023. In 2023, a draft OU X RI/FS Work Plan was prepared for regulatory agency review. The draft RI/FS was revised and resubmitted in March 2024.
Continuing Sr-90 source at BGRR, WCF, and Building 801	Monitor plume and continued degradation of source areas. Perform intermittent pulsed pumping of extraction wells SR-1, SR-2, and SR-3. Evaluate during next Five-Year Review.	June 2026	Extraction well SR-3 was restarted in 2024 due to an increase in Sr-90 concentrations above MCLs observed in source area wells at the BGRR and returned to standby in 2025. Based on monitoring data, it is assumed there is some residual Sr-90 in source area soils at the BGRR. The source area for the WCF remains controlled by SR-1 and SR-2.
Peconic River Remedy Optimization	Complete federally-required vegetation monitoring at Area PR-WC-06	September 2022	Semiannual inspections performed through September 2022 showed significant vegetation established across the monitoring area.
HFBR	Issue final stack demolition closeout report	Fall 2021	Stack demolition complete; Closeout Report issued in 2021.
HFBR	Explore the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large activated components earlier.	Recurring – Every Five Years	The September 2025 review determined that based on the evaluation criteria specified in the ROD, and the match between the predicted and measured dose rates, there is no reason to alter the current remedial action plan. In addition, no new technologies have been identified to accelerate the removal timeframe.
OUs III & VI – Maintain terms of groundwater treatment system property access agreements	Record property access agreements with County Clerk, continue to manage existing access agreements.	Ongoing	A total of seven access agreements are required to maintain access to offsite properties. One agreement (LIPA) requires renewal but does not currently require recording with Suffolk County. A new agreement is required with the new ownership of the former Dowling property and recording with Suffolk County. The Town of Brookhaven agreement requires an amendment to include the parcel that was subdivided from the former Dowling property and to be recorded with the County. The new Industrial Park agreement (2023) may require recording with the Suffolk County Clerk. BNL is confirming.

Issue	Recommended Actions	Milestone Date	Current Status
			One agreement with a private entity requires recording with the Suffolk County Clerk. The remaining two agreements are current and are properly recorded with the County.
Building 650	Update Building 650 LUIC fact sheet based on as left conditions documented in final D&D closeout report.	Fall 2021	Complete D&D in 2021; as-left conditions recorded in LUIC fact sheet.

The issues from the 2021 Five-Year Review identified in **Table 5-1** (above) that could affect future protectiveness are currently in the process of being corrected by BNL. BNL is working with outside counsel to help determine the recording status of agreements with the Suffolk County Clerk and properly record the agreements that are not recorded, to renew the agreements with LIPA and the new ownership entity of the former Dowling property, and to amend the Town of Brookhaven agreement. BNL has and currently maintains contact with each of the entities and their representatives to maintain access and the necessary insurance while the agreements are being negotiated between the parties.

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6.0 Five-Year Review Process

6.1 Administrative Components

The activities scheduled for this Five-Year Review included regulator and community stakeholder notification, site inspections, interviews with stakeholders and regulatory officials, development of the Five-Year Review Report including review by DOE, EPA, NYSDEC, NYSDOH, and SCDHS, and a briefing on the results to the Community Advisory Council (CAC). The review was led by BSA's EPD Groundwater Protection Group. The Five-Year Review team consisted of:

- BSA staff – B. Barth, V. Racaniello, D. Paquette, J. Michaels, J. Remien, J. Milligan, and A. Engel
- DOE staff – K. Green and C. Polanish
- Regulatory staff – A. Morochó (EPA), A. Klein (NYSDEC), R. Minzloff (NYSDOH), and A. Rapijko (SCDHS)

The team included Hydrogeologists, Environmental Scientists, Engineers, and a Community Involvement Coordinator.

6.2 Community Notification and Involvement

A Communications Plan for the 2026 Five-Year Review was distributed to the project team in April 2025. The plan identified specific outreach activities to be conducted, such as initial notification, interviews, report updates, and report issuance/notification.

An initial notification announcement was published in the local newspaper, *Newsday*, on April 14, 2025. It informed the public of the start of the review, as well as the purpose, schedule for completion, and how to contact DOE for more information. A copy of the announcement is available at <https://www.bnl.gov/gpg/5year-review.php>.

The CAC was briefed on the start of the Five-Year Review on April 10, 2025. On June 23, 2025, an email was distributed to the CAC and regulators requesting them to participate in a survey to gather information that will be appended to the 2026 Five-Year Review.

A brief summary of the CAC members' input/responses to the following four questions from the June 2025 email survey is provided below.

1. *What is your overall impression of BNL's cleanup and do you feel well informed about the cleanup activities and progress?*

The responses were overwhelmingly positive with most respondents echoing BNL is strongly committed to environmental cleanup and remediation. Many noted the cleanup can feel slow, but they understood that timeliness is reasonable given the technical complexity. The respondents feel as though they have been fully informed and the progress and challenges were presented with transparency.

2. *Are there any specific aspects of the cleanup that you feel should be of focus during the review? (e.g., RODs, cleanup goals, community input, etc.)*

Several respondents noted community involvement and communication should remain a focus. There were multiple responses concerning the prioritization of the 1,4-dioxane and PFAS characterization efforts through the RI/FS. There were also two responses commenting on the focus of meeting ROD goals and the closeout of groundwater treatment systems.

3. *Do you feel confident in BNL and DOE's management of the long-term cleanup operations for the site?*

Overall feedback was positive that BNL and DOE have demonstrated a management commitment and have been openly candid regarding all aspects of the cleanup. Several are confident that BNL and DOE

management will commit to funding the site cleanup for the long term; however, they recognize the ongoing difficulty in doing so.

4. *Do you have any comments, suggestions, or recommendations regarding BNL/DOE's management and communications of the cleanup?*

Several responses discussed enhancing public outreach and communication, specifically with the broader community, schools, and civic organizations. Respondents encouraged continued transparency, frequent updates, and ongoing engagement with regulators and the CAC. The RI for PFAS and 1,4-dioxane was noted multiple times as a priority.

The survey is included as **Attachment 3**.

Following regulator review/concurrence and EPA concurrence on the final protectiveness determination, the community will be notified that the Five-Year Review was completed, and it will be made available to the public. A public notice will be issued in *Newsday* at that time. The notice will include a brief summary of the results, the protectiveness statements, post-ROD information, repository locations where the report is available for viewing, and the timeframe of the next Five-Year Review. The repositories are:

- BNL Research Library, Upton, NY
- EPA Region II Office, New York City, NY

The CAC will be briefed on any changes to the report's conclusions and recommendations as a result of regulatory review. The Report will also be added to the BNL website.

6.3 Document Review

The Five-Year Review consisted of a review of relevant documents including the following:

- Records of Decision for OUs I (BNL, 1999), III (BNL, 2000a), IV (BNL, 1996a), V (BNL, 2001b; BNL, 2004a), VI (BNL, 2000b), BGRR (BNL, 2005a), g-2/BLIP (BNL, 2007a), and HFBR (BNL, 2009a)
- OU III ESDs (BNL, 2005b; BNL, 2009b; BNL, 2012a; BNL, 2012b)
- Annual BNL Groundwater Status Reports e.g., (BNL, 2025b)
- Annual landfill reports (e.g., (BNL, 2025d))
- Peconic River Monitoring Reports (2006-2011) (BNL, 2007b; BNL, 2008; BNL, 2009c; BNL, 2010c; BNL, 2011c; BNL, 2012d)
- *Soil and Peconic River Surveillance and Maintenance Plan* (BNL, 2013b)
- Final Five-Year Review Reports (e.g., (BNL, 2021a))
- Closeout/Closure reports for soil or sediment (BNL, 1997; Envirocon, 2005c; BNL, 2005d; BNL, 2005e)
- *Final Closeout Report for the Meadow Marsh Operable Unit I Area of Concern 8* (BNL, 2004d)
- *Final Closeout Report for the Ash Pit Operable Unit I Area of Concern 2F* (BNL, 2004e)
- *Final Closeout Report for the Brookhaven Graphite Research Reactor, Graphite Pile Removal, Area of Concern 9* (BNL, 2010d)
- *Final Closeout Report for the Brookhaven Graphite Research Reactor, Final Canal and Deep Soil Pockets Excavation and Removal* (BNL, 2005f)
- *BNL High Flux Beam Reactor Characterization Summary Report, Rev 1* (BNL, 2007d)
- *Final Completion Report for the Former Hazardous Waste Management Facility Perimeter Area Soil Remediation* (BNL, 2010a)
- *Addendum to the Former Hazardous Waste Management Facility Perimeter Area Completion Report* (BNL, 2015a)
- *Brookhaven National Laboratory, High Flux Beam Reactor, Area of Concern 31, Final Completion Report for Waste Loading Area Soil Remediation* (BNL, 2009d)

- *Final Closeout Report for Removal of the Buildings 801-811 Waste Transfer Lines (A/B Waste Lines with Co-Located Piping), Area of Concern 31* (BNL, 2010e)
- *Central Steam Facility Storm Water Outfall Remediation Closeout Report* (BNL, 2007e)
- *Environmental Monitoring Plan, Annual Updates* (e.g., (BNL, 2025d))
- *O&M manuals for the groundwater treatment systems* (e.g., (JRH, 2025))
- *BNL Land Use Controls Management Plan* (BNL, 2022b)
- *Comprehensive Five-Year Review Guidance* (EPA, 2001)
- *Five-Year Review Recommended Template* (EPA, 2016)
- *Final Closeout Report for the Brookhaven Graphite Research Reactor Engineered Cap and Monitoring System Installation, Area of Concern 9* (BNL, 2011g)
- *Final Closeout Report for the Brookhaven Graphite Research Reactor Biological Shield Removal, Area of Concern 9* (BNL, 2012e)
- *Final Closeout Report for the High Flux Beam Reactor Underground Utilities Removal, Area of Concern 31* (BNL, 2011d)
- *Final Closeout Report for the High Flux Beam Reactor Stabilization, Area of Concern 31* (BNL, 2011e)
- *Final Closeout Report for the High Flux Beam Reactor Fan Houses (Building 704 and Building 802) Decontamination and Dismantlement (D&D), Area of Concern 31* (BNL, 2011f)
- *Final Closeout Report for the High Flux Beam Reactor Removal of the Stack Silencer Baffles and Final Status Survey for Remaining Outside Areas, Area of Concern 31* (BNL, 2012g)
- *Addendum to the Final Completion Report for the Former Hazardous Waste Management Facility Perimeter Area Soil Remediation* (BNL, 2015a)
- *Closeout Report for Waste Concentration Facility (BLDG 811 - Area of Concern 10) and Surrounding Area - October 2016, rev 1* (BNL, 2016c)
- *Completion Report Peconic River Supplemental Sediment Removal Area, PR-WC-06 Area – December 2017* (Land, 2017)
- *Addendum to the Closeout Report Waste Concentration Facility (Bldg. 811 – Area of Concern 10) and Surrounding Area, June 2019* (BNL, 2019c)
- *Updated Remedial Design/Remedial Action Work Plan for the Decontamination and Dismantlement (D&D) of Building 705 (the Stack) and Associated Structures and Utilities – October 2019* (BNL, 2019a)
- *Phase 4 Characterization Report Per- and Polyfluoroalkyl Substances (PFAS) and 1,4-Dioxane in On-Site and Off-Site Monitoring Wells, Extraction Wells and Treatment Systems – February 2021* (BNL, 2021d)
- *Time Critical Removal Action for Per- and Polyfluoroalkyl Substances (PFAS) in Groundwater Downgradient of the Current and Former Firehouse Facilities Plume Characterization Report – June 2021* (BNL, 2021e)
- *Design Report for PFAS Source Area Groundwater Treatment Systems Time Critical Removal Action – May 2021* (BNL, 2021f)
- *Assessment of OU VI EDB Capture and Cleanup Timeframe – May 2021* (Arcadis, 2021a)
- *OU VI EDB Capture Evaluation – September 2022* (Arcadis, 2022)
- *Closeout Report for High Flux Beam Reactor Stack (Bldg 705) Decommissioning and Demolition (D&D) – March 2022, Rev 2* (BNL, 2022c)
- *Closeout Report for Decontamination and Dismantlement of Building 650 (Former Reclamation & Hot Laundry Facility)* (P.W. Grosser, 2022)
- *Draft Operable Unit X Remedial Investigation/Feasibility Study Work Plan – March 2023*
- *OU VI EDB Transport Evaluation Memo – March 2023* (Arcadis, 2023)
- *Groundwater Treatment Systems Discharge Compliance Plan – December 2024* (BNL, 2024d)
- *Petition for Closure, OU III LIPA Groundwater Treatment System – October 2024, Rev 2* (BNL, 2024a)
- *OU VI EDB Aquifer Pumping Test Report – September 2024* (JRH, 2024)

- *Building 96 Source Area Optimization Report – April 2025*
- *Chemical Holes Sr-90 Plume Analysis – October 2025* (Arcadis, 2025a)
- *Petition for Closure, OU III Industrial Park Groundwater Treatment System – October 2025* (BNL, 2025a)
- *Middle Road/South Boundary Modeling – January 2025* (Arcadis, 2025b)
- *Petition for Shutdown, OU III North Street East EDB Groundwater Treatment System – November 2025* (BNL, 2025f)

As noted in **Section 4.1** above, the remedial action objectives for the projects are identified in the RODs and the OU III ESDs.

6.4 Data Review

This section provides a brief summary review of analytical data and trends for each OU over the last five years (2021 through 2025). Figures are provided which display historical trends for key groundwater monitoring wells over the last several years. A detailed discussion of the status of the groundwater plumes and the progress of the groundwater remediation systems are provided in the annual Groundwater Status Reports, the most recent being the *2024 BNL Groundwater Status Report* (BNL, 2025b) (<https://www.bnl.gov/gpg/gw-reports.php>). The Groundwater Status Reports are published on an annual basis and are a source of comprehensive information on the groundwater remediation systems and contaminant plumes.

Since the start of active groundwater remediation in 1997, through 2025, approximately 7,900 pounds of VOCs have been removed, and 33 billion gallons of treated groundwater have been returned to the aquifer. The Chemical Holes Sr-90 treatment system and the BGRR/WCF treatment system have removed approximately 35 millicuries (mCi) of Sr-90 while returning nearly 297 million gallons of treated groundwater to the aquifer. Additionally, the Current Firehouse and Former Firehouse treatment systems have removed approximately 1.5 pounds of PFAS from the aquifer since the start of their operations.

Figure 4-1 shows the location of the groundwater treatment systems. **Table 6-1** below provides a summary of the treatment system status through December 2025.

Table 6-1: Groundwater Treatment System Status

Project	Target	Status	Treatment Type	Expected System Shutdown	Highlights
OU I					
OU I South Boundary (RA V)	VOCs	Closed	P&T with AS	2013 (Actual)	Petition for closure approved September 2019.
Current Landfill	VOCs tritium PFAS	Long-Term Monitoring & Maintenance	Landfill capping	NA	Periodic VOC increases in monitoring well 088-10.
Former Landfill	VOCs Sr-90 tritium	Long-Term Monitoring & Maintenance	Landfill capping	NA	No longer a continuing source of contamination to groundwater. (Groundwater monitoring discontinued in 2021)
Former HWMF	Sr-90	Long-Term Monitoring & Maintenance	Monitoring	NA	A total of 25 permanent monitoring wells, supplemented by temporary wells, are used to monitor the Sr-90 contamination. Groundwater modeling results continue to suggest that Sr-90 will attenuate to just at or slightly above the MCL by the time the plume segments reach the site boundary in 2080.
OU III					

Project	Target	Status	Treatment Type	Expected System Shutdown	Highlights
Chemical/Animal Holes	Sr-90	Standby	P&T with IE	2018 (Actual)	Petition for shutdown approved and system shut down in July 2018. Continue to monitor decline in Sr-90 concentrations in groundwater in former source area.
Carbon Tetrachloride source control	VOCs (carbon tetrachloride)	Decommissioned	P&T with carbon	2004 (Actual)	Decommissioned in 2010.
Building 96 source control	VOCs	Operational	Recirculation wells with AS for 3 of 4 wells. RTW-1 is P&T with AS.	2027	In-situ ZVI and colloidal carbon injection completed July of 2024. Monitoring suggests the injections were effective.
South Boundary	VOCs	Operational	P&T with AS	2035+	Extraction well EW-17 is capturing and treating deep VOCs at site boundary. Plume migration towards EW-17 is slower than anticipated which could impact system shutdown timeframe. Design plans for additional extraction wells are being prepared. It is expected the system will need to operate beyond the 2030 ROD cleanup timeframe goal.
Middle Road	VOCs	Operational	P&T with AS	2035+	Extraction wells RW-2 and RW-7 are capturing and treating deep VOCs. Monitoring persistent elevated deep VOCs south of Princeton Avenue. Plume migration towards extraction wells slower than anticipated which could impact system shutdown timeframe. Design plans for additional extraction wells are being prepared. It is expected the system will need to operate beyond the 2030 ROD cleanup timeframe goal.
Western South Boundary	VOCs	Operational	P&T with AS	2026	Temporary wells installed in 2017-2018 to delineate the deep VOC plume. Four new extraction wells became operational in 2019 to capture the deep VOCs. The water is now treated at the South Boundary/Middle Road air strippers.
Industrial Park	VOCs	Closed	In-well stripping. P&T with carbon for deep wells	2019 (Actual)	UVB wells placed in standby mode in 2017. Extraction wells IP-EW-8 and IP-EW-9 placed in standby mode July 2019. Approved for closure November 2025.
Industrial Park East	VOCs	Decommissioned	P&T with carbon	2009 (Complete)	Decommissioned in 2014.
North Street	VOCs	Closed	P&T with carbon	2016 (Actual)	Petition for closure approved March 2020.
North Street East	VOCs	Shutdown	P&T with carbon	2014 (Actual for VOCs)	Original VOC system approved for shutdown in 2014.
North Street East EDB	EDB	Operational	P&T with carbon	2026 (Actual)	Temporary well characterization for EDB performed 2018. Two new extraction wells became operational in July 2020 to remediate EDB. Petition for shutdown approved in 2026.
LIPA/Airport	VOCs	Airport-Operational; LIPA-Closed	P&T and recirculation wells with carbon	LIPA- 2025 (Actual) Airport – 2035+	LIPA Petition for Closure approved in December 2024. Persistently elevated VOCs in upgradient monitoring wells along Crestwood Drive may impact Airport system shutdown. The Airport system is expected to operate past

Project	Target	Status	Treatment Type	Expected System Shutdown	Highlights
					2030 as low level VOCs in the western portion of the plume are migrating slower than originally predicted.
Building 452 Freon-11	VOCs	Closed	Air stripping	2017 (Actual)	Petition for Closure approved August 2019.
HFBR Tritium	Tritium	Closed	Pump and recharge	2013 (Actual)	Petition for closure approved March 2019.
BGRR/WCF	Sr-90	Operational	P&T with IE	2030	Supplementing the current monitoring with temporary wells. Increased concentrations of Sr-90 detected downgradient of BGRR, Bldg. 801 and WCF source areas, consistent with rise in water table.
OU IV					
OU IV AS/SVE system	VOCs	Decommissioned	AS/SVE	2003 (Complete)	Decommissioned in 2003.
Building 650 Sump Outfall	Sr-90	Long-Term Monitoring	MNA	NA	Plume continues to slowly attenuate. Temporary wells installed in 2019 verified a southeast shift in the plume.
OU V					
STP	VOCs, tritium	Long-Term Monitoring (Complete)	MNA	NA	Monitoring completed 2014.
OU VI					
EDB	EDB	Operational	P&T with carbon	2030	Additional lithology and groundwater data collected in 2020-2021 supported a model update to estimate the duration of system operations and modifications required to capture deeper EDB and meet cleanup goals. Two additional deeper extraction wells were installed in 2024. Monitoring data suggests the new wells are capturing the plume. This system is unlikely to meet the 2030 cleanup goal as the plume is migrating slower than originally predicted.
OU X					
Current Firehouse/ Building 170	PFAS	Operational	P&T with carbon	Unknown	System became operational in 2022. An eastward shift in the plume will be evaluated in 2026. The system operational goals will be determined as a result of the RI/FS and ROD.
Former Firehouse	PFAS	Operational	P&T with carbon	Unknown	System became operational in 2023. The system operational goals will be determined as a result of the RI/FS and ROD.

Notes:

AS = Air Stripping

EW = Extraction wells

IE = Ion Exchange

In-Well = The air stripper in these wells is located in the well vault.

LIPA = Long Island Power Authority

MNA = Monitored Natural Attenuation

NA = Not Applicable

P&T = Pump and Treat

Recirculation = Double screened well with discharge of treated water back to the same well in a shallow recharge screen
 SVE – Soil Vapor Extraction

6.4.1 Operable Unit I

Soils:

There was no additional soil data to review during this five-year period. From 2014 to 2016, the former WCF Buildings 810 and 811 were decommissioned and demolished, waste transfer lines were removed, and radiologically contaminated soil was excavated. The soil excavation activities were also a follow-up to the 2005 Waste Concentration Facility Closeout Report that identified two residual areas of radiological soil contamination that were left behind at that time due to the proximity of the soil to operating facilities Buildings 810 and 811. The Closeout Report stated that these two areas would be remediated when the operating facilities are decommissioned. A final status survey and dose assessment was performed in May 2016 to ensure that the residential land-use cleanup goals have been met (BNL, 2005g). Independent verification of the cleanup was performed in October 2016 by ORISE, and the excavated area was backfilled and seeded. The *Closeout Report Waste Concentration Facility (Bldg. 811 – Area of Concern 10) and Surrounding Area* was submitted to the regulators for review in October 2016, and subsequently approved (BNL, 2016c). During the 2015-2016 excavation of the former WCF, an area of radiologically contaminated soil was identified along the north fence line to the adjacent storage yard. This yard contained activated steel, lead and equipment that were stored for potential reuse by the Collider-Accelerator Facility complex. Excavation of this area was completed in July 2018 and final status survey confirmation soil samples confirmed that the cleanup goals were met. The excavated soil was disposed of as low-level radioactive waste in November 2018. An Addendum to the Closeout Report was issued as final to the regulators in June 2019 (BNL, 2019c). The BNL soil cleanup levels for principal radiological contaminants, based on the selected land use for each area, are provided below in **Table 6-2**.

Table 6-2: BNL OU I Soil Cleanup Levels

Radionuclide	Soil Cleanup Level (pCi/g)	
	Residential Land Use	Industrial Land Use
Cesium-137	23	67
Strontium-90	15	15
Radium-226	5	5

Note: A post-cleanup dose assessment is required to determine compliance with the 15 mRem/yr above background cleanup level with 50 years of institutional control.

Landfills: Monitoring at the Current Landfill continues to identify methane soil gas exceeding 100% of the lower explosive limit in several soil-gas monitoring wells immediately to the west and south. This indicates that decomposition of the waste is still occurring. At the request of the NYSDEC, in 2016, soil-gas samples were obtained southeast of the Current Landfill to verify that contaminant concentrations were not migrating beyond the existing well network. Soil-gas samples were collected at two depths for each of three locations using a Geoprobe®. There were no detections of soil gas (methane and hydrogen sulfide) in any of the samples. Sample results are summarized in the *2015 Groundwater Status Report* (BNL, 2016d). A second round of testing in July 2016 confirmed that soil gas was non-detect. In addition to the temporary well locations, samples were collected from several nearby upgradient permanent soil-gas wells for comparison purposes. Results from the permanent wells indicated concentration ranges for the soil gas parameters which were consistent with historical data. Therefore, it was concluded that soil gas is not migrating south from the Current Landfill. The four outpost monitoring wells, located immediately north of the Current Landfill along the south side of Brookhaven Avenue, showed no methane detections from 2021 through 2025. These wells monitor the migration of any soil gas towards the closest facility, the National Weather Service building.

However, in response to regulator comments to the *2024 Environmental Monitoring Report – Current and Former Landfill Areas* (BNL, 2025d), indoor air monitoring in the National Weather Service building was conducted in 2025. The air monitoring included screening for landfill gases (methane, hydrogen sulfide, oxygen, and carbon monoxide). No measurable concentrations were present for methane or hydrogen sulfide, and oxygen and carbon monoxide were both in the expected range for the breathing zone. The indoor air monitoring will be conducted annually and captured in future annual Current and Former Landfill reports. Soil-gas monitoring at the Former Landfill Area has shown no detections of methane or hydrogen sulfide from 2020 through 2025. The soil-gas monitoring well networks are sufficient to monitor both landfill areas.

Because of variability within survey results for both mercury and lead at Wooded Wetland locations SD-12 and SD-2001, and in response to NYSDEC comments, BNL conducted supplemental sampling in December 2015. The results from this sampling event were within the range of mercury and lead historically detected at these locations. In addition, biological surveys have confirmed the survival of tiger salamanders in the Wooded Wetland. Based on these data, the NYSDEC agreed that surface water and sediment sampling of the Wooded Wetland would be discontinued after 2016. Land use restrictions are in place for the Wooded Wetlands to remain undisturbed so that layers of new organic matter can build up and separate the tiger salamanders from the pond sediments. Tiger salamander surveys will continue to be conducted by BNL and reported to the NYSDEC Special Licenses Unit.

Groundwater: The landfill areas were capped between 1995 and 1997. Monitoring data presented in the *2025 Environmental Monitoring Report, Current and Former Landfill Areas* (BNL, 2026) indicate that, in general, contaminant concentrations have decreased following the capping of the landfills and that landfill controls continue to be effective. Metals and VOCs continue to be detected downgradient of the Current Landfill. The most prevalent VOCs detected above MCLs are benzene, chloroethane and 1,1-dichloroethane (1,1-DCA). In 2025, these VOCs were detected at maximum concentrations of 1.7 µg/L, 46 µg/L and 5 µg/L, respectively. **Figures 6-1 and 6-2** depict VOC trends for individual wells near the Current Landfill and South Boundary. Consistent with previous years, in 2025, metals were detected downgradient from the Current Landfill at concentrations above applicable standards however, concentrations were similar to those detected historically. Maximum concentrations of antimony, arsenic, iron, manganese, and sodium in downgradient wells were 14 µg/L, 16 µg/L, 8,100 µg/L, 3,440 µg/L and 75,600 µg/L, respectively. These results are an indicator of continued low level leachate generation at this landfill. There have been no detections of radionuclides above standards at the Current Landfill since 1998. The 1,4-dioxane results from 2025 show detections above the 0.35 µg/L AWQS at a maximum concentration of 2.6 µg/L. The PFAS results from 2025 monitoring show PFOS was detected above the 2.7 ng/L AWQS at a maximum of 40 ng/L, and PFOA was detected above the 6.7 ng/L AWQS at a maximum of 13 ng/L. An updated groundwater modeling simulation was last performed in 2016 using the VOC results obtained from 12 temporary wells installed in 2016, along with data collected from well 088-109. Total VOC concentrations in groundwater downgradient of the Current Landfill were predicted to attenuate to below 5 µg/L prior to reaching the site boundary. A permanent monitoring well (098-99) was installed to monitor the leading edge of the plume. Individual VOCs have remained below the AWQS since the well was installed in 2017, with the exception of a detection of 1,1-DCA at 6 µg/L in June 2020. These data have verified the modeled attenuation predictions. The OU X RI/FS will further investigate PFAS at the Current Landfill.

Based on the groundwater data collected over the past two decades, it was recommended, and subsequently approved, in the *2020 Environmental Monitoring Report, Current and Former Landfill Areas* (BNL, 2021c) that groundwater monitoring of the Former Landfill monitoring well network be discontinued.

Total VOC concentrations in the OU I Pump and Treat System monitoring wells have remained below the system capture goal of 50 µg/L since the system was shut down in 2013. As a result, a *Petition for Closure* (BNL, 2019b) of the system was approved by the regulators in 2019. The monitoring and extraction wells will be maintained until the RI/FS for PFAS and 1,4-dioxane has been completed.

Groundwater monitoring continued for a plume of Sr-90 contamination that originated at the former HWMF. While concentrations of Sr-90 below 30 pCi/L had been observed in groundwater in this area since the late 1990s, a higher concentration plume was detected and characterized in 2015. It is likely that the higher concentrations resulted from source area remediation work conducted at the former HWMF in 2005. This work included the removal of contaminated soils as well as the removal of buildings and paved areas that may have protected contaminated soils from stormwater infiltration. This plume segment has been monitored since 2015 using a combination of permanent and temporary monitoring wells (**Figure 6-3**). During 2024 and 2025, 25 permanent monitoring wells and 16 temporary wells (installed in October 2024 through January 2025) were used to monitor the Sr-90 plume. Strontium-90 was detected at a concentration of 234 pCi/L in permanent monitoring well 098-100 in September 2025, which is historically high for this well. Well 098-100 is located immediately downgradient of the source area, and had been showing an increasing trend of Sr-90 concentrations since 2020. Further downgradient wells showed a generally decreasing trend since 2021. The increasing trend in concentrations in source area wells is likely due to precipitation infiltration through the unsaturated zone and/or water table flushing which is mobilizing the residual Sr-90 to groundwater. Natural attenuation modeling conducted in 2021 indicated that Sr-90 could reach the site boundary above the DWS by 2080 if concentrations above 750 pCi/L are observed in upgradient monitoring wells. Groundwater monitoring in 2025 showed a maximum concentration 234 pCi/L in well 098-100. Continued monitoring with both permanent and temporary wells will be used to evaluate the continued attenuation of the plume.

6.4.2 Operable Unit II/VII

The remedial actions for the OU II/VII AOCs are documented in the OU I, OU III and the g-2/BLIP/USTs RODs (see **Sections 6.4.1, 6.4.3, and 6.4.9**).

6.4.3 Operable Unit III

Soil:

Based upon a rebound in TVOC concentrations in groundwater in the Building 96 area following soil removal work completed in 2010, it was determined that meeting the cleanup goal by 2030 could not be met due to the presence of significant residual contamination within the vadose zone. An *in-situ* chemical treatment injection program consisting of liquid carbon and zero-valent iron was implemented in 2024 to reduce the mobility of PCE and enhance its degradation. A complete description of the work performed, and the results are provided in the approved *OU III – Building 96 Source Area Optimization Report* (P.W.Grosser, 2024). Based on the results of post-injection monitoring data collected in 2025, the chemical injection program was successful at reducing the mobility of PCE from the source area.

Groundwater:

Over the past five years, the OU III groundwater remediation systems continued to effectively capture and treat contaminants originating from the central portion of the BNL site. Since the *2021 Five-Year Review Report* (BNL, 2021a), the LIPA and Industrial Park systems were approved for closure. Both systems will remain in an operationally ready state until the OU X RI/FS is completed. The Chemical Holes Sr-90 system is currently in standby mode. At the Western South Boundary system, four new extraction wells were installed in 2019 and 2020 to address VOC contamination that was detected in the deep portion of the Upper Glacial aquifer. At the North Street East System, two new extraction wells were installed over the same timeframe to address EDB contamination in the Upper Glacial aquifer (now referred to as the North Street East EDB System). The North Street East EDB system was approved for shutdown in January 2026. The extent of the high-concentration segments of the OU III VOC plumes have decreased as the result of active groundwater remediation and natural attenuation. Plume remediation progress on- and off-site can be seen on **Figure 5-1**. Complete breaks in the plumes, where contaminant concentrations have dropped below MCLs, are discernable near the South Boundary and the LIPA systems. The southernmost segment of the OU III plume has been hydraulically controlled by the Airport Treatment System. As the plumes continue to decrease in

size, a number of the extraction wells have been placed in either a pulsed pumping mode or a standby mode (**Figure 4-1**).

A review and evaluation of the performance data for the treatment systems is conducted monthly for most of the systems and both quarterly and annually for all the systems. An evaluation of the groundwater monitoring data is documented in the annual Groundwater Status Reports.

The following is a brief status summary of OU III plume data through 2025.

Carbon Tetrachloride Treatment System

The Carbon Tetrachloride treatment system was successful in remediating the plume to below MCLs and was decommissioned in 2010. Monitoring of the source area was discontinued in 2013.

Building 96 Treatment System

In June 2019, the pumping rate for extraction well RTW-1 was increased from 30 gpm to 60 gpm and switched from a recirculation well to air stripping utilizing the Building 452 Freon-11 treatment equipment. This increased pumping rate expanded the capture zone to the west in response to increased TVOC concentrations in monitoring well 095-159. Recirculation wells RTW-2, RTW-3 and RTW-4 remained in standby mode through 2025. Since the source area soil remediation in 2010, VOCs in the Building 96 plume core monitoring wells have significantly declined (See trends on **Figure 6-4**) but continue to remain above MCLs. An SVE pilot study conducted in 2018 indicated that a full-scale SVE system would not be effective in addressing residual VOCs. However, an alternative remedial approach was developed to reduce the mobility of PCE and enhance its degradation by performing an in-situ chemical injection program consisting of liquid carbon and zero-valent iron. The Building 96 Source Area Optimization work was completed in 2024. Post-injection monitoring results indicate that the in-situ injections were successful through the observed reduction of PCE concentrations in the source area. Plume monitoring will continue to determine effectiveness of the injections and reevaluate the cleanup timeframe.

Building 452 Freon-11 Treatment System

Following regulatory approval of a Petition for Shutdown, the treatment system was shut down and placed in standby mode in March 2016 (BNL, 2016e). The system was briefly placed back into full-time operation from November 2016 to March 2017 due to a temporary rebound of Freon-11 concentrations. A Petition for Closure of the system was submitted to the regulators in June 2019 and approved in August 2019 (BNL, 2019d). Freon-11 concentrations declined to non-detect in 2022. In 2023, there was one detection of Freon-11 at an estimated concentration of 0.016 µg/L. Concentrations have remained non-detect since 2023.

Middle Road Treatment System

Five of the seven extraction wells (RW-1, RW-3, RW-4, RW-5 and RW-6) remained in standby mode as TVOC concentrations have remained below the system capture goal of 50 µg/L over the past five years. Extraction wells RW-2 and RW-7 remained in full-time operation. Extraction well RW-3 was placed in standby mode in 2025 as recommended in the modeling assessment *Middle Road/South Boundary Modeling – January 2025* (Arcadis, 2025b). Groundwater characterization was performed in 2018 for an area upgradient of well 104-37 to evaluate the source of the persistently elevated VOCs detected in this well. However, no significantly elevated VOC concentrations were identified. In 2021, three temporary vertical profile wells were installed to characterize the areas of persistent VOC detections above the capture goal. As a follow up to this work, two additional permanent monitoring wells (105-80 and 105-81) were installed in 2023 to allow for routine monitoring of the VOC concentrations in this area. Monitoring data from these wells indicated that there is a zone of higher concentration VOC contamination in the deep Upper Glacial aquifer. Although VOC concentrations in well 104-37 decreased over the last five years, the concentrations in this well, and surrounding wells, are not declining at a rate that indicates that the drinking water standards will be achieved by 2030 (**Figure 6-5**). As indicated by the modeling assessment, two additional extraction wells may be needed to expedite the cleanup in the Middle Road area of the plume (Arcadis, 2025b).

However, an evaluation is needed to help quantify the extent to which the cleanup timeframe can be reduced.

South Boundary Treatment System

The seven extraction wells (EW-3, EW-4, EW-5, EW-6, EW-7, EW-8, and EW-12) remained in standby mode as TVOC concentrations have remained below the system capture goal of 50 µg/L. One deeper extraction well, EW-17 has remained in full-time operation since it was installed in 2011. Monitoring well 121-49, located immediately upgradient of EW-17, exhibited TVOC concentrations exceeding 1,200 µg/L at that time. Monitoring well 121-43, located immediately downgradient of EW-17, have exhibited TVOC concentrations below the capture goal since 2011, which demonstrates that the extraction well is effectively mitigating the further downgradient migration of the plume at the site boundary. Total VOC concentrations in well 121-49 have remained below 300 µg/L since the third quarter of 2021. In 2021, an additional two temporary vertical profile wells were installed to characterize the areas of persistent VOC detections greater than 50 µg/L. As a follow up to this work permanent monitoring well 121-57 was installed in 2023 to allow for long-term monitoring of VOC concentrations in this area. This well is located 650 feet upgradient of EW-17 and showed a maximum TVOC concentration of 270 µg/L during 2025. Monitoring wells 121-53 and 121-54, located between the Middle Road and South Boundary treatment systems, have shown VOC concentrations that are not declining at a rate that would indicate that drinking water standards will be achieved by the 2030 cleanup goal (**Figure 6-5**). As indicated by the modeling assessment, an additional extraction well may be needed to expedite the cleanup in the South Boundary area of the plume (Arcadis, 2025b). However, an evaluation is needed to help quantify the extent to which the cleanup timeframe can be reduced.

Western South Boundary Treatment System

Plume and extraction well data show that VOC concentrations in the Western South Boundary area continue to decline as anticipated in the Western South Boundary area (**Figure 6-6**). Extraction wells WSB-1 and WSB-2, located in the eastern portion of this area, remained in standby mode due to TVOC concentrations remaining below the system capture goal of 20 µg/L. In 2019, four new extraction wells WSB-3, WSB-4, WSB-5, and WSB-6 were installed to address a zone of high VOC concentrations observed at slightly greater depths than previously characterized. Significant improvements in groundwater quality have been observed since the new extraction wells began operation. Extraction wells WSB-3, WSB-4, WSB-5 and WSB-6 were placed in a pulse pumping mode in 2023 due to declining TVOC concentrations.

Total VOC concentrations in the Western South Boundary area monitoring wells and extraction wells have decreased to levels below the 20 µg/L capture goal for this system, with the exception of a slight uptick in the concentration of dichlorodifluoromethane observed in downgradient monitoring well 000-558, located south of Carleton Drive. Due to TVOC concentrations observed over time, it is expected that a petition for shutdown will be submitted for the Western South Boundary Treatment System.

Industrial Park Treatment System

Following regulatory approval, this system was shut down in May 2013. In March 2014, recirculation wells UVB-4 through UVB-6 were returned to full-time operation due to a rebound in TVOC concentrations above the 50 µg/L capture goal. These wells were returned to standby mode in February 2017 as VOC concentrations declined.

In 2015, two extraction wells, IP-EW-8 and IP-EW-9, were installed to address deeper VOC contamination. These two extraction wells were placed in pulsed pumping mode in 2018 and then placed in standby mode in 2019. Due to low VOC concentrations observed across program monitoring wells since 2019 (**Figures 6-7 and 6-9**), the *Industrial Park Treatment System Petition for Closure* (BNL, 2025a) was approved by the regulators in 2025. The monitoring and extraction wells will be retained until the completion of the OU X RI/FS.

Industrial Park East Treatment System

The Industrial Park East treatment system was successful in remediating VOCs to below MCLs and was decommissioned in 2014. The post-closure groundwater monitoring program for this area was discontinued in 2018. The treatment building and related infrastructure were utilized for the remediation of VOC-contaminated water from Industrial Park extraction wells IP-EW-8 and IP-EW-9. The remaining monitoring and extraction wells will be retained until the completion of the OU X RI/FS.

North Street Treatment System

In March 2020, the *Petition for Closure OU III North Street Groundwater Treatment System* (BNL, 2020a) was approved by the regulators. Total VOC concentrations in the extraction wells and plume monitoring wells remain below the 50 µg/L capture goal for this treatment system. The monitoring and extraction wells will be retained until the completion of the OU X RI/FS.

North Street East Treatment System

The original North Street East VOC treatment system consisting of two extraction wells remains in standby mode. The system met its cleanup goal in 2014, and there has been no significant rebound in VOC concentrations. The *Petition for Shutdown OU III North Street East Groundwater Treatment System* (BNL, 2014a) was approved by the regulators in 2014. The infrastructure from this system is now being used for remediation of the EDB plume described below.

North Street East EDB Treatment System

In the vicinity of the original North Street East treatment system, EDB was observed in deep Upper Glacial monitoring well 000-394, which showed a peak concentration of 1.06 µg/L in October 2017. From March through October 2018, 17 temporary wells were installed to characterize the extent of EDB in this area. Groundwater modeling performed in November 2018 determined that two additional extraction wells are needed to remediate the EDB and to ensure that the OU III ROD cleanup goal is achieved. Two additional extraction wells (NSE-EDB-EW-3 and NSE-EDB-EW-4) were installed and became operational in July 2020. The EDB concentration in well 000-394 declined to 0.08 µg/L by December 2020. Over the last five years, the EDB concentrations have steadily declined to below the DWS. (**Figure 6-8**). A *Petition for Shutdown* of the North Street East EDB treatment system was approved in January 2026 (BNL, 2025f).

LIPA/Airport Treatment System

All four LIPA extraction wells were shut down and placed in standby mode in 2017. Total VOC concentrations in this area have remained below 10 µg/L over the last five years, and have remained significantly below the capture goal of 50 µg/L for the LIPA system. The *Petition for Closure OU III LIPA Groundwater Treatment System* (BNL, 2024a) was approved by the regulators in December of 2024. The extraction wells, monitoring wells, and associated infrastructure will be maintained in an operationally ready state until the completion of the OU X RI/FS.

Total VOC concentrations in the vicinity of Airport extraction wells RTW-2A and RTW-3A have remained below the 10 µg/L capture goal; therefore, these wells were put in standby mode in March 2020. Airport extraction well RTW-5A remained in standby mode as individual VOCs in monitoring well 800-103 (located immediately north of RTW-5A) have remained below applicable MCLs since 2004. Extraction wells RTW-1A, RTW-4A and RW-6A continued full-time operation due to monitoring results from upgradient monitoring wells continuing to show TVOC concentrations above the 10 µg/L capture goal. Monitoring wells 800-94 and 800-95 are located approximately 1,500 feet north of extraction wells RTW-1A, RTW-2A, and RW-6A. Both of these wells have shown persistently high TVOC concentrations, although concentrations are trending down in recent years. Monitoring well 800-101 is located immediately north of extraction well RTW-4A, and has shown consistently elevated TVOC concentrations as well. The concentrations observed in this well are likely due to a slug of contamination that migrated south of the North Street extraction wells prior to the system startup, and appears to have migrated past the system capture radius into the vicinity of monitoring well 800-101. See monitoring trends on **Figures 6-9** and **6-10**. Based on the observed

concentrations, it is unlikely this system will meet the cleanup goal of meeting MCLs in the Upper Glacial aquifer by 2030. The cleanup timeframe of this plume will need to be reevaluated with continued monitoring.

HFBR Pump and Recharge System/Plume

The petition for closure of this system was approved by the regulators in 2019 (BNL, 2018b). Since 2018, due to the consistently low tritium concentrations observed in monitoring wells, the monitoring network has been reduced, and stands at ten monitoring wells located immediately downgradient of the HFBR. The sampling frequency has been reduced from quarterly to semiannually. The maximum tritium concentration in the source area monitoring wells detected over the last five-year period was 17,217 pCi/L detected in 2025 in monitoring well 075-805. Historical peak tritium concentrations in the monitoring wells over time are shown on **Figure 6-11**. The remaining downgradient monitoring wells and the extraction wells will be maintained until the completion of the OU X RI/FS. The carbon vessels previously used for the HFBR Pump and Recharge system and a segment of piping have been repurposed for the OU X Former Firehouse Treatment System which began operation in 2023.

BGRR/WCF Treatment System

Extraction wells SR-4, SR-5, SR-6, and SR-7 have remained in standby mode over the last five year period due to the observed reduction in Sr-90 concentrations. Extraction well SR-8 was placed in standby mode in 2022. Extraction well SR-9 was placed in standby mode in 2023. Extraction well SR-3 was placed in standby mode in 2022 and was turned back on in October 2024 based on elevated Sr-90 concentrations observed in a source area monitoring well. Extraction wells SR-2 and SR-3 were placed in standby mode in 2025, with the observed reduction in Sr-90 concentrations. Extraction well SR-1 continues to operate full time.

The 2015-2016 demolition of the former WCF and removal of nearby impermeable surfaces may have allowed for the leaching of residual Sr-90 in the underlying soils to the groundwater. Since the demolition, Sr-90 concentrations have significantly dropped in source area monitoring well 065-175 from a historical high of 821 pCi/L observed in 2000 to 54 pCi/L in 2025. Strontium-90 concentrations in monitoring wells located immediately downgradient of extraction wells SR-1 and SR-2 have remained below the DWS since 2018. This indicates that the extraction wells are effectively capturing Sr-90 migrating from the source area. In 2022, 13 temporary wells were installed to monitor the downgradient segment of the Sr-90 plume originating from the WCF. The results showed the extent of the plume is decreasing in size.

Based on Sr-90 concentrations in BGRR source area monitoring well 075-701 ranging from non-detect to 115 pCi/L in August 2024, it appears that the water table elevation increase in 2024 had resulted in the release of residual Sr-90 located in the deep vadose zone soils beneath the BGRR area. The Sr-90 concentrations in this well were below the DWS from October 2024 through 2025 following a drop in water table elevation. As Sr-90 is released from the vadose zone through water table elevation fluctuations, the downgradient migration of Sr-90 from the BGRR source area is controlled by extraction well SR-3. Monitoring will continue in this area. See Sr-90 concentration trends on **Figure 6-12**.

Chemical Holes Treatment System

Overall, the Sr-90 plume extent and concentrations have significantly decreased since 2008 with no significant rebound identified. To date, the highest Sr-90 concentration observed in this area was 4,720 pCi/L in 2005 in well 106-99. Since 2021, Sr-90 concentrations have ranged from non-detect to 79 pCi/L observed in July 2025. See concentration trends on **Figure 6-13**. Although the monitoring results indicate a low-level continuing source of Sr-90, the inventory of residual Sr-90 in the source area has been significantly reduced since the removal action was completed in 1997. The periodic increase in concentrations may be associated with water table elevation fluctuations, resulting in flushing of residual Sr-90 from the vadose zone.

The treatment system has remained in standby mode since the *Petition for Shutdown* (BNL, 2018a) was approved in July 2018. Since that time, the combination of natural attenuation and radioactive decay is limiting downgradient migration of the plume. Based on the Sr-90 migration rate of 20-40 feet per year, a 29-

year half-life, and dispersion of the plume as it migrates, the Sr-90 plume is predicted to attenuate to levels below the DWS well before reaching the site boundary. Analytical modeling (Arcadis, 2025a) indicated that even with conservative estimates of Sr-90 concentrations of over 2,000 pCi/L in the source area, it is unlikely that Sr-90 impacted groundwater will reach the site boundary above the MCL. As a result, it is anticipated that a petition for closure will be submitted for this system.

6.4.4 Operable Unit IV

Soil: Remediated radiologically contaminated soil at the Building 650 Sump Outfall is included under OU I. Building 650 was formerly known as the Reclamation and Hot Laundry Facility. From the fall of 2020 to the spring of 2021, the building was decontaminated and dismantled. An as-left radiological survey of the building footprint and surrounding worksite was performed and the Building 650 LUIC fact sheet was updated to document current status. This demolition was not included in the scope of the original OU IV remedial action. The final closeout report titled *Decontamination and Dismantlement (D&D) of Building 650 Closeout Report* (P.W. Grosser, 2022) was published in September 2022.

Groundwater: The OU IV AS/SVE treatment system was decommissioned in 2003, and post-closure groundwater monitoring was completed in 2011.

Groundwater monitoring results confirm that Sr-90 originating at the former Building 650 Sump Outfall is attenuating as expected. Strontium-90 concentrations for key wells are shown on **Figure 6-14**. In 2019, five temporary wells were installed to evaluate the eastward shift and the southern portion of the plume. Two new monitoring wells (076-418 and 076-419) were installed in 2020 for improved monitoring of the Building 650 Sump Outfall Sr-90 plume core. Two new monitoring wells (076-420 and 076-421) were also installed in 2020 downgradient of the former Building 650 to monitor for any impacts to groundwater resulting from the Building 650 demolition. Strontium-90 concentrations observed in these two wells remained below the MCL over the last five-year period. However, over the same period, existing well 076-25 downgradient of former Building 650 has shown varying levels of Sr-90 ranging from 2 pCi/L up to 19 pCi/L. This range in concentrations is consistent with what has been observed historically in this well and will continue to be monitored for fluctuations of Sr-90.

6.4.5 Operable Unit V

Peconic River: Based on the recommendations presented in the *2016 Five-Year Review Report* (BNL, 2016a), further post-cleanup sediment, surface water and fish monitoring of the Peconic River was discontinued. However, in an August 2016 comment on the *2016 Five-Year Review Report* (BNL, 2016a), NYSDEC stated that future monitoring activities of the Peconic River shall be determined following the “Area WC-06” removal action. The *Completion Report, Peconic River Supplemental Sediment Removal, Area PR-WC-06*, dated December 2017 was approved by the regulators in 2018 (Land, 2017). As documented in the report, all 27 post-excavation confirmatory samples verified that the sediment cleanup goals from the ROD were met (average mercury concentration of less than 1.0 mg/kg and all individual samples are less than 2.0 mg/kg). With the completion of this supplemental cleanup at Area PR-WC-06 and the results from the post-excavation confirmation sampling, BNL proposed that no further post-cleanup monitoring of the Peconic River is warranted. However, NYSDEC believed that following a population survey and 100 mg/kg fish monitoring for mercury and PCBs should continue annually until they are reduced to “acceptable levels” as required by the ROD. It was agreed to between DOE, BSA, and NYSDEC that fish monitoring would be discontinued under CERCLA, however surveillance monitoring would be performed and documented in the annual Site Environmental Reports (BNL, 2022d; BNL, 2024c; BNL, 2025b; BNL, 2023a). A summary of fish monitoring, as stated in the annual Site Environmental Reports, is included in **Section 5**.

Peconic River Sediment: Following successful completion of the supplemental sediment cleanup performed in 2017 at Area WC-06, further sediment sampling was discontinued.

Peconic River Water Column: Water column sampling was discontinued following recommendations from the *2016 Five-Year Review Report* (BNL, 2016a) and concurrence by the regulators.

Peconic River Vegetation: In accordance with the NYSDEC Permit Equivalency Application, following the 2017 sediment remediation of Peconic River Area WC-06, BNL completed two years of wetland monitoring in September 2019. In November 2019, a letter report was submitted to NYSDEC for concurrence (BNL, 2019e). In February 2020, NYSDEC found the report acceptable and requested river flow data and fish population survey information. In May 2020, BNL provided the requested information. On August 5, 2020, the NYSDEC Region 1 Fisheries Biologist performed an inspection of the restored cleanup area as well as an assessment of the available fish habitat. NYSDEC approved closure of the permit in 2021. Vegetation monitoring and control of invasive species, as necessary (not to exceed 10 percent of cover), was performed through September 2022, to meet the federal duration requirements.

Groundwater: The groundwater monitoring requirements for the OU V ROD have been satisfied. Groundwater monitoring results for PFAS and 1,4-dioxane in this area are discussed in **Section 6.4.7** below. Groundwater quality in the vicinity of the STP is currently monitored under the SPDES program.

6.4.6 Operable Unit VI

Groundwater: As shown on **Figure 6-15**, monitoring over the past five years continues to show a steady decline in EDB concentrations as the plume migrates south and is captured by the EDB treatment system. Although EDB concentrations have significantly declined since the original system was installed in 2004, the plume is moving significantly slower than originally simulated by the groundwater model used during the system design. In 2018, two temporary wells were installed in the plume core upgradient of the extraction wells. The maximum EDB concentration detected in these temporary wells was 0.57 µg/L. Two permanent monitoring wells (000-549 and 000-550) were then installed at this location in January 2019. In 2020-2021, five vertical profile wells were installed to address data gaps in the distribution of EDB in the aquifer and to collect geologic data needed to update the groundwater model. This work confirmed that the Gardiners Clay is not present in this area and that the EDB plume is deeper in the Upper Glacial aquifer than originally understood. In December 2023, the original system was shut down to construct two new extraction wells to better capture the deeper portion of the EDB plume. The new extraction wells became operational in January 2024, and the original extraction wells were placed in standby mode. In addition to the extraction wells, three new monitoring wells (000-580, 000-581, 000-582) were installed during 2023. In June 2024, a one-week pumping test was performed to evaluate the capture zone of the new extraction wells. The pumping test suggested that the projected capture zone encompassed the deeper EDB plume, and that future monitoring will be needed to verify the effectiveness of extraction wells to capture the plume. The southern migration of the plume is shown on **Figure 6-15**. Comparing the plume distribution from 1999 to 2025, the southern movement of the plume has been controlled, and the overall size of the plume has been significantly reduced. Overall, the maximum EDB concentrations declined from 7.6 µg/L observed in 2001 to 0.047 µg/L observed in 2025. The monitoring data from 2025 suggests that the new, deeper, extraction wells are controlling and remediating the leading edge of the EDB plume. The cleanup timeframe of this plume will need to be reevaluated with continued monitoring.

6.4.7 Operable Unit X

Soil: Two soil borings were completed at the Current Firehouse source area during 2024 which were installed in an effort to evaluate the distribution of PFAS in unsaturated soil and groundwater close to the water table. The results showed elevated PFOS and PFOA results up to 230 nanogram per gram (ng/g) and 5.4 ng/g respectively. These results are summarized in greater detail in the *2024 Groundwater Status Report* (BNL, 2025b). Additional soil samples will be collected as part of the RI/FS.

Groundwater: Since 2018, several phases of groundwater characterization have been performed on the nature and extent of PFAS and 1,4-dioxane on and off of the BNL property. The monitoring results for 2018 and

2019 are presented in the *2019 Groundwater Status Report* (BNL, 2020b). In 2020, BNL conducted a comprehensive sampling of approximately 350 on-site and off-site monitoring wells and five off-site treatment systems for PFAS and 1,4-dioxane, and two onsite treatment systems for 1,4-dioxane. The results are presented in the *Phase 4 Characterization Report, Per- and Polyfluoroalkyl Substances (PFAS) and 1,4-Dioxane in On-Site and Off-Site Monitoring Wells, Extraction Wells and Treatment Systems* (BNL, 2021d).

A detailed characterization effort was conducted in 2020 and early 2021 of the high concentration segments of the PFAS plumes associated with BNL's Current and Former Firehouse facilities. During characterization of the Current Firehouse plume, a PFAS plume originating from a previously unknown AFFF training area near Building 170 was identified. As part of this effort, samples from select wells were also tested for 1,4-dioxane. A summary report of this investigation was submitted to the regulators in April 2021 (BNL, 2021e). These characterization data were used to support the design of two PFAS groundwater treatment systems. The design report was submitted to the regulators in June 2021 (BNL, 2021f). Both systems were installed as part of a TCRA to address PFAS-contaminated groundwater associated with the Current Firehouse/Building 170 area of the plume (sub-AOC 33D and sub-AOC 33J, respectively) and the Former Firehouse (sub-AOC 33E).

Current Firehouse/Building 170

The Current Firehouse PFAS groundwater treatment system began operations in October 2022. The treatment system consists of nine extraction wells, and two granular-activated carbon filters. The treated water is returned to the aquifer utilizing the onsite recharge basins. A complete design description of the system is included in the *Operations and Maintenance manual for the Current Firehouse Groundwater Treatment System* (BNL, 2023c).

In 2024 and 2025, the Current Firehouse and Building 170 PFAS source areas were monitored using 80 permanent monitoring wells, eight Geoprobe® temporary wells, and 15 temporary vertical profile wells. The eight temporary Geoprobe® wells were installed to evaluate an apparent shift in the position of the Current Firehouse and Building 170 plume segments. Twelve of the 15 temporary vertical profile wells were installed to evaluate the southern extent of the plume. The remaining three temporary vertical profile wells were installed within the capture zone of the SCWA William Floyd well field. The monitoring wells were sampled quarterly or semiannually to monitor the source area and the downgradient extent of the plume. Additionally, a subset of wells were analyzed for 1,4-dioxane.

With these temporary wells, the Current Firehouse PFAS plume was characterized to the southwestern site boundary, where a maximum PFOS concentration of 180 ng/L was detected, and an estimated maximum PFOA concentration of 120 ng/L was detected. 1,4-Dioxane was detected in nine of the 12 temporary wells with a maximum concentration of 12 µg/L detected. Consistent with previous characterization results, low levels of PFAS were detected in the three temporary wells that were used to further characterize the capture zone of the SCWA William Floyd well field. In this area, PFOS was detected up to 21 ng/L and PFOA was detected up to 10 ng/L. Trace levels of 1,4-dioxane were detected in all three wells, at a maximum concentration of 0.3 µg/L. These results are summarized in greater detail in the *2024 Groundwater Status Report* (BNL, 2025b).

At the Current Firehouse source area, in 2025, the highest concentration of PFOS was detected in well 073-33 at a concentration of 1,700 ng/L. The highest PFOA concentration in the Current Firehouse source area was detected in well 073-31 at a concentration of 360 ng/L. Both wells are located downgradient of the eastern (main) foam training area. In the Building 170 area, the highest PFOS and PFOA concentrations were detected in downgradient well 093-04 at 7,550 ng/L and 113 ng/L, respectively. See **Figure 6-16** for monitoring well trend graphs of PFOS and PFOA.

Figure 6-17 provides a comparison of the plume distributions for 2020-2021, 2023, and 2025. When comparing the plume distribution from the 2024 permanent monitoring well data, against the temporary well data from the TCRA Characterization Report (BNL, 2021e), there appears to be an easterly shift in the

downgradient portion of the plume. A possible cause is decreased use and suspension of two BNL potable supply wells located near the west side of the plume, resulting in a more southerly direction of groundwater flow. The results from the eight temporary wells installed in 2024 confirmed the shift.

Former Firehouse

The Former Firehouse treatment system began operations in January 2023. The treatment system consists of three extraction wells withdrawing PFAS contaminated water from the aquifer, treating the water using granular-activated carbon filters, and returning the treated water to the aquifer utilizing the onsite RA V recharge basin. A complete design description of the system is included in the *Operations and Maintenance Manual for the Former Firehouse PFAS Source Areas Groundwater Treatment System* (BNL, 2023d).

In 2025, a network of 72 monitoring wells was used to monitor the PFAS plume in the source area and downgradient to the off-site OU III Industrial Park treatment system area. A subset of 13 monitoring wells was used to analyze for 1,4-dioxane.

The highest concentrations of PFAS in this plume are consistently detected in two shallow monitoring wells, 075-809 and 075-810 (**Figure 6-18**) located immediately downgradient of the source area and upgradient of extraction well FF-RW-A. In 2025, the highest PFOS concentration was detected in well 075-809 at 3,000 ng/L and the highest PFOA concentration was detected in well 075-810 at 514 ng/L. The highest total PFAS (sum of the detections of the 46 PFAS compounds analyzed under EPA Method 1633) concentrations detected in 2025 were 5,615 ng/L in well 075-810 and 3,266 ng/L in 075-809.

Downgradient groundwater samples were also collected from Industrial Park area monitoring wells in 2025. The highest detected concentrations of PFOS and PFOA were 16 ng/L and 9.3 ng/L, in wells 000-267 and 000-265, respectively. **Figure 6-19** provides a comparison of plume distributions from 2020-2021, 2023 and 2025. The plume distribution map is consistent with the temporary well data presented in the TCRA Characterization Report (BNL, 2021e).

Treatment System Discharge Standards

In March 2023, NYSDEC issued Ambient Groundwater Quality Guidance Values (AWQGVs) for PFOS (2.7 ng/L), PFOA (6.7 ng/L), and 1,4-dioxane (0.35 µg/L) that are lower than the State drinking water standards. These guidance values apply to industrial discharges that require a SPDES permit. Based on upon the initial monitoring of groundwater treatment systems for these chemicals, it became apparent that the treatment system effluent for several of the on-site and off-site systems exceeded the guidance values for 1,4-dioxane and PFOS. Sampling from the extraction wells, influent and effluent at the combined OU III Western South Boundary, Middle Road and South Boundary systems, OU III LIPA/Airport system, OU III North Street system, OU VI EDB system, and OU III BGRR/WCF system was conducted from 2023-2024.

At the end of 2024, after the completion of the first four quarters of monitoring, BNL developed a plan that will allow for the active treatment systems to come into compliance with the discharge guidance values. The monitoring results and proposed modifications to the OU III WSB/Middle Road/South Boundary and Airport treatment systems, and more frequent GAC filter exchanges for the BGRR/WCF system, were documented in the *Groundwater Treatment System Discharge Compliance Plan* (BNL, 2024d). The compliance plan was approved by the regulatory agencies in early 2025. The compliance plan also recommended conducting routine quarterly monitoring of the treatment systems' effluent. The need to modify currently closed groundwater treatment systems will be evaluated during the OU X RI/FS.

In accordance with the *Compliance Plan*, during 2025, the treatment systems' extraction wells, system influent, and effluent were sampled in the first and third quarter, and the treatment system influent and effluent only were sampled in all four quarters. The results were very consistent with what was observed in the previous five sample rounds, indicating that 1,4-dioxane levels exceeded the 0.35 µg/L discharge guidance value in the combined OU III Western South Boundary, Middle Road, and South Boundary system effluent at a maximum concentration of 1.6 µg/L, and PFOS exceeded the 2.7 ng/L guidance value with a maximum

concentration of 8.6 ng/L. 1,4-Dioxane concentrations in the effluent from both the LIPA/Airport and North Street East EDB systems exceeded the guidance value, with maximum concentrations of 1.2 µg/L and 0.62 µg/L, respectively. The guidance value for 1,4-dioxane was not exceeded in either the OU VI or BGRR/WCF systems. However, PFOS was detected in the effluent for the OU III BGRR/WCF treatment system at a maximum concentration of 9.3 ng/L. A carbon changeout was performed on this system in July 2025 and the effluent results have not exceeded limits for PFOA or PFOS since.

6.4.8 BGRR

Structures and Soil: No soil sampling was performed since the *2016 Five-Year Review* (BNL, 2016a). Surveillance and maintenance inspections and follow-up repairs were performed on a routine basis. In addition, two steel storage containers were installed on the upper roof of Building 701. These storage containers are being used for the Quantum Network experiment. A Memorandum of Understanding between EPD and the Advanced Technology Research Office was signed in 2024 for this experiment to use the Building 701 roof. Repairs performed since 2021 include: the roof drain on the west air intake to protect against rainfall intrusion; the soffit and shingle repairs on the doghouse roof; repairs to the window gaskets; removal of vegetation; and a complete resealing of the engineered cap. Repairs to upper and lower roof parapets were made along with repairs to several holes in the metal sheeting in the west side of the high bay windows. An update to the Long-Term Surveillance and Maintenance Manual for the BGRR was issued in September 2023 (BNL, 2023b).

Groundwater: See OU III Groundwater **Section 6.4.3** for groundwater data review.

6.4.9 g-2/BLIP/USTs

Structures and Soil: No soil characterization was performed over the last five-year period. Routine inspections and maintenance of the caps and other stormwater controls at the g-2 and BLIP source areas are performed annually. Over the last five years, only minor repairs have been required for the BLIP and g-2 caps. For the former UST areas, no additional remedial actions were required.

Groundwater: Groundwater monitoring at the g-2 and BLIP source areas has shown that the stormwater controls have been effective in preventing additional leaching of radionuclides from the activated soil shielding. At the BLIP facility, all tritium concentrations have been less than the 20,000 pCi/L MCL since early 2006. The highest concentration of tritium detected in BLIP source area monitoring wells over the last five-year period was 1,890 pCi/L detected in well 064-67 in 2023.

At the g-2 source area, tritium concentrations have remained below the 20,000 pCi/L MCL in source area monitoring wells since 2021 when the tritium concentration in source area well 054-07 was detected at 23,200 pCi/L. The periodic detections of tritium at elevated concentrations is related to water table fluctuations and the flushing of residual tritium from the deep portion of the vadose (unsaturated) zone below the g-2 source area. The overall reductions in tritium concentrations observed in the source area wells suggest that the amount of residual tritium that is available to be flushed out of the deep vadose zone has decreased with time. See trend **Figure 6-20**. Contingency actions identified in the ROD for the g-2 tritium plume were not triggered over the last five years.

No groundwater monitoring is required for the former UST areas.

6.4.10 HFBR

Structures and Soil: The stack exterior coating (which contained lead and asbestos) was abated in November 2020 and the stack was demolished between December 2020 and February 2021. The final status survey (which includes soil sampling and a walkover survey) and ORISE independent verification of the cleanup was performed in mid-2021. In September 2025, radiation measurements of the V-14 port on top of the reactor

vessel were taken to confirm that radioactive decay is occurring at the modeled rate. These data are discussed in more detail in **Section 7.10**.

In 2020 and 2021, the Waste Loading Area was used as a staging area for temporary storage of waste from the HFBR stack and Building 650 demolition and for loading the waste onto rail cars for off-site disposal.

Since 2021, repairs performed at the HFBR as a result of surveillance and maintenance inspection findings included repairing cracked masonry in numerous locations on the east side exterior of the confinement dome. A repair to the east truck lock roof was performed and some minor asbestos cleanup and repairs were made to insulation in the confinement dome.

Groundwater: See OU III Groundwater **Section 6.4.3** for groundwater data review.

6.4.11 Groundwater Monitoring

Section 5.0 of the annual *Groundwater Status Reports* identify changes to the well monitoring network. Changes include the installation of additional temporary and permanent monitoring wells, and modifications to monitoring frequency and analytical parameters. As shown in **Table 6-3**, from 2021 through 2025, 135 permanent wells were installed to enhance the monitoring networks for the various plumes, and to support the continued characterization of OU X. Over the same period, 145 temporary wells were also installed to track and characterize contaminants in the Upper Glacial and Magothy aquifers. In addition, 15 new extraction wells were installed during this time. No monitoring wells, or extraction wells were decommissioned over this period.

6.5 Inspections

During fall and spring 2025, representative site inspections took place for the landfills, soils, Peconic River, and groundwater treatment systems. The purpose of the inspections was to assess the protectiveness of the various sites, including operating treatment systems and controls. No significant issues were identified during the site inspections; however, minor issues observed included vegetation clearing needed around buildings and wells, the presence of mold identified in two buildings, and one LUIC sign needed to be replaced. The completed inspection checklists are included in **Attachment 3**. All of the groundwater systems are routinely inspected as part of the ongoing O&M. In addition, Environmental Safety and Health assessments are performed to evaluate safety and operational concerns at all of the systems on an annual basis.

There were no significant issues identified during the long-term surveillance and maintenance of the HFBR facility. However, routine repairs and maintenance were performed over the last five years, as summarized in **Section 6.4.10**. The stack was demolished and removed in 2020. A *Final Status Survey Report* was issued in December 2021 documenting the as left radiological conditions in the area of the former stack (Olgoonik FPM, 2022). The follow-up recommendations from the Survey Report are for 50 years of institutional controls followed by unrestricted use. Structural inspections of the HFBR were performed annually from 2021 through 2025. Several items of note from these inspections were the repair of the roof on the East truck lock and numerous areas of the parge coating on the exterior wall of the HFBR have been repaired. Overall the interior and exterior of the building remained in good condition.

The scope of routine surveillance activities at the BGRR includes radiological and environmental monitoring; house and grounds keeping, testing, inspection, and preventive maintenance and repair of required systems and equipment; and verification of conditions throughout the year. The surveillance frequencies are quarterly for the former offices and high bay, semi-annually for the engineered cap, roofs, and below ground ducts, and annually for structural integrity. Repairs and maintenance performed over the last five years included roof repairs along the parapets on the upper and lower roof, and repairs to several broken windows. The entire cap was resealed in 2023. Resealing of cracks in the cap identified during inspections is performed on an annual basis. The Quantum Network experiment is in operation on the Upper Roof of Building 701. The

construction of this project resulted in some improvements in Building 701 including lighting on the west stairwell and a new aluminum stairway to allow access to the upper roof.

The caps and other stormwater controls at the g-2 and BLIP source areas are inspected two times per year and inspection reports are submitted to the regulatory agencies annually. There have been no significant issues identified. Minor cap maintenance is performed on a routine basis.

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7.0 Technical Assessment

The following subsections assess both the soil and groundwater remedies by OU and address the three EPA-designated questions. Information on the soil cleanup work completed prior to this Five-Year Review can be found in earlier documents (<https://www.bnl.gov/gpg/5year-review.php>). BNL performs a comprehensive assessment of each of the groundwater treatment systems' operation, performance, plume monitoring information, and opportunities for optimization as part of the annual Groundwater Status Report. The 2024 BNL Groundwater Status Report (BNL, 2025b) and reports from prior years are available for review online (<https://www.bnl.gov/gpg/gw-reports.php>).

The only significant institutional control issues identified over the past five years are related to the renewal of property access agreements:

- A key institutional control for the groundwater treatment systems located off of the BNL property is to ensure that the property access agreements are in place and have been kept in compliance with the agreed upon terms and conditions. To date, all requirements of the access agreements have been met, including communicating the LUICs and restrictions to the property owners. The use of these properties has conformed to these controls. There are a total of seven access agreements, five of which require recording or agreement renewal. BNL is working with outside counsel to negotiate renewed agreements with these entities but continues to maintain access to the properties. These agreements allow for BNL's continued access to operate and maintain groundwater treatment system-related infrastructure off of BNL property. In addition, the recording of the deeds for these properties with the Suffolk County Clerk's Office to reflect the controls and restrictions (i.e., easements) related to operation of the treatment systems has been completed for two of the six agreements that require it. The one agreement with the local electric utility (LIPA) does not require recording. BNL is working with outside counsel to properly recording these four agreements with the County.

7.1 Operable Unit I

OU I Question A: Is the remedy functioning as intended by the decision documents?

OU I Remedial Action Performance

- Based on a review of the closeout reports completed for the soil/disposal pit cleanups and wetland restoration, site inspections, and regulatory interviews, the remedies were implemented in accordance with the OU I ROD and the soil cleanup levels were met. This achieved the objectives of preventing human exposure including direct external exposure, ingestion, inhalation, and dermal contact, as well as environmental exposure to contaminants. Reconstruction of the Upland Recharge/Meadow Marsh Area wetlands was successfully implemented and has minimized uptake of contaminants in the soil/sediment by ecological receptors, including the eastern tiger salamander. Reconstruction activities included planting aquatic vegetation plants within the pond, planting native grasses adjacent to the pond, and adding riprap on the pond slopes to prevent erosion. Reconstruction of the former HWMF wetlands was performed in mid-2005. For the soil excavation remedies completed, such as the former HWMF, the former HWMF Perimeter Area, Building 811, and the former residual surface soils at the Chemical Holes, the work was performed in accordance with the ROD, applicable design documents, and Remedial Action Work Plans. The soil cleanup levels defined in the ROD have been met for these areas. Buildings 810 and 811 were demolished in 2015 following their decommissioning from active use. The removal of contaminated soils associated with these buildings was initiated in 2015 and completed in 2018. Final status surveys were performed following the completion of soil remediation and independent verification was conducted by ORISE.
- The landfill areas were capped in accordance with the ROD and the NYS Part 360 requirements. The buried waste is contained and groundwater monitoring results indicate that the caps have achieved

the objective to minimize the further leaching of contaminants into the groundwater. Although groundwater monitoring results for the Current Landfill indicate that several VOCs (e.g., chloroethane and benzene) and metals (e.g., iron and sodium) continue to be detected at concentrations above MCLs in several downgradient wells, there has been an overall reduction in VOC concentrations since the landfill was capped in 1995. VOCs continue to be released from the northeast side of the landfill. Characterization work to assess the downgradient migration of these VOCs was performed in 2016 and included the installation of several new wells to enhance the monitoring network. Groundwater monitoring results indicate that the VOC concentrations will attenuate to below the MCLs before the contaminated water migrates to the southern site boundary. An updated monitored natural attenuation (MNA) model simulation was performed in 2016, and the results were consistent with these observations. Sentinel well 098-99 was installed in 2016 to monitor groundwater quality approximately 1,000 feet south of the Current Landfill and 2,000 feet north of the site boundary. Over the past five years, there were no detections of VOCs in this well that exceeded the MCLs. Tritium has not been detected in Current Landfill monitoring wells since 2015. Sr-90 has not been detected since 2023, and concentrations have remained below the 8 pCi/L MCL since 1998. During 2025 there were no detectable levels of radiological concentrations in any of the Current Landfill wells. PFAS, and 1,4-dioxane have been detected in Current Landfill monitoring wells at concentrations that exceed applicable NYS DWS and AWQS. The OU X RI/FS will further evaluate the extent of PFAS and 1,4-dioxane downgradient of the Current Landfill.

- At the Former Landfill, there has been a significant reduction in contaminant concentrations since it was capped in 1996. Because VOC and radionuclide (e.g., tritium and Sr-90) concentrations have remained below MCLs, groundwater monitoring was discontinued at the Former Landfill starting in 2021.
- The soil cover placed on the ash pit prevents direct contact with the metals in surface soils and prevents the potential migration of the metals by wind.
- The OU I ROD selected the 1996 interim remedy of natural attenuation, monitoring, and institutional controls as the final remedy for this area. The 1996 Action Memo (BNL, 1996b) provides further details on the remedy. The OU I groundwater treatment system operated from 1997 to 2019. The treatment system was placed in standby mode in July 2013 following regulatory approval of the *Petition for Shutdown of Operable Unit I Groundwater Treatment System* (BNL, 2013a). Because TVOC concentrations remained below the capture goal of 50 µg/L in both the monitoring and extraction wells, the *Petition for Closure, OU I South Boundary Groundwater Treatment System* (BNL, 2019a) was approved by the regulators in September 2019. There has been no evidence of VOC concentration rebound since the system was shut down. The remediation system successfully remediated VOCs in groundwater which originated from the Current Landfill and former HWMF (Figures 5-1 and 6-1).
- In 2015 and 2016, groundwater monitoring identified Sr-90 in groundwater at the former HWMF at higher concentrations than were previously observed (See Section 6.4.1). It appears that the increase in Sr-90 concentrations was the result of the removal of structures and paved areas during the 2005 source area cleanup of the former HWMF, which resulted in uncapping and exposing residual soil contamination to the effects of precipitation and mobilization of Sr-90 to groundwater. The natural attenuation modeling for Sr-90 in groundwater was updated in 2021 (Arcadis, 2021b). The attenuation simulations were run using the conservative Method of Characteristics (MOC) solution which eliminates the effects of dispersion. A model sensitivity analysis was also conducted by varying peak plume concentrations. This analysis showed that the ultimate attenuation of the plume is primarily dependent on the overall plume mass. The model used a conservative concentration of 750 pCi/L to simulate transport solution schemes. The simulation indicated that Sr-90 concentrations slightly above the MCL could reach the site boundary by 2080. The peak concentrations observed in groundwater during 2025 was 234 pCi/L, a significant reduction from the peak of 689 pCi/L observed

in 2020, and from the concentration used during 2021 to model natural attenuation of the Sr-90. Monitoring data continues to support the 2021 updated model. Continued periodic monitoring of the plume will be conducted to verify the expected attenuation of the Sr-90 plume.

OU I System Operations/O&M

- BNL performs monthly surveillance of the caps and associated drainage structures at the Current and Former Landfill areas. Although evidence of burrowing by small animals is common, the burrows do not penetrate beyond the outer soil layer and therefore do not affect the protectiveness of the caps. The burrows are filled in and repaired as they are found through the inspection process. Grass areas are typically mowed twice per year, and small pine seedlings are removed before their roots can damage the caps. The landfills are used by migratory birds but not ground nesting birds. Monthly inspections will continue to ensure that the caps are properly maintained and repaired.
- The OU I Treatment System has been maintained since it was approved for closure in 2019. The treatment system and all associated components will be maintained in an operationally ready state until the completion of the OU X RI/FS.

OU I Costs of System Operations/O&M

The OU I treatment system was shut down in 2013, and approved for closure in 2019. The average annual O&M cost was approximately \$19K over the last five years. This does not include project engineering, project management, or groundwater monitoring well sampling and analysis costs.

OU I Implementation of Institutional Controls and Other Measures

The LUICs that are in place and maintained for OU I include:

- Postings to communicate potential hazards and aid in controlling access at areas such as Building 650 Sump Outfall, the former Waste Concentration Facility area, Upland Recharge/Meadow Marsh Area Pond, the Ash Pit, and former HWMF.
- Restriction on activities in the Landfills and Ash Pit areas that could compromise the integrity of the caps.
- Institutional controls for all three phases of the former HWMF Perimeter Areas are being implemented. The Phase II area was granted to the Long Island Solar Farm in 2010 via an easement from DOE. The Phase II cleanup allowed for industrial reuse of the property as a solar farm but prohibits soil removal from this area.
- Fencing around cleanup areas such as the Current Landfill and former HWMF to control physical access.
- Maintenance of landfill engineered caps to prevent continued groundwater contamination, and soil covers over residual soil contamination to prevent direct exposure to site workers, visitors, and wildlife.
- Several wetland areas that may contain protected habitats are adjacent to the former HWMF. NYSDEC regulates all work within 100 feet of wetlands with confirmed protected species habitats. Any work activities within 100 feet of a wetland requires DOE and NYSDEC notification and approval. Further, BNL limits activities within 850 feet of wetlands with confirmed protected species habitats.
- Restrictions/controls on the pumping and recharge of groundwater on the BNL site until cleanup levels are achieved. This will help maintain consistent groundwater flow directions.
- Groundwater monitoring to track contaminant plumes and verify the effectiveness of source controls. Monitoring results are summarized in the annual Groundwater Status Reports.

No activities were observed at OU I that violated the institutional controls.

OU I Monitoring Activities

- The data obtained from the groundwater monitoring wells provide the basis to evaluate the effectiveness of monitored natural attenuation and engineered caps. The monitoring wells for the OU I plume and treatment system are categorized as background, core, perimeter, or bypass wells. The landfill areas are monitored by upgradient and downgradient wells. Descriptions of the wells that are sampled and their monitoring frequencies are presented in the annual *BNL Environmental Monitoring Plan* (BNL, 2025d). The monitoring data are reported in the annual *BNL Groundwater Status Report* (BNL, 2025b) and the *BNL Environmental Monitoring Report – Current and Former Landfill Areas* (BNL, 2025d).
- The Sr-90 plume from the former HWMF is characterized periodically via temporary and permanent monitoring wells to monitor its movement and attenuation over time.

OU I Early Indicators of Potential Issues

- The OU I ROD selected the 1996 interim remedy of natural attenuation, monitoring, and institutional controls as the final remedy for this area. The 1996 Action Memo (BNL, 1996b) provides further details on the remedy. In 2015, groundwater characterization identified Sr-90 in groundwater at the former HWMF at higher concentrations than were previously observed (**Section 6.4.1**). The groundwater model was updated in 2021 where the attenuation of the Sr-90 plume was simulated based on conservative concentration estimate of 750 pCi/L. The model predicted that Sr-90 concentrations at or just above the drinking water standard of 8 pCi/L may reach the site boundary by 2080 (Arcadis, 2021b). Continued monitoring of the plume will be used to evaluate the potential for off-site migration of Sr-90 at concentrations that would exceed the 8 pCi/L MCL.
- Strontium-90 is migrating at a slow rate (20-40 feet per year) and there is a comprehensive groundwater monitoring network in place to verify the expected attenuation of the plume. Given the concentrations observed from 2021 through 2025, there does not appear to be any problems or issues at this time that could place protectiveness of the remedies at risk.

OU I Opportunities for Optimization

- Tracking Sr-90 contamination in groundwater migrating from the former HWMF yard requires continued monitoring using permanent monitoring wells and the periodic installation of temporary profile wells. The permanent monitoring network was improved over the past five years with the addition of monitoring wells positioned in the highest concentration segments of the plume along with several new sentinel monitoring wells that are positioned to provide information on the migration of the leading edge of the plume. Plume migration will be assessed on an annual basis and reported in the annual Groundwater Status Reports.

OU I Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

OU I Changes in Standards and items To Be Considered (TBCs)

- As identified in **Attachment 4**, the standards or TBCs in the OU I ROD have changed for lead, and could call into question the protectiveness of the remedy. The cleanup level for lead defined in the OU I ROD, based on EPA's soil screening level guidance at that time, was 400 mg/kg, which was protective of residential use (BNL, 1999). The Residential Lead Directive for CERCLA Sites and RCRA Hazardous Waste Cleanup Program Facilities published in October 2025, established the following: a removal management level of 600 mg/kg for; a regional screening level of 200 mg/kg for lead in residential soil; and a target children's blood lead level (BLL) of 5 µg/dL to develop PRGs (EPA, 2025). Lead was named a primary contaminant of concern in OU I at the following AOCs:

the former HWMF (AOC 1); landscape soils (AOC 16S.3); and Ash Pits (AOC 2F). The presence of lead in sediment was also detected at the Wooded Wetland (AOC 3), and Recharge Basin HW (24F) but not at concentrations that would impact human health (BNL, 1999).

- At the former HWMF (AOC 1), the remedy selected for the isolated area with lead contamination was excavation until the concentrations in those areas were below the cleanup goal of 400 mg/kg. The results of the confirmation sampling following the completion of the remediation effort demonstrated conformance of the site cleanup goals. Further, the maximum detection of lead from confirmation samples was 68 mg/kg. The remediated areas were backfilled with soil and topsoil to complete site restoration. Institutional controls, monitoring, and maintenance of the soil cap prevent access to residual contamination. Recreational and residential uses are prohibited (Envirocon, 2005).
- The remedy selected for Ash Pits (AOC 2F) was the installation of a 12-inch soil cap to address metal contamination in soil. Institutional controls, monitoring and maintenance of the soil cap limits access to the to the residual contamination. Recreational and residential uses are prohibited. These activities meet the EPA guidance on lead contaminated soil (BNL, 2004e).
- Several sub-AOCs are related to radiologically contaminated landscape soils. One of the sub-AOCs, AOC-16S.3 is an area south and west of Building 515. One soil sample result from supplemental sampling performed in this area detected lead at a concentration of 2,310 mg/kg, exceeding the cleanup goal of 400 mg/kg. The remedy for this sub-AOC included excavation of approximately 11 cubic yards of soil from the area (BNL, 2001c).

The institutional controls placed on each AOC noted above restrict recreational and residential uses of the areas. Further, confirmation samples at former HWMF (AOC 1) showed maximum lead detections far below the 2025 Directive. Therefore, the remedy is still protective of human health, and because of the implemented institutional controls that restrict access, specifically at former HWMF. Additionally, the remedy at Ash Pits and Landscape Soils AOC 16S.3 remains protective of human health due to the implemented institutional controls that restrict access.

- Radiological soil cleanup levels and the MCLs for remaining contaminants of concern are unchanged since the signing of the ROD in 1999. The EPA's fourth Six-Year Review of the drinking water standards was completed in July 2024. EPA determined that there are no additional candidates identified for regulatory revision.
- The 2020 issuance of the NYS MCLs for PFOS, PFOA and 1,4-dioxane, and the 2024 issuance of the federal MCLs for PFOS and PFOA will require additional characterization of these compounds in OU I groundwater. Data collected to date and future remedial investigation and/or remedial actions will be incorporated under OU X.
- The soil cleanup levels for radionuclides are based on 15 millirem per year (mRem/yr) above background. As stated in the 2014 *EPA memorandum on Radiation Risk Assessment at CERCLA Sites: Q&A* (EPA, 2014a), the Superfund recommendation is now 12 mRem/yr as the dose-based level protective of a target cancer risk of 1×10^{-4} . This could have a minor effect on risk-based levels of radionuclides in soil. However, it is noted that the soil cleanups performed to date have met the NYSDEC guidance of 10 mRem/yr above background. Therefore, despite the change in the recommendation, the remedy remains protective.
- **Attachment 5** provides the cleanup levels for the OU I primary contaminants of concern.

OU I Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU I or in the use of the site that would

reduce the protectiveness of the remedies or require updates to the risk assessment. The EPA screening level for lead was updated in October 2025, to reflect a lower residential screening level than originally used when performing the OU I soil remediation (EPA, 2025). Despite this, the original soil remediation achieved lower concentrations than the updated screening levels. The exposure assumptions used in the original risk assessment remain consistent with current land use.

- In general, the changes in standard default exposure parameters from the EPA's memorandum *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120* issued on February 6, 2014 (EPA, 2014b) (2014 Standard Default Exposure Factors) served to raise risk-based concentrations. In most cases the mix of higher and lower individual parameters, such as ingestion rates, body weights and exposure durations result in higher risk-based concentrations.
- Federal Guidance Report 15, entitled *External Exposure to Radionuclides in Air, Water and Soil* (EPA, 2019a), updated and expanded the 1993 Federal Guidance Report No. 12 to include age-specific reference person effective dose rate coefficients based on external exposure. The changes include updated tissue weighting factors and radionuclide decay data. While this change does not affect MCLs, risk-based levels and risk assessment for external exposure may be affected.
- As part of the *2006 Five-Year Review* (BNL, 2006), a preliminary screening of the OU I groundwater VOC plume was performed to evaluate the potential for soil-vapor intrusion. The Current Landfill is the only OU I area with VOC contamination that is close to an inhabited building. Although groundwater contamination immediately beneath the Current Landfill is shallow and the concentrations of several VOCs exceed MCLs, the closest office building, the National Weather Service building, is approximately 1,000 feet upgradient of the landfill. The downgradient portion of the plume is deeper and has a clean layer of groundwater above. Therefore, the contaminants are not present in the uppermost portion of the water column to present a soil-gas concern. As part of the *2021 Five-Year Review* (BNL, 2021a), *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway From Subsurface Vapor Sources to Indoor Air*, dated June 2015 (EPA, 2015), was reviewed. Although the contaminants of concern in the OU I shallow groundwater plume from the Current Landfill exceed either the MCLs or EPA's Vapor Intrusion Screening Levels (VISLs), the buffer distance laterally to the nearest building is 1,000 feet and there are no preferential vapor intrusion pathways. Consequently, the subsurface vapor to indoor air pathway is incomplete. As discussed in **Section 6.4.1**, no migration of methane gas is evident in the outpost soil-gas monitoring wells between the landfill and the National Weather Service building to the north. **Figure 6-1** shows the location of the National Weather Service building in relation to the Current Landfill. However, in response to regulator comments to the *2024 Environmental Monitoring Report – Current and Former Landfill Areas* (BNL, 2025d), indoor air monitoring in the National Weather Service building was conducted in 2025. The air monitoring included screening for landfill gases (methane, hydrogen sulfide, oxygen, and carbon monoxide). No measurable concentrations were present for methane or hydrogen sulfide, and oxygen and carbon monoxide were both in the expected range for the breathing zone. The indoor air monitoring will be conducted annually and the results will be provided in future annual Current and Former Landfill monitoring reports. In the event that further construction is planned at BNL within the area of the OU I landfills or former HWMF, BNL will reevaluate any potential vapor intrusion issues and, if necessary, undertake appropriate measures to address them. Any construction projects to be undertaken at BNL are reviewed for environmental, security, and safety and health concerns in the conceptual design or early planning phase. BNL procedure *EP-ES&H-500, Project Environmental, Security, Safety and Health Review*, includes an *ES&H 500A Evaluation Form* that requires any potential issues, such as potential soil-vapor gas intrusion, be identified, documented, and mitigated, if necessary. In addition, the LUCMP and the groundwater plumes fact sheet will be revised to reflect the potential for soil-vapor intrusion should new buildings be proposed.

OU I Expected Progress in Meeting Remedial Action Objectives

- Projects completed to date within OU I continue to meet the remedial action objectives identified in the OU I ROD, based on post-excavation confirmatory soil sampling results, continued monitoring of the surface waters and sediment, groundwater monitoring downgradient of potential source areas, and visual inspections of remediated areas. Institutional controls continue to remain effective.
- The OU I groundwater restoration project is on schedule for meeting the ROD cleanup goal of reaching MCLs for VOCs in the Upper Glacial aquifer within 30 years (by 2030). The Petition for Closure was approved by the regulators in September 2019 (BNL, 2019a). The system has successfully remediated VOCs in groundwater at the site boundary. Monitored natural attenuation will reduce any remaining low-level VOCs to below MCLs before migrating offsite.
- Based on groundwater modeling results, the Sr-90 from the former HWMF is projected to be at or near the 8 pCi/L MCL when it reaches the site boundary by approximately 2080. Monitoring of the attenuation of the plume will continue.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no additional information that calls into question the protectiveness of the remedies at OU I.

7.2 Operable Unit II

The AOCs in this OU are documented in the OU I and OU III RODs, except for BLIP, which was documented in the g-2/BLIP/UST ROD. The following questions relate to remedial actions taken at the BLIP facility.

OU II Question A: Is the remedy functioning as intended by the decision documents?

- Silica grout was injected into the activated soil at the BLIP facility in 2000. This Removal Action was an additional protective measure to reduce the permeability of the activated soil. Moreover, it would reduce the potential impact of rainwater leaching radionuclides into the groundwater should the primary stormwater controls fail. The g-2/BLIP/UST ROD includes requirements for maintenance of the building roof drains and surrounding cap (including paved areas and gunite cap), and continued groundwater monitoring. No further monitoring of the silica grout injection is required.
- As reported in the *BLIP Closeout Report Removal Action AOC 16K* (BNL, 2001d), the injection of the silica grout at BLIP can be characterized as successful; however, its deployment was not. Although the objectives of minimizing threats to human health, migration of contaminants to the groundwater, and migration from operations of the facility in the future appear to have been met, the displacement of contaminated soil-pore water during the grout injection process caused a short-term impact to groundwater quality. However, the goal of improving the control of the activation area has been achieved using a combination of stormwater controls and the silica grout. As discussed in **Section 6.4.9** above, the concentrations of tritium in the groundwater have remained less than the 20,000 pCi/L MCL since early 2006.
- The cap inspections and required repairs are included under BNL's Preventative Maintenance Program. The gunite cap, paved areas, and roof drains at BLIP are in good condition and are effectively controlling stormwater infiltration. Although direct inspection or maintenance of the silica grout is not possible, it is expected to be in good condition and would be effective in preventing significant leaching of tritium from the activation zone.
- Semiannual groundwater monitoring of the downgradient wells and annual monitoring of the upgradient well in the immediate vicinity of BLIP continues per the 2024 *Environmental Monitoring Plan* (BNL, 2025d), and the monitoring results are summarized in the annual Groundwater Status Reports.

The final remedy for the BLIP facility was documented in the g-2/BLIP/UST ROD, which was signed in 2007.

OU II Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

- The Remedial Action Objective to prevent further migration of radionuclides from the activated soil shielding to the groundwater is still valid. There have been no changes to the exposure assumptions or the MCLs for the primary contaminants of concern (Cs-137, tritium, Sodium-22).
- There have been no physical changes to the BLIP area except as an added measure of protection, an extension of the protective concrete cap over the Linac-to-BLIP spur was constructed in late 2004, and the spur cap was further extended in several areas in 2015. The spur is where the beam line from the Linac is directed into the Linac-to-BLIP beam line, and is an area where beam losses have the potential to activate the surrounding soil shielding.
- **Attachment 5** provides the cleanup levels for the primary contaminants of concern.

OU II Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no additional information that calls into question the protectiveness of the remedy at BLIP.

7.3 Operable Unit III

OU III Question A: Is the remedy functioning as intended by the decision documents?

OU III Remedial Action Performance

- The OU III groundwater plumes are tracked and monitored via a comprehensive network of temporary and permanent monitoring wells on and off the BNL property. Plume and treatment system monitoring data, and system performance and recommendations for optimization are described in the annual Groundwater Status Reports.
- The groundwater remediation program remains on track to reach the overall groundwater cleanup objectives for most of the OU III projects, as defined by the OU III ROD and modified by the OU III ESDs. These objectives are:
 - Meet MCLs for VOCs and tritium in the Upper Glacial aquifer by 2030.
 - Meet MCLs for Sr-90 at the former Chemical Holes plume and the BGRR/WCF plumes by 2040 and 2070, respectively.
 - Meet MCLs for VOCs in the Magothy aquifer by 2065.
- Remediation of the OU III plumes began in 1997. Fifteen of BNL's 20 groundwater treatment systems were implemented under OU III. Six of these systems are currently in active operation. Six systems met the cleanup goals and were closed (Carbon Tetrachloride, Industrial Park East, HFBR Tritium Pump and Recharge, Building 452 Freon-11, Industrial Park, and LIPA [portion of LIPA/Airport system]) and two systems (Chemical Holes Sr-90, and North Street East EDB) are shutdown in standby mode and will be restarted if a rebound in contaminant concentrations is observed. The original North Street East VOC treatment system was approved for shutdown in 2014.
- The operational timeframes for several treatment systems have recently been extended to ensure capture of upgradient contamination. Four additional extraction wells were added to the Western South Boundary System in 2019 to address VOC contamination that was deeper than what the originally designed treatment system could effectively capture. Two extraction wells were added to the North Street East System (currently referred to as the North Street East EDB treatment system) and began operation in 2020 to address a plume of EDB that had not been previously detected. With these modifications, these systems are on track to meet the cleanup objectives in the ROD. Design

plans for additional extraction wells at the Middle Road and South Boundary systems are underway to address VOCs that are present in a low permeability zone within the deep Upper Glacial aquifer that is slowing the migration and capture of the plume. Even if these modifications are implemented, it is likely that these two systems will not meet the cleanup objective for VOCs by 2030 due to the slow migration rate of the plume.

- A detailed discussion of the progress of the OU III groundwater remediation is available in the *2024 Groundwater Status Report* (BNL, 2025b) (see **Attachment 1** for the USB drive or <https://www.bnl.gov/gpg/gw-reports.php>).
- DOE offered free annual water testing to the one homeowner known to be using a private well for drinking water purposes in the OU III public water hookup area. The analytical results from 2024 indicated that the water quality did not comply with NYS drinking water standards for PFOA. In 2025, the NYSDEC, in consultation with NYSDOH, requested that DOE provide an alternate water supply to this residence, along with other potentially responsible parties. Based on the hydrogeologic conditions and the available groundwater characterization data collected in the area of the residence, DOE declined the request. The residence was provided with an alternate water supply by others, and was connected to public water in 2025.
- The additional extraction wells installed between 2012 and 2019 at the Middle Road, South Boundary, Western South Boundary, North Street East and Industrial Park systems are addressing the VOC/EDB contamination that is deeper than the extraction/recirculation wells originally installed in these areas. These wells continue to address contamination at or near the deep Upper Glacial/Magothy aquifer interface.
- In 2024, an in-situ chemical treatment of residual PCE in the Building 96 source area was performed to reduce the mobility of PCE and enhance its degradation as an effort to optimize active groundwater treatment and MNA. The effort was completed as an Issue/Recommendation identified in the 2021 Five-Year Review to accelerate the cleanup timeframe in the area. The treatment consisted of injecting colloidal carbon and liquid zero valent iron (ZVI) solution throughout the source area. The work is summarized in the *Building 96 Source Area Optimization Report* (P.W.Grosser, 2024). Post-injection monitoring of the source area and downgradient monitoring wells and the treatment system indicate the injection work was successful. However, additional monitoring is needed to verify the long-term effectiveness of the action and the cleanup timeframe.

OU III System Operations/O&M

The operation of each of the treatment systems is evaluated in a number of ways: weekly during project status meetings, monthly during preparation of the NYSDEC SPDES discharge monitoring reports, quarterly during preparation of the quarterly operation reports, and annually during preparation of the Groundwater Status Report. These evaluations include review of the extraction well and system influent data, treatment system midpoint data, if appropriate, and the effluent data. The systems' O&M manuals identify required preventative maintenance tasks. The systems are routinely inspected and are also monitored remotely via a computerized communications system which allows for control panel information to be viewed remotely. There does not appear to be any issues that would impact continued operations or the effectiveness of the remedies. The BNL Preventive Maintenance Program helps to eliminate unnecessary system shutdowns due to routine wear and tear on equipment. Maintenance of remediation system recharge basins, such as periodic scraping to remove sediment buildup, is performed in accordance with the *Natural Resource Management Plan for Brookhaven National Laboratory* (BNL, 2016f) to ensure protection of potential eastern tiger salamander habitats.

- Operational changes in system pumping during the past five years as individual extraction wells neared or met the capture goal include the following:
 - Western South Boundary extraction well WSB-2 remained in standby. Extraction wells

WSB-3, WSB-4, WSB-5, and WSB-6 were placed in pulsed pumping mode in 2023. Extraction well WSB-1 was placed in standby in 2024.

- Building 96 well RTW-1 was modified to accommodate a larger pump and motor in June 2019 to increase the capture zone of this well. The well was disconnected from the Building 96 Treatment System and re-routed to the nearby former Building 452 Freon-11 System air stripper to handle the increased flow. The well operated full time until May 1, 2022, when it was placed on a pulsed pumping schedule. In May 2024 the well was placed in standby during the chemical treatment injection project at the PCE source area. The well was returned to pulsed pumping in March 2025. Well RTW-2, RTW-3 and RTW-4 remained in standby mode.
- Middle Road extraction well RW-3 was placed in standby in 2025, following a recommendation presented in the *2024 Groundwater Status Report* (BNL, 2025b). Extraction wells RW-1, RW-4, RW-5 and RW-6 remained in standby. Extraction wells RW-2 and RW-7 were operational full time.
- South Boundary extraction wells EW-3, EW-5, EW-6, EW-7, EW-8, and EW-12 remained in standby mode. Extraction well EW-4 was placed in standby mode in 2021. Extraction well EW-17 remains in full-time operation.
- Airport extraction wells RTW-1A, RTW-4A, and RW-6A were fully operational. Wells RTW-2A and RTW-3A were in pulsed pumping mode until March 2020, when both were put on standby. RTW-5A remained in standby. All LIPA extraction wells have been in standby mode since 2017. The LIPA system was approved for closure in 2024 (BNL, 2024a).
- The North Street treatment system was approved for closure in March 2020.
- North Street East extraction wells NSE-1 and NSE-2 have remained in standby mode since 2014.
- The North Street East EDB extraction wells NSE-EDB-EW-3 and NSE-EDB-EW-4 began operation in July 2020 and were placed in pulsed pumping mode in May 2024. The system was approved for shutdown in January 2026 (BNL, 2025f).
- BGRR extraction well SR-1, continued to operate full time. Extraction well SR-2 was placed in standby mode in September 2025. Extraction wells SR-4 through SR-7 remained in standby mode. Extraction well SR-8 was placed on standby in 2022, and SR-9 was placed in standby mode in 2023. Extraction well SR-3 was originally placed in standby mode in 2022, and was turned back on in October 2024 due to elevated Sr-90 concentrations observed in monitoring well 075-701. The extraction well was placed back into standby mode in March 2025. The future operation of SR-3 will be contingent on the observed groundwater fluctuations and Sr-90 results within 075-701.
- The Chemical Holes System was approved for shutdown in July 2018 and extraction wells EW-1, EW-2, and EW-3 have remained in standby mode (BNL, 2018a).

The OU III treatment systems experienced only minor downtime or other operational issues over the past five years, and treatment system discharges have consistently met the NYSDEC SPDES discharge equivalency permit requirements for VOCs and Sr-90. As noted in **Section 6.4.7** multiple systems are discharging treated water above the NYS AWQGVs for PFOS, PFOA, and/or 1,4-dioxane that were established in 2023. These systems are being monitored in accordance with the *Groundwater Treatment System Discharge Compliance Plan* (BNL, 2024d), and are continuing to meet the requirements in the respective SPDES equivalency permits. A summary of issues, successes, and lessons learned from the operation of the various treatment systems follows.

- Four systems received updated SPDES Equivalency Permits over the last five-year period: Chemical

Holes (2023), North Street/North Street East (2025), Industrial Park (2025), and BGRR (2025). Changes to the equivalency permits included the following:

- Chemical Holes: Addition of monthly analysis for PFOS and PFOA should the system be restarted. The effluent limitation will be “monitor” until the completion of the upgrade for the treatment system as specified in the Schedule of Compliance established by DER.
 - North Street/North Street East: Addition of quarterly analysis for PFAS and 1,4-dioxane. The effluent limitation will be “monitor” until the completion of the upgrade for the treatment system as specified in the Schedule of Compliance established by DER.
 - Industrial Park: Addition of monthly analysis for 1,1-dichloroethane (1,1-DCA), and quarterly analysis for PFAS and 1,4-dioxane should the system be restarted. The effluent limit for 1,1-DCA was set for 5 µg/L. The effluent limitation for PFAS and 1,4-dioxane will be “monitor” until the completion of the upgrade for the treatment system as specified in the Schedule of Compliance established by DER.
 - BGRR: Addition of quarterly analysis for PFAS. The effluent limitation will be “monitor” until the completion of the upgrade for the treatment system as specified in the Schedule of Compliance established by DER.
- The Middle Road, South Boundary and Western South Boundary treated effluent is distributed between the OU III basin and the RA V basin. This is accomplished through the use of a wet well adjacent to the air strippers and allows for the management of the amount of water that is discharged to each basin. This balancing of discharges, in combination with carefully coordinating water withdrawals from BNL’s potable water supply wells, has been successful in allowing for the maintenance of relatively steady groundwater flow directions on the BNL site and minimizing the potential shifting of OU III plumes.
 - Resin usage for the Sr-90 treatment systems remains lower than originally estimated, resulting in lower operational costs. Due to the reduction in the number of extraction wells in full-time operation and the lower Sr-90 concentrations, the frequency of resin changeouts for the BGRR System has been reduced over the system’s operational life from two to three times per year to annually.
 - Granular activated carbon usage for the BGRR was minimal through 2024 due to the low level of VOCs being treated by the system. In 2025, the SPDES Equivalency Permit was renewed, resulting in the addition of PFOA and PFOS limits to the equivalency permit. The GAC in the vessels was immediately replaced to come into compliance with PFOS and PFOA discharge limits specified in the renewed equivalency permit. Granular activated carbon usage will increase for this system as PFAS are consistently detected in the extraction wells.
 - In 2015, a change was made to the method of disposal of the spent Sr-90 resin from the treatment systems which resulted in cost savings and waste minimization. Instead of disposing of the entire vessel that contains the spent resin as low-level radioactive waste, the resin is now vacuumed from the vessels and disposed of in 55-gallon drums. The vessels are then reused.
 - Lightning strikes in the vicinity of the treatment systems have caused occasional problems with the control systems. Systems are periodically disabled due to this issue. The programs for each system are backed up and spares of frequently impacted parts are stocked in order to mitigate system downtime. This is also a sitewide problem for other BNL utilities.
 - Systems have been placed in standby several times over the period as a result of winter storms. During these events, the systems are placed in standby as a precautionary measure due to the fact that they may become inaccessible for days to weeks.

OU III Costs of System Operations/O&M

- The O&M costs over the past five years for the OU III treatment systems are presented in **Table 4-1** in **Section 4.3**. The largest overall cost drivers for the systems are electricity, disposal or reuse of spent carbon and resins, and annual access payments to off-site property owners. It is noted that the O&M costs in this document do not include costs for field engineering and project management or costs associated with sampling and analysis of the monitoring wells associated with each project.
- Brookhaven National Laboratory continues to successfully minimize costs for many of the systems by shutting off extraction wells when influent concentration data and groundwater contamination levels at a given location are very low and meet the shutdown criteria. The extraction wells remain in standby mode and continue to be monitored. A few of the extraction wells were restarted due to rebound in VOC concentrations. A depiction of the current operating status of the individual extraction wells is provided on **Figure 4-1**.
- Due to the extensive use of activated carbon for the treatment of contaminated groundwater, a large-scale carbon services contract was awarded based on competitive bidding. The contractor performing this work regenerates the carbon in batches and returns the cleaned carbon back to that specific project the next time a carbon replacement is needed.
- Access agreements were negotiated with private property owners to allow the operation of treatment systems on their property. In consideration for access for the North Street East EDB system, payments are made to the property owners for as long as elements of the treatment system is on their property. Although access agreements are also in place for the other off-site treatment systems, no lease fees are required because they are either constructed on publicly owned property or along public rights-of-way, or the property owner did not request compensation for the use of the property.

OU III Implementation of Institutional Controls and Other Measures

Institutional controls are in place at BNL to ensure the effectiveness of all groundwater remedies. The OU III groundwater LUICs continue to be maintained and are effective in protecting human health and the environment. During the past five years, there have been no activities in any of the OU III areas that would have violated these institutional controls.

The LUICs that are in place and maintained for OU III include:

- Monitoring groundwater quality in the vicinity of each treatment system to evaluate the system's performance and to detect any change in conditions that might result in the system not meeting its stated objective or that might allow a plume to threaten a water supply source. The details of this monitoring program are described in the *BNL Environmental Monitoring Plan* (BNL, 2025d).
- An extensive groundwater monitoring program to track contaminant plumes.
- Monitoring of BNL potable water supply system and Suffolk County Water Authority (SCWA) monitoring of the SCWA's water supply wells closest to BNL.
- Continual assessment of remediation progress, preparation of quarterly treatment system operational reports, and preparation of annual Groundwater Status Reports.
- Performing five-year reviews in accordance with CERCLA until cleanup goals are met. These reviews help to communicate the effectiveness of the groundwater remediation program to the regulatory agencies and public.
- Controls placed on the installation of new supply wells and recharge basins on BNL property.
- Testing of private wells within the OU III hookup area is no longer conducted. The properties previously identified in OU III were connected to public water over the last five-year period.
- BNL maintaining an internal Water and Sanitary Planning Team to coordinate operational activities on the BNL site that may impact groundwater flow directions and possible plume migration pathways.

The committee also tracks and evaluates changes in groundwater management activities off of the BNL site (i.e. water withdrawals and recharge operations) to determine if they could affect BNL groundwater remedies.

- Property access agreements for treatment systems off of BNL property are in place and the requirements are being met. BNL is currently working to renew one expired agreement.
- Protecting the treatment systems installed off of the BNL site. These systems are fenced, with locked and alarmed buildings. No significant security violations have occurred.

OU III Monitoring Activities

- Monitoring data for the treatment systems and associated groundwater monitoring wells are used to evaluate the performance and effectiveness of the remediation activities. These data are reported in the annual Groundwater Status Report.
- Proposed changes to the groundwater monitoring program are presented each year in the annual Groundwater Status Report and are implemented following regulatory approval. Changes to several of the OU III plume monitoring networks were recommended in the *2024 Groundwater Status Report* (BNL, 2025b). Typically, these modifications include the installation of additional permanent and temporary monitoring wells, changes in sampling frequency, and changes in analytical procedures. Decommissioning of monitoring wells and extraction wells will be evaluated once the characterization of PFAS and 1,4-dioxane plumes are complete. Proposed changes to monitoring programs are designed to improve contaminant plume tracking and obtain the information required to assess remediation progress. **Tables 6-3** summarize the permanent monitoring and extraction wells installed over the last five years.

OU III Early Indicators of Potential Issues

- The Industrial Park treatment system was approved for closure in 2025 (BNL, 2025a). Concentrations of individual VOCs continue to periodically exceed MCLs in select monitoring wells. Monitoring will continue in accordance with the post-closure monitoring plan for the system.
- The Middle Road treatment system continues to operate with extraction wells RW-2 and RW-7 in full time operation, and the South Boundary treatment system continues to operate with extraction well EW-17 in full time operation. As noted in **Section 6.4.3**, the operation of EW-17 is effectively capturing the plume and preventing offsite migration; however, VOC concentrations in the deep Upper Glacial aquifer are not declining at a rate that will definitively meet the ROD cleanup goal of meeting MCLs by 2030. Per the 2021 CERCLA Five-Year Review Report recommendations (BNL, 2021a), groundwater modeling simulations were performed in 2025 to evaluate the performance of the existing Middle Road and South Boundary treatment systems and make recommendations for potential enhancements that may expedite aquifer cleanup efforts. The modeling assessment recommended installation of three additional extraction wells to expedite the cleanup timeframe, although their installation may not result in meeting the cleanup goal of 2030. The timeframe prediction is difficult to determine given the uncertainty of the migration rates of VOCs in the deep Upper Glacial aquifer. Further technical evaluation and development of preliminary designs and cost estimates is planned for 2026.
- Airport extraction wells RTW-1A, RTW-4A, and RW-6A continue in full-time operation. The nearest upgradient monitoring well, 800-94 (1,500 feet to the north), continues to show a very slow rate of decline in VOC concentrations. Because there are a limited number of upgradient wells due to access constraints, there is uncertainty as to the extent of the higher contaminant concentrations in this area. Given these access constraints, continued monitoring is required until a clear decline in VOC concentrations is observed. It is unlikely this system will meet the 2030 cleanup goal in the Upper Glacial aquifer.

- Monitoring of the groundwater downgradient of the BGRR has shown a correlation between the water table elevation fluctuations and the release of residual Sr-90 in the deep vadose zone. The fluctuations are not controlled or caused by on-site activities; rather, they are the result of natural fluctuations in water table elevation due to seasonal variations in precipitation and subsequent recharge of the aquifer. The persistent seasonal releases of Sr-90 from the deep vadose zone requires extraction well SR-3 to remain in standby mode and to operate when elevated levels of Sr-90 are detected in the nearby monitoring wells (e.g., 075-701 and 075-664).
- Periodic increases in Sr-90 concentrations at the former WCF present a similar issue to that discussed above for the BGRR. These extraction wells are operating longer than originally planned. To help optimize the groundwater cleanup at this area, WCF Buildings 810 and 811 along with contaminated soil were removed between 2015 and 2017, thereby reducing the levels of residual Sr-90 that could be leached to the groundwater. However, because the buildings and other paved areas served to cap underlying residual Sr-90 in soil Sr-90 concentrations increased in groundwater following the decommissioning activities. This is similar to increases in Sr-90 concentrations that were observed following the removal of soil and pavement in OU I at the former HWMF source area. The operation of extraction well SR-1 will continue to capture and contain the Sr-90 released to groundwater. Due to recent monitoring results for SR-2, it was recommended in the *2024 Groundwater Status Report* (BNL, 2025b) that the well be placed in standby mode. The extraction well will be restarted if elevated Sr-90 concentrations are observed in upgradient wells. Extraction well SR-1 will continue to operate full time.
- Sr-90 concentrations remained stable in several wells located in the area just south of the former Pile Fan Sump and Building 801. Underground piping and Sr-90 contaminated soils related to the former Pile Fan Sump were removed in 2000 as part of a BGRR removal action. The periodic detection of Sr-90 concentrations greater than 50 pCi/L indicates that residual contamination beneath Building 801 continues to be released to the groundwater. Attenuation mechanisms for Sr-90 are dispersion and radioactive decay (the half-life for Sr-90 is 28.8 years). At the observed concentrations, the Sr-90 is expected to attenuate to below the 8 pCi/L MCL within several hundred feet of the source area. Groundwater monitoring will continue and any significant increase from current concentrations will be evaluated.

Although the operational period of several of the VOC treatment systems will be longer than originally predicted, the treatment systems are continuing to prevent migration of the plumes and reduce overall plume size. There does not appear to be any problems or issues at this time that could place the protectiveness to human health and the environment of the remaining remedies at risk.

OU III Opportunities for Optimization

Optimization of several of the OU III groundwater treatment systems has been implemented or is being planned. The status of each groundwater treatment system and the operational status of the extraction wells are provided on **Figure 4-1**. The changes made or planned were based on an evaluation of treatment system and monitoring well contaminant concentration trends. Completed optimization activities and potential optimization opportunities include:

- Additional groundwater extraction wells were installed from 2018 through 2020 to address the deep VOC contamination in the Western South Boundary area and EDB contamination in the North Street East area. Monitoring results indicate that these modifications have been highly effective. A petition for shutdown of the North Street East EDB system was approved by the regulators in January 2026 (BNL, 2025f). A petition for shutdown for the Western South Boundary treatment system is expected to be submitted based on monitoring data.
- As noted in **Section 6.4.3**, many of the treatment system extraction wells have been in pulsed pumping mode (e.g., on one month, off the next), or have been shut down, due to a reduction in

contaminant concentrations. In several cases, entire systems have been shut down following regulatory approval (e.g., IP, NSE, LIPA). The systems and monitoring wells continue to be monitored in accordance with their respective shutdown or closure petitions to evaluate if any rebound in contamination is occurring. **Table 6-1** provides the operational status of each treatment system.

- Groundwater contaminant concentrations and areal extent of the OU III plume have decreased significantly due to the operation of the Middle Road and South Boundary Treatment Systems. However, several monitoring wells are not declining at a rate that will definitively achieve the cleanup goal of meeting MCLs by 2030 (**Figure 6-5**). Groundwater modeling simulations were performed in 2025 to evaluate the performance of the existing Middle Road and South Boundary treatment systems and make recommendations for the enhancements of the treatment systems to expedite aquifer cleanup efforts. The modeling assessment recommended installation of two additional extraction wells for the Middle Road treatment system and one additional extraction well at the South Boundary treatment system. An additional evaluation will be performed to help quantify the extent to which the cleanup timeframe can be reduced with the addition of the extraction wells. Further technical evaluation and development of preliminary designs and cost estimates for the modifications is planned for 2026.

OU III Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU III Changes in Standards and TBCs

- The standards or TBCs identified in the OU III ROD have not changed, nor do they call into question the protectiveness of the remedy.
- Guidance for radioactively contaminated soils has been issued in 2013 (NYS) but the dose limit of 10 mRem/year above background that was used to set BNL cleanup levels has not changed.
- EPA's fourth Six-Year Review of the drinking water standards was completed in July 2024. EPA determined that there are no additional candidates identified for regulatory revision.
- **Attachment 4** provides a review of any changes to the soil cleanup and drinking water standards and **Attachment 5** provides the cleanup levels for the OU III primary contaminants of concern (COCs).
- The 2020 issuance of the New York State MCLs for PFOS, PFOA and 1,4-dioxane, and the 2024 federal MCLs for PFOS and PFOA, will require additional characterization of the presence of these compounds in OU III groundwater. Data collected to date and future remedial investigation and/or remedial actions will be incorporated under OU X.

OU III Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU III or in the use of the site that would reduce the protectiveness of the remedies or render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the OU III ROD was signed in 2000 and the ESDs were signed in 2005, 2009, and 2012.
- In general, the changes in standard default exposure parameters from the EPA's memorandum *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120 issued on February 6, 2014* (EPA, 2014b) served to raise risk-based concentrations. In most cases the mix of higher and lower individual parameters, such as ingestion rates, body weights and exposure durations, result in higher risk-based concentrations.
- Federal Guidance Report 15, entitled *External Exposure to Radionuclides in Air, Water and Soil* (EPA, 2019a), updated and expanded the 1993 Federal Guidance Report No. 12 to include age-

specific reference person effective dose rate coefficients based on external exposure. The changes include updated tissue weighting factors and radionuclide decay data. While this change does not affect MCLs, risk-based levels and risk assessment for external exposure may be affected.

- There are no homes with private wells remaining in OU III that require annual water testing by DOE.
- A preliminary soil vapor screening of the OU III VOC groundwater plumes and the potential impact to newly planned buildings was documented in the 2011 *Five-Year Review Report* (2011a). Because a clean layer of groundwater exists above these plumes, the subsurface to indoor air pathway is incomplete and no further evaluation was needed. Since 2011, no additional buildings were constructed at BNL within identified OU III VOC plume areas that weren't previously evaluated. As part of the 2026 Five-Year Review, the EPA *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway From Subsurface Vapor Sources to Indoor Air*, dated June 2015 (EPA, 2015), was reviewed. The closest OU III VOC plume to an on-site building is the northern-most portion of the Western South Boundary. Geographically, Building 423, the government vehicle service station, is located approximately 475 feet west of the northern margin of the plume (**Figure 6-6**). Volatile organic compounds in this portion of the plume do not exceed MCLs; however, trichloroethene (TCE) does exceed EPA's VISL. Due to the significant buffer distance laterally and vertically (>100 feet) from the plume to Building 423, there are no preferential vapor intrusion pathways. Consequently, the subsurface vapor to indoor air pathway is incomplete.
- An ongoing construction project that BNL has been envisioning is a Federal land-use project to create a science and technology gateway zone. Labeled as "Discovery Park," this facility would be located outside the main security area to foster complimentary community and economic impact. The proposed site, the previously developed 40-acre apartment area, is contiguous to the research core of BNL and adjacent to the main entrance and William Floyd Parkway. The project would include offices, housing, and technical space. A traffic circle to access the planned facilities became operational in early 2020. The Science and User Support Center (SUSC) Building 101 was the first building constructed as part of the Discovery Park project, having been completed in 2025. The closest VOC plume is the Western South Boundary, which is approximately 2,000 feet to the east. Due to the distance laterally and vertically from the plume, the subsurface vapor to indoor air pathway is incomplete. In the event that further construction is planned at BNL within the area of the OU III VOC groundwater plumes, BNL will reevaluate any potential exposure issues and, if necessary, undertake appropriate measures to address them. Any construction projects to be undertaken at BNL are reviewed for environmental, security, and safety and health concerns in the conceptual design or early planning phase. BNL procedure *EP-ES&H-500, Project Environmental, Security, Safety and Health Review*, includes an *ES&H 500A Evaluation Form* that requires any potential issues, such as potential soil-vapor intrusion, be identified, documented, and mitigated, if necessary. In addition, the *BNL Land Use Controls Management Plan* and the LUIC groundwater plume fact sheets will be revised to reflect the potential for soil-vapor intrusion should new buildings be proposed.
- PFAS and 1,4-dioxane were detected in groundwater within the geographic area of OU III. These contaminants will be evaluated under OU X.

OU III Expected Progress in Meeting RAOs

- There are currently six groundwater remediation systems in operation under OU III. For reasons outlined above, it is unlikely that all projects will meet the ROD goal of reaching MCLs for VOCs in the Upper Glacial aquifer by 2030. The systems are on track for meeting the ROD and ESDs cleanup goal of reaching MCLs for VOCs in the Magothy aquifer and preventing or minimizing plume growth. The annual *Groundwater Status Reports* evaluates each system's performance based on decision rules identified from the BNL groundwater DQO process (see BNL *Environmental Monitoring Plan* (BNL, 2025d) for discussions of the DQO process).

- The Western South Boundary System was modified to incorporate four new extraction wells to remediate deeper VOC contamination and achieve groundwater cleanup goals by 2030. The four extraction wells have been operating in pulsed pumping mode since 2023. Groundwater monitoring upgradient of original system extraction well WSB-1 indicates that VOC concentrations are steadily declining in this area, and the extraction well was placed in standby mode in 2024. Extraction well WSB-2 was placed in standby in 2016. It is anticipated a petition for shutdown for this system will be submitted.
- The North Street East System was modified in 2020 to include two new extraction wells to address EDB contamination that had not been previously characterized. The North Street East EDB treatment system is expected to achieve its cleanup goals by 2030. The EDB extraction wells were placed in pulsed pumping mode in May 2024. A Petition for Shutdown of the North Street East EDB system was approved by the regulators in January 2026 (BNL, 2025f).
- Significant VOC cleanup progress has been accomplished in the Middle Road and South Boundary areas. Despite this progress, VOCs in a low permeability zone in the deep Upper Glacial aquifer is slowing the migration and capture of the plume. Additional extraction wells may be required to expedite the cleanup timeframe. Even with the addition of extraction wells, it is unlikely the systems will meet the cleanup goals of meeting MCLs by 2030. Design plans for additional extraction wells at the Middle Road and South Boundary systems are being prepared in 2026.
- BNL will remain alert to any new remediation techniques and technologies, as well as any operational efficiency that might accomplish cleanup sooner.
- The property access agreements for the groundwater treatment systems off of BNL property need to be recorded with the County Clerk.
- There are no known issues with any of the institutional controls that could jeopardize their future operation.

OU III Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the OU III remedies.

7.4 Operable Unit IV

OU IV Question A: Is the remedy functioning as intended by the decision documents?

Although the OU IV ROD states that a Five-Year Review of this remedial action is not necessary, the following items are provided as a summary.

- The OU IV remedial action objectives have been satisfied. The AS/SVE treatment system met its cleanup objectives and the regulators approved its dismantlement in 2003. A fence was installed as an interim measure around the Building 650 Sump Outfall in 1995 prior to excavation of the soil. The excavation of the radiologically contaminated soil in the Building 650 Sump, along with the discharge pipe and Sump Outfall, was included under the OU I ROD and was completed in 2002.
- From the fall of 2020 through the winter of 2021, Building 650 was decontaminated and dismantled. An as-left radiological survey of the building footprint and surrounding worksite was performed (BNL, 2003b). This demolition project was not included in the scope of the original OU IV remedial action; however, the regulators were kept informed of progress during monthly IAG teleconferences.
- The remediation has achieved the objectives of preventing or minimizing the leaching of contaminants from the soil into the groundwater, human exposure (including ingestion, inhalation, and dermal contact), and the uptake of contaminants present in the soil and groundwater by plants and animals.

- BNL continues to monitor for VOCs in groundwater at select wells downgradient of the former AS/SVE system, as well as monitoring for Sr-90 at the Building 650 Sump and Sump Outfall per the BNL *Environmental Monitoring Plan* (BNL, 2025d). In 2020, the installation of three temporary and two permanent monitoring wells enhanced monitoring of the Sr-90 plume core area, which has been subject to shifting groundwater flow conditions resulting from changes in nearby groundwater recharge. Two new monitoring wells were also installed immediately downgradient of former Building 650 to assist in the monitoring of any impacts to groundwater as the result of building demolition. The Sr-90 plume continues to attenuate as predicted as it migrates slowly to the south. Groundwater monitoring results are reported in the annual *Groundwater Status Reports*.
- The AS/SVE-remediated area is restricted to industrial use land use only.

OU IV Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

- The standards or TBCs identified in the OU IV ROD have not changed, nor do they call into question the protectiveness of the remedy. The radiological soil cleanup levels and the MCLs for COCs in drinking water have remained the same since 1999. **Attachment 5** provides the cleanup levels for the OU IV primary COCs.
- EPA's fourth Six-Year Review of the drinking water standards was completed in July 2024. EPA determined that there are no additional candidates identified for regulatory revision.
- The 2020 issuance of New York State MCLs for PFOS, PFOA and 1,4-dioxane, and the 2024 issuance of the federal MCLs for PFOS and PFOA will require additional characterization of these compounds in OU IV soil and groundwater. Data collected to date and future remedial investigation and/or remedial actions will be evaluated as part of the planned OU X RI/FS
- The remedial action objectives have been met and have not changed.
- The soil cleanup levels for radionuclides are based on 15 mRem/yr above background. As stated in the *EPA Memorandum on Radiation Risk Assessment at CERCLA Sites: Q&A* (EPA, 2014a), the Superfund recommendation is now 12 mRem/yr as the dose-based level protective of a target cancer risk of 1×10^{-4} . This could have a minor effect on risk-based levels of radionuclides in soil. However, it is noted that the soil cleanups performed to date have met the NYSDEC guidance of 10 mRem/yr above background. Therefore, despite the change in the recommendation, the remedy remains protective.
- Lead, a contaminant of concern in soil, had a cleanup level of 400 mg/kg, which was the EPA Regional Screening Level for residential soil and the New York State soil cleanup objective for residential and restricted residential use, and commercial or industrial use at the time of the remedial action.
 - The Residential Lead Directive for CERCLA Sites and RCRA Hazardous Waste Cleanup Program Facilities published in October 2025, established the following: a removal management level of 600 mg/kg for; a regional screening level of 200 mg/kg for lead in residential soil; and a target children's blood lead level (BLL) of 5 µg/dL to develop PRGs (EPA, 2025).
 - The institutional controls of the site do not allow for residential or unrestricted use of the areas remediated for lead contamination in soil under OU IV. Therefore, the remedy remains protective of human health.
- Federal Guidance Report 15, entitled *External Exposure to Radionuclides in Air, Water and Soil* (EPA, 2019a), updated and expanded the 1993 Federal Guidance Report No. 12 to include age-specific reference person effective dose-rate coefficients based on external exposure. The changes include updated tissue weighting factors and radionuclide decay data. While this change does not

affect MCLs, risk-based levels and risk assessment for external exposure may be affected.

- There is no remaining VOC plume in OU IV, as concentrations of VOCs in groundwater within OU IV have remained below MCLs since 2013. Further, the OU IV AS/SVE treatment system was decommissioned in 2003, and post-closure groundwater monitoring was completed in 2011. The closest building to the former area of the plume is approximately 380 feet upgradient. A clean layer of groundwater existing above the former plume area and the significant buffer distance to the nearest occupied building creates an incomplete pathway for exposure from the subsurface to indoor air. There have been no changes in toxicity values since the 2021 Five-Year Review for contaminants of concern at OU IV.

OU IV Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the remedy at OU IV.

7.5 Operable Unit V

The OU V RAOs have been met, the following items are provided as a summary.

OU V Question A: Is the remedy functioning as intended by the decision documents?

OU V Remedial Action Performance

- As a result, all groundwater monitoring requirements for OU V-STP have been met. Concentrations of VOCs have remained below MCLs since 2013, and tritium concentrations remained below the MCL over the same period.
- In 2017, supplemental sediment remediation of the PR-WC-06 area of the Peconic River was completed. Vegetation monitoring was performed in this area through 2022 to fulfill the federal monitoring duration requirement.
- The Peconic River remedy performed as intended:
 - As stated in the Peconic River ROD, the long-term monitoring program will continue to evaluate all available data to determine if additional remediation is required to ensure the protection of human health and the environment. Based on regulatory concurrence with the Peconic River sediment removal closeout reports, the most recent being Area PR-WC-06 in 2018, no additional sediment sampling is required.
 - As described in the 2016 *Five-Year Review Report* (BNL, 2016a), no additional surface water monitoring is required.
 - The 2004/2005 and 2011 Peconic River cleanup of mercury in the sediment has led to substantially reduced mercury concentrations in fish. The cleanup goal in the Peconic River ROD after remediation is limited to mercury in sediment, and no “acceptable level” in fish was identified. The annual fish monitoring results from 2006 through 2015 showed a substantial reduction in post-cleanup fish tissue average mercury concentrations relative to pre-cleanup (1997 and 2001) average concentrations. Reduced mercury concentrations mitigate potential health impacts for human and wildlife consumers of fish. Fish monitoring was discontinued under CERCLA in 2021 however, monitoring continues under the BNL Environmental Surveillance program and is documented in the annual Site Environmental Reports (BNL, 2025e; BNL, 2022d; BNL, 2024c; BNL, 2023a). In addition to the ROD-related environmental cleanup of the BNL STP soils and the Peconic River on-site and off-site sediment, remediation of the STP digester sludge and sand filter beds was completed in 2009.
 - To further improve Peconic River water quality, beginning in September 2014, the treated

STP effluent is now recharged directly to groundwater rather than continuing to be discharged into the Peconic River.

- DOE continues to offer free annual water testing to the property owner known to be using a private well for drinking water purposes in the OU V public water hookup area. The last time the property owners accepted the annual test was in 2025. The test results for 2025 indicate that the water quality complies with NYS drinking water standards.

OU V System Operations/O&M

As required by the OU V Peconic River ROD, a long-term monitoring program was implemented to ensure protection of human health and the environment. This monitoring program, conducted from 2006 through 2010, included: mercury, PCBs and cesium-137 in sediment; total mercury and methyl mercury in the water column; and mercury, PCBs and cesium-137 in fish on and off of BNL property, as appropriate. The sediment, surface water and fish monitoring results since completion of the 2004/2005 cleanup (i.e. 2006-2011) are available in the annual *Peconic River Monitoring Reports* (BNL, 2007b; BNL, 2008; BNL, 2009c; BNL, 2010c; BNL, 2011c; BNL, 2012d). From 2012 to 2014, the monitoring results were summarized in the annual *BNL Site Environmental Report* (BNL, 2013c; BNL, 2014b; BNL, 2015b). As noted in **Section 6.4.5** above, further post-cleanup sediment monitoring was discontinued in 2022. Continued fish population surveillance and monitoring was discontinued under CERCLA in 2021, however, monitoring continues under the BNL Environmental Surveillance program and is documented in the annual Site Environmental Reports. A summary of fish monitoring, as stated in the annual Site Environmental Reports, is included in **Section 5**.

OU V Costs of System Operations/O&M (Not applicable for this project.)

OU V Implementation of Institutional Controls and Other Measures

Institutional controls are in place at BNL to ensure the effectiveness of all remedies. The OU V land use and institutional controls continue to be maintained, and are effective in protecting human health and the environment. Over the last five year period, there have been no activities at any of the OU V areas that would have violated these institutional controls.

The land use and institutional controls that are in place and maintained for OU V include:

- The New York State general advisory on the consumption of freshwater fish caught from New York freshwaters applies to the Peconic River. The advisory is to eat no more than one meal (1/2 pound) of fish per week.
- The DOE does not envision any sale or transfer of property in the Peconic River area. If it were to occur, the sale or transfer would meet the requirements of Section 120 (h) of CERCLA to ensure that future users are not exposed to unacceptable levels of contamination.
- In accordance with CERCLA, five-year reviews are performed until cleanup goals are met and to determine the effectiveness of the groundwater monitoring program and sediment remediation. Following the 2017 supplemental sediment cleanup of Area PR-WC-06, sediment cleanup goals for the Peconic River have been met.
- Controls have been placed on the installation of new supply wells and recharge basins on BNL property.
- NYSDEC regulates all work within 100 feet of wetlands with confirmed protected species habitats. Any work activities within 100 feet of a wetland requires DOE and NYSDEC notification and approval.
- BNL limits activities within 850 feet of wetlands with confirmed protected species habitats.

OU V Monitoring Activities

- In January 2021, NYSDEC concurred that the wetland monitoring and maintenance performed by BNL from 2017 through 2019 at Area PR-WC-06 satisfied the conditions in the equivalency permit, and no further monitoring was needed. The details of the monitoring efforts are presented in the *2019 Peconic Wetland Monitoring Final Report – Area PR-WC-06* (BNL, 2019e). Vegetation monitoring and control the invasive species control was completed as necessary (not to exceed 10 percent of cover) through September 2022, to comply with federal duration requirements.
- All groundwater monitoring requirements detailed in the OU V Peconic ROD and OU V STP ROD were met in 2014, and no further sampling is required.

OU V Early Indicators of Potential Issues

- None.

OU V Opportunities for Monitoring Optimization

- An optimization to the Peconic River remedy was performed in 2017 with supplemental sediment removal in Area PR-WC-06. Post-excavation sediment samples indicated that the cleanup met the goals in the ROD.
- In accordance with the 2016 *Five-Year Review* (BNL, 2016a) monitoring recommendations, and following the successful supplemental sediment cleanup of Area PR-WC-06, and in consultation with the regulators, no additional Peconic River sediment or surface water sampling is needed.

OU V Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU V Changes in Standards and TBCs

- The standards or TBCs identified in the OU V ROD have not changed, nor do they call into question the protectiveness of the remedy. The mercury sediment cleanup level and the MCLs for drinking water have remained the same since 1999. **Attachment 4** provides a review of the applicable standards and **Attachment 5** provides the cleanup levels for the OU V primary contaminants of concern (mercury, Cs-137, and TCE).
- The 2020 issuance of New York State MCLs for PFOS, PFOA and 1,4-dioxane, and the 2024 issuance of the federal MCLs for PFOS and PFOA will require additional characterization of these compounds in OU V soil, sediment, and groundwater. Data collected to date and future remedial investigation and/or remedial actions will be evaluated as part of the planned OU X RI/FS.
- The soil cleanup levels for radionuclides are based on 15 mRem/yr above background. As stated in the *EPA memorandum on Radiation Risk Assessment at CERCLA Sites: Q&A* (EPA, 2014a), the Superfund recommendation is now 12 mRem/yr as the dose-based level protective of a target cancer risk of 1×10^{-4} . This could have a minor effect on risk-based levels of radionuclides in soil. It should be noted that the soil cleanups performed to date have also met the NYSDEC guidance of 10 mRem/yr above background (ALARA goal). Therefore, despite the change in the recommendation, the remedy remains protective.

OU V Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU V or in the use of the STP, the Peconic River, or the groundwater that would reduce the protectiveness of the remedies or render the initial risk analysis invalid. The exposure assumptions used in the original risk assessment are consistent with current land use.

- The diversion of the STP effluent from the Peconic River to a nearby groundwater recharge basin in September 2014 has resulted in a significant change in the extent of wet stream-bed and open water in the on-site portions of the Peconic River. This in turn affects the availability of fish sampling on site. This change also eliminated continued discharges of low levels of metals (such as mercury) to the river. The on-site portion of the Peconic River is still considered a stream, regardless of the intermittent flow patterns.
- DOE continues to offer free annual water testing to the property owner known to be using a private well for drinking water purposes in the OU V public water hookup area.
- PFAS and 1,4-dioxane have been detected in groundwater within the OU V area. These contaminants will be evaluated as part of the OU X RI/FS.
- The toxicity values for PCBs and methyl mercury are currently being reassessed under Integrated Risk Information System (IRIS) as part of Step 1 of the process (which includes a comprehensive search and systematic review of the scientific literature).

OU V Expected Progress in Meeting RAOs

- Excavation of the radiologically and metal-contaminated sediment at the STP and in the Peconic River on and off of BNL property met the appropriate cleanup levels and remedial action objectives specified in the OU V STP and Peconic River RODs. A monitoring program was implemented to demonstrate the effectiveness of the Peconic River cleanup to mitigate potential ecological effects.
- Based on the results of post-cleanup monitoring, the Peconic River remedy remains protective of human health and the environment. Supplemental remediation, followed by post-excavation confirmatory sampling in one small area was completed in 2017. As a result, further post-cleanup monitoring of the Peconic River under the ROD has been discontinued.
- Groundwater monitoring in OU V has demonstrated that MCLs for VOCs were met in 2013 and no further monitoring was needed. The need to monitor OU V groundwater for PFAS and 1,4-dioxane will be evaluated as part of the OU X RI/FS.

OU V Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the OU V remedies.

7.6 Operable Unit VI

OU VI Question A: Is the remedy functioning as intended by the decision documents?

OU VI Remedial Action Performance

- The trailing edge of the OU VI EDB groundwater plume migrated off-site in 2009 and continues to be monitored via a network of monitoring wells off of BNL property.
- The EDB groundwater treatment system was installed in accordance with the OU VI ROD and began operating in August 2004. In December 2023, the system was modified with two new extraction wells installed at greater depths than the two original extraction wells to better capture the deeper portions of the EDB plume. The new extraction wells became operational in January 2024, and based on monitoring data for 2025, the wells are effectively capturing the leading edge of the EDB plume.
- DOE continues to offer free annual water testing to the two property owners still using private wells for drinking water purposes in the OU VI public water hookup area. The last time the property owners accepted the annual test was in 2025. The test results from 2025 indicated that the water quality at both properties complies with NYS drinking water standards.

OU VI System Operations/O&M

- The treatment system operation is evaluated monthly during preparation of the discharge monitoring reports, quarterly during preparation of the quarterly operation reports, and annually in the Groundwater Status Reports. These evaluations include review of the extraction well and system influent data, treatment system midpoint data, and the effluent data.
- The treatment system experienced only minor downtime or other operational issues over the past five years, and treatment system discharges have consistently met the NYSDEC SPDES discharge equivalency permit requirements for VOCs.

OU VI Costs of System Operations/O&M

- The system has been operational for 21 years and the average annual O&M cost over the last five years is approximately \$238K. The largest overall cost drivers for the system are granular activated carbon change-outs, and electricity.
- Since the OU VI ROD was signed in 2001, two access agreements were negotiated with private property owners to allow for treatment system operations on their property. In consideration for the agreements, total payments of \$85K per year are made to the property owners as long as the treatment system is on their property.

OU VI Implementation of Institutional Controls and Other Measures

The OU VI groundwater land use and institutional controls continue to be maintained and effective in protecting human health and the environment. Based on inspections, no activities were observed at OU VI that would have violated these institutional controls.

OU VI Monitoring Activities

- The monitoring data obtained from the EDB treatment system and the plume monitoring wells provide the basis to evaluate the remediation system's performance and effectiveness.
- Several temporary and permanent monitoring wells have been incorporated into the OU VI plume monitoring network over the past five years, as recommended in the annual BNL Groundwater Status Reports. These modifications increase BNL's confidence in tracking the plume's distribution and evaluating remediation progress.

OU VI Opportunities for Optimization

- Based on a recommendation from the *2022 BNL Groundwater Status Report* (BNL, 2023a), the system was modified to include two new, deeper, extraction wells. The monitoring data from 2025 suggest that the extraction wells are controlling and remediating the leading edge of the EDB plume.

OU VI Early Indicators of Potential Issues

- The modification of the treatment system in 2023 addressed EDB contamination observed at greater depths than originally understood. The addition of the two new extraction wells are effectively preventing the further downgradient migration of the plume and reducing the overall plume size. However, additional monitoring will be needed to understand plume migration rates of this deeper contamination given the addition of the extraction wells. Based on the data collected since installation, it is unlikely this system will achieve the ROD goal to meet MCLs by 2030. The groundwater model will be updated using recent monitoring well data and aquifer pumping test data to reevaluate the cleanup timeframe.

OU VI Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU VI Changes in Standards and TBCs

- The regulatory standards or TBCs identified in the OU VI ROD have not changed, nor do they call into question the protectiveness of the remedy. The EDB standard and the MCL of 0.05 µg/L for drinking water have remained the same since 1999. **Attachment 5** provides the cleanup level for EDB, the OU VI primary contaminant of concern.
- There have been no detections of EDB in the system effluent above SPDES equivalency permit levels since the system began operations in 2004. In 2009, the NYSDEC changed the SPDES equivalency permit discharge level for EDB from 0.05 µg/L to 0.03 µg/L. In 2025, the NYSDEC modified the SPDES equivalency permit discharge level for EDB for EDB to 0.005 µg/L. There have been no detections of EDB in the system effluent above this more stringent discharge level.
- EPA's fourth Six-Year Review of the drinking water standards was completed in July 2024. EPA determined that there are no additional candidates identified for regulatory revision.
- The 2020 issuance of the New York State MCLs for PFOS, PFOA and 1,4-dioxane, and the 2024 issuance of the federal MCLs for PFOS and PFOA will require additional characterization of these compounds in OU VI groundwater. Data collected to date and future remedial investigation and/or remedial actions will be evaluated during the planned OU X RI/FS.

OU VI Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within OU VI or in the use of the site that would reduce the protectiveness of the remedies or render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2001.
- In general, the changes in standard default exposure parameters from the EPA's memorandum *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120 issued on February 6, 2014* (EPA, 2014b) served to raise risk-based concentrations. In most cases the mix of higher and lower individual parameters, such as ingestion rates, body weights and exposure durations result in higher risk-based concentrations.
- DOE continues to offer free annual water testing to the two property owners in the OU VI plume area who is still using a private well for drinking purposes. The last time the property owners accepted the annual test was in 2025. The test results from 2025 indicated that the water quality complies with NYS drinking water standards.
- An initial screening of the OU VI groundwater VOC plume was performed during the *2011 Five-Year Review* to evaluate the potential for soil-vapor intrusion. The remaining EDB plume is located off of the BNL property, is deeper (approximately 130 to 200 ft bls), and has a clean layer of groundwater above. There are periodic detections of EDB above the Target Concentration in source area monitoring well 000-570 however, the contaminants are not present in the uppermost portion of the groundwater table to complete an exposure pathway and present a soil-gas concern.

OU VI Expected Progress in Meeting RAOs

- The annual *BNL Groundwater Status Report* evaluates the system's performance based on decisions identified from the BNL groundwater DQO process (See *BNL Environmental Monitoring Plan* (BNL, 2025d) for the DQO process). As noted above, with the addition of two extraction wells, groundwater modeling will be used to reevaluate the cleanup timeframe for this treatment system. It is unlikely that the ROD cleanup goal of meeting MCLs by 2030 will be achieved.
- The two property access agreements for the groundwater treatment system need to be recorded with the County Clerk.

OU VI Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the OU VI remedy.

7.7 OU X

There is no final remedy (i.e., ROD) issued for this OU, therefore there is no associated discussion. The following is provided as a summary of the TCRA for PFAS.

OU X Question A: Is the remedy functioning as intended by the decision documents?

OU X TCRA Performance

- A TCRA for the construction of two PFAS groundwater treatment systems downgradient of the Current Firehouse and Former Firehouse was performed between 2022-2023. The Action Memorandum for the TCRA was submitted to the regulators for review in June 2021. Operation of the Current Firehouse treatment system started in October 2022, and the Former Firehouse treatment system started operation in January 2023. Final remedial responses for PFAS and 1,4-dioxane contamination will ultimately be documented in the OU X ROD.
- The Current Firehouse treatment system is effectively remediating the highest concentration portions of the PFAS plume near the Current Firehouse release area. However, an observed easterly shift in groundwater flow directions has reduced the effectiveness of several of the extraction wells to capture several downgradient portions of the Current Firehouse plume and the Building 170 plumes. The plume segments are currently being monitored using 80 permanent monitoring wells. During 2024-2025, eight temporary Geoprobe® wells were installed to confirm the shift in the positions of the plume segments. A likely cause for the shift in groundwater flow directions is the decreased use of water supply well BNL-7 and the suspended use of water supply wells, BNL-4 and BNL-6. During 2024, 12 temporary vertical profile wells were used to track the combined Current Firehouse and Building 170 plume to BNL's southwest boundary.
- The Former Firehouse treatment system is effectively remediation the highest concentration portion of the PFAS plume. The plume is being monitored using 73 permanent monitoring wells.

OU X System Operations/O&M

- The treatment system operation is evaluated monthly during preparation of the discharge monitoring reports, quarterly during preparation of the quarterly operation reports, and annually in the BNL Groundwater Status Reports. These evaluations include review of the extraction well and system influent data, treatment system midpoint data, and the effluent data.
- The treatment system experienced only minor downtime or other operational issues, and treatment system discharges have consistently met the NYSDEC SPDES discharge equivalency permit requirements for PFOA and PFOS.

OU X Costs of System Operations/O&M

- The O&M costs over the past five years for the two treatment systems are presented in **Table 4-1** in **Section 4.3**. The largest overall cost drivers for the systems are electricity and disposal or reuse of spent granular activated carbon. It should be noted that the O&M costs in this document do not include costs for field engineering and project management or costs associated with sampling and analysis of the monitoring wells associated with each project.

OU X Implementation of Institutional Controls and Other Measures

- Fact sheets and maps have been prepared for the 12 PFAS sub-Areas of Concern (33A through 33L) to maintain institutional control over PFAS-contaminated soil and groundwater. Fact sheets have not been prepared for 1,4-dioxane (AOC 34) because the historical source areas have been addressed as part of other remedial actions.

OU X Monitoring Activities

- As discussed in detail in **Section 6.4.7**, several phases of groundwater characterization have been performed since 2018 on the nature and extent of PFAS and 1,4-dioxane on and off of BNL property.
- Monitoring data for the treatment systems and associated groundwater monitoring wells are used to evaluate the performance of the TCRA. These data are reported in the annual BNL Groundwater Status Report. Additional monitoring using temporary and permanent wells will be conducted during the planned OU X RI/FS.

OU X Opportunities for Optimization

- Based on the recent characterization data which indicated that several downgradient portions of the Current Firehouse and Building 170 plume segments have shifted to the east, it may be necessary to install additional extraction wells to effectively capture the highest concentration segments of the plume segments.

OU X Early Indicators of Potential Issues

- Low levels of 1,4-dioxane are routinely detected in the influent of the Current Firehouse/Building 170 and Former Firehouse groundwater treatment systems. The treatment system effluent concentrations have been below the recently established NYS discharge standard of 0.35 µg/L. Groundwater treatment for 1,4-dioxane cannot be performed using the granular activated carbon filtration systems used from PFAS. Suitable treatment methods, such as the Advanced Oxidation Process (which use hydrogen peroxide and UV light) are costly to install and operate. Should treatment for 1,4-dioxane be required in the future for the PFAS systems, the cost is expected to be significant.
- 1,4-Dioxane concentrations above 0.35 µg/L NYS Discharge Limit have been detected in the effluent of several OU III on-site and off-site treatment systems (e.g., the OU III Middle Road/South Boundary/Western South Boundary system and OU III Airport system) that discharge the treated groundwater to recharge basins. Groundwater treatment for 1,4-dioxane cannot be performed using traditional remediation methods such as air stripping and granular activated carbon filtration. Suitable treatment methods, such as the Advanced Oxidation Process (which use hydrogen peroxide and UV light) are costly to install and operate. In accordance with the *Treatment Systems Discharge Compliance Plan* (BNL, 2024d), the design documents for 1,4-dioxane treatment systems for the OU III MR/SB/WSB and Airport systems were prepared and submitted to the regulators in 2025 (JRH, 2025b). Treatment costs for 1,4-dioxane are expected to be significant.
- PFOS has been detected in the treatment system effluent of the BGRR/WCF Sr-90 treatment system, the OU III Middle Road/South Boundary/Western South Boundary VOC treatment system, and the OU III Building 96 VOC treatment system at concentrations that exceed the NYS discharge standard of 2.7 ng/L. The discharges at the BGRR/WCF system were resolved by placing fresh GAC in the existing filters. However, as described in the *Groundwater Treatment Systems Discharge Compliance Plan* (BNL, 2024d), modifications to treat PFAS and 1,4-dioxane may be required for the OU III Middle Road/South Boundary/Western South Boundary system.

OU X Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

OU X Changes in Standards and TBCs

- In August 2020, New York State issued MCLs for PFOS (10 ng/L), PFOA (10 ng/L) and 1,4-dioxane (1.0 µg/L). Furthermore, in 2024 federal drinking water standards of 4 ng/L were established for PFOS and PFOA and four other PFAS. This requires characterization of the presence of these compounds in groundwater on and off of the BNL property. BNL has been proactively characterizing the extent of these contaminants in groundwater since 2017. The full extent of PFAS and 1,4-dioxane

contamination in soil, sediment and groundwater will be further evaluated during the planned OU X RI/FS.

- In May 2023, NYSDEC issued Ambient Water Quality Standards for PFOA and PFOS of 6.7 ng/L and 2.7 ng/L, respectively. These standards are applied to industrial discharges, such as groundwater treatment systems. Treatment systems discharging treated water above the AWQS for PFOA or PFOS will be brought into compliance in accordance with the Treatment Systems Discharge Compliance Plan (BNL, 2024).
- EPA's fourth Six-Year Review of the drinking water standards was completed in July 2024. EPA determined that there are no additional candidates identified for regulatory revision. The EPA did not include in this review cycle the PFAS regulations promulgated in April 2024, which established six new national primary drinking water regulations. The EPA anticipates that once the PFAS regulations go into effect and sufficient information regarding compliance monitoring becomes available, the six compounds will be subject to a more detailed regulatory review under a future Six-Year Review cycle.

OU X Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- On December 27, 2021, EPA published the fifth Unregulated Contaminant Monitoring Rule (UCMR 5). This action identifies a new list of 29 unregulated PFAS compounds for public water system monitoring between 2023-2025. The UCMR 5 fulfills a key commitment of the EPA's 2019 Per- and Polyfluoroalkyl Substances (PFAS) Action Plan (EPA 2019a) by including the collection of drinking water occurrence data for a broader group of PFAS (i.e., building on the monitoring for six PFAS that took place under UCMR 3). Some of these compounds have been detected during BNL groundwater characterization activities.
- There are several occupied buildings located near the Current Firehouse, Former Firehouse and Building 170 PFAS release areas. Although the primary PFAS of concern (PFOA and PFOS) are not considered volatile, several PFAS precursor compounds that may be present in source area soils are considered volatile. Currently available monitoring data indicate that 1,4-dioxane concentrations in the central, developed area of the BNL site are below the NYS MCL of 1 µg/L. Although 1,4-dioxane is considered volatile and has been detected above the MCL in several areas of the site, EPA's VISL is significantly higher than the maximum concentration detected in the plumes. The subsurface vapor to indoor air pathway for 1,4-dioxane is incomplete. Potential exposure pathways will be evaluated further as part of the OU X RI/FS.

OU X Expected Progress in Meeting RAOs

- Remedial action objectives have not yet been identified in a ROD. Until a ROD is established, the objectives of the TCRA are being achieved through operation of the Current Firehouse/Building 170 and Former Firehouse treatment systems. The annual BNL Groundwater Status Report evaluates the system's performance based on decisions identified from the BNL groundwater DQO process (See BNL Environmental Monitoring Plan (BNL, 2025d) for the DQO process).

OU X Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no final remedy issued for this OU therefore, no protectiveness statement can be made.

7.8 OU XI BGRR

BGRR Question A: Is the remedy functioning as intended by the decision documents?

BGRR Remedial Action Performance

- As described in the completion and closeout reports to date, site inspections, and regulatory

interviews, the interim cleanup measures were implemented in accordance with the Action Memoranda and NEPA categorical exclusions, and are consistent with the BGRR ROD. This has achieved the remedial action objectives of protecting human health from the hazards posed by the radiological inventory at the BGRR using the ALARA principle (i.e., limiting worker exposure) and implementing monitoring, maintenance, and institutional controls to manage remaining hazards. Specific activities completed to help reduce the radiological inventory, to reduce the potential for exposure, and to prevent the future migration of radiological contamination into surrounding soil and groundwater include:

- Removal of primary air cooling fans – Removed and properly disposed of contaminated equipment in the fan rooms and decontaminated or fixed surface contamination (Note: Fan house buildings and soil were removed under the HFBR ROD).
- Removal of the Pile Fan Sump, pipes, and contaminated soil.
- Removal of above-ground ducts, pipes, and contaminated soil – Prevented low-level radioisotopes from being released to soil and potential migration into groundwater.
- Removal of canal and water treatment house, piping, and accessible contaminated soils – Reduced the amount of contamination in the concrete structures of the canal and removed contaminated surface soil.
- Removal of the exhaust cooling coils and filters.
- Removal of below ground ducts primary liner.
- Sealing of the below ground ducts.
- The April 2005 completion of the removal of the canal structure and subsurface contaminated soil located outside the footprint of the reactor building was performed in accordance with the Action Memorandum (BNL, 2005f) and is consistent with the selected remedy in the BGRR ROD. A completion report was prepared and issued to the regulators in 2005.
- In 2005, a temporary asphalt cap was installed over the soil areas to minimize water infiltration prior to the final cap installation.
- In May 2010, Graphite Pile removal was completed in accordance with the ROD. A final closeout report was issued to the regulators in October 2010.
- In May 2012, the biological shield removal and the final engineered cap installation to prevent water infiltration were completed.

BGRR System Operations/O&M

As required by the BGRR ROD, long-term surveillance and maintenance activities are conducted to ensure effectiveness of the remedy. Specific measures are being implemented for the BGRR project. They include the following:

- Routine environmental health and safety monitoring
- Radiation detection monitoring
- Secure access via locked doors
- Periodic structural inspections of Building 701
- Water intrusion monitoring
- Preventive maintenance of Building 701 and the infiltration management system
- Groundwater monitoring required as part of the OU III ROD and the ESD

- Periodic inspections of the below-ground ducts
- Periodic maintenance and repairs as identified during the inspections, such as enhancements for roof access in 2019, sealing of precipitation infiltration areas, and minor repairs to the cap.
- An update to the *Long-Term Surveillance and Maintenance Manual for the BGRR* was issued in September 2023 (BNL, 2023b).

BGRR Costs of System Operations/O&M

The annual surveillance and maintenance cost over the past five years were \$17K (2021), \$34K (2022), \$60K (2023), \$52K (2024) and \$18K (2025). The annual O&M costs for the groundwater treatment system are provided in **Table 4-1**. Additionally, surveillance and maintenance costs for the BGRR include upkeep every 10 years for the infiltration barrier and every 20 years to refurbish the Building 701 exterior facade and roof system. The surveillance and maintenance activities include radiation and environmental monitoring, the testing, inspection and maintenance/repair of essential equipment and components, and verification of conditions throughout the facilities including the below-ground ducts. Activities also include preventive and corrective maintenance on the temporary asphalt cap to ensure its integrity.

BGRR Implementation of Land Use and Institutional Controls and Other Measures

In addition to the administrative controls placed on the future land use at BNL, the following specific institutional controls are being implemented:

- Control measures for future excavation of residual subsurface contamination. No digging, drilling, ground-disturbing activities, or groundwater shall be extracted within the area designated on Figure 10-1 of the BGRR ROD unless the activity has undergone a BNL review process, which includes, but is not limited to, the restrictions in BNL's LUCMP and the BNL digging permit review for any excavations. Any activity that occurs deeper than 15 feet will require EPA concurrence.
- Specific land-use restrictions are established within the BNL LUCMP limiting future use and development of the BGRR complex to commercial or industrial uses only. Additionally, any future plans for excavation of the inaccessible contaminated soils will include the assessment of risk to human health and the environment based on the actual distribution, depth, and concentrations of the residual radioactive material encountered.
- Annual certification is provided to the regulators verifying that the institutional controls and engineering controls put in place are unchanged from the last certification, and that nothing has occurred that would impair the ability of the control to protect public health or the environment. The annual certification is prepared and submitted by a professional engineer or environmental professional accepted by NYSDEC.
- Land-use restrictions and reporting requirements will be passed on to any/all future landowners through an environmental easement on the deed to the property. In light of the fact that a deed does not exist for property owned by a federal entity, DOE will be responsible for implementing, enforcing, maintaining, and reporting on these controls. Although DOE may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the DOE or its successor agency shall retain ultimate responsibility for remedy integrity. Upon transfer of the property to a nonfederal entity by the U.S. government, a deed will be established and an environmental easement will be added to the deed at that time.

BGRR Monitoring Activities

- Monitoring environmental health and safety, such as radiological dose monitoring, is an important component of the surveillance and maintenance work. Work is planned to limit worker exposure throughout all phases of the surveillance and maintenance effort.

- Groundwater monitoring in the vicinity of the BGRR complex will continue throughout the institutional control period. Results of the OU III BGRR/WCF monitoring program will be used to help verify the effectiveness of the BGRR remedy.
- Water intrusion monitoring is routinely performed in accordance with the surveillance and maintenance manual for the BGRR to ensure that water does not infiltrate into contaminated areas of the BGRR complex, which could potentially cause the migration of radiological contamination into surrounding soils and groundwater.

BGRR Opportunities for Optimization

- Inspection frequency of the below-ground ducts were modified to an annual schedule starting in 2021. Inspections since 2012 have shown little physical change, and only minor water accumulation has been observed which appears to be from condensation. The leak detection sensors placed in each duct can remotely monitor for water intrusion.

BGRR Early Indicators of Potential Issues

- A continuing source of Sr-90 contamination in the vadose zone soils beneath the BGRR below-ground ducts is a concern for the groundwater remediation system. See Section 7.3 for additional discussion.
- Water intrusion from the roof and walls, although minor at this time, is accelerating the degradation of the brick work on the south wall and may be an issue for the long-term maintenance of Building 701. The quantity of water has not been enough to cause any accumulation of water in the building.

BGRR Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

BGRR Changes in Standards and TBCs

- The standards or TBCs, including DOE Orders, identified in the BGRR ROD have not changed, nor do they call into question the protectiveness of the remedy. See Attachment 4 for a review of the standards and TBCs. Attachment 5 provides the cleanup levels for the primary contaminants of concern (Sr-90 and Cs-137).
- The soil cleanup levels for radionuclides are based on 15 mRem/yr above background. As stated in the EPA memorandum on Radiation Risk Assessment at CERCLA Sites: Q&A (EPA 2014a), the Superfund recommendation is now 12 mRem/yr as the dose-based level protective of a target cancer risk of 1×10^{-4} . This could have a minor effect on risk-based levels of radionuclides in soil. It should be noted that the soil cleanups performed to date have also met the NYSDEC guidance of 10 mRem/yr above background (ALARA goal). Therefore, despite the change in the recommendation, the remedy remains protective.

BGRR Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within the BGRR complex or in the use of the site that would reduce the protectiveness of the remedies, nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2005.
- No new contaminants or sources of contamination have been identified within the BGRR, and no unanticipated toxic byproducts have been detected.

BGRR Expected Progress in Meeting RAOs

- The removal and disposal of contaminated components, structures, water, and soil at the BGRR complex is complete. Based on sampling results, continued monitoring and surveillance of the facility, groundwater monitoring downgradient of potential source areas, and visual inspections of

remediated areas, those projects completed to date continue to meet the remedial action objectives identified in the ROD.

- The overall remedy removed over 99 percent of the radioactive material inventory at the BGRR complex.
- The remaining radiological inventory has been stabilized as a result of the cleanup actions.
- The implementation of long-term monitoring, maintenance, and institutional controls continues for the BGRR.
- Water infiltration management and institutional controls are effective in protecting human health and the environment. The Building 701 structure and engineered cap protect the contaminated soil and components that will remain under the building footprint. It forms a significant barrier to possible direct exposure to individuals entering this area, and serves as an effective stormwater control to prevent water infiltration and leaching of the remaining contaminants to groundwater.
- As noted in **Section 7.3** above, BNL is evaluating the performance and efficiency of the Sr-90 ion exchange treatment system currently used to remediate the BGRR/WCF plumes to ensure that these systems are on track to meet the objective, as stated in the OU III ROD and ESD, of meeting the MCL in the aquifer within 70 years. As discussed in **Section 7.3**, BNL has and will continue to evaluate any new Sr-90 remediation techniques and technologies as well as any operational efficiencies that might accomplish cleanup sooner and with less remediation waste. Continued evaluation of the continuing source of Sr-90 contamination in the vadose zone soils below the BGRR will be performed.

BGRR Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the BGRR remedy.

7.9 g-2/BLIP/USTs

g-2/BLIP/USTs Question A: Is the remedy functioning as intended by the decision documents?

g-2/BLIP/USTs Remedial Action Performance

- Groundwater monitoring at the BLIP source area has shown that the stormwater controls have been effective in preventing additional leaching of radionuclides from the activated soil shielding. All tritium concentrations in groundwater have been below the 20,000 pCi/L MCL since early 2006. Over the last five years, the maximum tritium concentration in the BLIP monitoring wells was 1,890 pCi/L in 2023. The stormwater controls (e.g., gunite cap, paved area, and drainage system for the building) are routinely inspected and maintained. Furthermore, the silica grout injected into the activated soil at the BLIP facility during the 2000 Removal Action provides an additional protective measure by reducing the permeability of the activated soil and the ability of rainwater to leach out contaminants should the primary stormwater controls fail. Although direct inspection or maintenance of the silica grout is not possible, it is expected to be in good condition.
- The cap at the g-2 source area is routinely inspected and maintained. Although the cap is effectively preventing rainwater infiltration into the remaining activated soil shielding, tritium concentrations in source area monitoring wells continue to periodically exceed the 20,000 pCi/L MCL. The maximum tritium concentration in the source area wells over the last five years was 23,200 pCi/L in 2021. This was the only time the MCL was exceeded over this five-year period. As in past years, periodic, short-term increases in tritium concentrations appear to be related to water table fluctuations and the flushing of residual tritium from the deep portion of the vadose zone below the source area. The overall reductions in tritium concentrations observed in source area wells suggest that the amount of

residual tritium that is available to be flushed out of the deep vadose zone is decreasing. Continued monitoring is required to verify the long-term effectiveness of the engineered controls.

- Tritium concentrations in the groundwater downgradient of the Alternating Gradient Synchrotron facility have attenuated (via radioactive decay and dispersion) to concentrations less than the 20,000 pCi/L MCL. The reductions in tritium concentrations are consistent with model predictions of decay and dispersion effects on the plume segments with distance from the source area. No additional remedial actions or continued monitoring for tritium south of the AGS are required.
- No groundwater monitoring is required for the former UST areas.

g-2/BLIP/USTs System Operations/O&M

As required by the 2007 ROD, long-term cap maintenance activities are conducted to ensure effectiveness of the remedy. The LUCMP contains sitewide control measures and land-use restrictions to prevent exposure to environmental contamination and to protect the integrity of remedies specified within the g-2/BLIP/USTs ROD and other approved RODs. To accomplish this objective, specific measures are being implemented for the g-2/BLIP project. They include the following:

- Routine inspections and maintenance of the caps and other stormwater controls at the g-2 source area and BLIP facility.
- Groundwater monitoring required to verify that the source controls remain effective.
- There are no actions associated with the former UST areas.

g-2/BLIP/USTs Costs of System Operations/O&M

The estimated annual costs for routine cap inspections and groundwater monitoring are:

- Approximately \$10,000 for routine inspections and minor maintenance of the caps and other stormwater controls at the g-2 source area and BLIP facility.
- Approximately \$10,000 for groundwater monitoring at the g-2 source area and approximately \$4,000 for monitoring groundwater at the BLIP facility.
- There are no costs associated with the former UST areas.

g-2/BLIP/USTs Implementation of Land Use and Institutional Controls and Other Measures

- The LUCMP provides an overview of land use and other controls that are deployed at BNL to prevent exposure to residual environmental contamination. The web-based *Land Use and Institutional Controls Mapping* tool contains map locations and fact sheets for the g-2 and BLIP facilities. The LUCMP is a living document and is periodically updated to stay current with evolving management techniques.
- There are no LUCMP issues associated with the former USTs.

g-2/BLIP/USTs Monitoring Activities

- Groundwater monitoring at the g-2 and BLIP source areas will continue throughout the institutional control period. Results of the g-2 and BLIP monitoring programs will be used to help verify the effectiveness of the remedy.
- No groundwater monitoring is required for the former UST areas.

g-2/BLIP/USTs Opportunities for Optimization

- Monitoring data indicate that the source area controls are effective.

g-2/BLIP/USTs Early Indicators of Potential Issues

- There have been no changes in the physical conditions at the g-2 or BLIP facilities or in the use of the site that would reduce the protectiveness of the remedies, nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2007.
- Groundwater monitoring data from both facilities suggest that the caps and other stormwater controls are effective.
- Because the g-2 facility has not operated since the completion of the project in April 2001, no additional buildup of radioactivity has occurred. Therefore, with natural radioactive decay, radionuclide levels in the soil shielding at the g-2 source area are less than when they were evaluated at the time of the 2007 ROD. Because BLIP is an active facility, additional buildup of radioactivity is occurring in a zone of soil shielding. In addition to the surface controls to prevent rainwater infiltration, the colloidal silica grout that was injected into the zone of activated soil shielding in 2002 offers additional protection from potential stormwater infiltration.

g-2/BLIP/USTs Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

g-2/BLIP/USTs Changes in Standards and TBCs

The standards or TBCs identified in the ROD have not changed, nor do they call into question the protectiveness of the remedy. See **Attachment 4**. **Attachment 5** provides the cleanup level for tritium, the primary contaminant of concern.

g-2/BLIP/USTs Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within the g-2 or BLIP facilities or use of the site that would reduce the protectiveness of the remedies, nor render the initial risk analysis invalid. Also, the exposure assumptions have not changed since the ROD was signed in 2007. There are no risks associated with the former UST areas.
- Federal Guidance Report 15, entitled *External Exposure to Radionuclides in Air, Water and Soil* (EPA 2019b), updated and expanded the 1993 Federal Guidance Report No. 12 to include age-specific reference person effective dose rate coefficients based on external exposure. The changes include updated tissue weighting factors and radionuclide decay data. While this change does not affect MCLs, risk-based levels and risk assessment for external exposure may be affected.

g-2/BLIP/USTs Expected Progress in Meeting RAOs

- Groundwater monitoring at the g-2 and BLIP source areas has shown that the stormwater controls have been effective in preventing additional leaching of radionuclides from the activated soil shielding. At the BLIP facility, all tritium concentrations in groundwater have been less than the 20,000 pCi/L MCL since early 2006. However, tritium concentrations continue to periodically exceed 20,000 pCi/L in the g-2 source area groundwater monitoring wells. The continued detection of tritium is related to water table fluctuations and the flushing of residual tritium from the deep portion of the vadose zone below the source area. The overall reductions in tritium concentrations observed in the g-2 source area wells since 2003 indicate that the amount of residual tritium that is available to be flushed out of the deep vadose zone is decreasing by means of this flushing mechanism and natural radioactive decay.
- The downgradient segment of the g-2 tritium plume had been tracked to the vicinity of the National Synchrotron Light Source II facility. Monitoring conducted in 2015 confirmed that natural attenuation (dispersion and radioactive decay) reduced tritium concentrations to less than the 20,000

pCi/L MCL. As a result, groundwater monitoring in the area south of the Alternating Gradient Synchrotron facility was discontinued.

- There are no continued environmental concerns associated with the former UST areas.

g-2/BLIP/USTs Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the remedy defined in the ROD.

7.10 HFBR

HFBR Question A: Is the remedy functioning as intended by the decision documents?

HFBR Remedial Action Performance

As described in the completion and closeout reports to date, site inspections, and regulatory interviews, the interim cleanup measures were implemented in accordance with the Action Memoranda (BNL 2007d and 2008b) and *National Environmental Policy Act* (NEPA) categorical exclusions, and are consistent with the HFBR ROD. This has achieved the remedial action objectives of protecting human health from the hazards posed by the radiological inventory at the HFBR using the ALARA principle, and implementing monitoring, maintenance, and institutional controls to manage potential hazards. Specific activities completed to help reduce the radiological inventory, to reduce the potential for exposure, and to prevent the future migration of radiological contamination into surrounding soil and groundwater include:

- The fuel was removed and sent to an off-site facility.
- The primary coolant was drained and sent to an off-site facility.
- The cooling tower superstructure was dismantled.
- The spent fuel canal was modified to meet Suffolk County Article 12 requirements.
- The Stack Monitoring Facility (Building 715) was dismantled.
- The Water Treatment House (Building 707B) was dismantled.
- The Cold Neutron Facility (Building 751) contaminated systems were removed.
- The Guard House (Building 753) was dismantled.
- Control rod blades and beam plugs were removed.
- Ancillary buildings and associated soils were removed.
- Fan houses were removed.
- Contaminated underground pipes and utilities were removed.
- Soils at the former HWMF WLA were excavated and disposed of.
- Buildings 801-811 underground waste transfer lines and associated soil were removed.
- Stack was demolished, and the stack drain tank, residual silencer structure and contaminated soil were removed.

HFBR System Operations/O&M

Long-term surveillance and maintenance activities are being conducted in accordance with the *Long-Term Surveillance and Maintenance Plan for the HFBR* (BNL, 2011h) to ensure effectiveness of the remedy. The BNL LUCMP contains sitewide control measures and land-use restrictions to prevent exposure to environmental contamination and to protect the integrity of remedies specified within the

HFBR ROD and other approved RODs. To accomplish this objective, specific measures are being implemented for the HFBR project. They include the following:

- Routine environmental health and safety monitoring including radiological surveys.
- Secure access via locked doors.
- Periodic structural inspections of Building 750.
- Periodic inspections of the stack and grounds (stack inspections complete in 2020).
- Water intrusion monitoring.
- Preventive maintenance of Building 750 and the infiltration management system.
- Management and disposal of water generated from precipitation through the stack (complete in March 2021).
- Groundwater monitoring required as part of the OU III ROD.

HFBR Costs of System Operations/O&M

The annual surveillance and maintenance cost required to ensure that the HFBR remained in a safe and stable condition during the safe storage phase for the confinement building over the past five years are \$17K (2021), \$12K (2022), \$29K (2023), \$21K (2024) and \$43K (2025). The surveillance and maintenance activities include radiation and environmental monitoring, management and disposal of stack drain water (through March 2021), the testing, inspection, and maintenance/repair of essential equipment, and verification of conditions throughout the facilities.

HFBR Implementation of Land Use and Institutional Controls and Other Measures

The HFBR remedy includes the continued implementation of LUICs in accordance with the LUCMP. These include:

- Measures for controlling future excavation and other actions that could otherwise disturb residual subsurface contamination.
- Land-use restrictions and an acceptable method for evaluating potential impact that the remaining contaminants have on future development.
- Annual certification to EPA and NYSDEC stating that the institutional and engineering controls put in place are unchanged from the last certification, and that nothing has occurred that would impair the ability of the control to protect public health or the environment or constitute a violation or failure to comply with the site management plan. This annual certification is prepared and submitted to NYSDEC on an annual basis as part of the LUIC letter report.

DOE is currently responsible for implementing the land-use controls with regard to the property that is the subject of the HFBR ROD. If the property is transferred out of federal ownership, it is DOE's intention that all continuing land-use restrictions, reporting requirements, and any other obligations relating to the property of DOE (or any other successor federal entity on behalf of the United States) will be satisfied through the United States' conveyance of a deed restriction/environmental easement prior to any such transfer of any deed(s) to the property.

While it is DOE's intention that any such deed restriction/environmental easement would require that the transferee (and subsequent transferees) would be required to satisfy all of DOE's obligations relating to the property, DOE acknowledges that, notwithstanding this intention, DOE (or any other successor federal entity on behalf of the United States) remains ultimately responsible for satisfying DOE's remedial obligations set forth in this ROD relating to the property if any subsequent transferee fails to satisfy the remedial obligations in this regard.

DOE will address any activity that is inconsistent with the land-use restrictions or actions that may interfere with the effectiveness of the institutional controls established for the HFBR complex with EPA and NYSDEC, as outlined in the BNL LUCMP. Land Use Institutional Controls will be maintained until the hazardous substances reach levels that allow unlimited use and unrestricted exposure.

HFBR Monitoring Activities

The *Long-Term Surveillance and Maintenance Plan for the HFBR* was developed to manage the inventory of radioisotopes that will remain in the HFBR Confinement Building during the safe storage (decay) period and subsequent decontamination and dismantlement (BNL, 2011h). The details of the surveillance and maintenance processes are contained in a supporting document – the *Long-Term Surveillance and Maintenance Manuals* (BNL, 2023b; BNL, 2023e). The Surveillance and Maintenance Plan and Manual are implemented to ensure that the inventory of stored radioisotopes and all residual contamination is maintained in a safe condition, and to preclude future human exposure pathways or migration from their locations within the HFBR. Inspections of the HFBR have been ongoing since the facility was placed in a long-term safe storage mode in 2012. The building is structurally sound, and little deterioration has been observed to date. There were no water intrusion alarms sounded in the facility. Minor maintenance and repair work have been performed including removal of asbestos containing material on the floor, repair of the overhead piping insulation, resealing the openings on the air intakes on the exterior walls adjacent to the generator room, and repairing cracked masonry on the east side exterior of the confinement building. Radiation measurements of the V-14 port (located at the top of the reactor vessel) were conducted in 2010, 2015, 2020, and 2025 to confirm that radioactive decay in the vessel is occurring at the modeled rate. The measurements to date suggest that decay is occurring as expected and that the selected 65-year decay period (until 2072) is justified. See **Attachment 4** for additional information. The water (from precipitation) generated from the stack was routinely pumped out and disposed of until March 2021, when the tank was removed.

HFBR Opportunities for Optimization

Removal of the reactor and its components requires underwater cutting for size reduction to fit into shipping containers. There have been no major advances in this field in the past several years. There are no technique or technology developments that would allow for the removal of the reactor vessel prior to the current 65-year-decay period. **Attachment 4** provides further discussion.

HFBR Early Indicators of Potential Issues

Protection of workers during the demolition of the stack was an important consideration. Strict safety controls developed and implemented by the demolition contractor were used to help mitigate potential risk during the abatement and demolition process. There were no injuries reported during the demolition activities.

HFBR Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

HFBR Changes in Standards and TBCs

- The standards or TBCs, including DOE Orders, identified in the HFBR ROD have not changed, nor do they call into question the protectiveness of the remedy. **Attachment 4** provides a review of the standards. **Attachment 5** provides the cleanup levels for Sr-90 and Cs-137, the primary contaminants of concern.
- The soil cleanup levels for radionuclides are based on 15 mRem/yr above background. As stated in the *EPA memorandum on Radiation Risk Assessment at CERCLA Sites: Q&A* (EPA, 2014a), the Superfund recommendation is now 12 mRem/yr as the dose-based level protective of a target cancer risk of 1×10^{-4} . This could have a minor effect on risk-based levels of radionuclides in soil. It should be noted that the soil cleanups performed to date have also met the NYSDEC guidance of 10

mRem/yr above background (ALARA goal). Therefore, despite the change in the recommendation, the remedy remains protective.

HFBR Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics, and Risk Assessment Methods

- There have been no changes in the physical conditions within the HFBR complex or in the use of the site that would reduce the protectiveness of the remedies, nor render the initial risk analysis invalid.
- Lead, a contaminant of concern in soil, has a cleanup level of 400 mg/kg which is the EPA Regional Screening Level for residential soil and the New York State soil cleanup objective for residential and restricted residential use, and commercial or industrial use at the time of the remedial action. The Residential Lead Directive for CERCLA Sites and RCRA Hazardous Waste Cleanup Program Facilities published in October 2025, established the following: a removal management level of 600 mg/kg for; a regional screening level of 200 mg/kg for lead in residential soil; and a target children's blood lead level (BLL) of 5 µg/dL to develop PRGs (EPA, 2025). The institutional controls of the HFBR do not allow for residential or unrestricted use of the areas remediated for lead contamination in soil. Therefore, the remedy remains protective of human health.
- Federal Guidance Report 15, entitled *External Exposure to Radionuclides in Air, Water and Soil* (EPA, 2019a), updated and expanded the 1993 Federal Guidance Report No. 12 to include age-specific reference person effective dose rate coefficients based on external exposure. The changes include updated tissue weighting factors and radionuclide decay data. While this change does not affect MCLs, risk-based levels and risk assessment for external exposure may be affected.
- No new contaminants or sources of contamination have been identified within the HFBR, and no unanticipated toxic byproducts have been detected.
- In accordance with the HFBR ROD, DOE continues to determine the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large, activated components earlier taking into consideration the following factors:
 - Advancements in cleanup technologies and transportation methods.
 - Availability of waste disposal facilities.
 - Changes in standards and regulations for worker, public, and environmental protection.
 - Worker safety impacts.
 - Environmental impacts.
 - Public health impacts.
 - Economic impacts.
 - Land use.
 - Existing stabilization and safety of the facility and hazardous materials.
 - Projected future stability and safety of the facility and hazardous materials.
- As discussed in **Attachment 4**, no advances in new technologies or other factors have been identified since the ROD was finalized in 2009 that would warrant a reduction in the 65-year safe storage (decay) period.
- Recognizing that there are uncertainties inherent in activation analyses, per the ROD, DOE conducted an additional investigation involving the following steps:

- Performed radiation surveys (measurements of radiation levels) after the removal of the control rod blades from the reactor vessel. (Surveys before the removal of control rod blades with high dose rates would not yield reliable results).
 - Reevaluated the dose rate at 1 foot from the large, activated, components (reactor vessel, thermal shield, and biological shield) based on the radiation surveys performed in 2015 and 2020.
 - Using the reevaluated dose rates, determined the decay period necessary for the dose rate at 1 foot to fall below 100 mRem/hour for the large, activated, components, including the limiting component.
 - Used the results of the additional investigation in this Five-Year Review to assess the feasibility of shortening the decay period.
- The following conclusions from this evaluation were reached:
 - The predicted time for when the large limiting activated component (i.e., thermal shield) will decay to 100 mRem/hour is in 65 years from 2007 (the safe storage decay period was determined based on the radiological inventory and radiation levels in 2007), or in the year 2072.
 - This predicted time was calculated based on activation analysis, and the calculations were supported by measurements of actual dose rates, most recently in 2020.
 - Radiation levels from the small highly activated components (transition plate and anti-critical grid) were within the bounds of expected levels when measured in a reactor vessel internal survey in 2009.
 - When the control rod blades were removed from the reactor, radiation levels and curie contents were in close agreement with the predicted levels.
 - Based on this close agreement between actual and predicted radiation levels, the calculated dose rates for the large, activated, components are also expected to be reasonably accurate. Therefore, there is no justification to change the safe storage (decay) period of 65 years.

HFBR Expected Progress in Meeting RAOs

- In accordance with the ROD, the removal and disposal of contaminated components, structures (including the stack), water, and soil at the HFBR complex is complete. Based on sampling results, continued monitoring and surveillance of the facility, groundwater monitoring downgradient of potential source areas, and visual inspections of remediated areas, those projects completed to date continue to meet the remedial action objectives identified in the ROD.
 - A portion of the radiological inventory at the HFBR complex has been either removed or stabilized as a result of the cleanup actions.
 - The ALARA principle was extensively used to help protect workers while implementing the cleanup actions.
 - Long-term monitoring, maintenance, and institutional controls continue to be performed for the HFBR.
- The remaining remedial action to be implemented for removal of the reactor vessel is also expected to meet the overall ROD remedial action objectives.

HFBR Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information calls into question the protectiveness of the HFBR remedy.

7.11 Technical Assessment Summary

Currently, nine RODs have been signed at BNL. The first was signed in 1996 and the last was signed in 2009. In addition, four ESDs were signed documenting changes to the OU III and BGRR RODs. With the exception of the HFBR reactor vessel removal, all selected remedies for the RODs and ESDs have been implemented. This includes the excavation and off-site disposal of contaminated soil, sediment, and tanks, and the installation and operation of groundwater treatment systems. All closeout reports submitted to the regulators were approved. The TCRA for PFAS and 1,4-dioxane was implemented in 2022 with the construction of two groundwater treatment systems. The final remedy for PFAS and 1,4-dioxane will be documented in the OU X ROD.

Remedies have been implemented in accordance with the RODs and the ESDs, based on the data presented in the closeout reports and the annual BNL Groundwater Status Reports, site inspections, and regulatory interviews. Soil cleanup levels were met and groundwater pump and treat systems have been functioning as intended by the RODs. The cleanup performed continues to meet the remedial action objectives identified in each ROD. However, the cleanup timeframes for several of the groundwater treatment systems may take longer than the originally defined goals for VOCs in the Upper Glacial aquifer.

For soil excavation/disposal remedies, work was performed in accordance with the RODs, applicable design documents, and Remedial Action Work Plans. Soil cleanup levels were met for these areas. The remaining work at the HFBR will be implemented in accordance with the ROD and the final remedy for PFAS and 1,4-dioxane will be documented in an OU X ROD. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedies. Soil and groundwater applicable or relevant and appropriate requirements in the RODs and ESDs have either been met or are expected to be met. There is no other information that calls into question the protectiveness of the remedies.

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8.0 Issues

Issues are identified in **Section 9, Table 9-1**.

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9.0 Issues and Recommendations

The following table summarizes issues and recommendations developed in the Technical Assessment section of this document. These recommendations are subject to regulatory review, and implementation will be based on the availability of funding.

Table 9-1: Issues/Recommendations

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
OU IX HFBR	Explore the feasibility of reducing the 65-year safe storage (decay) period and completing the removal of large, activated components earlier.	BNL	DOE, EPA, NYSDEC, SCDHS	Recurring	N	Y
OUs III & VI – Maintain terms of groundwater treatment system property access agreements	Record property access agreements with County Clerk, continue to manage existing access agreements. Renew one expired access agreement.	BNL	DOE, EPA, NYSDEC, SCDHS	Ongoing	N	Y

Notes:

Recommendations are subject to regulatory review; implementation will be based on the availability of funding

In addition, **Table 9-2** below summarizes Other Findings that were identified during the Five-Year Review that may improve performance of the remedy, improve management of O&M, and/or accelerate site closeout, but do not affect current and/or future protectiveness.

Table 9-2: Other Findings

Finding	Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date
OU X 1,4-dioxane contamination in OU III Middle Road/South Boundary/Western South Boundary and Airport Treatment System discharge	In accordance with the <i>Treatment Systems Discharge Compliance Plan</i> (BNL, 2024d), complete the 1,4-dioxane treatment systems design documents.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU III Building 96 Source Removal Effectiveness	Monitor plume and source area. Re-evaluate cleanup timeframe based on post-injection monitoring data and report in annual Groundwater Status Report.	BNL	DOE, EPA, NYSDEC, SCDHS	Annual, starting in 2026
OU III Middle Road VOC contamination	Prepare design plans for potential installation of additional extraction wells based on 2025 modeling recommendations.	BNL	DOE, EPA, NYSDEC, SCDHS	2026

Finding	Follow-Up Actions	Party Responsible	Oversight Agency	Milestone Date
OU III South Boundary VOC contamination	Prepare design plans for potential installation of additional extraction well based on 2025 modeling recommendations.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU VI EDB contamination	Continued operation of the new extraction wells. Reevaluate cleanup timeframe based upon new operational data and pump testing performed on the new extraction wells.	BNL	DOE, EPA, NYSDEC, SCDHS	2027
Sr-90 in OU I Former HWMF Groundwater	Continue to track Sr-90 plume attenuation. Enhance monitoring network with temporary and/or permanent wells as necessary. Monitor plume attenuation progress with 2021 groundwater model predictions and report in annual Groundwater Status Report.	BNL	DOE, EPA, NYSDEC, SCDHS	June 2031
OU X Current and Former Firehouse PFAS contamination	Continue full-time operation of the two PFAS treatment systems. Evaluate the easterly shift in segments of the Current Firehouse and Building 170 plumes and design additional extraction well locations as needed.	BNL	DOE, EPA, NYSDEC, SCDHS	2026
OU X RI/FS	Finalize the draft OU X RI/FS and implement investigation. Completion will be dependent on availability of funding.	BNL	DOE, EPA, NYSDEC, SCDHS	Ongoing
Continuing Sr-90 sources at BGRR, WCF, and Building 801	Monitor plume and continued degradation of source areas. Install temporary wells in WCF areas as necessary. Perform intermittent pulsed pumping of extraction wells. Evaluate during next Five-Year Review.	BNL	DOE, EPA, NYSDEC, SCDHS	June 2031
Building 650 Sr-90 contamination	Continue to monitor the 650 Sump Outfall source area and downgradient portions of the plume using the existing well network supplemented by the installation of temporary wells as needed.	BNL	DOE, EPA, NYSDEC, SCDHS	Annual, starting in 2026

Notes:

Recommendations are subject to regulatory review; implementation will be based on the availability of funding

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10.0 Protectiveness Statements

Individual Protectiveness Statements

Protectiveness statement for the individual OUs, including the BGRR, HFBR, and g-2/BLIP/USTs are presented below.

Operable Unit I: The remedy is protective of human health and the environment upon attainment of groundwater cleanup goals, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

- All soil cleanup actions are complete and the groundwater treatment system was approved for closure in 2019. The attainment of groundwater cleanup goals for VOCs is expected to require 30 years or less to achieve (by 2030). Strontium-90 in groundwater is expected to attenuate to near the DWS at the site boundary. In the interim, exposure pathways that could result in unacceptable risks are being controlled. Institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater and soil.
- Long-term protectiveness of the remedy will be verified by monitoring the movement and remediation of the plume. Current monitoring data indicate that the remedies are effective, and they are functioning as required to achieve the groundwater cleanup goals.

Operable Unit II/VII: Since there is no ROD or remedial action for OU II/VII, a protectiveness statement cannot be prepared. However, remedial actions for the AOCs in this OU are documented in the OU I and OU III RODs, except for BLIP and the g-2 tritium plume, which are documented in another ROD. Protectiveness statements for the respective RODs defining remedial actions for AOCs within OU II/VIII are identified below.

Operable Unit III: The remedy is short-term protective of human health and the environment upon attainment of groundwater cleanup goals and management of off site access agreements. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- All soil cleanup actions are complete, and all groundwater treatment systems are operational, in standby mode, or decommissioned/closed. The attainment of groundwater cleanup goals is expected to require:
 - 30 years or less to achieve MCLs for VOCs and tritium in the Upper Glacial aquifer (by 2030).
 - 40 years and 70 years or less to achieve MCLs for Sr-90 at the former Chemical Holes plume and the BGRR/WCF plumes, respectively (by 2040 and 2070, respectively).
 - 65 years or less to achieve MCLs for VOCs in the Magothy aquifer (by 2065).
- Exposure pathways that could result in unacceptable risks are being controlled. Site-specific institutional controls are preventing exposure to contaminated groundwater and soil.
- Long-term protectiveness of the remedies will be verified by continuing to monitor the movement and remediation of the plumes. Current monitoring data indicate that the remedies are functioning as required to achieve the groundwater cleanup goals. The cleanup timeframe for certain projects are being reevaluated, as they are unlikely to meet the originally estimated timeframe of 2030.

Operable Unit IV: The remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.

- The groundwater cleanup goals have been met for the VOCs/SVOCs present at the 1977 oil/solvent spill site and the treatment system has been dismantled. Institutional controls are preventing exposure to contaminated soil and groundwater. All threats at the site have been addressed through the installation of fencing and warning signs, and the implementation of institutional controls.

- Additional groundwater characterization performed in 2011 and 2015 (and updated groundwater modeling) verified that the remaining Sr-90 contamination in groundwater will remain in the central portion of the site and attenuate to below the 8 pCi/L MCL by 2034.

Operable Unit V: Following the 2017 supplemental sediment cleanup of Area PR-WC-06, sediment cleanup goals for the Peconic River have been met and the remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled. Revegetation of remediated areas has been completed. The post-cleanup, long-term monitoring has demonstrated the effectiveness of the Peconic River cleanup to mitigate potential human and ecological effects.

- The soil cleanup goals for the STP filter beds/berms and the groundwater goals have been met.
- The 2004/2005 cleanups, as well as the 2011 and 2017 supplemental sediment cleanups of the Peconic River met the remediation goals of the ROD.
- Long-term monitoring has demonstrated the effectiveness of the Peconic River cleanup and further post-cleanup monitoring of the Peconic River was discontinued. In response to a NYSDEC request, BNL has continued sampling of fish for mercury and PCBs in on-site portions of the Peconic River as part of the site environmental surveillance monitoring program. Fish sampling would be limited to times, as determined by BNL, when river conditions allow adequate size, number, and fish mobility to ensure results accurately represent risk levels to human health and the environment. Details of the sampling plan are documented in the Peconic River Fish Surveillance Monitoring Data Quality Objective.

Operable Unit VI: The remedy is short-term protective of human health and the environment upon attainment of the groundwater cleanup goals and management of off site access agreements. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- The EDB groundwater treatment system is operational. The groundwater cleanup timeframe of achieving MCL in the Upper Glacial aquifer by 2030 is being reevaluated with data from the monitoring wells as a result of the new extraction well installation.
- Exposure pathways that could result in unacceptable risks (e.g., off-site potable water supply) are being controlled and site-specific institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater.
- Long-term protectiveness of the remedies will be verified by continuing to monitor the movement and remediation of the plume. Current monitoring data indicate that the remedies are functioning as required to achieve the groundwater cleanup goals. The cleanup timeframe is being reevaluated, as the timeframe is unlikely to meet the originally estimated timeframe of 2030.

Operable Unit XI BGRR: The remedy is protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.

- The remedy is protective since the graphite pile and bioshield were removed and the final engineered cap was installed. Institutional controls are preventing exposure to contaminated structures, soil, and groundwater.
- All threats at the site have been addressed through removal or stabilization of the radiological inventory, excavation of contaminated soil, infiltration management, installation of signs, building access controls, and the implementation of specific institutional controls for the structures, soil, and groundwater.
- Long-term protectiveness of the remedy will be verified by continuing to perform periodic structural inspections of Building 701, water intrusion monitoring, preventive maintenance of the infiltration management system, and groundwater monitoring required as part of the OU III ROD and the ESD.

g-2/BLIP/USTs: The remedy defined in the ROD is protective of human health and the environment upon attainment of groundwater cleanup goals. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

- Groundwater monitoring in the downgradient portion of the plume is complete; however, monitoring of the source area continues.
- Institutional controls designed to prevent exposure to contaminated structures, soil, and groundwater are in place.
- Long-term protectiveness of the remedy will be verified by continuing inspections and maintenance of the g-2 and BLIP facilities' stormwater controls, and groundwater monitoring required by the ROD.

Operable Unit IX HFBR: The completed remedy is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled. Therefore, the remedy is considered short-term protective.

- The remedy is expected to be protective upon completion of the segmentation, removal, and disposal of the remaining HFBR structures, systems, and components (including the reactor vessel, internals, thermal shield and biological shield) following a safe storage decay period (not to exceed 65 years). In the interim, exposure pathways that could result in unacceptable risks are being controlled. Institutional controls are preventing exposure to contaminated structures, soil, and groundwater. Opportunities for reduction of the safe storage period and completing the removal of the activated components earlier than expected will continue to be explored.
- All threats at the site are being addressed through removal or stabilization of the radiological inventory, excavation of contaminated soil, infiltration management, installation of signs, building access controls, and the implementation of specific institutional controls for the structures, soil and groundwater.
- Long-term protectiveness of the remedy will be verified by continuing to perform periodic structural inspections of the reactor confinement building, water intrusion monitoring, preventive maintenance of the infiltration management system, and groundwater monitoring required as part of the OU III ROD.
- The closeout report for the stack demolition was approved by the regulators in 2021.

11.0 Next Review

The sixth sitewide Five-Year Review for BNL will be submitted within five years of issuance of this final report. This will include all OUs, including the g-2 Tritium Plume, the BLIP, and USTs ROD (AOCs 16T, 16K, and 12, respectively), and the BGRR and HFBR RODs.



Matthew Barger, Site Manager
Brookhaven Site Office
U.S. Department of Energy

8/4/2026

Date

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Figures

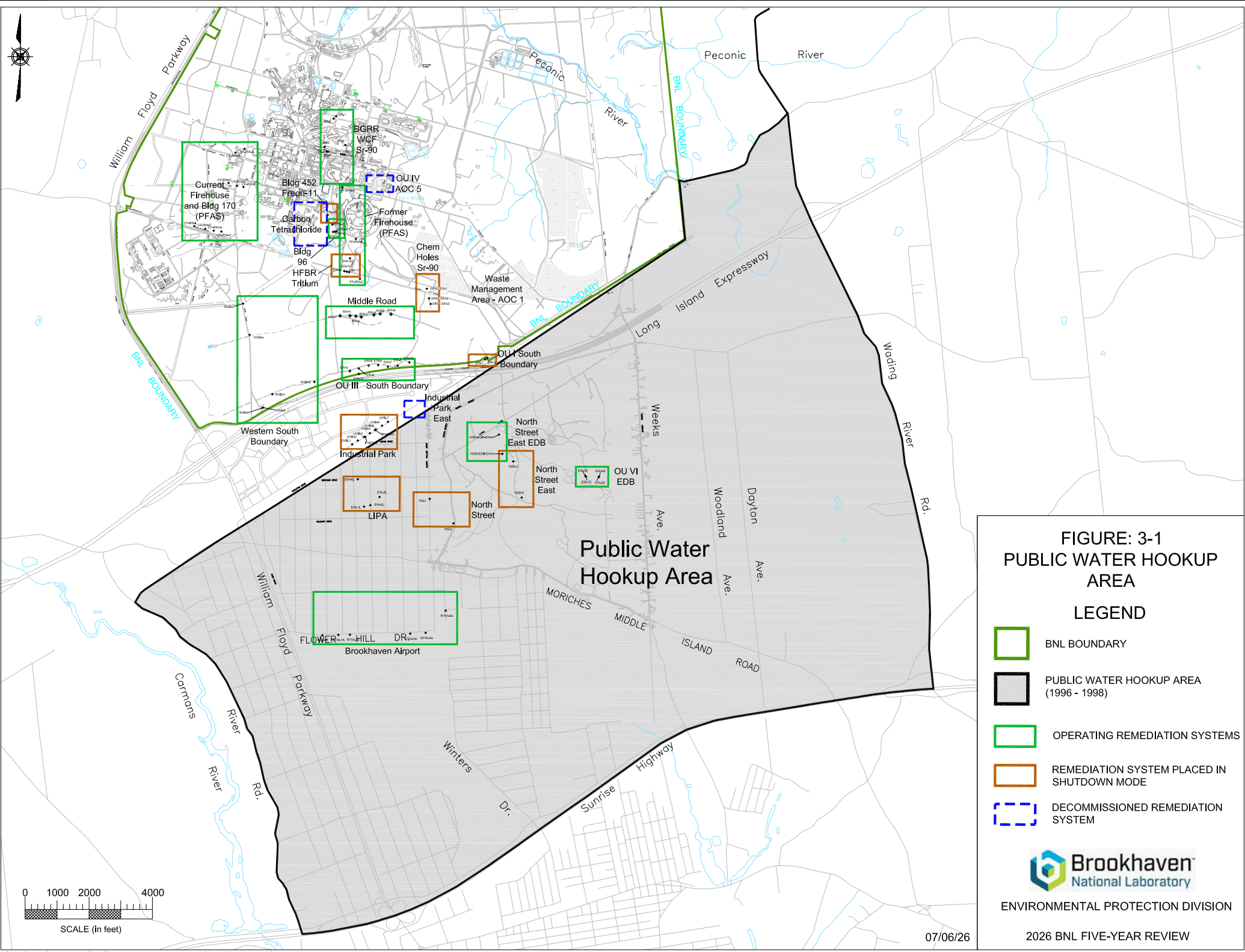


FIGURE: 3-1
PUBLIC WATER HOOKUP
AREA

LEGEND

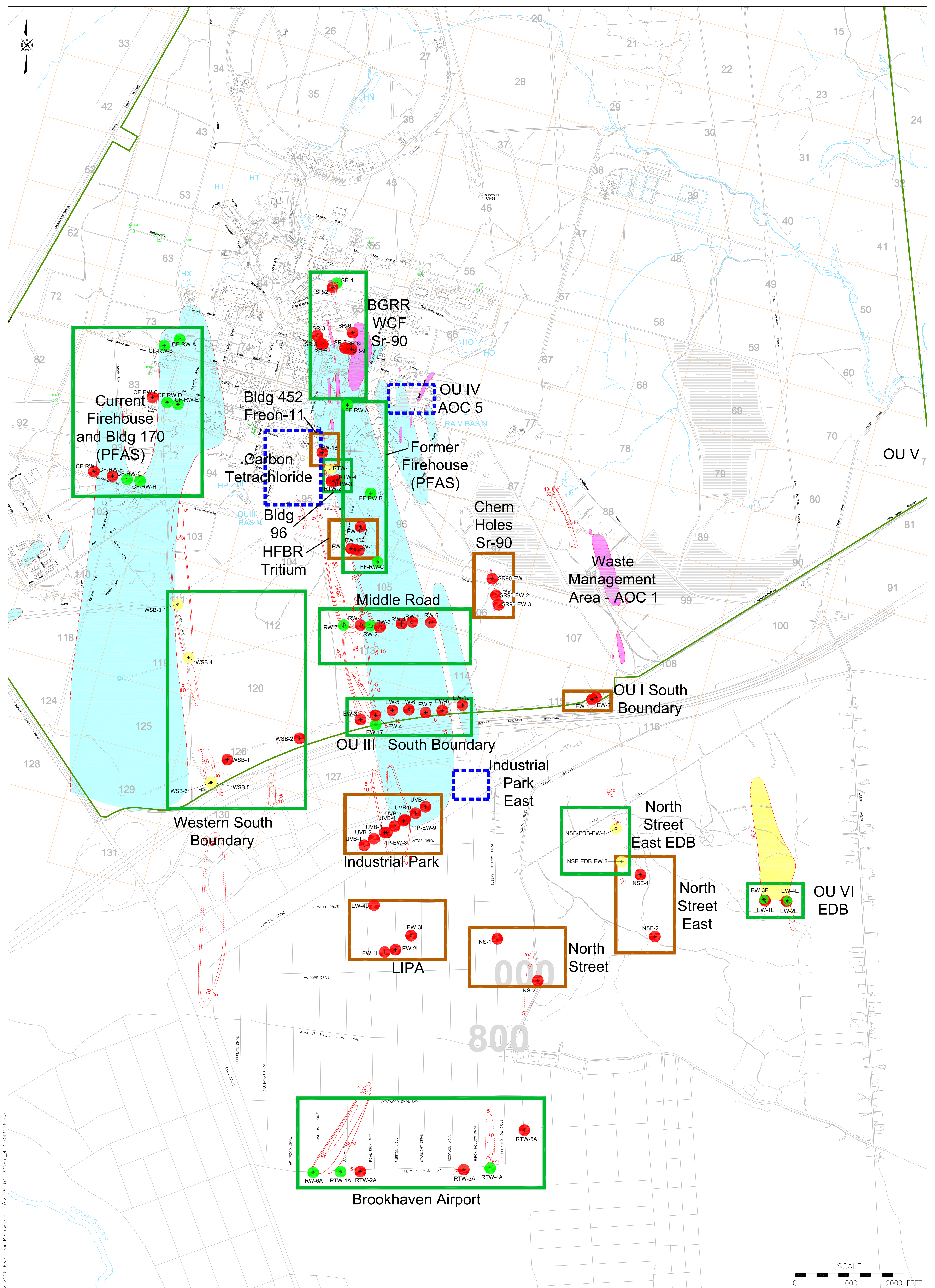
-  BNL BOUNDARY
-  PUBLIC WATER HOOKUP AREA (1996 - 1998)
-  OPERATING REMEDIATION SYSTEMS
-  REMEDIATION SYSTEM PLACED IN SHUTDOWN MODE
-  DECOMMISSIONED REMEDIATION SYSTEM



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2026 BNL FIVE-YEAR REVIEW

07/06/26



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LEGEND

- 32 BNL GRID NUMBER
- EW-12 BNL REMEDIATION WELL
- BNL-12 BNL SUPPLY / PROCESS WELL

- OPERATING REMEDIATION SYSTEMS
- REMEDATION SYSTEM PLACED IN SHUTDOWN MODE
- DECOMMISSIONED REMEDIATION SYSTEM

NOTE: NORTH STREET EAST EDB TREATMENT SYSTEM APPROVED FOR SHUTDOWN IN JANUARY 2026.

REMEDATION WELL STATUS

- RTW-4A ON-FULL TIME
- SR-9 PULSED PUMPING
- RTW-5A STAND-BY-OFF

- 2025 TVOC PLUME UNLESS SPECIFIED. CONCENTRATION AS INDICATED. (DASHED WHERE INFERRED)
- 2025 TRITIUM PLUME. OUTLINE IS 20,000 pCi/L.
- 2025 STRONTIUM 90 PLUME. OUTLINE IS 8 pCi/L.

- 2025 OU VI EDB PLUME. OUTLINE IS 0.05 µg/L.
- EXTENT OF PFOS PLUME OUTLINES BASED UPON 2025 MONITORING RESULTS. OUTLINE IS 10 ng/L.

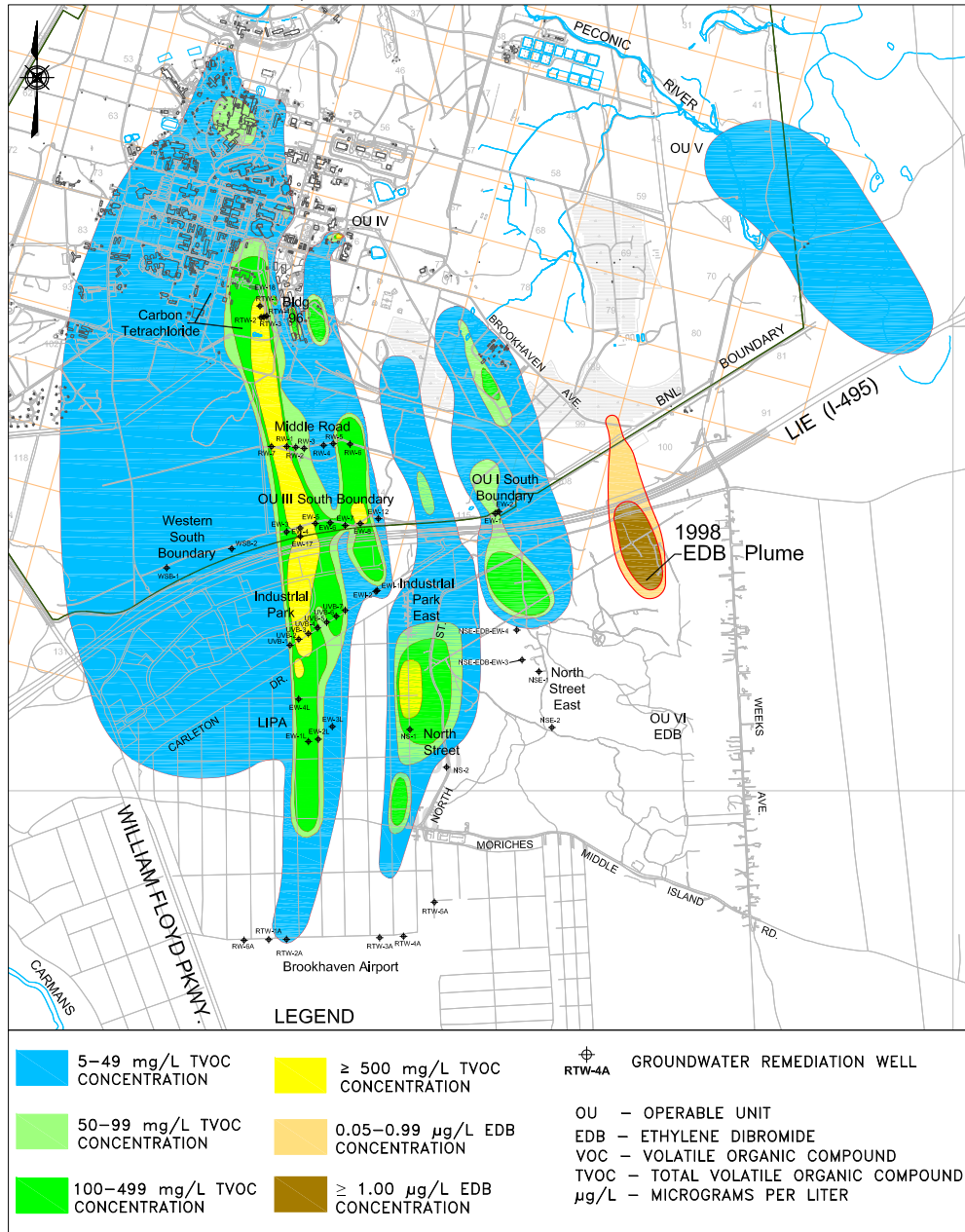
FIGURE 4-1 GROUNDWATER REMEDIATION SYSTEMS & OPERATIONAL STATUS OF WELLS



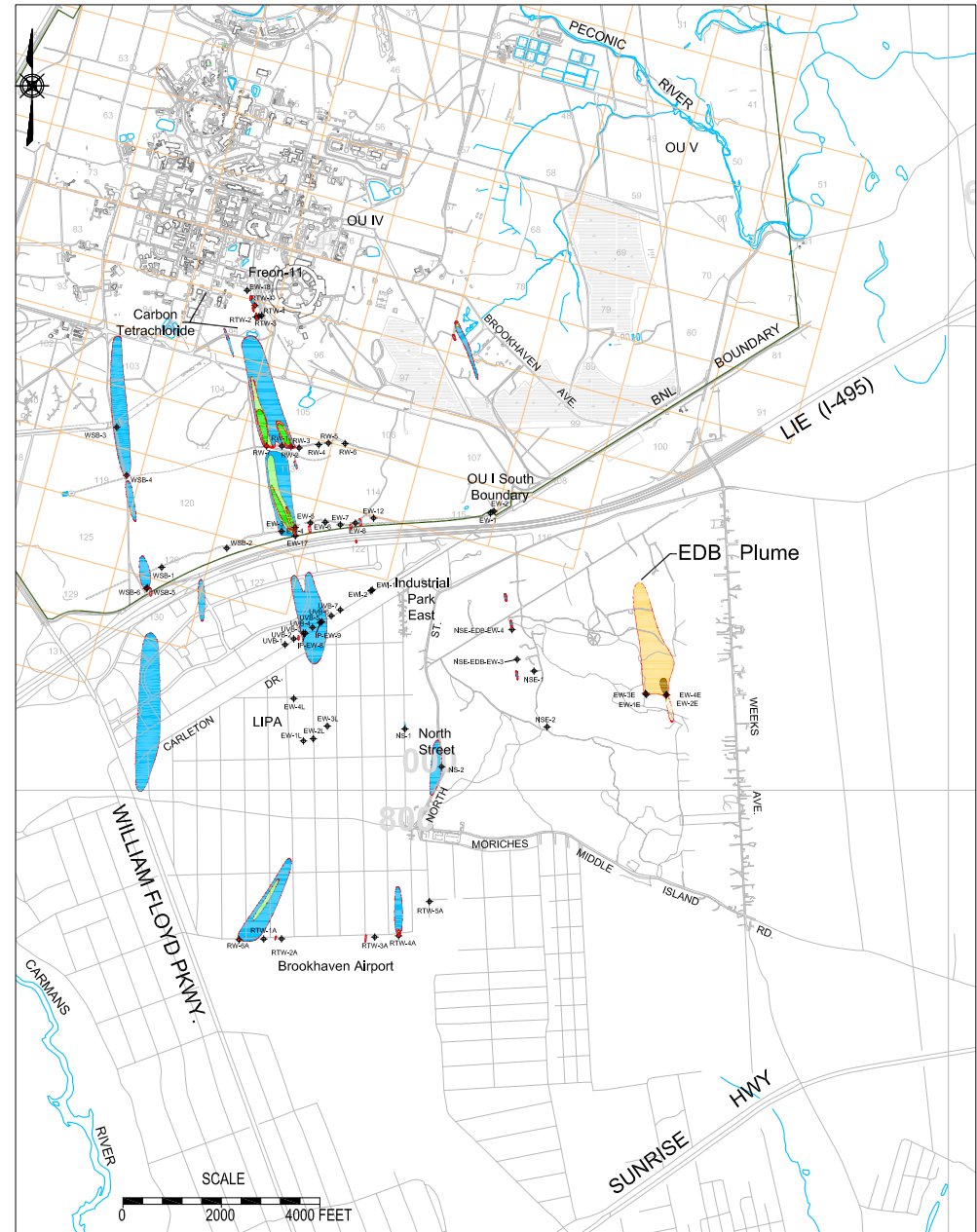
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2026 BNL FIVE-YEAR REVIEW

1997/1998 TVOC PLUME DISTRIBUTION



2025 TVOC PLUME DISTRIBUTION



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TITLE:

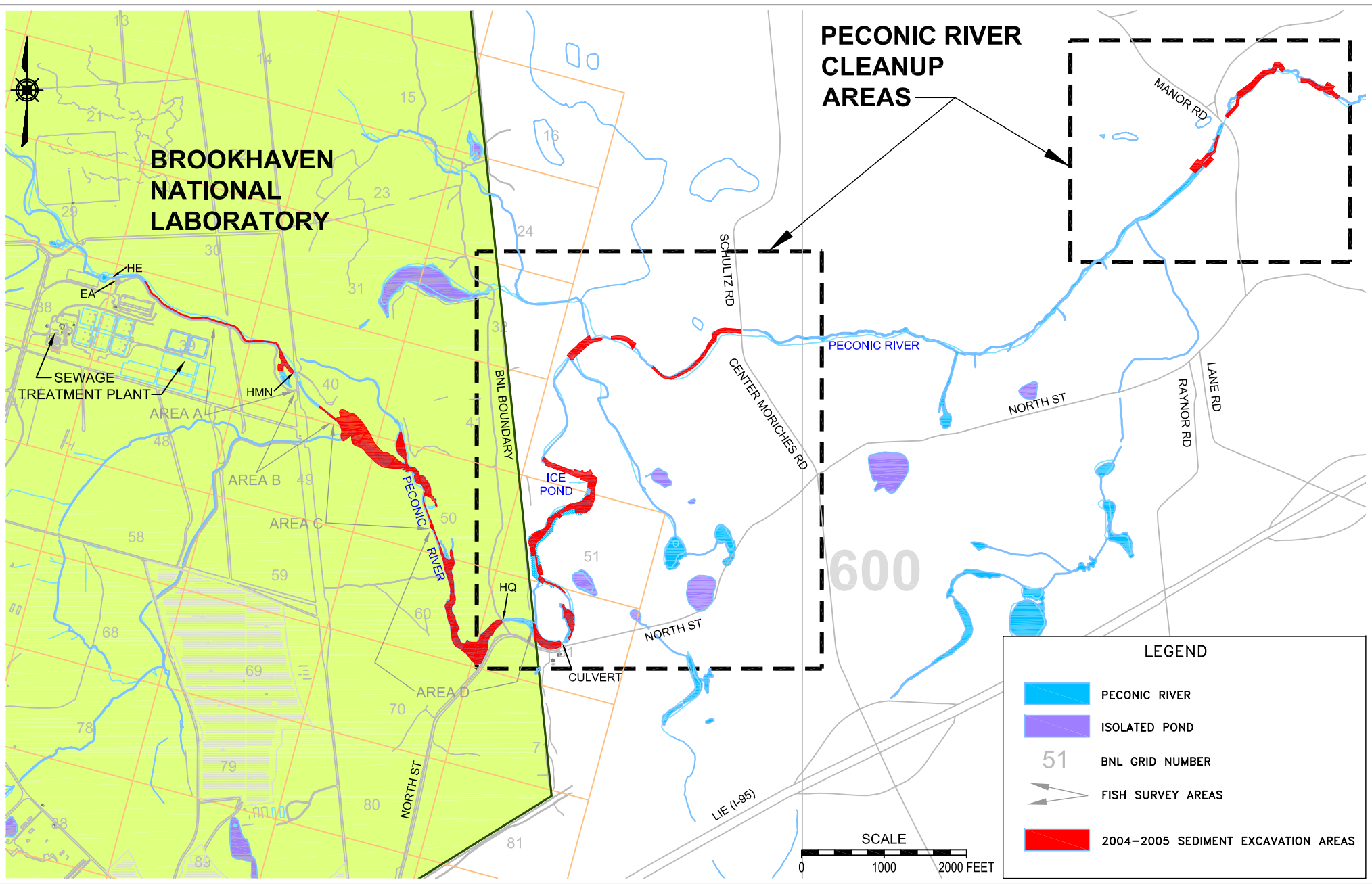
TVOC PLUME COMPARISON
1997/1998 – 2025
2026 BNL FIVE-YEAR REVIEW

DWN: AJZ	VT:HZ.: —	DATE: 04/30/26	PROJECT NO.: —
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FIGURE NO.:

5–1

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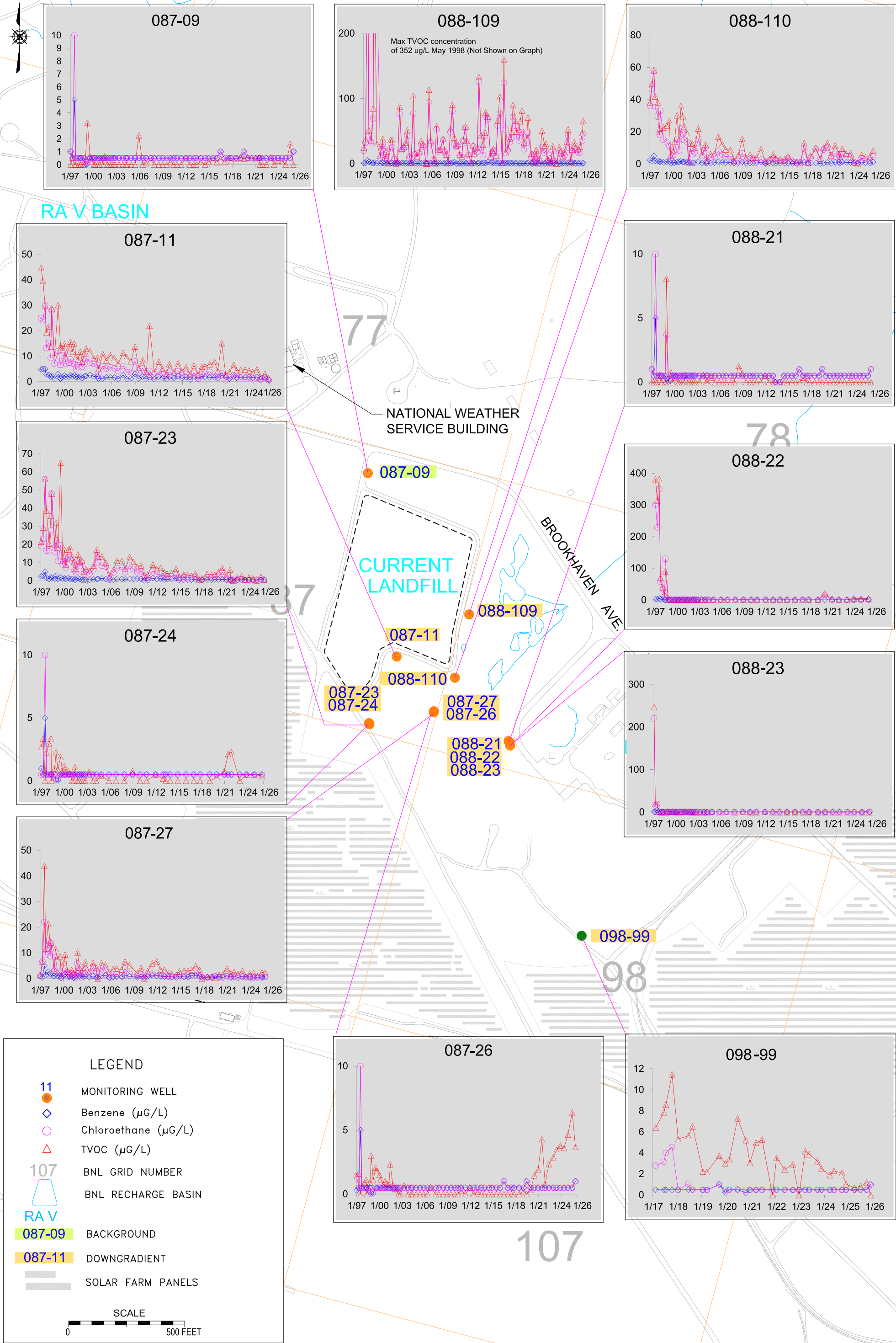
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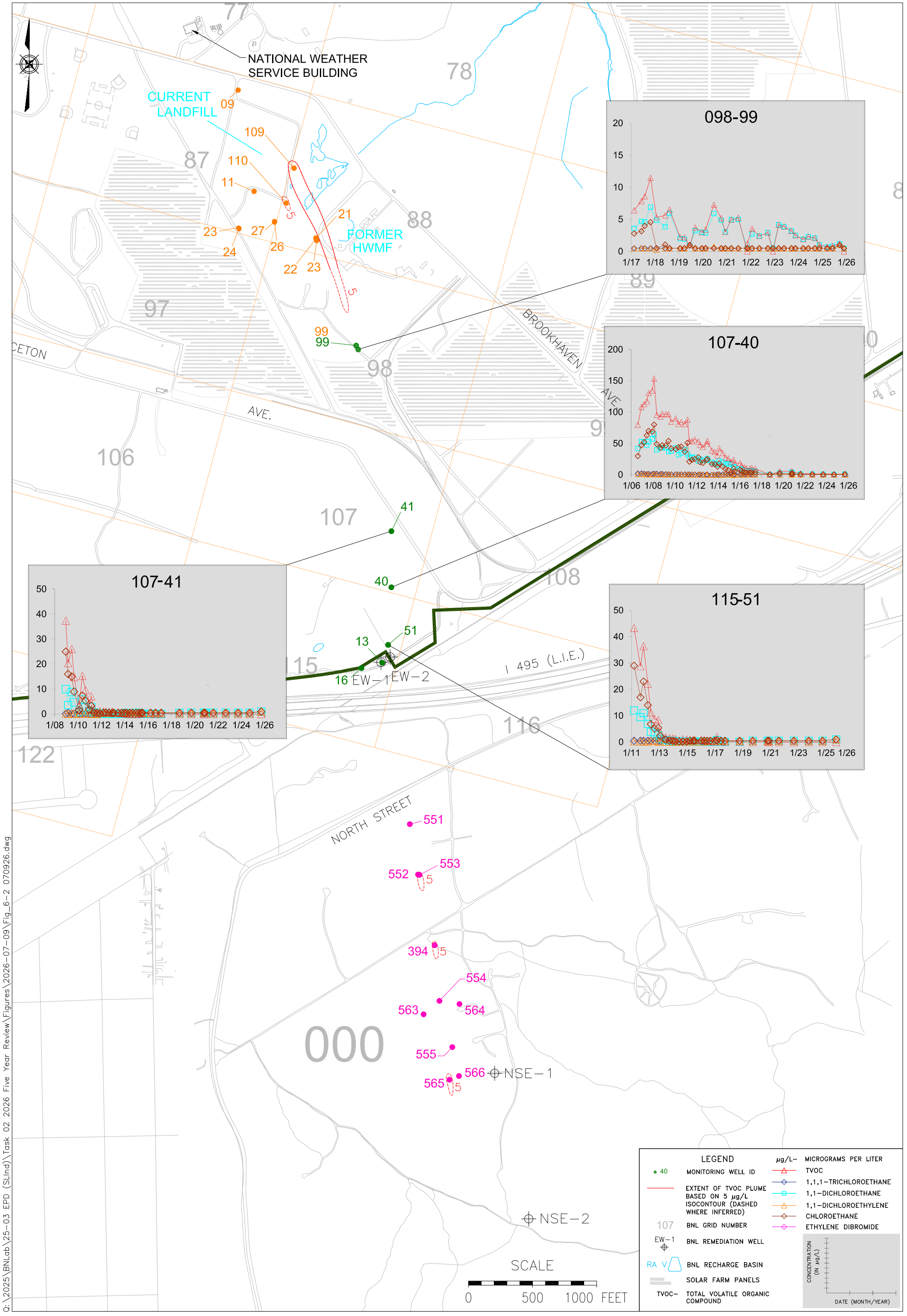
PECONIC RIVER CLEANUP AREAS

2026 BNL FIVE-YEAR REVIEW

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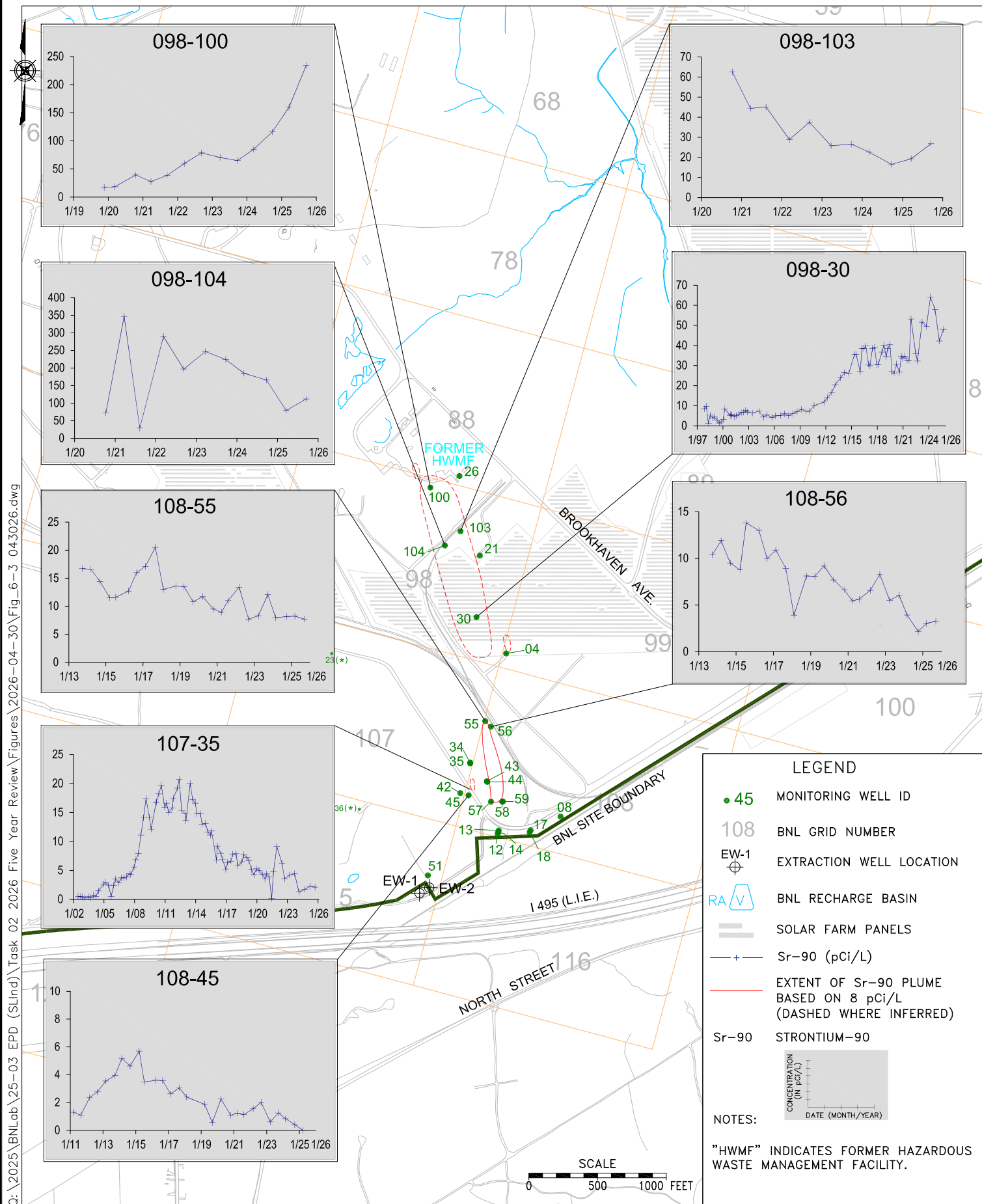
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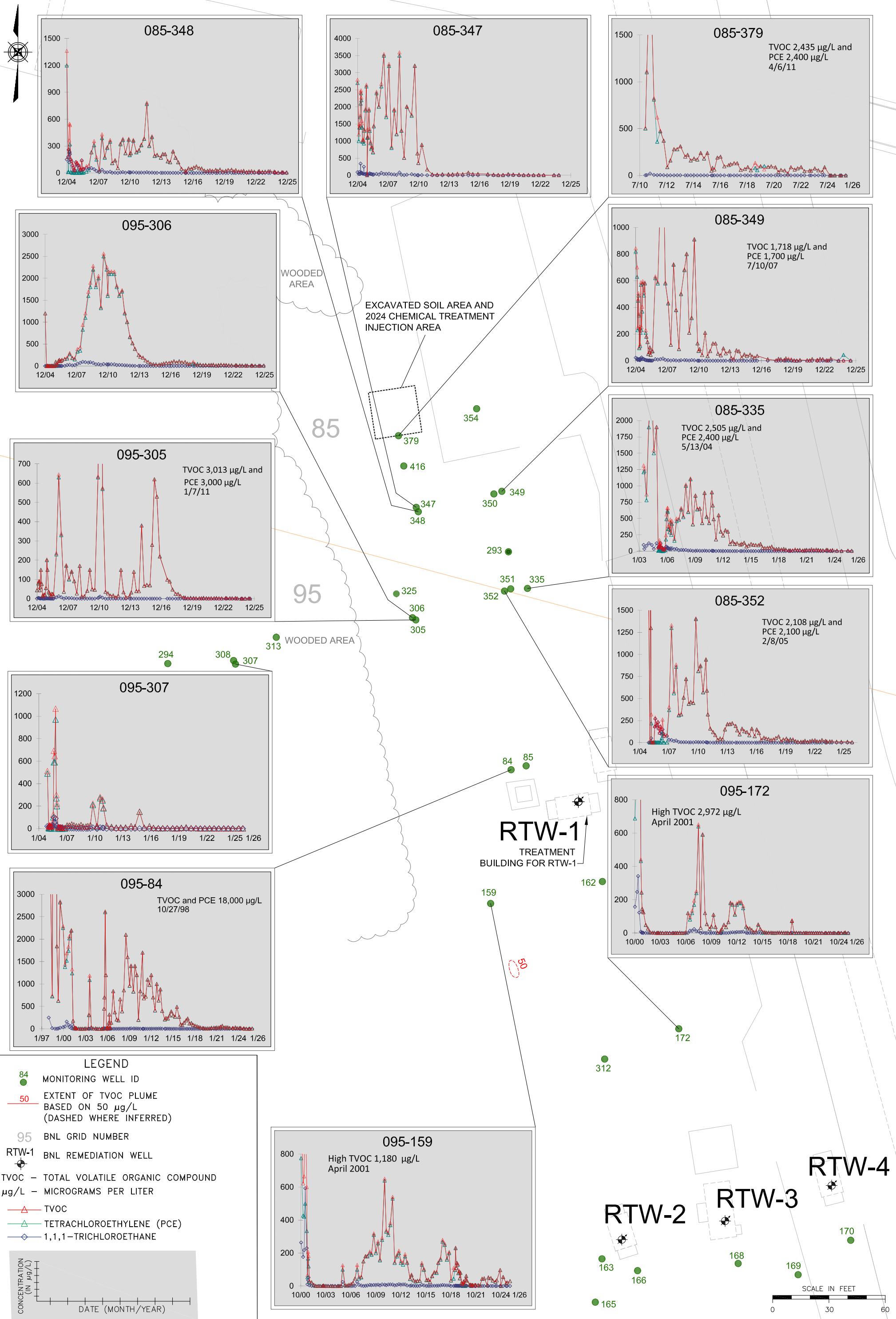
OU 1 FORMER HAZARDOUS WASTE MANAGEMENT FACILITY Sr-90 TRENDS

2026 BNL FIVE-YEAR REVIEW

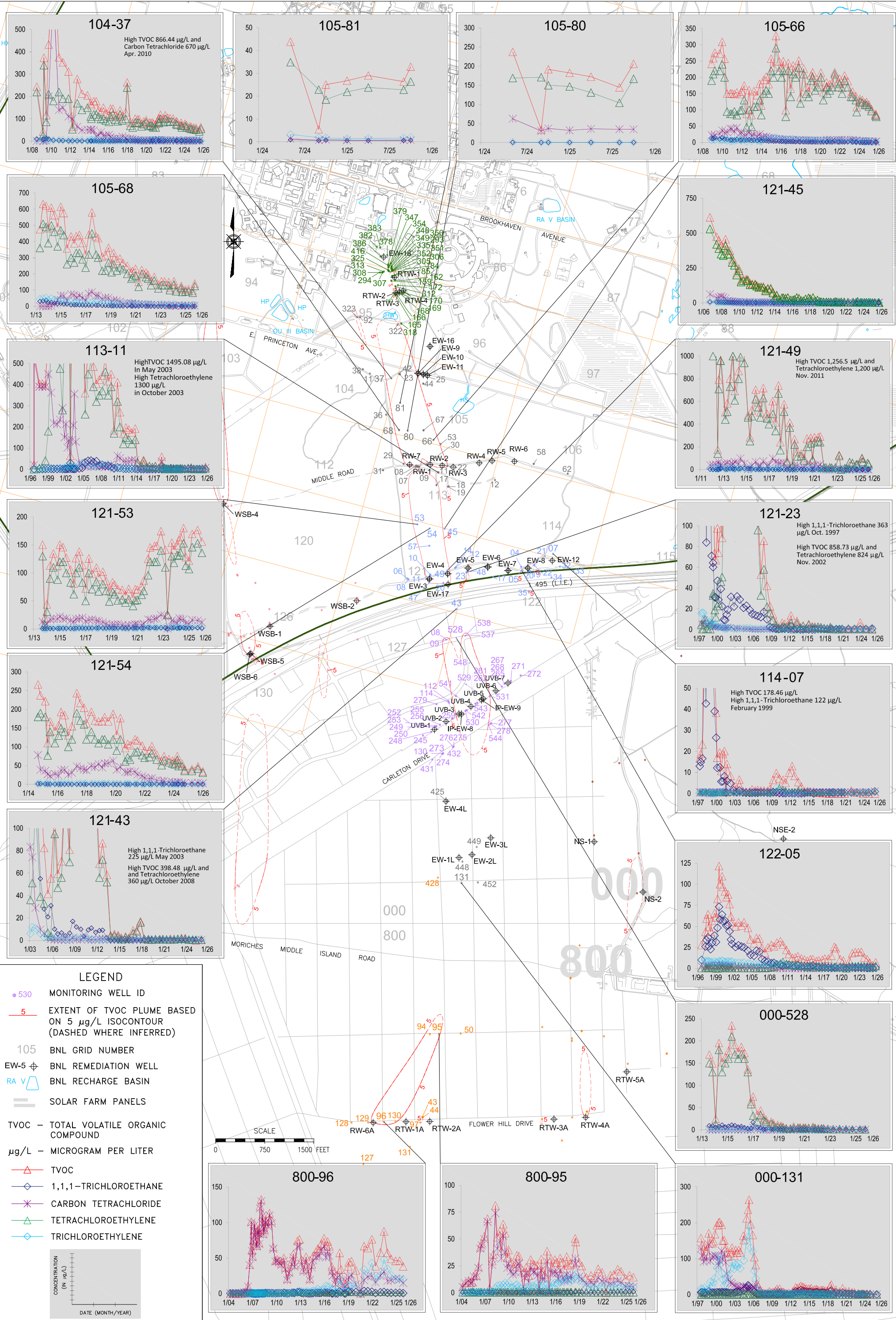
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FIGURE NO.: 6-3

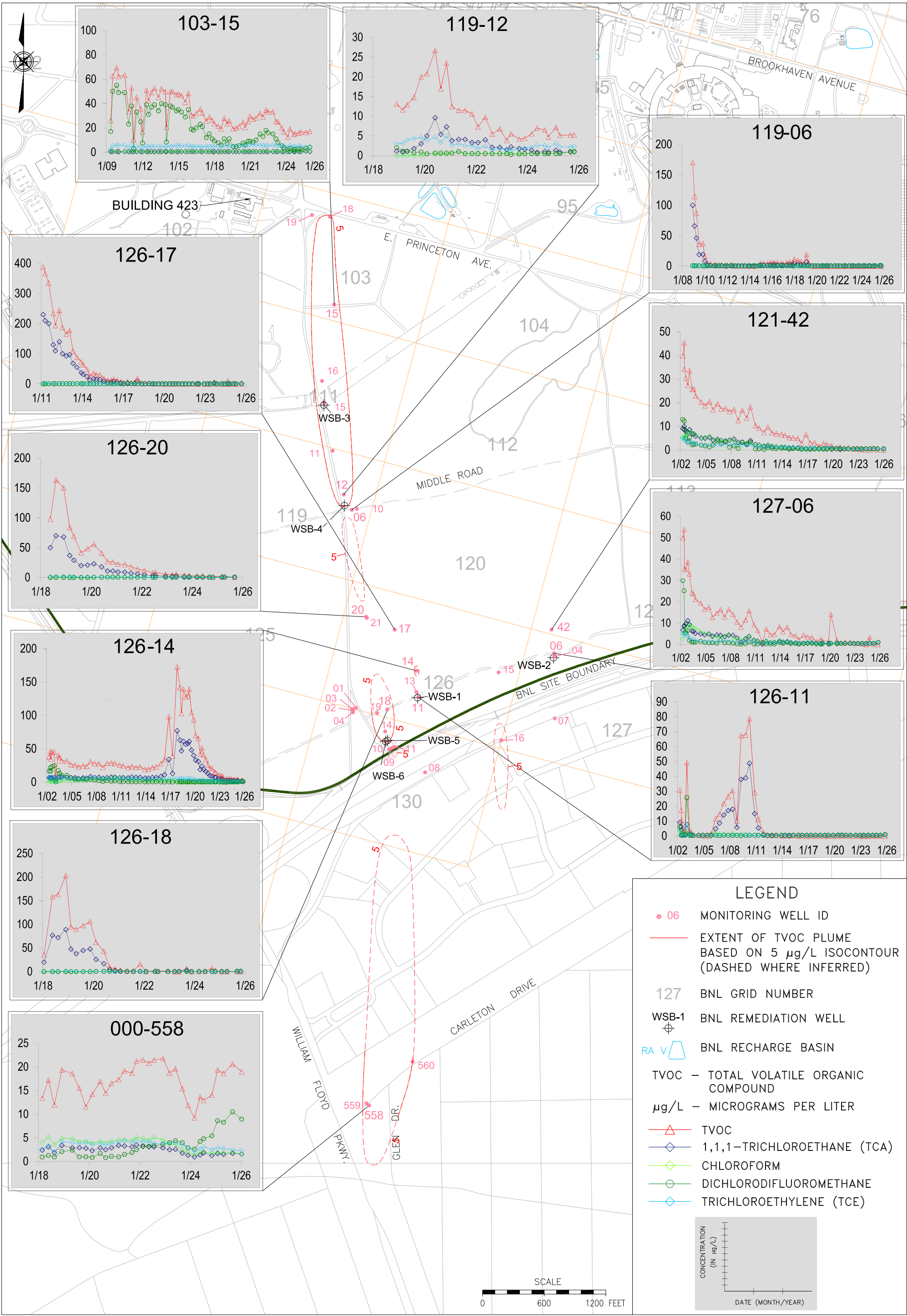
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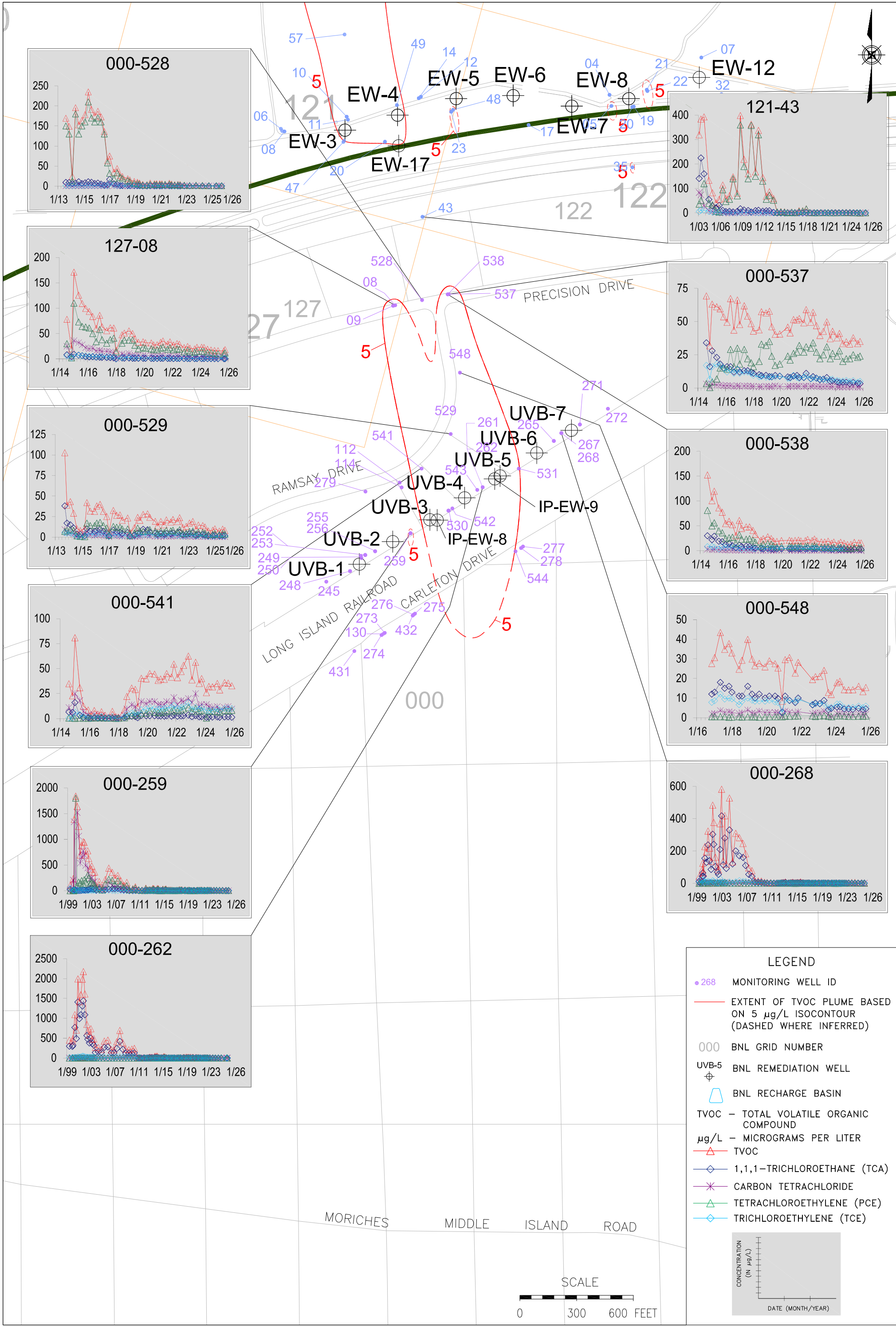
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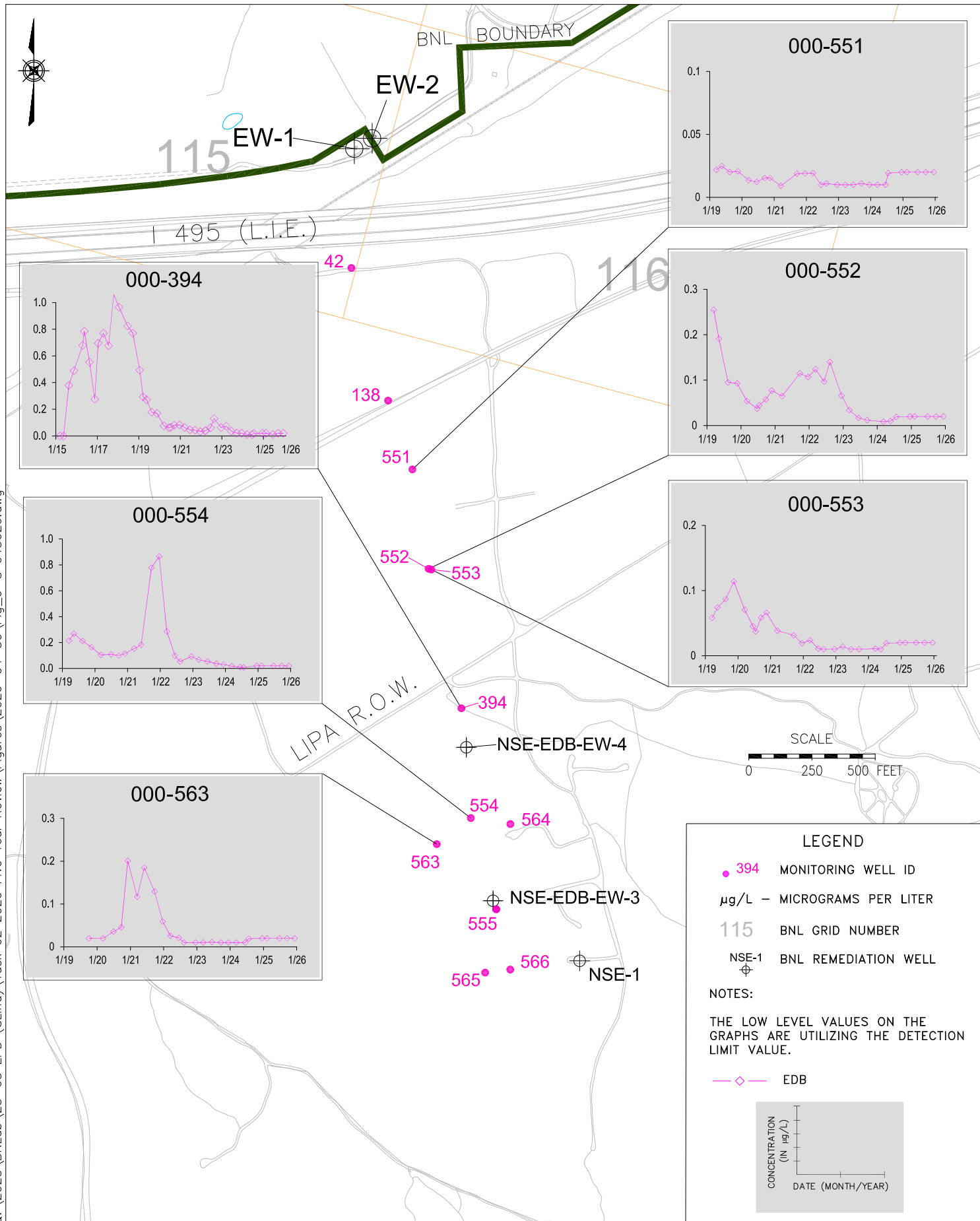
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ENVIRONMENTAL
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TITLE:

OU III NORTH STREET EAST HISTORICAL EDB TRENDS

2026 BNL FIVE-YEAR REVIEW

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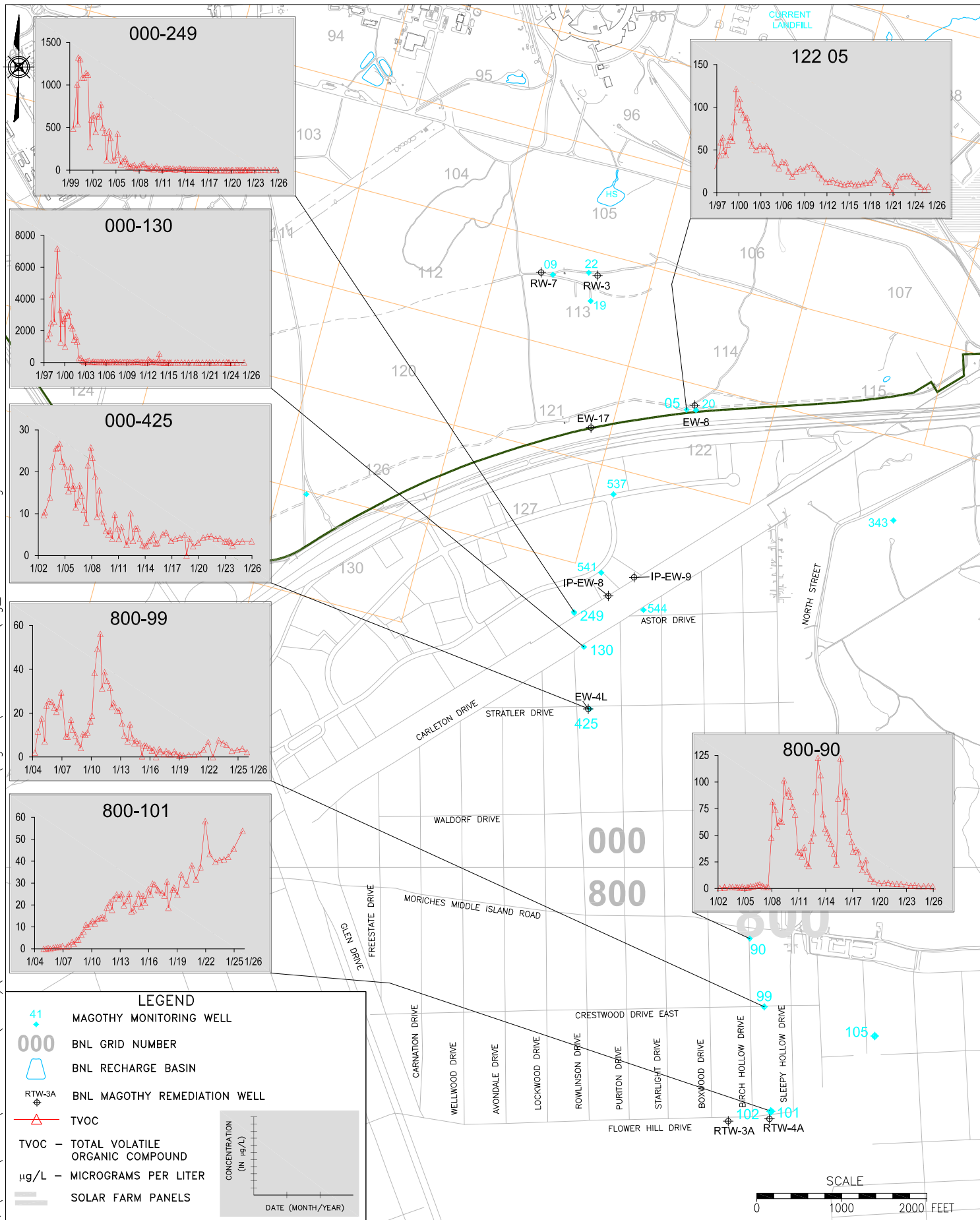
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FIGURE NO.:

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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

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2026 BNL FIVE-YEAR REVIEW

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FIGURE NO.:

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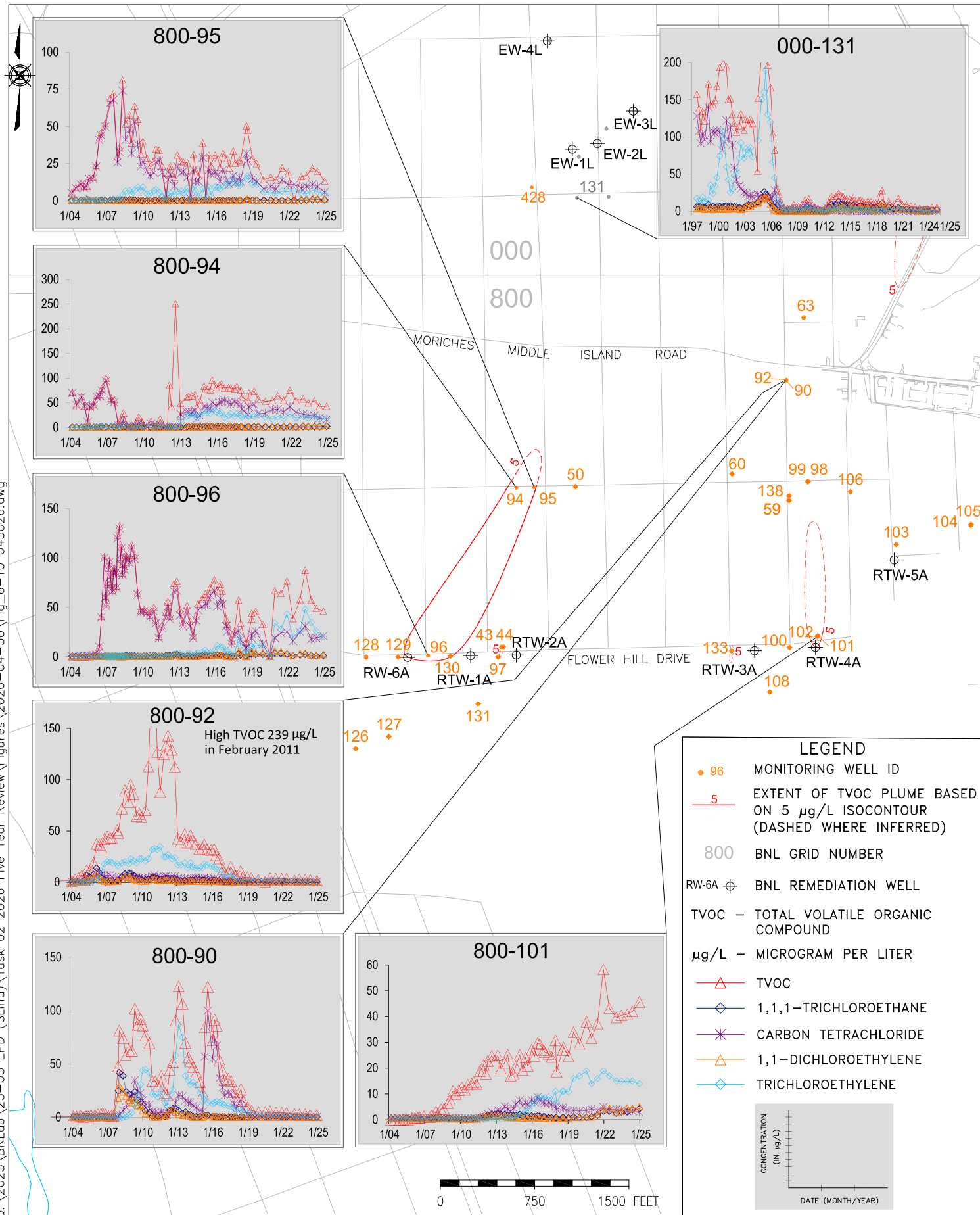
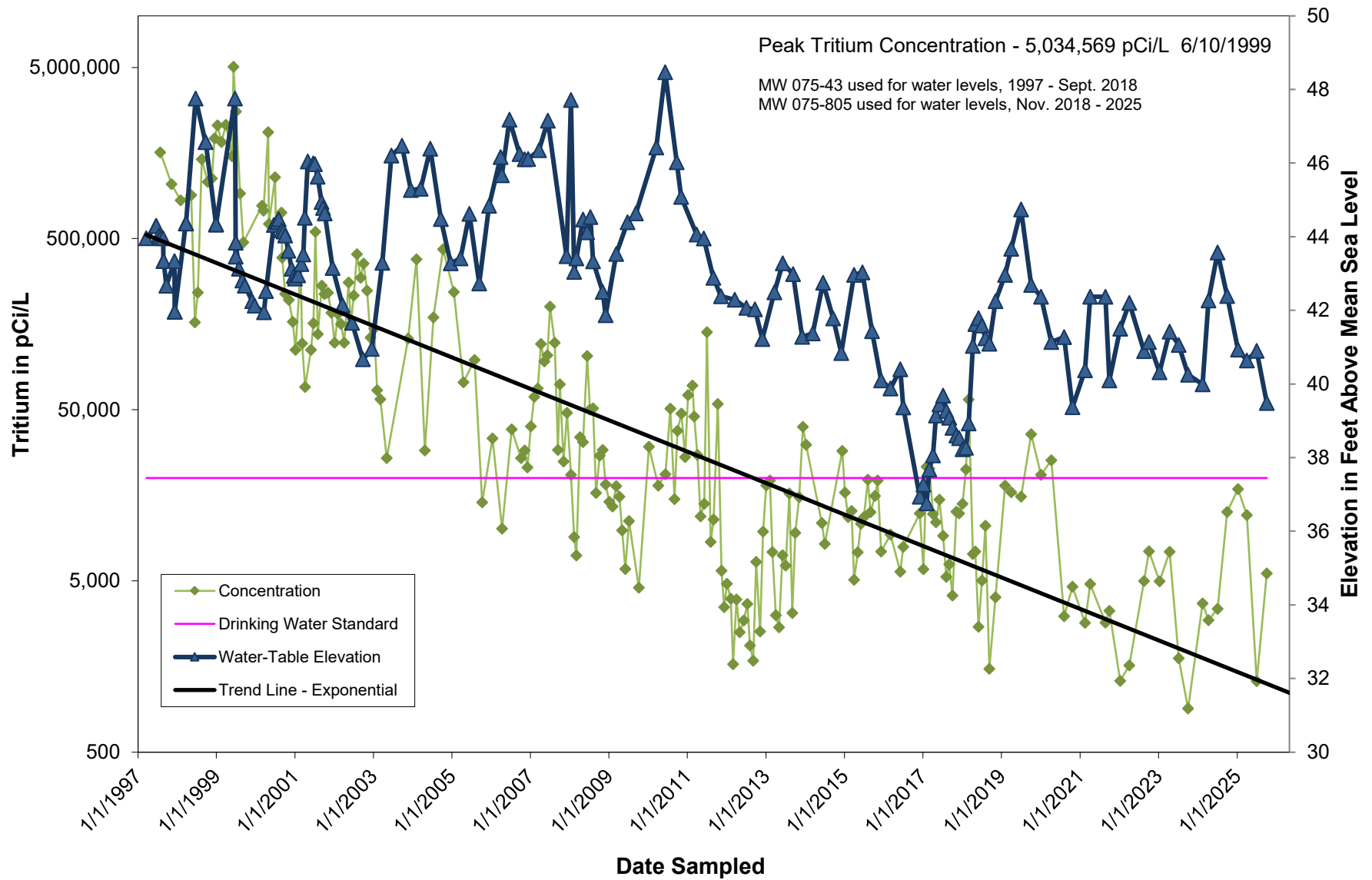
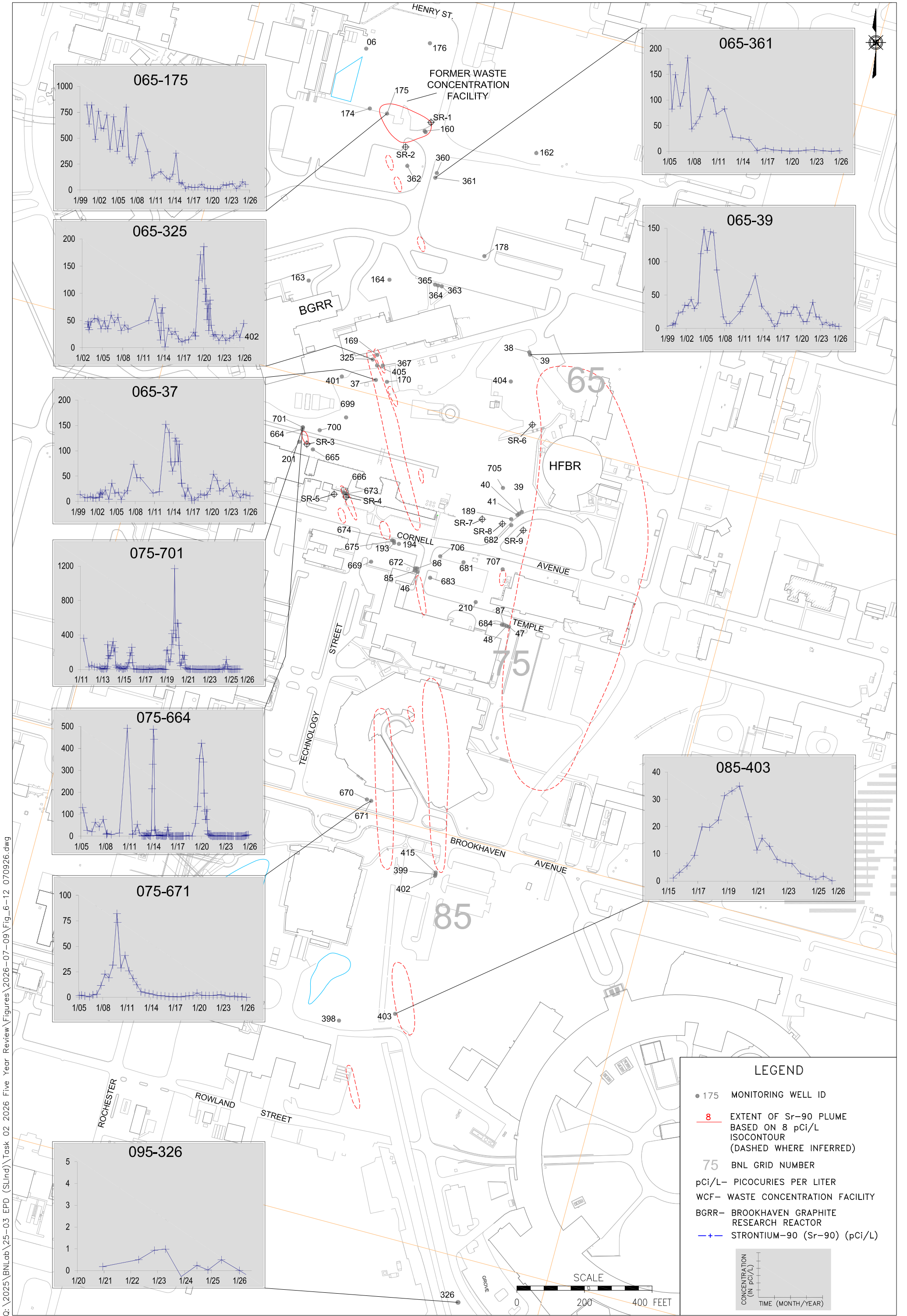


Figure 6-11
OU III HFBR
Peak Tritium Concentrations in Groundwater Monitoring Wells
HFBR to Cornell Avenue

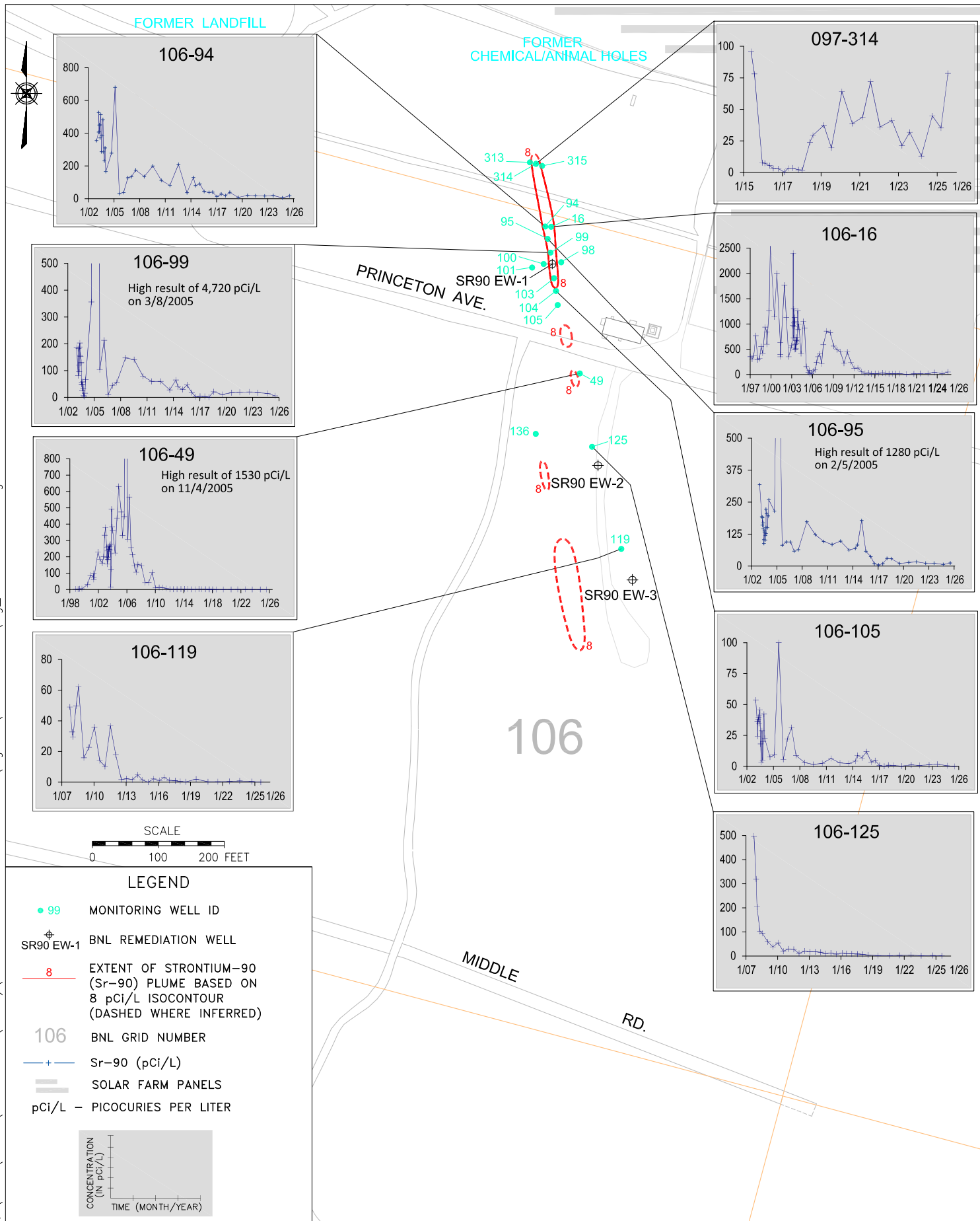
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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

OU III CHEMICAL/ANIMAL HOLES
HISTORICAL Sr-90 TRENDS

2026 BNL FIVE-YEAR REVIEW

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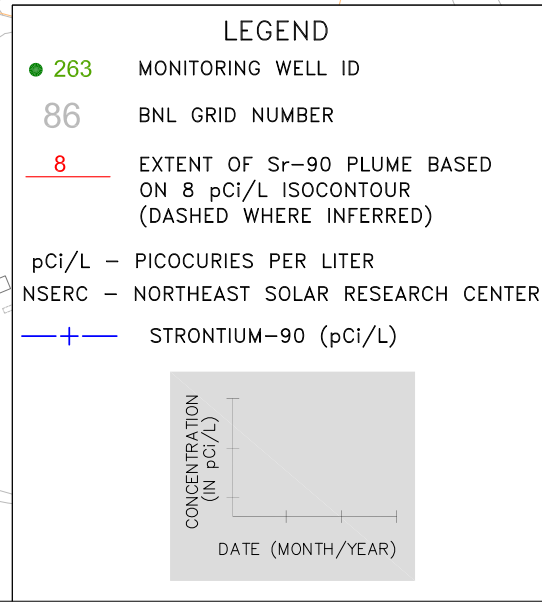
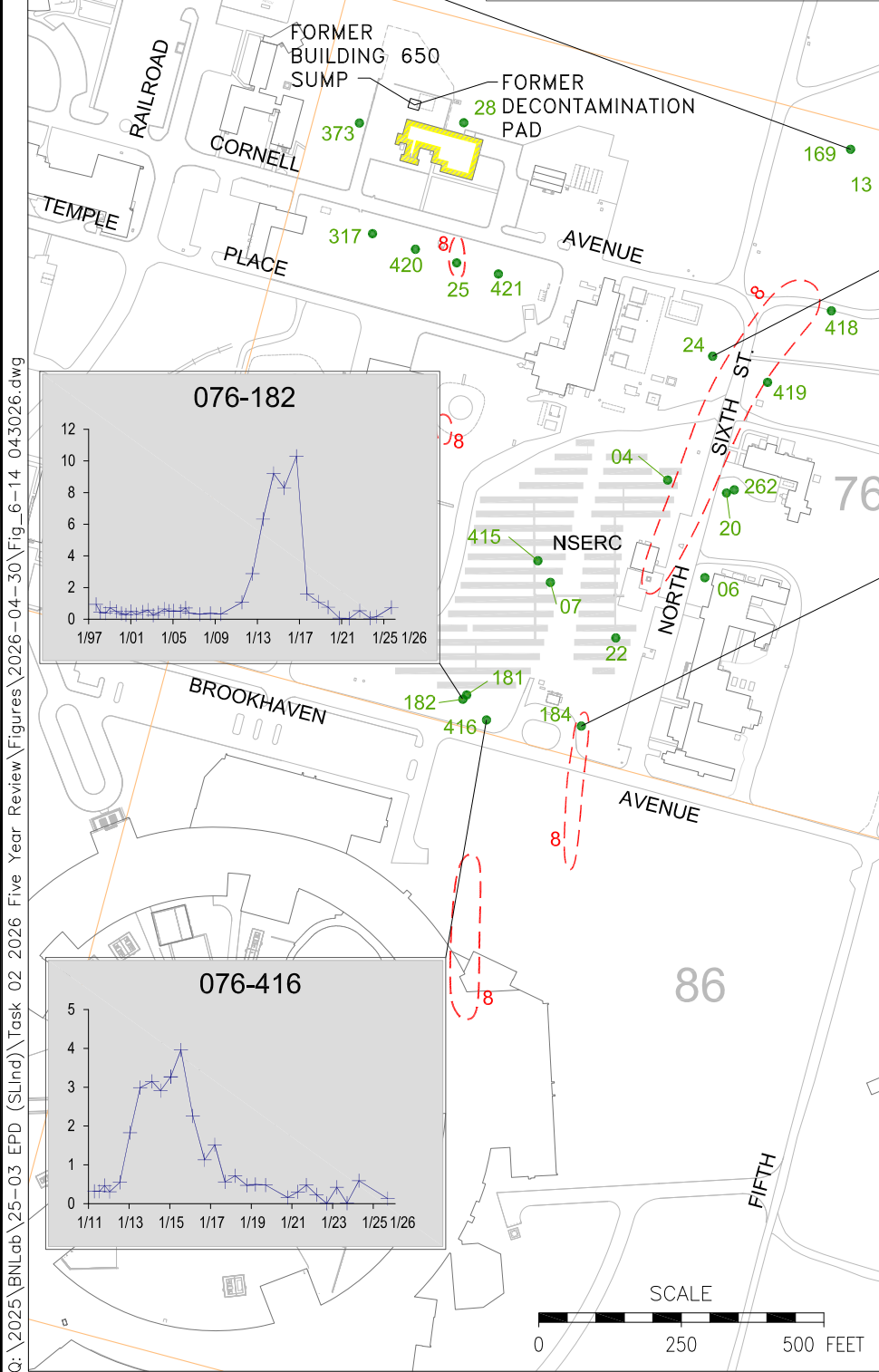
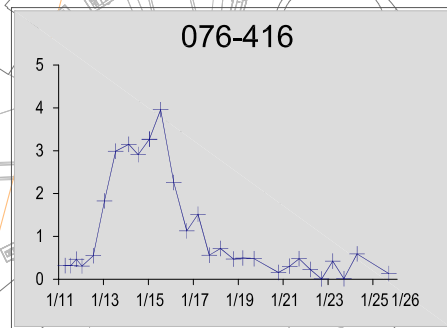
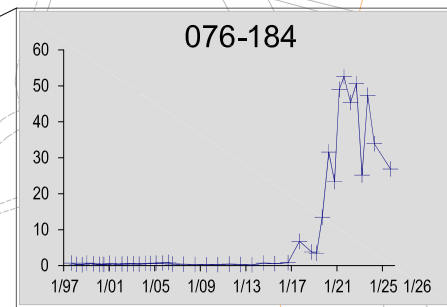
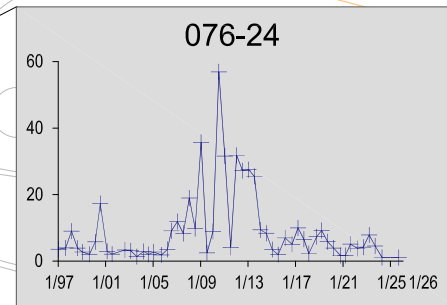
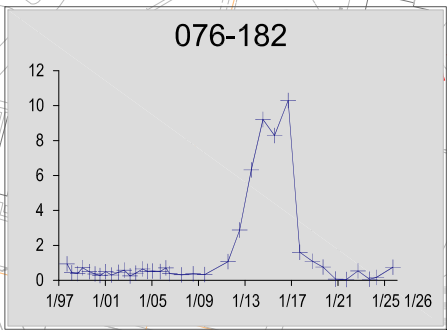
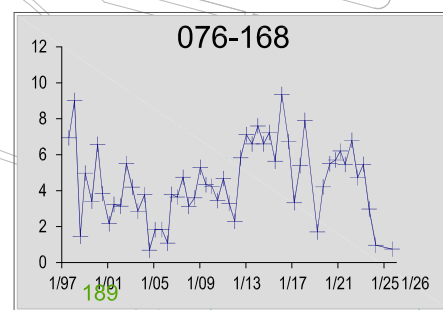
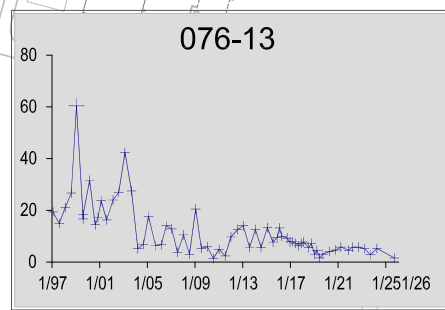
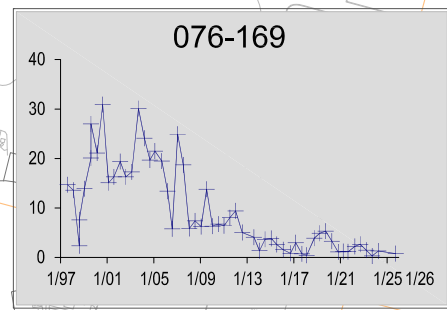
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FIGURE NO.:

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HISTORICAL Sr-90 TRENDS

2026 BNL FIVE-YEAR REVIEW

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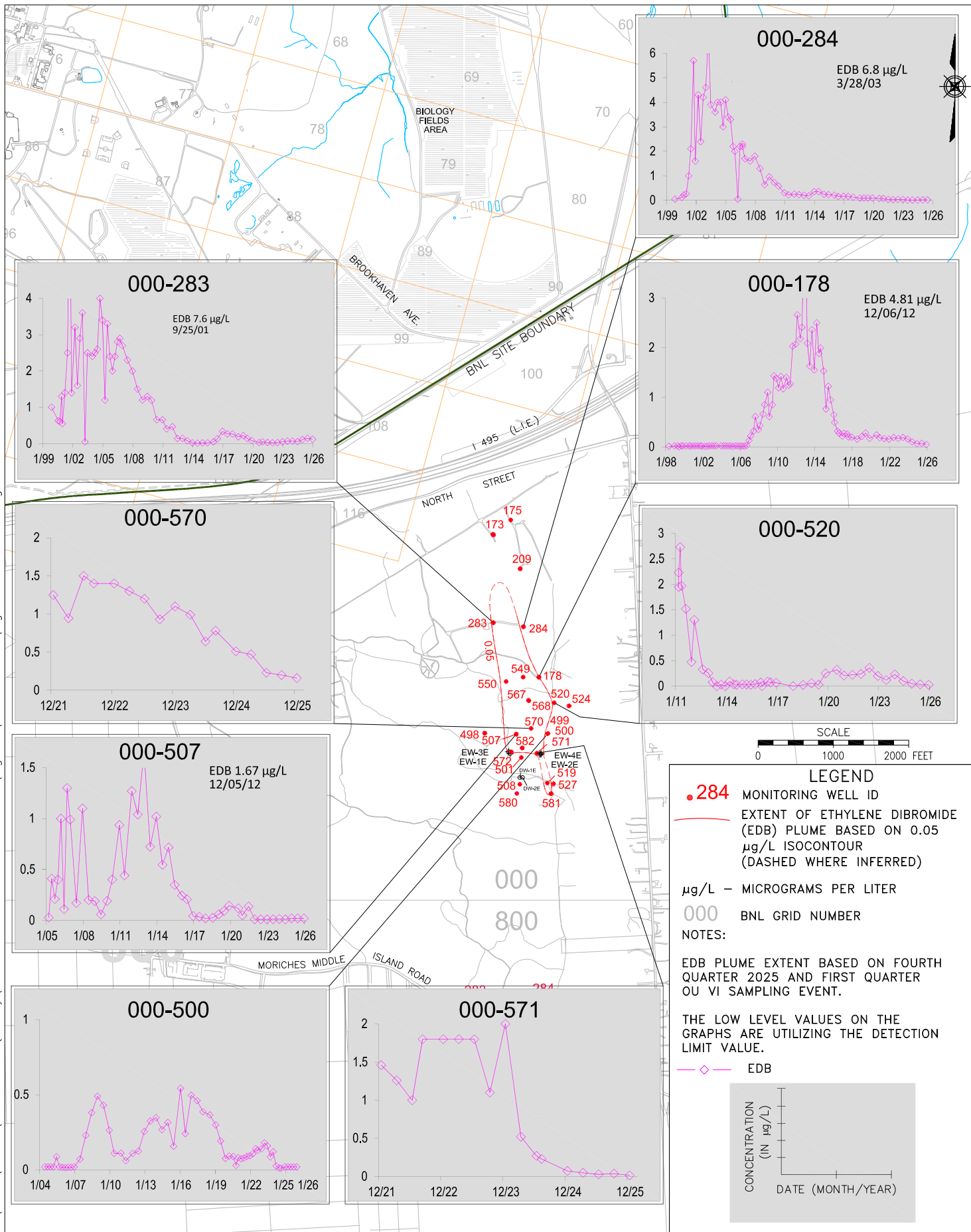
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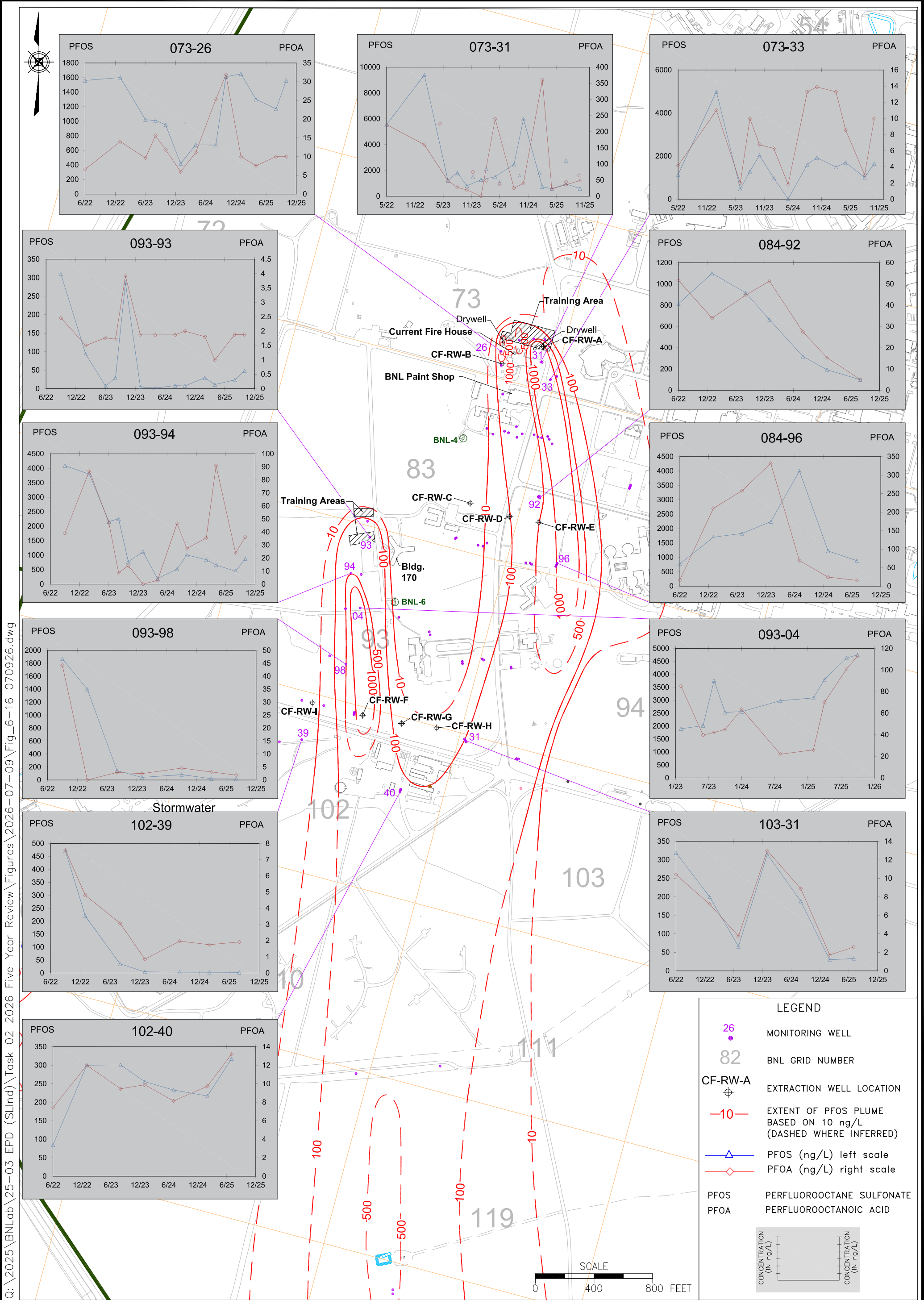
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FIGURE NO.:

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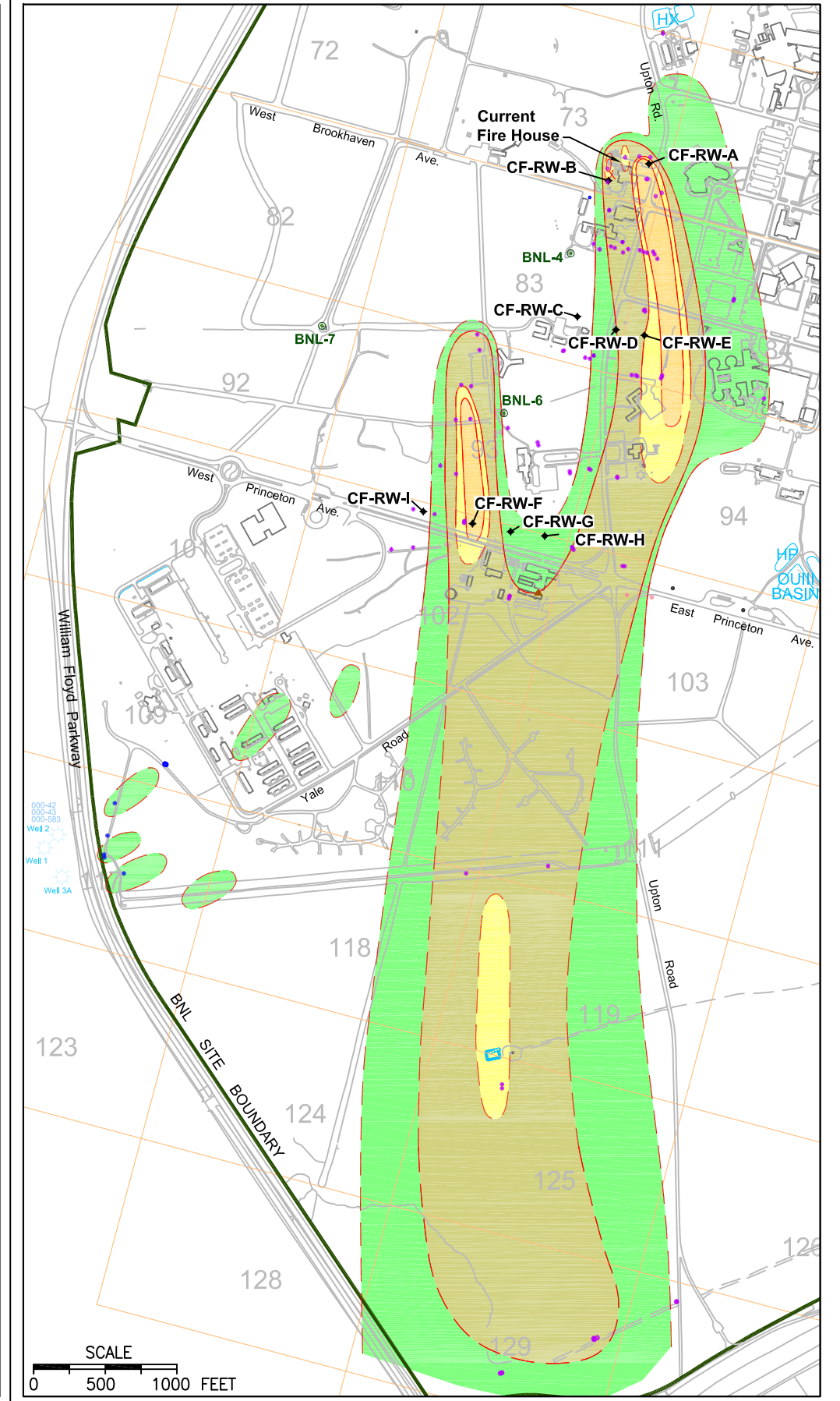
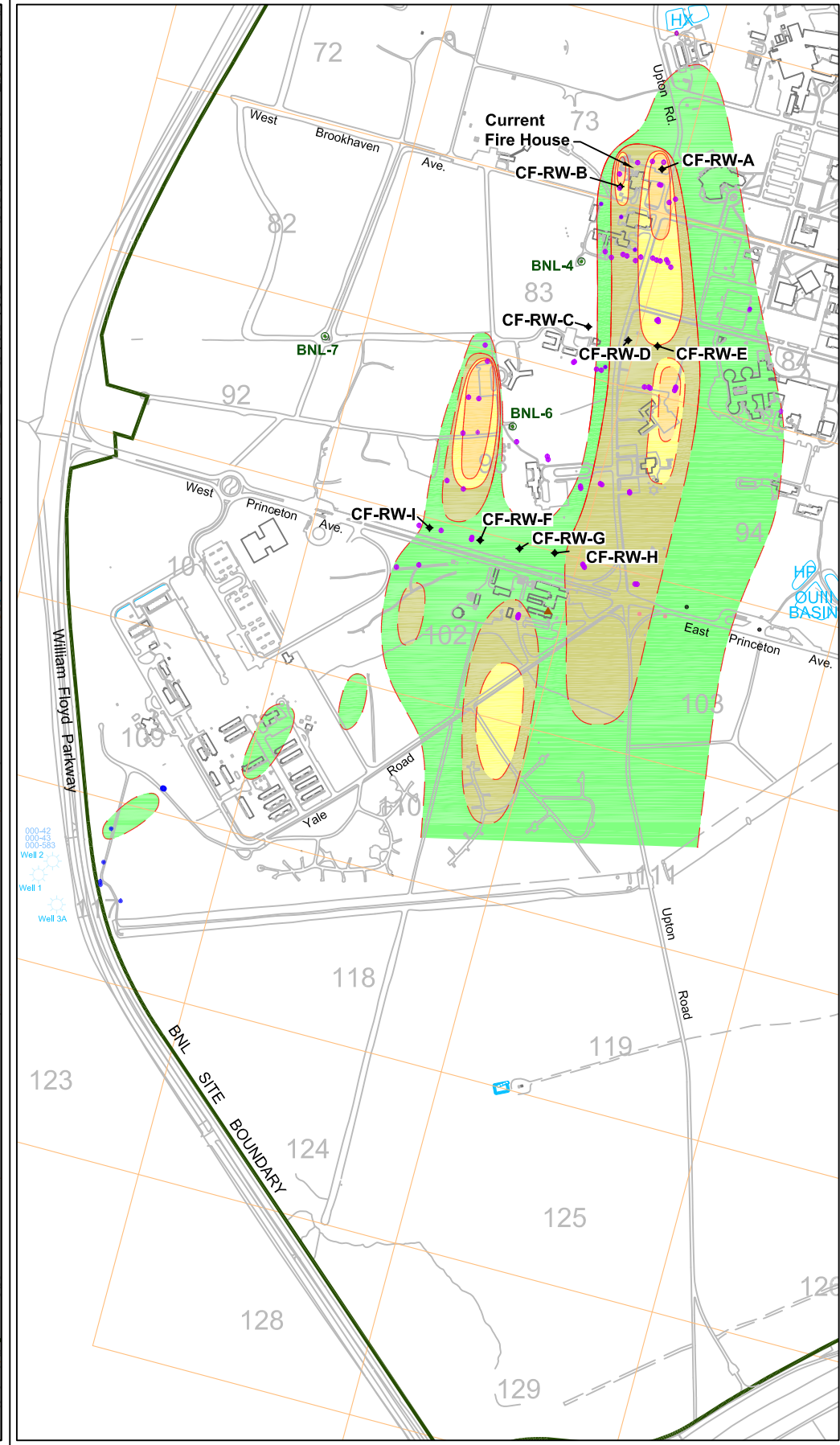
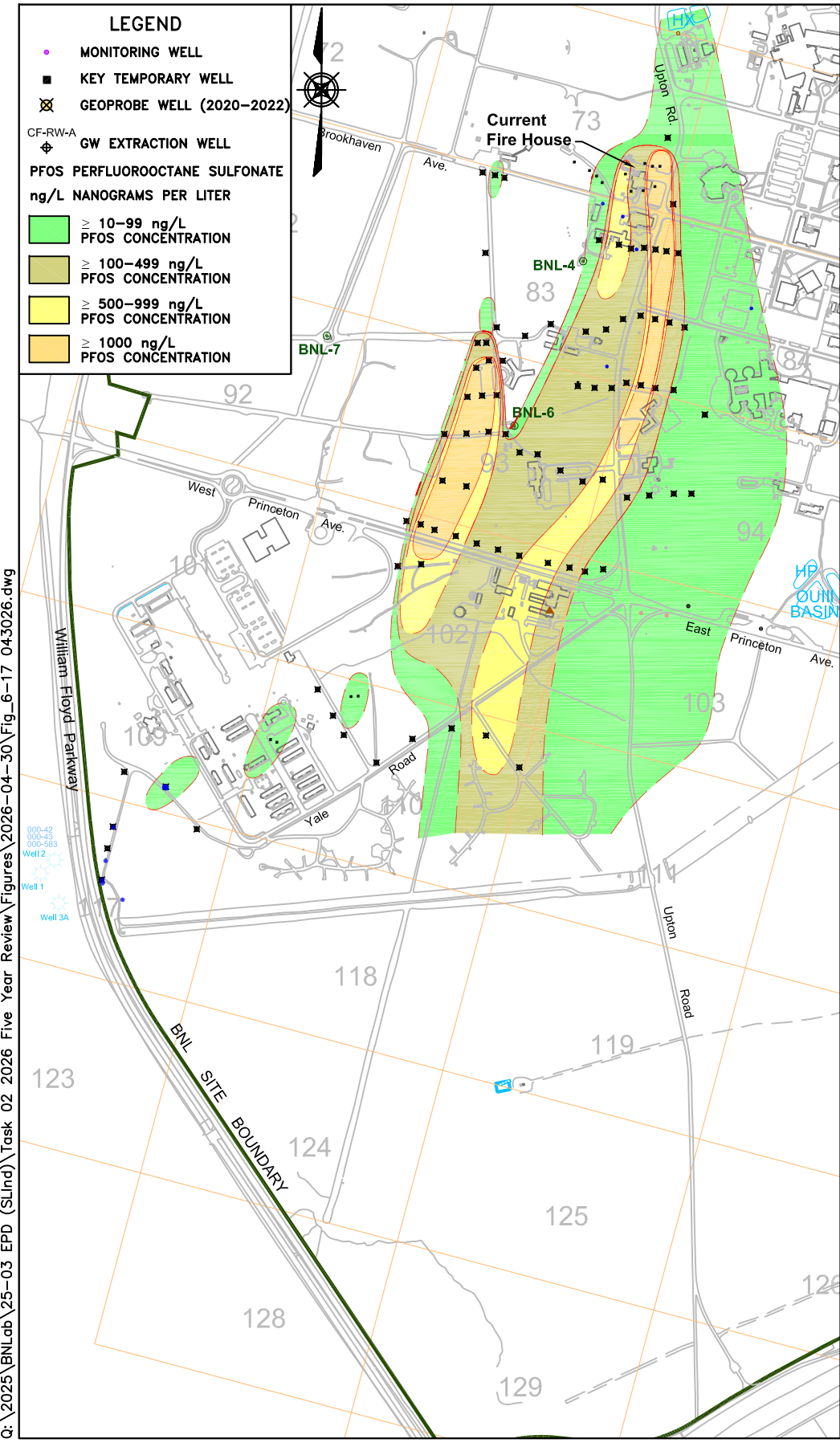
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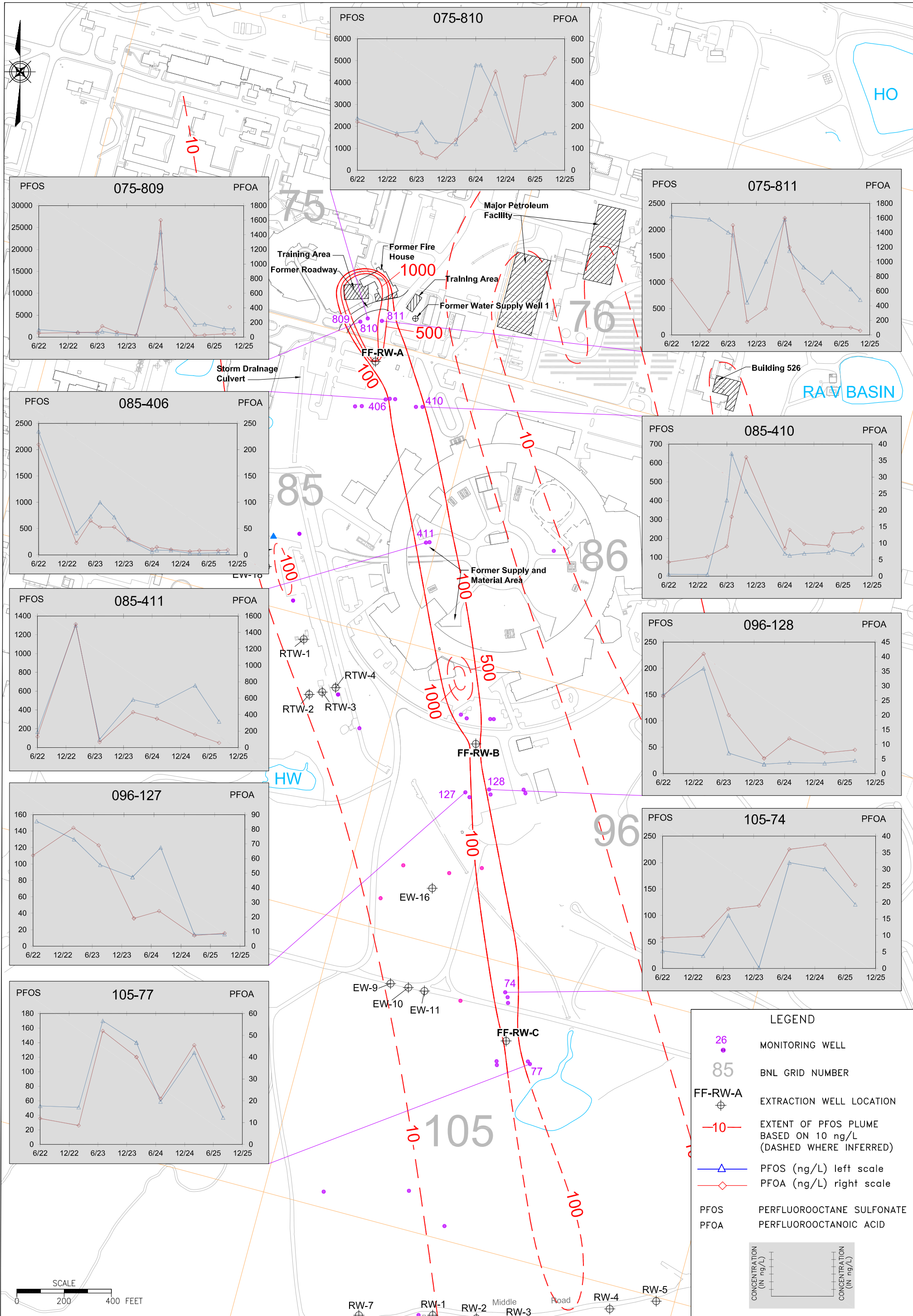
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PFOS PLUME COMPARISON 2020 – 2025

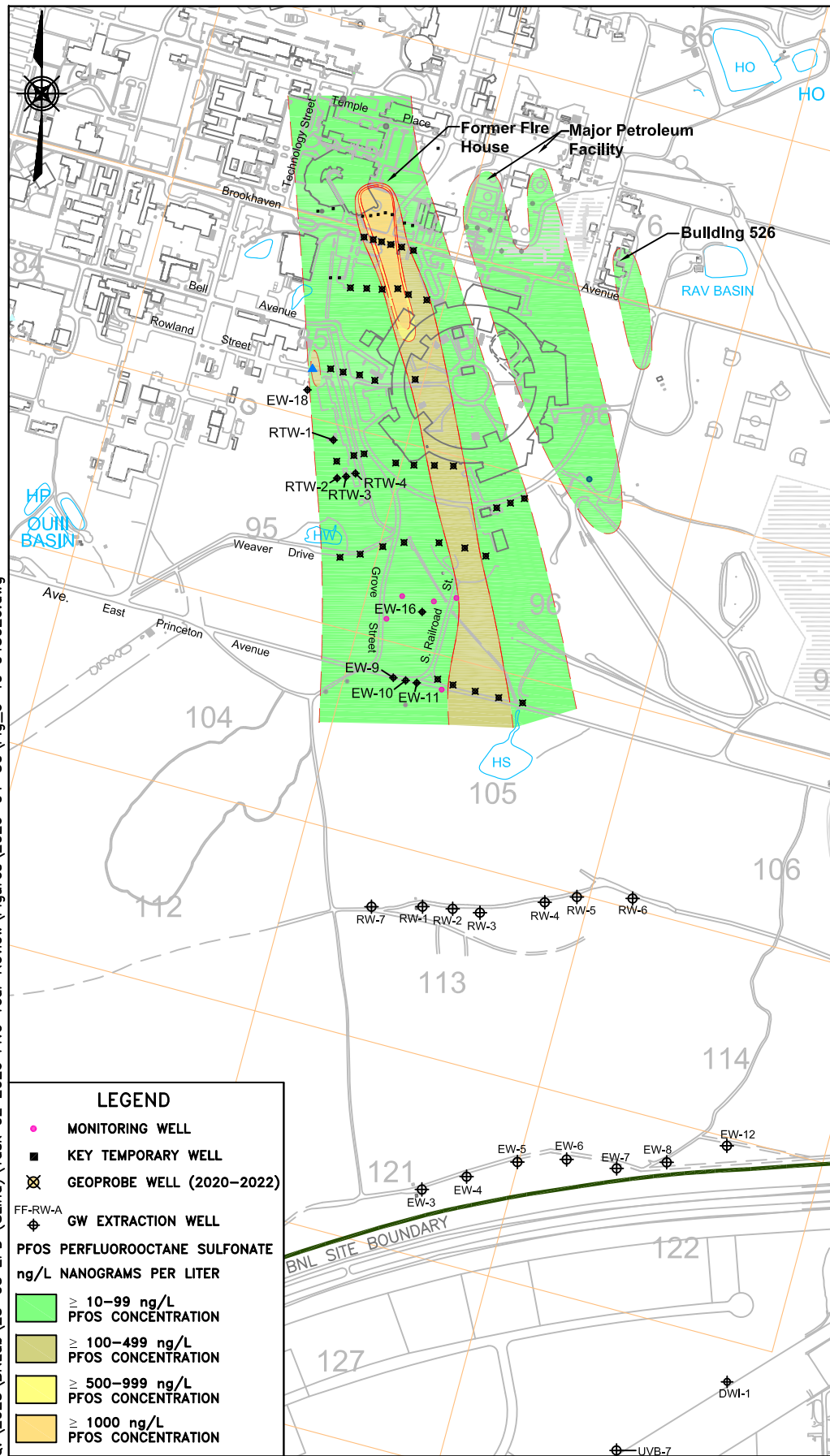
2026 BNL FIVE-YEAR REVIEW

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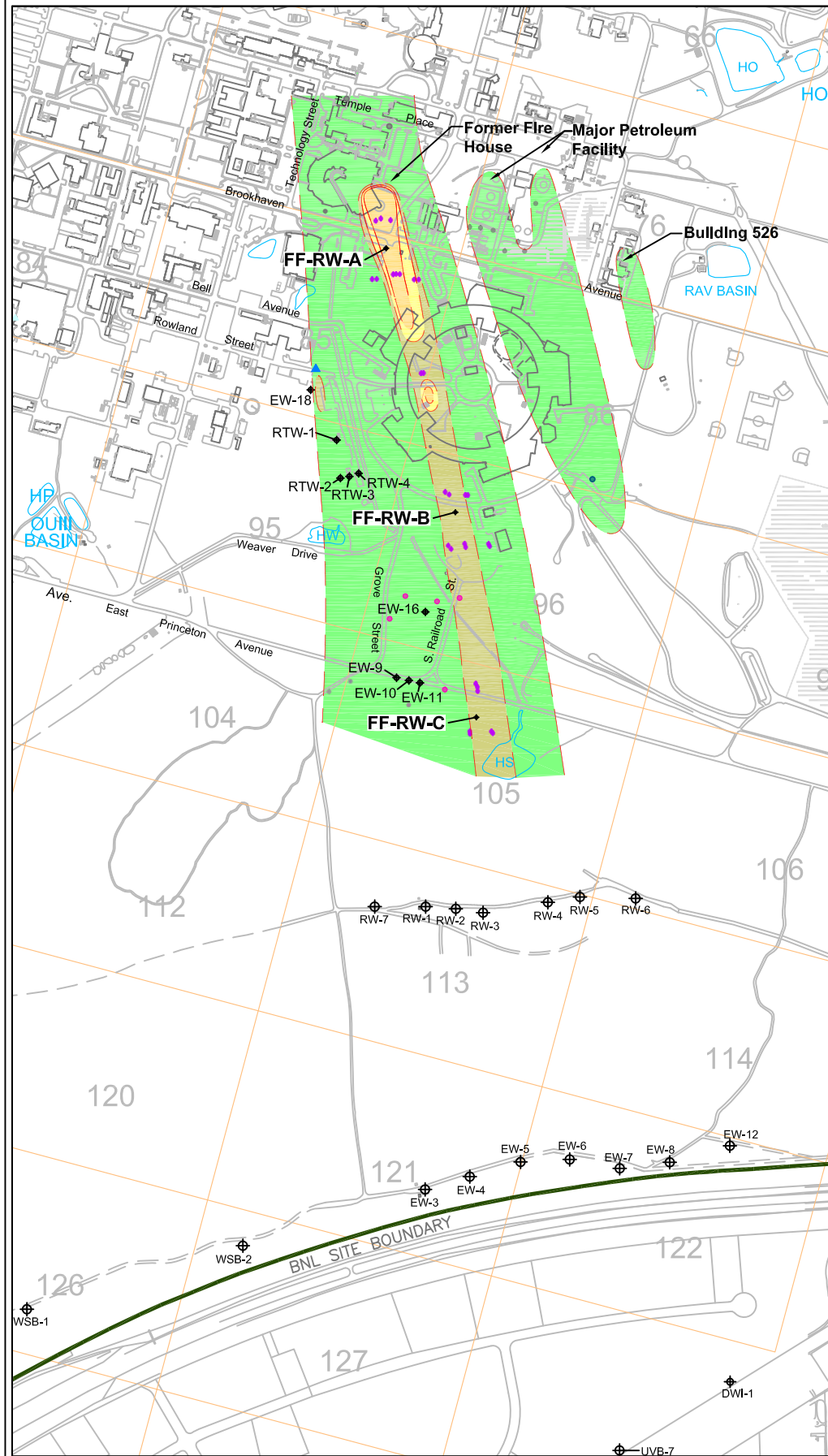
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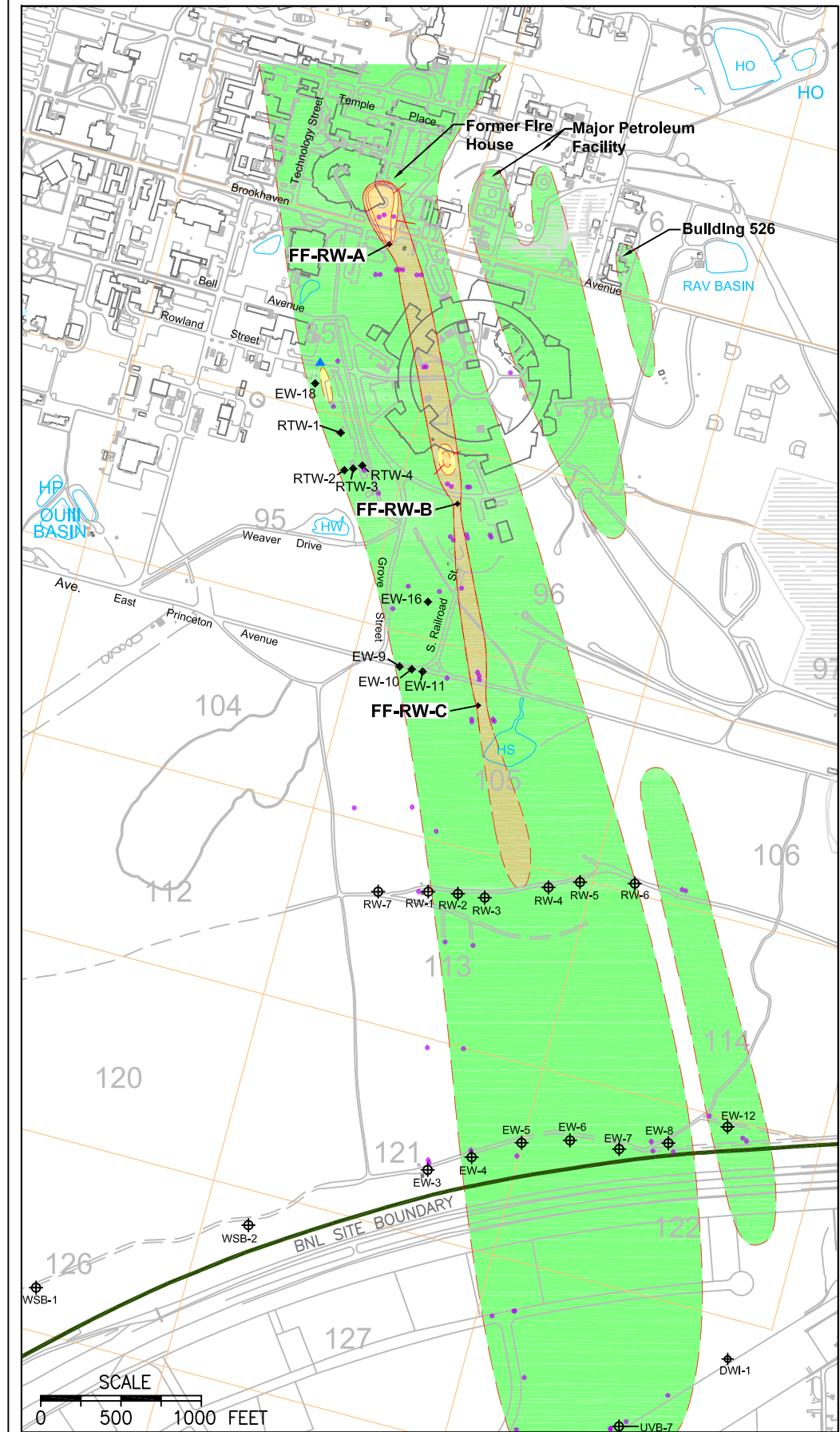
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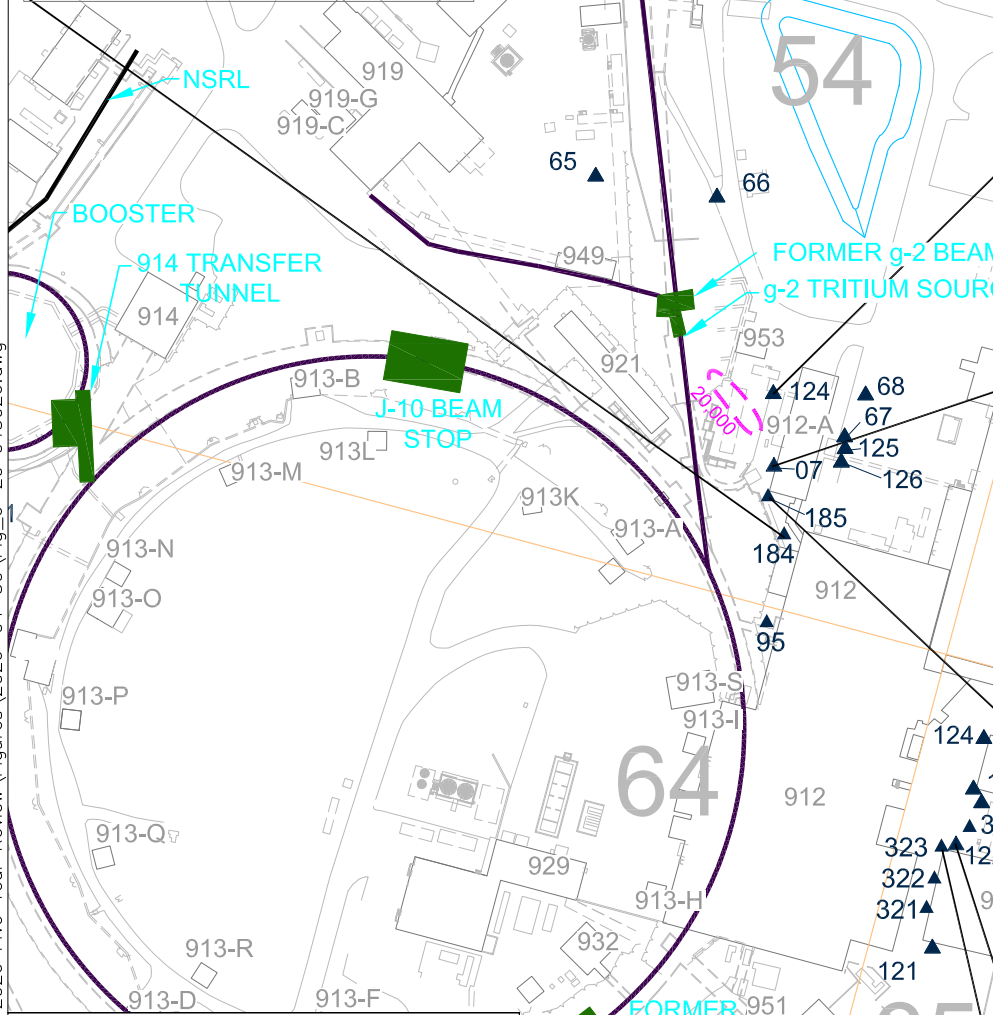
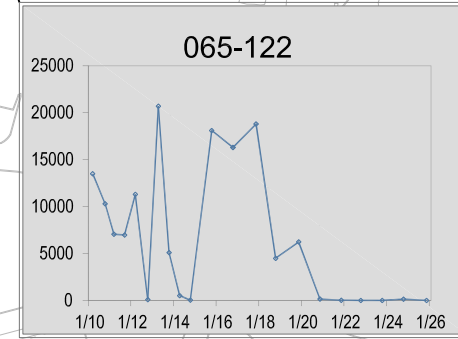
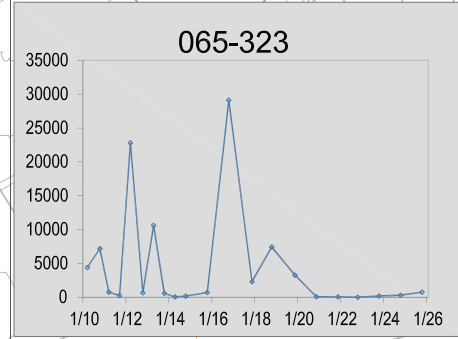
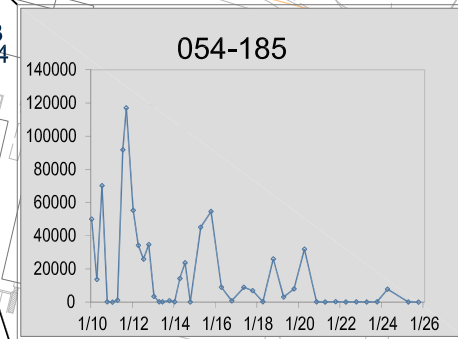
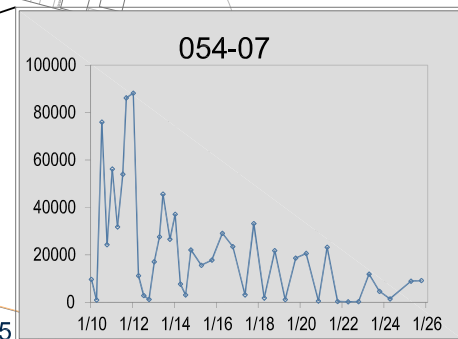
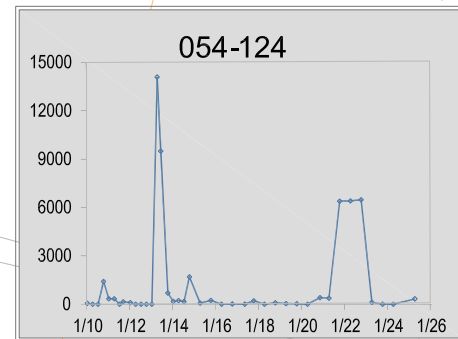
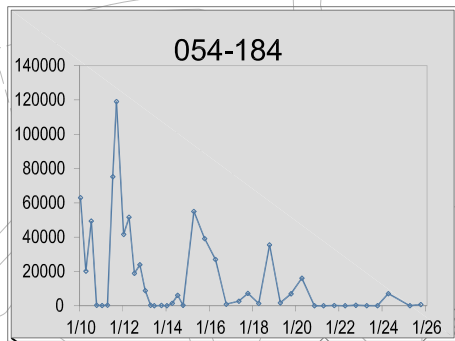
TITLE:

OU X FORMER FIREHOUSE
PFOS PLUME COMPARISON 2020 – 2025

2026 BNL FIVE-YEAR REVIEW

DWN:	AJZ	VT.HZ.:	—	DATE:	04/30/26	PROJECT NO.:	—
CHKD:	DEP	APPD:	BB	REV.:	—	NOTES:	—
FIGURE NO.:		6-19					

Q:\2025\BNLab\25-03 EPD (SLind)\Task 02 2026 Five Year Review\Figures\2026-04-30\Fig 6-20 043026.dwg



LEGEND

07▲ MONITORING WELL ID

20,000 TRITIUM PLUME (pCi/L),
CONTOUR INTERVAL AS INDICATED
(DASHED WHERE INFERRED)

BEAM LINE

55 BNL GRID NUMBER

919 BNL BUILDING NUMBER

NOTES:

TRITIUM PLUME DISTRIBUTION BASED ON
SECOND AND FORTH QUARTER 2025 SAMPLING
EVENTS.

Tables

Table 2-1
Operable Unit Crosswalk

BNL Revised OU No.	Description	EPA OU No./Desc.	Notes
0	Sitewide Removals/Five-Year Reviews	00 – Sitewide Removals/Five-Year Reviews	
I	Radiological Soil and Groundwater	01 – Radiological Soil	
II/VII	Radiological Soil Scattered	02 – Radiological Soil	Decision documented in OU I ROD
III	Groundwater	03 – Sitewide Groundwater	
IV	Groundwater and Soil	04 – Soils	
V	Sewage Treatment Plant Soil/Peconic Sediment	05 – Peconic River/STP	Two RODs
VI	Ethylene Dibromide (EDB) Groundwater	06 – EDB Plume/Upland Recharge Area	
VII	Covered Under OU II/VII	07 – BGRR	Decision documented in OU I ROD
VIII	g-2/BLIP/USTs	08 – g-2/BLIP/USTs	
IX	HFBR	09 – HFBR	
X	PFOS, PFOA, and 1,4-Dioxane	10 – PFOS, PFOA, and 1,4-Dioxane	
XI	BGRR	07 - BGRR	

Table 2-2
Chronology of Site Events

General Site Information	
Site of future BNL serves as Army Camp Upton for World Wars I and II, operated by the Civilian Conservation Corps between wars	1917 – 1946
Site transferred to the Atomic Energy Commission, BNL developed	1947
BNL transferred to the Energy Research and Development Administration	1975
BNL transferred to the DOE	1977
BNL added to NYSDEC list of Inactive Hazardous Waste Sites	1980
BNL listed on EPA National Priorities (“Superfund”) List	1989
DOE entered into Interagency Agreement with EPA and NYSDEC under CERCLA	1992
Operable Unit I	
RA for “D-waste” tanks removal	1994
RA for Landfill capping	1995–1997
RA for South Boundary groundwater treatment system construction and public water hookups	1996
RA for Chemical/Animal Pits and Glass Holes excavation	1997
ROD signed	1999
Completed excavating landscape soil; Closeout Report issued	2000/2001
Completed excavating sludge from Building 811 USTs; Closeout Report issued	2001
Completed excavating soil and pipeline associated with Building 650; Closeout Report issued	2002
Completed capping Ash Pit; Closeout Report issued	2003/2004
Completed excavating soil and reconstructed Upland Recharge and Meadow Marsh; Closeout Report issued	2003/2004
Completed excavating former HWMF soil; Closeout Report issued	2005
Completed excavating Building 811 USTs/soils; Closeout Report issued	2005
Completed excavating former Chemical Holes residual surface soils; Addendum to Closeout Report issued	2005
Completed decontamination of the Merrimack Hole at the former HWMF	2006
RA completed for excavating the former HWMF Phase I Perimeter Soils; Completion Report issued	2009
Completed excavating the former HWMF Phase II Perimeter Soils; Completion Report Addendum issued	2010
Former HWMF Perimeter Soils designated as Sub-Area of Concern 1J	2013
Petition approved for shutdown of the OU I South Boundary groundwater treatment system	2013
Completed excavating the former HWMF Phase III Perimeter Soils; Completion Report Addendum issued	2014
Completed demolition of former WCF and soil removal; Closeout Report issued	2017
Completed excavating soil north of former WCF; Addendum Closeout Report issued	2019
Petition approved for closure of the OU I South Boundary groundwater treatment system	2019
Complete decontamination and dismantlement of Building 650; Closeout Report issued.	2021

Table 2-2
Chronology of Site Events

Operable Unit II/VII	
RA for BLIP Facility (AOC 16K) cap, drainage control, grout injection; Closeout Report issued	1998/2002
Remedial Investigation performed; RI Report issued	1999
Evaluation of alternatives included under OU I Feasibility Study	1999
Operable Unit III	
RA for Building 479 PCB-contaminated soil excavation	1992
RA for Building 464 mercury-contaminated soil excavation	1993
RA for cesspools/septic tanks completed; Closeout Report issued	1994–1999
RA for USTs completed; Closeout Report issued	1994–1999
RA for public water hookups	1996–1998
RA for South Boundary groundwater treatment system construction	1997
RA for HFBR tritium plume groundwater treatment system	1997
RA for Carbon Tetrachloride groundwater treatment system construction	1999
RA for Industrial Park groundwater treatment system construction	1999
ROD signed	2000
Completed constructing Building 96 groundwater treatment system	2000
Completed constructing Middle Road groundwater treatment system	2001
Completed constructing low-flow pumping system for HFBR tritium plume	2001
Completed constructing Western South Boundary groundwater treatment system	2002
Completed constructing Chemical Holes Sr-90 groundwater treatment system (Pilot Study)	2003
Petition approved for shutdown of the Carbon Tetrachloride treatment system	2004
Completed constructing four remaining off-site groundwater treatment systems: Industrial Park East, North Street, North Street East, LIPA/Airport	2004
Completed constructing BGRR/WCF Sr-90 groundwater treatment system	2004
Completed excavating and off-site disposal of Building 96 PCB-contaminated soil; Closeout Report issued	2005
ESD issued for Magothy, Sr-90, Building 96 geophysical anomalies	2005
Building 96 Groundwater Treatment System Shutdown Petition Issued	2005
Completed construction of additional extraction wells for the HFBR, Chemical Holes, and Airport groundwater treatment systems	2007
ESD issued for Building 96 VOC soil excavation	2009
Petition approved for shutdown of the Industrial Park East groundwater treatment system	2009
Petition approved for closure of the Carbon Tetrachloride groundwater treatment system; system dismantled	2009-2010
Completed excavating and off-site disposal of Building 96 VOC-contaminated soil	2010
Completed construction of additional extraction wells for the WCF Sr-90 groundwater treatment system	2011

Table 2-2
Chronology of Site Events

Building 452 Freon-11 Source Area and Groundwater Plume designated as Area of Concern 32	2011
Issued ESD; completed construction of Building 452 Freon-11 groundwater treatment system	2012
Completed construction of additional deeper extraction wells for the OU III South Boundary and Middle Road groundwater treatment systems	2012-2013
Petition approved for shutdown of the Industrial Park groundwater treatment system	2013
Petition approved for closure of the Industrial Park East groundwater treatment system	2013
Petition approved for shutdown of the North Street groundwater treatment system	2013
Petition approved for shutdown of the HFBR Pump and Recharge groundwater system	2013
Petition approved for shutdown of the North Street East groundwater treatment system	2014
Completed construction of additional deeper extraction wells for the Industrial Park groundwater treatment system	2015
Petition approved for shutdown of the Building 452 Freon-11 groundwater treatment system	2016
Petition approved for shutdown of the Sr-90 Chemical Holes groundwater treatment system	2018
Completed construction of additional deeper extraction wells for the Western South Boundary treatment system	2019
Petition approved for closure of the Building 452 Freon-11 groundwater treatment system	2019
Petition approved for closure of the HFBR Tritium Pump and Recharge groundwater system	2019
Petition approved for closure of the North Street groundwater treatment system	2020
Completed construction of additional extraction wells for the North Street East groundwater treatment system to address an EDB plume (North Street East EDB is considered a separate treatment system)	2020
Petition approved for closure of the LIPA groundwater treatment system	2024
Petition approved for closure of the Industrial Park groundwater treatment system	2025
Petition for shutdown approved for the North Street East EDB groundwater treatment system	2026
Operable Unit IV	
RA for fence around Building 650 Sump Outfall area soil	1995
ROD signed	1996
Completed constructing AS/SVE remediation system	1997
Petition approved for shutdown of AS/SVE remediation system	2000
Five-Year Review submitted to EPA and NYSDEC	2002
Petition for closure of AS/SVE Remediation System approved by EPA and NYSDEC; system dismantled	2003
Final Five-Year Review Report issued	2003
Operable Unit V	
RA for Imhoff Tanks	1995
ROD signed for STP	2002
Completed excavation of STP soils; Completion Report issued	2003/2004
RA for Peconic River sediment excavation on site (Phase 1); Completion Report issued	2004/2005

Table 2-2
Chronology of Site Events

RA for Peconic River sediment excavation off site (Phase 2); Completion Report issued	2004/2005
ROD signed for Peconic River	2005
Closeout Report for Peconic River Phase 1 and 2 Remediation issued	2005
Initiated post-cleanup Peconic River monitoring program to demonstrate the effectiveness of the cleanup	2006
Completed sediment trap removal and Peconic River Supplemental Remediation: Closeout Report issued	2011/2012
Completed supplemental sediment remediation at Peconic River Area PR-WC-06: Closeout Report issued	2017
Completed federally required duration of vegetation monitoring of Area PR-WC-06	2022
Operable Unit VI	
RA for public water hookups	1996-1997
ROD signed	2001
Completed constructing EDB groundwater treatment system off site	2004
Completed construction of two additional deeper extraction wells for the OU VI EBD system	2023-2024
Operable Unit X	
DOE established OU VIII (OU X) for PFOS, PFOA (AOC 33), and 1,4-dioxane (AOC 34)	2021
TCRA Action Memorandum for PFAS Source Area Groundwater Treatment Systems approved by regulators	2021
Completed construction of the Current Firehouse/Building 170 PFAS treatment system	2022
Completed construction of the Former Firehouse PFAS treatment system	2022-2023
OU X RI/FS Draft Work Plan tentatively approved by regulators	2023
Groundwater Treatment System Discharge Compliance Plan approved by regulators	2024
Brookhaven Graphite Research Reactor	
RA for BGRR primary cooling fans and equipment	1999
RA for pile fan sump	1999–2000
RA for above-grade ducts	2000–2002
RA for canal house and water treatment house	2001–2002
RA for coolers and filters	2002–2003
RA for BGD primary liner	2004
RA for fuel canal and subsurface soils	2005
ROD signed	2005
Graphite pile removal; Closeout Report issued	2009-2010
Engineered cap installed; Closeout Report issued	2011
Issued ESD; Biological shield removed; Closeout Report issued	2012
Began Long-Term Surveillance and Maintenance	2012

Table 2-2
Chronology of Site Events

The demolition of the Waste Concentration Facility (WCF) buildings 810 and 811 completed; final Closeout Report issued	2014-2019
g-2/BLIP/USTs	
Impermeable caps placed over BLIP and g-2 source areas	1997 and 1999
Groundwater monitoring, cap inspections and maintenance	1999-2010
ROD signed	2007
ROD contingency triggered; additional groundwater monitoring initiated in downgradient plume segment	2011
Downgradient plume monitoring complete	2015
High Flux Beam Reactor	
Dismantlement and removal of several ancillary buildings	2006
RA completed for excavating former HWMF Waste Loading Area soils; Completion Report issued	2007-2009
ROD signed	2009
Removal of Bldgs. 801-811 underground waste transfer lines (A/B waste lines with co-located piping) and associated soil; Closeout Report issued.	2009
RA for removal/disposal of control rod blades and beam plugs; Completion Report issued	2009-2010
Long-Term Surveillance and Maintenance for Confinement Building and Stack	2010 and 2012
Fan houses (Bldgs. 704 and 802), above- and below-ground structures, soil removal; Closeout Report issued	2011
Confinement Building stabilization; Closeout Report issued	2011
Underground utilities and associated soil removal; Closeout Report issued	2011
Stack Silencer Baffles and survey of outside areas; Closeout Report issued	2012
Stack demolition completed; Closeout Report issued	2021

Notes:

AOC = Area of Concern

AS/SVE = Air Sparging/Soil Vapor Extraction

BLIP = Brookhaven Linac Isotope Producer

BGD = below-ground duct

BNL = Brookhaven National Laboratory

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act

DOE = Department of Energy

EPA = U.S. Environmental Protection Agency

EDB = ethylene dibromide

ESD = Explanation of Significant Differences

FS = Feasibility Study

Table 2-2
Chronology of Site Events

Notes contd.:

HFBR = High Flux Beam Reactor

HWMF = Hazardous Waste Management Facility

IAG = Interagency Agreement

LIPA = Long Island Power Authority

NYSDEC = New York State Department of Environmental Conservation

PCB = Polychlorinated Biphenyl

PFAS = Per- and Polyfluoroalkyl substances

RA = Removal Action

RI = Remedial Investigation

ROD = Record of Decision

Sr-90 = Strontium-90

STP = Sewage Treatment Plant

TCRA = Time Critical Removal Action

USTs = underground storage tanks

VOC = volatile organic compound

WCF = Waste Concentration Facility

Table 2-3
Operable Unit Areas of Concern

Category	AOC #	Description and Status
OU I (ROD approved)	AOC 1 (A, C, D, E, F, G, H, I, J)	Hazardous Waste Management Facility – complete
	AOC 1B	Spray Aeration site – removal action complete
	AOC 2 (A, B, C, D, E, F)	Former Landfill Area – complete
	AOC 3	Current Landfill – complete
	AOC 2 and 3	Former and Current Landfill Closures – removal actions complete
	AOC 6	Building 650 Sump and Sump Outfall – complete; Sr-90 groundwater monitoring ongoing
	AOC 8	Upland Recharge/Meadow Marsh Area– complete
	AOC 10A	Waste Concentration Facility – Tanks D-1, D-2, and D-3 – complete
	AOC 10B, C	Waste Concentration Facility – Underground pipelines and Six A/B USTs - complete
	AOC 12	USTs at Building 445 – removal action complete
	AOC 23	Off-Site Tritium Plume (southern component) – complete
	Sub AOC 24E	Recharge Basin HS, Outfall 005 – complete
	Sub AOC 24F	New Stormwater Runoff Recharge Basin – complete
(addressed in OU I ROD; Q, S)	AOC 10A, B, C	Waste Concentration Facility (Building 811) – complete (building removed 2015; supplemental soil removal completed in 2018)
	AOC 16 (A, B, C, D, E, F, G, H, I, J, L, M, N, O, P, Q, S)	Aerial Radioactive Monitoring System Results – complete
	AOC 17	Area Adjacent to Former Low-Mass Criticality Facility – complete
	AOC 18	AGS Scrapyard (“Boneyard”) – complete
	AOC 20	Particle Beam Dump, north end of Linac – complete
OU III (ROD approved)	AOC 7	Paint Shop – groundwater monitoring complete
	AOC 9	BGRR (groundwater) – treatment system operating
	AOC 10	Waste Concentration Facility (groundwater) – treatment system operating
	AOC 11	Building 830 Pipe Leak – complete; groundwater monitoring complete
	AOC 12	USTs at Building 830 – removal action complete
	AOC 13	Cesspools – removal action complete
	AOC 14	Bubble Chamber Spill Areas – groundwater monitoring complete
	Sub AOC 15A	Supply/Potable Wells 1, 2, 3, 4, 6, 7, 10, 11, 12; groundwater monitoring ongoing
	Sub AOC 15B	Monitoring Well 130-02 – treatment system operating
	AOC 16R	Aerial Radioactive Monitoring System results – Nuclear Waste Management Facility, Building 830 – complete (covered under AOCs 11 and 12)
	AOC 18	AGS Scrapyard (groundwater) – groundwater monitoring complete
	AOC 19	TCE Spill Area, Building T-111 – groundwater monitoring complete
	AOC 20	Particle Beam Dump, north end of Linac (includes Basin HT) – monitor and maintain per SPDES permit/NRMP
	AOC 21	Leaking sewer pipes (sitewide, not investigated under other OU study areas) – groundwater monitoring complete
	AOC 22	Old Firehouse – no further action per ROD

Table 2-3

Operable Unit Areas of Concern

	Sub AOC 24A	Process Supply Wells 104 and 105 – decommissioned; groundwater monitoring complete
	Sub AOC 24B	Recharge Basin HP, Outfall 004 – monitor and maintain per SPDES permit & NRMP
	Sub AOC 24C	Recharge Basin HN, Outfall 002 – monitor and maintain per SPDES permit and NRMP
	AOC 25	Building 479 PCB soil removal complete; groundwater monitoring complete
	AOC 26	Building 208 – removal action complete
	AOC 26A	Building 208 (groundwater) – groundwater monitoring complete
	AOC 26B	Former Scrapyard/Storage Area south of Building 96 – treatment system operating; soil removal complete
	AOC 27	Building 464 mercury soil removal complete; groundwater monitoring complete
	AOC 29	Spent fuel pool in HFBR and associated groundwater plume of tritium – pump and recharge system closure approved; groundwater monitoring ongoing
	AOC 32	Building 452 Freon-11 Source Area and Groundwater Plume – treatment system closure approved
OU IV (ROD approved)	AOC 5 (A, B, C, D)	Central Steam Facility – treatment system decommissioned
	AOC 6	Reclamation Facility Interim Action – complete
	AOC 12	USTs at Building 650 – removal action complete
	AOC 21	Leaking Sewer Pipes (in study area) – complete
	Sub AOC 24D	Recharge Basin HO, Outfall 003 – complete
OU V – STP (ROD Approved)	AOC 4 (A, B, C, D, E)	Sewage Treatment Plant – complete
	AOC 21	Leaking sewer pipes (in the study area) – complete
	AOC 23	Off-site tritium plume (eastern component) – groundwater monitoring complete
OU V – Peconic River (ROD Approved)	AOC 30	Peconic River – cleanup on and off of BNL property complete; monitoring complete
OU VI (ROD approved)	AOC 28	EDB groundwater contamination – treatment system operating
OU X (no ROD)	AOC 33	PFOS and PFOA
	AOC 33A	Former Bubble Chamber Experiment and Blockhouse Area – monitoring underway
	AOC 33B	Building 924 Area - monitoring underway
	AOC 33C	East of Building 902 - monitoring underway
	AOC 33D	Current Firehouse - TCRA Operational
	AOC 33E	Former Firehouse - TCRA Operational
	AOC 33F	Major Petroleum Facility - monitoring underway
	AOC 33G	Building 526 Area - monitoring underway
	AOC 33H	Recreation Center Area - monitoring underway
	AOC 33I	Sewage Treatment Plant - monitoring underway
	AOC 33J	Building 170 – TCRA Operational
	AOC 33K	Current Landfill – monitoring underway
	AOC 33L	Water Treatment Plant Recharge Basins – monitoring underway
	AOC 34	1,4-Dioxane – monitoring underway

Table 2-3
Operable Unit Areas of Concern

BGRR (ROD Approved)	AOC 9	Graphite Pile – complete Biological Shield/Engineered Cap – complete
	AOC 9A	Fuel Canal – complete
	AOC 9B	Below-ground ducts – complete
	AOC 9C	Spill sites – complete
	AOC 9D	Pile Fan Sump – complete
g-2 and BLIP (ROD Approved)	AOC 12	USTs, Buildings 462, 463, 527, 703, 927, 931B – complete
	AOC 16K	Aerial Radioactive Monitoring System results – BLIP, Building 931B – Source area protection and groundwater monitoring ongoing
	AOC 16T	Aerial Radioactive Monitoring System results – g-2 Source Area and Tritium Groundwater Plume – source area protection and groundwater monitoring ongoing
HFBR (ROD Approved)	AOC 31	Waste Loading Area – complete Control Rod Blades and Beam Plugs – complete Buildings 801-811 Waste Transfer Lines – complete HFBR Stabilization – complete Fan Houses (Buildings 704 and 802) – complete Underground Utilities – complete Stack – complete
Other Removal Action	Not applicable	Former HWMF Perimeter Soils – Phases I, II, and III – complete
	Not applicable	Central Steam Facility Lead-Contaminated Soil – complete
	Not applicable	Shotgun Range Lead-Contaminated Soil – complete

Notes:

AGS = Alternating Gradient Synchrotron

AOC = Area of Concern

BGRR = Brookhaven Graphite Research Reactor

BLIP = Brookhaven Linac Isotope Producer

EDB = ethylene dibromide

HFBR = High Flux Beam Reactor

NRMP = *Natural Resources Management Plan*

ROD = Record of Decision

SPDES = State Pollutant Discharge Elimination System

STP = Sewage Treatment Plant

TCE = trichloroethene

TCRA = Time critical removal action

USTs = Underground Storage Tanks

VOC = volatile organic compound

Table 6-3**Permanent Monitoring and Extraction Wells Installed Since January 2021**

<u>Permant Well Identification</u>	<u>Well Type</u>	<u>Installation Date</u>
101-10	MW	1/21/2021
000-572	MW	7/12/2021
000-571	MW	7/14/2021
000-570	MW	7/19/2021
109-29	MW	8/27/2021
110-26	MW	9/8/2021
102-25	MW	9/9/2021
101-09	MW	9/10/2021
110-27	MW	9/13/2021
118-04	MW	9/14/2021
117-04	MW	9/16/2021
117-07	MW	9/16/2021
117-05	MW	9/20/2021
124-04	MW	9/20/2021
075-811	MW	9/21/2021
117-06	MW	9/21/2021
075-810	MW	9/23/2021
073-30	MW	9/27/2021
075-809	MW	9/28/2021
073-28	MW	9/29/2021
083-33	MW	10/1/2021
083-34	MW	10/4/2021
083-35	MW	10/5/2021
083-36	MW	10/6/2021
083-37	MW	10/7/2021
083-38	MW	10/8/2021
083-39	MW	10/14/2021
084-87	MW	10/18/2021
084-88	MW	10/21/2021
083-40	MW	10/22/2021
084-89	MW	10/25/2021

Table 6-3**Permanent Monitoring and Extraction Wells Installed Since January 2021**

<u>Permant Well Identification</u>	<u>Well Type</u>	<u>Installation Date</u>
073-26	MW	11/2/2021
073-29	MW	11/4/2021
073-27	MW	11/5/2021
074-135	MW	11/5/2021
073-33	MW	11/9/2021
073-32	MW	11/10/2021
073-31	MW	11/12/2021
084-90	MW	11/17/2021
084-92	MW	11/18/2021
084-91	MW	11/29/2021
084-96	MW	12/7/2021
084-98	MW	12/10/2021
084-95	MW	12/14/2021
084-93	MW	12/17/2021
083-42	MW	12/22/2021
085-411	MW	1/5/2022
085-412	MW	1/6/2022
096-123	MW	1/6/2022
085-410	MW	1/10/2022
096-124	MW	1/10/2022
085-409	MW	1/11/2022
096-125	MW	1/11/2022
085-407	MW	1/12/2022
085-408	MW	1/12/2022
096-122	MW	1/12/2022
085-406	MW	1/13/2022
085-405	MW	1/14/2022
105-74	MW	1/19/2022
105-75	MW	1/20/2022
094-277	MW	1/21/2022
105-76	MW	1/21/2022

Table 6-3**Permanent Monitoring and Extraction Wells Installed Since January 2021**

<u>Permant Well Identification</u>	<u>Well Type</u>	<u>Installation Date</u>
094-278	MW	1/24/2022
105-73	MW	1/25/2022
105-72	MW	1/26/2022
096-129	MW	1/27/2022
096-128	MW	1/28/2022
096-131	MW	2/1/2022
105-78	MW	2/2/2022
096-127	MW	2/3/2022
105-77	MW	2/3/2022
096-126	MW	2/4/2022
094-275	MW	2/7/2022
094-276	MW	2/8/2022
093-88	MW	2/10/2022
093-92	MW	2/11/2022
093-89	MW	2/16/2022
093-90	MW	2/17/2022
083-44	MW	2/18/2022
083-41	MW	2/22/2022
102-31	MW	2/24/2022
102-30	MW	2/28/2022
102-29	MW	3/1/2022
103-34	MW	3/7/2022
103-33	MW	3/8/2022
103-30	MW	3/14/2022
103-31	MW	3/15/2022
103-32	MW	3/17/2022
102-28	MW	3/22/2022
102-27	MW	3/23/2022
102-26	MW	3/25/2022
102-40	MW	6/13/2022
083-47	MW	6/16/2022
093-93	MW	6/17/2022

Table 6-3**Permanent Monitoring and Extraction Wells Installed Since January 2021**

<u>Permant Well Identification</u>	<u>Well Type</u>	<u>Installation Date</u>
093-94	MW	6/21/2022
093-95	MW	6/22/2022
093-96	MW	6/24/2022
083-43	MW	6/27/2022
084-86	MW	6/27/2022
084-94	MW	6/27/2022
084-97	MW	6/27/2022
085-404	MW	6/27/2022
093-91	MW	6/27/2022
096-130	MW	6/27/2022
093-97	MW	6/28/2022
102-36	MW	6/30/2022
102-37	MW	7/5/2022
102-38	MW	7/7/2022
093-98	MW	10/24/2022
102-39	MW	10/24/2022
000-580	MW	8/22/2023
000-581	MW	8/22/2023
000-582	MW	8/22/2023
105-80	MW	10/18/2023
105-81	MW	10/18/2023
121-57	MW	10/18/2023
085-415	MW	11/30/2023
085-416	MW	3/29/2024
111-20	MW	10/24/2024
125-04	MW	10/24/2024
125-05	MW	10/24/2024
118-07	MW	11/14/2024
095-328	MW	11/21/2025
103-37	MW	11/21/2025
103-38	MW	11/21/2025
103-39	MW	11/21/2025

Table 6-3**Permanent Monitoring and Extraction Wells Installed Since January 2021**

<u>Permant Well Identification</u>	<u>Well Type</u>	<u>Installation Date</u>
103-40	MW	11/21/2025
105-84	MW	11/21/2025
105-85	MW	11/21/2025
129-09	MW	11/21/2025
129-10	MW	11/21/2025
129-11	MW	11/21/2025
129-12	MW	11/21/2025
129-13	MW	11/21/2025
130-16	MW	11/21/2025
000-578	EW	8/22/2023
000-579	EW	8/22/2023
073-34	EW	10/19/2022
073-35	EW	8/26/2021
083-45	EW	11/9/2021
083-46	EW	10/25/2021
084-102	EW	10/12/2021
085-413	EW	10/19/2022
085-414	EW	10/19/2022
096-132	EW	1/19/2022
102-32	EW	4/27/2022
102-33	EW	4/14/2022
102-34	EW	5/12/2022
102-35	EW	6/6/2022
105-79	EW	2/10/2022

Note:

MW - Monitoring Well

EW - Extraction Well

Attachment 1

2024 Site Environmental Report, Volume II Groundwater Status Report

Attachment 2

Inspection Checklists

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 18 AGS Storage Yards 1 and 2			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: Soil remediation not required in Yard 2.		
2.	S&M Documents ☒ S&M Plan ☐ Completion/Closeout Report ☒ Maintenance logs ☒ Readily available ☐ Readily available ☒ Readily available ☒ Up to date ☐ Up to date ☒ Up to date ☐ N/A ☒ N/A ☐ N/A Remarks: Area included in LUCMP, annual LUIC inspections logs are attached.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: No cover required as part of the remedy.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 2F Ash Pit			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Closeout Report for Ash Pit OU I AOC 2F, dated February 5, 2004 identifies LTS requirements, including inspection schedule.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Trees surrounding and within pit area. Grasses established across cover. Photos available.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☐ Needs Maintenance ☐ Good condition ☒ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: A gas main installation in 2022 was re-routed around the Ash Pit to avoid the IC area. Inspections indicate ICs are adequate and undisturbed. _____ Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU III AOC 26B Building 96			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: PCB soil excavation complete in 2005. VOC source area excavation was completed in 2010.		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: OU III B96 PCB Soil (AOC 26B) Closeout Report dated March 2005. Building 96 Soil Excavation (VOCs) dated January 2011.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass cover is well established throughout the area.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 17 Low Mass Criticality Facility			
1.	Soil Excavation Complete ☐ Yes ☐ No Remarks: No soil cleanup required for radiological or chemical contamination.		
2.	S&M Documents ☒ S&M Plan ☐ Completion/Closeout Report ☒ Maintenance logs ☒ Readily available ☐ Readily available ☒ Readily available ☒ Up to date ☐ Up to date ☒ Up to date ☐ N/A ☒ N/A ☐ N/A Remarks: Area included in LUCMP, annual LUIC inspections logs are attached.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☐ Grass ☐ Cover properly established ☐ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: No cover required as part of the remedy.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks: Monitoring wells in the area are sampled to support other groundwater projects.		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 6 Building 650 Sump Outfall			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: Demolition of Building 650 was completed in 2021. The Closeout Report is dated September 2022.		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Closeout Report dated January 2002 identifies LTS requirements, including institutional controls and inspection schedule.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass and trees/shrubs established across the cover.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels Previously installed fence partially surrounds the former sump outfall however, there is no restriction for entering area.		

VII. SOIL CLEANUP REMEDIES ☐ Applicable ☐ N/A			
A. Project OU I AOC 10 Building 811 UST and Soils			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: <u>Final Closeout Report for AOC 10 Waste Concentration Facility dated September 2005, Waste Concentration Facility (B811 AOC 10) and Surrounding Area dated January 2017, and Addendum to the Closeout Report Waste Concentration Facility (B811 AOC 10) and Surrounding Area dated June 2019.</u>		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: <u>Grass, trees, and/or shrubs established across the cover area.</u>		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: _____ <u>Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels</u> _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project Building 811 Former A/B Waste Transfer Lines			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: Final Closeout Report Removal of the Building 801-811 Waste Transfer Lines (A/B Waste Lines with Co-Located Piping) Area of Concern 31, dated July 2010 _____		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent: _____ Depth: _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent: _____ Depth: _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: _____ Vegetation established across cover.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent: _____ Areal extent: _____ Areal extent: _____ Areal extent: _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: _____ Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 11-Building 830 Pipe Leak, AOC 12-Building 830 USTs			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☒ Maintenance logs ☒ Readily available ☒ Readily available ☒ Readily available ☒ Up to date ☒ Up to date ☒ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: Completion Report for Building 830 UST Removal Action, dated August 1999. See attached LUIC inspection forms.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☐ Grass ☐ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Not applicable.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☒ N/A ☐ Good condition Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: <u>The building is currently occupied by the Nonproliferation and National Security Department. Outdoor Connex</u> <u>Storage boxes, waste collection area.</u> <u>Inspections performed by: B. Barth, J. Michaels, E. Kramer</u> _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 14 Bubble Chamber			
1.	Soil Excavation Complete ☐ Yes ☒ No Remarks: Cesspools and septic tanks were removed as part of Removal Action 3.		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☒ Maintenance logs ☒ Readily available ☒ Readily available ☒ Readily available ☒ Up to date ☒ Up to date ☒ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Area included in LUCMP, annual LUIC inspections logs are attached. Closeout Report for Removal Action III Cesspool/Septic Tanks, dated 1999.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☐ Grass ☐ Cover properly established ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: No cover required as part of the remedy.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☒ N/A ☐ Good condition Remarks:		
8.	Other Site Conditions Remarks: The fenced area is controlled by Collider-Accelerator Dept. (CAD) and is designated as the _____ Building 460 Waste Yard. The yard is used for storage of radiological materials. It is fenced, _____ locked, posted, and paved. The remainder of the area to the north is open and consists of grass, _____ pavement, and concrete slabs. The area is also designated as AOC 33A for PFAS contamination.		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 33 Current Firehouse and Building 170			
1.	Soil Excavation Complete ☐ Yes ☒ No Remarks: Soil contamination will be characterized during the pending RI/FS.		
2.	S&M Documents ☐ S&M Plan ☐ Completion/Closeout Report ☒ Maintenance logs ☐ Readily available ☐ Readily available ☒ Readily available ☐ Up to date ☐ Up to date ☒ Up to date ☒ N/A ☒ N/A ☐ N/A Remarks:		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks:		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: <u>Area contains a stockpile of soil contaminated with PFAS above New York State Dept of Environmental Conservation Part 375 Protection of Groundwater standards. The stockpile is covered with a tarp and posted as a LUIC area, pending future export.</u>		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 2B, C Chemical/Animal Pits, Glass Holes			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: <u>Animal/Chemical Pits and Glass Holes Remedial Action Closure Report, dated October 1997. Animal/Chemical Pits and Glass Holes Remedial Action Closure Report Addendum, dated September 2005</u>		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: <u>Vegetation established across cover area.</u>		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks _____ _____ _____		
8.	Other Site Conditions Remarks: <u>Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels</u> _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 3 Current Landfill and Wooded Wetland			
1.	Soil Excavation Complete ☐ Yes ☐ No Remarks: The removal action for the Current Landfill was capping, which was completed in 1995.		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: Final Operations and Maintenance Manuals for the Current Landfill and Former Landfill Areas, dated 1996. Construction Certification Report for the Current Landfill, dated 1996.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass established across entire cover area.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels The asphalt access road was in fair condition, some cracks with vegetation emerging was noted. The lock on the south side gate should be replaced.		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 33 Former Firehouse			
1.	Soil Excavation Complete ☐ Yes ☒ No Remarks: Soil contamination will be characterized during the pending RI/FS.		
2.	S&M Documents ☐ S&M Plan ☐ Completion/Closeout Report ☐ Maintenance logs ☐ Readily available ☐ Readily available ☐ Readily available ☐ Up to date ☐ Up to date ☐ Up to date ☒ N/A ☒ N/A ☒ N/A Remarks:		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks:		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: B. Barth, E. Kramer, J. Michaels _____ _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project Sub AOC 1J Former Hazardous Waste Management Facility Perimeter Soils			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Completion Report Former Hazardous Waste Management Facility Perimeter Area Soil Remediation dated, April 2010; Addendum to the Former Hazardous Waste Management Facility Perimeter Area Completion Report dated, December 2010; Addendum to the Final Completion Report Former Hazardous Waste Management Facility Perimeter Area Soil Remediation _____		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass, trees, and/or shrubs established across cover area. _____		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☒ N/A ☐ Good condition Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: _____ Inspections performed by: V. Racaniello, B. Barth, J. Michaels _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 1 Former Hazardous Waste Management Facility/Waste Loading Area			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: The Waste Loading Area was utilized for the staging and load-out of bulk waste from Former HFBR and BGRR Stack, BMRR Stack, and Building 650.		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Closeout Report for the Former Hazardous Waste Management Facility, dated September 2005. Final Completion Report for the HFBR Waste Loading Area, dated July 2009.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass, trees, and/or shrubs established across the cover area.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks: Standing water not observed during inspections however, wetland remains undisturbed.		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels The annual radiological survey of the fixed contamination on several of the concrete foundations was performed by BNL RadCon, no loose contamination was detected.		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 2A Former Landfill, AOC 2D Interim Landfill, AOC 2E Slit Trench			
1.	Soil Excavation Complete ☐ Yes ☐ No Remarks: The removal action for the Former Landfill, Interim Landfill, and Slit Trench was capping, which was completed in 1996.		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Operations and Maintenance Manuals for the Current Landfill and Former Landfill Areas, dated 1996. Construction Certification Report for the Former Landfill, dated 1997. Construction Certification Report for the Interim Landfill, dated 1997		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass established over entire cover area. Saplings are starting to establish in drainage swale and should be removed.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project Old Incinerator Facility			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: The area consists of a field covered with at least 12 inches of topsoil.		
2.	S&M Documents ☐ S&M Plan ☐ Completion/Closeout Report ☐ Maintenance logs ☐ Readily available ☐ Readily available ☐ Readily available ☐ Up to date ☐ Up to date ☐ Up to date ☒ N/A ☒ N/A ☒ N/A Remarks: Remediation performed similarly to that of AOC 2F - Ash Pits.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks:		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☐ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 16S Landscape Soil Areas			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Closeout Report dated April 10, 2001 identifies LTS requirements, including institutional controls and inspection schedule.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent: _____ Depth: _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent: _____ Depth: _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass, trees, and/or shrubs are established across the cover areas.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent: _____ Areal extent: _____ Areal extent: _____ Areal extent: _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☐ Needs Maintenance ☐ Good condition ☒ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 8 Meadow Marsh			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: Final Closeout Report dated February 6, 2004 identifies the LTS requirements including inspection schedule of institutional controls.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent: _____ Depth: _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent: _____ Depth: _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grasses and trees established across cover.		
6.	Wet Areas/Water Damage ☐ Wet areas ☒ Ponding ☐ Seeps ☐ Soft subgrade ☐ Wet areas/water damage not evident ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent: _____ Areal extent: _____ Areal extent: _____ Areal extent: _____ Remarks: The remediated area is designated Tiger Salamander habitat. During the 2025 inspections, the pond had significant water.		
7.	Monitoring Wells (within the excavated area) ☐ Properly secured/locked ☐ Evidence of leakage at penetration ☐ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☐ Needs Maintenance ☐ Good condition ☒ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, J. Milligan, J. Michaels _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU V AOC 30 Peconic River			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☐ N/A Remarks: Fish monitoring requirements are identified in the BNL Env. Monitoring Plan, under Peconic River Fish Surveillance Monitoring. Final Closeout Report for Peconic River Remediation Phases 1 and 2 dated, 8/25/2005, Supplemental Remediation Closeout Report dated March 2012, and Completion Report Peconic River Supplemental Sediment Removal Area dated December 2017.		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: Grass, trees, and/or shrubs established across the cover area.		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☒ Ponding ☒ Seeps ☒ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent Area B _____ Areal extent _____ Areal extent _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☐ Routinely sampled ☐ N/A ☒ Good condition Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels There is significant vegetation growth in all cleanup areas. _____ _____ _____		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project AOC 33 Potential PFAS Soil Contamination Areas			
1.	Soil Excavation Complete ☐ Yes ☒ No Remarks: Soil contamination will be characterized during the pending RI/FS.		
2.	S&M Documents ☐ S&M Plan ☐ Completion/Closeout Report ☒ Maintenance logs ☐ Readily available ☐ Readily available ☒ Readily available ☐ Up to date ☐ Up to date ☒ Up to date ☒ N/A ☒ N/A ☐ N/A Remarks:		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent _____ Depth _____ Remarks:		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent _____ Depth _____ Remarks:		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks:		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent _____ Areal extent _____ Areal extent _____ Areal extent _____ Remarks:		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks:		
8.	Other Site Conditions Remarks: <u>Several areas have been identified where firefighting foam had been used for training or testing and maintenance of fire suppression systems between 1966 and 2008. PFAS-containing waste materials may have also been disposed of at the Current Landfill, and PFAS contaminated water was released to the Sanitary System. Additional characterization of soil and groundwater will be performed during the planned OU X RI/FS.</u>		

VII. SOIL CLEANUP REMEDIES ☒ Applicable ☐ N/A			
A. Project OU I AOC 4 Sewage Treatment Plant			
1.	Soil Excavation Complete ☒ Yes ☐ No Remarks: _____		
2.	S&M Documents ☒ S&M Plan ☒ Completion/Closeout Report ☐ Maintenance logs ☒ Readily available ☒ Readily available ☐ Readily available ☒ Up to date ☒ Up to date ☐ Up to date ☐ N/A ☐ N/A ☒ N/A Remarks: Final Completion Report, Remedial Action, AOC 4 Sewage Treatment Plant, Sludge Drying Beds and Sand Filter Beds/Berms, AOC 21 Abandoned Former Sewer Lines, dated November 2004		
3.	Settlement (Low spots) ☐ Location shown on site map ☒ Settlement not evident Areal extent: _____ Depth: _____ Remarks: _____		
4.	Erosion ☐ Location shown on site map ☒ Erosion not evident Areal extent: _____ Depth: _____ Remarks: _____		
5.	Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☒ Trees/Shrubs (indicate size and locations on a diagram) Remarks: _____		
6.	Wet Areas/Water Damage ☒ Wet areas/water damage not evident ☐ Wet areas ☐ Ponding ☐ Seeps ☐ Soft subgrade ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map ☐ Location shown on site map Areal extent: _____ Areal extent: _____ Areal extent: _____ Areal extent: _____ Remarks: _____		
7.	Monitoring Wells (within the excavated area) ☒ Properly secured/locked ☐ Evidence of leakage at penetration ☒ Functioning ☐ Needs Maintenance ☒ Routinely sampled ☐ Needs Maintenance ☒ Good condition ☐ N/A Remarks: _____ _____ _____		
8.	Other Site Conditions Remarks: Inspections performed by: V. Racaniello, B. Barth, E. Kramer, J. Michaels _____ _____ _____		

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III Building 96	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: The system contains one extraction well, RTW-1 operating on a pulsed pumping schedule of one month on, one month off, and three recirculation wells, RTW-2 through RTW-4 which are in standby mode.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☒ Air stripping ☒ Filters Vapor phase GAC on recirculation wells RTW-2 through RTW-4 ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☐ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 17,000,000 gal/yr avg. ☐ Quantity of surface water treated annually Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: RTW-1 is effectively capturing VOC groundwater contamination. Recent chemical treatment injections in the source area have reduced the mobility of residual PCE. MCLs have not been achieved in all monitoring wells however, the significant decrease in TVOC and individual VOC concentrations over time show the treatment is effective.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III Freon-11	
1.	Construction Complete/System Operating ☐ Yes ☒ No Remarks: The system was closed in August 2019 following regulatory approval.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☒ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☐ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☐ Quantity of groundwater treated annually _____ ☐ Quantity of surface water treated annually _____ Remarks System was administratively closed in 2019.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: Monitoring data suggests that the treatment system was effective in remediating Freon-11 and the system was closed.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: A subset of Building 96 Treatment System monitoring wells are routinely monitored for Freon-11.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III BGRR/WCF	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: _____ _____
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks: _____ _____
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks: _____ _____
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks: _____ _____
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☒ Filters ion exchange ☐ Oil/water separation ☒ Carbon adsorbers ☐ Bioremediation ☐ Additive (e.g., chelation agent, flocculent): _____ ☐ Others: _____ ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 9,150,000 gal / yr avg. _____ ☐ Quantity of surface water treated annually _____ Remarks: Treatment system is remotely monitored in Building 462. Carbon adsorber vessels were added to address low level VOCs and PFAS. _____ _____
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: _____ _____
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☒ Proper secondary containment ☐ Needs Maintenance Remarks: _____ _____

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Concentrations of Sr-90 are generally declining however, intermittent spikes in concentration are observed with increases in water table elevation in areas with remaining source material. Extraction well SR-3 is positioned to capture slugs of Sr-90 that are mobilized as a result of groundwater elevation fluctuation. Extraction well SR-1 continues to address the source area of the plume.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU X Current Firehouse	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: System began operation as part of a TCRA in October 2022.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☒ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 210,000,000 gal/yr avg. ☐ Quantity of surface water treated annually Remarks The treatment system is remotely monitored in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances	☐ N/A ☒ Good condition ☐ Needs Maintenance	Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s)	☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored	Remarks:
6.	Monitoring Wells (pump and treatment remedy)	☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A	Remarks:
D. Monitoring Data			
1.	Monitoring Data	☒ Is routinely submitted on time ☒ Is of acceptable quality	
2.	Monitoring data suggests:	☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining	Remarks: Groundwater monitoring results indicate that PFAS continues to be released from the source areas at concentrations exceeding MCLs. The treatment system was designed and implemented as part of a Time Critical Removal Action therefore, the goal is to remediate the high concentration plume segments. The complete characterization of the downgradient extent of the plume has not been performed, and will be completed during the RI/FS.
E. Monitored Natural Attenuation			
1.	Monitoring Wells (natural attenuation remedy)	☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☒ N/A	Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A		
A. System OU III Chemical Holes		
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: The system was approved for shutdown in July 2018 and remains in standby mode.	
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A		
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:	
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks	
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks	
C. Treatment System ☒ Applicable ☐ N/A		
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☒ Filters ion exchange ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☐ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually _____ ☐ Quantity of surface water treated annually _____ Remarks Treatment system is remotely monitored in Building 462.	
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:	
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks: Secondary containment tanks are registered with SCDHS as CERCLA exempt.	

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Strontium-90 concentration trends in plume core wells have significantly declined over time. The observed concentrations of Sr-90 are predicted to attenuate to below the DWS before the groundwater reaches the site boundary.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: Following shutdown of the system, the combination of natural attenuation and radioactive decay is limiting downgradient migration of the plume.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU X Former Firehouse	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: System began operation as part of a TCRA in January 2023.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☒ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 106,000,000 gal/yr avg. ☐ Quantity of surface water treated annually Remarks Treatment system is remotely monitored in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: Groundwater monitoring results indicate that PFAS continues to be released from the source areas at concentrations exceeding MCLs. The treatment system was designed and implemented as part of a Time Critical Removal Action therefore, the goal is to remediate the high concentration plume segments. The complete characterization of the downgradient extent of the plume has not been performed, and will be completed during the RI/FS.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☒ N/A Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III AOC 29 HFBR	
1.	Construction Complete/System Operating ☐ Yes ☒ No Remarks: The system operated from 1997 to September 2000, when it was placed in standby mode. The system was approved for closure in March 2019.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☒ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☐ Quantity of groundwater treated annually _____ ☐ Quantity of surface water treated annually _____ Remarks The system is administratively closed. The carbon vessels are being utilized for the Former Firehouse Treatment System.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: The treatment system is administratively closed, and the program consists of groundwater monitoring of natural attenuation.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: Tritium concentrations in monitoring wells have not exceeded the Drinking Water Standard of 20,000 pCi/L since 2020.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III Industrial Park	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: System was approved for closure in 2025.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☒ Air stripping ☒ Filters ☐ Oil/water separation ☒ Carbon adsorbers ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Bioremediation ☐ Vapor phase GAC filters for air stripping portion of system ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☐ Quantity of groundwater treated annually _____ ☐ Quantity of surface water treated annually _____ Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Monitoring data shows VOCs are attenuating to below MCLs. System approved for closure in 2025.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III LIPA/Airport	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: System operating. Airport wells RTW-2, RTW-3, and RTW-5 are off in standby. The LIPA portion of the treatment system was administratively closed in December 2024.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☒ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 202,000,000 gal / yr avg. ☐ Quantity of surface water treated annually Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: _____ Maintenance performed as needed to injection wells.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: _____
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: _____
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: LIPA post-closure monitoring has not suggested any rebound in VOCs, and all monitoring well results remained below their respective MCLs. Monitoring wells associated with the Airport System continue to show elevated concentrations of VOCs, however, concentrations are decreasing over time. The monitoring data show that the capture goal of 50 ug/L total VOC (TVOC) concentration at the LIPA Upper Glacial and Magothy wells has been met. No TVOC concentrations above the 10 ug/L capture goal have been detected in the bypass monitoring wells associated with the Airport system.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: _____ _____ _____ _____

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III Middle Road	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: Two of seven extraction wells remain in full time operation. The remaining five wells are in standby mode.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☒ Air stripping ☐ Carbon adsorbers ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 173,000,000 gal/yr avg. ☐ Quantity of surface water treated annually Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: The groundwater plume in the deep Upper Glacial aquifer is being captured by extraction wells RW-2 and RW-7. Individual VOCs are still above MCLs in some monitoring wells however, groundwater contaminant concentrations and extent has greatly decreased due to the operation of the Middle Road treatment System.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III North Street/North Street East/North Street East EDB	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: The North Street East system was approved for shutdown in 2014. The North Street System was approved for closure in March 2020. A modification to the North Street East System was completed in July 2020 with the addition of two new extraction wells to remediate an Ethylene Dibromide (EDB) plume. Both wells are currently operating in pulsed pumping mode.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks: The two extraction wells, NSE-EDB-EW-3 and NSE-EDB-EW-4 were operating full time from startup to May 2024, then started operating on a pulsed pumping schedule of one month on, one month off, since May 2024.
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks: _____
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks: _____
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☒ Carbon adsorbers ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 100,000,000 gal/yr avg. ☐ Quantity of surface water treated annually ☐ Bioremediation Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: _____
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks: _____

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: _____ Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: _____
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: _____
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Based on the data from the monitoring wells and two new extraction wells, the system has controlled and reduced the plume concentrations to below the drinking water standards (DWS). EDB concentrations in both extraction wells have remained below the DWS since 2021, and the monitoring wells showed EDB concentrations declining to below the DWS in 2024.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: _____ _____ _____ _____

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A		
A. System OU I South Boundary		
1.	Construction Complete/System Operating ☐ Yes ☒ No Remarks: The treatment system was approved for closure in September 2019.	
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A		
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☐ All required wells properly operating ☐ Needs Maintenance Remarks: System is being maintained in an operationally ready state.	
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks System is being maintained in an operationally ready state.	
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks	
C. Treatment System ☒ Applicable ☐ N/A		
1.	Treatment Train (Check components that apply) ☐ Metals removal ☒ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☐ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☐ Quantity of groundwater treated annually _____ ☐ Quantity of surface water treated annually _____ Remarks The system is administratively closed.	
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:	
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:	

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Monitoring results indicate no rebound of VOCs since system closure in 2019.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: No rebound of VOC concentrations has been observed since the system was administratively closed. VOCs are still observed emanating from upgradient sources, however, they are attenuating as they migrate south toward the site boundary. Modeling simulations suggest that TVOC concentrations will attenuate to below 5 ug/L prior to reaching the site boundary. There were no exceedances of MCLs for individual VOCs in post-closure monitoring wells in 2024.

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III South Boundary	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: One extraction well, EW-17, is operating full time. The remaining seven extraction wells are in standby mode.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☒ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☐ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 71,000,000 gal/yr avg. ☐ Quantity of surface water treated annually Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: The groundwater plume is controlled at the site boundary due to EW-17. VOCs were not detected in bypass monitoring wells in 2024. Individual MCLs have not been achieved in monitoring wells, but have shown a decreasing trend since 2011.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System AOC 28 OU VI EDB	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: In December 2023 the system was shut down to construct two new extraction wells (EW-3E and EW-4E) at greater depths than the two existing extraction wells (EW-1E and EW-2E) to better capture the deeper portions of the EDB plume. The new wells became operational in January 2024, and extraction wells EW-1E and EW-2E were placed in standby mode. The two new extraction wells continue to operate full time.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks: _____
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks: _____
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks: _____
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☐ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☒ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 149,000,000 gal/yr avg. ☐ Quantity of surface water treated annually _____ Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: _____
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks: _____

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: _____ Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks: _____
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: _____
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining Remarks: _____ The installation of the two deeper extraction wells is expected to control and remediate the leading edge of the EDB plume. Concentrations of EDB are still detected in monitoring wells at concentrations above the DWS. No rebound of VOCs has been detected in standby extraction wells, and full time operation will continue for the two new extraction wells.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks: _____ _____ _____ _____

VIII. GROUNDWATER REMEDIES ☒ Applicable ☐ N/A	
A. System OU III Western South Boundary	
1.	Construction Complete/System Operating ☒ Yes ☐ No Remarks: The system is currently operational: extraction wells WSB-1 and WSB-2 are off in standby mode; WSB-3 through WSB-6 are operating on a pulsed pumping schedule of one month on, one month off.
B. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A	
1.	Pumps, Wellhead Plumbing, and Electrical ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance Remarks:
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances ☒ Good condition ☐ Needs Maintenance Remarks
3.	Spare Parts and Equipment ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks
C. Treatment System ☒ Applicable ☐ N/A	
1.	Treatment Train (Check components that apply) ☐ Metals removal ☒ Air stripping ☐ Filters ☐ Additive (e.g., chelation agent, flocculent): ☐ Others ☐ Oil/water separation ☐ Carbon adsorbers ☐ Bioremediation ☒ Good condition ☐ Needs Maintenance ☒ Sampling ports properly marked and functional ☒ Sampling/maintenance log displayed and up to date (See remarks) ☒ Equipment properly identified ☒ Quantity of groundwater treated annually 175,000,000 gal/yr avg. ☐ Quantity of surface water treated annually Remarks Remote monitoring of the system is performed in Building 462.
2.	Electrical Enclosures and Panels (properly rated and functional) ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks:
3.	Tanks, Vaults, Storage Vessels ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks:

4.	Discharge Structure and Appurtenances ☐ N/A ☒ Good condition ☐ Needs Maintenance Remarks: Maintenance performed as needed to discharge structures and appurtenances.
5.	Treatment Building(s) ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks:
6.	Monitoring Wells (pump and treatment remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:
D. Monitoring Data	
1.	Monitoring Data ☒ Is routinely submitted on time ☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining Remarks: Four extraction wells installed in 2019 address the migration of the deeper VOC contamination. The bypass wells continue to stay below MCLs, indicating the plume is contained by the operating extraction wells. Plume core wells remain below the TVOC capture goal for the system. There has been significant reduction in VOC concentrations in the monitoring wells, and overall plume concentrations since the startup of the deeper extraction wells.
E. Monitored Natural Attenuation	
1.	Monitoring Wells (natural attenuation remedy) ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☒ All required wells located ☐ Needs Maintenance ☐ N/A Remarks:

Attachment 3

Interview Records

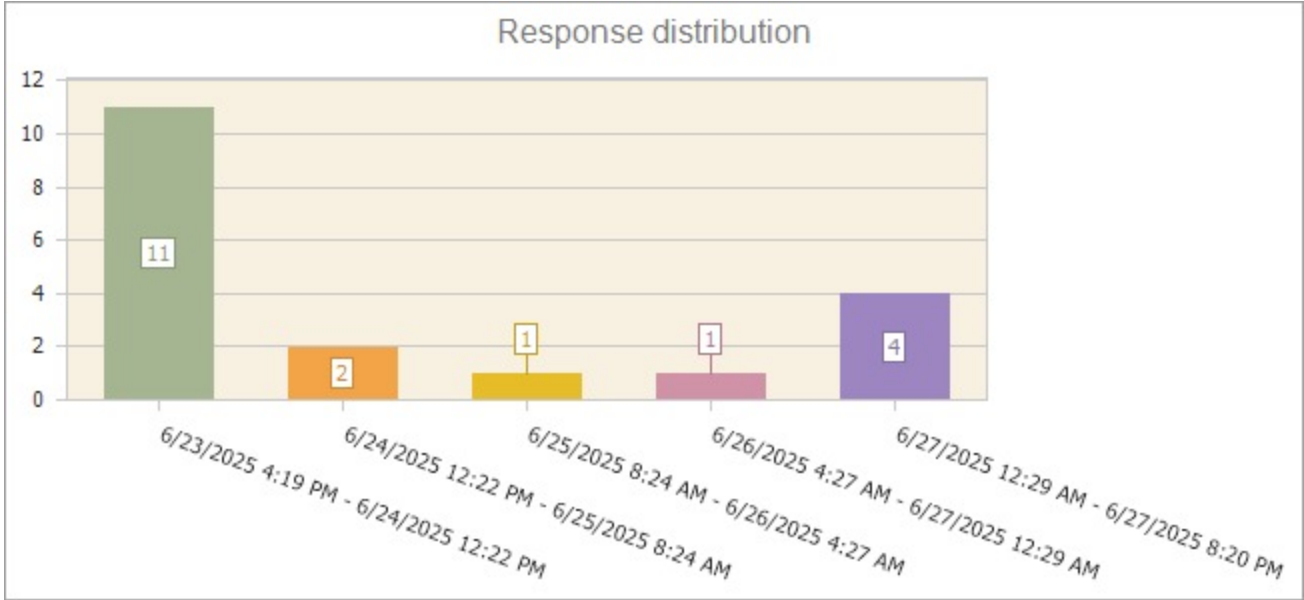
Community Advisory Council 5-year Review Survey

Survey Responses

4/6/2026 9:58:34 AM

Summary of surveys in the report

Survey	# Pages	# Questions	Date opened	Date closed	Responses	# Complete responses
5-year Review Survey Members of the Lab's Community Advisory Council	2	4	6/23/2025	6/28/2025	19	19



1.

1.1. P2Q1 – Q1

What is your overall impression of BNLS cleanup and do you feel well informed about the cleanup activities and progress?*

Question type: Open ended

Number of responses: 19

Number of respondents: 19

Not answered: 0

Date	Respondent	Answer
6/23/2025	Anonymous	The BNL effort to maintain clean water and environment are extremely impressive. The community is involved and informed with regular CAC meetings, which has been a good model to interface with local stakeholders.
6/23/2025	Anonymous	Impression is that a good, well organized effort to clean up environmental issues is being made
6/23/2025	Anonymous	I di feel well informed, and I believe that bbl does a sound job in cleaning up, and continuing to monitor, its contaminated sites.
6/23/2025	Anonymous	Excellent. NL has a very competent ES&H professional staff that addresses any all emerging issues, and continuously presents and advises the CAC as to their approach and status until final closure.
6/23/2025	Anonymous	Periodic updates of continuing cleanups are helpful. We are also kept informed of newer spills, monitoring and close outs. In short. BNL's clean up efforts are satisfactory.
6/24/2025	Anonymous	yes
6/24/2025	Anonymous	BNL continues to make progress on its cleanup goals. Although it is slow, it is still progress. I feel informed throughout the cleanup process.
6/24/2025	Anonymous	Excellent and yes.
6/24/2025	Anonymous	Overall, BNL does a decent job of cleaning up the site. That said, there are outstanding major issues that need to be addressed ASAP. Most notable being the PFAS/1-4 Dioxane Comprehensive RI and the Building 197 Mercury issue.
6/24/2025	Anonymous	In my view BNL it is clear that BNL is strongly committed to remediation of any hazardous spills, both legacy and current. In general the Environmental Protection team does a good job keeping the CAC informed about all ongoing cleanup efforts. (Please see also my response to question 4.)
6/24/2025	Anonymous	I have the utmost confidence that BNL will continue their clean up efforts of any hazardous conditions. They have been transparent with the CAC on any necessary challenges involving the Demolition, removal and prevention of exposure of Mercury and Groundwater leaks.
6/24/2025	Anonymous	good overall. Talented and committed staff.
6/24/2025	Anonymous	I appreciate the team's efforts to be transparent and keep the community informed about cleanup efforts and progress.
6/25/2025	Anonymous	Though clean up can feel frustratingly slow, the context given in updates makes sense for the timeline.
6/26/2025	Anonymous	BNL seems to be comprehensive in their remediation plans and implementation of those plans. Yes, I feel well informed about cleanup actions.
6/27/2025	Anonymous	Yes
6/27/2025	Anonymous	You have a great environmental team there and they have done a great job managing and cleaning the groundwater of that site.
6/27/2025	Anonymous	BNL does an excellent job in performing cleanup activities and in keeping the public and the CAC informed. BNL is thorough and comprehensive and provides an extraordinary amount of detail.
6/27/2025	Anonymous	BNL is dedicated to continued cleanup of both onsite and offsite groundwater contamination and is in the forefront of cleanup of PFAS. Routine updates continue to provide information on progress.

1.2. P2Q2 – Q2

Are there any specific aspects of the cleanup that you feel should be of focus during the review?*

Question type: Open ended

Number of responses: 19

Number of respondents: 19

Not answered: 0

Date	Respondent	Answer
6/23/2025	Anonymous	Community involvement, feedback and communication via CAC has been a great asset to the local area. The BNL and DOE teams have all cleanup operations monitored with strict protocols.
6/23/2025	Anonymous	I don't have a comment on this issue.
6/23/2025	Anonymous	they should continue being open and responsive to the cac.
6/23/2025	Anonymous	No, I believe they are very strong, as well as totally transparent in these areas.
6/23/2025	Anonymous	Prevention and progress should be stressed.
6/24/2025	Anonymous	no
6/24/2025	Anonymous	The focus should be on the required aspects of a CERCLA five-year review. Are the remedies protective of human health and the environment? It should touch on all the examples provided.
6/24/2025	Anonymous	No
6/24/2025	Anonymous	PFAS and 1-4 Dioxane site impacts are slowly being discovered. The offsite impact has not been assessed. It is my opinion that PFAS and 1-4 Plumes likely mimic historical plumes, except PFAS and 1-4 plumes are likely longer and more dispersed than historical VOC plumes as contaminated water in many cases was discharged with PFAS and 1-4 still in effluent. If not dealt with, the Building 197 Mercury abatement needs to happen sooner rather than later. If it can't be remediated, than it needs to be stabilized to prevent exposures to lab workers, wildlife, and weather events.
6/24/2025	Anonymous	Perhaps more emphasis on emerging contaminants, e.g., PFAS. By the way, I do not know what "RODs" are. An acronym finder website suggests that it might be "Record of Decision," "Report of Deficiency," or "Report of Discrepancy," but it could be something else. (Please see also my response to question 4.)
6/24/2025	Anonymous	During the last CAC meeting it was brought to our attention that additional funds were needed to continue the removal efforts of Mercury from the lab property. My question is: Was this completed?
6/24/2025	Anonymous	Would want to be sure that older RODs and cleanups are effective and consistent or in compliance with current standards.
6/24/2025	Anonymous	-
6/25/2025	Anonymous	How to acquire the funds to pay for the clean up.
6/26/2025	Anonymous	Groundwater and surface water (Peconic River) should be given the highest priority during a review.
6/27/2025	Anonymous	More advertising to the community of what is being done .
6/27/2025	Anonymous	I always want to hear what the lab is working on. Its been a long time since the lab received a Noble Prize and I think it needs to focus more on producing results that move humanity forward
6/27/2025	Anonymous	No
6/27/2025	Anonymous	Closeout of groundwater systems and progress towards establishing cleanup goals for PFAS.

1.3. P2Q3 – Q3

Do you feel confident in BNL and DOE's management of the long-term cleanup operations for the site?*

Question type: Open ended

Number of responses: 19

Number of respondents: 19

Not answered: 0

Date	Respondent	Answer
6/23/2025	Anonymous	Yes. The detail, transparency, accountability and updates during all cleanup operations are great.
6/23/2025	Anonymous	Yes, I have confidence in the cleanup operations.
6/23/2025	Anonymous	yes.
6/23/2025	Anonymous	Yes, very confident. However, I am somewhat concerned with DOE's continuing commitment under the current administration.
6/23/2025	Anonymous	Yes. If past is prologue, long term cleanups will be successful
6/24/2025	Anonymous	yes
6/24/2025	Anonymous	Although I do feel confident that BNL/DOE are doing the best they can with the resources allotted to them, they should make a more concerted effort to attain the resources to conduct the PFAS and 1,4-Dioxane RI/FS and cleanup as well as complete the Building 197 remediation.
6/24/2025	Anonymous	Yes
6/24/2025	Anonymous	I do not believe DOE takes its environmental responsibilities seriously enough. The contractors at BNL live and work in this area, and their sole responsibility is cleaning up the site and maintaining compliance with existing statues, so I do not necessarily blame them, but I think DOE management should make funding available to advance the previously stated issues.
6/24/2025	Anonymous	Yes, I am confident that BNL and DOE will continue to do a good job managing the on- (and sometimes off-) site cleanup, /as long as sufficient funding is available/. This may be a critical issue in the present political climate.
6/24/2025	Anonymous	I do feel confident that all parties involved will make it a priority to see all projects are fulfilled.
6/24/2025	Anonymous	Recognize that long term management is difficult to predict. Depends on priorities and funding. Recently there was disappointment in regulatory and community partners that due to a lack of funds, mercury encountered during bldg 197 demolition could not be completely cleaned up during this funding cycle.
6/24/2025	Anonymous	I feel confident.
6/25/2025	Anonymous	Yes.
6/26/2025	Anonymous	currently, yes
6/27/2025	Anonymous	Yes
6/27/2025	Anonymous	Yes they are the example we have on Long Island
6/27/2025	Anonymous	Yes, BNL and DOE have performed wellI am confidentthat their excellent performance will continue in the future.
6/27/2025	Anonymous	Dedicated funding for determining full extent of PFAS contamination and establishment of goals is less than certain and reflects poorly on DOE management.

1.4. P2Q4 – Q4

Do you have any comments, suggestions, or recommendations regarding BNL/DOE's management and communication of the cleanup?*

Question type: Open ended

Number of responses: 19

Number of respondents: 19

Not answered: 0

Date	Respondent	Answer
6/23/2025	Anonymous	Keep up the good work! The GIS maps and ground water survey studies are awesome. Communications are excellent. Thank you!
6/23/2025	Anonymous	No further comment.
6/23/2025	Anonymous	no.
6/23/2025	Anonymous	Only that the current administration continue to provide DOE and BNL with the resources necessary to continue with their cleanup efforts.
6/23/2025	Anonymous	I've seen increased candor concerning causation and remediation.
6/24/2025	Anonymous	no
6/24/2025	Anonymous	BNL/DOE should conduct the PFAS and 1,4-dioxane RI/FS.
6/24/2025	Anonymous	No.
6/24/2025	Anonymous	Current administrative environment at DOE suggests funding for cleanup activities will be slow and minimal at best. DOE needs to concern themselves with the environmental impacts their facilities have on the municipalities and states in which they lie regardless of the administrative environment, since these environmental impacts do not change with new electeds and appointees.
6/24/2025	Anonymous	BNL does a pretty good job of conveying necessary information to the CAC, although sometimes I fear it is overly technical for the group. I am a recently retired physicist (who was raised by chemists!), and even I am sometimes a bit overwhelmed by the various presentations. I try to ask questions that might help those who did not discuss science at the dinner table from a young age. I know from experience that it is can be difficult (and time consuming!) for technical people to tailor a presentation to a more general audience. It's hard to find the right balance of forest and trees, but perhaps more effort in this would be worthwhile. There is also a broader question: getting cleanup information to the CAC is one thing, but getting it out to the public at large is something else. Maybe Environmental Protection Division needs an easy to find web site that gives a list of main clean-up accomplishments over the past decades, and also very brief outlines of ongoing efforts. Such a list would be quite impressive--recently someone gave a number for the total volume of water that had been treated over the years at the lab. I do not have it at hand, but remember that it is a BIG number. This of course also takes time, and perhaps money, and would need to be curated, something BNL has not been very good at in my experience. (As one small example, note that the photo of the CAC under Stakeholder Relations is very old--very few of the people in the photo are in the current list of members that appears below.) An outside-the-box suggestion: produce YouTube style short videos about the different cleanup operations to post on the website.
6/24/2025	Anonymous	I would suggest that if we can continue to get updates on the cleanup prior to meeting in September.
6/24/2025	Anonymous	When in doubt it always better to communicate and share information rather than hold back. Be open and up front.
		I am confident in BNL's management and communication of the cleanup. I get the sense from my

6/24/2025	Anonymous	fellow CAC members that they would appreciate more immediate communication when there are important developments or news, rather than waiting until the next CAC meeting, especially if it will be some time before the next meeting.
6/25/2025	Anonymous	No.
6/26/2025	Anonymous	no
6/27/2025	Anonymous	More public outreach, possibly yo civic organizations and schools. Get the school district kids involved.
6/27/2025	Anonymous	I was disappointed in the wat the lab director dealt with the small tritiated water leak on the roof. She seemed to blame the field team, but the root cause is really the lab leadership not investing in infrastructure. I think she should have handled that better. I don't think she needs to keep bring up the fact that the lab has an all-female leadership team. You should have the very best leadership team you can get and if they happen to be all-female that's great but if you feel the need to keep announcing that it makes me think that may have been the reason you hired some of them. The lab should concentrate of the world's most challenging problems and leave the social issues out of it. Thanks!
6/27/2025	Anonymous	No
6/27/2025	Anonymous	Continue to seek the needed funding to complete cleanup operations.

Attachment 4

Technology Assessment, Question B Standards
Review Memo, HFBR Decay Assessment

Ms. Julia Michaels
Groundwater Protection Group
Environmental Protection Division
Brookhaven National Laboratory Building 462
Upton, New York 11973-5000

Arcadis of New York, Inc.
290 Broadhollow Road
Suite 307E
Melville, New York 11747
Phone: 631 249 7600
www.arcadis.com

Date: March 6, 2026

Our Ref: 30304449

Subject: Summary of Technical Assessment for 2026 Five-Year Review
Brookhaven National Laboratory, Upton, New York

Dear Ms. Michaels:

The United States Environmental Protection Agency (USEPA) requires a Five-Year Review be completed for Brookhaven National Lab's (BNL's) environmental remediation program as part of the Comprehensive Environmental Response, Compensation, and Liability Act. Arcadis is providing support for the technical assessment portion for the 2026 Five-Year Review. More specifically, Arcadis has reviewed each of the groundwater 12 groundwater remediation projects selected by BNL using available documentation including the Groundwater Status Reports and previous Five-Year Review Report to assess each plume or groundwater treatment system (and corresponding plume). The technical assessment was completed for each system or plume to determine if it is on track to meet Record of Decision (ROD) cleanup goals, if there are any operational adjustments or new or alternative cleanup technologies that should be considered to accelerate cleanup or address residual contaminant mass, and if updated groundwater modeling is required to complete the assessment. The 12 groundwater remediation projects reviewed are as follows:

- Operable Unit (OU) I Strontium-90 (Sr-90)
 - Former Hazardous Waste Management Facility (HWMF)
- OU III Volatile Organic Compounds (VOCs)
 - Building 96 Treatment System
 - Middle Road Treatment System
 - OU III South Boundary Treatment System
 - Industrial Park Treatment System
 - Long Island Power Authority (LIPA)/Airport Treatment System
 - Western South Boundary Treatment System
- OU III Ethylene Dibromide (EDB) - North Street East Treatment System
- OU III Strontium-90 (Sr-90)
 - Brookhaven Graphite Research Reactor (BGRR)/Waste Concentration Facility (WCF) Treatment System
- OU VI EDB Treatment System
- OU X Time Critical Removal Action (TCRA) Per- and Polyfluoroalkyl Substances (PFAS)
 - Current Firehouse/Building 170

- Former Firehouse

The assessment for each of these systems/plumes is described in the following sections. All references to figures in this letter report refer to the *2024 Groundwater Status Report* (BNL 2025).

The remedial objectives stated in the ROD for groundwater for the various OUs as they relate to the 12 groundwater remediation projects reviewed are:

- OU I and OU III – to meet drinking water standards, cleanup of the groundwater in the Upper Glacial aquifer by 2030 for VOCs (2070 for OU I Sr-90 Former HWMF and OU III Sr-90 BGRR/WCF Sr-90 plumes), complete cleanup of the groundwater in the Magothy aquifer by 2065, and to prevent or minimize further migration of contaminants in groundwater.
- OU VI – to meet the drinking water standard for EDB in groundwater, cleanup of the groundwater in a timely manner (for the Upper Glacial aquifer, this goal is by 2030), and prevent or minimize further migration of EDB in groundwater vertically and horizontally.

OU I Strontium-90 – Former HWMF

Introduction

The remedy for OU I Sr-90 groundwater contamination from the former HWMF, located in the southeastern portion of the BNL campus, requires on-site monitored natural attenuation of the Sr-90 plume to achieve the cleanup goal of 8 picocuries per liter (pCi/L) by 2070 within the site south boundary. The monitoring program consists of routine sampling of permanent monitoring wells along with periodic sampling at temporary well locations to supplement the permanent monitoring well network. Periodically, modeling has also been used to re-evaluate the expected attenuation timeframe for Sr-90 based on the monitoring data. For example, in 2020 groundwater monitoring identified Sr-90 in groundwater at the former HWMF at higher concentrations than were previously observed (peak concentration of 689 pCi/L in a temporary well). As a result, the groundwater model was updated in April 2021 to re-evaluate the expected attenuation timeframe for Sr-90. A sensitivity analysis conducted during the 2021 attenuation modeling showed that the ultimate attenuation of the plume is primarily dependent on the overall plume mass and not a small area of higher Sr-90 concentrations.

Currently, 25 permanent wells are monitored for Sr-90 contamination originating from the former HWMF (Figure 3.1-4 [BNL 2025]). A total of 16 temporary wells were installed from October 2024 through January 2025 to supplement the monitoring well network.

Review of OU I Sr-90 Groundwater Plume

Recent groundwater data provides the following observations. The highest Sr-90 concentration was detected in permanent monitoring well 098-104 with a concentration of 186 pCi/L observed in March 2024. The highest concentration observed in the temporary wells was 130 pCi/L in OU I-SR-90-GP-71 in December 2024 at a depth of 40 to 44 feet (ft) below ground surface (bgs). Monitoring well 098-100 is located immediately downgradient of the former HWMF and has shown an increasing trend of Sr-90 concentrations since 2020. The sampling results for this monitoring well in 2024 have concentrations that ranged from 85 pCi/L and 116 pCi/L, an increase from the 2023 results (Figure 3.1-5 [BNL 2025]).

The highest concentrations of Sr-90 in this plume are located between the southern boundary of the former HWMF yard and the southern boundary of the Long Island Solar Farm, as demonstrated by the permanent and temporary well results. The persistence of the Sr-90 groundwater plume in this area can be attributed to the removal of buildings and pavement in the former HWMF area as part of the 2005 soil remediation work. Subsequent precipitation and infiltration through the unsaturated zone and/or water table flushing are the likely mechanisms for mobilizing residual Sr-90 to groundwater.

The data obtained from the temporary and permanent wells over the previous eleven years indicates a Sr-90 migration rate of approximately 20-25 feet per year. This rate is similar to migration rates calculated for other BNL Sr-90 plumes. The 2024 monitoring data indicate that the Sr-90 plume is continuing to move slowly, generally decreasing in concentration with time on-site. South of the former HWMF and the Long Island Solar Farm, Sr-90 concentrations are attenuating to below 8 pCi/L on-site (Figure 3.1-5 [BNL 2025]).

Recommendations for OU I Sr-90 Groundwater Plume

The *2024 Groundwater Status Report* recommended installing temporary wells as needed to fill monitoring data gaps and characterize the extent of the Sr-90 plume, including installing a temporary well to the west of OU I-Sr-90-GP-74 to verify the western extent of this higher concentration plume segment (Figure 3.1-4 [BNL 2025]). The primary recommendation is to continue the Sr-90 monitoring program (sampling permanent monitoring wells and installing temporary wells) and track the contaminant trends throughout the plume, including near the source area. While the groundwater model will continue to be used as a tool, as appropriate, to refine the estimated cleanup timeframe of the Sr-90 plume, continued monitoring of the plume will identify if there is potential for Sr-90 to leave the site at concentrations above the MCL.

OU III VOCs – Building 96 Treatment System

Introduction

The OU III Building 96 Treatment System began operation in February 2001. It is the first groundwater treatment system along a major segment of the OU III VOC plume path. The contamination in this area is relatively shallow due to its close proximity to the source (Figure 3.2-2 [BNL 2025]). The depth of the only operating Building 96 source area extraction well (RTW-1) is approximately 60 ft bgs (Figure 3.2.1-2 [BNL 2025]).

The Building 96 source area is located approximately 250 to 300 ft upgradient of extraction well RTW-1. A significant source area remediation (soil excavation) occurred in 2010. The extent of the excavated source area is shown on Figure 3.2.1-1 (BNL 2025). Following the source area remediation, groundwater contamination concentrations in the source area decreased significantly (Figure 3.2.1-3 [BNL 2025]). During the previous review of the Building 96 Treatment System in 2021 (Arcadis 2020), the data from monitoring wells 085-379 and 095-159 indicated that the remediation effort was not on track to achieve the cleanup goal of meeting individual VOC maximum contaminant levels (MCLs) by 2030.

In the *2021 Five Year Review* (BNL 2021a), the recommended follow-up action included evaluating the injection of a liquid carbon and zero-valent iron as an in-situ chemical treatment to address remaining source area contamination. This remedial action was performed in July 2024 to reduce the mobility of tetrachloroethene (PCE) and enhance its degradation. The work was performed in accordance with the approved *OU III – Building 96 Source Area Optimization Work Plan* (P.W. Grosser 2024).

Prior to performing the injections, one new monitoring well (085-416) was installed downgradient of the source area, and extraction well RTW-1 was shut down to reduce groundwater migration and increase the residence time of the chemical treatment within the source area (Figures 3.2.1-1 and 3.2.1-2 [BNL 2025]). A total of 19 injection points were installed spanning the water table (approximately 21 ft bgs) from approximately 19 ft bgs to 29 ft bgs throughout the source area to inject the chemical treatment solution in-situ.

Review of Building 96 Treatment System

The initial results of the in-situ chemical treatment are encouraging. Monitoring well 085-379, located immediately downgradient of the residual source/treatment area, had no detections of VOCs since the injections. New monitoring well 085-416, installed about 20 ft downgradient of monitoring well 085-379, has had total VOC concentrations (consisting primarily of PCE) that ranged from 11 to 18 micrograms per liter (µg/L) since the chemical treatment. It is expected that total VOC concentrations will decline in monitoring well 085-416 as clean groundwater migrates downgradient to this location.

At this time, it is uncertain whether VOC concentrations within the source area will rebound following the chemical treatment. Continued groundwater monitoring will be needed to determine if follow-up actions will be necessary.

Extraction well RTW-1 has a significant influence on groundwater flow at monitoring well 095-159. The monitoring well is screened in a similar depth interval and is located only about 60 ft away, albeit slightly down and side gradient of the extraction well. Since 2002, total VOC concentrations have generally ranged between 5 and 10 µg/L at this location. During 2020, total VOC concentrations in monitoring well 095-159 were 134 µg/L in August but decreased to non-detect in December. After extraction well RTW-1 was turned off for the chemical treatment in 2024, total VOC concentrations rebounded to 98 µg/L. Extraction well RTW-1 has since been turned back on, and it is expected that VOC concentrations in monitoring well 095-159 will decrease as the extraction well provides hydraulic control in this area.

Recommendations for Building 96 Treatment System

The areal extent and peak total VOC concentrations have been significantly reduced since 2001 by the Building 96 treatment system and the other remedial activities (Figure 3.2.1-6 [BNL 2025]). Data collected following the remedial efforts at the Building 96 source area, including the source area excavation in 2010 and the chemical treatment in 2024, indicate that they have been successful at improving groundwater quality and optimizing the cleanup timeframe. In addition, the remedy has prevented and minimized migration of contaminants in groundwater. However, based on the monitoring data, it is unclear if the cleanup goal of meeting MCLs for individual VOCs will be achieved by 2030 because there has not been enough time since the injections to determine if VOC concentrations will rebound. Continued groundwater monitoring will determine if there is rebound in VOC concentrations and if additional treatment is

warranted. Continued operation of extraction well RTW-1 is recommended to provide hydraulic control and continue to improve downgradient groundwater quality until capture goals are met and remain stable.

OU III VOCs – Middle Road Treatment System

Introduction

The Middle Road Treatment System began operating in October 2001 and is located downgradient of the Building 96 Groundwater Treatment System. This system is currently using extraction wells RW-2 and RW-7 (Figure 3.2.2-1 [BNL 2025]). Extraction well RW-3 was also being used through 2024, but it was shut down in 2025 as it had achieved the total VOC capture goal of 50 µg/L and was no longer positively impacting the cleanup in this area. The inactive remedial wells (RW-1, -4, -5, and -6) are currently in standby mode. In this area of the site, the groundwater contamination primarily migrates within the approximately 20 to 60 ft thick Upton Unit which makes up the basal segment of the Upper Glacial aquifer in this area (Figures 3.2.2-2 and 3.2.2-4 [BNL 2025]). As recommended in the *2020 Technical Review* (Arcadis 2020) for the Middle Road Treatment System, several temporary vertical profile wells were installed in 2021 as part of a pre-design investigation to confirm the distribution of VOC concentrations in the area. The pre-design investigation also included additional hydrogeologic characterization, including aquifer testing (i.e., slug testing) to evaluate hydraulic conductivity of Upper Glacial aquifer (including the Upton Unit), and grain size evaluation of soil samples collected from vertical profile borings. Based on the water quality data collected from these profile borings, and as recommended in the *2022 Groundwater Status Report* (BNL 2023a), two additional monitoring wells (105-80 and 105-81) were installed at the locations of the temporary vertical profile wells in 2021 to further evaluate VOC concentrations and aquifer hydraulic conductivity within the core of the plume.

Review of Middle Road Treatment System

The previous technical assessment of the Middle Road Treatment System conducted in 2020 (Arcadis 2020) concluded that while the existing remediation technology (pump and treat) was the most effective remedial technology available given the depth and large areal extent of the groundwater contamination, the system was not on track to achieve cleanup goals. During the previous assessment, three monitoring wells (104-37, 105-68, and 105-66) were specifically discussed, and because of the lengthy data history and consistent operation of the treatment system, trend data can be used to estimate the timeframe to achieve the individual VOC MCL cleanup goals. For the analysis presented below, total VOC concentrations were used as a surrogate for achieving the individual VOC MCL cleanup goals.

Monitoring Well 104-37: Monitoring well 104-37 is located approximately 1,000 ft upgradient of extraction well RW-7. Total VOC concentrations declined from approximately 200 µg/L in 2014 to approximately 100 µg/L in 2019 (five years). Five years later (by October 2024, total VOC concentrations declined to 64 µg/L. Assuming concentrations continue to halve every five years, cleanup goals of meeting MCLs for the individual VOCs will likely be achieved in about 20 years (2044).

Monitoring Well 105-68: Monitoring well 105-68 is located approximately 500 ft upgradient of extraction well RW-7. The total VOC concentrations declined from approximately 600 µg/L in 2014 to approximately 300 µg/L in 2019 (five years). Five years later (by February 2024), total VOC concentrations declined to

156 µg/L. Assuming concentrations halve every five years, cleanup goals of meeting MCLs for individual VOCs should be achieved in about 25 years (2049).

Monitoring Well 105-66: Monitoring well 105-66 is located approximately 300 ft upgradient of extraction well RW-2. An approximate cleanup timeframe could not be calculated using data from this monitoring well because the trend is not consistent due to an east to west shift of the plume resulting from changes in the operation of the extraction wells as seen on Figure 3.2.2-3 (BNL 2025). Nevertheless, total VOC concentrations declined from approximately 200 µg/L in 2019 to 133 µg/L in 2024 (five years).

In addition, new monitoring well 105-80, installed along the core of the plume had a maximum total VOC concentration of 238 µg/L in this area in 2024. Continued monitoring at this well should provide useful data for future assessment of cleanup timeframes.

The slower than expected decline of contaminant concentrations in monitoring wells could be due to a number of factors. These include historical operation of the HFBR Pump and Recharge System (shallower portions of the contamination) and variations in the hydraulic conductivity where the Upton Unit (typically consisting of lower hydraulic conductivity, fine-grained sands) transitions into the underlying Magothy aquifer. The presence of the groundwater plume over an extended period of time has allowed contaminants to diffuse into the fine-grained/lower hydraulic conductivity portions of the Upton Unit. As the groundwater plume in the higher hydraulic conductivity portions of the Upper Glacial aquifer have been removed by the extraction wells, the concentration gradient between high and low hydraulic conductivity zones has been reversed. The contaminants in the lower hydraulic conductivity zones will take time to diffuse back into the higher hydraulic conductivity zones to be removed by the extraction wells. This situation is not uncommon as isolated or varying zones of lower hydraulic conductivity on such a large scale can occur.

The Middle Road Treatment System is meeting the intent of the ROD. The system is effectively containing the VOC plume by achieving hydraulic capture of the total VOC impacts above 50 µg/L, is reducing the lateral and vertical extents of the plume, and is preventing the further downgradient migration of the plume. While the system is achieving capture, it is not expected to achieve the cleanup goal of reducing individual VOCs to concentrations below MCLs by 2030. In part, this is due to the plume's presence in the previously unrecognized Upton Unit, a local hydrogeologic unit with hydraulic properties (i.e., transmissivity) more closely aligned with the Magothy aquifer than the Upper Glacial aquifer. Recent observations suggest that the Upton Unit is retarding the movement of the VOC plume, which will increase the time required to achieve the cleanup goal. While the lower hydraulic conductivity zones have extended the time necessary to achieve the cleanup goal of MCLs for the individual VOCs, the pump and treat remedy remains the most effective remedial technology for maintaining hydraulic control (i.e., capture) of the plume and achieving the remedial goals, considering the groundwater plumes cover a large areal extent, are relatively deep, and are generally in a highly conductive aquifer.

Recommendations for Middle Road Treatment System

As stated in the *2024 Groundwater Status Report* (BNL 2025), it is recommended to place extraction well RW-3 in standby mode based on the recommendations found in the *OU III Middle Road/South Boundary Groundwater Modeling Assessment* (Arcadis, 2024). Extraction wells RW-2 and RW-7 should continue full-time operation.

Additionally, deep Upper Glacial aquifer VOC concentrations in this area of the site are not declining at a rate that will meet the cleanup goal of MCLs for the individual VOCs by 2030. As per the *OU III Middle Road/South Boundary Groundwater Modeling Assessment* (Arcadis, 2024) recommendations, two additional extraction wells may be installed in the approximate locations of monitoring wells 105-80 and 105-81 to expedite the cleanup timeframe for the Middle Road portion of the plume. Previous modeling results indicated a potential reduction in the cleanup time frame of about 37 percent by installing the two new extraction wells. However, these modeling results suggest that the 2030 cleanup timeframe cannot be met even with the addition of two additional extraction wells. An additional evaluation is needed to help quantify the extent to which the cleanup timeframe can be reduced. However, due to the uncertainty with the diffusion of the VOCs in the Upton Unit it is difficult to predict a cleanup time frame for this area of the Middle Road. These recommendations were stated in the *2024 Groundwater Status Report* (Section 3.2.2.7) (BNL 2025).

OU III VOCs – South Boundary Treatment System

Introduction

The OU III South Boundary Treatment System began operation in June 1997. The treatment system is downgradient from the Middle Road Treatment System and is similarly used for the treatment of VOC contaminated groundwater. Of the eight extraction wells that were installed for this system, extraction well EW-17 is the only well currently in operation. The remainder of the extraction wells are in standby mode. The groundwater contamination primarily migrates within the higher hydraulic conductivity Upper Glacial sands and the lower hydraulic conductivity Upton Unit (Figure 3.2.3-2 [BNL 2025]).

The previous technical assessment of the South Boundary Treatment System conducted in 2020 (Arcadis 2020) concluded that while the existing remediation technology (pump and treat) was the most effective remedial technology available given the depth and large areal extent of the groundwater contamination, the system was not on track to achieve cleanup goals. This conclusion was based on trends in monitoring wells located in the core of the plume, specifically monitoring well 121-54 which exhibited persistent total VOC concentrations between 100 and 250 µg/L from 2015 through 2020. This monitoring well is located approximately 900 ft upgradient of extraction well EW-17 and is approximately 800 ft downgradient of the Middle Road System's extraction well RW-2.

As recommended in the *2020 Technical Review* (Arcadis 2020) for the South Boundary Treatment System, a temporary vertical profile well was installed in 2021 as part of a pre-design investigation to confirm the distribution of VOCs concentrations in the area and conduct additional hydrogeologic characterization. As recommended in the *2022 Groundwater Status Report* (BNL 2023a), an additional monitoring well (121-57) was installed in 2023 at the location of the temporary vertical profile well, approximately 650 ft upgradient of the extraction well EW-17, to further evaluate VOC concentrations and aquifer hydraulic conductivity within the core of the plume.

Review of South Boundary Treatment System

Similar to the OU III treatment systems previously discussed, data from monitoring wells along the fringe of the plume and in the vicinity of the South Boundary extraction wells indicate that these portions of the

plume are on track to achieve cleanup goals of meeting MCLs for individual VOCs by 2030. Monitoring wells such as 121-45, 121-49, 121-43, 122-05, and 121-23 have demonstrated sharp declines in contaminant concentrations as the various extraction systems have divided and subsequently decreased the overall size of the OU III plume segments (Figure 3.2.2-3 [BNL 2025]). However, monitoring wells in the core of the plume such as 121-53 and 121-54 are not currently declining at a rate that will achieve MCLs for individual VOCs by 2030. Recently-installed monitoring well 121-57 is also located within the core of the plume. These wells are located approximately 650 to 900 feet upgradient of extraction well EW-17 and are screened in Upton Unit.

The total VOC concentration in the new monitoring well 121-57 was 235 µg/L during the October 2024 sampling event. Continued monitoring at this well should provide useful data for future assessment of cleanup timeframes.

The contaminant trends over time at plume core monitoring wells 121-53 and 121-54 have not been as consistent over time as the plume core monitoring wells upgradient of the Middle Road Treatment System (Figure 3.2.2-3 [BNL 2025]). These inconsistencies correlate to changes in the operation of the South Boundary Treatment System and should not be viewed as a deficiency in the operation of the remedy. While monitoring well 121-54 has exhibited decreasing trends from 2020 through 2024 since the previous five year review, monitoring well 121-53 exhibited increasing contaminant concentrations from 2020 through 2022 (Figure 3.2.2-3 [BNL 2025]). Contaminant concentrations have plateaued the last few years (between 100 and 200 µg/L) and are expected to decline in the near future based on the concentrations in upgradient and side-gradient monitoring wells. The increased concentrations at monitoring well 121-53 are likely the result of lateral shift of the groundwater plume to the west based on changes in the operation of the extraction wells of the South Boundary Treatment System.

Because of the continued detection of high levels of VOCs in these upgradient “core” monitoring wells it is unlikely that the South Boundary System will achieve the cleanup goals of meeting MCLs for individual VOCs by 2030. However, given the similar distance from the source area, geology, contaminant concentrations, and remedy of the groundwater plumes controlled by the Middle Road and South Boundary Treatment Systems, it may be reasonably assumed that contaminant concentrations will decrease at a similar rate in portions of the aquifer upgradient of the South Boundary Treatment System extraction wells.

The plume behavior in this area is similar to the area treated by the Middle Road Treatment System. The presence of the groundwater plume over an extended period of time has allowed contaminants to diffuse into the fine-grained/lower hydraulic conductivity portions of the Upton Unit. Although the groundwater plume in the higher hydraulic conductivity portions of the Upper Glacial Aquifer have cleaned up, it will take time for the contamination in the lower conductivity Upton Unit to diffuse back out in order to be treated. However, a change in the remediation technology is not necessary. The groundwater plumes cover a large areal extent, are relatively deep, and are generally in a highly conductive aquifer. Therefore, the most effective remedial technology for this portion of the contaminated groundwater is the current pump and treat system, which is effectively meeting the intent of the ROD by containing the groundwater plume, mitigating the potential for plume migration and removing mass from the aquifer. While the cleanup goal of achieving MCLs for individual VOCs by 2030 is unlikely to be met, the plume is being contained at the BNL site boundary.

Recommendations for South Boundary Treatment System

The *2024 Groundwater Status Report* (BNL 2025) recommended to install one additional extraction well in the approximate location of monitoring well 121-57 to expedite the cleanup timeframe for the South Boundary portion of the plume. By placing an extraction well midway between the existing Middle Road and South Boundary extraction wells, the cleanup timeframe will be accelerated by reducing the contaminant travel time to an extraction well. This timeframe could be reduced by as much as half although a more precise cleanup timeframe would need to be determined through additional evaluation, including groundwater modeling. However, even with the additional extraction well, the 2030 cleanup timeframe may not met due to the uncertainty with the diffusion of the VOCs in the Upton Unit making it difficult to predict a cleanup timeframe.

OU III VOCs - Industrial Park Treatment System

Introduction

As of 2024, the OU III groundwater plume south of the South Boundary Treatment System has largely been eliminated in the area of the Industrial Park.

The Industrial Park Treatment System began operation in September 1999. All of the Industrial Park extraction wells are currently in standby mode because total VOC concentrations in monitoring wells are below the total VOC capture goal of 50 µg/L. A petition for closure was approved by the regulatory agencies in December 2025 (BNL 2025).

Review of Industrial Park Treatment System

The plume core monitoring well with the maximum total VOC concentration is monitoring well 000-537 with a concentration of 41 µg/L in April 2024. The next highest total VOC concentration was detected in monitoring well 000-541 with a concentration of 35 µg/L in November 2024. Generally, total VOC concentrations are below 10 µg/L throughout the area treated by the Industrial Park Treatment System (Figure 3.2.3-1 [BNL 2025]).

Recommendations for the Industrial Park Treatment System

The *2024 Groundwater Status Report* (BNL 2025) recommended that a petition for shutdown of the Industrial Park Treatment System be prepared because total VOC concentrations in plume core wells remained below the total VOC capture goal of 50 µg/L during 2024. The petition for closure was approved by the regulatory agencies in December 2025. Current monitoring data suggest that the cleanup goal of meeting MCLs for individual VOCs will be achieved by 2030 for this area of the off-site OU III groundwater plume.

OU III VOCs – LIPA/Airport Treatment System

Introduction

The LIPA/Airport system consists of two sets of extraction wells (LIPA extraction wells and Airport extraction wells). The LIPA extraction wells and Airport extraction wells all feed to the LIPA/Airport Treatment system and the treated water is reinjected in the vicinity of the Brookhaven Airport.

As of 2024, the OU III groundwater plume south of the Industrial Park Treatment System has largely been eliminated in the LIPA Treatment System area as shown on Figure 3.2.5-7 (BNL 2025).

The LIPA extraction wells are located downgradient of the Industrial Park Treatment System and were designed to provide capture and control of the downgradient portion of the VOC plume that migrated south of the Industrial Park Treatment System before that system became operational in 1999. The four LIPA extraction wells have controlled and effectively eliminated the groundwater plume in this area and a petition for closure for this portion of the system was approved by the regulators in December 2024. Each of the 17 LIPA monitoring wells were below the cleanup goal of MCLs for individual VOCs during 2024 (Figure 3.2.5-1 [BNL 2025]).

The Airport extraction wells, located downgradient of the LIPA extraction wells, were designed to capture the leading edge of the OU III and OU I/IV VOC plumes and to prevent further migration of the plumes, which migrated south of the LIPA extraction wells and the North Street extraction wells before the system began operations. There are six Airport extraction wells. Currently three of the extraction wells are in full-time operation (RTW-1A, RTW-4A, and RW-6A), and three are being maintained in standby mode (RTW-2A, RTW-3A, and RTW-5A). Extraction wells RTW-1A and RW-6A capture the OU III VOC plume south of the LIPA Treatment System and extraction well RTW-4A captures the VOC plume south of the North Street Treatment System. The Airport System has a total VOC capture goal of 10 µg/L (Figure 3.2.8-1 [BNL 2025]).

Review of LIPA/Airport Treatment System

The capture goals for the LIPA extraction wells have been achieved and as a result, this portion of the system was approved for closure in December 2024. Groundwater contaminant concentrations in this area are below the total VOC capture goal of 10 µg/L. Based on review of the monitoring results, the cleanup goal of meeting MCLs for individual VOCs is expected to be achieved by 2030 by means of monitored natural attenuation.

Further downgradient and approaching the Airport extraction wells, total VOC concentrations are higher. On the OU III side (western side) of the Airport extraction wells, monitoring well 800-94 had a maximum total VOC concentration of 43 µg/L in December 2024 and monitoring well 800-95 had a maximum concentration of 20 µg/L in May 2024. Both monitoring wells have had persistently elevated total VOC concentrations, although concentrations are trending down in recent years (Figure 3.2.8-6 [BNL 2025]). These wells are approximately 1,500 ft north of Airport extraction wells RTW-1A and RW-6A.

On the OU I/IV side (eastern side) of the Airport Treatment System, monitoring well 800-101 is located directly upgradient of extraction well RTW-4A. The most recent total VOC concentration in monitoring well

800-101 was 46 µg/L in December 2024. VOC concentrations have been steadily increasing at this well for the past 15 years (Figure 3.2.8-6 [BNL 2025]). However, data from side- and upgradient wells have decreased to below detection limits and VOC concentrations in monitoring well 800-101 are expected to decline as clean groundwater is drawn toward extraction well RTW-4A.

Recommendations for LIPA/Airport Treatment System

Currently, it is prudent to continue operation of the Airport extraction wells because total VOC concentrations have been persistently above the 10 µg/L total VOC capture goal in upgradient monitoring wells. On the OU I/IV side (eastern side), VOC concentrations in monitoring well 800-101 are the sole controlling factor to the continued operation of extraction well RTW-4A. As discussed above, while the VOC concentrations in monitoring well 800-101 have slowly and steadily increased, it is expected that the concentrations will start to decline based on the data of the other monitoring wells. However, the monitoring wells are spaced quite far from one another in this area, so it is difficult to predict how quickly the VOC concentrations will decline. On the OU III side (western side) of the Airport Treatment System, monitoring well data indicate that the system will not achieve cleanup goals by 2030. Monitoring wells 800-94 (47 µg/L in December 2025) and 800-95 (15 µg/L in December 2025) are approximately 1,500 ft upgradient of the extraction wells and without additional extraction well(s), it will take significant time for the VOCs currently detected in these monitoring wells to reach the extraction wells. The pump and treat technology remains the best option for this area as it is successfully meeting the ROD goal of preventing further migration of the contaminants and serves as the final barrier to migration of the OU III VOC groundwater plume. The pump and treat technology is also the best option in this area where site access makes it difficult to evaluate and implement other possibilities.

Continued active remediation of groundwater is required. A cleanup timeframe is difficult to estimate because of the large spacing between the monitoring wells. Given access constraints for the installation of additional monitoring wells, continued monitoring of the existing monitoring well network is required until the anticipated decline in VOC concentrations will verify the position of the trailing edge of the plume.

OU III VOCs – Western South Boundary Treatment System

Introduction

The Western South Boundary System was designed to capture VOCs in the Upper Glacial aquifer. The capture goal for this system is 20 µg/L total VOCs. The system was designed to prevent the continued off-site migration of VOCs, and reduce potential impacts from potential VOC discharges into the Carmans River. The system began operating in September 2002. During 2019, four additional extraction wells were added to the system. The four new extraction wells are currently operating in a pulsed pumping mode.

Review of Western South Boundary Treatment System

During 2016-2018 characterization efforts to define the extent of a Freon-12 plume, a zone of high VOC concentrations was encountered at slightly greater depths than previously seen in the area (140 to 210 ft bgs). A total of 21 temporary vertical profile wells were installed to characterize these VOCs followed by the installation of 17 new monitoring wells for long-term surveillance. As a result of the characterization efforts, new extraction wells WSB-3, WSB-4, WSB-5, and WSB-6 were installed to address the deeper VOC contamination. The new extraction wells began operation in 2019.

Since the addition of the four new extraction wells, there has been a dramatic decrease in VOC concentrations and the areal extent of the plume, as depicted on Figures 3.2.4-3 and 3.2.4-8 (BNL 2025). Monitoring wells 103-15 and 126-14 deserve special mention as they were specifically discussed in the previous technical assessment (Arcadis 2020).

Monitoring well 103-15: The increase in VOC concentrations from 2019 through 2022 was likely due to the operation of newly installed extraction well WSB-3 as the groundwater plume shifted due to its operation. As the system has stabilized, the VOC concentrations have declined in 2023 and 2024 (Figure 3.2.4-3 [BNL 2025]).

Monitoring well 126-14: The well was identified as a potential issue in the previous assessment due to the increasing VOC concentrations. However, operation of the new extraction wells has dramatically reduced the VOC concentrations at this location to below the cleanup goal of MCLs for the individual VOCs (Figure 3.2.4-3 [BNL 2025]).

Recommendations for the Western South Boundary Treatment System

Currently, total VOC concentrations throughout the Western South Boundary plume are below the capture goal of 20 µg/L total VOCs. As stated in the *2024 Groundwater Status Report* (BNL 2025), it is recommended that a petition for shutdown be submitted for this system. The current monitoring program should continue to track the residual VOC concentrations, and to confirm whether the cleanup goal of MCLs for individual VOCs by the 2030 goal will be achieved by monitored natural attenuation.

OU III EDB – North Street East Treatment System

Introduction

The original North Street East VOC Groundwater Treatment System operated from 2004 to 2014 to capture and control the downgradient portion of the OU I VOC plume, which migrated beyond the BNL site boundary. The original treatment system (which includes extraction wells NSE-1 and NSE-2) met its goals and was placed in standby mode in 2014. There has been no significant rebound identified since that time. Following the detection of a previously undetected EDB plume in this area, in September 2019 a modification to the North Street East Groundwater Treatment System was submitted to the regulators to treat the EDB. This included the addition of two new extraction wells (NSE-EDB-EW-3 and NSE-EDB-EW-4). The North Street East EDB system became operational in July 2020.

Review of North Street East EDB Treatment System

The North Street East EDB Treatment System has addressed the EDB plume in this area (Figure 3.2.7-3 [BNL 2025]). The extraction wells operated on a fulltime basis until May 2024 when the system began pulsed pumping operations. In 2024, the EDB concentrations in each of the 12 monitoring wells were below the 0.05 µg/L cleanup goal (Figures 3.2.7-1 and Figure 3.2.7-7 BNL 2025).

Recommendations for the North Street East EDB Treatment System

As stated in the *2024 Groundwater Status Report* (BNL 2025), it is recommended to prepare a petition for shutdown. Pulsed pumping of extraction wells NSE-EDB-EW-3 and NSE-EDB-EW-4 should continue until a petition for shutdown is approved by the regulators.

OUIII Strontium 90 – BGRR/WCF Treatment System

Introduction

The BGRR/WCF Treatment System addresses the Sr-90 plumes originating from these facilities. A total of nine extraction wells are used to control the downgradient migration of the plumes. Groundwater from the extraction wells is treated by ion exchange. The goal is to achieve the cleanup goal of 8 pCi/L by 2070. There are three primary areas of elevated Sr-90 in groundwater: one extending south from the former WCF area, a second extending south from the BGRR (Building 701)/Below Ground Ducts and former Canal House, and a third that originates from the former Pile Fan Sump (PFS)/Building 801 Area (Figure 3.2.11-1 [BNL 2025]).

Review of Strontium 90 Treatment System

Figure 3.2.11-10 (BNL 2025) shows the significant reduction in areal extent and contaminant concentrations from 2004 until 2024. There are two extraction wells (SR-1 and SR-2) located south of the former WCF, three extraction wells (SR-3, SR-4, and SR-5) located south of the former BGRR, and four extraction wells (SR-6, SR-7, SR-8, and SR-9) in the vicinity of the High Flux Beam Reactor. In recent years, extraction wells SR-4 through SR-9 have been in standby mode. Extraction well SR-3, downgradient of the Building 701 area, controls the source mass from the BGRR plume and is only operated when Sr-90 concentrations in a source area monitoring well are elevated due usually to a significant seasonal rise in the water table (discussed further below). Extraction wells SR-1 and SR-2, downgradient of the WCF source area, operate on a continuous basis. Sr-90 migrates within the aquifer in this area at the rate of approximately 20 to 40 ft per year and the half-life of Sr-90 is approximately 29 years (BNL 2025).

WCF Plume: The removal of Building 811 and associated radiologically contaminated structures and soils was completed in 2016. Extraction wells SR-1 and SR-2 have been effective at capturing source area contamination and preventing its southward migration (Figure 3.2.11-1 [BNL 2025]).

The maximum Sr-90 detection in source area monitoring well 065-175 in 2024 was 79 pCi/L. Based on current groundwater monitoring data, it appears that there continues to be residual Sr-90 in the source area soils although the current concentrations observed in groundwater are well below historic high values.

BGRR (Building 701 Area) Plume: The source area is capped by Building 701 and an engineered cap that extends to the south of the building. The effectiveness of the caps is evaluated using monitoring well 075-701, which is screened at the surface of the water table and located immediately downgradient of the cap and upgradient of extraction well SR-3 (Figure 3.2.11-2 [BNL 2025]). Contaminant concentrations at this monitoring well have fluctuated significantly in the last 10 years, ranging from below the 8 pCi/L cleanup goal to concentrations as high as 1,000 pCi/L.

As discussed in the previous technical assessment (Arcadis 2020), the increases in Sr-90 concentrations (Figure 3.2.11-6 [BNL 2025]) in extraction well SR-3 during 2018-2019 appear to have been caused by the water table elevation increase which resulted in the flushing of residual Sr-90 contaminant mass in the deep vadose zone beneath the Building 701 area. This phenomenon repeated itself in 2024, although not to the extent of 2018-2019, with an elevated water table that caused an increase in Sr-90 concentrations at monitoring well 075-701 (up to 115 pCi/L in August). However, the Sr-90 concentrations quickly declined as the water table dropped (Figure 3.2.11-6 [BNL 2025]).

Extraction well SR-3 has been utilized historically to address observed Sr-90 concentration increases in monitoring well 075-701. In October 2024, extraction well SR-3 was turned on due to an observed increase in Sr-90 concentrations related to the elevated water table. Contaminant concentrations downgradient of extraction well SR-3 are relatively low and continue to decrease indicating that contaminant concentrations are not migrating beyond SR-3 near the source area and downgradient concentrations are declining (Figure 3.2.11-10 [BNL 2025]).

PFS/Building 801 Area Plume: This area is partially capped by Building 801 and surrounding paved areas. This plume is not being actively remediated. As recommended in the *2022 Groundwater Status Report* (BNL 2023a), two temporary vertical profile wells were installed south of Building 725 to obtain data to characterize the leading edge of the Building 801/PFS plume and determine the appropriate depth to screen new sentinel monitoring well 085-415 (Figure 3.2.11-1 [BNL 2025]). In 2024, Sr-90 concentrations in well 085-415 were approximately 3 pCi/L in both samples. During 2024, the maximum Sr-90 concentration in the source area monitoring wells was 104 pCi/L in monitoring well 065-170 (Figure 3.2.11-5 [BNL 2025]).

Recommendations for the Strontium 90 Treatment System

WCF Plume: The source area remediation work and continued operation of extraction wells SR-1 and SR-2 has effectively controlled contaminant migration. As stated in the *2024 Groundwater Status Report* (BNL 2025), it is recommended to shut down extraction well SR-2 due to continuously low concentrations of Sr-90. The extraction well should be restarted if Sr-90 concentrations increase significantly after shutdown. Extraction well SR-1 should continue to be operated full time, as it is effectively controlling plume migration in the source area. Sr-90 concentrations continue to decline and are expected to achieve the cleanup goal in the expected timeframe. Other than the planned shutdown of SR-2, no other changes need to be made to existing operation of the groundwater remediation system at this time.

BGRR (Building 701 Area) Plume: The primary remaining issue for the BGRR Plume is the apparent seasonal fluctuation in source area Sr-90 concentrations observed in monitoring well 075-701. This apparently occurs when the water table reaches a relatively high elevation (approximately 44 ft above mean sea level), which flushes out residual Sr-90 from the deep portions of the vadose zone soils. Extraction well SR-3 needs to be maintained in standby mode and operated when necessary to provide control for the source area when the water table is elevated for as long as these fluctuations are observed or until a source area cleanup is implemented. Contaminant concentrations downgradient of extraction well SR-3 are on track to achieve cleanup goals in the expected timeframe.

The amount of source area mass in the vadose zone is unknown. BNL's need to maintain Building 701 and the surrounding cap structures and the significant thickness of the vadose zone (approximately 65 ft bgs) make addressing the issue of direct remediation of residual Sr-90 contamination complicated and, basically, impractical. A review of other Sr-90 source areas in the United States (such as at Hanford, Washington) have seen the effective use of apatite injections below the water table to stabilize Sr-90 contamination. While the use of apatite at the BGRR Plume source area may be effective at controlling the dissolved mass temporarily, until the Sr-90 contamination in the vadose zone soils below Building 701 is dealt with, such a solution would only be temporary and unlikely to be more effective than the current approach. It is recommended that the current approach be continued and reassessed if decisions regarding source area remediation are made or groundwater monitoring indicates the source has been reduced to acceptable levels.

PFS/Building 801 Area Plume: This plume is not being actively remediated and should continue to be monitored. This plume is expected to attenuate before the 2070 goal by means of monitored natural attenuation.

OU VI EDB Treatment System

Introduction

The OU VI EDB Treatment System addresses an EDB plume currently located off-site from south of North Street, southward for approximately 2,500 ft. During the 1970s, EDB was used as a fumigant for the BNL Biology Department's biology fields located in the southeastern portion of the site (Figure 3.4-1 [BNL 2025]). In the mid-1990s, low levels of EDB were detected in groundwater near the fields. Higher levels were found at the southern site boundary and off-site to the south. EDB has not been detected on BNL property since 2009, and on-site monitoring was discontinued in 2016. A comparison of the migration of the EDB plume between 1999 and 2024 is shown on Figure 3.4-4 (BNL 2025). The groundwater remediation system to address the off-site EDB plume began operations in August 2004 and consisted of two extraction wells.

Review of OU VI EDB Treatment System

The EDB Treatment System was recently modified with the addition of two new extraction wells. In 2020 and 2021, additional groundwater characterization efforts determined that the EDB plume is deeper in the Upper Glacial aquifer than originally understood. During the characterization effort, it was determined that the Gardiners Clay unit was not present south of monitoring well 000-209 and that a local silt and clay

layer was present in the deep Upper Glacial aquifer south of monitoring well 000-284 (Figure 3.4-2 [BNL 2025]). This information meant the original extraction wells were too shallow to effectively capture the deeper portions of the EDB plume.

In December 2023, the system was shut down while two new extraction wells (EW-3E and EW-4E) were installed at greater depths than the two original wells to better capture the deeper portions of the EDB plume (Figure 3.4-2 [BNL 2025]). The two new extraction wells began operation in early 2024. The previous extraction wells were placed in standby mode and will continue to be monitored to ensure there is no continued EDB migration at this depth interval. The initial operation of extraction wells EW-3E and EW-4E captured much higher concentrations than had been observed from extraction wells EW-1E and EW-2E, as shown on Figure 3.4-5 (BNL 2025).

In June 2024, a one-week aquifer pumping test was performed to evaluate the capture zone of the new extraction wells. The pumping test report (J.R. Holzmacher P.E., LLC 2024) concluded that; *“The projected capture zone includes the entire horizontal width and vertical thickness of the plume having EDB concentrations above 0.05 parts per billion within the Upper Glacial aquifer.”*

Recommendations for the OU VI EDB Treatment System

Since the last technical assessment in 2020 (Arcadis 2020), the groundwater investigation and modifications to the EDB Treatment System have greatly increased the effectiveness and protectiveness of the remediation system. However, groundwater monitoring results indicate that EDB concentrations greater than the cleanup goal of 0.05 µg/L remain as far as 1,000 ft upgradient of the extraction wells (e.g., monitoring well 000-283). Without additional upgradient extraction wells to reduce the distance the trailing edge of the EDB plume has to migrate, it is unlikely that the cleanup goals will be achieved by the 2030 goal. However, the current remedy is meeting the intent of the ROD and in particular, the new extraction wells are preventing further migration. The need for additional optimization of the existing system (i.e., additional extraction wells) could be evaluated with modeling as the system is not expected to meet the cleanup goals by 2030 in its current configuration. However, there are accessibility limitations which may make further optimization of this system or options to alter it difficult or cost prohibitive.

Because of the changes made to the remediation system with the installation of two new deeper extraction wells and the data collected during the June 2024 aquifer pumping test, it is recommended that the groundwater model for this area be updated to better understand the cleanup timeframe of the current system and to evaluate whether an additional extraction well or wells could be used to accelerate cleanup timeframe and to what degree.

OU X TCRA PFAS

At BNL, per- and poly fluoroalkyl substances (PFAS) have impacted groundwater quality in areas where aqueous film forming foam (AFFF) was used for firefighter training and fire suppression systems, the landfilling of PFAS-containing wastes, and discharges of PFAS contaminated water to the sanitary system.

Since 2017, BNL has been investigating the impact that PFAS are having on groundwater quality at the laboratory and in nearby off-site areas. The results of the investigations conducted from 2017 through

early 2021 were summarized in the 2018 through 2021 Groundwater Status Reports (BNL 2019, BNL 2020, BNL 2021b, and BNL 2022). Results for characterization efforts conducted during 2020 through 2022 were also presented in the *Phase 4 Characterization Report* (BNL 2021c) and the *TCRA Characterization Report* (BNL 2023b). Data collected during 2024 are summarized in Sections 3.5.1, 3.5.2, and 3.5.3 of the *2024 Groundwater Status Report* (BNL 2025). To establish the appropriate CERCLA regulatory framework for future remedial actions for PFAS and 1,4-dioxane (an emerging contaminant of concern which had been used as a chemical stabilizer for 1,1,1-Trichlorethane), new Areas of Concern (AOCs) 33 and 34 were established in 2021. Due to the high levels of PFAS contamination present in the groundwater downgradient of the Current Firehouse (AOC 33D), the Former Firehouse (AOC 33E), and at the former AFFF training area near Building 170 (AOC 33J), BNL installed two groundwater remediation systems as a Time Critical Removal Action (TCRA). The Current Firehouse Building 170 Treatment System began operations in October 2022. The Former Firehouse Treatment System began operation in January 2023. PFAS contaminated water from both systems is treated using granular activated carbon (GAC).

Current Firehouse/Building 170

Introduction

The Current Firehouse Treatment System was installed as a TCRA to address PFAS-contaminated groundwater associated with the Current Firehouse and Building 170 firefighting training areas (sub-AOC 33D and sub-AOC 33J, respectively) (Figure 3.5.1-1 [BNL 2025]).

The Current Firehouse PFAS groundwater remediation system began operations in October 2022. PFAS-contaminated water is withdrawn from the aquifer using nine extraction wells.

Review of Current Firehouse/Building 170

The full extent of the Current Firehouse and Building 170 PFAS plume segments are still in the process of being defined. The plume from its early definition in 2020 and 2021 to the current data set in 2024 is depicted on Figure 3.5.1-4 (BNL 2025). As depicted, the source areas have been better defined but the full downgradient extent of the groundwater plume remains incomplete until the OU X RI/FS is conducted.

The two pressing issues for the Current Firehouse/Building 170 are source area control, downgradient definition and, subsequently, the protection of receptors. The nine extraction wells (CF-RW-A through CF-RW-E for Current Firehouse and CF-RW-F through CF-RW-I for Building 170) were focused on controlling the highest PFAS concentrations (with a goal of capturing groundwater with PFOS and/or PFOA concentrations greater than 100 ng/L) and preventing further downgradient migration.

Analysis of temporary Geoprobe/Vertical Profiling monitoring datasets indicate that the current extraction system is not effectively controlling portions of the plume that shifted to the east following initial plume characterization and treatment system design. This shift has caused portions of the plumes to migrate outside of the effective capture zones for several extraction wells. The shift appears to be the result of recent changes to pumping and recharge (i.e., changes to pumping rates for BNL water supply wells 6

and 7, and the distribution of treated groundwater to recharge basins) in the western portion of the BNL site.

Current Firehouse: Further investigation is warranted to determine the effectiveness of source area extraction well CF-RW-A. Monitoring wells, 073-31, and 073-33 which are immediately downgradient of this extraction well exhibit increasing PFAS concentrations after an initial decline, suggesting incomplete capture or rebound effects due to aquifer heterogeneity and potential contaminant mobilization or desorption (Figure 3.5.1-3 [BNL 2025]). These monitoring wells are screened slightly shallower than CF-RW-A.

Monitoring results from temporary profile wells installed in 2024 indicate that the centerline of the Current Firehouse plume appears to have shifted slightly east of extraction wells CF-RW-E and CF-RW-H. Further evaluation is needed to determine whether modifications to the existing wells or the installation of additional extraction wells are needed to ensure capture of the plume.

Building 170: Extraction CF-RW-I was installed close to the water table along the center line of the Building 170 plume segment. As a result reduced pumpage of BNL supply wells 6 and 7, the centerline of the Building 170 plume has shifted to the east and is now positioned near extraction well CF-RW-F, which was screened deeper to capture a segment of the Current Firehouse plume which is deeper than the Building 170 plume in this area. As a result, the screen zone for CF-RW-F is too deep to effectively capture the Building 170 plume.

South of West Princeton Avenue: The continued characterization of the downgradient portions of the combined Current Firehouse and Building 170 plumes located south of West Princeton Avenue is being addressed (definition and receptor protection) through various investigation activities that have occurred during the past five years (Figure 3.5.1-4 [BNL 2025]) and documented in the *2024 Groundwater Status Report* (BNL 2025).

Recommendations for the Current Firehouse/Building 170

BNL is planning to conduct additional groundwater investigation using temporary wells to confirm conditions in the source areas, verify distribution of high concentrations, and confirm the eastern extent of PFAS concentrations. This additional information will provide updated information to address the eastward shift of the building 170 plume and the Current Firehouse plume. For the Building 170 plume, an evaluation is needed to determine whether a shallower extraction well should be installed near CF-RW-F and/or an extraction well closer to the Building 170 source area. Furthermore, for the Current Firehouse plume, an evaluation is needed to determine whether additional extraction wells are needed east of CF-RW-E and CF-RW-H. Additionally, in the source area of the Current Firehouse, the capture zone of extraction well CF-RW-A should be evaluated relative to the affected monitoring wells and to determine if these monitoring wells are located in a stagnation zone. An increase in the pumping rate for CF-RW-A may be beneficial in addressing the concentrations observed in the downgradient monitoring wells. This well has been operated at around 50 gpm and it is recommended that the flow rate be increased to at least 100 gpm.

Because of the dynamic nature of groundwater flow in vicinity of these source areas, including the impact on the hydraulic capture performance resulting from changes to supply well pumping and the distribution of treated water to recharge basins, a groundwater flow model may not only be beneficial to evaluate

remedy performance and quantify changes in plume migration resulting from ongoing groundwater extraction activities, but also with the management of supply well production and the discharge/distribution of treated groundwater to recharge basins. When operational changes are made related to supply wells or the distribution of treated groundwater to recharge basins, the model could be used to assess the impact of these changes on the hydraulic efficiency of the groundwater treatment system.

Long-term cleanup goals for PFAS will be defined at the conclusion of the OU X Remedial Investigation/Feasibility Study.

Former Firehouse

Introduction

The Former Firehouse Treatment System was installed as a TCRA to address PFAS-contaminated groundwater associated with the Former Firehouse firefighter training areas (sub-AOC 33E).

The Former Firehouse PFAS remediation system started operations in January 2023. PFAS-contaminated groundwater is withdrawn from the aquifer using three extraction wells FF-RW-A through FF-RW-C (Figure 3.5.2-1 [BNL 2025]).

Review of Former Firehouse

Although the downgradient extent of the Former Firehouse PFAS plume is still in the process of being defined, the plume immediately downgradient of the Former Firehouse source area is well defined and narrower. Compared to the Current Firehouse/Building 170 area, groundwater flow directions in the Former Firehouse area are relatively stable, and less impacted by on-site supply well pumpage and water recharge operations. The plume from its early definition in 2020 to the current data set in 2024 is depicted on Figure 3.5.2-4 (BNL 2025), which shows the source area has become more defined, and the extent of the plume is further downgradient than initially depicted due to more sampling being conducted in this area.

Based upon the groundwater monitoring data the groundwater plume is being captured by the three extraction wells spaced along the flow path (Figures 3.5.2-1 and 3.5.2-6 [BNL 2025]), and the system is meeting the goal of capturing groundwater with PFOS and/or PFOA concentrations greater than 100 ng/L.

Recommendations for the Former Firehouse

The three extraction wells (FF-RW-A through FF-RW-C) should continue to be operated full-time. Based upon the data, the Former Firehouse PFAS plume is behaving as expected and continued groundwater monitoring is recommended to confirm continued hydraulic capture of the plume. Long-term cleanup goals for PFAS will be defined at the conclusion of the OU X Remedial Investigation/Feasibility Study.

Ms. Julia Michaels
March 6, 2026

In closing, this letter report summarizes Arcadis' evaluation related to the selected groundwater treatment systems in support of the 2026 Five-Year Review. Please let us know if you have any questions or require additional information as you incorporate our evaluation into the technical assessment portion of the Five-Year Review.

Sincerely,

Arcadis of New York, Inc.



Eric Panhorst
Principal Scientist



William S. Wittek, PE
Principal Engineer
NYS PE License #080827

Email: 267.685.1825
Phone: eric.panhorst@arcadis.com



Art Zahradnik
Project Manager

Email: 631.391.5208
Phone: art.zahradnik@arcadis.com

CC. Brian Barth, BNL
Robert Porsche, Arcadis

Attachment:
Figures

References

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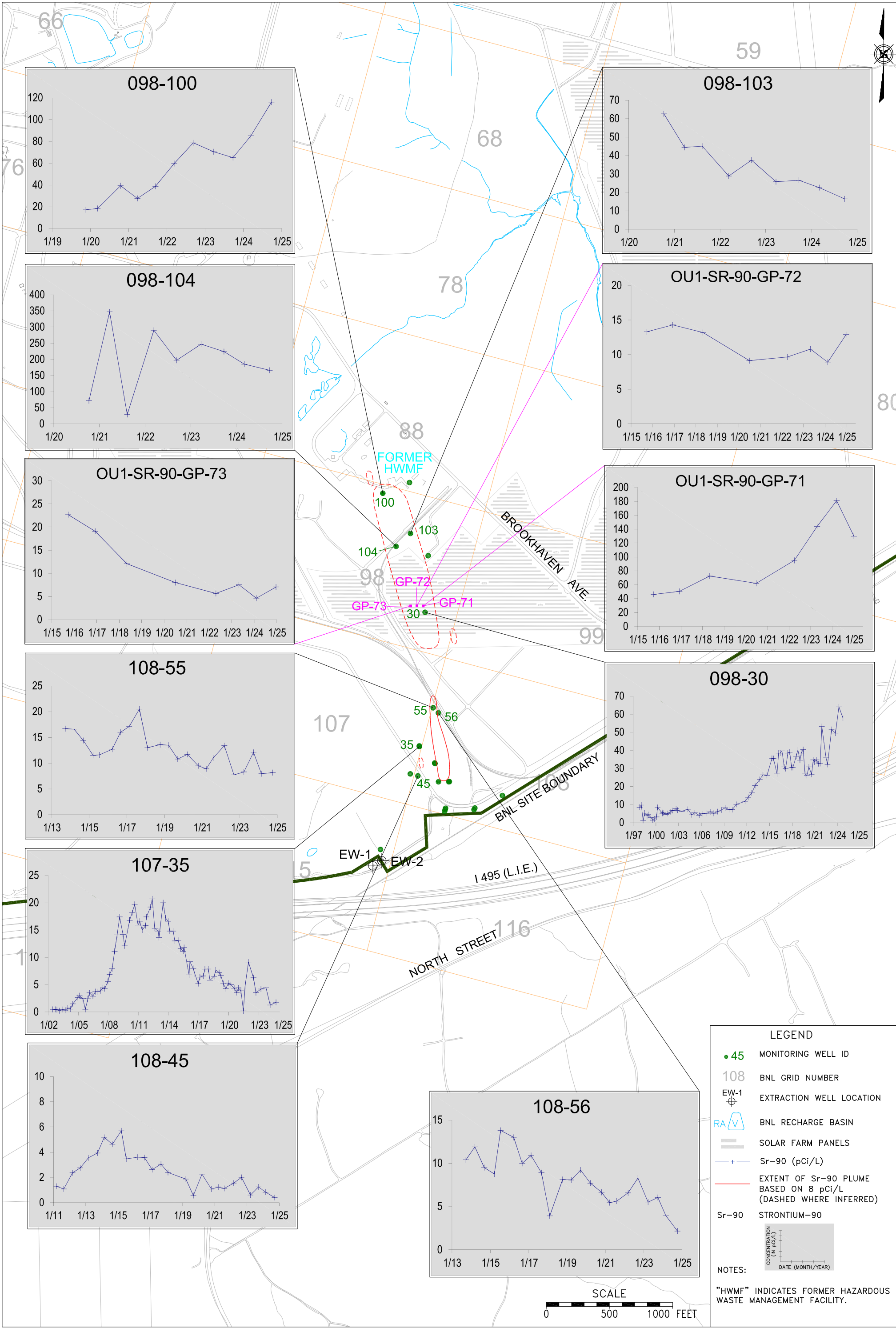
Ms. Julia Michaels
March 6, 2026

USEPA. 2016. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS). United States Environmental Protection Agency, Office of Water (4304T), Health and Ecological Criteria Division, Washington, DC.

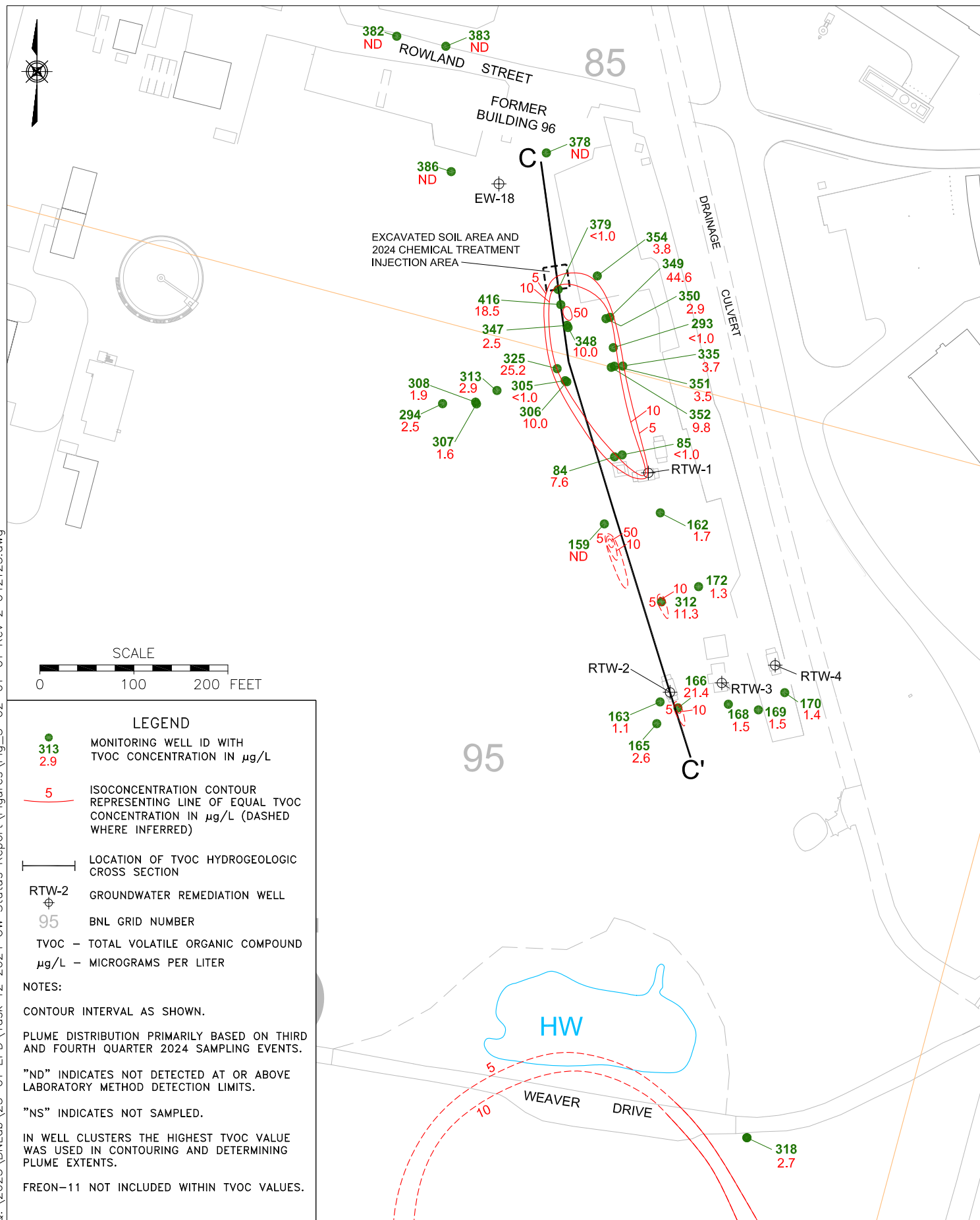
Figures

OU I Strontium-90 – Former HWMF

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OU III VOCs – Building 96 Treatment System



TITLE:

OU III BUILDING 96 AREA
TVOC PLUME DISTRIBUTION

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

VT:HZ.:

DATE:

03/06/25

PROJECT NO.:

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CHKD:

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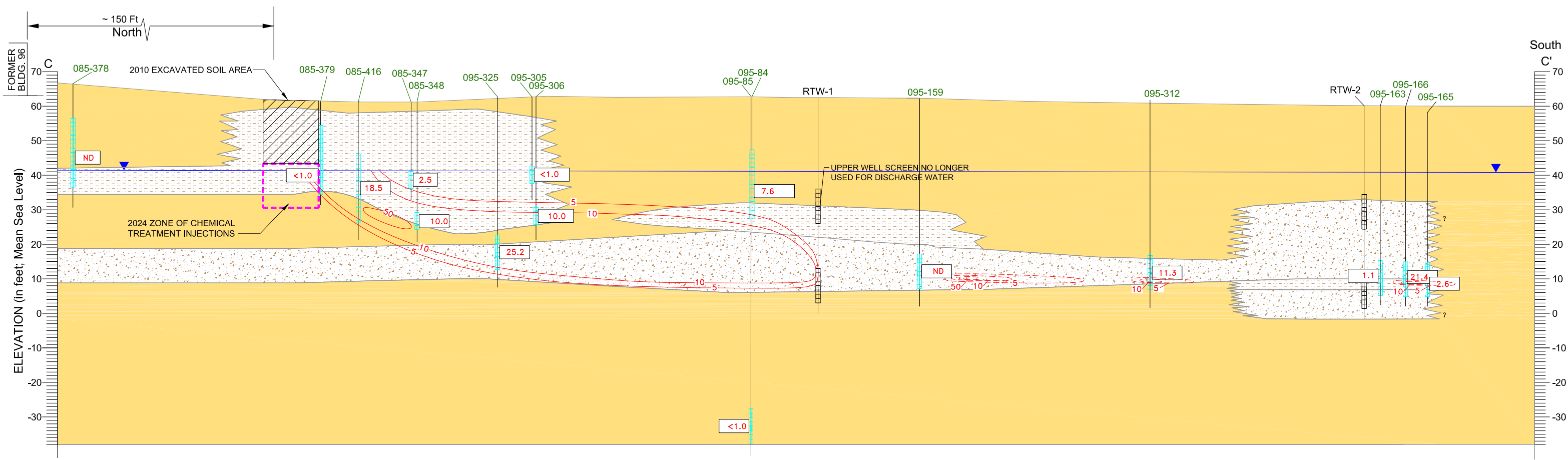
NOTES:

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FIGURE NO.:

3.2.1-1

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LEGEND

Upper Glacial aquifer

- Fine to coarse sand, trace to little silt and/or fine to medium gravel.
- Very fine sand and/or silt, with silt and sand lenses interbedded.
- Coarse to very coarse sand, with or without gravel or gravel with sand.

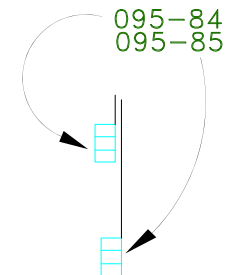
- 095-85 BNL Monitoring Well ID
- 10.2 TVOC Concentration ($\mu\text{g/L}$)
- NS Not Sampled
- 50 TVOC Contour ($\mu\text{g/L}$) (Dashed Where Inferred)

RTW-1 Recirculation Well

- Monitoring Well Screen
- Extraction Well Screen
- Water Table As Of Aug 12 - Aug 20, 2024

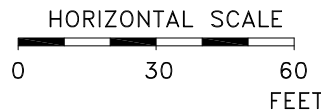
- TVOC - Total Volatile Organic Compound
- $\mu\text{g/L}$ - Micrograms Per Liter
- PCE - Tetrachloroethylene

Monitoring Well IDs are stacked in order of the depth of the well from shallow to deep



NOTES:

- GEOLOGIC INFORMATION SHOWN IS BASED ON GEOLOGIC DATA FROM 1999, SUPPLEMENTED WITH LITHOLOGIC DATA COLLECTED JUNE AND NOV. 2004.
- PLUME DISTRIBUTION BASED ON FOURTH QUARTER 2024 BLDG 96 SAMPLING EVENTS.
- CONTOUR INTERVAL IS AS SHOWN.
- BNL WELL ID COLOR CORRESPONDS TO LONG-TERM MONITORING PROGRAM WELL LOCATION MAP.



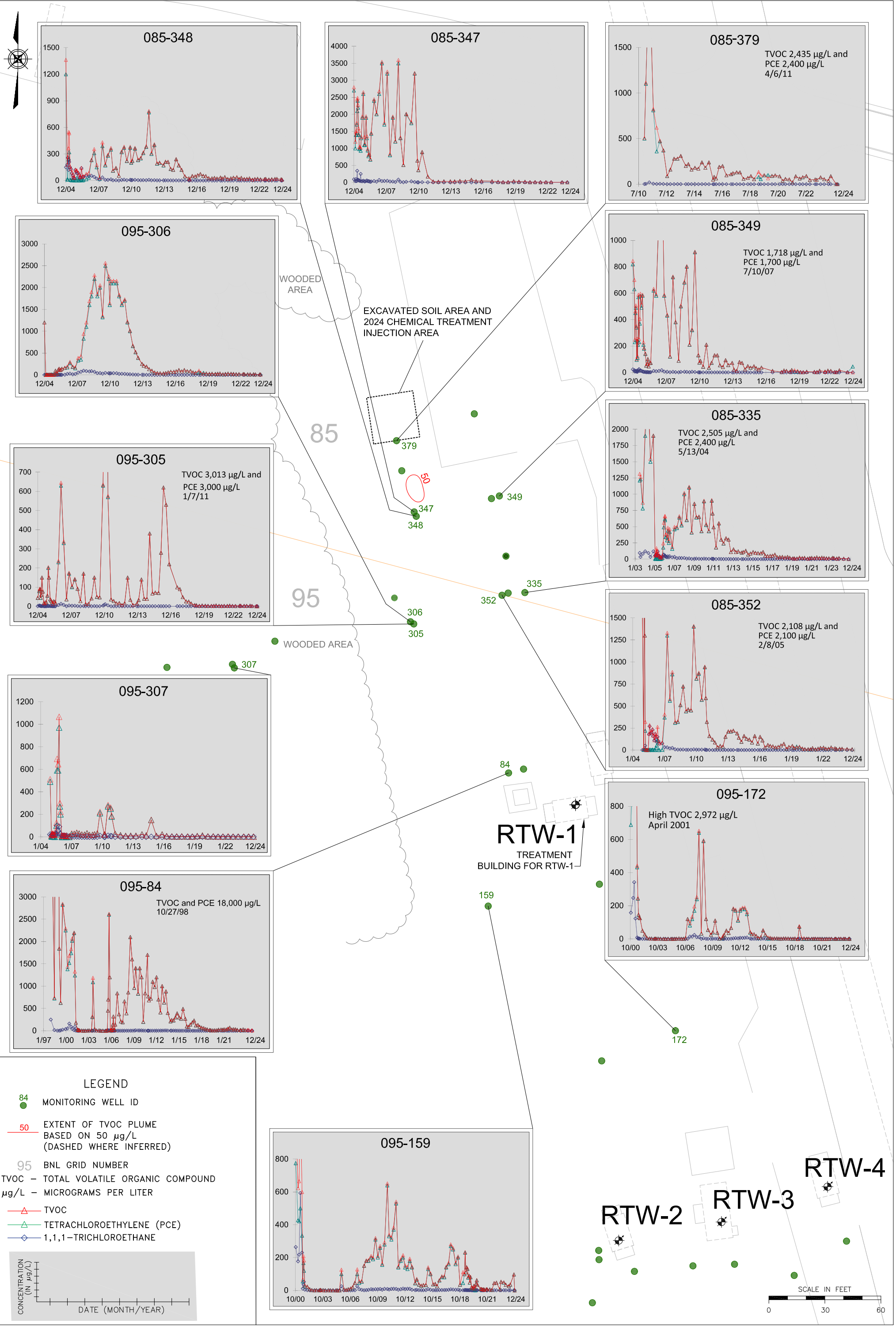
TITLE:

OU III BUILDING 96 AREA
TVOC HYDROGEOLOGIC CROSS SECTION (C-C')

2024 BNL GROUNDWATER STATUS REPORT

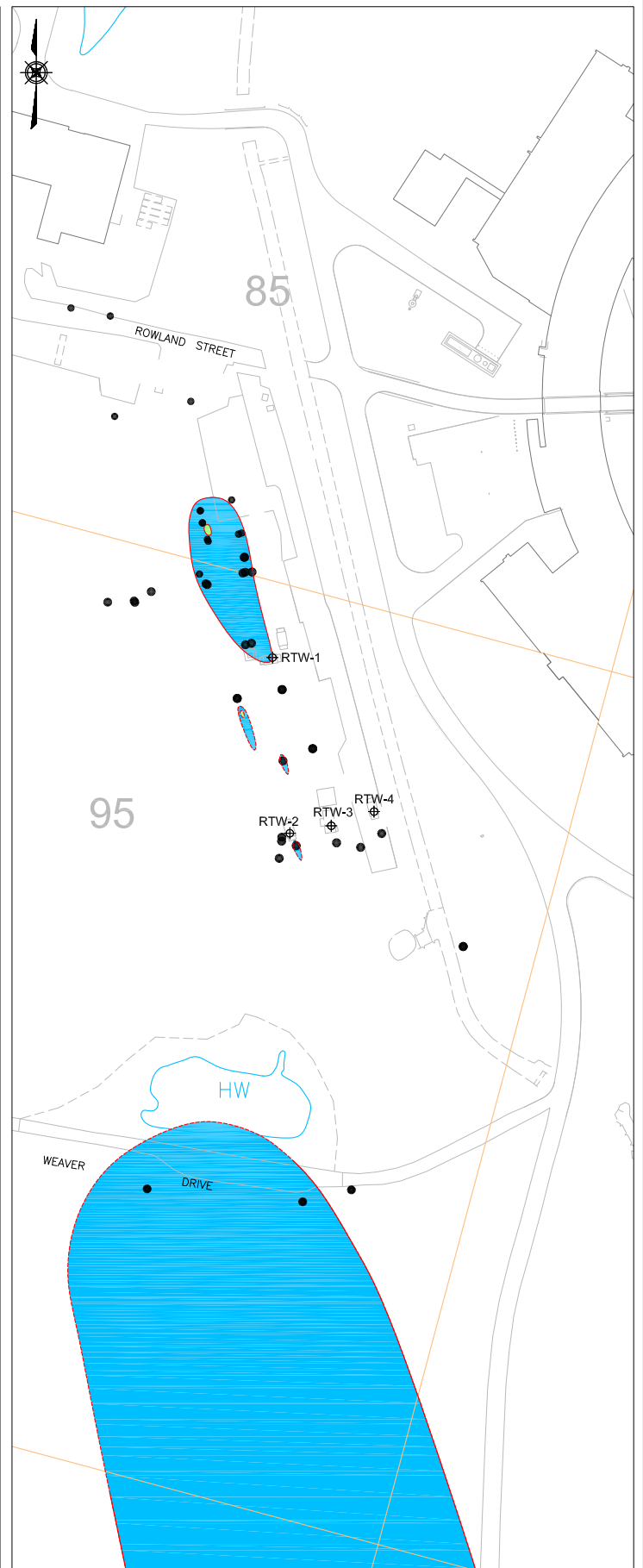
DWN: AJZ	VT:HZ.: 1.5:1	DATE: 03/06/25	PROJECT NO.: -
CHKD: BB	APPD: BB	REV.: 05/13/25	NOTES: -
FIGURE NO.:		3.2.1-2	

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2000 TVOC PLUME DISTRIBUTION

2024 TVOC PLUME DISTRIBUTION



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PROTECTION DIVISION

TITLE:

OU III BUILDING 96 AREA
TVOC PLUME COMPARISON
2000-2024

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

VT:HZ.:

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DATE:

03/10/25

PROJECT NO.:

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05/14/25

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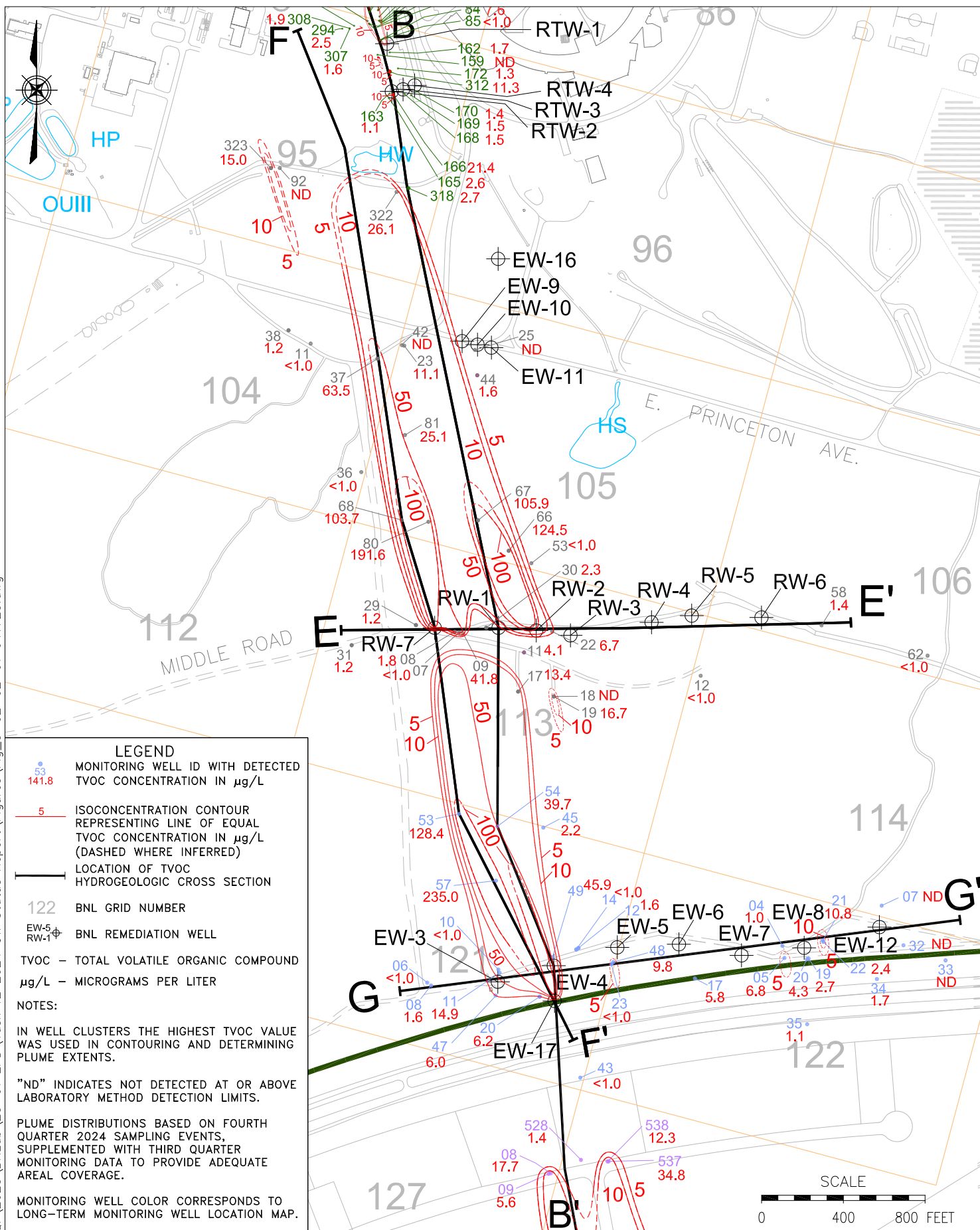
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FIGURE NO.:

3.2.1-6

OU III VOCs – Middle Road Treatment System

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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

OU III MIDDLE ROAD AREA,
TVOC PLUME DISTRIBUTION

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

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DATE:

03/11/25

PROJECT NO.:

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REV.:

04/17/25

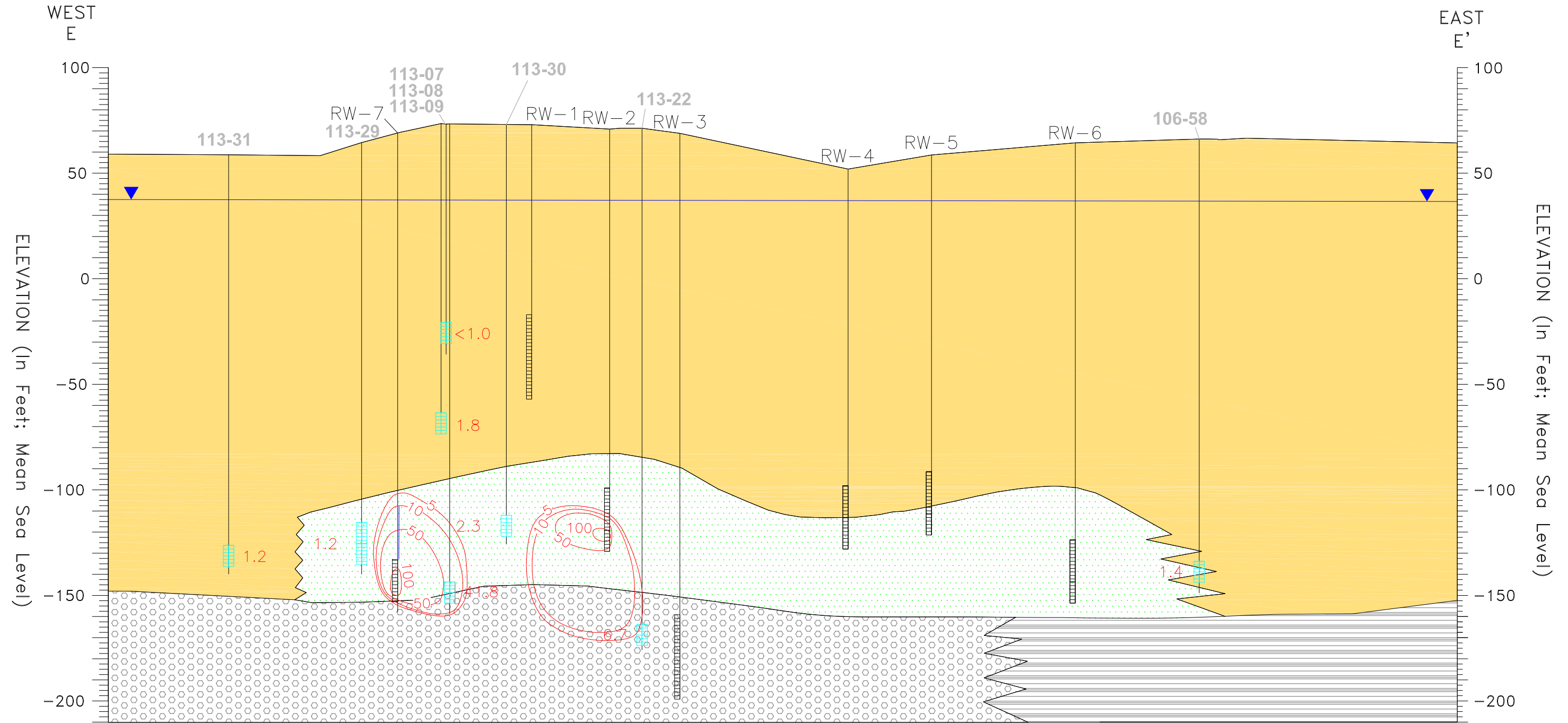
NOTES:

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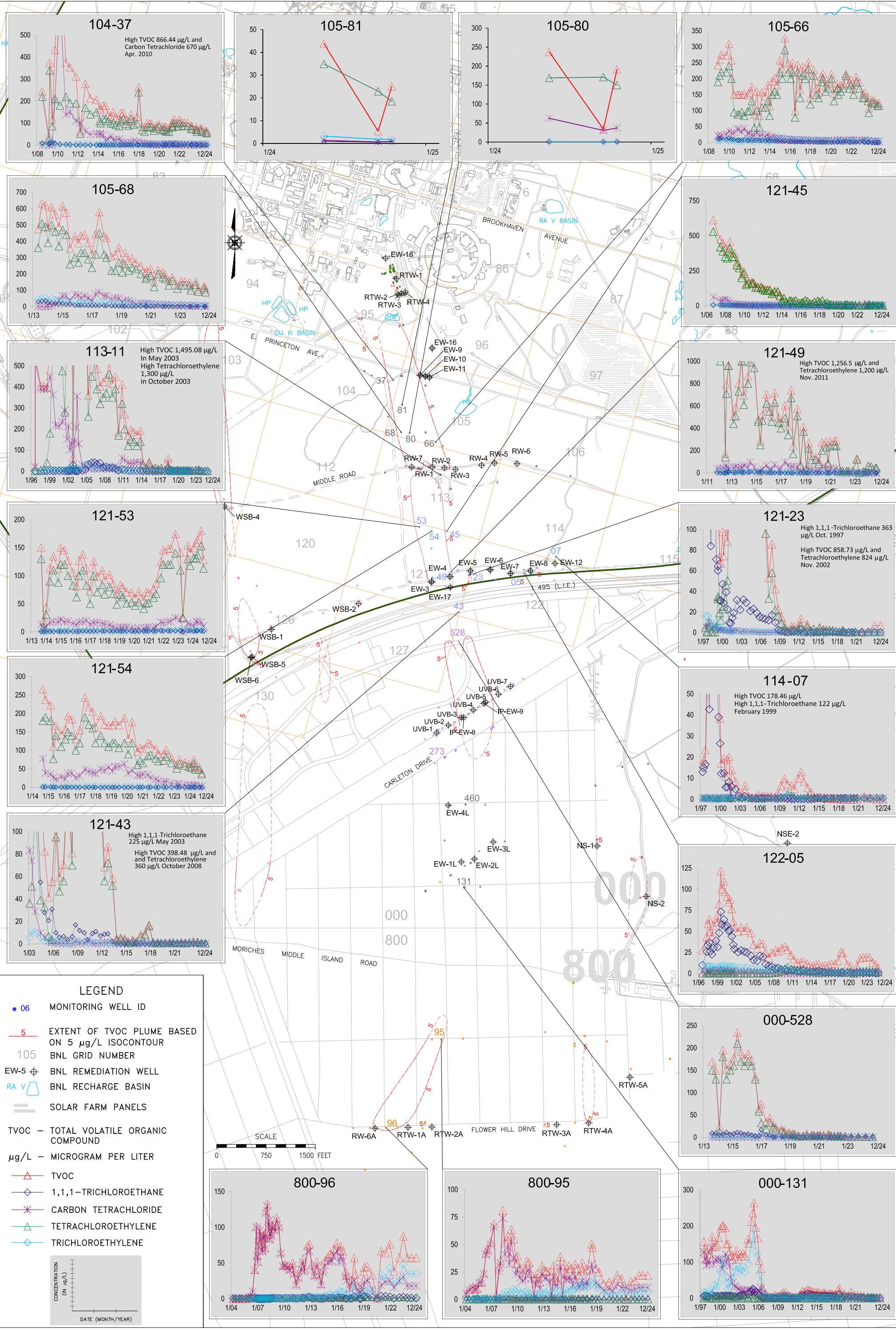
FIGURE NO.:

3.2.2-1

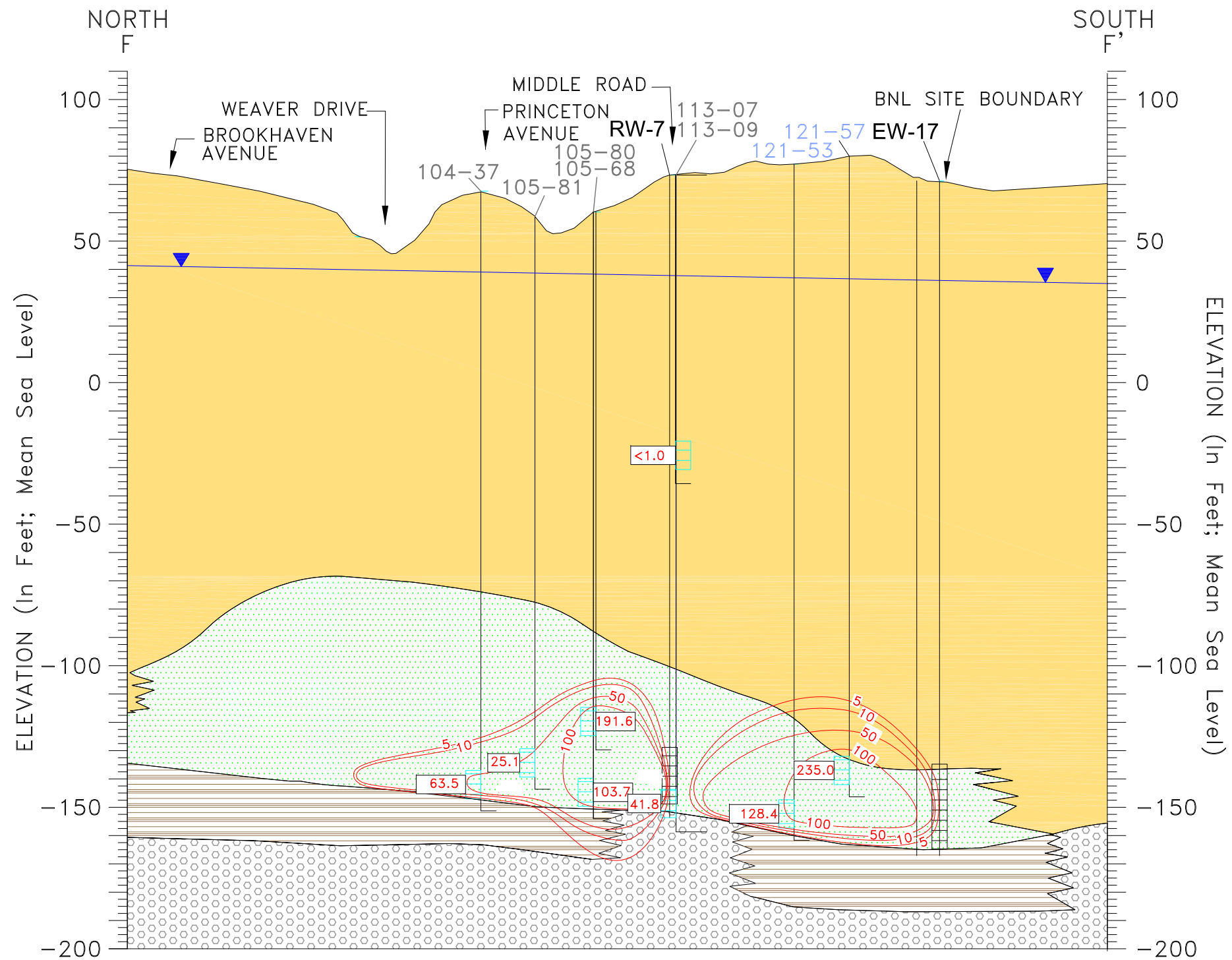
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LEGEND

Upper Glacial aquifer

- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit

Gardiners Clay

- GL Gardiners Clay
- GS Gardiners Clay - Silt

Magothy aquifer

- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undiff)
- MO Magothy - OTHER

121-53 BNL Well ID

- 1.84 TVOC Concentration (µg/L)
- ND Not detected at or above laboratory method detection limits
- NS Not Sampled
- 50 TVOC Contour (µg/L) (Dashed Where Inferred)
- Monitoring Well Screen
- Extraction Well Screen

Water Table As Of Aug 12 - Aug 20, 2024

- TVOC - Total Volatile Organic Compound
- µg/L - Micrograms Per Liter

HORIZONTAL SCALE
0 500 1000 FEET

NOTES:

- 1) GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, MORE DETAILED REPORTS, 2001 PREDESIGN CHARACTERIZATION, AND WELL 105-22 SAMPLING EVENT APRIL 2005.
- 2) PLUME DISTRIBUTION IS BASED ON FOURTH QUARTER 2024 OU III SAMPLING EVENT.
- 3) CONTOUR INTERVAL IS AS SHOWN.
- 4) BNL WELL ID COLOR CORRESPONDS TO LONG-TERM MONITORING WELL LOCATION MAP.

TITLE:

OU III MIDDLE ROAD AREA TVOC HYDROGEOLOGIC CROSS SECTION (F-F')

2024 BNL GROUNDWATER STATUS REPORT

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5:1

DATE:

03/06/25

PROJECT NO.:

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NOTES:

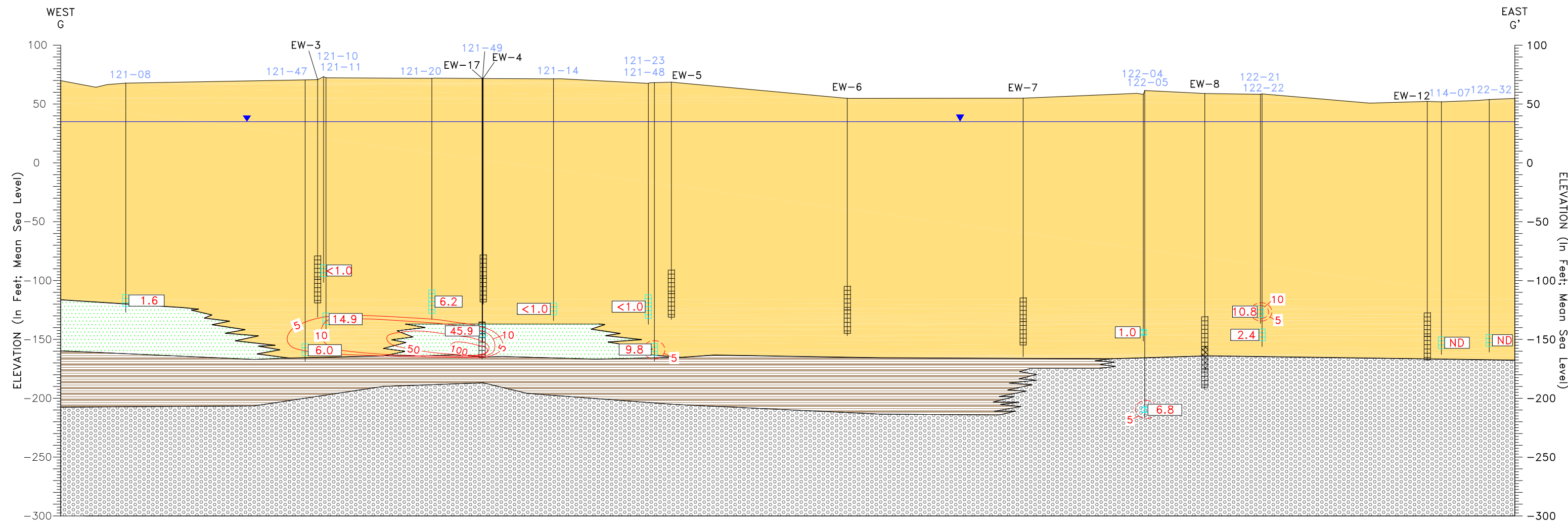
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FIGURE NO.:

3.2.2-4

OU III VOCs – South Boundary Treatment System

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LEGEND

Upper Glacial aquifer

- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit
- GL Gardiners Clay
- GS Gardiners Clay - Silt

Magothy aquifer

- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undiff)
- MO Magothy - OTHER

- BNL Well ID
- TVOC Concentration (µg/L)
- TVOC Contour (µg/L) (Dashed Where Inferred)
- Indicates not detected at or above laboratory method detection limits
- Monitoring Well Screen
- Extraction Well Screen

Monitoring Well IDs are stacked in order of the depth of the well from shallow to deep

Water Table As Of Aug 12 - Aug 20, 2024

TVOC - Total Volatile Organic Compound

µg/L - Micrograms Per Liter

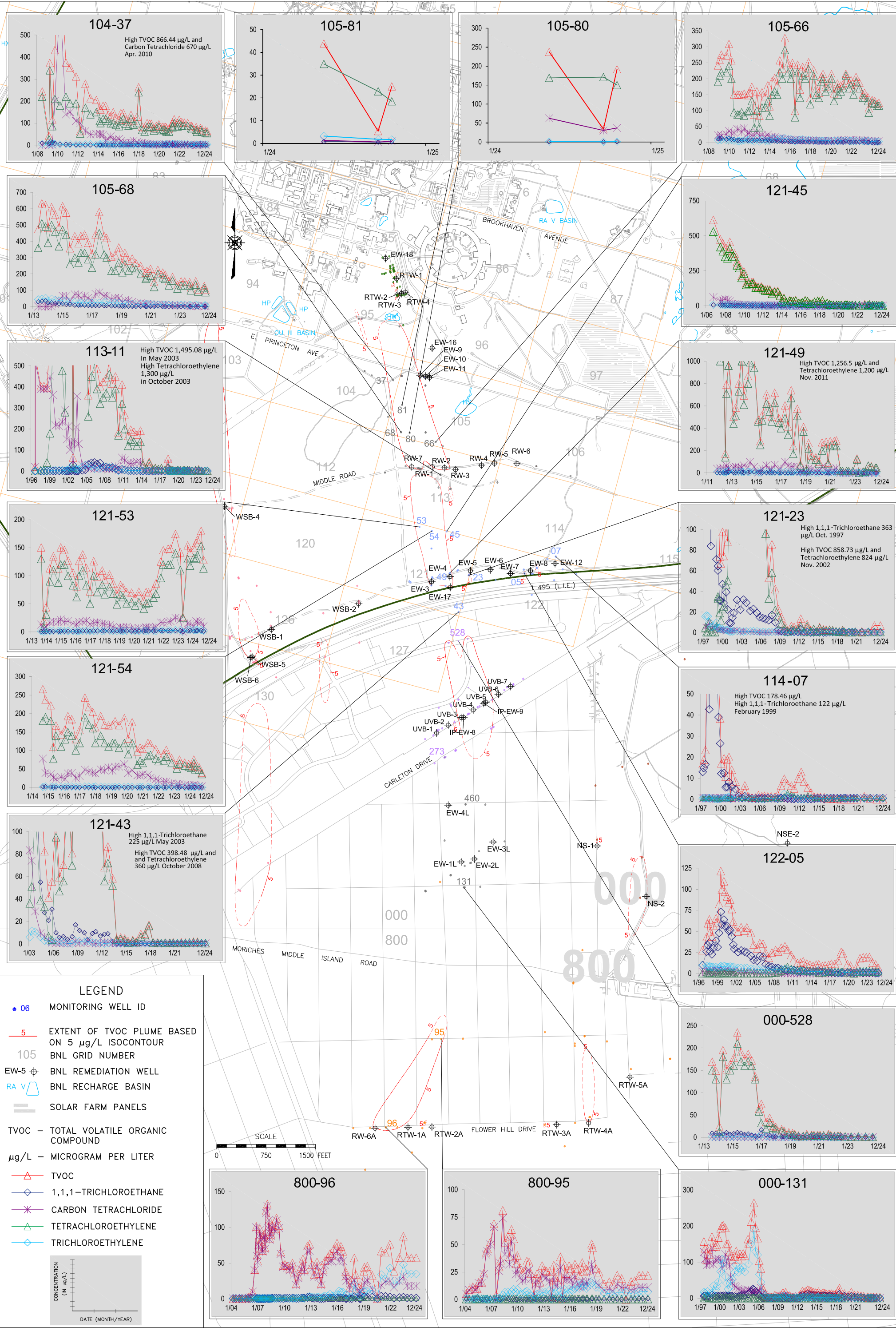
HORIZONTAL SCALE
0 50 100 FEET

NOTES:

- GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, MORE DETAILED REPORTS.
- PLUME DISTRIBUTION IS BASED ON FOURTH QUARTER 2024, SUPPLEMENTED BY THIRD QUARTER OU III SAMPLING EVENTS.
- CONTOUR INTERVAL IS AS SHOWN.
- BNL WELL ID COLOR CORRESPONDS TO LONG-TERM MONITORING PROGRAM COLOR CODE.

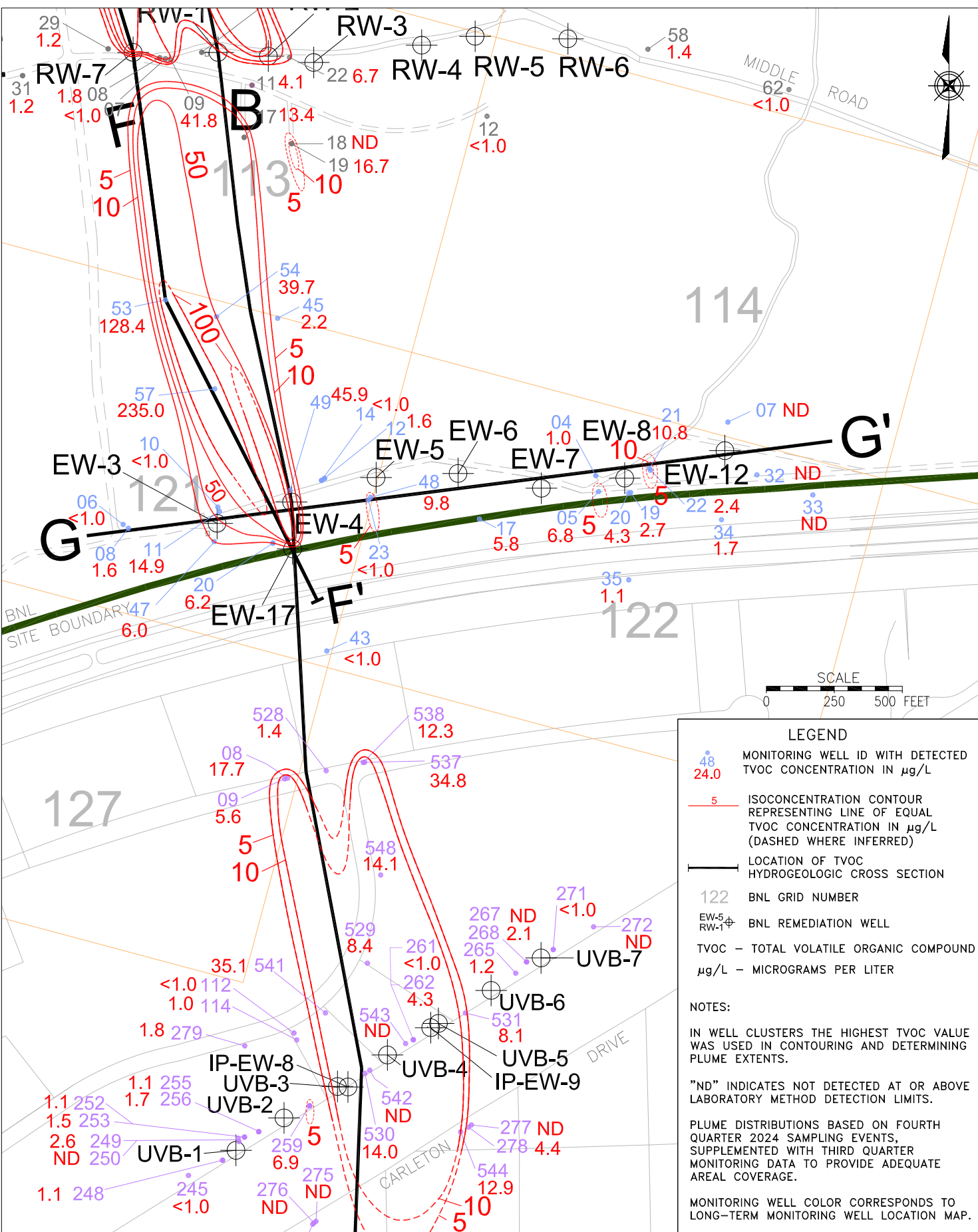
TITLE:

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OU III VOCs - Industrial Park Treatment System

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PROTECTION DIVISION

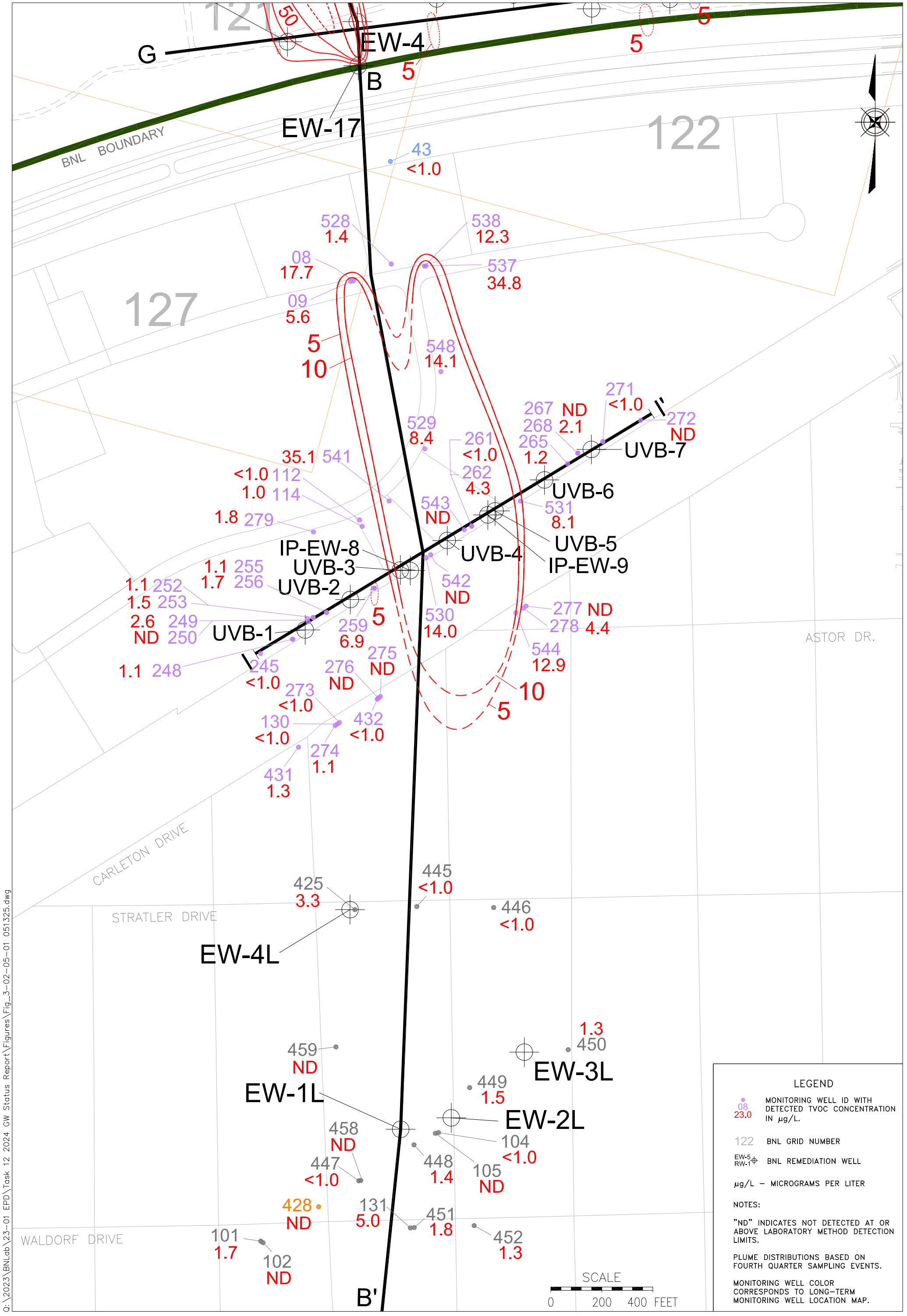
TITLE:
OU III AND OU IV SOUTH BOUNDARY/
INDUSTRIAL PARK AREAS,
TVOC PLUME DISTRIBUTION

2024 BNL GROUNDWATER STATUS REPORT

DWN:	VT.HZ.:	DATE:	PROJECT NO.:
AJZ	—	03/11/25	—
CHKD:	APPD:	REV.:	NOTES:
JM	BB	04/17/25	—

FIGURE NO.:
3.2.3-1

OU III VOCs – LIPA/Airport Treatment System



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LEGEND

08

23.0

MONITORING WELL ID WITH DETECTED TVOC CONCENTRATION IN µg/L.

122

BNL GRID NUMBER

EW-5

RW-1

BNL REMEDIATION WELL

µg/L

– MICROGRAMS PER LITER

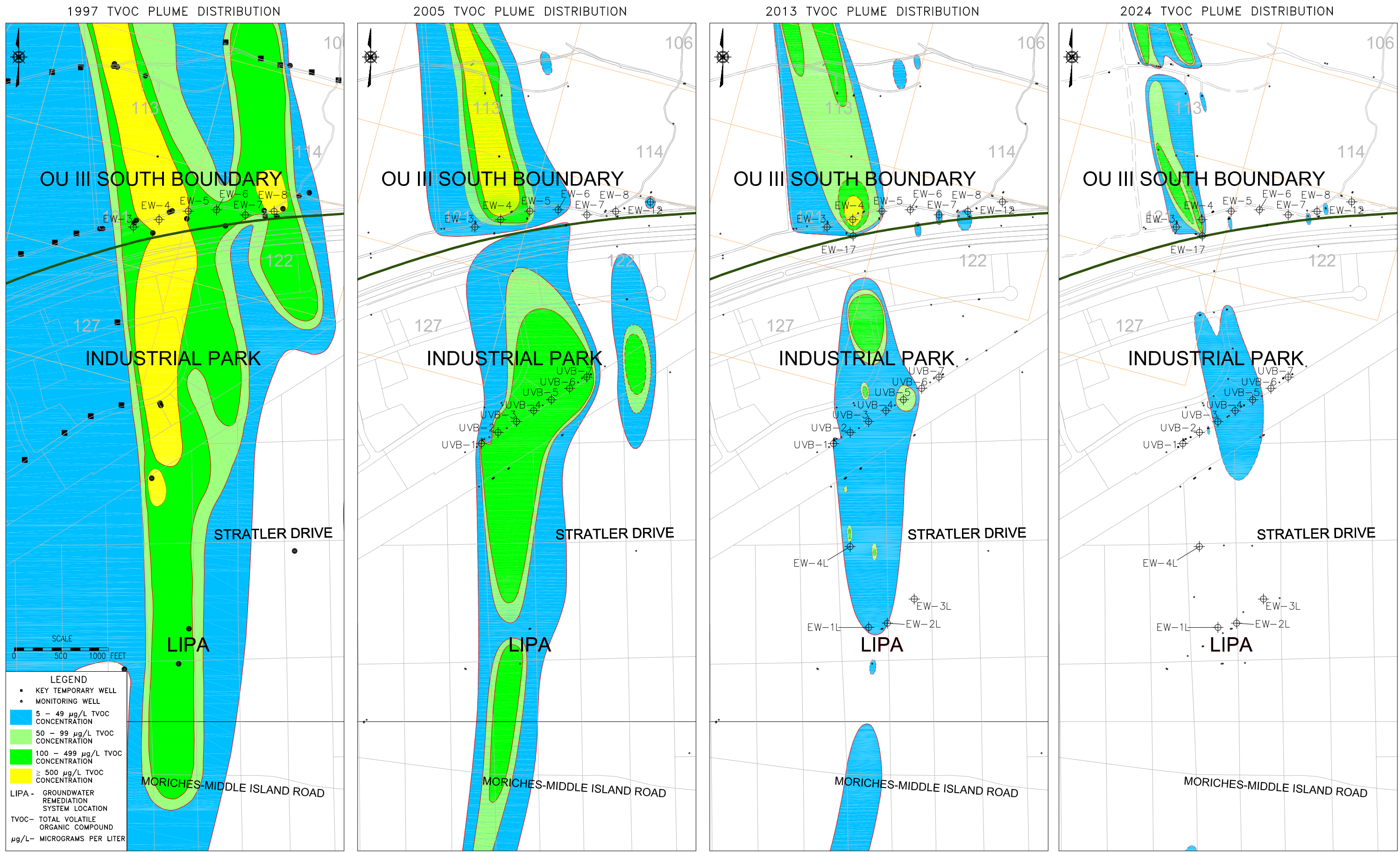
NOTES:

"ND" INDICATES NOT DETECTED AT OR ABOVE LABORATORY METHOD DETECTION LIMITS.

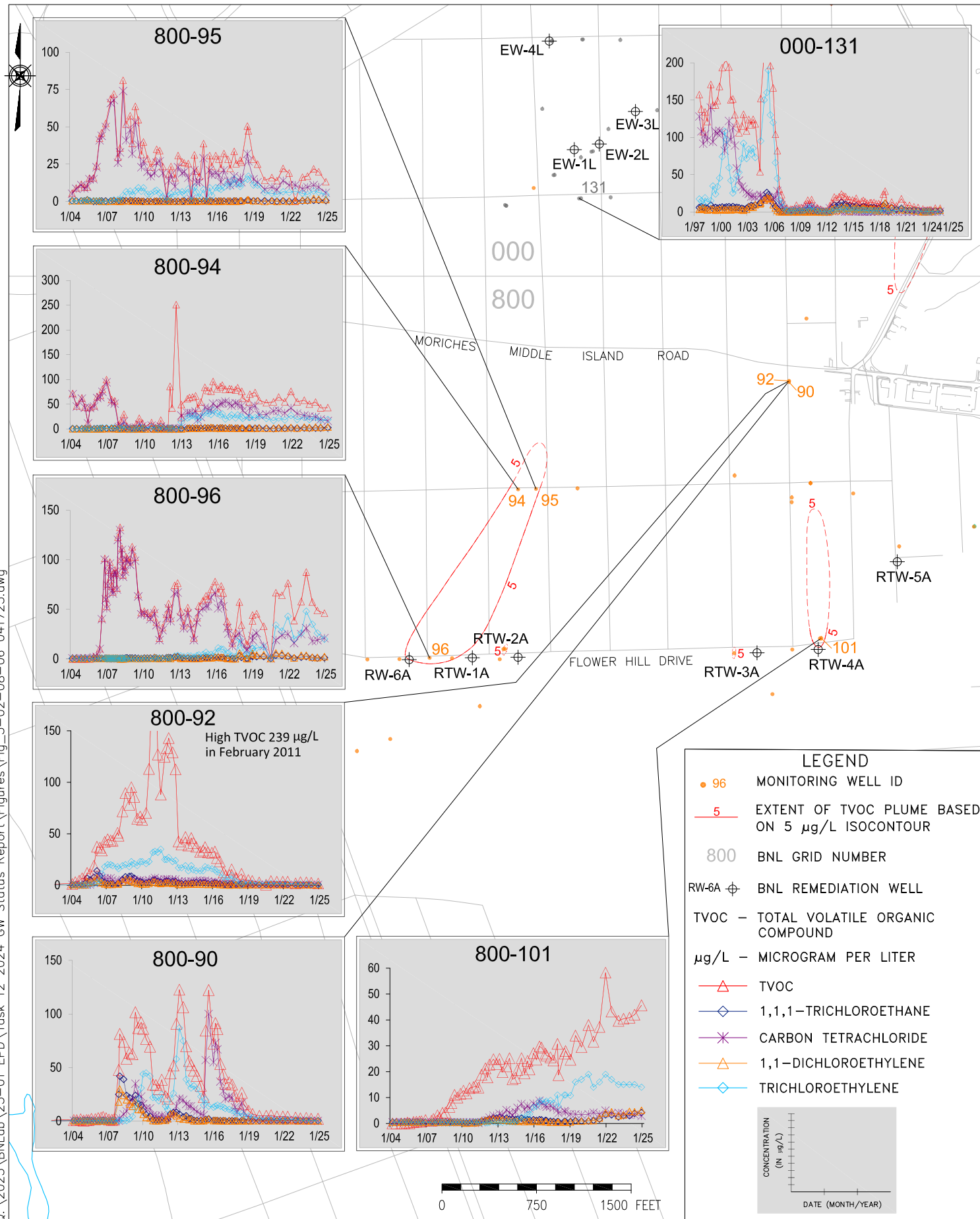
PLUME DISTRIBUTIONS BASED ON FOURTH QUARTER SAMPLING EVENTS.

MONITORING WELL COLOR CORRESPONDS TO LONG-TERM MONITORING WELL LOCATION MAP.

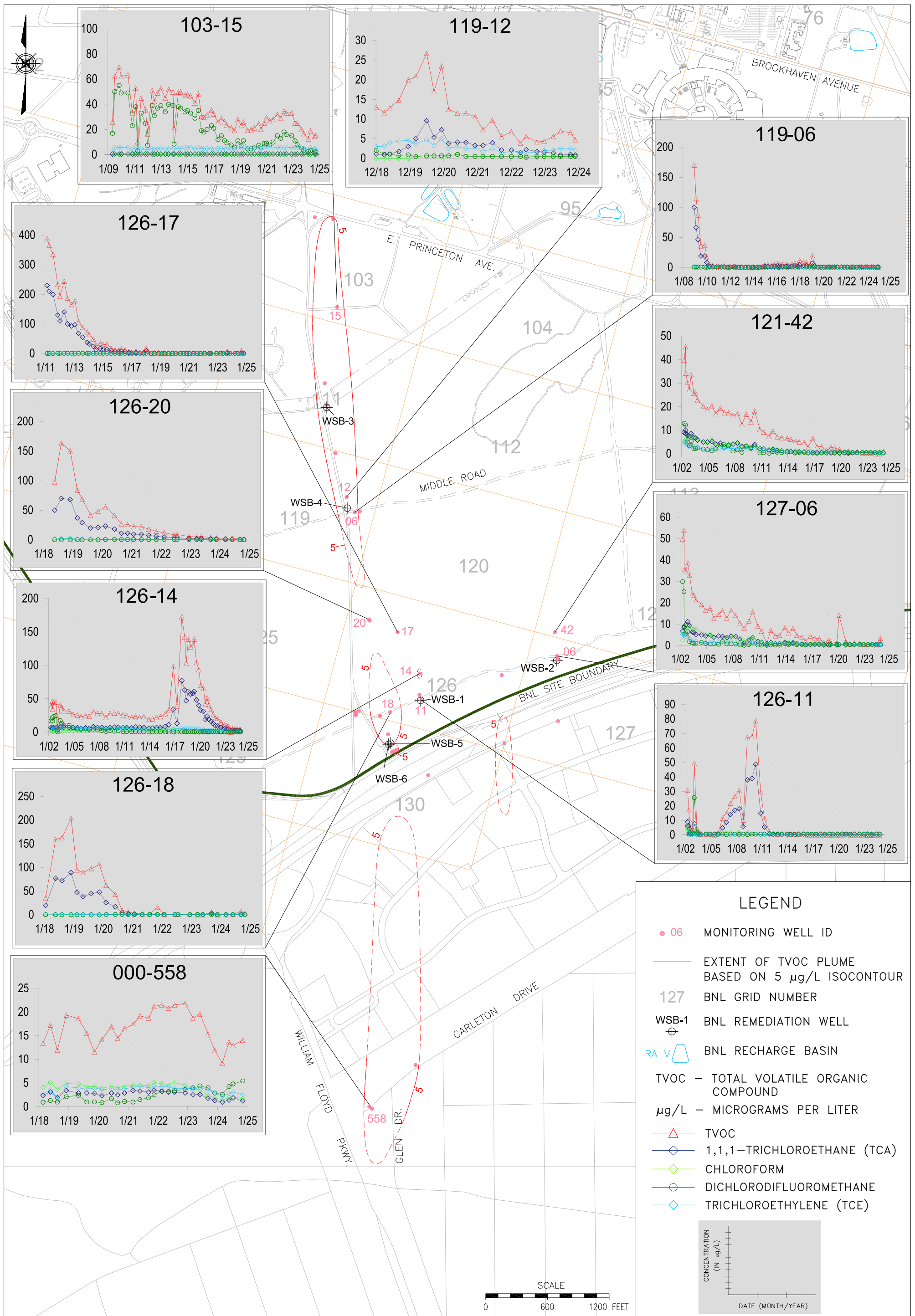
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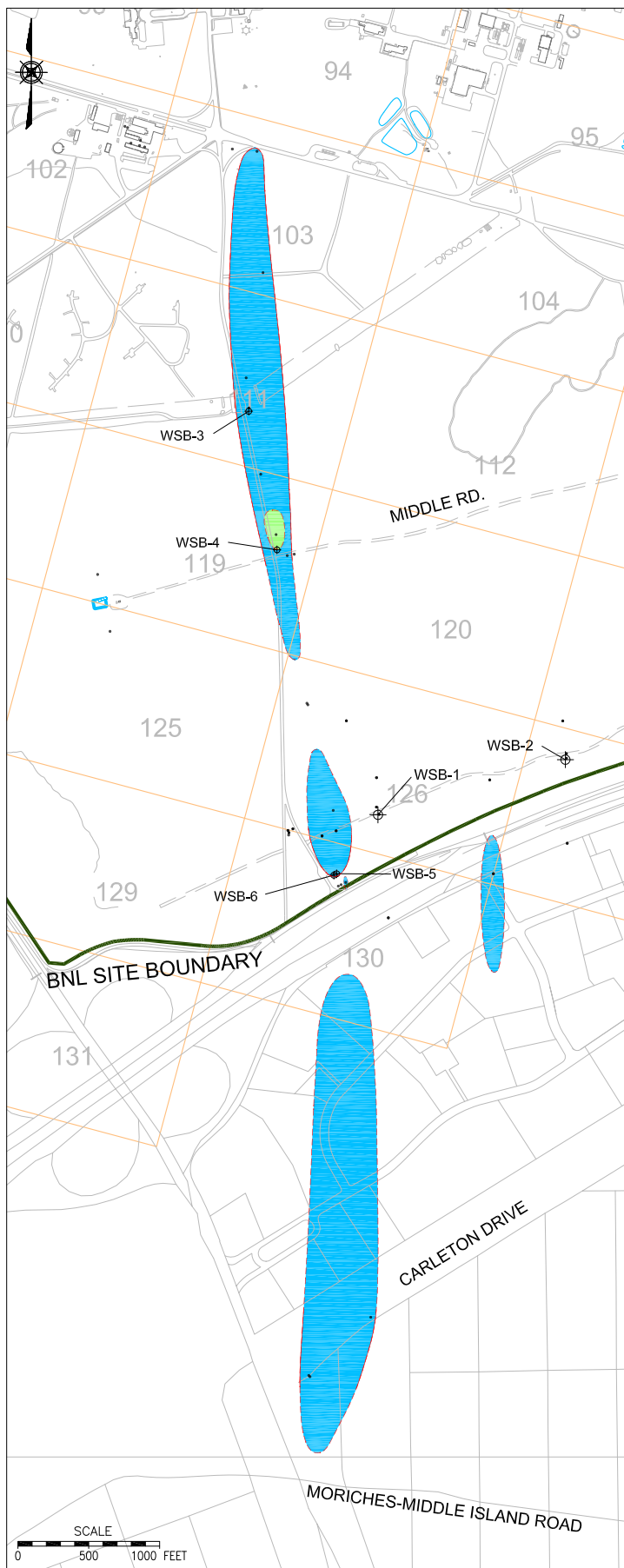
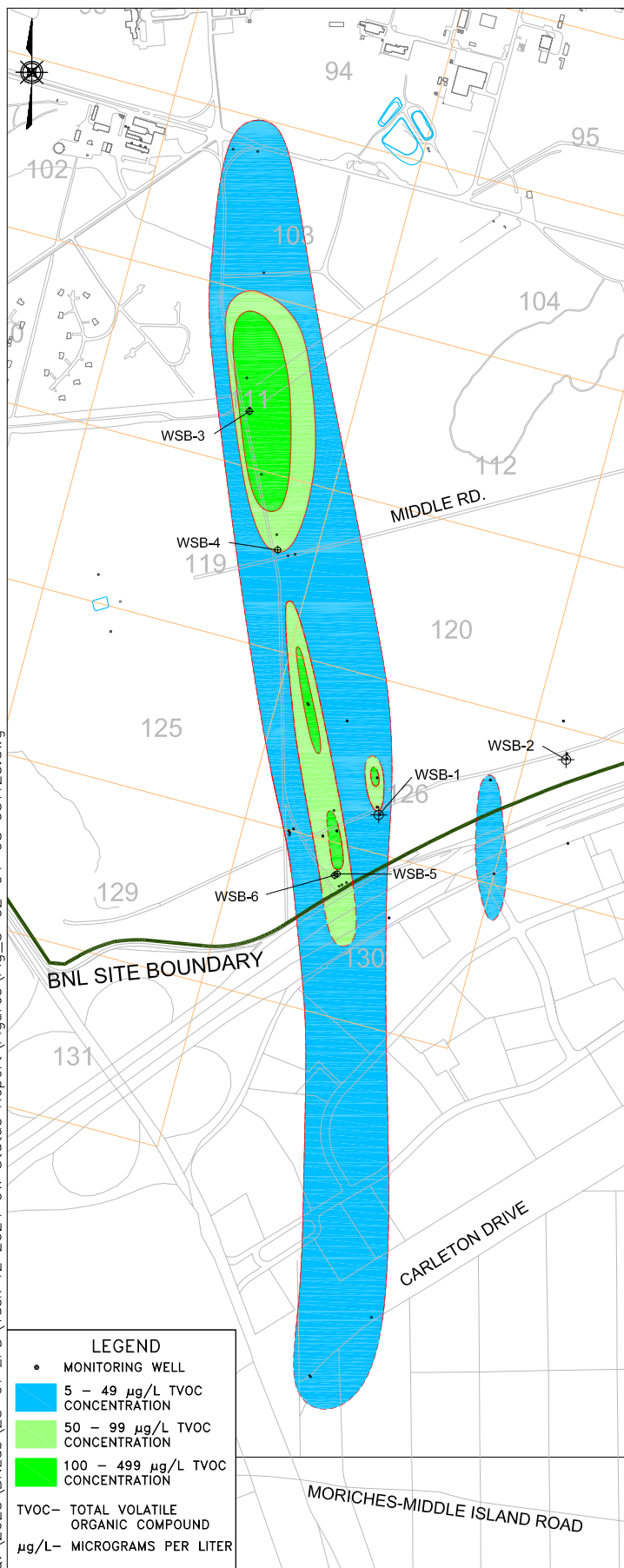


OU III VOCs – Western South Boundary Treatment System



2018 WSB TVOC PLUME DISTRIBUTION

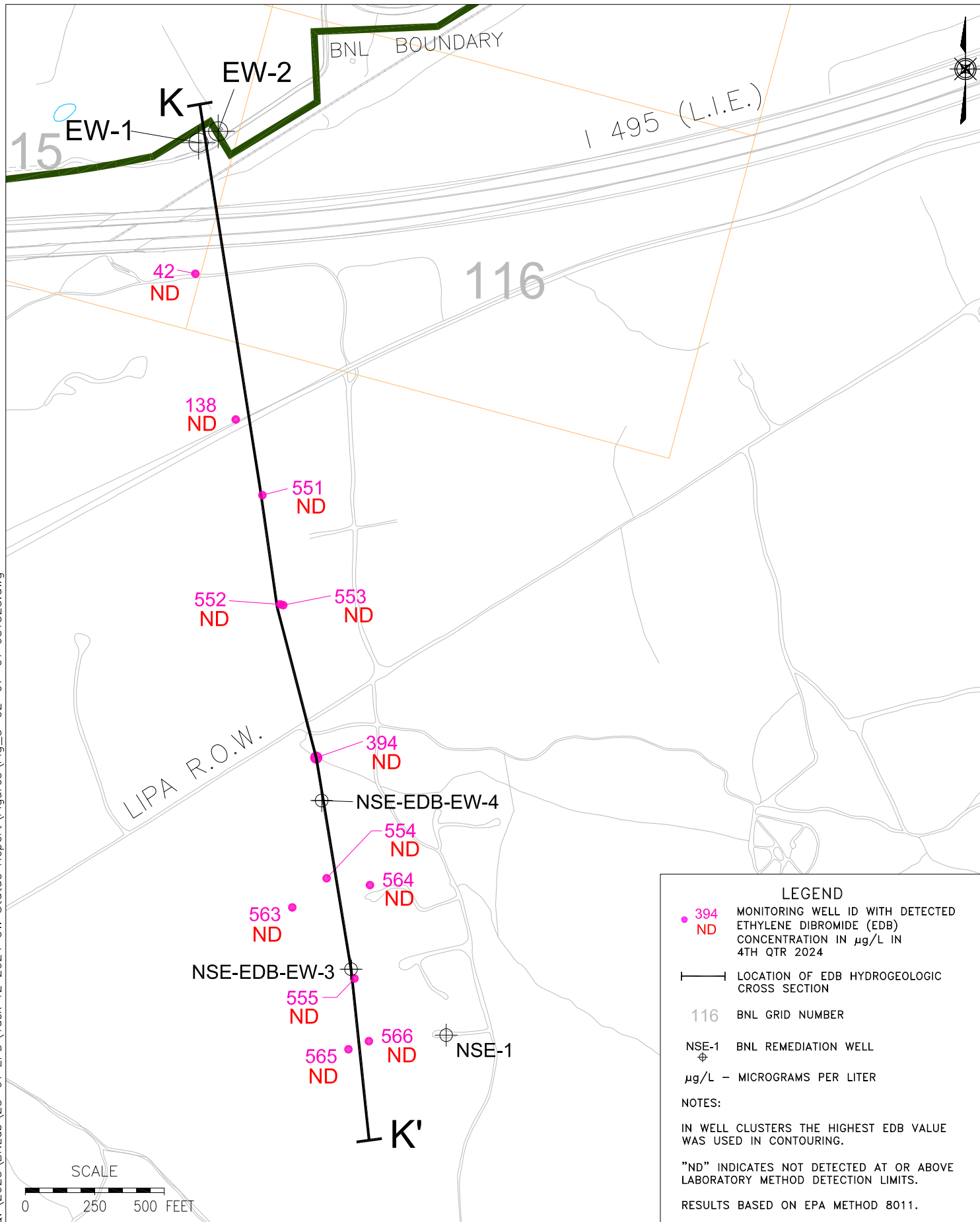
2024 WSB TVOC PLUME DISTRIBUTION



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OU III EDB – North Street East Treatment System

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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

OU III NORTH STREET EAST EDB PLUME DISTRIBUTION

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

VT:HZ.:

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DATE:

03/13/25

PROJECT NO.:

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CHKD:

VJR

APPD:

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REV.:

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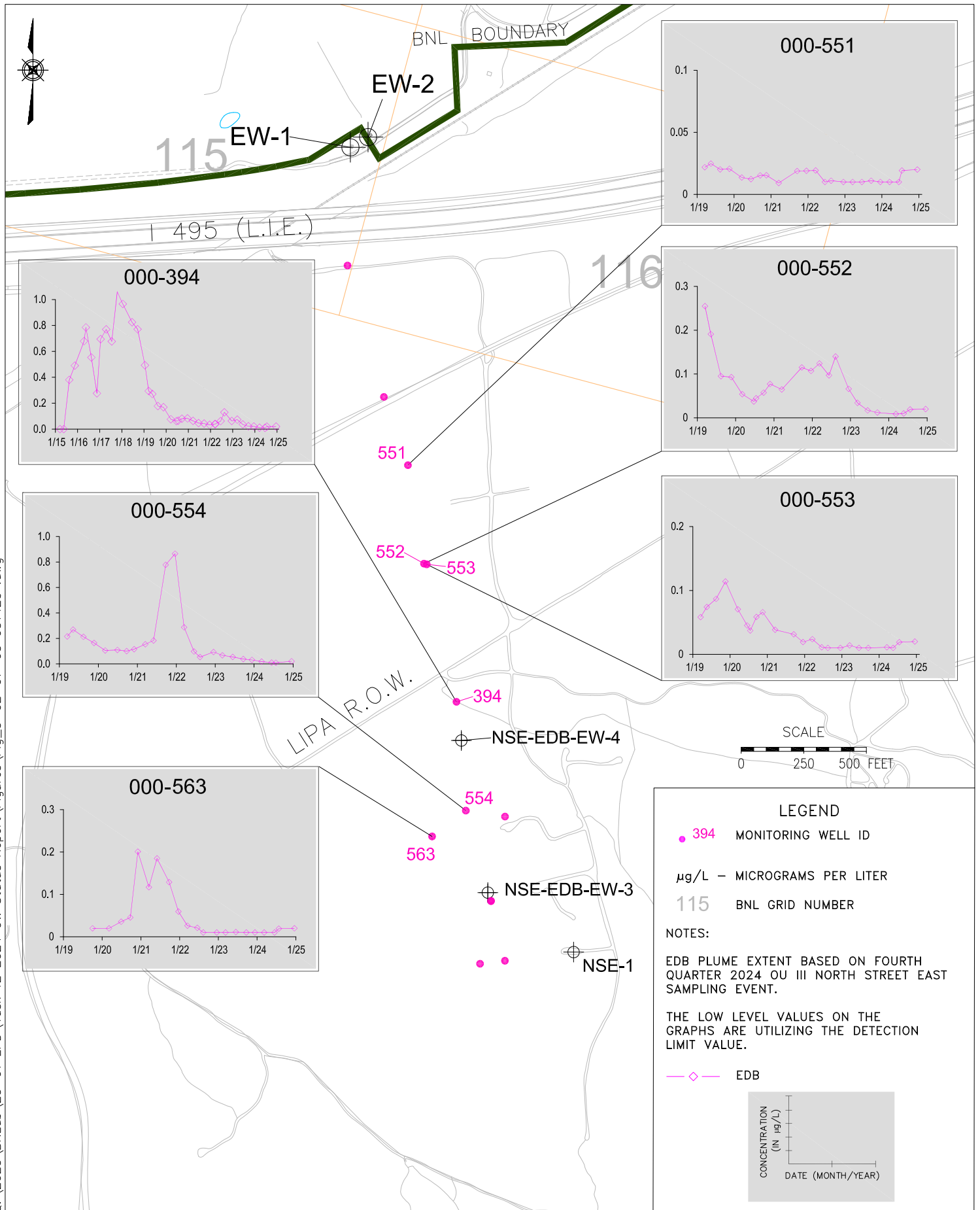
NOTES:

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FIGURE NO.:

3.2.7-1

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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

OU III NORTH STREET EAST HISTORICAL EDB TRENDS

2024 BNL GROUNDWATER STATUS REPORT

DWN:	VT.HZ.:	DATE:	PROJECT NO.:
AJZ	—	03/13/25	—
CHKD:	APPD:	REV.:	NOTES:
VJR	BB	05/14/25	—

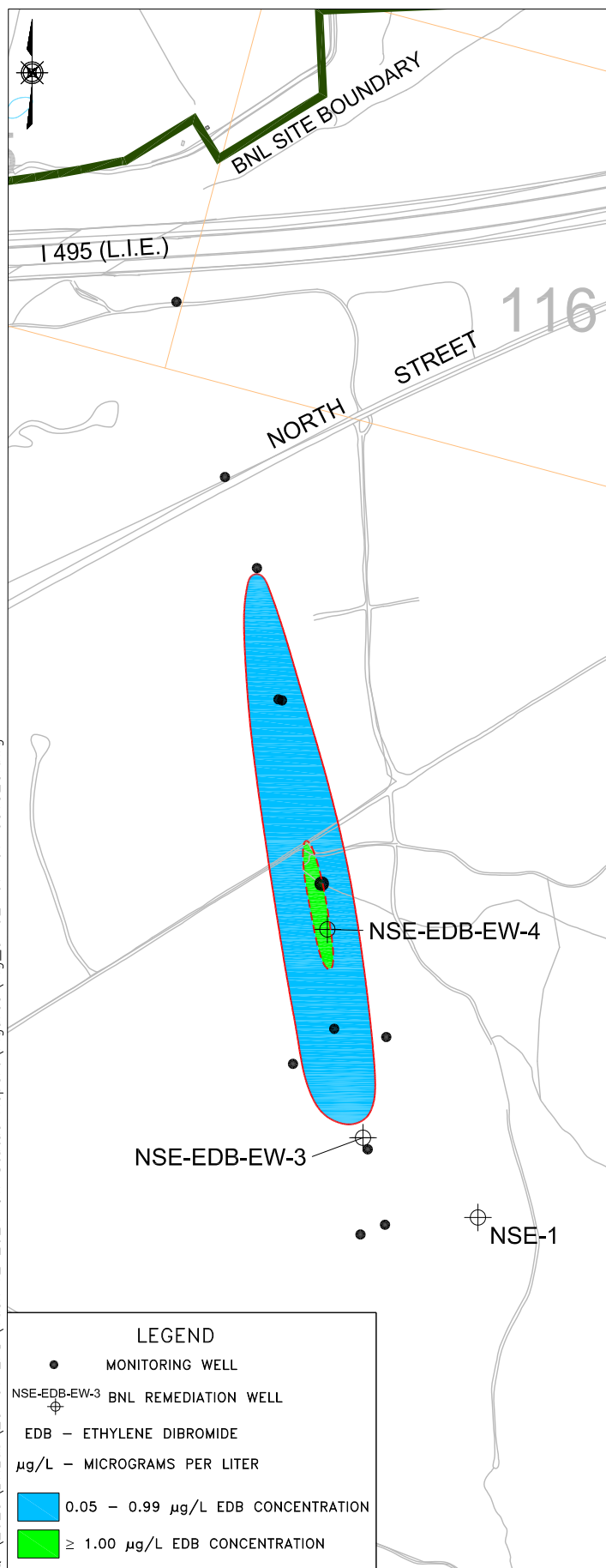
FIGURE NO.:

3.2.7-3

2019 NSE EDB PLUME DISTRIBUTION

2024 NSE EDB PLUME DISTRIBUTION

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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

OU III NORTH STREET EAST
EDB PLUME COMPARISON
2019 - 2024

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

VT:HZ.:

-

DATE:

03/13/25

PROJECT NO.:

-

CHKD:

VJR

APPD:

BB

REV.:

-

NOTES:

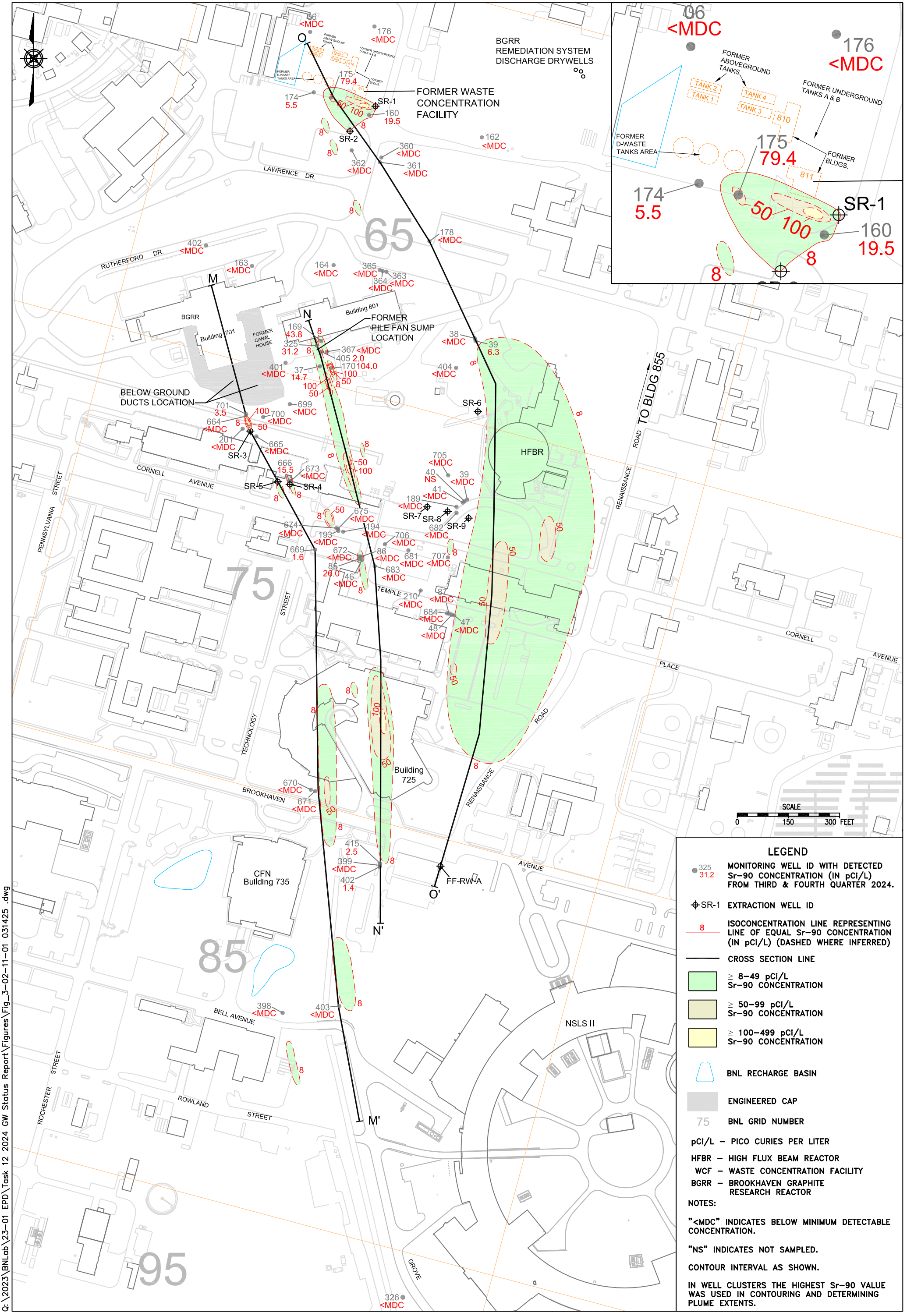
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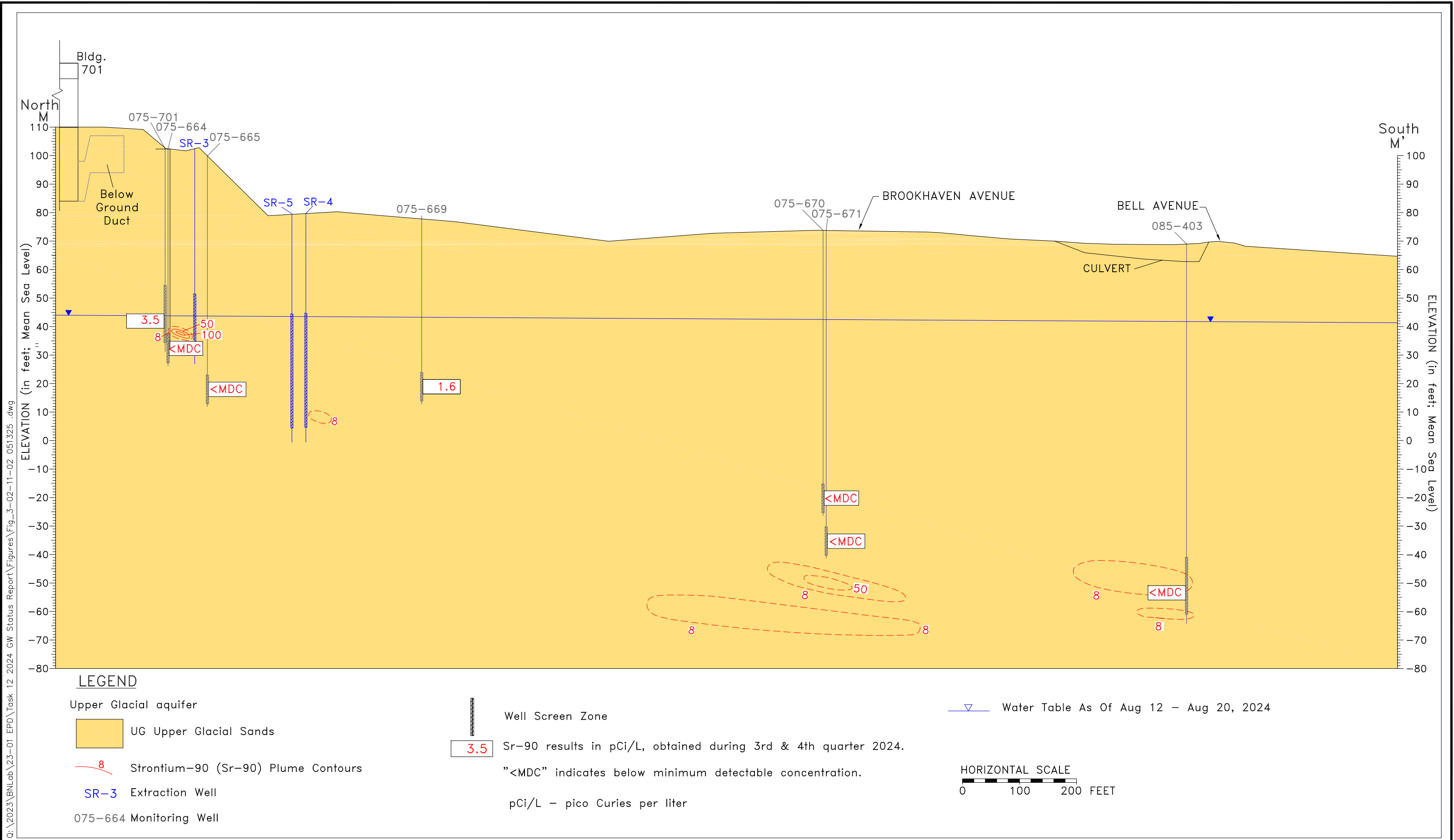
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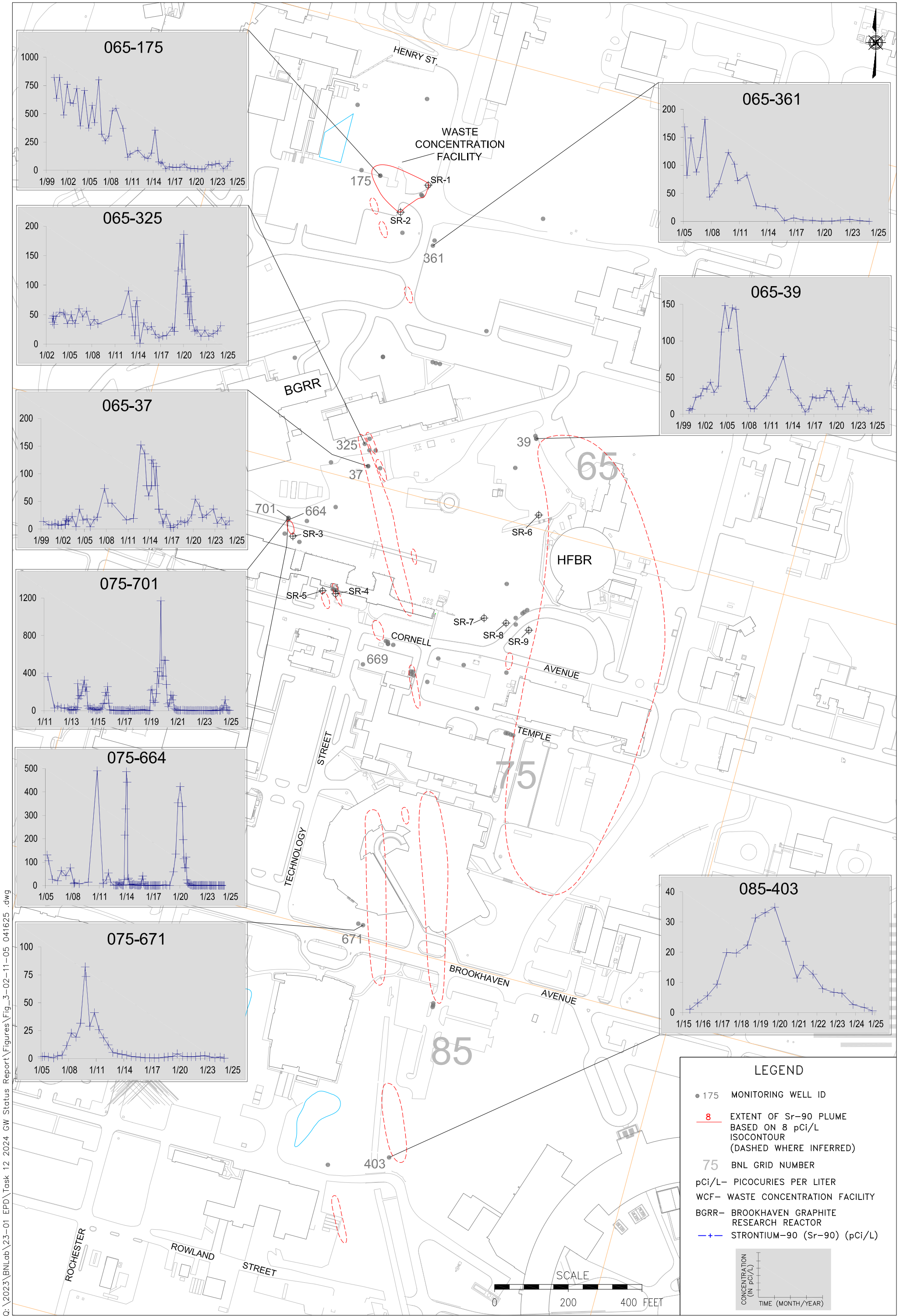
3.2.7-7

OUIII Strontium 90 — BGRR/WCF Treatment System

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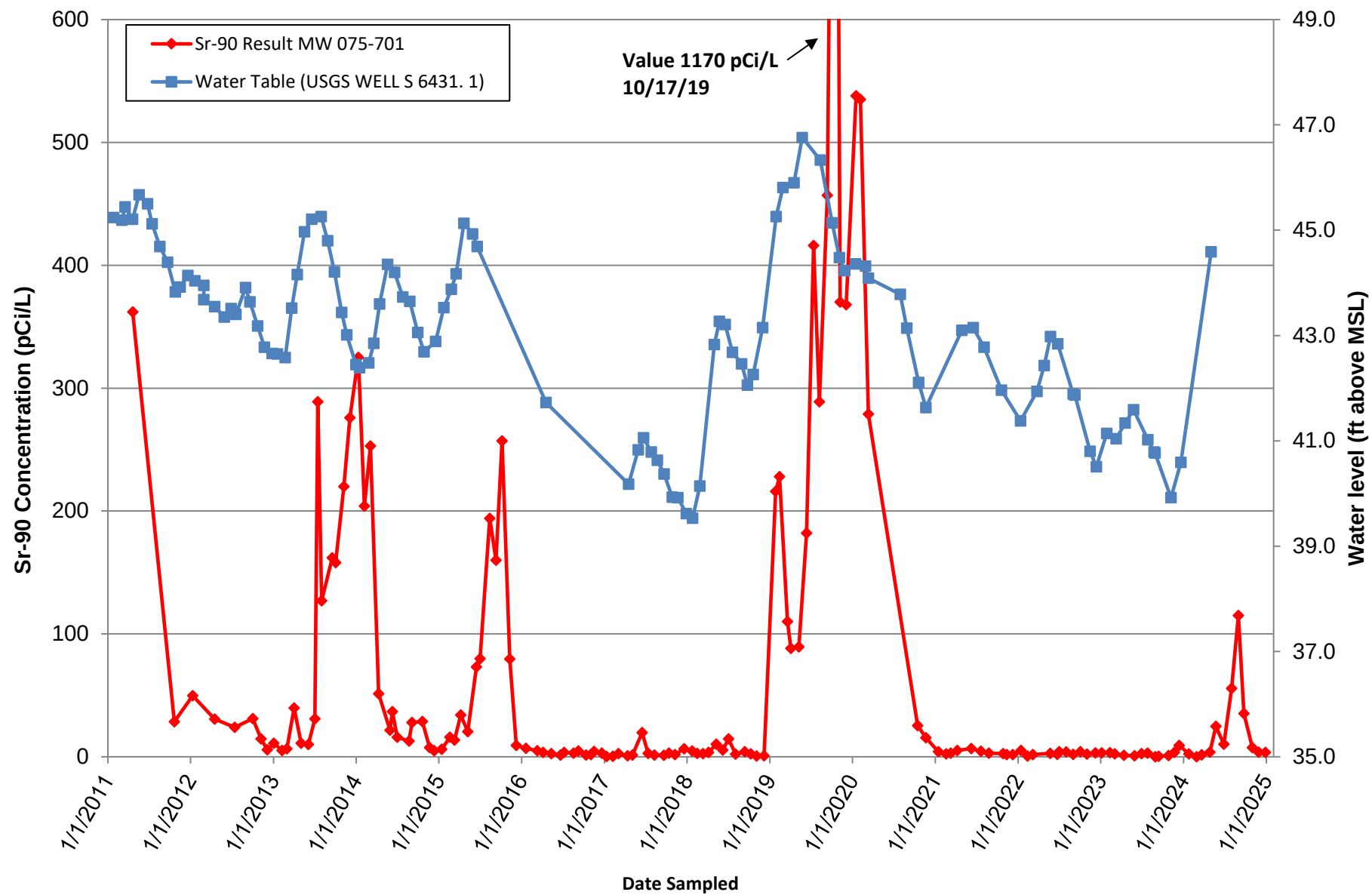




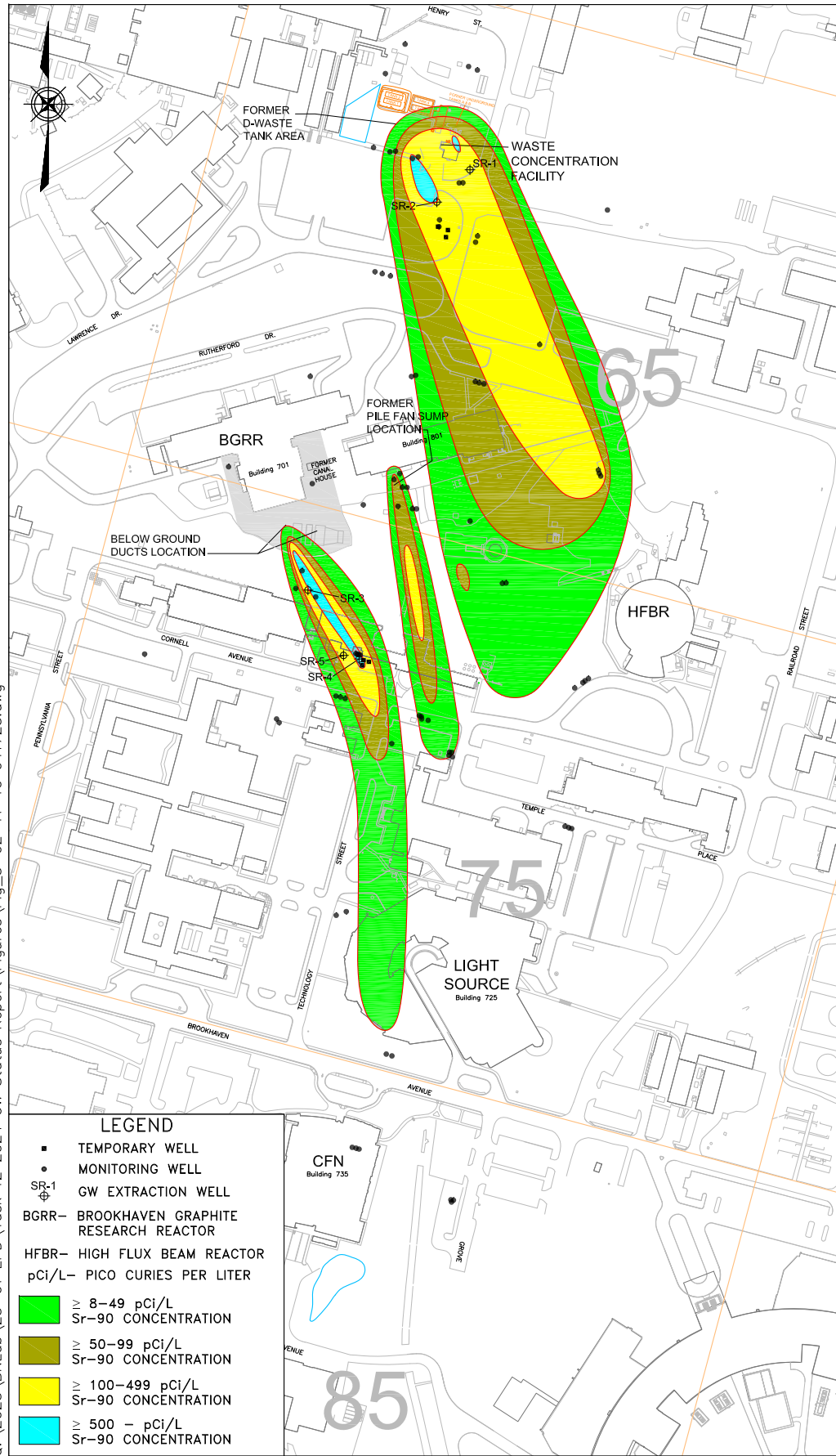
C:\2023\BNLab\23-01 EPD\Task 12 2024 GW Status Report\Figures\Fig_3-02-11-05 041625 .dwg

Figure 3.2.11-6
OU III BGRR/WCF Monitoring Well 075-701
Sr-90 Concentration Comparison to Water Table Elevation

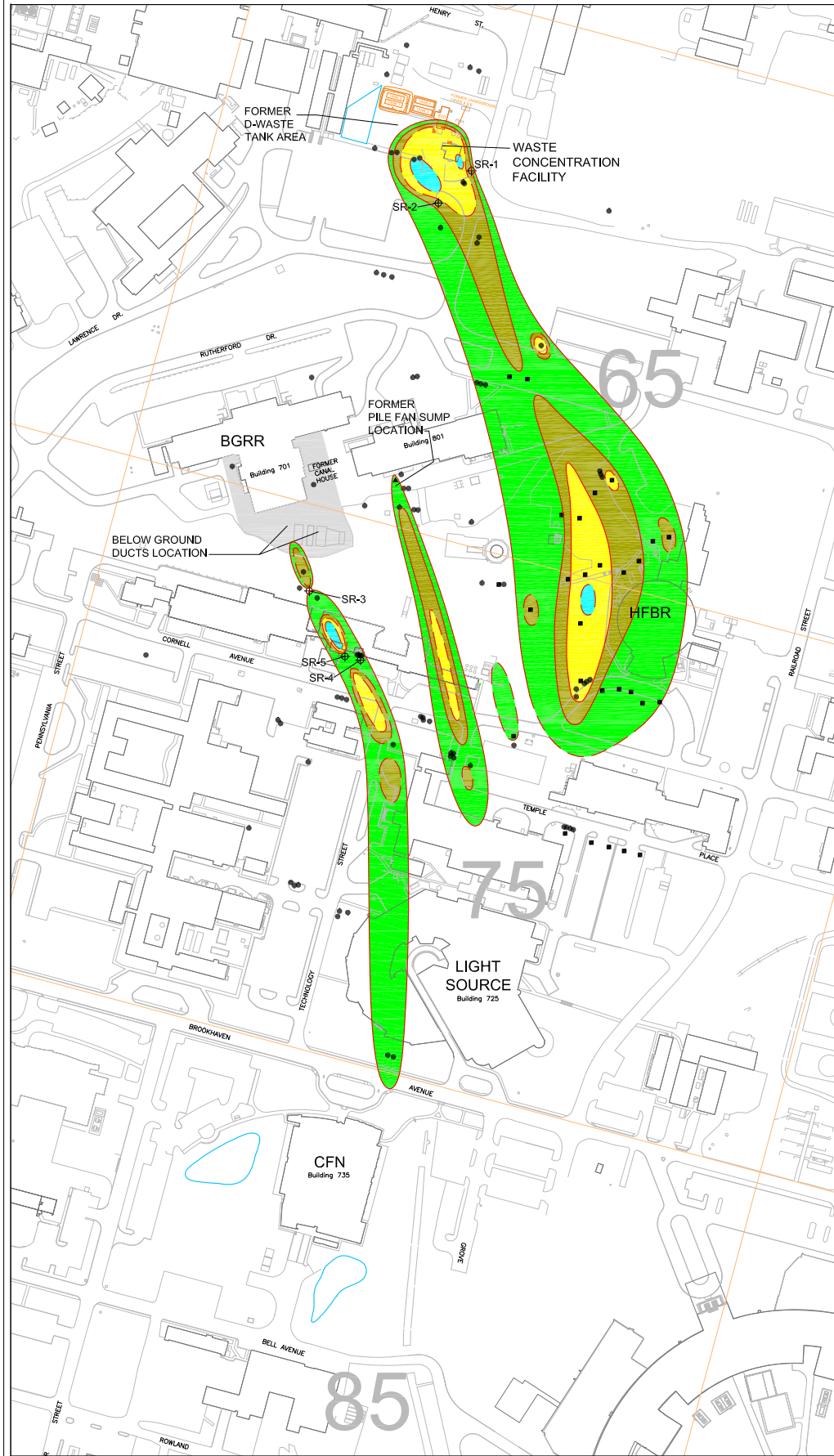
2024 BNL Groundwater Status Report



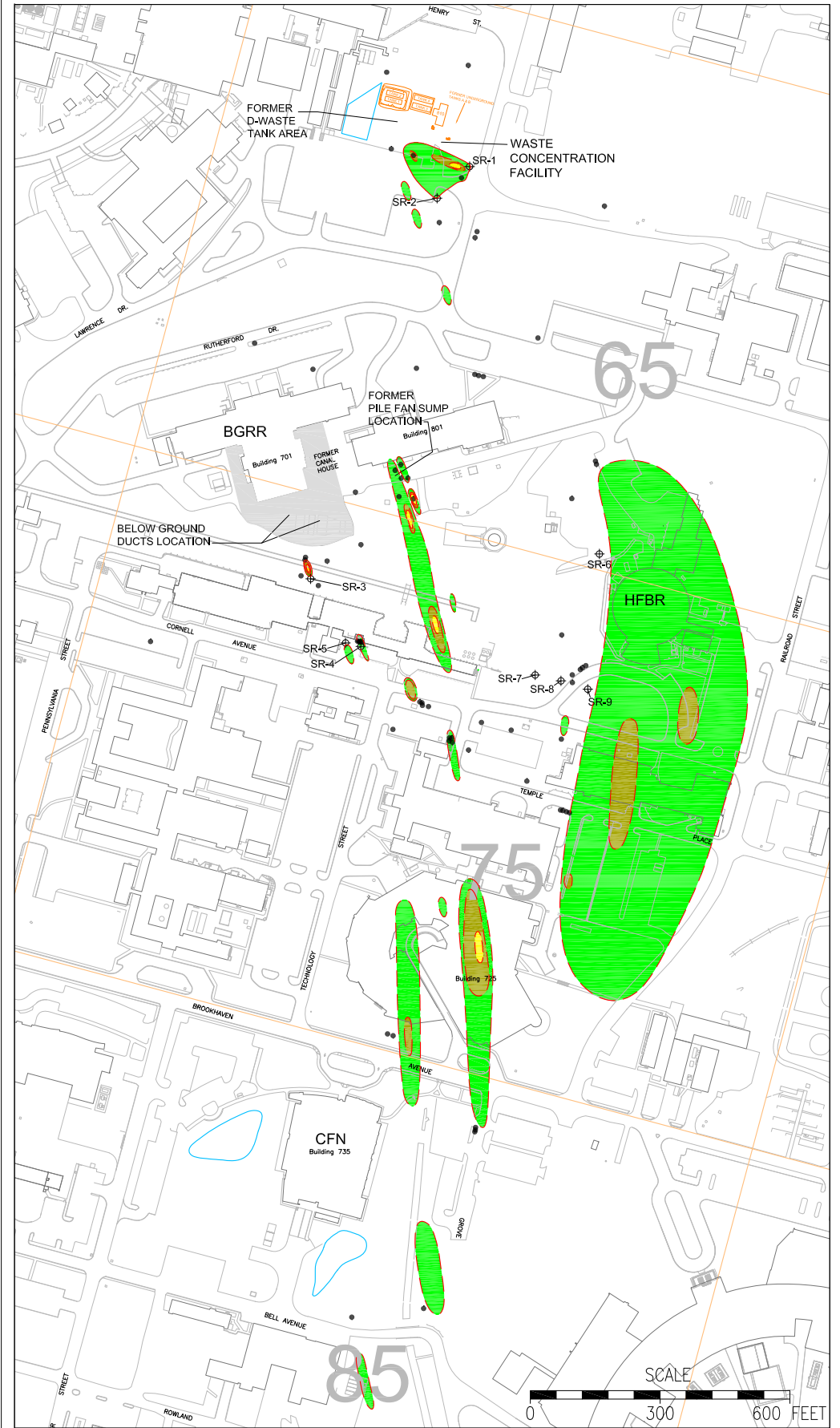
2004



2008



2024



ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU III BGRR/WCF
Sr-90 PLUME COMPARISON 2004 - 2024

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

VT: HZ.:

-

DATE:
03/14/25

PROJECT NO.:

-

CHKD:

VJR

APPD:

BB

REV.:
04/17/25

NOTES:

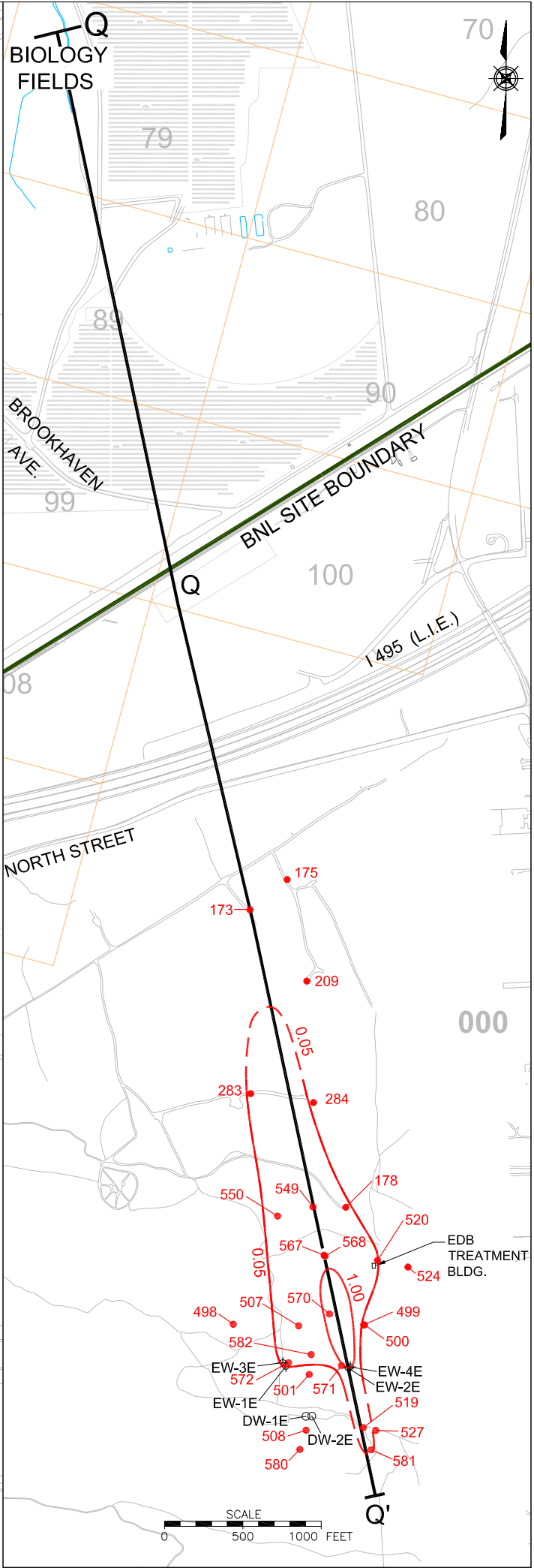
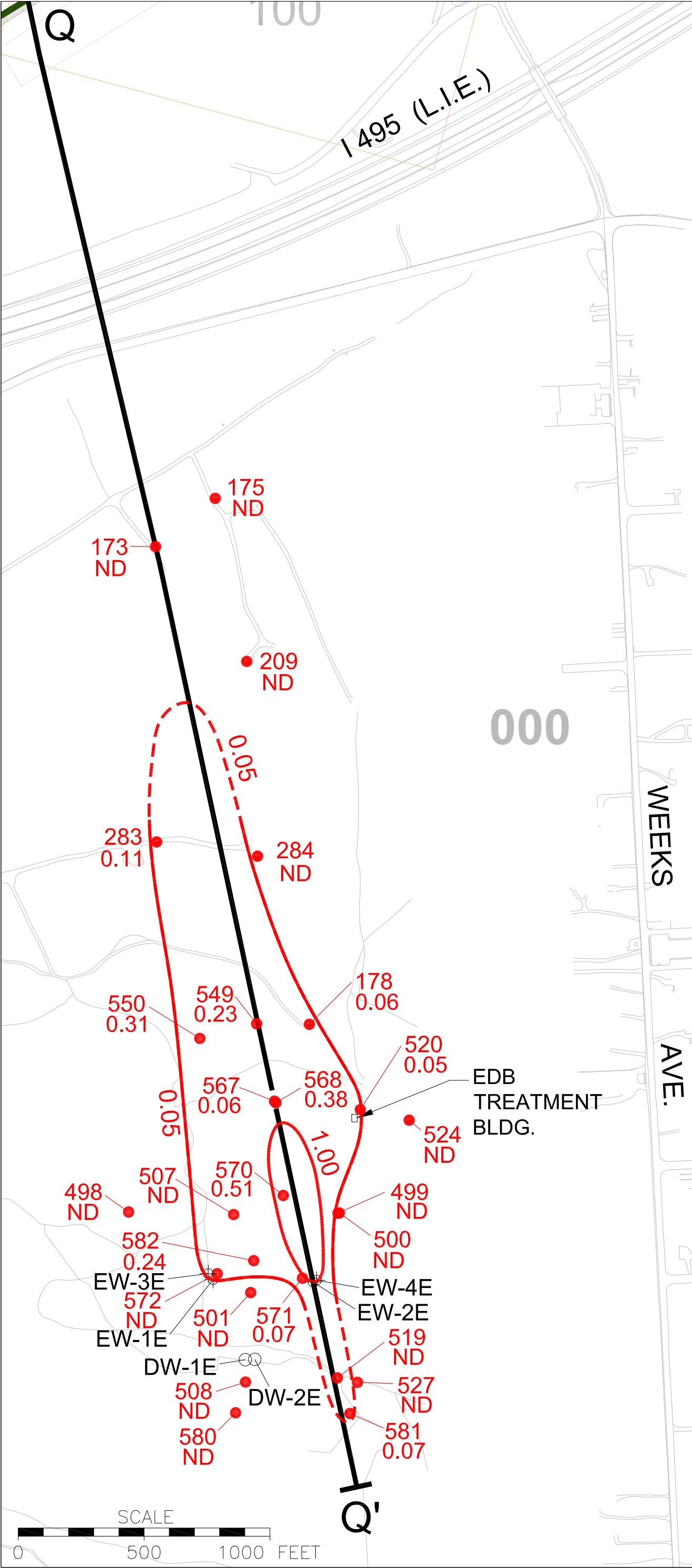
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FIGURE NO.:

3.2.11-10

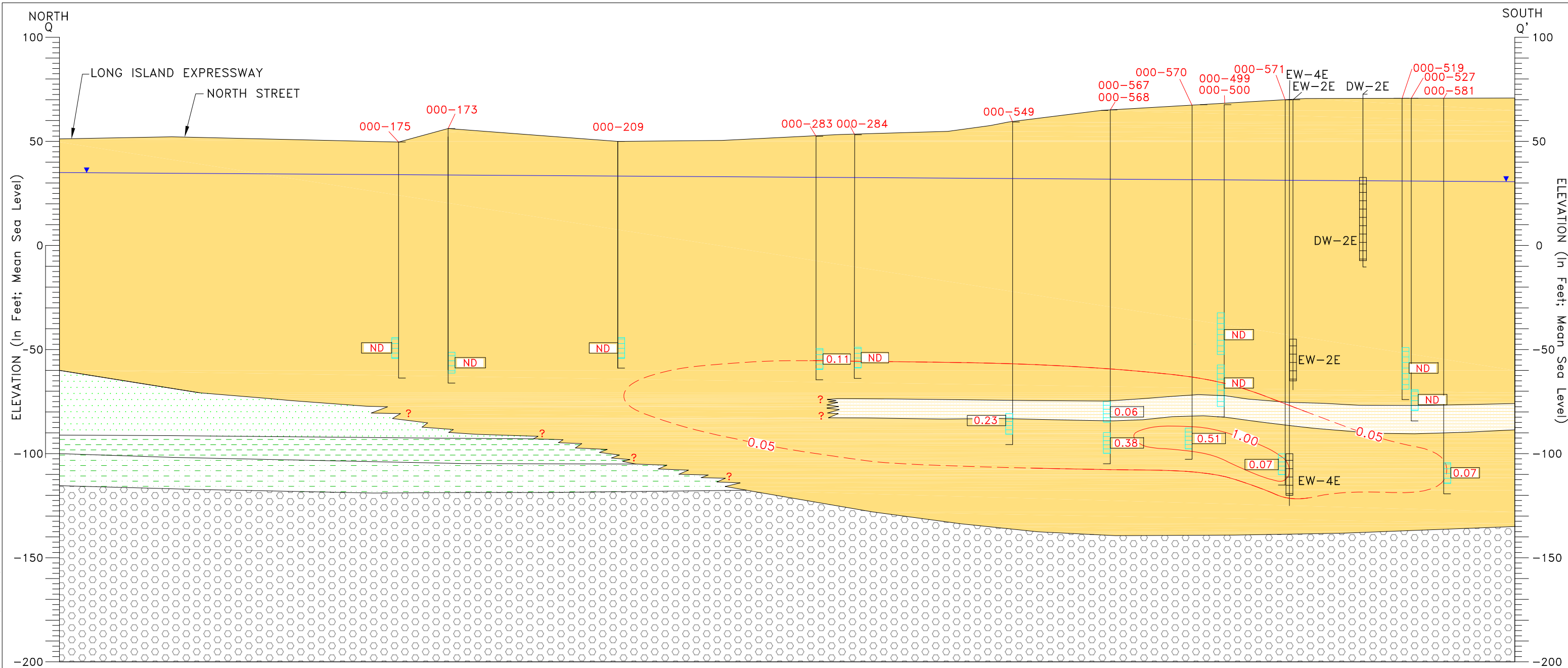
OU VI EDB Treatment System

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- LEGEND**
- 570 1.10 MONITORING WELL ID WITH DETECTED ETHYLENE DIBROMIDE (EDB) CONCENTRATION IN µg/L
 - 0.05 EDB ISOCONCENTRATION CONTOUR IN µg/L
 - LOCATION OF EDB HYDROGEOLOGIC CROSS SECTION
 - 000 BNL GRID NUMBER
 - EW-1E BNL REMEDIATION WELL
 - DW-1E BNL DIFFUSION WELL
 - µg/L - MICROGRAMS PER LITER
- NOTES:**
- IN WELL CLUSTERS THE HIGHEST EDB VALUE WAS USED IN CONTOURING.
- EDB PLUME EXTENT BASED ON FOURTH QUARTER 2024 OU VI EDB SAMPLING EVENT. MONITORING WELLS 000-567, 568 AND 581 BASED ON FEBRUARY 2025 SAMPLING EVENT.
- "ND" INDICATES NOT DETECTED AT OR ABOVE LABORATORY METHOD DETECTION LIMITS.
- RESULTS BASED ON EPA METHOD 8011.

Q: \2023\BNLab\23-01 EPD\Task 12 2024 GW Status Report\Figures\Fig_3-04-02 031825.dwg



LEGEND

Upper Glacial aquifer

- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit

Gardiners Clay

- GL Gardiners Clay
- GS Gardiners Clay - Silt

Magothy aquifer

- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undifferentiated)
- MO Magothy - OTHER

000-500 BNL Well ID

- ND Indicates not detected at or above laboratory method detection limits
- NS Indicates not sampled
- .080 Ethylene dibromide (EDB) Concentration ($\mu\text{g/L}$)
- 0.05 EDB Contour ($\mu\text{g/L}$) (Dashed Where Inferred)

$\mu\text{g/L}$ - Micrograms Per Liter

Water Table As Of Aug. 12 - Aug. 20, 2024

Monitoring Well Screen

Extraction Well Screen

HORIZONTAL SCALE

0 300 600

Monitoring Well IDs are stacked in order of the depth of the well from shallow to deep

000-499

000-500

NOTES:

1) GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, MORE DETAILED REPORTS.

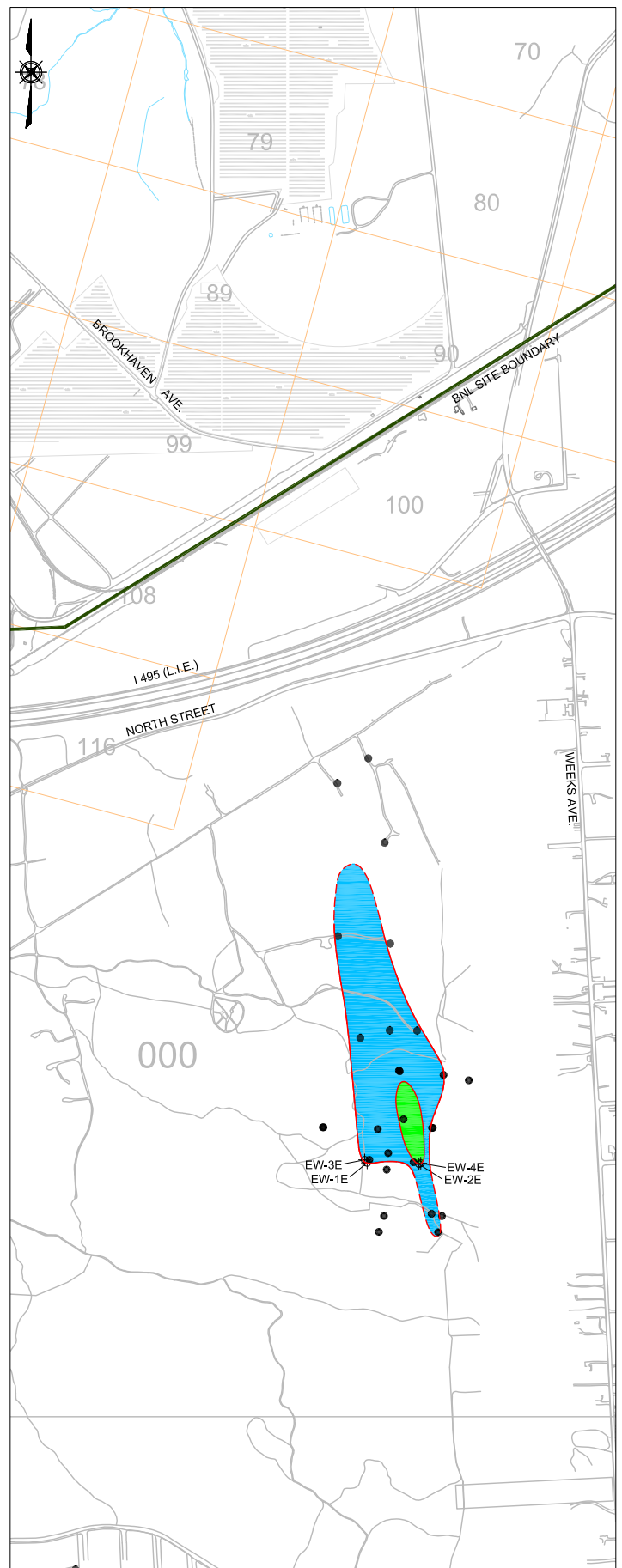
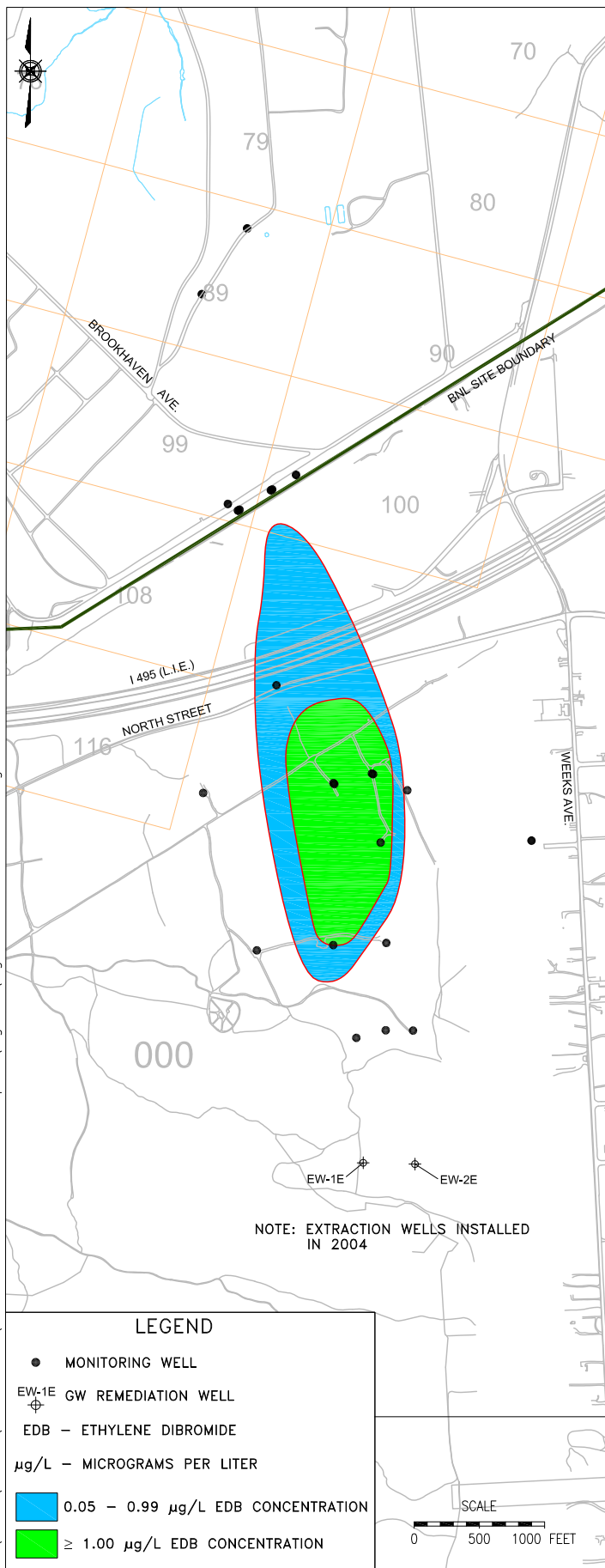
2) EDB EXTENT IS BASED ON FOURTH QUARTER 2024 OU VI SAMPLING EVENT. MONITORING WELLS 000-567, 568 AND 581 BASED ON FEBRUARY 2025 SAMPLING EVENT.

3) RESULTS BASED ON EPA METHOD 8011.

1999 EDB PLUME DISTRIBUTION

2024 EDB PLUME DISTRIBUTION

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ENVIRONMENTAL
PROTECTION DIVISION

TITLE:

OU VI
EDB PLUME COMPARISON
1999 - 2024

2024 BNL GROUNDWATER STATUS REPORT

DWN:

AJZ

VT:HZ.:

-

DATE:

03/18/25

PROJECT NO.:

-

CHKD:

VJR

APPD:

BB

REV.:

-

NOTES:

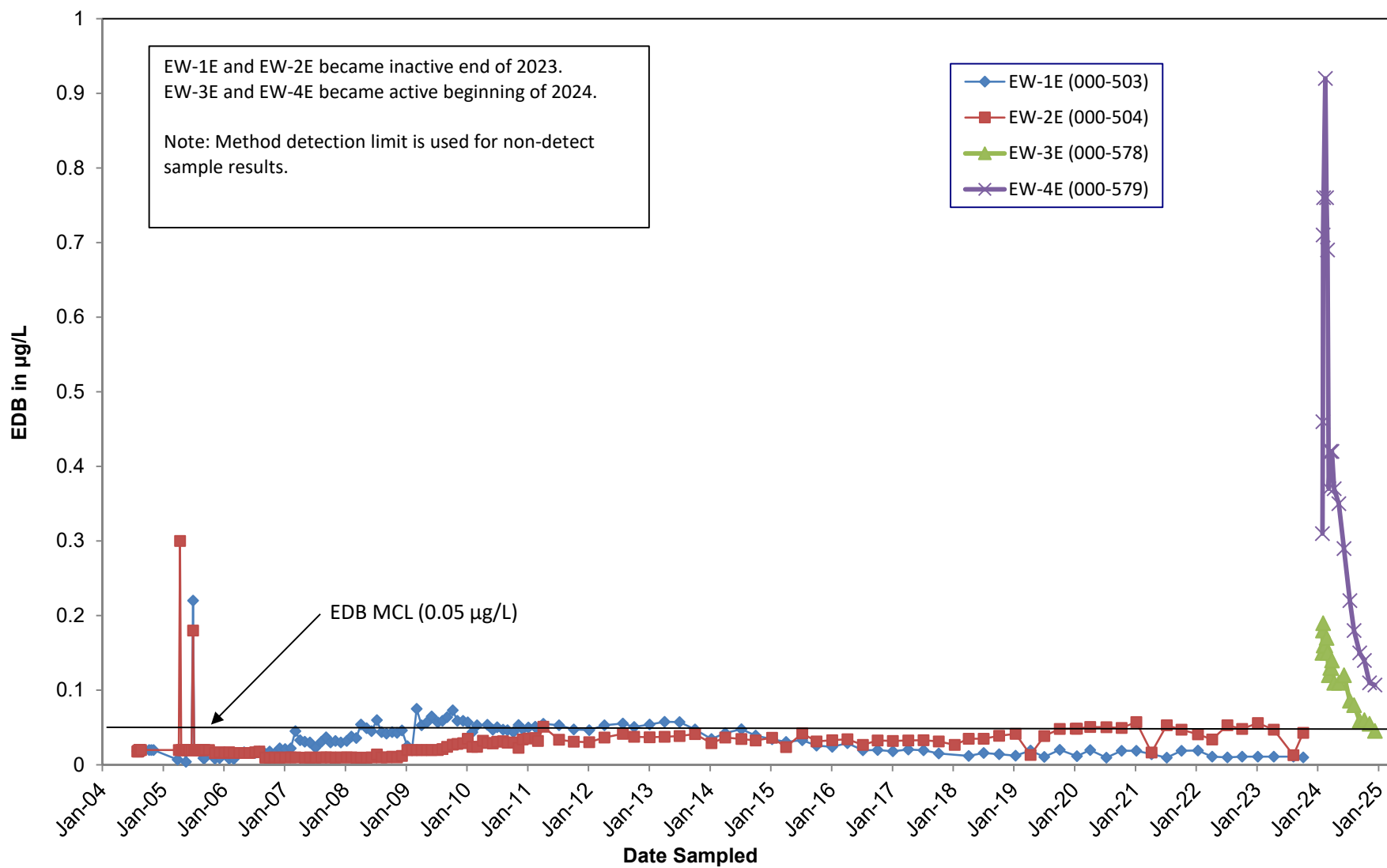
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FIGURE NO.:

3.4-4

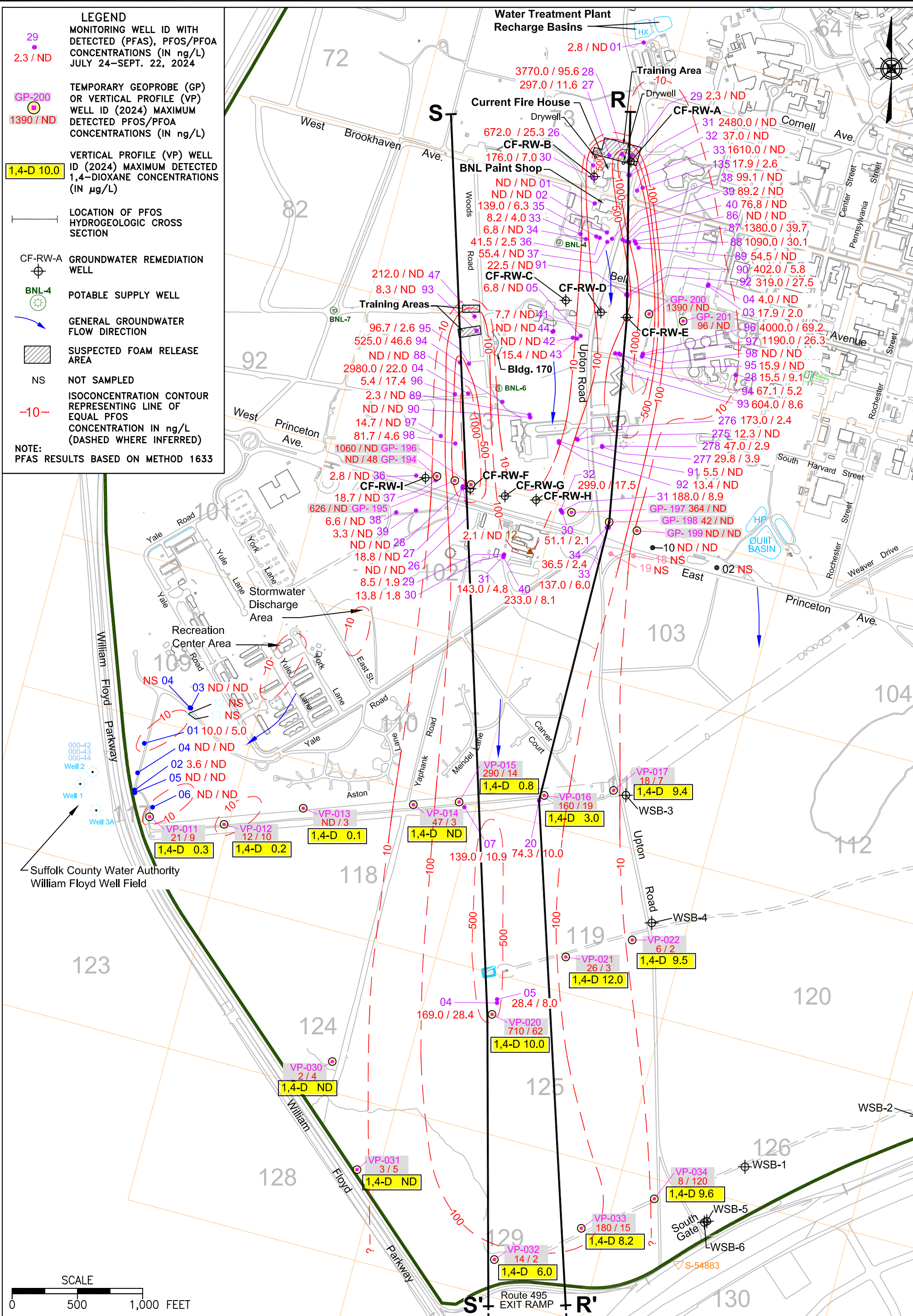
Figure 3.4-5
OU VI EDB
EDB Concentrations in Extraction Wells

2024 BNL Groundwater Status Report

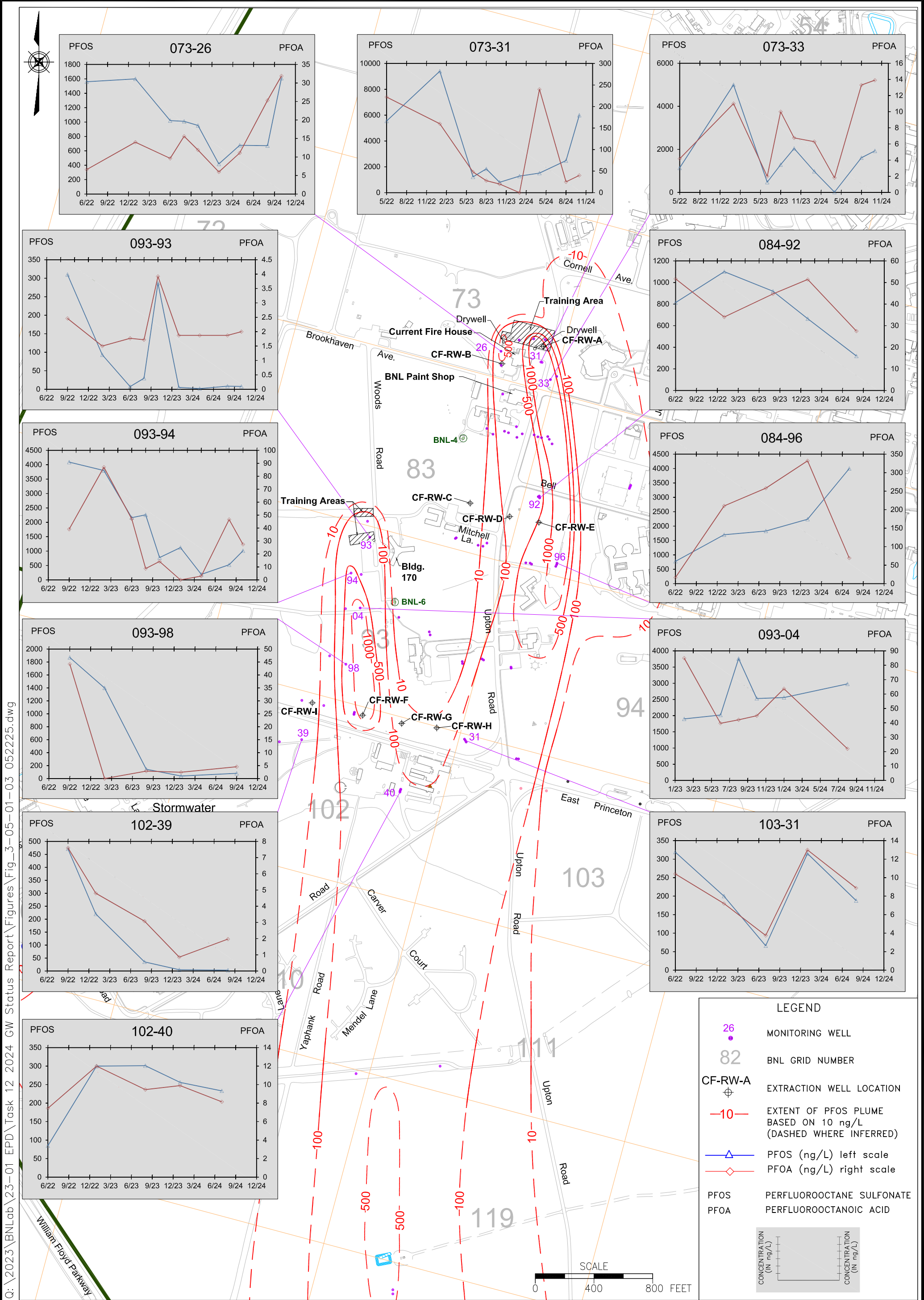


OU X TCRA PFAS - Current Firehouse/Building 170

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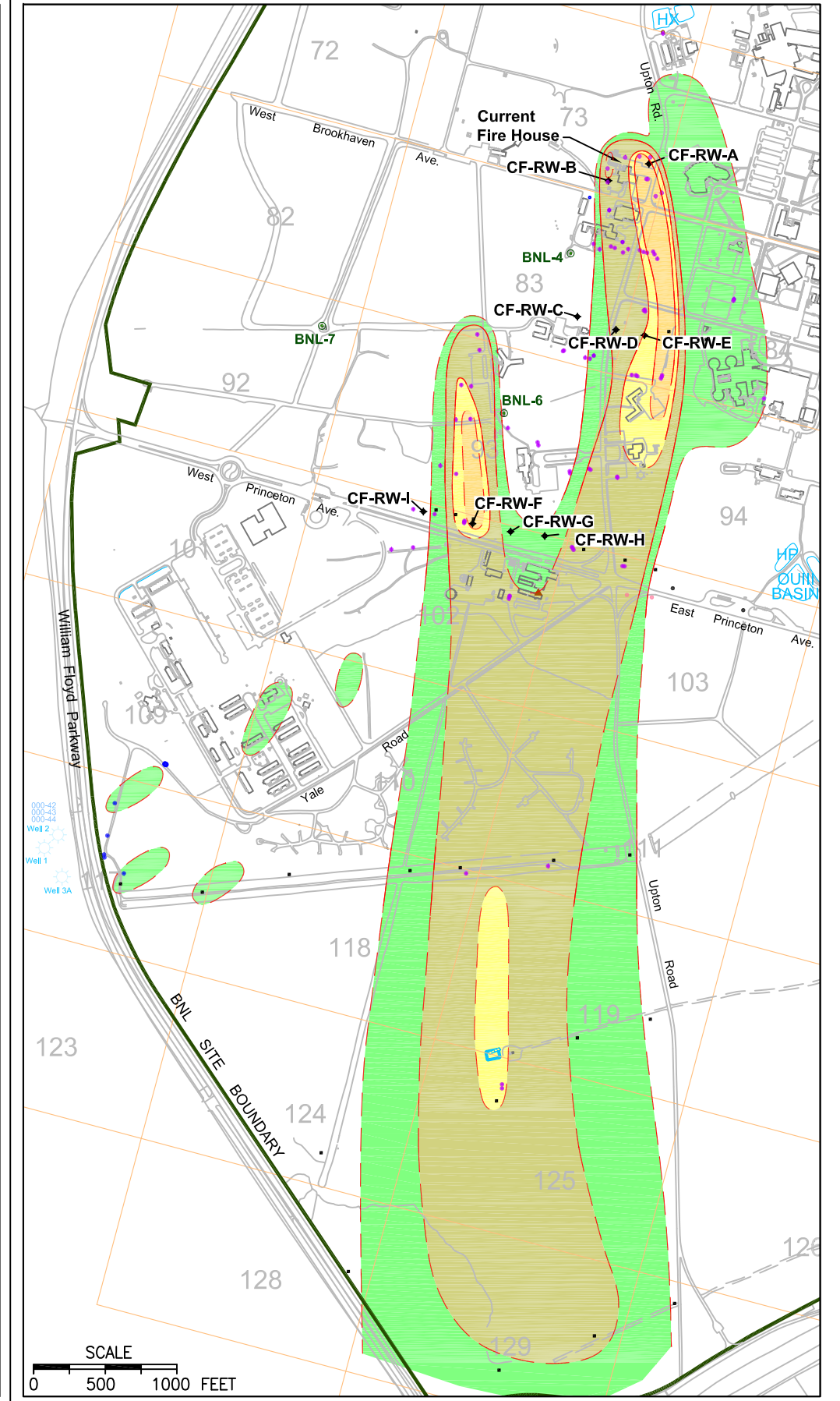
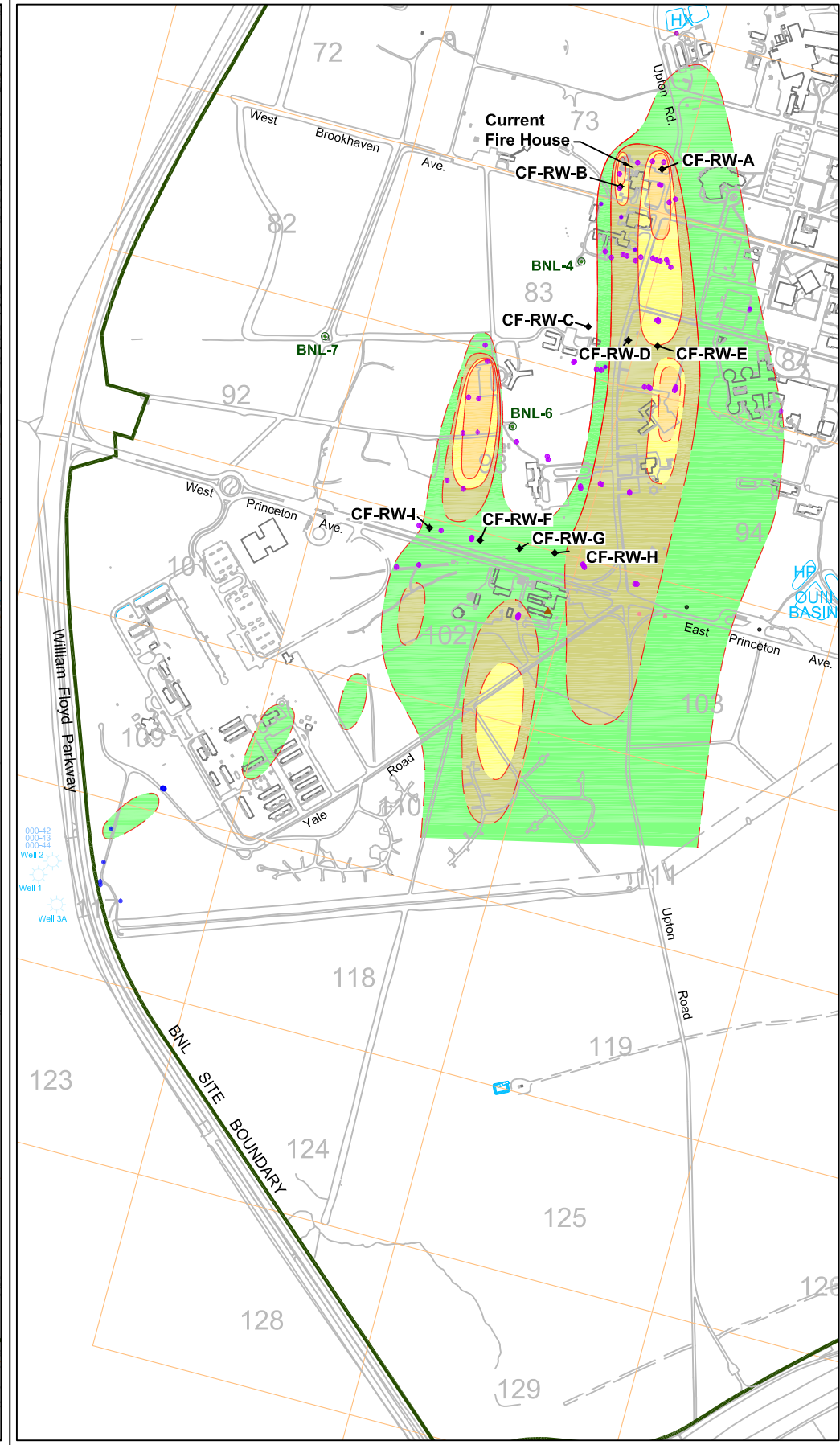
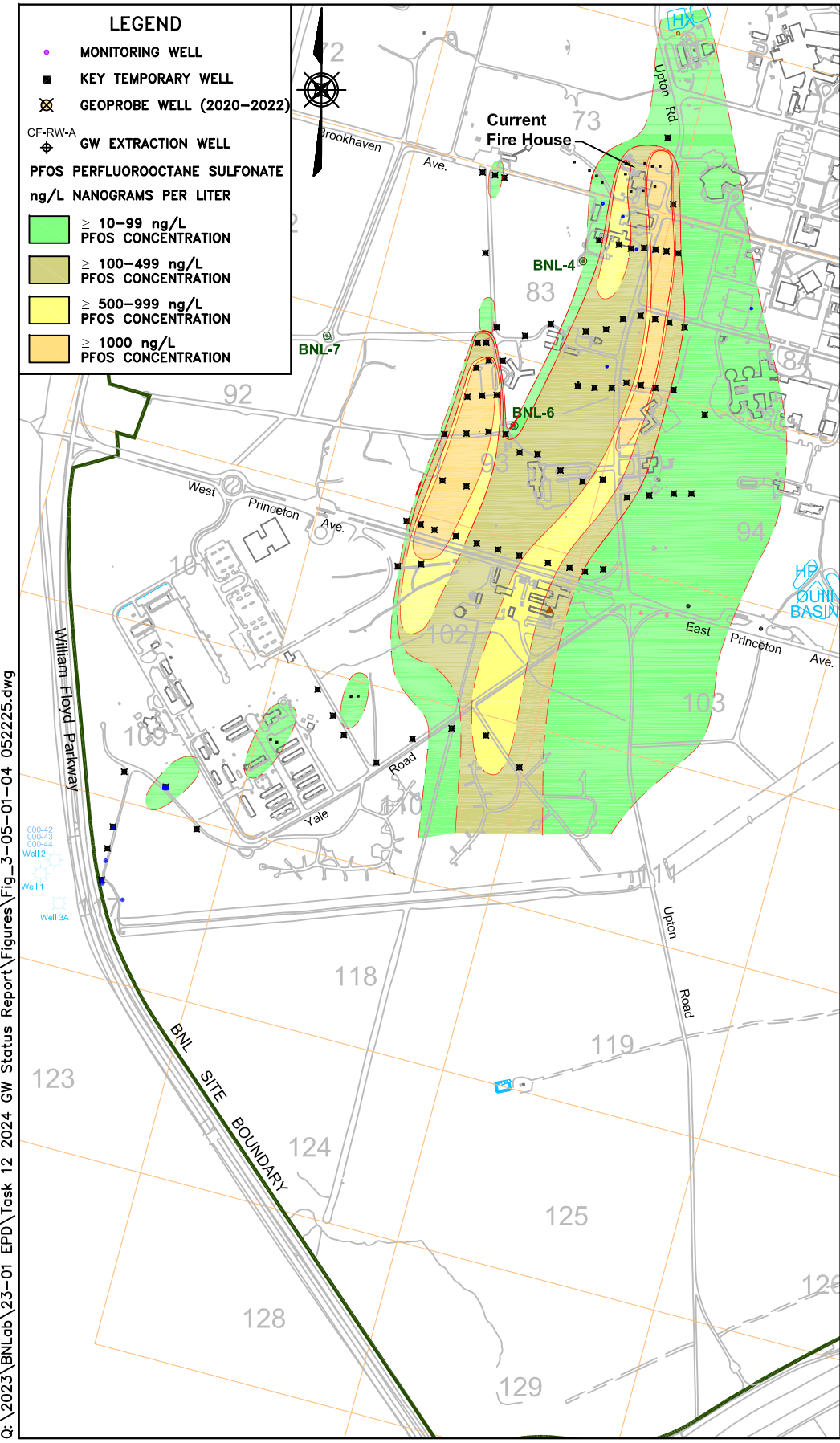
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2020-2021

2023

2024



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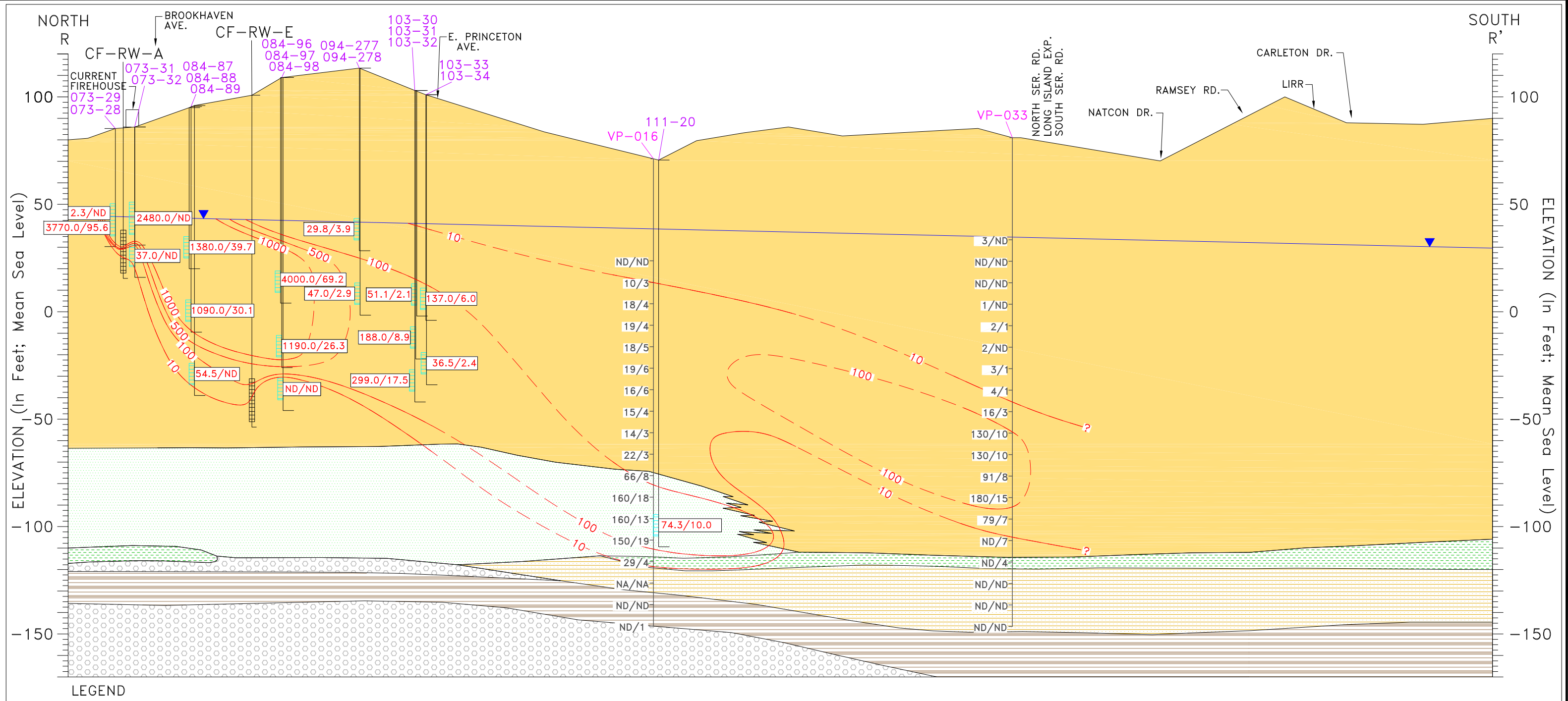
TITLE:

OU X CURRENT FIREHOUSE AND BUILDING 170
PFOS PLUME COMPARISON 2020 - 2024

2024 BNL GROUNDWATER STATUS REPORT

DWN:	AJZ	VT.HZ.:	—	DATE:	04/02/25	PROJECT NO.:	—
CHKD:	DEP	APPD:	BB	REV.:	05/22/25	NOTES:	—
FIGURE NO.:		3.5.1-4					

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ENVIRONMENTAL PROTECTION DIVISION

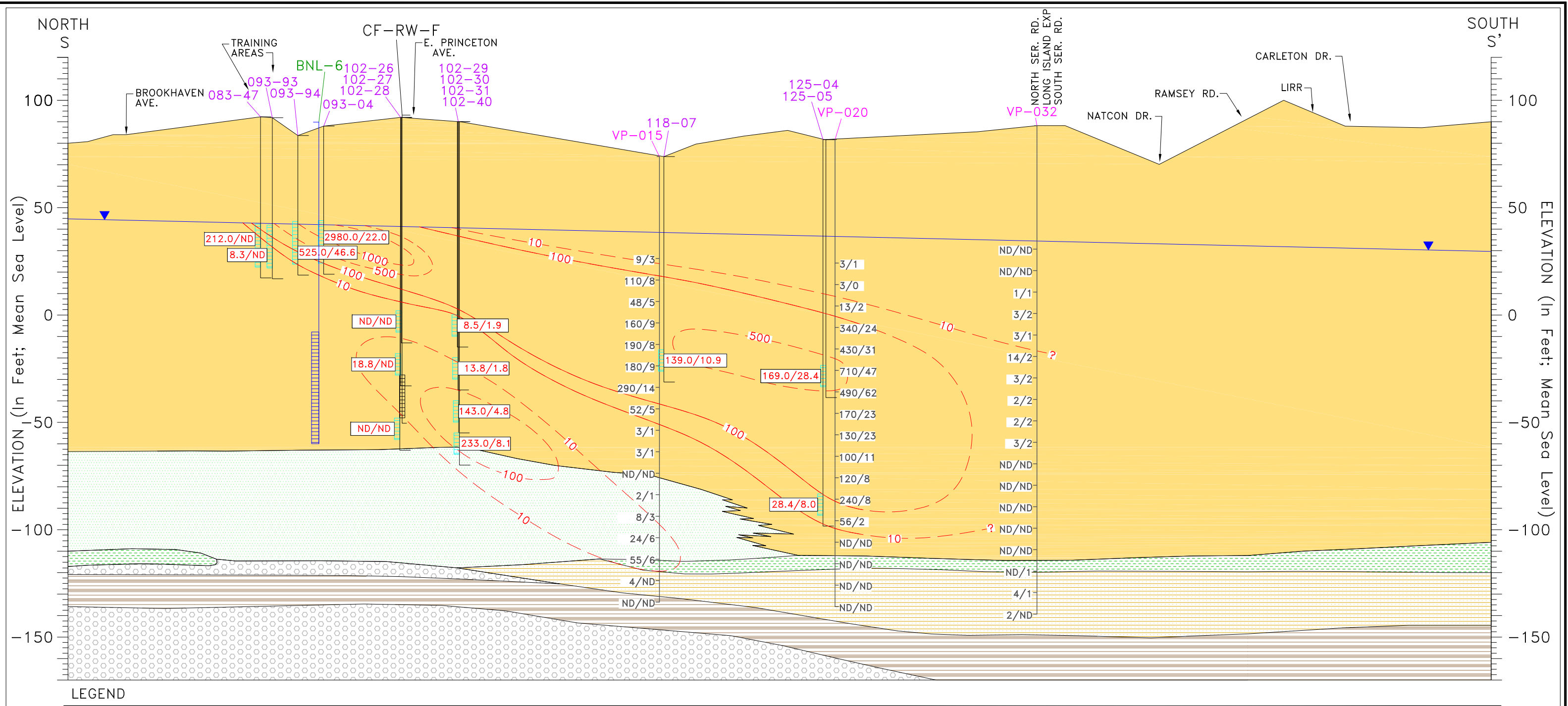
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OU X CURRENT FIREHOUSE PFOS HYDROGEOLOGIC CROSS SECTION (R-R')

2024 BNL GROUNDWATER STATUS REPORT

DWN:	AJZ	VT:HZ:	20:1	DATE:	04/10/25	PROJECT NO.:	—
CHKD:	DEP	APPD:	BB	REV.:	05/13/25	NOTES:	—
FIGURE NO.:		3.5.1-7					

Q: \2023\BNLab\23-01 EPD\Task 12 2024 GW Status Report\Figures\Fig_3-05-01-08 041625.dwg



LEGEND

Upper Glacial aquifer

- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit

Gardiners Clay

- GL Gardiners Clay
- GS Gardiners Clay - Silt

Magothy aquifer

- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undifferentiated)
- MO Magothy - OTHER

93-04 BNL Well ID

- ND Indicates not detected at or above laboratory method detection limits
- 74.3/10.0 PFOS Value/PFOA Value in (ng/L)
- 10 PFOS Contour (ng/L) (Dashed Where Inferred)
- Monitoring Well Screen
- Extraction Well Screen

Water Table As Of Aug 12 - Aug 20, 2024

ng/L- Nanograms Per Liter

BNL-6 BNL Water Supply Well (Inactive)

HORIZONTAL SCALE
0 500 1000 FEET

NOTES:

- 1) GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, CHARACTERIZATION REPORTS.
- 2) PFOS/PFOA RESULTS IN MONITORING WELLS BASED ON JULY 24 THROUGH SEPT. 22, 2024 SAMPLING EVENTS.
- 3) PFOS/PFOA RESULTS IN TEMPORARY WELLS, (GP) (VP) BASED ON MAY 17, 2024 THGROUGH MAR. 7, 2025 SAMPLING EVENTS.
- 4) CONTOUR INTERVAL IS AS SHOWN.
- 5) BNL WELL ID COLOR CORRESPONDS TO LONG-TERM MONITORING PROGRAM WELL LOCATION MAP.



ENVIRONMENTAL PROTECTION DIVISION

TITLE:

OU X BUILDING 170
PFOS HYDROGEOLOGIC CROSS SECTION (S-S')

2024 BNL GROUNDWATER STATUS REPORT

DWN:	AJZ	VT:HZ:	20:1	DATE:	04/14/25	PROJECT NO.:	-
CHKD:	DEP	APPD:	BB	REV.:	04/16/25	NOTES:	-
FIGURE NO.:						3.5.1-8	

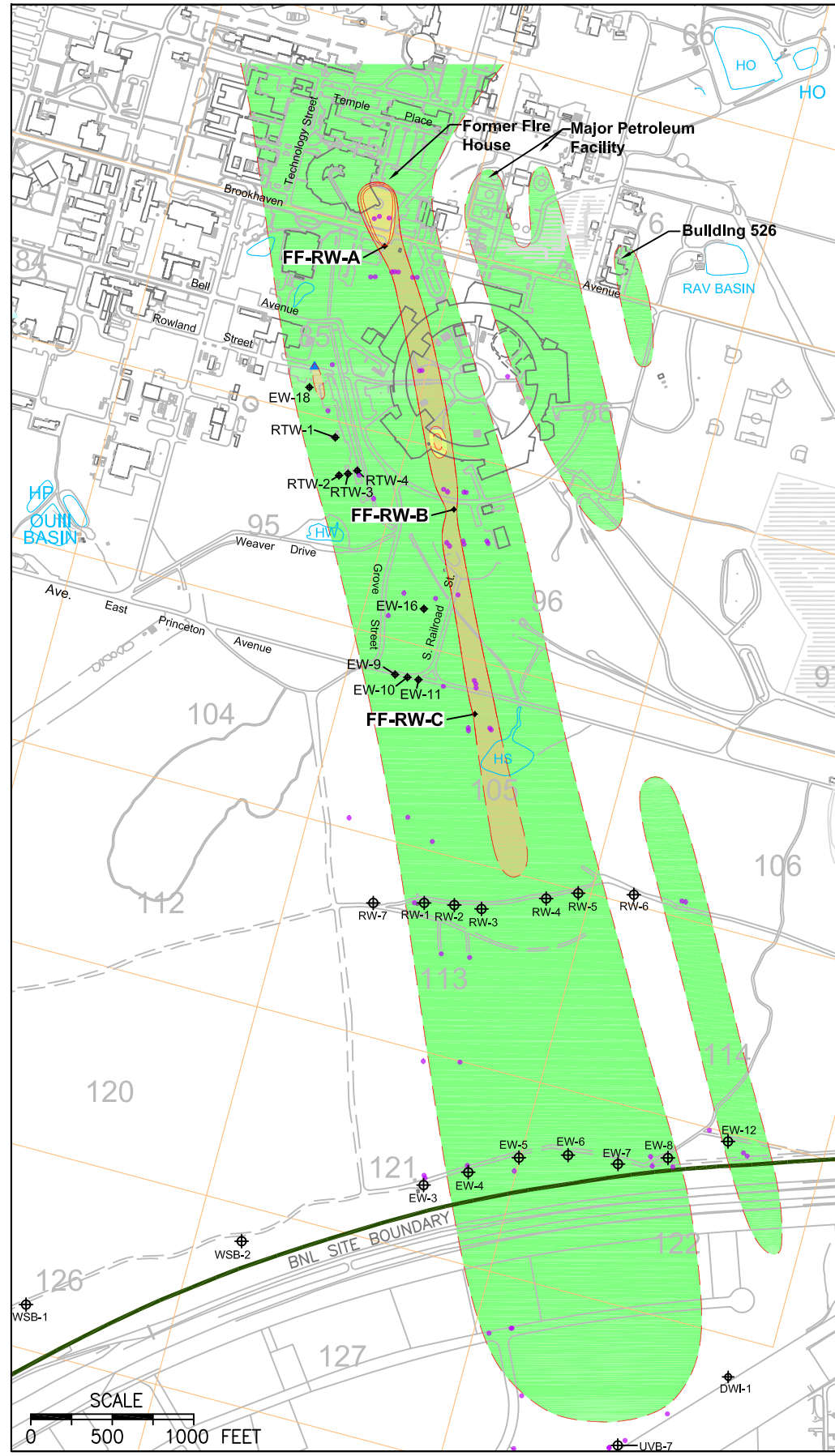
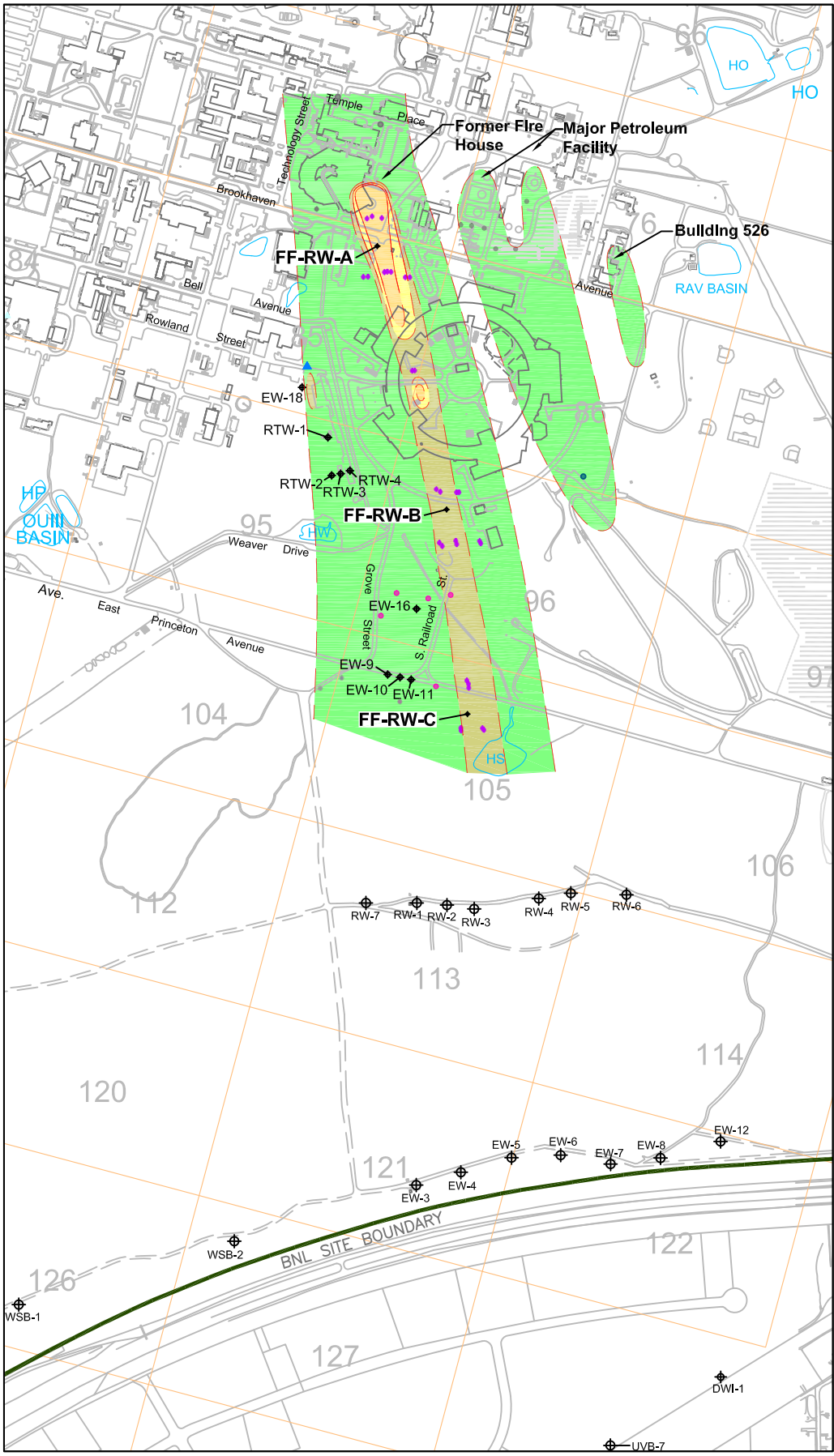
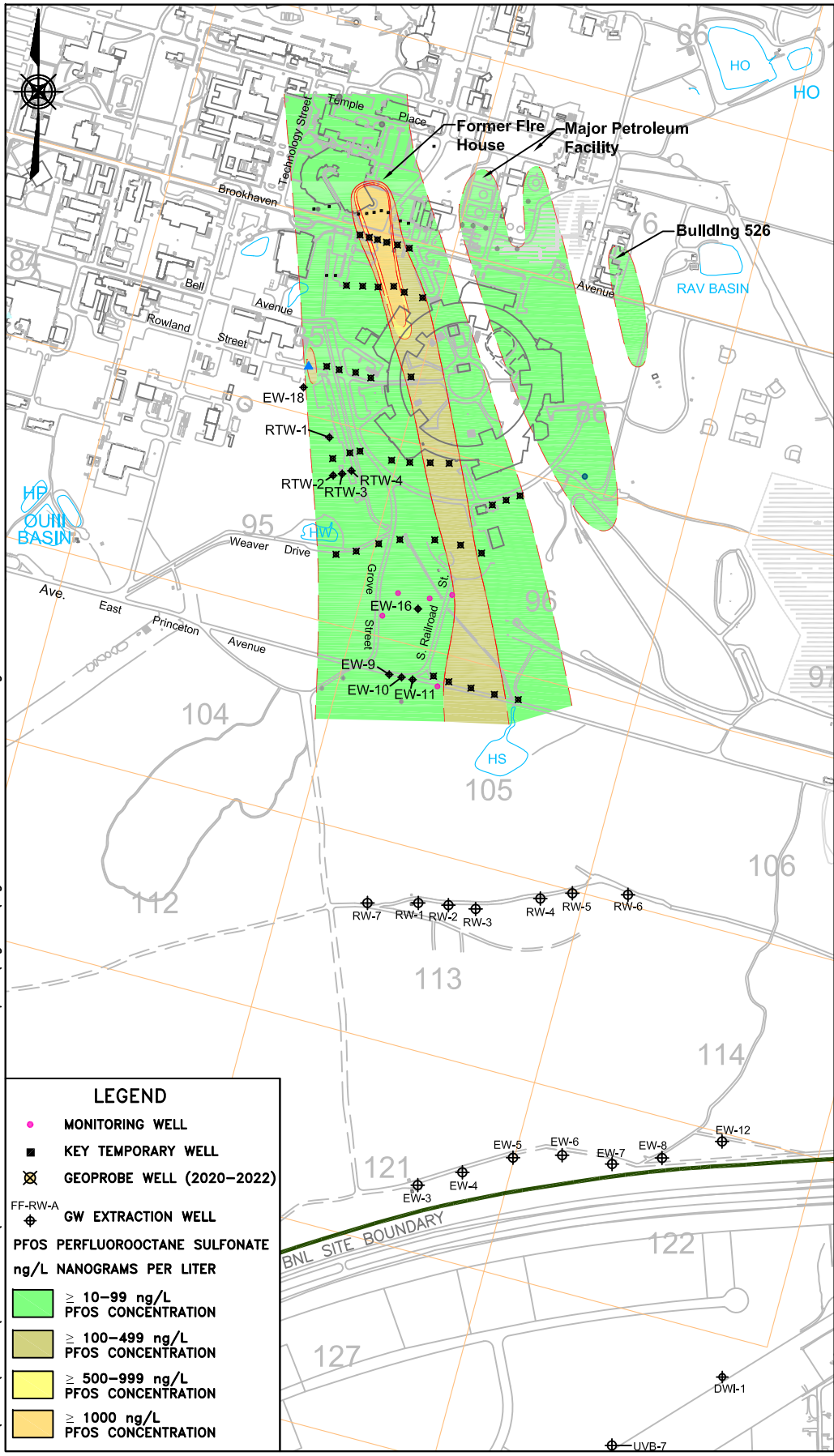
OU X TCRA PFAS - Former Firehouse

2020-2021

2023

2024

Q:\2023\BNLab\23-01 EPD\Task 12 2024 GW Status Report\Figures\Fig_3-05-02-04 052225.dwg



LEGEND

- MONITORING WELL
- KEY TEMPORARY WELL
- ⊗ GEOPROBE WELL (2020-2022)
- ⊕ GW EXTRACTION WELL

PFOS PERFLUOROOCTANE SULFONATE
ng/L NANOGRAMS PER LITER

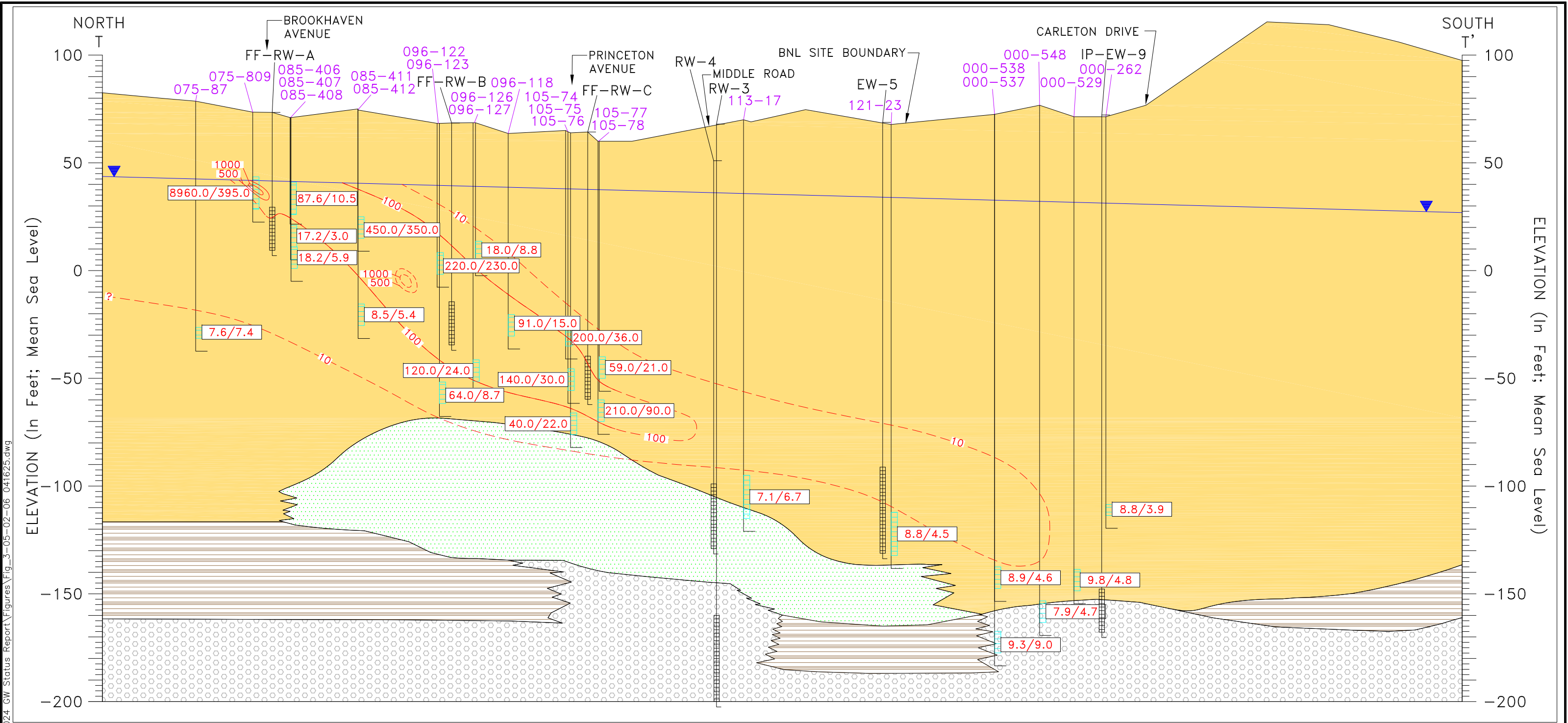
- 10-99 ng/L PFOS CONCENTRATION
- 100-499 ng/L PFOS CONCENTRATION
- 500-999 ng/L PFOS CONCENTRATION
- ≥ 1000 ng/L PFOS CONCENTRATION

TITLE:

OU X FORMER FIREHOUSE
PFOS PLUME COMPARISON 2020 – 2024

2024 BNL GROUNDWATER STATUS REPORT

DWN:	AJZ	VT.HZ.:	—	DATE:	04/02/25	PROJECT NO.:	—
CHKD:	DEP	APPD:	BB	REV.:	05/22/25	NOTES:	—
FIGURE NO.:		3.5.2-4					



LEGEND

Upper Glacial aquifer

- UG Upper Glacial Sands
- UC Upper Glacial Silts & Clays
- UU Upton Unit

Gardiners Clay

- GL Gardiners Clay
- GS Gardiners Clay - Silt

Magothy aquifer

- MA Magothy Sands and Clay
- MB Magothy Brown Clay
- MC Magothy Clays (undiff)
- MO Magothy - OTHER

075-809 BNL Well ID

- ND Indicates not detected at or above laboratory method detection limits
- 74.3/10.0 PFOS Value/PFOA Value in (ng/L)
- 10 PFOS Contour (ng/L) (Dashed Where Inferred)
- Monitoring Well Screen
- Extraction Well Screen

Water Table As Of Aug 12 - Aug 20, 2024

ng/L- Nanograms Per Liter

HORIZONTAL SCALE

0 500 1000 FEET

Monitoring Well IDs are stacked in order of the depth of the well from shallow to deep

085-406
085-407
085-408

NOTES:

- GEOLOGIC INFORMATION SHOWN IS BASED ON ADDITIONAL EXPLORATIONS (e.g., HYDROPUNCHES, GEOPROBES, VERTICAL PROFILES, AND/OR TEST WELLS) DOCUMENTED IN PREVIOUS, CHARACTERIZATION REPORTS.
- PFOS/PFOA RESULTS IN MONITORING WELLS BASED ON JULY 24 THROUGH SEPT. 22, 2024 SAMPLING EVENTS.
- CONTOUR INTERVAL IS AS SHOWN.
- BNL WELL ID COLOR CORRESPONDS TO LONG-TERM MONITORING PROGRAM WELL LOCATION MAP.

MEMO

To:

Julia Michaels, BNL
Brian Barth, BNL

Copies:

Bill Wittek, Arcadis
Art Zahradnik, Arcadis

Arcadis of New York, Inc.
290 Broadhollow Road,
Suite 307E
Melville
New York 11747
Tel 631 249 7600
Fax 631 249 7610

From:

Hope Nemickas, Arcadis

Date:

March 12, 2026, Revised July 29,
2026

Arcadis Project No.:

30304449

Subject:

Technical Support on Question B for the Five-Year Review

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INTRODUCTION.....	2
TOXICITY VALUES.....	3
Lead.....	7
Radionuclides.....	8
EXPOSURE PARAMETERS.....	10
PFAS AND 1,4-DIOXANE.....	10
PFAS AND 1,4-DIOXANE.....	10
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INTRODUCTION

The purpose of this memo is to provide supporting information for Question B in the Technical Assessment, regarding whether there are changes in standards, toxicity values (based on the IRIS Agenda, and other readily available sources as outlined in OSWER Directive 9285.7-53), or exposure assumptions related to Brookhaven National Laboratory's (BNL's) contaminants of concern (COCs) since the 2021 Five Year Review Report (BNL 2021). The comments provided by the United States Environmental Protection Agency (EPA) and BNL responses that require addressing in the 2026 Five-Year Review were reviewed and information to support responses to those comments is provided. As discussed during our task kick-off call, it has been our experience that the EPA has required evaluation of the screening values, toxicity parameters, and exposure assumptions used in the risk assessment that supported remedy selection be reviewed for potential changes in chemicals of potential concern and in resulting risk estimates. The following sections are directly from the EPA guidance on addressing Question B. As stated in Section 4.2 of the EPA Comprehensive Five-Year Review Guidance (EPA 2001a):

“Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?”

In conducting your five-year review, you should evaluate the effects of significant changes in standards and assumptions that were used at the time of remedy selection. Changes in the promulgated standards or "to be considered" (TBCs) may impact the protectiveness of the remedy. Similarly, you should **investigate the effect of significant changes in the risk parameters that were used to support the remedy selection, such as reference doses, cancer potency factors, and exposure pathways of concern**. Finally, you should evaluate whether the original assumptions regarding current and future land/groundwater uses and **contaminants of concern are still valid**, and whether any physical features (or understanding of physical site conditions) have changed (e.g., changes in anticipated direction or rate of groundwater or identification of a new groundwater divide). All of these factors may have a bearing on the validity of the remedial action objectives and may affect the protectiveness of the remedy.”

The EPA also provided the following clarification in Question 24 of their *Five-Year Reviews, Frequently Asked Questions (FAQs) and Answers* (EPA 2001b):

“Is it necessary to evaluate toxicity data for chemicals that were not carried forward as contaminants of concern in the original risk assessment?”

Generally, when evaluating remedy performance, data should be collected and reviewed to **determine if contaminants of concern (as stated in the Record of Decision), are being remediated so that the remedy remains protective**. In Question B of the Technical Assessment section of the five-year review report, the toxicity data evaluation done in the risk assessment should be reviewed to ensure that any assumptions made at the time of the original risk assessment continue to be protective. In addition to reviewing the toxicity information from the original risk assessment, Regions generally should evaluate **new toxicity information for other chemicals identified at the site**. New toxicity information may result in the determination that the additional contaminant source(s) poses a risk to human health or the environment. The review of both the original risk assessment and any new site contaminant information is intended to ensure that the implemented remedy

continues to be protective both currently and in the future. (See section 4.2 of the FYR guidance)”

While Section 4.2 of the Five-Year Review Guidance seems less specific, it does state that assumptions used at the time of remedy selection be evaluated. The time of remedy selection for TBCs is interpreted as the risk assessment conducted during Remedial Investigation/Feasibility Study as incorporated into the Record of Decision (ROD). Question 24 of the FAQs in OSWER 9355.7-21 specifically asks whether chemicals in the risk assessment not carried forward as COCs in the ROD require evaluation. The answer clearly states that the evaluation should determine if COCs are being remediated so that the remedy is protective. However, the answer also states that “new toxicity information for other chemicals identified at the site” should also be evaluated. Therefore, an evaluation of the risk assessment accounting for changes in screening values used to select chemicals of potential concern and incorporation of new chemicals of potential concern, along with changes in toxicity and exposure parameters could theoretically lead to updated risk estimates that would result in the TBCs no longer being protective (i.e., estimated cancer risks greater than the cumulative goal of 10^{-4} and/or estimated noncancer hazards greater than the goal of 1).

As we’ve discussed, EPA has not required BNL to review toxicity data (and therefore screening levels) for non-COC constituents from the past risk assessments. Therefore, this memo focuses on changes in toxicity values for the COCs as discussed in Section 3.4 of the 2021 Five Year Review Report (BNL 2021), as provided in the list of COCs. The memo also addresses changes in exposure parameters and exposure modeling for vapor intrusion.

TOXICITY VALUES

The following table lists the predominant COCs and several constituents detected more recently (listed by date) and summarizes the last significant changes to toxicity values on the EPA Integrated Risk Information System (IRIS). The Operable Unit (OU) or area for the COC and other sources of toxicity information are also shown.

Constituent	Last Significant IRIS Update ¹	OU/Area	Other Sources ²
Bromomethane	Apr-01-1992	May 2018	
Bromodichloromethane	Feb-01-1993	May 2018	CalEPA IUR, PPRTV RfD
Carbon tetrachloride	Mar-31-2010	OU III-Groundwater	
Chloroethane	Apr-01-1991	OU I-Leaking Tanks	PPRTV RfC
Copper	Sep-07-1988	OU V-STP	HEAST RfD
1,1-Dichloroethane	Oct-01-1990	OU I- Leaking Tanks	PPRTV RfD, Cal EPA SFO and IUR
1,2-Dibromo-3-chloropropane (DBCP)	Oct-01-1991	June 2015	PPRTV RfD, SFO, IUR
1,2-Dibromoethane (EDB)	Jul-29-2004	OU VI	

(continued on next page)

MEMO

Constituent	Last Significant IRIS Update ¹	OU/Area	Other Sources ²
Benzene	Apr-17-2003	OU IV - Oil/Solvent Tank	
Ethylbenzene	Mar-01-1991	OU IV-Oil/Solvent Tank	Cal EPA SFO and IUR, PPRTV RfD
Freon-11 (Trichlorofluoromethane)	Jan-31-1987	Building 452	
Freon-12 (Dichlorodifluoromethane)	Jan-31-1987	(OU III)	PPRTV Screening Level RfC
Lead and compounds (inorganic)	Jul-08-2004	OU I-Former Landfills	
Tetraethyl lead	Jan-31-1987		
Mercury (elemental)	Jun-01-1995	OU I-Former Landfills	
Mercury (methyl)	Jul-27-2001	OU V-STP	
Mercuric chloride	May-01-1995		
Methylene chloride (Dichloromethane)	Nov-18-2011	June 2015	
Polychlorinated Biphenyls (PCBs)	Oct-01-1996	OU V-STP	
Radionuclides"		OU I-Former Landfills (Cs-137 and Sr-90)	
Cesium-137	Strontium stable - Oct-01-1992	OU II/VII (Cs-137)	
Strontium-90		OU III-Groundwater (Sr-90, tritium)	
Tritium		OU IV (Sr-90)	
		OU V-STP (Cs-137)	
		BGRR (Cs-137, Sr-90)	
		g-2/BLIP/USTs	
		HFBR-Tritium	
Semi-volatile Organic Compounds (SVOC)	Benzo(a)pyrene Jan-19-2017	OU IV-Oil/Solvent Tank	
Polycyclic Aromatic Hydrocarbons (PAHs)			
Silver	Dec-01-1991	OU V-STP	
Tetrachloroethene (PCE)	Feb-10-2012	OU III-Groundwater	
Toluene	Sep-23-2005	OU IV-Oil/Solvent Tank	

(continued on next page)

Constituent	Last Significant IRIS Update ¹	OU/Area	Other Sources ²
Trichloroethene (TCE)	Sep-28-2011	OU V-STP	
1,1,1-Trichloroethane (TCA)	Sep-28-2007	OU III-Groundwater	
Trimethylbenzenes (1,2,3-; 1,2,4-; and 1,3,5-)	Sep-09-2016	June 2017	
PFOS, PFOA	Dec-01-2024	OUX	
1,4-Dioxane	Sep-20-2013	OUX	

Notes:

¹ EPA IRIS accessed online at: <https://www.epa.gov/iris>

² Sources other than IRIS identified by EPA in the Regional Screening Level Table (November 2024 update) available online at: <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>. These sources are Tier 2 (PPRTVs) and Tier 3 (CalEPA) sources identified in the EPA's hierarchy of human health toxicity values (EPA 2003) and include:

- EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) developed by the Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) on a chemical specific basis when requested by EPA's Superfund program.
- The California Environmental Protection Agency (Cal EPA) toxicity values are peer reviewed and address both cancer and non-cancer effects. Cal EPA toxicity values are available on the Cal EPA internet website at <http://www.oehha.ca.gov/risk/chemicalDB/index.asp>.

Additionally, mercury salts (inorganic), methyl mercury, ethylbenzene, and PCBs are currently being reassessed under IRIS and all are in Step 1 of the process, which is *Draft Development* and includes with a comprehensive search and systematic review of the scientific literature. Steps 2 through 6 involve agency review, interagency consultation, public comment and external peer review, revised assessment, and final agency review and interagency discussion. The process ends at Step 7 with a Final IRIS Assessment.

As shown in the table above, no changes in toxicity values are documented since the 2021 Five Year Review Report (BNL 2021). New COCs have been added, namely PFOS, PFOA, and 1,4-dioxane, and toxicity values for PFOS and PFOA are the most current (2024). Any changes in these toxicity values do not have bearing on the New York State Soil Cleanup Objectives developed in 2010 or maximum contaminant levels, which are not necessarily risk based, they are (or may be) changes from what was estimated at the time of the RODs.

Lead

Lead, a COC in soil at OU I has a cleanup level of 400 mg/kg, which was the EPA Regional Screening Level for residential soil and the New York State soil cleanup objective for residential and restricted residential use, and commercial or industrial use. This cleanup level is protective of residential exposure to lead in soil based on a target blood lead level of 10 µg/dL in children. Since the time that target blood lead level was set and recommended by EPA (1994 and later), increasing evidence has shown that blood lead levels below 10 micrograms per deciliter (µg/dL) may also have negative health impacts to sensitive receptors of children and pregnant women which may not be applicable to soil at BNL OU1 I. On December 22, 2016, the Office of Land and Emergency Management (OLEM) issued Directive 9200.2-167 (EPA 2016a), stating:

“The current scientific literature on lead toxicology and epidemiology provides evidence that adverse health effects [in children] are associated with blood lead levels less than 10 µg/dL.”

The Directive specifically referenced the 2012 National Toxicology Program's (NTP's) Monograph on Health Effects of Low-Level Lead (NTP 2012), which found sufficient evidence of effects including delayed puberty, reduced post-natal growth, and decreased hearing for children with blood lead levels below 10 µg/dL, and on academic achievement, IQ, other cognitive measures, attention-related behaviors, and problem behaviors at blood lead levels below 5 µg/dL. The Directive also referenced the EPA's 2013 Integrated Science Assessment for Lead (EPA 2013), which found clear evidence of cognitive function deficits at blood lead levels between 2 and 8 µg/dL. In October 2021, the Centers for Disease Control and Prevention again lowered the target blood lead level to 3.5 µg/dL based on more recent data (collected from 2015-2016 and 2017-2018).

As of October 2025, the EPA's guidance is to use:

- A removal management level of 600 parts per million.
- A regional screening level of 200 mg/kg for lead in residential soil.
- A target children's blood lead level of 5 µg/dL to develop preliminary remediation goals.

Therefore, the lead cleanup value of 400 mg/kg may no longer be protective.

Radionuclides

Federal Guidance Report 15, entitled *External Exposure to Radionuclides in Air, Water and Soil* (EPA 2019), updated and expanded the 1993 Federal Guidance Report No. 12 to include age-specific reference person effective dose rate coefficients based on external exposure. The changes include updated tissue weighting factors as recommended in ICRP Publication 103 and radionuclide decay data as provided in ICRP Publication 107, and with updated computing power, provides more precise calculations. While this change does not affect maximum contaminant levels, risk-based levels and risk assessment for external exposure would be affected.

Additionally, the 2021 Five Year Review Report (BNL 2021) indicates soil cleanup levels for radionuclides at OU1 are based on 15 millirem per year (mrem/year) above background. As stated in the EPA memorandum on *Radiation Risk Assessment At CERCLA Sites: Q&A* (EPA 2014a), the Superfund recommendation is now 12 mrem/year as the dose-based level protective of a target cancer risk of 1×10^{-4} . This could also have some effect on risk-based levels of radionuclides in soil.

In comments on the 2021 Five Year Review Report (BNL 2021), EPA requested that BNL conduct a calculation using the EPA radiological preliminary remediation goal (PRG) calculator vs. the RESidual RADiation (RESRAD) code. In 2015, Argonne National Laboratory (ANL) released the report, *RESRAD [version 7.0] for Radiological Risk Assessment: Comparison with EPA Tools – PRG and DCC Calculators* (ANL 2015), in which they noted several differences between the PRG calculator and RESRAD. Some differences mentioned in this document include statements about radionuclides that are COCs, including:

Water-Independent Pathways (direct contact with soil, external gamma radiation from soil, inhalation of dust from soil)

- Overall, for the COCs Cs-137, Ra-226, Sr-90, tritium, the water-independent pathways (direct contact with soil, external gamma radiation from soil, inhalation of dust from soil), the results from PRG and RESRAD are comparable, as noted in TABLE 3.2-5 Comparison of Cancer Risks Associated with Water-independent Pathways at Time 0 – Total versus Parent Contributions of the ANL document.
- However, for tritium, the authors noted that the PRG calculator uses the assumption that all the air moisture above the center of the contaminated area results from the evaporation of soil water in the contaminated zone, which is reasonable only when the contaminated area is infinitely large. Therefore, the PRG calculator overestimates the potential cancer risk associated with the inhalation of tritium by a factor of about 50 (ANL 2015).
- The authors also reported for Ra-226, that the most critical pathways (or routes of exposure) identified by the PRG Calculator and RESRAD are different, with ingestion of produce being the most critical in the PRG calculator, and external gamma radiation the most critical in RESRAD (ANL 2015). This is due to very conservative plant uptake factors incorporated into the PRG calculator.
- The PRG calculator does not analyze the exposures associated with the inhalation of radon that is generated by the decay of Ra-226 in soils and diffuses to the outdoor atmosphere or to a confined space inside a residence (or building), so the radon inhalation pathway in RESRAD was included in the evaluation.

EPA does, however, have separate radon vapor intrusion screening levels available at: <https://epa-visi.ornl.gov/radionuclides/>. The default risk-based target sub-slab and exterior soil gas and groundwater concentrations for resident and commercial worker, protective of a target cancer risk of 1×10^{-6} , are shown in the table below.

Constituent	Target Sub-Slab and Exterior Soil Gas Concentration (pCi/m ³)		Target Groundwater Concentration (pCi/L)	
	Resident	Commercial Worker	Resident	Commercial Worker
Rn-219	5.92	10	0.0409	0.0694
Rn-220	1.08	3.88	0.00744	0.0268
Rn-222	1.52	2.6	0.0105	0.018

Water-Dependent Pathways (leaching from soil to groundwater and subsequent ingestion of groundwater, irrigation of produce and subsequent consumption of produce)

- For water-dependent pathways (leaching from soil to groundwater and subsequent ingestion of groundwater, irrigation of produce and subsequent consumption of produce), the authors reported leachate concentrations of Cs-137, Ra-226, and Sr-90 were greatly overestimated based on the default Distribution Coefficients (Kds) in the PRG calculator versus those in RESRAD.
- The authors reported some misuse of cancer slope factors for inhalation of radon progeny from Ra-226 associated with use of groundwater in a potable water scenario.
- For estimating radionuclide concentration in a contaminated well, RESRAD considers the loss of radionuclide inventory in the contaminated zone through radiological decay and leaching during the transport through the unsaturated zone and in the groundwater aquifer, while the PRG calculator considers only radiological decay and does consider transport conditions. This results in decrease in radionuclide concentration with time and the parent nuclide concentration in the leachate is greater with RESRAD than with the PRG calculator, but also is the most significant cause of the difference in groundwater concentration calculated by RESRAD and the PRG calculator and depends on the transport assumptions used in RESRAD. This difference is marked for Ra-226, given default assumptions.

For the radionuclides studied by the authors (including the COCs identified in the table above), the PRG calculator's results, the risk from the ingestion of water pathway accounted for 64% to 79% of the total risk (except for COCs Ra-226 and tritium), while the RESRAD results for the risk from the ingestion of water pathway accounted for 86% to 98% of the total risk (except for the COC Cs-137).

Lastly, one significant difference between the PRG calculator and RESRAD at the time of the evaluation (2015), was that the PRG calculator did not have the capability to model the variation of radionuclide concentration as a function of time; for example, such as long-lived progeny ingrowth during exposure duration, and water pathway delay during transport through unsaturated and saturated zones. However, in October 2020, the PRG calculator added a new output option, called peak PRG, which calculates the activity of the parent radionuclide to be protective of the peak risk for the entire decay chain over time.

Therefore, today the PRG calculator has a component to assess long-lived progeny. However, the PRG calculator still does not account for decay and ingrowth during transport through unsaturated and saturated zones. Based on local hydrogeology, the modeling of this transport in RESRAD may or may not result in differences in groundwater concentrations from the PRG calculator.

An evaluation of differences between use of PRG calculator vs. RESRAD to calculate risks and remedial goals may or may not result in differences, depending on the initial modeled pathways and assumptions in the risk assessments/feasibility studies.

EXPOSURE PARAMETERS

In general, the changes in standard default exposure parameters from the EPA's memorandum *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors*, OSWER Directive 9200.1-120 issued on February 6, 2014 (EPA 2014b) (2014 Standard Default Exposure Factors) served to raise risk-based concentrations. In most cases the mix of higher and lower individual parameters result in higher risk-based concentrations. For example, while the adult tapwater ingestion rate was increased from 2 liters per day (L/day) to 2.5 L/day, the child tapwater ingestion rate was decreased from 1 liter per day (L/day) to 0.78 L/day, and while the adult total body skin surface area was increased from 18,000 squared centimeters (cm²) to 19,652 cm² the child's was decreased from 6,600 cm² to 6,365 cm². Combined with the increase in adult body weight from 70 kilograms (kg) to 80 kg and decreased total residential exposure duration from 30 years to 26 years, resulting tapwater regional screening levels increased overall.

The EPA 2014 Standard Default Exposure Factors also indicate that the fish consumption rate which was 54,000 milligrams per day (mg/day) or 54 grams per day (g/day) should be determined on a site-specific basis. Note that a fish consumption rate of 54 g/day equates to approximately 2 meals per week and the Peconic River in the vicinity of BNL may not support sustained catches for 2 meals per week over a 52-week year for a 30- or 26-year residential exposure duration. The fish consumption rate used to establish national ambient water quality criteria is now 22 g/d, which represents the 90th percentile consumption rate of fish and shellfish from inland and nearshore waters for the United States adult population 21 years of age and older, based on NHANES data from 2003 to 2010 (EPA 2014c). Recreational fish consumption is likely lower. Fish consumption rates should be reviewed in the event risk assessment or risk-based values protective of fish consumption are required in future Five Year Reviews or other documentation.

PFAS AND 1,4-DIOXANE

The following section outlines the current state and federal regulatory and screening values for Per- and Polyfluoroalkyl Substances (PFAS), particularly Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS), and also for 1,4-dioxane.

Groundwater/Drinking Water (Tapwater)

New York State (NYS)

In 2020, New York State (NYS) Department of Health set maximum contaminant levels (MCLs) of 10 nanograms per liter (ng/L) or parts per trillion (ppt) or 0.01 micrograms per liter (µg/L) or parts per billion (ppb) each for PFOA and PFOS, and 1 µg/L or ppb for 1,4-dioxane. NYS is working to pass even more drinking water standards and notification levels for up to 23 PFAS compounds. However, Senate Bill 149 was introduced on January 7, 2026 and referred to the Committee on Health, which requires the NYS department of health and DEC to establish a maximum contaminant level of 0.35 parts per billion for the

presence of 1,4-Dioxane in public supplies of potable water, ground water and runoff water from a wastewater treatment plant or water supply treatment plant.

Federal

On April 10, 2024, EPA announced the final National Primary Drinking Water Regulations (NPDWR) for six PFAS, including MCLs of 4 ppt or 0.04 ppb each for PFOA and PFOS. However, on May 14, 2025, EPA announced while the agency will keep the current NPDWR for PFOA and PFOS, it intends to rescind the regulations and reconsider the regulatory determinations for Perfluorohexanesulfonic acid (PFHxS), Perfluorononanoic acid (PFNA), Hexafluoropropylene oxide dimer acid (HFPO-DA) (commonly known as GenX), and the Hazard Index mixture of these three PFAS plus Perfluorobutanesulfonic acid (PFBS) to ensure the determinations and any resulting drinking water regulation follow the Safe Drinking Water Act process. For more information, see EPA's Press Release accessed online at:

<https://www.epa.gov/newsreleases/epa-announces-it-will-keep-maximum-contaminant-levels-pfoa-pfos>.

The current (November 2024) EPA tapwater Regional Screening Levels (RSLs) for PFOA, PFOS, and 1,4-dioxane are shown in the table below. RSLs are protective of a target cancer risk of 1×10^{-6} and, for screening purposes, a target noncancer hazard quotient of 0.1.

Constituent	Tapwater RSL (ppb or µg/L)
PFOS	0.0002
PFOA	0.0000027
1,4-Dioxane	0.46

Cleanup levels are typically defined as the lower of the state and federal MCLs, which in the case of PFOS and PFOA, are the federal MCLs at 4 ng/L each.

Soil

New York State (NYS)

The NYS Department of Environmental Conservation (DEC) is developing soil cleanup standards for Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS). As part of that effort, NYS DEC was required to consider rural soil background concentrations. Based on a study of background concentrations, NYS DEC proposes to use the Upper Tolerance Limit (95-95 UTL) to establish soil background concentrations of 3.0 µg/kg (ppb) for PFOS and 1.5 µg/kg (ppb) for PFOA. The NYS DEC provided the following “guidance values” under Commissioner’s Policy 51 (CP-51) for two PFAS compounds to be used until formal soil cleanup objectives (SCOs) are established under Part 375.

Guidance Value	PFOA (µg/kg or ppb)	PFOS (µg/kg or ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440

Protection of Groundwater	0.8	1
Protection of Ecological Resources	570	8.7

There is no proposed soil cleanup objective for 1,4-dioxane.

Federal

The current (November 2024) EPA RSLs for residential and industrial soil are shown in the table below. RSLs are protective of a target cancer risk of 1×10^{-6} and, for screening purposes, a target noncancer hazard quotient of 0.1.

Constituent	Residential Soil RSL (ppb or $\mu\text{g/kg}$)	Industrial Soil RSL (ppb or $\mu\text{g/kg}$)
PFOS	0.63	8.2
PFOA	0.019	0.078
1,4-Dioxane	5,300	24,000

Surface Water

New York State (NYS)

In February 2023, the NYS DEC issued Final Ambient Water Quality Guidance Values (AWQGVs) to regulate PFOA, PFOS, and 1,4-dioxane. These guidance values are lower than the State drinking water standards that were established in 2020. The guidance values are applied as discharge effluent limits to industrial discharges that require State Pollutant Discharge Elimination System (SPDES) permits, which include groundwater remediation systems with SPDES equivalency permits managed by the Division of Environmental Remediation. The discharge effluent limit values are 2.7 nanograms per liter (ng/L or ppt) for PFOS, 6.7 ng/L or ppt for PFOA, and 0.35 $\mu\text{g/L}$ or ppb for 1,4-dioxane.

Federal

On December 26, 2024 the EPA published draft National Recommended Ambient Water Quality Criteria for PFOA, PFOS, and PFBS, shown in the table below.

Constituent	NRWQC Water + Organism Human Health Criteria (ppt or ng/L)	NRWQC Organism Only Human Health Criteria (ppt or ng/L)
PFOA	0.0009	0.00036
PFOS	0.06	0.07
PFBS	400	500
1,4-Dioxane	5,300	24,000

There are also final NRWQC protective of Aquatic Life in freshwater, criterion maximum concentration (CMC) (acute) and criterion continuous concentration (CCC) (chronic), for PFOA and PFOS, as shown in the following table. There are NRWQC for other PFAS, which were not summarized below.

Constituent	NRWQC Freshwater CMC (ppb or µg/L)	NRWQC Freshwater CCC (ppb or µg/L)
PFOA	3,100	100
PFOS	71	0.25

Ambient Air

New York State (NYS)

The NYS DEC has also set air guidelines for PFOA and 1,4-dioxane in the DAR-1 Guidelines for the Evaluation and Control of Ambient Air Contaminants Under 6NYCRR Part 212, issued February 12, 2021, as shown in the table below.

Constituent	Short-Term Guideline Concentrations (SGC) (µg/m³)	Annual Guideline Concentrations (AGC) (µg/m³)
PFOA	--	0.0053
1,4-Dioxane	3,000	0.20

The AGC for PFOA was derived using an inhalation reference dose based on route-to-route extrapolation from an oral reference dose. The oral reference dose used was 0.00002 milligram per kilogram per day (mg/kg-day) derived by EPA for both PFOS and used to derive the health advisory level of 70 ppt (EPA 2016b, 2016c). However, since that time the IRIS assessment for PFOA was finalized and the oral reference dose now three orders of magnitude lower (0.00000003 mg/kg-day). For 1,4-dioxane, the AGC is based on the IRIS reference concentration or unit risk values, presumably consistent with the current IRIS values.

Federal

Although there are no current regulations for PFAS or 1,4-dioxane as hazardous air pollutants, a bill (H.R. 6990) known as the Protect Act (Prevent Release of Toxics Emissions, Contamination and Transfer) was introduced and referred to the House Committee on Energy and Commerce on January 8, 2026, which directs the EPA Administrator to direct the Administrator of the Environmental Protection Agency to issue a final rule adding PFAS as a class of substances to the list of hazardous air pollutants under section 112(b) of the Clean Air Act (42 U.S.C. 7412(b)) (see: <https://trackbill.com/bill/us-congress-house-bill-6990-to-direct-the-administrator-of-the-environmental-protection-agency-to-issue-a-final-rule-adding-as-a-class-all-perfluoroalkyl-and-polyfluoroalkyl-substances-with-at-least-one-fully-fluorinated-carbon-atom-to-the-list-of-hazardous-air-pollutants-under-section-112-b-of-the-clean-air-act-42-u-s-c-7412-b-and-for-other-purposes/2766467/>).

The current (November 2024) EPA RSLs for 1,4-Dioxane in residential and industrial air are shown in the table below. There are no EPA RSLs for PFAS in air. RSLs are protective of a target cancer risk of 1×10^{-6} and, for screening purposes, a target noncancer hazard quotient of 0.1.

Constituent	Residential Air RSL (µg/m³)	Industrial Air RSL (µg/m³)
1,4-Dioxane	0.56	2.5

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High Flux Beam Reactor

5 Year Review of Radiological Decay for the High Flux Beam Reactor (HFBR) 65-Year Safe Storage (Decay) Period

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Prepared by:

DAQ, Inc. for

Brookhaven National Laboratory
Environmental Restoration Projects
Upton, New York 11973

Prepared by: Dennis Quinn Date: 2-16-2026
Dennis Quinn, CHP

Reviewed by: Scott H. Mon Date: 3/04/2026

Approved by: Brian Barts Date: 3/10/2026

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

Purpose

The purpose of this document is to calculate the expected decay for HFBR large, activated components in 2025 compared to the previous evaluation in 2020 and to determine if the information gathered from radiation surveys warrant a change in the 65-year safe storage period specified in the High Flux Beam Reactor (HFBR) Record of Decision (ROD).

Summary and Recommendations

1. Calculations were performed to update the radiological inventory of the HFBR.
2. A survey was performed in September 2025 to determine if the radiological decay was proceeding as expected based on the previously determined radionuclide mix, and the reduction in dose rate closely matches the predicted reduction.
3. Based on this close agreement between actual and predicted radiation levels, the calculated dose rates for the large, activated components are also expected to be reasonably accurate. Therefore, it is reasonable to maintain the safe storage (decay) period of 65 years:

Recommendation: For future surveys of the HFBR Reactor Vessel, use a probe more sensitive than the AMP-100. The readings at 2 ft and 4 ft from the V-14 port are below the detection limit of the probe, and the reading at 10 ft is approaching the limit of detection.

Background Information

The HFBR ROD stated that the following additional investigations would be performed:

- Perform radiation surveys (measurements of radiation levels) after the removal of the Control Rod Blades (CRB) from the reactor vessel. (complete)
- Reevaluate the dose rate at 1 ft from the large, activated components (reactor vessel, thermal shield, and biological shield) based on the radiation surveys. (complete)
- Using the reevaluated dose rates, determine the decay period necessary for the dose rate at 1 ft to fall below 100 mrem/hr for the large, activated components, including the limiting component, which is the thermal shield. (complete)
- Use the results of the radiation surveys every 5 years to assess the feasibility of shortening the decay period.

Basis for the 65-year Safe Storage (Decay) Period

For activated components involving short-lived radioisotopes, decay-in-storage results in a substantial reduction in dismantlement and waste management risks, hazards, project complexity, and cost.

The 65-year safe storage (decay) period was selected based on the estimated time when the radiation dose rates associated with the large components (reactor vessel, thermal shield, and biological shield) would be reduced below 100 mrem/hr at a distance of 1 ft in air from the component. Of these large components, the thermal shield has the highest activity and dose rate. While there are other high activity components, such as the transition plate and the anti-critical

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

grid, these are smaller components that can be handled remotely. The large components will need to be segmented because they are too large and too heavy to fit into transportation casks in one piece. Currently, because of the high radiation dose rates, the large components would need to be segmented and handled under water. Several feet of water would be needed to serve as a radiation shield to protect the workers from the high radiation levels. Therefore, a waiting period will allow radioactive decay to reduce the radiation dose rate to below 100 mrem/hr at a distance of 1 ft. At this dose rate, it would not be necessary to perform the segmentation and handling operations under water.

The 100 mrem/hr value was selected because it is the standard nuclear industry benchmark used to distinguish a “radiation area” from a “high radiation area.” More importantly, the segmentation of the large components could be carried out in “air” (i.e., without the need to perform the work under water).

Based on detailed activation analysis conducted in 2007, the 100 mrem/hr dose rate for the limiting large component (the component with the highest dose rate, the thermal shield) will be reached after a decay period of approximately 65 years. Figures 1 and 2 show, in increasing detail, the dose rates for the large, activated components from 2007 to 2072 and 2032 to 2087, respectively. Figure 3 shows the thermal shield dose rates over time. As shown in Figures 2 and 3, the 100 mrem level for the thermal shield is reached after a decay period of approximately 65 years in 2072.

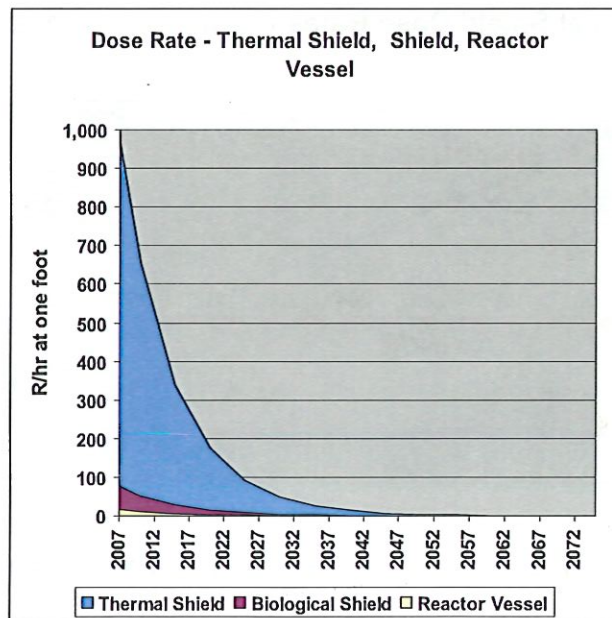


Figure 1 – Dose Rate 2007 – 2072

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

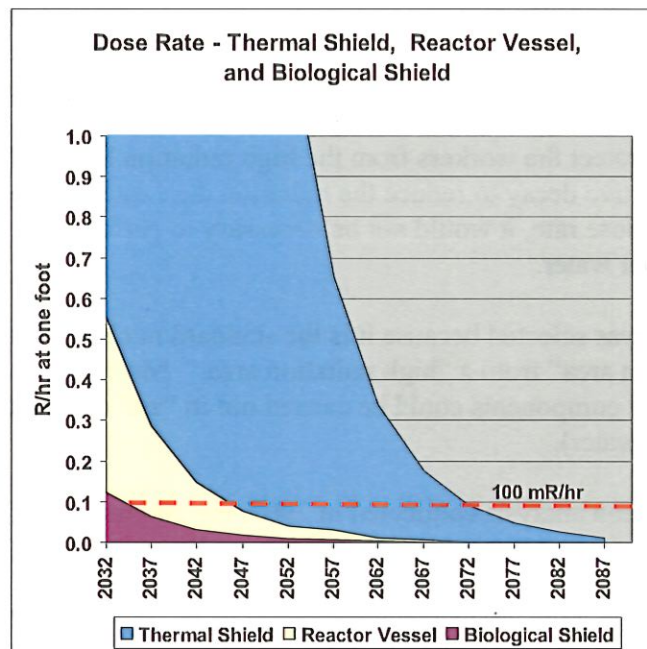


Figure 2 – Dose Rate (Detail) 2032 – 2087

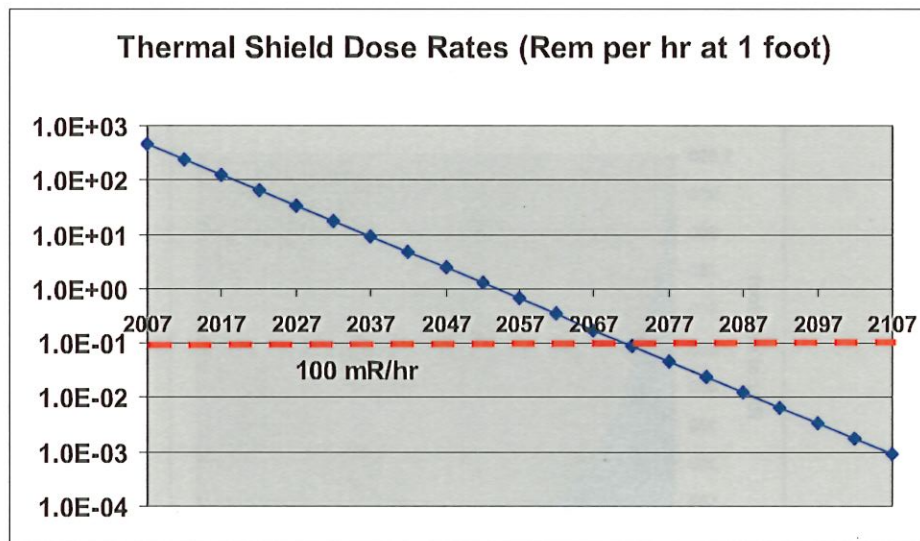


Figure 3 – Thermal Shield Dose Rates 2007 – 2107

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

The calculated dose rates for large, activated components (based on activation analysis) are presented in Table 1.

Table 1 – HFBR Large Activated Components: Calculated Dose Rates with Radioactive Decay

Component	Dose Rate 2007	Current Dose Rate (2025)	Dose Rate - 50 years (2057)	Dose Rate - 65 years (2072)
Reactor Vessel	15,000 mR/hr	1,290 mR/hr	21 mR/hr	3 mR/hr
Thermal Shield	471,000 mR/hr	40,500 mR/hr	650 mR/hr	91 mR/hr
Biological Shield	3,000 mR/hr	260 mR/hr	5 mR/hr	< 1 mR/hr

Recognizing that there are uncertainties inherent in activation analyses, the HFBR ROD included the requirement to conduct an evaluation based on radiation surveys conducted after the removal of the CRBs from the reactor vessel.

Radiation Decay Calculations

Inventories of HFBR components were calculated based on the previously determined radionuclide mix and the radioactivity was decayed to 9/1/2025. These calculations include the following:

- Table 2: Reactor Vessel Internals
- Table 3: Reactor Vessel
- Table 4: Thermal Shield
- Table 5: Biological Shield and Liner

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

Table 2: HFBR Reactor Vessel Internals – Radiological Inventory 9-9-2025 (Curies)

Internal Component	C-14	Fe-55	Co-60	Ni-59	Ni-63	Zn-65	Nb-94	Tc-99	Total for Component
Grid Plate w/ Aux Blade Guide	0.00E+00	2.10E-01	4.66E-01	1.01E-01	2.86E+01	4.53E-11	0.00E+00	0.00E+00	2.94E+01
Saddle	0.00E+00	2.04E-02	4.52E-02	9.77E-03	2.78E+00	4.38E-12	0.00E+00	0.00E+00	2.85E+00
Flow Shroud	0.00E+00	9.56E-03	2.11E-02	4.56E-03	1.29E+00	2.05E-12	0.00E+00	0.00E+00	1.33E+00
Core Edge Thimble	0.00E+00	3.55E-02	7.86E-02	1.70E-02	4.83E+00	7.62E-12	0.00E+00	0.00E+00	4.96E+00
Fast Thimble	0.00E+00	3.82E-02	8.45E-02	1.83E-02	5.19E+00	8.19E-12	0.00E+00	0.00E+00	5.33E+00
Transition Plate	1.05E+01	3.32E+01	4.29E+02	2.34E+01	4.66E+03	0.00E+00	4.74E-02	4.20E-04	5.16E+03
Anti-Critical Grid	7.64E-01	2.47E+00	5.58E+01	4.75E+00	5.05E+02	0.00E+00	4.06E-03	3.70E-05	5.69E+02
Anti-Critical Grid Holdown Nuts	7.43E-02	2.37E-01	3.75E+00	2.33E-01	3.84E+01	0.00E+00	3.57E-04	3.20E-06	4.26E+01
Grid Plate Holdown Bolts	1.47E-01	4.63E-01	5.84E+00	3.13E-01	6.39E+01	0.00E+00	6.57E-04	5.90E-06	7.06E+01
Grid Plate Holdown Studs	5.64E-02	1.80E-01	2.84E+00	1.77E-01	2.91E+01	0.00E+00	2.71E-04	2.40E-06	3.24E+01
Saddle Holdown Cap Screws	1.23E-01	3.93E-01	6.21E+00	3.86E-01	6.35E+01	0.00E+00	5.91E-04	5.30E-06	7.06E+01
Grid Plate Locating Pins	2.10E-02	6.62E-02	8.34E-01	4.47E-02	9.15E+00	0.00E+00	9.38E-05	8.40E-07	1.01E+01
Support Tube (both)	2.69E-05	8.78E-05	2.03E-03	1.77E-04	1.81E-02	0.00E+00	1.44E-07	1.55E-07	2.04E-02
Main Rack Assembly	3.19E-05	1.03E-04	2.41E-03	2.10E-04	2.16E-02	0.00E+00	1.71E-07	1.84E-07	2.43E-02
Aux Rack Assembly	3.77E-02	1.23E-01	2.84E+00	2.48E-01	2.54E+01	0.00E+00	2.02E-04	2.17E-04	2.87E+01
Total Reactor Internals	1.2E+01	3.7E+01	5.0E+02	2.9E+01	5.4E+03	6.8E-11	5.3E-02	4.7E-04	6.0E+03

Table 3: HFBR Reactor Vessel – Radiological Inventory 9-9-2025 (Curies)

Portion of Reactor Vessel	Fe-55	Co-60	Ni-59	Ni-63	Zn-65	Total for Component
Vessel Sphere - top 1/3	3.0E-01	6.7E-01	1.4E-01	4.1E+01	6.6E-11	4.22E+01
Vessel Sphere - Center 30"	7.2E-01	1.6E+00	3.4E-01	9.9E+01	1.6E-10	1.01E+02
Vessel Sphere - Bottom 1/3	2.6E-01	5.7E-01	1.2E-01	3.5E+01	5.7E-11	3.61E+01
Vessel Cylinder Bottom 3 ft	9.3E-04	2.1E-03	4.4E-04	1.3E-01	2.0E-13	1.29E-01
Total	1.3E+00	2.8E+00	6.1E-01	1.7E+02	2.8E-10	1.80E+02

Table 4: HFBR Thermal Shield - Radiological Inventory 9-9-2025 (Curies)

Portion of Thermal Shield	C-14	Fe-55	Co-60	Ni-59	Ni-63	Nb-94	Total for Component
Upper Thermal Shield	1.5E+00	3.7E+01	5.4E+01	3.6E+00	3.7E+02	9.3E-03	4.6E+02
Lower Thermal Shield	5.7E+00	1.4E+02	2.0E+02	1.1E+01	1.3E+03	3.4E-02	1.6E+03
Total Thermal Shield	7.2E+00	1.7E+02	2.5E+02	1.4E+01	1.6E+03	4.3E-02	2.1E+03

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

Table 5: HFBR Bioshield and Liner - Radiological Inventory 9-9-2025 (Curies)

Portion of Bioshield	H-3	C-14	Ca-41	Fe-55	Co-60	Ni-59	Ni-63	Nb-94	Total for Component
Bioshield Concrete	2.5E+00	2.7E-02	3.4E-02	6.4E-01	7.3E-01	4.8E-02	4.9E+00	1.3E-04	8.9E+00
Bioshield Liner	0.0E+00	8.8E-03	0.0E+00	2.1E-01	3.1E-01	2.1E-02	2.1E+00	5.3E-05	2.7E+00
Total Bioshield	2.5E+00	3.6E-02	3.4E-02	8.5E-01	1.0E+00	6.9E-02	7.0E+00	1.8E-04	9.0E+00

Radiation Surveys

Following the removal of the CRBs, a radiological survey was conducted inside the HFBR Reactor Vessel inside the V-14 port on 6/29/2010. The detector was lowered into the reactor vessel at locations 2 feet, 4 feet, and 10 feet below the Reactor Vessel Flange. This survey was then repeated on 6/3/2015, on 7/29/2020, and most recently on 9/9/2025. The September 2025 survey is included as Attachment 1.

Table 6 provides a comparison of the survey data from 2010, 2015, 2020 and 2025. The readings at 10' below the flange are expected to be the most accurate, as they will be the closest to the activated components, particularly the transition plate. The transition plate dose rate is dominated by Cobalt-60 (Co-60), so the dose rate is expected to follow the decay of Co-60 with a 5.3-year half-life. The reduction of the 10' reading dose rate closely follows the fraction of Co-60 in the transition plate and therefore supports the continuation of the current remedial action plan.

Table 6: HFBR Measured Dose Rates inside Reactor Vessel (mR/hr)

Survey Location	6/29/2010	6/3/2015	7/29/2020	9/9/2025
2' below vessel flange	0	0	1	0
4' below vessel flange	2	3	1	0
10' below vessel flange	12	6	3	1.5*
fraction of 6/29/10 dose rate	1.00	0.50	0.25	0.125
Co-60 in transition plate (Ci)	3166	1656	840	429
fraction of 6/29/10 Ci	1.00	0.52	0.27	0.14
* Readings varied between 1.0 and 2.0 mR/hr; the average reading is listed.				

5 Year Review of Radiological Decay for the HFBR 65-Year Safe Storage Period

Summary and Conclusion

1. Calculations were performed to update the radiological inventory of the HFBR.
2. A survey was performed in September 2025 to determine if the radiological decay was proceeding as expected based on the previously determined radionuclide mix, and the reduction in dose rate closely matches the predicted reduction.
3. Based on this close agreement between actual and predicted radiation levels, the calculated dose rates for the large, activated components are also expected to be reasonably accurate. Therefore, it is reasonable to maintain the safe storage (decay) period of 65 years.

Recommendation: For future surveys of the HFBR Reactor Vessel, use a probe more sensitive than the AMP-100. The readings at 2 ft and 4 ft from the V-14 port are below the detection limit of the probe, and the reading at 10 ft is approaching the limit of detection.

Attachment 1: Radiation Survey of HFBR Reactor Vessel on 9-1-2025

RADIOLOGICAL SURVEY FORM FS-SOP-1000		REASON FOR SURVEY		INSTRUMENT																																																																																																			
ROUTINE	5 Year	SPECIAL		Model #	Serial #																																																																																																		
SWP	GPC-25-002	WFS		Ltd-3	70090																																																																																																		
DATE	09/09/25	TIME	0930	AMP-100	IN06895																																																																																																		
LOCATION / EQUIPMENT	Bldg 750 OPS Level Pile Top			N	A																																																																																																		
				N	A																																																																																																		
				LEGEND ○ - SMOKE SURVEY LOCATION △ - AIR SAMPLE LOCATION □ - MASSLON SURVEY LOCATION # - DETECT FRISK LOCATION ⊞ - CONTAMINATION AREA * - Contact Dose Rate XXX - XXX - contact reading Y - radiation type ZZZ - reading @ Y feet AIRBORNE ACTIVITY SURVEY <table border="1"> <thead> <tr> <th>Sample #</th> <th>Direction</th> <th>Flow Rate</th> <th>cpm</th> <th>μCi/cv</th> <th>% DAC</th> </tr> </thead> <tbody> <tr> <td>N/A</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> DOSE RATE (HIGHEST) CONTACT READING See Notes GENERAL AREA READING NA MASSLON SURVEY RESULTS (in dpm) <table border="1"> <thead> <tr> <th>1.</th> <th>2.</th> <th>3.</th> <th>4.</th> <th>5.</th> <th>6.</th> </tr> </thead> <tbody> <tr> <td><1K dpm</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> SNEAR SURVEY LOCATIONS (dpm/100cm²) α, β-γ, 7H <table border="1"> <thead> <tr> <th>1.</th> <th>2.</th> <th>3.</th> <th>4.</th> <th>5.</th> <th>6.</th> <th>7.</th> </tr> </thead> <tbody> <tr> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Sample #	Direction	Flow Rate	cpm	μCi/cv	% DAC	N/A						1.	2.	3.	4.	5.	6.	<1K dpm	NA	NA	NA	NA	NA																			1.	2.	3.	4.	5.	6.	7.	NA	NA	NA	NA	NA	NA	NA																																										
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Notes:

- 5 Year survey of V-14 Port for dose rates.
- Reading at 2 feet: 0.0 mR/hr
- Reading at 4 feet: 0.0 mR/hr
- Reading at 10 feet: 1.0 to 2.0 mR/hr
- LAW of flange and inside port opening. Floor around cover plate and AMP-100 probe and cord after survey all < 1K dpm/LAW.
- Risk of AMP-100 probe and cord ≤ BKG. BKG = 50 cpm.

Distances were measured out with a tape measure and marked with a smear on the cable prior to survey. The picture shows the probe in the V-14 port at 10 feet.

The 10 ft reading would "bounce" from 1.0 to 2.0 mR/hr

The probe was held at each distance for approximately 30 seconds to get a stable reading.

Surveyed By: Rovig  Date: 9/09/25 Reviewed By:  Date: 9/10/25

FS-SOP-1000
Attachment 9.2

Attachment 5

Operable Unit Cleanup Levels Matrix

Attachment 5
Operable Unit Cleanup Levels Matrix

OU	Contaminants of Concern	Cleanup Levels			Note any Changes to Cleanup Levels	Remedial Action Objectives
		Soil		Groundwater		
		Residential	Industrial			
I	Cesium-137	23 pCi/g	67 pCi/g			Prevent or minimize: 1. Leaching of contaminants from soil into groundwater, 2. Human exposure from surface and subsurface soil, 3. Uptake to ecological receptors. Rad soil cleanup levels are based on 15 mRem/year above background. The State ALARA goal is 10 mRem/year above background.
	Strontium-90	15 pCi/g	15 pCi/g	8 pCi/L		
	Radium-226	5 pCi/g	5 pCi/g			
	Lead	200 mg/kg ¹			See note 1.	
	Mercury	1.84 mg/kg				
	1,2-Dichloroethane			0.6 µg/L		
	Chloroethane			5 µg/L		
II/VII	Cesium-137	23 pCi/g	67 pCi/g			Documented in the OU I, OU III and g-2/BLIP/USTs RODs.
	Tritium			20,000 pCi/L		
	Sodium-22			400 pCi/L		
III	1,1,1-Trichloroethane			5 µg/L		1. Meet MCLs for VOCs and tritium in Upper Glacial aquifer within 30 years, 2. Meet MCLs for VOCs in Magothy aquifer within 65 years, 3. Meet MCLs for Sr-90 in Upper Glacial aquifer within 40 years and 70 years at Chemical Holes and BGRR/WCF plumes, respectively.
	Tetrachloroethylene			5 µg/L		
	Carbon tetrachloride			5 µg/L		
	Ethylene dibromide			0.05 µg/L		
	Tritium			20,000 pCi/L		
	Strontium-90			8 pCi/L		
	PCBs	1 mg/kg - Surface NYSDEC TAGM	10 mg/kg - Subsurf. NYSDEC TAGM			
IV	Ethylbenzene			5 µg/L		Restore groundwater quality to MCLs or background, and prevent or minimize: 1. Leaching of contaminants from soil into groundwater, 2. Human exposure from surface and subsurface soil. Cleanup of radiologically-contaminated soil was performed under the OU I comprehensive soil cleanup.
	Toluene			5 µg/L		
	Strontium-90			8 pCi/L		

Attachment 5
Operable Unit Cleanup Levels Matrix

OU	Contaminants of Concern	Cleanup Levels			Note any Changes to Cleanup Levels	Remedial Action Objectives
		Soil		Groundwater		
		Residential	Industrial			
V	Mercury	2 mg/kg				Protect public health and the sole-source aquifer, monitor the groundwater, and prevent or minimize: 1. Migration of contaminants present in surface soil via surface runoff, 2. Human and environmental exposure from surface and subsurface soil, 3. Reduce site-related contaminants (e.g., mercury) in sediment to levels that are protective of human health, 4. Reduce or mitigate, to the extent practicable, existing and potential adverse ecological effects of contaminants in the Peconic River, 5. Prevent or reduce the migration of contaminants off BNL property.
	Cesium-137	23 pCi/g				
	Trichloroethene			5 µg/L		
VI	Ethylene dibromide			0.05 µg/L		1. Meet MCL for EDB in the Upper Glacial aquifer within 30 years, 2. Prevent or minimize further migration of EDB in groundwater vertically and horizontally.
X	PFOS			4 ng/L	Federal MCL Issued 2024	A ROD has not yet been established for this OU. A Time Critical Removal Action underway in 2020 for installation of groundwater treatment systems downgradient of the Current and Former Firehouse PFOS/PFOA source areas.
	PFOA			4 ng/L	Federal MCL Issued 2024	
	1,4-Dioxane			1.0 µg/L	New York State MCL issued August 2020	

Attachment 5
Operable Unit Cleanup Levels Matrix

OU	Contaminants of Concern	Cleanup Levels			Note any Changes to Cleanup Levels	Remedial Action Objectives
		Soil		Groundwater		
		Residential	Industrial			
g-2/BLIP	Tritium			20,000 pCi/L		1. Prevent additional rainwater infiltration into activated soil shielding, 2. Inspect and maintain the caps and other stormwater controls at the source areas, 3. Conduct groundwater monitoring to verify the effectiveness of the stormwater controls, and monitor the downgradient portion of the g-2 plume until tritium concentrations decrease to below the MCL.
BGRR	Strontium-90	ALARA (1)	ALARA	8 pCi/L		1. Ensure protection of human health and the environment from the potential hazards posed by the radiological inventory that resides in the BGRR complex, 2. Use ALARA while implementing the remedial action, 3. Implement long-term monitoring, maintenance, and institutional controls to manage potential hazards.
	Cesium-137	ALARA	ALARA			
HFBR	Strontium-90	15 pCi/g	15 pCi/g	8 pCi/L		1. Control, minimize, or eliminate:1. All routes of future human and/or environmental exposure to radiologically contaminated facilities or materials, 2. The potential for future release of non-fixed radiological or chemical contamination to the environmen, 3. All routes of future human and/or environmental exposure to contaminated soils, and 4. The future potential for contaminated soils to impact groundwater.
	Cesium-137	23 pCi/g	67 pCi/g for WLA			

Attachment 5
Operable Unit Cleanup Levels Matrix

OU	Contaminants of Concern	Cleanup Levels			Note any Changes to Cleanup Levels	Remedial Action Objectives
		Soil		Groundwater		
		Residential	Industrial			

Notes:

pCi/g = picocuries per gram

pCi/L = picocuries per liter

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

ng/L = nanograms per liter

TAGM = Technical and Administrative Guidance Memorandum

BLIP = Brookhaven Linac Isotope Producer

BGRR = Brookhaven Graphite Research Reactor

HFBR = High Flux Beam Reactor

ALARA = As Low as Reasonably Achievable

OU = Operable Unit

WLA = Waste Loading Area

MCL = Maximum Contaminant Level

EDB = Ethylene dibromide

PFOS = perfluorooctane sulfonate

PFOA = perfluorooctanoic acid

VOC = Volatile Organic Compound

ROD = Record of Decision

WCF = Waste Concentration Facility

1. The USEPA Residential Screening Level for lead was lowered to 200 mg/kg in October 2025. The EPA residential soil screening level for lead at the time the ROD was signed was 400 mg/kg.