



Groundwater Update

Highlights of 2023 Groundwater Status Report and Cleanup Progress

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November 14, 2024



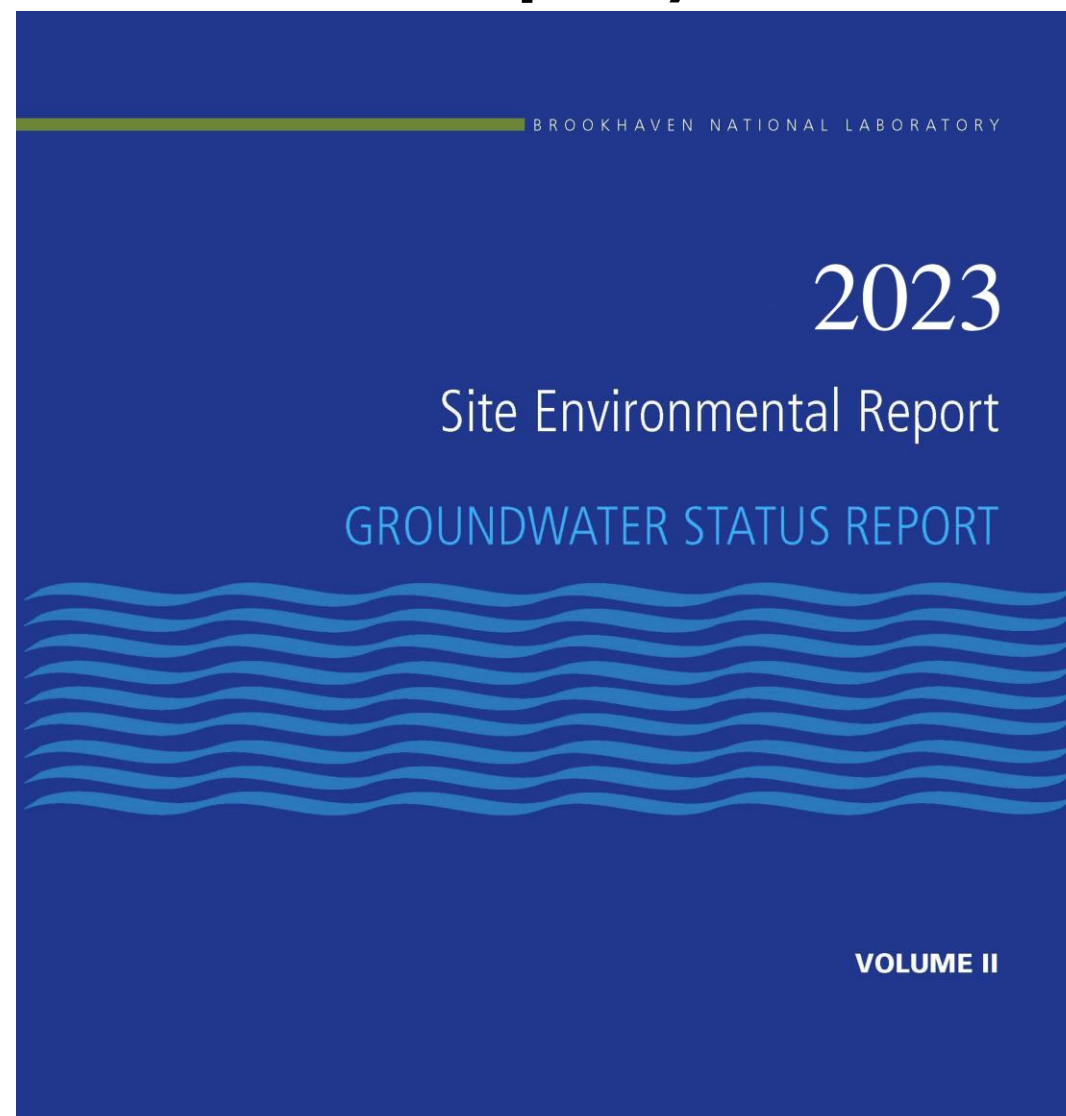
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Agenda:

- Groundwater Cleanup Updates:
 - Progress Updates/Milestones Achieved
 - Recent Work to Address CERCLA 5-Year Review Recommendations
- Radiological Plume Comparison
- Operable Unit (OU) X (PFAS/1,4-dioxane):
 - Time Critical Removal Action (TCRA) Groundwater Treatment System Status
 - Recent Groundwater Characterization
- PFAS/1,4-Dioxane Compliance Plan for Currently Operating Groundwater Remediation Systems

Groundwater Status Report (Volume 2 of Site Environmental Report)

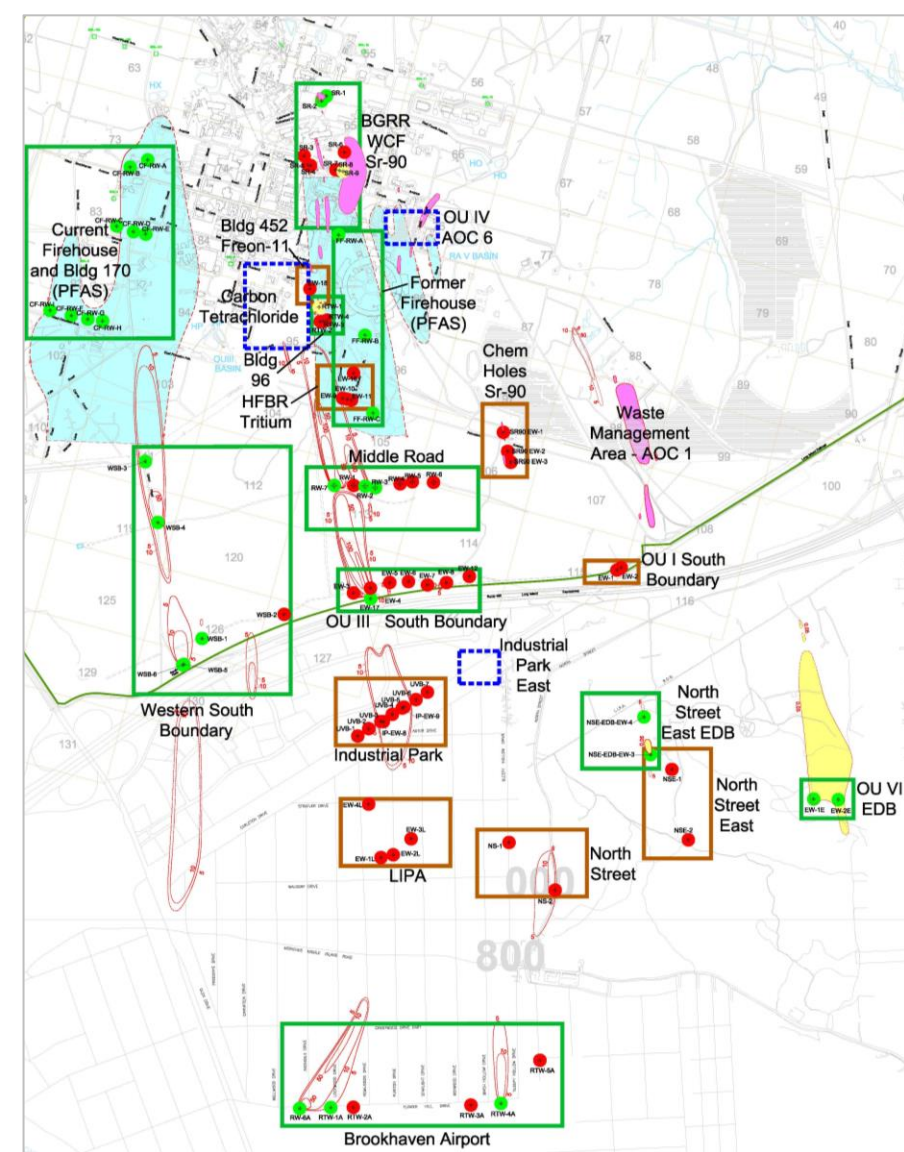
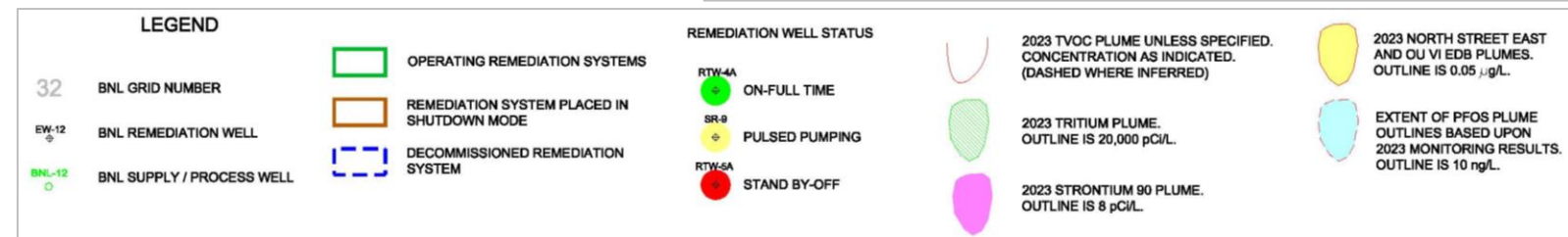
- Chapter 7 of SER Vol. I provides a high-level overview.
- Groundwater Status Report (GSR) provides comprehensive details on groundwater monitoring and remediation conducted during 2023.
- Web link for 2023 Groundwater Status Report will be available soon.



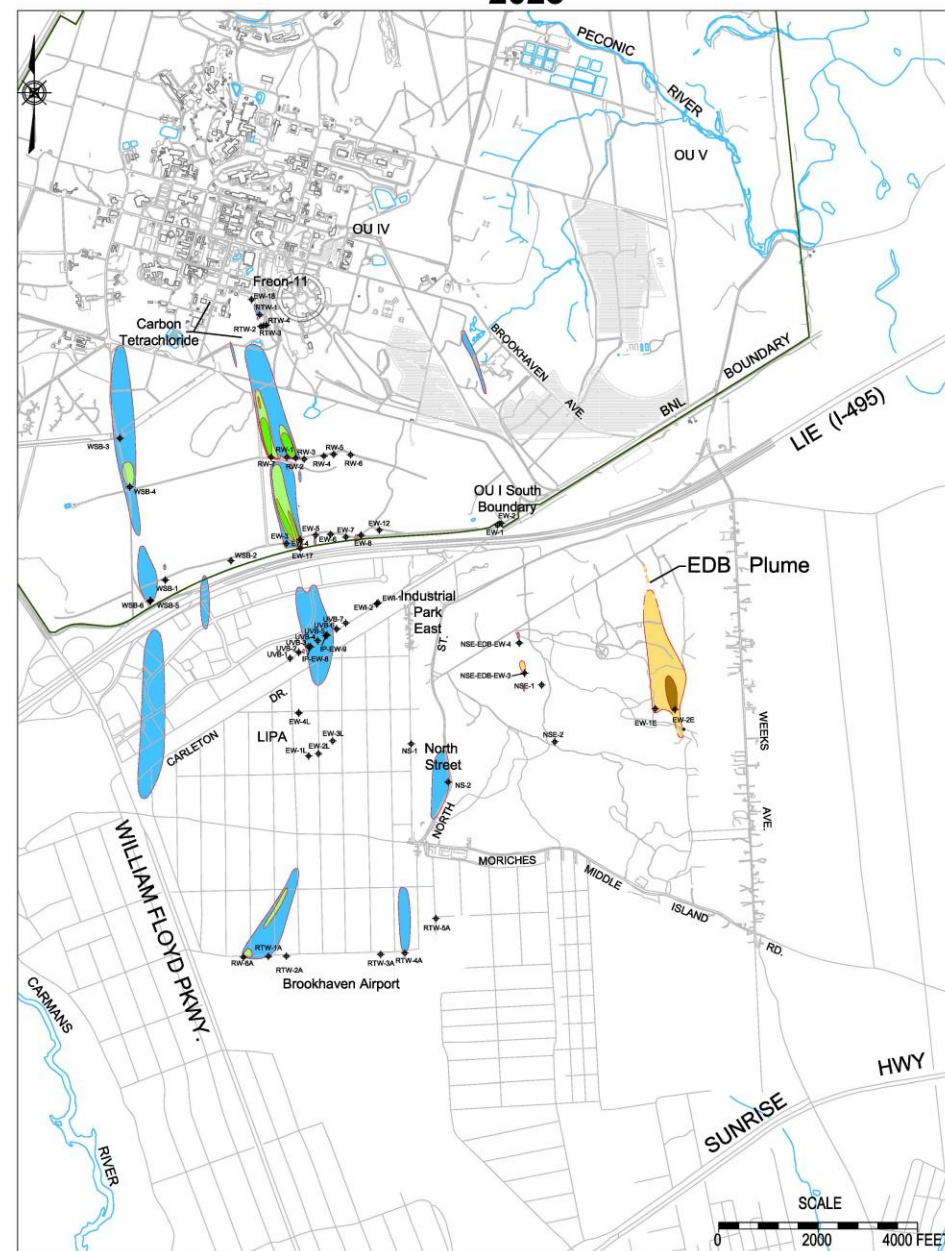
Remediation System Overview

- Currently Operational:
 - Seven Volatile Organic Compound (VOC) Groundwater Remediation Systems.
 - Two PFAS Remediation Systems
 - One Strontium-90 (Sr-90) System.
- 34 of 83 total extraction wells in operation.
- 1.2 billion gallons groundwater treated in 2023.
- 7,872 lbs. of VOCs removed from groundwater to date, 35 milli Curies (mCi) Sr-90, and 0.6 lbs. of PFAS.

Note: Above statistics and system status as of December 2023



1997 —————→ 2023



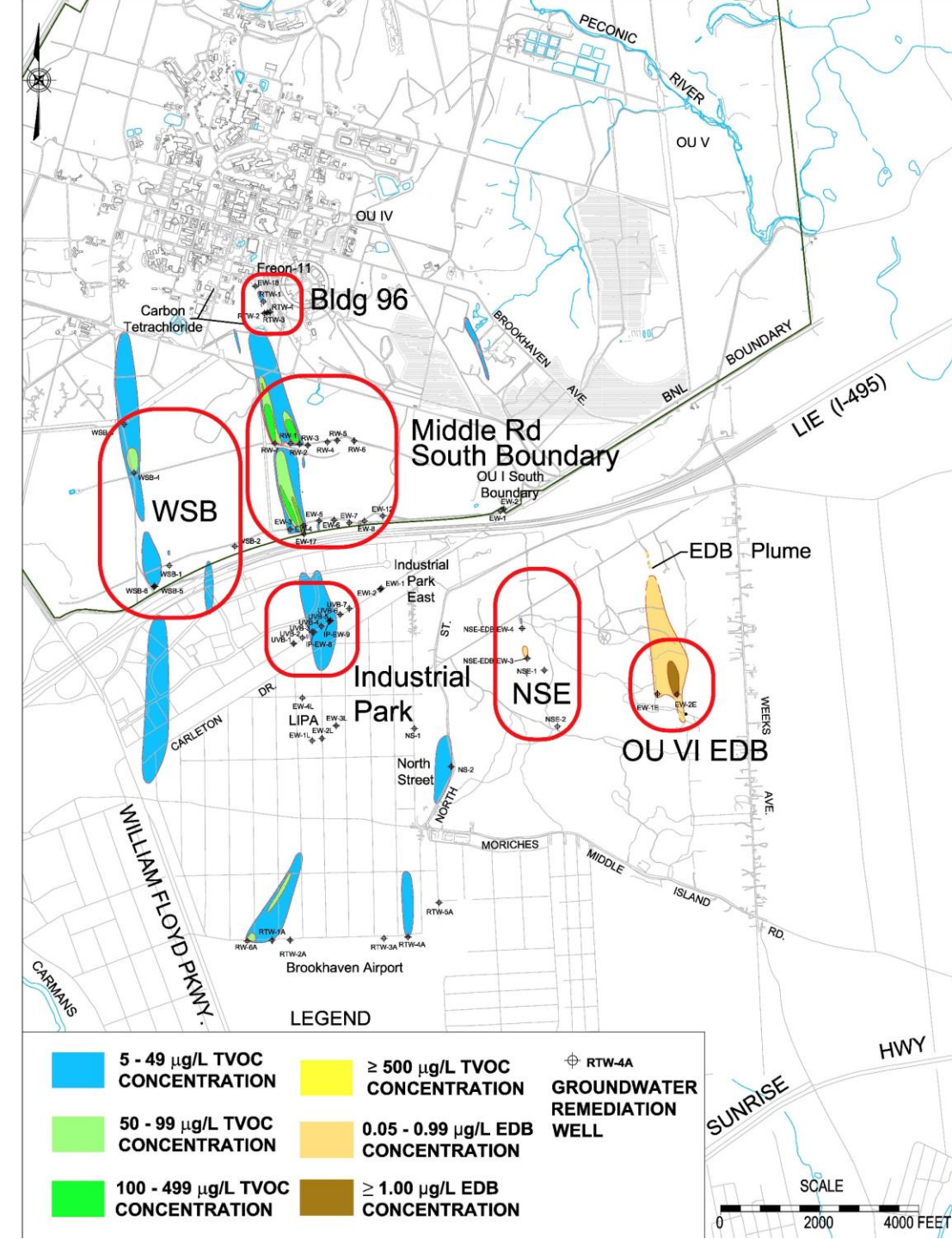
System Updates/Milestones and Recent 5-Year Review Work

Progress Updates:

- OU III - Western South Boundary (WSB)
- OU III - Industrial Park
- OU III - North Street East (NSE)
Ethylene Dibromide (EDB)

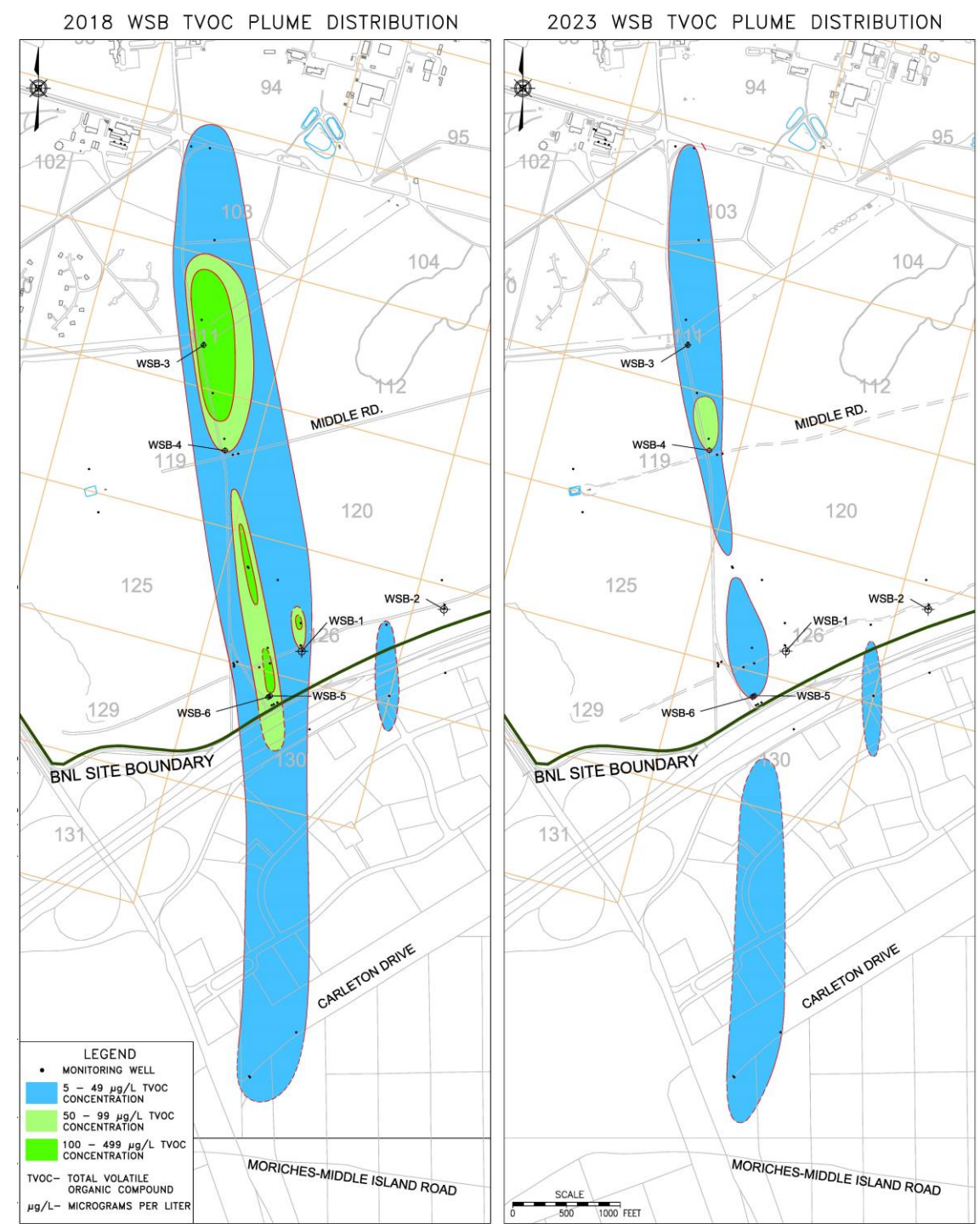
Recent Work Activities Addressing 5-Year Review Recommendations:

- OU III - Building 96
 - Source Area Chemical Treatment Injections
- OU III - Middle Road/South Boundary
 - Characterization and System Evaluation
- OU VI – EDB
 - Operation of two new deep extraction wells



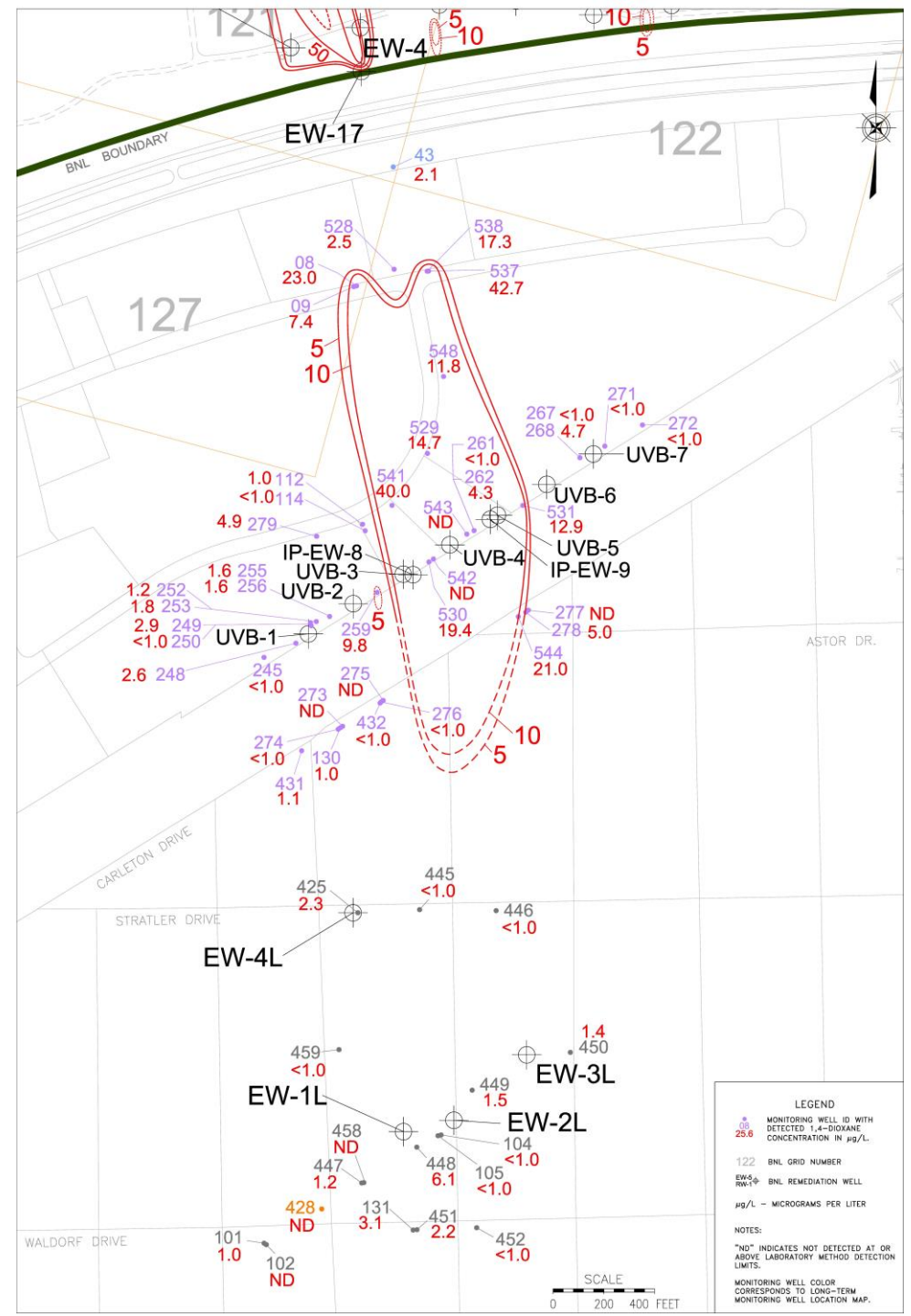
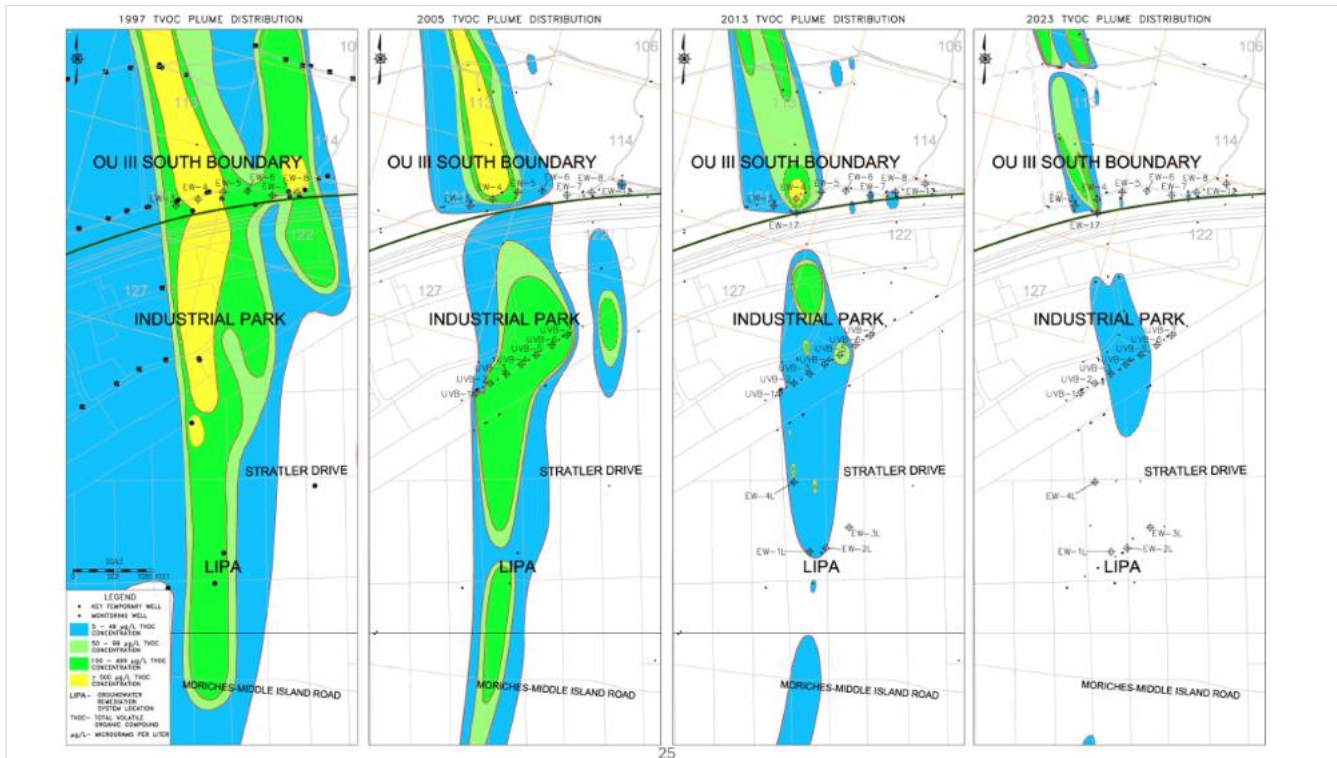
OU III Western South Boundary

- Following the installation of the four new deep extraction wells in 2019, **a significant reduction in deep Upper Glacial aquifer VOC contamination has been observed.**
- Offsite monitoring wells continue to show low VOC concentrations.
- Will maintain the four deep extraction wells (WSB-3, 4, 5, and 6) in pulsed pumping mode (one month on, one month off)
- WSB-1 has achieved its capture goal (20 µg/L total VOCs [TVOCs]) and was placed in standby.
- **Based on the VOC concentration trends in both the monitoring and extraction wells, it is anticipated that a Petition for Shutdown will be submitted in 2025 for this system.**



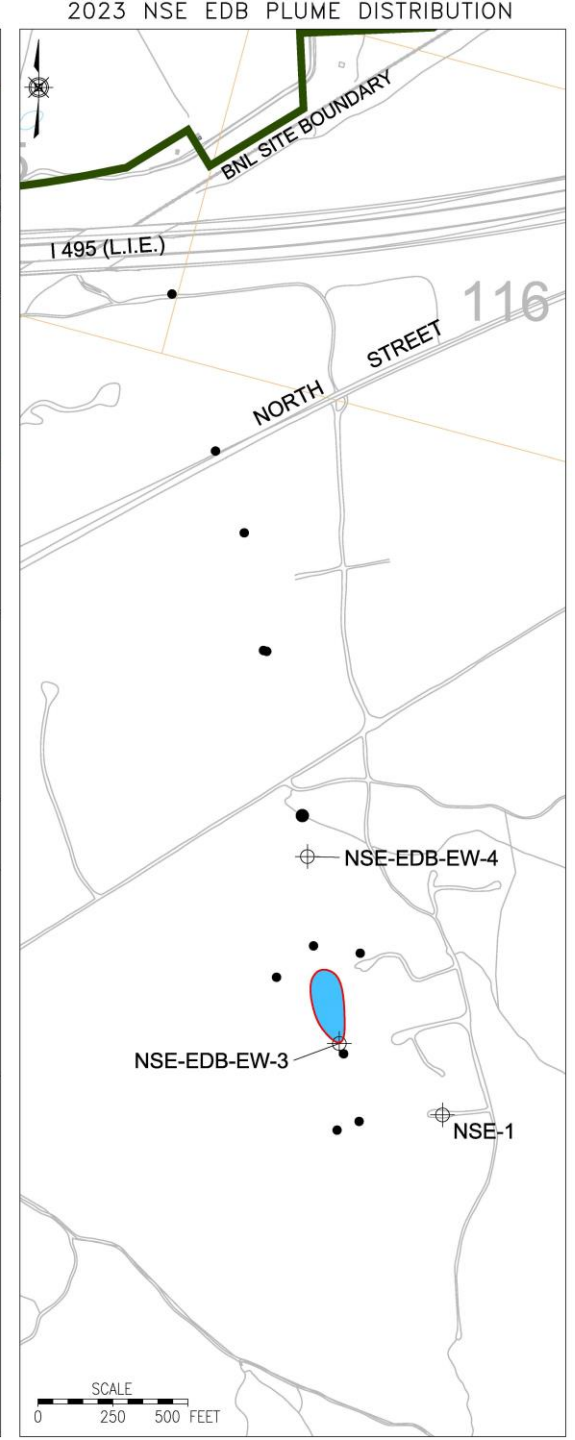
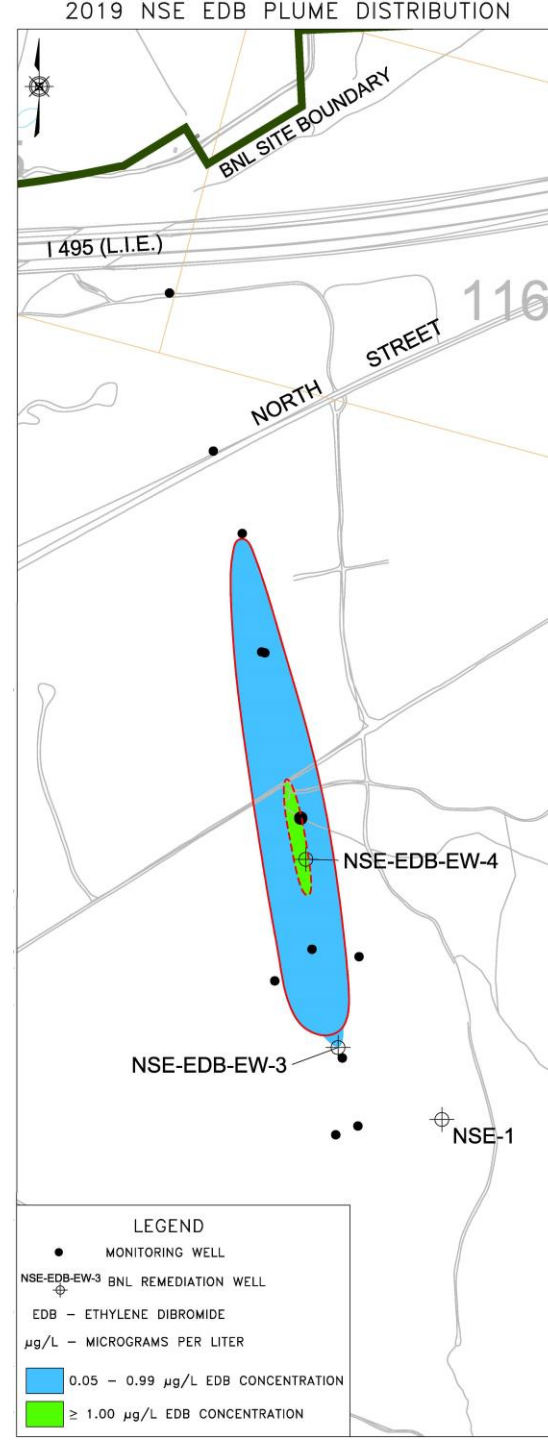
OU III Industrial Park

- Plume core monitoring well TVOC concentrations have remained below the 50 µg/L goal.
 - All TVOC concentrations were below the capture goal during the first three quarters of 2024.
- ***A Petition for Closure will be prepared and submitted in 2025 for this system.***



OU III North Street East

- VOC system (extraction wells NSE-1 and NSE-2) was shut down in 2014.
- In 2020, extraction wells NSE-EDB-EW-03 and NSE-EDB-EW-04 were installed to address EDB contamination.
- Following the installation of these extraction wells, **a significant reduction in EDB concentrations has been observed in this area.**
- Beginning in May 2024, the extraction wells were placed in a pulsed pumping mode (one month on and one month off).
- **Through 2023 and 2024, EDB concentrations have remained below the Drinking Water Standard (DWS) (0.05 µg/L) in monitoring and extraction wells.**
- **A Petition for Shutdown will be prepared and submitted in 2025 for this system.**

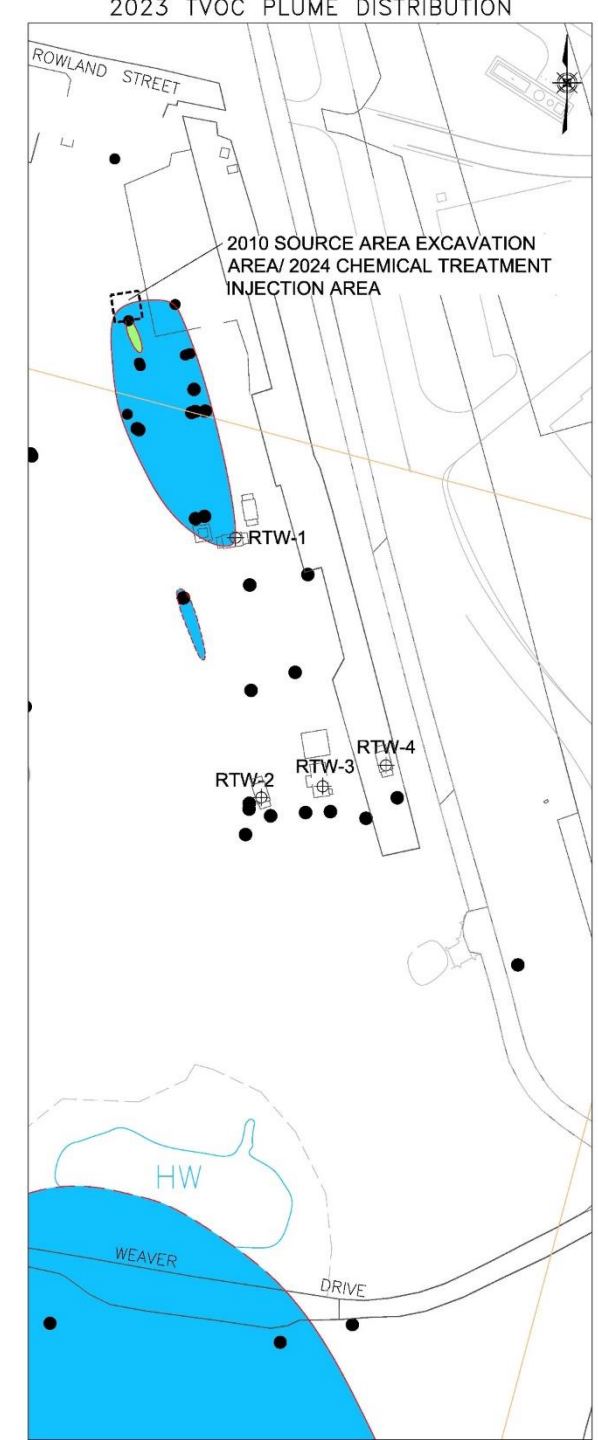
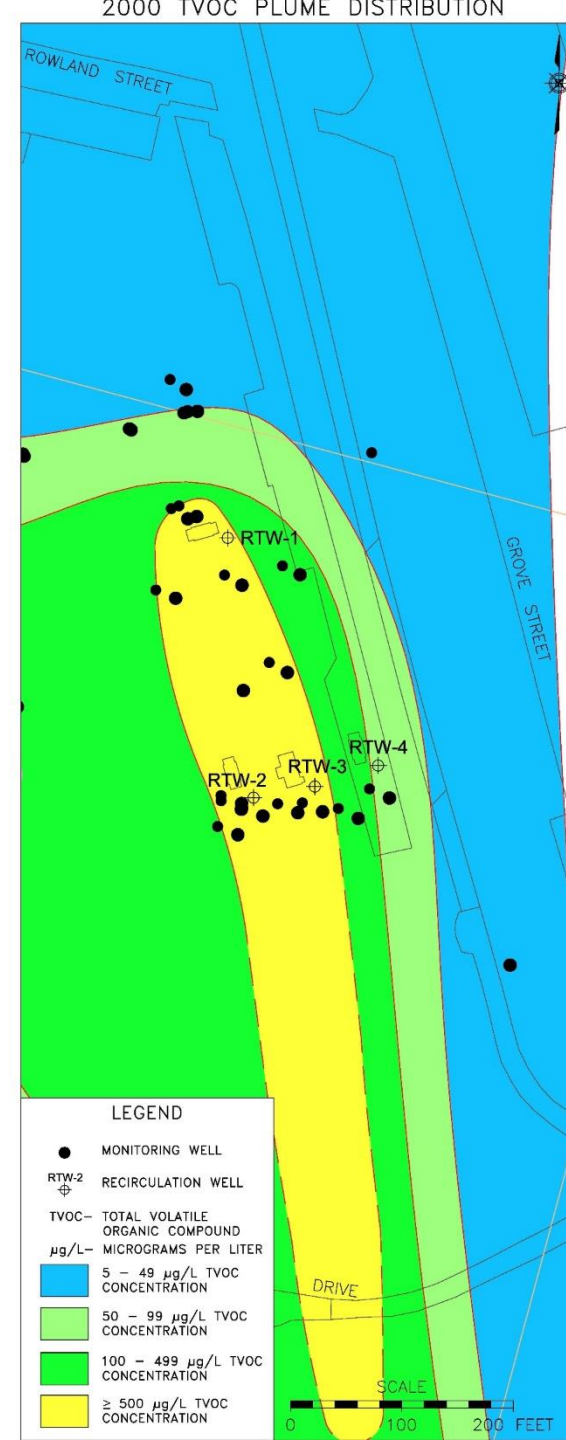


OU III Building 96

- Extraction well RTW-1 has been below the 50 µg/L TVOC capture goal since 2015 and individual VOCs have been below their Maximum Contaminant Levels (MCLs) since 2020.
- RTW-1 placed in pulsed pumping mode (one month on one month off) in May 2022.
- Overall VOC plume cleanup complete with exception of immediate source area.
- Well 085-379, located in the immediate source area, has been slow to improve: **April 2024 TVOC concentration was 89 µg/L.**

CERCLA 5-Year Review Recommended Follow-Up Actions:

- ***An active remediation technology should be considered to reduce concentrations near source area monitoring well 085-379.***

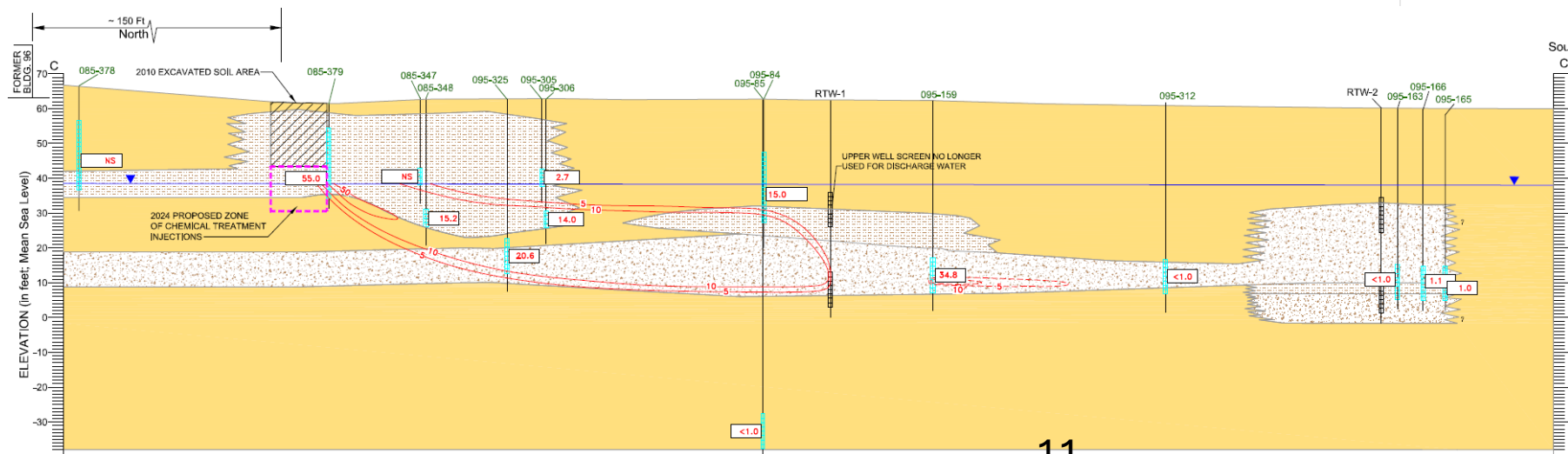


OU III Building 96

- Completed liquid carbon and zero valent iron (ZVI) injections to promote in-situ groundwater remediation in late June 2024.
- 19 injection locations from 19-29 feet below land surface (bls).
- Conducting post-remediation groundwater monitoring to evaluate effectiveness of injections.
- Post injection monitoring results to date shows non-detectable concentrations of tetrachlorethylene (PCE) in key monitoring well 085-379.***



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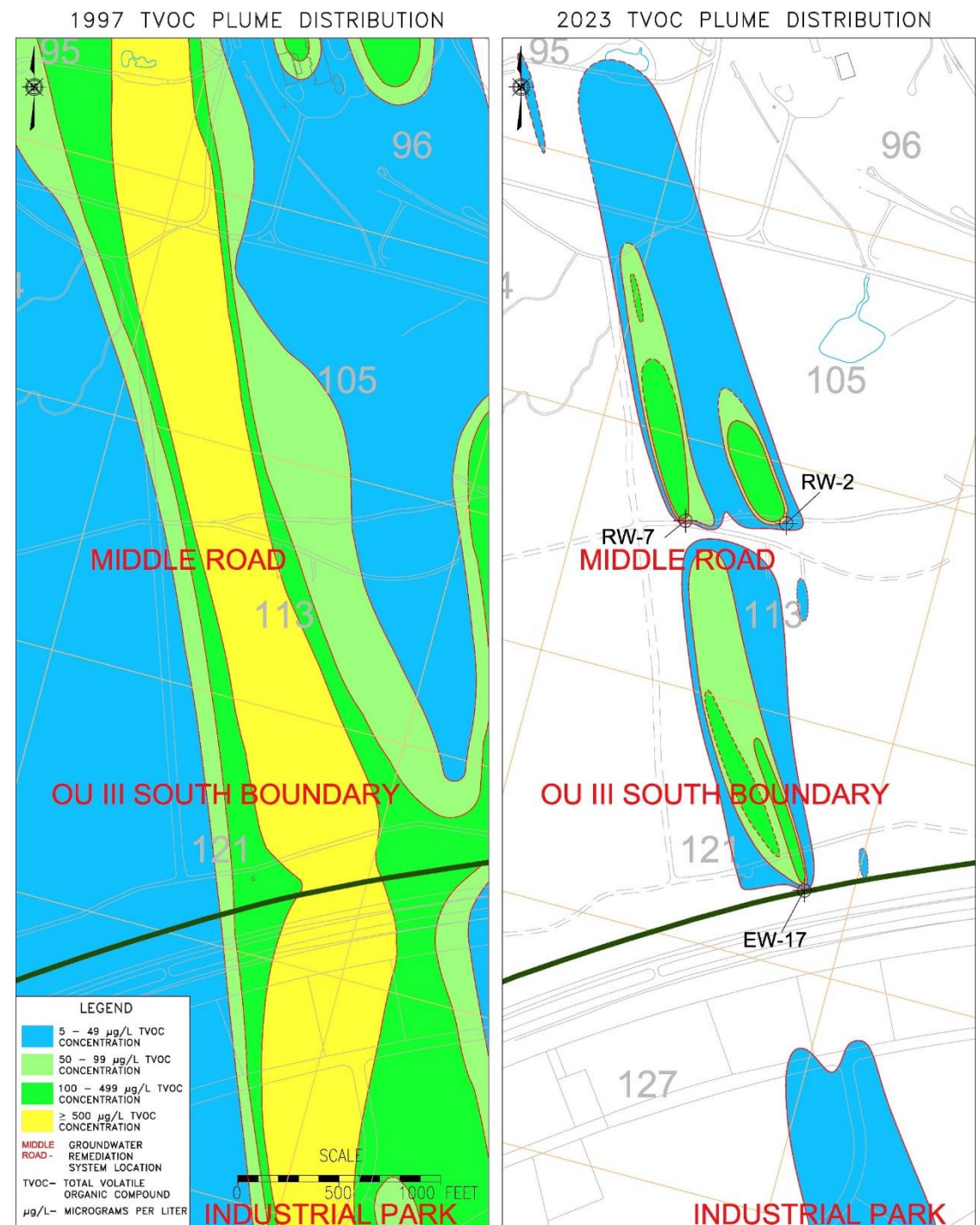
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OU III Middle Road/South Boundary

- **VOC concentrations remain elevated in deep Upper Glacial aquifer.**
- Based on current conditions, continue to operate Middle Road extraction wells RW-2, 3, and 7; and South Boundary extraction well EW-17.

CERCLA 5-Year Review Recommended Follow-Up Actions:

- Installed temporary vertical profile wells to further characterize VOCs in key areas.
- Obtained additional hydraulic conductivity data from deep Upper Glacial aquifer.
- Updating hydrogeologic framework and groundwater model based on the new data to evaluate system modifications to enhance the cleanup timeframe.
- This work is ongoing.



- Groundwater monitoring data indicated that the existing extraction wells (EW-1E and EW-2E) were not effectively capturing deeper EDB contamination.

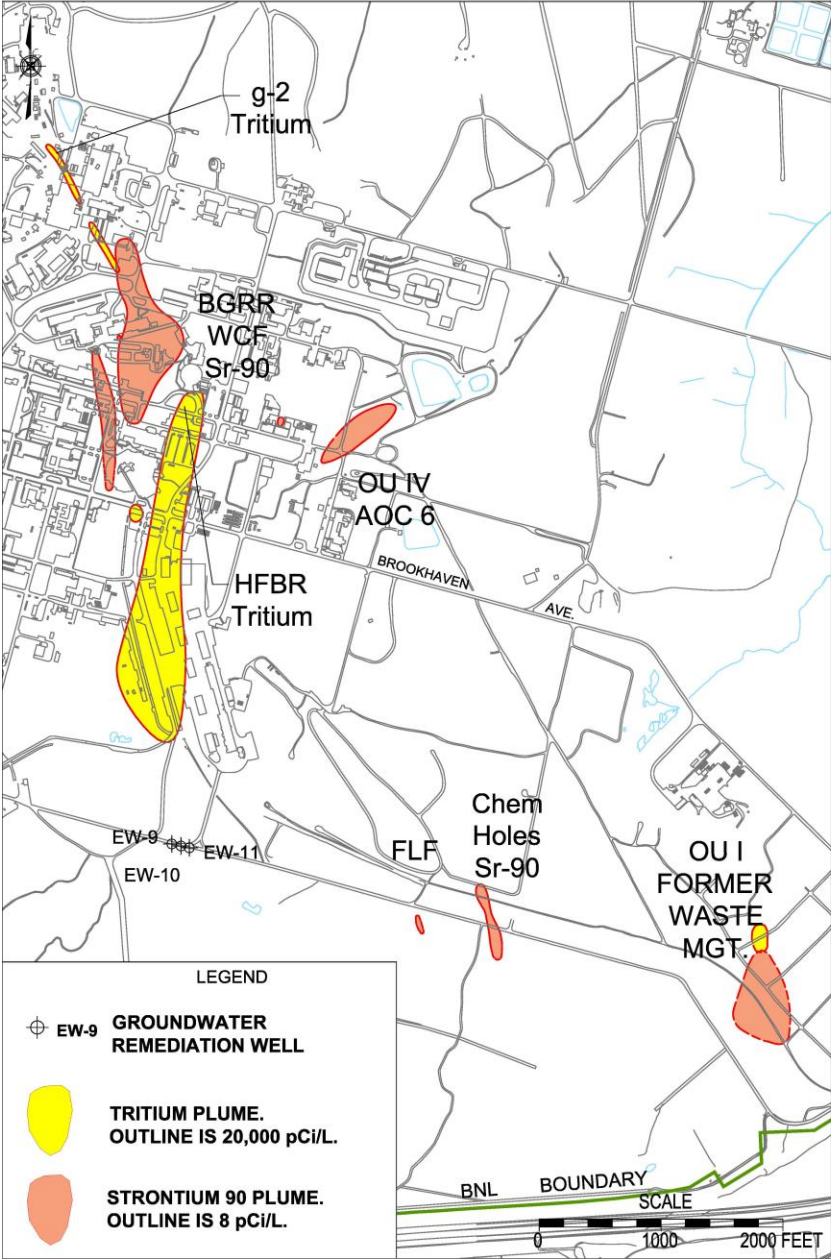
- ***Modify the system to meet Record of Decision (ROD) cleanup goals and ensure capture of deeper EDB.***

- Two new (deeper) extraction wells (EW-3E and EW-4E) became operational in January 2024.
- Extraction well pumping test conducted during summer 2024. The data indicated the new extraction wells are capturing deep and shallow portions of the EDB plume.
- Monitoring well data supports new extraction wells capturing deeper EDB and cutting off EDB migration to the south.

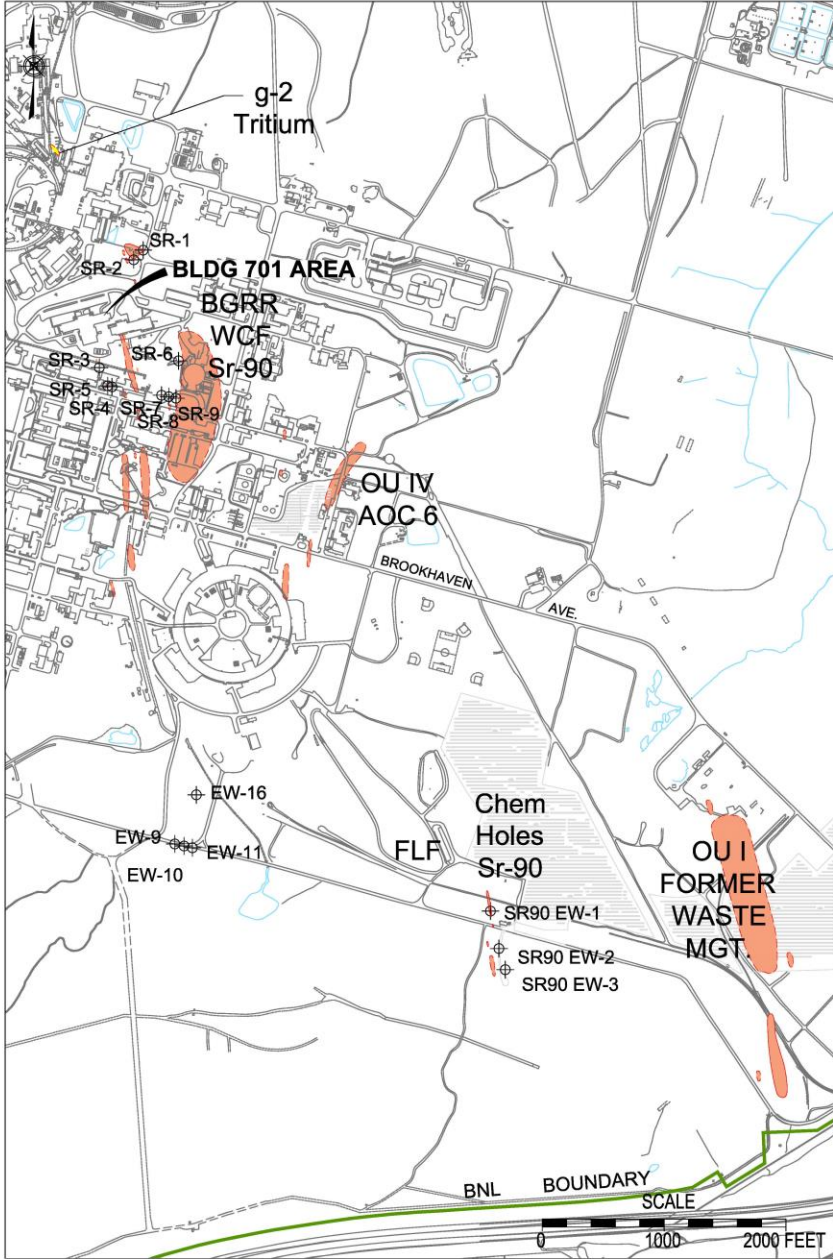


Radiological Plume Comparison

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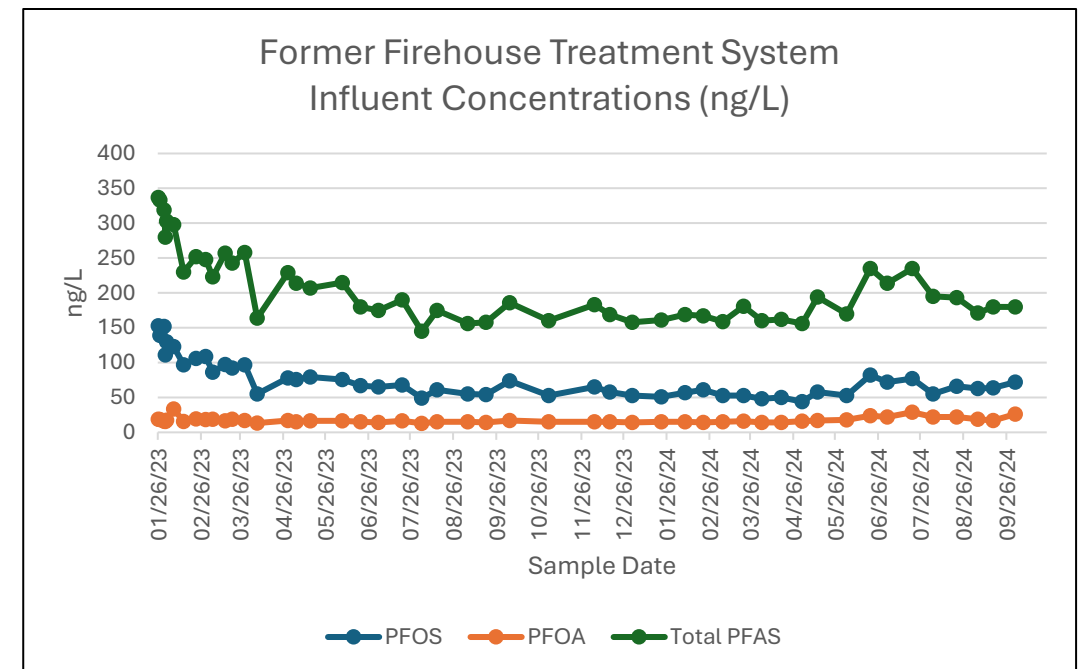
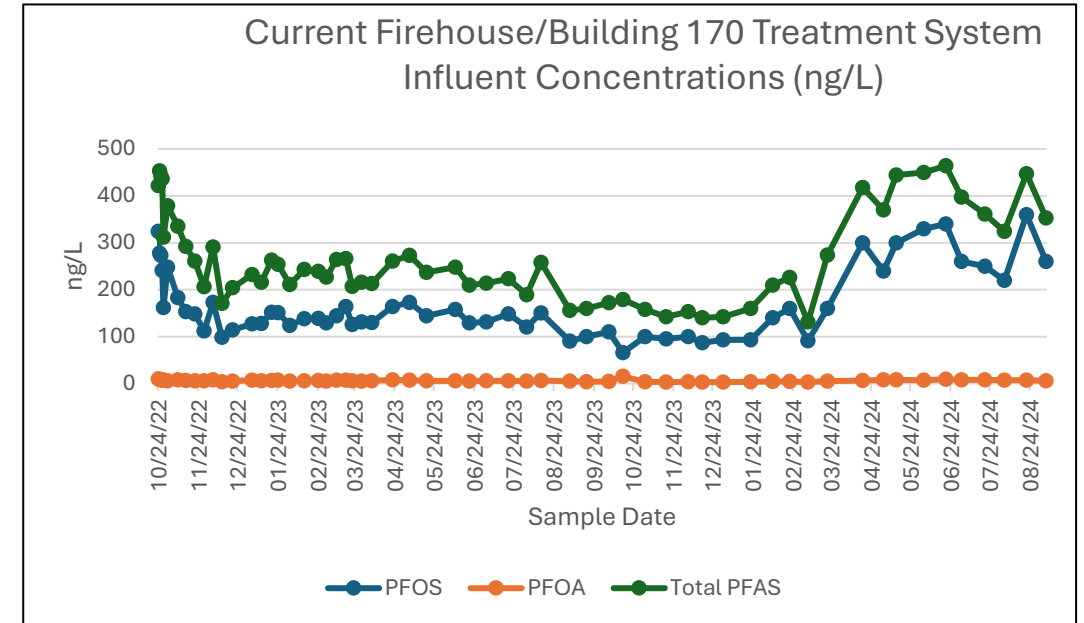


2023 RAD PLUME DISTRIBUTION



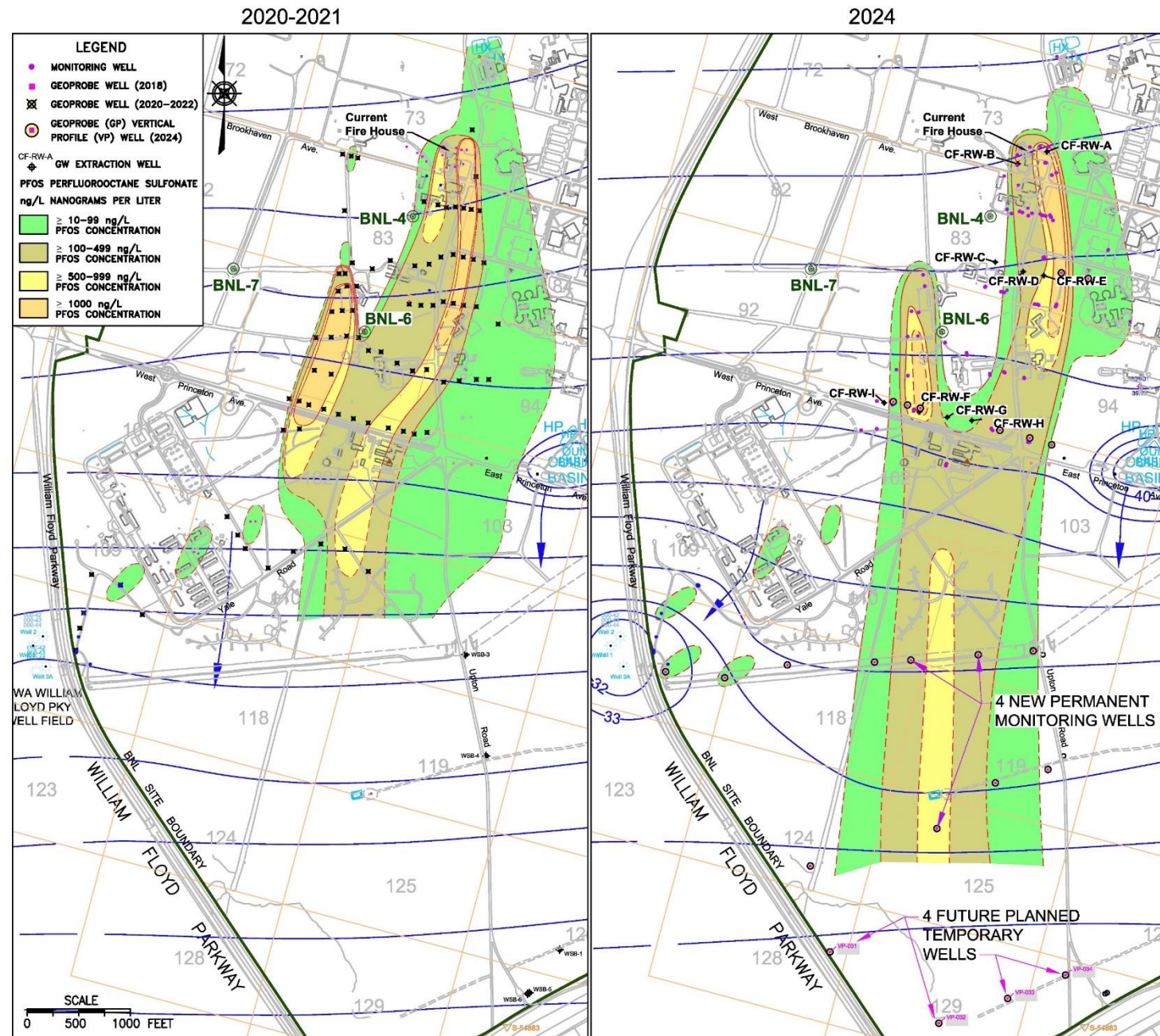
OU X TCRA PFAS Groundwater Remediation

- Current Firehouse/Building 170 treatment system began operating in October 2022.
- Former Firehouse treatment system began operating in January 2023.
- PFOS and PFOA are not detected in the treatment system effluent.
 - Low levels of 1,4-dioxane detected in system effluent (less than the 0.35 µg/L NYS effluent limit).
- To date, the two systems have treated a combined ~400M gallons of groundwater and removed ~0.7 pounds of PFAS.

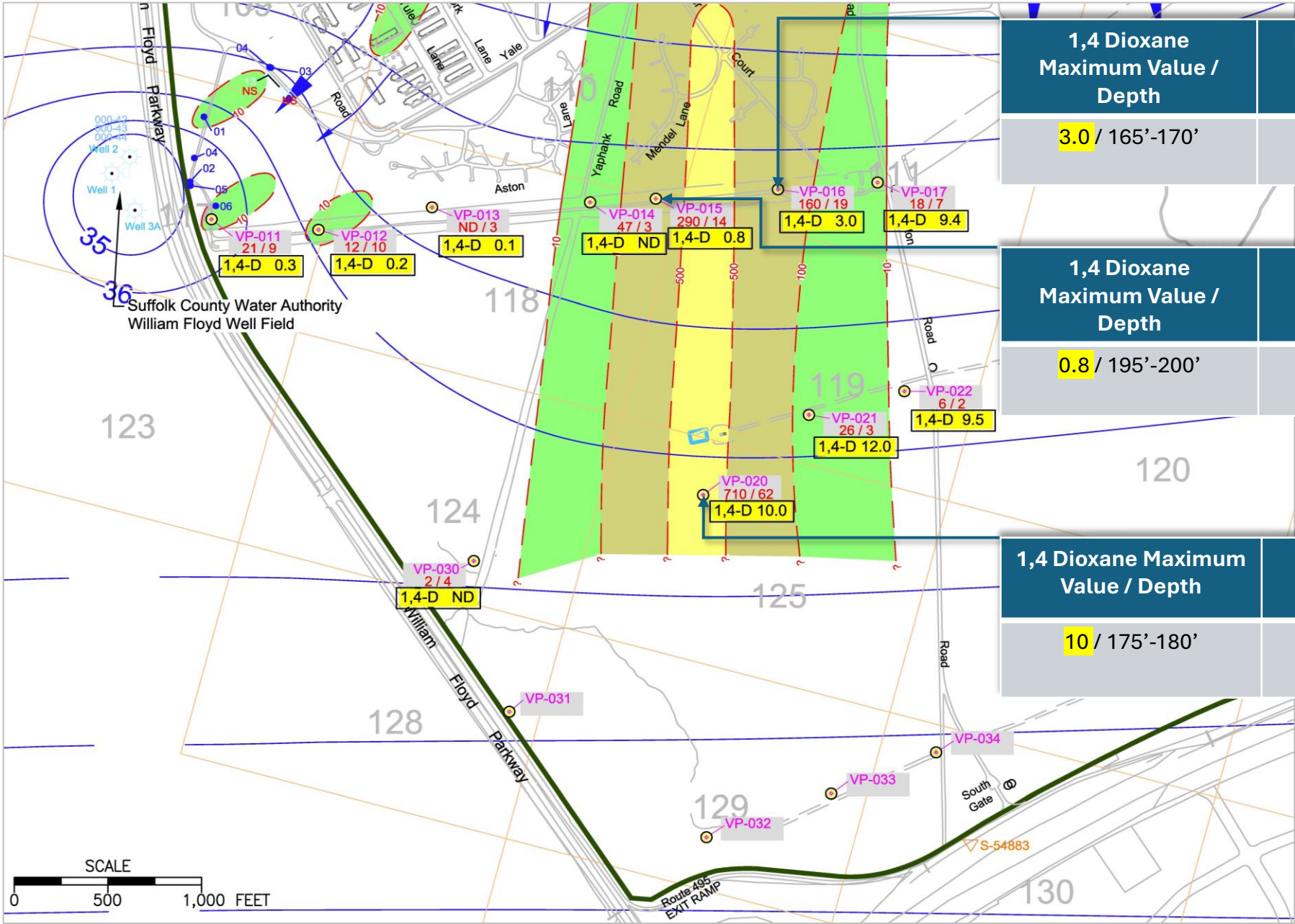


OU X Current Firehouse/Building 170 PFAS Groundwater Characterization

- Routine sampling of ~77 permanent monitoring wells.
- Since the 2020-2021 TCRA characterization:
 - Shutdown of BNL potable water supply wells BNL-4 and BNL-6. Significant reduction in use of supply well BNL-7.
 - Startup of the Current Firehouse (CFH) treatment system.
- Based on extraction and monitoring well data, there appeared to be an easterly shift in the plume flow path.
- 2024 synoptic water level measurements indicated an easterly shift in groundwater flow following changes in supply well pumping.
- During summer 2024, eight temporary vertical profile wells were installed to help evaluate the shift.
- Prior to 2024, the downgradient portions of these plume segments were not characterized.
- To address this, to date, total of 11 deep vertical profiles were installed to a depth of ~225 feet bls.
 - Four permanent monitoring wells installed at select locations.
 - Four more vertical profiles planned at southwestern site boundary.



OU X Current Firehouse/Building 170 PFAS Groundwater Characterization



1,4 Dioxane Maximum Value / Depth	PFOS Maximum value/ Depth	PFOA Maximum Value / Depth
3.0 / 165'-170'	160 / 165'-170'	14 / 175'-180'

1,4 Dioxane Maximum Value / Depth	PFOS Maximum Value / Depth	PFOA Maximum Value / Depth
0.8 / 195'-200'	290 / 105'-110'	14 / 105'-110'

1,4 Dioxane Maximum Value / Depth	PFOS Maximum Value / Depth	PFOA Maximum Value / Depth
10 / 175'-180'	710 / 105'-110'	62 / 115'-120'

- Notes:
- 1,4-dioxane results reported in µg/L
 - PFOS/PFOA results reported in ng/L
 - Depth in feet bls

PFOS, PFOA and 1,4-Dioxane in Operating Treatment System Discharges

- New York State Pollutant Discharge Elimination System (SPDES) equivalency permits are required for all groundwater treatment systems.
- In February 2023, NYSDEC issued discharge effluent limits for PFOS, PFOA and 1,4-dioxane that are lower than the State drinking water standards.
- Based on the new effluent limits and existing data from the 2019-2020 Phase 4 Characterization, some operating treatment systems discharges were potentially exceeding the new standards.
- In early 2023, meetings were held with the DOE, NYSDEC, EPA, and SCDHS.
- Starting in June 2023, BNL began a quarterly monitoring program of each of the operating treatment systems (extraction wells, influent, and effluent) to collect data and establish a sufficient baseline to support decision making.
- After one year of monitoring (June 2023 – April 2024) a compliance plan would be prepared and submitted to the regulators.
- The Draft Groundwater Treatment System Compliance Plan was submitted in August 2024.

Chemical	NYS Drinking Water Standard	NYS Discharge Effluent Limit
PFOS	10 ppt	2.7 ppt
PFOA	10 ppt	6.7 ppt
1,4-Dioxane	1.0 ppb	0.35 ppb

Compliance Plan Recommendations to Attain System Discharge Compliance

- **OU III Middle Road/South Boundary/Western South Boundary:**
 - Onsite VOC treatment system utilizing air-stripping technology. PFAS and 1,4-dioxane are present in system extraction wells.
 - Air-stripping is ineffective at treating both PFAS and 1,4-dioxane.
 - ***PFOS, PFOA, and 1,4-dioxane in system discharge is in excess of Discharge Effluent Limits.***
- **OU III Airport:**
 - Offsite VOC treatment system utilizing granular activated carbon (GAC) filtration technology.
 - Has 1,4-dioxane present in system extraction wells.
 - GAC is ineffective at treating 1,4-dioxane.
 - ***1,4-dioxane in system discharge is in excess of Discharge Effluent Limit.***
- **Recommendations:**
 - ***Install additional Advanced Oxidation Process (AOP) treatment to each of the systems.***
 - The MR/SB/WSB AOP system will include GAC filtration.
 - Continue to monitor for PFAS and 1,4-dioxane at the remaining systems.
- **Actions Based on Regulator Feedback:**
 - Investigate the recharge basins that have received discharges in excess of PFOS, PFOA, and/or 1,4-dioxane.
 - Perform routine groundwater monitoring downgradient of these recharge basins.
- *The need to remediate PFAS and 1,4-dioxane will be evaluated during the OU X Remedial Investigation/Feasibility Study (RI/FS).*

Current Compliance Implementation Schedule

Schedule Element	Target Date	Est. Duration
Submit Draft Compliance Plan to the regulators.	August 2024 (Complete)	
Provide a briefing of the Draft Compliance Plan and discuss with NYSDEC DER/DOW/DOH during the upcoming Annual Groundwater Status Report Briefing.	August 22, 2024 (Complete)	
Receive regulator comments, prepare responses and a revised Compliance Plan, and receive regulator approval.	September - November 2024 (Complete)	3 months
Continue to monitor the treatment systems for PFOS, PFOA, and 1,4-dioxane.	Begin in October 2024 (Underway)	TBD
Complete Engineering Designs/Cost Estimates for the OU III MR/SB/WSB and OU III Airport 1,4-dioxane treatment systems.	March 2025 (Underway)	6 months

Next Steps

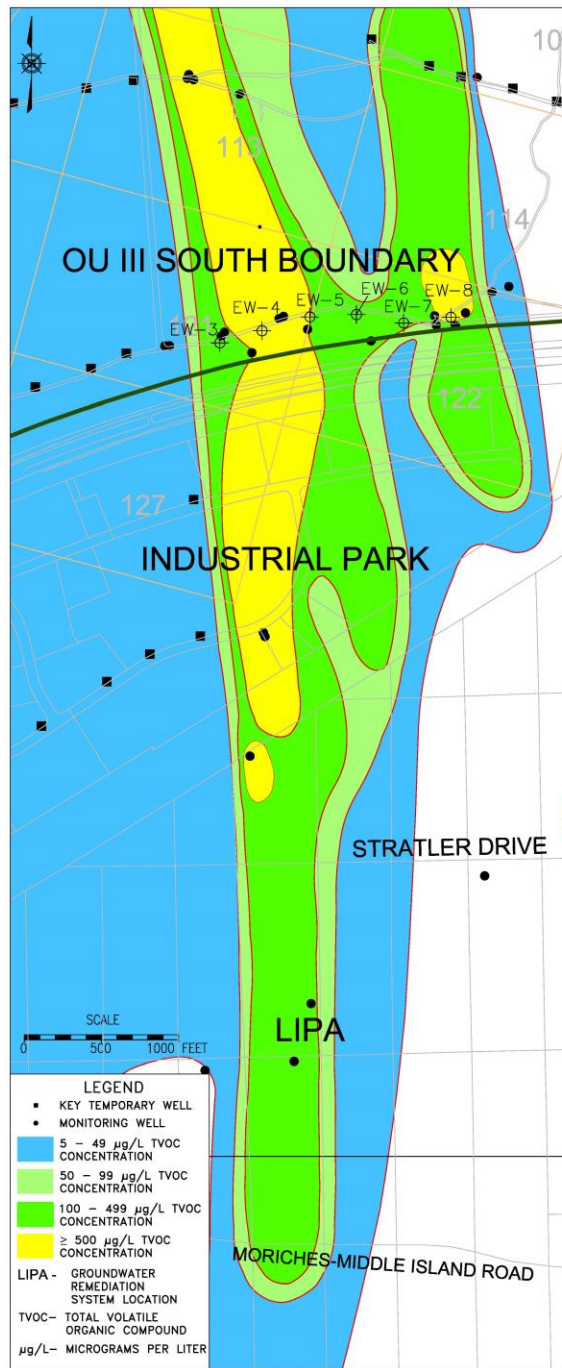
- Post Annual Groundwater Status Report to BNL website (Pending).
- Complete PFAS Characterization Work to evaluate plume shift and downgradient extent of Current Firehouse Plume.
- Finalize Groundwater Treatment System Compliance Plan based on regulator comments.
- Initiate recharge basin investigation and downgradient groundwater monitoring.
- Continue to monitor operating groundwater remediation systems for effluent compliance and complete engineering designs/cost estimates for OU III MR/SB/WSB and OU III Airport 1,4-dioxane treatment systems.

Questions!





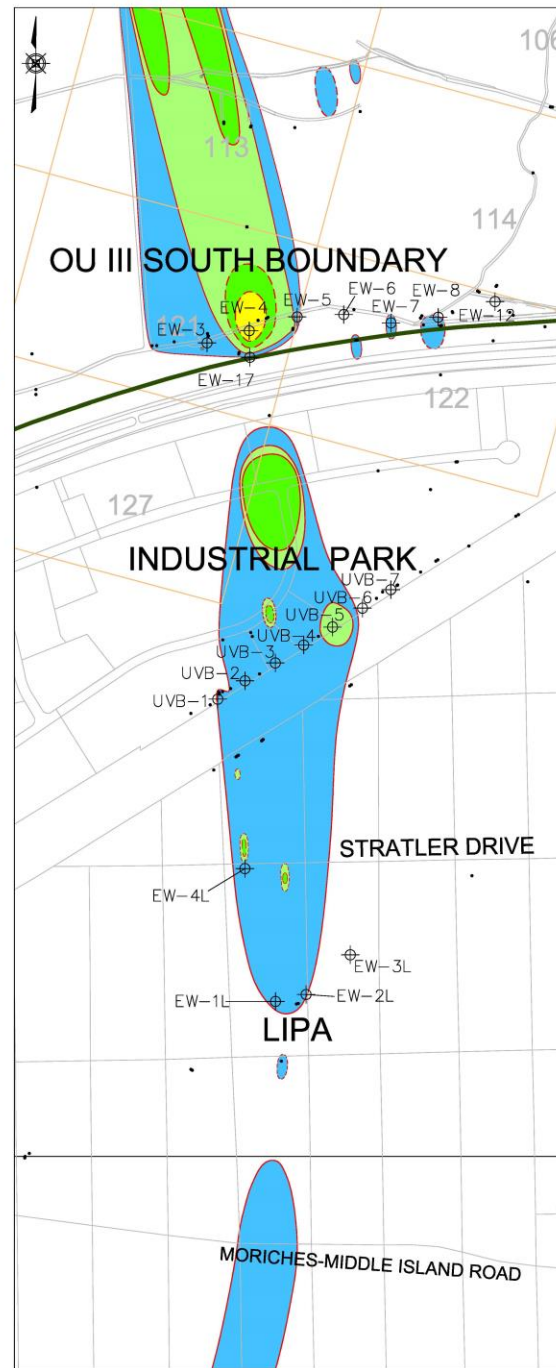
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2013 TVOC PLUME DISTRIBUTION



2023 TVOC PLUME DISTRIBUTION

