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FERNALD PRESERVE

2025 Site Environmental Report



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https://www.energy.gov/lm/fernald-preserve-ohio-site.
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Cover images: Spotted Salamanders *(Ambystoma maculatum).*

Contents

Abbreviations iv
Measurement Abbreviations v
Executive Summary vii
1.0 Site Background 1
1.1 The Path to Site Closure 3
1.2 Environmental Monitoring Program 6
1.3 Characteristics of the Site and Surrounding Area 6
1.3.1 Land Use and Demography 6
1.3.2 Geography 7
1.3.3 Geology 10
1.3.4 Surface Hydrology 10
1.3.5 Natural Resources 13
2.0 Remediation Status and Compliance Summary 17
2.1 CERCLA Remediation Status 17
2.2 Summary of Compliance with Other Requirements 19
2.2.1 RCRA 21
2.2.1.1 RCRA Property Boundary Groundwater Monitoring 21
2.2.1.2 Waste Management 21
2.2.2 Clean Water Act 21
2.2.3 Clean Air Act 22
2.2.4 Superfund Amendments and Reauthorization Act of 1986 22
2.2.5 Other Environmental Regulations 22
2.2.6 Permits and Licenses 25
2.2.7 Federal Facility Compliance Agreement 25
2.3 Prohibited Activities 25
2.4 Split Sampling Program 26
3.0 Groundwater Pathway 29
3.1 Summary of the Nature and Extent of Groundwater Contamination 29
3.2 Selection and Design of the Groundwater Remedy 31
3.3 Groundwater Monitoring Highlights for 2025 37
3.3.1 Restoration Monitoring 38
3.3.1.1 Operational Summary 39
3.3.1.2 South Plume/South Plume Optimization Module Operational Summary 46
3.3.1.3 South Field Module Operational Summary 46
3.3.1.4 Waste Storage Area Module Operational Summary 48
3.3.1.5 Monitoring Results for Total Uranium 48
3.3.1.6 Monitoring Results for Non-Uranium Constituents 51
3.3.2 Other Monitoring Commitments 54
3.4 Groundwater Remediation Assessment 55
3.5 OSDF Monitoring 58
4.0 Surface Water and Effluent Pathway 63
4.1 Summary of Surface Water and Effluent Pathway 63
4.2 Surface Water and Effluent Monitoring Program 65
4.2.1 Surveillance Monitoring 67
4.2.2 Compliance Monitoring 70

4.2.2.1 FFCA and OU5 ROD Compliance 70
4.2.2.2 NPDES Permit Compliance 70
4.2.3 Uranium Discharges in Surface Water and Effluent....70
5.0 Inspections and Natural Resource Management 75
5.1 Inspections....75
5.1.1 Legacy Debris 79
5.1.2 OSDF Vegetation Monitoring....80
5.2 Natural Resource Management 80
5.2.1 Natural Resource Maintenance Activities 82
5.2.2 Ecological Monitoring 86
6.0 Community Involvement and Visitors Center Activities....89
6.1 Ongoing Decisions and Community Involvement 89
6.1.1 Annual Community Meeting—CERCLA Five Year Review Kickoff....90
6.1.2 Meetings with Stakeholder Groups....90
6.1.3 Briefings for Local, State, and Federal Elected Officials 90
6.2 Visitors Center Activities 91
6.3 Site Visitors 92
6.4 Conclusions 92
7.0 References 93
8.0 Glossary....99

Figures

Figure 1. Fernald Preserve and Vicinity 7
Figure 2. Major Communities in Southwestern Ohio 8
Figure 3. Fernald Preserve Perspective.... 9
Figure 4. Schematic Cross Section of the New Haven Trough, Looking North 11
Figure 5. Regional Groundwater Flow in the Great Miami Aquifer 11
Figure 6. Southern Portion of the Great Miami River Drainage Basin 12
Figure 7. Cincinnati Area Annual Precipitation, 1991–2025 14
Figure 8. Monthly Precipitation for 2025 Compared to Average Monthly Precipitation for 1951–2025.... 15
Figure 9. Uncertified Areas and Subgrade Utility Corridors.... 20
Figure 10. DOE and Ohio EPA Groundwater Split Sample Location.... 28
Figure 11. Extraction Wells Active in 2025 30
Figure 12. Locations for Semiannual Total Uranium Monitoring.... 34
Figure 13. Diagram of a Typical Groundwater Monitoring Well.... 40
Figure 14. Monitoring Well Screen Locations 41
Figure 15. Locations for Non-Uranium Monitoring.... 42
Figure 16. Groundwater Elevation Monitoring Wells.... 43
Figure 17. Yearly and Cumulative Mass of Uranium Removed from the Great Miami Aquifer, 1993–2025 45
Figure 18. Total Uranium Plume in the Aquifer with Concentrations Greater Than or Equal to 30 µg/L at the End of 2025.... 49
Figure 19. Non-Uranium Constituents with 2025 Results Above FRLs 53
Figure 20. OSDF Footprint and Monitoring Well Locations 60
Figure 21. Uncontrolled Surface Water Areas and Runoff Flow Directions.... 64

Figure 22. IEMP/NPDES Surface Water and Effluent Sample Locations 66
Figure 23. Annual Average Total Uranium Concentrations in Paddys Run at Willey Road (Sample Location SWP-03) 68
Figure 24. Mass of Uranium Discharged to the Great Miami River Through the Parshall Flume (PF 4001) in 2025 71
Figure 25. 2025 Monthly Average Total Uranium Concentration in Water Discharged 72
Figure 26. Uranium Discharged via the Surface Water Pathway, 1993−2025 73
Figure 27. Site Inspection Findings 76
Figure 28. OSDF Inspection Findings 78
Figure 29. Restoration Project Areas and Ecological Community Types 81
Figure 30. Ecological Maintenance Activities 84

Tables

Table 1. Operable Unit Remedies 4
Table 2. Compliance with Other Environmental Regulations 23
Table 3. Prohibited Activities 25
Table 4. 2025 DOE and Ohio EPA Groundwater Split Sampling Total Uranium Result Comparison 27
Table 5. Model-Predicted Cleanup Years 36
Table 6. Groundwater Restoration Module Status for 2025 44
Table 7. Non-Uranium Constituents with Results Above FRLs During 2025 52
Table 8. Comparison of 2024 and 2025 Maximum Total Uranium Plume Footprint Areas 55
Table 9. Ricker Method Bulk Plume Metrics (2006 to 2025) 56
Table 10. Earth Volumetric Studio Bulk Plume Metrics 57
Table 11. OSDF Groundwater, Leachate, and LDS Monitoring Summary 61
Table 12. Annual Debris Quantities 79
Table 13. Invasive Herbaceous Species Treated in 2025 83
Table 14. Invasive or Non-Native Woody Vegetation Species Treated in 2025 85
Table 15. Summary of Visitors Center Programs and Participants for 2025 91

Appendixes

Appendix A Supplemental Groundwater Information
Appendix B Supplemental Surface Water and Effluent Information
Appendix C Site Inspections and Natural Resource Management

Abbreviations

ARAR	applicable or relevant and appropriate requirement
CAWWT	Converted Advanced Wastewater Treatment
CC	coefficient of conservatism
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facility Compliance Agreement
FQAI	Floristic Quality Assessment Index
FRL	final remediation level
IEMP	Integrated Environmental Monitoring Plan
LCS	leachate collection system
LDS	leak detection system
LM	Department of Energy, Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRRP	Natural Resource Restoration Plan
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU5 ROD	Operable Unit 5 Record of Decision
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PPDD	Pilot Plant Drainage Ditch
PRRS	Paddys Run Road Site
RAMP	Restored Area Maintenance Plan
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision

SARA	Superfund Amendments and Reauthorization Act of 1986
SSOD	storm sewer outfall ditch
USC	*United States Code*
VAM-3D	Variable Saturated Analysis Model in Three Dimensions

Measurement Abbreviations

Bgal	billion gallons
ft	feet
gpm	gallons per minute
lb	pounds
Mgal	million gallons
µg/L	micrograms per liter

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Executive Summary

The *Fernald Preserve 2025 Site Environmental Report* provides stakeholders with the results from the Fernald Preserve, Ohio, Site's environmental and natural resource management programs for 2025; a summary of U.S. Department of Energy (DOE) activities conducted onsite; a status of the ongoing groundwater remediation; and a summary of the site's compliance with the various environmental regulations, compliance agreements, and DOE policies that govern site activities. This report has been prepared in accordance with the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2025a).

Remediation of the Fernald Preserve has been successfully completed, with the exception of the groundwater. During 2025, activities at the Fernald Preserve included the following:

- Environmental monitoring activities related to groundwater and surface water
- Monitoring as specified in the site's National Pollutant Discharge Elimination System (NPDES) permit
- Extraction, monitoring, and treatment of contaminated groundwater from the Great Miami Aquifer (Operable Unit 5)
- On-Site Disposal Facility (OSDF) leak detection monitoring and collection, monitoring, and treatment of leachate from the OSDF
- Inspections and follow-up maintenance of the site and the OSDF to ensure that provisions of the LMICP are fully implemented
- Ongoing operation of the Fernald Preserve Visitors Center, associated outreach, and educational activities
- Natural resource management including ecological monitoring and maintenance activities to enhance, protect, and preserve site natural resources

Environmental monitoring programs were developed to ensure that the remedy remains protective of the environment. Ecological monitoring is used to evaluate whether natural resource management goals are being met. Outreach and educational activities are conducted to continue community awareness of the site's history and maintain environmental controls. The requirements and objectives of these programs are described in detail in the LMICP and reported in this Site Environmental Report as outlined below.

Liquid Pathway Highlights

Groundwater Pathway

The groundwater pathway at the Fernald Preserve is routinely monitored to:

- Verify that hydraulic capture of the total uranium plume is maintained; track the aquifer restoration in the area of the plume, including non-uranium constituents; and evaluate water quality conditions in the aquifer that may indicate a need to modify the design or the operation of the wellfield.
- Meet compliance-based groundwater monitoring obligations.

During 2025, active restoration of the Great Miami Aquifer continued. A total of 91 groundwater monitoring wells were sampled to determine water quality. Aquifer water elevations were measured in 172 groundwater monitoring wells. The following highlights describe the key findings from the 2025 groundwater data:

- A total of 1.9 billion gallons (Bgal) of groundwater was extracted by pumping from the Great Miami Aquifer, and 288 pounds (lb) of uranium was removed from the aquifer in 2025.
- Since 1993, 60.9 Bgal of water have been pumped from the Great Miami Aquifer, and 16,618 net pounds of uranium have been removed from the Great Miami Aquifer. Net pounds of uranium removed include a small amount of uranium that was reinjected into the aquifer between 1998 and 2004.
- Data collected in 2025 indicate that uranium concentrations within the footprint of the 30 micrograms per liter (µg/L) maximum uranium plume continue to decrease in response to pumping. The footprint of the maximum uranium plume in 2025 was approximately 65.6 acres, a decrease of 3.8 acre or approximately 5.5% from 2024. Since 2005, the area of the total uranium plume has decreased from 196.1 acres to 65.6 acres (66.5%).
- Results from the groundwater capture analysis and monitoring for total uranium and non-uranium constituents indicate that the design of the groundwater remedy for the aquifer restoration system remains appropriate for capture of the plume.
- Pumping of extraction wells continued to meet the objective of capturing the remaining uranium plume and preventing expansion of the plume.
- With regulatory approval and stakeholder coordination, the Paddys Run Road Site constituent monitoring was discontinued at the end of 2025. Further discussion is provided in Appendix A, Attachment A.1, Section A.1.4.1.

Groundwater Remedy

In 2006, when the Fernald site transferred from DOE, Office of Environmental Management (EM) to the DOE, Office of Legacy Management, the groundwater remedy was following a design completed in 2005 (DOE 2005b); this 2005 design has undergone two optimizations (i.e., 2014 and 2024).

The first optimization was implemented on July 1, 2014. Three extraction wells that were no longer providing benefit to the remediation were shut down, and the pumping capacity from those wells was reallocated to extraction wells in the South Plume and southern portion of the South Field to accelerate cleanup of those areas. The system pumping rate was increased to 300 gallons per minute (gpm) from 4,775 to 5,075 gpm.

The second optimization was implemented on March 25, 2024, based on modeling completed in early 2022 (DOE 2022a). The groundwater model was updated with uranium concentrations measured in the first half of 2021. This new operational design has all six original South Plume/Optimization extraction wells (3924, 3925, 3926, 3927, 32308, and 32309) permanently shut down, and two new replacement wells (33616 and 33617) operating.

The longest model-predicted cleanup dates for the second optimization for the South Plume, the South Field, and the Waste Storage Area were determined to be 2025, 2038, and 2045, respectively. These dates assumed that the optimization would be implemented in 2021 which

was the dataset that was used in the model. When adjusted for the date when the design was operationally implemented in 2024, these predicted cleanup dates shift year-for-year and become 2028, 2041, and 2048, respectively. This approach is conservative as it does not take credit for decreasing concentrations that were observed between 2021 and 2024.

Now that two new replacement extraction wells (33616 and 33617) are operational in the South Plume Module, DOE will focus efforts on optimizing the southern South Field plume. A few of the aging extraction wells in the South Field are no longer responding to rehabilitation efforts. Modeling will be conducted to determine if replacement of the older, nonresponsive wells is necessary, and how to improve cleanup efficiency in the southern South Field area.

DOE collaborated with the DOE National Laboratory Network in 2021 through two focus groups to determine ways to address the continuing issues with the aging aquifer restoration infrastructure (Focus Group 1) and improve the efficiency of the aquifer cleanup (Focus Group 2). DOE is implementing National Laboratory Network recommendations that target improving the aquifer remediation and providing better model predicted cleanup dates (Focus Group 2). In late 2022 to early 2023, DOE completed work using alternative mathematical functions to trend uranium concentration data and using three-dimensional aquifer interpretations over time to improve plume metrics used to assess cleanup progress. Both methods have been successfully added to the Fernald Preserve toolbox for evaluation of the aquifer remedy. For example, in 2024, to provide better model predicted cleanup dates, DOE completed comparing the use of the Variable Saturated Analysis Model in Three Dimensions (VAM-3D) to MODFLOW for the site groundwater modeling code. MODFLOW is a more transparent code which provides for more robust use of algorithm-based optimization programs. The comparison report issued recommends using the MODFLOW model at the Fernald Preserve (DOE 2024a), which was approved by EPA and Ohio EPA. More information is provided in Section 3.4 and Appendix A. DOE is currently in the process of validating and calibrating a MODFLOW groundwater model for the Fernald site.

The aquifer remedy continues to achieve uranium discharge limits (i.e., average monthly concentration of less than 30 µg/L and 600 lb annually) established in the Operable Unit 5 Record of Decision without routine groundwater treatment. Routine groundwater treatment has not been needed since 2010. Occasionally, groundwater is sent to treatment for very short periods of time. The reasons for the short periods of treatment vary, but most are related to times when wells pumping low uranium concentrations are turned off for maintenance and wells pumping higher uranium concentrations continue pumping. In 2025, 1.9 Bgal of groundwater were pumped from the Great Miami Aquifer and 4.3 million gallons (0.23%) of groundwater were treated.

DOE evaluated the Property/Plume Boundary groundwater monitoring program and is recommending changes. Based on 30 years of data, DOE is proposing to eliminate the Property/Plume Boundary groundwater monitoring program, but continue monitoring the Property/Plume Boundary monitoring wells located south of Willey Road (i.e., offsite wells) for total uranium on an annual basis. With regulatory approval, these changes would begin with calendar year 2027. Additional details are provided in Section 3.3.2 and Appendix A, Attachment A.4.

OSDF Monitoring

Data collected during 2025 indicate that engineered features within the OSDF continue to perform as designed, indicating that a leak from the facility is not occurring. Leachate flow continues to decrease as expected, and leak detection system flow volumes in 2025 were zero in all but two of the eight cells indicating that the cell liners are performing as designed. It should be noted that flow volume in the Cell 1 leak detection system (LDS) was likely affected by work related to the video survey of the lines conducted in 2025. The 2025 video inspection was conducted of the leachate collection system, redundant leachate collection system, and leak detection system of the OSDF. No significant additional scale or infiltration of gravel were observed in the lines. There was no visible change in pipe integrity or signs of structural impacts (i.e., crushing or ovality), and it was determined that there was no need to clean out any of the lines. Several suggestions were made during the review of the 2025 results with the intent of improving the consistency of the surveys between events (e.g., speed at which the camera moves during the survey). DOE plans to incorporate the changes into the LMICP for implementation in future video surveys. Further discussion is provided in Attachment A.5 and Subattachment A.5.1.

Vegetation monitoring occurs annually on the OSDF; 2025 results indicate that the goals for the vegetated cap were exceeded and predominantly native vegetation remains established on the OSDF cap.

Surface Water and Effluent Pathway

Surface water and effluent are monitored to determine the effects of Fernald Preserve activities on Paddys Run (an intermittent stream), the Great Miami River, and the underlying Great Miami Aquifer, as well as to meet compliance-based surface water and effluent monitoring obligations.

In 2025, eight surface water locations and one effluent location were sampled at various frequencies. The following highlights describe the key findings from the 2025 surface water and effluent monitoring programs:

- Since 1995, the annual uranium mass discharged in Fernald Preserve effluent to the Great Miami River has been less than the Operable Unit 5 Record of Decision limit of 600 lb per year. In 2025, 288 lb of uranium were removed from the Great Miami Aquifer. A total of 283 lb of uranium was discharged in effluent to the Great Miami River in 2025. The difference of 5 lb was the uranium removed via treatment.
- An estimated 30.3 lb of uranium were released to the environment through uncontrolled stormwater runoff from the site. Therefore, the total amount of uranium released through the effluent (283 lb) and uncontrolled surface water pathway (30.3 lb) during 2025 is estimated to be 313.3 lb. DOE will continue to report the pounds of uranium discharged to the Great Miami River through the Parshall Flume, but is planning to no longer report the mass of uranium in uncontrolled runoff to Paddys Run, reflecting the successful remediation and restoration of the site. Additional discussion is provided in Section 4.2.3.
- Compliance sampling, consisting of sampling for nonradiological pollutants in effluent discharges from the Fernald Preserve, is regulated under the state-administrated NPDES program. Discharges in 2025 were in compliance with limits identified in the NPDES permit.

- In 2025, the two onsite surface water locations (SWD-05 and SWD-09) located west of the former waste pits continue to trend downward. This area is where a limited maintenance activity was completed in fall 2007 and DOE committed to continue monitoring of the elevated uranium area.
- In 2025, the surface water final remediation level for total uranium outside the mixing zone in the Great Miami River was not exceeded.
- The groundwater final remediation level is compared to concentrations at surface water locations that are points where the surface water infiltrates down to the aquifer. These are referred to as cross-media impacts. Analytical results of surface water samples collected at location SWD-04 and SWD-05 did exceed the groundwater final remediation level for total uranium. Both locations are in the former Waste Storage Area; SWD-05 is one of the two locations established to monitor the 2007 maintenance action completed west of the former waste pits. Total uranium concentrations have been trending downward since 2010. The surface water from this area remains isolated and does not drain normally to Paddys Run; it either evaporates or infiltrates into the ground. Any infiltration down to the aquifer in this area is within the capture zone of nearby extraction wells operating as part of the groundwater remediation.

Site and OSDF Inspections

Routine site and OSDF inspections continued in 2025 and included post-controlled burn walkdowns for 20 acres of prairie and the 75-acre OSDF cap. Site inspection findings were mainly nonradiological debris, and findings related to remnants of former deer exclosure fencing. Woody vegetation was the most identified finding on the cap of the OSDF. There were no activity or use limitations as defined in the LMICP reported in 2025. In 2025, 19 minor prohibited site activities were identified and are discussed in Section 2.3.

Debris continues to be found onsite and is most often observed during the post-burn walkdowns in the Former Production and Waste Storage Areas. Examples of debris include pieces of concrete, rebar, clay tile, and metal. Weather, erosion, and earth-moving activities occasionally reveal small pieces of debris that were not visible during remediation and restoration efforts. A total of 126 pieces of debris were found and removed in 2025. No debris had radiological contamination above background levels.

Because a prescribed burn allows for a more thorough inspection of the surface of the OSDF, DOE is proposing to change the annual walkover inspection to every other year to align this complete cap walkover with the OSDF prescribed burns. OSDF cap vegetation monitoring results indicate that the vegetative cover goals for the cap typically exceed established goals of maintaining greater than 90% cover. In the event that an OSDF burn cannot be completed, DOE will still complete a walkover of the entire OSDF cap at least every other year. The next prescribed burn of the OSDF is planned for spring 2027. Additional discussion is provided in Section 5.1.

OSDF permanent features (e.g., survey monuments, fences) are photographed annually, but minimal to no changes are noted from year to year; therefore, DOE is proposing to reduce the frequency of photographs not related to inspection findings to every 5 years to align with the CERCLA five-year review. With approval by the regulators, the next set of photographs will be

taken in 2030. Significant inspection findings will be photographed and reported in the Site Environmental Report, when necessary. Additional discussion is provided in Appendix C.

Natural Resources

Floristic inventories were conducted in remediation successional areas and remediation prairie areas in 2025. Results of this effort indicate that native vegetation is established across all the remediation areas monitored and ecological progression continues. Several species not previously recorded at the site were observed for the first time. DOE is planning to implement a new ecological monitoring method in 2027 which will also be implemented for OSDF vegetation monitoring. This new method will better identify natural resource maintenance needs across the site to ensure continued habitat improvement and will ensure that 90% total vegetation consisting of 50% native vegetation is maintained on the OSDF cap.

The focus of natural resource maintenance activities in 2025 involved continued eradication of invasive herbaceous and woody vegetation species [e.g., teasel (*Dipsacus* species*)*, giant reed (*Phragmites australis*), lesser celandine (*Ficaria verna*), and Callery pear (*Pyrus calleryana*)]. Fall foliar herbicide application to Amur honeysuckle (*Lonicera maackii*), in conjunction with manual removal, also continued in 2025. Natural resource and habitat improvement activities in 2025 also included planting trees and shrubs to increase species diversity and support ecological succession, to help combat invasive species by planting native trees in areas where invasive honeysuckle was removed, and to restore a declining non-native pine habitat with native deciduous trees. Twenty acres of prairie vegetation and the 75-acre vegetated OSDF cap were burned.

Community Involvement and Visitors Center

In 2025, DOE continued to successfully fulfill the primary function of being an informational and educational resource within the surrounding community. The information made available at the Fernald Preserve Visitors Center serves as an institutional control for the site and provides an important forum to help the community understand post-closure site conditions and the controls in place to protect human health and the environment. Over 50,000 visitors came to the site in 2025, and the site recorded the highest number of Visitors Center program participants since opening in 2008, with 17,025 participants. Walk-in totals remained high with 5,325 people visiting the Visitors Center. Staff engaged with visitors on trail through the roving interpretive staff program, making contact with 665 visitors who learned from staff during the year.

The annual public meeting was held at the Visitors Center in October 2025. A discussion of the information in the Site Environmental Report as well as other activities occurring at the site were provided by site personnel. The 2025 annual meeting was also the kickoff for the sixth CERCLA five-year review with questionnaires provided for attendees to provide feedback on the remediation of the site. Twenty-eight individuals attended the meeting with several first-time attendees.

The Fernald Preserve continues to be a source of lessons learned for communities facing similar remediation issues.

1.0 Site Background

Abbreviated Timeline: 1951–2006

1951	Construction of the Feed Materials Production Center began.
1952	Uranium production started.
1986	U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) signed the Federal Facility Compliance Agreement, thus initiating the remedial investigation/feasibility study process under the National Contingency Plan.
1989	Uranium production suspended. The Fernald site was placed on the National Priorities List; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites most in need of cleanup.
1991	As part of the Amended Consent Agreement, the site was divided into operable units for characterization and remedy determination. Uranium production formally ended. The site mission changed from uranium production to environmental remediation and site restoration.
1992	Large-scale groundwater pumping to contain the off-property South Plume began.
1994	Decontamination and dismantling of the first building was completed under the Operable Unit 3 Interim Record of Decision (ROD).
1996	The last operable unit's ROD was signed, signifying the end of the 10-year remedial investigation/feasibility study process. (The Operable Unit 4 ROD was later reopened.) Construction began in support of the Operable Unit 1 selected remedy. Soil remedial excavation began as part of the Operable Unit 5 selected remedy.
1997	Construction of the On-Site Disposal Facility (OSDF) began. First waste placement began in December. Environmental monitoring and reporting were consolidated under the Integrated Environmental Monitoring Plan.
1998	Operable Unit 2 remedial excavations began.
1999	Excavation of the waste pits began (Operable Unit 1 ROD), and the first rail shipment of waste was transported to Envirocare of Utah, Inc.
2000	The ROD Amendment for Operable Unit 4 Silos 1 and 2 Remedial Actions was signed by EPA, thus establishing a new selected remedy for Operable Unit 4.
2001	Cell 1 of the OSDF was capped. Remediation of the Operable Unit 2 Southern Waste Units was completed.
2002	The Silos 1 and 2 Radon Control System began operation and successfully reduced radon levels within the silos. The offsite transfer of nuclear product material was completed. Wastes were placed in OSDF Cells 2 through 5.
2003	All major Operable Unit 2 remedial actions were completed. In addition, approximately 412,000 cubic yards of waste were placed in OSDF Cells 3 through 6.
2004	Removal of wastes from Silos 1 and 2 to the holding tank facility began. Plans to reduce the size of the site's wastewater treatment infrastructure were approved and implemented. The last of the Fernald site's 10 uranium production complexes, plus an additional 35 structures and 73 trailers, were demolished. All eight cells of the OSDF were capped or received waste. Approximately 513,000 cubic yards of waste were placed in Cells 4 through 8.
2005	Removal of Operable Unit 4, Silo 3 waste began and the first shipment of this waste arrived at Envirocare of Utah. Remedial actions for Operable Unit 1 were completed in June. The first shipment of Silos 1 and 2 waste arrived at Waste Control Specialists in Texas.
2006	With the exception of groundwater remediation, site remediation was completed October 29, 2006. The site was officially transferred to DOE's Office of Legacy Management on November 17, 2006.

In 1951, the U.S. Atomic Energy Commission, a predecessor agency of the U.S. Department of Energy (DOE), began building the Feed Materials Production Center on a 1,050-acre tract of land outside the small farming community of Fernald, Ohio. The facility's mission was to produce "feed materials" in the form of purified uranium compounds and metal for use by other government facilities involved in the production of nuclear weapons for the nation's defense.

Uranium metal was produced at the Feed Materials Production Center from 1952 through 1989. During that time, more than 500 million pounds (lb) of uranium metal products were delivered to other sites. These production operations caused releases to the surrounding environment, which resulted in contamination of soil, surface water, sediment, and groundwater on and around the site.

In 1991, the mission of the site officially changed from uranium production to environmental cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund), as amended (Title 42 *United States Code* Section 9601 et seq. [42 USC 9601 et seq.]). The site was renamed the Fernald Environmental Management Project in 1991. In 2003, the site name changed to the Fernald Closure Project to reflect the mission of the site as on a path to closure. In 2007, the site name changed to the Fernald Preserve to reflect the completion of the cleanup (with the exception of groundwater) ushered in by the successful transition to the DOE Office of Legacy Management (LM) in

late 2006. In addition to completing groundwater remediation, the LM mission for the site is now to be an asset to the community as an undeveloped park, with an emphasis on wildlife.

Abbreviated Timeline: 2006–Present

2008	The old Silos Warehouse was remodeled into the new Fernald Preserve Visitors Center and opened to the public in August 2008. The community was allowed unescorted access to the Fernald Preserve.
2012	The throughput capacity of the Converted Advanced Wastewater Treatment Facility (CAWWT) was reduced from 1,800 gallons per minute (gpm) to 500−600 gpm.
2014	On July 1, 2014, a new groundwater remediation operational design was implemented (DOE 2014b). The target system pumping rate was 300 gpm higher than the previous design and accelerated cleanup.
2015	The decision to reduce wastewater treatment capacity to 50 gpm was made.
2017	Completed removal of treatment media, demolition of existing piping and tanks to allow room for the new wastewater treatment system within CAWWT, and design of the new system, which began in 2016. Low-level radioactive waste from the demolition project was disposed of at Waste Control Specialists in Texas. Construction of the new treatment system began.
2018	The new water treatment system became operational in April 2018.
2019	The refurbished CAWWT backwash basin was operational in November 2019.
2024	Two new South Plume extraction wells became operational and the last of the original South Plume recovery wells was turned off.

DOE's Legacy Management Support contractor continues to perform site activities, including the ongoing groundwater remedy. The U.S. Environmental Protection Agency (EPA) Region 5 and the Southwest District Office of the Ohio Environmental Protection Agency (Ohio EPA) provide regulatory oversight.

In the 1980s, the goals of environmental monitoring were to assess the impact of production operations and monitor the environmental pathways through which residents of the local community might be exposed to contaminants from the site (exposure pathways). The environmental monitoring program provided comprehensive on- and off-property surveillance of contaminant levels in surface water, groundwater, air, and biota (agricultural produce). The goal was to measure the levels of contaminants associated with uranium production operations and report this information to the regulatory agencies and stakeholders.

After the conclusion of the site's uranium production and the completion of the CERCLA remedy selection process, the focus was on the safe and efficient implementation of environmental remediation activities and facility decontamination and dismantling operations. In recognition of this shift in emphasis toward remedy implementation, in 1997 the environmental monitoring program was revised to align with the remediation activities planned for the Fernald site. The site's environmental monitoring program is described in the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2025a). The Fernald Preserve Quality Assurance Project Plan (DOE 2014a) allows for LMICP revision either via the variance process or a full revision, depending on anticipated changes. In 2024, a full revision of the LMICP was completed and approved for implementation in calendar year 2025 (DOE 2025a).

The environmental monitoring program is designed to ensure the continued protectiveness of the completed remedial actions as well as implementation of the ongoing groundwater remedy and performance of the On-Site Disposal Facility (OSDF). This *Fernald Preserve 2025 Site Environmental Report* summarizes the findings from the monitoring program and provides a status on the progress toward final site restoration. This report consists of the following:

- **Summary Report:** The summary report (Sections 1.0 through 6.0) documents the results of environmental monitoring activities at the Fernald Preserve in 2025. It includes a discussion of ongoing groundwater remediation activities and summaries of environmental data from groundwater, surface water and effluent, inspections, and natural resources management

programs. This report also summarizes the information contained in the appendixes. A glossary is included at the end of the summary report.

- **Appendixes:** The detailed appendixes provide the 2025 monitoring data for the various media, primarily in the form of graphs, figures, and tables. The appendixes are generally distributed only to the regulatory agencies. However, a complete copy of the appendixes is available on the LM public website at https://www.energy.gov/lm/fernald-preserve-ohio-site or by contacting the Fernald Preserve Visitors Center at (513) 648-3330; or by sending an email to fernald@lm.doe.gov.

CERCLA Remedial Process

The process of cleaning up sites under CERCLA consists of the following general phases:

Site Characterization: During this phase, contaminants are identified and quantified, and the potential impacts of those contaminants on human health are determined. This phase includes the remedial investigation and the baseline risk assessment.

Remedy Selection: During this phase, cleanup alternatives are developed and evaluated. Activities include the feasibility study and proposed remedial action plan. After public comments are received and addressed, a remedy is selected and documented in a Record of Decision (ROD).

Remedial Design and Remedial Action: This phase of the CERCLA process includes the detailed design and implementation of the remedy. The CERCLA process ends with certification and site closure.

A CERCLA five-year review process is triggered by the onset of construction for the first operable unit remedial action that will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Of all the operable units, the site preparation construction to support the Waste Pits Project under the Operable Unit 1 ROD (DOE 1995b) was the first such action. This construction began on April 1, 1996. To date, DOE has conducted, and the regulatory agencies have approved, five CERCLA five-year reviews (April 2001 [DOE 2001c], April 2006 [DOE 2006c], September 2011 [DOE 2011], August 2016 [DOE 2016b]), and September 2021 (DOE 2021). These reviews verify that the remedy remains effective and continues to be protective of human health and the environment. The next five-year review began in late 2025.

Long-Term Stewardship of CERCLA Remedies: Site closure, relative to the completion of remediation, was defined in the contract between Fluor Fernald Inc. and DOE as the physical completion of the scope of work required by the five RODs with the exception of the groundwater remedy.

LM assumed the long-term surveillance monitoring and maintenance of the Fernald site on November 17, 2006, to ensure continued protection of human health and the environment and continued operation of the groundwater remedy. The *Comprehensive Legacy Management and Institutional Controls Plan* (DOE 2025a) defines the activities to be conducted with respect to long-term stewardship at the Fernald Preserve. The CERCLA five-year review process will continue to provide stakeholders information on remedy performance and long-term stewardship.

The remainder of this introductory Section 1.0 provides:

- An overview of the environmental remediation completed as well as ongoing remedy implementation.
- A description of environmental monitoring activities at the Fernald Preserve.
- A description of the physical and ecological characteristics of the Fernald Preserve.

1.1 The Path to Site Closure

In 1986, the Fernald site initiated working through the CERCLA process to characterize the nature and extent of contamination at the site, to establish risk-based cleanup standards, and to select the appropriate remediation technologies to achieve those standards. To facilitate this process, in 1991 the site was organized into five operable units. The purpose of the operable unit concept under CERCLA was to organize site components by geographical location and by the potential for similar technologies to be used for environmental remediation. The remedy selection process culminated in 1996 with the approval of the final Records of Decision (RODs) for all five operable units. However, several of the RODs (including those for Operable Units 1, 4, and 5) have subsequently been modified through issuance of Explanation of Significant Difference documents or ROD Amendment documents. These documents were prepared, submitted for EPA and public review, and issued in accordance with CERCLA regulations. Following approval of the initial RODs, work began on the design

and implementation of the operable unit remedies. Table 1 describes each operable unit and gives an overview of its associated remedy.

Table 1. Operable Unit Remedies

Operable Unit	Description	Remedy Overview
1	• Waste Pits 1–6 • Clear well • Burn pit • Berms, liners, caps, and soil within the boundary	ROD approved: March 1995 Explanation of Significant Differences approved: September 2002 ROD Amendment approved: November 2003 Excavation of materials with constituents of concern above final remediation levels (FRLs), waste processing and treatment by thermal drying (as necessary), offsite disposal at a permitted facility, and soil remediation/certification. **Remedial actions completed: June 2005** **Final Remedial Action Report approved: August 2006**
2	• Solid waste landfill • Inactive Flyash Pile • Active Flyash Pile (now inactive) • North and South Lime Sludge Ponds • Other South Field areas • Berms, liners, and soil within the operable unit boundary	ROD approved: May 1995 Post-ROD fact sheet approved: April 1999 Excavation of all materials with constituents of concern above FRLs, treatment for size reduction and moisture control as required, onsite disposal in the OSDF, and offsite disposal of excavated material that exceeded the waste acceptance criteria for the OSDF. This was the first ROD to specify onsite disposal in the OSDF. **Remedial actions completed: June 2006** **Final Remedial Action Report approved: September 2006**
3	Former Production Area, associated facilities, and equipment (includes all above- and below-grade improvements), including but not limited to: • All structures, equipment, utilities, effluent lines, and K-65 transfer line • Wastewater treatment facilities • Fire training facilities • Coal pile • Scrap metals piles • Drums, tanks, solid waste, waste product, feedstocks, and thorium	ROD for Interim Remedial Action approved: June 1994 ROD for Final Remedial Action approved: August 1996 Adoption of Operable Unit 3 Interim ROD; alternatives to disposal through the unrestricted or restricted release of materials as economically feasible for recycling, reuse, or disposal; treatment of material for onsite or offsite disposal; required offsite disposal for process residues, product materials, process-related metals, acid brick, concrete from specific locations, and any other material exceeding the OSDF waste acceptance criteria; and onsite disposal for material that meets the OSDF waste acceptance criteria. Post-ROD fact sheet that identifies clean buildings, structures, and materials for beneficial reuse under LM. Approved: December 2006. **Remedial actions completed: October 2006** **Final Remedial Action Report approved: February 2007**

Table 1. Operable Unit Remedies (continued)

Operable Unit	Description	Remedy Overview
4	• Silos 1 and 2 (containing K-65 residues; demolished in 2005) • Silo 3 (containing cold metal oxides; demolished in 2006) • Silo 4 (empty and never used; demolished in 2003) • Decant tank system • Berms and soil within the operable unit boundary	ROD approved: December 1994 Explanation of Significant Differences for Silo 3 approved: March 1998 ROD Amendment for Silos 1 and 2 approved: July 2000 ROD Amendment for Silo 3 approved: September 2003 Explanation of Significant Differences for Silos 1 and 2 approved: November 2003 Explanation of Significant Differences for Operable Unit 4 approved: January 2005 Removal of Silo 3 materials for treatment and Silos 1 and 2 residues and decant sump tank sludges with onsite stabilization of materials, residues, and sludges followed by offsite disposal. Excavation of silos area soils contaminated above the FRLs with onsite disposal for contaminated soils and debris that met the OSDF waste acceptance criteria, and site restoration. Concrete from Silos 1 and 2 and contaminated soil and debris that exceeded the OSDF waste acceptance criteria were disposed of offsite. **Remedial actions for Silo 3 completed: April 2006** **Remedial actions involving the completion of the shipment of stabilized Silos 1 and 2 material to a temporary storage facility in Texas completed: May 2006** **Final Remedial Action Report approved: September 2006** **Permanent disposal of the 3,776 containers of Silos 1 and 2 material began on October 7, 2009, and the last container was placed on November 2, 2009.**
5	• Groundwater • Surface water and sediments • Soil not included in the definitions of Operable Units 1 through 4 • Flora and fauna	ROD approved: January 1996 Explanation of Significant Differences was approved in November 2001, formally adopting EPA's Safe Drinking Water Act maximum contaminant level for uranium of 30 micrograms per liter as both the FRL for groundwater remediation and the monthly average uranium effluent discharge limit to the Great Miami River. Extraction of contaminated groundwater from the Great Miami Aquifer to meet FRLs at all affected areas of the aquifer. Treatment of contaminated groundwater, storm water, and wastewater to attain concentration and mass-based discharge limits and FRLs in the Great Miami River. Excavation of contaminated soil and sediment to meet FRLs. Excavation of contaminated soil containing perched water that presented an unacceptable threat through contaminant migration to the underlying aquifer. Onsite disposal of contaminated soil and sediment that met the OSDF waste acceptance criteria. Soil and sediment with contaminant concentrations that exceeded the waste acceptance criteria for the OSDF was treated, when possible, to meet the OSDF waste acceptance criteria or was disposed of at an offsite facility. Also includes site restoration, institutional controls, and postremediation maintenance. **Interim Remedial Action Report approved: August 2008**

1.2 Environmental Monitoring Program

In the 1980s, DOE initiated an environmental monitoring program to assess the impact of past operations on the environment and to monitor potential exposure pathways to the local community. Additionally, for nearly 10 years DOE conducted characterization activities at the Fernald site through the remedial investigation phase of the CERCLA process. The initial environmental evaluations performed during the remedial investigation/feasibility study process were used to select the final remedy for Operable Unit 5, which addressed contamination in soil, groundwater, surface water, sediment, air, and biota—in short, all environmental media and contaminant exposure pathways affected by past uranium production operations at the site. The selected remedy for Operable Unit 5 defined the site's final contaminant cleanup levels and established the extent of on- and off-property remedial actions necessary to provide permanent solutions to environmental concerns posed by the site.

The Operable Unit 5 remedy included plans for removing the contamination that might be released through these exposure pathways and for monitoring these pathways to measure the site's continuing impact on the environment as remediation progressed. The characterization data used to develop the final remedy were also used to focus on and develop the environmental monitoring program documented in the IEMP. The IEMP key elements are as follows:

- Defines monitoring activities for environmental media, such as groundwater, surface water, and effluent. In general, the primary exposure pathway is monitored, and the program focuses on assessing the effect on the surrounding environment.
- Establishes a data evaluation and decision-making process for each environmental medium. Through this process, environmental conditions at the site are continually evaluated. For example, environmental data are routinely evaluated to identify any significant trends that may indicate the potential for an unacceptable future impact to human health or the environment if action is not taken.
- Ensures that the monitoring program adequately addresses monitoring requirements through annual review and revision, as necessary.
- Consolidates routine reporting of environmental data into this comprehensive annual report.

1.3 Characteristics of the Site and Surrounding Area

The natural settings of the Fernald Preserve and nearby communities were important factors in selecting the final remedy and remain important in the continual evaluation of the environmental monitoring program. Land use and demography, local geography, geology, surface hydrology, meteorology, and natural resources all impact monitoring activities and implementation of the site remedy.

1.3.1 Land Use and Demography

Economic activities in the area rely heavily on the physical environment. Land in the area is used primarily for crop farming and gravel pit excavation operations. A private water utility approximately 2 miles east of the Fernald Preserve pumps groundwater primarily for industrial use.

Downtown Cincinnati is approximately 18 miles southeast of the Fernald Preserve (Figure 1). The cities of Fairfield and Hamilton are 6 and 8 miles to the east and northeast, respectively (Figure 2). Scattered residences and several villages, including Fernald, New Baltimore, New Haven, Ross, and Shandon, are also near the site.

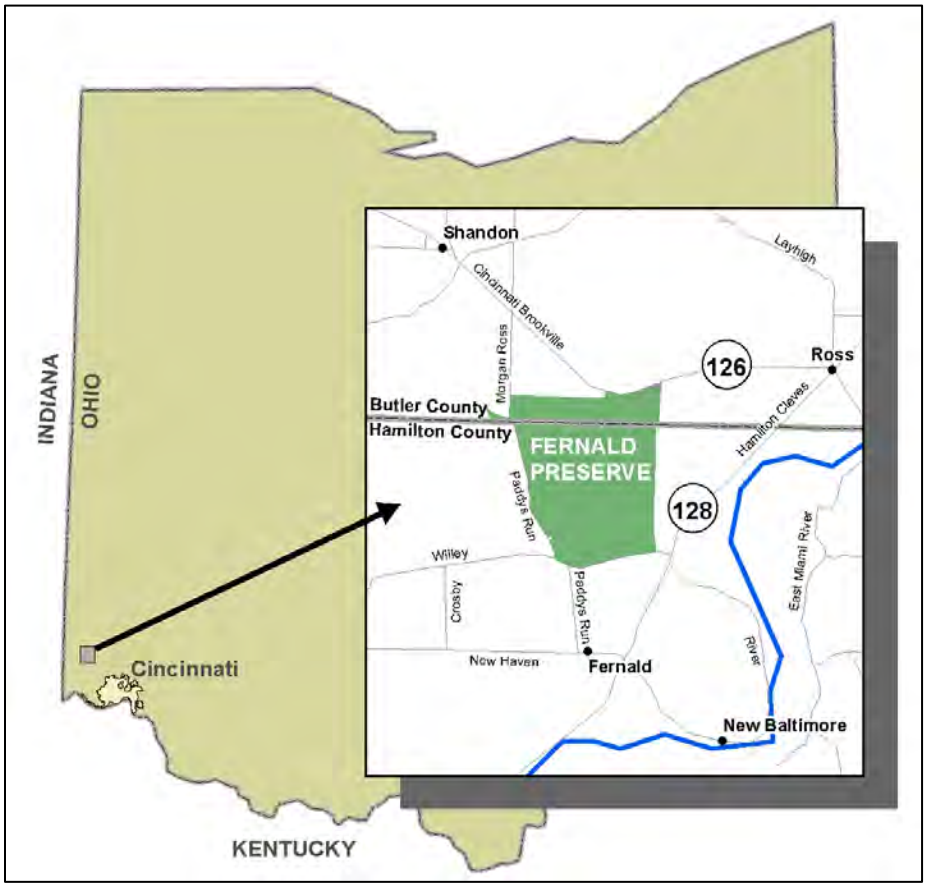


Figure 1. Fernald Preserve and Vicinity

1.3.2 Geography

Figure 3 depicts the location of the major physical features of the site, such as the buildings and supporting infrastructure. The Former Production Area and the OSDF dominate this view. The Former Production Area occupied approximately 136 acres in the center of the site and the OSDF occupies approximately 100 acres. The Great Miami River cuts a terraced valley to the east of the site, and Paddys Run (an intermittent stream) flows from north to south along the site's western boundary. In general, the site lies on a terrace that slopes gently among vegetated bedrock outcrops to the north, southeast, and southwest.

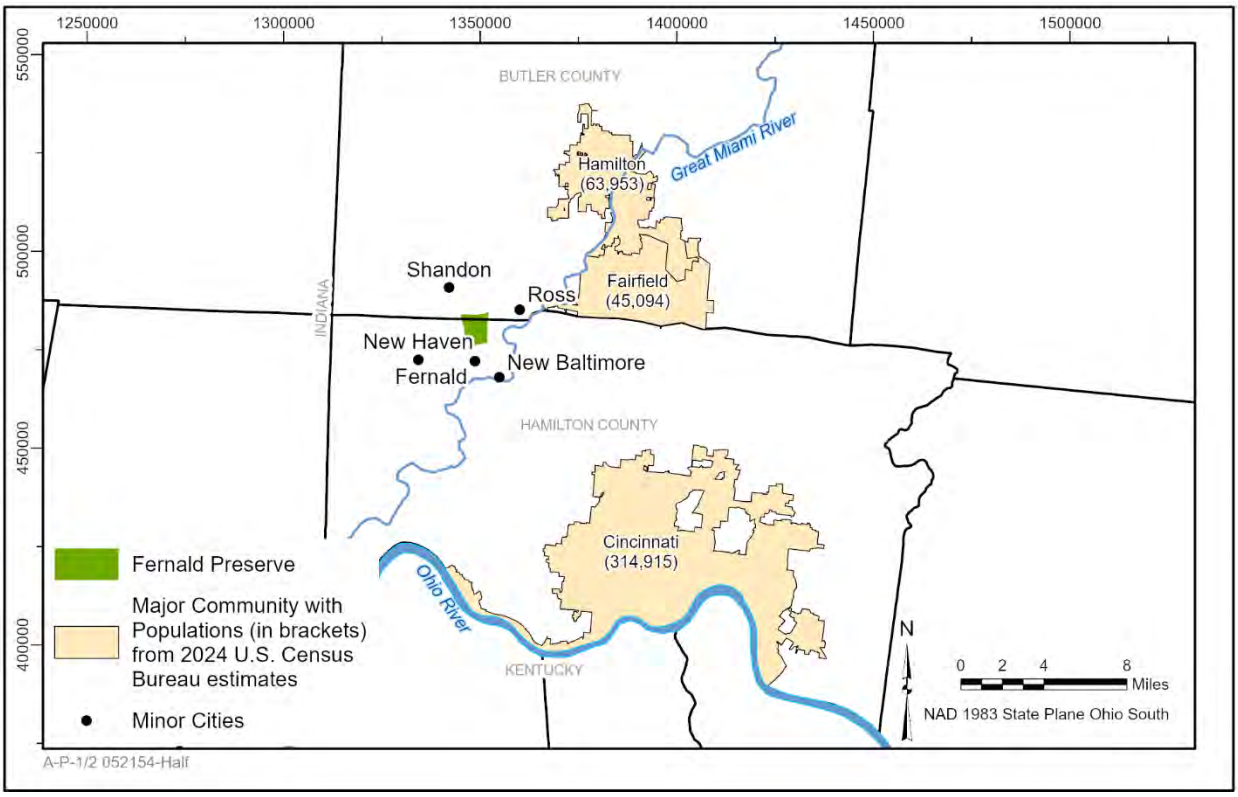


Figure 2. Major Communities in Southwestern Ohio

Figure 3. Fernald Preserve Perspective

1.3.3 Geology

Bedrock in the area indicates that approximately 450 million years ago a shallow sea covered the Cincinnati area. Sediments that later became flat-lying shale with interbedded limestone were deposited in the shallow sea, as evidenced by the abundance of marine fossils in the bedrock. In the more recent geologic past, the advance and retreat of three separate glaciers shaped the southwestern Ohio landscape. A large river drainage system south of the glaciers created river valleys up to 200 feet (ft) deep, which were then filled with sand and gravel when the glaciers melted. These filled river valleys are called buried valleys.

The last glacier to reach the area left a glacial overburden—a low-permeability mixture of clay and silt with minor amounts of sand and gravel—deposited across the land surface. The Fernald Preserve is situated on a layer of glacial overburden that overlies portions of a 2- to 3-mile-wide buried valley. This valley, known as the New Haven Trough, makes up part of the Great Miami Aquifer. The impermeable shale and limestone bedrock that defines the edges and bottom of the New Haven Trough restricts the groundwater to the sand and gravel within the buried valley. Where present, the glacial overburden limits the downward movement of precipitation and surface water runoff into the underlying sand and gravel of the Great Miami Aquifer.

The Great Miami River and its tributaries have eroded considerable portions of the glacial overburden and exposed the underlying sand and gravel of the Great Miami Aquifer. Thus, in some areas, precipitation and surface water runoff can easily migrate into the underlying Great Miami Aquifer and also transport contaminants to the aquifer. Natural and man-made breaches of the glacial overburden in some areas of the Fernald site were key pathways where contaminated water entered the aquifer, causing the groundwater contamination plumes that are being addressed by aquifer restoration activities. Figure 4 provides a view of the structure of subsurface deposits in the region along an east-west cross section beneath the site and through the New Haven Trough, and Figure 5 presents the regional groundwater flow patterns in the Great Miami Aquifer.

1.3.4 Surface Hydrology

The Fernald Preserve is in the Great Miami River drainage basin (Figure 6). Natural drainage from the site to the Great Miami River occurs primarily via Paddys Run. This intermittent stream begins losing flow to the underlying sand and gravel aquifer south of the former waste pits. Paddys Run empties into the Great Miami River 1.5 miles south of the site. The Great Miami River, 0.6 mile east of the Fernald Preserve, runs in a southerly direction and flows into the Ohio River about 24 miles downstream of the site. The segment of the Great Miami River between the Fernald Preserve and the Ohio River is not used as a source of public drinking water.

The average flow volume for the Great Miami River in 2025 was 4,252 cubic feet per second. This average is based on daily measurements collected at the U.S. Geological Survey Hamilton stream gauge (USGS 3274000) approximately 10 river miles upstream of the site’s effluent discharge.

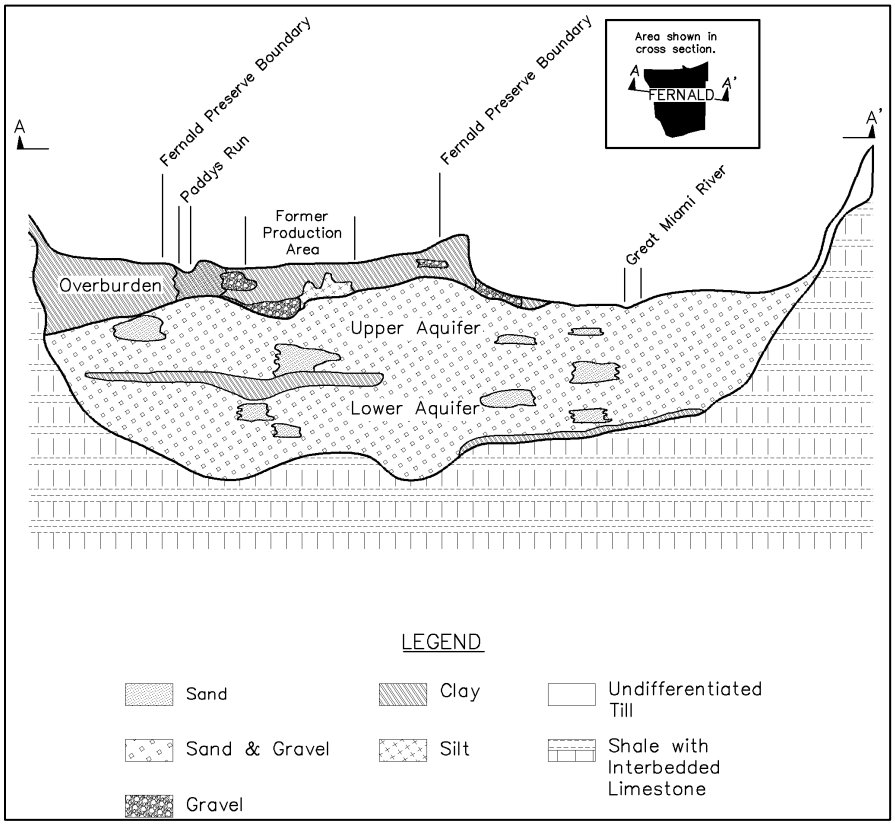


Figure 4. Schematic Cross Section of the New Haven Trough, Looking North

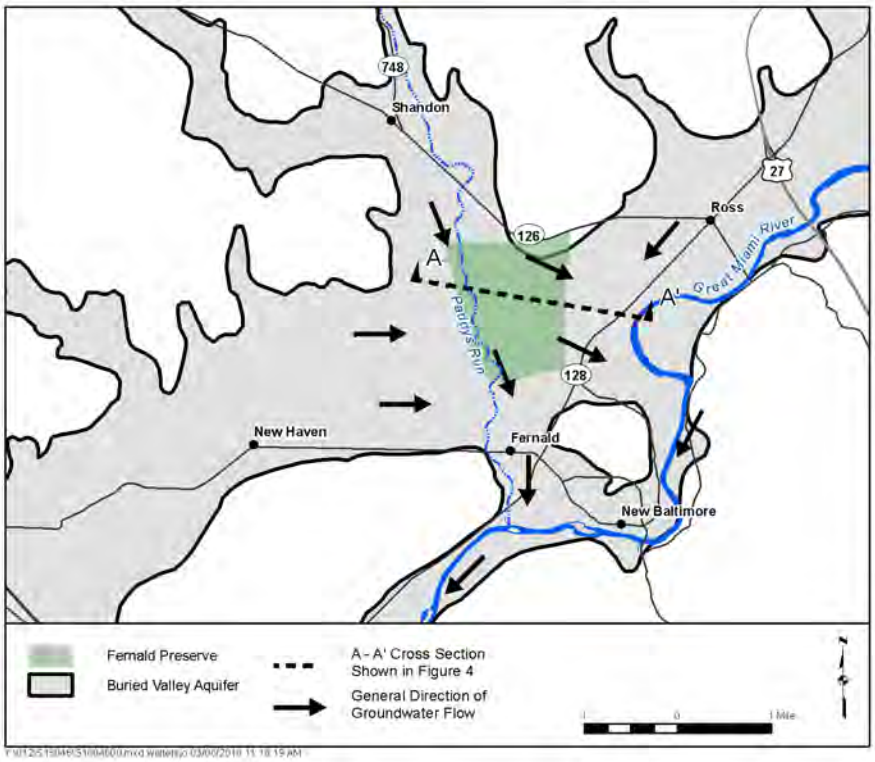


Figure 5. Regional Groundwater Flow in the Great Miami Aquifer

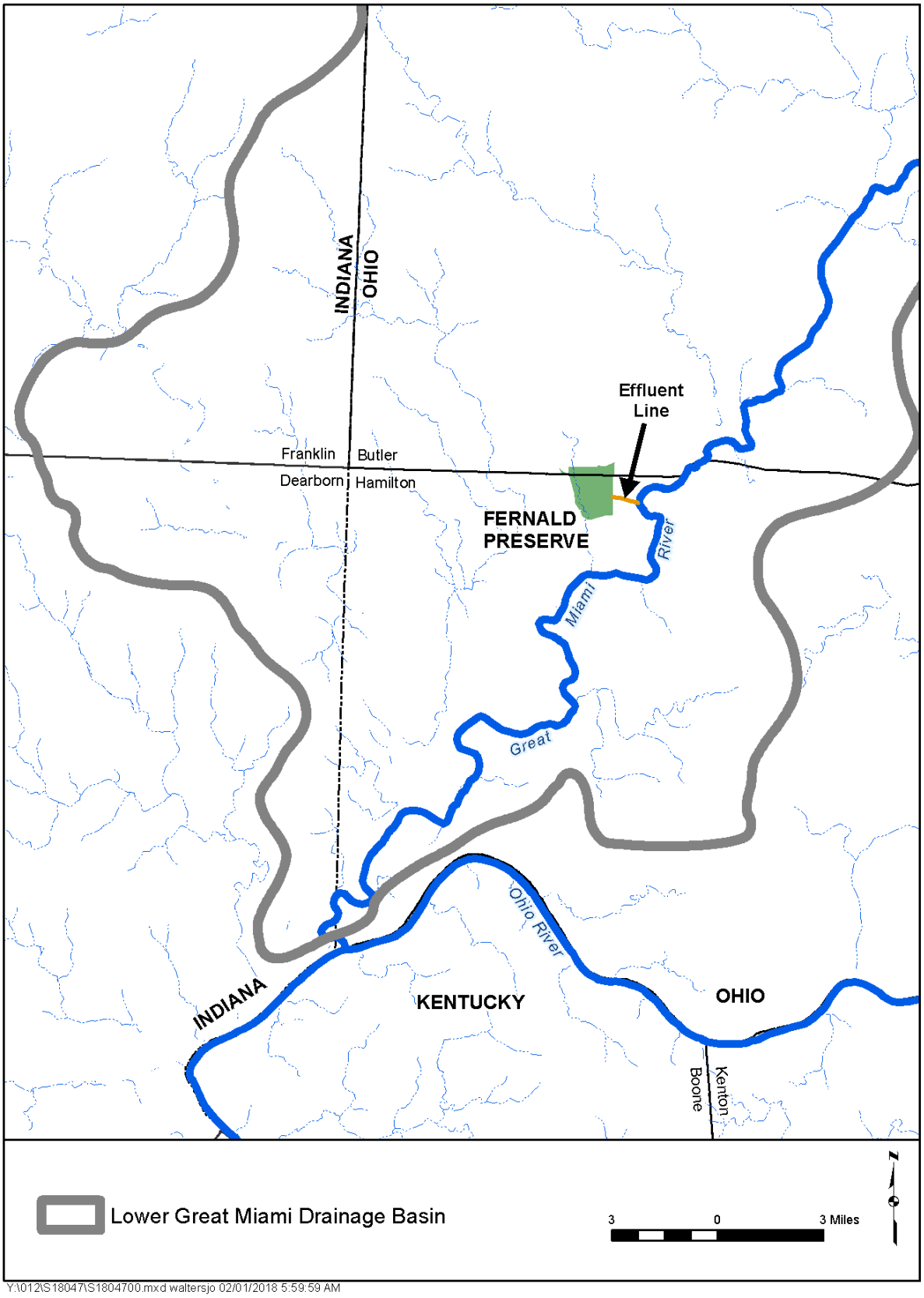


Figure 6. Southern Portion of the Great Miami River Drainage Basin

In 2025, 37.8 inches of precipitation were measured at the Butler County Regional Airport. This measurement, which represents precipitation at the site, is lower than the average annual Cincinnati-area precipitation of 41.2 inches for 1951 through the reporting year. Figure 7 shows the total annual precipitation recorded at the Fernald Preserve for each year from 1991 through the reporting year and the average annual precipitation for the Cincinnati area from 1951 through the reporting year. Figure 8 shows monthly precipitation at the site for the reporting year compared to the Cincinnati-area average monthly precipitation for 1951 through the reporting year.

1.3.5 Natural Resources

Natural resources have important aesthetic, ecological, economic, educational, historical, recreational, and scientific value to the United States. Their establishment and protection are an ongoing process at the Fernald Preserve. Section 5.0 discusses the site's natural resource management activities. The site is located near the transition of the Interior Plateau and Eastern Corn Belt Plains ecoregions. These ecoregions are subsections of the Eastern Deciduous Forest which consists of a mosaic of oak-hickory and beech-maple forests. Regional ecology has been greatly altered by past agricultural and land management practices. Large portions of forests have been cleared and converted into agricultural land or pasture. These changes led to a fragmented landscape with a patchwork of cleared land, old fields, and second growth woodlands, with very little mature forest remaining. At the Fernald Preserve, additional changes took place with the planting of several areas of non-native pine plantations in the northern and southern portions of the property. Wet forest habitat was recognized in the northern portion of the site as part of sitewide wetland delineation efforts in the 1990s.

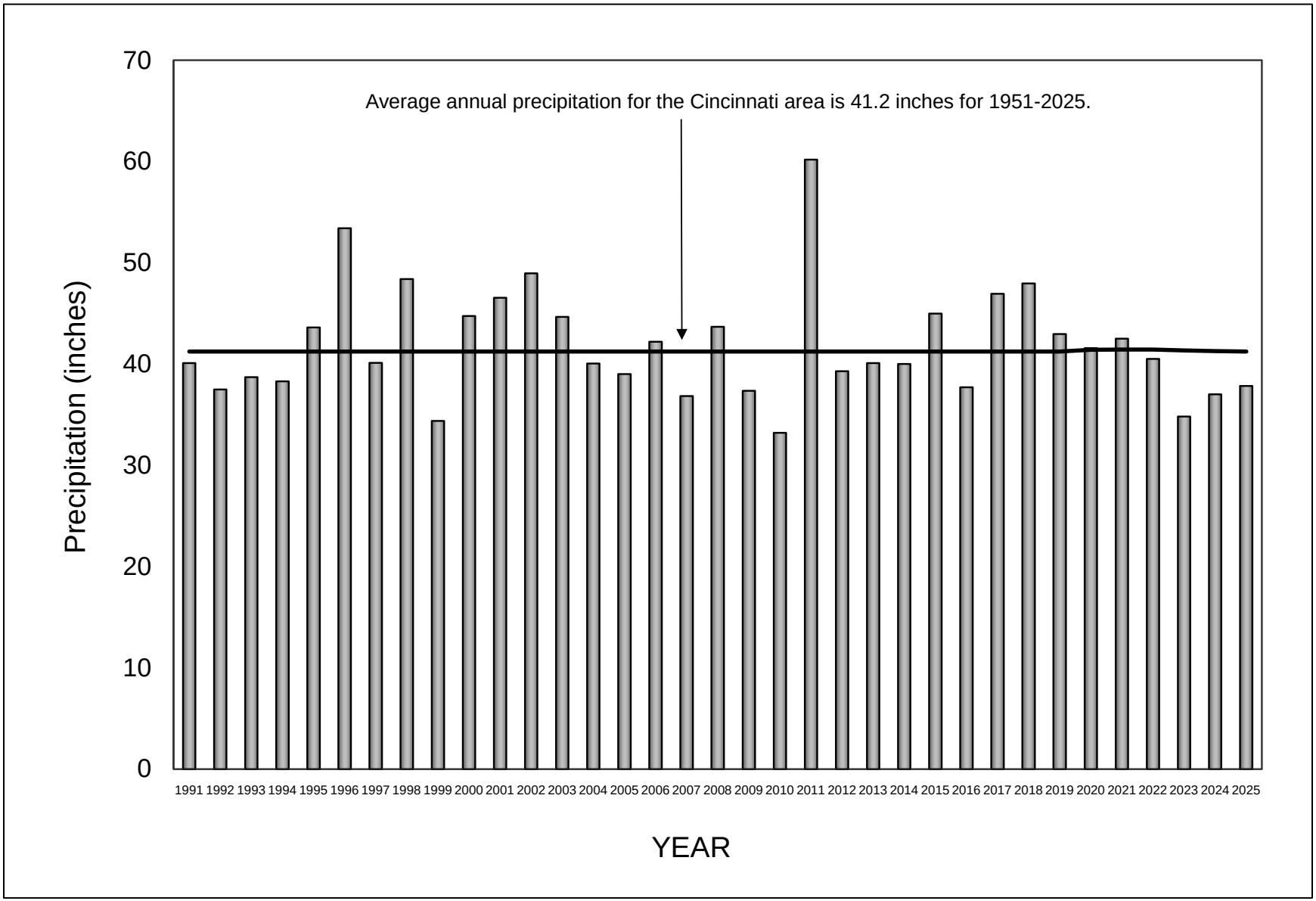


Figure 7. Cincinnati Area Annual Precipitation, 1991–2025

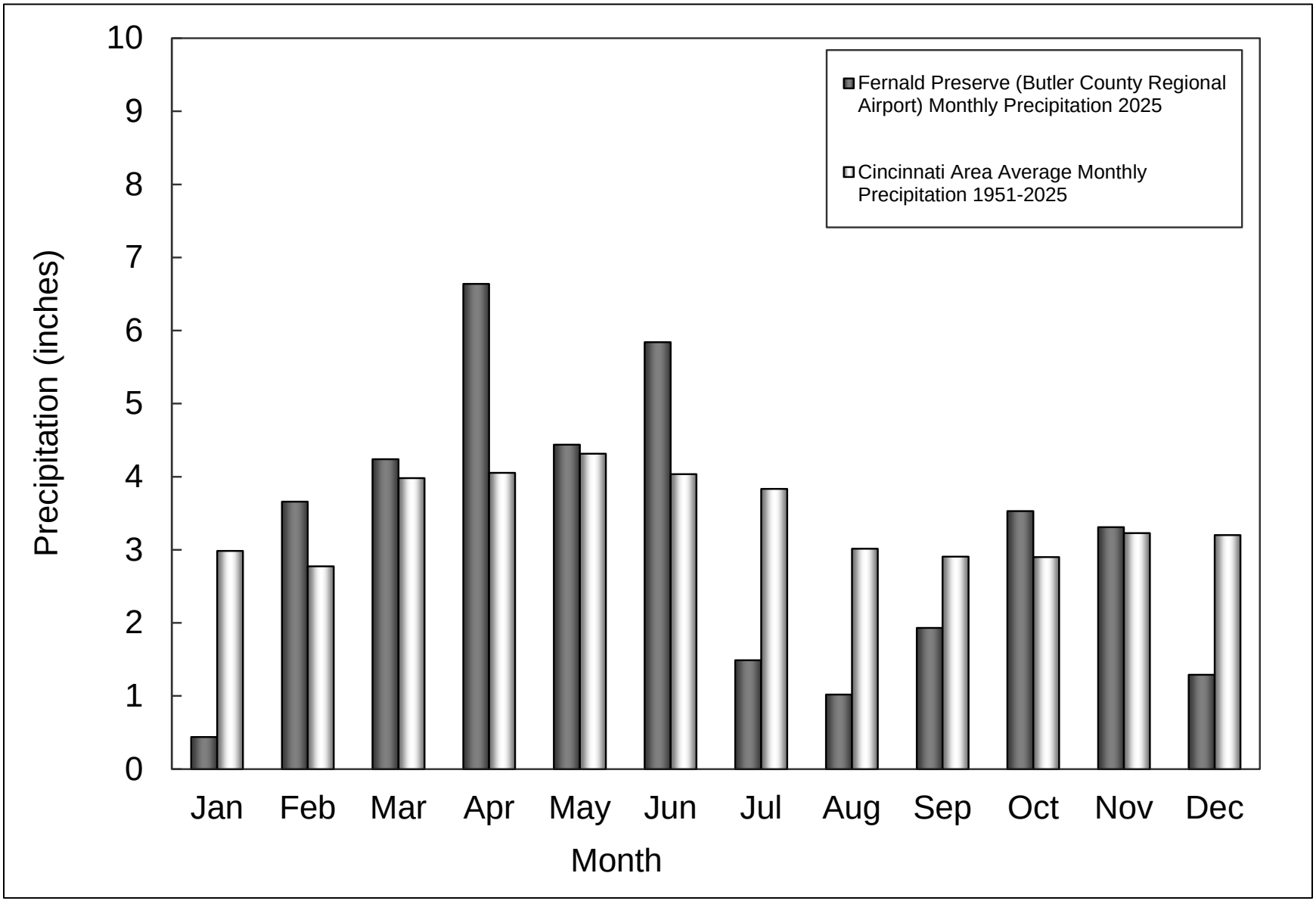


Figure 8. Monthly Precipitation for 2025 Compared to Average Monthly Precipitation for 1951–2025

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2.0 Remediation Status and Compliance Summary

This section provides a summary of CERCLA remediation activities in 2025 and summarizes compliance activities with other applicable environmental laws, regulations, and legal agreements. Compliance under CERCLA dictates the environmental remediation of the Fernald Preserve.

EPA and Ohio EPA enforce the environmental laws, regulations, permits, and legal agreements governing work at the Fernald Preserve. EPA develops, promulgates, and enforces environmental protection regulations and technology-based standards. EPA regional offices and state agencies enforce these regulations and standards by review of data collected at the Fernald Preserve. EPA Region 5 has regulatory oversight of the CERCLA process at the Fernald Preserve, with active participation from Ohio EPA.

For some programs—such as those under the Resource Conservation and Recovery Act (RCRA), as amended (42 USC 6901 et seq.); the Clean Air Act, as amended (42 USC 7401 et seq.), excluding National Emissions Standards for Hazardous Air Pollutants compliance; and the Clean Water Act, as amended (33 USC 1251 et seq.)—EPA has authorized the State of Ohio to act as the primary enforcement authority. For these programs, the State of Ohio promulgates state regulations that must be at least as stringent as federal requirements. Several legal agreements between DOE, EPA Region 5, and Ohio EPA identify site-specific requirements for compliance with the regulations.

2.1 CERCLA Remediation Status

By October 2006, remedial actions were completed for four of the five operable units. As of October 29, 2006, the only remaining active remediation involves the ongoing groundwater remedy under Operable Unit 5. Activities under CERCLA during 2025 involved monitoring the performance of the completed remedies and implementing the requirements of the LMICP.

All cleanup-related CERCLA documentation, including a copy of the Administrative Record and Post-Record of Decision Index, is available at https://www.energy.gov/lm/fernald-preserve-ohio-site. The Fernald Preserve staff can be contacted by phone at (513) 648-3330 for assistance in searching for a document in the CERCLA Administrative Record or Post-Record of Decision Index. The CERCLA Administrative Record and Post-Record of Decision Index are updated as new documents are created.

The completion and closure of a National Priorities List (NPL) site encompasses several milestones and specific documentation requirements for each milestone completed, as specified in the EPA publication *Close Out Procedures for National Priorities List Sites* (EPA 2022). These milestones begin with remedial action completion and end with deletion from the NPL and include:

- Remedial action completion (Final or Interim Remedial Action Reports).
- Construction completion (Preliminary Closeout Report)—all construction activities are complete, immediate threats are addressed, and long-term threats are under control.

- Site completion (Final Closeout Report)—all site cleanup goals are met, all RODs are complete, institutional controls are in place, and site conditions are protective of human health and the environment.
- Site deletion from the NPL (Notice of Intent to Delete).

DOE has prepared, and both EPA and Ohio EPA have approved, Final Remedial Action Reports for Operable Units 1, 2, 3, and 4. EPA approved the *Interim Remedial Action Report for Operable Unit 5* (DOE 2008) in August 2008. That report detailed the ongoing aquifer restoration activities and provided information indicating that all required groundwater infrastructure had been installed and was functioning as designed. Furthermore, the report provides information that all soils have been remediated (except those associated with the aquifer restoration infrastructure) and that the OSDF is functioning as designed. Operable Unit 5 will remain open until a future final Remedial Action Report for Operable Unit 5 has been prepared. DOE will develop that report once groundwater actions are complete and all soils and infrastructure associated with the groundwater remedy have been adequately addressed (estimated completion date in 2045, based on modeling projections reported in the 2022 Modeling Report [DOE 2022a]). EPA issued the *Preliminary Closeout Report, U.S. DOE Feed Materials Production Center, Fernald, Ohio* (EPA 2006) in December 2006. The estimated durations for certifying the last area of the aquifer as being clean and for removing the wellfield infrastructure can be found in the *Fernald Groundwater Certification Plan* (DOE 2006a).

CERCLA Section 121(c) also requires a five-year review process for remedial actions implemented under the signed ROD for each operable unit. The purpose of a five-year review is to determine, through evaluation of performance of the selected remedy, whether the remedy at a site remains protective of human health and the environment. The methods, findings, and conclusions are documented in five-year review reports. In addition, the five-year review reports identify issues found during the review, if any, and document recommendations to address the issues.

EPA approved the first five-year review report for the Fernald Preserve (DOE 2001c) in September 2001. The second five-year review report was submitted in April 2006 (DOE 2006c) and approved by EPA in September 2006. The third five-year review report was submitted to EPA in March 2011 (DOE 2011) and approved by EPA in August 2011. The fourth five-year review began in 2015 and was approved by EPA in August 2016 (DOE 2016b). The fifth five-year review began in fall 2020 and was approved in September 2021 (DOE 2021). The sixth CERCLA five-year review began in late 2025 and will be finalized in 2026.

CERCLA remediation highlights during 2025 included the following:

- For 2025, the ongoing groundwater remedy resulted in extraction of approximately 1.91 billion gallons (Bgal) of groundwater from the Great Miami Aquifer and removal of 288 lb of uranium from the aquifer. Section 3.0 discusses groundwater monitoring and remediation performance.
- The OSDF continues to operate as designed. The OSDF cap underwent four formal inspections. Such inspections are part of the standard operation and maintenance requirements for the facility. Minor maintenance of the cap and associated drainages continues; examples include the removal of small trees, shrubs, and other invasive plant species with spot herbicide application and repairing animal burrows. The eight leachate

valve houses continued to be inspected daily via operational rounds. Leachate generation has continued to decline as expected, and the OSDF is meeting design requirements. Leachate flow and leak detection performance is discussed in Section 3.0. Cap performance is discussed further in Section 5.0.

- In 2025, a video survey was conducted in the LCS, redundant leachate collection system (RLCS), and LDS lines of the OSDF. No significant additional scale or infiltration of gravel was observed in the lines. There was no visible change in pipe integrity or signs of structural impact (i.e., crushing or ovality), and it was determined that there was no need to clean any of the lines. The survey is further discussed in Attachment A.5.
- Figure 9 indicates soil areas that remain uncertified, pending completion of aquifer restoration and the decontamination and decommissioning of related facilities and associated utilities.
- Elevated uranium concentrations persist in surface water in an area adjacent to former Waste Pit 3. (This issue is further discussed in Section 4.0.) Quarterly sampling continued in 2025. The Paddys Run streambank stabilization project was completed in 2016 to prevent migration of the Paddys Run streambed into this area. The project included the installation of two cross vanes that were built across the stream to reduce water velocity and energy along the streambank. The streambank remains stable, no additional migration has occurred, and no maintenance to the cross vanes occurred in 2025.
- All required site and OSDF inspections were performed in 2025. A post-burn walkdown of the 20 acres of prairie and the 75-acre vegetated cap of OSDF that were burned occurred in spring 2025. The post-burn walkdown was incorporated into regularly scheduled site and OSDF inspections. Inspection findings in 2025 were similar to those from previous years, and consisted mainly of non-radiological debris and issues related to deer exclosure fencing. Debris continues to be found onsite, however, no radiologically contaminated debris was identified in 2025. Section 5.0 includes further discussion of the inspection and natural resource management processes.
- Minor violations of the site's prohibited activities established in the LMICP included occasional instances of hikers straying off trail and visitors attempting to fish; additional information is provided in Section 2.3.

2.2 Summary of Compliance with Other Requirements

CERCLA requires compliance with other laws and regulations as part of remediation of the Fernald Preserve. These requirements are referred to as applicable or relevant and appropriate requirements (ARARs). ARARs that are pertinent to remediation of the Fernald Preserve are specified in the ROD for each operable unit. This section of the report highlights some of the major requirements related to environmental monitoring and waste management and describes how the Fernald Preserve complied with these requirements in 2025.

The regulations discussed in this section have been identified as ARARs within the RODs. The Fernald Preserve must comply with these regulations while site remediation under CERCLA is underway; compliance is enforced by EPA and Ohio EPA. Some of these requirements include permits for effluent discharges to the Great Miami River, which are also discussed in this section.

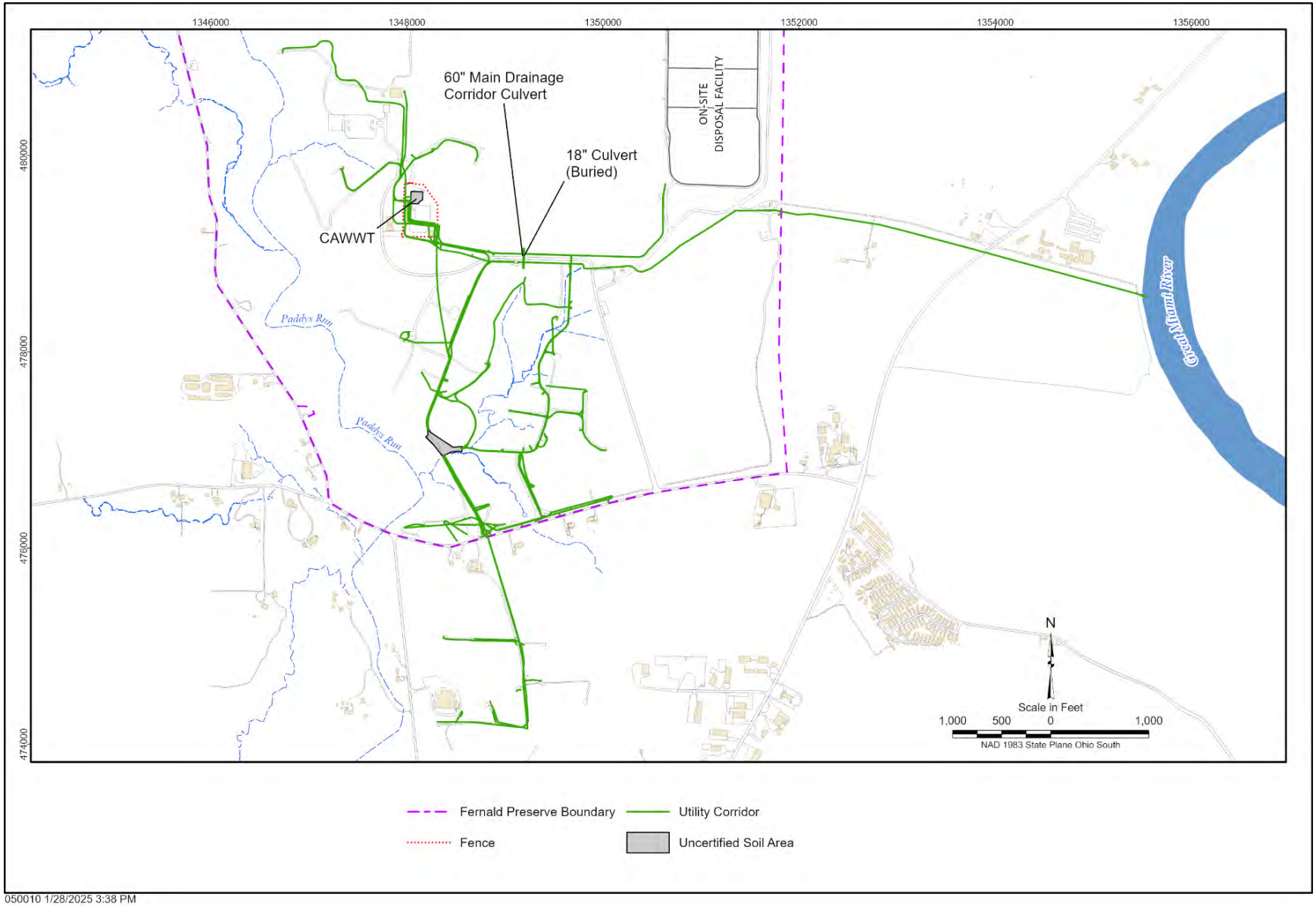


Figure 9. Uncertified Areas and Subgrade Utility Corridors

2.2.1 RCRA

RCRA regulates the treatment, storage, and disposal of hazardous waste and mixed waste (waste that contains radioactive and hazardous waste components). These wastes are regulated under RCRA and Ohio hazardous waste management regulations; therefore, the Fernald Preserve must comply with legal requirements for managing hazardous and mixed wastes. EPA has authorized Ohio EPA to enforce its hazardous waste management regulations in lieu of the federal RCRA program. In addition, hazardous-waste management is subject to the 1988 Consent Decree between the State of Ohio and DOE, the 1993 Stipulated Amendment to the Consent Decree between the State of Ohio and DOE, and a series of Director's Final Findings and Orders issued by Ohio EPA.

2.2.1.1 RCRA Property Boundary Groundwater Monitoring

The Ohio EPA Director's Findings and Orders for Groundwater, which were signed September 10, 1993, described an alternative monitoring system for RCRA groundwater monitoring. A revision of this document was approved on September 7, 2000, to align with the groundwater monitoring strategy identified in the IEMP. Section 3.3.2 provides a more detailed discussion of the groundwater monitoring program.

2.2.1.2 Waste Management

Although the RCRA regulations remain applicable, the Fernald Preserve had no hazardous waste treatment, storage, or disposal activities during 2025. Wastes managed during 2025 were limited to universal waste (e.g., spent batteries and light bulbs) and low-level radiologically contaminated solid wastes. Low-level radiological waste is properly managed at the site until enough waste is accumulated to ship for disposal. The last low-level radiological waste shipments occurred in 2024, when six containers of low-level radiological waste were transported in one shipment to Waste Control Specialists in Texas for disposal. The low-level radiological waste resulted mainly from the replacement of metal piping in the OSDF valve houses that occurred in 2022. The total volume shipped was 21.3 cubic yards. The total weight shipped was 14.4 tons and the total radioactivity was 0.009 microcuries. The radioactivity levels for the 2024 shipment were less than the last low-level radioactive waste shipment that was transported for disposal at Waste Control Specialists in 2019.

2.2.2 Clean Water Act

Under the Clean Water Act, as amended, the Fernald Preserve is governed by National Pollutant Discharge Elimination System (NPDES) regulations that require the control of discharges of nonradiological pollutants to waters of the State of Ohio. The NPDES permit, issued by the State of Ohio for stormwater and wastewater, specifies discharge and sample locations, sampling and reporting schedules, and discharge limitations. Until June 1, 2022, the site operated under an NPDES permit that took effect on March 1, 2015. A new permit was approved and took effect on March 2, 2022. This permit will expire on May 31, 2027. Fernald Preserve submits monthly reports on NPDES activities to Ohio EPA to document compliance with stipulated discharge limits. There were no instances of noncompliance at any of the permitted outfalls in 2025. With the current NPDES permit, the site is exempt, under normal operations, from the definition of stormwater discharge associated with industrial activity, also known as the No Exposure

Exclusion (EPA 2005). For certain additional qualified activities (e.g., construction activity), an Ohio General Construction Permit will be submitted and approved by Ohio EPA prior to start of the qualified activity. No activities occurred onsite in 2025 that required a permit.

2.2.3 Clean Air Act

Ohio EPA is authorized to enforce the State of Ohio's air standards for particulate matter at the Fernald Preserve. During construction activities onsite speed limits, water spray, and roadway cleaning are enforced to comply with fugitive dust requirements.

2.2.4 Superfund Amendments and Reauthorization Act of 1986

The Superfund Amendments and Reauthorization Act of 1986 (SARA) amended CERCLA and was enacted, in part, to clarify and expand CERCLA requirements. SARA Title III is also known as the Emergency Planning and Community Right-to-Know Act. No chemicals exceeded threshold reporting quantities during 2025, so no report was required.

Another SARA Title III report, the Section 313 Toxic Chemical Release Inventory Report (Form R), is required if quantities of chemicals used or released at the Fernald Preserve exceed an applicable threshold for any SARA 313 chemical. If required, the Toxic Chemical Release Inventory Report lists routine and accidental releases and information about the activities, uses, and waste for each reported toxic chemical. No chemical usage or releases have exceeded the threshold for several years at the Fernald Preserve and, as in past years, no chemical exceeded the reporting threshold during 2025.

Also under SARA Title III, any offsite release meeting or exceeding a reportable quantity as defined by SARA Title III, Section 304, requires that immediate notifications be made to local emergency planning committees and the state emergency response commission. Notifications are also made to the National Response Center and other appropriate federal, state, and local regulatory entities. DOE evaluates and documents all releases that might occur at the Fernald Preserve to ensure that proper notifications are made in accordance with SARA and under CERCLA Section 103, RCRA, the Toxic Substances Control Act, the Clean Air Act, the Clean Water Act, and Ohio environmental laws and regulations. During 2025, there were no releases at the Fernald Preserve that met the reporting criteria.

2.2.5 Other Environmental Regulations

In addition to those described above, the Fernald Preserve is also required to comply with other environmental laws and regulations. Table 2 summarizes compliance with each of these requirements for 2025.

Table 2. Compliance with Other Environmental Regulations

Regulation and Purpose	Background Compliance Issues	2025 Compliance Activities
Toxic Substances Control Act		
Regulates the manufacturing, use, storage, and disposal of toxic materials, including polychlorinated biphenyls (PCBs) and PCB items.	EPA Region 5 conducted the last routine Toxic Substances Control Act (15 USC 2601 et seq.) inspection of the Fernald Preserve's program on September 21, 1994. No violations of PCB regulations were identified during the inspection.	No PCB liquids or items were used, stored, or shipped in 2025.
Ohio Solid Waste Act		
Regulates infectious waste.	The Fernald Preserve was registered with Ohio EPA as a generator of infectious waste (generating more than 50 lb per month) until December 6, 1999, when Ohio EPA concurred with the Fernald Preserve's qualification as a small quantity generator.	No infectious waste was generated in 2025.
Federal Insecticide, Fungicide, and Rodenticide Act		
Regulates the registration, storage, labeling, and use of pesticides (such as insecticides, herbicides, and rodenticides).	The last inspection of the Federal Insecticide, Fungicide, and Rodenticide Act (7 USC 136 et seq.) program conducted by EPA Region 5 on September 21, 1994, found the Fernald Preserve to be in full compliance with the requirements of the mandated Act.	Pesticide applications at the Fernald Preserve were conducted according to federal and state regulatory requirements.
National Environmental Policy Act		
Requires the evaluation of environmental, socioeconomic, and cultural impacts before any action, such as a construction or cleanup project, is initiated by a federal agency.	An Environmental Assessment for proposed final land use was issued for public review in 1998. It was prepared under DOE's guidelines for implementation of the National Environmental Policy Act, Title 10 *Code of Federal Regulations* Section 1021 (10 CFR 1021). The assessment requires DOE to consult the public before making any decisions on land use; it includes previous DOE commitments. One categorical exclusion was approved in 2023 to support delivery and installation of a stand-alone solar electric vehicle charging supply equipment.	No National Environmental Policy Act activities were required in 2025.
Endangered Species Act		
Requires the protection of any threatened or endangered species found at the site as well as any critical habitat that is essential for the species' existence.	The following threatened and endangered species have potential habitats located at the Fernald Preserve: **Federally Endangered:** • Indiana bat (*Myotis sodalis*) • Northern long-eared bat (*Myotis septentrionalis*) **State Endangered:** • Little brown bat (*Myotis lucifugus*) • Cave salamander (*Eurycea lucifuga*) • Unexpected Cycnia moth (*Cycnia inopinatus*) • Slender baskettail (*Epitheca costalis*) • Tri-colored bat (*Perimyotis subflavus)* **State Threatened:** • Pink streak moth (*Faronta rubripennis*) • Least bittern (*Ixobrychus exilis*) • Barn owl (*Tyto alba*)	No additional surveys were completed, and no habitats were affected in 2025.

Table 2. Compliance with Other Environmental Regulations (continued)

Regulation and Purpose	Background Compliance Issues	2025 Compliance Activities
Floodplains/Wetlands Review Requirements		
DOE regulations require a floodplain/wetlands assessment for DOE construction and improvement projects. The Clean Water Act also protects jurisdictional wetlands and "Waters of the U.S."	A wetlands delineation of the Fernald Preserve, completed in 1992 and approved by the U.S. Army Corps of Engineers in August 1993, identified 36 acres of freshwater wetlands on the Fernald Preserve property. Wetland mitigation monitoring activities from 2009 to 2011 resulted in the delineation of approximately 31 acres (13 hectares) of mitigated jurisdictional wetlands on the Fernald Preserve property (DOE 2012b).	No construction and improvement projects occurred in 2025 that required an assessment.
National Historic Preservation Act		
Establishes a program for the protection, maintenance, and stewardship of federal prehistoric and historic properties.	The Fernald Preserve is in an area of sensitive historic and prehistoric cultural resources that are eligible for or are listed on the National Register of Historic Places. These cultural resources include historic structures, buildings, and bridges, plus Native American villages and campsites.	No archaeological surveys were required, and no unexpected cultural discoveries were identified in 2025.
Native American Graves Protection and Repatriation Act		
Establishes a means for Native Americans to request the return or repatriation of human remains and other cultural items. Federal agencies must return human remains, associated funerary objects, sacred objects, and objects of cultural patrimony to the Native American nations or tribes with cultural affiliation to the remains or material.	Native American remains have been discovered during remediation activities at the Fernald Preserve. Native American remains and artifacts have been removed or left in place with consultation from Native American nations, tribes, and groups.	No Native American remains were discovered or repatriated to Native American nations, tribes, or groups in 2025.

2.2.6 Permits and Licenses

Certain environmental regulations are implemented through permits. The Fernald Preserve's permit for discharging water under NPDES regulations is discussed in Section 2.2.2. In addition, the Fernald Preserve maintains permits administered through the Ohio Department of Natural Resources (ODNR) and U.S. Fish and Wildlife Services for collection of wildlife specimens. A permit is also obtained to remove Canada goose nests or addle eggs, if necessary. A commercial pesticide applicator license is maintained by site personnel to apply herbicide at the Fernald Preserve. As a result of the 2022 interagency agreement between DOE and the U.S. Forest Service for conducting prescribed burns, the U.S. Forest Service secures burn-ban waivers and permits for prescribed burning activities onsite. These activities are discussed in Section 5.0.

2.2.7 Federal Facility Compliance Agreement

In July 1986, DOE entered into a Federal Facility Compliance Agreement (FFCA) with EPA, which requires the Fernald Preserve to:

- Maintain a sampling program for the South Plume extraction wells and report the results to EPA, Ohio EPA, and the Ohio Department of Health. The sampling program conducted to address this requirement has been modified over the years and is currently governed by an agreement reached with EPA and Ohio EPA on May 1, 1996 (DOE 1996a). These data are reported in Appendix A and Appendix B.
- Maintain a continuous sample collection program for radiological constituents at the effluent discharge point and report the results to EPA, Ohio EPA, and the Ohio Department of Health. The sampling program was modified several times and was governed by an agreement reached with EPA and Ohio EPA that became effective May 1, 1996 (DOE 1996a). The first IEMP, finalized in 1997, was developed to combine the multiple programs (including the FFCA effluent monitoring) under one reporting structure to facilitate review of the performance of the environmental protection actions for various media under CERCLA remediation of the site. These data are reported in Section 4.2.3 and Appendix B. DOE proposes to eliminate the reporting of the estimate of uranium loading to Paddys Run; this is discussed in Section 4.2.3.

2.3 Prohibited Activities

Controls are established to ensure that the Fernald Preserve remains in a configuration consistent with the designated land use and that prohibited activities do not occur. The list of prohibited activities and items for the site (e.g., removing or damaging natural or man-made materials, pets, camping, etc.) are stated in Volume II of the LMICP and posted at the site to inform the public of the restrictions. In 2025, 19 minor prohibited activities were reported and are summarized in Table 3.

Table 3. Prohibited Activities

Prohibited Activities Category	Number of instances in 2025
Pets	9
Visitor off trail	6
Fishing	2
Littering	1
Drone use	1

2.4 Split Sampling Program

Since 1987, DOE has participated in a split sampling program with Ohio EPA. Split samples are obtained when technicians alternately add portions of a sample to two individual sample containers. This collection method helps ensure that both samples are as close as possible to being identical. The split samples are then submitted to two analytical laboratories; this allows for an independent comparison of data to ascertain quality assurance for laboratory analysis and field sampling methods. Ohio EPA occasionally performs independent sampling in addition to split sampling.

The split sampling program is composed of private homeowner wells and is the longest running groundwater monitoring effort at the site. The program was initiated in 1982 in response to monitoring results indicating above background concentrations of uranium in private wells near the site. By 1984, the site had officially established the program with the monthly sampling of 19 privately-owned wells. In 1996, the private well program had grown to 32 private wells. At a property owner's request, any drinking water well near the site was sampled for uranium, and the one-time results were reported to the well owner. If any special request sample showed a questionable or significant total uranium concentration, or if the private well was determined to provide critical groundwater information in an area, the property owner had the option to participate in the routine sampling program. These private wells were sampled monthly or quarterly depending upon location, and sampling results were reported annually in the Site Environmental Report. In 1997, with implementation of the IEMP, the private well program was modified to only include three private wells (13, 14, and 2060). Well 2060 is the private well where off-property contamination was initially reported in 1981 (DOE 1997a). The other private wells previously monitored were not carried forward into the IEMP program because a public water supply was made available to the surrounding properties that had been affected by the off-property groundwater contamination (DOE 1998). These three private wells continued to be sampled through 2022. Data from these three remaining private wells have contributed to the delineation of the total uranium plume presented in Section 3.0.

At the end of sampling in 2022, well 13 had been below the final remediation level (FRL) since 2002 and well 14 has been below the FRL since this well was first sampled in 1988. These wells are located offsite and are outside of the uranium plume boundary identified in Section 3.0, and had been below the FRL for over 20 years. For these reasons, DOE proposed to eliminate monitoring in two of the private wells (13 and 14) which are outside the current plume and to continue monitoring in well 2060. That change took effect in the 2023 LMICP (DOE 2023a) with approval from the regulators and coordination with stakeholders and property owners. Notification letters were distributed to affected property owners.

As reported in the 2024 Site Environmental Report (DOE 2025b), DOE's split sampling results differed from Ohio EPA's results potentially due to analytical laboratory method differences. Ohio EPA's higher split results were used in the 2024 report. In early 2025, Ohio EPA requested their subcontracted laboratory reanalyze the second half 2024 sample. The laboratory reanalysis of the 2024 result was more comparable to the DOE subcontracted laboratory result.

Table 4 provides the analytical results of groundwater samples collected in 2025. The 2025 split results are more comparable. Figure 10 shows the split sample location 2060. Additional information is provided in Appendix A, Attachment A.2.

Table 4. 2025 DOE and Ohio EPA Groundwater Split Sampling Total Uranium Result Comparison

Sample Location	2025 Sample Date	DOE Result (µg/L)[a]	Ohio EPA Result (µg/L)[a]	FRL[b] (µg/L)[a]
2060	May	17.8	15.2	30
2060	October	23.9	19.2	30

[a] µg/L = micrograms per liter
[b] The groundwater pathway and final remediation levels (FRLs) are discussed in Section 3.0.

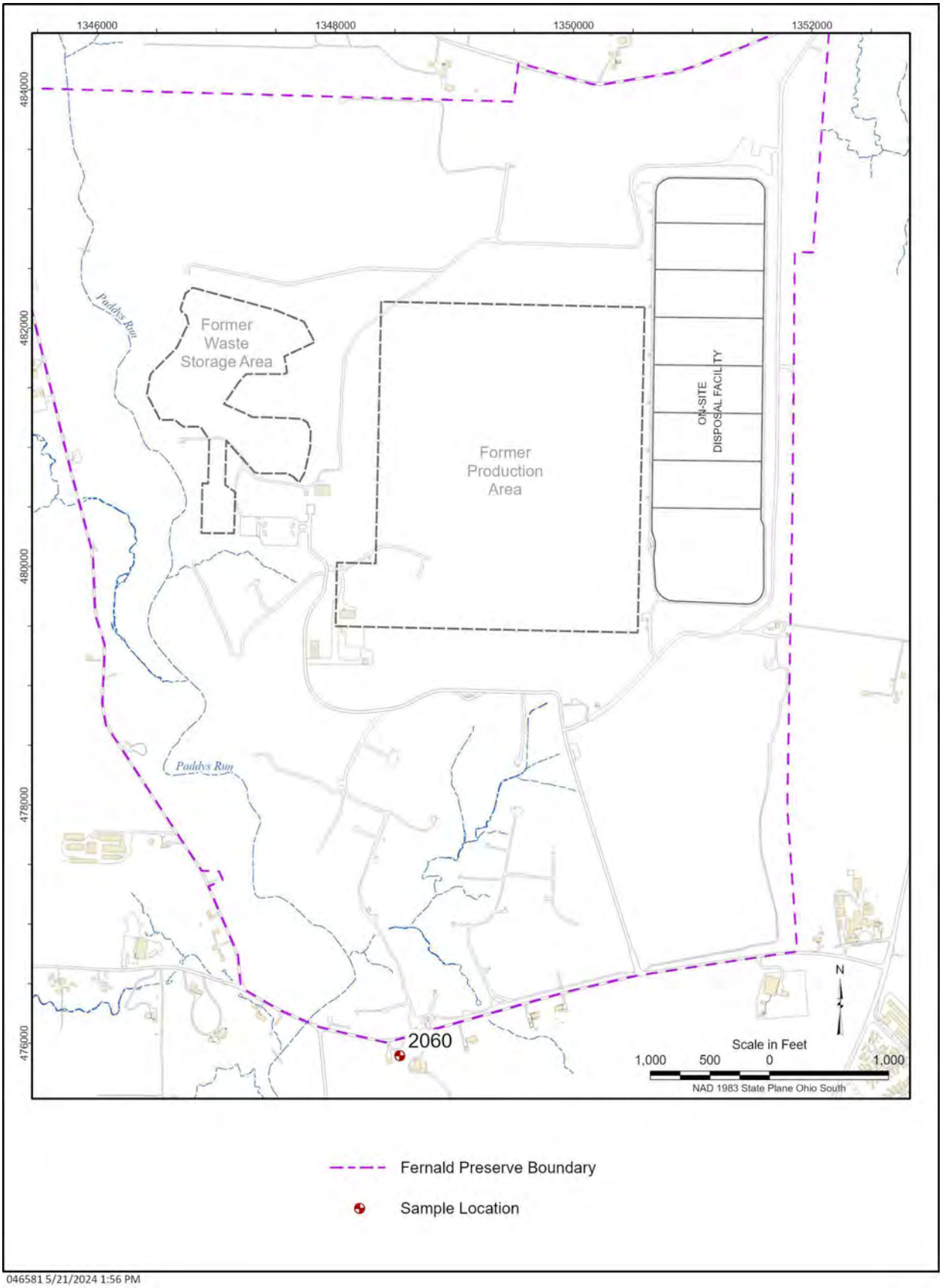


Figure 10. DOE and Ohio EPA Groundwater Split Sample Location

3.0 Groundwater Pathway

Results in Brief: 2025 Groundwater Pathway

Groundwater Remedy

Since 1993

- 60.885 Bgal of water have been pumped from the Great Miami Aquifer.
- 16,618 net lb of uranium have been removed from the Great Miami Aquifer.

During 2025

- 1.910 Bgal of water were pumped from the Great Miami Aquifer.
- 288 lb of uranium were removed from the Great Miami Aquifer.

Groundwater Monitoring Results: Data collected in 2025 show continued progress in reducing the footprint of the maximum uranium plume and that the pumping wells were capturing the uranium plume. Between 2024 and 2025:

- The footprint of the greater than or equal to 30 µg/L total uranium plume was reduced by 3.8 acres (5.5%).
- The footprint of the greater than or equal to 50 µg/L total uranium plume decreased by 1.6 acres (3.3%)
- The footprint of the greater than or equal to 100 µg/L total uranium plume decreased by 1 acre (3.6%).

OSDF Monitoring: In 2025, Great Miami Aquifer wells for each of the eight OSDF cells were sampled semiannually for 13 parameters. The leachate collection system (LCS), leak detection system (LDS), and horizontal till well of each cell were sampled semiannually for uranium, boron, sodium, and sulfate. Flow data from the disposal facility, coupled with the water quality monitoring results and the results of quarterly facility physical inspections, indicate that the OSDF performed as designed in 2025.

In 2025, a video survey was conducted in the LCS, redundant leachate collection system (RLCS), and LDS lines of the OSDF. No significant additional scale or infiltration of gravel was observed in the lines. There was no visible change in pipe integrity or signs of structural impact (i.e., crushing or ovality), and it was determined that there was no need to clean any of the lines. The survey is further discussed in Attachment A.5.

This section provides background information on the nature and extent of groundwater contamination in the Great Miami Aquifer due to past operations at the Fernald Preserve, and it summarizes aquifer restoration progress and groundwater monitoring activities and results for 2025.

Restoration of the affected portions of the Great Miami Aquifer and continued protection of the groundwater pathway are primary considerations in the groundwater remediation strategy for the Fernald Preserve. The groundwater pathway will be monitored following remediation according to the *Fernald Groundwater Certification Plan* (DOE 2006b).

3.1 Summary of the Nature and Extent of Groundwater Contamination

The *Remedial Investigation Report for Operable Unit 5* (DOE 1995d) described the nature and extent of groundwater contamination from operations at the Fernald site and evaluated the risk to human health and the environment from those contaminants. As documented in that report, the primary groundwater contaminant at the site is uranium.

Groundwater contamination resulted from infiltration of contaminated surface water through the bed of Paddys Run, the storm sewer outfall ditch (SSOD), the Pilot Plant Drainage Ditch (PPDD), and the old drainage ditch from the Plant 1 Pad. In these areas, the glacial overburden is absent (eroded), creating a direct pathway between surface water and the sand and gravel of the aquifer. To a lesser degree, groundwater contamination also resulted where past excavations (such as the waste pits) removed some of the protective clay contained in the glacial overburden and exposed the aquifer to contamination.

Figure 11 shows the 2025 maximum extent (most conservative) footprint of the 30 micrograms per liter (µg/L) uranium plume within the aquifer, as well as the current active restoration wells involved in the groundwater remedy. The current active restoration modules are represented by extraction wells that belong to each module.

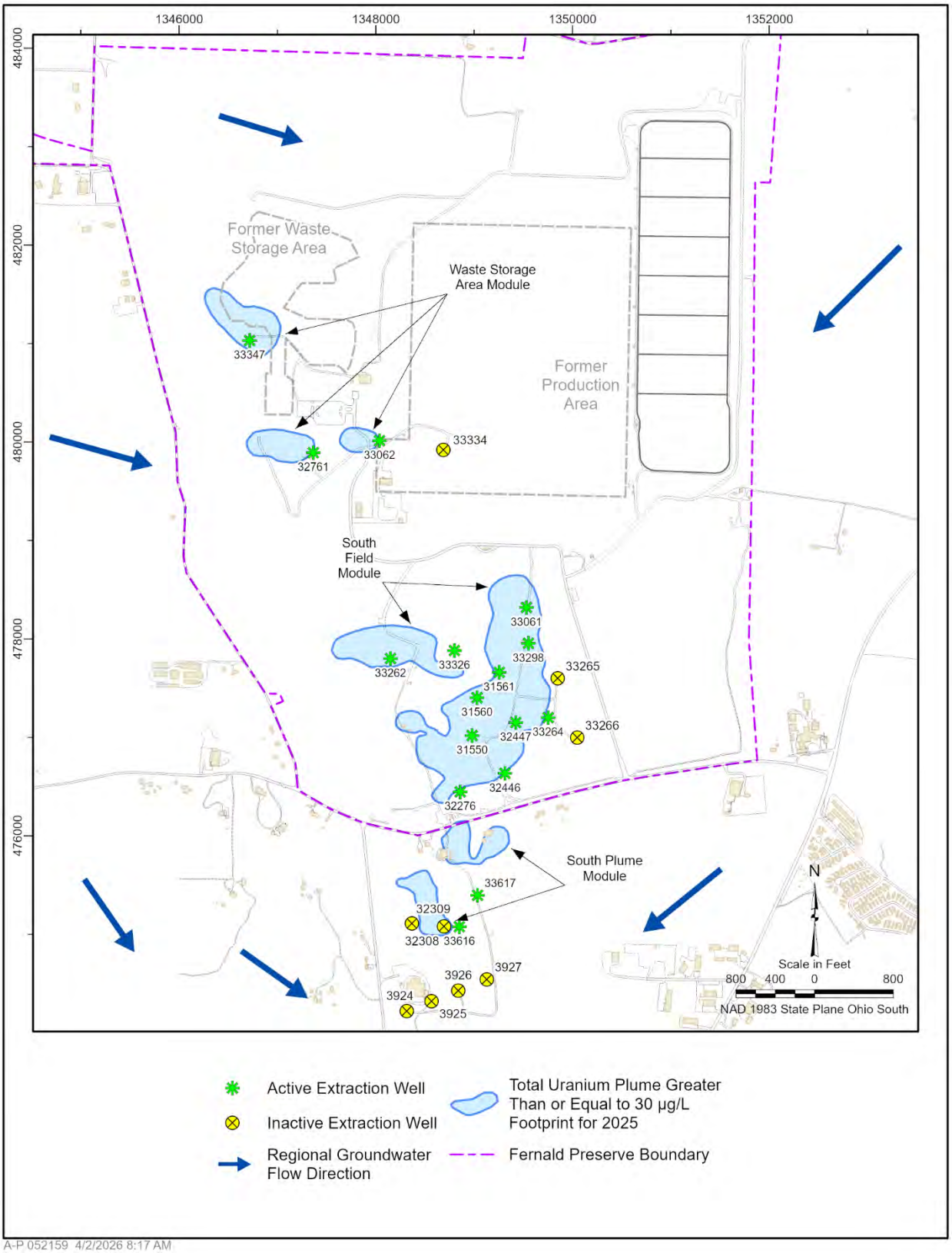


Figure 11. Extraction Wells Active in 2025

3.2 Selection and Design of the Groundwater Remedy

Groundwater Modeling at the Fernald Preserve

The Fernald Preserve uses a computer model to make predictions about how the concentration and location of contaminants in the aquifer will change over time. Because the model contains simplifying assumptions about the aquifer and the contaminants, the predictions about future behavior must be verified with laboratory analyses of groundwater samples collected during monitoring activities.

If groundwater monitoring data indicate the need for operational changes to the groundwater remedy, the groundwater model is run to predict the effect those changes might have on the aquifer and the contaminants. If the predictions indicate the proposed changes would increase cleanup efficiency and potentially reduce the cleanup time and cost, the operational changes are made once EPA and Ohio EPA concurrence is obtained. Monitoring data are then collected after the changes to verify whether model predictions were correct. If model predictions prove to be incorrect, modifications may be made to the model to improve its predictive capabilities.

While a remedial investigation/feasibility study was in progress and a groundwater remedy was being selected, off-property contaminated groundwater was being pumped from the South Plume area by the South Plume Removal Action System (referred to as the South Plume Module). In 1993, this system was installed south of Willey Road and east of Paddys Run Road to stop the uranium plume in this area from migrating any farther to the south. Figure 11 shows the South Plume Module and the inactive South Plume extraction wells. Two replacement extraction wells (33616 and 33617) began pumping in 2024 to replace the original wells.

After the nature and extent of groundwater contamination was defined in the *Remedial Investigation Report for Operable Unit 5* (DOE 1995d), various remediation technologies were evaluated in the *Feasibility Study Report for Operable Unit 5* (DOE 1995a). Remediation cost and various land-use scenarios were considered during the development of the preferred remedy for restoring the quality of groundwater in the aquifer. The *Feasibility Study Report for Operable Unit 5* recommended a concentration-based, pump-and-treat remedy for the groundwater contaminated with uranium, consisting of 28 groundwater extraction wells located on and off property. Groundwater modeling suggested that the 28 extraction wells pumping at a combined rate of 4,000 gallons per minute (gpm) would remediate the aquifer within 27 years.

The recommended groundwater remedy, which included EPA, Ohio EPA, and community acceptance, was presented in the *Proposed Plan for Operable Unit 5* (DOE 1995c) as the preferred groundwater remedy. Once the proposed plan was approved, the *Record of Decision for Remedial Actions at Operable Unit 5* (OU5 ROD) (DOE 1996b) was issued. The OU5 ROD formally defines the selected groundwater remedy and establishes FRLs for all constituents of concern.

The OU5 ROD commits to an ongoing evaluation of innovative remediation technologies so that remedy performance can be improved as such technologies become available. As a result of this commitment, an enhanced groundwater remedy was presented in the Operable Unit 5 *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)* (DOE 1997b).

Reinjection at the Fernald Site
From 1998 to 2004, reinjection was an enhancement to the groundwater remedy at the Fernald site, supplementing pump-and-treat operations. The term "well-based" refers to the injection of treated groundwater through specially designed reinjection wells. Groundwater pumped from the aquifer was treated via ion exchange to remove contaminants and then reinjected into the aquifer at strategic well locations. Because the treatment process was not 100% efficient, a small amount of uranium was reinjected into the aquifer with the treated water. However, the reinjected groundwater increased the speed at which dissolved contaminants moved through the aquifer and were pulled by extraction wells, thereby decreasing the overall remediation time. Based on updated groundwater modeling and the unfavorable results of a cost-benefit analysis, well-based reinjection was discontinued in 2004.

Groundwater modeling studies conducted to design the enhanced groundwater remedy suggested that, with the early installation of additional extraction wells and the use of reinjection technology, the remedy could potentially be reduced to 10 years. EPA and Ohio EPA approved the enhanced groundwater remedy that relied on pump-and-treat and reinjection technology. The groundwater remedy included the use of well-based reinjection until September 2004.

Evolution of the enhanced groundwater remedy has been documented through a series of approved designs. These designs are:

- Operable Unit 5 *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)* (DOE 1997b).
- *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a).
- *Design for Remediation of the Great Miami Aquifer South Field (Phase II) Module* (DOE 2002).
- *Comprehensive Groundwater Strategy Report* (DOE 2003a).
- *Groundwater Remedy Evaluation and Field Verification Plan* (DOE 2004a).
- *Waste Storage Area Phase II Design Report* and addendum (DOE 2005b).
- *Operational Design Adjustments-1, WSA Phase-II Groundwater Remediation Design, Fernald Preserve* (DOE 2014b).
- *2022 Groundwater Modeling Report, Fernald Preserve, Ohio, Site*, Revision 1 (DOE 2022a).

The enhanced groundwater remedy commenced in 1998 with the startup of the South Field (Phase I), the South Plume Optimization, and the Reinjection Demonstration Modules. It focused primarily on the removal of uranium but was also designed to limit further expansion of the plume, achieve removal of all targeted contaminants to concentrations below designated FRLs, and prevent undesirable groundwater drawdown impacts beyond the site boundary. Startup of the enhanced groundwater remedy included a year-long reinjection demonstration that began in September 1998. Through the years, extraction and reinjection wells had been added and removed from these initial restoration modules.

In 2001, EPA and Ohio EPA approved the *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a). Approval of this design initiated the installation of the next planned aquifer restoration module. The design specified three extraction wells in the former Waste Storage Area to address contamination in the PPDD plume (Phase I) and two extraction wells to address the remaining contamination after the waste pits excavation was completed (Phase II). One of the three Phase I Waste Storage Area wells (well 32761) was installed in 2000 to support an aquifer pumping test to help determine the restoration wellfield design. The remaining two Phase I wells (well 33062 and well 33063) were installed in summer 2001 after EPA and Ohio EPA approved the design. All three wells became operational

on May 8, 2002. Well 33063 was abandoned in 2004 to facilitate site remediation work. A replacement well (well 33347) was installed and began operating in 2006. Figure 11 shows the existing well locations.

The *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a) also provided data indicating that the uranium plume in the former Plant 6 Area was no longer present. It was believed that the uranium concentrations in the plume had decreased to levels below the FRL as a result of plant operations shutting down in the late 1980s and the pumping of highly contaminated perched water as part of the Perched Water Removal Action No. 1 in the early 1990s. Because a uranium plume with concentrations above the groundwater FRL was no longer present in the former Plant 6 Area at the time of the design, a restoration module for the area was determined to be unnecessary. Groundwater monitoring continues in the former Plant 6 Area, with one well (well 2389) in the area identified as having intermittent uranium FRL exceedances. This well is further discussed in Attachment A.2. Figure 12 shows the location of monitoring well 2389.

In 2002, EPA and Ohio EPA approved the next planned groundwater restoration design document, the *Design for Remediation of the Great Miami Aquifer South Field (Phase II) Module* (DOE 2002). The Phase II design presents an updated interpretation of the uranium plume in the South Field area along with recommendations on how to proceed with remediation in the area, based on the updated plume interpretation. Installation of Phase II components began in 2002. The overall system (Phases I and II) is referred to as the South Field Module.

In 2003, groundwater remediation approaches were evaluated to determine the most cost-effective groundwater remedy infrastructure, including the wastewater treatment facility, to remain after site closure. An evaluation of alternatives was presented in the *Comprehensive Groundwater Strategy Report* (DOE 2003a). In October 2003, DOE held initial discussions with the regulators and the public concerning the various alternatives identified in the report. These discussions culminated in an identified path forward to work collaboratively with the Fernald Citizens Advisory Board, EPA, and Ohio EPA to determine the most appropriate course of action for the ongoing aquifer restoration and water treatment activities at the Fernald site.

In 2004, following regulatory and public input, a decision regarding the future aquifer restoration and wastewater treatment approach was made. In May 2004, EPA and Ohio EPA approved the decision to reduce the size of the advanced wastewater treatment facility and in June 2004 approved the decision to discontinue the use of well-based reinjection. Reducing the size of the advanced wastewater treatment facility provided the opportunity to dismantle and dispose of approximately 90% of the existing facility in the OSDF in time to meet the 2006 closure schedule. This resulted in a protective, more cost-effective, long-term water treatment facility to complete aquifer restoration. Well-based reinjection was discontinued in 2004 on the basis of groundwater modeling cleanup predictions presented in the *Comprehensive Groundwater Strategy Report* (DOE 2003a) and the *Groundwater Remedy Evaluation and Field Verification Plan* (DOE 2004a). As a result of refined modeling input, updated modeling indicated that the aquifer restoration time frame would likely be extended beyond dates previously predicted.

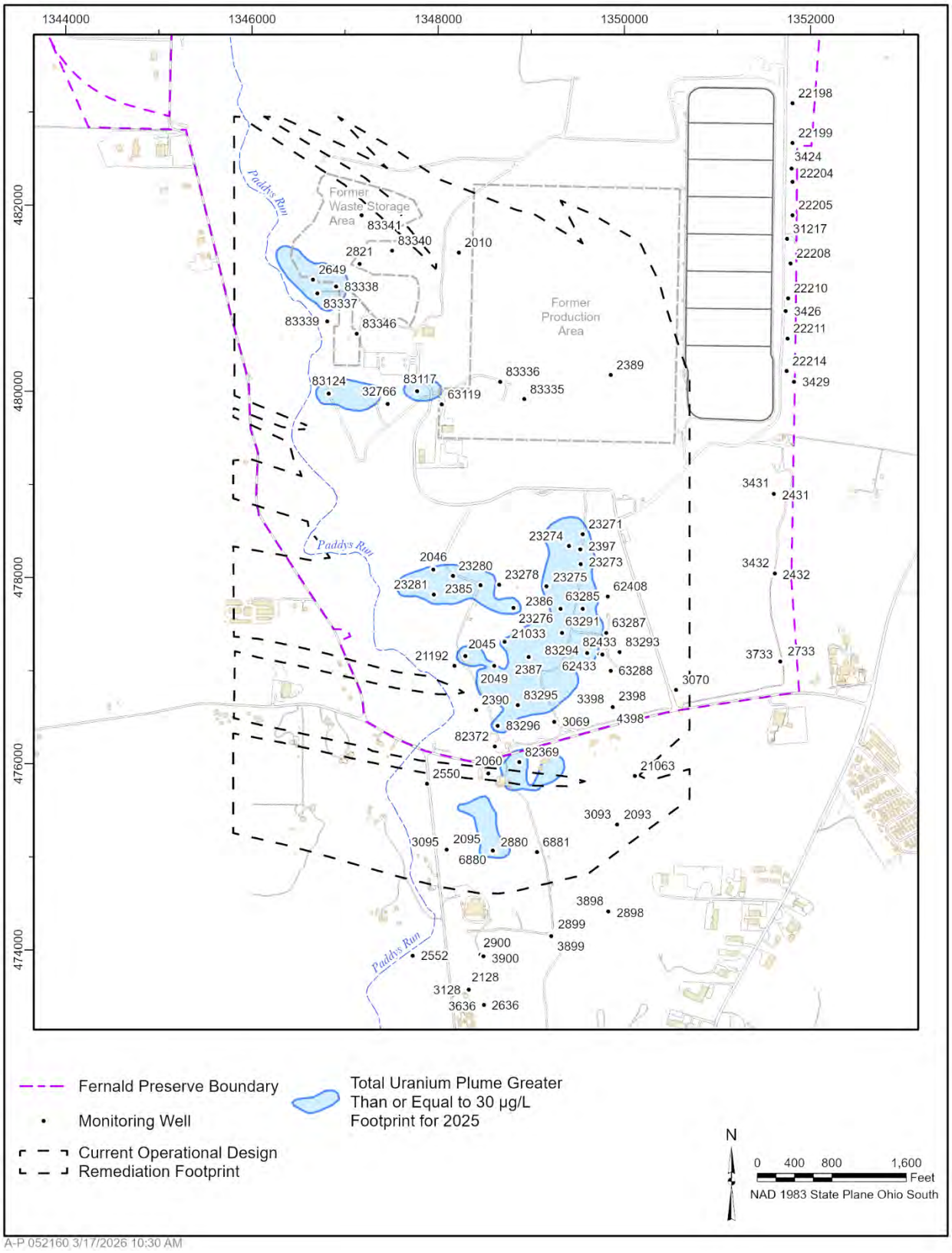


Figure 12. Locations for Semiannual Total Uranium Monitoring

The updated modeling also indicated that continued use of the groundwater reinjection wells would shorten the aquifer remedy by approximately 3 years. However, the cost of maintaining the reinjection infrastructure was more than operating the extraction wellfield for 3 years. Therefore, well-based reinjection was discontinued in September 2004 to support construction of the Converted Advanced Wastewater Treatment (CAWWT) facility. All reinjection wells remain in place as potential groundwater remedy performance monitoring locations.

In 2005, the *Waste Storage Area Phase II Design Report* (DOE 2005b) was issued. Comments received from EPA and Ohio EPA resulted in the issuance of an addendum to the report in December 2005. The design consisted of the installation of one more extraction well (well 33347) in the former Waste Storage Area, near the former silos area. Figure 11 shows the location of well 33347.

In 2005, an infiltration test was conducted in the SSOD. The test consisted of gauging the flow into and out of the SSOD with six Parshall Flumes to obtain the overall infiltration rate along the SSOD. Findings from the test were included in the *Storm Sewer Outfall Ditch Infiltration Test Report* (DOE 2005a). The decision was made that pumped, clean groundwater would supplement natural stormwater flow into the SSOD. This activity continued from 2006 through 2012, when DOE concluded that enough data had been collected to document infiltration rates through the base of the SSOD. Under normal flow conditions, potential infiltration to the aquifer from within the monitored portion of the SSOD (while flowing at or near 500 gpm) is approximately 109–129 gpm. With Ohio EPA and EPA concurrence, supplemental pumping of clean groundwater to the ditch was stopped and the flumes were removed in 2013 to allow water to freely flow down the SSOD. The rapid movement of water through the ditch during storm events will help to scour the ditch channel of fine-grained sediment and is expected to increase the potential for infiltration.

The *Fernald Groundwater Certification Plan* (DOE 2006b) defines a programmatic strategy for certifying completion of the aquifer remedy. It was developed through a series of four technical information exchange meetings held in 2005 among DOE, EPA, and Ohio EPA. Approved by EPA and Ohio EPA, the *Fernald Groundwater Certification Plan* identifies that the IEMP will continue to be the plan that includes remedy performance monitoring requirements.

In 2006, the Waste Storage Area Phase II Module components became operational, marking completion of the groundwater remediation system design. Completion of the Waste Storage Area Phase II Module construction brought the total number of extraction wells in the former Waste Storage Area to four (wells 32761, 33062, 33334, and 33347). These four well locations are shown in Figure 11.

In 2014, with approval from EPA and Ohio EPA, DOE implemented operational changes to optimize the groundwater remedy. Three wells no longer providing benefit to the groundwater remediation were shut down. The freed-up pumping budget was reallocated to the South Plume and South Field to accelerate cleanup of those areas. The operational changes were based on groundwater modeling results reported in 2014 (DOE 2014b).

Figure 11 shows the extraction well locations. The following subsections present the operational information associated with these modules.

Groundwater modeling conducted in 2012 (in support of the 2014 operational changes) predicted that under the current pumping rates, pumping would continue until 2022 in the South Plume and southern South Field, 2030 in the northern South Field, and 2035 in the former Waste Storage Area. Annual monitoring results used to track remedy progress indicate that these dates would not be achieved.

In early 2022, the groundwater model was rerun to determine what the new cleanup times would be if uranium concentrations measured in the first half of 2021 were loaded into the model as initial conditions.

As was done for past model runs, modeled predicted cleanup date uncertainty, due to changes in the elevation of the water table in the aquifer over time, was bracketed by modeling using three different sets of boundary conditions for the elevation of the water table (i.e., wet, nominal, and dry). During wet boundary conditions the water table elevation is at its highest, and during dry boundary conditions the water table elevation is at its lowest. Nominal is the average elevation of the water table. Table 5 shows the results based on implementing the design changes in 2021 presented in the modeling report (DOE 2022a).

Table 5. Model-Predicted Cleanup Years

Plume Area	Wet Boundary Conditions	Nominal Boundary Conditions	Dry Boundary Conditions
South Plume	2024	2025	2024
South Field	2035	2033	2038
Waste Storage Area	2040	2040	2045

As was done in previous modeling runs, the maximum model-predicted cleanup date for each boundary condition was selected as the new targeted cleanup date, resulting in the following new predicted cleanup years.

- South Plume: 2025
- South Field: 2038
- Waste Storage Area: 2045

These new cleanup time predictions assume that no wellfield pumping changes are made to the modeled operational design. It should be noted that the new design was implemented in 2024, not 2021, so for operational purposes, 3 years should be added to each model-predicted cleanup date. This approach does not account for any concentration reductions in the plume that were achieved through pumping from 2021 to 2024.

- South Plume: 2025 + 3 years = 2028
- South Field: 2038 + 3 years = 2031
- Waste Storage Area: 2045 + 3 years = 2048

There was a concern that the original South Plume and South Plume Optimization Wells might need to pump longer than 2028; therefore, an option to extend the operational longevity of the wells was considered (i.e., pumping at lower rates to extend the lives of the wells). Groundwater modeling

predicted that pumping at lower rates would be a viable alternative. However, continued operation of the existing aging wells came with an unacceptable operational risk because their dependability was uncertain. Additionally, the original six South Plume wells were no longer situated in strategic locations to remediate the remaining uranium plume. For instance, the leading edge of the South Plume was now located well north (approximately 600 ft) of the location of the original recovery wells 3924, 3925, 3926, and 3927. New wells that would be better positioned to remediate the present location of the plume would produce a more efficient cleanup.

To address the unacceptable operational risk of continuing to pump the existing South Plume recovery wells, and to provide for a more efficient cleanup of the remaining South Plume, a modeled operational alternative was selected that replaced the six existing original South Plume recovery wells with two new recovery wells (DOE 2022a). The two new recovery wells are better positioned to capture and remediate the remaining South Plume than the current original six recovery wells. The modeling further predicted that when the two new wells were operational, the original South Plume recovery wells (3924, 3925, 3926, and 3927) would no longer be needed to maintain capture of the remaining South Plume. This operational alternative (replacing the six original South Plume wells with two newly positioned recovery wells) was approved by EPA and Ohio EPA and implemented by DOE.

In 2022, the original South Plume recovery wells began to fail. During the years 2022 to 2024, all six of the original South Plume wells (3924, 3925, 3926, 3927, 32308, and 32309) were permanently shut down.

- In 2022, recovery wells 3927 and 32308 were permanently turned off on June 6, 2022, and July 25, 2022, respectively, and the target pumping rate for 32309 was reduced from 300 to 200 gpm.
- In 2023, three additional wells were permanently turned off: well 3925 on October 31, 2023, well 3926 on June 12, 2023, and well 32309 on October 24, 2023.
- In November 2024, the last remaining original South Plume well (well 3924) was permanently turned off.

During this time period (2022–2024), care was taken to demonstrate that capture of the uranium plume was maintained by the operation of the remaining wells. Installation of the two new wells began in 2023; and the two new wells (33616 and 33617) became operational in March 2024. The locations of the two new wells are shown on Figure 11. Additional information is provided in Appendix A, Attachment A.1.

3.3 Groundwater Monitoring Highlights for 2025

Groundwater monitoring results are discussed in terms of restoration and compliance monitoring. The key elements of the Fernald Preserve groundwater monitoring program design are described in this section. Site personnel completed all groundwater monitoring requirements.

Sampling: Sample locations, frequency, and constituents address operational assessment, restoration assessment, and compliance requirements. Monitoring is conducted to ascertain groundwater quality and groundwater flow direction.

As part of the comprehensive groundwater monitoring program specified in the current IEMP, 91 wells were monitored for water quality in 2025. Figure 12 identifies the location of the current

water quality sampling locations for total uranium. Figure 13 is a diagram of a typical groundwater monitoring well. Figure 14 illustrates relative monitoring well depths and screen locations. Figure 15 indicates the locations for non-uranium monitoring. In addition to water quality monitoring, 172 wells were used to measure groundwater elevations to verify groundwater flow direction. Figure 16 depicts the routine water-level (groundwater elevation) monitoring wells.

Figure 14 illustrates that there are six different types of monitoring wells (i.e., Type 1, 2, 3, 4, 6, and 8). Monitoring well Types 1, 2, 3, 4, and 6 are single-level monitoring wells with a well screen that is 10 or 15 ft in length. Type 8 monitoring wells are multichannel monitoring wells that contain three to six individual 10 ft screens. The Type 8 multichannel monitoring wells provide for sampling a depth profile at a single location. The single-level wells monitor a single 10 ft depth. As summarized below, the location of the monitoring depth is identified by the first digit in the well identification number:

- Type 1: Screen positioned in perched groundwater in the glacial overburden
- Type 2: Screen positioned at the water-table zone of the Great Miami Aquifer
- Type 3: Screen positioned above a clay layer in the Great Miami Aquifer
- Type 4: Screen positioned below a clay layer in the Great Miami Aquifer
- Type 6: Screen positioned at a depth that is between a Type 2 and Type 3

Additionally, 30 locations were sampled using a direct-push (i.e., temporary) sampling tool in 2025. Results are provided in Appendix A, Attachment A.2.

Data Evaluation: The integrated data evaluation process involves review and analysis of the data collected from wells and direct-push sampling locations. The evaluation determines capture and restoration of the total uranium plume, capture and restoration of non-uranium FRL constituents, water quality conditions in the aquifer that indicate a need to modify the design and installation of restoration modules. Through 2025, the evaluation included the impact of ongoing Fernald Preserve groundwater restoration on the downgradient Paddys Run Road Site (PRRS) plume. The PRRS plume is a separate contaminant plume, unrelated to the Fernald Preserve, which resulted from industrial activities on privately owned land in the area south of the Fernald Preserve along Paddys Run Road. A summary of the sampling effort was provided in the 2024 Site Environmental Report (DOE 2025b). With EPA and Ohio EPA approval, sampling for PRRS constituents ended on January 1, 2026.

Reporting: All data listed for collection in the IEMP are reported in the annual Site Environmental Reports.

3.3.1 Restoration Monitoring

The Operable Unit 5 ROD (DOE 1996b) states that “areas of the Great Miami Aquifer exceeding FRLs will be restored through extraction methods.” Uranium is the primary constituent of concern for groundwater. The groundwater FRL for total uranium is 30 µg/L. The background total uranium concentration for unfiltered groundwater samples from the Great Miami Aquifer near the Fernald Preserve is 1.2 µg/L (DOE 1994). Both the area of the aquifer targeted for remediation and the statistical procedures that will be used to verify that the aquifer cleanup objectives have been achieved are presented in the *Fernald Groundwater Certification Plan* (DOE 2006b).

In general, restoration monitoring tracks the progress of the pump-and-treat stage of the groundwater remedy and water quality conditions. Operations are evaluated throughout the year to determine the progress of aquifer remediation. Total uranium concentration maps are developed from analytical data and compared with groundwater elevation maps to show the status of remediation progress and to verify capture of the total uranium plume.

Appendix A provides more-detailed information. Sections that follow identify the specific attachment of Appendix A where the detailed information can be found.

3.3.1.1 Operational Summary

During 2025, the wellfield underwent an annual planned shutdown that lasted for 34 days (from June 4 to July 8, 2025).

Since 1993:

- 60.9 Bgal of water have been pumped from the Great Miami Aquifer.
- 1.9 Bgal of treated water were reinjected into the Great Miami Aquifer.
- 16,617 net lb of total uranium have been removed from the Great Miami Aquifer.

Appendix A, Attachment A.1, provides detailed operational information on each extraction well. The following subsections provide an overview of the individual modules.

CAWWT

As presented in the *Fernald Preserve 2015 Site Environmental Report* (DOE 2016a), the CAWWT system had become oversized and reached the end of its useful life. Additionally, equipment corrosion and corrective maintenance had become ongoing issues for facility operations.

In March 2015, a CAWWT Condition Assessment Report was finalized (Whitman, Requardt & Associates 2015) confirming that many of the treatment system components were at or nearing the end of their useful life. A decision was made to replace the CAWWT treatment system with a 50-gpm system inside the CAWWT building. DOE received concurrence on a path forward in July 2015 from EPA and Ohio EPA and in August 2015 from the Fernald Community Alliance (FCA). DOE planning for the project began in August 2015. The project was initiated in 2016 and completed in April 2018. The new system became operational on April 3, 2018.

Refurbishment of the nearby backwash basin occurred in 2019. The backwash basin is used to temporarily store wastewater originating from a variety of sources (i.e., well rehabilitation, CAWWT backwash, OSDF leachate, groundwater sampling, CAWWT laboratory, and CAWWT storm water drainage). Construction began in late summer 2019 and was completed in December 2019. Accumulated sediment was removed, dried, and packaged for shipment to a licensed low-level radioactive waste disposal facility, Waste Control Specialists, in Texas. The basin liner and wall panels were replaced, and aeration cover systems were installed.

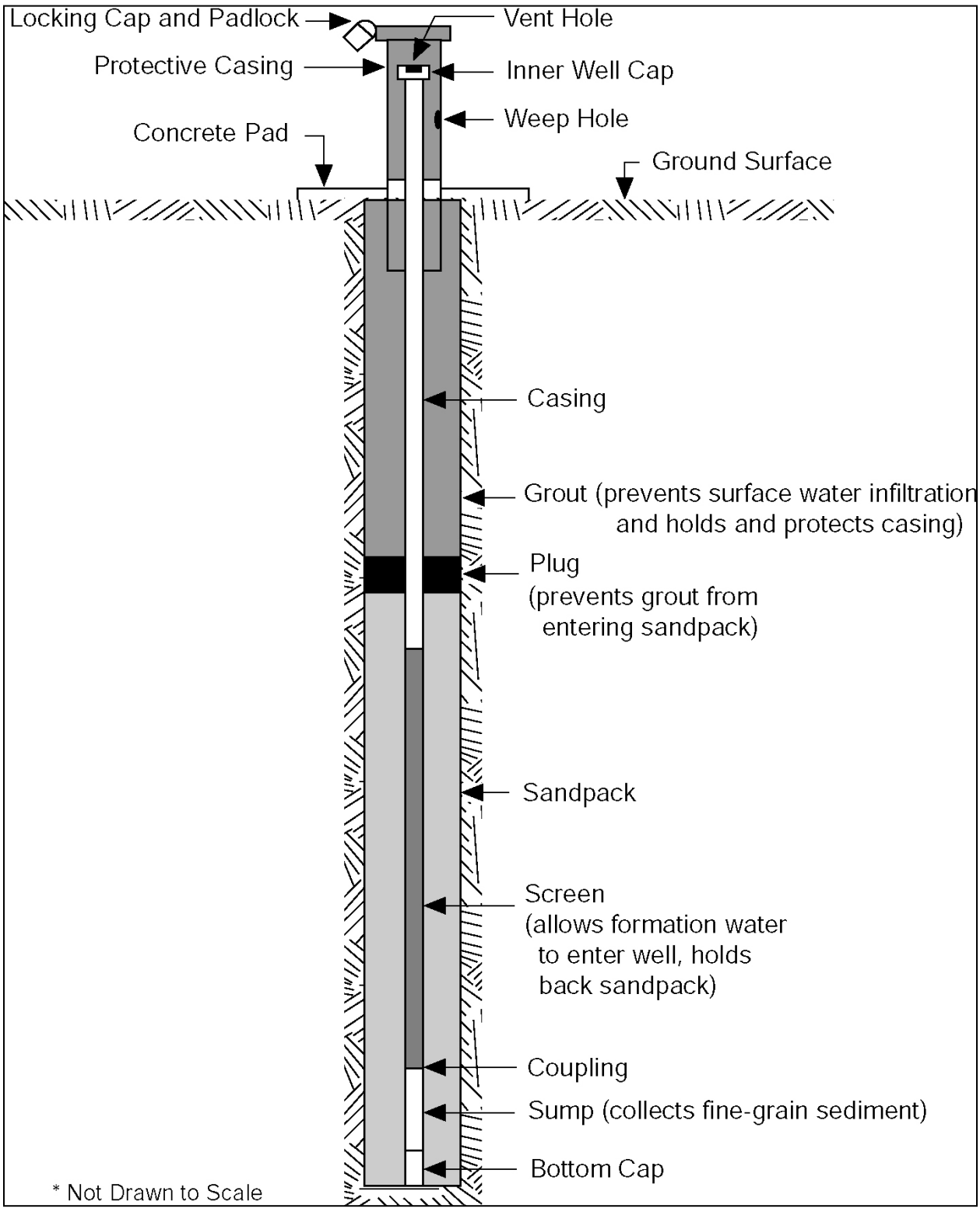


Figure 13. Diagram of a Typical Groundwater Monitoring Well

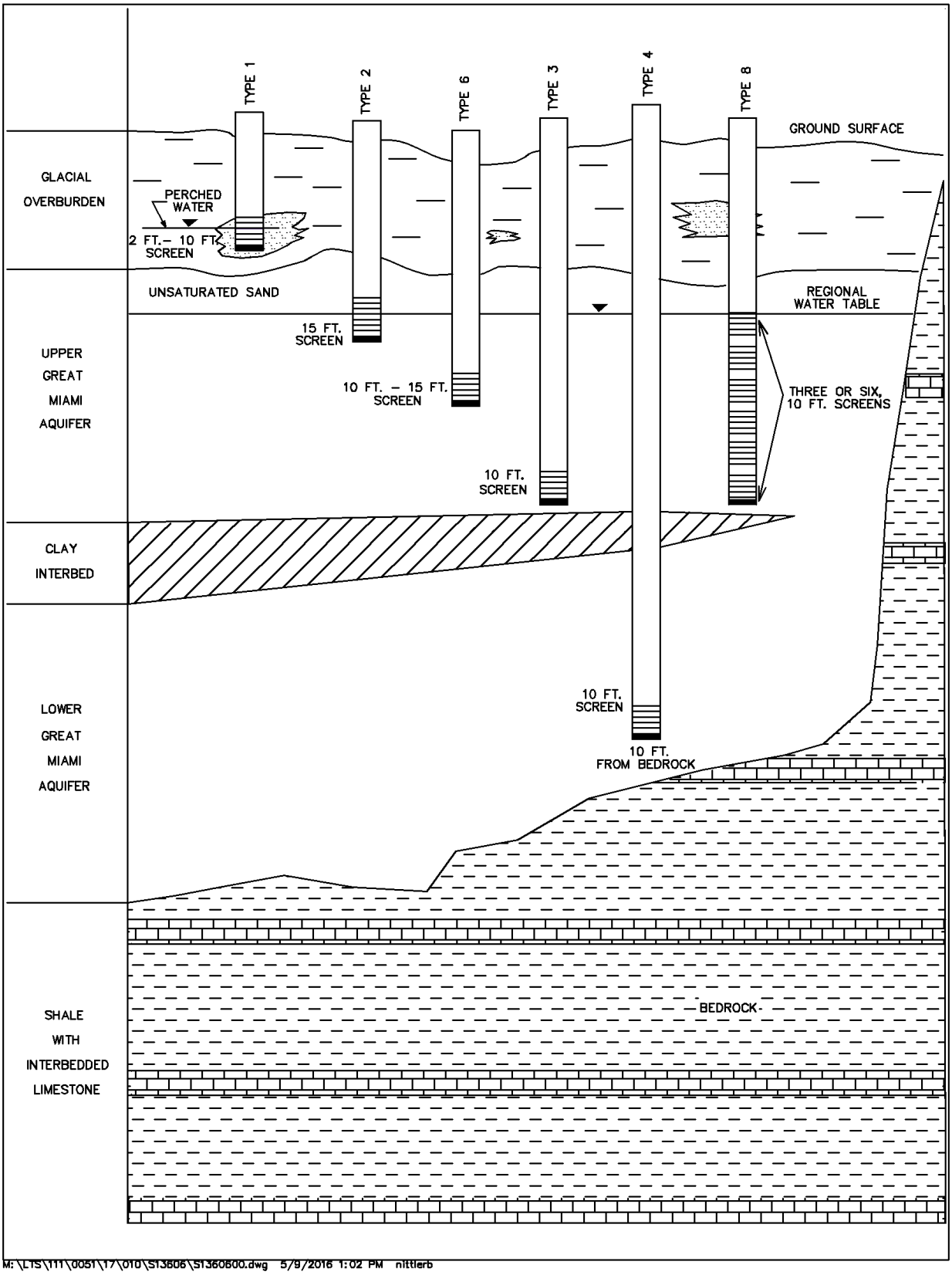


Figure 14. Monitoring Well Screen Locations

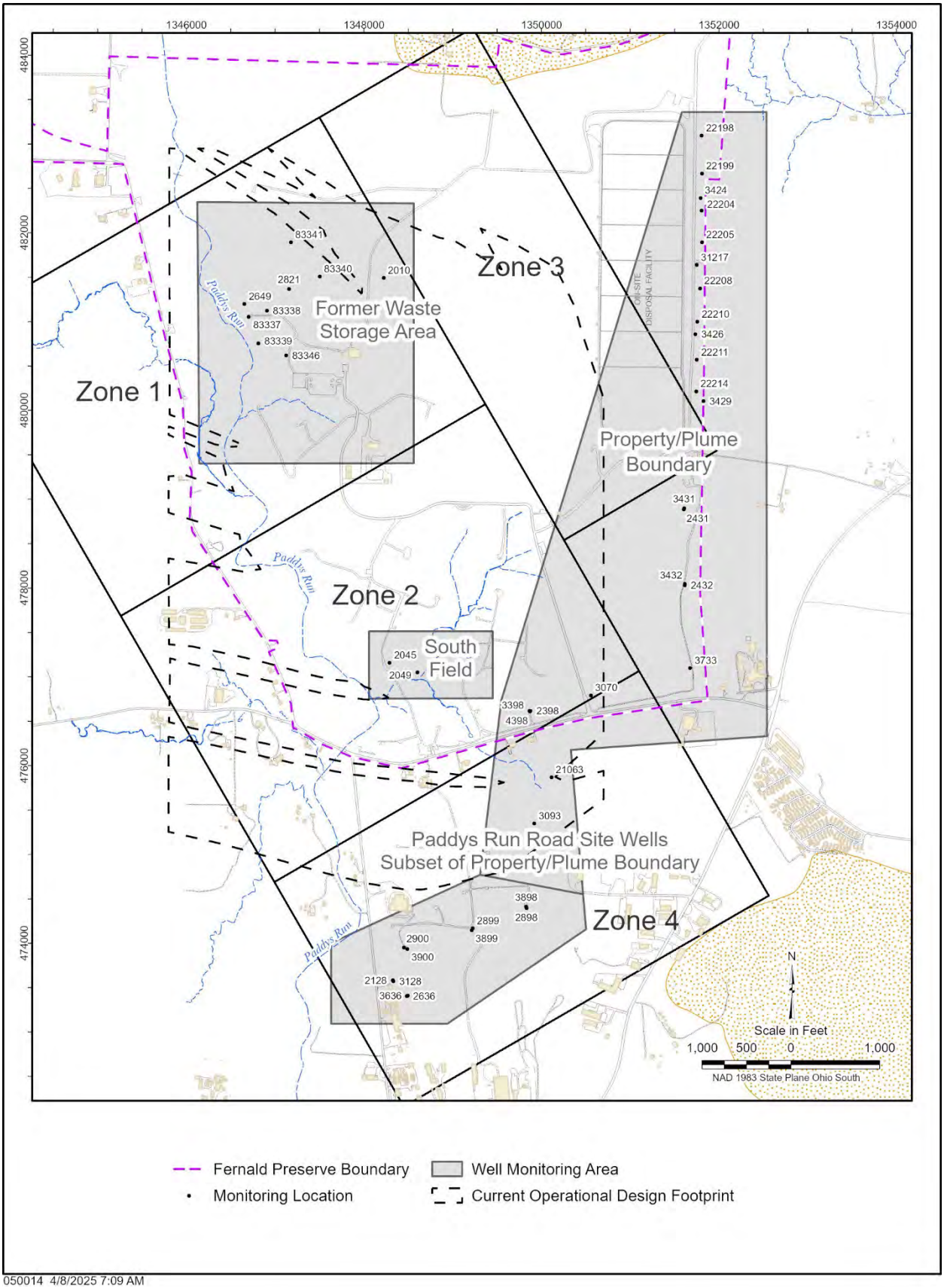


Figure 15. Locations for Non-Uranium Monitoring

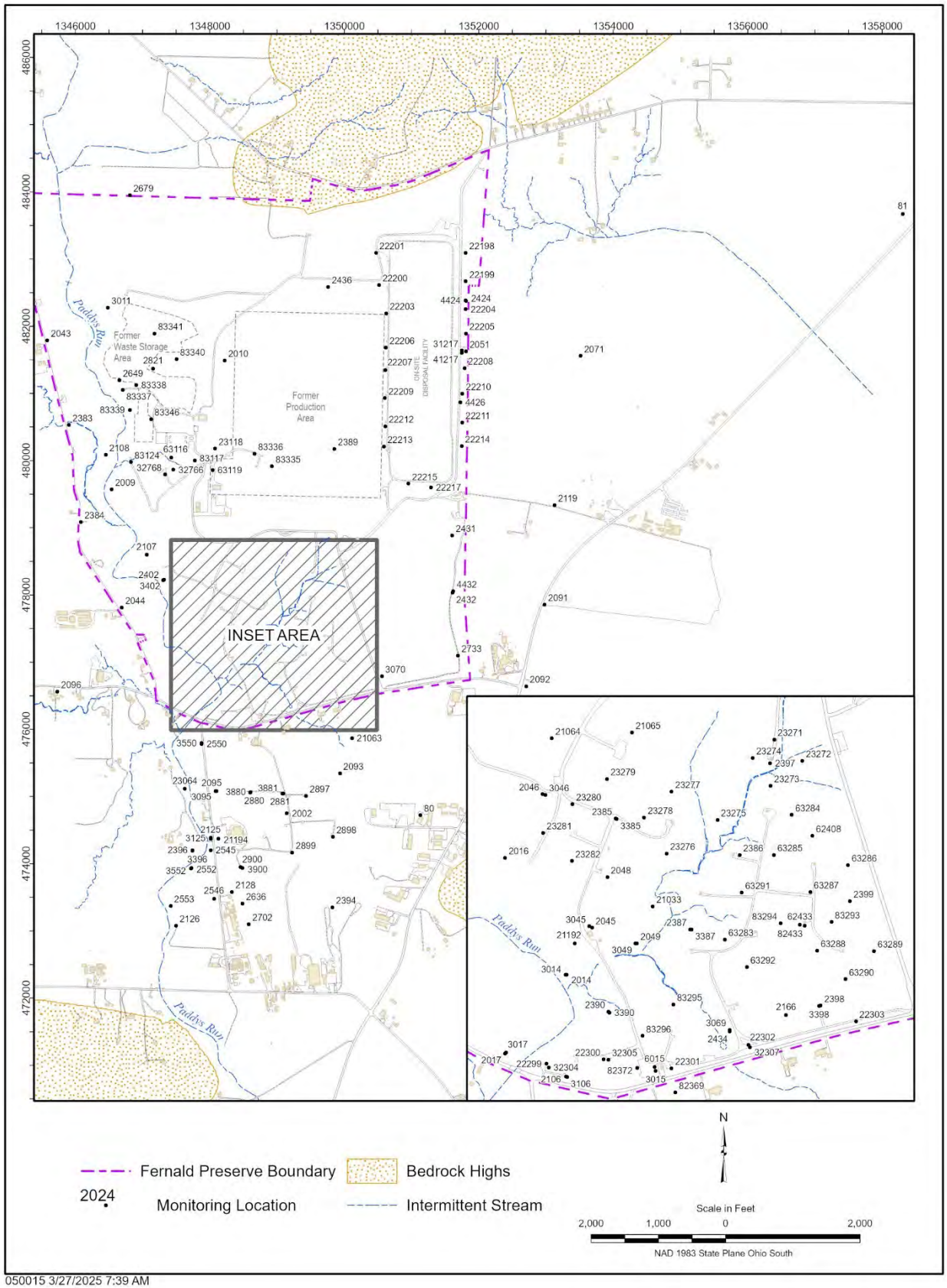


Figure 16. Groundwater Elevation Monitoring Wells

Pulse Pumping

In September 2012, with concurrence from EPA and Ohio EPA, a pulse-pumping exercise began at extraction wells 31550, 31560, 31561, and 33061. These four wells are equipped with pumps and motors that operate most efficiently at rates of approximately 300 gpm. The Waste Storage Area (Phase II) design called for a target pumping rate of 100 gpm for each of these wells. The 100-gpm rate was being achieved by throttling back on the flow from each of the wells; however, this type of operation was not energy efficient.

To become more energy efficient, beginning in 2012, the wells were being pumped at a higher rate for a shorter period each day to remove the daily volume of water prescribed by the Waste Storage Area (Phase II) design (DOE 2005b). Specifically, the wells are being pumped for 300 gpm for 8 hours a day (a total of 144,000 gallons per day) rather than 100 gpm for 24 hours a day (a total of 144,000 gallons per day). Flow and particle path monitoring predictions indicated that the new pumping schedule would maintain capture of the total uranium plume. With implementation of the 2014 optimization, the target pumping rate of extraction well 31561 was increased from 100 to 200 gpm, so pulse pumping was stopped at this well. Pulse pumping continued for the other three wells.

Figure 11 shows the extraction well locations associated with the restoration modules operating in 2025. Also shown in Figure 11 are the three extraction wells that were shut down in April 2014 (33265, 33266, and 33334) and the six wells shutdown in the South Plume as of the end of 2024 (3924, 3925, 3926, 3927, 32308 and 32309). Table 6 summarizes the mass of total uranium removed and the volume of groundwater pumped during 2025. Additional details are provided in the module operational summaries in Sections 3.3.1.2 through 3.3.1.4. Figure 17 identifies the yearly and cumulative mass of total uranium removed from the Great Miami Aquifer from 1993 through 2025.

Table 6. Groundwater Restoration Module Status for 2025

Modules and Restoration Wells	Target Design Pumping Rate	Volume Pumped	Uranium Removed
	gpm	Bgal	lb
South Plume Module: 33616, 33617	600	0.290	54.04
South Field Module: 31550, 31560, 31561, 32276, 32446, 32447, 33061, 33262, 33264, 33298, 33326	2,875	1.249	182.40
Waste Storage Area Module: 32761, 33062, 33347	800	0.370	51.13
Aquifer Restoration System Total	4,275	1.910	287.57

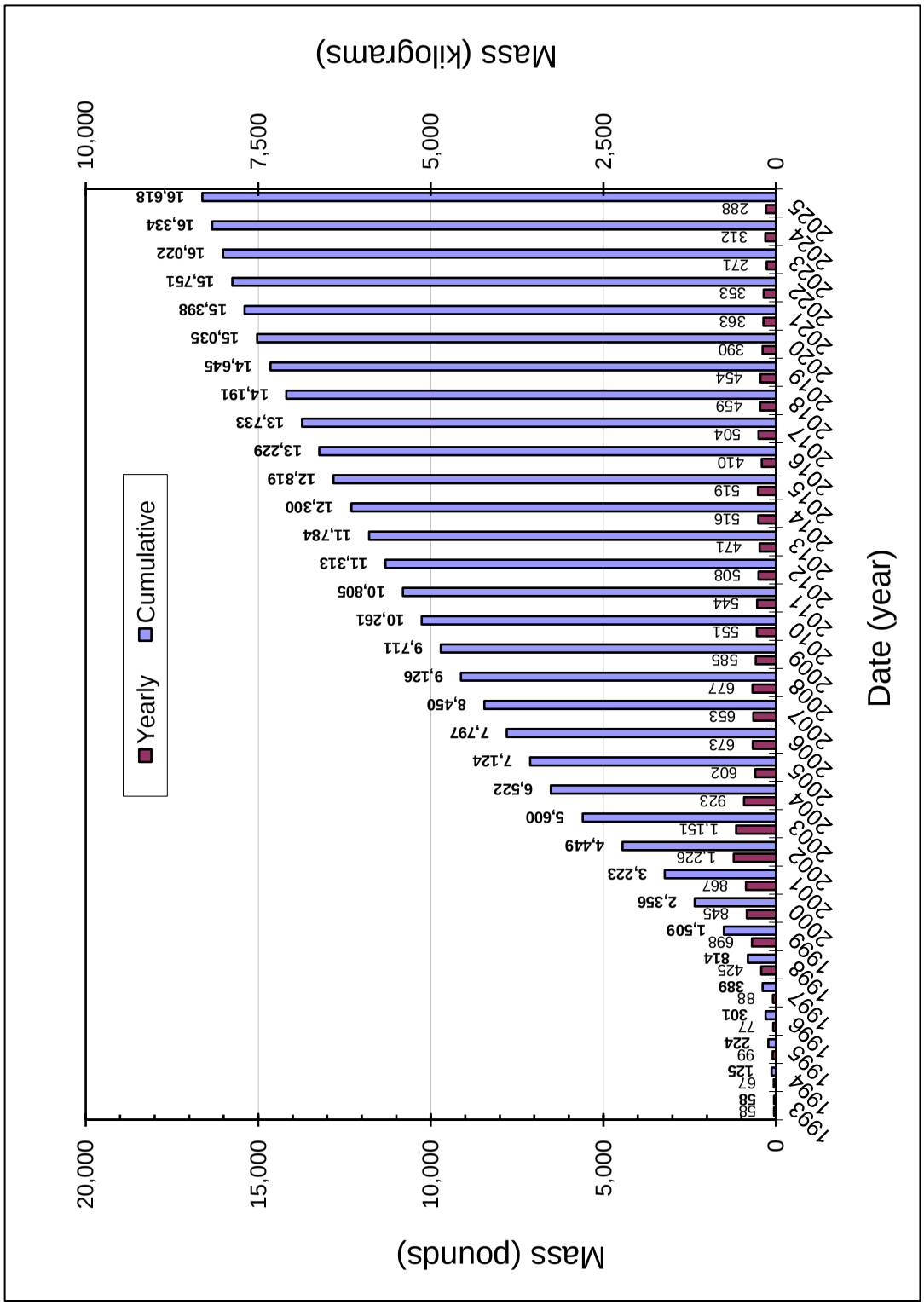


Figure 17. Yearly and Cumulative Mass of Uranium Removed from the Great Miami Aquifer, 1993–2025

3.3.1.2 South Plume/South Plume Optimization Module Operational Summary

The four original extraction wells (3924, 3925, 3926, and 3927) of the South Plume Module began operating in August 1993. The two original extraction wells (32308 and 32309) of the South Plume Optimization Module began operating in August 1998.

The South Plume/South Plume Optimization Module is now identified as the South Plume Module because between 2022 and 2024, all six original South Plume wells were permanently shut down as follows (DOE 2025b):

- 3927: June 6, 2022
- 32308: July 25, 2022
- 3926: June 12, 2023
- 32309: October 24, 2023
- 3925: October 31, 2023
- 3924: November 12, 2024

During 2025, the South Plume Module removed 290 million gallons (Mgal) of groundwater and 54 lb of total uranium from the Great Miami Aquifer. The two operating extraction wells in the South Plume met the following objectives:

- Southward movement of the total uranium plume beyond the southernmost extraction wells was not detected.
- Active remediation of the central portion of the off-property total uranium plume continues to reduce plume concentration. The entire off-property total uranium plume concentration was below 100 µg/L in 2025. When pumping began in 1993, areas in the off-property total uranium plume had concentrations of over 300 µg/L.

As discussed previously, all six original South Plume extraction wells were shut down between 2022 and 2024. In March 2024, replacement wells 33616 and 33617 began operating approximately 600 ft north of the original Southern Extent of the South Plume.

DOE will continue to utilize the existing annual direct-push groundwater sampling program to monitor for potential concentration rebound in the area between the original South Plume Module recovery wells and the two new replacement wells that began operating in 2024. This effort will provide continued water quality data in this area prior to certification being conducted in accordance with the *Fernald Groundwater Certification Plan* (DOE 2006b). Any plan to address concentration rebound would include getting input from stakeholders and approval from regulators.

3.3.1.3 South Field Module Operational Summary

The South Field Module was constructed in two phases. Phase I began operating in July 1998, and Phase II began operating in July 2003. During 2025, 11 extraction wells were operational.

The 10 original extraction wells installed under Phase I were 31550, 31560, 31561, 31562, 31563, 31564, 31565, 31566, 31567, and 32276. Six of the original 10 wells have been shut down (31562, 31563, 31564, 31565, 31566, and 31567).

- Extraction wells 31564 and 31565 were shut down in December 2001 and May 2001, respectively. Because these wells were located near the upgradient edge of the plume, total uranium concentrations in that region of the aquifer were low. In addition, soil remediation was underway in the area around the wells.
- Extraction well 31566 was shut down in August 1998 and was replaced by extraction well 33262, which was installed as part of South Field (Phase II) Module.
- Extraction well 31563 was shut down in December 2002 and converted to a reinjection well that operated in 2003 and 2004.
- Extraction well 31562 was shut down in March 2003 and replaced by extraction well 33298.
- Extraction well 31567 was shut down in September 2005 and replaced by extraction well 33326.

Three new extraction wells (32446, 32447, and 33061) were added to the South Field Module between 1998 and 2002. These new wells were installed in the eastern, downgradient portion of the South Field plume at locations where total uranium concentrations were considerably above the FRL. Two of these three wells (32446 and 32447) were installed in late 1999 and began pumping in February 2000. The third extraction well (33061) was installed in 2001 and became operational in 2002.

Phase II components of the South Field Module are described in the *Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module* (DOE 2002), which was issued in May 2002. The design provided an updated characterization of the total uranium plume in the Great Miami Aquifer beneath the southern portion of the site and a modeled design for the South Field Module in that area. All Phase II design components became operational in 2003. The components include:

- Four additional extraction wells; one in the former Southern Waste Units (extraction well 33262) and three along the eastern edge of the on-property portion of the southern total uranium plume (extraction wells 33264, 33265, and 33266).
- One additional reinjection well in the former Southern Waste Units (reinjection well 33263).
- An extraction well (31563) that was converted into a reinjection well.
- An injection pond that was located in the western portion of the former Southern Waste Units excavations.

In September 2004, the South Field Module reinjection components were shut down. In 2014, operational changes were made to wells in the South Field following recommendations made in a modeling study that was released in 2014 (DOE 2014b). On April 14, 2014, extraction wells 33265 and 33266 were shut down because the data indicated that they were no longer providing benefit to the groundwater remedy.

During 2025, the South Field Module removed 1,249 Mgal of groundwater and 182.4 lb of total uranium from the Great Miami Aquifer.

3.3.1.4 Waste Storage Area Module Operational Summary

The Waste Storage Area Module was constructed in two phases. Phase I became operational on May 8, 2002, nearly 17 months ahead of the October 1, 2003, start date established in the Operable Unit 5 Remedial Action Work Plan. Phase I consisted of three extraction wells (32761, 33062, and 33063). These three wells were installed to remediate a total uranium plume in the PPDD area, according to the *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a). In July 2004, extraction well 33063 was plugged and abandoned to make way for surface excavation activities required for site remediation. A replacement well for extraction well 33063 was installed in 2005 (extraction well 33334) and became operational on June 29, 2006. Phase II consisted of one additional extraction well (extraction well 33347), which became operational on October 5, 2006.

In 2014, operational changes were made to wells in the former Waste Storage Area following recommendations made in a modeling study that was released in 2014 (DOE 2014b). On April 14, 2014, extraction well 33334 was shut down because the data indicated that it no longer provided a benefit to the groundwater remedy.

During 2025, 370 Mgal of groundwater and 51.1 lb of uranium were removed from the Great Miami Aquifer through the Waste Storage Area Module.

3.3.1.5 Monitoring Results for Total Uranium

Total uranium is the primary FRL constituent because it is the most prevalent site contaminant, and it has affected the largest area of the aquifer. Focusing on remediating the uranium plume also addresses the remaining contaminants. Figure 18 shows the mapped outline of the total uranium plumes in the aquifer through the end of 2025. The total uranium plumes identified in the figure represent the interpreted size of the maximum total uranium plume in which concentrations are at or above the 30 µg/L groundwater FRL for total uranium.

Data collected in 2025 show continued progress in reducing the uranium footprint, as follows:

- The mapped footprint of the total uranium plume decreased by 3.8 acre (5.5%). The area at or above 30 µg/L in 2024 was mapped as being 69.4 acres, and the area above 30 µg/L in 2025 was mapped as being 65.6 acres.
- The area of the total uranium plume above a concentration of 50 µg/L decreased by 1.6 acre (3.3%). The area at or above 50 µg/L in 2024 was mapped as being 48.8 acres, and the area above 50 µg/L in 2025 was mapped as being 47.2 acres.
- The area of the total uranium plume above a concentration of 100 µg/L decreased by 1 acre (3.6%). The area at or above 100 µg/L in 2024 was mapped as being 27.8 acres, and the area above 100 µg/L in 2025 was mapped as being 26.8 acres.

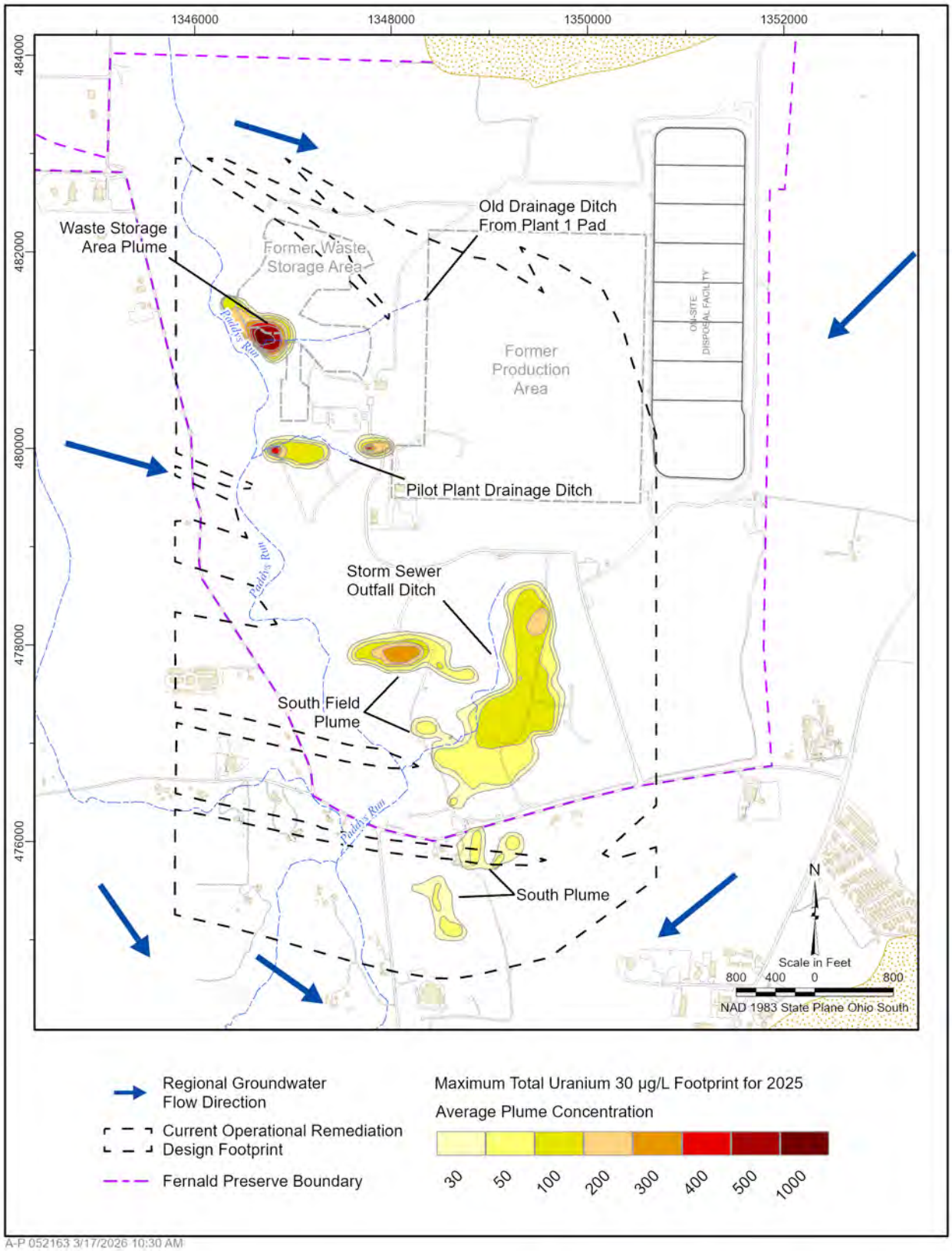


Figure 18. Total Uranium Plume in the Aquifer with Concentrations Greater Than or Equal to 30 µg/L at the End of 2025

Figure 18 presents the influence of hydraulic capture predicted by the groundwater model (i.e., Current Operational Design Remediation Footprint) and supported by water level measurements (Appendix A, Attachment A.3). Figure 18 also presents regional groundwater flow directions. The map indicates that the existing extraction system is hydraulically capturing the plume. There is a small portion of the South Plume that is caught in a stagnation zone that exists between the South Plume extraction wells and the South Field extraction wells, just south of the site boundary. This stagnation zone is within hydraulic capture.

Appendix A, Attachment A.2, provides detailed total uranium plume maps for 2025. Appendix A, Attachment A.3, provides quarterly groundwater elevation. Highlights for 2025 for the former Waste Storage Area, former Plant 6 area, South Field area, and South Plume area are provided below.

Geoprobe (Direct-Push) Sampling
The Geoprobe, a hydraulically powered, direct-push sampling tool, is used at the Fernald Preserve to obtain groundwater samples at specific depth intervals without installing a permanent monitoring well. Direct-push employs the weight of the vehicle the tool is mounted on and percussive force (hammering) to push the tool into the ground without drilling (or cutting) to displace soil in the tool's path. The Fernald Preserve uses this technique to collect data on the progress of aquifer restoration and to determine the optimal location and depth of additional monitoring and extraction wells that may be installed in the future.

Former Waste Storage Area: This area includes the PPDD plume. In 2025, direct-push sampling was focused on the South Plume and South Field areas, so no direct-push samples were collected from the former Waste Storage Area to supplement routine sampling of monitoring wells.

Since 2025, the mapped footprint of the 30 µg/L total uranium plume remained essentially the same at 12.4 acres. In 2024, the size was 12.5 acres. This is because no direct-push sampling took place in the Former Waste Storage area as direct-push sampling efforts are focused on the South Plume Module. More direct-push sampling is expected to occur in the former Waste Storage Area as the remedy progresses and emphasis shifts from the South Plume and South Field to the former Waste Storage Area. Figure 18 shows the outline of the maximum total uranium plumes in the former Waste Storage Area, as measured in 2025. Data are presented in Appendix A, Attachment A.2.

Former Plant 6 Area: Plans for a restoration module in the former Plant 6 area were abandoned in 2001 based on the outcome of the *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a). The design data indicated that the total uranium plume in the former Plant 6 area was no longer present. EPA and Ohio EPA concurred with this decision. Monitoring in the area continues.

Monitoring well 2389 is the only well remaining in the area. Total uranium FRL exceedances were detected at this well again in 2025. As discussed in past Site Environmental Reports, FRL exceedances occur in this area when the water-table elevation exceeds 515 ft above mean sea level. The well was sampled twice in 2025, and the results were 34.8 and 39.5 µg/L. Both results were collected at an elevation at or above 515 feet amsl. For several years, samples at this elevation have been above 30 µg/L. The former Plant 6 area will continue to be targeted for additional direct-push sampling when the water table is high to determine whether the total uranium groundwater FRL exceedance is dissipating over time. This location is within the capture zone of the pump-and-treat system.

South Field and South Plume Areas: In 2025, direct-push samples were collected at 30 locations in the South Field and South Plume areas to supplement routine sampling of monitoring wells. Direct-push data for 2025 are presented in Appendix A, Attachment A.2.

In 2025, the mapped footprint of the 30 µg/L total uranium plume in the South Field and South Plume decreased by 3.7 acres. The area above 30 µg/L in 2024 was mapped as 56.9 acres, and the area above 30 µg/L in 2025 was mapped as 53.2 acres.

In 2025, the area of the total uranium plume in the South Field and South Plume above a concentration of 50 µg/L decreased by 1.6 acre. The area above 50 µg/L in 2024 was mapped as 39.0 acres, and the area above 50 µg/L in 2025 was 37.4 acres.

In 2025, the area of the total uranium plume in the South Field and South Plume above a concentration of 100 µg/L decreased by 0.9 acre. The area above 100 µg/L in 2024 was mapped as 19.9 acres, and the area above 100 µg/L in 2025 was 19.0 acres.

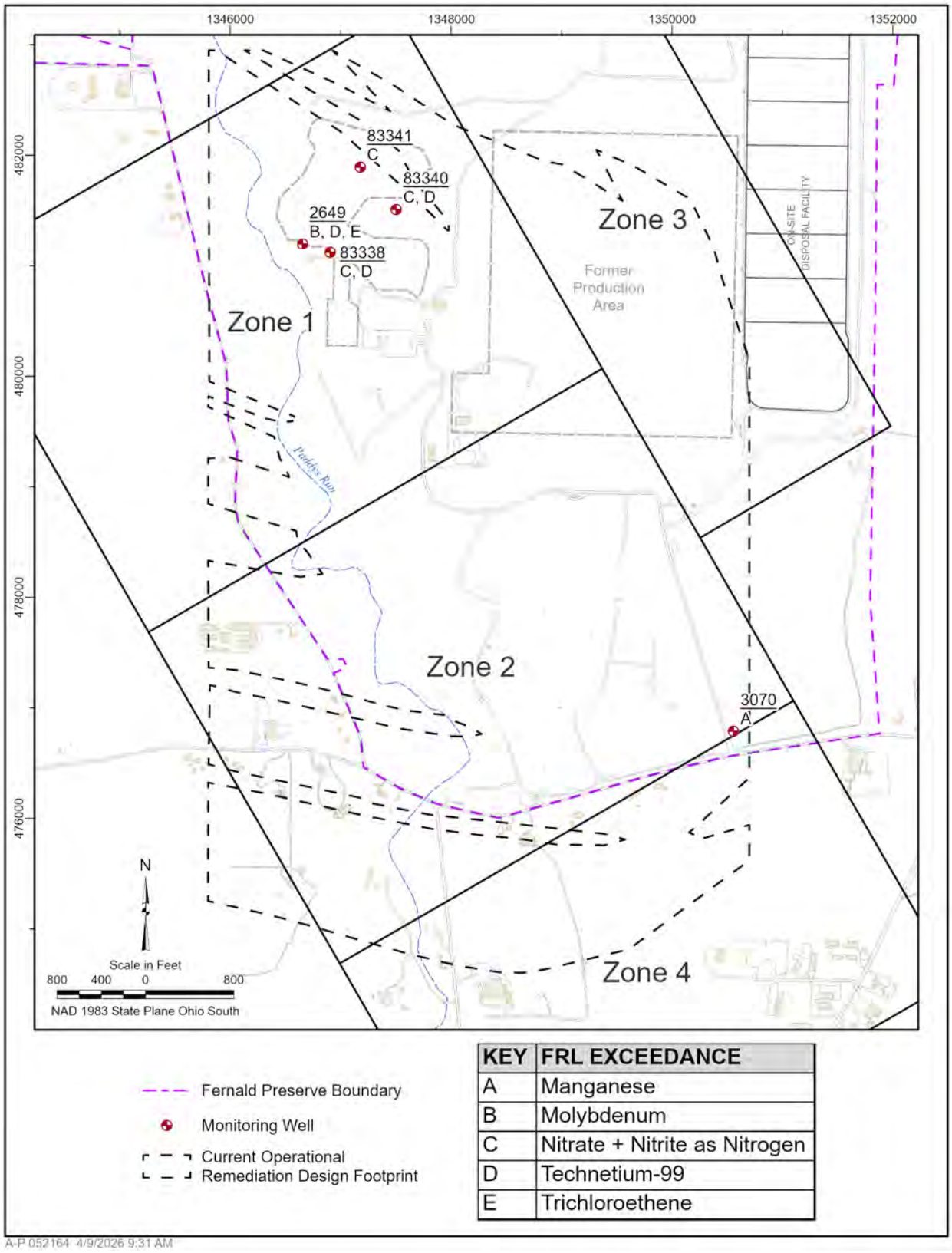
3.3.1.6 Monitoring Results for Non-Uranium Constituents

Although the groundwater remedy is primarily targeting remediation of the total uranium plume, other FRL constituents within the total uranium plume are also being monitored. Figure 19 identifies the locations of the monitoring wells that had non-uranium FRL exceedances. Table 7 shows the number of wells with non-uranium constituents exceeding FRLs in 2025, the number of wells with constituents exceeding FRLs outside the current Operational Design Remediation Footprint, the groundwater FRLs, and the range of 2025 data inside and outside the current Operational Design Remediation Footprint. During 2025, five non-uranium constituents had FRL exceedances. None of the locations were outside the current uranium-based Operational Design Remediation Footprint. No plumes were identified for the non-uranium constituents above FRLs at the locations outside the current Operational Design Remediation Footprint in the extensive groundwater characterization efforts evaluated as part of the *Remedial Investigation Report for Operable Unit 5* (DOE 1995d). More details are provided in Appendix A, Attachment A.4.

Table 7. Non-Uranium Constituents with Results Above FRLs During 2025

Constituent	Number of Wells Exceeding the FRL	Number of Wells Exceeding the FRL Outside the Current Operational Design Remediation Footprint	Groundwater FRL[a]	Range of 2025 Data Inside the Current Operational Design Remediation Footprint[a]	Range of 2025 Data Outside the Current Operational Design Remediation Footprint[a]
General Chemistry			(mg/L)	(mg/L)	(mg/L)
Nitrate + Nitrite as Nitrogen	3	0	11[b]	10.3 to 36.8	Not Applicable
Inorganics			(mg/L)	(mg/L)	(mg/L)
Manganese	1	0	0.90	1.07	Not Applicable
Molybdenum	1	0	0.10	0.205 to 0.540	Not Applicable
Organics			(µg/L)	(µg/L)	(µg/L)
Trichloroethene	1	0	5	1.87 to 11.6	Not Applicable
Radionuclides			(pCi/L)	(pCi/L)	(pCi/L)
Technetium-99	3	0	94	76.2 to 413	Not Applicable

[a] mg/L = milligrams per liter, µg/L = micrograms per liter, pCi/L = picocuries per liter.
[b] FRL is based on nitrate from OU5 ROD, Table 9-4; however, the sampling results are for nitrate + nitrite as nitrogen.



KEY	FRL EXCEEDANCE
A	Manganese
B	Molybdenum
C	Nitrate + Nitrite as Nitrogen
D	Technetium-99
E	Trichloroethene

Figure 19. Non-Uranium Constituents with 2025 Results Above FRLs

3.3.2 Other Monitoring Commitments

Two other groundwater monitoring activities are included in the IEMP: private well monitoring and Property/Plume Boundary monitoring. As stated earlier, the groundwater data from these activities, along with the data from all other IEMP groundwater monitoring activities, are collectively evaluated for total uranium and, where necessary, non-uranium constituents of concern. This section provides additional details on these two other compliance monitoring activities.

As indicated in Section 2.0, Ohio EPA issued the Director's Findings and Orders on September 7, 2000. These orders specify that the site's groundwater monitoring activities will be implemented in accordance with the IEMP. The revised language allows modification of the groundwater monitoring program as necessary, via the IEMP revision or variance process (subject to Ohio EPA approval), without issuance of a new Director's Order. As determined by Ohio EPA, the IEMP will remain in effect following remediation.

Private Well Monitoring
The sampling program at private homeowner wells is the longest running groundwater monitoring effort at the site. In 2025, one private well (2060) along Willey Road was monitored under the IEMP to assist in the evaluation of the remediation of the total uranium plume. Data from the private well sampled under the IEMP are detailed in Section 2.3 and were incorporated into the total uranium plume maps shown in Figure 18 and Appendix A, Attachment A.2. A brief history of the Private Well Monitoring Program is provided in the 2024 Site Environmental Report (DOE 2025b).

Property/Plume Boundary Monitoring
The objective of the Property/Plume Boundary groundwater monitoring program is to detect and assess potential changes in groundwater conditions along the eastern property boundary and downgradient of the leading edge of the 30-µg/L total uranium plume south of the Fernald Preserve property. This includes a subset of wells in the South Plume to determine the impact that the Fernald site groundwater remediation has had on the PRRS plume area that is located South of the southernmost extraction wells.

The aquifer remedy has been operating for over 30 years. Water level and water quality data collected during the remedy demonstrate that both uranium and non-uranium constituents monitored for in the Property/Plume Boundary Program in the Great Miami Aquifer have been successfully captured and contained within the footprint of the total uranium plume and that pumping from the southernmost South Plume extraction wells has not adversely impacted the PRRS plume located downgradient, and south of the southernmost South Plume extraction wells. This was demonstrated through both groundwater flow and water quality assessments.

Thirty years of water level data presented in Attachment A.3 of the Site Environmental Report have demonstrated that groundwater flow direction along the east property boundary is west (toward the uranium plume, not east or away from the plume). Twenty nine years of data presented in Attachment A.4 of the Site Environmental Report demonstrate that no persistent non-uranium FRL exceedance has been detected outside of the Operational Remediation Design Footprint, which also demonstrates that plumes of non-uranium constituents are not present outside of the currently mapped 30 µg/L total uranium plume footprint. Data collected from the 10 wells in the PRRS area under the Property/Plume Boundary monitoring program has shown

that the PRRS plume (contamination not attributed to Fernald site operations), downgradient of the Fernald Preserve extraction wells, was not being pulled north toward the South Plume recovery wells.

Based on 30 years of data, DOE is proposing to eliminate the Property/Plume Boundary groundwater monitoring program, but to continue monitoring Property/Plume Boundary monitoring wells located south of Willey Road for total uranium on an annual basis. With regulatory approval, these changes would begin with calendar year 2027. Additional details concerning the change are detailed in Appendix A.4.

3.4 Groundwater Remediation Assessment

Data collected in 2025 indicate that the maximum total uranium plume continues to decrease in response to pumping. Table 8 provides a summary.

Table 8. Comparison of 2024 and 2025 Maximum Total Uranium Plume Footprint Areas

Year	Area Greater Than 30 µg/L	Area Greater Than 50 µg/L	Area Greater Than 100 µg/L
2024 (acres)	69.4	48.8	27.8
2025 (acres)	65.6	47.2	26.8
Change (acres)	−3.8	−1.6	1.0
Change (%)	−5.5	−3.3	-3.6

Groundwater elevations measured in 2025 continue to indicate that the pumping wells are maintaining capture of the uranium plume by enhancing and modifying natural groundwater flow directions within the aquifer. Appendix A, Attachment A.3, provides additional information concerning capture of the total uranium plume.

Each year, three predictions of how much uranium will be removed annually in future years to make progress toward achieving cleanup of the aquifer are provided in Attachment A.2 of the Site Environmental Report. In the 2024 Site Environmental Report (DOE 2025b), the following predictions for uranium mass to be removed in 2025 were presented:

- 296 lb calculated using stretched exponential regressions of concentration data
- 263 lb based on model prediction
- 355 lb using the 95% upper confidence limit

Data collected in 2025 show that the mass of uranium removed from the aquifer was 288 lb. Appendix A, Attachment A.1, provides additional information concerning the mass of uranium removed from the aquifer.

In 2022, the site groundwater model was updated with uranium concentrations measured in the first half of 2021. Updated modeled cleanup date predictions for the South Plume, South Field, and Waste Storage Area were determined to be 2025, 2038, and 2045, respectively. These new cleanup time predictions assume that no wellfield pumping changes were made to the current operational design and that the implementation began in 2021. Since the operational design was

not implemented until 2024, there is a year-for-year lag in the predicted cleanup dates which now become 2028, 2041, and 2048, respectively.

In 2022, DOE also modeled how best to optimize the South Plume extraction wells moving forward, and how to possibly speed up the cleanup of the South Plume. The selected model alternative replaced the four existing South Plume recovery wells (3924 through 3927) and two existing South Plume Optimization Module recovery wells (32308 [RW-6] and 32309 [RW-7]) with two new recovery wells that are better positioned for capture and remediation of the remaining South Plume. DOE is currently operating to this modeling design. As discussed in Section 3.3.1.2, all original South Plume and South Plume Optimization Module recovery wells (3924 [RW-1], 3925 [RW-2], 3926 [RW-3], 3927 [RW-4], 32308 [RW-6] and 32309 [RW-7]) have been permanently shut down. And two replacement extraction wells (33316 [RW-6a] and 33317 [RW-7a]) began operating in 2024.

Bulk plume metrics (i.e., plume acres, average plume concentration, and dissolved uranium mass) are also provided in this year's Site Environmental Report to track groundwater remediation progress. Until 2022, these bulk plume metrics were based on Ricker method calculations (Ricker 2008). Beginning with the 2022 Site Environmental Report (DOE 2023b), bulk plume metrics are also provided using Earth Volumetric Studio software. Table 9 provides a summary of the Ricker method bulk plume metrics over time, showing an overall decrease for all three metrics between 2006 and 2025.

Table 9. Ricker Method Bulk Plume Metrics (2006 to 2025)

Year	Plume Area (Acres)	Average Total Uranium Concentration (µg/L)	Remaining Dissolved Uranium Mass (lb)
2006	145.7	92.11	306
2010	132.7	89.96	272
2014	108.0	86.41	213
2016	108.0	79.32	195
2017	97.3	79.12	175
2018	95.9	86.23	190
2019	89.2	81.58	166
2020	85.9	80.77	158
2021[a]	81.6	82.46	153
2022	80.7	88.58	163
2023	75.6	87.25	150
2024	71.7	83.36	136
2025	71.8	94.82	155

[a] Average plume concentration and remaining dissolved uranium mass were corrected from data reported in the 2021 Site Environmental Report (DOE 2022b) from 80.85 µg/L and 150 lb, respectively.

Based on the Ricker method, dissolved mass decreased by approximately 49.3% between 2006 and 2025, decreasing from 306 lb in 2006 to 155 lb in 2025. It should be noted that between 2024 and 2025 all three metrics (acres, concentration, and dissolved mass increased. As discussed in Attachment A.2, this increase is attributed to higher dissolved uranium concentrations based on 2025 monitoring well sampling results. No action is recommended at

this time other than continued monitoring. Monitoring will demonstrate whether this increase continues, or if a decreasing trend resumes.

Earth Volumetric Studio software-determined bulk plume metric results for October 1 in years 2006 and 2021 through 2025 are shown in Table 10.

Table 10. Earth Volumetric Studio Bulk Plume Metrics

Year	Plume Area (acres)	Average Total Uranium Concentration (µg/L)	Remaining Dissolved Mass (lb)	Volume (gallons)	Average Thickness (ft)
October 1, 2006	136.50	68.44	159.64	279.55	22.45
October 1, 2021	88.87	67.47	67.21	119.39	14.73
October 1, 2022	84.93	61.10	56.59	111.00	14.33
October 1, 2023	83.13	64.12	56.93	102.67	13.54
October 1, 2024	75.50	63.25	46.62	88.30	12.83
October 1, 2025	82.10	64.89	48.31	89.41	11.94

Based on Earth Volumetric Studio software, dissolved plume mass decreased by approximately 69.7% between 2006 and 2025, decreasing from a maximum 159.64 lb in 2006 to 48.31 lb in 2025. As discussed above and in Attachment A.2, all Ricker method metrics, with the exception of plume thickness increased when comparing 2025 to 2024.

It should be noted that the residual total mass computed by Earth Volumetric Studio software is significantly lower than the mass calculated by the Ricker method. The 2006 plume mass calculated by the Ricker method is 306 lb compared to 159.64 lb calculated by the software. The Ricker method is a two-dimensional approach, and conservative assumptions are applied to account for the third vertical dimension. A conservative plume thickness of 30 ft is assumed in the Ricker calculations, and the maximum uranium concentration at each sample location is applied to the full plume thickness. These assumptions are not needed when concentration variations are visualized in three dimensions, so Earth Volumetric Studio software provides a more realistic estimate of plume mass. For example, the average plume thickness calculated by the software for October 2006 is 22.45 ft (25% less than the 30 ft plume thickness assumed for the Ricker method), and the average concentration is 68.44 µg/L (26% less than the 92.11 µg/L estimated by the Ricker method). If the mass calculated by the Ricker method is adjusted to account for the overestimates of plume thickness and average concentration, then the 2006 Ricker method calculated mass becomes 170 lb, which is very similar to the 159.64 lb mass calculate by Earth Volumetric Studio software. Note that this only addresses dissolved uranium; sorbed uranium mass is discussed below.

Two calculations, plume center-of-mass and total uranium mass remaining in the aquifer, are presented in Appendix A, Attachment A.2. Plume center-of-mass calculations show that the center of mass of each plume area has shifted slightly upgradient, but otherwise has remained fairly stationary between 2006 and 2025, indicating that the surrounding pumping wells are capturing the plume and not allowing the center of mass to migrate as it would if no pumping was taking place. Of note is that the center of mass has shifted to the north in the South Field.

This provides additional support for the determination that uranium concentrations in the South Plume are decreasing, and that progress is being made in achieving the objective of cleaning up the South Plume first.

The Ricker method calculation for mass remaining in the aquifer estimates the dissolved mass present in the groundwater as total aqueous uranium. The estimate for the mass of aqueous uranium is used to estimate the sorbed uranium mass adsorbed to aquifer sediments (Deutsch 1997). The dissolved mass and sorbed mass combined provide an estimate of the total uranium mass remaining in the aquifer. Calculation of the pounds of uranium remaining in the aquifer (dissolved and sorbed) for both the Ricker method and through Earth Volumetric Studio software analysis is 3,228.65 lb and 1,006.30 lb, respectively.

National Laboratory Network Recommendations

In early 2021, a DOE National Laboratory Network Collaboration was conducted concerning the Fernald Preserve groundwater remediation. EPA and Ohio EPA participated in the collaboration, with the understanding that any official input or endorsement for any of the recommendations would be reserved for if, and when, DOE decides to pursue implementation of a recommendation at the site. The objective of the collaboration was to present recommendations to improve the ongoing aquifer remediation at the Fernald Preserve.

The collaboration involved two focus groups. Focus Group 1 was challenged with developing recommendations on how to maintain and keep an aging wellfield system operating efficiently. Focus Group 2 was challenged with developing recommendations to improve the efficiency and success of the existing pumping remedy and to improve the aquifer cleanup predictions for planning purposes while considering the following three site priorities:

1. Focus first on the off-property plume.
2. Focus second on the southern South Field plume.
3. Focus third on the recalcitrant areas of the plume in the South Field and former Waste Storage Area.

A summary of the recommendations and LM implementation of National Laboratory Network Focus Group 1 recommendations is provided in the 2024 Site Environmental Report.

In 2025, DOE continued with calibration and validation of a MODFLOW model for the Fernald site to replace the current VAM3D groundwater model. DOE anticipates completion of calibration and validation of the new groundwater model in 2026. Once approved, DOE plans to begin modeling to optimize remediation of the South Field.

3.5 OSDF Monitoring

Monitoring of the OSDF is conducted in the leachate collection system (LCS), LDS, glacial till (perched water), and Great Miami Aquifer. Figure 20 identifies the OSDF footprint and monitoring well locations for Cells 1 through 8. Flow is monitored within the facility in the LCS and LDS to determine whether the facility is operating as designed. Water quality is monitored in the LCS, LDS, glacial till, and Great Miami Aquifer to identify any potential water quality changes that could have resulted from leakage from the facility.

LCS and LDS flow data collected in 2025 indicate that engineered features within the OSDF continue to perform as designed. Leachate flow continues to diminish as expected, and LDS flow volumes indicate that the cell liners are performing as designed. Now that the LDS volume can be more accurately measured following the 2023 completion of the OSDF valve house piping project, and with seven of eight cells showing no flow in the LDS, the importance of the bivariate plots to evaluate mixing between the horizons has become a secondary evaluation measure. DOE will continue to assess LDS flow data as a primary function in the evaluation of mixing and the use of bivariate plots as a secondary measure to augment evaluation of OSDF performance.

A comparison of water quality data collected in 2025 from within the facility (LCS and LDS) to water quality data collected beneath the facility (perched groundwater in the glacial till and groundwater in the Great Miami Aquifer) indicates that the facility is operating as designed. Table 11 summarizes the monitoring information for Cells 1 through 8 of the OSDF by providing the range of total uranium concentrations measured in 2025. The majority of total uranium concentrations measured in 2025 fell within the historical range of concentrations previously measured for each monitoring horizon. New high and new low concentrations measured in 2025 are identified in bold in Table 11. As shown in Table 11, no new high total uranium concentrations were measured in 2025.

In 2025, a camera video inspection was conducted of the LCS, redundant leachate collection system (RLCS), and LDS lines of the OSDF. No significant additional scale or infiltration of gravel were observed in the lines. There was no visible change in pipe integrity or signs of structural impacts (i.e. crushing or ovality), and it was determined that there was no need to clean out any of the lines. Several suggestions were made during the review of the 2025 results with the intent of improving the consistency of the surveys between events (e.g., speed at which the camera moves during the survey, the collection of more still photos of certain areas). DOE plans to incorporate these suggestions into the LMICP so that they can be carried forward and used during future video surveys.

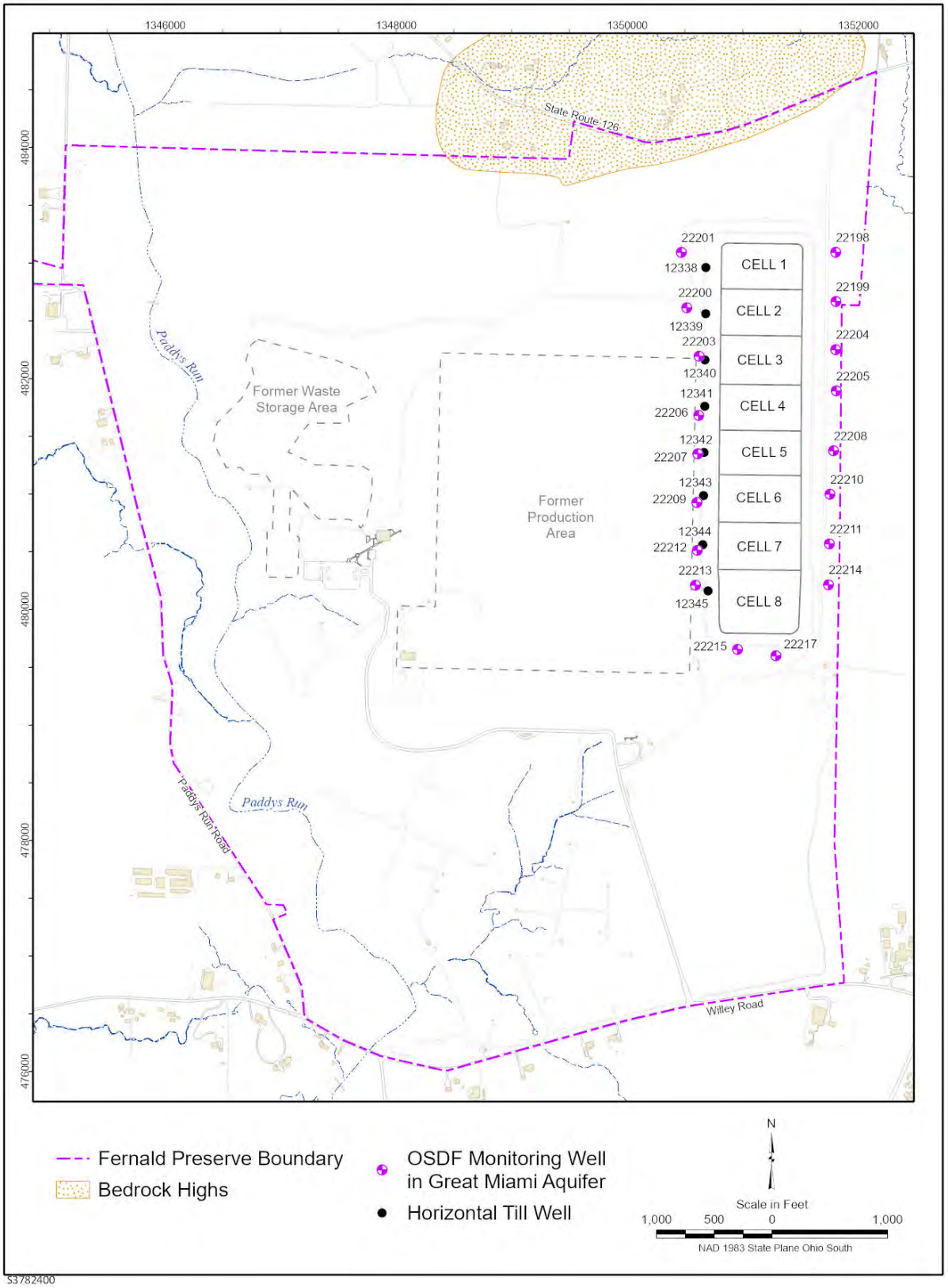


Figure 20. OSDF Footprint and Monitoring Well Locations

Table 11. OSDF Groundwater, Leachate, and LDS Monitoring Summary

Cell (Waste Placement)	Monitoring Location	Monitoring Zone	Date Sampling Started	Total Number of Samples	Range of Total Uranium Concentrations[a,b] (µg/L)	First Half 2025[a,c] (µg/L)	Second Half 2025[a,c] (µg/L)	Historical Trend[d] (Year Last Sampled)
Cell 1 (Dec 1997)	12338C	LCS	Feb 17, 1998	82	ND–206	7.91	15.8	None (2025)
	12338D	LDS	Feb 18, 1998	38	1.50–37.0	DRY	27.9	Up (2025[e])
	12338	Glacial Till	Oct 30, 1997	91	ND–19.0	6.67	7.45	Up (2025)
	22201	Great Miami Aquifer	Mar 31, 1997	98	ND–12.4	8.41	6.74	Up (2025)
	22198	Great Miami Aquifer	Mar 31, 1997	149	0.540–15.2	2.73	2.80	Down (2025)
Cell 2 (Nov 1998)	12339C	LCS	Nov 23, 1998	78	4.51–686	19.1	23.3	Up (2025)
	12339D	LDS	Dec 14, 1998	29	4.08–25.8[f]	DRY	DRY	None (2013)
	12339	Glacial Till	Jun 29, 1998	102	ND–36.9	14.5	17.1	Up (2025)
	22200	Great Miami Aquifer	Jun 30, 1997	93	ND–4.69	0.237	0.181	Up (2025)
	22199	Great Miami Aquifer	Jun 25, 1997	126	ND–12.1	0.487	0.433	Down (2025)
Cell 3 (Oct 1999)	12340C	LCS	Oct 13, 1999	76	9.27–206	161	154	Up (2025)
	12340D	LDS	Aug 26, 2002	20	8.90–27.7[f]	DRY	DRY	Down (2007)
	12340	Glacial Till	Jul 28, 1998	35	ND–58.5	13.8	14.4	None (2025)
	22203	Great Miami Aquifer	Aug 24, 1998	88	ND–23.6	22.4	9.09	Up (2025)
	22204	Great Miami Aquifer	Aug 24, 1998	121	ND–22.9	4.28	3.98	Up (2025)
Cell 4 (Nov 2002)	12341C	LCS	Nov 04, 2002	62	4.41–234	75.2	81.3	None (2025)
	12341D	LDS	Nov 04, 2002	41	5.74–79.8	DRY	DRY	Up (2022)
	12341	Glacial Till	Feb 26, 2002	75	**2.89**–7.91	**2.89**	3.31	Down (2025)
	22206	Great Miami Aquifer	Nov 06, 2001	79	ND–5.78	0.662	1.31	Up (2025)
	22205	Great Miami Aquifer	Nov 05, 2001	108	0.446–19.7	0.924	5.86	None (2025)
Cell 5 (Nov 2002)	12342C	LCS	Nov 04, 2002	64	3.39–285	106	98.9	None (2025)
	12342D	LDS	Nov 04, 2002	40	2.93–27.1	DRY	DRY	Down (2013)
	12342	Glacial Till	Feb 26, 2002	76	**6.49**–21.1	**6.49**	8.48	Down (2025)
	22207	Great Miami Aquifer	Nov 06, 2001	79	ND–4.48	0.327	0.273	Down (2025)
	22208	Great Miami Aquifer	Nov 05, 2001	107	ND–2.1	0.346	0.310	None (2025)

Table 11. OSDF Groundwater, Leachate, and LDS Monitoring Summary (continued)

Cell (Waste Placement)	Monitoring Location	Monitoring Zone	Date Sampling Started	Total Number of Samples	Range of Total Uranium Concentrations[a,b] (µg/L)	First Half 2025[a,c] (µg/L)	Second Half 2025[a,c] (µg/L)	Historical Trend[d] (Year Last Sampled)
Cell 6 (Nov 2003)	12343C	LCS	Oct 27, 2003	61	8.03–276	99.4	113	Down (2025)
	12343D	LDS	Oct 27, 2003	59	3.10–160	53.6	53.8	Up (2025)
	12343	Glacial Till	Mar 14, 2003	68	ND–24.2	6.44	4.50	None (2025)
	22209	Great Miami Aquifer	Dec 16, 2002	74	ND–2.43	0.422	0.431	None (2025)
	22210	Great Miami Aquifer	Dec 16, 2002	102	ND–1.02	0.520	0.672	None (2025)
Cell 7 (Sep 2004)	12344C	LCS	Sep 02, 2004	57	4.72–355	126	135	Down (2025)
	12344D	LDS	Sep 02, 2004	29	12.2–169[f]	DRY	DRY	Up (2015)
	12344	Glacial Till	Feb 24, 2004	65	0.674–12.1	3.50	4.46	Up (2025)
	22212	Great Miami Aquifer	Jan 21, 2004	67	ND–5.53	0.461	0.470	None (2025)
	22211	Great Miami Aquifer	Jan 21, 2004	92	ND–4.31	0.549	0.327	None (2025)
Cell 8 (Dec 2004)	12345C	LCS	Oct 18, 2004	54	1.51–335	142	150	Down (2025)
	12345D	LDS	Oct 18, 2004	45	9.38–315	DRY	DRY	Up (2021)
	12345	Glacial Till	May 19, 2004	20	3.48–7.30	DRY	DRY	Up (2008)
	22213	Great Miami Aquifer	Mar 31, 2004	66	ND–0.710	0.374	0.491	Up (2025)
	22214	Great Miami Aquifer	Mar 31, 2004	92	ND–2.95	0.296	1.62	None (2025)
	22215	Great Miami Aquifer	Aug 22, 2005	57	ND–16.4	0.483	0.390	None (2025)
	22217[g]	Great Miami Aquifer	Aug 22, 2005	54	ND–18.3	1.91	5.11	None (2025)

Note: The data on this table represent the raw data from the database. However, data presented in the Attachment A.5 subattachments have gone through statistical processing and analysis. In regard to the statistical processing, the data were quarterized (normalized to one result per quarter) and outliers were removed to arrive at an accurate distribution model. Because of the processing, the total number of samples and range of concentrations on this table might not match the text, tables, and figures in Attachment A.5. The rules used for the statistical processing and analysis in Attachment A.5 are discussed in Section A.5.2.1, and the results are summarized in Table A.5-2.

Note: Uranium concentration versus time graphs can be found in the Attachment A.5 subattachments. See Figures A.5.1-5A and A.5.1-5B for Cell 1; Figures A.5.2-5A and A.5.2-5B for Cell 2; Figures A.5.3-5A and A.5.3-5B for Cell 3; Figures A.5.4-5A and A.5.4-5B for Cell 4; Figures A.5.5-5A and A.5.5-5B for Cell 5; Figures A.5.6-5A and A.5.6-5B for Cell 6; Figures A.5.7-5A and A.5.7-5B for Cell 7; and Figures A.5.8-7A and A.5.8-7B for Cell 8.

[a] **Bold text indicates a new high or low detected in 2025**.
[b] ND = not detected.
[c] Where there are more than two data points for the half year, the higher result is used.
[d] The trends presented here are based on nonparametric Mann-Kendall procedure and come from the tables in Attachment A.5 subattachments for each cell. See Tables A.5.1-1, A.5.2-1, A.5.3-1, A.5.4-1, A.5.5-1, A.5.6-1, A.5.7-1, and A.5.8-1.
[e] Trend include a sample result from second half of 2025. See Attachment A.5 which discusses the impact of the video survey.
[f] Some data are not considered representative of LDS in Cell 2 (December 14, 1998, through May 23, 2000, dataset) due to malfunction in Cell 2 leachate pipeline and resulting mixing of individual flows. It is suspected that some November 2004 samples were switched (i.e., 12339C with 12339D, and 12340C with 12340D). If data from these events were included above, maximum total uranium concentrations would be 71 µg/L for 12339D and 72.4 µg/L for 12340D. It is suspected that samples were switched in 2014 (i.e., 12344D with the field duplicate for 12345C). If the data point from this sampling event was not included above, maximum total uranium concentration for 12344D would be 37.6 µg/L.
[g] Monitoring location 22216 was plugged and abandoned in April 2006. Monitoring location 22217 is its replacement. The results listed for location 22217 also include the results for location 22216.

4.0 Surface Water and Effluent Pathway

Results in Brief: 2025 Surface Water and Effluent Pathway

Surveillance Monitoring: No effluent analytical results from samples collected in 2025 exceeded any surface water FRL, which is applicable outside the mixing zone in the Great Miami River.

Uranium Discharges: In 2025, 283 lb of uranium were discharged in effluent to the Great Miami River. Approximately 30.3 lb of uranium were released to the environment through uncontrolled stormwater runoff. The estimated total mass of uranium released through the surface water and effluent pathway was approximately 314 lb.

NPDES Permit Compliance: There were no instances of noncompliance at any sample location in 2025.

This section presents the 2025 monitoring activities and results for surface water and effluent to determine the effects of site activities on the surface water pathway.

In general, low levels of contaminants enter the surface water pathway at the Fernald Preserve by two primary mechanisms: effluent that is monitored as it is discharged to the Great Miami River and uncontrolled runoff entering the site's drainages from remediated areas that are now certified and restored. Because these discharges have continued through remediation and legacy management, the surface water pathway will continue to be monitored.

4.1 Summary of Surface Water and Effluent Pathway

The effluent pathway consists of flows discharged to the Great Miami River via the Parshall Flume, sample location PF 4001. Effluent is currently composed of treated and untreated groundwater, treated leachate from the OSDF, and treated storm water associated with the footprint of the outdoor processing activities at the wastewater treatment facility. Groundwater is no longer routinely treated to meet discharge limits. A small volume of groundwater is blended with other wastewater stored in the CAWWT backwash basin when basin water is treated. The backwash basin is an above-ground lined impoundment that is used to temporarily store wastewater originating from a variety of sources (i.e., well rehabilitation, CAWWT backwash, OSDF leachate, groundwater sampling, CAWWT laboratory, and CAWWT stormwater drainage).

To assist in the understanding of this section, the following key definitions are provided:

- **controlled runoff.** Storm water that is collected and, under normal circumstances, treated and discharged to the Great Miami River as effluent. However, currently, the only storm water that is controlled is associated with the footprint of the outdoor processing activities at the wastewater treatment facility.
- **effluent.** Primarily untreated groundwater discharged to the Great Miami River via the effluent line. A small amount of groundwater is routed to treatment each month and blended with water from the backwash basin. The small volume of treated water is blended with untreated groundwater and is discharged to the Great Miami River via the outfall line.
- **surface water.** Water that flows within natural drainage features.
- **uncontrolled runoff.** Storm water that is not collected for treatment but enters the site's natural drainages.

The volume and flow rate of uncontrolled runoff depend on several tributaries to Paddys Run (e.g., SSOD) as well as the northeast drainage that flows to the Great Miami River. The arrows in Figure 21 indicate the general flow direction of uncontrolled runoff as determined from the topography. Uncontrolled runoff from the Fernald Preserve leaves the property via two drainage pathways: Paddys Run and the northeast drainage ditch.

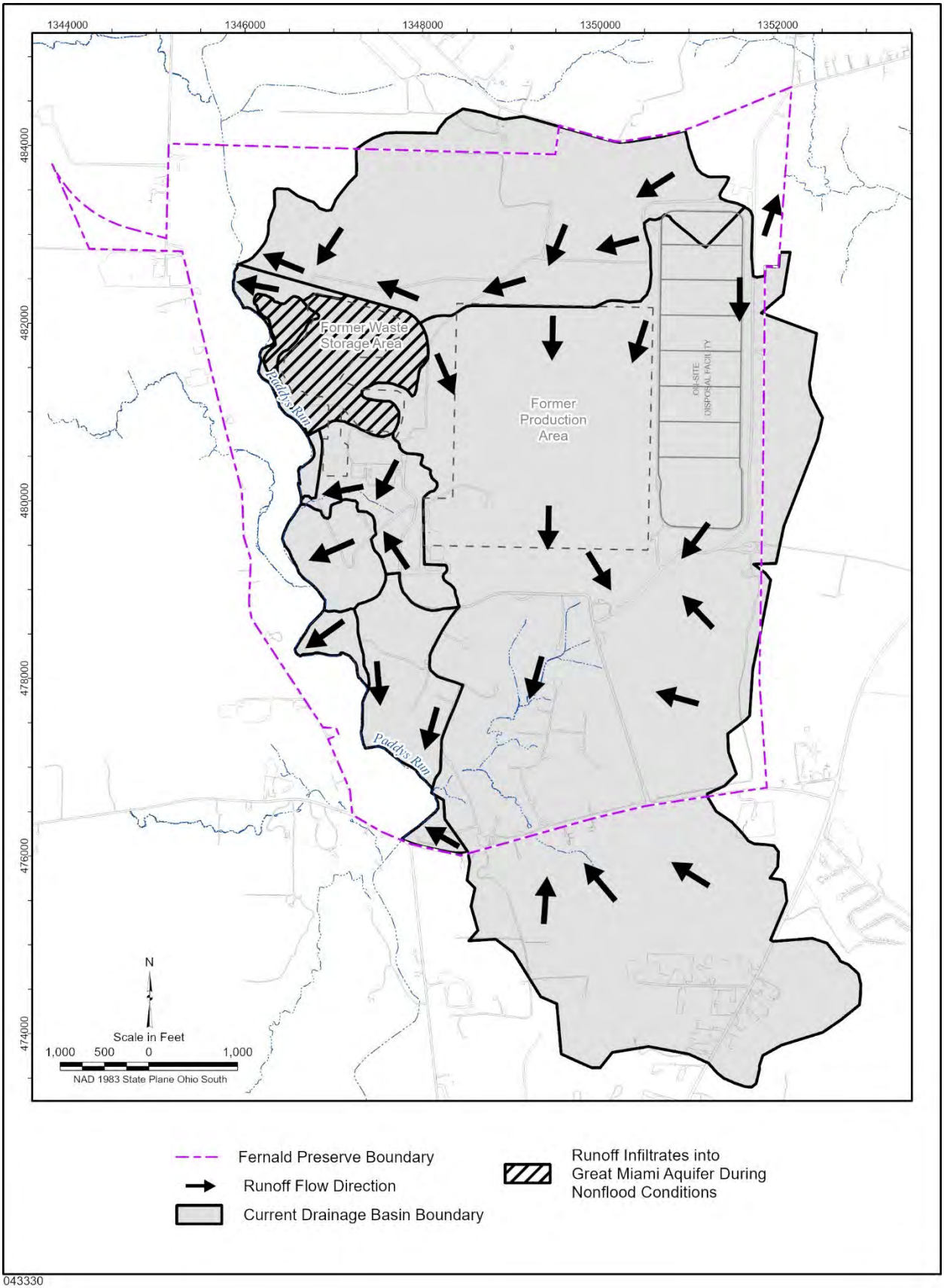


Figure 21. Uncontrolled Surface Water Areas and Runoff Flow Directions

4.2 Surface Water and Effluent Monitoring Program

Surface water and effluent are sampled to determine the effect of the Fernald Preserve's activities on the environment. Surface water is sampled at several locations in the site's drainage areas and analyzed for various radiological and nonradiological constituents. Effluent is sampled before discharge into the Great Miami River.

The key elements of the surface water and effluent program design are:

- **Sampling:** Sample locations, frequency, and constituents were selected to address requirements of the NPDES permit, the FFCA, and the OU5 ROD and to provide a comprehensive assessment of surface water quality at key locations, including two offsite locations (Figure 22). Surface water is monitored for three FRL constituents; surface water FRLS are applicable outside the mixing zone in the Great Miami River.
- **Data Evaluation:** The integrated data evaluation process focuses on tracking and evaluating data and comparing analytical results with background and historical ranges, FRLs (which apply outside the mixing zone of the Great Miami River), and NPDES permit limits. This information is used to assess impacts on surface water due to site remediation activities affecting uncontrolled runoff or effluent to the Great Miami River. The assessment also includes identifying the potential for impacts from surface water to groundwater in the Great Miami Aquifer. The ongoing data evaluation is designed to support remedial action decision making.
- **Reporting:** Surface water and effluent data are reported through the annual Site Environmental Report. Monthly discharge monitoring reports required by the NPDES permit are submitted to Ohio EPA.

Data from samples collected under the IEMP are used to fulfill surveillance and compliance monitoring functions. Surveillance monitoring results of the IEMP surface water and effluent program are used to assess the collective effectiveness of site remediation in preventing unacceptable impacts to the surface water and groundwater. Compliance monitoring includes sampling at stormwater and effluent discharge points and is conducted to comply with provisions in the NPDES permit, the FFCA, and the OU5 ROD. The data are routinely evaluated to identify any unacceptable trends and to trigger corrective actions, when needed, to ensure protection of these critical environmental pathways. Figure 22 depicts IEMP and NPDES surface water and effluent sample locations for 2025.

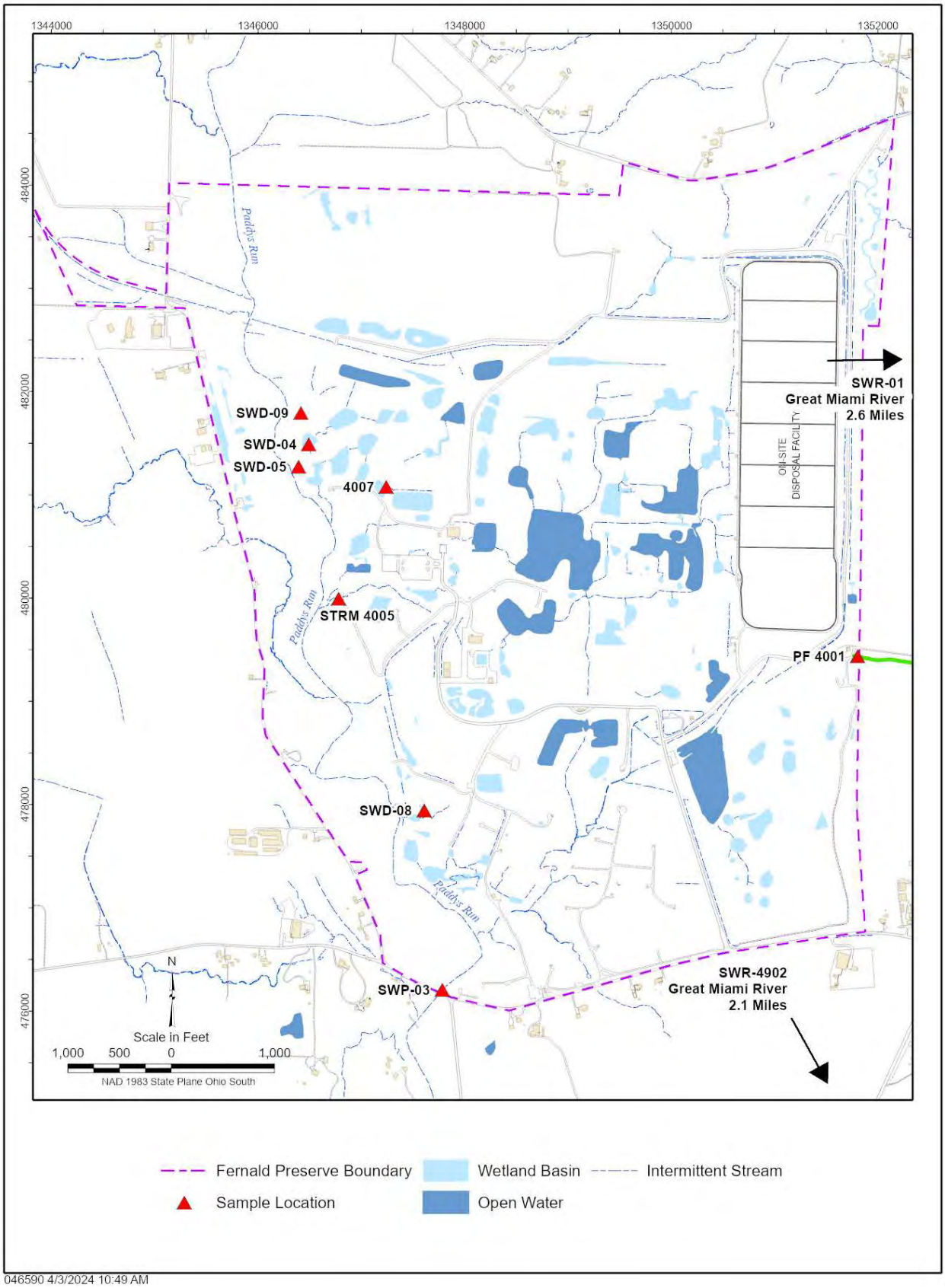


Figure 22. IEMP/NPDES Surface Water and Effluent Sample Locations

4.2.1 Surveillance Monitoring

Effluent is discharged to the Great Miami River through the effluent line identified in Figure 22. Samples of the effluent are collected at the Parshall Flume (PF 4001). The resulting data are used to calculate the concentration of each FRL constituent after the effluent mixes with the water in the Great Miami River.

Surveillance monitoring in 2025 was based on an evaluation of analytical results from samples collected during the year. This evaluation indicated that during 2025, there was one exceedance of surface water FRLs for total uranium in a surface water sample collected and analyzed from SWD-09. Appendix B provides additional details.

The following two key sample locations represent points where surface water or effluent leaves the site:

- Paddys Run at the Willey Road property boundary (surface water sample location SWP-03)
- Parshall Flume (sample location PF 4001) at the entry point of the effluent line leading to the Great Miami River

The total uranium concentration at location SWP-03 was 1.9 µg/L, well below the surface water total uranium FRL of 530 µg/L that applies outside the mixing zone in the Great Miami River and within the very low historical ranges. Figure 23 illustrates the decrease of the total uranium concentration in Paddys Run from 1985 through 2025. The large decrease in concentration in 1987 is attributable to the installation of the stormwater retention basin in 1986, which greatly reduced the volume of contaminated runoff flowing into Paddys Run from the Former Production Area.

Samples collected at PF 4001 are used in the surveillance evaluation because this is the last point where effluent is sampled before discharge to the Great Miami River. The maximum daily total uranium concentration at PF 4001 in 2025 was 22.4 µg/L on April 26, 2025. This result is below the drinking water standard (30 µg/L) and far below the surface water total uranium FRL of 530 µg/L, which applies outside the mixing zone in the Great Miami River. A mixing equation is used to account for the actual flow rate in the Great Miami River and the discharge flow rate at PF 4001 when the maximum uranium concentration was detected. The resulting concentration in the river after mixing was estimated to be 2.58 µg/L for April 26, 2025.

Surface water data are also evaluated to provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer. In areas where glacial overburden is absent, a direct pathway exists for contaminants to reach the aquifer. This contaminant pathway to the aquifer was considered in the design of the Fernald Preserve groundwater remedy. The groundwater remedy includes pumping from groundwater extraction wells downgradient of these areas where direct infiltration occurs. This pumping serves to capture and remove contaminated groundwater from the aquifer, mitigating any potential cross-media impacts. To provide this assessment, sample locations were selected to evaluate contaminant concentrations in surface water just upstream or within those areas where site drainages have eroded through the protective glacial overburden. The locations are SWD-04, SWD-05, and SWD-08.

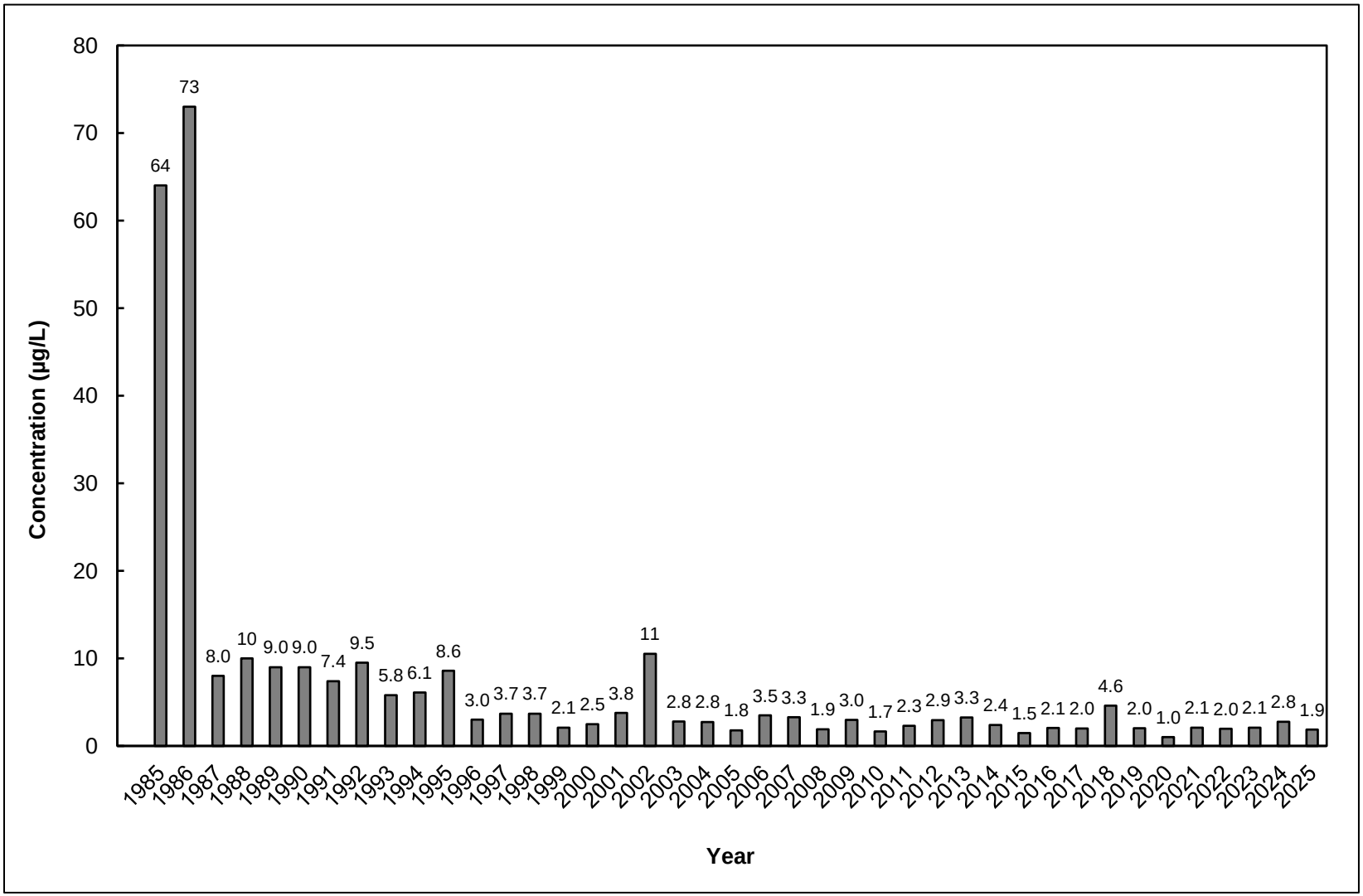


Figure 23. Annual Average Total Uranium Concentrations in Paddys Run at Willey Road (Sample Location SWP-03)

In 2025, sample results from surface water cross-media impact locations SWD-04 and SWD-05 exceeded the total uranium groundwater FRL of 30 µg/L. Location SWD-04 is in the former Waste Storage Area and SWD-05 is in the swale west of the Waste Storage Area. These locations are within the capture zone of the aquifer remediation system. Appendix A, Attachment A.2, provides additional information concerning the impact of surface water infiltrating into the Great Miami Aquifer. Sampling at these locations will continue to provide an assessment of the cross-media impact. Appendix B presents additional details of the FRL exceedances.

One small area west of the former waste pits, continued to show elevated total uranium concentrations in surface water samples. The elevated uranium area is a series of small puddles and drainage ditches due west of the center of former Waste Pit 3, which drain generally south to a depression near the former Waste Storage Area runoff control basin known as the “cement pond.” This area does not drain directly to Paddys Run and is not open to the public. A streambank stabilization project was conducted in 2014 and 2015 to ensure that Paddys Run does not erode into this area.

After a limited maintenance activity was completed in the fall of 2007, DOE committed to continue monitoring the elevated uranium area. Two monitoring points (SWD-05 and SWD-09) were added to the surface water program to fulfill this monitoring commitment (Figure 22). Until 2024, these two locations were sampled weekly when water was present. Since 2024, the sampling frequencies were semiannual for SWD-05, and quarterly for SWD-09. The reduced frequencies resulted from analysis of the large datasets that have been established since 2007 indicating downward trends in contaminant concentrations at each location. Additional information is provided in Appendix B.

In 2015, DOE conducted an assessment of the scope of the surface water quality monitoring program. The assessment concluded that the scope of the program could be reduced. With approval from EPA, Ohio EPA, and local stakeholders, DOE implemented these reductions in 2017. A similar assessment of the surface water quality monitoring program occurred in 2021 and based on this assessment, which was presented in Appendix B of the 2021 Site Environmental Report (DOE 2022b), additional monitoring reductions were warranted. With approval of the 2023 LMICP (DOE 2023a), these reductions were incorporated into the surface water program beginning in calendar year 2023.

Additional assessment of the surface water program was presented in the 2022 Site Environmental Report (DOE 2023b) related to sampling frequency at SWD-05 and SWD-09. Based on the number of years of data collected at SWD-05 and SWD-09, DOE proposed reducing the frequency of sampling at these locations from weekly to semiannual to align with the sampling of the remaining surface water locations. After discussions with the regulators, sampling of SWD-09 was reduced to quarterly and SWD-05 was reduced to semiannually. This change was implemented in 2024 with approval of the 2024 LMICP variances.

4.2.2 Compliance Monitoring

4.2.2.1 FFCA and OU5 ROD Compliance

The Fernald Preserve is required to monitor effluent discharges at the Parshall Flume (sample location PF 4001) for total uranium mass discharges and total uranium concentrations. This requirement is identified in the July 1986 FFCA and the OU5 ROD (DOE 1996b). The OU5 ROD requires treatment of effluent so that the mass of total uranium discharged to the Great Miami River through PF 4001 does not exceed 600 lb per year. The OU5 ROD and the subsequent *Explanation of Significant Differences for Operable Unit 5* (DOE 2001b) also require that the monthly average total uranium concentration in the effluent not exceed 30 µg/L, the EPA-established drinking water standard.

Figure 24 shows that the cumulative mass of total uranium discharged to the Great Miami River through the Parshall Flume (PF 4001) during 2025 was 283 lb, which is below the annual discharge limit of 600 lb. Figure 25 shows that the monthly average total uranium concentration in water discharged through the Parshall Flume (PF 4001) was below the 30 µg/L discharge limit every month during 2025.

4.2.2.2 NPDES Permit Compliance

Compliance sampling, consisting of sampling for nonradiological pollutants from uncontrolled runoff in the SSOD and effluent discharges from the Fernald Preserve, is regulated under the state-administrated NPDES program. A new NPDES permit was approved in early 2022 and took effect on June 2, 2022, and will expire on May 31, 2027. There were no instances of noncompliance at any of the permitted outfalls in 2025.

4.2.3 Uranium Discharges in Surface Water and Effluent

As identified in Figure 24, 283 lb of uranium in effluent were discharged to the Great Miami River through the Parshall Flume (PF 4001) in 2025. In addition to the effluent, the contribution of uranium in uncontrolled runoff in Paddys Run is also calculated. Figure 26 presents the mass of uranium from the uncontrolled runoff and controlled discharges from 1993 through 2025.

A loading term of 0.8 lb of uranium per inch of rainfall is used to estimate the pounds of uranium discharged to Paddys Run via uncontrolled runoff. During 2025, 37.83 inches of precipitation fell at the Fernald Preserve; therefore, an estimated 30.3 lb of uranium entered the environment through uncontrolled runoff. The estimated total amount of uranium discharged to the surface water pathway for the year, including controlled effluent discharges and uncontrolled runoff, was approximately 314 lb.

As stated in Section 2.2.7, the requirement for reporting these estimates was originally required in the 1986 FFCA. The FFCA reporting requirements were combined into the Consent Agreement, Federal Facility Compliance Agreement, Federal Facilities Agreement, RI, FS, and Consent Decree (Consolidated CA/FFCA/FFA/RI/FS/CD) Report. In 2003, the regulators agreed to DOE's proposed elimination of the Consolidated CA/FFCA/FFA/RI/FS/CD Report (DOE 2003b). The reporting of remaining environmental data, including the estimate for uranium loading to Paddys Run, was incorporated into the Site Environmental Report at that time.

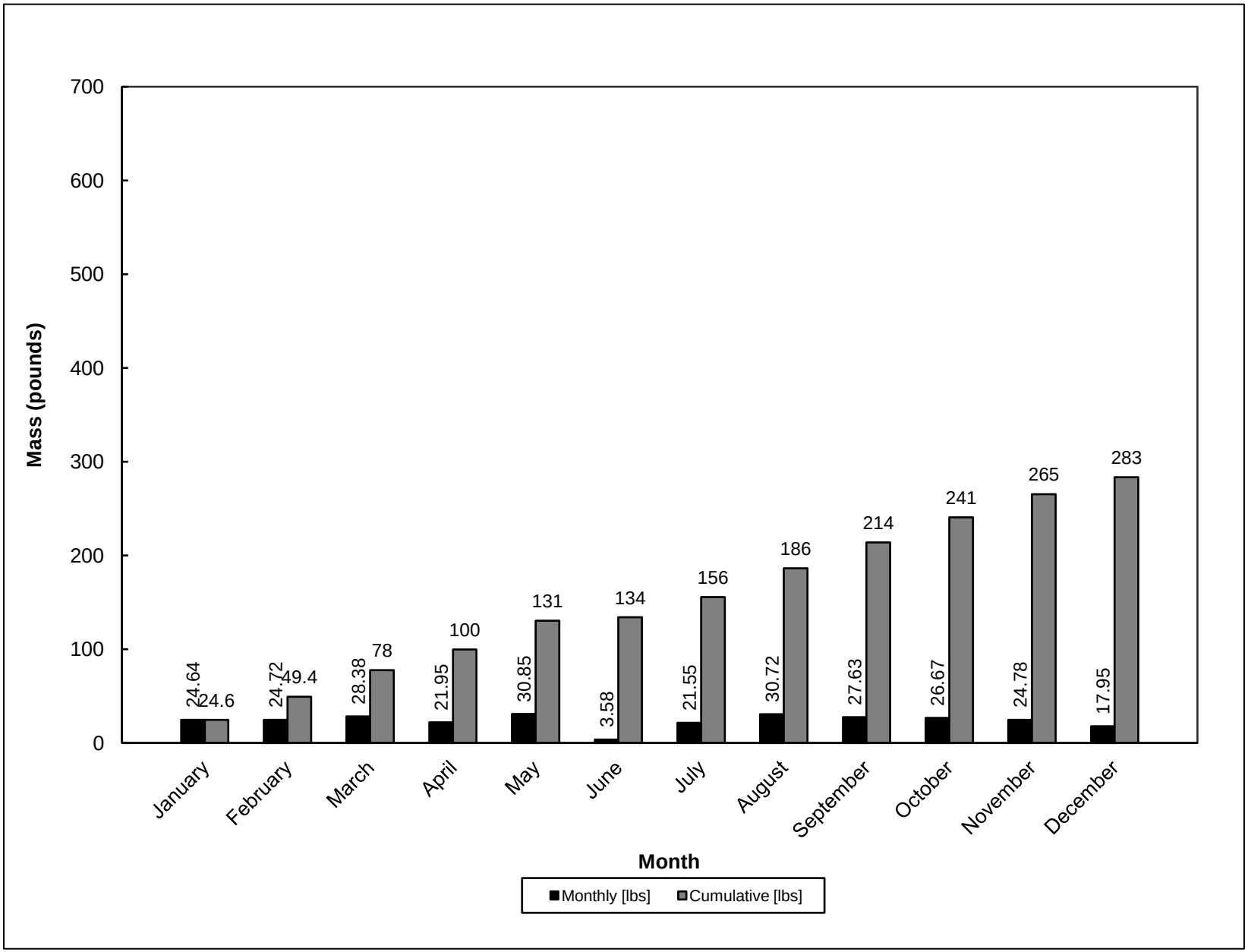


Figure 24. Mass of Uranium Discharged to the Great Miami River Through the Parshall Flume (PF 4001) in 2025

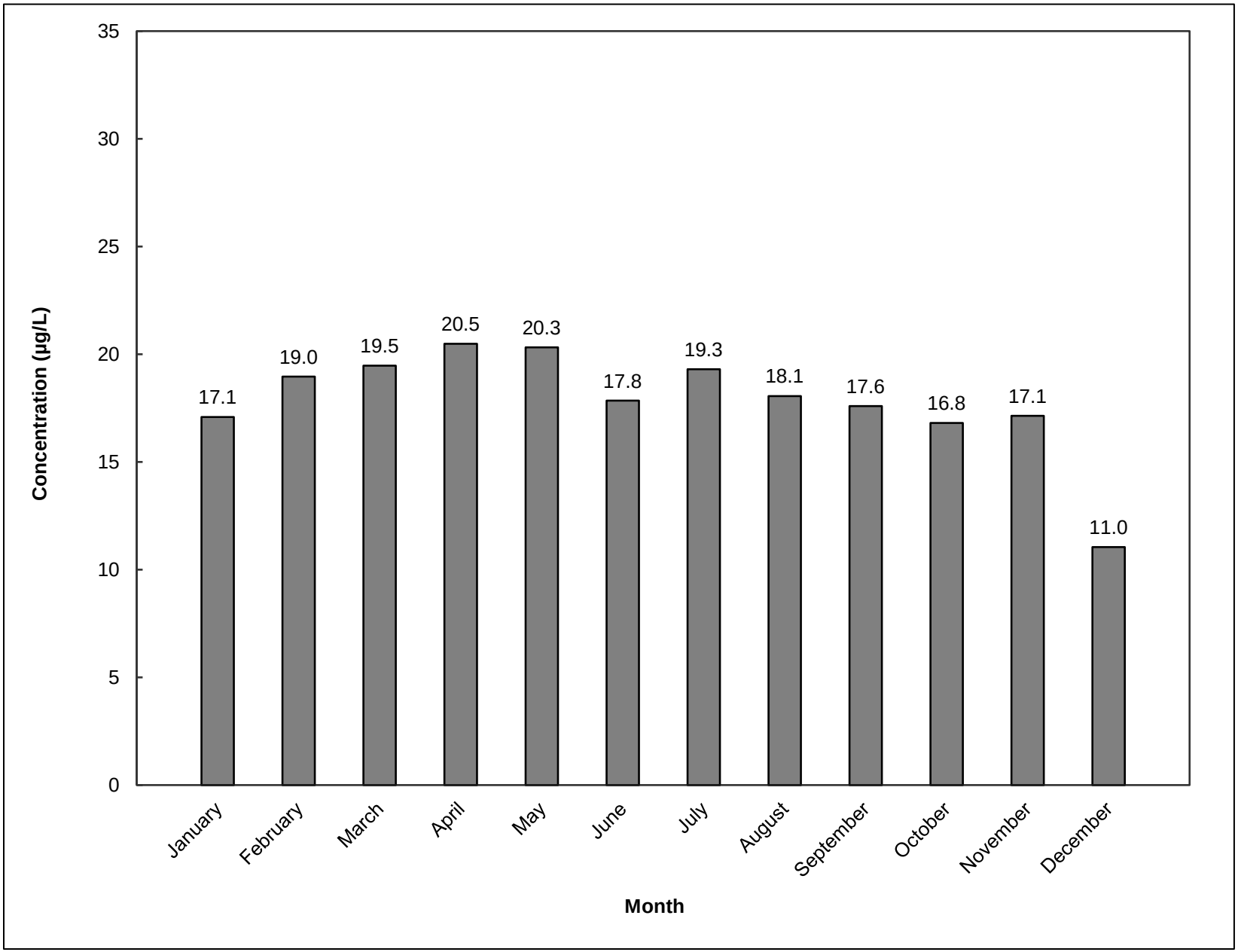


Figure 25. 2025 Monthly Average Total Uranium Concentration in Water Discharged

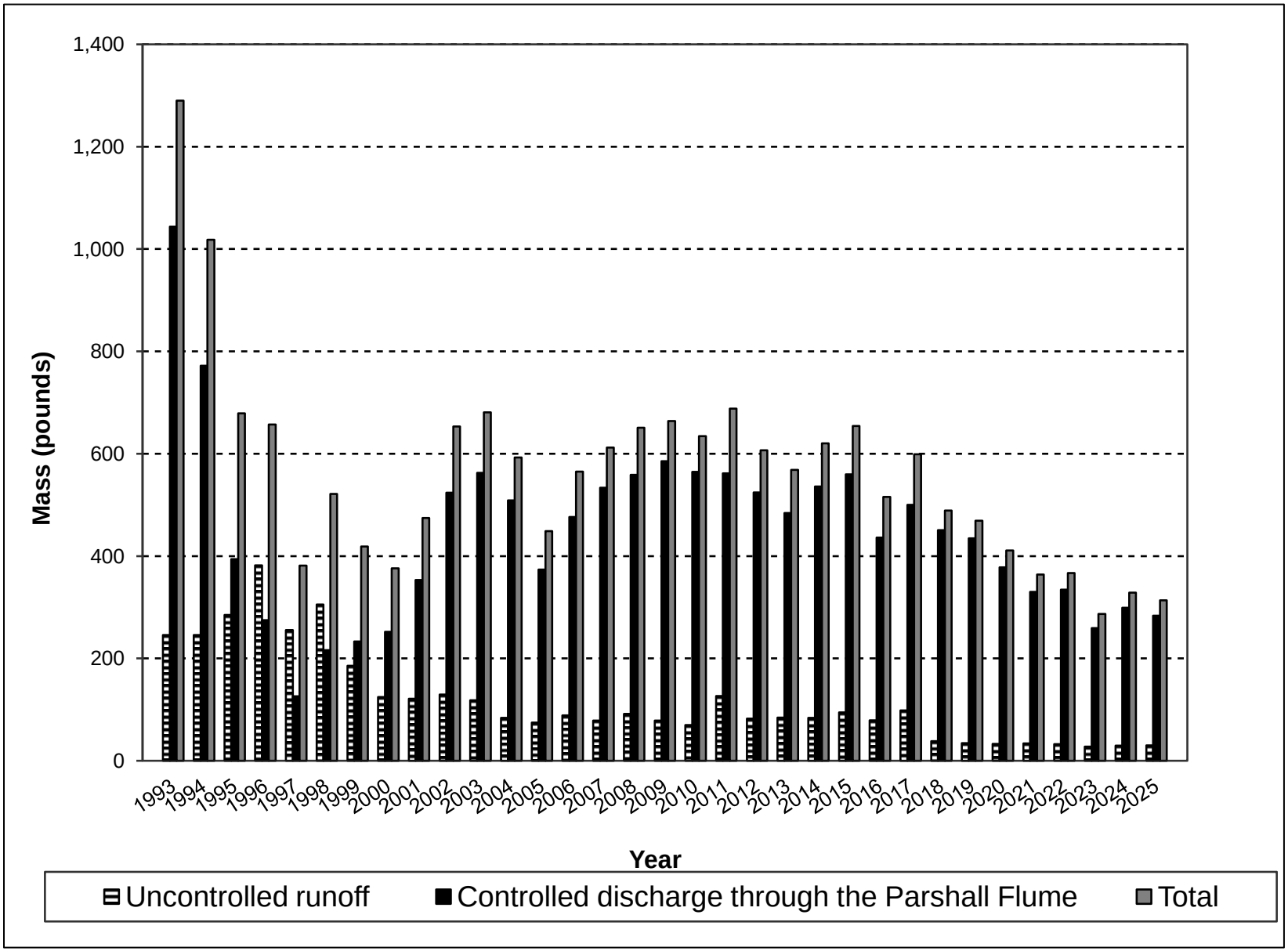


Figure 26. Uranium Discharged via the Surface Water Pathway, 1993−2025

The loading term to estimate the pounds of uranium discharged through uncontrolled runoff to Paddys Run was developed during the Operable Unit 5 Remedial Investigation using data from the 1980s and early 1990s. Loading terms have been modified over the years based on surface water concentrations in the drainages to Paddys Run as a result of lower total uranium concentrations measured in Paddys Run due to significant historical improvements in the capture of contaminated stormwater and remediation of site soil. The loading term used during the majority of site cleanup activities (1980s to 2004) was 6.25 lb of uranium per inch of rainfall. The value was recalculated in 2004 using updated surface water concentrations. This revised loading term (2.1 lb of uranium per inch of rainfall) was used from 2005 to 2017 to estimate the uranium in uncontrolled runoff. The current loading term, 0.8 lb of uranium per inch of rainfall, was recalculated in 2017 (DOE 2017) using updated surface water data. Reductions of these loading terms through the years parallels the site cleanup and restoration.

DOE will continue to report the pounds of uranium discharged to the Great Miami River through the Parshall Flume, but is planning to no longer report the mass of uranium in uncontrolled runoff to Paddys Run, reflecting the successful remediation and restoration of the site.

5.0 Inspections and Natural Resource Management

Results in Brief: Site and OSDF Inspections

- No issues were observed with respect to institutional controls or the integrity of the OSDF cap.
- Inspection findings were primarily nonradiological legacy debris and fencing issues for site inspections and woody vegetation on the OSDF. Prescribed burns in early 2025 allowed more visibility to observe woody vegetation on the OSDF.

Results in Brief: Natural Resource Management

- Vegetation management activities including prescribed burns and invasive species removal continued. A prescribed burn of the 75-acre OSDF cap and 20 acres of prairie occurred in spring 2025. The post-burn walkdowns were conducted in conjunction with routine OSDF and site inspection walkdowns.
- Monitoring of remediation succession and prairie communities indicates continued ecological progression across the site.
- Vegetation monitoring of the OSDF indicates vegetation goals for the vegetated cap are exceeded.

This section provides background information on the management of natural resources at the Fernald Preserve and summarizes the activities in 2025 relating to these resources.

5.1 Inspections

The LMICP, Volume II, *Institutional Controls Plan*, and Attachment B, "On-site Disposal Facility Post-Closure Care and Inspection Plan," identifies the inspection process for the site and OSDF, respectively.

Inspections are conducted routinely with participation from regulators. Inspections document evidence of unauthorized uses, the effectiveness of institutional controls, and any need for maintenance or repairs. To manage the site inspections more easily, the site was divided into four quadrants: central, south, east, and west. The field walkdowns are conducted by quadrant and are conducted in several phases.

Site inspections focus on ensuring the following:

- Infrastructure that is in place for protection against human exposure to contaminants (i.e., signs, fencing, gates, and 60-inch Main Drainage Corridor access control grating) are in proper condition and functioning.
- Soil is not being removed by wind or water erosion, which entails ensuring water control structures, swales, and discharge points are maintained and that burrowing animals are not causing erosion.
- Prohibited activities (e.g., digging, off-trail travel, camping, or hunting) are not taking place.
- Legacy-related debris is identified and properly disposed.

Site inspection field walkdowns take place in the winter months when vegetation is dormant, optimizing visibility of site conditions and allowing for easier access to some areas.

Ecologically restored areas are also evaluated for the presence of noxious weeds, and the condition of vegetation. Following a prescribed burn of prairie areas on site, a post-burn inspection is conducted and included as part of the site inspections. Approximately 20 acres of prairie were burned in March 2025 and a post-burn inspection was completed as part of the 2025 site inspections.

Site inspection findings in 2025 (Figure 27) consisted mostly of non-radiological debris, and findings related to deer exclosure fencing. Figure 27 identifies the approximate location of the 2025 site inspection finding locations, type of finding, number of findings by type, and if the finding has been resolved. No activity and use limitation findings occurred in 2025, so none were reported in the 2025 quarterly inspection reports.

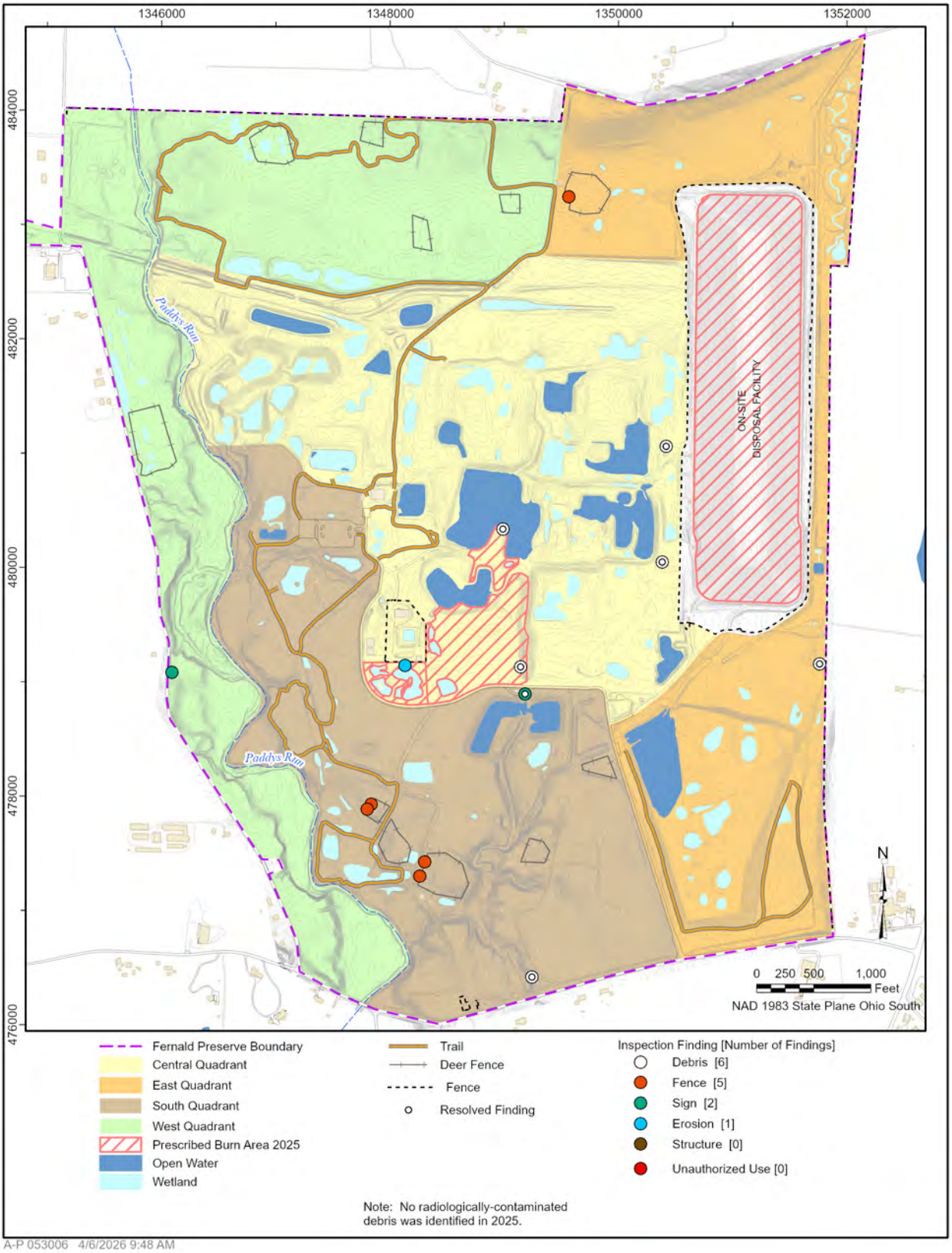


Figure 27. Site Inspection Findings

OSDF inspections consist of quarterly walkdowns of the perimeter and toe of the cap, and an annual walkdown and evaluation of the entire vegetated cap to verify its integrity. OSDF inspections focus on the following:

- General health, density, and variety of vegetation cover
- Presence of deep rooted (woody) species
- Evidence of burrowing animals
- Erosion or surface cracking
- Subsidence or water ponding
- Presence of leachate seeps
- Integrity of run-on and runoff control features
- Benchmark integrity

The annual walkdown in March also served as the post-burn walkdown which followed a March 3, 2025, prescribed burn of the OSDF cap. Any indications that there may be an issue with the proper functioning of the cap are flagged and repaired. In 2025, there were no signs that the integrity of the cap had been compromised in any way. Because the prescribed burn of the vegetated OSDF cap exposed all woody vegetation, findings (Figure 28) consisted mainly of woody vegetation, which was eventually addressed. Additional OSDF inspection details are provided in Appendix C and details regarding treatment of the woody vegetation are included in Section 5.2.1.

Because a prescribed burn allows for a more thorough inspection of the surface of the OSDF, the U.S. Department of Energy (DOE) is proposing to change the annual walkover inspection required in the Post-Closure Care and Inspection Plan to every other year to align this complete cap walkover with the OSDF prescribed burns. The OSDF cap vegetation monitoring results also indicate that the vegetative cover goals of 90% cover typically exceed established goals (Section 5.1.2). In the event that an OSDF burn cannot be completed, DOE will complete a walkover of the entire OSDF cap at least every other year. The next prescribed burn of the OSDF is planned for spring 2027.

In addition to routine site and quarterly point-specific institutional control inspections, the public trails and overlooks are inspected routinely to ensure that institutional controls are in place and that the trails are safe and usable for the public. Beginning in 2025, trail inspections are completed monthly and following an event such as a significant weather storm. Examples of findings during trail inspections may include broken tree limbs across the trail after a storm, downed trees following a storm or from beaver activity, or erosion of a trail surface after heavy rain.

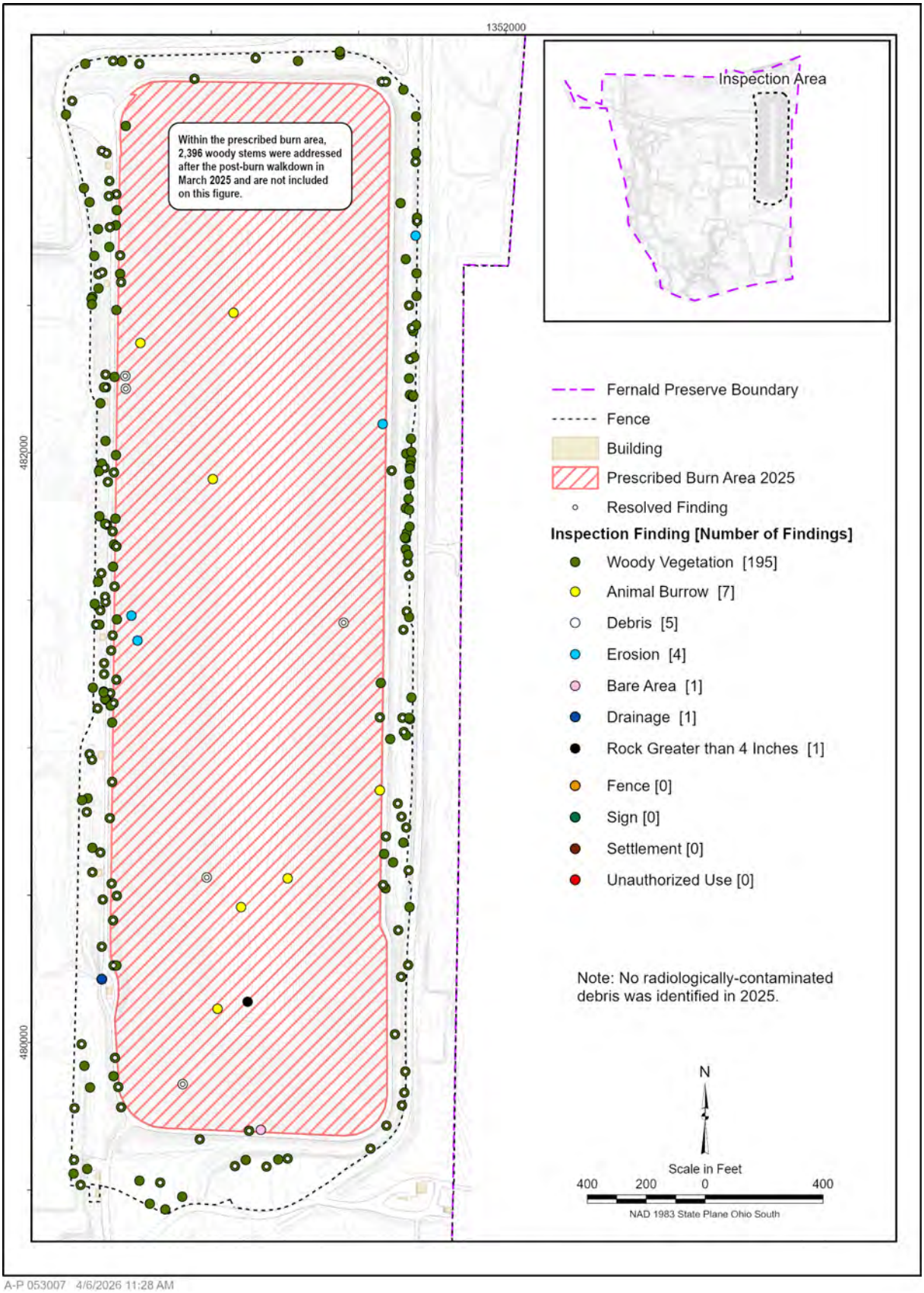


Figure 28. OSDF Inspection Findings

5.1.1 Legacy Debris

Legacy debris continues to be found onsite. Debris finding numbers have decreased each year since 2019, but increased slightly in 2025 (Table 12). During remediation of the Fernald Preserve, every effort was made to remove and dispose of all debris. However, weather, erosion, and earth-moving activities occasionally reveal small pieces of debris that were not visible during remediation and restoration efforts. Examples of legacy debris include pieces of concrete, rebar, clay tile, asphalt, and metal. Debris is discovered during site and OSDF inspections, construction activities, and by personnel during other field activities. While not the case for 2025, inspection debris findings often occur at a higher frequency in areas in which a prescribed burn was conducted because the burns result in greater visibility of the ground surface. A post-burn inspection is required following any prescribed burn. In 2025, 126 pieces of debris were managed. Radiological surveys were conducted of all debris discovered onsite in 2025 and no debris was observed to have radiological contamination above background levels. No radiologically contaminated debris has been identified since 2021 (Table 12). All debris was removed from the field and properly disposed.

Table 12. Annual Debris Quantities

Year	Free-Release Debris Count[a,b]	Contaminated Debris Count[a]	Percent Contaminated[a,b]
2007	—	108	—
2008	—	128	—
2009	—	36	—
2010	—	21	—
2011	204	4	1.9%
2012	1,480	12	0.8%
2013	391	8	2.0%
2014	814	8	1.0%
2015	453	13	2.8%
2016	261	9	3.3%
2017	574	3	0.5%
2018	294	3	1.0%
2019	925	0	0.0%
2020	241	1	0.4%
2021	143	6	4.0%
2022	128	0	0.0%
2023	79	0	0.0%
2024	70	0	0.0%
2025	126	0	0.0%
Total[b]	4,883	67	1.4%

[a] 10 CFR 835, "Occupational Radiation Protection."
[b] DOE began recording free-release debris counts in 2011; totals are 2011 to current year.

5.1.2 OSDF Vegetation Monitoring

Vegetation monitoring on the OSDF is outlined in Volume II of the LMICP (DOE 2023a). DOE and regulatory agencies agree that the goal is not necessarily to establish a functioning prairie on the OSDF cap, but 90% total cover with 50% native vegetation are the goals for the vegetated cap. Monitoring to determine the percentage of total and native cover on one-third of the OSDF cap is completed annually so that the entire cap is monitored over a 3-year period. In 2025, Cells 7 and 8 were monitored; total cover and native species exceeded the goals for both cells monitored. Additional details are provided in Appendix C.

DOE is proposing a modified vegetation monitoring methodology for the site which will also be adopted for OSDF vegetation monitoring. This methodology will ensure that 90% of total vegetation consisting of 50% native vegetation is maintained on the cap as well as ensuring prioritization of OSDF vegetative cap maintenance needs in the same manner as other areas of the site. Additional details are provided in Appendix C.

5.2 Natural Resource Management

Much of the 1,050 acres of the Fernald Preserve property is undeveloped land that provides habitat for a wide variety of animals and plants. Wetlands, deciduous and riparian (streamside) woodlands, old fields, grasslands, and aquatic habitats are among the site's natural resources. Over 900 acres of the site have undergone ecological restoration, often completed as smaller restoration projects (Figure 29). The goals of natural resource management include maintaining high-quality habitats, continued development of restoration areas, and promoting species richness.

Monitoring of the natural resources was addressed in the "Natural Resource Monitoring Plan," which was included as Appendix A, Attachment D, of the LMICP (DOE 2019). The Natural Resource Monitoring Plan presented an approach for monitoring and reporting the status of several priority natural resources to remain in compliance with pertinent regulations and agreements. The approach for the monitoring and maintenance of ecologically restored areas was also addressed. Restored area monitoring has been ongoing since 2009 after DOE and Ohio EPA signed a Consent Decree in November 2008, which settled a long-standing natural resource damage claim under Section 107 of CERCLA. As part of the settlement, the Fernald Natural Resource Trustees (DOE, Ohio EPA, and the U.S. Department of the Interior) finalized the Natural Resource Restoration Plan (NRRP), which is Appendix B of the *Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008). The NRRP specified an ecological monitoring program for restored areas at the site. This included an enhanced wetland mitigation monitoring program and a functional monitoring program that evaluated restored communities. An implementation monitoring program was also in place and was used to determine whether revegetation efforts were successful following construction activities.

The NRRP also specified creation of a Restored Area Maintenance Plan (RAMP). This document detailed the approach that was used to manage ecologically restored areas across the site through 2020. The RAMP included provisions for planting and seeding, control of invasive species, management of wetland water levels, erosion control, nuisance animal control, and maintenance of public amenities (DOE 2012a).

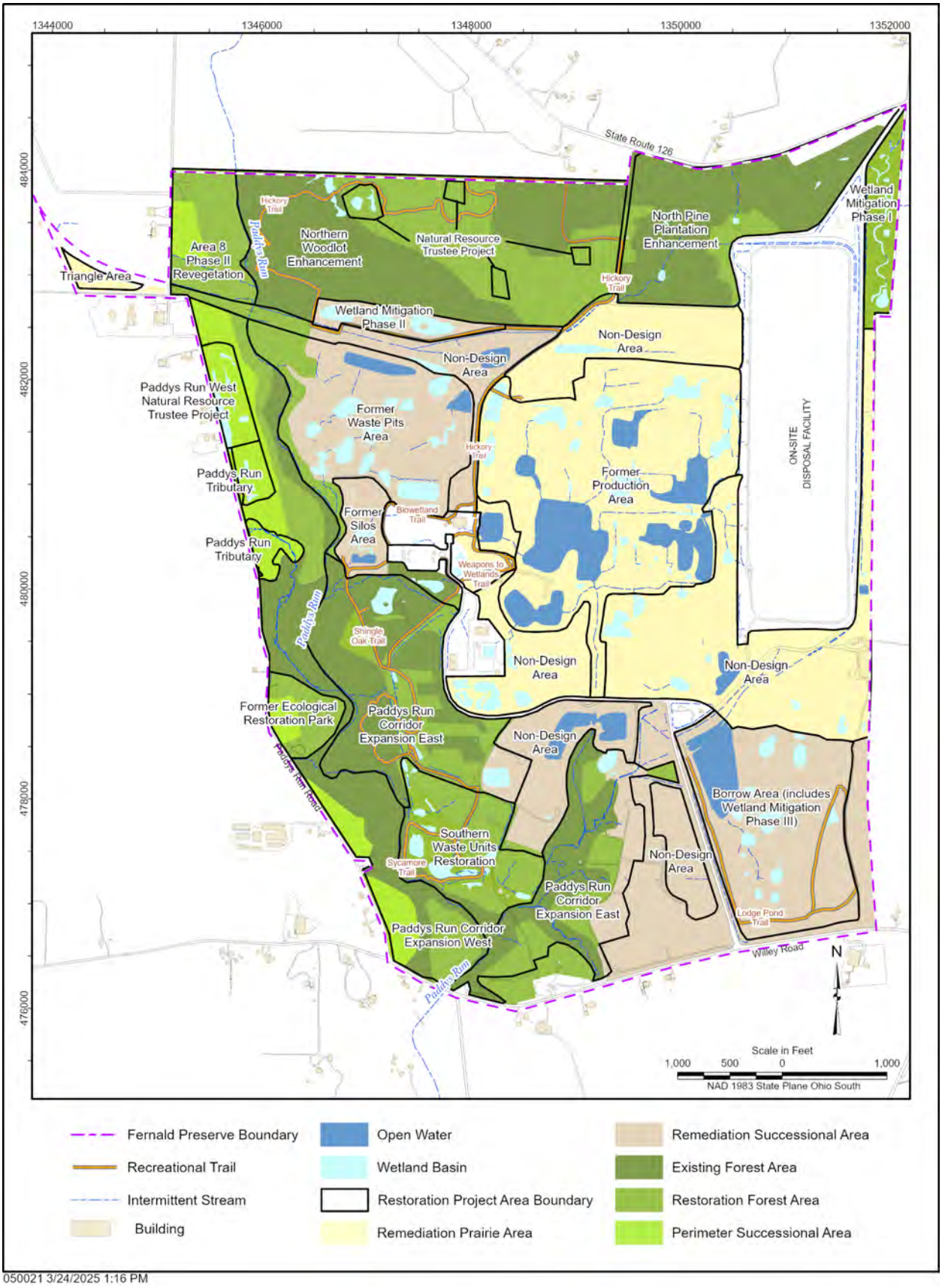


Figure 29. Restoration Project Areas and Ecological Community Types

The NRRP required that the RAMP be reviewed after 10 years of implementation. DOE, along with the other Natural Resource Trustees, conducted this review in 2020, which resulted in the development of the Natural Resource Management Plan. The Natural Resource Management Plan outlines the management and evaluation of ecologically restored areas, including revised ecological monitoring methods. A 10-year review of ecological monitoring results showed that restored communities have for the most part been successfully established across the site. The floristic inventory monitoring method outlined in the Natural Resource Management Plan shifted the focus from management area evaluations to restored community evaluations. The Fernald Preserve's mission of long-term stewardship under LM includes establishing, managing, and monitoring ecologically restored areas across the site. In 2023, the Fernald Natural Resource Trustees agreed that DOE has completed the ecological restoration requirements of the 2008 Consent Decree at the Fernald Preserve. DOE committed to continue to manage the ecologically restored site as part of their stewardship responsibilities. The Natural Resource Management Plan was incorporated as Appendix A of Volume I of the 2023 LMICP (DOE 2023a). Figure 29 shows the breakdown of the communities to be evaluated. Prairies were monitored in 2025 using the floristic inventory monitoring method. Forests are planned for monitoring in 2026, which will complete two full rounds of monitoring using the floristic inventory monitoring method since its implementation in 2021. DOE will continue to evaluate its ecological monitoring and restoration efforts in accordance with the Natural Resource Management Plan (DOE 2025a).

Natural resource maintenance activities and results of the 2025 monitoring are discussed in the following sections.

5.2.1 Natural Resource Maintenance Activities

Maintenance in ecologically restored areas included prescribed burns; controlling invasive herbaceous plants, shrubs, and trees; mowing; planting trees and shrubs; installing protective tree cages; and mitigating potential impacts to site infrastructure caused by beaver activities. Figure 30 shows the location of 2025 ecological maintenance activities.

Prescribed burning is a prairie management tool and has been used onsite since 2009. In 2022, DOE and the U.S. Forest Service entered into an interagency agreement to conduct prescribed burns at the site. In spring 2025, the U.S. Forest Service conducted prescribed burns of approximately 20 acres of prairie and the 75-acre OSDF vegetated cap at the Fernald Preserve.

Invasive herbaceous species are addressed using a variety of methods including herbicide application, mowing, burning, manual removal, or a combination of these methods. In 2025, areas with infestations of teasel (*Dipsacus species*), Chinese bush clover (*Lespedeza cuneata)*, reed canary grass (*Phalaris arundinacea)*, mugwort (*Artemisia vulgaris*) and Johnson grass (*Sorghum halepense*) were mowed, then treated with herbicide after the vegetation began to grow. Approximately 30 acres were mowed for the purpose of invasive species control.

Spot spraying with herbicide to control noxious and invasive herbaceous weeds in restored areas continued in 2025. The 20 acres of prairie and the 75-acre OSDF cap that were burned early in the year were a primary focus of restored prairie herbicide application due to the better accessibility and visibility as a result of the prescribed burn. The invasive and non-native species typically emerge before the native vegetation, making them much easier to address.

Target herbaceous species treated in 2025 are listed on Table 13. Invasive herbaceous species across approximately 423 acres across the site (including the OSDF) were treated with herbicide.

Table 13. Invasive Herbaceous Species Treated in 2025

Scientific Name	Common Name
Alliaria petiolata	Garlic mustard
Artemisia vulgaris	Mugwort
Carduus nutans	Nodding plumeless thistle
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle
Conium maculatum	Poison hemlock
Coronilla varia	Crown vetch
Dipsacus species	Teasel species
Ficaria verna	Lesser celandine
Lespedeza cuneata	Chinese bush clover
Lythrum salicaria	Purple loosestrife
Microstegium vimineum	Japanese stiltgrass
Phalaris arundinacea	Reed canary grass
Phragmites australis	Giant reed
Sorghum halepense	Johnson grass

Of the 423 acres, over 90% of the treated acreage was for teasel species (*Dipsacus species*), lesser celandine (*Ficaria verna*), Japanese stiltgrass (*Microstegium vimineum*) and Johnson grass (*Sorghum Halepense)*. These species are highlighted in the table above.

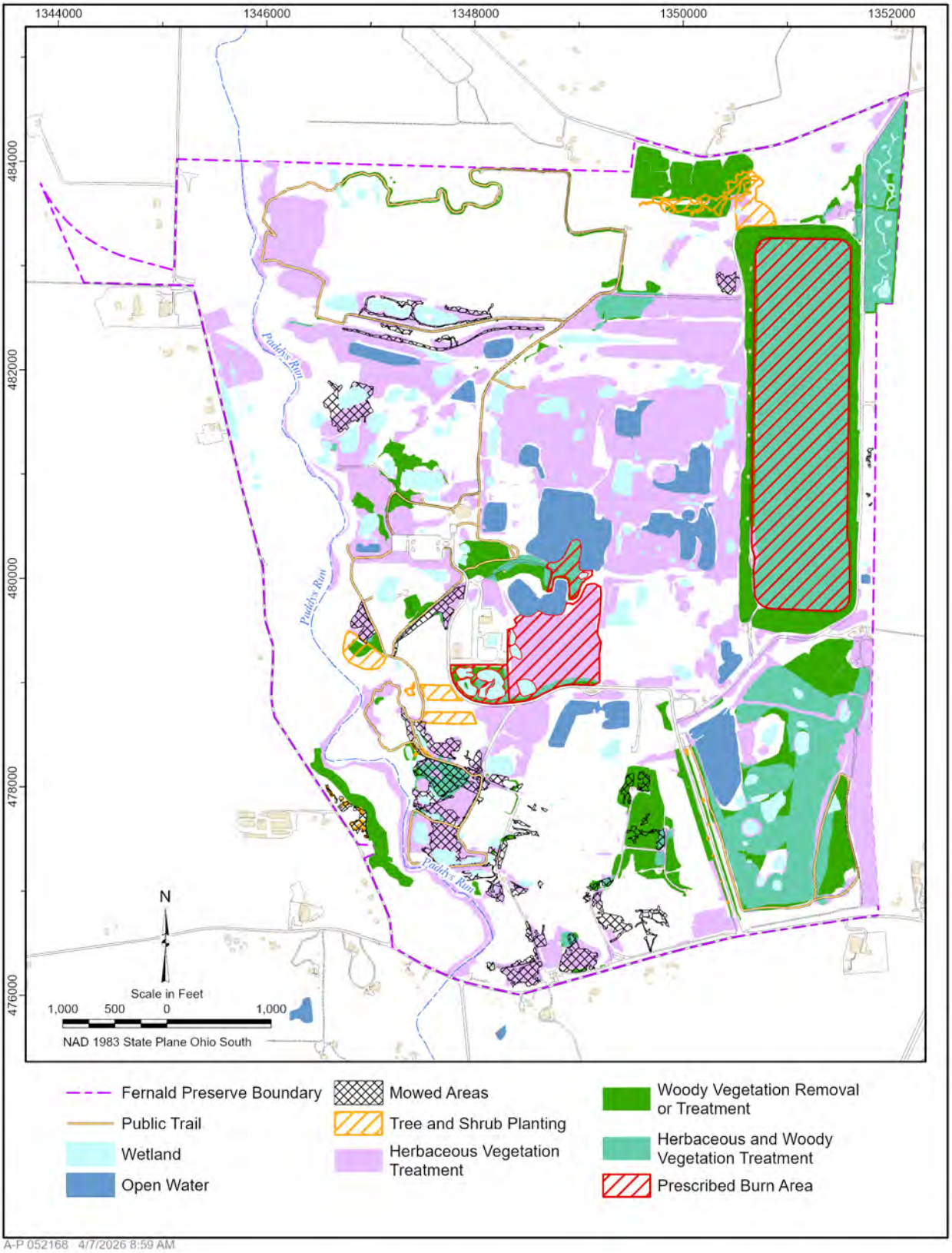


Figure 30. Ecological Maintenance Activities

Invasive woody vegetation is physically removed or treated with herbicide across the site and on the OSDF cap and perimeter drainages. Trees and shrubs must not become established on the OSDF cap or in the drainages, so they are removed or treated with herbicide once discovered. In spring of 2025, following the OSDF prescribed burn, 2,396 stems of woody vegetation were treated on the OSDF cap by cutting woody vegetation and painting the cut stumps with herbicide (cut and paint method).

Large-scale foliar herbicide application to control Amur honeysuckle (*Lonicera maackii*) continued in fall 2025 across the site. Dense infestations of honeysuckle will crowd out native species, prevent sunlight from reaching the ground, and prevent seedling development of desirable vegetation. A characteristic of honeysuckle is that it does not go dormant until a few weeks after most other vegetation. Timing herbicide application after nearby plants have gone dormant in the fall allows the use of herbicide to treat honeysuckle while avoiding harm to surrounding vegetation. This technique is widely used and has proven to be an effective means of control. Approximately 20 acres of honeysuckle were treated in 2025 using this method. In addition to the cut and paint method and foliar herbicide application, applying herbicide to the lower 12–15 inches of bark all around the tree trunk (basal bark application method), or cutting the bark to create a frill and applying herbicide to the tissue in the frill (hack and squirt method) are techniques used to aid in the control of several different invasive woody vegetation species. Targeted foliar spot spraying of small individual trees and shrubs was also conducted at various times throughout the year. Invasive or non-native woody vegetation was managed across approximately 160 acres using this combination of methods across the site (Table 14). This 160 acre total does not include the 75 acres of the OSDF woody vegetation treatment areas discussed above.

Table 14. Invasive or Non-Native Woody Vegetation Species Treated in 2025

Scientific Name	Common Name
Ailanthus altissima	Tree-of-heaven
Celastrus orbiculatus	Oriental bittersweet
Elaeagnus umbellata	Autumn olive
Ligustrum vulgare	Privet
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	Amur honeysuckle
Pyrus calleryana	Callery pear
Quercus acutissima	Sawtooth oak
Rhamnus cathartica	Buckthorn
Rosa multiflora	Multiflora rose
Toxicodendron radicans	Poison ivy

Of the 160 acres, over 76% of the treated acreage was for 2025 are Callery pear (*Pyrus calleryana*) and Amur honeysuckle (*Lonicera maackii*). These species are highlighted in the table above. Because the prescribed burn occurred on the OSDF, the species of woody vegetation could not be identified and is not included in the acreage totals.

In addition to treatment and removal of invasive and non-native vegetation, approximately 525 bareroot trees and 270 container-grown trees and shrubs were planted to help increase

species richness, enhance successional development of restored areas, and decrease forest fragmentation (Figure 30). Some of these trees were planted to add species richness and improve habitat where dense honeysuckle was mechanically and chemically removed in 2024. Others were planted to add species richness in an area that is in the early stages of forest succession. Additionally, several trees were planted in gaps within the pine trees lining the site's main entrance road and several shrubs were planted near access road speed bumps to encourage visitors to stay on the road.

There is a resident population of Canada geese (*Branta canadensis*) at the Fernald Preserve. Canada geese are considered nuisance animals primarily because of their potential for aggression to humans. Due to establishment of vegetation and an increase in natural predators, goose hazing (i.e., scaring and harassing) which was used extensively, has not been needed since 2014. Site personnel continue to monitor the Canada goose population each year. The site applies for an ODNR permit to remove nests or addle eggs annually, if necessary.

The mute swan (*Cygnus olor*) is non-native, invasive, and considered a nuisance species by ODNR; therefore, ODNR grants permission to addle the eggs of the mute swans. No formal permit is required. Reduced site staffing in response to the coronavirus pandemic prevented Fernald Preserve staff from monitoring nesting activities and addling eggs in 2020, which resulted in an increase in the number of mute swans onsite. In spring 2021, DOE authorized ODNR personnel to conduct mute swan management activities onsite in support of the ODNR statewide mute swan management program. Mute swan egg addling by site staff is expected to continue if eggs are present. DOE maintains the agreement with ODNR to allow mute swan management activities by ODNR personnel onsite.

Vegetation Monitoring

There are a number of ways to evaluate the type and quality of habitats within an area. At the Fernald Preserve, vegetation monitoring focuses on determining the extent of native plant species composition and calculating a Floristic Quality Assessment Index (FQAI). The FQAI process is described in the *Floristic Quality Assessment Index (FQAI) for Vascular Plants and Mosses for the State of Ohio* (Andreas et al. 2004). The specific parameters used at the Fernald Preserve include the following:

- **Total Species**: The total number of species sampled within a given area.
- **Native Species**: The total number of species native to Ohio. The updated *Ohio Vascular Plant Database* is used to determine whether a species is native (Gara 2013).
- **Percent Native Species**: The number of native species divided by the total number of species. Relative frequency of native species is also used. This is calculated by dividing the frequency (or number of times a species is observed) by the total number of observations for a given area.
- **Average Coefficient of Conservatism (CC)**: The CC is a number between 0 and 10 that has been assigned to virtually every species that may be found in Ohio. The CC value is related to how "tolerant" a species is, as well as its habitat requirements. Nonnative plants have a CC of 0. Common species that can grow in a wide variety of habitats are considered "tolerant" and are scored a CC between 0 and 3. Native plants with very specific habitat requirements are scored high CC values, in the 7–10 range. The updated *Ohio Vascular Plant Database* (Gara 2013) lists the CC for each plant found in Ohio.
- **Floristic Quality Assessment Index (FQAI)**: The CC values described above are used to calculate the FQAI. The FQAI is the average CC value divided by the square root of the total number of species for a given area.

5.2.2 Ecological Monitoring

Before 2021, a two-tier ecological monitoring program was used to assess restoration efforts. Implementation monitoring was used to assess vegetation establishment following seeding and planting projects. Functional monitoring was used to assess the progress of the development of a restored community (prairie, wetland, forest) by comparing floristic quality parameters to those of baseline and reference sites. Reference sites are offsite communities that represent an ideal end-state for site restoration projects. The NRRP states that the goals for vegetation establishment were 50% native species and 90% total cover. For woody vegetation, the goal was 80% survival (State of Ohio 2008).

As stated in Section 5.2, the Fernald Preserve Natural Resource Trustees reviewed the ecological monitoring program as part of the 2020 RAMP update. A revised approach to functional monitoring methods and area focus was proposed and subsequently implemented in 2021. This revised method consists of conducting floristic inventories and focuses on a specific restored community type each year. Perimeter wetland and remediation wetland areas were monitored in 2021. Prairie areas and remediation successional areas were monitored in 2022, and existing forest, restoration forest, and perimeter successional areas were monitored in 2023 (Figure 29). This same community-type cycle will continue through 2026 with forest community monitoring.

Functional monitoring activities previously conducted compared restored communities to prerestoration "baseline" conditions and high-quality reference sites. Baseline and reference sites were characterized in 2001 and 2002. From 2003 to 2005, restored areas were evaluated. Wetlands were evaluated in 2003, prairie communities in 2004, and forest habitats in 2005. The same 3-year rotation resumed in 2009 and continued through 2014. In 2015, monitoring efforts shifted from sitewide community types to an area-based approach on a 3-year basis. The area-based approach continued through 2020, completing two full cycles of monitoring. In 2021, the floristic inventory method was implemented in the cycle described above. Monitoring in remediation prairie and remediation successional areas was repeated in 2025. For each floristic inventory, the entire monitoring area was examined, and each species observed was recorded. Native and non-native species richness (percent nativity) and composition, area mean coefficient of conservatism (CC), and Floristic Quality Assessment Index (FQAI) were calculated from the data to assess the condition of the monitoring areas. The latest Ohio FQAI database (Gara 2013) is used to determine nativity status and CC values. Appendix C provides a more detailed discussion regarding ecological monitoring results, including the identification of new species identified at the site.

The 2025 vegetation monitoring results indicate that native vegetation is established across all the remediation areas monitored. Percent nativity, mean CC, and FQAI values are higher in the remediation successional areas. The management goal for the remediation successional areas is to allow the areas to progress through succession from prairie habitat to forest. As succession takes place, plant species from both habitat types are present, resulting in higher species diversity which directly influences the results. The percent nativity, mean CC, and FQAI results for the remediation prairie areas were lower values, but this is expected. Management goals in the prairie areas are to maintain one habitat type which results in fewer plant species than the successional areas. A historical comparison of these values suggests that habitat development continues to progress in both areas as intended with these goals.

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6.0 Community Involvement and Visitors Center Activities

2025 Results in Brief

CERCLA Community Involvement
The sixth CERCLA five-year review began during the October public meeting. Questionnaires were provided to attendees to solicit feedback on the site cleanup.

Visitors and Programs
Over 50,000 visitors came to the Fernald Preserve in 2025 and the site recorded the highest number of Visitors Center program participants since opening in 2008, with 17,025 participants. Walk-in visitation remained high with 5,325 people visiting the Fernald Preserve Visitors Center. Staff also engaged with visitors on trails through the roving interpretive staff program, making contact with 665 visitors who learned from staff during the year.

Twenty-two subject matter experts were hosted to share their knowledge with program participants ranging in expertise from caterpillar biologists to former Fernald site workers sharing the history of the site. Eleven self-guided interpretive hikes were provided.

Community Collaboration
The public utilizes the trail system at the site to make natural resource observations to community science monitoring programs throughout the year. In 2025, the public provided data during the National Audubon Society Christmas bird count, the North American Butterfly Association butterfly count, and through several computer applications (e.g., iNaturalist and eBird).

DOE granted permission to a local university researcher to utilize the site to study plant and insect interactions onsite. The project was conducted by observing the interaction along the onsite public trails throughout the summer and late fall and did not require authorization from the site's prohibited activities (e.g., removing natural materials).

Long-term site management objectives encompassed informing future generations and new residents about the site's history and characteristics, ensuring the efficacy of institutional controls, and sustaining community support for the implemented site remedy. This section delineates the efforts undertaken in 2025 to ensure the archival accessibility of the site's historical data for future generations.

DOE refurbished the former Silos Warehouse, a clean building designated for beneficial reuse (DOE 2006a) converting it into an onsite Visitors Center, which became operational in summer 2008. The opening of the Visitors Center provided the public unescorted access to the site for the first time. Subsequent to its public opening in 2008, several public amenities were integrated into the site, including a program shelter adjacent to the Visitors Center, a 7-mile trail network, multiple observation decks, a wetland boardwalk, and a wildlife observation blind. The Visitors Center and public programming continue to strive to be an asset to the local community.

The Visitors Center provides an informational and educational focus as envisioned by the stakeholders and functions as an institutional control by providing information relevant to the remediation of the Fernald Preserve, including details on site history and remediation, ongoing remedy actions and long-term stewardship activities, and prohibited site activities. The CERCLA Administrative Record and Post-ROD index can also be accessed using computers provided at the Visitors Center.

6.1 Ongoing Decisions and Community Involvement

Since the early 1990s, DOE has prioritized integrating community input into its decision-making processes. The remediation of the Fernald Preserve serves as a successful case study, benefiting significantly from early-stage dialogue among state and federal regulatory bodies, stakeholder organizations, elected officials, and the public.

Opportunities for community involvement at the site in 2025 included providing input on general site activities via the Annual Community Meeting, participation in the sixth CERCLA five-year review and routine site updates with stakeholder groups. One topic that included active stakeholder participation was in the design of the Visitor Center lobby improvements project. These opportunities are discussed below.

6.1.1 Annual Community Meeting—CERCLA Five Year Review Kickoff

DOE held public meetings quarterly for the first year after closure in 2006 and has since held meetings at least annually to address post-closure issues of importance to stakeholders. The 2025 annual meeting was the 21st community meeting held since 2006. Notification of the meeting was completed through post-card mailing to over 4,000 stakeholder email addresses and posting signs around the site so visitors were aware of the meeting. The meeting provided a discussion of the information in each year's Site Environmental Report as well as other activities occurring at the site. The 2025 annual meeting doubled as the kickoff of the CERCLA five-year review with questionnaires provided to meeting attendees to provide feedback on the site's remediation; questionnaires were also made available online and in the Visitors Center. General site updates were also presented; these updates included an introduction to planning for the 20th Anniversary of the site to be held in 2026 as well as the Visitors Center Community Meeting Room lobby exhibit remodel which is planned to be completed in 2027. Twenty-eight individuals attended the meeting with several first-time attendees.

6.1.2 Meetings with Stakeholder Groups

DOE continues to meet with stakeholder groups to discuss topics of interest and concern. In 2025, DOE continued to meet with the FCA, an active site stakeholder group, on a quarterly basis. The meeting is hosted by FCA with participation from DOE. Public attendance at the meetings is encouraged. The FCA's mission is to:

- Provide community oversight for long-term stewardship and environmental activities at the Fernald Preserve.
- Promote the lessons learned during the environmental investigations and remediation of the Fernald site to other sites and communities facing similar challenges.
- Preserve the history of the land, people, culture and the Cold War for the benefit of current and future generations and to promote the Fernald Preserve as an asset to the community.
- Work in cooperation with the DOE regarding education and long-term stewardship of the site.

Quarterly FCA discussion topics generally include updates related to remedy and OSDF performance, natural resource management, educational programs, as well as general site updates. In addition to the quarterly meetings, several design meetings were held to incorporate key stakeholder input into the design of the interactive displays for the Community Meeting Room Lobby area of the Visitors Center. DOE expects to complete construction of this exhibit in 2027.

6.1.3 Briefings for Local, State, and Federal Elected Officials

There were no briefings to elected officials in 2025.

6.2 Visitors Center Activities

Multiple educational programs were provided in 2025 (Table 15). The overall 2025 program attendance was the highest since opening in 2008. Program content focused primarily on the site history and the remedy, natural resource programs, and current long-term stewardship activities.

Table 15. Summary of Visitors Center Programs and Participants for 2025

Type of Program (Quantity)	Number of Participants	Description
Onsite Programs		
History walks (9)	26	Site hike through time to envision the former location of production era structures while learning about the history of the site.
History book club (3)	25	Book discussion related to the site's history and the Cold War. Books discussed in 2025 included *Cleaning up the Bomb Factory* (Huegel 2024) and *The Radium Girls* (Moore 2017).
Monthly Bird Walks (12)	131	Guided evening walk to learn about some of the over 260 bird species that can be found at the site depending on the season.
Bird banding (7)	129	Joining a federally-permitted bird bander to learn more about the birds of Fernald Preserve.
Owl Hikes (10)	300+	Birding walks in the evening at the site to learn about owls and other birds.
Winter Bird Fest (1)	1,400+	A weeklong bird fest composed of 19 separate events related to birds that overwinter at Fernald Preserve. Programs included duck identification, short eared owl hikes, and bird banding. This was the first week-long event for the Visitors Center.
Community Meeting Room use (69)	1,748	Meeting room usage included adult and youth nonprofit groups, government agencies, community groups, and former worker groups.
School and college programs (23)	937	Elementary school through college groups participating in programs tailored to the federal and Ohio learning standards. Topics included CERCLA remediation, ecological restoration, site history, and the OSDF.
Offsite Outreach		
Historic Harrison, Ohio Farmer's Market	992	Outreach provides an opportunity to share Fernald site history, remediation and ecology within the surrounding community.
Hamilton County, Ohio Fair	774	
Butler County, Ohio Fair	85	
Harvest Home Fair, Cheviot, Ohio	1,234	
DOE's Greater Cincinnati Science Bowl	85	
Cincinnati, Ohio Native Plant Fest	814	

6.3 Site Visitors

Over 50,000 visitors came to the Fernald Preserve in 2025, providing an opportunity to learn about the site's remediation history and enjoy the site's plentiful natural resources. The site was visited by other federal agencies and their stakeholders who were interested in the history and performance of the OSDF. The site also continues to be visited frequently by outdoor enthusiasts and birders who enjoy the 7 miles of hiking trails, especially during spring and fall bird migration.

6.4 Conclusions

DOE expects to continue and advance public programming, community science, and outreach activities in 2026, DOE continues to successfully fulfill the primary function of being an informational and educational resource within the surrounding community. The information made available at the Visitors Center serves as an institutional control for the site and provides an important forum to help the community understand post-closure site conditions and the controls in place to protect human health and the environment.

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10 CFR 1021. "National Environmental Policy Act," *Code of Federal Regulations*.

7 USC 136 et seq. "Federal Insecticide, Fungicide, and Rodenticide Act", as amended, *United States Code*.

15 USC 2601 et seq. "Toxic Substances Control Act," as amended,

33 USC 1251 et seq. "Clean Water Act" (Federal Water Pollution Control Act), as amended, *United States Code*.

42 USC 6901 et seq. "Resource Conservation and Recovery Act," as amended, *United States Code*.

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8.0 Glossary

applicable or relevant and appropriate requirement (ARAR). Requirements set forth in regulations that implement environmental and public health laws that a selected remedy must attain unless a waiver is invoked. ARARs are divided into three categories: chemical-specific, location-specific, and action-specific, according to whether the requirement is triggered by the presence or emission of a chemical, by a vulnerable or protected location, or by a particular action.

aquifer. A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.

capture zone. Estimated area that is being "captured" by the pumping of groundwater extraction wells. The definition of the capture zone is important in ensuring that the total uranium plumes targeted for cleanup are being remediated.

certification. The process by which a soil remediation area is certified as clean. Samples from the area are collected and analyzed, and then the contaminant levels are compared to the FRLs established in the OU5 ROD. Not all soil remediation areas at the Fernald Preserve require excavation before certification is done.

contaminant. A substance that when present in air, surface water, sediment, soil, or groundwater above naturally occurring (background) levels causes degradation of the media.

cross vane. A U-shaped structure of boulders built across a stream channel to reduce water velocity and energy along the streambank.

effluent. Water from numerous areas at the site that is routed through the site's wastewater treatment facility and discharged to the Great Miami River.

Floristic Quality Assessment Index (FQAI). A method of evaluating an ecosystem based on the type and quality of plants present.

glacial overburden/glacial till: Silt, sand, gravel, and clay deposited by glacial action on top of the Great Miami Aquifer and surrounding bedrock highs.

Great Miami Aquifer. Sand and gravel deposited by the meltwaters of Pleistocene glaciers within the entrenched ancestral Ohio and Miami rivers. This is also called a buried channel or a sand and gravel aquifer.

groundwater. Water in a saturated zone or stratum beneath the surface of land.

mixed waste. Hazardous waste (as defined by RCRA) that has been contaminated with low-level radioactive materials.

radionuclide. Refers to a radioactive nuclide. There are several hundred known radionuclides that can be artificially produced or naturally occurring. Radionuclides are characterized by the number of neutrons and protons in an atom's nucleus and their characteristic decay processes.

remedial action. The actual construction and implementation phase of a Superfund site cleanup that follows the remedy selection process and remedial design.

remedial investigation/feasibility study. The first major event in the remedial action process that serves to assess site conditions and evaluate alternatives to the extent necessary to select a remedy.

removal action. A short-term cleanup or removal of released hazardous substances from the environment. A removal action is performed in response to a release or the imminent threat of release of hazardous substances into the environment.

surface water. Water that is flowing within natural drainage features.

uncontrolled runoff. Storm water that is not collected by the site for treatment but enters the site's natural drainages.

waste acceptance criteria. A disposal facility's specifications for the types and sizes of materials, the acceptable levels of constituents, and other criteria for all material that can be disposed of in that facility. Offsite disposal facilities such as the Nevada National Security Site (formerly called the Nevada Test Site) that dispose of Fernald Preserve waste have specific waste acceptance criteria. In addition, the OSDF had waste acceptance criteria that were approved by the regulatory agencies.

Appendix A

Supplemental Groundwater Information

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Contents

Attachment A.1 Operational Assessment
Attachment A.2 Assessment of Total Uranium Results
Attachment A.3 Groundwater Elevations and Capture Assessment
Attachment A.4 Non-Uranium Final Remediation Level Results
Attachment A.5 On-Site Disposal Facility Monitoring Results
- Subattachment A.5.1 Cell 1
- Subattachment A.5.2 Cell 2
- Subattachment A.5.3 Cell 3
- Subattachment A.5.4 Cell 4
- Subattachment A.5.5 Cell 5
- Subattachment A.5.6 Cell 6
- Subattachment A.5.7 Cell 7
- Subattachment A.5.8 Cell 8

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Appendix A presents groundwater data and analysis in support of Section 3.0, “Groundwater Pathway.” This appendix consists of the following five attachments:

- Attachment A.1 provides operational data for the South Field Module, the South Plume Module, and the Waste Storage Area Module
- Attachment A.2 provides groundwater monitoring total uranium results, including summary statistics and plume maps
- Attachment A.3 provides groundwater elevation data and quarterly water-level maps
- Attachment A.4 provides an analysis of the non-uranium final remediation level exceedances both inside and outside the current Operational Design Remediation Footprint
- Attachment A.5 provides results for the On-Site Disposal Facility leak detection and leachate monitoring program

Groundwater analytical data are available through the U.S. Department of Energy Office of Legacy Management’s Geospatial Environmental Mapping System (https://gems.lm.doe.gov/).

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Attachment A.1

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Contents

Abbreviations iv
Measurement Abbreviations iv
A.1.0 Operational Assessment 1
A.1.1 Operational System Overview 2
A.1.2 Wellfield Shutdowns 5
A.1.3 South Field Module 5
A.1.4 South Plume Module 6
A.1.4.1 Paddys Run Road Site 6
A.1.5 Waste Storage Area Module 7
A.1.6 Total Uranium Data 8
A.1.6.1 Total Uranium Concentration Data 11
A.1.6.2 Model 11
A.1.6.3 95% UCL 11
A.1.7 Total Uranium Data Discussion 12
A.1.8 DOE National Laboratory Network Collaboration 14
A.1.8.1 Results of Focus Group 1: Aging Wellfield System 15
A.1.8.2 Results of Focus Group 2: Improve Efficiency of the Aquifer Cleanup 15
A.1.9 Pumping Rates 17
A.1.10 CAWWT Capacity Reduction and Backwash Basin Replacement 17
A.1.11 References 18

Tables

Table A.1-1. Aquifer Restoration System Operational Summary 20
Table A.1-2. Extraction Well 31550 (EW-18) Operational Summary for 2025 21
Table A.1-3. Extraction Well 31560 (EW-19) Operational Summary for 2025 22
Table A.1-4. Extraction Well 31561 (EW-20) Operational Summary for 2025 23
Table A.1-5. Extraction Well 33326 (EW-17a) Operational Summary for 2025 24
Table A.1-6. Extraction Well 32276 (EW-22) Operational Summary for 2025 25
Table A.1-7. Extraction Well 32446 (EW-24) Operational Summary for 2025 26
Table A.1-8. Extraction Well 32447 (EW-23) Operational Summary for 2025 27
Table A.1-9. Extraction Well 33061 (EW-25) Operational Summary for 2025 28
Table A.1-10. Extraction Well 33262 (EW-15a) Operational Summary for 2025 29
Table A.1-11. Extraction Well 33264 (EW-30) Operational Summary for 2025 30
Table A.1-12. Extraction Well 33298 (EW-21A) Operational Summary for 2025 31
Table A.1-13. Extraction Well 33616 (RW-6A) Operational Summary for 2025 32
Table A.1-14. Extraction Well 33617 (RW-7A) Operational Summary for 2025 33
Table A.1-15. PRRS Groundwater Summary Statistics and Trend Analysis 34
Table A.1-16. Extraction Well 32761 (EW-26) Operational Summary for 2025 36
Table A.1-17. Extraction Well 33062 (EW-27) Operational Summary for 2025 37
Table A.1-18. Extraction Well 33347 (EW-33a) Operational Summary for 2025 38
Table A.1-19. Stretched Exponential Regression Equations for Uranium Concentration Data from Extraction Wells—Through December 31, 2025 39

Table A.1-20. Estimated Pounds of Uranium to Be Removed to Achieve Concentration-Based FRL Goals 40
Table A.1-21. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations 41
Table A.1-22. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations in Selected Monitoring Wells 43
Table A.1-23. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations with Select Wells Removed 45
Table A.1-24. Extraction Well Target Design Pumping Rates 47

Figures

Figure A.1-1. Well Locations for South Plume, South Field, WSA, and PRRS Monitoring Activities 48
Figure A.1-2. 2022 Model-Predicted Cleanup Dates, Nominal Boundary Conditions 49
Figure A.1-3. Clean Pump (Top) Versus Iron-Fouled Pump (Bottom) 50
Figure A.1-4. Potassium Concentration Versus Time Plot for Monitoring Well 2898 51
Figure A.1-5. Potassium Concentration Versus Time Plot for Monitoring Well 2899 51
Figure A.1-6. Potassium Concentration Versus Time Plot for Monitoring Well 3898 52
Figure A.1-7. Potassium Concentration Versus Time Plot for Monitoring Well 3899 52
Figure A.1-8. Sodium Concentration Versus Time Plot for Monitoring Well 2898 53
Figure A.1-9. Sodium Concentration Versus Time Plot for Monitoring Well 2899 53
Figure A.1-10. Sodium Concentration Versus Time Plot for Monitoring Well 3898 54
Figure A.1-11. Sodium Concentration Versus Time Plot for Monitoring Well 3899 54
Figure A.1-12. Total Uranium Concentration Versus Time Plot for Extraction Well 32761 (EW-26) with Regression Analysis 55
Figure A.1-13. Total Uranium Concentration Versus Time Plot for Extraction Well 33062 (EW-27) with Regression Analysis 55
Figure A.1-14. Total Uranium Concentration Versus Time Plot for Extraction Well 31550 (EW-18) with Regression Analysis 56
Figure A.1-15. Total Uranium Concentration Versus Time Plot for Extraction Well 31560 (EW-19) with Regression Analysis 56
Figure A.1-16. Total Uranium Concentration Versus Time Plot for Extraction Well 31561 (EW-20) with Regression Analysis 57
Figure A.1-17. Total Uranium Concentration Versus Time Plot for Extraction Wells 31562 (EW-21) and 33298 (EW-21a) with Regression Analysis 57
Figure A.1-18. Total Uranium Concentration Versus Time Plot for Extraction Wells 31567 (EW-17) and 33326 (EW-17a) with Regression Analysis 58
Figure A.1-19. Total Uranium Concentration Versus Time Plot for Extraction Well 32276 (EW-22) with Regression Analysis 58
Figure A.1-20. Total Uranium Concentration Versus Time Plot for Extraction Well 32446 (EW-24) with Regression Analysis 59
Figure A.1-21. Total Uranium Concentration Versus Time Plot for Extraction Well 32447 (EW-23) with Regression Analysis 59
Figure A.1-22. Total Uranium Concentration Versus Time Plot for Extraction Well 33061 (EW-25) with Regression Analysis 60

Figure A.1-23. Total Uranium Concentration Versus Time Plot for Extraction Well 33264 (EW-30) with Regression Analysis 60
Figure A.1-24. Total Uranium Concentration Versus Time Plot for Extraction Well 33262 (EW-15a) with Regression Analysis 61
Figure A.1-25. Total Uranium Concentration Versus Time Plot for Extraction Well 33347 (EW-33a) with Regression Analysis 61
Figure A.1-26. Total Uranium Concentration Versus Time Plot for Extraction Well 33616 (RW-6A) with Regression Analysis 62
Figure A.1-27. Total Uranium Concentration Versus Time Plot for Extraction Well 33617 (RW-7A) with Regression Analysis 62
Figure A.1-28. Estimate of Yearly Pounds of Uranium to Be Pumped from Aquifer to Achieve Concentration-Based FRL Goals (Model Predictions, Nominal Boundary Conditions Versus Measured Concentration Trends) Data Collected Through 2025 63

Abbreviations

CAWWT	Converted Advanced Wastewater Treatment
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EVS	Earth Volumetric Studio
FRL	final remediation level
GMA	Great Miami Aquifer
Ohio EPA	Ohio Environmental Protection Agency
PRRS	Paddys Run Road Site
VAM-3D	Variable Saturated Analysis Model in Three Dimensions
WSA	Waste Storage Area

Measurement Abbreviations

95% UCL	95% upper confidence limit
amsl	above mean sea level
ft	feet
gpm	gallons per minute
K_d	partition (or distribution) coefficient
lb	pounds
Mgal	million gallons
mg/L	milligrams per liter
µg/L	micrograms per liter

A.1.0 Operational Assessment

This attachment provides operational data for the South Field Module, the South Plume Module, and the Waste Storage Area (WSA) Module at the Fernald Preserve, Ohio, Site, including:

- Operational data for the extraction wells pumping in 2025.
- Uranium concentration trends for each extraction well compared to model-predicted concentration trends.
- Uranium concentrations at selected monitoring wells compared to model-predicted concentrations.
- Pounds of uranium removed from the aquifer.
- Estimates of the pounds of uranium remaining to be removed from the aquifer to complete the pumping stage of the aquifer remedy.

The design pumping rate, which is used in the groundwater model to estimate cleanup times for the aquifer remedy, has changed and will change again in the future as the remedy progresses.

- From 2005 to 2014, the design pumping rate was 4,775 gallons per minute (gpm) (DOE 2005).
- From July 1, 2014, through June 2018, the design pumping rate was 5,075 gpm. (DOE 2014).
- Beginning in July 2018, the design pumping rate was 4,975 gpm due to the pumping rate in RW-4 being reduced from 200 to 100 gpm.
- Between June 6, 2022, and November 12, 2024, the design pumping rate transitioned from 4,975 to 4,275 gpm (DOE 2022).

Figure A.1-1 depicts the locations of the active extraction and former reinjection wells and identifies surrounding monitoring wells. Table A.1-1 provides summaries of the gallons of water pumped, total uranium removed, and uranium removal indexes for 2025 and the duration of the remedy to date (August 1993 through December 2025).

Information in this attachment is organized into the following subsections:

- Operational System Overview (Section A.1.1)
- Wellfield Shutdowns (Section A.1.2)
- South Field Module (Section A.1.3)
- South Plume Module (Section A.1.4)
- Waste Storage Area Module (Section A.1.5)
- Total Uranium Data (Section A.1.6)
- Total Uranium Data Discussion (Section A.1.7)
- DOE National Laboratory Network Collaboration (Section A.1.8)
- Pumping Rates (Section A.1.9)
- CAWWT Capacity Reduction and Backwash Basin Replacement (Section A.1.10)

A.1.1 Operational System Overview

The 2005 Operational Design was optimized in 2014 and 2024. The 2024 optimization design continued in 2025. The main objective of both optimizations was to remediate the South Plume area first. Under the 2014 Operational Design, modeling predictions indicated that the pumping stage of the aquifer remedy would be achieved as follows:

- 2022 for the South Plume and southern South Field
- 2030 for the northern South Field
- 2035 for the former WSA

As shown below, progress was made in decreasing the South Plume and South Field plumes between 2014 and the end of 2023.

Area	Total Uranium Plume Size 2014 (acres)	Total Uranium Plume Size 2023 (acres)	Percent Reduction
South Plume	29.8	13.1	55.9%
South Field	62.0	46.5	25.0%

Although progress was made by reducing the uranium plume, uranium concentration data measured in the aquifer indicated that model-predicted cleanup goals for the South Plume and southern South Field were not being achieved. In early 2022, the groundwater model was rerun to determine what the new cleanup times would be if uranium concentrations measured in the first half of 2021 were loaded into the model as initial conditions.

As was done for past model runs, model-predicted cleanup date uncertainty, due to changes in the elevation of the water table in the aquifer over time, was bracketed by modeling three different sets of boundary conditions for the elevation of the water table (i.e., wet, nominal, and dry). During wet boundary conditions, the water table elevation is at its historic high, and during dry boundary conditions, the water table elevation is at its historic low. Nominal is the average elevation of the water table. For one of the modeling runs all original South Plume wells were operational, but the pumping rates used in the model for RW-1 through RW-4 were reduced to 100 gpm each. The model-predicted cleanup years were as follows:

Plume Area	Wet Boundary Conditions	Nominal Boundary Conditions	Dry Boundary Conditions
South Plume	2024	2025	2024
South Field	2035	2033	2038
Waste Storage Area	2040	2040	2045

As in previous modeling runs, the latest model-predicted cleanup year for each boundary condition was selected as the new targeted cleanup year, resulting in the following new predicted cleanup years.

- South Plume: 2025
- South Field: 2038
- WSA: 2045

Modeling was also conducted in 2022 to predict cleanup dates if all original South Plume wells failed due to age. In late 2024, the last remaining original South Plume well failed and was permanently shut down, so this modeling scenario actually became the new operational design in 2024. Modeling showed that implementation of this new design (i.e., all original South Plume extraction wells turned off, and two new replacement wells operating at 300 gpm each) resulted in the same predicted cleanup times for each module. Figure A.1-2 illustrates how the 2022 model run predicts that the cleanup will progress under nominal boundary conditions (the most conservative boundary condition for cleanup of the south plume). It should be noted that the new design was implemented in 2024 not 2021, so for operational purposes 3 years should be added to each model-predicted cleanup date shown in Figure A.1-2.

- South Plume: 2025 plus 3 years = 2028
- South Field: 2033 plus 3 years = 2036
- WSA: 2040 plus 3 years = 2043

The first optimization (implemented in 2014) and referred to as the 2014 design was more aggressive than the previous design (2005) because the target system design pumping rate was higher. The 2014 design was also more efficient than previous designs because pumping was more concentrated where and when the pumping was needed. The 2014 design also introduced the strategy of decreasing design pumping rates as the remedy progresses. These strategies were carried forward with the 2022 optimization.

The more-aggressive pumping rates required more maintenance (due to iron fouling of the pumps and well screens) than earlier less-aggressive pumping rates required. Figure A.1-3 shows the difference between a clean pump and one removed from an active pumping well at the Fernald Preserve after it had been operating for some time. As shown in the bottom photo, the pump pulled from the well is coated with iron, which interfered with operation of the pump and motor.

Operational experience was used to create and refine an aggressive and initially successful well maintenance program to address this iron fouling. Extraction wells are treated with a chemical solution called liquid acid descaler when operational parameters indicate that cleaning is warranted. As shown in the following table, the number of extraction wells decreased from 23 to 20 in 2014, but the number of chemical treatments increased after 2014 as a result of more-aggressive pumping rates and aging well infrastructure. In more recent years, the number of treatments has decreased due to realization that the long-term use of liquid acid descaler over time is harmful to metal components of an aging wellfield system.

Year	Number of Extraction Wells	Number of Chemical Treatments
2025	16	11
2024	16[a]	19
2023	15[b]	11
2022	18[c]	17
2021	20	30
2020	20	43
2019	20	19[d]
2018	20	28[e]
2017	20	35
2016	20	22[f]
2015	20	41
2014	23/20[g]	32
2013	23	38

[a] The number of operating extraction wells was modified in 2024 (i.e., RW-1 was turned off; RW-6A and RW-7A began pumping).
[b] The number of operating extraction wells was reduced in 2023 (i.e., RW-2, RW-3, and RW-7 were turned off).
[c] The number of operating extraction wells was reduced in 2022. (i.e., RW-4 and RW-6 were turned off).
[d] Number of chemical treatments was affected by replacement of the Converted Advanced Wastewater Treatment facility (CAWWT) backwash basin.
[e] Number of chemical treatments was affected by the CAWWT construction project.
[f] Number of chemical treatments was affected by an extended unplanned shutdown (DOE 2017).
[g] The number of operating extraction wells was reduced in July 2014.

There were some exceptions to the increase in the number of treatments. The number of treatments was down in 2016, but 2016 was not a normal operating year due to an unplanned wellfield shutdown discussed in the 2016 Site Environmental Report (DOE 2017). The number of treatments was also down in 2018 and 2019. In 2018, it was due to the impact that the Converted Advanced Wastewater Treatment (CAWWT) construction project had on the availability of the backwash basin for wastewater generated by well treatment. In 2019, it was due to a construction project to replace the CAWWT backwash basin.

In 2021, the site began reducing the number of liquid acid descaler treatments due to the realization that the long-term use of liquid acid descaler over time was harmful to metal components of an aging wellfield system. In 2025, the number of treatments remained lower than treatments prior to 2021 with the realization that the use of liquid acid descaler was causing pitless adaptor problems in the off-property wells. Operating experience also indicated that the wellfield was experiencing other problems that would not be responsive to treatments. For example, the same iron fouling that was occurring in the pumps and well screens was also occurring in the discharge piping. The iron fouling restricted flow through the discharge pipes creating backpressure on the flow from the wells. A historical summary of the challenges of using chemical treatments in the original aging South Plume wells is provided in the 2024 Site Environmental Report (DOE 2025).

The U.S. Department of Energy (DOE) made efforts to address the iron fouling that extraction wells experience through the choice of equipment. DOE purchased stainless steel pumps beginning in 2016 to help alleviate some of the maintenance challenges associated with operating the pumps continuously. Installation of the stainless steel pumps occurred as older pumps were removed for maintenance. Based on the maintenance history, the stainless steel pumps have proven to last longer.

DOE continues to work with recognized wellfield maintenance experts to determine whether the well maintenance program can be improved to extend the life of the pumps. The issue of well maintenance was discussed in a DOE National Laboratory Network Collaboration that was held in 2021. More information on the National Laboratory Network Collaboration is provided in Section A.1.8.

A.1.2 Wellfield Shutdowns

The planned annual wellfield shutdown in 2025 lasted 34 days (June 4 to July 8, 2025). During this shutdown, extraction well 33062 (EW-27) in the former WSA continued to operate to supply water for CAWWT.

In addition to the annual planned wellfield shutdown, the wellfield is shut down whenever the Great Miami River reaches a river stage of 14 feet (ft) at the National Oceanic and Atmospheric Administration measurement gauge at Miamitown, Ohio (Reach Identification 3885998). When flow in the river reaches this level, gravity flow from the site discharge pipe is affected. The wellfield remains off until the river stage falls below 14 ft. This approach was discussed with the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA) during the March 14, 2018, regulatory meeting. These temporary wellfield shutdowns have not had a negative impact on remediation progress and could be beneficial from a rebound perspective. Two shutdowns occurred in 2025 due to the Great Miami River stage. The total number of days the wellfield was shut down due to high river stage from 2018 to 2025 was as follows:

Year	Wellfield Shut Down Due to River Stage (days)
2018	10
2019	7
2020	4
2021	0
2022	4
2023	4
2024	0
2025	7

A.1.3 South Field Module

Eleven extraction wells were operational in the South Field Module in 2025. The 11 active extraction wells were 31550 (EW-18), 31560 (EW-19), 31561 (EW-20), 33326 (EW-17a), 32276 (EW-22), 32446 (EW-24), 32447 (EW-23), 33061 (EW-25), 33262 (EW-15a), 33264 (EW-30), and 33298 (EW-21a).

The target combined pumping rate for the South Field Module wells in 2025 was 2,875 gpm. Table A.1-1 presents the combined performance data for the South Field Module. Tables A.1-2 through A.1-12 provide individual extraction well performance data for the South Field Module wells in 2025. Target pumping rates are reported on each individual extraction well performance table, and footnotes explain individual extraction well outages of greater than 24 hours.

During 2025, 1.25 billion gallons (Bgal) of groundwater were pumped from the active extraction wells in the South Field Module, resulting in the removal of 182.40 pounds (lb) of uranium from the Great Miami Aquifer (GMA). Since startup in July 1998, the South Field Module has removed 32.800 Bgal of water and 10,221.47 lb of uranium from the GMA.

A.1.4 South Plume Module

Two wells were operational in the South Plume module in 2025: 33616 (RW-6A) and 33617 (RW-7A). Both wells operated at a design set point of 300 gpm. Table A.1-1 presents the combined performance data for the South Plume Module. Table A.1-13 through A.1-14 provide individual extraction well performance data for the South Plume Module wells operating in 2025. Target pumping rates are reported on each individual extraction well performance table, and footnotes explain individual extraction well outages of greater than 24 hours.

Between 2022 and 2024, all six of the original six South Plume/South Plume Optimization extraction wells were permanently shut down due to age, maintenance problems, and location in relation to the remaining plume:

- 3927 (RW-4): Permanently turned off June 6, 2022
- 32308 (RW-6): Permanently turned off July 25, 2022
- 3926 (RW-3): Permanently turned off June 12, 2023
- 32309 (RW-7): Permanently turned off October 24, 2023
- 3925 (RW-2): Permanently turned off October 31, 2023
- 3924 (RW-1): Permanently turned off November 12, 2024

As discussed in this attachment, these operational changes reflect a transition in the South Plume Module from an aging system of six extraction wells to an updated module comprised of two new replacement wells (33616 [RW-6A] and 33617 [RW-7A]). A historical summary of the transition can be found in the 2024 Site Environmental Report (DOE 2025).

During 2025, 290.20 Mgal of groundwater were pumped from the active extraction wells in the South Plume Module, resulting in the removal of 54.04 lb of uranium from the GMA. Since its startup in August 1993, the South Plume Module has removed 20.098 billion gallons of groundwater and 3,773.55 lb of uranium from the GMA.

A.1.4.1 Paddys Run Road Site

In 2025, as in previous years, Paddys Run Road Site (PRRS) constituents of concern (arsenic, phosphorus, potassium, sodium, and volatile organic compounds) were monitored at 10 monitoring well locations immediately south of the South Plume Module to ensure that the operation of the system does not adversely impact the PRRS plume. The 10 wells monitored were 2128, 2636, 2898, 2899, 2900, 3128, 3636, 3898, 3899, and 3900 (Figure A.1-1).

The Mann-Kendall test for trend was run on PRRS constituent data collected from these wells. As indicated in Table A.1-15, the following two parameters monitored for PRRS constituents of concern in four different wells had “up” trends:

- Potassium in monitoring wells 2898, 2899, 3898, and 3899
- Sodium in monitoring wells 2898, 2899, 3898, and 3899

Figures A.1-4 through A.1-11 provide plots of concentration (milligrams per liter [mg/L]) versus time for these constituents and wells.

Groundwater flow directions are reported in Attachment A.3 in the form of groundwater elevation maps (Figures A.3-1 through A.3-4). The groundwater elevation maps for 2025 indicate that flow to monitoring wells 2898, 2899, 3898, and 3899 was from the northeast to the southwest. This suggests that the increasing concentrations at these locations were moving toward the PRRS plume, not away from it.

The monitoring activity for PRRS constituents of concern also included sampling for volatile organic compounds. These compounds are monitored because they were present in the PRRS plume, which is not of Fernald site origin (ERM Midwest Inc. 1994). No volatile organic compounds were detected in 2025.

Monitoring water levels appears to be more effective than monitoring water quality for determining whether pumping in the South Plume is pulling the PRRS plume toward the South Plume recovery wells.

As reported in the 2024 Site Environmental Report (DOE 2025), 2025 is the last year for PRRS monitoring. Section A.1.11 of the 2024 Site Environmental Report provides a historic summary of PRRS monitoring program data and a recommendation to discontinue this monitoring effort. With EPA and Ohio EPA concurrence this activity ended on December 31, 2025.

A.1.5 Waste Storage Area Module

Three extraction wells were operational in the former WSA Module in 2025. The three extraction wells were 32761 (EW-26), 33062 (EW-27), and 33347 (EW-33a).

The target combined pumping rate for the WSA Module wells in 2025 was 800 gpm. The combined performance data for the WSA Module are presented in Table A.1-1. Tables A.1-16 through A.1-18 provide individual extraction well performance data for the WSA Module wells for 2025. Target pumping rates are reported on each individual extraction well performance table, and footnotes explain individual extraction well outages of greater than 24 hours.

During 2025, 370.13 Mgal of groundwater were pumped from extraction wells in the WSA Module, resulting in the removal of 51.13 lb of uranium from the GMA. Since startup in May 2002, the WSA Module has removed 9.894 billion gallons of water and 2,702.05 lb of uranium from the GMA.

A.1.6 Total Uranium Data

In 2025, water samples were collected monthly from the extraction wells and analyzed for total uranium. The total uranium concentrations were used to calculate an annual mass of uranium removed from the well. The data are also used to determine whether a well needs to be routed to treatment.

The current aquifer remedy is able to achieve uranium discharge limits (i.e., average monthly concentration of less than 30 micrograms per liter [µg/L] and 600 lb annually) established in the Operable Unit 5 Record of Decision (DOE 1996) without routine groundwater treatment. Routine groundwater treatment has not been needed since 2010. Since 2010, groundwater was occasionally sent to treatment for very short periods. The reasons for the short periods of treatment varied. For instance, treatment can be needed when wells pumping low uranium concentrations are turned off for maintenance and wells pumping higher uranium concentrations continue pumping. With conversion to the smaller 50 gpm treatment system (which became operational on April 3, 2018), a small amount of groundwater is routed to treatment each month and blended with water from the backwash basin to dilute anion concentrations in the backwash basin water before treatment.

In 2025, 1.910 billion gallons of groundwater were pumped from the GMA, and 4.33 Mgal (0.23%) of groundwater was treated. The following table provides a summary of how much groundwater was treated each month. The minimum and maximum total uranium concentrations provided are for individual wells. The average is for all wells operating that month.

Month	Water Treated (gallons)	Minimum Total Uranium (µg/L)	Maximum Total Uranium (µg/L)	Average Total Uranium (µg/L)
January	615,695	5.70	26.6	15.8
February	416,485	5.70	30.2	18.2
March	288,175	0	32.2	18.6
April	255,285	0	26.2	16.8
May	286,587	8.90	29.9	20.3
June	200,505	6.00	30.7	19.5
July	258,300	7.80	31.0	19.1
August	296,640	6.00	29.7	18.9
September	317,535	0	31.6	18.3
October	341,340	5.20	30.5	17.9
November	294,715	5.47	33.1	18.6
December	758,523	5.20	28.7	16.5
Total	**4,329,785**			

A data assessment exercise is conducted each year and reported in the Site Environmental Report where uranium concentration data collected from the extraction wells are tracked graphically and statistically to assess how the concentrations are trending. Uranium concentrations are plotted over time and fitted with a regression line. Until 2022, expressions used for regression of extraction well data included power functions, exponential functions, and polynomials. These functions were fit to uranium concentration data using Microsoft Excel.

The assessment exercise changed in 2022. A collaborative effort between DOE and the National Laboratory Network resulted in recommendations to reduce risk involved with the ongoing aquifer remedy. One recommendation was the use of alternative mathematical expressions to project remedial time frames through (1) implementing new statistical projection methods for uranium concentration data as an alternative to the current methods used, and (2) refining the calculation approach for confidence intervals on the time projections. The objective for making these changes was to improve the accuracy of groundwater cleanup projections, including uranium mass removal projections for extraction wells and remedial time frame projections for the uranium plume. This recommendation was implemented in the 2022 Site Environmental Report (DOE 2023).

For the implementation, dual exponential functions were evaluated and from that stretched exponential functions were selected to conduct regression analysis of yearly extraction well datasets to project uranium mass removal. A bootstrapping approach was used to calculate 95% confidence intervals for the stretched exponential functions.

Figures A.1-12 through A.1-27 are uranium concentration versus time plots for 16 extraction wells operating in 2025. Each graph displays uranium concentration data measured at the well, a regression trend of the uranium concentration dataset using stretched exponential equations, a 95% confidence level about the stretched exponential trend prepared using a bootstrapping approach, and groundwater model predictions.

The data in Figures A.1-12 through A.1-27 illustrate that as pumping continues, the uranium concentration of the pumped groundwater decreases. The slope of a fitted regression curve through the uranium concentration dataset at each extraction well provides a prediction of how pumping concentrations will continue to decrease and can be used to make uranium mass removal predictions over time for each extraction well.

EPA guidelines found in *General Methods for Remedial Operation Performance Evaluations* (EPA 1992) suggest that a 95% upper confidence limit (95% UCL) of the measured uranium concentration dataset should also be used to help evaluate the uncertainty of the predicted trend. Figures A.1-12 through A.1-27 display both the upper and lower 95% confidence level, with the 95% uncertainty region shaded gray.

The Fernald Preserve aquifer remediation was designed using the Variable Saturated Analysis Model in Three Dimensions (also called VAM-3D). When the site transitioned to the Office of Legacy Management in 2006, the remediation was operating to a design that was established in 2005 called the WSA Phase II Design (DOE 2005). As explained in Section A.1.1, the 2005 design was optimized in 2014, based on plume concentrations measured in 2012 (DOE 2014), and in 2024, based on plume concentrations measured in 2021 (DOE 2022). Groundwater model predictions for all designs assume that an equilibrium linear isotherm adequately describes the partitioning of total uranium between the sorbed and dissolved phases.

The Fernald Preserve groundwater model predicts the future average pounds of uranium that will be removed from the aquifer for each year of the modeled remedy to eventually achieve concentration-based final remediation level (FRL) goals. This prediction (broken down by year) is used to judge how closely the actual remediation is tracking the model predictions. The actual pounds of uranium removed from the aquifer are compared to the model predictions to assess how reasonable the model predictions were. Stretched exponential equations based on measured

concentration data collected at the extraction wells are used to provide a prediction of the number of pounds of uranium that will be removed from the aquifer in future years to achieve concentration-based FRL goals. Stretched exponential equations based on uranium concentration data collected at extraction wells through December 31, 2025, are summarized in Table A.1-19.

Changing water levels in the aquifer result in cleanup prediction uncertainty. Modeling is therefore conducted under low water-level conditions, high water-level conditions, and nominal water-level conditions to bracket the uncertainty in model-predicted cleanup times. Until 2021, this tracking exercise used model predictions for high water-level conditions because they were the most conservative (i.e., presented the longest predicted cleanup times for the overall remedy). As discussed below, new model predictions from 2022 and beyond use nominal boundary conditions because this is the most conservative boundary condition for cleanup of the off-property South Plume (i.e., presented the longest predicted cleanup time for the South Plume).

Every year, the average uranium concentration data used to create the stretched exponential curves for each extraction well are updated with the data for the current reporting year. This results in the equations for each well changing slightly from year to year in response to the incorporation of the new data. At the end of December 2025, data indicated that 16,621 net lb of uranium had been removed from the GMA by the pump-and-treat remedy. Net pounds of uranium include a small amount of uranium that was reinjected into the aquifer between 1998 and 2004.

Groundwater modeling conducted in 2012 predicted that under the current pumping rates, pumping would continue until 2022 in the South Plume and southern South Field, 2030 in the northern South field, and 2035 in the former WSA. Annual monitoring results used to track remedy progress indicated that those dates would not be achieved. In early 2022, the groundwater model was rerun to determine what the new cleanup times would be if uranium concentrations measured in the first half of 2021 were loaded into the model as initial conditions.

As was done for past model runs, modeled-predicted cleanup date uncertainty due to changes in the elevation of the water table in the aquifer over time was bracketed by modeling three different sets of water table boundary conditions (i.e., wet, nominal, and dry). During wet boundary conditions the water table elevation is at its highest, and during dry boundary conditions the water table elevation is at its lowest. Nominal is the average elevation of the water table. The results were as follows:

Plume Area	Wet Boundary Conditions	Nominal Boundary Conditions	Dry Boundary Conditions
South Plume	2024	2025	2024
South Field	2035	2033	2038
Waste Storage Area	2040	2040	2045

As in previous modeling runs, the maximum model-predicted cleanup date for each boundary condition was selected as the new target cleanup date, resulting in the following new predicted cleanup years.

- South Plume: 2025
- South Field: 2038
- WSA: 2045

It should be noted that the new design was implemented in 2024 not 2021, so for operational purposes 3 years should be added to each model predicted cleanup date.

- South Plume: 2025 + 3 years = 2028
- South Field: 2028 + 3 years = 2031
- WSA: 2045 + 3 years = 2048

Since the longest model-predicted cleanup date for the South Plume (2025) was determined using nominal boundary conditions, and the immediate objective of the aquifer remedy is to clean up the South Plume first, it was decided to present cleanup predictions for nominal boundary conditions for the 2022 model run in this Site Environmental Report. Table A.1-20 provides a yearly breakdown of the pounds of uranium to be removed from 2026 to 2040 to achieve concentration-based FRL goals, based on three predictions (i.e., uranium concentration data, model predictions, 95% UCL). Figure A.1-28 illustrates the relationship between the three predictions. Each prediction is further discussed below.

Stretched exponential predictions are shown in Table A.1-19 for all operating extraction wells. Model predictions reflect the selected modeling scenario from the 2022 modeling report that has all original South Plume Extraction wells turned off, and replacement wells RW-6A and RW-7A operating at 300 gpm each.

A.1.6.1 Total Uranium Concentration Data

Using stretched exponential functions, the estimated pounds of uranium to be removed from the aquifer between 2026 and 2040 to achieve remediation goals is 2,205 lb.

A.1.6.2 Model

Modeling conducted in 2022 predicts that from 2026 through 2040 an additional 1,390 lb of uranium will need to be removed from the GMA to achieve concentration-based cleanup goals under nominal boundary conditions.

A.1.6.3 95% UCL

Use of a bootstrapping approach to calculate a 95% confidence interval resulted in an estimate that between 2026 and 2040 an additional 2,755 lb of uranium will need to be removed from the aquifer to achieve concentration-based cleanup goals.

A summary of the three predictions is provided below.

Net pounds of uranium extracted through December 2025	16,621		
	Data	**Model**	**95% UCL**
Predicted pounds of uranium to be extracted between 2026 and the end of the pump-and-treat stage of the aquifer remedy (in accordance with the current Operational Design, nominal boundary conditions)	2,205	1,390	2,755
Total predicted pounds of uranium to be removed to achieve concentration-based FRL goals	18,826	18,011	19,376
Estimated percent complete (based on pounds of uranium to be removed)	88%	92%	86%

Results shown above indicate that as of December 31, 2025, the estimated percent complete (based on pounds of uranium to be removed to achieve concentration-based FRL goals) are 88%, 92%, and 86% for the data, model, and 95% UCL of the data, respectively. Following the EPA guidelines mentioned earlier, the estimated percent complete based on pounds of uranium removed is between 88% and 86%. The groundwater model prediction indicates 92% complete.

Tracking pounds of uranium removed against groundwater modeling predictions provides an indirect status on progress being made to attain cleanup goals. Other methods (mapping, Ricker method, and Earth Volumetric Studio [EVS] software) of tracking reduction in the plume size are presented in Attachment A.2.

A.1.7 Total Uranium Data Discussion

In early 2022, the groundwater model (DOE 2022) was rerun with updated uranium plume concentrations consistent with monitoring results for the first half of 2021. The groundwater model run previously was based on an initial mass loading of 16,000 lb of uranium. As shown in Table A.1-20 both monitoring data and modeling now predict that between 18,011 and 18,826 lb of dissolved uranium will need to be pumped from the aquifer to achieve concentration-based cleanup objectives. The 95% UCL estimate is higher at 19,376 lb.

A comparison of the actual uranium concentrations measured at each extraction well and groundwater model-predicted uranium concentrations is provided in Table A.1-21. For 7 years (2015 to 2021) this comparison was made using model predictions made in 2012 and implemented in 2014. Beginning with the 2022 Site Environmental Report (DOE 2023), model predictions shown in Table A.1-21 were made using model predictions made in 2022 and implemented in 2024 (i.e., uranium plume concentrations measured in 2021). Model-predicted data for Table A.1-21 in this year's report comes from the 2022 model run that had all original South Plume extraction wells turned off, and replacement wells 33616 (RW-6A) and 33617 (RW-7A) operating.

The comparison for 2025 shows that the actual average measured concentration in December 2025 was 16.55 µg/L. The average model-predicted total uranium concentration for 2025 was 12.56 µg/L. The residual average uranium concentration (actual uranium concentration minus model-predicted uranium concentration) was 3.99 µg/L. The standard deviation for the residual dataset was 7.61. As reported in Section A.1.8, DOE continues to identify improvements to the predictive capability of the site groundwater model.

A comparison of groundwater model-predicted concentrations and actual observed concentrations measured at selected monitoring wells in 2025 is provided in Table A.1-22. Model predictions shown in Table A.1-22 were made with the updated model run that used initial uranium plume concentrations measured in 2021. For this year's report the table has model-predicted data from the 2022 modeling scenario where all six original South Plume wells are turned off and two new replacement wells are operating at 300 gpm each.

Actual uranium concentrations measured in the first half of 2025 are compared against model-predicted uranium concentrations for April 2025. Changing water levels in the aquifer result in model-predicted cleanup variations and uncertainty. Modeling is, therefore, conducted under low water-level conditions, high water-level conditions, and nominal water-level conditions. The comparison shown in Table A.1-22 represents nominal water-level conditions. Groundwater modeling conducted in 2022 under nominal water-level conditions resulted in the longest cleanup time predictions for the South Plume; therefore, they are the most conservative for the South Plume.

As shown in Table A.1-22, the average residual uranium concentration in 2025 was 30.18 µg/L. As was presented in previous years, Table A.1-23 shows the average residual uranium concentration for 2025 with five monitoring wells that were the main contributors to the difference in 2025 (i.e., 2049, 2386, 2387, 23273, and 23276) removed. Those five wells are in the South Field. The average residual uranium concentration decreases from 30.18 µg/L (all measured wells) to 12.26 µg/L (five wells removed). The larger discrepancies found at these five wells are indicators that the model predictions are less reasonable for these five locations. As reported in Section A.1.8, DOE continues to identify improvements to the predictive capability of the site groundwater model.

Decreasing efficiency in mass removal is a common challenge for pumping operations. Uranium concentration curves are trending asymptotic. It was this trend, in part, that resulted in DOE optimizing the remediation operation and implementing a more aggressive cleanup design in 2014 and again in 2024.

As discussed in Attachment A.2, calculations show that more uranium is sorbed to aquifer sediments than is dissolved in the water. The slow desorption process controls how much uranium is dissolved each year into the water and subsequently pumped out of the aquifer by the extraction wells. As the remedy proceeds, the desorption rate becomes slower and the remedy becomes less efficient, regardless of how much water is flushed through the sediments. Finding the right balance between desorption rate and pumping rate is difficult.

Collectively, this information indicated that additional work was needed to optimize the performance of the system again (as was done in 2014 and again in 2022). Additional groundwater conceptualization and modeling work is being conducted following recommendations made during a DOE National Laboratory Network Collaboration in early 2021. More information is provided in Section A.1.8.

It should be recognized that pumping may only progress the remediation to a certain point and there may be recalcitrant areas remaining that will need to be addressed using a different approach. For instance, progress in achieving a concentration-based cleanup is being assessed in part by attributing uranium concentration declines being measured to the pounds of uranium

being removed from the aquifer through active pumping. Reducing conditions in the aquifer that caused uranium to sorb to sediments could also contribute to lower dissolved uranium concentrations in the groundwater. Reducing conditions could therefore also be a factor in why some areas of the aquifer might not respond to pump-and-treat as well as other areas. As the aquifer remedy progresses and the plume decreases in size, such that only recalcitrant areas are left, the need to have a better understanding of the geochemical conditions within the recalcitrant areas (such as oxidation-reduction conditions) could become more important for completing cleanup in those areas.

Some recalcitrant areas in the GMA are likely the result of sediment grain size variations that are present within the aquifer and are common to braided stream depositional environments like the GMA. The presence of areas of finer-grained sediment may be limiting the success of pumping dissolved uranium from all impacted areas of the aquifer. Uranium will tend to sorb more to finer-grained sediments, because there is more surface area available. Movement of groundwater, due to pumping, will be easier through coarser-grained sediments, and groundwater will tend to move around areas where finer-grained sediments are present. Essentially the finer-grained areas are not flushed as easily as the coarser-grained areas. In effect, uranium slowly desorbs from the areas of finer-grained sediments as the water moves past and around them. This slow desorption process lengthens aquifer cleanup times by hindering uranium transport and mobility in the aquifer.

As the groundwater remedy progresses, additional work to define the uranium partition coefficient (K_d) may also be deemed beneficial to help refine cleanup efforts in recalcitrant areas of the uranium plume. Selecting a K_d for uranium in the groundwater model that reflects actual site conditions everywhere in the uranium plume over the life of the groundwater remediation effort might not be appropriate. Groundwater model predictions for the Fernald Preserve assume that an equilibrium linear isotherm adequately describes the partitioning of total uranium between sorbed and dissolved phases. One K_d value ($K_d = 3$) is used to represent the entire model domain and time frame. This value was determined empirically by the Sandia National Laboratories using core samples of aquifer sediment collected from contaminated areas across the Fernald site (SNL 2004). It is considered to be a good representative K_d value overall, but it might not reflect reality in all areas of the plume.

A.1.8 DOE National Laboratory Network Collaboration

In early 2021, a DOE National Laboratory Network Collaboration was conducted concerning the Fernald Preserve groundwater remediation. EPA and Ohio EPA participated, with the understanding that any official input or endorsement for any of the recommendations would be reserved for when and if DOE decides to pursue implementation of a recommendation at the site. The objective of the collaboration was to present recommendations to improve the ongoing aquifer remediation at the Fernald Preserve.

The collaboration involved two focus groups. Focus Group 1 was challenged with developing recommendations on how to maintain and keep an aging wellfield system operating efficiently. Focus Group 2 was challenged with developing recommendations to improve the efficiency and success of the existing pumping remedy and to improve the aquifer cleanup predictions for planning purposes while considering the following three site priorities:

1. Focus first on the off-property plume
2. Focus second on the southern South Field plume
3. Focus third on the recalcitrant areas of the plume in the South Field and former WSA

A.1.8.1 Results of Focus Group 1: Aging Wellfield System

Focus Group 1 did not identify anything that was then currently being done to maintain the aging wellfield system at the Fernald Preserve that should stop being done. Focus Group 1 acknowledged that operating an aging wellfield system efficiently was somewhat of an art in that there is no one proven method or process that seems to always work. Success involves a degree of trial and error to determine the optimal operational practice for any given well. Given the operational challenges at the Fernald Preserve, the current operation and maintenance program was determined to be sound. When the DOE National Laboratory Network Collaboration personnel contacted area experts for information, those familiar with the Fernald site's wellfield maintenance program emphasized that they often refer to the Fernald Preserve when they need an example of how to approach the challenge. Focus Group 1 presented the following three consensus recommendations:

1. Test the use of automated biofilm and scale control in the extraction wells.
2. Test the use of carbon dioxide to rehabilitate extraction wells.
3. Enhance rehabilitation contact (i.e., use of satellite wells to deliver treatments).

In 2021, DOE conducted a small-scale manual test of the biofilm and scale-control recommendation. As discussed in the 2024 Site Environmental Report (DOE 2025), the test resulted in no improvement.

All three National Laboratory Network recommendations from Focus Group 1 pertain to extending the life of an extraction well. Considering the age of the existing extraction wells, rather than trying to prolong their lives further, the best option may be to just begin to strategically replace them. DOE will revisit all three Focus Group 1 National Laboratory Network recommendations as deemed appropriate when replacement of an extraction well is being considered. No Focus Group 1 recommendations were revisited in 2025.

A.1.8.2 Results of Focus Group 2: Improve Efficiency of the Aquifer Cleanup

Focus Group 2 did not identify anything that was then currently being done to improve efficiency of the aquifer cleanup at the Fernald Preserve that should be stopped. Six recommendations were presented. Four recommendations involved doing things that were *not* currently being done at the Fernald Preserve. Two recommendations involved things that were being done at the Fernald Preserve but should be supplemented with something that the Fernald Preserve was *not* doing.

What the Fernald Preserve was not doing but should be doing:

1. Use alternative mathematical expressions to predict cleanup time frames.
2. Conduct targeted data mining of available site information for enhanced understanding of prior fate and transport behavior and improved predictions of future behavior.
3. Prepare three-dimensional visualizations of key hydrogeologic and geochemical parameter distributions over time.
4. Conduct algorithm-based optimization for future remedy operation and design.

What the Fernald Preserve was doing that should continue, and should be supplemented with something else:

1. Refine plume metric calculations to reduce uncertainty.
2. Continue to port the site groundwater model to a modern hydrologic software platform.

DOE began implementation of these Focus Group 2 recommendations in 2022. Implementation of any National Laboratory Network recommendation is subject to availability of resources, stakeholder coordination (as appropriate), and regulatory approval.

DOE completed two of the Group 2 National Laboratory Network recommendations in 2022: (1) Alternative Mathematical Expressions for Projecting Remedial Time Frame, and (2) Three Dimensional Visualizations Over Time.

The use of alternative mathematical expressions was briefly discussed in Section A.1.6, and three-dimensional mapping over time and interpretation is briefly discussed below.
A four-dimensional mapping tool was developed using EVS software, with *time* being the fourth dimension. This tool facilitates interpretation and communication of extensive environmental datasets. The tool can be used for both visual, qualitative, and quantitative analysis. A three-dimensional geologic model, a time series of water table surfaces, and a time series of volumetric plume models were generated. Water table mapping and streamline analysis were used to assess the capture influence of the remediation system. This evaluation indicated that the current operational design achieves full containment of the uranium plume. This is discussed further in Attachment A.3. Uranium plume mapping and calculation of bulk metrics was used to assess plume stability. The results demonstrate that the lateral and vertical dimensions of the plume are contracting, the total dissolved uranium mass is decreasing, and the center of mass has not migrated downgradient. These results are further discussed in Attachment A.2. With the four-dimensional mapping implementation complete, incorporating additional site data into the EVS tool is straightforward. DOE plans to update this tool as deemed appropriate and use it for ongoing evaluation and communication of data for the Fernald Preserve, as well as update the site groundwater model as needed.

In 2023, DOE began working on comparing the VAM-3D modeling code to the MODFLOW modeling code for running the Fernald site groundwater model. The objective was to determine if MODFLOW could be used in order to be more user friendly and transparent for running future algorithm-based optimization codes. In 2024, DOE decided, with input from Ohio EPA and EPA, to proceed with MODFLOW (DOE 2024). In 2024 work began on calibrating and validating a new MODFLOW model for the groundwater remedy. The MODLFOW model is scheduled to be calibrated and validated in 2026. Once the MODLFOW model is calibrated and validated, the model will be used to optimize pumping in the South Field.

A.1.9 Pumping Rates

Target design extraction well pumping rates for 2025 are provided in Table A.1-24. The target design pumping rate is the pumping rate used in the groundwater model to estimate cleanup times for the aquifer remedy. The target design pumping rate has changed over time.

- From 2005 to July 1, 2014, the target design pumping rate was 4,775 gpm.
- From July 1, 2014, through June 2018, the target design pumping rate was 5,075 gpm (DOE 2014).
- Beginning in July 2018, the design pumping rate was 4,975 gpm due to the pumping rate in RW-4 being reduced from 200 to 100 gpm.
- Between June 6, 2022, and November 12, 2024, the design pumping rate transitioned from 4,975 gpm to 4,275 gpm.

A historical summary of the pumping reductions in the South Plume from 2018 through 2024 is provided in the 2024 Site Environmental Report (DOE 2025).

Pulse Pumping

In September 2012, with concurrence from EPA and Ohio EPA, a pulse pumping exercise was initiated at extraction wells 31550 (EW-18), 31560 (EW-19), 31561 (EW-20), and 33061 (EW-25). At the time, these four wells were equipped with pumps and motors that operated most efficiently at rates of approximately 300 gpm. The WSA Phase II Design called for a target pumping rate of 100 gpm for each of these wells. The 100 gpm rate was being achieved by throttling back on the flow from each of the wells; however, this type of operation was not energy efficient.

With the exception of extraction well 31561 (EW-20), the current operational design also calls for a pumping rate of 100 gpm for each of these wells. To be more energy efficient, when weather or temperatures are above freezing, the three wells that remained at 100 gpm under the current operational design targets are being pumped at a higher rate for a shorter period each day to remove the daily volume of water prescribed by the current Operational Design. Specifically, the wells are being pumped for 300 gpm for 8 hours a day (a total of 144,000 gallons per day) rather than 100 gpm for 24 hours a day (a total of 144,000 gallons per day). Flow and particle path monitoring predictions indicate that the new pumping schedule will maintain capture of the 30 µg/L uranium plume. Extraction well 31561 (EW-20) has a target pumping rate of 200 gpm under the current Operational Design, so pulse pumping is no longer being used at this well.

A.1.10 CAWWT Capacity Reduction and Backwash Basin Replacement

As presented in the *Fernald Preserve 2015 Site Environmental Report* (DOE 2016), the CAWWT system had become oversized and had reached the end of its useful life. Additionally, equipment corrosion and corrective maintenance had become ongoing issues for facility operations.

In March 2015, a CAWWT Condition Assessment Report was finalized (Whitman, Requardt & Associates LLP 2015) confirming that many of the treatment system components were at or nearing the end of their useful life. A decision was made to replace the

CAWWT system with a 50-gpm system inside the CAWWT building. DOE received concurrence on a path forward in July 2015 from EPA and Ohio EPA and in August 2015 from the Fernald Community Alliance. Planning for the project began in August 2015.

The project was initiated in 2016 and implemented in three steps:

1. Treatment media removal and demolition of existing piping and tanks to allow room for the new system in the existing building.
2. Design of the new system.
3. Construction, installation, and commissioning of the new system.

Step 1 was completed in January 2017. Four multimedia filters, four of the six existing ion-exchange vessels, and associated piping were removed to provide space for installation of the new system. Two ion-exchange vessels and associated piping remained to be available to handle treatments needs until the new system was operational. The current CAWWT building remains to house the smaller treatment system, laboratory, operations control room office, and maintenance shop and to provide storage space.

Step 2, design of the new system, was completed in spring 2017. The system was designed to meet the site's wastewater treatment needs through 2039.

Step 3, construction, installation, and commissioning of the new system was completed in 2018. The new system became operational on April 3, 2018.

In 2019, the backwash basin (which is used to hold wastewater from the site before being treated) was refurbished. Refurbishment efforts included the removal, shipping, and disposal of approximately 600 cubic yards of low-level radiological waste at a commercial disposal facility in west Texas. While the backwash basin was being refurbished, wellfield maintenance activities were put on hold until the new backwash basin was available to temporarily store spent well maintenance fluids before being treated in the CAWWT system.

A.1.11 References

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Table A.1-1. Aquifer Restoration System Operational Summary

	Reporting Period					
	January 2025 Through December 2025			August 1993 Through December 2025		
	Volume Pumped/ Reinjected (Mgal)	Total Uranium Removed/ Reinjected (lb)	Uranium Removal Index (lb/Mgal)	Volume Pumped/ Reinjected (Mgal)	Total Uranium Removed/ Reinjected (lb)	Uranium Removal Index (lb/Mgal)
South Field Module	1,249.39	182.40	0.15	32,799.95	10,221.47	0.31
Waste Storage Area Module	370.13	51.13	0.14	9,893.74	2,702.05	0.27
South Plume Module	290.20	54.04	0.19	20,098.25	3,773.55	0.19
Reinjection Module[a]	0	0	Not applicable	1,936.48	76.27	Not applicable
Aquifer Restoration Systems Totals						
Extraction Wells	1,909.72	287.57	0.15	62,791.92	16,697.04	0.27
(Reinjection Wells[a])	0	0	Not applicable	(1,936.48)	(76.27)	Not applicable
Net	1,909.72	287.57	0.15	60,855.45	16,617.77	Not applicable

[a] Reinjection Module was shut down in September 2004.

Table A.1-2. Extraction Well 31550 (EW-18) Operational Summary for 2025

Reference Elevation (feet above mean sea level [ft amsl]): 572.11 (top of well)
Northing Coordinate (1983): 477,018.5
Easting Coordinate (1983): 1,348,979.8

Hours in reporting period: 8,760 Hours pumped: 7,569 Target pumping rate: 100 gpm
Hours not pumped: 1,191 Operational percent: 86.4

Adjusted operational percent[a]: 95.27

Monthly Measurements at Wellfield							
Month	Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)	Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan	100.8		4.498	18.5		0.15	
Feb	109.4		4.412	29.5		0.25	
Mar	113.8		5.082	32.3		0.27	
Apr	90.5		3.911	24.4		0.20	
May	146.8		6.555	29.9		0.25	
Jun	20.5		0.887	28.8		0.24	
Jul	106.1		4.737	25.8		0.22	
Aug	111.1		4.958	29.7		0.25	
Sep	111.6		4.820	31.6		0.26	
Oct	118.2		5.278	26.1		0.22	
Nov	111.3		4.806	28.0		0.23	
Dec	111.9		4.993	24.1		0.20	
Average	104.3	Total	54.937	Average	27.4	Average	0.23

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-18 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-18 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-18 was down from March 24 to March 26 for liquid acid descaler chemical treatment.
Well EW-18 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-18 was down from June 4 to July 10 for annual wellfield shutdown.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-3. Extraction Well 31560 (EW-19) Operational Summary for 2025

Reference Elevation (ft amsl): 574.93 (top of well)
Northing Coordinate (1983): 477,403.1
Easting Coordinate (1983): 1,349,028.9

Hours in reporting period: 8,760 Hours pumped: 7,661 Target pumping rate: 100 gpm
Hours not pumped: 1,099 Operational percent: 87.45

Adjusted operational percent[a]: 96.43

Monthly Measurements at Wellfield							
Month	Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)
Jan	104.0		4.642		13.0		0.11
Feb	108.2		4.363		12.9		0.11
Mar	101.8		4.545		12.3		0.10
Apr	91.7		3.963		10.9		0.09
May	124.8		5.572		13.6		0.11
Jun	11.8		0.508		13.6		0.11
Jul	99.9		4.461		14.1		0.12
Aug	111.1		4.961		14.9		0.12
Sep	109.7		4.740		16.6		0.14
Oct	111.3		4.967		15.1		0.13
Nov	111.8		4.829		16.6		0.14
Dec	111.2		4.962		15.5		0.13
Average	99.8	Total	52.515	Average	14.1	Average	0.12

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-19 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-19 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-19 was shut down from March 25 to March 27 for liquid acid descaler chemical treatment.
Well EW-19 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-19 was down from June 4 to July 10 for annual wellfield shutdown.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-4. Extraction Well 31561 (EW-20) Operational Summary for 2025

Reference Elevation (ft amsl): 578.77 (top of well)
Northing Coordinate (1983): 477,660.8
Easting Coordinate (1983): 1,349,254.5

Hours in reporting period: 8,760 Hours pumped: 7,669 Target pumping rate: 200 gpm
Hours not pumped: 1,091 Operational percent: 87.54

Adjusted operational percent[a]: 96.53

Monthly Measurements at Wellfield				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**Volume Pumped (Mgal)**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lb of total uranium removed/Mgal pumped)**
Jan	162.5	7.256	26.6	0.22
Feb	179.8	7.249	30.2	0.25
Mar	187.5	8.372	29.1	0.24
Apr	174.9	7.554	26.2	0.22
May	196.3	8.763	28.6	0.24
Jun	19.0	0.821	30.7	0.26
Jul	147.6	6.587	23.1	0.19
Aug	184.1	8.219	27.7	0.23
Sep	172.9	7.470	31.3	0.26
Oct	150.2	6.705	30.5	0.25
Nov	138.3	5.975	33.1	0.28
Dec	139.5	6.226	28.7	0.24
Average	154.4	Total 81.197	Average 28.8	Average 0.24

Note: Extraction well EW-20 can no longer achieve its target pumping rate of 300 gpm.
[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-20 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-20 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-20 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-20 was down from June 4 to July 10 for annual wellfield shutdown.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-5. Extraction Well 33326 (EW-17a) Operational Summary for 2025

Reference Elevation (ft amsl): 574.84 (top of well)
Northing Coordinate (1983): 477,905.5
Easting Coordinate (1983): 1,348,854.1

Hours in reporting period: 8,760 Hours pumped: 7,333 Target pumping rate: 175 gpm
Hours not pumped: 1,427 Operational percent: 83.71

Adjusted operational percent[a]: 92.31

Monthly Measurements at Wellfield									
Month	Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan	180.2		8.043		7.90		0.07	
Feb	184.3		7.432		9.10		0.08	
Mar	195.2		8.716		9.00		0.07	
Apr	158.1		6.830		7.50		0.06	
May	191.5		8.547		8.90		0.07	
Jun	20.7		0.896		8.50		0.07	
Jul	132.5		5.914		11.5		0.10	
Aug	121.7		5.433		7.20		0.06	
Sep	193.8		8.374		8.20		0.07	
Oct	194.5		8.682		7.70		0.06	
Nov	195.6		8.452		7.80		0.06	
Dec	194.6		8.688		7.10		0.06	
Average	163.6	Total	86.006	Average	8.4	Average	0.07	

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-17A was down from January 26 to January 28 due to power outage on east side of site.
Well EW-17A was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-17A was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-17A was down from June 4 to July 8 for annual wellfield shutdown.
Well EW-17A was down from July 29 to August 14 for rehabilitation.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-6. Extraction Well 32276 (EW-22) Operational Summary for 2025

Reference Elevation (ft amsl): 567.14 (top of well)
Northing Coordinate (1983): 476,447.3
Easting Coordinate (1983): 1,348,857.3

Hours in reporting period: 8,760 Hours pumped: 7,202 Target pumping rate: 300 gpm
Hours not pumped: 1,558 Operational percent: 82.21

Adjusted operational percent[a]: 90.66

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate[b] (gpm)	Volume Pumped (Mgal)	Monthly Total Uranium Concentration[c] (µg/L)	Uranium Removal Index (lb of total uranium removed/Mgal pumped)
Jan	295.0	13.169	13.0	0.11
Feb	313.0	12.620	13.6	0.11
Mar	329.3	14.698	14.3	0.12
Apr	266.4	11.507	13.5	0.11
May	323.9	14.457	16.5	0.14
Jun	33.9	1.465	16.6	0.14
Jul	30.7	1.369	16.0	0.13
Aug	329.2	1.697	18.9	0.16
Sep	328.0	14.168	15.1	0.13
Oct	328.8	14.677	13.0	0.11
Nov	330.0	14.254	12.6	0.11
Dec	329.0	14.689	11.9	0.10
Average	269.7	Total 128.771	Average 14.6	Average 0.12

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-22 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-22 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-22 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-22 was down from June 4 to July 29 for annual wellfield shutdown and rehabilitation.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-7. Extraction Well 32446 (EW-24) Operational Summary for 2025

Reference Elevation (ft amsl): 578.37 (top of well)
Northing Coordinate (1983): 476,634.5
Easting Coordinate (1983): 1,349,312.4

Hours in reporting period: 8,760 Hours pumped: 7,154 Target pumping rate: 400 gpm
Hours not pumped: 1,606 Operational percent: 81.66

Adjusted operational percent[a] 90.05

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate[b] (gpm)	Volume Pumped (Mgal)	Monthly Total Uranium Concentration[c] (µg/L)	Uranium Removal Index (lb of total uranium removed/Mgal pumped)
Jan	359.5	16.047	18.8	0.16
Feb	395.3	15.939	19.2	0.16
Mar	393.1	17.546	18.5	0.15
Apr	322.2	13.921	16.6	0.14
May	425.7	19.001	17.9	0.15
Jun	43.6	1.883	18.9	0.16
Jul	38.0	1.697	18.9	0.16
Aug	438.9	19.591	17.7	0.15
Sep	437.6	18.905	20.0	0.17
Oct	438.8	19.587	18.7	0.16
Nov	439.9	19.005	20.9	0.17
Dec	438.5	19.575	17.8	0.15
Average	347.6	Total 182.696	Average 18.7	Average 0.16

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-24 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-24 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-24 was down from April 1 to April 3 for liquid acid descaler chemical treatment.
Well EW-24 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-24 was down from June 4 to July 29 for annual wellfield shutdown and rehabilitation.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-8. Extraction Well 32447 (EW-23) Operational Summary for 2025

Reference Elevation (ft amsl): 574.53 (top of well)
Northing Coordinate (1983): 477,150.2
Easting Coordinate (1983): 1,349,421.2

Hours in reporting period: 8,760 Hours pumped: 7,593 Target pumping rate: 500 gpm
Hours not pumped: 1,167 Operational percent: 86.68

Adjusted operational percent[a]: 95.58

Monthly Measurements at Wellfield								
Month	Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan	474.3		21.172		18.7		0.16	
Feb	497.4		20.055		19.5		0.16	
Mar	467.2		20.855		17.4		0.15	
Apr	421.6		18.215		18.4		0.15	
May	537.5		23.993		21.8		0.18	
Jun	56.3		2.433		22.3		0.19	
Jul	387.9		17.318		15.7		0.13	
Aug	502.7		22.440		21.1		0.18	
Sep	456.8		19.735		22.9		0.19	
Oct	526.5		23.503		20.6		0.17	
Nov	546.7		23.618		20.1		0.17	
Dec	511.8		22.848		17.4		0.15	
Average	448.9	Total	236.183	Average	19.7	Average	0.16	

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-23 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-23 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-23 was down from March 31 to April 2 for liquid acid descaler chemical treatment.
Well EW-23 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-23 was down from June 4 to July 10 for annual wellfield shutdown.
Well EW23 was down from September 30 to October 2 for liquid acid descaler chemical treatment.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-9. Extraction Well 33061 (EW-25) Operational Summary for 2025

Reference Elevation (ft amsl): 575.56 (top of well)
Northing Coordinate (1983): 478,318.8
Easting Coordinate (1983): 1,349,531.0

Hours in reporting period: 8,760 Hours pumped: 7,547 Target pumping rate: 100 gpm
Hours not pumped: 1,213 Operational percent: 86.15

Adjusted operational percent[a]: 95.0

Monthly Measurements at Wellfield									
Month		Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan		102.5		4.574		9.40		0.08	
Feb		140.9		5.681		19.5		0.16	
Mar		103.6		4.625		18.3		0.15	
Apr		88.4		3.819		19.3		0.16	
May		112.8		5.038		27.0		0.23	
Jun		12.0		0.520		15.5		0.13	
Jul		87.8		3.917		31.0		0.26	
Aug		107.9		4.816		19.3		0.16	
Sep		113.1		4.886		18.1		0.15	
Oct		111.8		4.989		18.7		0.16	
Nov		111.6		4.822		17.1		0.14	
Dec		109.6		4.895		13.2		0.11	
	Average	100.2	Total	52.582	Average	18.9	Average	0.16	

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-25 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-25 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-25 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-25 was down from April 15 to April 17 for liquid acid descaler chemical treatment.
Well EW-25 was down from June 4 to July 9 for annual wellfield shutdown.
Well EW-25 was down from September 22 to September 24 for liquid acid descaler chemical treatment.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-10. Extraction Well 33262 (EW-15a) Operational Summary for 2025

Reference Elevation (ft amsl): 568.37 (top of well)
Northing Coordinate (1983): 477,799.9
Easting Coordinate (1983): 1,348,150.0

Hours in reporting period: 8,760 Hours pumped: 7,379 Target pumping rate: 300 gpm
Hours not pumped: 1,381 Operational percent: 84.23

Adjusted operational percent[a]: 92.88

Monthly Measurements at Wellfield									
Month		Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan		295.1		13.173		13.7		0.11	
Feb		310.9		12.535		15.8		0.13	
Mar		329.3		14.700		19.5		0.16	
Apr		198.5		8.576		19.6		0.16	
May		249.3		11.129		24.3		0.20	
Jun		34.0		1.468		22.2		0.19	
Jul		254.7		11.368		30.1		0.25	
Aug		329.0		14.688		21.7		0.18	
Sep		328.1		14.172		20.5		0.17	
Oct		328.7		14.674		16.5		0.14	
Nov		329.9		14.253		14.5		0.12	
Dec		328.8		14.677		13.8		0.12	
	Average	276.4	Total	145.413	Average	19.4	Average	0.16	

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-15A was down from January 26 to January 28 due to power outage on east side of site.
Well EW-15A was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-15A was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-15A was down from April 25 to May 8 to replace variable frequency drive and breaker replacement.
Well EW-15A was down from June 4 to July 8 for annual wellfield shutdown.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-11. Extraction Well 33264 (EW-30) Operational Summary for 2025

Reference Elevation (ft amsl): 573.82 (top of well)
Northing Coordinate (1983): 477,200.9
Easting Coordinate (1983): 1,349,751.5

Hours in reporting period: 8,760 Hours pumped: 5,061 Target pumping rate: 400 gpm
Hours not pumped: 3,699 Operational percent: 57.77

Adjusted operational percent[a]: 63.71

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate[b] (gpm)	Volume Pumped (Mgal)	Monthly Total Uranium Concentration[c] (µg/L)	Uranium Removal Index (lb of total uranium removed/Mgal pumped)
Jan	254.4	11.354	5.70	0.05
Feb	0.0	0.000	0.00	0.00
Mar	0.0	0.000	0.00	0.00
Apr	0.0	0.000	0.00	0.00
May	332.2	14.828	9.30	0.08
Jun	45.4	1.961	6.00	0.05
Jul	325.1	14.514	7.80	0.07
Aug	438.8	19.590	6.00	0.05
Sep	291.9	12.611	6.20	0.05
Oct	438.6	19.578	5.20	0.04
Nov	437.1	18.883	5.40	0.05
Dec	430.1	19.201	5.20	0.04
Average	249.5	Total 132.520	Average 4.70	Average 0.04

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-30 was down from January 19 to May 9 due to faulty transformer and fuse.
Well EW-30 was down from June 4 to July 9 for annual wellfield shutdown.
Well EW-30 was down from September 8 to September 18 to install a new pump.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-12. Extraction Well 33298 (EW-21A) Operational Summary for 2025

Reference Elevation (ft amsl): 576.21 (top of well)
Northing Coordinate (1983): 477,953.1
Easting Coordinate (1983): 1,349,499.9

Hours in reporting period: 8,760 Hours pumped: 7,652 Target pumping rate: 300 gpm
Hours not pumped: 1,108 Operational percent: 87.35
Adjusted operational percent[a]: 96.32

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate[b] (gpm)	Volume Pumped (Mgal)	Monthly Total Uranium Concentration[c] (µg/L)	Uranium Removal Index (lb of total uranium removed/Mgal pumped)
Jan	135.9	6.068	18.0	0.15
Feb	172.8	6.969	23.0	0.19
Mar	190.1	8.487	26.4	0.22
Apr	188.1	8.125	25.4	0.21
May	208.0	9.285	29.4	0.25
Jun	20.0	0.865	29.9	0.25
Jul	173.0	7.721	19.4	0.16
Aug	214.0	9.554	27.8	0.23
Sep	187.9	8.116	26.8	0.22
Oct	157.6	7.035	21.7	0.18
Nov	133.5	5.768	22.6	0.19
Dec	125.1	5.584	19.1	0.16
	Average 158.8	Total 83.578	Average 24.1	Average 0.20

Note: Extraction well EW-21A can no longer achieve its target pumping rate of 300 gpm.
[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-21A was down from January 25 to January 28 due to power outage on east side of site.
Well EW-21A was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-21A was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-21A was down from June 4 to July 10 for annual wellfield shutdown.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-13. Extraction Well 33616 (RW-6A) Operational Summary for 2025

Reference Elevation (ft amsl): 588.10 (top of well)
Northing Coordinate (1983): 475,076.8
Easting Coordinate (1983): 1,348,849.0

Hours in reporting period: 8,760 Hours pumped: 7,690.5 Target pumping rate: 300 gpm
Hours not pumped: 1,069.5 Operational percent: 87.79
Adjusted operational percent[a]: 96.81

Monthly Measurements at Wellfield								
Month	Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan	300.4		13.408		22.0		0.18	
Feb	314.4		12.675		23.9		0.20	
Mar	324.2		14.474		23.5		0.20	
Apr	266.0		11.489		20.2		0.17	
May	323.2		14.428		22.4		0.19	
Jun	24.3		1.048		21.7		0.18	
Jul	253.2		11.305		16.2		0.14	
Aug	327.6		14.623		20.6		0.17	
Sep	325.4		14.058		24.0		0.20	
Oct	327.3		14.609		23.5		0.20	
Nov	328.3		14.183		24.6		0.21	
Dec	328.2		14.652		22.9		0.19	
	Average	286.9	Total	150.953	Average	22.1	Average	0.18

[a] Adjusted for planned wellfield shutdowns.
[b]Well RW-6A was down from January 26 to January 28 due to power outage on east side of site.
Well RW-6A was down from February 16 to February 17 due to high water level in Great Miami River.
Well RW-6A was down from April 3 to April 9 due to high water level in Great Miami River.
Well RW-6A was down from June 3 to July 8 for rehabilitation and annual wellfield shutdown.
[b] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-14. Extraction Well 33617 (RW-7A) Operational Summary for 2025

Reference Elevation (ft amsl): 578.58 (top of well)
Northing Coordinate (1983): 475,395.1
Easting Coordinate (1983): 1,349,034.1

Hours in reporting period: 8,760 Hours pumped: 7,312.5 Target pumping rate: 300 gpm
Hours not pumped: 1,447.5 Operational percent: 83.48
Adjusted operational percent[a]: 92.05

Monthly Measurements at Wellfield									
Month	Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[b] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan	292.7		13.067		22.7		0.19	
Feb	305.2		12.305		23.5		0.20	
Mar	299.2		13.358		23.7		0.20	
Apr	258.2		11.155		20.9		0.17	
May	282.3		12.601		22.4		0.19	
Jun	18.6		0.803		22.6		0.19	
Jul	252.8		11.284		20.3		0.17	
Aug	327.0		14.596		20.9		0.17	
Sep	325.4		14.059		22.9		0.19	
Oct	161.7		7.216		21.0		0.18	
Nov	327.9		14.167		24.4		0.20	
Dec	327.8		14.632		22.1		0.18	
	Average	252.3	Total	110.445	Average	22.1	Average	0.18

[a] Adjusted for planned wellfield shutdowns.
[b] Well RW-7A was down from January 26 to January 28 due to power outage on east side of site.
Well RW-7A was down from February 16 to February 17 due to high water level in Great Miami River.
Well RW-7A was down from April 3 to April 9 due to high water level in Great Miami River.
Well RW-7A was down from June 3 to July 8 for rehabilitation and annual wellfield shutdown.
Well RW-7A was down from October 8 to October 23 to replace variable frequency drive and motor.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-15. PRRS Groundwater Summary Statistics and Trend Analysis

Analyte	Monitoring Well	Number of Samples[a,b,c]	Minimum[a,b,c,d] (mg/L)	Maximum[a,b,c,d] (mg/L)	Average[a,b,c,d] (mg/L)	SD[a,b,c,d,e]	Trend[a,b,c,d,f]
Arsenic	2128	257	0.000195	0.188	0.0107	0.0199	Down
	2636	195	0.0100	0.0939	0.0428	0.0188	Down
	2898	74	0.000147	0.0820	0.00402	0.0101	No Trend[g]
	2899	67	0.000320	0.0283	0.00253	0.00376	No Trend[g]
	2900	256	0.000320	0.0609	0.00482	0.00526	Down
	3128	77	0.000400	0.234	0.00666	0.0267	No Trend
	3636	74	0.000500	0.0233	0.00290	0.00362	No Trend[g]
	3898	74	0.000500	0.0434	0.00416	0.00603	No Trend[g]
	3899	75	0.000147	0.0307	0.00281	0.00435	No Trend[g]
	3900	75	0.000375	0.0208	0.00299	0.00346	No Trend
Phosphorus	2128	83	0.0250	16.2	1.21	2.20	Down
	2636	47	9.60	170	75.2	41.8	Down
	2898	75	0.00500	9.95	0.210	1.16	Down
	2899	66	0.00500	0.831	0.0519	0.106	Down
	2900	73	0.0431	4.74	0.417	0.605	Down
	3128	84	0.00500	13.0	0.208	1.41	No Trend
	3636	73	0.00910	1.10	0.0643	0.131	No Trend
	3898	73	0.00750	1.24	0.0882	0.157	Down
	3899	74	0.00500	1.86	0.101	0.247	Down
	3900	75	0.00500	1.38	0.0788	0.214	Down
Potassium	2128	75	0.830	18.0	3.10	3.02	Down
	2636	47	4.60	218	54.9	48.3	Down
	2898	75	1.11	9.64	4.40	1.11	Up
	2899	67	1.36	8.85	4.09	0.88	Up
	2900	74	0.00950	6.00	1.91	1.02	No Trend
	3128	77	1.08	3.70	1.86	0.60	Down
	3636	73	1.09	4.24	2.05	0.58	Down
	3898	74	0.610	4.23	2.73	0.72	Up
	3899	75	0.875	4.55	2.87	0.78	Up
	3900	75	0.975	3.19	1.69	0.36	Down

Table A.1-15. PRRS Groundwater Summary Statistics and Trend Analysis (continued)

Analyte	Monitoring Well	Number of Samples[a,b,c]	Minimum[a,b,c,d] (mg/L)	Maximum[a,b,c,d] (mg/L)	Average[a,b,c,d] (mg/L)	SD[a,b,c,d,e]	Trend[a,b,c,d,f]
Sodium	2128	75	12.3	75.2	32.5	11.4	Down
	2636	47	14.4	148	45.7	26.9	Down
	2898	75	4.94	31.0	19.8	4.6	Up
	2899	67	11.2	25.1	18.1	3.4	Up
	2900	74	0.0136	43.3	24.5	8.3	Down
	3128	77	3.52	13.4	5.38	2.41	Down
	3636	73	3.14	13.0	5.52	2.59	Down
	3898	74	7.29	28.8	12.9	5.7	Up
	3899	75	6.24	43.6	14.1	9.9	Up
	3900	75	3.13	10.8	4.71	1.65	Down

[a] The data are primarily based on unfiltered sample result with some filtered sample results (i.e., 2001-2007).
[b] If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples, and the sample with the maximum concentration is used to determine the summary statistics (minimum, maximum, average, standard deviation, and Mann-Kendall test for trend).
[c] Rejected data qualified with an R were not included in this count or the summary statistics.
[d] Where concentrations are below the detection limit, each result used in the summary statistics is set at half the detection limit.
[e] SD = standard deviation.
[f] Trend starts on August 27, 1993, and is based on the startup of the South Plume extraction wells (DOE 1993). This Mann-Kendall test for trend is performed with a 95% confidence interval.
[g] The original statistics indicated an upward trend; however, the upward trend was due to a slight increase in the method detection limit for nondetected concentrations. As a result, “No Trend” is indicated.

Table A.1-16. Extraction Well 32761 (EW-26) Operational Summary for 2025

Reference Elevation (ft amsl): 570.88 (top of casing)
Northing Coordinate (1983): 479,892.4
Easting Coordinate (1983): 1,347,364.0

Hours in reporting period: 8,760 Hours pumped: 6,368 Target pumping rate: 300 gpm
Hours not pumped: 2,392 Operational percent: 72.69
Adjusted operational percent[a]: 80.15

Monthly Measurements at Wellfield				
Month	**Monthly Average Pumping Rate[b] (gpm)**	**Volume Pumped (Mgal)**	**Monthly Total Uranium Concentration[c] (µg/L)**	**Uranium Removal Index (lb of total uranium removed/Mgal pumped)**
Jan	308.8	13.784	15.3	0.13
Feb	312.2	12.587	15.9	0.13
Mar	328.0	14.641	17.2	0.14
Apr	25.5	1.102	15.7	0.13
May	113.7	5.078	18.5	0.15
Jun	33.8	1.461	19.6	0.16
Jul	244.7	10.922	21.1	0.18
Aug	329.8	14.721	16.9	0.14
Sep	328.0	14.170	17.6	0.15
Oct	329.6	14.712	16.0	0.13
Nov	175.5	7.581	16.8	0.14
Dec	328.8	14.680	14.9	0.12
Average	238.2	Total 125.438	Average 17.1	Average 0.14

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-26 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-26 was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-26 was down from April 3 to May 19 due to high water level in Great Miami River and motor replacement.
Well EW-26 was down from June 4 to July 9 for annual wellfield shutdown.
Well EW-26 was down from November 3 to November 17 to facilitate Visitors Center transformer replacement.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-17. Extraction Well 33062 (EW-27) Operational Summary for 2025

Reference Elevation (ft amsl): 575.10 (top of casing)
Northing Coordinate (1983): 480,013.0
Easting Coordinate (1983): 1,348,037.2

Hours in reporting period: 8,760 Hours pumped: 7,842 Target pumping rate: 200 gpm
Hours not pumped: 918 Operational percent: 89.51

Monthly Measurements at Wellfield				
Month	Monthly Average Pumping Rate[a] (gpm)	Volume Pumped (Mgal)	Monthly Total Uranium Concentration[b] (µg/L)	Uranium Removal Index (lb of total uranium removed/Mgal pumped)
Jan	203.5	9.085	15.6	0.13
Feb	223.0	8.989	16.8	0.14
Mar	219.6	9.804	20.8	0.17
Apr	155.3	6.711	16.7	0.14
May	189.6	8.463	17.1	0.14
Jun	127.0	5.489	16.9	0.14
Jul	224.4	10.017	16.3	0.14
Aug	219.3	9.791	18.8	0.16
Sep	203.7	8.798	17.4	0.15
Oct	219.8	9.811	16.3	0.14
Nov	117.1	5.061	16.2	0.14
Dec	219.3	9.789	15.1	0.13
Average	193.5	Total 101.807	Average 17.0	Average 0.14

[a] Well EW-27 was down from January 26 to January 28 due to power outage on east side of site.
Well EW-27 was down from April 3 to April 9 due to high water level in Great Miami River.
Well EW-27 was down from April 15 to April 17 for liquid acid descaler chemical treatment.
Well EW-27 was down from June 14 to June 23 due to a sitewide power outage.
Well EW-27 was down from September 23 to September 25 for liquid acid descaler chemical treatment.
Well EW-27 was down from November 3 to November 17 to facilitate Visitors Center transformer replacement.
[b] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-18. Extraction Well 33347 (EW-33a) Operational Summary for 2025

Reference Elevation (ft amsl): 574.86 (top of casing)
Northing Coordinate (1983): 481,031.8
Easting Coordinate (1983): 1,346,715.8

Hours in reporting period: 8,784 Hours pumped: 7,259 Target pumping rate: 300 gpm
Hours not pumped: 1,501 Operational percent: 82.87

Adjusted operational percent[a]: 91.38

Monthly Measurements at Wellfield									
Month		Monthly Average Pumping Rate[b] (gpm)		Volume Pumped (Mgal)		Monthly Total Uranium Concentration[c] (µg/L)		Uranium Removal Index (lb of total uranium removed/Mgal pumped)	
Jan		298.6		13.329		13.6		0.11	
Feb		306.8		12.372		13.5		0.11	
Mar		328.8		14.678		15.1		0.13	
Apr		264.6		11.432		13.7		0.11	
May		316.0		14.106		17.4		0.15	
Jun		33.8		1.460		18.2		0.15	
Jul		236.5		10.557		18.2		0.15	
Aug		329.0		14.686		18.2		0.15	
Sep		328.1		14.172		17.1		0.14	
Oct		315.6		14.090		15.7		0.13	
Nov		175.3		7.574		16.9		0.14	
Dec		323.2		14.426		16.0		0.13	
	Average	271.4	Total	142.883	Average	16.1	Average	0.13	

[a] Adjusted for planned annual wellfield shutdowns.
[b] Well EW-33A was down from January 26 to January 28 due to power outage on east side of site.
Well EW-33A was down from February 16 to February 17 due to high water level in Great Miami River.
Well EW-33A was down from April 3 to April 9 due to high water level in Great Miami River
Well EW-33A was down from June 4 to July 9 for annual wellfield shutdown.
Well EW-33A was down from November 3 to November 17 to facilitate Visitors Center transformer replacement.
[c] Average is used if more than one concentration measurement is available for a particular month.

Table A.1-19. Stretched Exponential Regression Equations for Uranium Concentration Data from Extraction Wells—Through December 31, 2025

Extraction Well Number	Database Identification	Stretched Exponential Equations
RW-6a	33616	Y=56.62*e^(-(x/147.21)^0.1932)
RW-7a	33617	Y=65.37*e^(-(x/138.93)^0.1288)
EW-15a	33262	Y=91.76*e^(-(x/2747.18)^0.3932)
EW-17a	33326	Y=41.91*e^(-(x/6112.74)^1)
EW-18	31550	Y=500*e^(-(x/0.24)^0.0989)
EW-19	31560	Y=236.62*e^(-(x/460.02)^0.3567)
EW-20	31561	Y=117.34*e^(-(x/575.45)^0.1194)
EW-21a	33298	Y=221.32*e^(-(x/1130.42)^0.3883)
EW-22	32276	Y=332.09*e^(-(x/873.32)^0.4807)
EW-23	32447	Y=409.05*e^(-(x/616.33)^0.3868)
EW-24	32446	Y=157.56*e^(-(x/1615.31)^0.3843)
EW-25	33061	Y=55.59*e^(-(x/6994.26)^0.7644)
EW-30	33264	Y=227.1*e^(-(x/1144.22)^0.6172)
EW-26	32761	Y=167.23*e^(-(x/917.69)^0.3872)
EW-27	33062	Y=260.22*e^(-(x/399.73)^0.339)
EW-33a	33347	Y=65.91*e^(-(x/454.77)^0.0802)

Table A.1-20. Estimated Pounds of Uranium to Be Removed to Achieve Concentration-Based FRL Goals

Year	Based on Concentration Data and Use of Stretched Exponential Equations	Based on Model Predictions (Nominal Boundary Conditions)	Based on 95% UCL
2026	243	201	291
2027	236	176	286
2028	231	158	281
2029	225	143	277
2030	220	132	273
2031	215	122	269
2032	210	114	265
2033	205	107	261
2034	64	39	82
2035	63	37	81
2036	61	35	80
2037	60	33	79
2038	59	32	78
2039	58	31	77
2040	57	30	76
Estimate of total to be extracted	2,205	1,390	2,755
Actual net pounds extracted through December 31, 2025	*16,621*	*16,621*	*16,621*
Estimate of total pounds to be extracted to achieve concentration-based FRL goals	18,826	18,011	19,376

Estimate of Mass Removal Completeness Based on Concentration Data	Estimate of Mass Removal Completeness Based on Model Predictions	Estimate of Mass Removal Completeness Based on 95% UCL of Concentration Data
88%	92%	86%

Table A.1-21. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations

Extraction Well	Model-Predicted Total Uranium Concentration December 2025 (µg/L)	Total Uranium Concentration December 2025 (µg/L)	Residual Total Uranium Concentration[a] (µg/L)
33616 (RW-6A)	11.76	22.9	11.14
33617 (RW-7A)	10.72	22.1	11.38
33262 (EW-15A)	10.50	13.8	3.3
33326 (EW-17A)	6.08	7.10	1.02
31550 (EW-18)	11.50	24.1	12.6
31560 (EW-19)	18.16	15.5	−2.66
31561 (EW-20)	17.01	28.7	11.69
33298 (EW-21A)	12.50	19.1	6.6
32276 (EW-22)	9.01	11.9	2.89
32447 (EW-23)	14.97	17.4	2.43
32446 (EW-24)	6.94	17.8	10.86
33061 (EW-25)	11.36	13.2	1.84
32761 (EW-26)	17.28	14.9	–2.38
33062 (EW-27)	6.10	15.1	9.00
33264 (EW-30)	4.07	5.20	1.13
33347 (EW-33A)	33.01	16.0	−17.01
2025 Average	12.56	16.55	3.99
2025 Standard Deviation	6.87	6.05	7.61
2025 Maximum	33.01	28.70	12.60
2025 Minimum	4.07	5.20	−17.01
2025 Range	28.94	23.50	29.61
2024 Average	13.91	17.63	3.72
2024 Standard Deviation	8.60	6.79	9.94
2024 Maximum	41.21	32.00	14.19
2024 Minimum	4.53	5.50	–25.71
2024 Range	36.68	26.50	39.90
2023 Average	16.50	16.55	0.05
2023 Standard Deviation	12.69	7.01	12.88
2023 Maximum	54.90	29.20	12.20
2023 Minimum	2.80	6.10	–41.10
2023 Range	52.10	23.10	53.30
2022 Average	20.85	16.3	–4.5
2022 Standard Deviation	28.49	8.0	27.7
2022 Maximum	136.13	30.3	14.2
2022 Minimum	2.25	0.0	–117.1
2022 Range	133.88	30.3	131.3

Table A.1-21. Comparison of Model-Predicted Versus Actual Total Uranium Concentration (continued)

Extraction Well	Model-Predicted Total Uranium Concentration December 2025 (µg/L)	Total Uranium Concentration December 2025 (µg/L)	Residual Total Uranium Concentration[a] (µg/L)
2021 Average	13.2	20.2	7.07
2021 Standard Deviation	5.91	7.90	8.0
2021 Maximum	26.28	31.6	18.4
2021 Minimum	3.23	2.80	–13.3
2021 Range	23.05	28.8	31.7
2020 Average	14.1	20.7	6.66
2020 Standard Deviation	6.8	7.90	8.0
2020 Maximum	29.8	32.3	18.6
2020 Minimum	3.23	2.90	–13.0
2020 Range	26.6	29.4	31.6
2019 Average	15.3	19.9	4.70
2019 Standard Deviation	7.8	8.20	9.10
2019 Maximum	34.0	34.8	20.5
2019 Minimum	3.23	2.80	–14.6
2019 Range	30.8	32.0	35.1
2018 Average	16.8	21.1	4.3
2018 Standard Deviation	9.0	8.5	9.7
2018 Maximum	39.5	37.2	20.9
2018 Minimum	3.22	2.80	–16.6
2018 Range	36.3	34.4	37.6
2017 Average	18.5	22.0	3.5
2017 Standard Deviation	10.4	8.70	11.4
2017 Maximum	46.5	40.9	22.0
2017 Minimum	3.20	2.60	–26.8
2017 Range	43.3	38.3	48.8
2016 Average	20.5	23.5	2.99
2016 Standard Deviation	15.1	8.50	14.3
2016 Maximum	55.84	44.4	21.7
2016 Minimum	3.18	3.80	–35.4
2016 Range	52.7	40.6	57.1
2015 Average	23.1	22.6	–0.48
2015 Standard Deviation	15.1	8.50	15.4
2015 Maximum	69.2	41.0	14.7
2015 Minimum	3.16	3.60	–50.4
2015 Range	66.0	37.4	65.1

[a] Residual total uranium concentration = actual total uranium concentration – model-predicted total uranium concentration.

Table A.1-22. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations in Selected Monitoring Wells

Well Number	Observed Total Uranium Concentrations First Half 2025 (µg/L)	Predicted Total Uranium Concentrations[a] April 1, 2025 (µg/L)	Total Uranium Concentration Residuals (µg/L)
2045	46.8	18.56	28.24
2046	13.9	17.22	−3.32
2049	89.5	13.20	76.3
2093	3.72	2.46	1.26
2385	28.1	18.25	9.85
2386	233	68.30	164.7
2387	114	29.40	84.6
2821	6.88	8.47	−1.59
23271	30.9	16.54	14.36
23273	127	27.98	99.02
23274	75	39.63	35.37
23275	67.2	25.91	41.29
23276	76.5	27.72	48.78
23278	16.6	9.98	6.62
23280	15.6	20.02	−4.42
23281	54.1	23.32	30.78
82433_C2	3.3	7.32	−4.02
83117_C2	19.2	18.80	0.4
83124_C2	21.3	29.55	−8.25
83293_C2	2.1	3.69	−1.59
83294_C2	53.8	32.27	21.53
83295_C2	61.6	15.44	46.16
83296_C2	21.9	13.91	7.99
2025 Average	51.39	21.21	30.18
2025 Standard Deviation	53.22	13.95	42.20
2025 Maximum	233.00	68.30	164.70
2025 Minimum	2.10	2.46	−8.25
2025 Range	230.90	65.84	172.95

Table A.1-22. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations in Selected Monitoring Wells (continued)

Well Number	Observed Total Uranium Concentrations First Half 2025 (µg/L)	Predicted Total Uranium Concentrations[a] April 1, 2025 (µg/L)	Total Uranium Concentration Residuals (µg/L)
2024 Average	48.66	23.71	24.95
2024 Standard Deviation	42.49	16.06	30.84
2024 Maximum	153	76.92	89.20
2024 Minimum	2.12	2.51	–9.11
2024 Range	150.88	74.41	98.31
2023 Average	57.61	23.99	33.62
2023 Standard Deviation	50.43	16.19	42.72
2023 Maximum	176.00	72.02	131.17
2023 Minimum	2.20	2.18	–21.02
2023 Range	173.80	69.84	152.19
2022 Average	63.54	33.99	29.55
2022 Standard Deviation	65.71	25.12	61.02
2022 Maximum	278.00	108.22	263.88
2022 Minimum	2.42	2.63	–32.58
2022 Range	275.58	105.59	296.46

[a] Model predictions based on nominal water levels.

Table A.1-23. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations with Select Wells Removed

Well Number[a]	Observed Total Uranium Concentrations First Half 2025 (µg/L)	Predicted Total Uranium Concentrations April 1, 2025[b] (Nominal Boundary Conditions) (µg/L)	Total Uranium Concentration Residuals (µg/L)
2045	46.8	18.56	28.24
2046	13.9	17.22	−3.32
2093	3.72	2.46	1.26
2385	28.1	18.25	9.85
2821	6.88	8.47	−1.59
23271	30.9	16.54	14.36
23274	75	39.63	35.37
23275	67.2	25.91	41.29
23278	16.6	9.98	6.62
23280	15.6	20.02	−4.42
23281	54.1	23.32	30.78
82433_C2	3.3	7.32	−4.02
83117_C2	19.2	18.8	0.4
83124_C2	21.3	29.55	−8.25
83293_C2	2.1	3.69	−1.59
83294_C2	53.8	32.27	21.53
83295_C2	61.6	15.44	46.16
83296_C2	21.9	13.91	7.99
2025 Average	30.11	17.85	12.26
2025 Standard Deviation	23.59	9.83	17.36
2025 Maximum	75.0	39.63	46.16
2025 Minimum	2.1	2.46	−8.25
2025 Range	72.90	37.17	54.41
2024 Average	32.17	20.02	12.15
2024 Standard Deviation	27.70	11.63	19.22
2024 Maximum	87.9	46.49	44.78
2024 Minimum	2.12	2.51	–9.11
2024 Range	85.78	43.98	53.89
2023 Average	37.21	21.47	15.74
2023 Standard Deviation	32.11	13.51	26.21
2023 Maximum	92.80	46.02	68.68
2023 Minimum	2.20	2.18	–21.02
2023 Range	90.60	43.84	89.71

Table A.1-23. Comparison of Model-Predicted Versus Actual Total Uranium Concentrations with Select Wells Removed (continued)

Well Number[a]	Observed Total Uranium Concentrations First Half 2025 (µg/L)	Predicted Total Uranium Concentrations April 1, 2025[b] (Nominal Boundary Conditions) (µg/L)	Total Uranium Concentration Residuals (µg/L)
2022 Average	38.88	32.69	6.19
2022 Standard Deviation	37.00	27.46	20.25
2022 Maximum	146.00	108.22	39.19
2022 Minimum	2.42	2.63	–32.58
2022 Range	143.58	105.59	71.77

[a] Data from monitoring wells 2049, 2386, 2387, 23273, 23276 are not presented.
[b] Model predictions are based on nominal water levels.

Table A.1-24. Extraction Well Target Design Pumping Rates

Extraction Well	Target Pumping Rate (gpm)
South Plume	
33616 (RW-6A)	300
33617 (RW-7A)	300
Subtotal	600
Waste Storage Area	
32761 (EW-26)	300
33062 (EW-27)	200
33347 (EW-33a)	300
Subtotal	800
South Field	
31550 (EW-18)	100
31560 (EW-19)	100
31561 (EW-20)	200
33298 (EW-21A)	300
33326 (EW-17A)	175
32276 (EW-22)	300
32446 (EW-24)	400
32447 (EW-23)	500
33061 (EW-25)	100
33264 (EW-30)	400
33262 (EW-15A)	300
Subtotal	2,875
Total Pumping	4,275

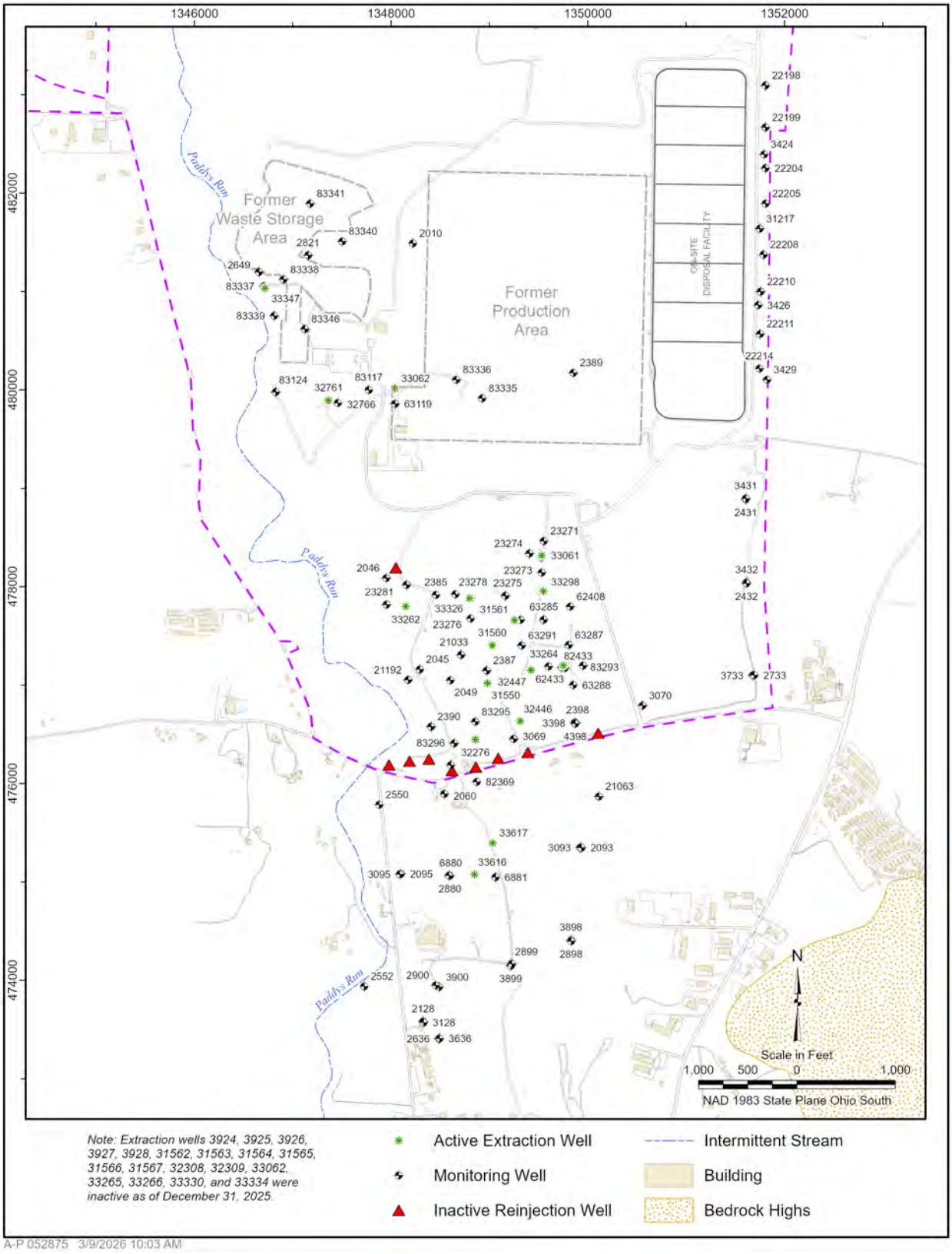


Figure A.1-1. Well Locations for South Plume, South Field, WSA, and PRRS Monitoring Activities

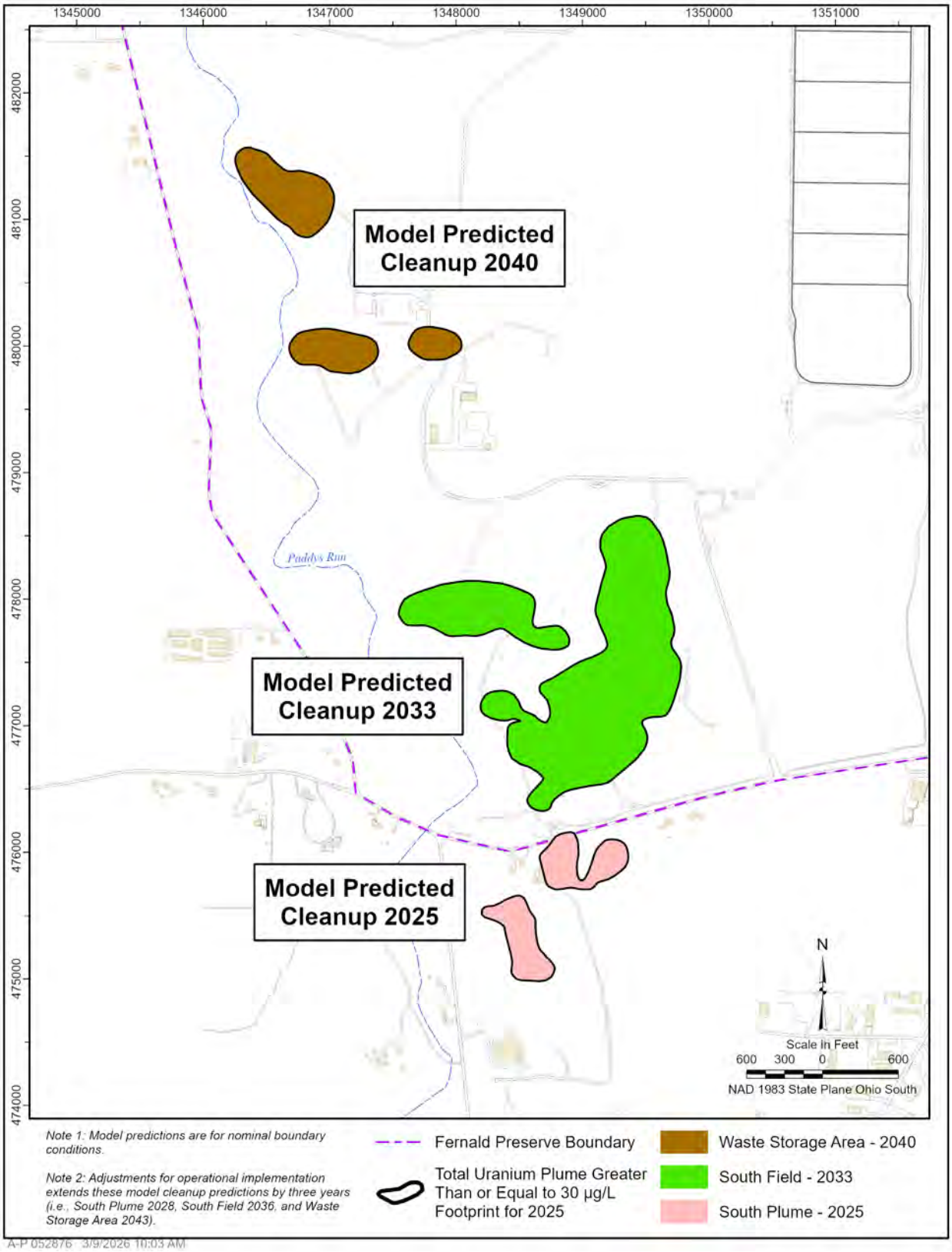


Figure A.1-2. 2022 Model-Predicted Cleanup Dates, Nominal Boundary Conditions



Figure A.1-3. Clean Pump (Top) Versus Iron-Fouled Pump (Bottom)

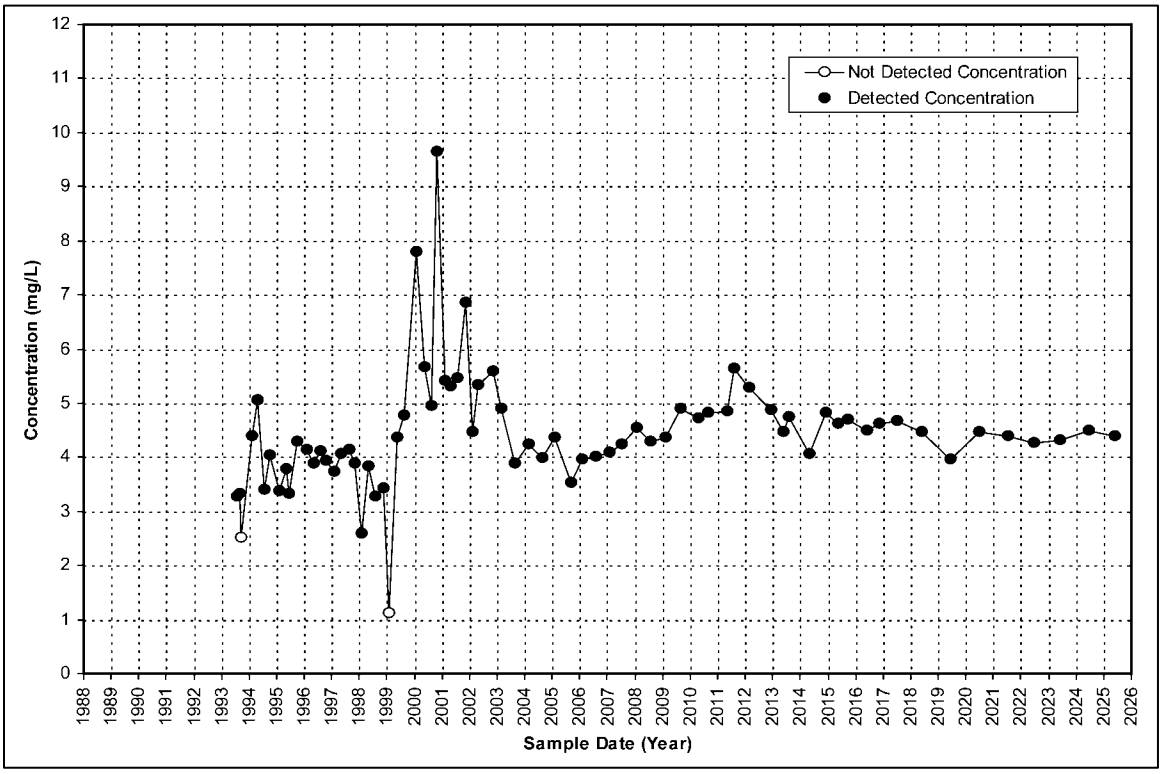


Figure A.1-4. Potassium Concentration Versus Time Plot for Monitoring Well 2898

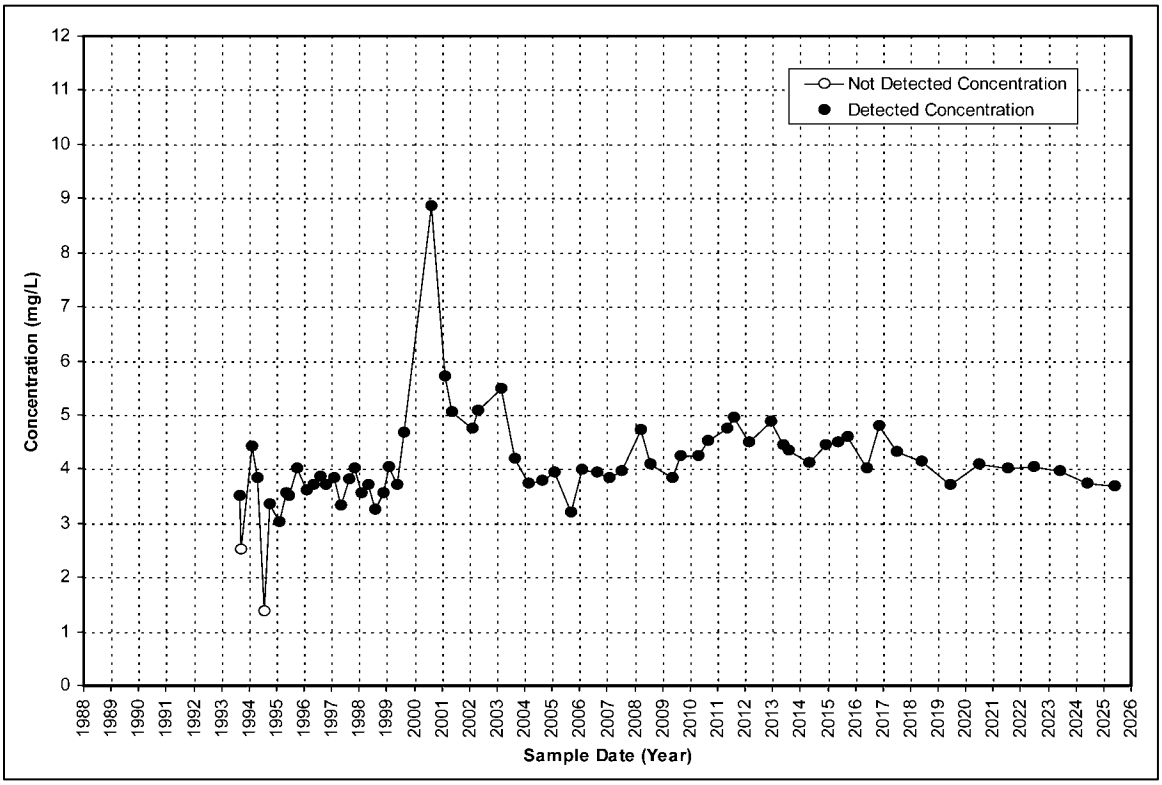


Figure A.1-5. Potassium Concentration Versus Time Plot for Monitoring Well 2899

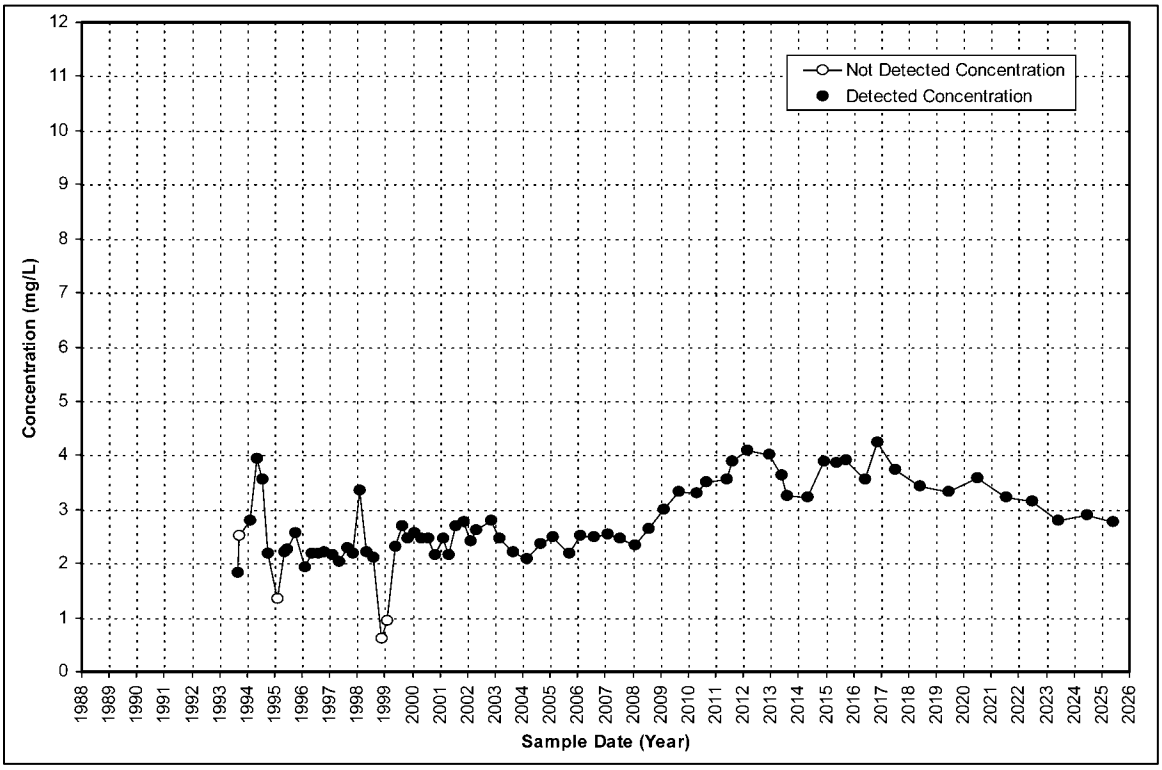


Figure A.1-6. Potassium Concentration Versus Time Plot for Monitoring Well 3898

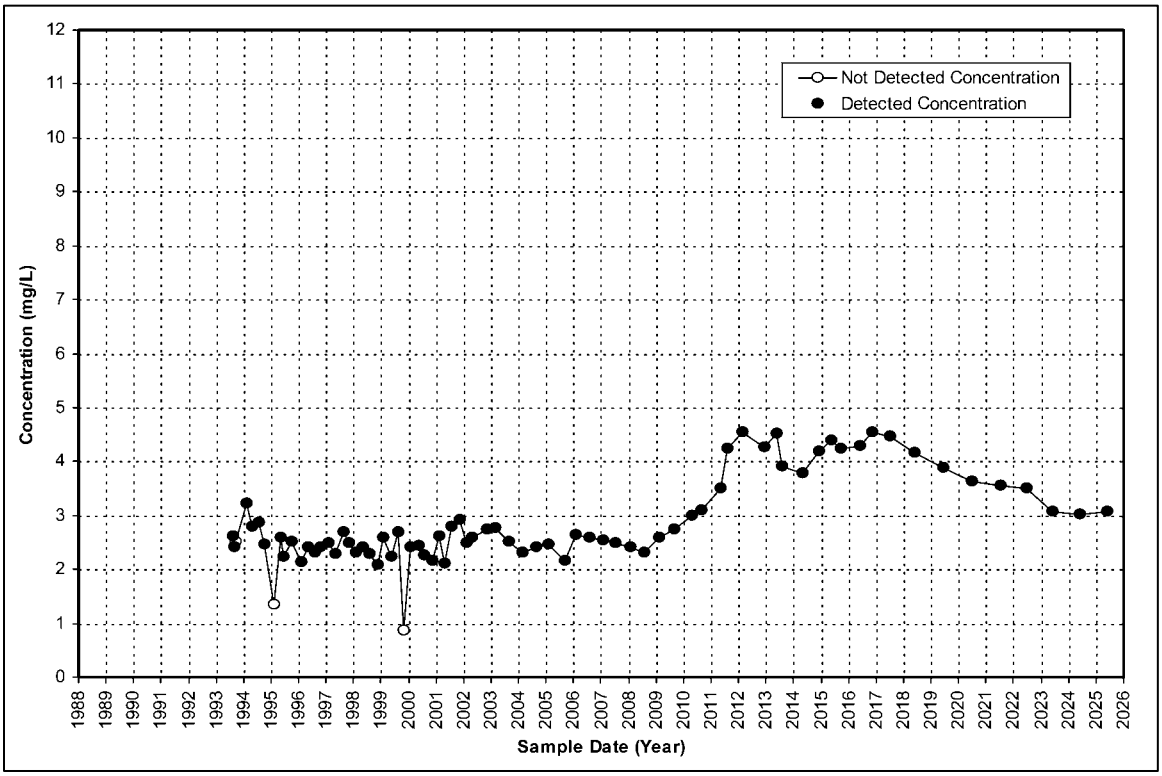


Figure A.1-7. Potassium Concentration Versus Time Plot for Monitoring Well 3899

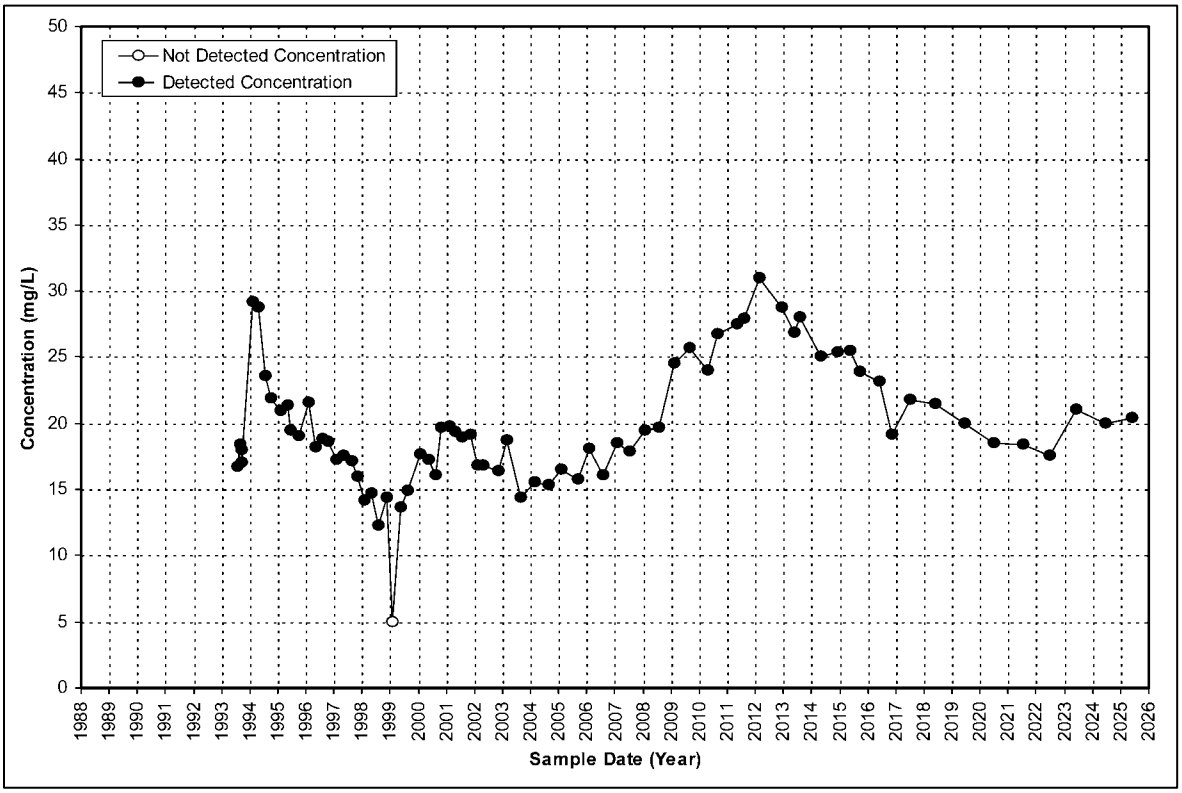


Figure A.1-8. Sodium Concentration Versus Time Plot for Monitoring Well 2898

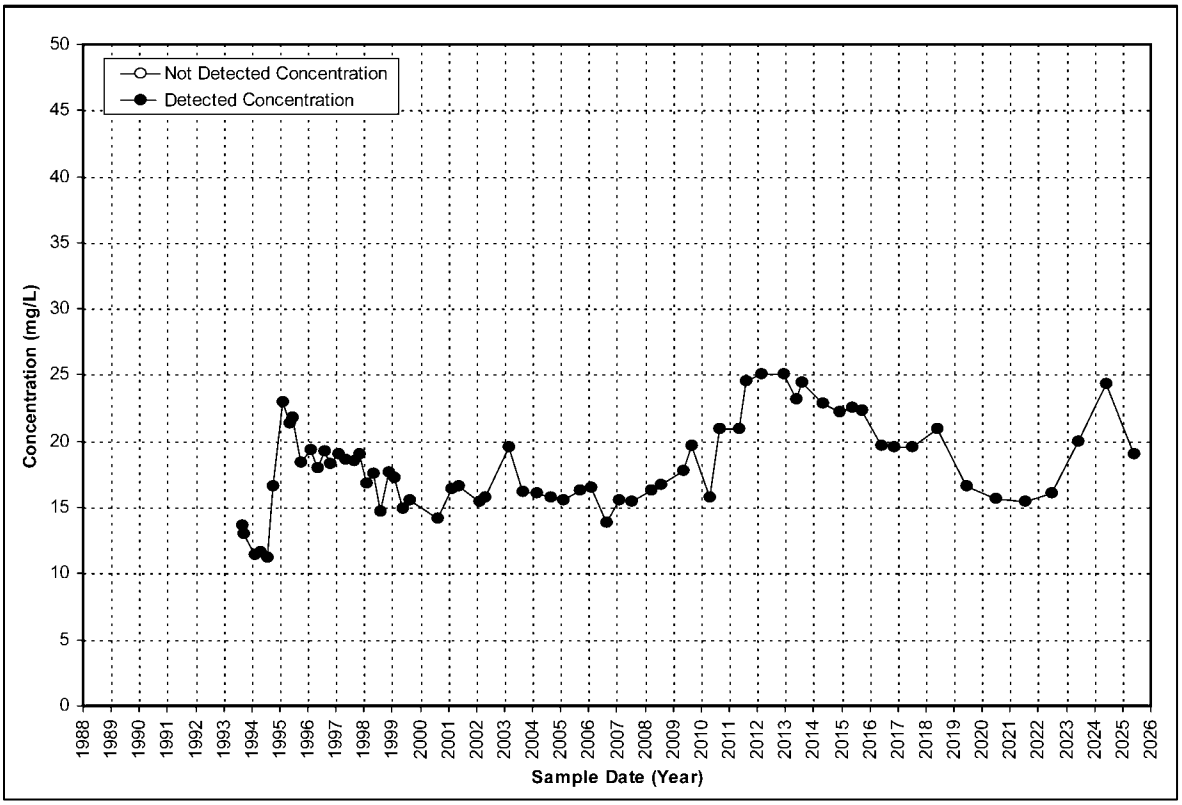


Figure A.1-9. Sodium Concentration Versus Time Plot for Monitoring Well 2899

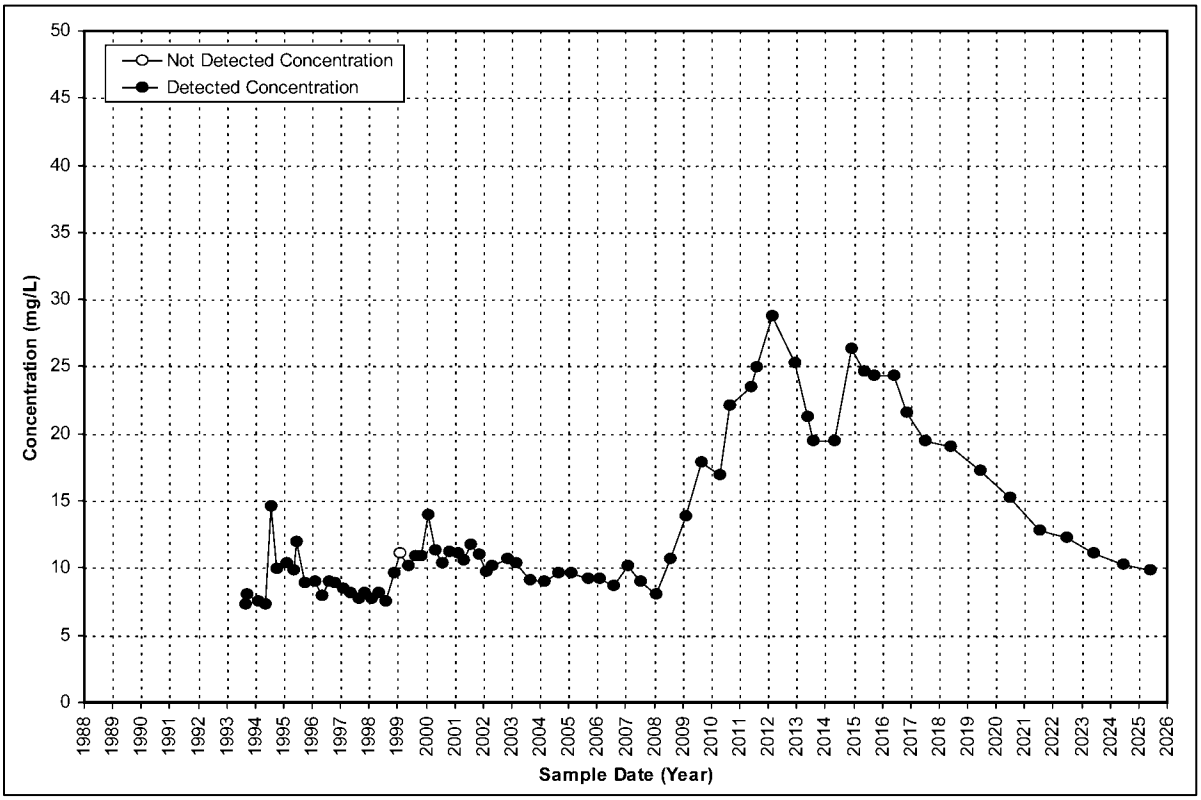


Figure A.1-10. Sodium Concentration Versus Time Plot for Monitoring Well 3898

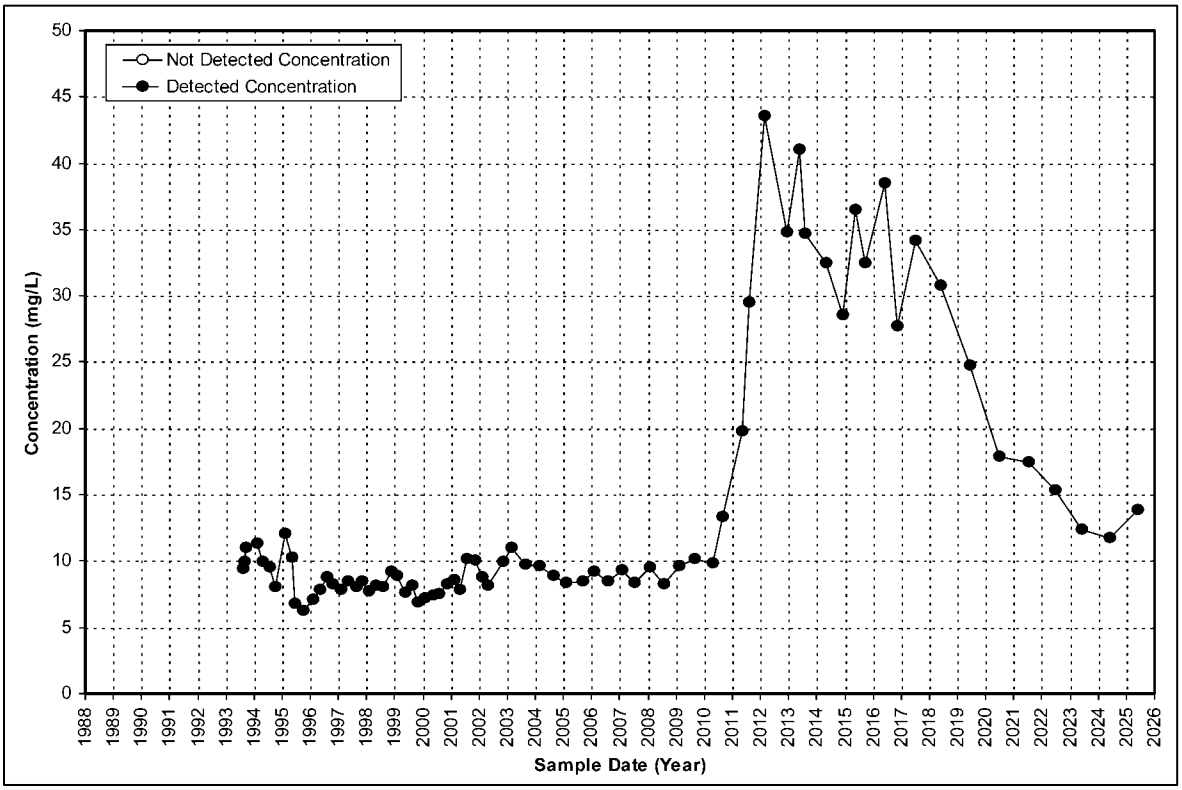


Figure A.1-11. Sodium Concentration Versus Time Plot for Monitoring Well 3899

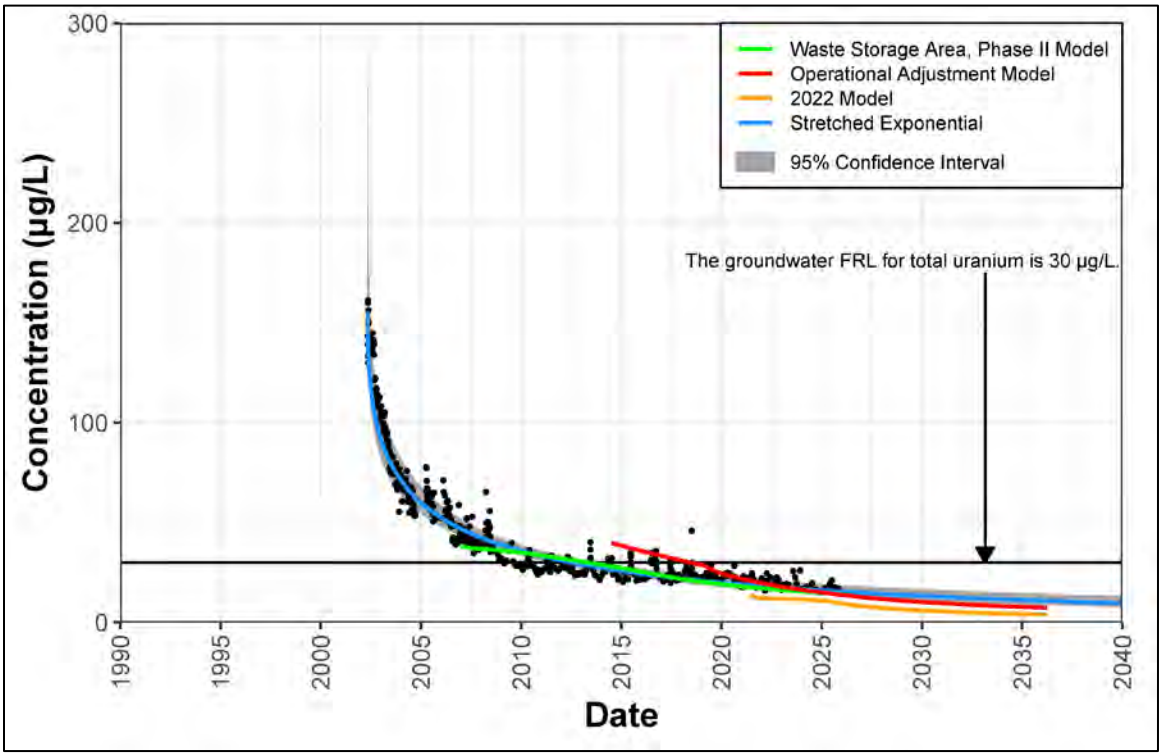


Figure A.1-12. Total Uranium Concentration Versus Time Plot for Extraction Well 32761 (EW-26) with Regression Analysis

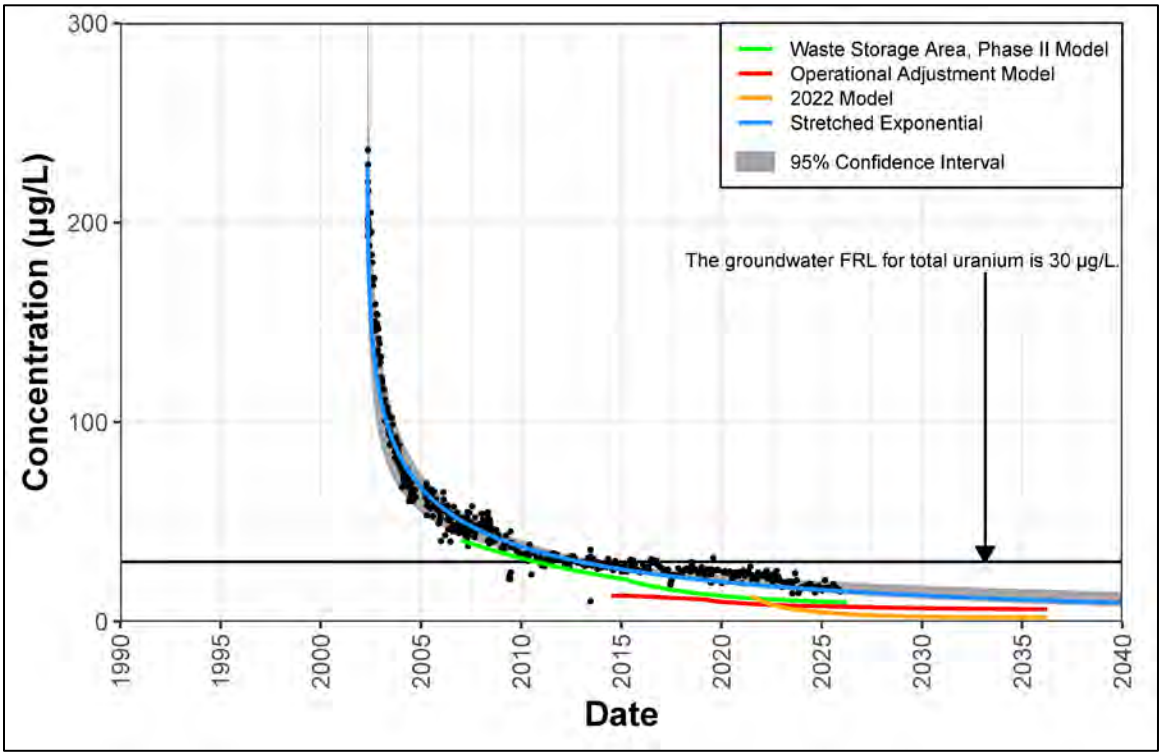


Figure A.1-13. Total Uranium Concentration Versus Time Plot for Extraction Well 33062 (EW-27) with Regression Analysis

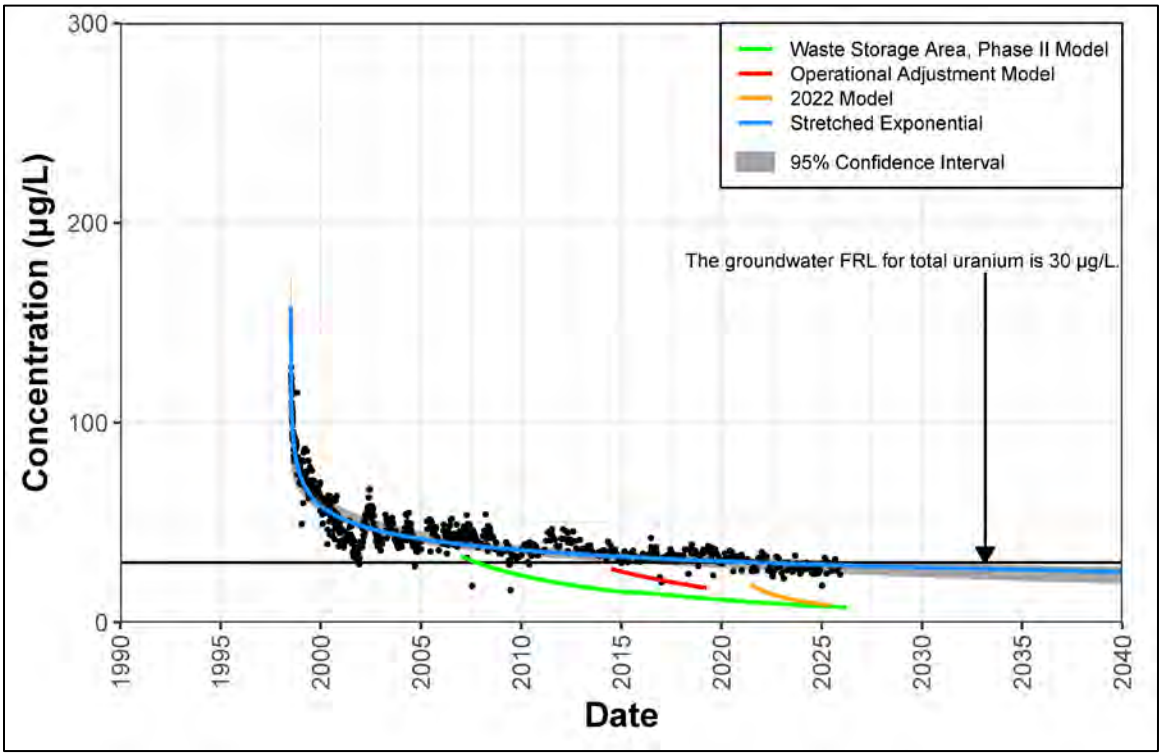


Figure A.1-14. Total Uranium Concentration Versus Time Plot for Extraction Well 31550 (EW-18) with Regression Analysis

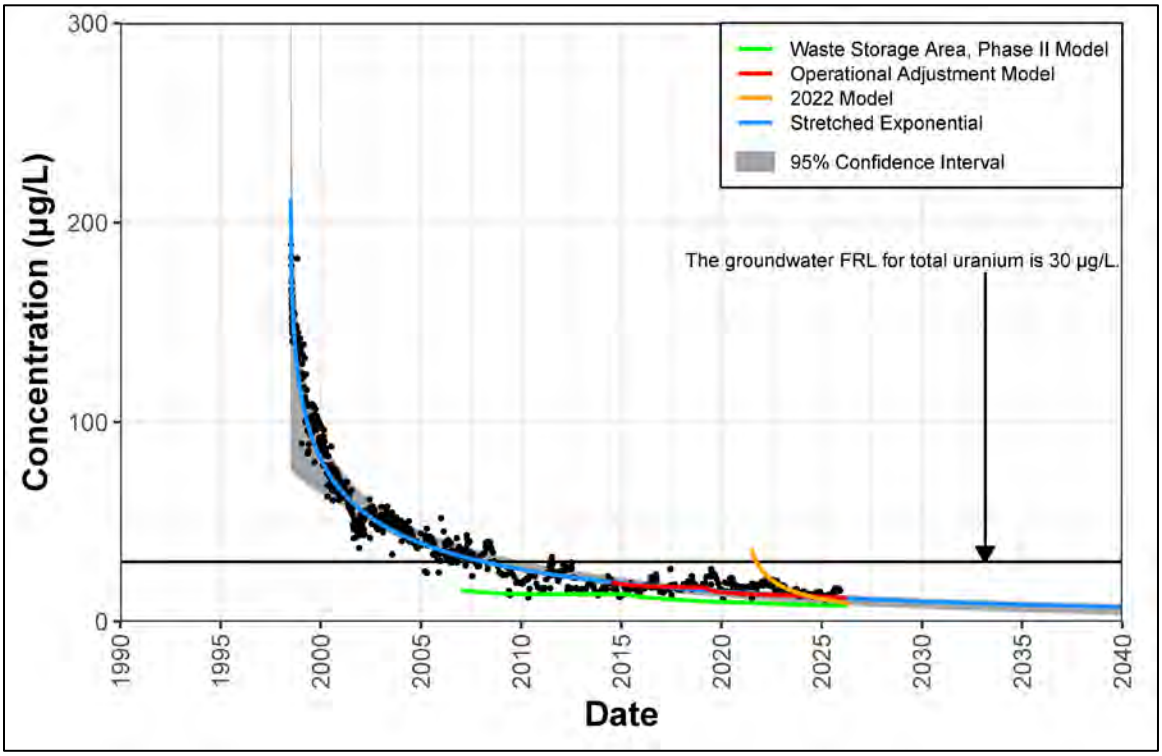


Figure A.1-15. Total Uranium Concentration Versus Time Plot for Extraction Well 31560 (EW-19) with Regression Analysis

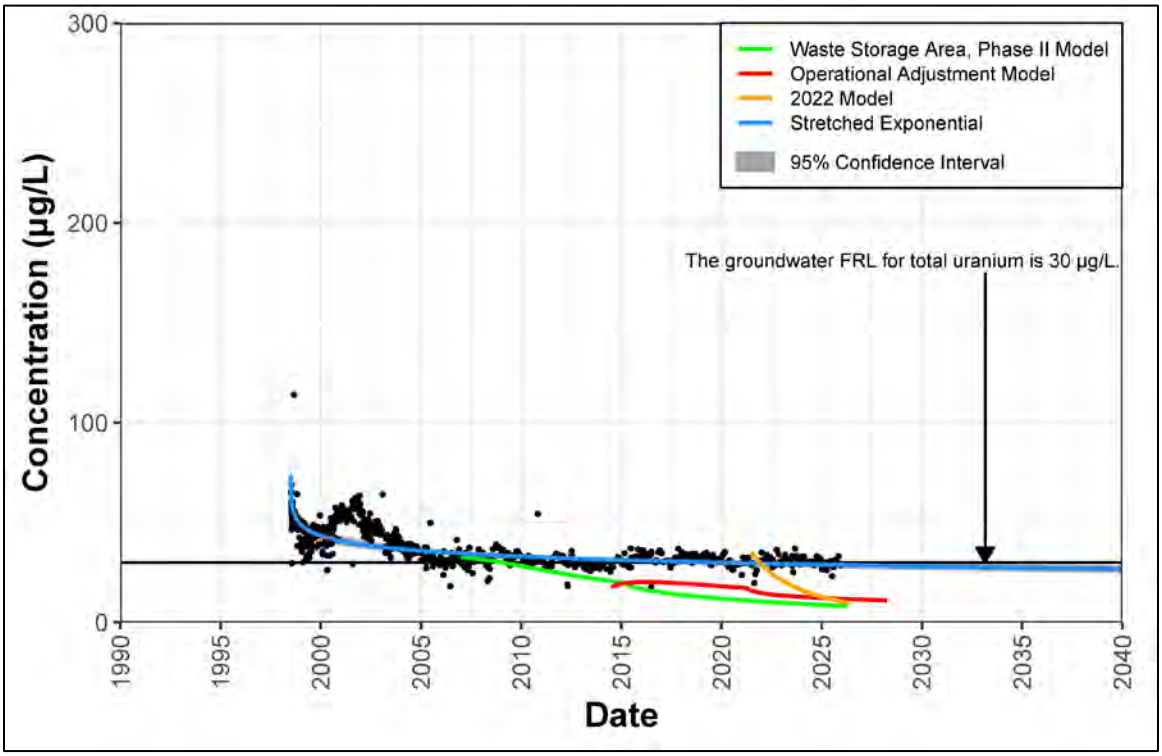


Figure A.1-16. Total Uranium Concentration Versus Time Plot for Extraction Well 31561 (EW-20) with Regression Analysis

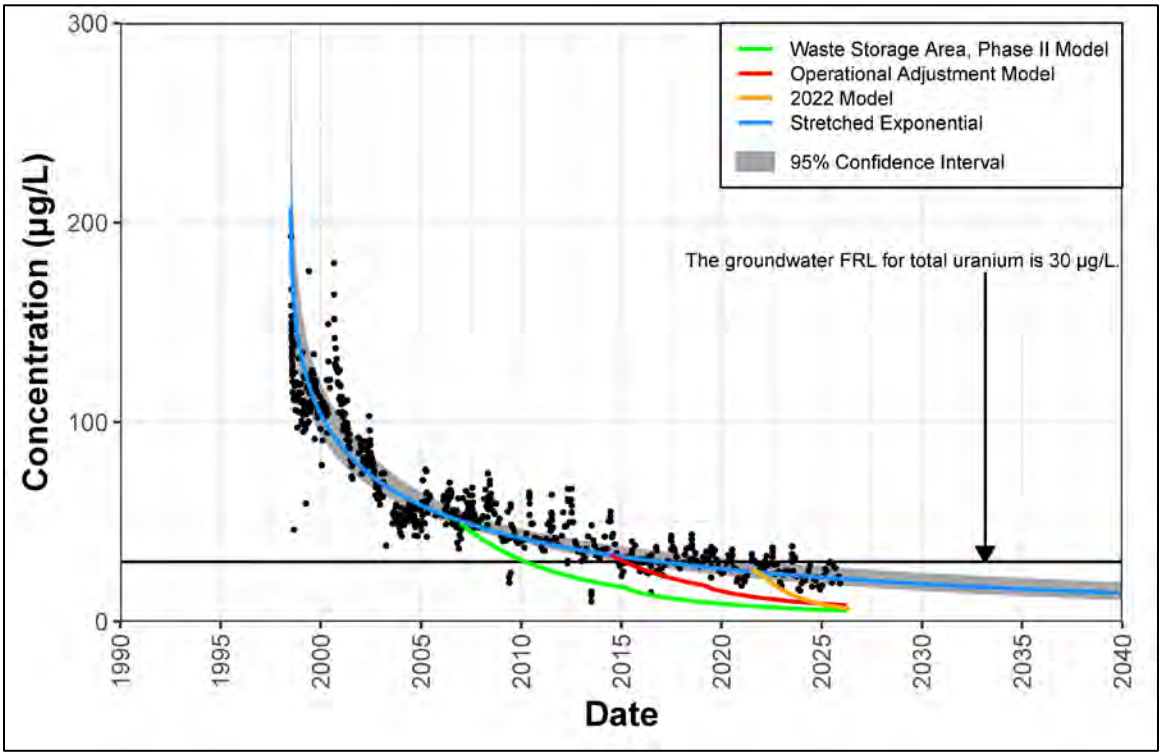


Figure A.1-17. Total Uranium Concentration Versus Time Plot for Extraction Wells 31562 (EW-21) and 33298 (EW-21a) with Regression Analysis

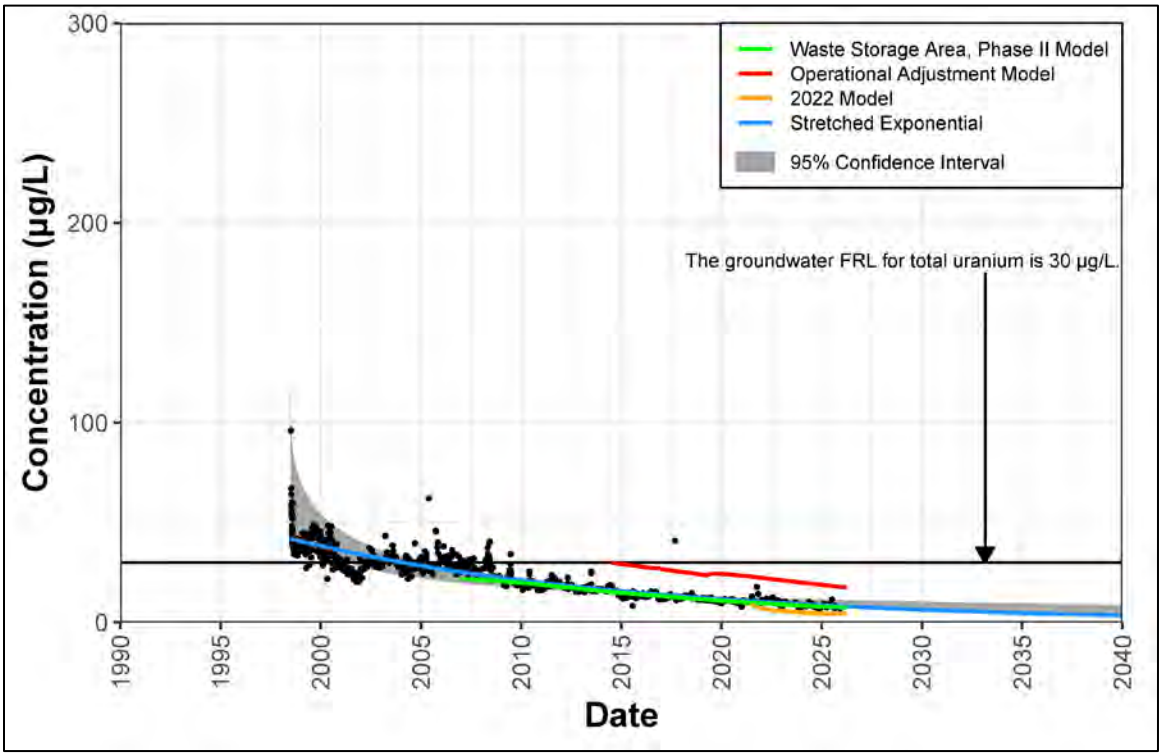


Figure A.1-18. Total Uranium Concentration Versus Time Plot for Extraction Wells 31567 (EW-17) and 33326 (EW-17a) with Regression Analysis

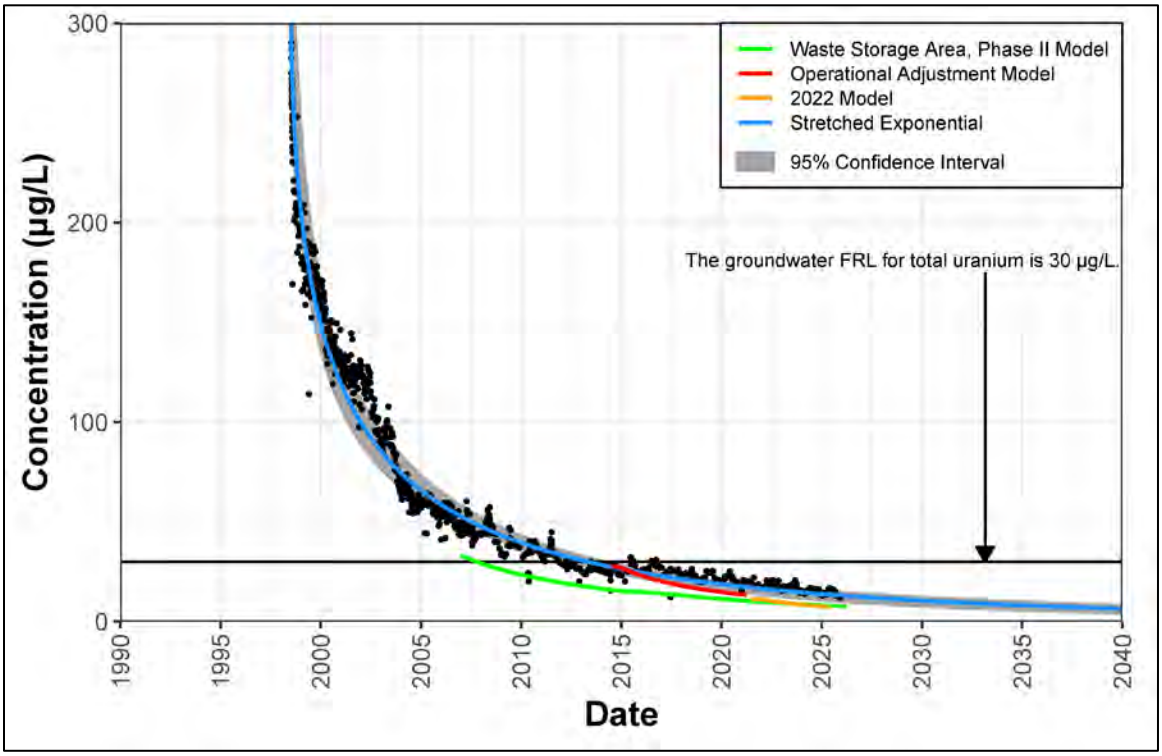


Figure A.1-19. Total Uranium Concentration Versus Time Plot for Extraction Well 32276 (EW-22) with Regression Analysis

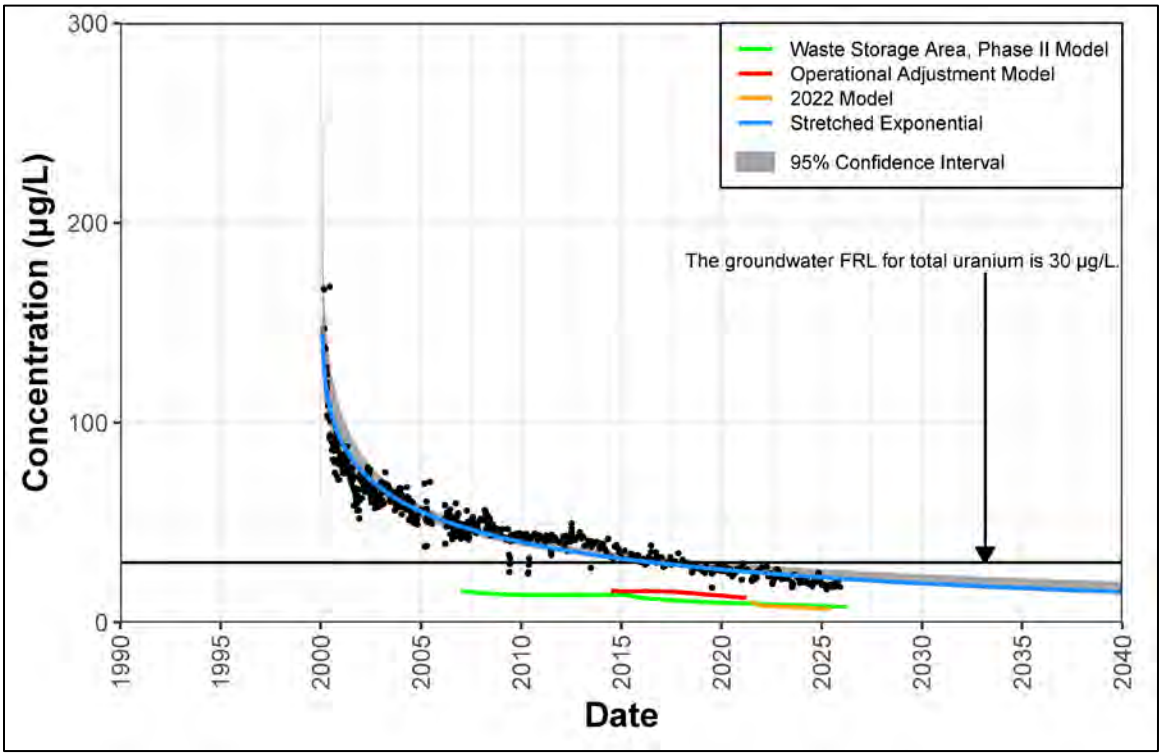


Figure A.1-20. Total Uranium Concentration Versus Time Plot for Extraction Well 32446 (EW-24) with Regression Analysis

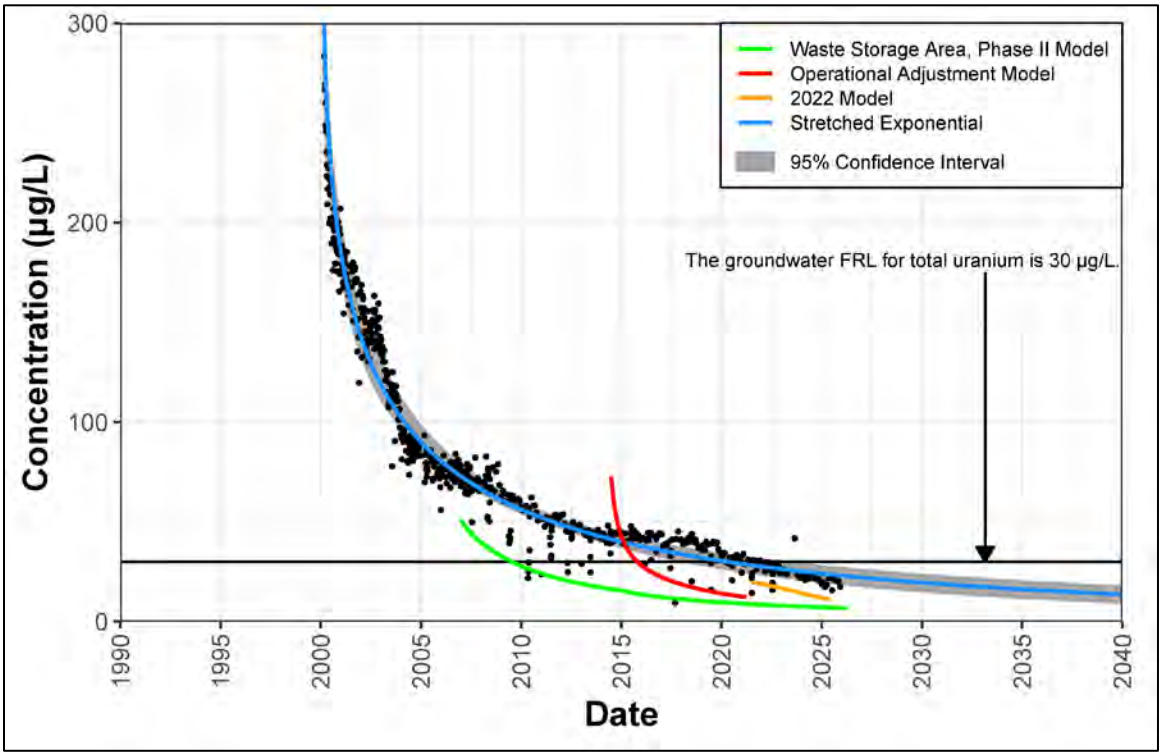


Figure A.1-21. Total Uranium Concentration Versus Time Plot for Extraction Well 32447 (EW-23) with Regression Analysis

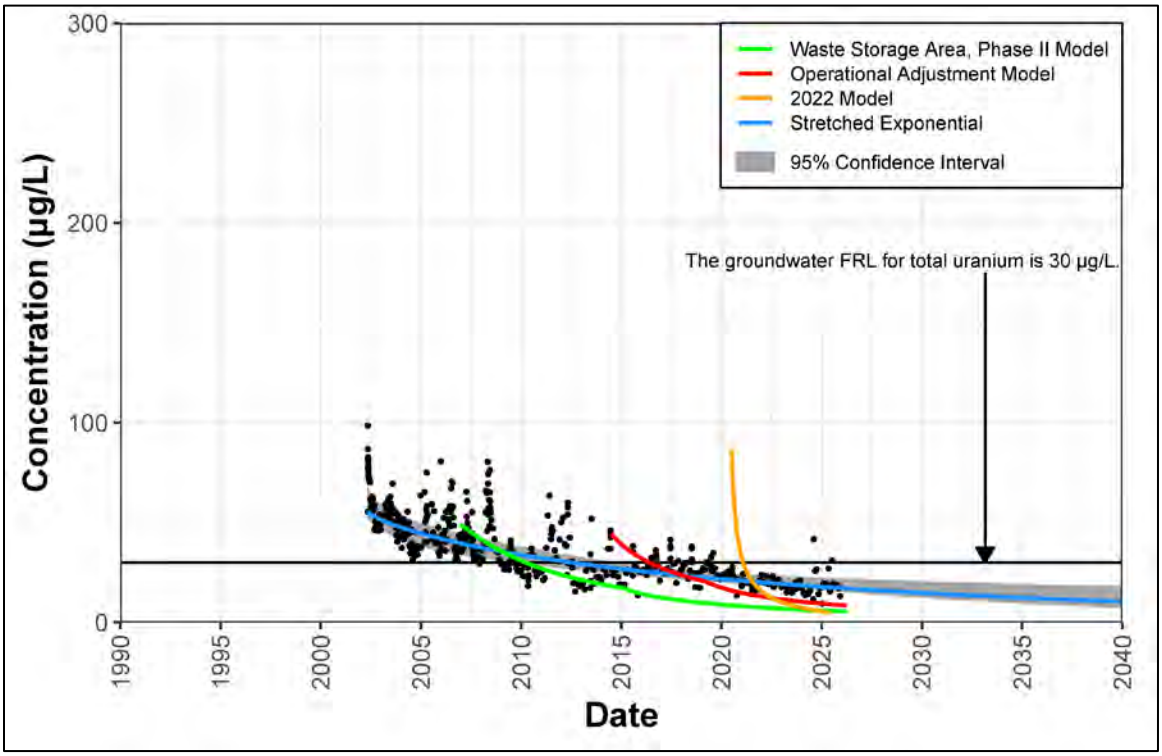


Figure A.1-22. Total Uranium Concentration Versus Time Plot for Extraction Well 33061 (EW-25) with Regression Analysis

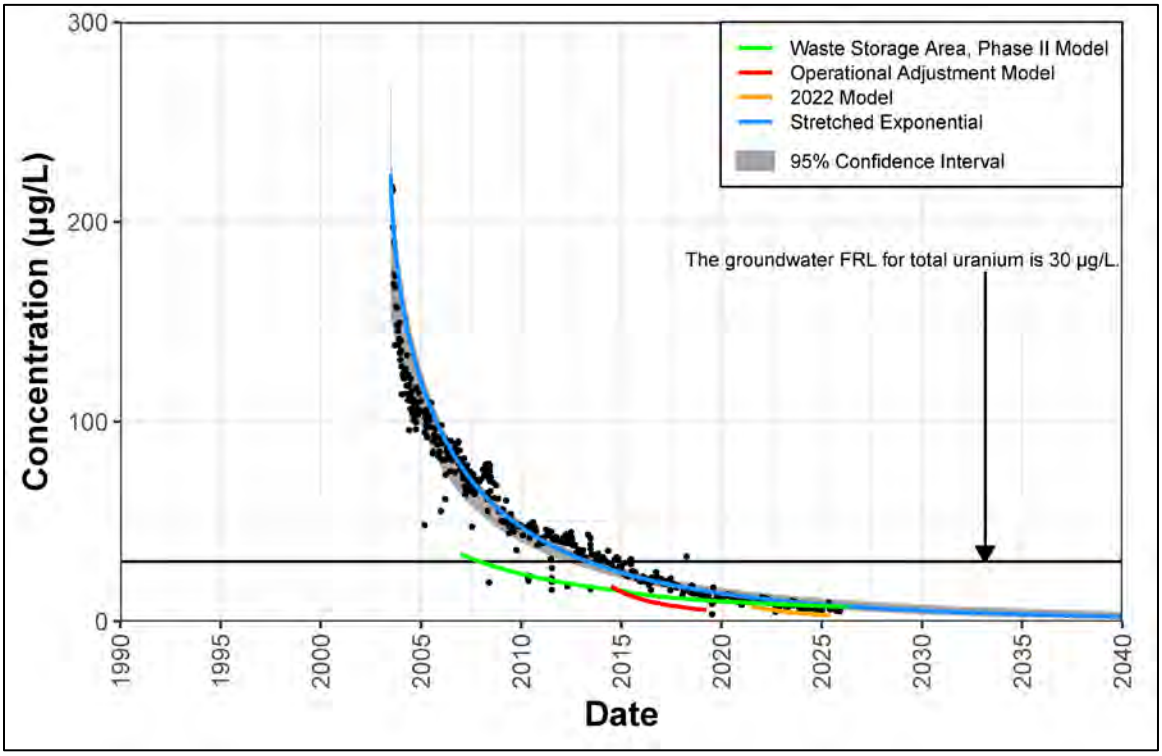


Figure A.1-23. Total Uranium Concentration Versus Time Plot for Extraction Well 33264 (EW-30) with Regression Analysis

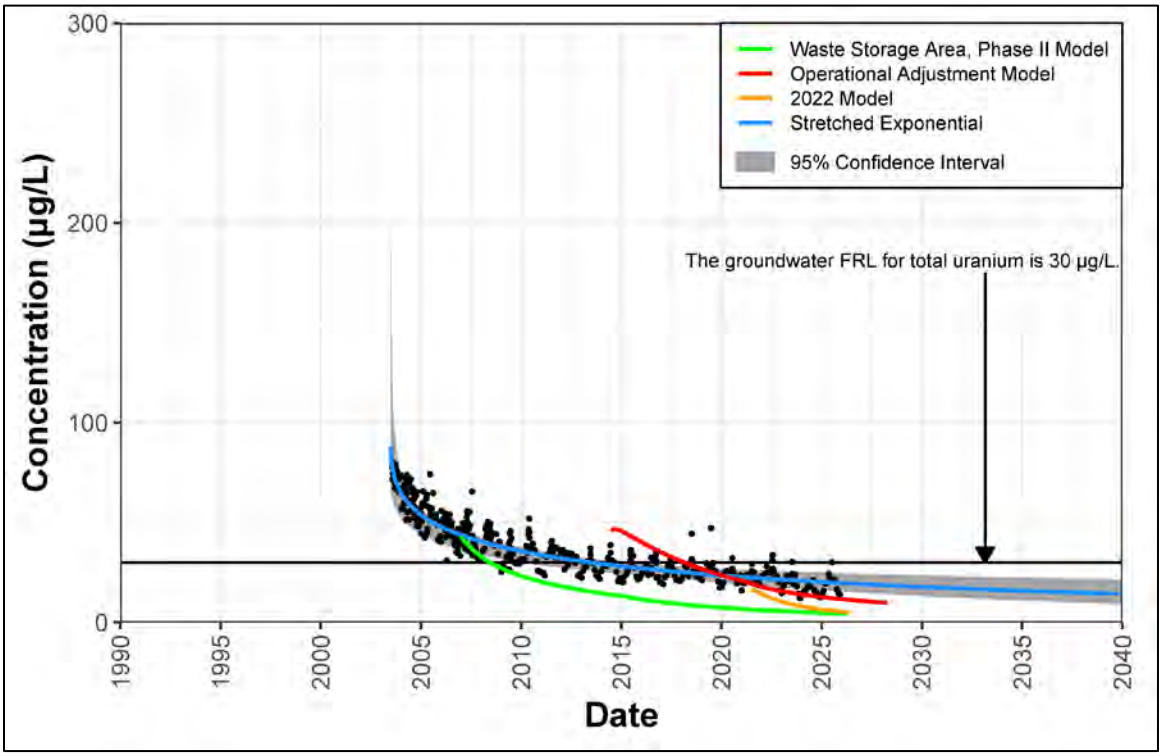


Figure A.1-24. Total Uranium Concentration Versus Time Plot for Extraction Well 33262 (EW-15a) with Regression Analysis

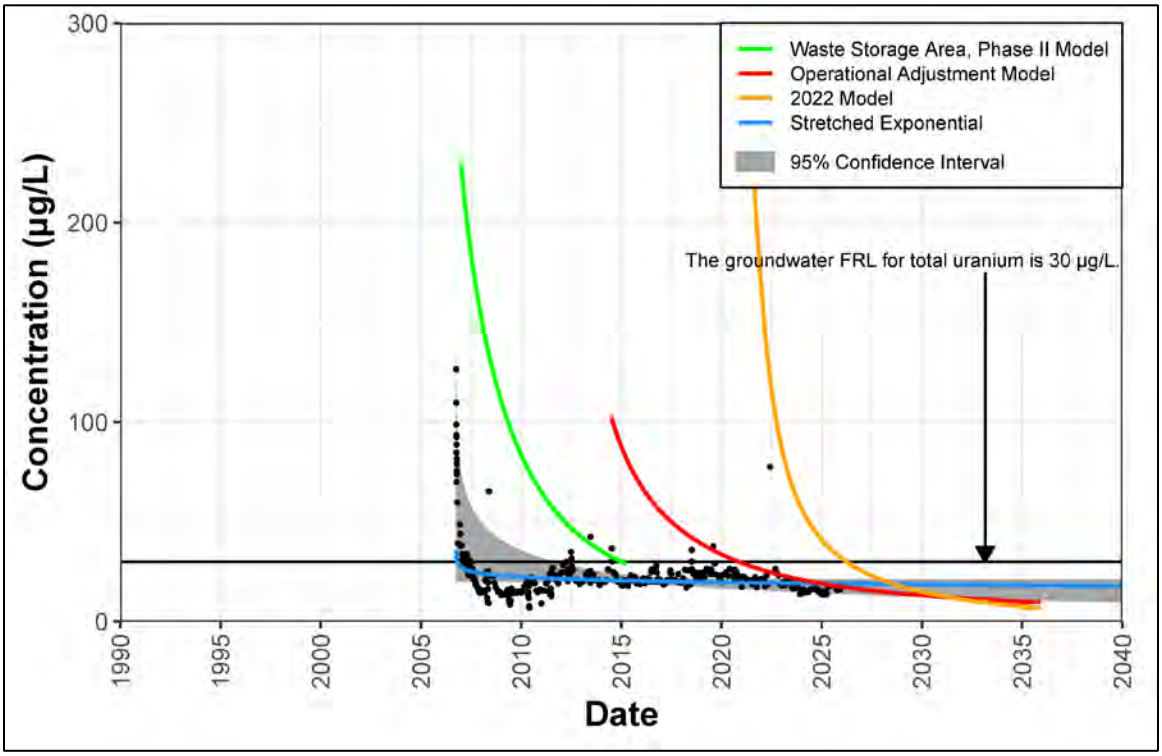


Figure A.1-25. Total Uranium Concentration Versus Time Plot for Extraction Well 33347 (EW-33a) with Regression Analysis

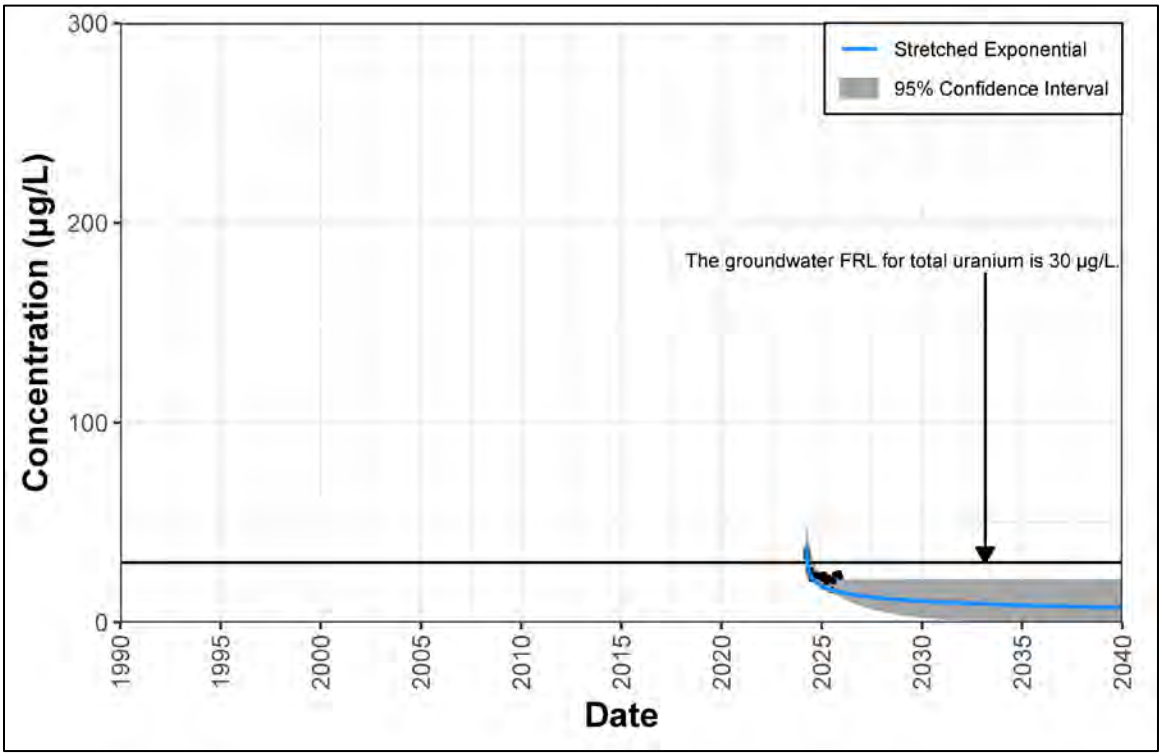


Figure A.1-26. Total Uranium Concentration Versus Time Plot for Extraction Well 33616 (RW-6A) with Regression Analysis

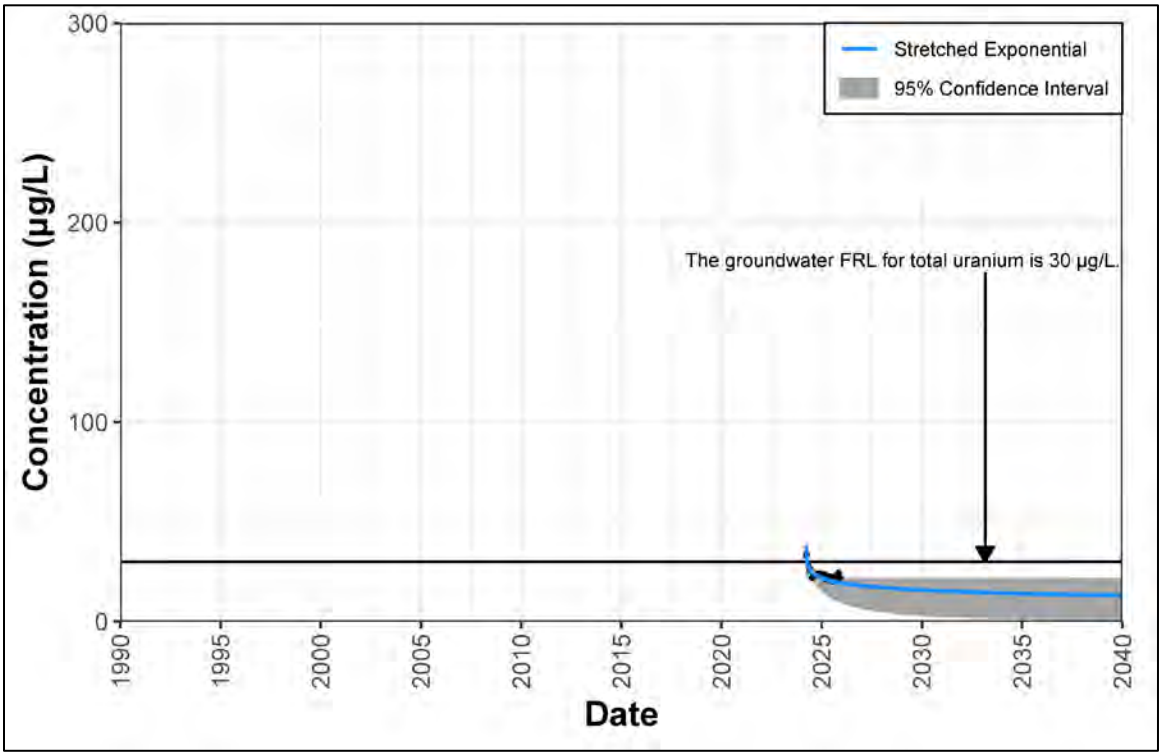


Figure A.1-27. Total Uranium Concentration Versus Time Plot for Extraction Well 33617 (RW-7A) with Regression Analysis

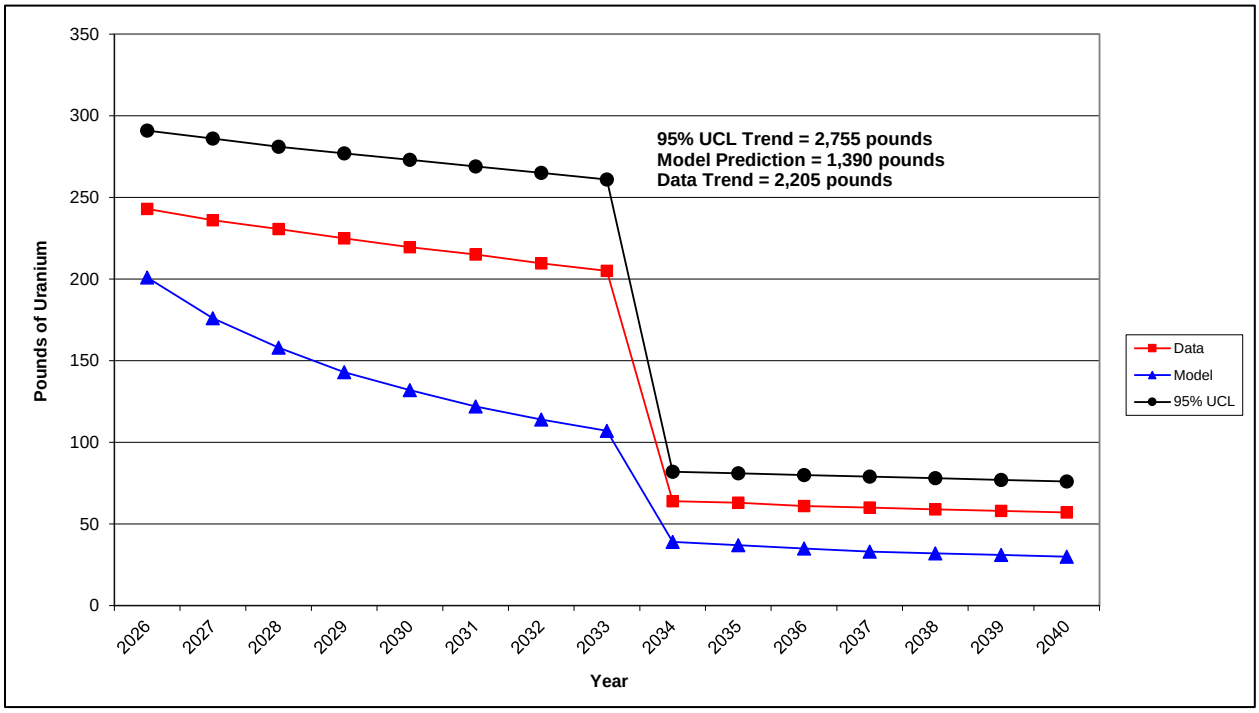


Figure A.1-28. Estimate of Yearly Pounds of Uranium to Be Pumped from Aquifer to Achieve Concentration-Based FRL Goals (Model Predictions, Nominal Boundary Conditions Versus Measured Concentration Trends) Data Collected Through 2025

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Attachment A.2

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Contents

Abbreviations iv
Measurement Abbreviations iv
A.2.0 Assessment of Total Uranium Results 1
A.2.1 Former Waste Storage Area 3
A.2.1.1 Former Waste Storage Area Maximum Total Uranium Plume 3
A.2.1.1.1 Direct-Push Sampling Data in the Former WSA 3
A.2.1.1.2 Intermittent Total Uranium FRL Exceedance Locations in the Former WSA 4
A.2.1.1.3 Monitoring Wells with Increasing Total Uranium Concentration Trends in the Former WSA 4
A.2.1.1.4 Former WSA Summary 5
A.2.1.2 PPDD Maximum Total Uranium Plume 6
A.2.1.2.1 Direct-Push Sampling Data in the PPDD Area 6
A.2.1.2.2 Intermittent Total Uranium FRL Exceedance Locations in the PPDD Area 6
A.2.1.2.3 Monitoring Wells with Increasing Total Uranium Concentration Trends in the PPDD Area 7
A.2.2 Former Plant 6 Area 7
A.2.2.1 Direct-Push Sampling Data in the Plant 6 Area 7
A.2.2.2 Intermittent Total Uranium FRL Exceedance Locations and Monitoring Wells with Increasing Total Uranium Concentration Trends 7
A.2.3 South Field and Off-Property South Plume Total Uranium Plumes 8
A.2.3.1 South Field 8
A.2.3.1.1 Intermittent Total Uranium FRL Exceedance Locations and Monitoring Wells with Increasing Total Uranium Concentration Trends 10
A.2.3.1.2 Monitoring Wells with Increasing Total Uranium Concentration Trends in the South Field 11
A.2.3.2 South Plume 11
A.2.3.2.1 New Direct-Push Sampling Data in the South Plume 11
A.2.3.2.2 Intermittent Total Uranium FRL Exceedance Locations in the South Plume 28
A.2.3.2.3 Monitoring Wells with Increasing Total Uranium Concentration Trends in the South Plume 29
A.2.4 Monitoring Well Inspection and Maintenance 29
A.2.5 Plume Metrics 30
A.2.5.1 Ricker Method Results 31
A.2.5.2 Earth Volumetric Studio Software Results 32
A.2.5.3 Total Uranium Plume Area 34
A.2.5.4 Total Mass of Uranium Remaining in the Aquifer 35
A.2.6 Total Uranium Plume Cross Sections 38
A.2.7 Split Sampling Program 38
A.2.8 Uranium Concentration Trends at Select Monitoring Wells 39
A.2.9 References 40

Tables

Table A.2-1. Geoprobe Location 13509D 42
Table A.2-2. Geoprobe Location 13651 42
Table A.2-3. Geoprobe Location 13652 43
Table A.2-4. Geoprobe Location 13653 43
Table A.2-5. Geoprobe Location 13655 44
Table A.2-6. Geoprobe Location 13603B 44
Table A.2-7. Geoprobe Location 12196D 45
Table A.2-8. Geoprobe Location 13229L 45
Table A.2-9. Geoprobe Location 13230E 46
Table A.2-10. Geoprobe Location 13237G 46
Table A.2-11. Geoprobe Location 13239H 47
Table A.2-12. Geoprobe Location 13306F 47
Table A.2-13. Geoprobe Location 13307B 48
Table A.2-14. Geoprobe Location 13308F 48
Table A.2-15. Geoprobe Location 13465A 49
Table A.2-16. Geoprobe Location 13513E 49
Table A.2-17. Geoprobe Location 13542D 50
Table A.2-18. Geoprobe Location 13606A 50
Table A.2-19. Geoprobe Location 13609A 51
Table A.2-20. Geoprobe Location 13612A 51
Table A.2-21. Geoprobe Location 13613A 52
Table A.2-22. Geoprobe Location 13614A 52
Table A.2-23. Geoprobe Location 13621B 53
Table A.2-24. Geoprobe Location 13623B 53
Table A.2-25. Geoprobe Location 13625A 54
Table A.2-26. Geoprobe Location 13647 54
Table A.2-27. Geoprobe Location 13648 55
Table A.2-28. Geoprobe Location 13649 55
Table A.2-29. Geoprobe Location 13650 56
Table A.2-30. Geoprobe Location 13654 56
Table A.2-31. Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium with 2025 Results Above FRLs 57
Table A.2-32. Summary Statistics and Trend Analysis of Extraction Wells for Total Uranium 58
Table A.2-33. Plume Size 1997 Through 2025 59
Table A.2-34. Comparison of Plume Size Interpretations 60
Table A.2-35. Predicted Cleanup Date Range Using Dual Exponential Equation 61

Figures

Figure A.2-1. IEMP Water Quality Monitoring Wells and Extraction Wells 62
Figure A.2-2. Direct-Push Data and Maximum Total Uranium Plume for 2025 63
Figure A-2A. Direct-Push Data and Maximum Total Uranium Plume for 2025, Inset 64
Figure A.2-3. Monitoring Well Data and Maximum Total Uranium Plume for 2025 65
Figure A.2-4. Monitoring Wells with 2025 Exceedances for Total Uranium with Up, Down, or No Significant Trends 67

Figure A.2-5. 2025 Monitoring Well Data Comparison to Maximum Total Uranium Footprint at End of 2024 68
Figure A.2-6. Total Uranium Concentration Versus Time Plot for Monitoring Well 83339 69
Figure A.2-7. Total Uranium Concentration Versus Time Plot for Monitoring Well 83340 69
Figure A.2-8. Total Uranium Concentration Versus Time Plot for Monitoring Well 83341 70
Figure A.2-9. Total Uranium Concentration Versus Time Plot for Monitoring Well 83346 70
Figure A.2-10. Total Uranium Concentration Versus Time Plot for Monitoring Well 2649 71
Figure A.2-11. Total Uranium Concentration Versus Time Plot for Monitoring Well 83337 71
Figure A.2-12. Total Uranium Concentration Versus Time Plot for Monitoring Well 83335 72
Figure A.2-13. Total Uranium Concentration Versus Time Plot for Monitoring Well 83124 72
Figure A.2-14. Total Uranium Concentration Versus Time Plot for Monitoring Well 2389 73
Figure A.2-15. Total Uranium Concentration Versus Time Plot for Monitoring Well 82372 73
Figure A.2-16. Total Uranium Concentration Versus Time Plot for Monitoring Well 21033 74
Figure A.2-17. Total Uranium Concentration Versus Time Plot for Monitoring Well 2386 74
Figure A.2-18. Total Uranium Concentration Versus Time Plot for Monitoring Well 83294 75
Figure A.2-19. Total Uranium Concentration Versus Time Plot for Monitoring Well 2049 75
Figure A.2-20. Total Uranium Concentration Versus Time Plot for Monitoring Well 2095 76
Figure A.2-21. Total Uranium Concentration Versus Time Plot for Monitoring Well 3095 76
Figure A.2-22. Total Uranium Concentration Versus Time Plot for Monitoring Well 2552 77
Figure A.2-23. Total Uranium Concentration Versus Time Plot for Monitoring Well 2900 77
Figure A.2-24. Total Uranium Concentration Versus Time Plot for Monitoring Well 2880 78
Figure A.2-25. Ricker Method Center of Mass 79
Figure A.2-26. Ricker Method Total Uranium Plume Calculations 80
Figure A.2-27. Total Uranium Concentration Versus Time Plot for Monitoring Well 2386 81
Figure A.2-28. Total Uranium Concentration Versus Time Plot for Monitoring Well 23280 81
Figure A.2-29. Total Uranium Concentration Versus Time Plot for Monitoring Well 23281 82
Figure A.2-30. EVS Total Uranium Plume Interpretation 83
Figure A.2-31. EVS 2025 Plume Metrics 84
Figure A.2-32. Total Uranium Plume Cross Section Overview Map 85
Figure A.2-33. Total Uranium Plume South Cross Section Location Map 86
Figure A.2-34. Total Uranium Plume North Cross Section Location Map 87
Figure A.2-35. EVS Total Uranium Plume Cross Section A–A′ 88
Figure A.2-36. EVS Total Uranium Plume Cross Section B–B′ 89
Figure A.2-37. EVS Total Uranium Plume Cross Section C–C′ 90
Figure A.2-38. EVS Total Uranium Plume Cross Section D–D′ 91
Figure A.2-39. EVS Total Uranium Plume Cross Section E–E′ 92
Figure A.2-40. Total Uranium Concentration Versus Time for Monitoring Well 2060 93

Abbreviations

DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EVS	Earth Volumetric Studio
FRL	final remediation level
IEMP	Integrated Environmental Monitoring Plan
K_d	distribution coefficient
Ohio EPA	Ohio Environmental Protection Agency
PPDD	Pilot Plant Drainage Ditch
WSA	Waste Storage Area

Measurement Abbreviations

amsl	above mean sea level
ft	feet
g/cm^3	grams per cubic centimeter
L	liters
lb	pounds
L/kg	liters per kilogram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
µg/L	micrograms per liter
mS/cm	millisiemens per centimeter
NTU	nephelometric turbidity unit
SU	standard unit

A.2.0 Assessment of Total Uranium Results

This attachment provides groundwater monitoring total uranium results through 2025, including summary statistics and plume maps, at the Fernald Preserve, Ohio, Site. The groundwater remediation at the Fernald Preserve is a concentration-based cleanup. The *Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996) states that "areas of the Great Miami Aquifer exceeding final remediation levels (FRLs) will be restored through extraction methods." Uranium is the primary constituent of concern for groundwater. The groundwater FRL for total uranium is 30 micrograms per liter (µg/L). The background total uranium concentration for unfiltered groundwater samples from the Great Miami Aquifer near the Fernald Preserve is 1.2 µg/L. This background value is based on the 95th percentile of unfiltered samples (*Remedial Investigation Report for Operable Unit 5* [DOE 1995], Section 4, Table 4-8). Both the area of the aquifer targeted for remediation and the statistical procedures that will be used to verify that aquifer cleanup objectives have been achieved are described in the *Fernald Groundwater Certification Plan* (DOE 2006).

Groundwater total uranium sampling requirements are presented in the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (DOE 2025). IEMP groundwater monitoring and extraction well locations are shown in Figure A.2-1. For integration purposes, locations of the On-Site Disposal Facility monitoring wells used to monitor the Great Miami Aquifer are also shown in Figure A.2-1.

In addition to the routine well monitoring specified in the IEMP, 30 locations were sampled using a direct-push sampling tool (Geoprobe) in 2025. This direct-push sampling focused on the South Plume and South Field areas, with emphasis on the South Plume. Direct-push sampling results for the 30 locations (12196D, 13229L, 13230E, 13237G, 13239H, 13306F, 13307B, 13308F, 13465A, 13509D, 13513E, 13542D, 13603B, 13606A, 13609A, 13612A, 13613A, 13614A, 13621B, 13623B, 13625A, 13647, 13648, 13649, 13650, 13651, 13652, 13653, 13654, and 13655) are presented in Tables A.2-1 through A.2-30.

Direct-push sampling locations are often sampled several times over the course of the remediation. When a direct-push location is resampled, the convention is to identify the new sample with the same location number but with an alphabetical extension to differentiate the earlier sample (e.g., 12230, 12230A, 12230B). If a resample location is moved more than 50 feet (ft) from the original location, a new number is assigned.

Figures A.2-2, A.2.2A, and A.2-3 show maximum total uranium plume maps for 2025. Figure A.2-2 and Figure A.2.2A show direct-push data. Figure A.2-3 shows monitoring well and extraction well data. Data collected from the aquifer are used to progressively update the maximum total uranium plume maps in the following conservative manner:

- Total uranium concentration data are posted on a map with the contours from the previous map. The highest representative total uranium value at a monitoring well location is posted. The highest concentration associated with each direct-push location is also posted.
- If a recently measured concentration from a well is greater than the previous concentration contour value at that location, then the plume is recontoured using the higher value.

- If the most recent concentration measurement from a well is less than the previous contour value for that location, then the new data are posted, but the plume contours are not adjusted using the new data until confirmatory direct-push sampling can be conducted.
- If direct-push data or multilevel monitoring well data are available, and a complete vertical profile of an area indicates that concentrations have changed, then the map is recontoured using the new direct-push data or multilevel well data. Under this strategy, a reduction in the size of the mapped plume is based on vertical profile data.
- If a monitoring well has a history of intermittent exceedances and the well location appears to be isolated from the main plume, then the well location is identified on the maximum uranium plume map as a location with intermittent exceedances. This serves to keep track of the locations with intermittent exceedances so that their presence can be carried forward into the certification stage of the remediation project.

Until 2020, the Site Environmental Report contained both a first half and a second half of the year total uranium plume map. Routinely producing an annual first half total uranium plume map provided little benefit to the annual Site Environmental Report. Yearly comparisons of remedy progress reported in the Site Environmental Report are based on the second half total uranium plume map. Beginning with the 2021 Site Environmental Report (DOE 2022), the U.S. Department of Energy (DOE) no longer routinely presented a first half total uranium plume map in the Site Environmental Report each year. Uranium concentration data continue to be collected in the first half of the year as prescribed by the IEMP, but the data are no longer reported in a first half total uranium plume map. If uranium concentration data ever indicate that a first half total uranium plume map would provide benefit to the reporting presented in the Site Environmental Report, then a first half map will be added on a case-by-case basis, as deemed appropriate.

Table A.2-31 lists the monitoring wells where total uranium concentrations exceeded the 30 µg/L FRL during 2025. Included in the table are total uranium statistical summaries for each well, which include Mann-Kendall trend analyses. Table A.2-32 provides total uranium statistical summaries for the extraction wells, including Mann-Kendall trend analyses. Extraction well trends are discussed in Attachment A.1. Figure A.2-4 illustrates the statistics presented in Table A.2-31, showing where total uranium concentrations have an upward trend, downward trend, or no trend. Monitoring wells with an upward trend based on the Mann-Kendall analysis are discussed further.

Tracking the acreage of the maximum total uranium plume footprint provides a means for assessing progress in achieving remediation goals. Figure A.2-5 shows the footprint of the 30 µg/L total uranium plume from 2024 compared to the footprint of the 30 µg/L total uranium plume from 2025. The 2024 plume is highlighted yellow, indicating areas where the plume was reduced for mapping purposes in 2025. Acreage changes within the 30 µg/L footprint (i.e., area above 50 µg/L and area above 100 µg/L) are also tracked and reported. A breakdown for the past 2 years is provided below.

Comparison of 2024 and 2025 Maximum Total Uranium Plume Footprint Area

Year	Area Greater Than 30 µg/L	Area Greater Than 50 µg/L	Area Greater Than 100 µg/L
2024 (acres)	69.4	48.8	27.8
2025 (acres)	65.6	47.2	26.8
Change (acres)	−3.8	−1.6	1.0
Change (percent)	−5.5	−3.3	-3.6

Since 1997, the footprint of the total uranium plume being targeted for cleanup has decreased 172.0 acres. Table A.2-33 provides a tabulation of plume area from 1997 through 2025.

Monitoring results are presented in the following three sections:

- Section A.2.1, "Former Waste Storage Area," including the Pilot Plant Drainage Ditch (PPDD) area
- Section A.2.2, "Former Plant 6 Area"
- Section A.2.3, "South Field and Off-Property South Plume Total Uranium Plumes"

For each of the three sections, information is presented concerning:

- New direct-push sampling data.
- Intermittent total uranium FRL exceedance locations.
- Monitoring wells with increasing total uranium concentration trends.

The remainder of the attachment is organized as follows:

- Section A.2.4 presents information concerning monitoring well inspection and maintenance
- Section A.2.5 presents information concerning center-of-mass plume calculations for the total uranium plumes
- Section A.2.6 presents total uranium plume cross sections
- Section A.2.7 presents the split sampling program
- Section A.2.8 presents the uranium concentration trends at select monitoring wells

A.2.1 Former Waste Storage Area

A.2.1.1 Former Waste Storage Area Maximum Total Uranium Plume

The size of the mapped footprint of the 30 µg/L maximum total uranium plume in the former Waste Storage Area (WSA) between 2024 and 2025 decreased 0.1 acre. In 2024 the area was 6.7 acres and in 2025 the area was 6.6 acres.

A.2.1.1.1 Direct-Push Sampling Data in the Former WSA

No direct-push sampling was conducted in 2025 in the former WSA.

A.2.1.1.2 Intermittent Total Uranium FRL Exceedance Locations in the Former WSA

Four monitoring wells (83339, 83340, 83341, and 83346) are identified on the maximum total uranium plume map for 2025 in the former WSA (Figure A.2-3) as being monitoring locations with intermittent total uranium FRL exceedances.

Figure A.2-6 is a time versus concentration graph for monitoring well 83339. The graph shows that the total uranium concentrations for two of the channels (channels 2 and 3) have always been below 30 µg/L. Channel 1 has had one exceedance of the uranium FRL since 2013, and that exceedance was in 2019. Samples collected in 2025 were below the uranium FRL.

Figure A.2-7 is a time versus concentration graph for monitoring well 83340. The graph shows that the total uranium concentrations for two of the channels (channels 2 and 3) have always been below 30 µg/L. The total uranium concentration for channel 1 has been at or above 30 µg/L since 2018.

Figure A.2-8 is a time versus concentration graph for monitoring well 83341. The graph shows that the total uranium concentrations for two of the channels (channels 2 and 3) have always been below 30 µg/L. Channel 1 of monitoring well 83341 is frequently dry. As shown in Figure A.2-8, only one uranium FRL exceedance has been measured in channel 1 since 2012. The uranium concentration measured in channel 1 during the first half of 2025 was below 30 µg/L. Channel 1 was dry during the second half of 2025.

Figure A.2-9 is a time versus concentration graph for monitoring well 83346. The graph shows that the total uranium concentrations for two of the channels (channels 2 and 3) have always been below 30 µg/L. The total uranium concentration for channel 1 was above 30 µg/L in 2018 and 2019. It was below 30 µg/L between 2019 and 2023. In 2024, the total uranium concentration for channel 1 was slightly above 30 µg/L. In the first half of 2025, the total uranium concentration for channel 1 was below 30 µg/L. Channel 1 was dry during the second half of 2025.

All four of these monitoring wells will continue to be monitored. If future monitoring indicates that the intermittent total uranium FRL exceedances are continuing or increasing, additional direct-push sampling may be conducted in the areas when water levels are high to determine whether a plume can be defined. These four wells will continue to be identified on maximum total uranium plume maps as locations where intermittent total uranium FRL exceedances have been measured so that their presence will be carried forward into the certification stage of the aquifer remediation.

A.2.1.1.3 Monitoring Wells with Increasing Total Uranium Concentration Trends in the Former WSA

As shown in Figure A.2-4, two monitoring wells (83340 and 2649) had an increasing total uranium concentration trend in the former WSA in 2025. Monitoring well 83340 is discussed in the previous section. Monitoring well 2649 is discussed below. Table A.2-31 provides summary statistics for monitoring well 2649. Monitoring well 2649 is within capture of the groundwater remediation system.

Figure A.2-10 is a total uranium concentration versus time plot for monitoring well 2649. The figure shows an increase in uranium concentration in 2007. The increase is attributed to pumping in nearby extraction well 33347, which began in late 2006. As is shown in Figure A.2-10, the concentration of uranium in monitoring well 2649 has exceeded 1,000 µg/L in 2013, 2018, 2022, 2023, and 2025. In the first half of 2025, the uranium concentration was 1,680 µg/L. In the second half of 2025 the uranium concentration was 349 µg/L. Monitoring well 2649 is in an area of the plume where uranium contamination is known to be sorbed to aquifer sediments in the vadose zone. When this sediment is saturated or flushed due to high water levels in the aquifer, the uranium can desorb into the water, resulting in the high concentration measurements. This dynamic presents a challenge when it comes to remediating the aquifer using pump-and-treat technology. Multichannel well 83337 is near monitoring well 2649. The shallowest channel in well 83337 is channel 1. As shown in Figure A.2-11, the uranium concentration of channel 1 in monitoring well 83337 has also been above 1,000 µg/L, while the other two deeper channels in that well have not. In 2025, the concentration in monitoring well 83337_C1 was below 1,000 µg/L.

A.2.1.1.4 Former WSA Summary

The following two groundwater remediation issues present challenges in the former WSA:

- Uranium contamination sorbed to sediments in the vadose zone beneath former source areas
- High surface water uranium concentrations occur in a swale located between the former waste pits area and Paddys Run

Uranium Contamination Sorbed to Sediments in the Vadose Zone Beneath Former Source Areas: High total uranium concentrations that correspond to high water levels continue to be a concern for the former WSA plume. Located beneath a former source area, total uranium contamination is sorbed to aquifer sediments in the vadose zone. When pumping is stopped and the water level rises, dissolved total uranium concentrations in the groundwater may increase (rebound) enough to exceed groundwater FRLs.

This issue is being somewhat alleviated each year by conducting a planned wellfield shutdown to allow water levels to rise and desorb some of the contamination in these areas. The confirmation that this issue has been addressed will be documented as described in the *Fernald Groundwater Certification Plan* (DOE 2006) during the certification stage of the remedy for this area. A different technology other than pumping will most likely be needed in this area to achieve FRLs in the aquifer.

High Surface Water Uranium Concentrations Occur in a Swale Located Between the Former Waste Pits Area and Paddys Run: Intermittent puddles of surface water occur in a swale bounded by Paddys Run to the west and the former waste pits to the east. As presented in Appendix B, the total uranium concentrations of many of the surface water samples collected in past years from this area exceed the groundwater FRL. The highest measured surface water concentration in 2025 was from SWD-09 (799 µg/L).

Surface water that collects in the swale is sampled at surface water sampling locations SWD-05 and SWD-09. The highest uranium concentration reported was 2,087 µg/L in December 2016. The uranium contamination appears to be localized to the area around SWD-09, and the uranium concentrations measured in the surface water from SWD-09 appear to be influenced by seasonal changes.

During normal flow conditions, surface water from the swale area infiltrates into the ground. This is also the case in the former Waste Pit 3 area, where water infiltrates into the ground and serves as a source of recharge to the aquifer. The uranium concentration in the aquifer beneath this infiltration area is above the uranium groundwater FRL (30 µg/L). Surface water from much of the former WSA drains into the former Waste Pit 3. The area of infiltration in the swale and former WSA is within capture of the groundwater remediation system. Because the area is within capture, there is minimal risk to the public from the infiltrating surface water. Continued monitoring will document whether the concentration in the infiltrating surface water decreases over time.

In 2014, groundwater modeling was conducted to determine the potential impact to model-predicted aquifer cleanup times if uranium-contaminated surface water is infiltrating into the aquifer from the swale. A modeled worst-case scenario was based on the highest total uranium concentration measured in ponded water within the swale and high infiltration rates. The conservative groundwater modeling scenario:

- Took no credit for attenuation of uranium in glacial till or alluvium.
- Used input infiltration rates of 50 inches per year rather than 6 inches per year.
- Used an input infiltrating total uranium concentration of 1,900 µg/L, which was the highest total uranium concentration measured in ponded water within the swale between 2007 and 2014.

Modeling under these extremely conservative conditions had no impact to model-predicted cleanup times for the aquifer in this area. DOE will work with the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA) to determine the best path forward for remediation of the aquifer in this area.

A.2.1.2 PPDD Maximum Total Uranium Plume

The mapped footprint of the 30 µg/L maximum total uranium plume in the PPDD area between 2024 and 2025 remained unchanged at 5.8 acres.

A.2.1.2.1 Direct-Push Sampling Data in the PPDD Area

No direct-push sampling was conducted in 2025 in the PPDD area.

A.2.1.2.2 Intermittent Total Uranium FRL Exceedance Locations in the PPDD Area

One monitoring well, 83335, is identified on the maximum total uranium plume map for 2025 in the former PPDD area (Figure A.2-3) as being a monitoring location with intermittent total uranium FRL exceedances.

Figure A.2-12 provides a time versus total uranium concentration plot for monitoring well 83335. The figure shows that total uranium concentrations measured from 2013 through the first half of 2019 were below the total uranium groundwater FRL for all monitoring channels. In the second half of 2019, channel 2 had a concentration of 32.4 µg/L. Since 2019, the uranium concentration of both collected samples were below the total uranium groundwater FRL. Channel 1 has always been dry. This well will continue to be identified on maximum total

uranium plume maps as being a location where intermittent total uranium FRL exceedances have been measured so that its presence will be carried forward into the certification stage of the aquifer remediation.

A.2.1.2.3 Monitoring Wells with Increasing Total Uranium Concentration Trends in the PPDD Area

As shown in Table A.2-31 and Figure A.2-4, one monitoring well (83124_C4) had an increasing total uranium concentration trend in 2025 in the PPDD Area. Figure A.2-13 is a total uranium concentration versus time plot for monitoring well 83124. This monitoring well is upgradient of extraction well 33062. The increase in uranium concentration in channel 4 is attributed to pumping in the nearby extraction well.

A.2.2 Former Plant 6 Area

A.2.2.1 Direct-Push Sampling Data in the Plant 6 Area

No direct-push sampling was conducted in 2025 in the Plant 6 Area.

A.2.2.2 Intermittent Total Uranium FRL Exceedance Locations and Monitoring Wells with Increasing Total Uranium Concentration Trends

Plans for a groundwater restoration module in the former Plant 6 Area were abandoned in 2001 based on the outcome of the *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001). The data in this design indicated that the total uranium plume in the former Plant 6 Area was no longer present. EPA and Ohio EPA concurred with this decision.

Monitoring well 2389 is the only groundwater monitoring well remaining in the area of the Former Production Area where Plant 6 was once located (Figure A.2-1). This well is identified as a location with intermittent total uranium FRL exceedances on the maximum total uranium plume map (Figure A.2-3). It is also identified as a monitoring location where total uranium concentrations are trending up (Figure A.2-4 and Table A.2-31).

Figure A.2-14 is a total uranium concentration versus time plot for monitoring well 2389 and shows that sporadic total uranium FRL exceedances were detected at this well between 2002 and 2007, but exceedances have been constant since 2011. As discussed below, FRL exceedances are detected in this area when the sample is approximately 515 ft above mean sea level (amsl) or higher. Since 2011, water levels have been at or near 515 ft amsl, and the uranium FRL exceedances have been consistent. In 2025, consistent exceedances returned for both sampling events. The total uranium concentration was above 30 µg/L for both the first half and second half of the year: 34.8 µg/L and 39.5 µg/L, respectively.

Previous direct-push sampling in this area indicates that the total uranium FRL exceedances are associated with high water-table conditions. The former Plant 6 Area is targeted for direct-push sampling when the water-table elevation is at or above 515 ft amsl. As shown below, unless the water table is above an elevation of 515 ft amsl, total uranium FRL exceedances are normally not detected. The last direct-push sample was collected in 2019 (13360E). The elevation of the

collected sample was the highest ever recorded for this geoprobe location (517 ft amsl). The concentration measured was also the highest ever measured for this geoprobe location at 63.0 µg/L.

Year	Location	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)
2007	13360	<1.00	512
2008	13360A	37.2	515
2010	13360B	4.40	510
2011	13360C	37.7	515
2018	13360D	12.2	513
2019	13360E	63.0	517

Monitoring well 2389 will continue to be identified on the maximum total uranium plume map as being a location where intermittent total uranium FRL exceedances have been measured so that its presence will be carried forward into the certification stage of the aquifer remediation. This well is within capture of the groundwater remediation system.

A.2.3 South Field and Off-Property South Plume Total Uranium Plumes

The mapped footprint of the 30 µg/L maximum total uranium plume in the South Field and off-property South Plume decreased in size between 2024 and 2025. The size of the footprint was 56.87 acres in 2024 and 53.19 acres in 2025, a decrease of 3.68 acres (6.47%) (Figure A.2-5).

The mapped footprint of the 50 µg/L area of the plume decreased in size between 2024 and 2025. The size of the area was 38.97 acres in 2024 and 37.43 acres in 2025, a decrease of 1.54 acre (3.95%).

The mapped footprint 100 µg/L area of the plume decreased in size between 2024 and 2025. The size of the area was 20.0 acres in 2024 and 19.0 acres in 2025, a decrease of 1 acre (5.0%).

A.2.3.1 South Field

In 2025, direct-push sampling was conducted at six locations in the South Field (locations 13509D, 13651, 13652, 13655, 13603B, and 13653). Figure A.2-2A shows the locations and the 2025 total uranium results. All six locations are in the southwest area of the South Field Plume just north of Willey Road. It should be noted that since 2024 the maximum uranium plume has been divided into an on-property South Field plume and an off-property South Plume.

Location 13509D

Location 13509D is located just north of Willey Road in the South Field. Direct-push sampling results for location 13509D are provided in Table A.2-1. The location is identified in Figure A.2-2A.

This location has been sampled five times beginning in 2018. The location sampled in 2018 was identified as location 13509. The location sampled in 2025 was identified as location 13509D. The following table provides total uranium concentrations from the sampling events.

Location 13509 (2018)		Location 13509A (2020)		Location 13509B (2021)		Location 13509C (2023)		Location 13509D (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl	Total Uranium (µg/L)
515	43.3	514	33.0	512	36.8	512	34.6	515	23.1
505	13.4	504	22.9	502	14.2	502	5.2	505	5.71
495	3.9	494	9.3	492	5.7	492	4.5	495	2.77
485	7.3	484	7.2	482	5.9	482	8.0	485	6.23
475	8.8	474	4.1	472	<1.0	472	1.9	475	3.12

Sample results in the table above show that the maximum uranium concentration at this location has decreased from 43.3 µg/L in 2018 (elevation 515 ft amsl) to 23.1 µg/L in 2025 (elevation also at 515 ft amsl). The 2025 maximum uranium plume map was adjusted to honor the 2025 result.

Location 13651

Location 13651 is in the South Field uranium plume, just north of Willey Road in the South Field. Direct-push sampling results for location 13651 are provided in Table A.2-2. The location is identified in Figure A.2-2A.

As shown in Table A.2-2 the highest uranium concentration measured at this location was 28.9 µg/L (elevation 514 ft amsl). The 2025 total uranium plume map was adjusted to honor this location.

Location 13652

Location 13652 is located just north of Willey Road in the South Field. Direct-push sampling results for location 13652 are provided on Table A.2-3, and the location is identified on Figure A.2-2A.

As shown in Table A.2-3 the highest uranium concentration measured at this location in 2025 was 15.2 µg/L (elevation 514 ft amsl). The 2025 total uranium plume map was adjusted to honor this location.

Location 13653

Location 13653 is located north of Willey Road in the South Field. Direct-push sampling results for location 13653 are provided on Table A.2-4, and the location is identified on Figure A.2-2A.

As shown in Table A.2-4, the maximum total uranium concentration measured at this location in 2025 was 38.5 µg/L (elevation 502 ft amsl). The maximum uranium plume map was adjusted to honor the 2025 result.

Location 13655

Location 13655 is located north of Willey Road in the South Field. Direct-push sampling results for location 13655 are provided on Table A.2-5, and the location is identified on Figure A.2-2A.

As shown in Table A.2-5, the highest uranium concentration measured at this location in 2025 was 39.7 µg/L (elevation 514 ft amsl). The 2025 maximum uranium plume map honors the 2025 result.

Location 13603B

Location 13603B is located north of Willey Road in the South Field. Direct-push sampling results for location 13603B are provided on Table A.2-6, and the location is identified on Figure A.2-2A.

This location has been sampled three times beginning in 2022. The location sampled in 2022 was identified as location 13603. The location sampled in 2025 was identified as location 13603B. The following table provides total uranium concentrations from the sampling events.

Location 13603 (2022)		Location 13603A (2023)		Location 13603B (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
516	105.5	511	18.8	514	10.5
506	12.9	501	12.6	504	7.84
496	16.8	491	12.4	494	14.4
486	16.9	481	6.0	484	6.28
476	9.1	471	9.9	474	6.48

As shown in the table above, the maximum uranium concentration has decreased from 105.5 µg/L in 2022 (elevation 516 ft amsl) to 14.4 µg/L (elevation 496 ft amsl) and to 10.5 µg/L in 2025 (elevation 514 ft amsl). The 2025 maximum uranium plume map was revised to honor the 2025 results.

A.2.3.1.1 Intermittent Total Uranium FRL Exceedance Locations and Monitoring Wells with Increasing Total Uranium Concentration Trends

One monitoring well (82372) is identified on the maximum total uranium plume map for 2025 in the South Field (Figure A.2-3) as being a monitoring location with intermittent total uranium FRL exceedances. This designation was made for the first time based on 2023 sampling results. Figure A.2-15 provides a time versus total uranium concentration plot for monitoring well 82372. The figure shows that total uranium concentrations measured from 2018 through 2025 at 82372 were below the 30 µg/L uranium concentration with an exception in 2020, 2023, and 2025 where the concentration was just slightly above 30 µg/L. In 2025, the well was sampled on a semiannual frequency. The first half sample was 25.4 µg/L and the second half sample was 30.1 µg/L. This well will continue to be identified on maximum total uranium plume maps as being a location where intermittent total uranium FRL exceedances have been measured so that its presence will be carried forward into the certification stage of the aquifer remediation.

A.2.3.1.2 Monitoring Wells with Increasing Total Uranium Concentration Trends in the South Field

As Table A.2-31 shows, three monitoring wells in the South Field—21033, 2386, and 83294_C1—had upward trends for total uranium concentrations in 2025. The locations are shown in Figure A.2-4. Figures A.2-16 through A.2-18 provide time versus total uranium concentration plots for these three wells. The total uranium concentration increases are attributed to changes in the plume caused by the active groundwater remediation. Uranium contamination is being pulled toward the extraction wells.

A large increase in uranium concentration was measured in monitoring well 2049 in 2022. As shown in Figure A.2-19, in the first half of 2022 the uranium concentration increased from being below 30 µg/L in 2021 to a new all-time high for the well of 278 µg/L. In the second half of 2022, the result was 207 µg/L. As shown in Table A.2-31 the uranium dataset from this well is trending down statistically. The cause for this sudden increase in uranium concentration in 2022 is being attributed to a slug of dissolved uranium in this area. Samples were collected in March and September of 2025. The uranium concentration was 89.5 and 36.7 µg/L, respectively.

DOE will continue to monitor these wells but plans no action at this time. All these wells are within the capture zone of the groundwater remediation system.

A.2.3.2 South Plume

A.2.3.2.1 New Direct-Push Sampling Data in the South Plume

In 2025, direct-push sampling was conducted at 24 locations in the South Plume (12196D, 13229L, 13230E, 13237G, 13239H, 13306F, 13307B, 13308F, 13465A, 13513E, 13542D, 13606A, 13609A, 13612A, 13613A, 13614A, 13621B, 13623B, 13625A, 13647, 13648, 13649, 13650, and 13654). Sampling results are discussed below.

Location 12196D

Location 12196D is located in the northeast corner of the South Plume. Direct-push sampling results for location 12196D are provided in Table A.2-7. The location is identified in Figure A.2-2A.

This location has been sampled five times beginning in 1996. The samples collected in 1996 were identified as location 12196. The samples collected in 2025 were identified as location 12196D. Total uranium concentration data from all five sampling events are provided below.

12196 (1996)		12196A (2005)		12196B (2007)		12196C (2022)		12196D (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
518	0.4	514	4.3	517	6.7	514	33.7	514	9.81
509	0.3	505	87.5	507	59.6	504	40.3	504	21.3
499	0.7	495	100.7	497	103.7	494	<1.0	494	7.18
489	0.5	485	14.4	487	3.2	484	20.0	484	6.49
479	0.3	475	37.4	477	9.0	474	2.8	474	1.94
469	0.5	465	18.7	467	3.0				
459	0.7								
449	0.4								
439	1.6								

The maximum uranium concentration at this location has decreased from a high of 103.7 µg/L in 2007 (elevation 497 ft amsl) to 21.3 µg/L in 2025 (elevation 504 ft amsl). The 2025 maximum uranium plume map was not adjusted to honor this location. Additional direct-push sampling will be planned in the future to verify a plume map reduction.

Location 13229L

Location 13229L is located on the west edge of the South Plume. Direct-push sampling results for location 13229L are provided in Table A.2-8. The location is identified in Figure A.2-2A.

This location has been sampled 13 times beginning in 2002. The samples collected in 2002 were identified as location 13229. The samples collected in 2025 were identified as location 13229L. Total uranium concentration data from all 13 sampling events are provided below.

Location 13229 (2002)		Location 13229A (2003)		Location 13229B (2008)		Location 13229C (2013)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
517	58.0	515	81.8				
508	101	506	89.3	509	72.7	510	61.2
498	47.0	496	92.7	499	65.3	500	40.8
488	29.0	486	51.2	489	42.2	490	41.2
478	19.0	476	11.3	479	37.4	480	15.2
468	15.0	466	4.50	469	17.8	470	5.9
458	3.20	456	1.20			460	3.4
448	<1.0						

Location 13229D (2015)		Location 13229E (2017)		Location 13229F (2018)		Location 13229G (2019)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
511	47.1	512	49.8	511	58.2	516	58.8
501	49.8	502	32.2	501	36.3	506	37.2
491	39.8	492	14.0	491	24.7	496	32.9
481	26.7	482	13.5	481	21.5	486	17.5
471	11.6	472	5.3	471	14.9		
		462	3.7				

Location 13229H (2020)		Location 13229I (2022)		Location 13229J (2023)		Location 13229K (2024)		Location 13229L (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
515	46.7	512	52.8	512	39.3	512	22.7	515	32.5
505	20.8	502	33.1	502	15.5	502	12.0	505	21.2
495	18.1	492	19.9	492	19.4	492	5.8	495	20.7
485	12.5	482	20.0	482	12.4	482	3.8	490	13.4
		472	13.0	472	12.3	472	10.5	485	5.15

Between 2002 and 2024, the samples collected from this location show that the maximum uranium concentration decreased from 101 µg/L in 2002 (elevation 508 ft amsl) to 22.7 µg/L in 2024 (elevation 512 ft amsl). In 2020, the maximum uranium concentration was below 50 µg/L at an elevation of 515 ft amsl, but water levels have not been that high during sample collection since that time. The 50 µg/L contour was revised for the 2024 map to reflect the 2024 concentration, but the 30 µg/L contour was not. The sample collected in 2025 had a maximum uranium concentration of 32.5 µg/L (elevation 515 ft amsl). The 2025 maximum uranium plume map did not need to be adjusted to honor the 2025 concentration.

Location 13230E

Location 13230E is between the southern and northern portions of the current South Plume. Direct-push results are provided in Table A.2-9. The location is identified in Figure A.2-2A.

This location has been sampled six times beginning in 2002. The samples collected in 2002 were identified as location 13230. The samples collected in 2025 were identified as location 13230E. Total uranium concentration data from the sampling events are provided below.

Location 13230 (2002)		Location 13230A (2003)		Location 13230B (2008)	
Midpoint Screen Elevation (ft amsl)	Total Uranium	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
514	36.0	515	23.5		
504	116.0	505	79.9	509	68.8
494	101.0	495	63.6	499	32.7
484	66.0	485	32.9	489	48.9
474	12.0	475	36.1	479	37.4
464	11.0	465	2.9	469	4.2
454	3.1	455	1.6		
444	1.8				
434	1.1				

Location 13230C (2013)		Location 13230D (2024)		Location 13230E (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
				515	20.7
510	34.1	510	27.2	505	20.2
500	44.7	500	18.1	495	10.4
490	33.9	490	12.4	485	6.75
480	27.8	480	9.3	475	4.98
470	4.7	470	2.8		
460	3.8				

The uranium concentration profiles show the highest elevation maximum uranium concentrations at 514 and 515 ft amsl in 2002 and 2003, respectively. In 2002, the highest elevation concentration was 36 µg/L (elevation 514 ft amsl). In 2003, the highest elevation uranium concentration was 23.5 µg/L (elevation 515 ft amsl). This comparison indicates that the uranium concentrations were below 30 µg/L at this elevation in the aquifer by 2003.

From 2002 to 2024 water levels were lower than 514 ft amsl during sampling. The uranium concentration deeper in the aquifer (lower elevation) decreased from a high of 116 µg/L (elevation 504 ft amsl) to 27.2 µg/L (elevation 510 ft amsl), respectively.

In 2024, results indicated that uranium concentrations were below 30 µg/L at this location. Previous year's direct-push sampling near this area further documented that the maximum uranium concentration in this area was below 30 µg/L. The 2024 maximum uranium plume map was adjusted to honor the 2024 results. This adjustment resulted in a separation of the South Plume into a northern and southern portion.

In 2025, additional direct-push sampling was conducted in this area to further verify the plume separation. The maximum uranium result in 2025 was 20.7 µg/L (elevation 515 ft amsl) confirming that the plume is below 30 µg/L at this location.

Location 13237G

Location 13237G is located in the center of the northern half of the South Plume. Direct-push results are provided in Table A.2-10. The location is identified in Figure A.2-2A.

This location has been sampled eight times since 2002. The samples collected in 2002 were identified as location 13237. The samples collected in 2025 were identified as location 13237G. Total uranium concentration data from the sampling events are provided below.

Location 13237 (2002)		Location 13237A (2007)		Location 13237B (2014)		Location 13237C (2015)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
518	9.50						
509	80.0	510	22.7	512	30.4	512	75.1
499	92.2	500	85.6	502	29.5	502	37.5
489	33.9	490	22.6	492	22.5	492	36.8
479	16.0	480	5.2	482	25.5		
469	3.90	470	2.3	472	13.9		

Location 13237D (2017)		Location 13237E (2018)		Location 13237F (2019)		Location 13237G (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
510	46.3	513	63.5	514	50.5	514	54.4
500	23.5	503	42.8	504	32.6	504	21.5
490	23.8	493	36.1	494	27.6	494	14.8
480	7.6	483	42.1	484	26.8	484	17.9
470	2.4					474	12.6
460	1.3						

The data reported in the above table shows that the maximum uranium concentration at this location remains above 50 µg/L (elevation 514 ft amsl). No change to the 2025 maximum uranium plume map was made based on the 2025 results.

Location 13239H

Location 13239H is located in the center of the southern half of the South Plume. Direct-push results are provided in Table A.2-11. The location is identified in Figure A.2-2A.

This location has been sampled nine times since 2002. The samples collected in 2002 were identified as location 13239. The samples collected in 2025 were identified as location 13239H. Total uranium concentration data from the sampling events are provided below.

Location 13239 (2002)		Location 13239A (2013)		Location 13239B (2015)		Location 13239C (2016)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
515	65.0						
507	49.0	511	64.0	511	62.0	511	58.5
497	69.0	501	43.5	501	50.6	501	54.3
487	32.0	491	25.5	491	30.9	491	38.7
477	12.0	481	5.70	481	10.9	481	15.1
467	4.90	471	2.00	471	4.8	471	9.3
457	1.90						
447	1.20						

Location 13239D (2017)		Location 13239E (2019)		Location 13239F (2020)		Location 13239G (2022)		Location 13239H (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
511	46.5	514	59.5	512	53.6	512	74.3	515	53.3
501	40.5	504	45.5	502	46.4	502	29.4	505	12.8
491	34.7	494	40.6	492	33.2	492	18.5	495	20.1
481	3.0	484	12.3	482	11.7	482	10.6	485	15.7
471	4.8	474	14.6	472	6.9	472	2.5	475	3.31

The maximum uranium concentration measured at this location in 2025 was 53.3 µg/L (elevation 515 ft amsl). No change was required for the 2025 plume map to honor this result.

Location 13306F

Location 13306F is located south of the South Plume. Direct-push sampling results for location 13306F are provided in Table A.2-12. The location is identified in Figure A.2-2A.

This location has been sampled seven times since 2003. The samples collected in 2003 were identified as location 13306. The samples collected in 2025 were identified as location 13306F. Total uranium concentration data from all seven sampling events are provided below.

Location 13306 (2003)		Location 13306A (2009)		Location 13306B (2013)		Location 13306C (2015)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
515	69.7						
506	30.7	508	13.7	511	43.0	509	38.9
496	24.4	498	43.1	501	11.8	499	11.0
486	39.9	488	10.7	491	9.8	489	17.4
476	47.2	478	15.7	481	12.5	479	33.8
466	5.90	468	5.0	471	9.6	469	30.6
456	5.10	458	2.2				
446	<1.0						
436	<1.0						
426	<1.0						

Location 13306D (2016)		Location 13306E (2017)		Location 13306F (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
510	27.3	510	13.7	512	17.5
500	10.5	500	6.1	502	6.00
490	13.5	490	9.1	492	5.45
480	20.6	480	17.7	482	12.6
470	13.6	470	8.8	472	6.72
460	4.4	460	4.3		
450	5.0	450	1.2		

This sampling location is south of the current leading edge of the South Plume in an area of the aquifer that is no longer being actively flushed by pumping operations. The last extraction well that was helping to flush this area of the aquifer (i.e., RW-1) was turned off in November 2024. Sampling at this location in 2025 provides data to document whether concentration rebound is occurring now that active pumping in this area has stopped.

The highest uranium concentration measured in 2025 at this location was 17.5 µg/L (elevation 512 ft amsl) indicating that concentrations have not rebounded above 30 µg/L. As the data in the table above shows, the uranium concentration has been below 30 µg/L since 2016 at an elevation in the aquifer of 512 ft amsl or deeper. In 2003, a sample of groundwater was collected from the aquifer at an elevation of 515 ft amsl that had a uranium concentration of 69.7 µg/L. It is therefore possible that some uranium remains sorbed to aquifer sediments at an elevation higher than 512 ft amsl. DOE will look for future opportunities to sample in this location if/when water levels approach 515 ft amsl. It should be noted that this is just a preliminary assessment of current conditions in this area. A formal certification process outlined in the *Fernald Groundwater Certification Plan* (DOE 2006) will be conducted to verify that cleanup objectives have been achieved once pumping in all of the South Plume area has been turned off.

Location 13307B

Location 13307B is located south of the South Plume. Direct-push sampling results for location 13307B are provided in Table A.2-13. The location is identified in Figure A.2-2A.

This location has been sampled three times since 2003. The samples collected in 2003 were identified as location 13307. The samples collected in 2025 were identified as location 13307B. Total uranium concentrations from all three sampling events are provided below.

Location 13307 (2003)		Location 13307A (2009)		Location 13307B (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
516	19.1	512	23.0	514	9.96
507	72.7	502	13.4	504	6.57
497	55.8	492	28.9	494	11.8
487	77.2	482	12.7	484	11.3
477	30.9	472	3.5	474	17.1
467	3.7	462	<1.00		
457	1.5				
447	<1.00				
437	<1.00				
427	<1.00				

Similar to location 13306F, this sampling location is south of the current leading edge of the South Plume. It is in an area of the aquifer that is no longer being actively flushed by pumping operations. The last extraction well that was helping to flush this area of the aquifer (i.e., RW-1) was turned off in November 2024. Sampling at this location in 2025 provides data to document whether concentration rebound is occurring now that active pumping in this area has stopped.

The highest uranium concentration measured in 2025 at this location was 17.1 µg/L (elevation 474 ft amsl) indicating that concentrations have not rebounded above 30 µg/L. The uranium concentration at this location has been below 30 µg/L since 2009. It should be noted that this is just a preliminary assessment of current conditions in this area. A formal certification process outlined in the *Fernald Groundwater Certification Plan* (DOE 2006) will be conducted to verify that cleanup objectives have been achieved once pumping in all of the South Plume area has been turned off.

Location 13308F

Location 13308F is located south of the South Plume. Direct-push results are provided in Table A.2-14. The location is identified in Figure A.2-2A.

This location has been sampled seven times: 2003, 2009, 2013, 2014, 2017, 2018, and 2025. The samples collected in 2003 were identified as location 13308. The samples collected in 2025 were identified as location 13308F. Total uranium concentration data from all sampling events are provided below.

Location 13308 (2003)		Location 13308A (2009)		Location 13308B (2013)		Location 13308C (2014)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
512	39.5	513	31.2	510	22.0	512	24.9
503	67.6	503	32.8	500	38.6	502	55.6
493	22.1	493	2.10	490	6.00	492	37.4
483	3.10	483	2.60	480	3.10	482	1.20

Location 13308D (2017)		Location 13308E (2018)		Location 13308F (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
513	37.7	516	16.1	512	18.2
503	41.5	506	10.0	502	12.0
493	36.0	496	12.0	492	11.7
483	2.0	486	4.8	482	1.30
473	<1.0	473	<1.0	472	2.16

Similar to locations 13306F and 13307B, this sampling location is south of the current leading edge of the South Plume. It is in an area of the aquifer that is no longer being actively flushed by pumping operations. The last extraction well that was helping to flush this area of the aquifer (i.e., RW-4) was turned off in 2022. Sampling at this location in 2025 provides data to document whether concentration rebound is occurring now that active pumping in this area has stopped.

The highest uranium concentration measured in 2025 at this location was 18.2 µg/L (elevation 512 ft amsl) indicating that concentrations have not rebounded above 30 µg/L. The uranium concentration at this location has been below 30 µg/L since 2018. It should be noted that this is just a preliminary assessment of current conditions in this area. A formal certification process outlined in the *Fernald Groundwater Certification Plan* (DOE 2006) will be conducted to verify that cleanup objectives have been achieved once pumping in all of the South Plume area has been turned off.

Location 13465A

Location 13465A is located south of the South Plume. Direct-push results are provided in Table A.2-15. The location is identified in Figure A.2-2A.

This location has been sampled two times: 2013 and 2025. The samples collected in 2013 were identified as location 13465. The samples collected in 2025 were identified as location 13465A. Total uranium concentration data from both sampling events are provided below.

Location 13465 (2013)		Location 13465A (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
515	26.5	513	13.8
505	11.2	503	9.75
495	20.5	493	11.6
485	16.9	483	14.3
		473	12.5

Similar to locations 13306F, 13307B, and 13308F, this sampling location is south of the current leading edge of the South Plume. It is in an area of the aquifer that is no longer being actively flushed by pumping operations. The last extraction well that was helping to flush this area of the aquifer (i.e., RW-4) was turned off in 2022. Sampling at this location in 2025 provides data to document whether concentration rebound is occurring now that active pumping in this area has stopped.

The highest uranium concentration measured in 2025 at this location was 14.3 µg/L (elevation 483 ft amsl) indicating that concentrations are below 30 µg/L. The uranium concentration at this location has never been recorded above 30 µg/L. It should be noted that this is just a preliminary assessment of current conditions in this area. A formal certification process outlined in the *Fernald Groundwater Certification Plan* (DOE 2006) will be conducted to verify that cleanup objectives have been achieved once pumping in all of the South Plume area has been turned off.

Location 13513E

Location 13513E is on the southeast edge of the South Plume. Direct-push results are provided in Table A.2-16. The location is identified in Figure A.2-2A.

This location has been sampled six times since 2018. The samples collected in 2018 were identified as location 13513. The samples collected in 2025 were identified as location 13513E. Total uranium concentration data from the sampling events are provided below.

Location 13513 (2018)		Location 13513A (2020)		Location 13513B (2021)		Location 13513C (2022)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
513	10.1	515	10.3	514	38.0	515	23.2
503	26.4	505	19.3	504	25.7	505	46.4
493	43.5	495	45.3	494	28.6	495	32.2
483	33.0	485	10.8	484	22.7	485	16.1
473	<1.0	475	1.4	474	2.2	475	3.2

Location 13513D (2024)		Location 13513E (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
511	16.1	514	29.5
501	32.3	504	16.3
491	27.3	494	9.45
481	10.4	484	2.54
471	4.0	474	<1.0

The maximum uranium plume concentration measured at this location in 2025 was 29.5 µg/L (elevation 514 ft amsl). The 2025 maximum uranium plume map was adjusted to honor this concentration. DOE will revisit this location in the future to verify that concentrations remain below 30 µg/L. Other locations sampled in this area support that this area is below 30 µg/L.

Location 13542D

Location 13542D is west of the southwest corner of the South Plume. Direct-push results are provided in Table A.2-17. This location is identified on Figure A.2-2A.

Location 13542 has been sampled seven times beginning in 2021. The first three samples collected in 2021 were identified as location 13542. The samples collected in 2025 were identified as 13542D. Total uranium concentrations from all six sampling events are provided in the table below.

Location 13542 (7/20/2021)		Location 13542 (7/28/2021)		Location 13542 (8/6/2021)		Location 13542A (2022)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
509	32.2	509	21.1	509	21.9	512	40.4
499	5.4	499	4.8	499	2.7	502	5.9
489	8.9	489	6.1	489	6.8	492	5.4
479	22.7	479	17.2	479	9.7	482	11.4
469	40.9	469	20.2	469	19.8	472	23.6
		459	10.2	459	15.4	462	20.5
		449	3.9	449	8.0	452	18.5

Location 13542B (2023)		Location 13542C (2024)		Location 13542D (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
512	12.8	517	20.2	513	17.7
502	4.9	507	4.1	503	4.75
492	4.2	497	6.4	493	7.55
482	12.5	487	15.3	483	10.5
472	32.1	477	28.7	473	12.2
462	19.5	467	14.3	463	9.62
452	21.6	457	8.5	453	10.2
442	4.8	447	<1.0	443	1.42

The first sample at this location was collected on July 20, 2021, and resulted in a maximum uranium concentration of 40.9 µg/L (elevation 469 ft amsl). In 2021, monitoring well 3095, located just north of location 13542, had a maximum uranium concentration of 39.8 µg/L. This indicates that there is a deep lens of contamination in this area below the water table. It was decided to do a confirmatory sampling on July 28, 2021, and results were different enough from the results on July 20, 2021, that it was decided to do a third confirmatory sampling on August 6, 2021. As shown in the table above, no uranium concentrations above 30 µg/L were measured in the July 28, 2021, and August 6, 2021, samples. To be conservative, sample results from July 20, 2021, the highest total uranium concentrations measured, were selected for the 2021 maximum total uranium plume map. The 2021 uranium plume map showed a concentration

above 30 µg/L based on the July 20, 2021, samples from location 13542 and 2021 monitoring results from monitoring well 3095.

From 2022 to 2024 the maximum uranium plume concentration decreased from 40.4 µg/L (512 ft amsl) to 20.2 µg/L (517 ft amsl) and from 32.1 µg/L (472 ft amsl) to 28.7 µg/L (477 ft amsl). The 2024 maximum uranium plume map was revised to honor the 2024 concentrations measured in 2024. The location was resampled in 2025 to document whether uranium concentration remain below 30 µg/L. The maximum uranium concentration measured in 2025 at this location was 17.7 µg/L (elevation 513 ft amsl).

Uranium concentrations measured at nearby monitoring wells 2095 and 3095 are provided in Figures A.2-20 and A.2-21, respectively. As shown in Figure A.2-20, concentrations in monitoring well 2095 have been increasing since 2023, but are still below 30 µg/L. As shown in Figure A.2-21 concentrations in monitoring well 3095 have been oscillating around the 30 µg/L concentration since 2023. In both 2024 and 2025, the first half sample was slightly above 30 µg/L, and the second half sample was slightly below 30 µg/L. Monitoring well 3095 is identified as an intermittent exceedance location on the 2025 maximum uranium plume map.

Location 13606A

Location 13606A is located on the north side of the southern portion of the South Plume. Direct-push results are provided in Table A.2-18. This location is identified on Figure A.2-2A.

Location 13606A has been sampled two times (2022 and 2025). The first samples collected in 2022 were identified as location 13606. The samples collected in 2025 were identified as 13606A. Total uranium concentrations from both sampling events are provided in the table below.

Location 13606 (2022)		Location 13606A (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
513	56.1	515	37.5
503	23.5	505	9.54
493	17.3	495	5.05
483	10.5	485	3.78
473	8.9	475	4.16

As shown in the table above, the maximum uranium concentration at this location has decreased from 56.1 µg/L in 2022 (elevation 513 ft amsl) to 37.5 µg/L in 2025 (elevation 515 ft amsl). The 2025 maximum uranium plume map was revised to honor the 2025 concentration.

Location 13609A

Location 13609A is located on the north side of the southern portion of the South Plume. Direct-push results are provided in Table A.2-19. This location is identified on Figure A.2-2A.

Location 13609A has been sampled two times (2022 and 2025). The first samples collected in 2022 were identified as location 13609. The samples collected in 2025 were identified as 1360A. Total uranium concentrations from both sampling events are provided in the table below.

Location 13609 (2022)		Location 13609A (2025)	
Midpoint Screen Elevation (ft amsl)	**Total Uranium (µg/L)**	**Midpoint Screen Elevation (ft amsl)**	**Total Uranium (µg/L)**
513	50.8	515	54.6
503	32.0	505	18.7
493	11.1	495	10.5
483	5.1	485	4.73
473	6.3	475	5.48

As shown in the table above, the maximum uranium concentration at this location has been above 50 µg/L both sampling years. No change was required to the 2025 total uranium plume map.

Location 13612A

Location 13612A is in the middle of the southern portion of the South plume. Direct-push results are provided in Table A.2-20. The location is identified in Figure A.2-2A.

This location has been sampled two times: 2022 and 2025. The samples collected in 2022 were identified as location 13612. The samples collected in 2025 were identified as location 13612A. Total uranium concentration data from the sampling events are provided below.

Location 13612 (2022)		Location 13612A (2025)	
Midpoint Screen Elevation (ft amsl)	**Total Uranium (µg/L)**	**Midpoint Screen Elevation (ft amsl)**	**Total Uranium (µg/L)**
512	28.8	513	31.0
502	38.8	503	20.4
492	10.0	493	11.8
482	4.9	483	11.1
472	2.8	473	9.07

The 2025, maximum total uranium concentration was 31 µg/L (elevation 513 ft amsl). The 2025 maximum uranium plume map was revised to honor the 2025 result. The 30 µg/L was moved to a location just east of 13612A. Additional sampling is planned for this location (and west of this location) in 2026.

Location 13613A

Location 13613A is in the middle of the southern portion of the South Plume. Direct-push results are provided in Table A.2-21. The location is identified in Figure A.2-2A.

This location has been sampled two times: 2022 and 2025. The samples collected in 2022 were identified as location 13613. The samples collected in 2025 were identified as location 13613A. Total uranium concentration data from the sampling events are provided below.

Location 13613 (2022)		Location 13613A (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
513	29.5	513	16.1
503	33.6	503	20.0
493	31.5	493	14.3
483	11.3	483	11.5
473	11.9	473	5.63

The maximum total uranium concentration at this location went from 33.6 µg/L in 2022 (elevation 503 ft amsl) to 20.0 µg/L in 2025 (elevation 503 ft amsl). The 2025 maximum uranium plume map was revised to honor the 2025 result.

Location 13614A

Location 13614A is in the middle of the southern portion of the South Plume. Direct-push results are provided in Table A.2-22. The location is identified in Figure A.2-2A.

This location has been sampled two times: 2022 and 2025. The samples collected in 2022 were identified as location 13614. The samples collected in 2025 were identified as location 13614A. Total uranium concentration data from the sampling events are provided below.

Location 13614 (2022)		Location 13614A (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
514	71.9	515	43.2
504	34.6	505	23.8
494	27.1	495	6.99
484	6.1	485	6.06
474	<1.0	475	1.54

As shown in the table above, the maximum uranium concentration at this location decreased from 71.9 µg/L in 2022 (elevation 514 ft amsl) to 43.2 µg/L in 2025 (elevation 515 ft amsl). The 2025 maximum uranium plume map was revised to honor the lower 2025 concentration. This plume adjustment resulted in the area above 50 µg/L being separated into two areas.

Location 13621B

Location 13621B is south of the northern portion of the South Plume. Direct-push results are provided in Table A.2-23. The location is identified in Figure A.2-2A.

This location has been sampled three times beginning in 2023. The samples collected in 2023 were identified as location 13621. The samples collected in 2025 were identified as location 13621B. Total uranium concentration data from the sampling events are provided below.

Location 13621 (2023)		Location 13621A (2024)		Location 13621B (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
511	29.2	510	30.4	514	25.1
501	17.3	500	17.7	504	24.6
491	4.3	490	13.0	494	18.8
481	8.3	480	2.4	484	14.9
471	2.6	470	1.2	474	11.7

The 2025 maximum total uranium result at this location was 25.1 µg/L (elevation 514 ft amsl). The 2025 maximum total uranium plume map was revised to honor the 2025 concentration.

Location 13623B

Location 13623B is located in the southern half of the north portion of the South plume. Direct-push results are provided in Table A.2-24. This location is identified on Figure A.2-2A.

This location has been sampled three times beginning in 2023. The samples collected in 2023 were identified as location 13623. The samples collected in 2025 were identified as location 13623B. Total uranium concentration data from the sampling events are provided below.

Location 13623 (2023)		Location 13623A (2024)		Location 13623B (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
511	22.7	511	30.5	515	28.1
501	19.7	501	5.0	505	24.1
491	11.9	491	13.1	495	14.6
481	8.7	481	3.4	485	16.7
471	5.7	471	1.6	475	10.5

The maximum total uranium concentration measured in 2023 was 22.7 µg/L (elevation 511 ft amsl). The maximum total uranium concentration measured in 2024 was 30.5 µg/L (elevation 511 ft amsl). The maximum total uranium concentration measured in 2025 was 28.1 µg/L (elevation 515 ft amsl). The 2025 total uranium plume map honors the 2025 concentration.

Location 13625A

Location 13625A is located on the west edge of the south portion of the South Plume. Direct-push results are provided in Table A.2-25. This location is identified on Figure A.2-2A.

This location has been sampled two times: 2023 and 2025. The samples collected in 2023 were identified as location 13625. The samples collected in 2025 were identified as location 13625A. Total uranium concentration data from the two sampling events are provided below.

Location 13625 (2023)		Location 13625A (2025)	
Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)	Midpoint Screen Elevation (ft amsl)	Total Uranium (µg/L)
513	28.0	515	44.9
503	23.6	505	11.4
593	34.1	495	23.2
483	7.7	485	13.1
473	5.9	475	14.0

The maximum total uranium concentration at this location increased from 2023 to 2025. The maximum total uranium concentration in 2025 was 44.9 µg/L (elevation 515 ft amsl). The 2025 maximum total uranium plume map did not need to be adjusted.

Location 13647

Location 13647 is in the center of the north portion of the South Plume. Direct-push sampling results for location 13647 are provided on Table A.2-26, and the location is identified on Figure A.2-2A.

As shown in Table A.2-26, the maximum total uranium concentration measured in 2025 was 42.1 µg/L (elevation 513 ft amsl). The 2025 maximum uranium plume map did not need to be adjusted to honor the 2025 result.

Location 13648

Location 13648 is in the southern half of the south portion of the South Plume. Direct-push sampling results for location 13648 are provided on Table A.2-27, and the location is identified on Figure A.2-2A.

As shown in Table A.2-27, the maximum total uranium concentration measured in 2025 was 27.4 µg/L (elevation 514 ft amsl). The 2025 maximum uranium plume map was adjusted to honor the 2025 result.

Location 13649

Location 13649 is located along the south edge of the north portion middle of the South Plume. Direct-push sampling results for location 13649 are provided on Table A.2-28, and the location is identified on Figure A.2-2A.

As shown in Table A.2-28, the maximum total uranium concentration measured in 2025 was 28.0 µg/L (elevation 504 ft amsl). The 2025 maximum uranium plume map was adjusted to honor the 2025 result.

Location 13650

Location 13650 is in the north half of the south portion of the South Plume. Direct-push sampling results for location 13650 are provided on Table A.2-29, and the location is identified on Figure A.2-2A.

As shown in Table A.2-29, the maximum total uranium concentration measured in 2025 was 59.7 µg/L (elevation 515 ft amsl). The 2025 maximum uranium plume map was adjusted to honor the 2025 result.

Location 13654

Location 13654 is south of the southern half of the South Plume. Direct-push sampling results for location 13654 are provided on Table A.2-30, and the location is identified on Figure A.2-2A.

As shown in Table A.2-30, the maximum total uranium concentration measured in 2025 was 24.2 µg/L (elevation 484 ft amsl).

This sampling location is south of the current leading edge of the South Plume. It is in an area of the aquifer that is no longer being actively flushed by pumping operations. The last extraction well that was helping to flush this area of the aquifer (i.e., RW-3) was turned off in 2023. Sampling at this location in 2025 provides data to document whether concentration rebound is occurring now that active pumping in this area has stopped. It should be noted that this is a preliminary assessment of current conditions in this area. A formal certification process outlined in the Fernald Preserve Groundwater Certification Plan (DOE 2006) will be conducted to verify that cleanup objectives have been achieved once pumping in the South Plume has been turned off.

A.2.3.2.2 Intermittent Total Uranium FRL Exceedance Locations in the South Plume

Three monitoring wells (2552, 2900, and 3095) are identified on the maximum total uranium plume maps for 2025 in the South Plume (Figure A.2-3) as being monitoring locations with intermittent total uranium FRL exceedances. Beginning in 2017, monitoring well 2900 is sampled only once a year, during the first half of the year.

A time versus total uranium concentration plot for monitoring well 2552 is provided in Figure A.2-22. The figure shows that no total uranium FRL exceedances have been measured since 2016.

A time versus total uranium concentration plot for monitoring well 2900 is provided in Figure A.2-23. The figure indicates that no total uranium FRL exceedances occurred in 2025. Only two total uranium FRL exceedances have been measured at this well since 1993. The last FRL exceedance occurred in 2012.

A time versus total uranium concentration plot for monitoring well 3095 is provided in Figure A.2-21. Monitoring well 3095 is sampled on a semiannual frequency. In the first half total uranium concentration was 30.7 µg/L and the second half total uranium concentration was 28.7 µg/L.

These wells will continue to be identified on maximum total uranium plume maps as locations where intermittent total uranium FRL exceedances have been measured so that their presence will be carried forward into the certification stage of the aquifer remediation.

A.2.3.2.3 Monitoring Wells with Increasing Total Uranium Concentration Trends in the South Plume

As shown in Figure A.2-4 and Table A.2-31, one monitoring well (2880) had upward trends for total uranium concentration in the South Plume in 2025. Time versus concentration graphs for this well is provided in Figures A.2-24. This well is located within the capture zone of the extraction wells and, as such, the increasing concentration trends are not considered to be a threat to human health or the environment.

A.2.4 Monitoring Well Inspection and Maintenance

All monitoring wells were inspected in 2025 with emphasis on wells that are not routinely sampled or used for water level measurements. The main concern noted for wells not routinely sampled was that protective casings needed to be painted and have identification markings reapplied. Additional minor findings included vegetation or branches removed from around the well to improve access and well lids and locks need to be easier to open.

Many of the inspection findings noted above were corrected immediately (e.g., vegetation removal). Deficiencies that could not be corrected immediately (e.g., removal of overhanging trees) will be corrected as time permits. Annual visual inspections of all monitoring wells will continue in future years with any deficiencies documented and corrected.

Video surveys of monitoring wells that are not routinely sampled are conducted every 5 years. The most recent video survey began in 2022 and was completed in 2023. Leaking well riser joints were identified in eight monitoring wells, and one monitoring well has a surface protective casing that is leaning and preventing easy access to the well. DOE proposed corrective actions for these wells are stated in the table below. In summary:

- Three wells that are not in any sampling program (i.e., 2008, 2935, and 2936) that are not protective of the aquifer will be properly plugged and abandoned.
- Leaking wells that are being used for groundwater elevations will be repaired so that leaking joints are sealed and the well can be of continued use.

Identified Issues Based on Video Survey Results

Well Number	Date of Installation	Program Use	Issue Identified	Proposed Corrective Action
2008	1988	None	Leaking well riser joints	Pull well and seal borehole
2043	1987	Groundwater Elevations Only	Bent riser and leaking well riser joints	Modify well to seal leaking
2044	1988	Groundwater Elevations Only	Leaking well riser joints	Modify well to seal leaking
2051	1987	Groundwater Elevations Only	Leaking well riser joints	Modify well to seal leaking
2383	1990	Groundwater Elevations Only	Leaking well riser joints	Modify well to seal leaking
2881	1993	Groundwater Elevations Only	Leaking well riser joints	Modify well to seal leaking
2935	1993	None	Leaking well riser joints	Pull well and seal borehole
2936	1993	None	Leaking well riser joints	Pull well and seal borehole
3011	1987	Groundwater Elevations Only	Leaking well riser joints	Modify well to seal leaking

A.2.5 Plume Metrics

Uranium plume area, center of mass, and remaining uranium mass calculations were first reported in the 2015 Site Environmental Report (DOE 2016), in response to a request from Ohio EPA. Those calculations follow the approach presented by Joseph A. Ricker in "A Practical Method to Evaluate Ground Water Contaminant Plume Stability" (Ricker 2008).

Using the Ricker method calculations supplements other remedy tracking metrics (i.e., maximum uranium plume maps, model predictions, and uranium concentration data regressions) that are also being reported. The other metrics, developed over many years of interaction with EPA and Ohio EPA, have proven to be reasonable and useful, and are considered to be good for measuring the extraction system's effectiveness. The Ricker method provides an additional good assessment tool.

Starting with the 2022 Site Environmental Report (DOE 2023b), Earth Volumetric Studio (EVS) software was also used to provide a second, separate assessment of plume metrics (i.e., volume, footprint area, average plume thickness, and center of mass). This additional assessment stems from a recommendation made during a collaborative effort with the DOE National Laboratory Network. The National Laboratory Network recommended a four-dimensional mapping exercise (i.e., three spatial dimensions with time as the fourth dimension). Plume metric trends demonstrate that the lateral and vertical dimensions of the uranium plume are contracting, the total dissolved uranium mass is decreasing, and the center of mass has not migrated downgradient. These results also indicate that the pumping system is successfully containing the contamination, preventing plume expansion, and reducing uranium concentrations throughout the contaminated aquifer. Ricker and EVS interpretations are generally similar and are further discussed below.

A.2.5.1 Ricker Method Results

As reported in the 2016 Site Environmental Report (DOE 2017a), plume area calculations based on the Ricker method compared reasonably well with plume area calculations made by conservatively mapping the maximum uranium plume each year. However, the Ricker method calculation of uranium mass remaining in the aquifer was reported as being an order of magnitude lower than predictions presented in Attachment A.1 (based on groundwater modeling predictions and a regression of monitoring data). As discussed below, refinement of the calculation methodology since 2017 indicates that the calculations are in closer agreement when the difference between the mass of uranium in the groundwater and the mass of uranium sorbed to aquifer sediments is recognized and considered in the calculation.

As reported in the 2016 Site Environmental Report (DOE 2017a), a notable difference between the Ricker method and the other metrics being used was that the Ricker method did not include the results of groundwater samples collected using the Geoprobe, while the other metrics did include these data. The groundwater data collected using the Geoprobe were not included in the Ricker calculation because the Ricker calculation requires a dataset that is consistent in location over time; the annual Geoprobe effort does not sample the same locations every year. Ohio EPA requested that future calculations include Geoprobe results to see if the included data improve estimates of the uranium mass remaining (DOE 2017b).

The analysis presented in this year's report uses the annual maximum concentration in 2006, 2010, 2014, 2016 through 2025, and a consistent set of monitoring well data that span all 13 selected years. The most recent maximum total uranium results available at Geoprobe locations were also included. Surfer software (version 26.2.289) was used for kriging the data and mapping the results. Until 2017, the analysis was conducted for three separate plume areas: the PPDD, the South Field and South Plume, and the former WSA. With the addition of Geoprobe data, the analysis in 2017 changed to being applied to the entire plume. A homogenous effective porosity equal to that modeled for the aquifer (28%) was assumed, and a plume thickness of 30 ft was used.

Figure A.2-25 provides a uranium plume map (Ricker interpretation) that identifies the calculated center of mass for each year (2006, 2010, 2014, and 2016 through 2025). As shown in Figure A.2-25, the center of mass in each plume area has remained fairly stationary (i.e., in the same general area) over this period, indicating that the surrounding pumping wells are capturing the plume and not allowing the center of mass to migrate as it would if no pumping were taking place. In the former WSA, the center of mass has shifted slightly to the northwest over time. This is attributed to the higher uranium results in the northwest area as a result of additional Geoprobe sampling in the area. In the PPDD Area, the center of mass has shifted slightly to the west. This is attributed to cleanup of the east portion of the PPDD plume. In the South Field and South Plume, the center of mass has shifted slightly to the north. This is attributed to continuing uranium concentration reductions in the South Plume and southern South Field as cleanup proceeds. With inclusion of the Geoprobe data beginning in 2017, the dataset included more samples collected near and outside plume boundaries, which helps better define the boundaries of the plume.

DOE plans to continue presenting these plume metrics in future Site Environmental Reports and will include Geoprobe data. With the addition of Geoprobe data, the analysis lends itself better to

being applied to the entire plume, rather than dividing the plume into three different areas (i.e., WSA, PPDD, and the combined South Field and South Plume). Including the Geoprobe data also provides plume maps that appear to be better defined at the plume boundaries.

Figure A.2-26 provides 2025 Ricker method results for the total uranium plume area, the average total uranium concentration within the plume, and the total dissolved uranium mass remaining within the plume area. These trends are useful in illustrating remediation progress. As shown in Figure A.2-26, for 2025, the Ricker method calculations indicate that the total uranium plume area was 71.8 acres, the average uranium plume concentration was 94.82 µg/L, and the total uranium plume dissolved mass remaining was 155 pounds (lb).

It should be noted that all three metrics calculated in 2025 (i.e., area, uranium concentration, and mass) slightly increased compared to 2024. Area increased from 71.7 to 71.8 acres. Average total uranium concentration increased from 83.36 to 94.82 µg/L. Total uranium dissolved mass increased from 136 to 155 lb. This increase is attributed to total uranium concentration fluctuations in monitoring wells 2386, 2649, 23280, and 23281. Total uranium concentration versus time graphs for monitoring well 2649 is provided in Figure A.2-10. Time versus concentration graphs for monitoring wells 2386, 23280, and 23281 are provided in Figures A.2-27 through A.2-29, respectively. The figures illustrate that the uranium concentration at three of the four wells shows a pattern of erratic concentration changes. At this time the changes are being attributed to effects caused by pumping in the areas of the wells. No action is recommended at this time, other than continued monitoring.

A.2.5.2 Earth Volumetric Studio Software Results

To address a National Laboratory Network recommendation for obtaining better understanding of the remediation progress, an EVS data assessment exercise began in the 2022 Site Environmental Report for data collected in 2021.

The National Laboratory Network report concluded that uranium plume metric interpretations could be improved if, in addition to calculating plume metrics using the Ricker method, a robust computer visualization software program capable of producing three-dimensional visualizations of the plume could also be used. EVS software was selected.

The EVS plume metric assessments are slightly different than the Ricker assessments. The Ricker method assessment used the maximum yearly uranium concentration measured at direct-push and monitoring well locations to provide a plume size area assessment that could be directly compared to the mapped maximum uranium plume footprint, which also uses the maximum yearly uranium concentrations. The EVS plume metric assessment used the most recent monitoring well concentration and the highest direct-push concentration, not the maximum yearly monitoring well concentration, to provide a better snapshot in time for the monitoring well data.

Using the EVS capability to produce plume metrics correlated to sampling events for the monitoring wells should aid in better detailing how the remedy is progressing. The key conclusion from tracking plume metrics, whether using the Ricker technique or EVS software, is that the metrics should indicate that the plume is decreasing in size over time. This is further discussed below.

A footprint of the 2025 uranium plume generated through EVS and the bulk plume metrics (i.e., uranium plume dissolved mass, average concentration, volume, footprint area, and average thickness) for the 2025 EVS plume interpretation are presented in Figures A.2-25 and A.2-30, respectively.

The bulk plume EVS metrics provided in Figure A.2-31 were calculated for the combined plume and for four separate plume areas: the South Plume, the South Field Plume, WSA, and the PPDD. Trends in plume metrics observed through the EVS exercise illustrate downward trends, but as with the Ricker metrics, the EVS metrics for 2025, are slightly increased compared to 2024. Results are provided in the table below.

As shown in the table below, remaining dissolved plume mass determined through EVS decreased by approximately 70% between 2006 and 2025, decreasing from 160 lb in 2006 to 48 lb in 2025 (Figure A.2-31).

EVS-determined bulk plume metric for the results from October 1, 2006, and October 1, 2021, through October 1, 2025, for the entire uranium plume are as follows.

Year	Plume Area (acres)	Average Total Uranium Concentration (µ/L)	Remaining Dissolved Mass (lb)	Volume (million gallons)	Average Thickness (ft)
October 1, 2006	136.50	68.44	159.64	279.55	22.45
October 1, 2021	88.87	67.47	67.21	119.39	14.73
October 1, 2022	84.93	61.10	56.59	111.00	14.33
October 1, 2023	83.13	64.12	56.93	102.67	13.54
October 1, 2024	75.50	63.25	46.62	88.30	12.83
October 1, 2025	82.10	64.89	48.31	89.41	11.94

It should be noted that the total mass computed by EVS is significantly lower than the mass calculated by the Ricker method. The 2006 plume mass calculated by the Ricker method is 306 lb compared to 160 lb calculated by EVS. For the Ricker method, conservative assumptions are applied to account for the third vertical dimension. A conservative plume thickness of 30 ft is assumed in the Ricker calculations, and the maximum uranium concentration at each sample location is applied to the full plume thickness. These thickness assumptions are not needed when plume dimensions are interpreted in the vertical dimension by EVS, so EVS theoretically should be providing a more realistic estimate of plume mass. For example, the average plume thickness calculated by EVS for October 2006 is 22.5 ft (25% less than the 30 ft plume thickness assumed for the Ricker method), and the average concentration is 68 µg/L (26% less than the 92 µg/L estimated by the Ricker method). If the mass calculated by the Ricker method is adjusted to account for the potential overestimates of plume thickness and average concentration, then the 2006 mass becomes 170 lb, which is very similar to the 160 lb mass calculated by EVS. It should also be noted that this comparison between methods compares the maximum uranium concentration from monitoring wells and Geoprobe locations (used in the Ricker method) to the most recent uranium concentration for the monitoring wells and maximum for geoprobe locations (used in the EVS method) which is also contributing to the difference.

A.2.5.3 Total Uranium Plume Area

Table A.2-34 presents a comparison of the three different 2025 plume size interpretations (i.e., mapped maximum plume interpretation, Ricker and EVS calculations). Comparison for previous years are also presented. The comparison indicates that between 2014 and 2025, the percent difference between the mapped maximum plume size and the Ricker interpretation has ranged between 2.6% and 9.5%. The percent difference in 2025 was 9.5%. Between 2021 and 2025, the relative percent difference between the mapped approach and the EVS interpretation ranged between 25.2.5% and 8.8%. The percent difference in 2025 was 25.2%.

The comparison between the three different plume size interpretation methods shown in Table A.2-34 provides insight into the uncertainty involved in determining the area of the plume footprint. The worst-case mapped interpretation of plume size has been presented each year in the Site Environmental Report. For this worst-case interpretation, the maximum uranium concentration, both monitoring wells and geoprobe locations, regardless of depth measured, is projected onto a two-dimensional surface to produce the plume footprint. This approach is considered to be the most conservative mapping method for interpreting the size of the footprint. For 2025, this conservative mapping approach produced a footprint that measured 65.6 acres (Table A.2-34).

In 2015, Ricker method plume metrics began to be reported in the Site Environmental Report. This method also uses the maximum yearly uranium concentration at monitoring wells and direct-push locations in the plume metric calculations. A kriging algorithm is used to provide a statistical interpretation of predicted concentration changes between and around the monitoring points. For 2025, the Ricker interpretation of the size of the uranium plume footprint was 71.8 acres (Table A.2-34) which is in close agreement to the conservative mapping approach result of 65.6 acres.

In 2022, EVS method plume metrics began to be reported in the Site Environmental Report. For the EVS metrics, the most recent monitoring well data (along with the highest geoprobe data from each location) was used instead of the maximum annual monitoring uranium concentration. This provides a better snapshot in time of the monitoring well data. EVS also uses a kriging algorithm to provide a statistical interpretation of predicted concentration changes between and around the monitoring points. For 2025, the EVS interpretation of the size of the uranium plume footprint (Figure A.2-31) was 82.1 acres, which is larger than the other two methods. As shown in Table A.2-34, this difference is 25.2%.

In summary, both the conservative mapping approach and the Ricker method use the maximum monitoring well data for the year and the maximum Geoprobe location concentrations. The EVS method uses the most recent concentration measured at the monitoring wells and maximum Geoprobe data providing a more precise snapshot in time of for at least the monitoring well data. As the remedy progresses, DOE plans to continue using these interpretation methods.

A.2.5.4 Total Mass of Uranium Remaining in the Aquifer

As has been done in previous Site Environmental Reports a calculation of the total mass of uranium remaining in the aquifer is presented. This year, the calculation is presented for dissolved mass determined using the both the Ricker method and the EVS interpretation.

Ricker Method

The value of 155 lb for the total mass of uranium remaining in the aquifer based on the Ricker method presented in Figure A.2-26 represents the dissolved mass of total uranium remaining in the aquifer based on 2025 data. As shown below, this result can be put into the context of the aquifer remediation by using the relationship of the contaminant distribution coefficient (K_d).

The distribution coefficient is the ratio of the concentration of a contaminant sorbed on the surfaces of the aquifer sediments to the concentration of the contaminant dissolved in groundwater and is represented as follows:

$$K_d = C_s/C_{aq}$$

where:

K_d = distribution coefficient, liters per kilogram (L/kg)

C_s = concentration of total uranium sorbed to aquifer sediments, milligrams per kilogram (mg/kg)

C_{aq} = concentration of total uranium dissolved in groundwater, milligrams per liter (mg/L)

The site-specific K_d for uranium used in the groundwater model is 3 L/kg (DOE 2003), which indicates that the concentration of uranium sorbed to aquifer sediments is three times the concentration of uranium in the groundwater. However, as discussed below, the sorbed mass of uranium is actually greater than three times the dissolved mass in solution because of the units used for K_d (Deutsch 1997).

The mass of aquifer solid in contact with 1 liter (L) of groundwater under saturated conditions can be defined as the bulk density of the solid (ρ_b) divided by the porosity of the aquifer (η). In the groundwater model, the bulk density is 1.85 grams per cubic centimeter (g/cm^3) and aquifer porosity is 28%; therefore, $\rho_b/\eta = 6.61$ g/cm^3.

The total uranium mass in the aquifer can be estimated by adding both the aqueous mass and solid mass using the following formula (Deutsch 1997):

$$\text{Total mass} = [(C_{aq})(1\text{ L})] + [(\rho_b/\eta)(C_s)(1\text{ L})]$$

where:

C_{aq} = concentration of total uranium dissolved in groundwater, mg/L

ρ_b = bulk density of aquifer sediments, g/cm^3

η = porosity of aquifer, percent

C_s = concentration of total uranium sorbed to aquifer sediments, mg/kg

This equation is solved below for a 1 L aquifer volume with an assumed C_{aq} of 1 mg/L. Site-specific values defined in the groundwater model for bulk density (1.85 g/cm^3) and aquifer porosity (28%) are used. A K_d of 3 L/kg is used to define a C_s of 3 mg/kg.

$$\text{Total Mass} = [(C_{aq})(1\text{ L})] + [(\rho_b/\eta)(C_s)(1\text{ L})]$$

$$\text{Total Mass} = [(1\text{ mg}_{aq}/\text{L})(1\text{ L})] + \{[(1.85\text{ g/cm}^3)/0.28][(3\text{ mg/kg})(1\text{ L})]\}$$

$$\text{Total Mass} = (1\text{ mg}_{aq}) + \{(6.61\text{ g/cm}^3)[(3\text{ mg/kg})(1\text{ L})]\}$$

Unit Conversions

$(6.61\text{ g/cm}^3)(1{,}000\text{ cm}^3/\text{L}) = 6{,}610\text{ g/L}$

$(6{,}610\text{ g/L})(1{,}000\text{ mg/g}) = 6{,}610{,}000\text{ mg/L})$

$$\text{Total Mass} = (1\text{ mg}_{aq}) + [(6{,}610{,}000\text{ mg/L})(3\text{ mg/kg})(1\text{ L})]$$

Unit Conversion

$(3\text{ mg/kg})(1\text{ kg}/1{,}000{,}000\text{ mg}) = 0.000003$

$$\text{Total Mass} = 1\text{ mg}_{aq} + (6{,}610{,}000\text{ mg/L})[(0.000003)(1\text{ L})]$$

$$\text{Total Mass} = 1\text{ mg}_{aq} + 19.83\text{ mg}_s$$

This total mass calculation shows that the uranium mass sorbed in a 1 L volume of aquifer is 19.83 times greater than the uranium mass dissolved. This relationship can be combined with the result of the Ricker dissolved mass estimate to determine a total uranium mass for the aquifer. The Ricker method estimated a dissolved uranium mass of 155 lb (Figure A.2-26); therefore, the estimated total mass in the aquifer (based on 2025 data) is 3,228.65 lb. It should be noted that this estimate does not include any uranium that is sorbed to aquifer sediments in the vadose zone.

$$3{,}228.65\text{ lb total} = 155\text{ lb}_{aq} + (155\text{ lb}_{aq})(19.83)$$

$$3{,}228.65\text{ lb total} = 155\text{ lb} + 3{,}073.65\text{ lb}$$

The result of 3,228.65 lb of uranium mass total from the Ricker method can be compared to the predicted dissolved mass removal estimates presented in Attachment A.1 to achieve an estimate of the dissolved mass required to be removed from the aquifer to achieve a concentration-based cleanup of 30 µg/L. The estimate will also show how much sorbed uranium mass will remain in the aquifer when the concentration-based cleanup is achieved.

As shown in Table A.1-20 in Attachment A.1, two estimates are provided for the estimated total pounds of dissolved uranium mass to be removed from the aquifer to achieve the concentration-based cleanup FRL of 30 µg/L:

- 1,390 lb dissolved mass (based on 2022 model predictions)
- 2,205 lb dissolved mass (based on regression of concentration data)

The range in the predicted mass of dissolved uranium that needs to be removed indicates that between 1,023.65 and 1,838.65 lb of uranium will remain sorbed to aquifer sediments when the concentration-based cleanup of 30 µg/L is achieved:

- 3,228.65 lb – 1,390 lb = 1,838.65 lb sorbed uranium mass remains
- 3,228.65 lb – 2,205 lb = 1,023.65 lb sorbed uranium mass remains

EVS Interpretation

As presented earlier, through EVS analysis, the dissolved uranium mass present in the aquifer in October 2025 was determined to be 48.31 lb (considerably lower than the 155 lb determined through the Ricker method). Using 48.31 lb and a multiplier of 19.83 (as shown below), results in an estimated mass remaining of 971.09 lb.

$$1{,}006.30 \text{ lb total} = 48.31 \text{ lb}_{aq} + (48.31 \text{ lb}_{aq})(19.83)$$

$$1{,}006.30 \text{ lb total} = 48.31 \text{ lb} + 957.99 \text{ lb}$$

In Attachment A.1, Table A.1-20, two estimates are provided for the total pounds of dissolved uranium mass to be removed from the aquifer to achieve the concentration-based cleanup FRL of 30 µg/L:

1,390 lb dissolved mass (based on 2022 model predictions)

2,205 lb dissolved mass (based on regression of concentration data)

As shown below, subtracting the predicted dissolved mass removal estimates presented in Table A.1-19 from the EVS interpreted result of 1,006.30 lb remaining in the aquifer results in negative numbers.

1,006.30 lb – 1,390 lb = −383.7 lb sorbed uranium mass remains

1,006.30 lb – 2,205 lb = −1,198.7 lb sorbed uranium mass remains

Summary

The estimated range for dissolved mass of uranium remaining in the aquifer is 48.31 lb (EVS) to 155 lb (Ricker). These dissolved mass estimates were put into the context of the aquifer remediation by using the contaminant distribution coefficient (K_d) relationship presented by Deutsch (1997).

The Deutsch relationship indicates that the uranium mass sorbed in a 1 L volume of aquifer is 19.83 times greater than the uranium mass dissolved. Using this multiplier, the estimated range of mass remaining in the aquifer (both dissolved and sorbed) was determined to be 1,006.30 lb (EVS) to 3,228.65 lb (Ricker).

Of the two estimate methods, the EVS method appears to be underestimating the total uranium mass in the aquifer. Both the model prediction and the stretched exponential regressions indicate that an additional mass of uranium between 1,390 and 2,205 lb needs to be removed from the aquifer to achieve cleanup goals. The EVS interpretation indicates that there are only 1,006.30 lb of uranium in the aquifer.

DOE will continue to refine these interpretation methods. For instance, as more EVS interpretation work is conducted, a better understanding of actual plume dimensions and volume will evolve. Additional work to better understand how K_d varies in the braided stream deposits found in the aquifer could result in better cleanup time predictions and better remediation results in recalcitrant areas.

A.2.6 Total Uranium Plume Cross Sections

Five total uranium plume cross sections are presented to provide a vertical interpretation of the EVS total uranium plume. All five cross sections were constructed using EVS software. The locations of each cross section are shown in Figures A.2-32, A.2-33, and A.2-34. The cross sections (A–A′, B–B′, C–C′, D–D′, and E–E′) are provided in Figures A.2-35 through A.2-39, respectively.

Each cross section depicts the ground surface, the base of the glacial till (clay overburden), the top of the unconsolidated sand and gravel Great Miami Aquifer, and the highest average quarterly water elevation for the year, which for 2025 was in July. Monitoring well data are the most recent monitoring results. The midpoint of the monitoring well screen or Geoprobe screen is shown for each location with a small triangle symbol. Vertical depth total uranium profiles are provided for each Geoprobe location. Extraction well screen locations and depths are also shown in the cross sections, if applicable. The plume profile depicted by EVS on the cross sections is dependent upon the water table elevation. Only uranium concentrations below the water table are displayed. Therefore, to be conservative (i.e., to illustrate the most plume profile), the highest quarterly average water table elevation for 2025 was selected for the cross sections (i.e., July 2025).

As illustrated in the cross sections, the top of the 30 µg/L total uranium plume is normally situated at the water table, but in a few areas of the aquifer the upper surface of the 30 µg/L total uranium plume is located beneath the water table. Also, some of the plume areas used to interpret the conservative mapped maximum uranium plume footprint are actually smaller, separate plume areas. The cross sections help to identify where the small separate plume areas are located. Tracking the location and size of the small separate plume areas beneath the water table will help in making remediation operational decisions as the remedy progresses.

A.2.7 Split Sampling Program

The sampling program at private homeowner wells is the longest running groundwater monitoring effort at the site. The private homeowner well sampling program was initiated in 1982 in response to monitoring results indicating above background concentrations of uranium in private wells near the site. By 1984, the site had officially established the program with the monthly sampling of 19 privately-owned wells. In 1996, the private well program had grown to 32 private wells. At a property owner's request, any drinking water well near the site was sampled for uranium, and the one-time results were reported to the well owner. If any special request sample showed a questionable or significant total uranium concentration, or if the private well was determined to provide critical groundwater information in an area, the property owner had the option to participate in the routine sampling program.

Since 1987, DOE has participated in a split sampling program with Ohio EPA at the homeowner wells. Split samples are obtained when technicians alternately add portions of a sample to two individual sample containers. This collection method helps ensure that both samples are as close as possible to being identical. The split samples are then submitted to two analytical laboratories; this allows for an independent comparison of data to ascertain quality assurance for laboratory analysis and field sampling methods. Ohio EPA occasionally performs independent sampling in addition to split sampling.

In 1997, with implementation of the IEMP, the private well program was modified to include only private wells 13, 14, and 2060, which included the private well where off-property contamination was initially reported in 1981 (DOE 1997). Other private wells that had been previously monitored were not carried forward into the IEMP program because a public water supply was made available to the surrounding properties that had been affected by the off-property groundwater contamination (DOE 1998). These three private wells were sampled monthly or quarterly depending upon location, and sampling results were reported annually in the Site Environmental Report. Data from these three remaining private wells were used to produce the total uranium plume maps presented in the Site Environmental Reports. These three private wells were sampled through 2022. Beginning in 2023, the scope of this program was reduced from three wells to one well.

In the 2022 Site Environmental Report, results for locations 13 and 14 were presented showing that the historical sampling results for total uranium at wells 13 and 14 are well below the 30 µg/L FRL. Well 13 had been below the FRL since 2002 and well 14 had been below the FRL since this well was first sampled in 1988. With concurrence from EPA and Ohio EPA, DOE stopped monitoring in these two private wells which occur outside the current plume (wells 13 and 14) in 2023 and continued monitoring uranium in well 2060.

The time versus concentration graph for well 2060 is provided in Figure A.2-40. This well continues to be monitored semiannually as part of the IEMP split sampling program and results are used to help prepare the total uranium plume map. As shown in Figure A.2-40, the total uranium concentration has been below 30 µg/L since 2020. Split sampling results in 2025 were below 30 µg/L. Additional information is provided in Section 2.4.

A.2.8 Uranium Concentration Trends at Select Monitoring Wells

Beginning in the 2022 Site Environmental Report (DOE 2023b), an additional prediction of when cleanup goals would be achieved at individual monitoring wells, which was independent of the groundwater model, was presented. The new predictions were made by applying dual exponential mathematical functions to uranium concentration data at groundwater monitoring wells that had uranium FRL exceedances in 2022 and showed downward trending concentrations in 2022. This work was completed as part of the National Laboratory Network mathematical model recommendation discussed earlier. A brief summary of the results of the exercise is provided below. A more detailed presentation of the work is provided in *Alternative Mathematical Expressions for Projecting Remedial Time Frame Report, Fernald Preserve, Ohio Site* (DOE 2023a).

The results of the exercise (i.e., the model was updated to include the two new extraction wells in the South Plume) are provided in Table A.2-35. The results help identify how individual monitoring wells are responding to the aquifer remedy. For instance, in the South Plume, the current uranium concentration trend at monitoring well 6880 indicates that based on the current data trend, remediation goals at this well may not be achieved until sometime between 2034 and 2039. The 2022 groundwater modeling prediction for achievement of remediation goals in the South Plume through pumping is between 2024 and 2025. Implementation of the modeling scenario in 2024 by starting up two new extraction wells moves these dates out to 2027 and 2028. The two new extraction wells in this area should help accelerate the decreasing trend observed at this well. Table A.2-35 provides similar results for the South Field, PPDD, and former WSA.

In summary, the assessment of the trend of uranium concentration data shown in Table A.2-35 at individual monitoring wells through the application of dual exponential mathematical functions will continue to be used to help track remediation progress, identify recalcitrant areas, and be compared to modeling predictions to determine how the remedy is progressing. Now that the two new replacement extraction wells (33616 [RW-6A] and 33617 [RW-7A]) are operational in the South Plume Module, DOE will focus efforts on optimizing the southern South Field Plume area next. A few of the aging extraction wells in the South Field are no longer responding to rehabilitation efforts. Modeling will be conducted to determine how best to replace, if necessary, the older, nonresponsive wells, and how to improve cleanup efficiency in the southern South Field area.

A.2.9 References

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Table A.2-1. Geoprobe Location 13509D

Easting '83:	**1348727**	feet
Northing '83:	**476134**	feet
Ground Elevation:	**579**	feet above mean sea level (AMSL)
Depth to Water Table:	**59.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.69**	feet AMSL
Work Completed:	**5/28/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	64	0 - 10	23.1	17.2	7.28	0.854	>999	151	6.60
2	505	74	10 - 20	5.71	15.8	7.48	0.745	>999	26.7	5.18
3	505	74	10 - 20	5.24	15.8	7.48	0.745	>999	26.7	5.18
4	495	84	20 - 30	2.77	15.2	7.58	0.705	>999	136	5.59
5	485	94	30 - 40	6.23	14.9	7.38	0.787	>999	>999	5.34
6	475	104	40 - 50	3.12	14.7	7.34	0.891	>999	704	4.77

[a]Samples are filtered through a 5 micron filter.

Table A.2-2. Geoprobe Location 13651

Easting '83:	**1348799**	feet
Northing '83:	**476231**	feet
Ground Elevation:	**576**	feet above mean sea level (AMSL)
Depth to Water Table:	**57.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.80**	feet AMSL
Work Completed:	**5/21/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	62	0 - 10	28.9	17.9	7.18	0.857	>999	465	6.51
2	504	72	10 - 20	9.38	15.7	7.43	0.736	>999	>999	6.23
3	504	72	10 - 20	8.45	15.7	7.43	0.736	>999	>999	6.23
4	494	82	20 - 30	4.65	15.0	7.50	0.728	>999	54.3	4.82
5	484	92	30 - 40	2.82	15.1	7.45	0.843	>999	978	4.45
6	474	102	40 - 50	9.40	14.8	7.23	0.922	>999	222	4.62

[a]Samples are filtered through a 5 micron filter.

Table A.2-3. Geoprobe Location 13652

Easting '83:	**1348777**	feet
Northing '83:	**476288**	feet
Ground Elevation:	**573**	feet above mean sea level (AMSL)
Depth to Water Table:	**54.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.77**	feet AMSL
Work Completed:	**5/29/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	59	0 - 10	15.2	18.5	7.38	0.802	>999	88.6	5.58
2	504	69	10 - 20	8.40	15.9	7.51	0.832	>999	>999	4.15
3	504	69	10 - 20	7.06	15.9	7.51	0.832	>999	>999	4.15
4	494	79	20 - 30	4.13	15.6	7.41	0.886	>999	750	4.29
5	484	89	30 - 40	2.34	15.9	7.41	0.886	>999	52.6	4.72
6	474	99	40 - 50	7.48	15.7	7.20	0.924	>999	578	5.10

[a]Samples are filtered through a 5 micron filter.

Table A.2-4. Geoprobe Location 13653

Easting '83:	**1348922**	feet
Northing '83:	**476548**	feet
Ground Elevation:	**561**	feet above mean sea level (AMSL)
Depth to Water Table:	**44.00**	feet below ground surface (BGS)
Water Table Elevation:	**516.63**	feet AMSL
Work Completed:	**6/3/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	512	49	0 - 10	21.1	22.8	7.49	0.736	>999	5.57	5.61
2	502	59	10 - 20	38.5	16.1	7.48	0.727	>999	3.74	5.87
3	502	59	10 - 20	35.5	16.1	7.48	0.727	>999	3.74	5.87
4	492	69	20 - 30	11.8	15.5	7.65	0.659	>999	10.7	4.53
5	482	79	30 - 40	15.8	15.1	7.58	0.602	>999	56.4	4.94
6	472	89	40 - 50	13.6	16.0	7.48	0.621	>999	131	5.84

[a]Samples are filtered through a 5 micron filter.

Table A.2-5. Geoprobe Location 13655

Easting '83:	**1348654**	feet
Northing '83:	**476339**	feet
Ground Elevation:	**576**	feet above mean sea level (AMSL)
Depth to Water Table:	**57.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.69**	feet AMSL
Work Completed:	**5/22/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	62	0 - 10	39.7	15.8	7.20	0.770	>999	26.2	5.85
2	504	72	10 - 20	7.77	14.4	7.41	0.766	>999	228	4.35
3	504	72	10 - 20	7.51	14.4	7.41	0.766	>999	228	4.35
4	494	82	20 - 30	6.43	13.9	7.38	0.833	>999	81.1	4.92
5	484	92	30 - 40	7.31	14.5	7.54	0.789	>999	951	5.82
5	474	102	40 - 50	2.22	13.2	7.38	0.789	>999	31.9	4.92

[a]Samples are filtered through a 5 micron filter.

Table A.2-6. Geoprobe Location 13603B

Easting '83:	**1348650**	feet
Northing '83:	**476573**	feet
Ground Elevation:	**572**	feet above mean sea level (AMSL)
Depth to Water Table:	**53.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.80**	feet AMSL
Work Completed:	**6/2/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	58	0 - 10	10.5	20.4	7.56	0.726	>999	>999	6.51
2	504	68	10 - 20	7.84	16.6	7.59	0.696	>999	>999	6.45
3	504	68	10 - 20	7.50	16.6	7.59	0.696	>999	>999	6.45
4	494	78	20 - 30	14.4	17.0	7.43	0.706	>999	>999	5.78
5	484	88	30 - 40	6.28	16.8	7.50	0.657	>999	726	6.17
6	474	98	40 - 50	6.48	16.0	7.37	0.765	>999	17.8	4.70

[a]Samples are filtered through a 5 micron filter.

Table A.2-7. Geoprobe Location 12196D

Easting '83:	**1349175**	feet
Northing '83:	**475882**	feet
Ground Elevation:	**582**	feet above mean sea level (AMSL)
Depth to Water Table:	**63.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.81**	feet AMSL
Work Completed:	**5/19/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	68	0 - 10	9.81	16.7	7.16	0.966	>999	780	6.80
2	504	78	10 - 20	21.3	16.2	7.51	0.803	>999	517	4.48
3	504	78	10 - 20	21.1	16.2	7.51	0.803	>999	517	4.48
4	494	88	20 - 30	7.18	17.2	7.67	0.766	>999	32.4	5.81
5	484	98	30 - 40	6.49	15.8	7.52	0.750	>999	>999	5.44
6	474	108	40 - 50	1.94	15.4	7.35	0.785	>999	124	4.69

[a]Samples are filtered through a 5 micron filter.

Table A.2-8. Geoprobe Location 13229L

Easting '83:	**1348245**	feet
Northing '83:	**475525**	feet
Ground Elevation:	**571**	feet above mean sea level (AMSL)
Depth to Water Table:	**51.00**	feet below ground surface (BGS)
Water Table Elevation:	**520.38**	feet AMSL
Work Completed:	**5/13/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	56	0 - 10	32.5	16.8	7.04	0.775	>999	106	8.16
2	505	66	10 - 20	21.2	15.5	7.26	0.719	>999	425	8.08
3	505	66	10 - 20	19.3	15.5	7.26	0.719	>999	425	8.08
4	495	76	20 - 30	20.7	15.3	7.33	0.720	>999	549	7.04
5	485	86	30 - 40	13.4	15.1	7.43	0.611	>999	48.6	4.39
6	475	96	40 - 50	5.15	15.3	7.48	0.628	>999	50.3	5.67

[a]Samples are filtered through a 5 micron filter.

Table A.2-9. Geoprobe Location 13230E

Easting '83:	**1348651**	feet
Northing '83:	**475590**	feet
Ground Elevation:	**578**	feet above mean sea level (AMSL)
Depth to Water Table:	**58.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.51**	feet AMSL
Work Completed:	**4/22/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	63	0 - 10	20.7	16.8	7.22	0.815	>999	740	7.40
2	505	73	10 - 20	20.2	16.3	7.46	0.718	>999	267	5.84
3	505	73	10 - 20	18.6	16.3	7.46	0.718	>999	267	5.84
4	495	83	20 - 30	10.4	15.6	7.48	0.740	>999	>999	5.29
5	485	93	30 - 40	6.75	16.4	7.51	0.793	>999	>999	5.26
6	475	103	40 - 50	4.96	14.8	7.39	0.781	>999	17.0	5.02

[a]Samples are filtered through a 5 micron filter.

Table A.2-10. Geoprobe Location 13237G

Easting '83:	**1348846**	feet
Northing '83:	**475801**	feet
Ground Elevation:	**575**	feet above mean sea level (AMSL)
Depth to Water Table:	**56.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.35**	feet AMSL
Work Completed:	**5/6/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	61	0 - 10	54.4	13.2	7.05	0.834	>999	331	8.13
2	504	71	10 - 20	21.5	13.2	7.47	0.706	>999	17.2	6.50
3	504	71	10 - 20	19.4	13.2	7.47	0.706	>999	17.2	6.50
4	494	81	20 - 30	14.8	13.0	7.53	0.663	>999	233	6.06
5	484	91	30 - 40	17.9	13.2	7.47	0.650	>999	23.9	5.90
6	474	101	40 - 50	12.6	13.3	7.33	0.719	>999	69.0	5.49

[a]Samples are filtered through a 5 micron filter.

Table A.2-11. Geoprobe Location 13239H

Easting '83:	**1348458**	feet
Northing '83:	**475396**	feet
Ground Elevation:	**579**	feet above mean sea level (AMSL)
Depth to Water Table:	**59.00**	feet below ground surface (BGS)
Water Table Elevation:	**520.04**	feet AMSL
Work Completed:	**4/16/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	64	0 - 10	53.3	14.5	7.20	0.835	>999	28.6	5.17
2	505	74	10 - 20	12.8	14.3	7.46	0.776	>999	>999	5.09
3	505	74	10 - 20	12.0	14.3	7.46	0.776	>999	>999	5.09
4	495	84	20 - 30	20.1	13.8	7.46	0.617	>999	392	3.99
5	485	94	30 - 40	15.7	13.9	7.42	0.628	>999	>999	3.37
6	475	104	40 - 50	3.31	13.7	7.41	0.768	>999	12.7	3.42

[a]Samples are filtered through a 5 micron filter.

Table A.2-12. Geoprobe Location 13306F

Easting '83:	**1348313**	feet
Northing '83:	**474542**	feet
Ground Elevation:	**534**	feet above mean sea level (AMSL)
Depth to Water Table:	**17.00**	feet below ground surface (BGS)
Water Table Elevation:	**516.63**	feet AMSL
Work Completed:	**6/17/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	512	22	0 - 10	17.5	20.9	7.16	1.011	>999	39.0	5.88
2	502	32	10 - 20	6.00	19.0	7.29	0.796	>999	580	5.02
3	502	32	10 - 20	5.96	19.0	7.29	0.796	>999	580	5.02
4	492	42	20 - 30	5.45	16.0	7.43	0.672	>999	765	5.49
5	482	52	30 - 40	12.6	16.2	7.29	0.679	>999	497	6.40
6	472	62	40 - 50	6.72	14.8	7.20	0.759	>999	323	5.30

[a]Samples are filtered through a 5 micron filter.

Table A.2-13. Geoprobe Location 13307B

Easting '83:	**1348540**	feet
Northing '83:	**474486**	feet
Ground Elevation:	**537**	feet above mean sea level (AMSL)
Depth to Water Table:	**18.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.79**	feet AMSL
Work Completed:	**6/10/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	23	0 - 10	9.96	16.9	7.26	0.872	>999	611	5.05
2	504	33	10 - 20	6.57	15.7	7.38	0.708	>999	214	4.01
3	504	33	10 - 20	6.43	15.7	7.38	0.708	>999	214	4.01
4	494	43	20 - 30	11.8	15.2	7.35	0.653	>999	8.38	3.57
5	484	53	30 - 40	11.3	15.0	7.28	0.677	>999	19.7	4.07
6	474	63	40 - 50	17.1	15.1	7.15	0.796	>999	832	4.12

13477F

Table A.2-14. Geoprobe Location 13308F

Easting '83:	**1348966**	feet
Northing '83:	**474570**	feet
Ground Elevation:	**584**	feet above mean sea level (AMSL)
Depth to Water Table:	**67.00**	feet below ground surface (BGS)
Water Table Elevation:	**517.33**	feet AMSL
Work Completed:	**6/25/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	512	72	0 - 10	18.2	19.0	7.22	0.758	>999	17.2	5.12
2	502	82	10 - 20	12.0	18.3	7.38	0.725	>999	44.4	5.02
3	502	82	10 - 20	11.8	18.3	7.38	0.725	>999	44.4	5.02
4	492	92	20 - 30	11.7	16.5	7.29	0.710	>999	37.8	4.70
5	482	102	30 - 40	1.30	16.5	7.25	0.758	>999	20.2	3.88
6	472	112	40 - 50	2.16	16.4	7.19	0.777	>999	>999	4.67

[a]Samples are filtered through a 5 micron filter.

Table A.2-15. Geoprobe Location 13465A

Easting '83:	**1348769**	feet
Northing '83:	**474735**	feet
Ground Elevation:	**582**	feet above mean sea level (AMSL)
Depth to Water Table:	**64.00**	feet below ground surface (BGS)
Water Table Elevation:	**517.61**	feet AMSL
Work Completed:	**6/24/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	513	69	0 - 10	13.8	20.1	7.23	0.801	>999	57.6	4.30
2	503	79	10 - 20	9.75	19.3	7.39	0.727	>999	110	4.64
3	503	79	10 - 20	7.82	19.3	7.39	0.727	>999	110	4.64
4	493	89	20 - 30	11.6	17.9	7.24	0.724	>999	42.0	4.03
5	483	99	30 - 40	14.3	18.1	7.19	0.809	>999	41.1	3.96
6	473	109	40 - 50	12.5	17.4	7.15	0.818	>999	30.5	3.88

[a]Samples are filtered through a 5 micron filter.

Table A.2-16. Geoprobe Location 13513E

Easting '83:	**1348893**	feet
Northing '83:	**475086**	feet
Ground Elevation:	**581**	feet above mean sea level (AMSL)
Depth to Water Table:	**62.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.01**	feet AMSL
Work Completed:	**4/14/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	67	0 - 10	29.5	15.5	7.13	1.020	>999	228	4.56
2	504	77	10 - 20	16.3	16.6	7.34	0.920	>999	11.9	4.19
3	504	77	10 - 20	15.7	16.6	7.34	0.920	>999	11.9	4.19
4	494	87	20 - 30	9.45	16.0	7.30	0.902	>999	32.5	3.88
5	484	97	30 - 40	2.54	16.1	7.32	0.817	>999	6.42	2.88
6	474	107	40 - 50	< 1.0	16.2	7.37	0.692	>999	872	3.87

[a]Samples are filtered through a 5 micron filter.

Table A.2-17. Geoprobe Location 13542D

Easting '83:	**1348156**	feet
Northing '83:	**474985**	feet
Ground Elevation:	**539**	feet above mean sea level (AMSL)
Depth to Water Table:	**22.00**	feet below ground surface (BGS)
Water Table Elevation:	**517.24**	feet AMSL
Work Completed:	**6/4/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	512	27	0 - 10	17.7	17.9	7.33	0.687	>999	135	6.19
2	502	37	10 - 20	4.75	16.5	7.31	0.797	>999	68.0	4.95
3	502	37	10 - 20	4.73	16.5	7.31	0.797	>999	68.0	4.95
4	492	47	20 - 30	7.55	14.9	7.19	0.851	>999	257	4.92
5	482	57	30 - 40	10.5	14.8	7.16	0.808	>999	17.4	4.41
6	472	67	40 - 50	12.2	14.3	7.18	0.770	>999	57.2	3.18
7	462	77	50 - 60	9.62	14.3	7.20	0.789	>999	26.1	3.35
8	452	87	60 - 70	10.2	14.1	7.22	0.797	>999	68.2	3.79
9	442	97	70 - 80	1.42	14.7	7.28	0.737	>999	18.0	3.15

[a]Samples are filtered through a 5 micron filter.

Table A.2-18. Geoprobe Location 13606A

Easting '83:	**1348494**	feet
Northing '83:	**475626**	feet
Ground Elevation:	**578**	feet above mean sea level (AMSL)
Depth to Water Table:	**58.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.51**	feet AMSL
Work Completed:	**4/24/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	63	0 - 10	37.5	17.0	7.23	0.709	>999	299	7.54
2	505	73	10 - 20	9.54	17.1	7.52	0.732	>999	31.1	5.02
3	505	73	10 - 20	8.11	17.1	7.52	0.732	>999	31.1	5.02
4	495	83	20 - 30	5.05	17.2	7.59	0.721	>999	15.0	4.61
5	485	93	30 - 40	3.78	16.3	7.44	0.782	>999	21.1	4.89
6	475	103	40 - 50	4.16	16.3	7.37	0.792	>999	669	6.12

[a]Samples are filtered through a 5 micron filter.

Table A.2-19. Geoprobe Location 13609A

Easting '83:	**1348482**	feet
Northing '83:	**475546**	feet
Ground Elevation:	**578**	feet above mean sea level (AMSL)
Depth to Water Table:	**58.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.74**	feet AMSL
Work Completed:	**4/17/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	63	0 - 10	54.6	15.4	7.24	0.778	>999	>999	6.01
2	505	73	10 - 20	18.7	15.4	7.50	0.788	>999	>999	4.53
3	505	73	10 - 20	18.4	15.4	7.50	0.788	>999	>999	4.53
4	495	83	20 - 30	10.5	14.5	7.53	0.705	>999	136	3.86
5	485	93	30 - 40	4.73	14.6	7.44	0.788	>999	272	3.51
6	475	103	40 - 50	5.48	14.5	7.50	0.733	>999	>999	4.08

[a]Samples are filtered through a 5 micron filter.

Table A.2-20. Geoprobe Location 13612A

Easting '83:	**1348601**	feet
Northing '83:	**475410**	feet
Ground Elevation:	**579**	feet above mean sea level (AMSL)
Depth to Water Table:	**61.00**	feet below ground surface (BGS)
Water Table Elevation:	**517.77**	feet AMSL
Work Completed:	**5/8/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	513	66	0 - 10	31.0	15.7	7.13	0.785	>999	413	7.58
2	503	76	10 - 20	20.4	15.7	7.41	0.731	>999	13.7	4.52
3	503	76	10 - 20	18.8	15.7	7.41	0.731	>999	13.7	4.52
4	493	86	20 - 30	11.8	15.7	7.50	0.664	>999	11.9	4.82
5	483	96	30 - 40	11.1	15.5	7.43	0.698	>999	19.3	5.34
6	473	106	40 - 50	9.07	14.9	7.32	0.709	>999	>999	5.74

[a]Samples are filtered through a 5 micron filter.

Table A.2-21. Geoprobe Location 13613A

Easting '83:	**1348708**	feet
Northing '83:	**475331**	feet
Ground Elevation:	**580**	feet above mean sea level (AMSL)
Depth to Water Table:	**62.00**	feet below ground surface (BGS)
Water Table Elevation:	**517.98**	feet AMSL
Work Completed:	**5/7/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	513	67	0 - 10	16.1	17.4	7.22	0.793	>999	12.0	4.96
2	503	77	10 - 20	20.0	16.7	7.51	0.714	>999	18.2	5.37
3	503	77	10 - 20	13.2	16.7	7.51	0.714	>999	18.2	5.37
4	493	87	20 - 30	14.3	16.2	7.53	0.654	>999	20.4	5.15
5	483	97	30 - 40	11.5	16.0	7.42	0.696	>999	>999	5.42
6	473	107	40 - 50	5.63	16.1	7.39	0.690	>999	38.6	5.00

[a]Samples are filtered through a 5 micron filter.

Table A.2-22. Geoprobe Location 13614A

Easting '83:	**1348501**	feet
Northing '83:	**475266**	feet
Ground Elevation:	**581**	feet above mean sea level (AMSL)
Depth to Water Table:	**61.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.64**	feet AMSL
Work Completed:	**4/15/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	66	0 - 10	43.2	13.5	7.17	0.789	>999	272	6.05
2	505	76	10 - 20	23.8	13.0	7.26	0.747	>999	244	4.74
3	505	76	10 - 20	23.7	13.0	7.26	0.747	>999	244	4.74
4	495	86	20 - 30	6.99	12.9	7.56	0.629	>999	19.3	3.88
5	485	96	30 - 40	6.06	12.9	7.51	0.723	>999	477	4.80
6	475	106	40 - 50	1.54	12.6	7.45	3.850	>999	485	0.785

[a]Samples are filtered through a 5 micron filter.

Table A.2-23. Geoprobe Location 13621B

Easting '83:	**1348714**	feet
Northing '83:	**475640**	feet
Ground Elevation:	**577**	feet above mean sea level (AMSL)
Depth to Water Table:	**58.00**	feet below ground surface (BGS)
Water Table Elevation:	**519.11**	feet AMSL
Work Completed:	**4/29/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	63	0 - 10	25.1	17.7	7.11	0.765	>999	76.7	7.57
2	504	73	10 - 20	24.6	16.5	7.33	0.688	>999	192	6.41
3	504	73	10 - 20	24.5	16.5	7.33	0.688	>999	192	6.41
4	494	83	20 - 30	18.8	16.9	7.46	0.669	>999	8.15	5.48
5	484	93	30 - 40	14.9	13.2	7.40	0.725	>999	174	4.69
6	474	103	40 - 50	11.7	16.2	7.31	0.733	>999	264	5.09

[a]Samples are filtered through a 5 micron filter.

Table A.2-24. Geoprobe Location 13623B

Easting '83:	**1348723**	feet
Northing '83:	**475711**	feet
Ground Elevation:	**576**	feet above mean sea level (AMSL)
Depth to Water Table:	**56.00**	feet below ground surface (BGS)
Water Table Elevation:	**520.20**	feet AMSL
Work Completed:	**4/21/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	61	0 - 10	28.1	17.4	7.26	0.740	>999	196	6.62
2	505	71	10 - 20	24.1	15.2	7.32	0.649	>999	296	6.00
3	505	71	10 - 20	24.0	15.2	7.32	0.649	>999	296	6.00
4	495	81	20 - 30	14.6	15.6	7.50	0.649	>999	527	5.81
5	485	91	30 - 40	16.7	15.0	7.42	0.695	>999	591	5.08
6	475	101	40 - 50	10.5	14.4	7.36	0.723	>999	383	6.04

[a]Samples are filtered through a 5 micron filter.

Table A.2-25. Geoprobe Location 13625A

Easting '83:	**1348347**	feet
Northing '83:	**475467**	feet
Ground Elevation:	**575**	feet above mean sea level (AMSL)
Depth to Water Table:	**55.00**	feet below ground surface (BGS)
Water Table Elevation:	**520.00**	feet AMSL
Work Completed:	**5/15/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	60	0 - 10	44.9	14.5	7.01	0.737	>999	605	7.02
2	505	70	10 - 20	11.4	14.9	7.41	0.720	>999	460	5.90
3	505	70	10 - 20	11.1	14.9	7.41	0.720	>999	460	5.90
4	495	80	20 - 30	23.2	14.9	7.36	0.725	>999	69.6	4.37
5	485	90	30 - 40	13.1	14.7	7.50	0.598	>999	795	5.09
6	475	100	40 - 50	14.0	14.9	7.49	0.652	>999	>999	6.14

[a]Samples are filtered through a 5 micron filter.

Table A.2-26. Geoprobe Location 13647

Easting '83:	**1348949**	feet
Northing '83:	**475773**	feet
Ground Elevation:	**579**	feet above mean sea level (AMSL)
Depth to Water Table:	**61.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.48**	feet AMSL
Work Completed:	**5/12/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	513	66	0 - 10	42.1	15.4	7.10	0.783	>999	597	6.37
2	503	76	10 - 20	15.4	15.8	7.42	0.690	>999	14.0	4.67
3	503	76	10 - 20	15.3	15.8	7.42	0.690	>999	14.0	4.67
4	493	86	20 - 30	3.48	17.8	7.64	0.726	>999	20.8	5.19
5	483	96	30 - 40	5.30	15.6	7.48	0.705	>999	14.8	4.23
6	473	106	40 - 50	5.73	15.7	7.35	0.761	>999	24.6	4.50

[a]Samples are filtered through a 5 micron filter.

Table A.2-27. Geoprobe Location 13648

Easting '83:	**1348707**	feet
Northing '83:	**475190**	feet
Ground Elevation:	**581**	feet above mean sea level (AMSL)
Depth to Water Table:	**62.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.86**	feet AMSL
Work Completed:	**4/28/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	67	0 - 10	27.4	16.5	7.18	0.785	>999	803	7.10
2	504	77	10 - 20	12.2	16.4	7.47	0.639	>999	477	5.75
3	504	77	10 - 20	11.1	16.4	7.47	0.639	>999	477	5.75
4	494	87	20 - 30	13.7	15.5	7.50	0.619	>999	105	4.74
5	484	97	30 - 40	8.18	15.5	7.46	0.710	>999	36.1	4.61
6	474	107	40 - 50	2.62	15.4	7.37	0.736	>999	131	4.45

[a]Samples are filtered through a 5 micron filter.

Table A.2-28. Geoprobe Location 13649

Easting '83:	**1348928**	feet
Northing '83:	**475709**	feet
Ground Elevation:	**577**	feet above mean sea level (AMSL)
Depth to Water Table:	**58.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.78**	feet AMSL
Work Completed:	**4/30/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	63	0 - 10	12.7	18.0	7.31	0.865	>999	17.8	5.98
2	504	73	10 - 20	28.0	16.3	7.36	0.735	>999	11.6	5.93
3	504	73	10 - 20	26.4	16.3	7.36	0.735	>999	11.6	5.93
4	494	83	20 - 30	9.91	17.0	7.58	0.683	>999	79.6	6.17
5	484	93	30 - 40	7.42	15.5	7.45	0.713	>999	714	4.60
6	474	103	40 - 50	3.55	16.2	7.33	0.732	>999	21.0	4.54

[a]Samples are filtered through a 5 micron filter.

Table A.2-29. Geoprobe Location 13650

Easting '83:	**1348466**	feet
Northing '83:	**475472**	feet
Ground Elevation:	**578**	feet above mean sea level (AMSL)
Depth to Water Table:	**58.00**	feet below ground surface (BGS)
Water Table Elevation:	**520.49**	feet AMSL
Work Completed:	**4/23/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	515	63	0 - 10	59.7	17.2	7.19	0.791	>999	34.3	6.93
2	505	73	10 - 20	39.9	16.4	7.26	0.778	>999	254	6.96
3	505	73	10 - 20	36.1	16.4	7.26	0.778	>999	254	6.96
4	495	83	20 - 30	19.7	15.5	7.42	0.616	>999	234	5.29
5	485	93	30 - 40	19.0	15.7	7.32	0.700	>999	115	5.67
6	475	103	40 - 50	9.98	15.4	7.32	0.760	>999	21.4	4.99

[a]Samples are filtered through a 5 micron filter.

Table A.2-30. Geoprobe Location 13654

Easting '83:	**1348815**	feet
Northing '83:	**474421**	feet
Ground Elevation:	**585**	feet above mean sea level (AMSL)
Depth to Water Table:	**66.00**	feet below ground surface (BGS)
Water Table Elevation:	**518.91**	feet AMSL
Work Completed:	**5/5/2025**	

Sample Point	Elevation (ft AMSL)	Depth (ft BGS)	Sample Interval (ft)	Uranium Filtered[a] (µg/L)	Temperature Filtered[a] (°C)	pH Filtered[a] (SU)	Specific Conductance Filtered[a] (mS/cm)	Turbidity Unfiltered (NTU)	Turbidity Filtered[a] (NTU)	Dissolved Oxygen Filtered[a] (mg/L)
1	514	71	0 - 10	9.43	15.2	7.27	0.833	>999	>999	7.39
2	504	81	10 - 20	11.5	15.1	7.44	0.730	>999	10.1	5.14
3	504	81	10 - 20	8.29	15.1	7.44	0.730	>999	10.1	5.14
4	494	91	20 - 30	9.27	14.6	7.36	0.690	>999	10.6	4.77
5	484	101	30 - 40	24.2	14.5	7.26	0.738	>999	591	5.03
6	474	111	40 - 50	14.7	14.4	7.21	0.792	>999	47.9	4.70

[a]Samples are filtered through a 5 micron filter.

Table A.2-31. Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium with 2025 Results Above FRLs

Well	No. of Samples	Minimum (µg/L)[a,b,c]	Maximum (µg/L)[a,b,c]	Average (µg/L)[a,b,c,d]	Standard Deviation (µg/L)[a,b,c,d]	Trend[a,b,c,d]
2045	104	12.0	462	104	90	No Trend
2049	77	3.00	278	69.5	52.0	Down
21033	68	7.34	43.2	23.0	8.4	Up
23271	48	30.9	144	64.9	29.8	Down
23273	48	79.2	421	197	83	Down
23274	72	17.3	384	143	65	Down
23275	47	56.3	349	144	59	Down
23276	48	3.56	115	76.8	18.5	Down
23280	48	13.5	700	114	124	Down
23281	48	16.1	367	115	72	Down
2386	71	6.67	233	48.7	51.2	Up
2387	71	18.1	492	147	73	No Trend
2389	60	0.899	120	33.2	20.2	Up
2397	55	135	737	335	128	Down
2649	67	6.01	1,680	303	385	Up
2880	71	0.400	71.8	31.2	26.5	Up
3095	91	2.00	94.0	28.6	16.2	No Trend
63285	48	43.3	277	149	72	Down
6880	58	30.0	145	71.1	26.8	Down
82369_C1	26	12.1	210	116	44	No Trend
82369_C2	16	25.1	50.6	34.3	6.6	No Trend
82369_C3	14	24.0	41.3	32.2	4.8	No Trend
82372_C1	29	19.8	62.4	34.4	9.6	Down
83117_C1	47	1.28	1,620	665	309	Down
83117_C4	29	28.6	111	63.4	24.4	Down
83124_C1	75	41.4	1,070	444	219	Down
83124_C4	25	25.4	62.2	42.6	8.4	Up
83124_C5	25	24.4	61.4	44.8	8.9	Down
83294_C1	42	98.5	340	214	60	Up
83294_C2	66	1.24	575	261	136	Down
83295_C2	43	50.6	178	103	40	Down
83295_C3	30	28.5	175	95.4	48.3	Down
83296_C1	24	49.3	135	74.5	19.8	Down
83337_C1	45	255	2,660	1,280	560	Down
83337_C2	66	2.40	835	104	153	Down
83338_C1	32	282	1,100	489	149	Down
83338_C2	40	3.91	648	76.5	126	Down
83340_C1	34	13.2	72.7	32.0	10.0	Up

[a] The data are primarily based on unfiltered sample results with some filtered sample results (i.e., 2001-2006). .
[b] If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[c] Rejected data qualified with an R were not included in this count, the summary statistics, or Mann-Kendall test for trend.
[d] For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.

Table A.2-32. Summary Statistics and Trend Analysis of Extraction Wells for Total Uranium

Well	Number of Samples[a,b]	Minimum (µg/L)[a,b,c]	Maximum (µg/L)[a,b,c]	Average (µg/L)[a,b,c]	Standard Deviation (µg/L)[a,b,c]	Trend[a,b,c,d]
South Plume Module (August 27, 1993, through December 31, 2025)						
33616	25	16.2	35.6	25.1	5.1	Down
33617	25	20.3	33.7	25.0	4.2	Down
South Field Module (July 13, 1998, through December 31, 2025)						
31550	731	16.2	128	46.1	18.2	Down
31560	758	10.9	183	48.8	37.2	Down
31561	730	17.7	114[e]	38.0	10.0	Down
32276	771	11.9	290	81.7	64.0	Down
32446	623	16.7	168	50.6	22.5	Down
32447	644	9.40	302	86.2	56.1	Down
33061	528	9.36	98.5	38.5	16.1	Down
33262	487	12.1	110	38.4	15.5	Down
33264	467	3.60	364	58.0	45.4	Down
33298	435	10.1	76.2	42.8	14.0	Down
33326	381	6.60	62.2	19.4	8.7	Down
Waste Storage Area Module (May 8, 2002, through December 31, 2025)						
32761	509	14.9	161	48.0	31.9	Down
33062	533	10.2	236	53.3	41.9	Down
33347	337	7.00	126	24.3	14.8	Down

[a] If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[b] Rejected data qualified with an R were not included in this count, the summary statistics, or Mann-Kendall test for trend.
[c] For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[d] Mann-Kendall test for trend is performed with a 95% confidence interval.
[e] This result (sampled August 31, 1998) appears to be an outlier. It is suspected that the sample for this well was switched with the sample from extraction well 31562, which is no longer active as an extraction well.

Table A.2-33. Plume Size 1997 Through 2025

Year	Area Greater than 30 µg/L Total Uranium (acres)
1997	237.6[a]
1998	216.9[a]
1999	228.9[a]
2000	233.4[a]
2001	171.1
2002	176.0
2003	179.1
2004	195.2
2005	196.1
2006	189.3
2007	186.0
2008	186.9
2009	186.0
2010	184.0
2011	144.3
2012	130.3
2013	127.3
2014	110.9
2015	109.5
2016	105.0
2017	94.4
2018	89.3
2019	86.5
2020	81.5
2021	75.0
2022	74.0
2023	72.1
2024	69.36
2025	65.60

[a] Plume size based on 20 µg/L total uranium.

Table A.2-34. Comparison of Plume Size Interpretations

Year	Maximum Uranium Plume Size Interpretation (acres)	Ricker Method Plume Size Calculation (acres)	Ricker Relative Percent Difference[a]	EVS Method Plume Size Calculation (acres)	EVS Relative Percent Difference[b]
2006	189.3	145.7	23.0%		
2010	184.0	132.7	27.9%		
2014	110.9	108.0	2.6%		
2016	105.0	108.0	2.9%		
2017	94.4	97.3	3.1%		
2018	89.3	95.9	7.4%		
2019	86.5	89.2	3.1%		
2020	81.5	85.9	5.4%		
2021	75.0	81.6	8.8%	88.9	18.5%
2022	74.0	80.7	9.1%	85.3	15.3%
2023	72.1	75.6	4.8%	83.1	15.5%
2024	69.4	71.7	3.3%	75.5	8.8%
2025	65.6	71.8	9.5%	82.1	25.2%

[a] Relative percent difference = [(maximum-Ricker)/maximum] × 100.

[b] Relative percent difference = [(maximum-EVS)/maximum] × 100.

Table A.2-35. Predicted Cleanup Date Range Using Dual Exponential Equation

Well	Predicted Cleanup Date Range
South Plume	
2095	2016–2018
6880	2034–2039
South Field	
2045	2038–Not Determined[a]
2049	2043-Not Determined[a]
2397	2066-2119
23271	2058-2282
23273	2059–Not Determined[a]
23274	2048-2079
23275	2060-2345
23281	2068–Not Determined[a]
63285	2033-2048
83294_C2	2039-2052
83295_C2	2034-2072
83295_C3	2025-2029
83296_C1	2062-Not Determined[a]
Pilot Plant Drainage Ditch	
83117_C1	2390-Not Determined[a]
83117_C4	2025–2034
83124_C2	2019–2023
83124_C5	2030–2047
Waste Storage Area	
83337_C1	2141-Not Determined[a]
83338_C1	2107-2230

[a]Not determined because the trend went flat (i.e., asymptotic).

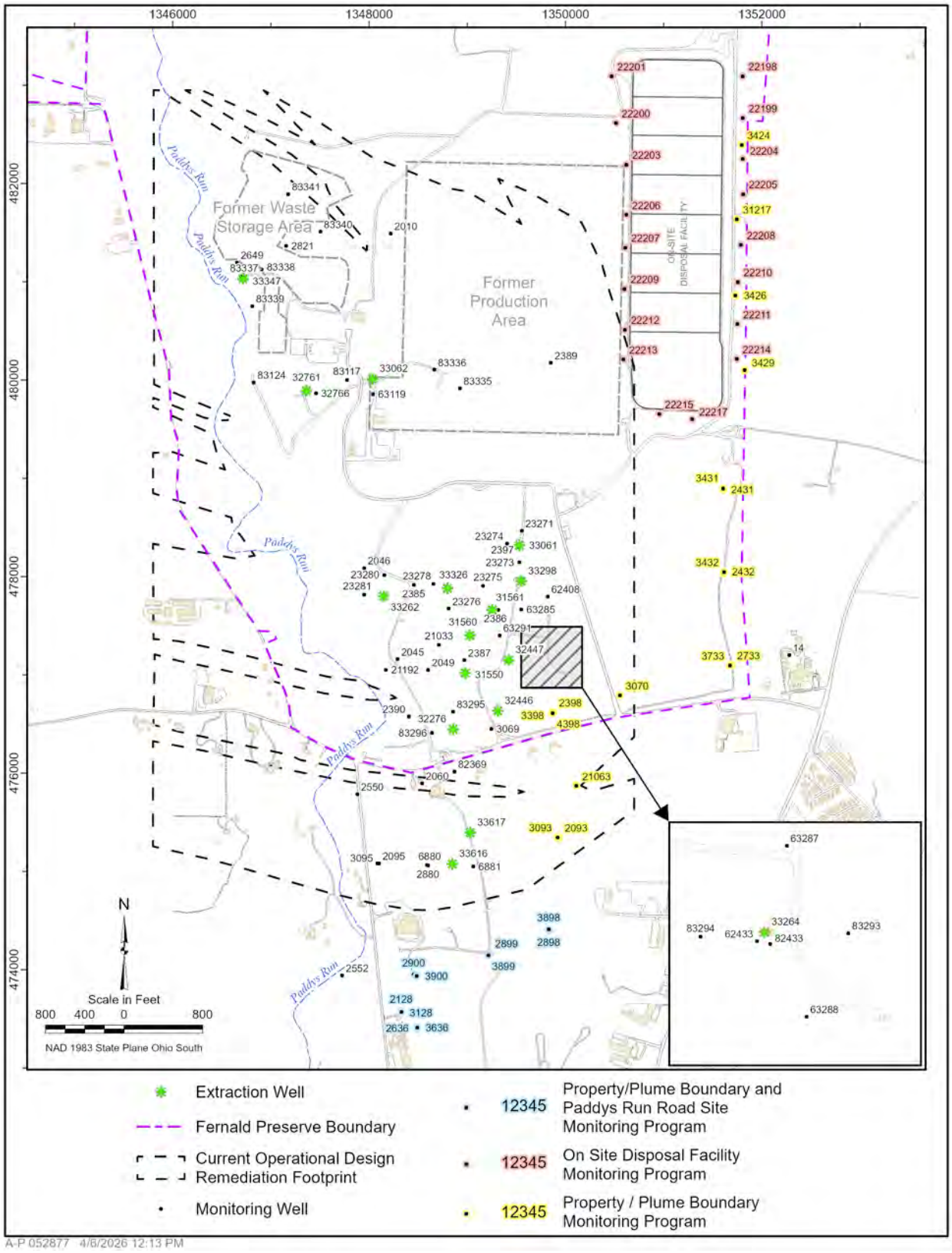


Figure A.2-1. IEMP Water Quality Monitoring Wells and Extraction Wells

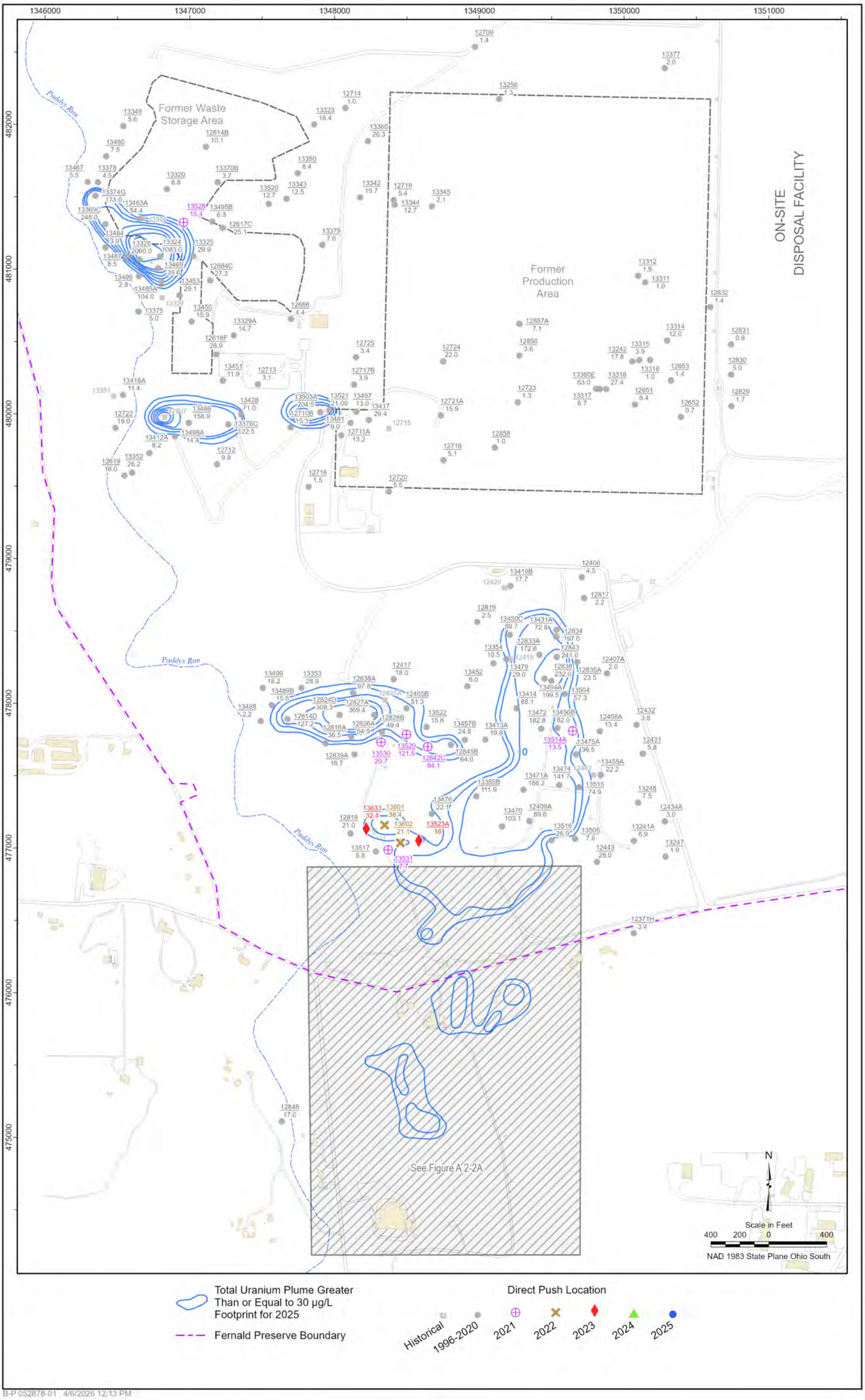


Figure A.2-2. Direct-Push Data and Maximum Total Uranium Plume for 2025

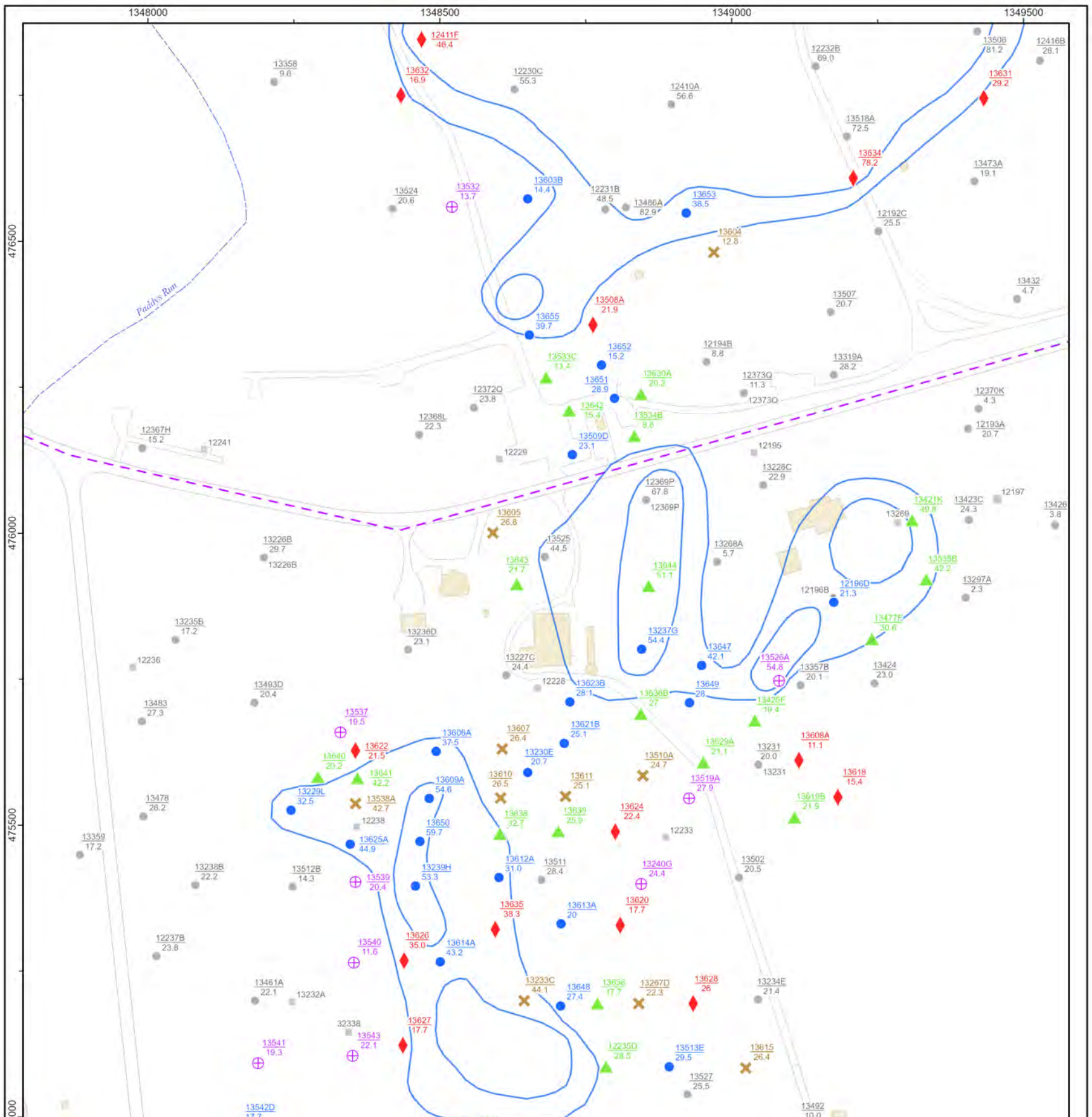


Figure A-2A. Direct-Push Data and Maximum Total Uranium Plume for 2025, Inset

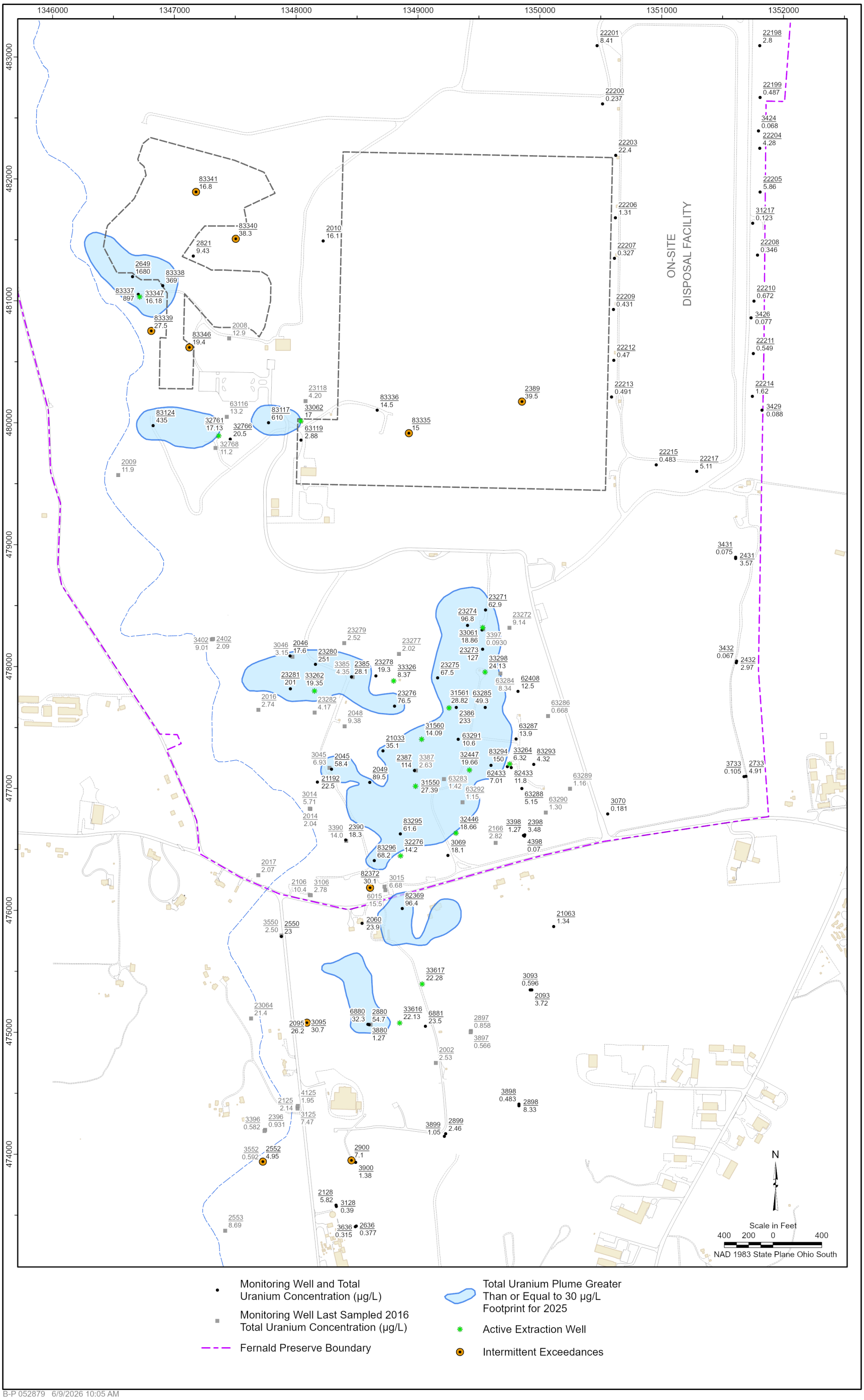


Figure A.2-3. Monitoring Well Data and Maximum Total Uranium Plume for 2025

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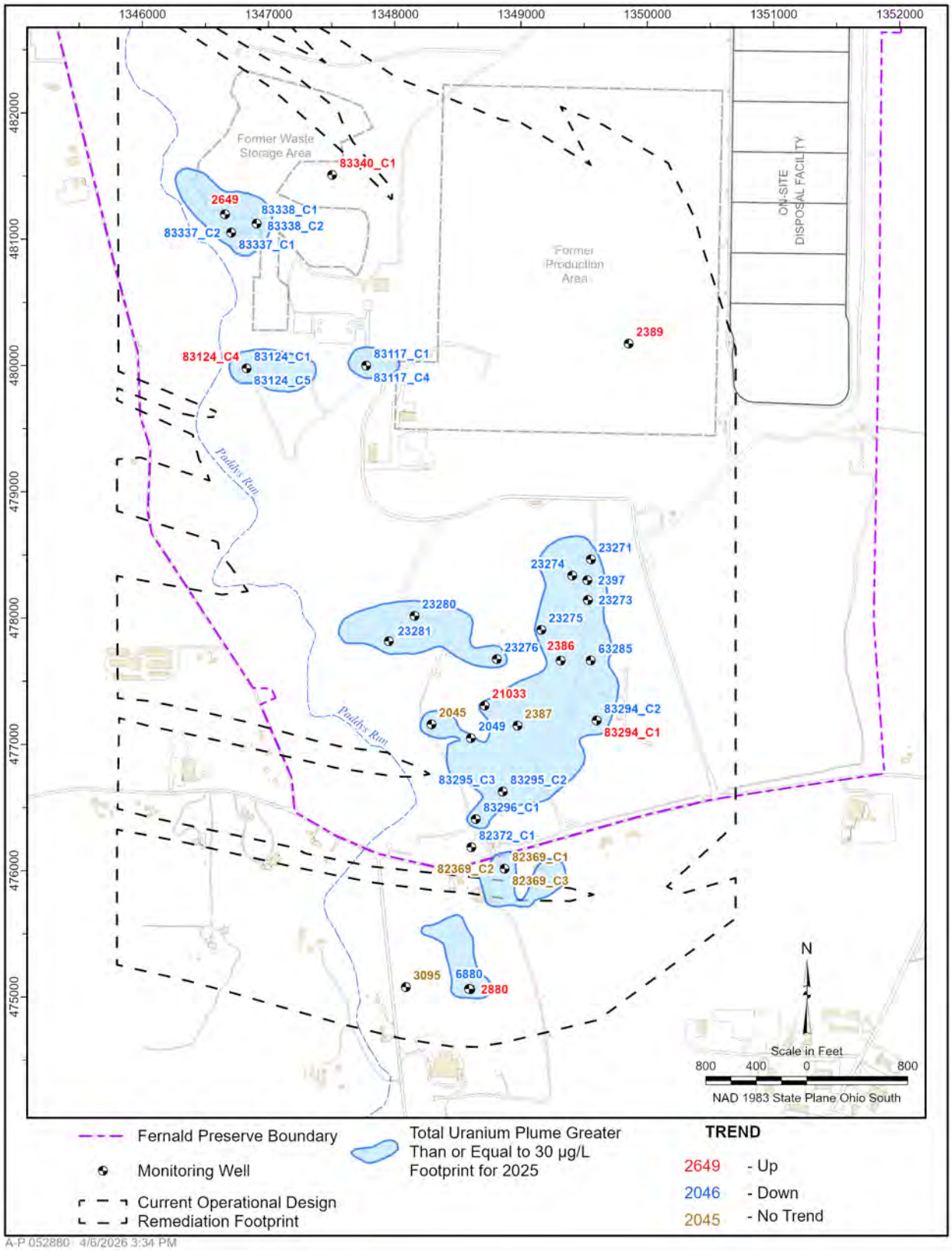


Figure A.2-4. Monitoring Wells with 2025 Exceedances for Total Uranium with Up, Down, or No Significant Trends

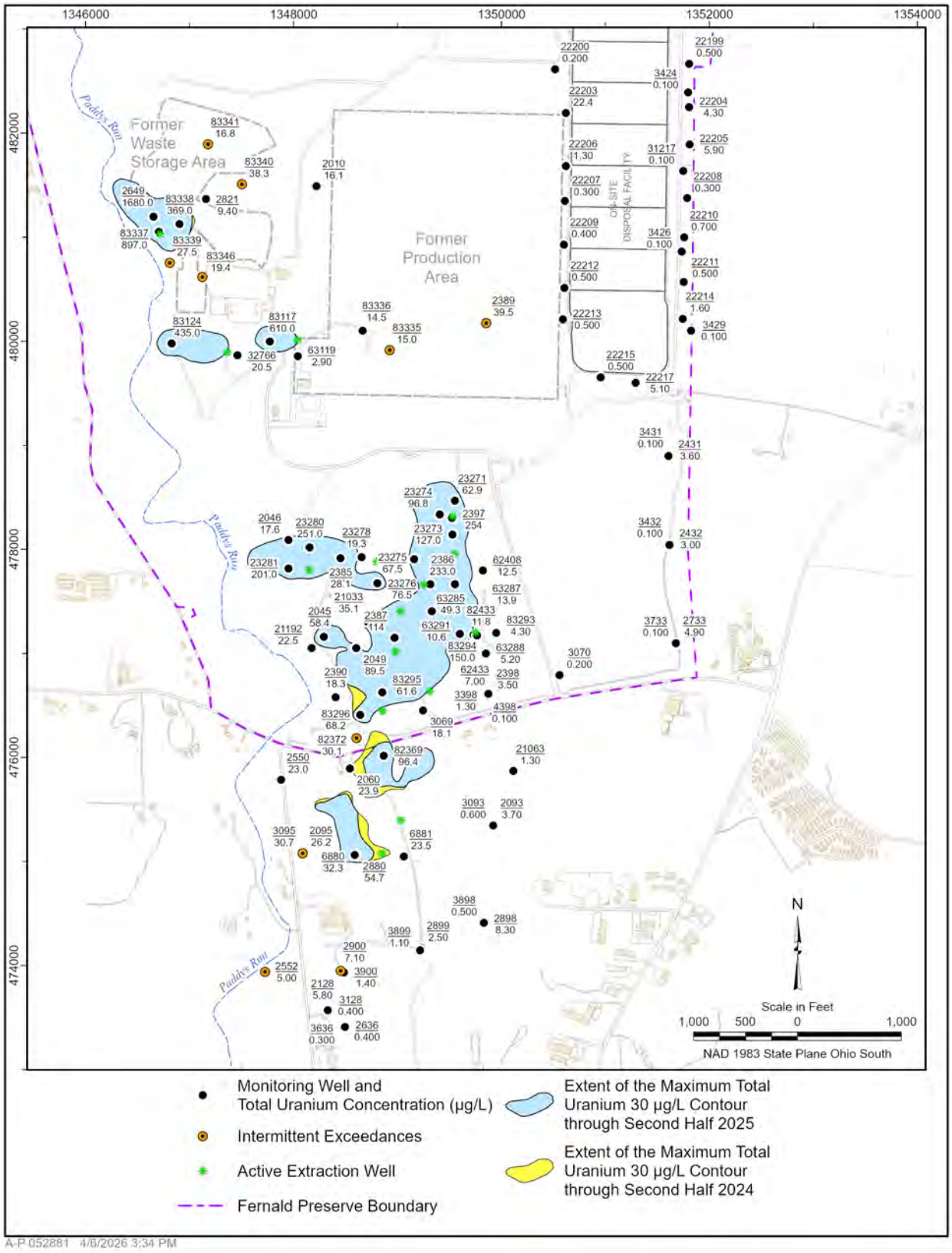


Figure A.2-5. 2025 Monitoring Well Data Comparison to Maximum Total Uranium Footprint at End of 2024

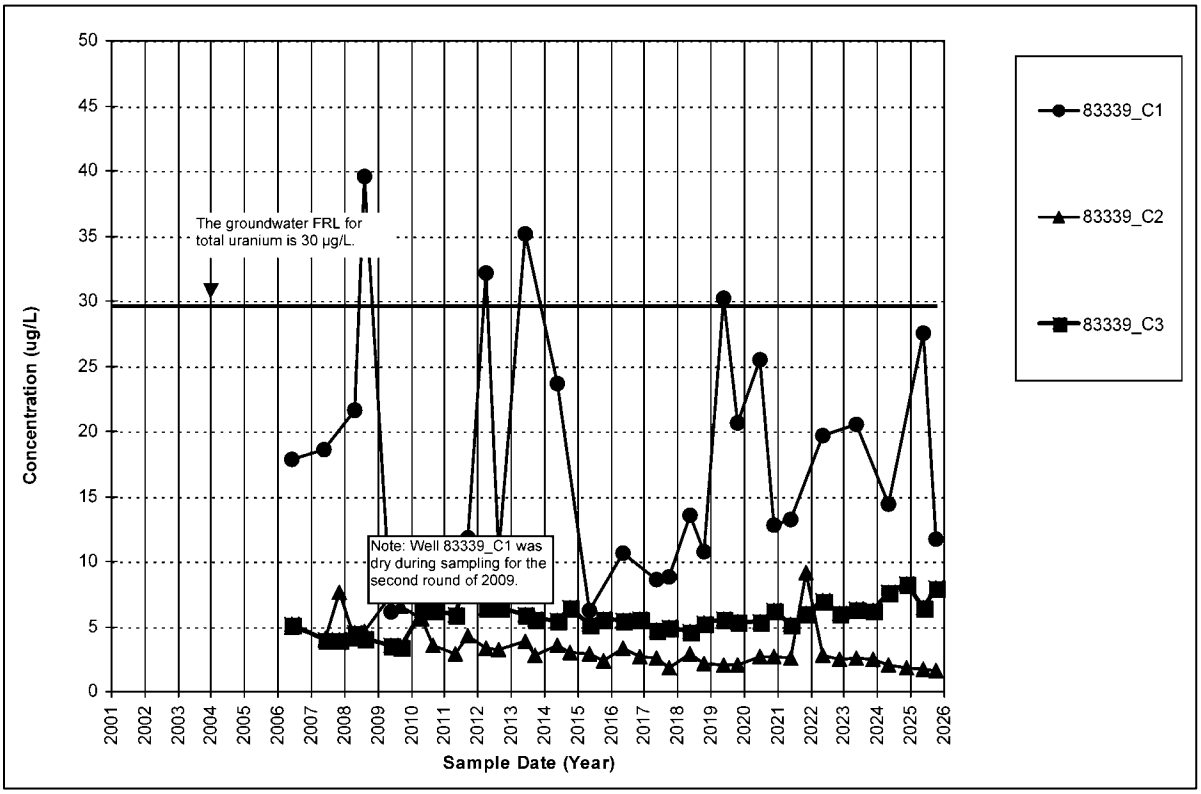


Figure A.2-6. Total Uranium Concentration Versus Time Plot for Monitoring Well 83339

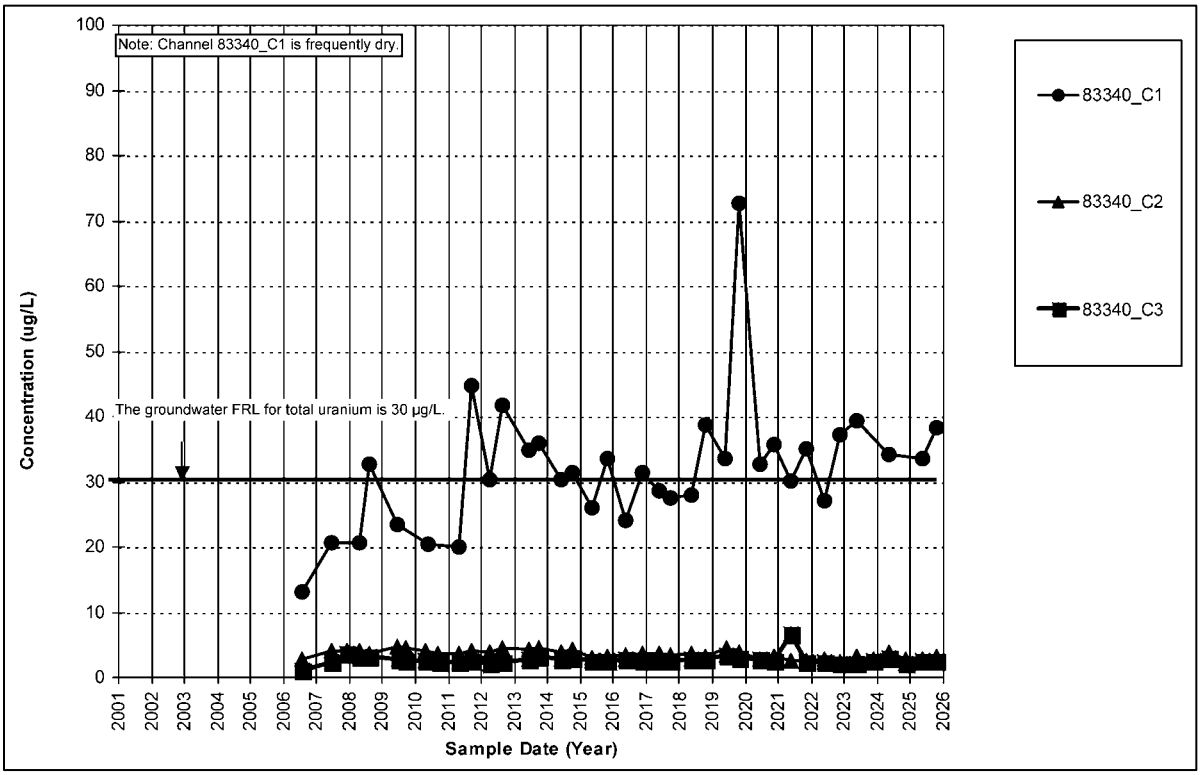


Figure A.2-7. Total Uranium Concentration Versus Time Plot for Monitoring Well 83340

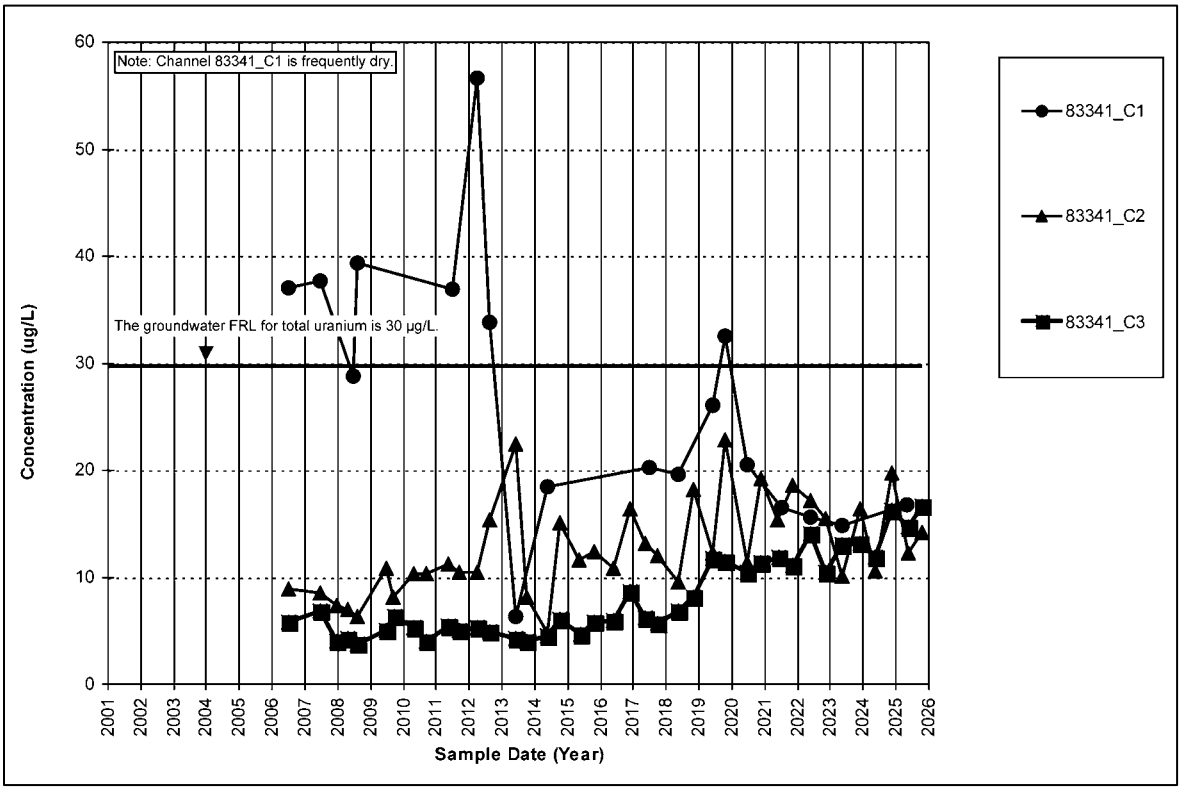


Figure A.2-8. Total Uranium Concentration Versus Time Plot for Monitoring Well 83341

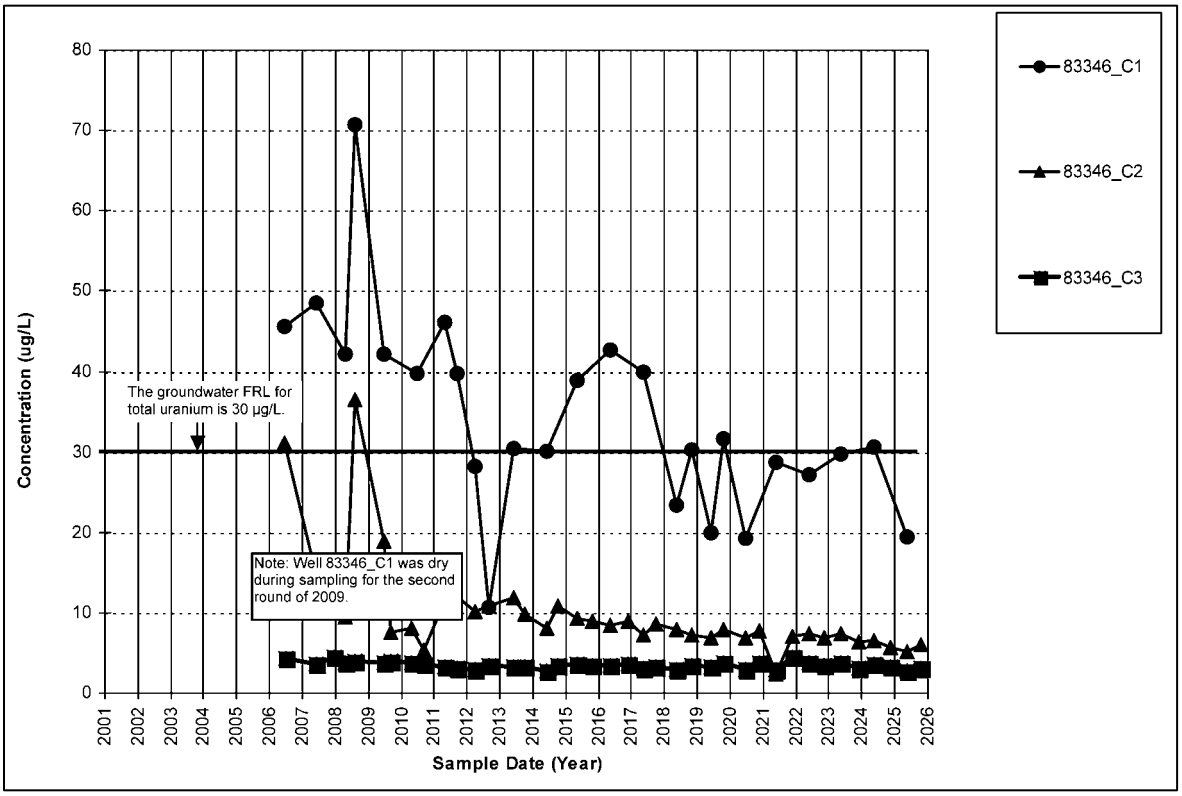


Figure A.2-9. Total Uranium Concentration Versus Time Plot for Monitoring Well 83346

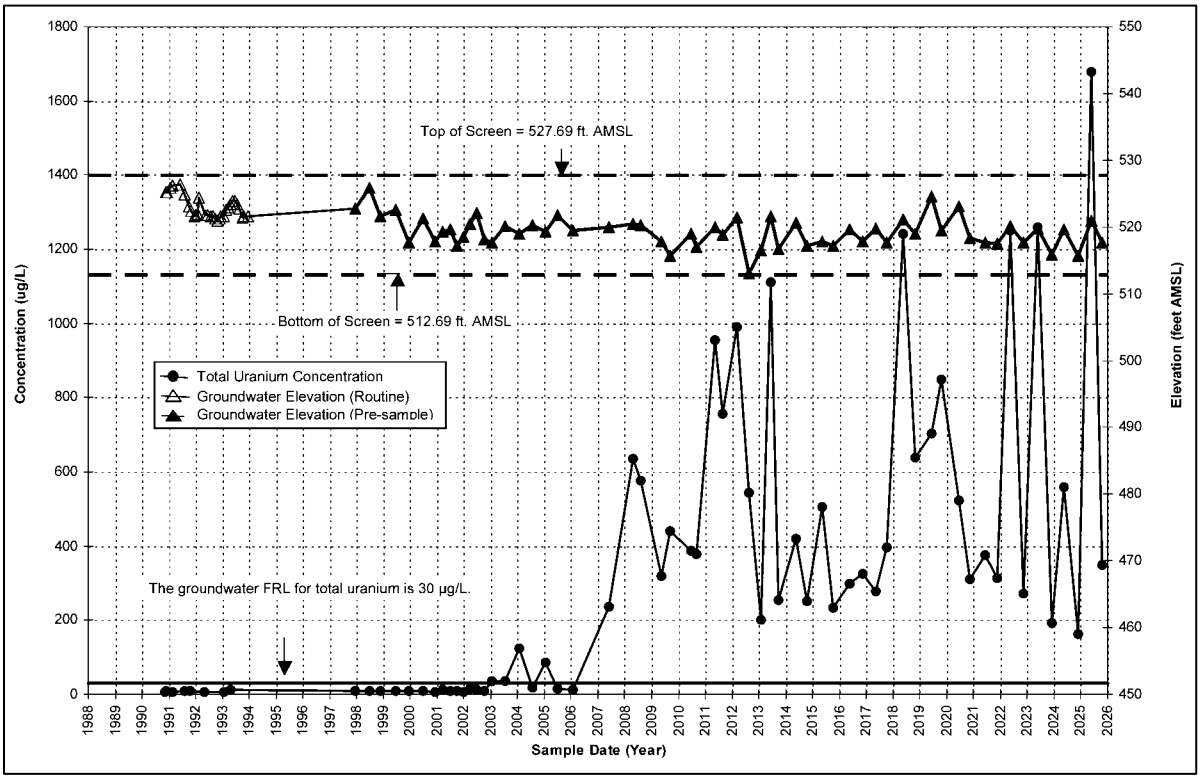


Figure A.2-10. Total Uranium Concentration Versus Time Plot for Monitoring Well 2649

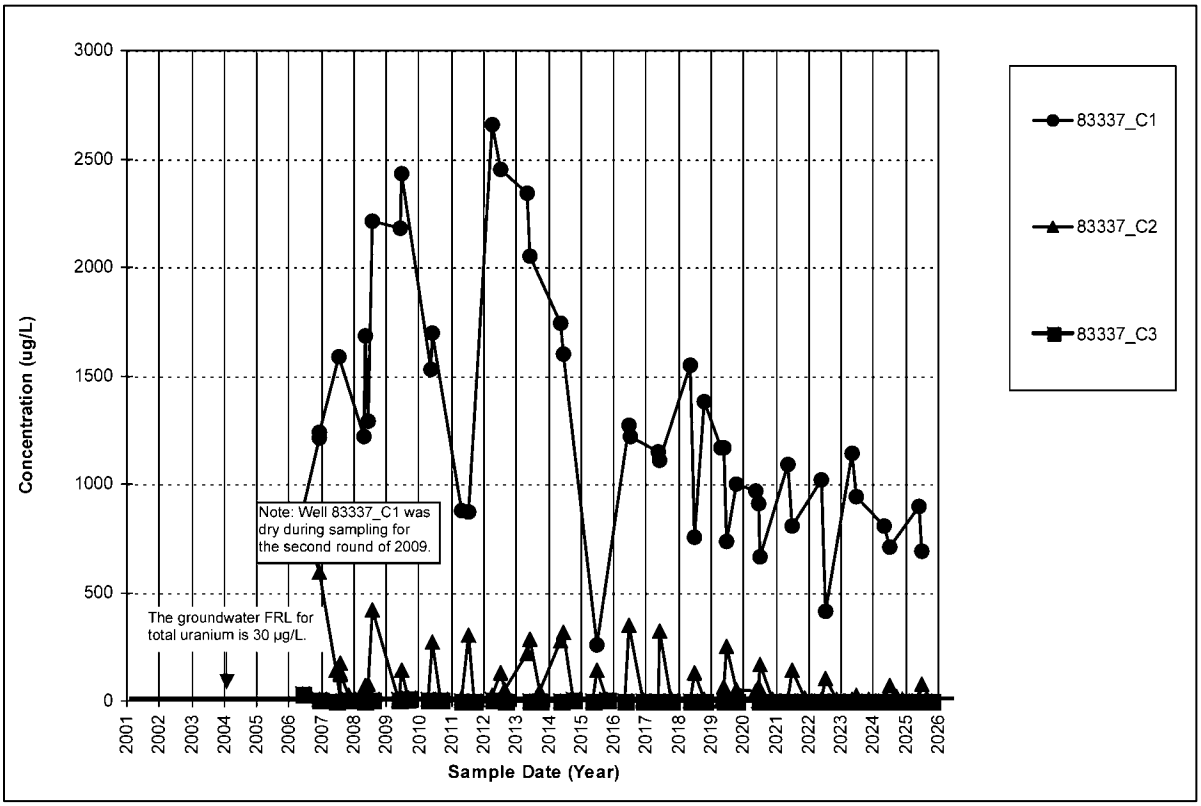


Figure A.2-11. Total Uranium Concentration Versus Time Plot for Monitoring Well 83337

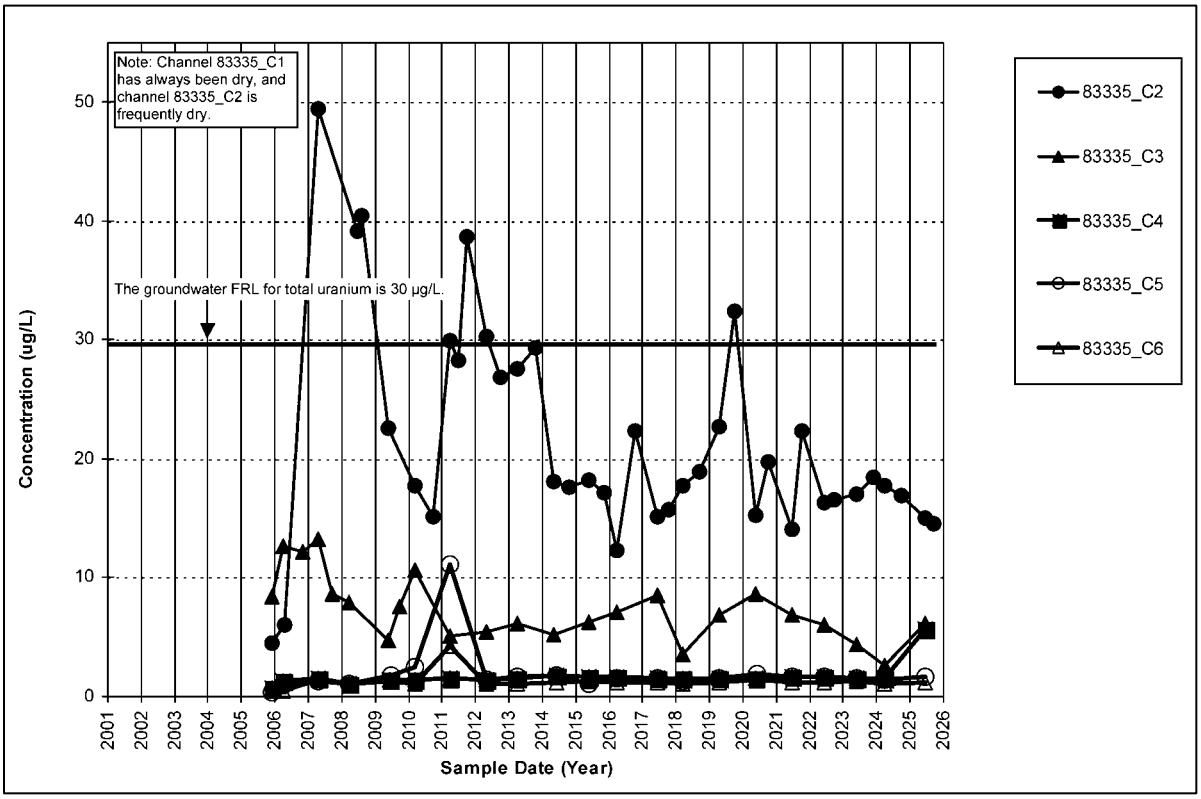


Figure A.2-12. Total Uranium Concentration Versus Time Plot for Monitoring Well 83335

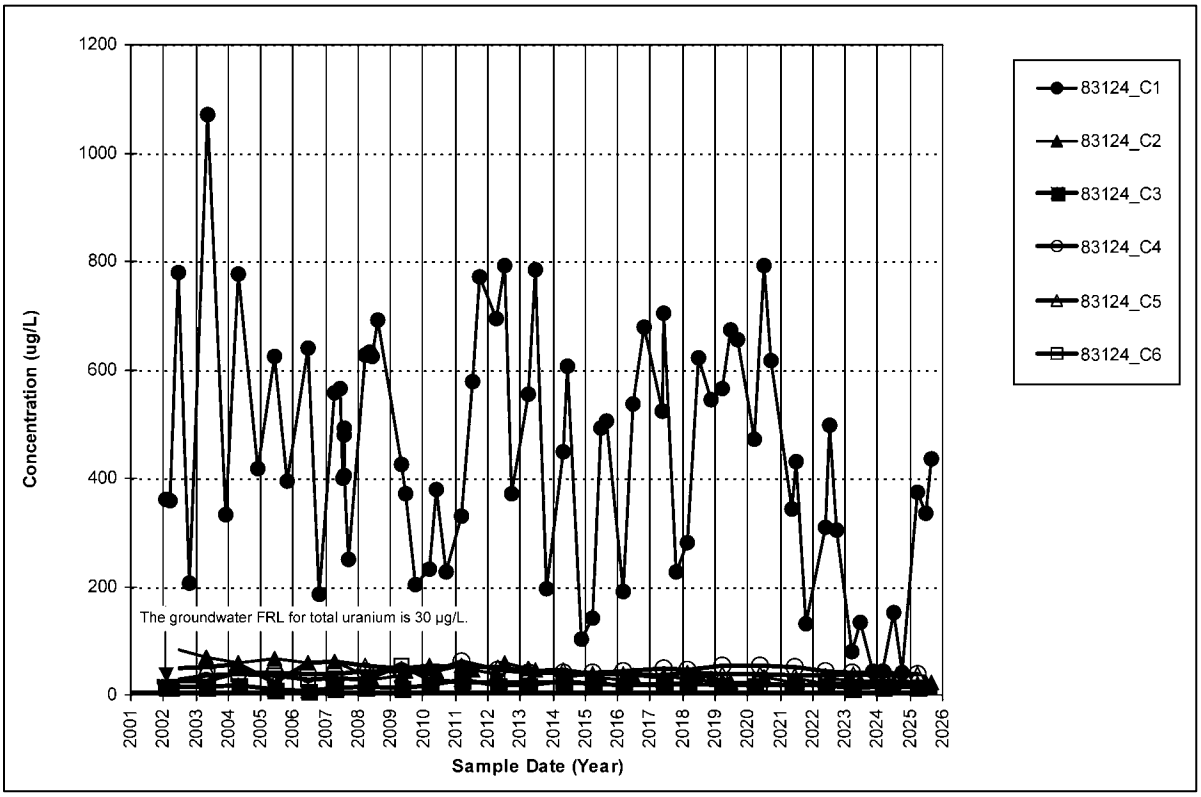


Figure A.2-13. Total Uranium Concentration Versus Time Plot for Monitoring Well 83124

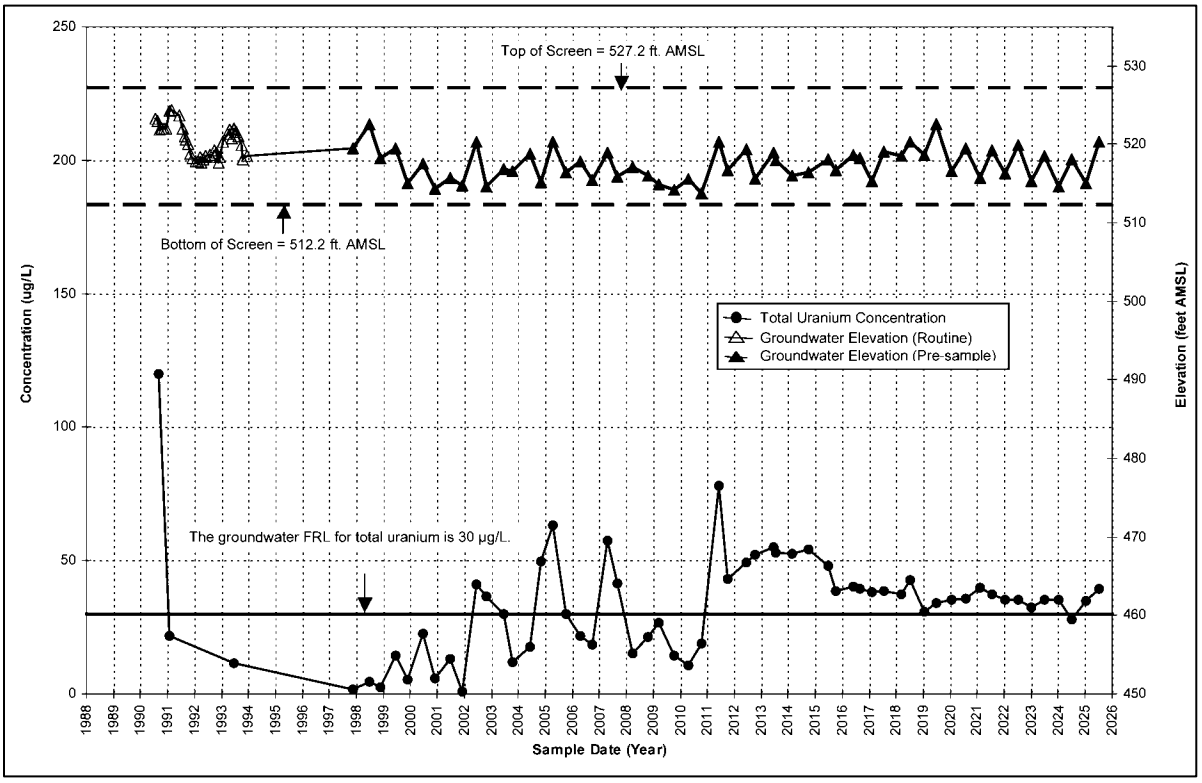


Figure A.2-14. Total Uranium Concentration Versus Time Plot for Monitoring Well 2389

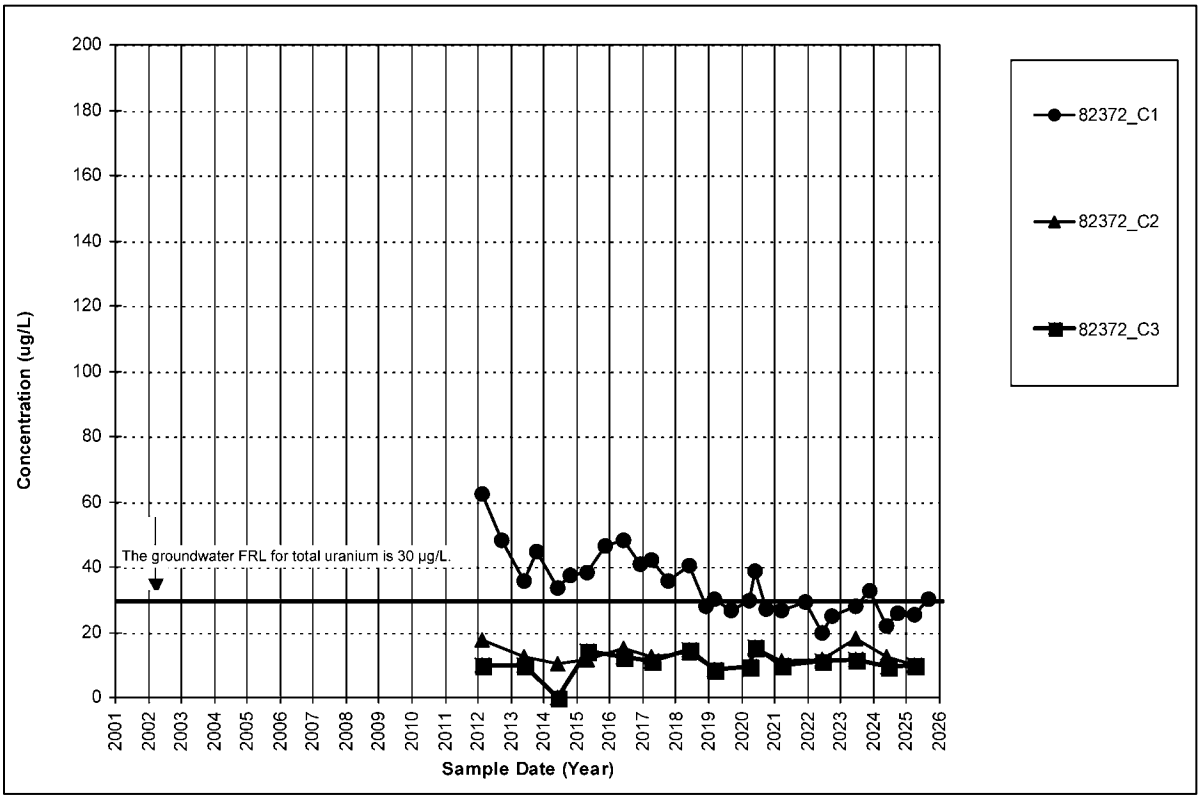


Figure A.2-15. Total Uranium Concentration Versus Time Plot for Monitoring Well 82372

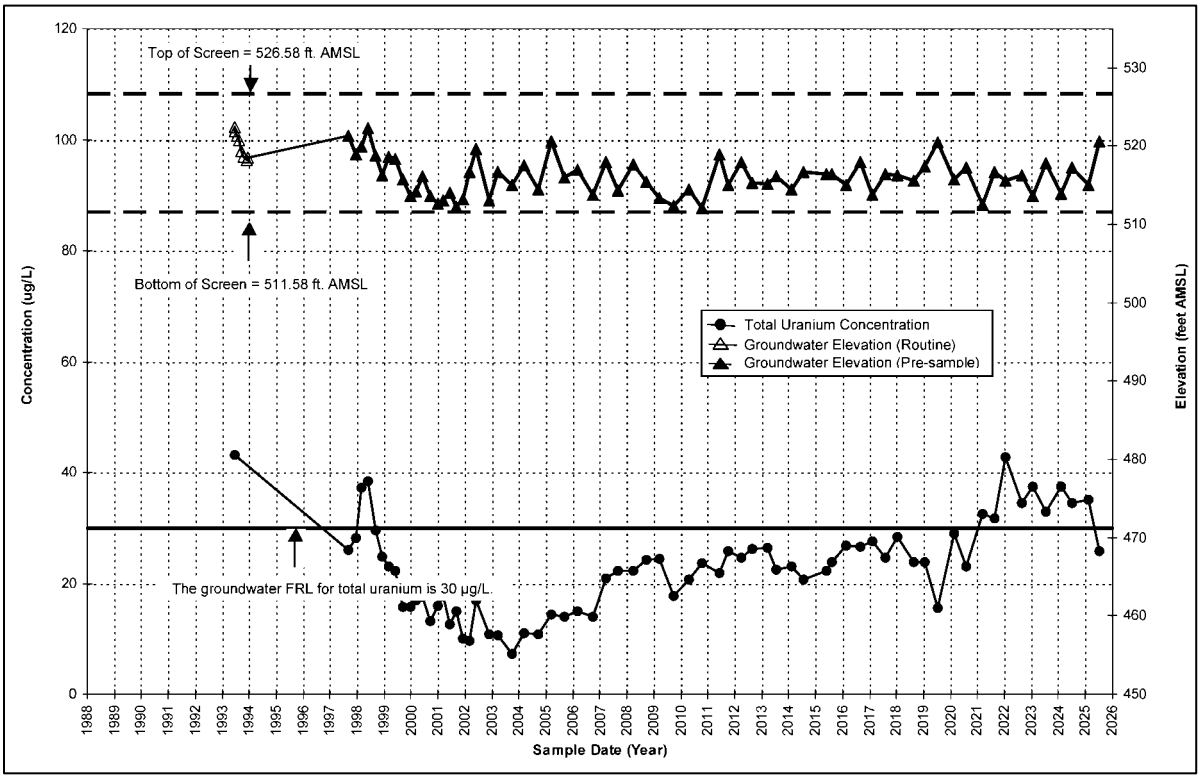


Figure A.2-16. Total Uranium Concentration Versus Time Plot for Monitoring Well 21033

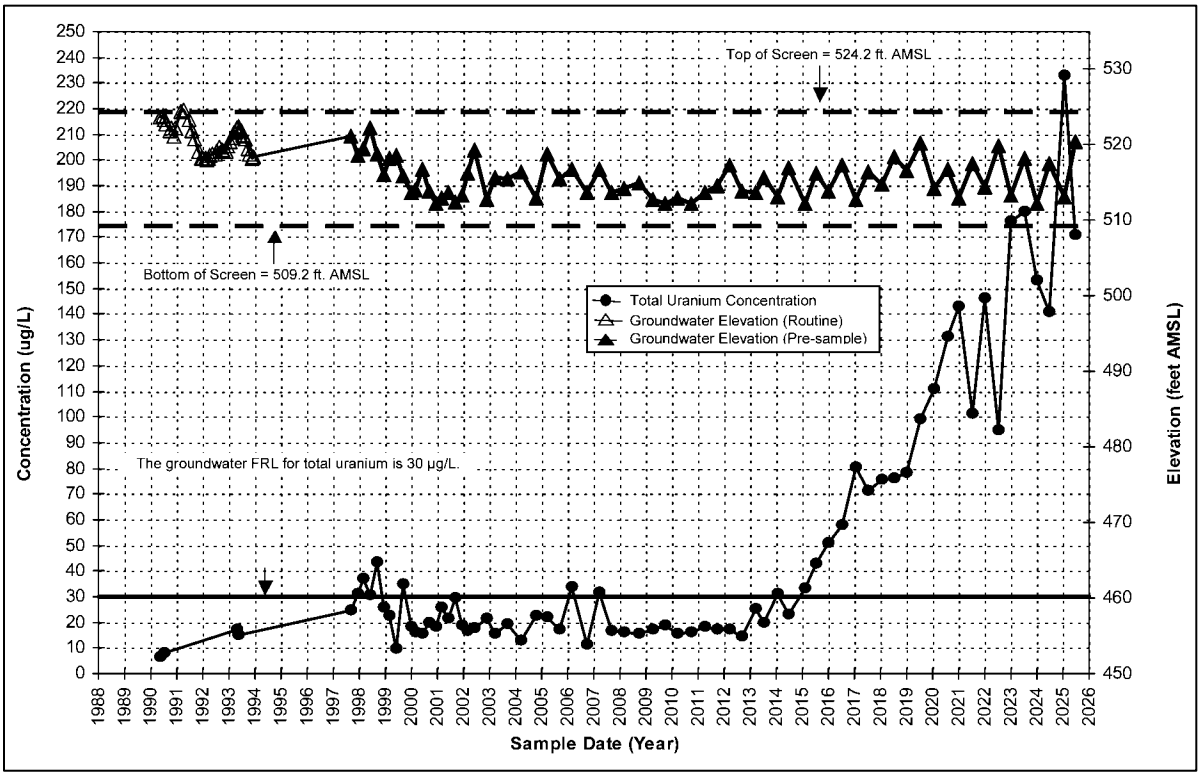


Figure A.2-17. Total Uranium Concentration Versus Time Plot for Monitoring Well 2386

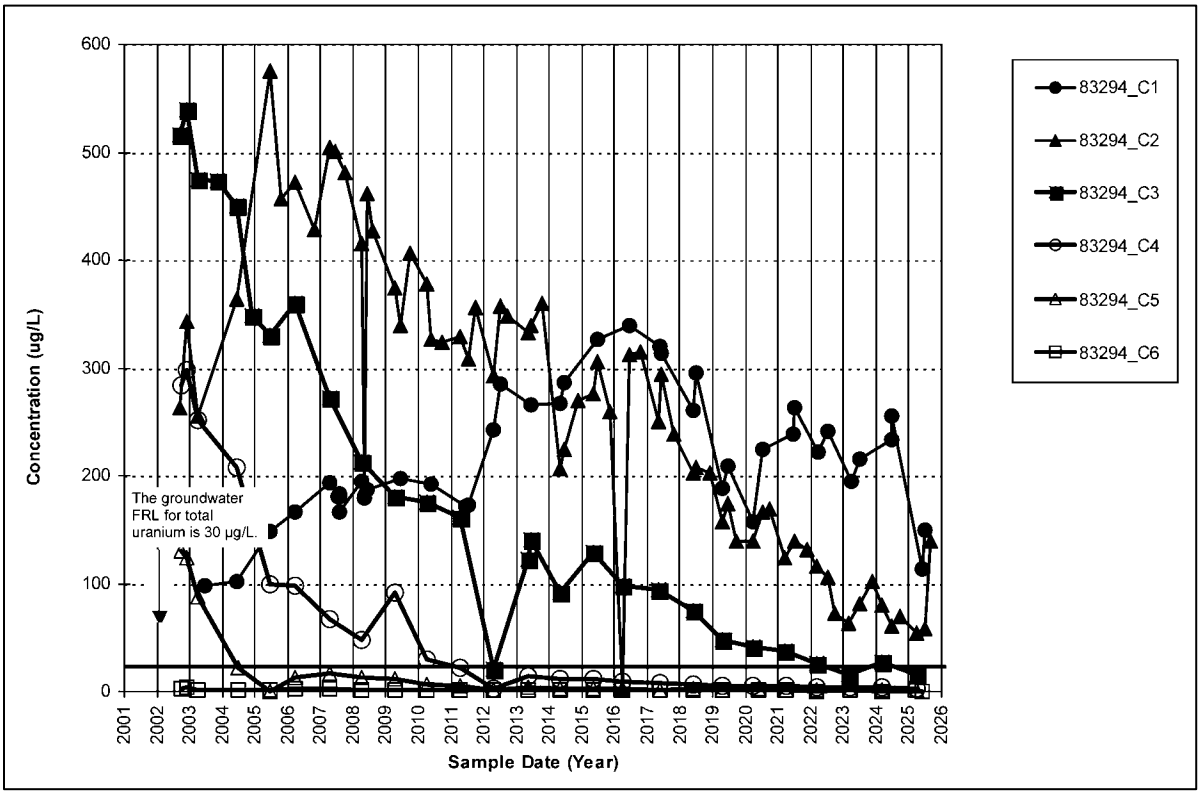


Figure A.2-18. Total Uranium Concentration Versus Time Plot for Monitoring Well 83294

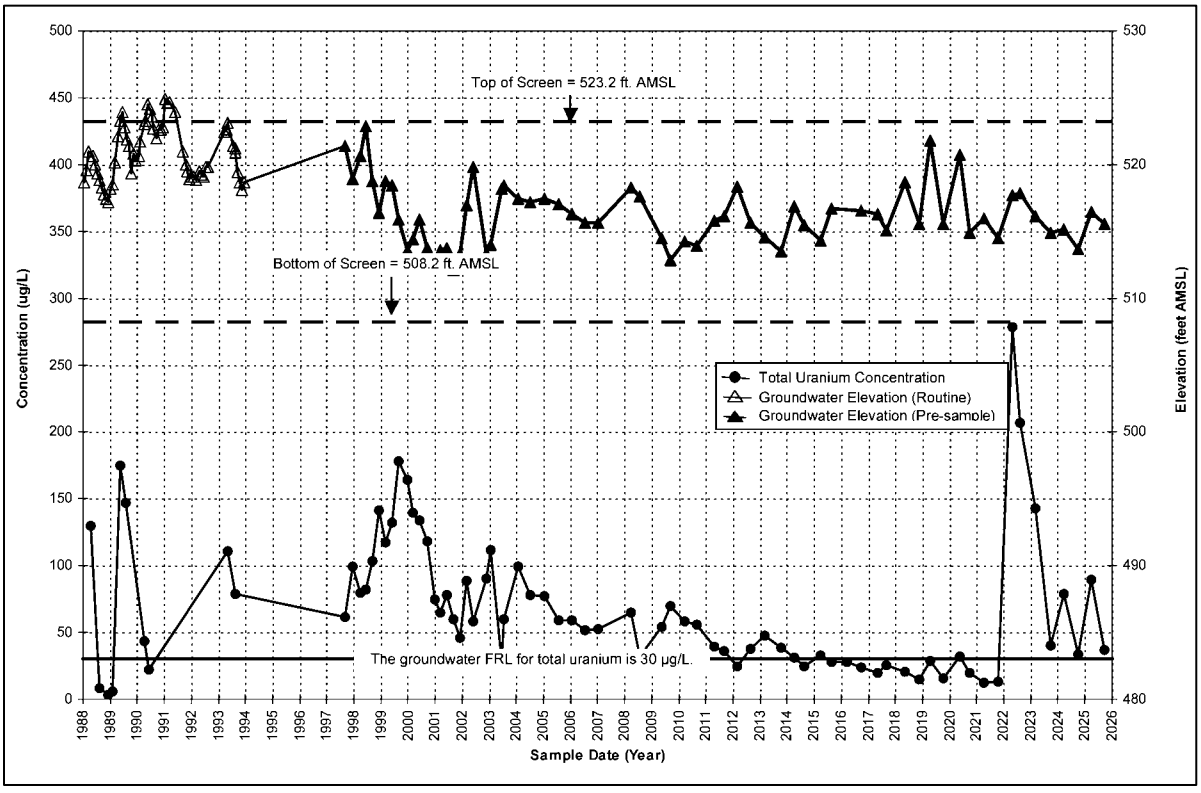


Figure A.2-19. Total Uranium Concentration Versus Time Plot for Monitoring Well 2049

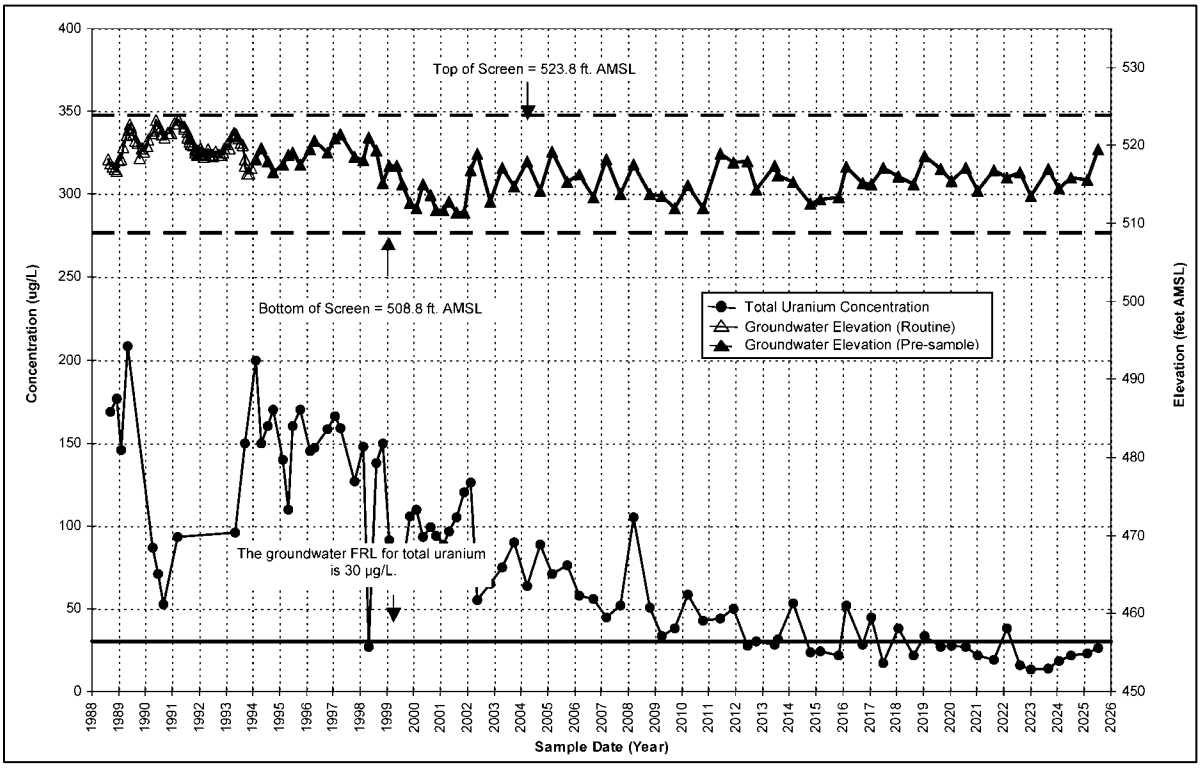


Figure A.2-20. Total Uranium Concentration Versus Time Plot for Monitoring Well 2095

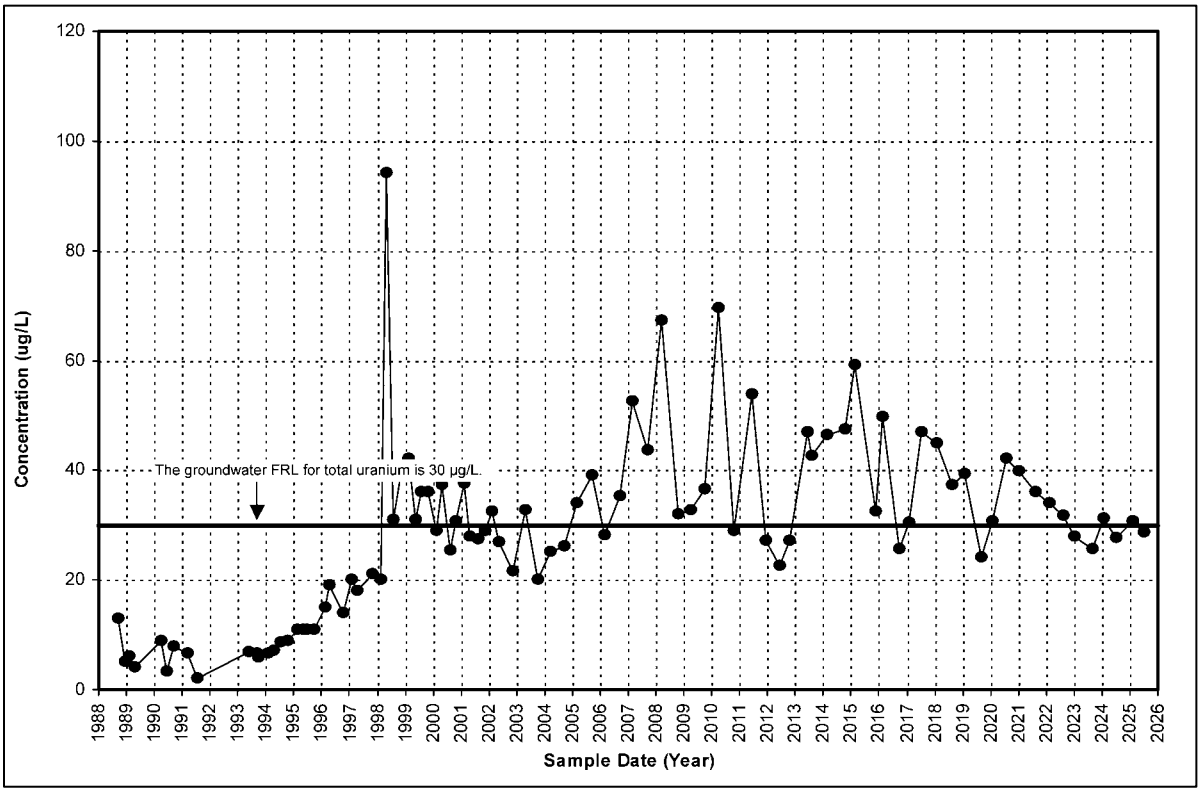


Figure A.2-21. Total Uranium Concentration Versus Time Plot for Monitoring Well 3095

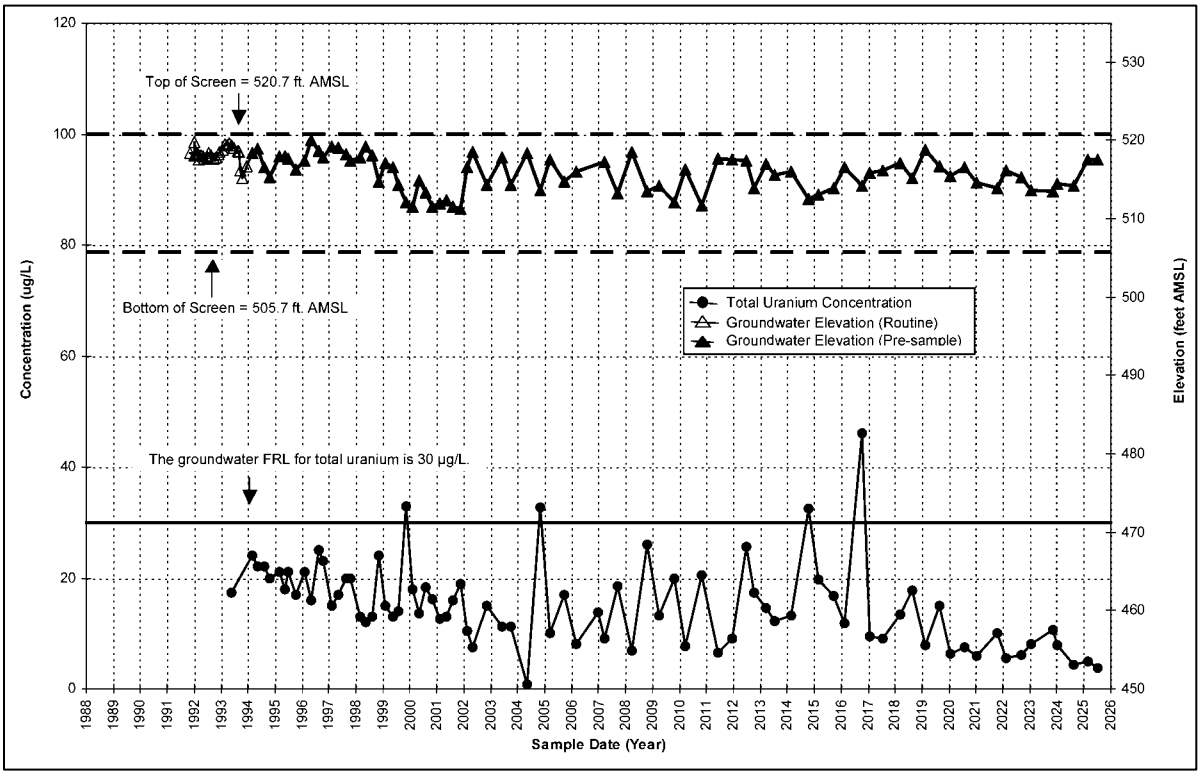


Figure A.2-22. Total Uranium Concentration Versus Time Plot for Monitoring Well 2552

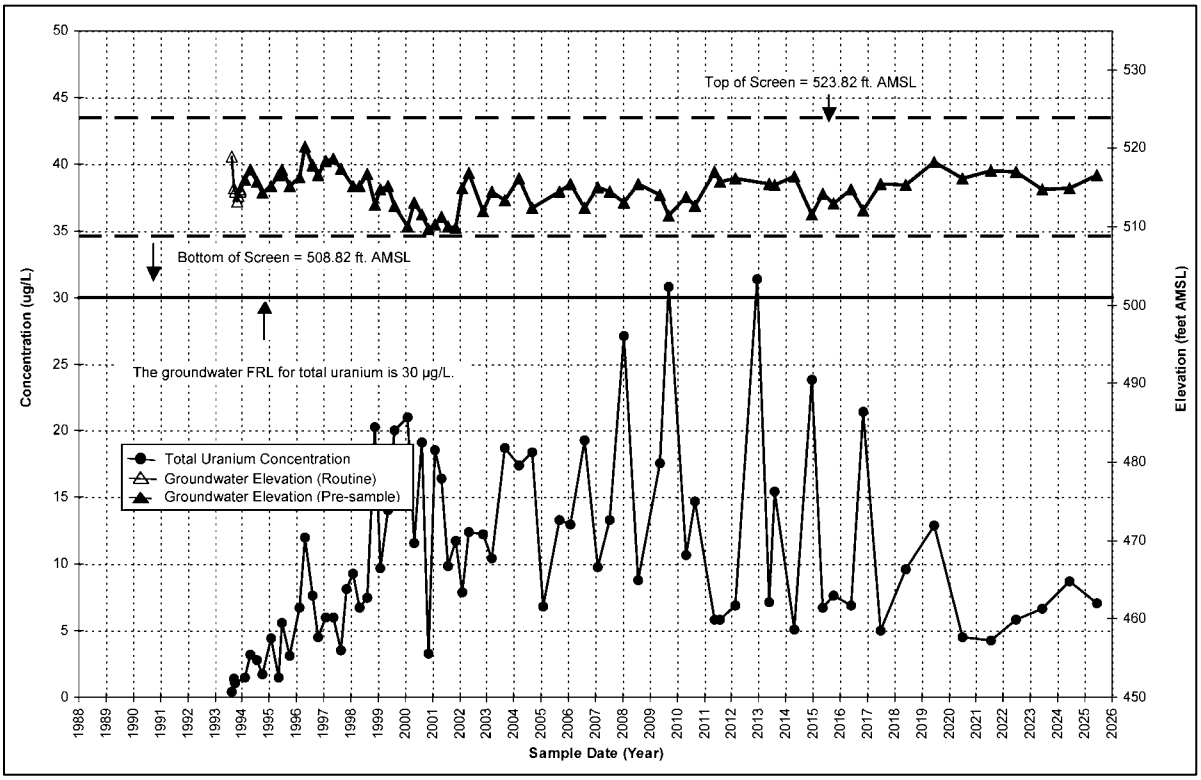


Figure A.2-23. Total Uranium Concentration Versus Time Plot for Monitoring Well 2900

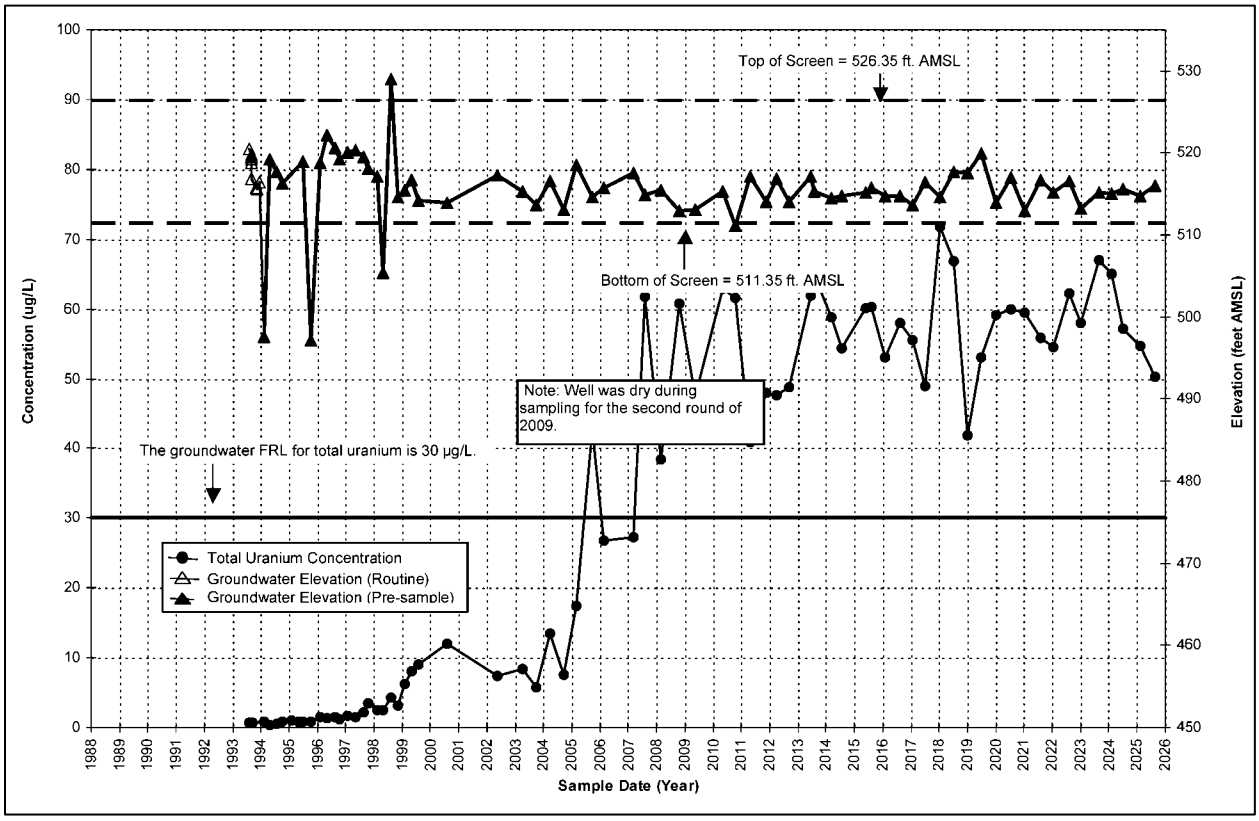


Figure A.2-24. Total Uranium Concentration Versus Time Plot for Monitoring Well 2880

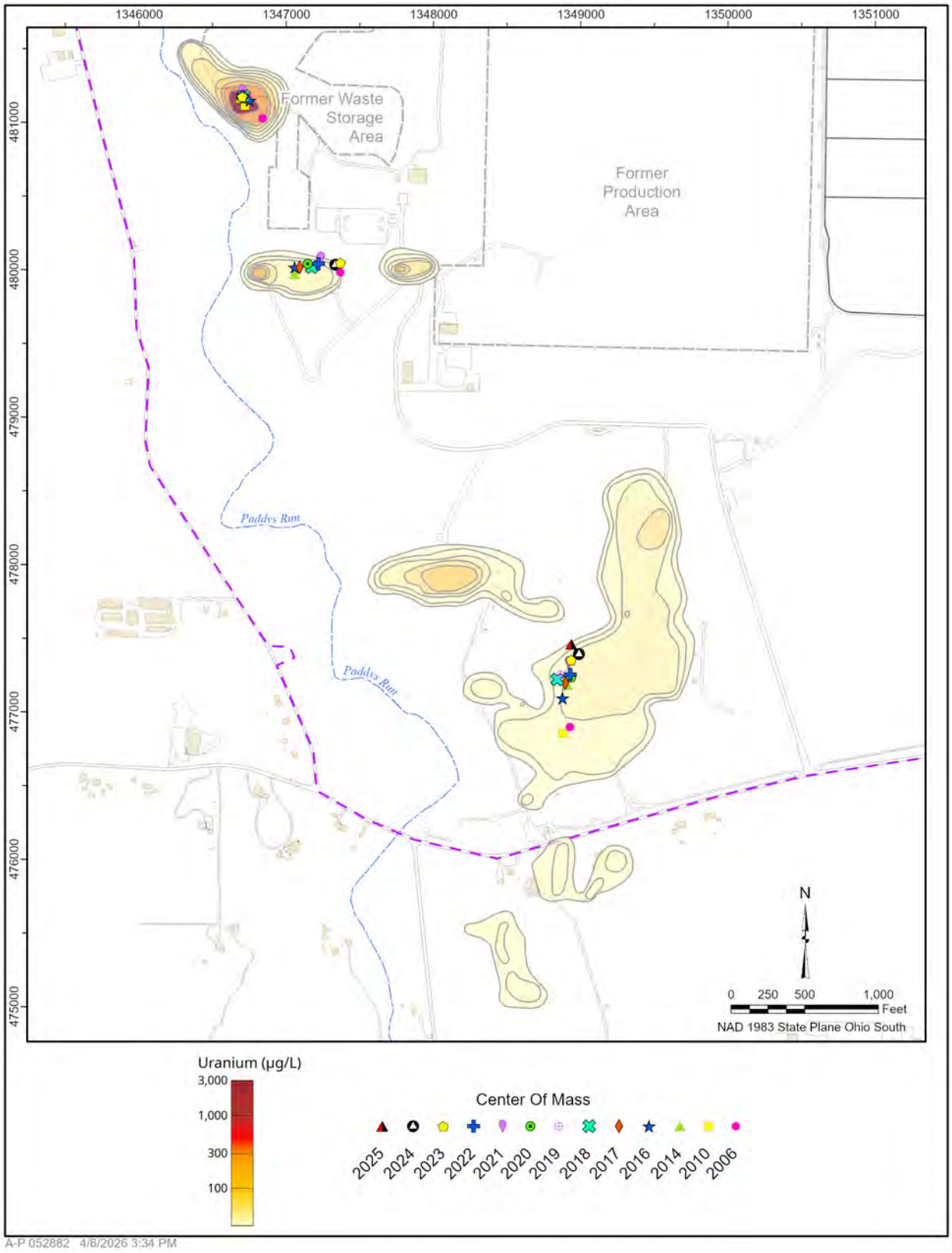


Figure A.2-25. Ricker Method Center of Mass

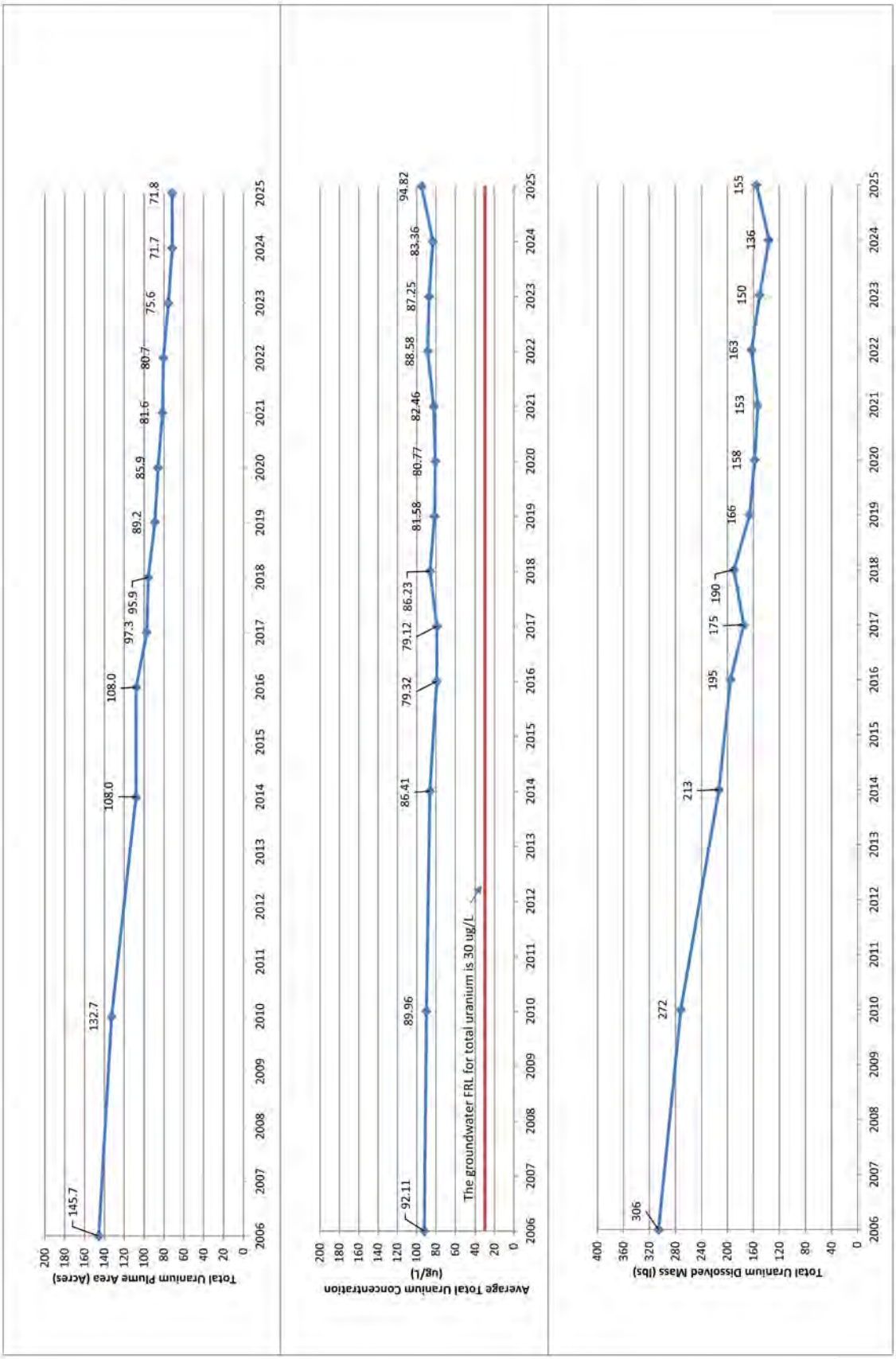


Figure A.2-26. Ricker Method Total Uranium Plume Calculations

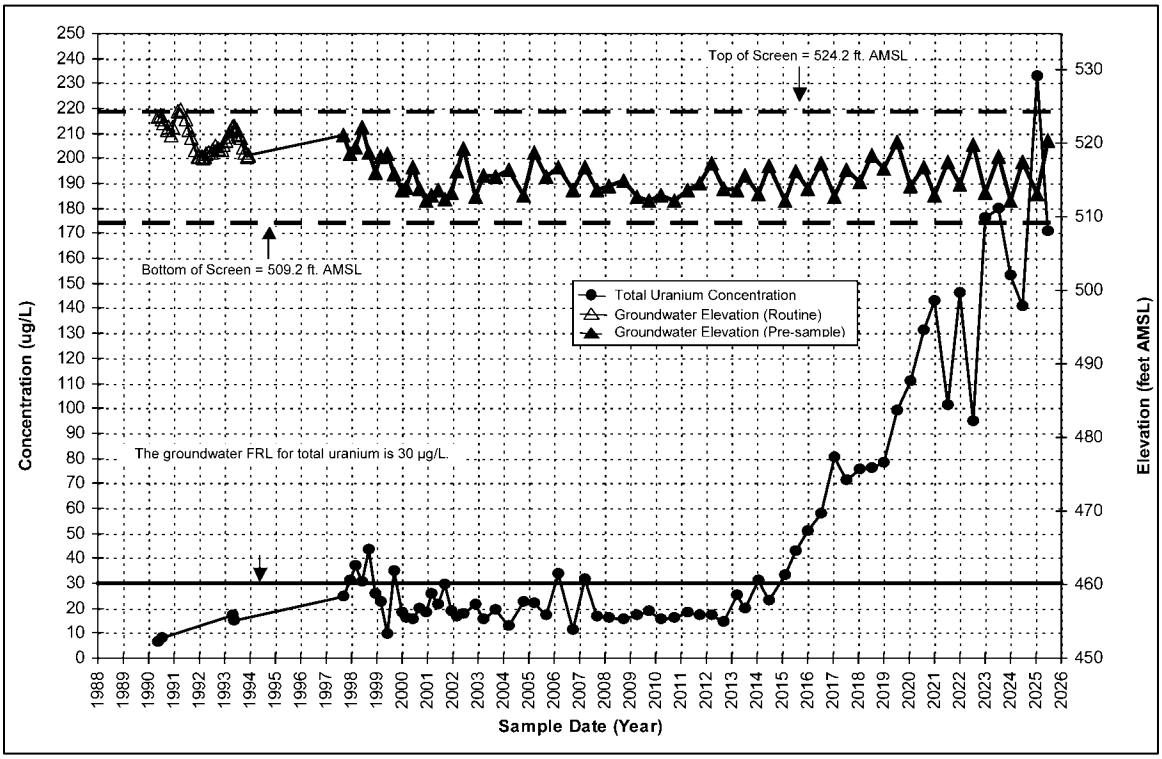


Figure A.2-27. Total Uranium Concentration Versus Time Plot for Monitoring Well 2386

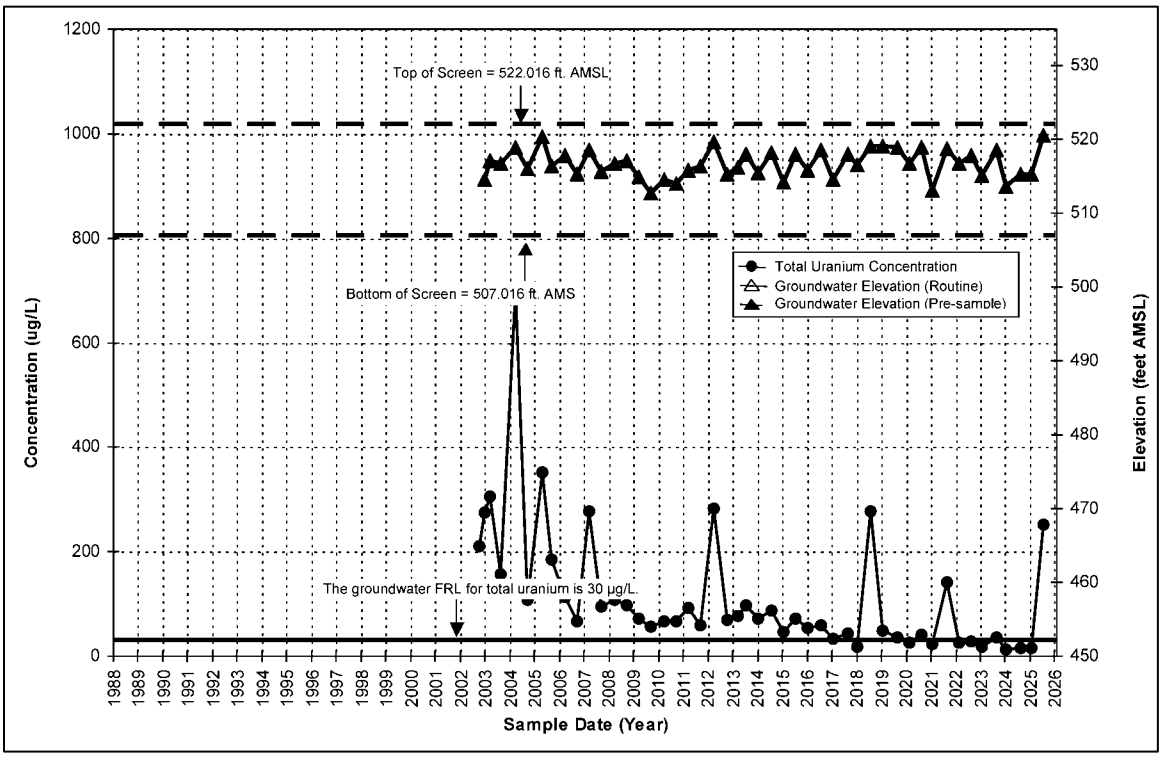


Figure A.2-28. Total Uranium Concentration Versus Time Plot for Monitoring Well 23280

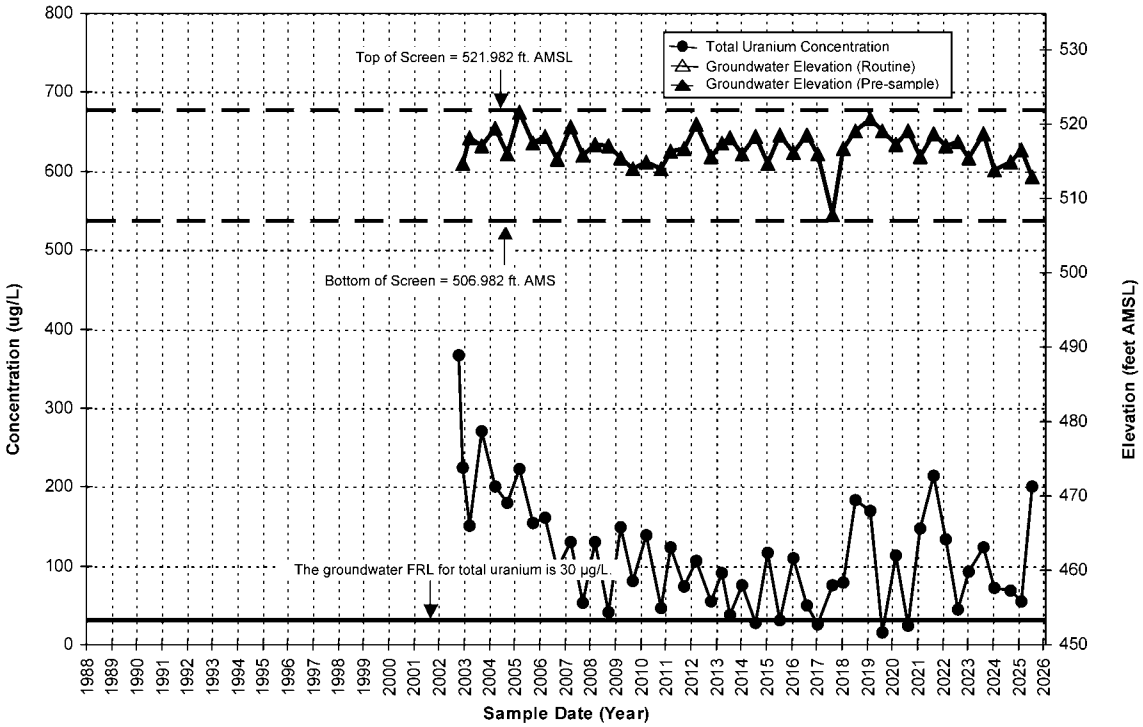


Figure A.2-29. Total Uranium Concentration Versus Time Plot for Monitoring Well 23281

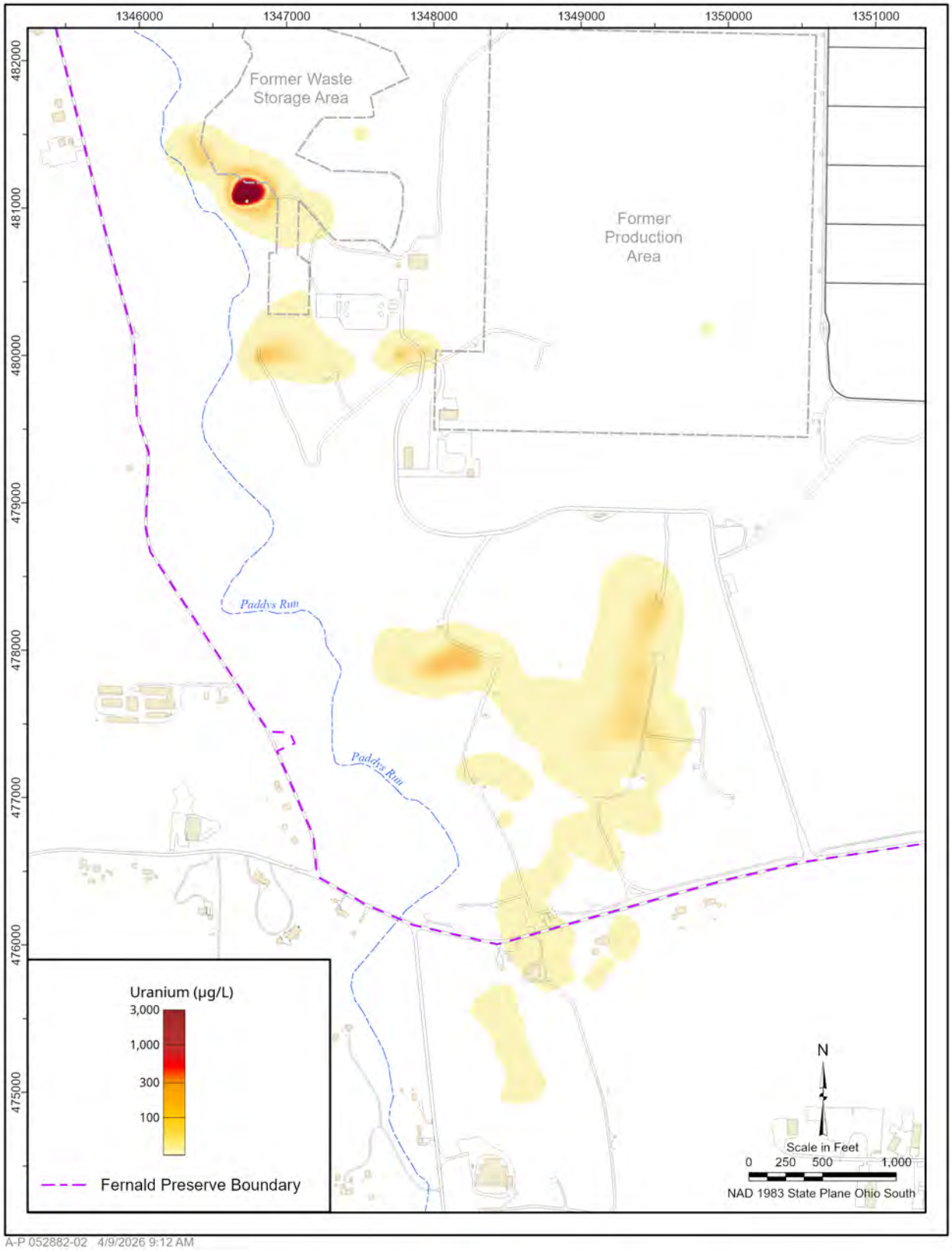


Figure A.2-30. EVS Total Uranium Plume Interpretation

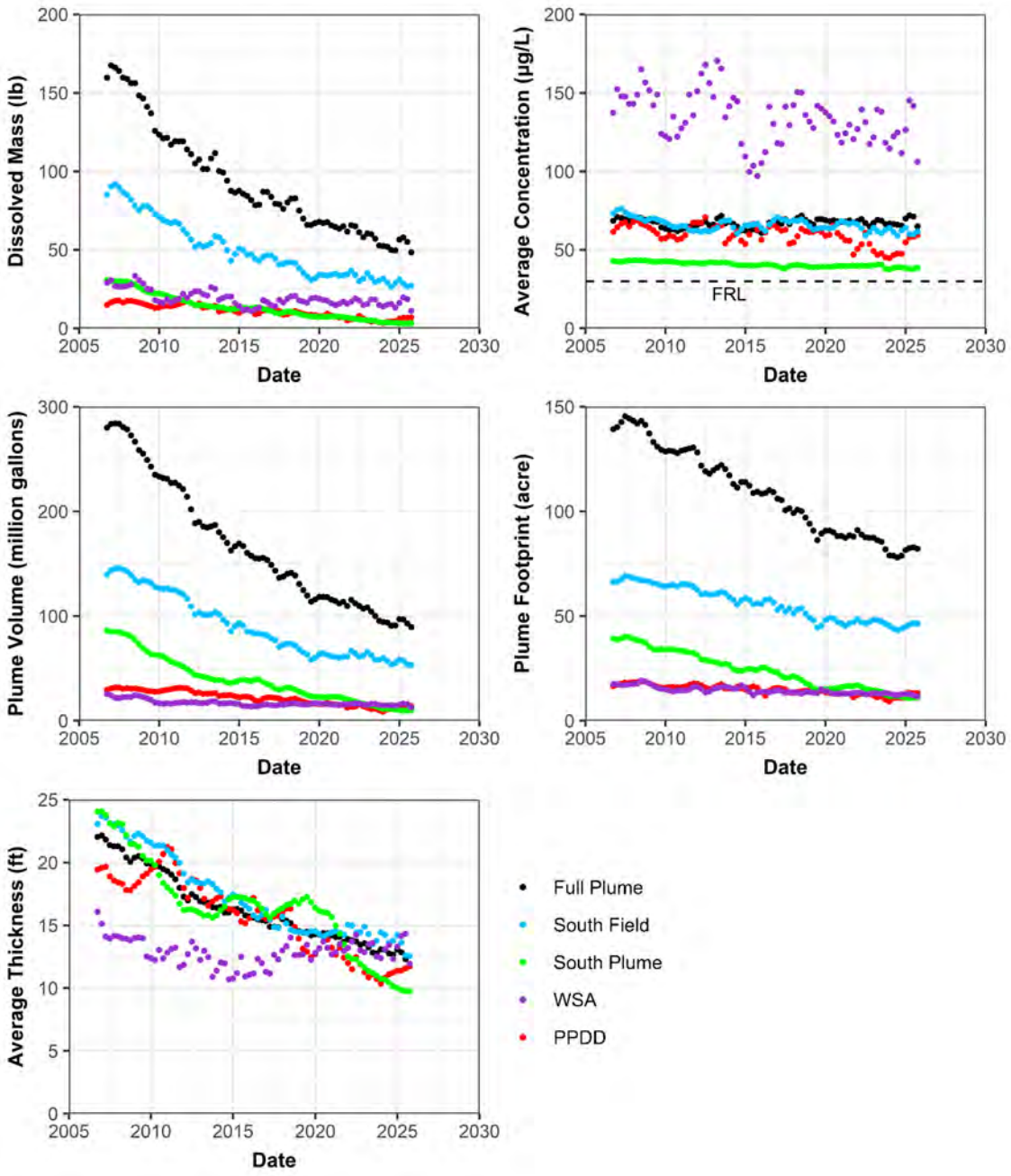


Figure A.2-31. EVS 2025 Plume Metrics

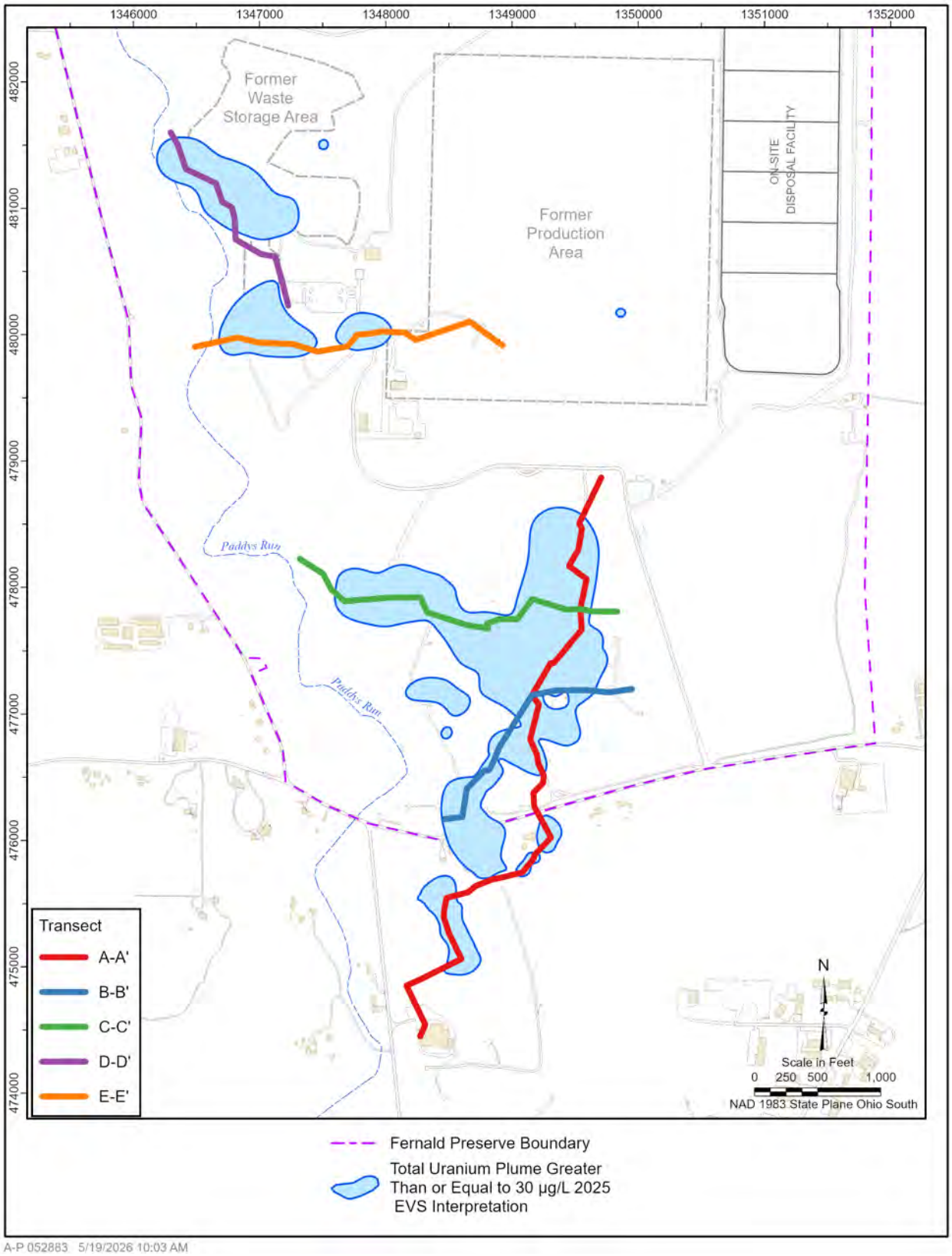


Figure A.2-32. Total Uranium Plume Cross Section Overview Map

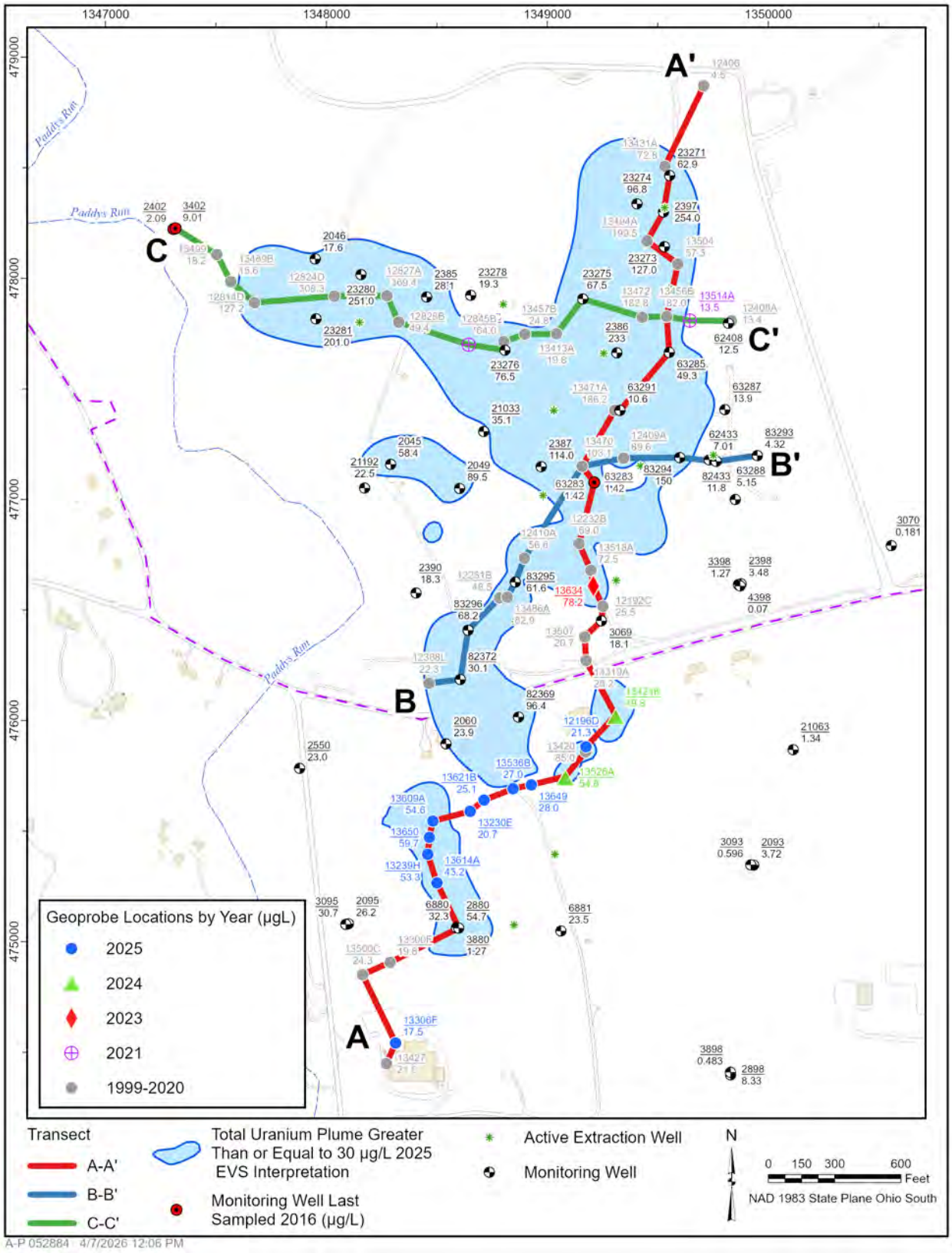


Figure A.2-33. Total Uranium Plume South Cross Section Location Map

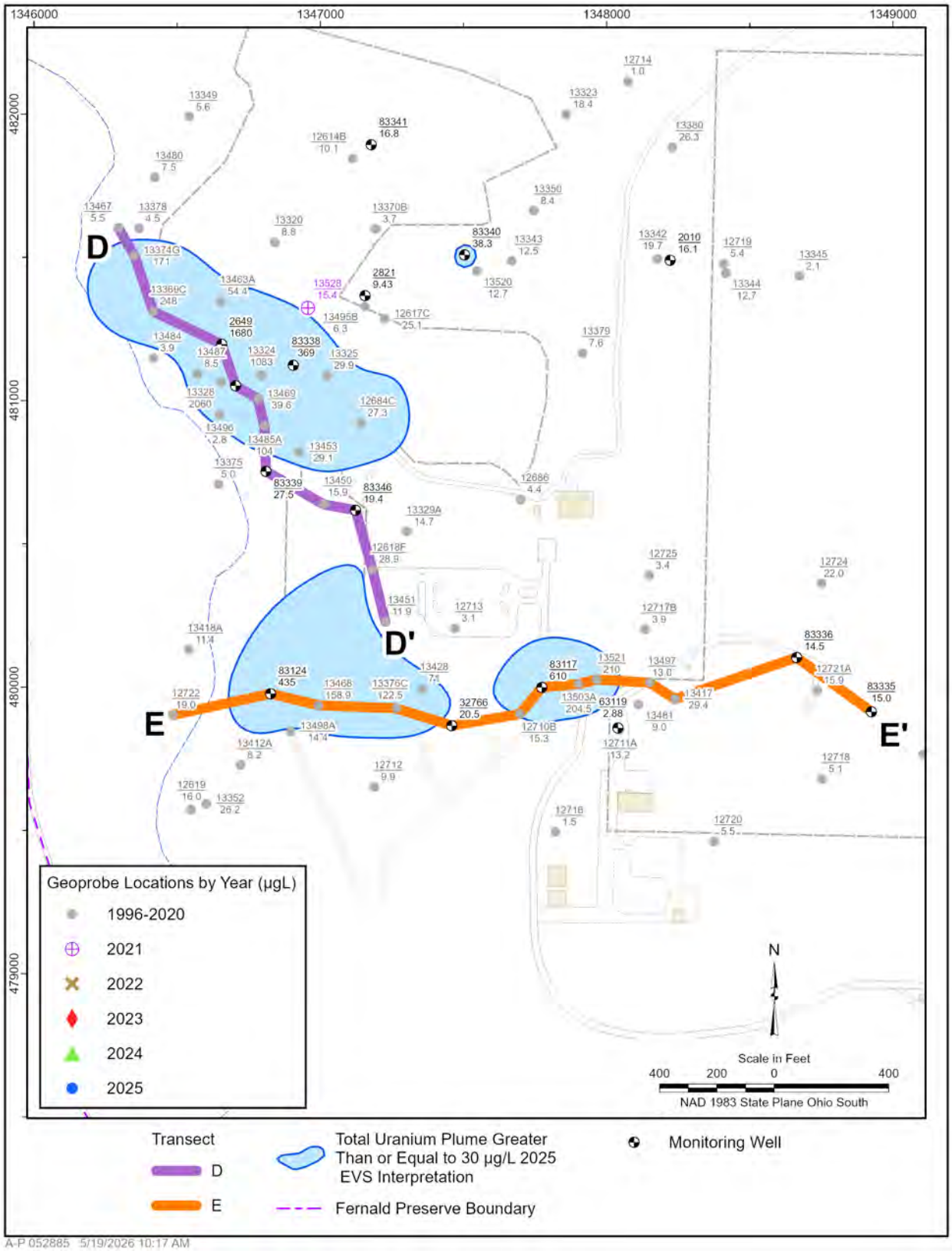


Figure A.2-34. Total Uranium Plume North Cross Section Location Map

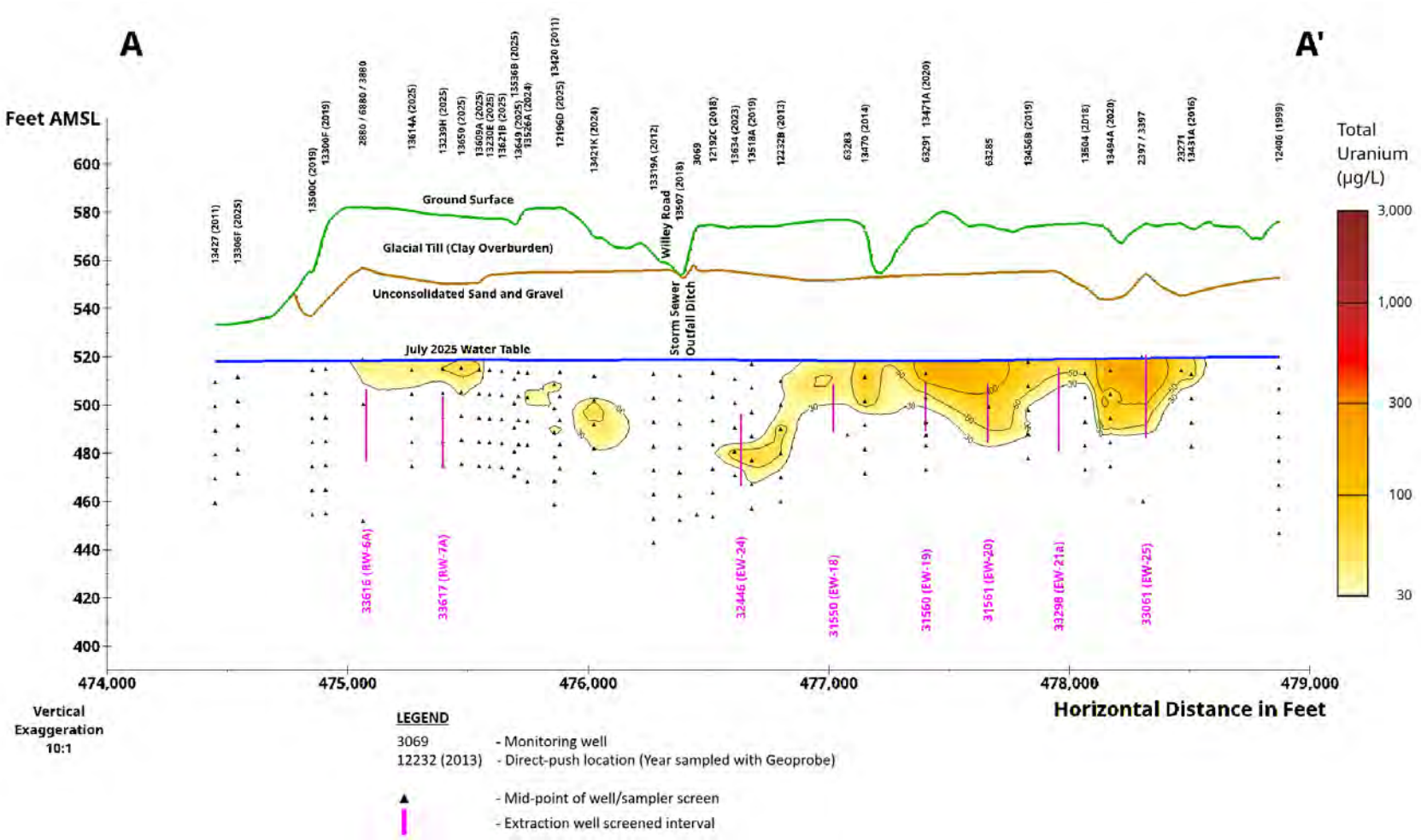


Figure A.2-35. EVS Total Uranium Plume Cross Section A–A'

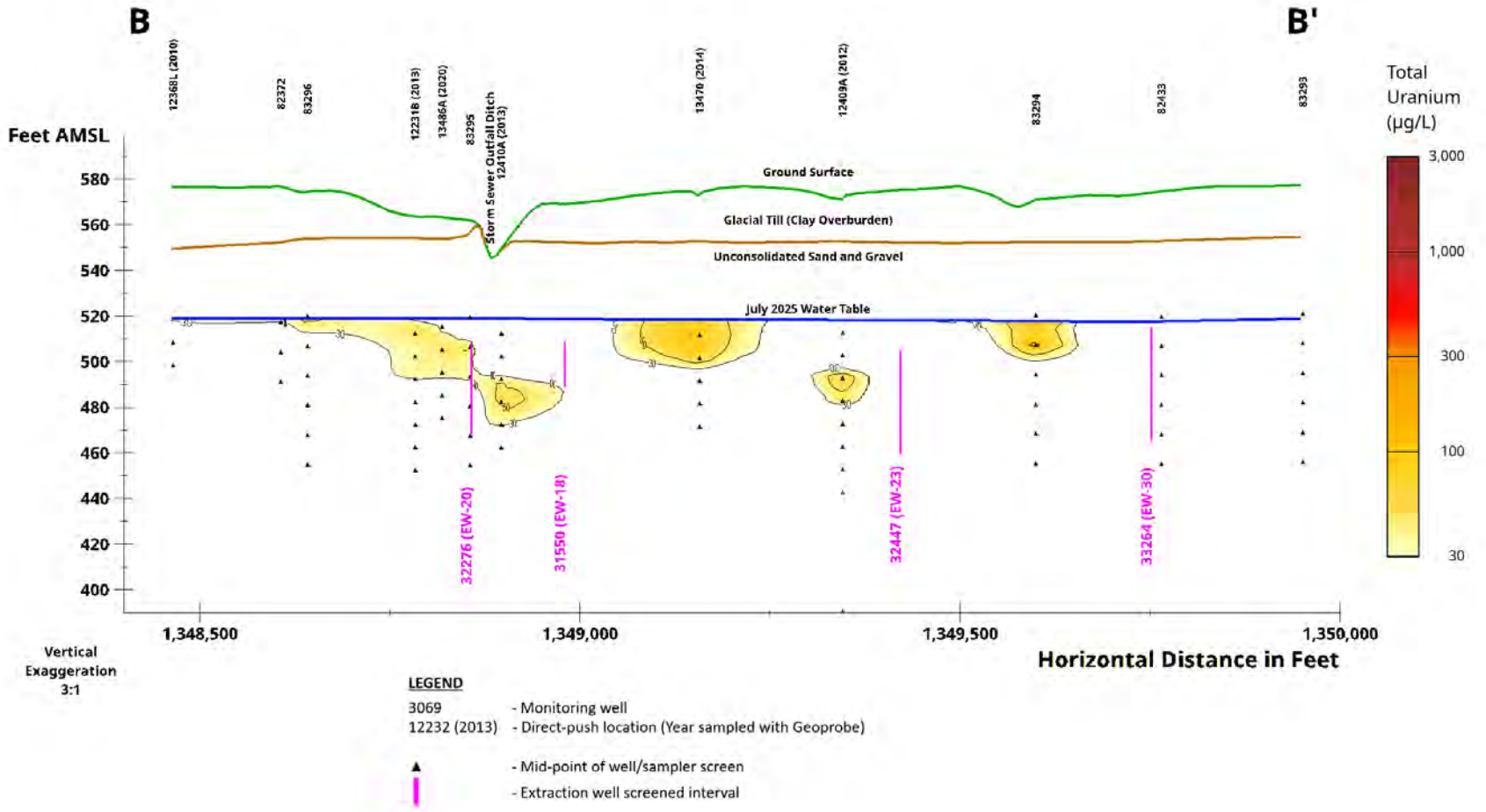


Figure A.2-36. EVS Total Uranium Plume Cross Section B–B'

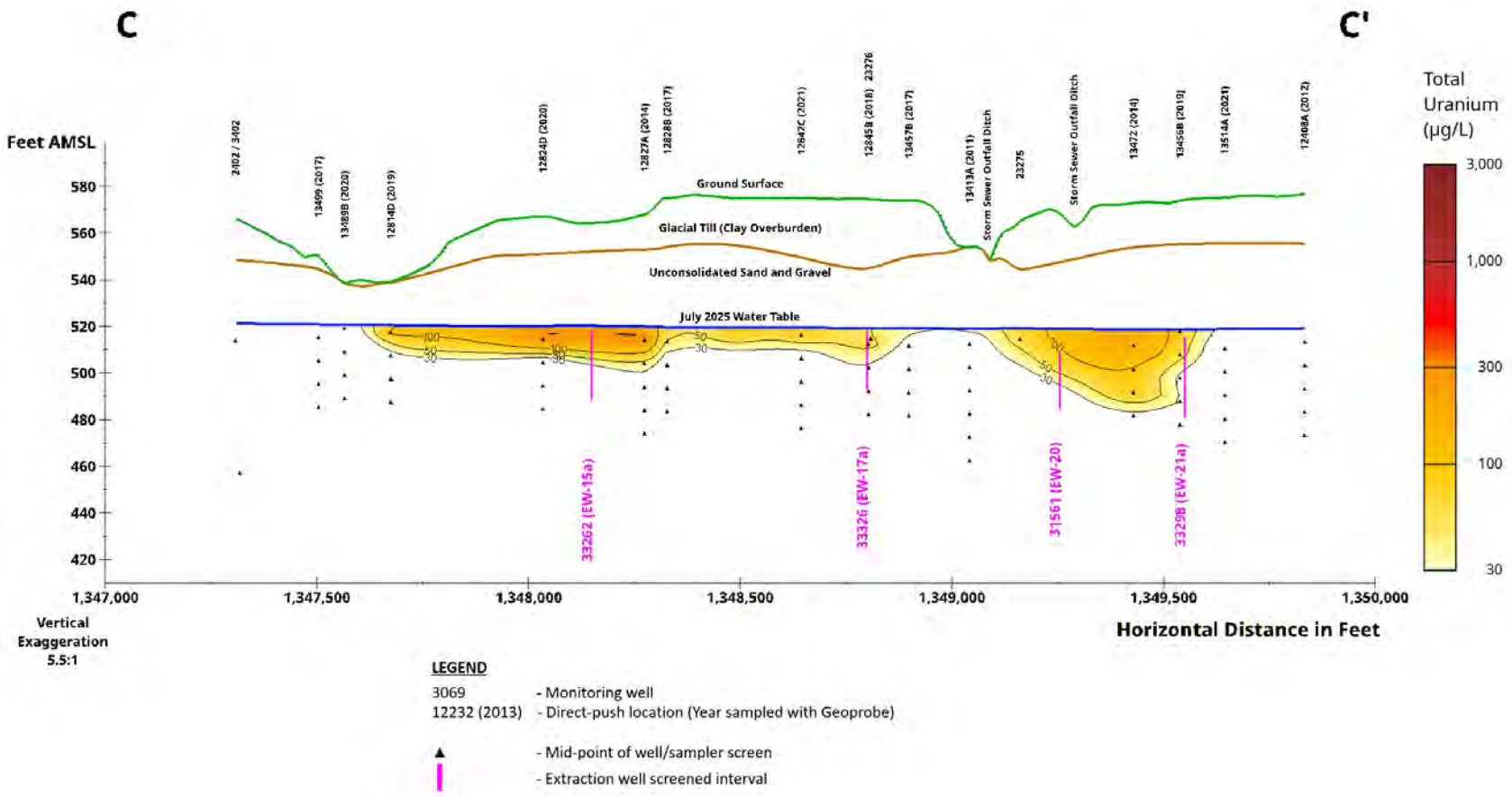


Figure A.2-37. EVS Total Uranium Plume Cross Section C–C'

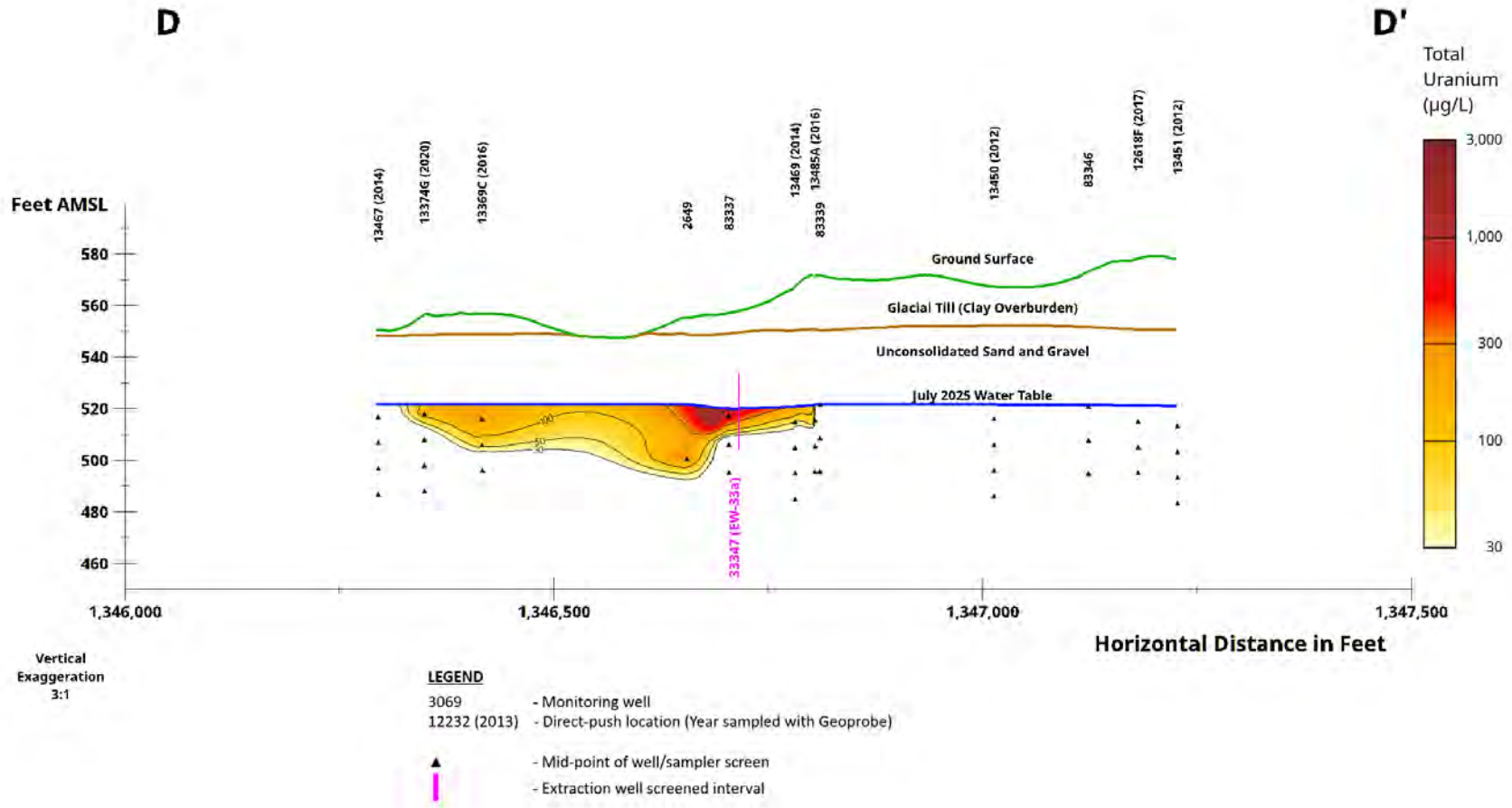


Figure A.2-38. EVS Total Uranium Plume Cross Section D–D'

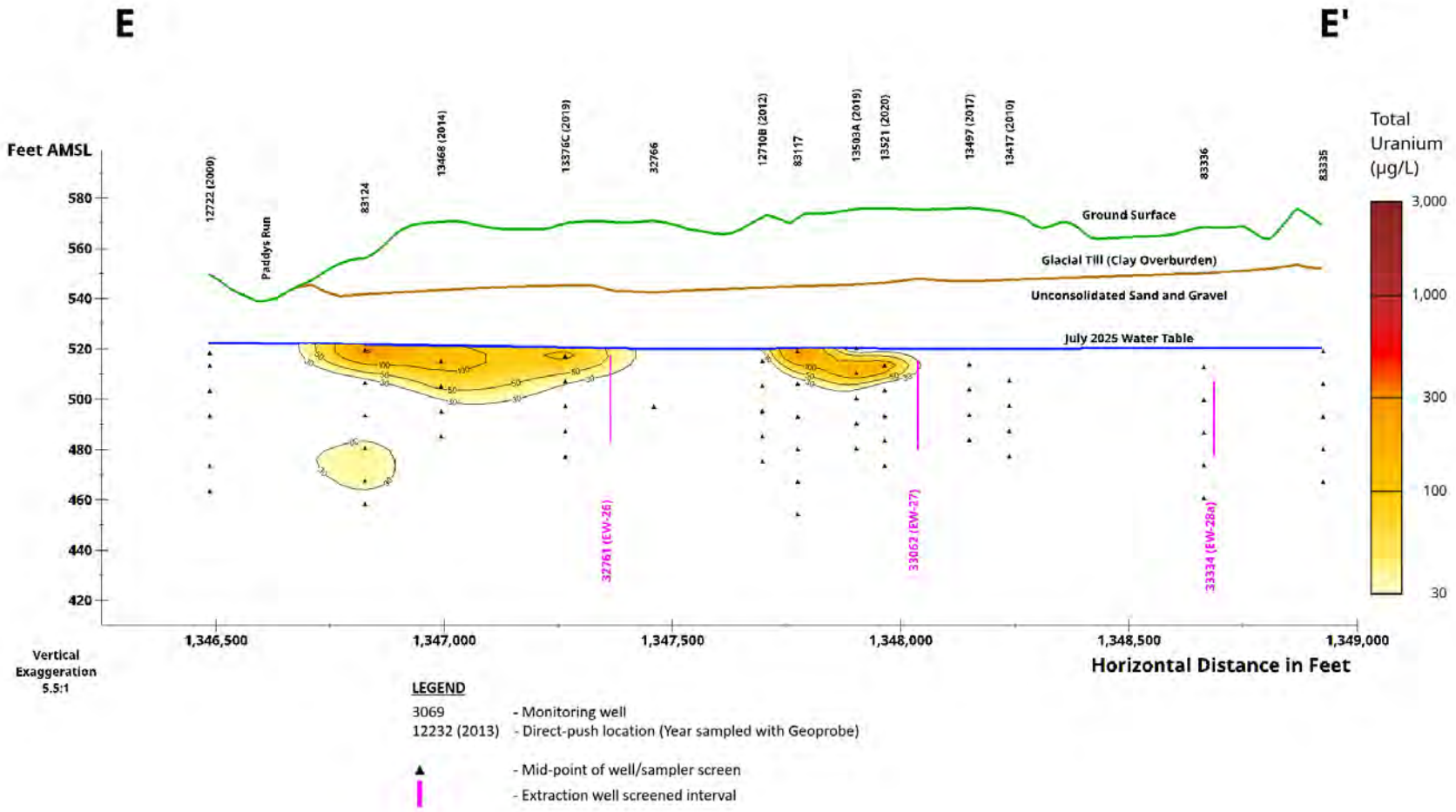


Figure A.2-39. EVS Total Uranium Plume Cross Section E–E'

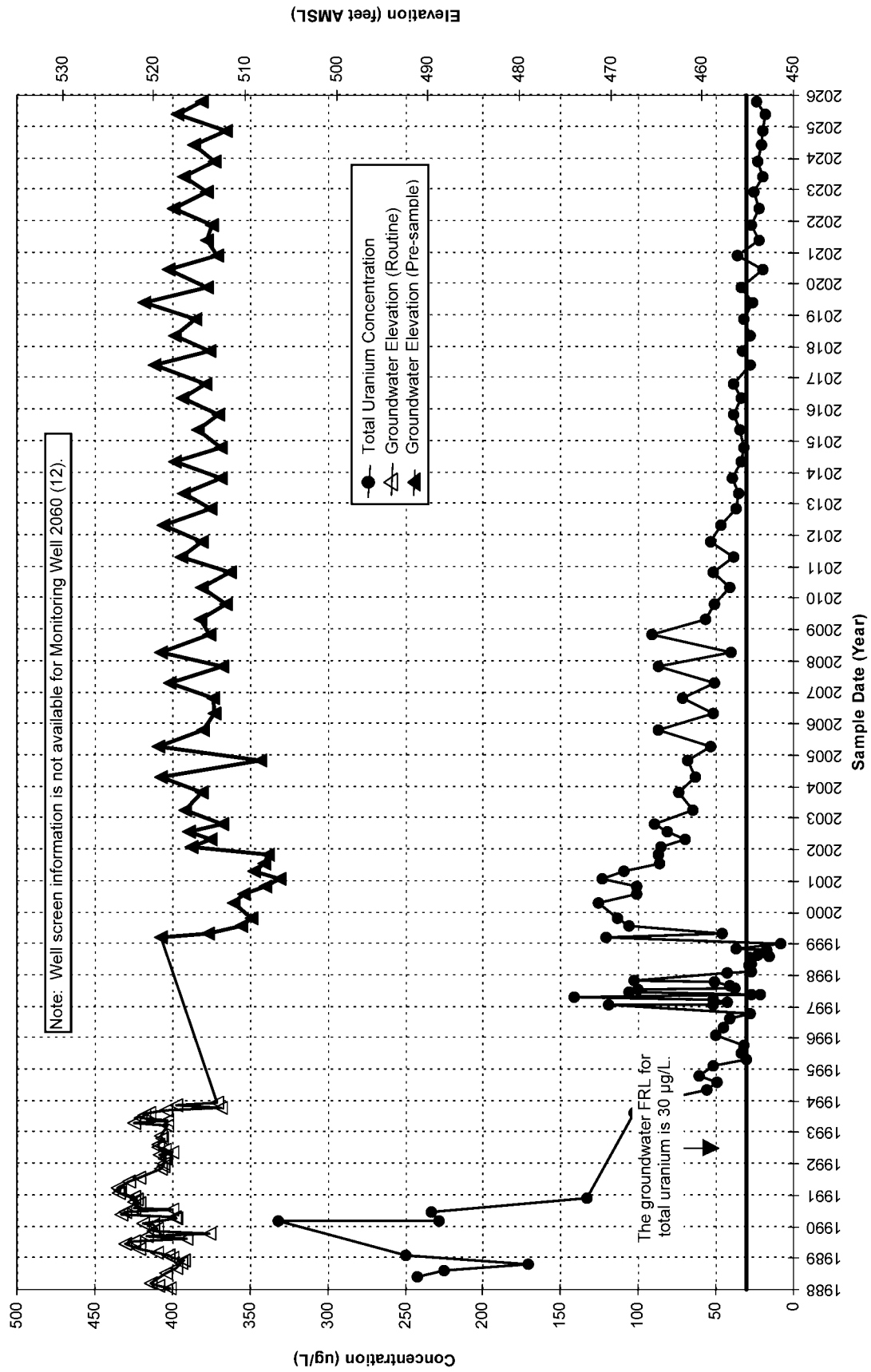


Figure A.2-40. Total Uranium Concentration Versus Time for Monitoring Well 2060

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Attachment A.3

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Contents

Abbreviations ii
Measurement Abbreviations ii
A.3.0 Groundwater Elevations and Capture Assessment 1
A.3.1 Groundwater Elevations and Capture Assessment 1
A.3.2 Annual Planned Wellfield Shutdown 4
A.3.2.1 Water Level Results 5
A.3.2.2 Uranium Concentration Results 6
A.3.3 Continued Transducer Monitoring 7
A.3.4 References 7

Tables

Table A.3-1. Uranium Concentrations at Monitoring Wells Before, During, and After the 2025 Wellfield Shutdown 8
Table A.3-2. Total Uranium Concentration at Extraction Wells During 2025 Wellfield Shutdown 9

Figures

Figure A.3-1. Routine Groundwater Elevation Map, First Quarter 2025 (January 20 to January 22, 2025) 11
Figure A.3-2. Routine Groundwater Elevation Map, Second Quarter 2025 (April 21 Through April 23, 2025) 12
Figure A.3-3. Routine Groundwater Elevation Map, Third Quarter 2025 (July 14 Through July 16, 2025) 13
Figure A.3-4. Routine Groundwater Elevation Map, Fourth Quarter 2025 (December 1 to 3, 2025) 14
Figure A.3-5. Current Operational Design Remediation Footprint 15
Figure A.3-6. Cumulative Annual Precipitation: 2004 Through 2025 as Recorded at the Butler County Regional Airport 16
Figure A.3-7. Transducer Locations for the 2025 Operational Shutdown 17
Figure A.3-8. Water Levels Versus Monthly Precipitation May 25, 2007, Through December 31, 2025 18
Figure A.3-9. Monitoring Well Locations for the 2025 Operational Shutdown. 19

Abbreviations

DOE	U.S. Department of Energy
IEMP	Integrated Environmental Monitoring Plan
OSDF	On-Site Disposal Facility
VAM-3D	Variable Saturated Analysis Model in Three Dimensions
WSA	Waste Storage Area

Measurement Abbreviations

amsl	above mean sea level
ft	feet
gpm	gallons per minute
µg/L	micrograms per liter

A.3.0 Groundwater Elevations and Capture Assessment

A.3.1 Groundwater Elevations and Capture Assessment

Quarterly groundwater elevation maps for 2025 are provided in Figures A.3-1 through A.3-4. Each groundwater elevation map contains the following quarter-specific information:

- Groundwater elevation data
- Interpreted water-table contours, capture zones, and flow divides
- Bedrock highs
- Model-predicted current Operational Design Remediation Footprint (based on particle tracks)
- Extent of the maximum 30 micrograms per liter (μg/L) total uranium plume
- Number of extraction wells in each module and the module-specific pumping rates during the period in which the groundwater elevations were measured

Water levels in 2025 were measured as specified in the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (DOE 2025). A total of 172 monitoring wells were available for measurement. As required by the IEMP, during the second quarter of 2025, all 172 wells were targeted for water level measurements. During the other three quarters, 99 of 172 available wells were targeted for measurement. A summary of the results is shown below.

Quarter	Measurement Dates (2025)	Number of Days	Average Water Level (ft amsl)[a]
1	January 20 to January 22	3	515.18
2	April 21 to April 23	3	519.30
3	July 14 to July 16	3	519.53
4	December 1 to December 3	3	515.56

[a] ft amsl = feet above mean sea level.

Five monitoring wells, and the uppermost channel in 11 multichannel wells were dry at various times of the year. A summary is provided below.

Well	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
2014	DRY			DRY
2384	DRY			DRY
2636				DRY
22192	DRY			DRY
22303	DRY			
83117_C1	DRY			
83293_C1	DRY			DRY
83295_C1	DRY			DRY
83335_C1	DRY	DRY	DRY	DRY
83336_C1	DRY	DRY	DRY	DRY
83337_C1	DRY			DRY
83338_C1	DRY			DRY
83339_C1	DRY			
83340_C1	DRY			
83341_C1	DRY			DRY
83346_C1				DRY

Quarterly groundwater elevation maps for 2025 are provided in Figures A.3-1 through A.3-4. Water level measurements are generally collected during times when all extraction wells are pumping; however, due to certain conditions (e.g., well maintenance), individual wells might be shut down during the measurement period. Any specific well shutdowns during the elevation measurement period are noted in Figures A.3-1 through A.3-4. The maps for 2025 illustrate capture of the maximum total uranium plume using groundwater elevation contours derived from quarterly water level measurements and model-predicted capture. The pumping rates reported in Figures A.3-1 through A.3-4 are averages of the actual pumping rates during the measurement period.

Model-predicted capture (called the current Operational Design Remediation Footprint) is based on particle tracks that were created using target system pumping rates defined in the current Operational Design. The current Operational Design Remediation Footprint used in this report was constructed using reverse, nonretarded, particle path interpretations from the Variable Saturated Analysis Model in Three Dimensions (VAM-3D) Zoom Groundwater Model that was updated in 2022. The design has all original South Plume/South Plume Optimization extraction wells turned off (3924 [RW-1], 3925 [RW-2], 3926 [RW-3], 3927 [RW-4], 32308 [RW-6], and 32309 [RW-7]) and two replacement wells operating at 300 gallons per minute (gpm) each (33616 [RW-6A] and 33617 [RW-7A]). Figure A.3-5 shows the resulting particle tracks that were used to define the remediation footprint. Model particles were seeded at each extraction well. The resulting particle tracks represent the individual path that each particle traveled during each of the three pumping stages modeled for the cleanup. The limits of most of the particle tracks are truncated because the particles reached the edge of the VAM-3D Zoom Groundwater Model domain.

The times of travel used to define the particle paths considered the pumping changes that are predicted to occur when different portions of the uranium plume achieve cleanup goals. The following three pumping stages were defined:

- **Stage 1:** 16 wells, at a system rate of 4,275 gpm (i.e., combined South Plume, South Field, and Waste Storage Area (WSA)
- **Stage 2:** 9 wells at a system rate of 3,075 gpm (i.e., combined South Field and WSA)
- **Stage 3:** 3 wells at a system rate of 1,100 gpm (i.e., WSA)

A groundwater flow divide between the Paddys Run Outlet and the New Baltimore Outlet is not readily distinguishable. Groundwater flow diverges around the bedrock high that separates the Paddys Run Outlet from the New Baltimore Outlet, but without additional measurement locations in the New Baltimore Outlet, the location where flow is dividing is not apparent. However, additional measurement locations in the New Baltimore Outlet are not needed for capture assessment purposes.

During 2025, flow in the vicinity of the On-Site Disposal Facility (OSDF) was generally from the northeast to southwest. Flow direction is influenced by seasonal fluctuations in the aquifer and by the active pumping taking place for the groundwater remediation. Before the start of pumping for the groundwater remediation, flow in the vicinity of the OSDF was generally west to east. It is anticipated that when pumping stops, flow in the vicinity of the OSDF will return to a generally west-to-east direction, absent any other influences external to the Fernald site.

Figure A.3-6 shows cumulative annual precipitation levels for 2004 through 2025, as recorded at the Butler County Regional Airport. Cumulative precipitation in 2025 was 37.83 inches. Between 2004 and 2025, the annual precipitation level has been as low as 33.20 inches (2010) and as high as 60.20 inches (2011).

Average annual water-table fluctuations and yearly ranges for 2006 through 2025 are provided in the table below.

Year	Average Fluctuation (feet)	Fluctuation Range (feet)
2025	4.65	2.29 to 6.31
2024	2.84	0.8 to 4.51
2023	2.84	1.5 to 5.74
2022	3.46	1.2 to 5.73
2021	4.14	1.4 to 7.24
2020	4.35	2.1 to 5.97
2019	3.82	0.21 to 7.09
2018	3.92	1.0 to 7.57
2017	3.76	0.15 to 4.83
2016	2.50	0.20 to 4.93
2015	4.64	0.35 to 4.99
2014	5.14	1.21 to 6.35
2013	3.45	0.35 to 4.28
2012	4.70	1.1 to 6.79
2011	7.50	7.4 to 14.5
2010	3.78	0.06 to 12.1
2009	2.46	0.1 to 5.5
2008	5.70	1.0 to 10.46
2007	4.45	1.7 to 7.7
2006	3.40	2.0 to 7.1

Capture zone interpretations for 2025 coupled with the particle track interpretations and contoured water-table gradients indicate that the 30 µg/L total uranium plume was being captured in 2025.

During 2020, the U.S. Department of Energy (DOE) collaborated with the DOE National Laboratory Network to determine what could be done to improve the Fernald Preserve groundwater remediation effort. One recommendation was to utilize available software to conduct four-dimensional mapping exercises: three spatial dimensions with time as the fourth dimension. Earth Volumetric Software was utilized to carry out the recommendation. As part of that exercise, water table mapping was conducted using quarterly water level data collected from August 2014 through April 2022. A total of 30 different quarterly water level events were used for the analysis. Water table interpretation was performed using kriging with external drift, following the methodology of Tonkin and Larson (2002). The kriging results were imported into the software for visualizing and streamline analyses. The streamline capture fraction was used to assess whether full containment is being achieved by the current Operational Design. Results indicated that the current Operational Design achieves full containment of the uranium plume, consistent with previous evaluations reported in this and past Site Environmental Reports.

A.3.2 Annual Planned Wellfield Shutdown

The entire wellfield (excluding the WSA well 33062 [EW-27]) was shut down from June 4 to July 8, 2025, as planned to allow water levels to recover to nonpumping elevations. Well 33026 (EW-27) remained operating to supply flow to the Converted Advanced Wastewater Treatment

(CAWWT) system. Quarterly measurement of water levels in 2025 was planned so that measurements were not collected during the planned shutdown.

Uranium is bound to sediments in the unsaturated zone of the Great Miami Aquifer in former contamination source areas. This contamination will remain bound unless water levels in the aquifer rise and saturate the contaminated sediments, allowing the bound uranium to dissolve into the groundwater.

This presents a challenge to a pump-and-treat remedy, because pumping lowers the water level. In a pump-and-treat remedy, only the dissolved uranium is removed by the pumping action. Sorbed uranium on the aquifer sediment in the vadose zone is not removed. The concern is that once pumping ends, water levels will rise and provide a means for additional uranium to dissolve into the water, potentially raising dissolved contaminant levels above final remediation goals. This process is referred to as "concentration rebound" and is a concern for pump-and-treat groundwater remedies. Planned annual wellfield shutdowns have been conducted since 2007 to allow water levels in the aquifer to rise as high as possible to saturate aquifer material that is not normally saturated. To achieve the highest water level rise possible, the wellfield shutdowns are planned to coincide with seasonal high-water levels in the aquifer. As the remedy progresses, DOE may consider alternative pumping schemes such as pulse-pumping to account for rebound prior to certification. DOE would coordinate any pumping alterations with the regulatory agencies.

A.3.2.1 Water Level Results

Pressure transducers, which automatically record water levels, are installed in 11 groundwater monitoring wells (2045, 2046, 2095, 2649, 3881, 23274, 62433, 32763, 22301, 22302, and 63119) for the shutdown (Figure A.3-7). Water level measurements were recorded twice each day (i.e., midnight and noon).

The zero-hour transducer readings (midnight) were used to track water level changes in the transducer wells during the shutdown periods. The maximum water level rise at each well, measured during the shutdown period in 2025, is presented below.

Location	Elevation at Midnight Prior to Shutdown June 4, 2025 (ft amsl)	Elevation at Midnight Prior to Restart July 8, 2025 (ft amsl)	Water Level Rise (ft)
2045	517.56	520.58	3.02
2046	518.48	520.95[a]	2.47
2649	521.93[b]	522.97	1.04
23274	517.98	520.64	2.66
63119	518.79	520.27	1.48
22302	516.57	519.86	3.29
3881	517.33	519.46	2.13
22301	517.16	519.83	2.67
2095	518.56	520.46	1.90
32763	521.03[c]	521.82	0.79
62433	515.86	520.06	4.20

[a] Data are from July 1, 2025, due to transducer malfunction.
[b] Data are from May 27, 2025, due to transducer malfunction.
[c] Data are from May 1, 2025, due to transducer malfunction.

The water level rise measurements indicate that during the shutdown, the water level "rise" ranged from 0.79 ft (well 32763) to 4.20 ft (well 62433).

Figure A.3-8 shows water levels versus precipitation from May 25, 2007, through January 5, 2026. Three wells are shown in the figure: well 2649 (former WSA), well 2046 (west side of South Field Area), and well 62433 (east side of South Field Area). The combination of the shutdown and seasonal water level rise in 2025 resulted in the following water level rises:

- 7.84 ft in the former WSA (monitoring well 2649)
- 7.80 ft in the west side of the South Field (monitoring well 2046)
- 9.38 ft in the east side of the South Field (monitoring well 62433)

A.3.2.2 Uranium Concentration Results

Consistent with previous years, total uranium concentrations were measured in six groundwater monitoring wells (2045, 2046, 23274, 83124, 83294, and 83337 [Figure A.3-9]) before, during, and after the 2025 shutdown. The results of the 2025 IEMP first-half uranium sampling are used to represent uranium concentrations in the well before the shutdown. Groundwater samples collected in June 2025 represent concentrations during the shutdown. The results of the 2025 IEMP second-half uranium sampling are used to represent uranium concentrations in the well after the shutdown exercise was completed. The two shallowest channels (channels 1 and 2) of the type-8 monitoring wells were sampled unless the channel was dry. Uranium concentration measurements at the six monitoring wells before, during, and after the 2025 shutdown are provided in Table A.3-1.

A comparison of pre-shutdown uranium concentrations to pre-startup uranium concentrations in the monitoring wells indicated that concentrations increased in five of the six wells during the shutdown: 2045, 2046, 83124 (channel 2), 83294 (channels 1 and 2), and 83337 (channel 2). As stated in the IEMP, during the second half of the year, the channel with the highest uranium concentration (as measured during the first half of the year) is sampled if it is not dry. If the targeted channel is dry, the next deeper channel is sampled. In the second half of 2025, wells 83294_C1 and 83337_C1 were dry.

Total uranium concentrations were also measured at the extraction wells before and after the wells were restarted. After each well was restarted, the first water sample was collected after the well had been pumping for approximately 5 minutes. Results for the shutdown are provided in Table A.3-2.

The last column of Table A.3-2 provides the difference between the maximum uranium concentration measured after the wells were restarted and the average uranium concentration measured within a month prior to the shutdown at each extraction well. Seven of 15 extraction wells had higher uranium concentrations when they were initially restarted in July.

A.3.3 Continued Transducer Monitoring

Although not required by the IEMP, pressure transducers installed in 2007 to support the first annual wellfield shutdown remain in the wells and continue to operate so that daily changes in water levels can be recorded on a continuous, routine basis at key points in the aquifer. The transducers are programmed to record a water level measurement twice daily, (i.e., noon and midnight). Data from three of the six locations (former WSA [2649], west side of the South Field Area [2046], and east side of the South Field Area [62433]) are shown in Figure A.3-7 and are plotted in Figure A.3-8 along with precipitation data collected through December 31, 2025. The transducers will continue to record data to provide a more complete record of seasonal and short-term water-table fluctuations and continue to be used to plan the timing of future wellfield shutdowns.

A.3.4 References

DOE (U.S. Department of Energy), 2025. *Comprehensive Legacy Management and Institutional Controls Plan*, LMS/FER/S03496-14.0, Rev. 14, Office of Legacy Management, January.

Tonkin, M.J., and S.P. Larson, 2002. "Kriging Water Levels with a Regional-Linear and Point-Logarithmic Drift," *Groundwater* 40(2):185–193.

Table A.3-1. Uranium Concentrations at Monitoring Wells Before, During, and After the 2025 Wellfield Shutdown

Well	Easting	Northing	First Half 2025 Pre-Shutdown Concentrations		Pre-Start-Up Concentrations June 2025		Second Half 2025 Post-Shutdown Concentrations	
			Date	Uranium (μg/L)	Date	Uranium (μg/L)	Date	Uranium (μg/L)
2045	1348291	477159	3/20/2025	46.8	6/26/2025	58.4	9/17/2025	46.3
2046	1347950	478088	2/12/2025	13.9	6/26/2025	17.6	8/25/2025	15.1
23274	1349406	478337	2/18/2025	75.0	6/26/2025	17.3	8/25/2025	96.8
83124_C1	1346826	479977	3/25/2025	374.0	6/25/2025	335.0	8/26/2025	435.0
83124_C2	1346826	479977	3/25/2025	21.3	6/25/2025	23.0	8/26/2025	22.5
83294_C1	1349599	477190	5/28/2025	113.0	6/25/2025	150.0	8/27/2025	Dry
83294_C2	1349599	477190	3/27/2025	53.8	6/25/2025	57.8	8/27/2025	139.0
83337_C1	1346704	481052	5/19/2025	897.0	6/30/2025	690.0	10/8/2025	Dry
83337_C2	1346704	481052	5/21/2025	11.10	6/30/2025	75.1	10/8/2025	2.64

Table A.3-2. Total Uranium Concentration at Extraction Wells During 2025 Wellfield Shutdown

Extraction Well	June 3, 2025 Total Uranium Concentration (µg/L)	Date of Well Restart	July Restart Sample Total Uranium Concentration (µg/L)	July Restart Sample Total Uranium Concentration Minus June 3, 2025 Total Uranium Concentration[a] (µg/L)
RW-6A	21.7	7/8/2025	16.2	−5.5
RW-7A	22.6	7/8/2025	20.3	−2.3
EW-15A	22.2	7/8/2025	30.1	7.9
EW-17A	8.50	7/8/2025	11.5	3.0
EW-18	28.8	7/10/2025	25.8	−3.0
EW-19	13.6	7/10/2025	14.1	0.5
EW-20	30.7	7/10/2025	23.1	−7.6
EW-21A	29.9	7/10/2025	19.4	−10.5
EW-22[b]	16.6	7/29/2025	16.0	−0.6
EW-23	22.3	7/10/2025	15.7	−6.6
EW-24[b]	18.9	7/29/2025	18.9	0.0
EW-25	15.5	7/9/2025	31.0	15.5
EW-26	19.6	7/9/2025	21.1	1.5
EW-30	6.00	7/9/2025	7.80	1.8

[a] Shutdown began on June 4, 2025, and ended on July 8, 2025, for a duration of 34 days. EW-27 continued to operate during the shutdown.
[b] Restart of EW-22 and EW-24 was delayed until July 29, 2025, due to chemical rehabilitation.

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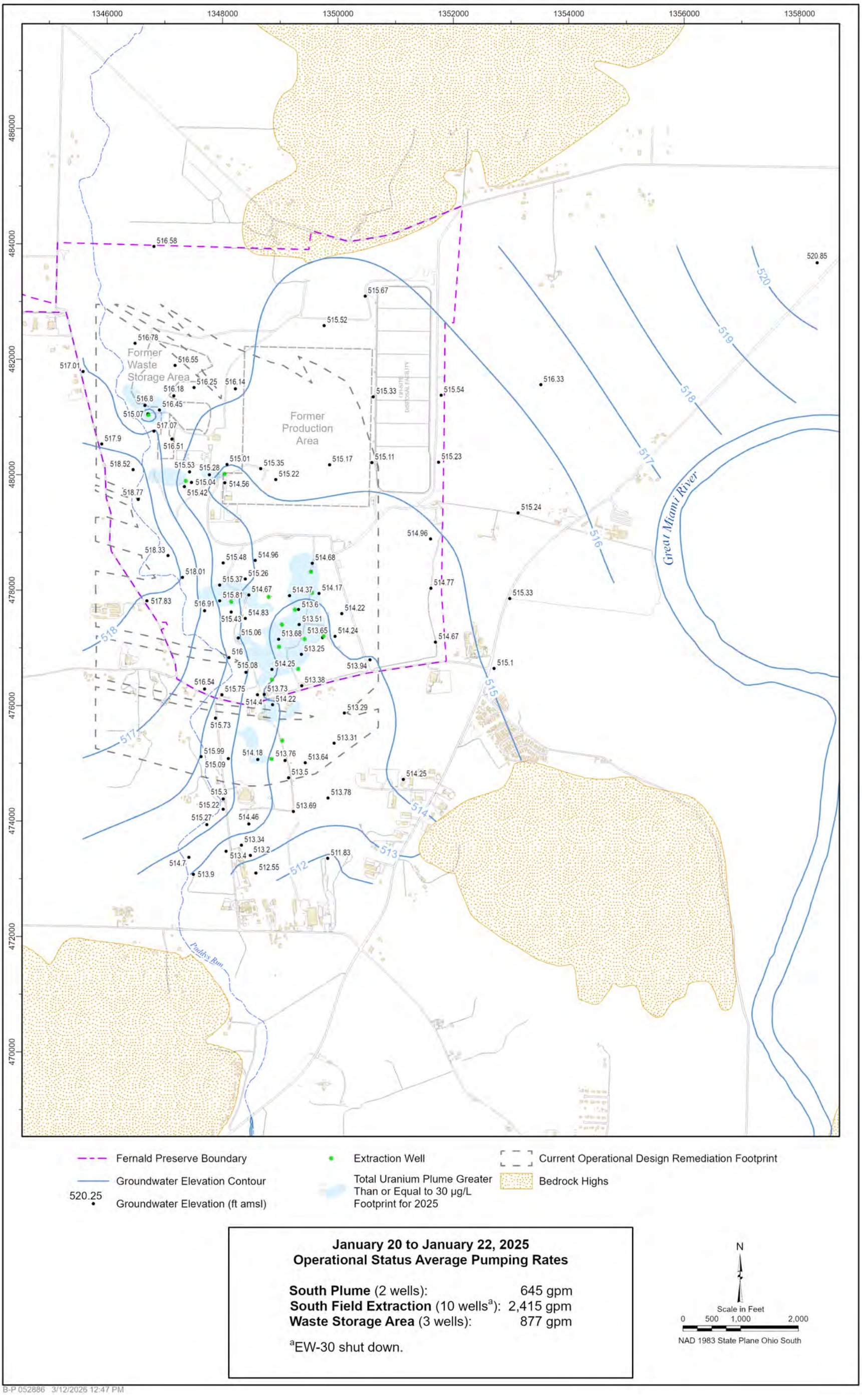


Figure A.3-1. Routine Groundwater Elevation Map, First Quarter 2025 (January 20 to January 22, 2025)

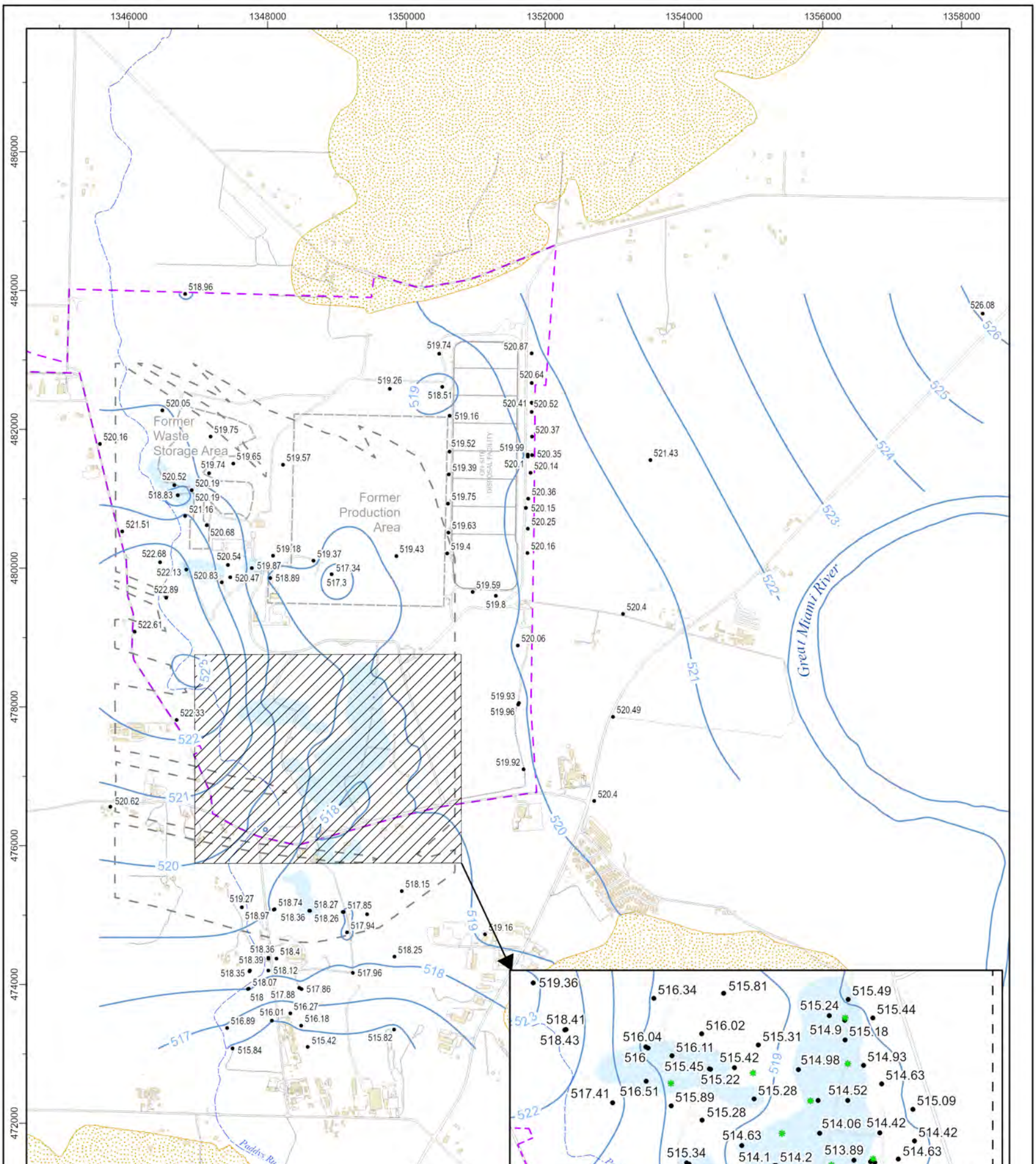


Figure A.3-2. Routine Groundwater Elevation Map, Second Quarter 2025 (April 21 Through April 23, 2025)

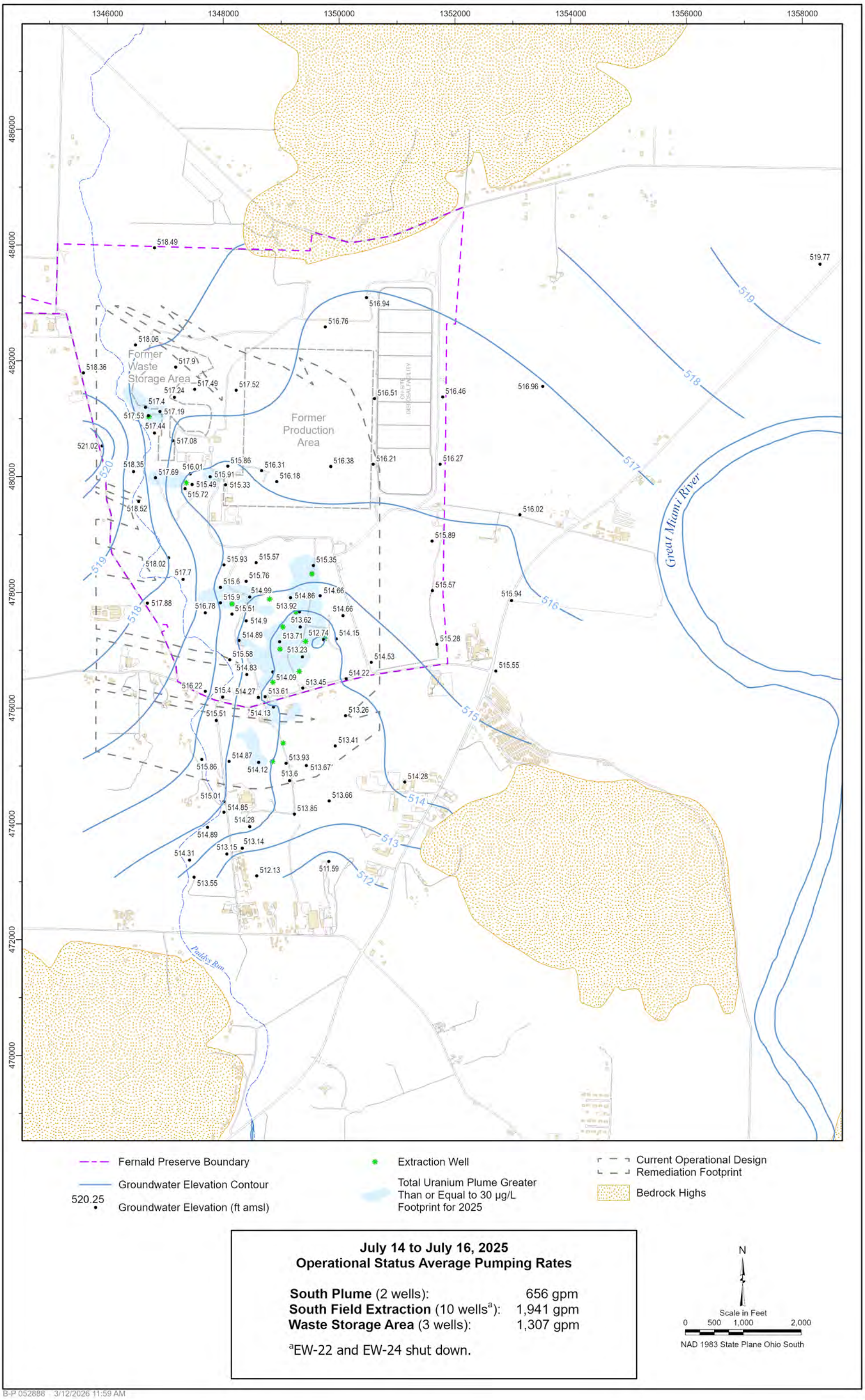


Figure A.3-3. Routine Groundwater Elevation Map, Third Quarter 2025 (July 14 Through July 16, 2025)

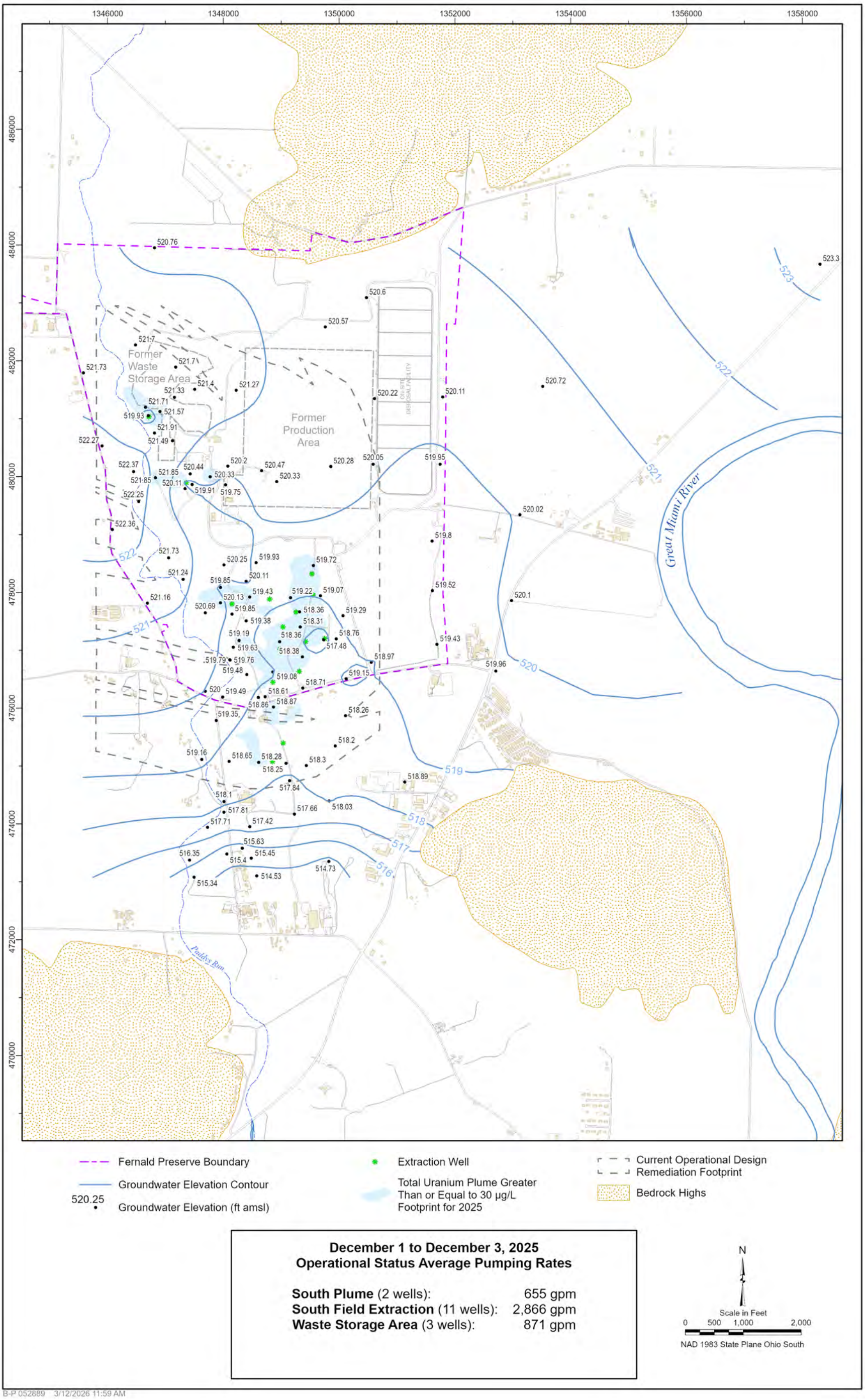


Figure A.3-4. Routine Groundwater Elevation Map, Fourth Quarter 2025 (December 1 to 3, 2025)

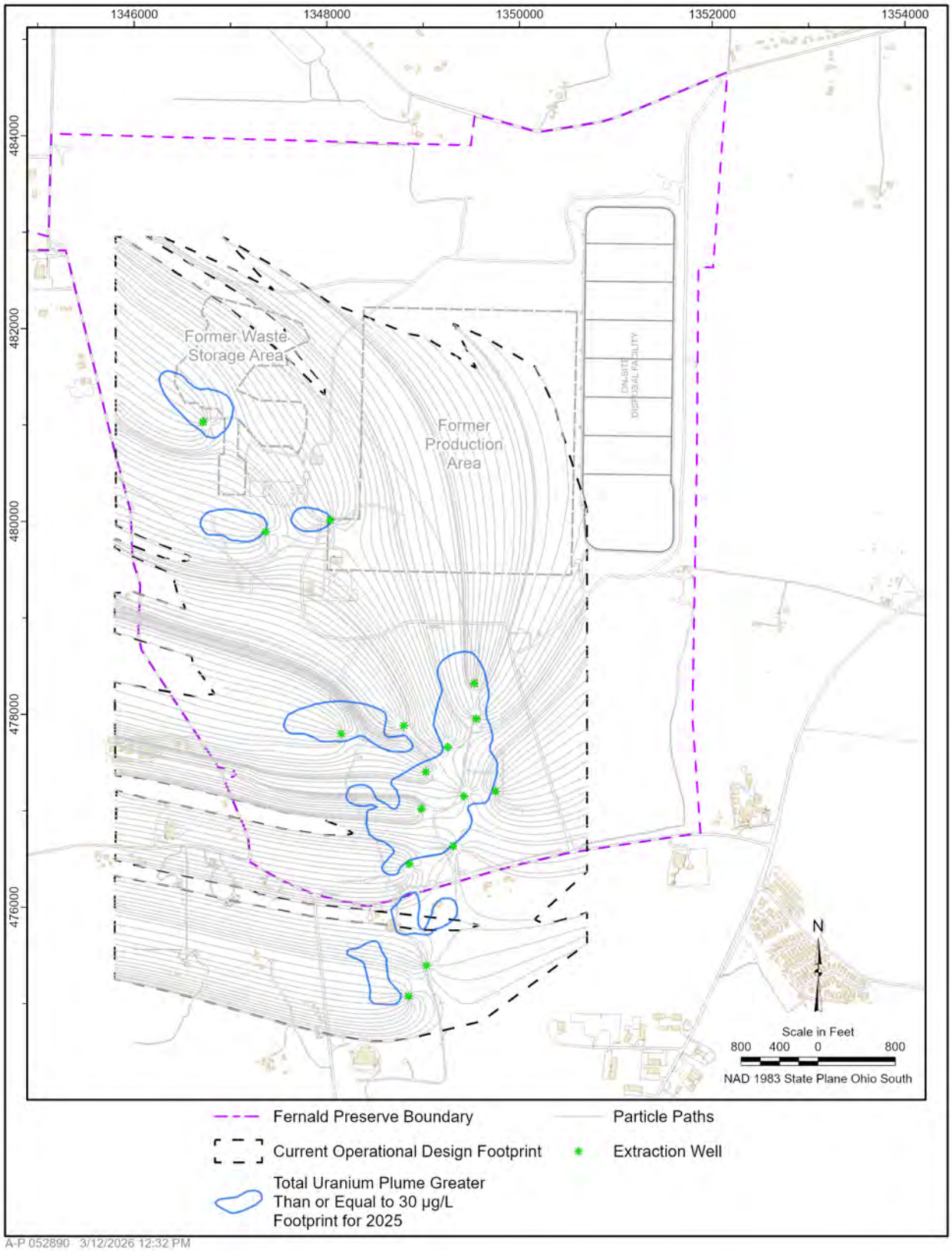


Figure A.3-5. Current Operational Design Remediation Footprint

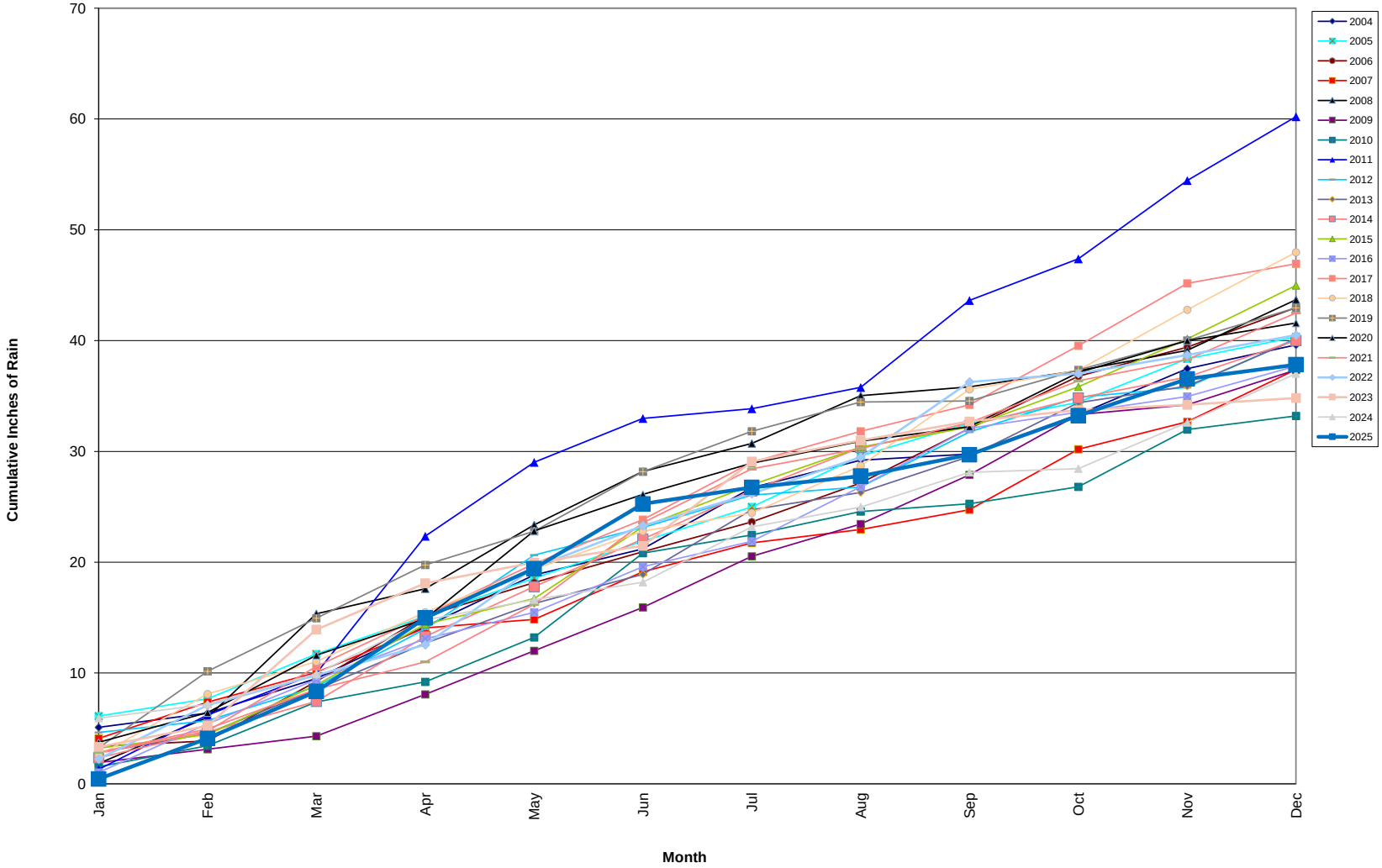


Figure A.3-6. Cumulative Annual Precipitation: 2004 Through 2025 as Recorded at the Butler County Regional Airport

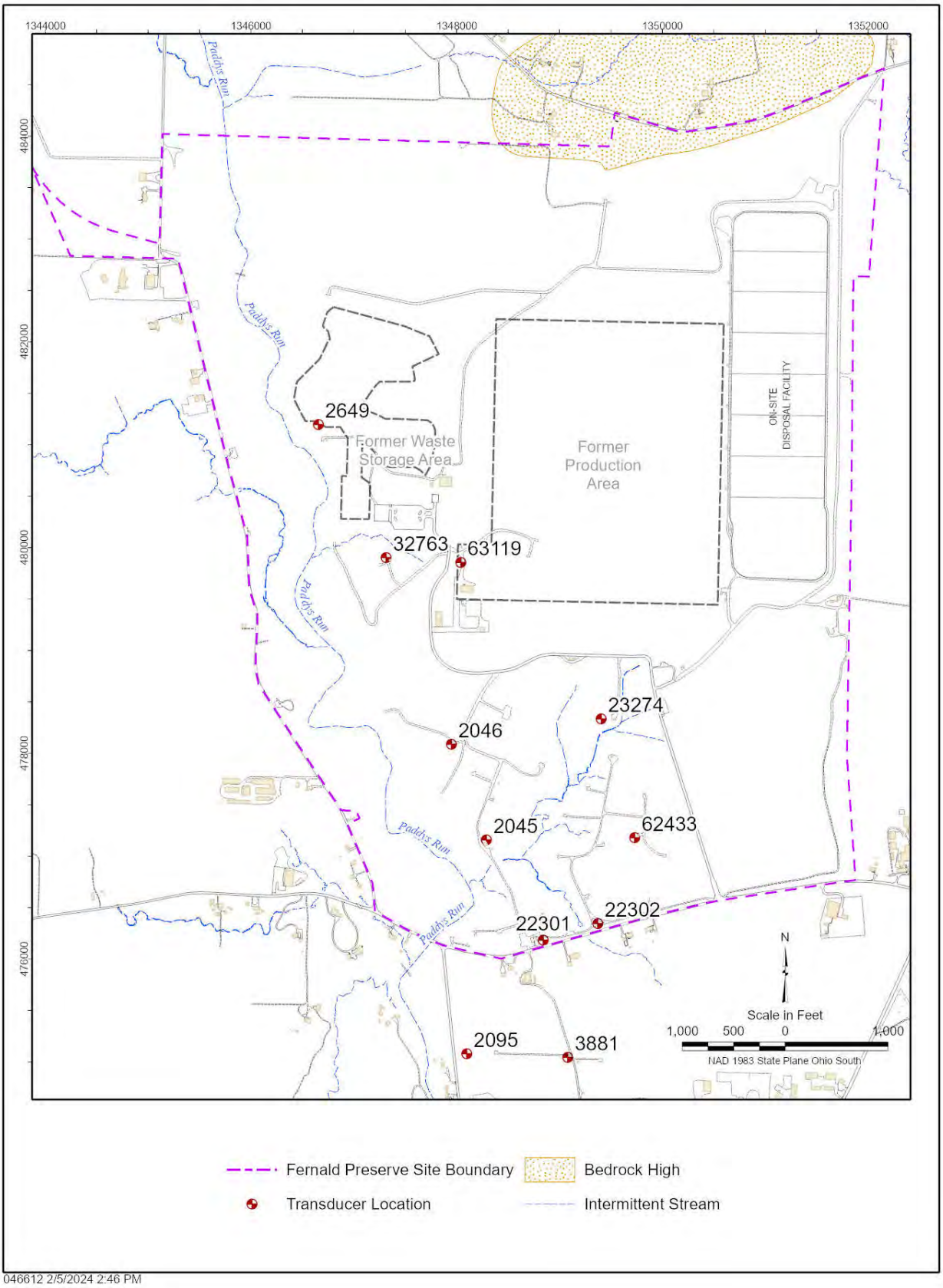


Figure A.3-7. Transducer Locations for the 2025 Operational Shutdown

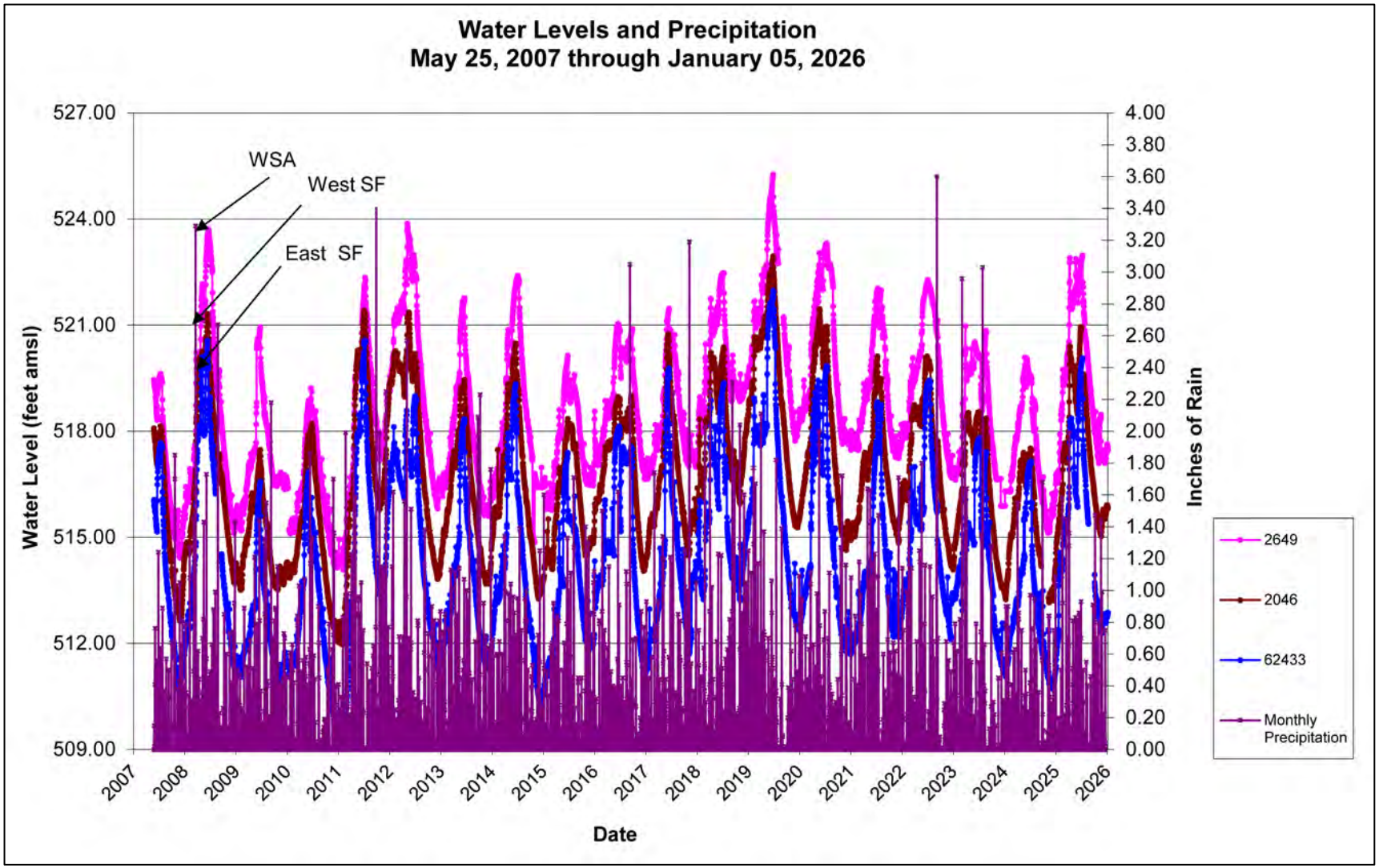


Figure A.3-8. Water Levels Versus Monthly Precipitation May 25, 2007, Through December 31, 2025

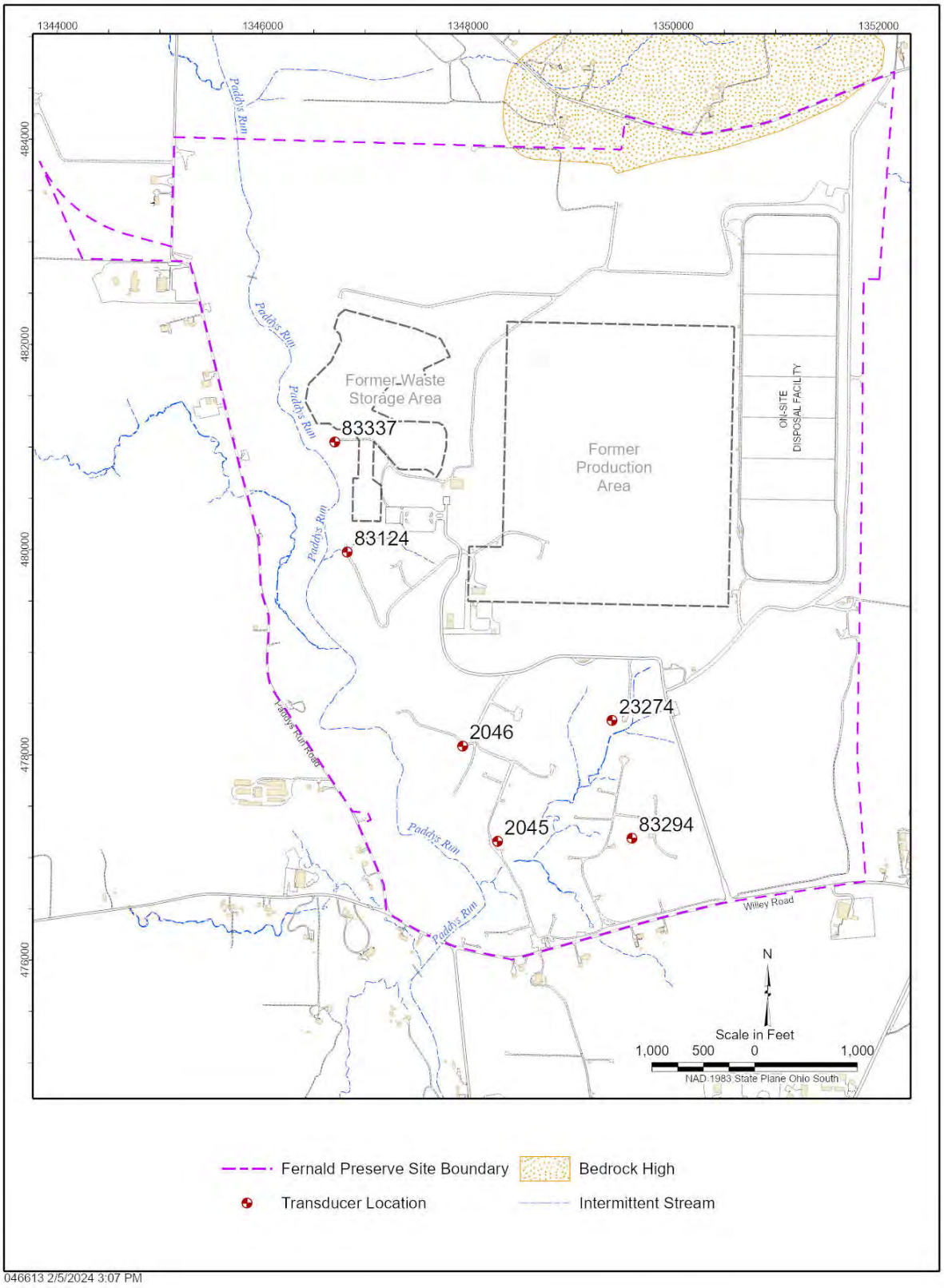


Figure A.3-9. Monitoring Well Locations for the 2025 Operational Shutdown.

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Attachment A.4

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Contents

Abbreviations viii
Measurement Abbreviations viii
A.4.0 Non-Uranium Final Remediation Level Results 1
A.4.1 Non-Uranium FRL Exceedances for 2025 1
A.4.1.1 Non-Uranium Direct-Push Sampling Results for 2025 3
A.4.2 Evaluation of 2025 Non-Uranium FRL Exceedances Outside the Current Operational Design Remediation Footprint 3
A.4.2.1 Background 3
A.4.2.2 Evaluation and Discussion 4
A.4.3 Conclusions 4
A.4.4 Property/Plume Boundary Groundwater Monitoring 4
A.4.5 References 7

Tables

Table A.4-1. Summary Statistics and Trend Analysis for Non-Uranium Constituents with 2025 Results Above FRLs 9
Table A.4-2. Groundwater FRL Exceedances from 1997 Through 2025 11

Figures

Figure A.4-1. Non-Uranium Constituent Locations with 2025 Results Above FRLs 13
Figure A.4-2. Antimony Concentration Versus Time Plot for Monitoring Well 2093 14
Figure A.4-3. Antimony Concentration Versus Time Plot for Monitoring Well 2128 14
Figure A.4-4. Antimony Concentration Versus Time Plot for Monitoring Well 2398 15
Figure A.4-5. Antimony Concentration Versus Time Plot for Monitoring Well 2431 15
Figure A.4-6. Antimony Concentration Versus Time Plot for Monitoring Well 2432 16
Figure A.4-7. Antimony Concentration Versus Time Plot for Monitoring Well 2636 16
Figure A.4-8. Antimony Concentration Versus Time Plot for Monitoring Well 2733 17
Figure A.4-9. Antimony Concentration Versus Time Plot for Monitoring Well 2898 17
Figure A.4-10. Antimony Concentration Versus Time Plot for Monitoring Well 2899 18
Figure A.4-11. Antimony Concentration Versus Time Plot for Monitoring Well 2900 18
Figure A.4-12. Antimony Concentration Versus Time Plot for Monitoring Well 3070 19
Figure A.4-13. Antimony Concentration Versus Time Plot for Monitoring Well 3093 19
Figure A.4-14. Antimony Concentration Versus Time Plot for Monitoring Well 3128 20
Figure A.4-15. Antimony Concentration Versus Time Plot for Monitoring Well 3398 20
Figure A.4-16. Antimony Concentration Versus Time Plot for Monitoring Well 3424 21
Figure A.4-17. Antimony Concentration Versus Time Plot for Monitoring Well 3426 21
Figure A.4-18. Antimony Concentration Versus Time Plot for Monitoring Well 3429 22
Figure A.4-19. Antimony Concentration Versus Time Plot for Monitoring Well 3431 22
Figure A.4-20. Antimony Concentration Versus Time Plot for Monitoring Well 3432 23
Figure A.4-21. Antimony Concentration Versus Time Plot for Monitoring Well 3636 23
Figure A.4-22. Antimony Concentration Versus Time Plot for Monitoring Well 3733 24

Figure A.4-23. Antimony Concentration Versus Time Plot for Monitoring Well 3898 24
Figure A.4-24. Antimony Concentration Versus Time Plot for Monitoring Well 3899 25
Figure A.4-25. Antimony Concentration Versus Time Plot for Monitoring Well 3900 25
Figure A.4-26. Antimony Concentration Versus Time Plot for Monitoring Well 4398 26
Figure A.4-27. Antimony Concentration Versus Time Plot for Monitoring Well 21063 26
Figure A.4-28. Antimony Concentration Versus Time Plot for Monitoring Well 22198 27
Figure A.4-29. Antimony Concentration Versus Time Plot for Monitoring Well 22199 27
Figure A.4-30. Antimony Concentration Versus Time Plot for Monitoring Well 22204 28
Figure A.4-31. Antimony Concentration Versus Time Plot for Monitoring Well 22205 28
Figure A.4-32. Antimony Concentration Versus Time Plot for Monitoring Well 22208 29
Figure A.4-33. Antimony Concentration Versus Time Plot for Monitoring Well 22210 29
Figure A.4-34. Antimony Concentration Versus Time Plot for Monitoring Well 22211 30
Figure A.4-35. Antimony Concentration Versus Time Plot for Monitoring Well 22214 30
Figure A.4-36. Antimony Concentration Versus Time Plot for Monitoring Well 31217 31
Figure A.4-37. Arsenic Concentration Versus Time Plot for Monitoring Well 2093 31
Figure A.4-38. Arsenic Concentration Versus Time Plot for Monitoring Well 2128 32
Figure A.4-39. Arsenic Concentration Versus Time Plot for Monitoring Well 2398 32
Figure A.4-40. Arsenic Concentration Versus Time Plot for Monitoring Well 2431 33
Figure A.4-41. Arsenic Concentration Versus Time Plot for Monitoring Well 2432 33
Figure A.4-42. Arsenic Concentration Versus Time Plot for Monitoring Well 2636 34
Figure A.4-43. Arsenic Concentration Versus Time Plot for Monitoring Well 2733 34
Figure A.4-44. Arsenic Concentration Versus Time Plot for Monitoring Well 2898 35
Figure A.4-45. Arsenic Concentration Versus Time Plot for Monitoring Well 2899 35
Figure A.4-46. Arsenic Concentration Versus Time Plot for Monitoring Well 2900 36
Figure A.4-47. Arsenic Concentration Versus Time Plot for Monitoring Well 3070 36
Figure A.4-48. Arsenic Concentration Versus Time Plot for Monitoring Well 3093 37
Figure A.4-49. Arsenic Concentration Versus Time Plot for Monitoring Well 3128 37
Figure A.4-50. Arsenic Concentration Versus Time Plot for Monitoring Well 3398 38
Figure A.4-51. Arsenic Concentration Versus Time Plot for Monitoring Well 3424 38
Figure A.4-52. Arsenic Concentration Versus Time Plot for Monitoring Well 3426 39
Figure A.4-53. Arsenic Concentration Versus Time Plot for Monitoring Well 3429 39
Figure A.4-54. Arsenic Concentration Versus Time Plot for Monitoring Well 3431 40
Figure A.4-55. Arsenic Concentration Versus Time Plot for Monitoring Well 3432 40
Figure A.4-56. Arsenic Concentration Versus Time Plot for Monitoring Well 3636 41
Figure A.4-57. Arsenic Concentration Versus Time Plot for Monitoring Well 3733 41
Figure A.4-58. Arsenic Concentration Versus Time Plot for Monitoring Well 3898 42
Figure A.4-59. Arsenic Concentration Versus Time Plot for Monitoring Well 3899 42
Figure A.4-60. Arsenic Concentration Versus Time Plot for Monitoring Well 3900 43
Figure A.4-61. Arsenic Concentration Versus Time Plot for Monitoring Well 4398 43
Figure A.4-62. Arsenic Concentration Versus Time Plot for Monitoring Well 21063 44
Figure A.4-63. Arsenic Concentration Versus Time Plot for Monitoring Well 22198 44
Figure A.4-64. Arsenic Concentration Versus Time Plot for Monitoring Well 22199 45
Figure A.4-65. Arsenic Concentration Versus Time Plot for Monitoring Well 22204 45
Figure A.4-66. Arsenic Concentration Versus Time Plot for Monitoring Well 22205 46
Figure A.4-67. Arsenic Concentration Versus Time Plot for Monitoring Well 22208 46
Figure A.4-68. Arsenic Concentration Versus Time Plot for Monitoring Well 22210 47
Figure A.4-69. Arsenic Concentration Versus Time Plot for Monitoring Well 22211 47
Figure A.4-70. Arsenic Concentration Versus Time Plot for Monitoring Well 22214 48

Figure A.4-71. Arsenic Concentration Versus Time Plot for Monitoring Well 31217 48
Figure A.4-72. Fluoride Concentration Versus Time Plot for Monitoring Well 2093 49
Figure A.4-73. Fluoride Concentration Versus Time Plot for Monitoring Well 2128 49
Figure A.4-74. Fluoride Concentration Versus Time Plot for Monitoring Well 2398 50
Figure A.4-75. Fluoride Concentration Versus Time Plot for Monitoring Well 2431 50
Figure A.4-76. Fluoride Concentration Versus Time Plot for Monitoring Well 2432 51
Figure A.4-77. Fluoride Concentration Versus Time Plot for Monitoring Well 2636 51
Figure A.4-78. Fluoride Concentration Versus Time Plot for Monitoring Well 2733 52
Figure A.4-79. Fluoride Concentration Versus Time Plot for Monitoring Well 2898 52
Figure A.4-80. Fluoride Concentration Versus Time Plot for Monitoring Well 2899 53
Figure A.4-81. Fluoride Concentration Versus Time Plot for Monitoring Well 2900 53
Figure A.4-82. Fluoride Concentration Versus Time Plot for Monitoring Well 3070 54
Figure A.4-83. Fluoride Concentration Versus Time Plot for Monitoring Well 3093 54
Figure A.4-84. Fluoride Concentration Versus Time Plot for Monitoring Well 3128 55
Figure A.4-85. Fluoride Concentration Versus Time Plot for Monitoring Well 3398 55
Figure A.4-86. Fluoride Concentration Versus Time Plot for Monitoring Well 3424 56
Figure A.4-87. Fluoride Concentration Versus Time Plot for Monitoring Well 3426 56
Figure A.4-88. Fluoride Concentration Versus Time Plot for Monitoring Well 3429 57
Figure A.4-89. Fluoride Concentration Versus Time Plot for Monitoring Well 3431 57
Figure A.4-90. Fluoride Concentration Versus Time Plot for Monitoring Well 3432 58
Figure A.4-91. Fluoride Concentration Versus Time Plot for Monitoring Well 3636 58
Figure A.4-92. Fluoride Concentration Versus Time Plot for Monitoring Well 3733 59
Figure A.4-93. Fluoride Concentration Versus Time Plot for Monitoring Well 3898 59
Figure A.4-94. Fluoride Concentration Versus Time Plot for Monitoring Well 3899 60
Figure A.4-95. Fluoride Concentration Versus Time Plot for Monitoring Well 3900 60
Figure A.4-96. Fluoride Concentration Versus Time Plot for Monitoring Well 4398 61
Figure A.4-97. Fluoride Concentration Versus Time Plot for Monitoring Well 21063 61
Figure A.4-98. Fluoride Concentration Versus Time Plot for Monitoring Well 22198 62
Figure A.4-99. Fluoride Concentration Versus Time Plot for Monitoring Well 22199 62
Figure A.4-100. Fluoride Concentration Versus Time Plot for Monitoring Well 22204 63
Figure A.4-101. Fluoride Concentration Versus Time Plot for Monitoring Well 22205 63
Figure A.4-102. Fluoride Concentration Versus Time Plot for Monitoring Well 22208 64
Figure A.4-103. Fluoride Concentration Versus Time Plot for Monitoring Well 22210 64
Figure A.4-104. Fluoride Concentration Versus Time Plot for Monitoring Well 22211 65
Figure A.4-105. Fluoride Concentration Versus Time Plot for Monitoring Well 22214 65
Figure A.4-106. Fluoride Concentration Versus Time Plot for Monitoring Well 31217 66
Figure A.4-107. Lead Concentration Versus Time Plot for Monitoring Well 2093..... 66
Figure A.4-108. Lead Concentration Versus Time Plot for Monitoring Well 2128..... 67
Figure A.4-109. Lead Concentration Versus Time Plot for Monitoring Well 2398..... 67
Figure A.4-110. Lead Concentration Versus Time Plot for Monitoring Well 2431..... 68
Figure A.4-111. Lead Concentration Versus Time Plot for Monitoring Well 2432..... 68
Figure A.4-112. Lead Concentration Versus Time Plot for Monitoring Well 2636..... 69
Figure A.4-113. Lead Concentration Versus Time Plot for Monitoring Well 2733..... 69
Figure A.4-114. Lead Concentration Versus Time Plot for Monitoring Well 2898..... 70
Figure A.4-115. Lead Concentration Versus Time Plot for Monitoring Well 2899..... 70
Figure A.4-116. Lead Concentration Versus Time Plot for Monitoring Well 2900..... 71
Figure A.4-117. Lead Concentration Versus Time Plot for Monitoring Well 3070..... 71
Figure A.4-118. Lead Concentration Versus Time Plot for Monitoring Well 3093..... 72

Figure A.4-119. Lead Concentration Versus Time Plot for Monitoring Well 3128..... 72
Figure A.4-120. Lead Concentration Versus Time Plot for Monitoring Well 3398..... 73
Figure A.4-121. Lead Concentration Versus Time Plot for Monitoring Well 3424..... 73
Figure A.4-122. Lead Concentration Versus Time Plot for Monitoring Well 3426..... 74
Figure A.4-123. Lead Concentration Versus Time Plot for Monitoring Well 3429..... 74
Figure A.4-124. Lead Concentration Versus Time Plot for Monitoring Well 3431..... 75
Figure A.4-125. Lead Concentration Versus Time Plot for Monitoring Well 3432..... 75
Figure A.4-126. Lead Concentration Versus Time Plot for Monitoring Well 3636..... 76
Figure A.4-127. Lead Concentration Versus Time Plot for Monitoring Well 3733..... 76
Figure A.4-128. Lead Concentration Versus Time Plot for Monitoring Well 3898..... 77
Figure A.4-129. Lead Concentration Versus Time Plot for Monitoring Well 3899..... 77
Figure A.4-130. Lead Concentration Versus Time Plot for Monitoring Well 3900..... 78
Figure A.4-131. Lead Concentration Versus Time Plot for Monitoring Well 4398..... 78
Figure A.4-132. Lead Concentration Versus Time Plot for Monitoring Well 21063..... 79
Figure A.4-133. Lead Concentration Versus Time Plot for Monitoring Well 22198..... 79
Figure A.4-134. Lead Concentration Versus Time Plot for Monitoring Well 22199..... 80
Figure A.4-135. Lead Concentration Versus Time Plot for Monitoring Well 22204..... 80
Figure A.4-136. Lead Concentration Versus Time Plot for Monitoring Well 22205..... 81
Figure A.4-137. Lead Concentration Versus Time Plot for Monitoring Well 22208..... 81
Figure A.4-138. Lead Concentration Versus Time Plot for Monitoring Well 22210..... 82
Figure A.4-139. Lead Concentration Versus Time Plot for Monitoring Well 22211..... 82
Figure A.4-140. Lead Concentration Versus Time Plot for Monitoring Well 22214..... 83
Figure A.4-141. Lead Concentration Versus Time Plot for Monitoring Well 31217..... 83
Figure A.4-142. Manganese Concentration Versus Time Plot for Monitoring Well 2093 84
Figure A.4-143. Manganese Concentration Versus Time Plot for Monitoring Well 2128 84
Figure A.4-144. Manganese Concentration Versus Time Plot for Monitoring Well 2398 85
Figure A.4-145. Manganese Concentration Versus Time Plot for Monitoring Well 2431 85
Figure A.4-146. Manganese Concentration Versus Time Plot for Monitoring Well 2432 86
Figure A.4-147. Manganese Concentration Versus Time Plot for Monitoring Well 2636 86
Figure A.4-148. Manganese Concentration Versus Time Plot for Monitoring Well 2733 87
Figure A.4-149. Manganese Concentration Versus Time Plot for Monitoring Well 2898 87
Figure A.4-150. Manganese Concentration Versus Time Plot for Monitoring Well 2899 88
Figure A.4-151. Manganese Concentration Versus Time Plot for Monitoring Well 2900 88
Figure A.4-152. Manganese Concentration Versus Time Plot for Monitoring Well 3070 89
Figure A.4-153. Manganese Concentration Versus Time Plot for Monitoring Well 3093 89
Figure A.4-154. Manganese Concentration Versus Time Plot for Monitoring Well 3128 90
Figure A.4-155. Manganese Concentration Versus Time Plot for Monitoring Well 3398 90
Figure A.4-156. Manganese Concentration Versus Time Plot for Monitoring Well 3424 91
Figure A.4-157. Manganese Concentration Versus Time Plot for Monitoring Well 3426 91
Figure A.4-158. Manganese Concentration Versus Time Plot for Monitoring Well 3429 92
Figure A.4-159. Manganese Concentration Versus Time Plot for Monitoring Well 3431 92
Figure A.4-160. Manganese Concentration Versus Time Plot for Monitoring Well 3432 93
Figure A.4-161. Manganese Concentration Versus Time Plot for Monitoring Well 3636 93
Figure A.4-162. Manganese Concentration Versus Time Plot for Monitoring Well 3733 94
Figure A.4-163. Manganese Concentration Versus Time Plot for Monitoring Well 3898 94
Figure A.4-164. Manganese Concentration Versus Time Plot for Monitoring Well 3899 95
Figure A.4-165. Manganese Concentration Versus Time Plot for Monitoring Well 3900 95
Figure A.4-166. Manganese Concentration Versus Time Plot for Monitoring Well 4398 96

Figure A.4-167. Manganese Concentration Versus Time Plot for Monitoring Well 21063 96
Figure A.4-168. Manganese Concentration Versus Time Plot for Monitoring Well 22198 97
Figure A.4-169. Manganese Concentration Versus Time Plot for Monitoring Well 22199 97
Figure A.4-170. Manganese Concentration Versus Time Plot for Monitoring Well 22204 98
Figure A.4-171. Manganese Concentration Versus Time Plot for Monitoring Well 22205 98
Figure A.4-172. Manganese Concentration Versus Time Plot for Monitoring Well 22208 99
Figure A.4-173. Manganese Concentration Versus Time Plot for Monitoring Well 22210 99
Figure A.4-174. Manganese Concentration Versus Time Plot for Monitoring Well 22211 100
Figure A.4-175. Manganese Concentration Versus Time Plot for Monitoring Well 22214 100
Figure A.4-176. Manganese Concentration Versus Time Plot for Monitoring Well 31217 101
Figure A.4-177. Nickel Concentration Versus Time Plot for Monitoring Well 2093..... 101
Figure A.4-178. Nickel Concentration Versus Time Plot for Monitoring Well 2128..... 102
Figure A.4-179. Nickel Concentration Versus Time Plot for Monitoring Well 2398..... 102
Figure A.4-180. Nickel Concentration Versus Time Plot for Monitoring Well 2431..... 103
Figure A.4-181. Nickel Concentration Versus Time Plot for Monitoring Well 2432..... 103
Figure A.4-182. Nickel Concentration Versus Time Plot for Monitoring Well 2636..... 104
Figure A.4-183. Nickel Concentration Versus Time Plot for Monitoring Well 2733..... 104
Figure A.4-184. Nickel Concentration Versus Time Plot for Monitoring Well 2898..... 105
Figure A.4-185. Nickel Concentration Versus Time Plot for Monitoring Well 2899..... 105
Figure A.4-186. Nickel Concentration Versus Time Plot for Monitoring Well 2900..... 106
Figure A.4-187. Nickel Concentration Versus Time Plot for Monitoring Well 3070..... 106
Figure A.4-188. Nickel Concentration Versus Time Plot for Monitoring Well 3093..... 107
Figure A.4-189. Nickel Concentration Versus Time Plot for Monitoring Well 3128..... 107
Figure A.4-190. Nickel Concentration Versus Time Plot for Monitoring Well 3398..... 108
Figure A.4-191. Nickel Concentration Versus Time Plot for Monitoring Well 3424..... 108
Figure A.4-192. Nickel Concentration Versus Time Plot for Monitoring Well 3426..... 109
Figure A.4-193. Nickel Concentration Versus Time Plot for Monitoring Well 3429..... 109
Figure A.4-194. Nickel Concentration Versus Time Plot for Monitoring Well 3431..... 110
Figure A.4-195. Nickel Concentration Versus Time Plot for Monitoring Well 3432..... 110
Figure A.4-196. Nickel Concentration Versus Time Plot for Monitoring Well 3636..... 111
Figure A.4-197. Nickel Concentration Versus Time Plot for Monitoring Well 3733..... 111
Figure A.4-198. Nickel Concentration Versus Time Plot for Monitoring Well 3898..... 112
Figure A.4-199. Nickel Concentration Versus Time Plot for Monitoring Well 3899..... 112
Figure A.4-200. Nickel Concentration Versus Time Plot for Monitoring Well 3900..... 113
Figure A.4-201. Nickel Concentration Versus Time Plot for Monitoring Well 4398..... 113
Figure A.4-202. Nickel Concentration Versus Time Plot for Monitoring Well 21063..... 114
Figure A.4-203. Nickel Concentration Versus Time Plot for Monitoring Well 22198..... 114
Figure A.4-204. Nickel Concentration Versus Time Plot for Monitoring Well 22199..... 115
Figure A.4-205. Nickel Concentration Versus Time Plot for Monitoring Well 22204..... 115
Figure A.4-206. Nickel Concentration Versus Time Plot for Monitoring Well 22205..... 116
Figure A.4-207. Nickel Concentration Versus Time Plot for Monitoring Well 22208..... 116
Figure A.4-208. Nickel Concentration Versus Time Plot for Monitoring Well 22210..... 117
Figure A.4-209. Nickel Concentration Versus Time Plot for Monitoring Well 22211..... 117
Figure A.4-210. Nickel Concentration Versus Time Plot for Monitoring Well 22214..... 118
Figure A.4-211. Nickel Concentration Versus Time Plot for Monitoring Well 31217..... 118
Figure A.4-212. Total Uranium Concentration Versus Time Plot for Monitoring Well 2093... 119
Figure A.4-213. Total Uranium Concentration Versus Time Plot for Monitoring Well 2128... 119
Figure A.4-214. Total Uranium Concentration Versus Time Plot for Monitoring Well 2398... 120

Figure A.4-215. Total Uranium Concentration Versus Time Plot for Monitoring Well 2431 ... 120
Figure A.4-216. Total Uranium Concentration Versus Time Plot for Monitoring Well 2432 ... 121
Figure A.4-217. Total Uranium Concentration Versus Time Plot for Monitoring Well 2636 ... 121
Figure A.4-218. Total Uranium Concentration Versus Time Plot for Monitoring Well 2733 ... 122
Figure A.4-219. Total Uranium Concentration Versus Time Plot for Monitoring Well 2898 ... 122
Figure A.4-220. Total Uranium Concentration Versus Time Plot for Monitoring Well 2899 ... 123
Figure A.4-221. Total Uranium Concentration Versus Time Plot for Monitoring Well 2900 ... 123
Figure A.4-222. Total Uranium Concentration Versus Time Plot for Monitoring Well 3070 ... 124
Figure A.4-223. Total Uranium Concentration Versus Time Plot for Monitoring Well 3093 ... 124
Figure A.4-224. Total Uranium Concentration Versus Time Plot for Monitoring Well 3128 ... 125
Figure A.4-225. Total Uranium Concentration Versus Time Plot for Monitoring Well 3398 ... 125
Figure A.4-226. Total Uranium Concentration Versus Time Plot for Monitoring Well 3424 ... 126
Figure A.4-227. Total Uranium Concentration Versus Time Plot for Monitoring Well 3426 ... 126
Figure A.4-228. Total Uranium Concentration Versus Time Plot for Monitoring Well 3429 ... 127
Figure A.4-229. Total Uranium Concentration Versus Time Plot for Monitoring Well 3431 ... 127
Figure A.4-230. Total Uranium Concentration Versus Time Plot for Monitoring Well 3432 ... 128
Figure A.4-231. Total Uranium Concentration Versus Time Plot for Monitoring Well 3636 ... 128
Figure A.4-232. Total Uranium Concentration Versus Time Plot for Monitoring Well 3733 ... 129
Figure A.4-233. Total Uranium Concentration Versus Time Plot for Monitoring Well 3898 ... 129
Figure A.4-234. Total Uranium Concentration Versus Time Plot for Monitoring Well 3899 ... 130
Figure A.4-235. Total Uranium Concentration Versus Time Plot for Monitoring Well 3900 ... 130
Figure A.4-236. Total Uranium Concentration Versus Time Plot for Monitoring Well 4398 ... 131
Figure A.4-237. Total Uranium Concentration Versus Time Plot for Monitoring Well 21063 . 131
Figure A.4-238. Total Uranium Concentration Versus Time Plot for Monitoring Well 22198 . 132
Figure A.4-239. Total Uranium Concentration Versus Time Plot for Monitoring Well 22199 . 132
Figure A.4-240. Total Uranium Concentration Versus Time Plot for Monitoring Well 22204 . 133
Figure A.4-241. Total Uranium Concentration Versus Time Plot for Monitoring Well 22205 . 133
Figure A.4-242. Total Uranium Concentration Versus Time Plot for Monitoring Well 22208 . 134
Figure A.4-243. Total Uranium Concentration Versus Time Plot for Monitoring Well 22210 . 134
Figure A.4-244 Total Uranium Concentration Versus Time Plot for Monitoring Well 22211 .. 135
Figure A.4-245. Total Uranium Concentration Versus Time Plot for Monitoring Well 22214 . 135
Figure A.4-246. Total Uranium Concentration Versus Time Plot for Monitoring Well 31217 . 136
Figure A.4-247. Zinc Concentration Versus Time Plot for Monitoring Well 2093 136
Figure A.4-248. Zinc Concentration Versus Time Plot for Monitoring Well 2128 137
Figure A.4-249. Zinc Concentration Versus Time Plot for Monitoring Well 2398 137
Figure A.4-250. Zinc Concentration Versus Time Plot for Monitoring Well 2431 138
Figure A.4-251. Zinc Concentration Versus Time Plot for Monitoring Well 2432 138
Figure A.4-252. Zinc Concentration Versus Time Plot for Monitoring Well 2636 139
Figure A.4-253. Zinc Concentration Versus Time Plot for Monitoring Well 2733 139
Figure A.4-254. Zinc Concentration Versus Time Plot for Monitoring Well 2898 140
Figure A.4-255. Zinc Concentration Versus Time Plot for Monitoring Well 2899 140
Figure A.4-256. Zinc Concentration Versus Time Plot for Monitoring Well 2900 141
Figure A.4-257. Zinc Concentration Versus Time Plot for Monitoring Well 3070 141
Figure A.4-258. Zinc Concentration Versus Time Plot for Monitoring Well 3093 142
Figure A.4-259. Zinc Concentration Versus Time Plot for Monitoring Well 3128 142
Figure A.4-260. Zinc Concentration Versus Time Plot for Monitoring Well 3398 143
Figure A.4-261. Zinc Concentration Versus Time Plot for Monitoring Well 3424 143
Figure A.4-262. Zinc Concentration Versus Time Plot for Monitoring Well 3426 144

Figure A.4-263. Zinc Concentration Versus Time Plot for Monitoring Well 3429 144
Figure A.4-264. Zinc Concentration Versus Time Plot for Monitoring Well 3431 145
Figure A.4-265. Zinc Concentration Versus Time Plot for Monitoring Well 3432 145
Figure A.4-266. Zinc Concentration Versus Time Plot for Monitoring Well 3636 146
Figure A.4-267. Zinc Concentration Versus Time Plot for Monitoring Well 3733 146
Figure A.4-268. Zinc Concentration Versus Time Plot for Monitoring Well 3898 147
Figure A.4-269. Zinc Concentration Versus Time Plot for Monitoring Well 3899 147
Figure A.4-270. Zinc Concentration Versus Time Plot for Monitoring Well 3900 148
Figure A.4-271. Zinc Concentration Versus Time Plot for Monitoring Well 4398 148
Figure A.4-272. Zinc Concentration Versus Time Plot for Monitoring Well 21063 149
Figure A.4-273. Zinc Concentration Versus Time Plot for Monitoring Well 22198 149
Figure A.4-274. Zinc Concentration Versus Time Plot for Monitoring Well 22199 150
Figure A.4-275. Zinc Concentration Versus Time Plot for Monitoring Well 22204 150
Figure A.4-276. Zinc Concentration Versus Time Plot for Monitoring Well 22205 151
Figure A.4-277. Zinc Concentration Versus Time Plot for Monitoring Well 22208 151
Figure A.4-278. Zinc Concentration Versus Time Plot for Monitoring Well 22210 152
Figure A.4-279. Zinc Concentration Versus Time Plot for Monitoring Well 22211 152
Figure A.4-280. Zinc Concentration Versus Time Plot for Monitoring Well 22214 153
Figure A.4-281. Zinc Concentration Versus Time Plot for Monitoring Well 31217 153

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
FRL	final remediation level
GMA	Great Miami Aquifer
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
IEMP	Integrated Environmental Monitoring Plan
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
OSDF	On-Site Disposal Facility
RCRA	Resource Conservation and Recovery Act
WSA	Waste Storage Area

Measurement Abbreviations

mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

A.4.0 Non-Uranium Final Remediation Level Results

This attachment provides an analysis of the non-uranium final remediation level (FRL) exceedances both inside and outside the current Operational Design Remediation Footprint at the Fernald Preserve, Ohio, Site. This attachment evaluates non-uranium FRL results for 2025 collected under the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2025). The purpose of the evaluation is to:

- Identify 2025 non-uranium FRL exceedances (Section A.4.1).
- Determine the persistence of non-uranium FRL exceedances outside the current Operational Design Remediation Footprint (Section A.4.2).
- Describe the evaluation of 2025 non-uranium FRL exceedances outside the current Operational Design Remediation Footprint (Section A.4.2).
- Present conclusions (Section A.4.3).
- Proposed Changes to the Property Boundary Monitoring Program (Section A.4.4).

Consistent with past Site Environmental Reports, non-uranium groundwater monitoring results from wells monitored in the Great Miami Aquifer (GMA) for performance of the On-Site Disposal Facility (OSDF) are included in the data evaluation presented in this section of the Site Environmental Report. Beginning in 2017, the number of non-uranium constituents being sampled in the OSDF monitoring program was reduced. Data presented and discussed in the *Fernald Preserve 2015 Site Environmental Report* (DOE 2016) supported making the changes to the OSDF monitoring program. The proposed changes were approved by the U.S. Environmental Protection Agency, the Ohio Environmental Protection Agency, and stakeholders during the routine review and approval process of the 2017 LMICP (DOE 2017a).

As a result of the OSDF monitoring changes, the following nine non-uranium constituents are no longer being routinely sampled for in the GMA as part of the OSDF monitoring program: total organic carbon, iron, sodium, cobalt, total alkalinity, barium, chloride, copper, and chromium. The non-uranium constituents currently being sampled in the GMA as part of the IEMP are provided in Table 6 in Attachment D of the LMICP (DOE 2025). A list of the constituents routinely sampled in the GMA as part of the OSDF monitoring program can be found in Section 3.2.1.3 in Attachment C of the LMICP. Tables and data analyses presented below reflect the current combined sampling effort.

A.4.1 Non-Uranium FRL Exceedances for 2025

Table A.4-1 shows the summary statistics and trend analysis for the 2025 non-uranium FRL exceedances from monitoring wells both inside and outside the current Operational Design Remediation Footprint. Five non-uranium FRL constituents had one or more FRL exceedances during 2025. Figure A.4-1 identifies the locations of these exceedances.

Figure A.4-1 shows that four of the five non-uranium FRL exceedances in 2025 were in the former Waste Storage Area (WSA). The exceedances in the WSA are within the current Operational Design Remediation Footprint. Additionally, institutional controls remain in place to prevent exposure to constituents in this area. Specific discussion regarding exceedances and

persistence outside the footprint is provided in Section A.4.2. The single non-uranium FRL exceedance outside the WSA was for manganese in monitoring well 3070 which is located along the southern property boundary of the site, just inside the current Operational Design Remediation Footprint.

Table A.4-2 identifies the locations and constituents that have had non-uranium FRL exceedances since 1997 for constituents monitored in 2025. The first column in Table A.4-2 lists the groundwater FRL constituents monitored in 2025. As discussed above, Table A.4-2 reflects the current monitoring effort. The 2016 Site Environmental Report (DOE 2017b) provides a discussion concerning the changes implemented in 2017. The second column in Table A.4-2 identifies the wells monitored that have had an exceedance since 1997 for each constituent. The third column identifies the associated aquifer zone monitored. The fourth column identifies the associated monitoring program for each well or constituent. The remaining columns show monitoring years that reflect a semiannual sampling frequency; a "1" denotes an exceedance for one of the two samples, and a "2" denotes an exceedance for both samples. Beginning in 2017, the sampling frequency of several of the wells that had been sampled quarterly through 2013 was reduced from a semiannual to annual frequency. Data presented and discussed in the 2015 Site Environmental Report (DOE 2016) supported making the sampling frequency change. Table A.4-2 also indicates whether exceedances occurred inside or outside the remediation footprint (shading indicates the well is located outside the footprint).

As specified in Table 4 in the IEMP (DOE 2025), there were 13 non-uranium constituents monitored in 2025; as stated above, five constituents had FRL exceedances during 2025. The following table summarizes the 2025 non-uranium monitoring information.

Constituent (units[a])	Groundwater Final Remediation Level	2025 Monitoring Summary	2025 Maximum Exceedance
Antimony (mg/L)	0.0060	No exceedances	Not applicable
Arsenic (mg/L)	0.050	No exceedances	Not applicable
Boron (mg/L)	0.33	No exceedances	Not applicable
Carbon disulfide (mg/L)	5.5	No exceedances	Not applicable
Fluoride (mg/L)	4	No exceedances	Not applicable
Lead (mg/L)	0.015	No exceedances	Not applicable
Manganese (mg/L)	0.90	Exceedance along the southeastern property boundary	1.07
Molybdenum (mg/L)	0.10	Exceedances in former WSA wells	0.540
Nickel (mg/L)	0.10	No exceedances	Not applicable
Nitrate + nitrite, as nitrogen (mg/L)	11	Exceedances in former WSA wells	36.8
Technetium-99 (pCi/L)	94	Exceedances in former WSA wells	413
Trichloroethene (µg/L)	5	Exceedance in former WSA wells	11.6
Zinc (mg/L)	0.021	No exceedances	Not applicable

[a] mg/L = milligrams per liter, µg/L = micrograms per liter, pCi/L = picocuries per liter.

A.4.1.1 Non-Uranium Direct-Push Sampling Results for 2025

In 2025, no direct-push sampling was conducted for non-uranium constituents.

A.4.2 Evaluation of 2025 Non-Uranium FRL Exceedances Outside the Current Operational Design Remediation Footprint

This section presents an evaluation of the persistence of non-uranium FRL exceedances outside the current Operational Design Remediation Footprint.

A.4.2.1 Background

The *Restoration Area Verification Sampling Program Summary Report* (DOE 1998) states that any FRL exceedance detected at the property boundary during routine monitoring outside the 10-year uranium-based restoration footprint (DOE 1997a) would also be evaluated for persistence. The evaluation would be performed using the same conservative data evaluation method approved in the *Restoration Area Verification Sampling Program Project-Specific Plan* (DOE 1997b) to determine whether a change in the aquifer restoration remedy is required. This evaluation was expanded, beginning with the *2000 Integrated Site Environmental Report* (DOE 2001a), to include all non-uranium FRL exceedances detected outside the 10-year uranium-based restoration footprint, not just those detected at the property boundary. In the 2003 Site Environmental Report (DOE 2004), the 10-year uranium-based restoration footprint was replaced with a 10-year time-of-travel remediation footprint based on 2003 target pumping rates and using the Variable Saturated Analysis Model in Three Dimensions Zoom (VAM-3D) groundwater model. The footprint was updated in 2005 to reflect capture during the period modeled for the WSA (Phase II) remediation design. The footprint was updated in 2014 to reflect capture during the time period modeled for the 2014 Operational Design Adjustment (DOE 2014) (Figure A.4-1). The footprint was updated again in 2022 to reflect capture during the same time period modeled for the 2022 Groundwater Modeling Report (DOE 2022).

Analytical data from samples collected immediately following an FRL exceedance are evaluated to determine whether the exceedance is persistent. In accordance with the approved *Restoration Area Verification Sampling Program Project-Specific Plan* (DOE 1997b), if two or more consecutive sampling events following an FRL exceedance indicate that the concentration has decreased below the groundwater FRL, then the exceedance is not considered persistent. If an FRL exceedance outside the current Operational Design Remediation Footprint is determined to not be persistent, then no additional action is required beyond the routine groundwater monitoring specified in the current IEMP. If an FRL exceedance is determined to be persistent, then the cause of the persistent exceedance will be identified and its effect on the aquifer remedy design assessed. Ultimately, the cause needs to be addressed either through a modification of the aquifer remedy or by other means. It is recognized that some non-uranium constituents can be oxidation-reduction sensitive, and their stability is controlled in large measure by the oxidation-reduction state of the groundwater, which can vary, perhaps causing transient FRL exceedances to come and go.

A.4.2.2 Evaluation and Discussion

Figure A.4-1 and the shaded portion of Table A.4-1 identify the 2025 non-uranium FRL exceedances outside the current Operational Design Remediation Footprint. In 2025, there were no FRL exceedances outside the current Operational Design Remediation Footprint.

The year 2025 marks 29 years that an evaluation for persistence of non-uranium FRL exceedances in wells outside the current Operational Design Remediation Footprint has been conducted, as part of the IEMP. In the past, many exceedances identified as persistent became not persistent in later years. As of 2025, no potential persistent exceedances are identified outside the remediation footprint, as was the case for the 2024 evaluation.

A.4.3 Conclusions

From the information provided in this attachment, no potential persistent exceedances are identified outside the remediation footprint.

A.4.4 Property/Plume Boundary Groundwater Monitoring

Section 3.2.2 in Attachment D, "Integrated Environmental Monitoring Plan", of the LMICP (DOE 2025) summarizes the regulatory drivers, compliance agreements, and U.S. Department of Energy (DOE) requirements that govern the monitoring scope and reporting requirements for remedy performance monitoring and general surveillance of the protectiveness of the GMA groundwater remedy. The Property/Plume Boundary monitoring program was initially driven by the September 10, 1993, *Ohio EPA Director's Final Findings and Orders* (Ohio EPA 1993). This order stipulates groundwater monitoring at the Fernald Preserve's property boundary to satisfy Resource Conservation and Recovery Act (RCRA) facility groundwater monitoring requirements. The 1993 Final Findings and Orders were superseded by the September 7, 2000, order which specifies that the site's groundwater monitoring activities will be implemented in accordance with the IEMP. The revised language allows modification of the groundwater monitoring program as necessary via the IEMP revision process without issuance of a new order.

The Property/Plume Boundary program evolved from the RCRA Groundwater Monitoring Program which was first initiated near Waste Pit 4 in 1985 to comply with federal and state RCRA hazardous waste regulations to determine if the hazardous waste unit was impacting groundwater (DOE 2001b). By 1988, monitoring results from the program indicated that Waste Pit 4 was indeed impacting the groundwater (i.e., former WSA plume area). In 1991, additional waste management units were identified as requiring groundwater monitoring under RCRA regulations. It was necessary to develop a monitoring strategy to efficiently integrate Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and RCRA monitoring activities. For this reason, DOE proposed an alternate monitoring approach that was accepted by the State of Ohio EPA in September 1993 (Ohio EPA 1993). The alternate monitoring approach consisted of groundwater contaminant characterization under CERCLA, and groundwater monitoring at the downgradient facility boundary under RCRA while the CERCLA characterization was underway. With approval of the IEMP in 1997, DOE intended that the IEMP replace the *Project-Specific Plan for the Routine Groundwater Monitoring Program Along the Downgradient Boundary of the FEMP* (DOE 1993). The Ohio EPA Director's Findings and Orders were revised to facilitate this replacement (Ohio EPA 2000).

The objective of the Property/Plume Boundary groundwater monitoring program is to detect and assess potential changes in groundwater conditions along the eastern property boundary (which was the general direction of the groundwater flow prior to installation of the pump and treat remedy) and downgradient of the leading edge of the 30 micrograms per liter (µg/L) total uranium plume south of the Fernald Preserve property. This is accomplished by monitoring for uranium and seven non-uranium parameters that were identified as having had historical groundwater FRL exceedances in multiple zones. The Property/Plume Boundary monitoring program wells are sampled annually for these eight parameters in the table below.

Property/Plume Boundary Monitoring Requirements

General Chemistry	Inorganic	Radionuclides
Fluoride	Antimony	Total Uranium[a]
	Arsenic	
	Lead	
	Manganese	
	Nickel	
	Zinc	

[a] Uranium is monitored as part of the sitewide uranium monitoring.

Thirty years of water level data presented in Attachment A.3 of the Site Environmental Report have demonstrated that groundwater flow direction along the east property boundary (during active remediation) is west, toward the uranium plume, not east or away from it. The only boundary where non-uranium contamination could move away from the current plume is the south boundary, through the subsurface Paddys Run Outlet of the buried valley aquifer. Monitoring in this area has also demonstrated that this has not occurred. In fact, monitoring has demonstrated that the extreme southern area of the South Plume (once mapped as being within the 30 µg/uranium plume) is now outside the current mapped footprint of the 30 µg/L uranium plume footprint.

Twenty-nine years of data presented in Attachment A.4 of the Site Environmental Report demonstrates that no persistent non-uranium FRL exceedance has been detected outside of the Operational Remediation Design Footprint, which also demonstrates that no plumes or FRL exceedances of non-uranium constituents are present outside of the currently mapped 30 µg/L total uranium plume footprint.

The table below further summarizes the non-uranium data collected at the Paddys Run Road Site wells from 1997 through 2025. As shown in the table below, the non-uranium constituent with the most samples above the FRL in the Property/Plume Boundary program is manganese with 71 samples. The manganese FRL is based on the 95th percentile of background in the Great Miami Aquifer. Manganese exceedances have been discussed before in the Site Environmental Report and have not been attributed to a manganese plume. Figures A.4-2 through A.4-282 present concentration versus time graphs by well for each parameter monitored for the Property/Plume Boundary monitoring program.

Summary Statistics for the Property/Plume Boundary Sampling

Constituent (FRL)[a]	No. of Samples[b,c]	No. of Samples Above FRL[b,c]	Percent of Samples Above FRL	Minimum Concentration Above FRL	Maximum Concentration Above FRL
Antimony (0.006 mg/L)	1,654	31	1.87	0.00601	0.0334
Arsenic (0.05 mg/L)	2,125	10	0.47	0.0510	0.0887
Fluoride (4 mg/L)	1,666	1	0.06	12.3	12.3
Lead (0.015 mg/L)	1,654	4	0.24	0.0157	0.201
Manganese (0.9 mg/L)	1,867	71	3.80	0.913	5.52
Nickel (0.1 mg/L)	1,854	9	0.48	0.101	0.324
Total Uranium (30 µg/L)	2,545	4	0.16	30.4	35.7
Zinc (0.021 mg/L)	1,846	35	1.9	0.0214	1.11

[a] From *Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996), Table 9-4; mg/L = milligram per liter.
[b] Based on samples from August 1997 through 2025.
[c] If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted; Rejected data qualified with an R were not included in the counted.

The figures (Figure A.4-2 through A.4-281) visually demonstrate that sufficient data have been collected at these wells to establish long-term concentration trends and demonstrate that no persistent FRL exceedances have been identified at these monitoring locations. Based on the extensive collection of data, DOE plans to eliminate the property/plume boundary program monitoring, beginning in 2027. Monitoring wells currently in the Property/Plume Boundary monitoring program located south of Willey Road will continue to be sampled annually for total uranium beginning with calendar year 2027. Sampling for uranium would continue until the South Plume is certified clean.

Several Property/Plume Boundary monitoring program wells along the eastern side of the site are also utilized to monitor the OSDF per the Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP, Attachment C of the LMICP). Monitoring will continue as required by the GWLMP. The following table summarizes the proposed changes to Property/Plume Boundary groundwater monitoring program.

Off-Property Wells Monitored Annually for Total Uranium	On-Property Wells Monitored for OSDF	On-Property Wells No Longer Monitored
2093	22198	3424
3093	22199	31217
21063	22204	3426
3898	22205	2429
2898	22208	2431
2899	22210	3431
3899	22211	2432
2900	22214	3432
3900		2733
2128		3733
3128		3070
2636		2398
3636		3398
		4398

If approved by the regulators and stakeholders, the monitoring changes would take effect on January 1, 2027, and be reflected in the 2027 LMICP. To summarize, the proposed changes presented above are based on the following:

- The monitoring effort was originally meant to proceed while the CERCLA characterization of the aquifer was underway. The CERCLA characterization of the aquifer was complete prior to transition of the site from the DOE Office of Environmental Management to the DOE Office of Legacy Management in late 2006.
- Water level data collected over the past 30 years and reported in Attachment A.3 of the Site Environmental Report demonstrate that flow direction during active remediation is generally from the east to the west, towards the uranium plume.
- Water quality results collected over the past 29 years and reported in Attachment A.4 of the Site Environmental Report demonstrate that no persistent non-uranium FRL exceedance has been identified outside of the Operational Remediation Design Footprint.

A.4.5 References

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Ohio EPA (Ohio Environmental Protection Agency), 1993. Director's Final Findings and Orders, G-000-703, September 10. https://lmpublicsearch.lm.doe.gov/SiteDocs/109923.pdf.

Ohio EPA (Ohio Environmental Protection Agency), 2000. Director's Final Findings and Orders, September 7. https://lmpublicsearch.lm.doe.gov/SiteDocs/7303.pdf.

Table A.4-1. Summary Statistics and Trend Analysis for Non-Uranium Constituents with 2025 Results Above FRLs

Constituent (FRL)[a]	Monitoring Well	No. of Samples[b]	No. of Samples Above FRL[b,c]	No. of Samples Above FRL for 2025[c]	Maximum Exceedance for 2025[b]	Minimum[b]	Maximum[b]	Average[b]	Standard Deviation[b]	Trend[b]
					(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	
Manganese (0.90 mg/L)	3070	60	1	1	1.07	0.243	1.07	0.425	0.145	Up
Molybdenum (0.10 mg/L)	2649	51	50	2	0.540	0.0983	1.26	0.451	0.237	Down
Nitrate + nitrite as nitrogen (11 mg/L)	83338_C1	31	26	2	36.8	0.404	73.8	39.6	19.3	No Trend
	83340_C1	33	21	1	22.5	0.470	761	40	130	Down
	83341_C1	17	13	1	12.9	0.265	56.3	22.1	18.0	Up
					(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	
Technetium-99 (94 pCi/L)	2649	59	52	1	413	40.1	1,660	447	420	Down
	83338_C1	31	26	2	258	10.1	515	240	123	Up
	83340_C1	33	26	2	112	45.9	817	175	146	Down
					(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	
Trichloroethene (5 µg/L)	2649	51	30	1	11.6	0.125	120	22.8	29.2	Down

[a] From *Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996), Table 9-4; pCi/L = picocuries per liter.

[b] Based on samples from August 1997 through 2025.

[c] If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted; rejected data qualified with an R are not included in the count.

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Table A.4-2. Groundwater FRL Exceedances from 1997 Through 2025

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998		1999		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016[d]		2017[e]		2018[e]		2019[e]		2020[e]		2021[e]		2022[e]		2023[e]		2024[e]		2025[e]	
				2[c]		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Antimony																																																									
	22198	0	P/PB													1												1	1																												
	22199	0	P/PB																									1																												
	22204	0	P/PB																									1																												
	22205	0	P/PB																									1																												
	22208	0	P/PB													1												1																												
	2398	2	P/PB																					1																																
	2431	0	P/PB													1												1																												
	2432	0	P/PB																					1				1																												
	2636	4	PRRS															1		1				1					1		1											1															
	2733	0	P/PB																					1																																
	3070	2	P/PB																					1				1																												
	31217	0	P/PB																									1																												
	3398	2	P/PB																					1																																
	3424	0	P/PB																					1				1																												
	3426	0	P/PB																					1																																
	3431	0	P/PB																									1																												
	3432	0	P/PB																					1				1																												
	4398	2	P/PB																					1				1																												
Arsenic																																																								
	2636	4	PRRS	1		1	1	2						1				1											1																												
	2898	4	PRRS							1																																													
	2900	4	PRRS							1																																												
Boron																																																								
	2045	2	SF					1	1	1																																												
	2049	2	SF	2		2		2	2	2	1			1																																								
Carbon disulfide																																																							
	2649	1	WSA			1																																																
	3821	1	WSA					1										1																																				
Fluoride																																																						
	2431	0	P/PB			1																																															
Lead																																																							
	22198	0	P/PB																											1																												
	2431	0	P/PB							1																																												
	3733	0	P/PB	1							1																																											
Manganese																																																						
	2010	1	WSA							1		1				1	1	1	1	1		1	1	1	1	1	1		1			1	1	1	1	2	1	1				1		1		1							
	22198	0	P/PB											1																																								
	22203	0	P/PB																																									1											
	22204	0	P/PB													1		1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2	1										
	22205	0	P/PB																	1										1																								
	22214	0	P/PB																													1																						
	2431	0	P/PB			2																																															
	2432	0	P/PB								1		2	1		1																																					
	2648	1	WSA	1			1		1	1		1		1					1	1		1																																
	2733	0	P/PB																																	1																		
	3070	2	P/PB																																																		1
	3093	4	P/PB																									1																										
	3429	0	P/PB																																																		
	3821	1	WSA					1		1		1		1		1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1																		
	83337_C1	1	WSA																					1	1	1	1																												
	83337_C2	1	WSA																							1																												
	83337_C3	1	WSA																							1		1																										
	83338_C2	1	WSA																					1		1		1						1																		
	83339_C1	1	WSA																					1		1	1																										
	83339_C2	1	WSA																							1																										
	83339_C3	1	WSA																							1				1																						
	83341_C1	1	WSA																					1		1	1							1												1	1				
	83341_C2	1	WSA																					1	1					1					1							1				1					
	83346_C1	1	WSA																					1		1	1	1																								
	83346_C2	1	WSA																					1	1		1	1																								
Molybdenum																																																						
	2649	1	WSA	1		1		1		1		1		1		1	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nickel																																																						
	22198	0	P/PB					1																																													
	2649	1	WSA									1																																									
	2398	2	P/PB	1	2	2		2																																											
	4398	2	P/PB				1																																												
	83346_C1	1	WSA																							1																										
	83346_C2	1	WSA																							1	1																										
Nitrate/Nitrite																																																					
	2648	1	WSA			1		1		1		1				1	1	1				1																																
	2649	1	WSA	1		1	1	1	1	1	1	2	2	2	1	1	1	1	1		1	1		1		1	1				1		1		1																
	2821	1	WSA					1						1		1				1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1		1	1	1	1	1	1				
	3821	1	WSA								1							1			1				1	1	1	1	1	1	1																						
	83338_C1	1	WSA																									1		1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83338_C2	1	WSA															1											1	1	1	1	1	1		1																
	83338_C3	1	WSA															1										1	1	1	1	1			1																		
	83340_C1	1	WSA															1		1	1	1		1				1		1	1	1	1	1		1	1																
	83340_C2	1	WSA															1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83340_C3	1	WSA															1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83341_C1	1	WSA															1											1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83341_C2	1	WSA															1	1							1																										
	83341_C3	1	WSA																					1		1																										
Selenium																																																					
	22198	0	P/PB																																																	
	22199	0	P/PB																																																	
	22203	0	P/PB																																																	
	22206	0	P/PB																																																	
	22209	3	P/PB																																																	
	22212	3	P/PB																																																	
Technetium-99																																																					
	2648	1	WSA					1				2				1																																					
	2649	1	WSA	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1		1		1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2821	1	WSA					1						1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	2	1							1		1								
	83338_C1	1	WSA																									1		1	1	1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83338_C2	1	WSA															1											1	1	1	1	1	1		1																
	83338_C3	1	WSA															1										1	1	1	1	1			1																		
	83340_C1	1	WSA															1		1	1	1		1				1		1	1	1	1	1		1	1																
	83340_C2	1	WSA															1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83340_C3	1	WSA															1	1	1	1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83341_C1	1	WSA															1											1	1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	83341_C2	1	WSA																					1	1																										
	83341_C3	1	WSA																					1																										
Trichloroethene																																																				
	2649	1	WSA			1		1		1		1		1		1	1	1	1	1	1	1		1		1		1				1	1	1	1	1	1							1		1		1				1	
	2821	1	WSA																					1	1	1		1		1	1	1	1	1	1	2															
Zinc																																																			
	22198	0	P/PB																									1																										
	22199	0	P/PB													1																																						
	22204	0	P/PB													1								1				1																										
	22205	0	P/PB																																			1															
	22210	0	P/PB																	1		1						1																										
	2398	2	P/PB		1																																																
	2431	0	P/PB		2			1																																												
	2432	0	P/PB			1		1	1																	1	1																									
	2636	4	PRRS							1	1															1	1																									
	2733	0	P/PB			1																														1																
	2900	4	PRRS							1								1						1																												
	3128	4	PRRS																	1																																
	3426	0	P/PB			1	1																														1														
	3429	0	P/PB			2																																1													
	3431	0	P/PB											1																																						
	3733	0	P/PB													1																																				
	3899	4	PRRS									1																																								

Note: Shading indicates well is outside the current Operational Design remediation footprint.

[a]A "1" denotes an exceedance for the time period; a "2" denotes two exceedances during the time period due to quarterly sampling frequency or multiple sampling projects.

[b]WSA = Waste Storage Area; SF = South Field; P/PB = Property/Plume Boundary for FRL Exceedances; PRRS = Property/Plume Boundary for Paddys Run Road Site.

[c]Sampling for the IEMP was initiated in August 1997.

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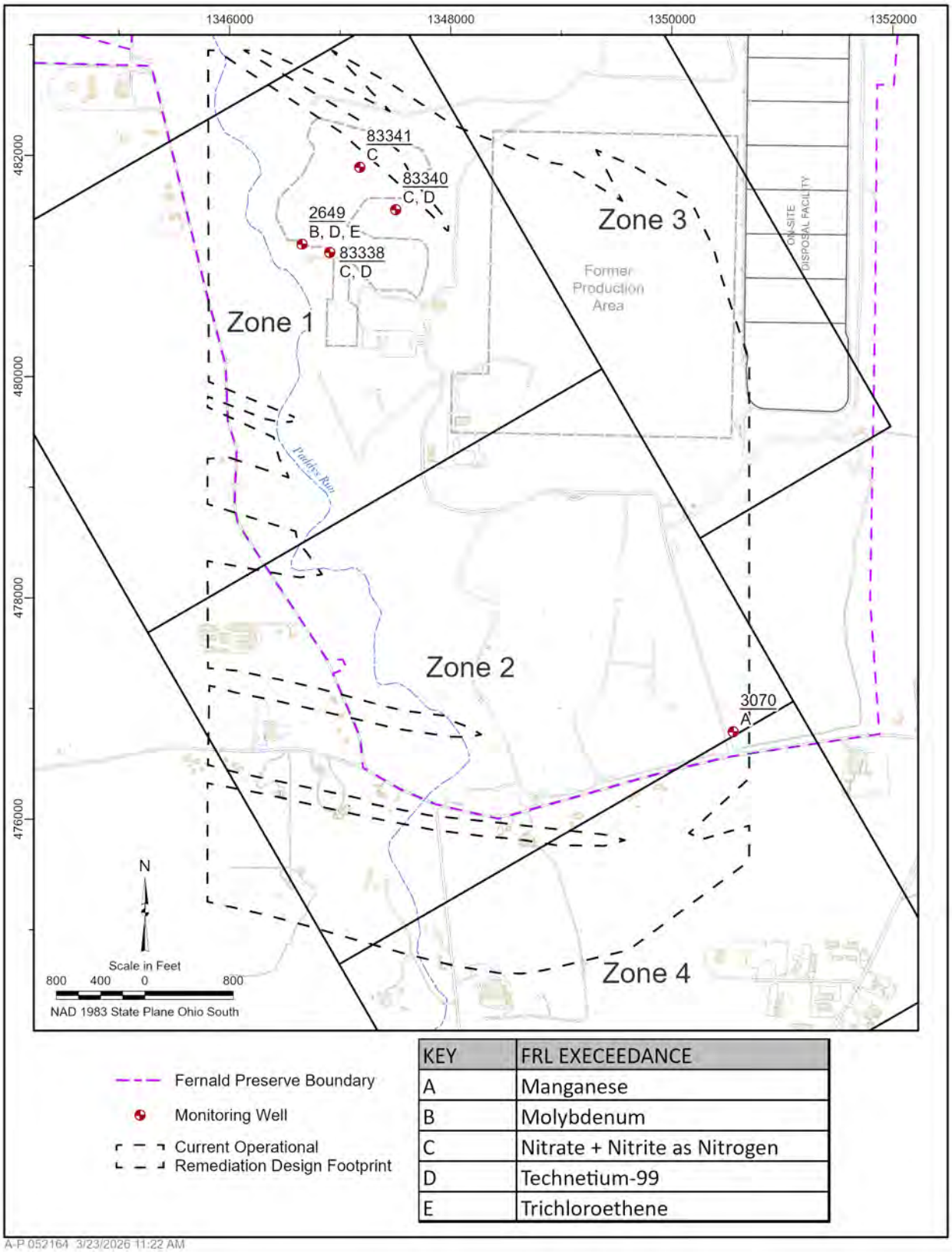


Figure A.4-1. Non-Uranium Constituent Locations with 2025 Results Above FRLs

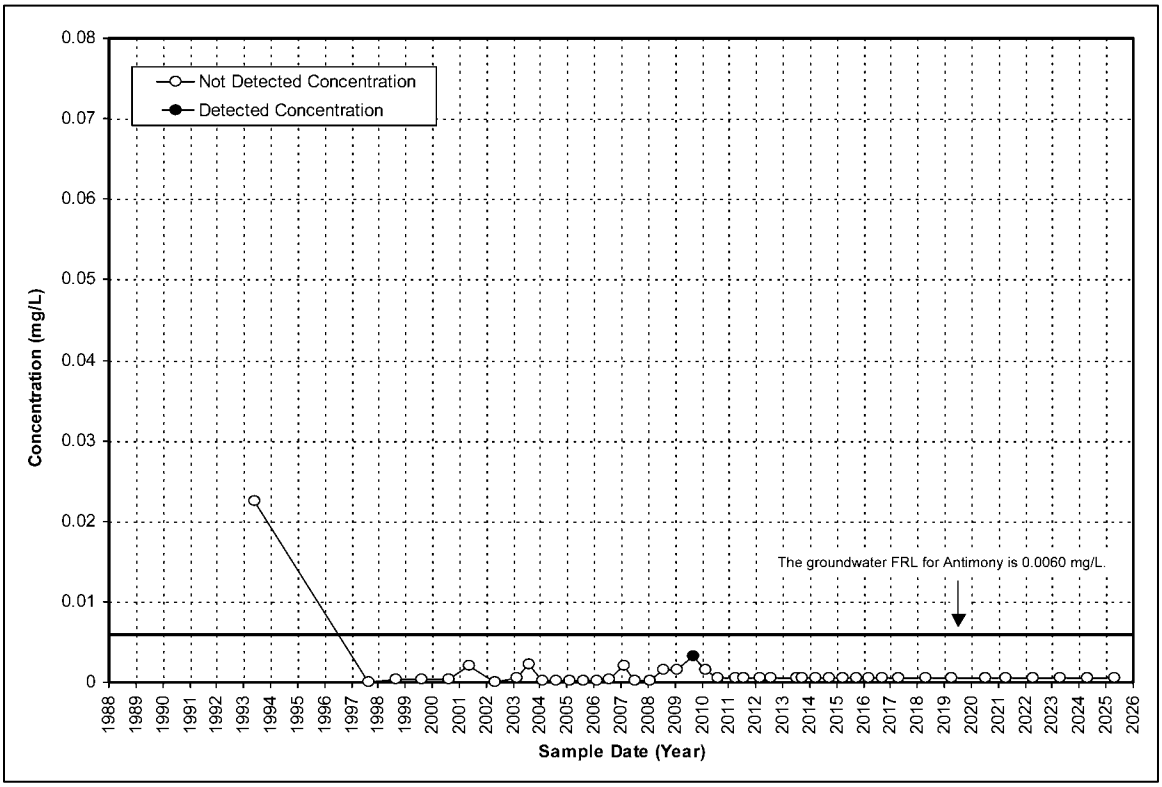


Figure A.4-2. Antimony Concentration Versus Time Plot for Monitoring Well 2093

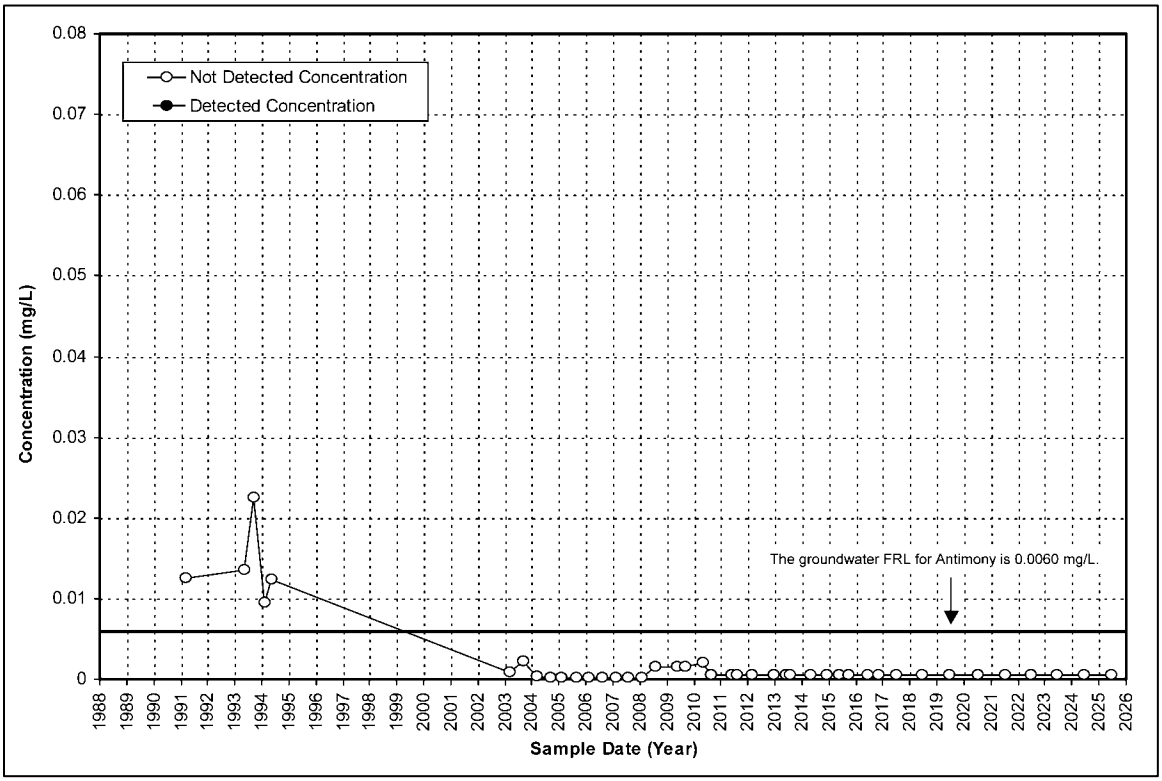


Figure A.4-3. Antimony Concentration Versus Time Plot for Monitoring Well 2128

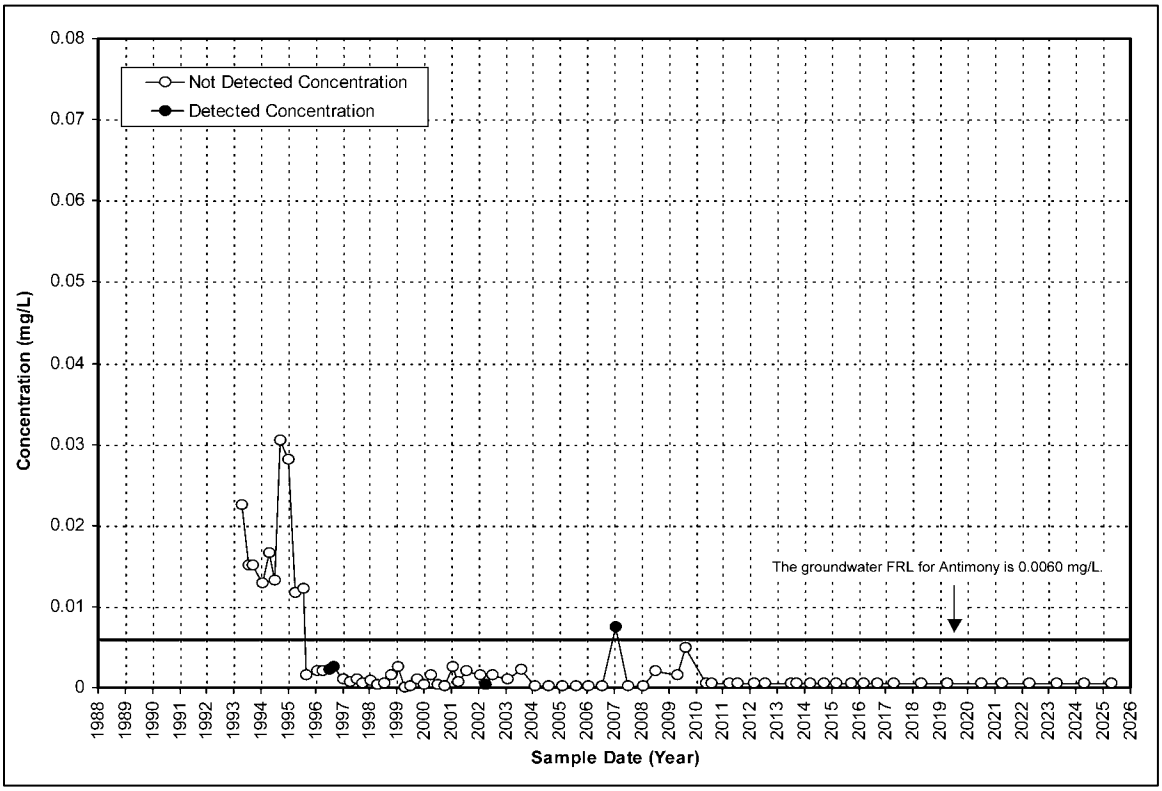


Figure A.4-4. Antimony Concentration Versus Time Plot for Monitoring Well 2398

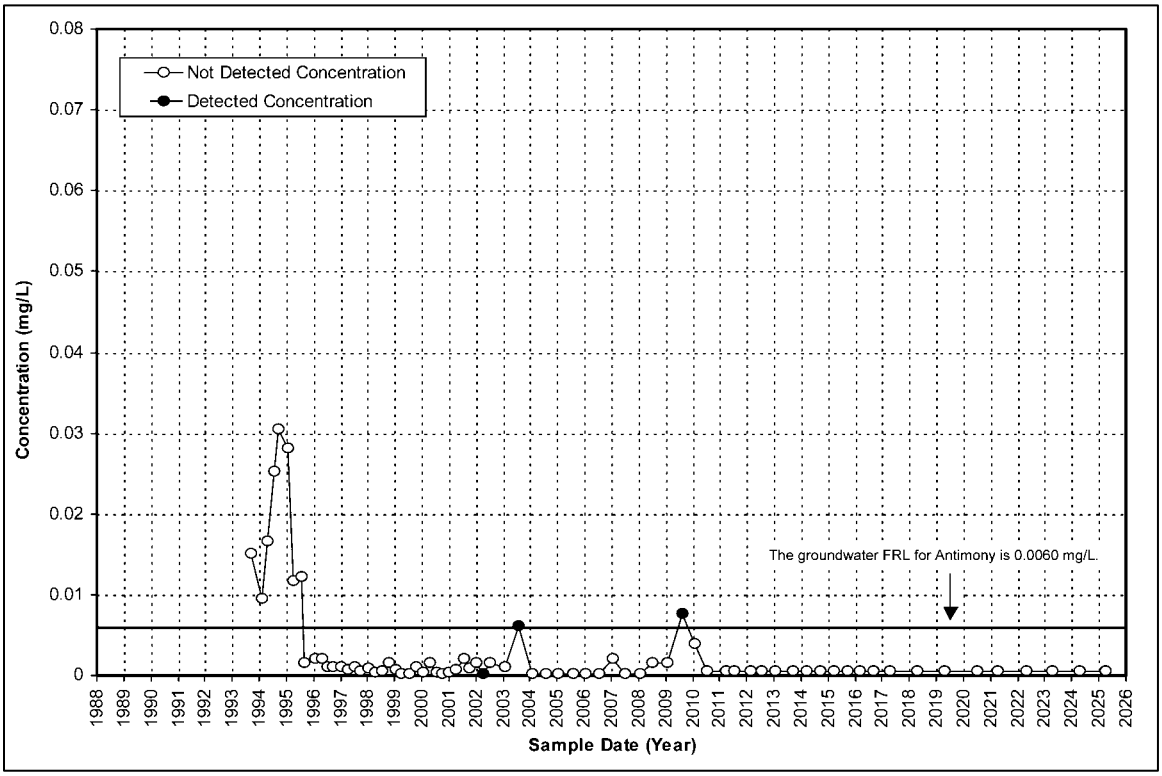


Figure A.4-5. Antimony Concentration Versus Time Plot for Monitoring Well 2431

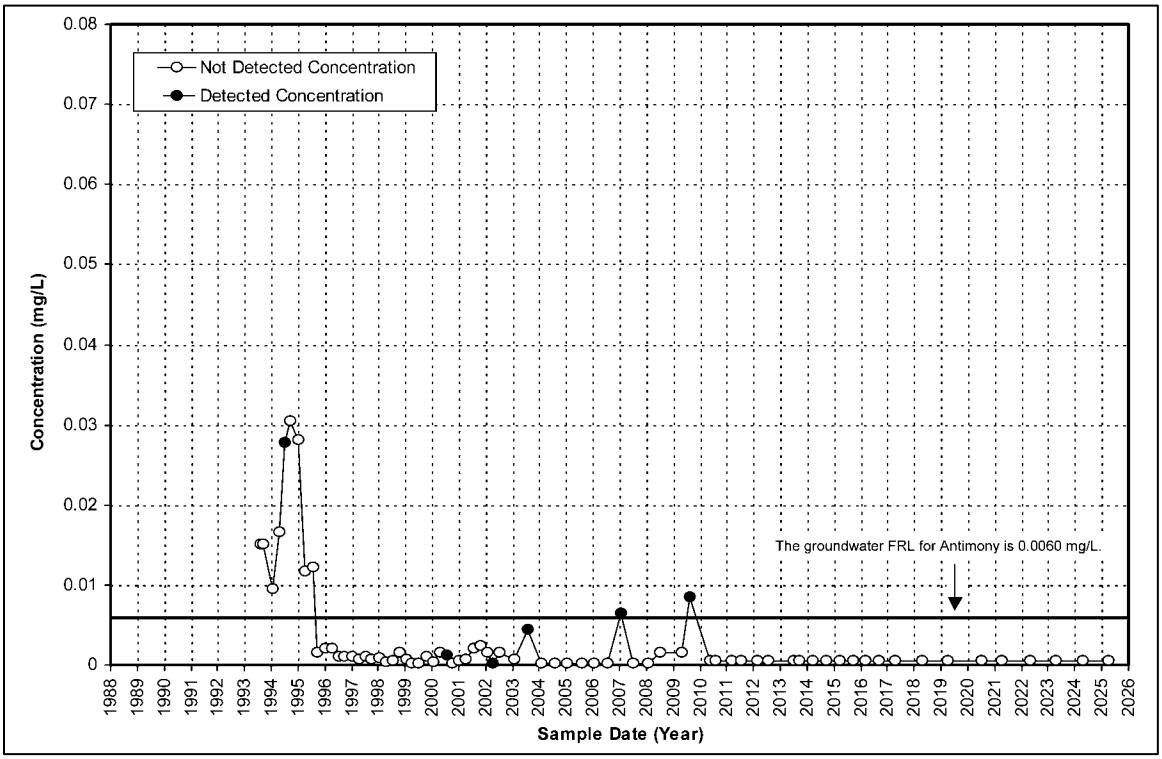


Figure A.4-6. Antimony Concentration Versus Time Plot for Monitoring Well 2432

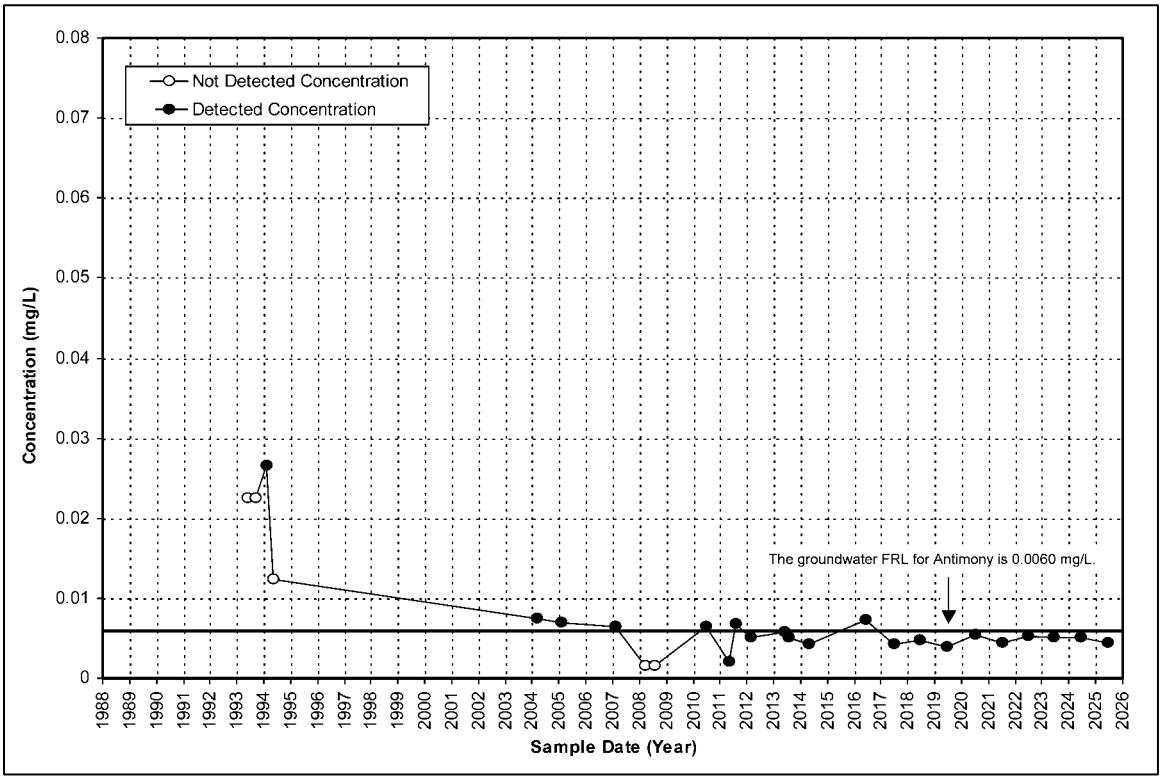


Figure A.4-7. Antimony Concentration Versus Time Plot for Monitoring Well 2636

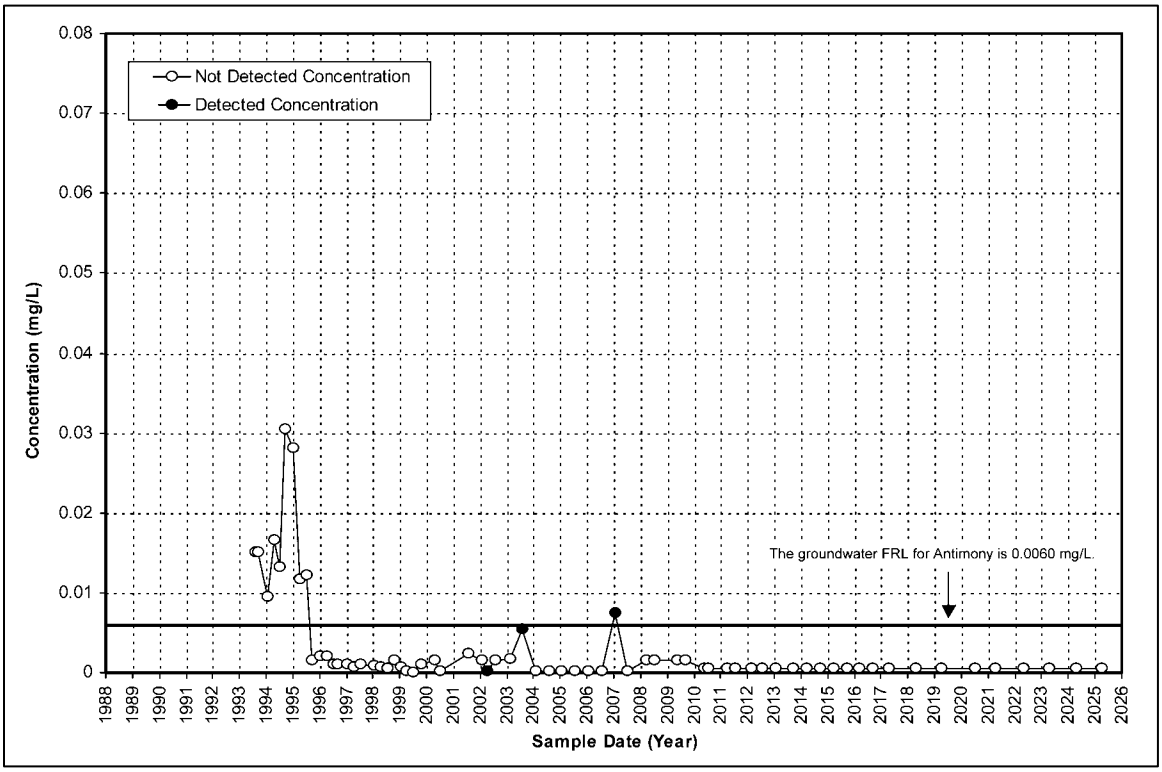


Figure A.4-8. Antimony Concentration Versus Time Plot for Monitoring Well 2733

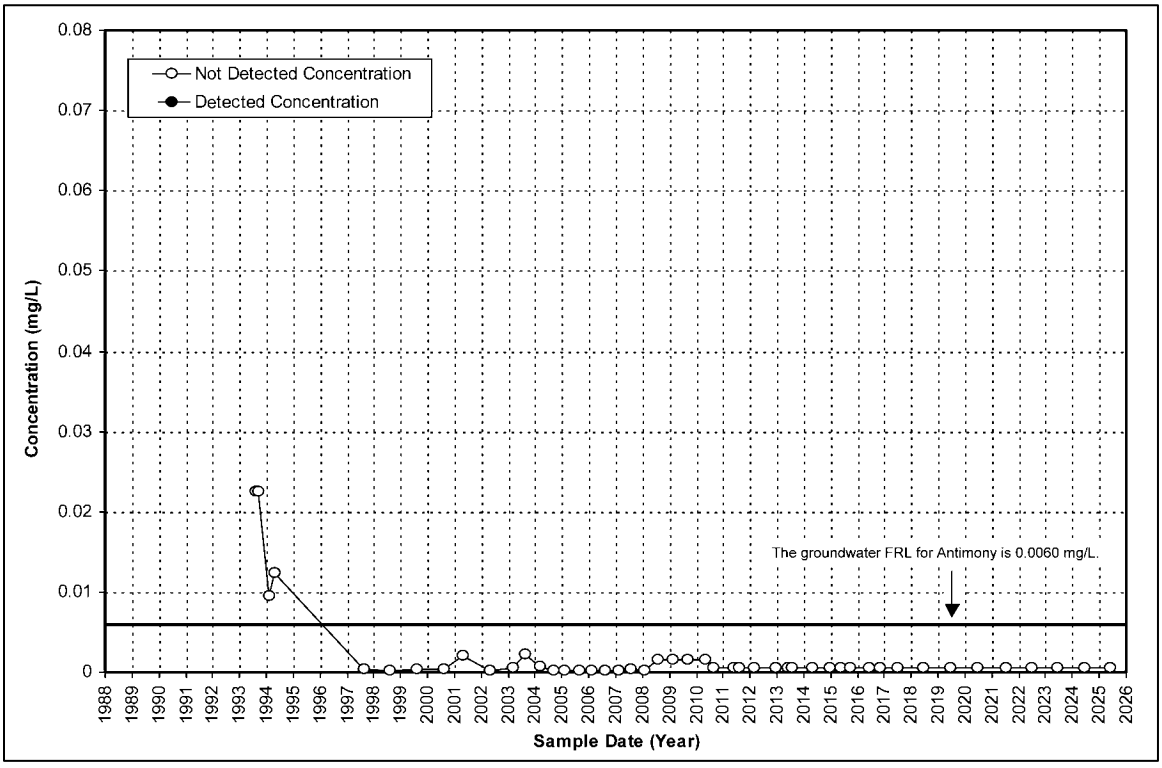


Figure A.4-9. Antimony Concentration Versus Time Plot for Monitoring Well 2898

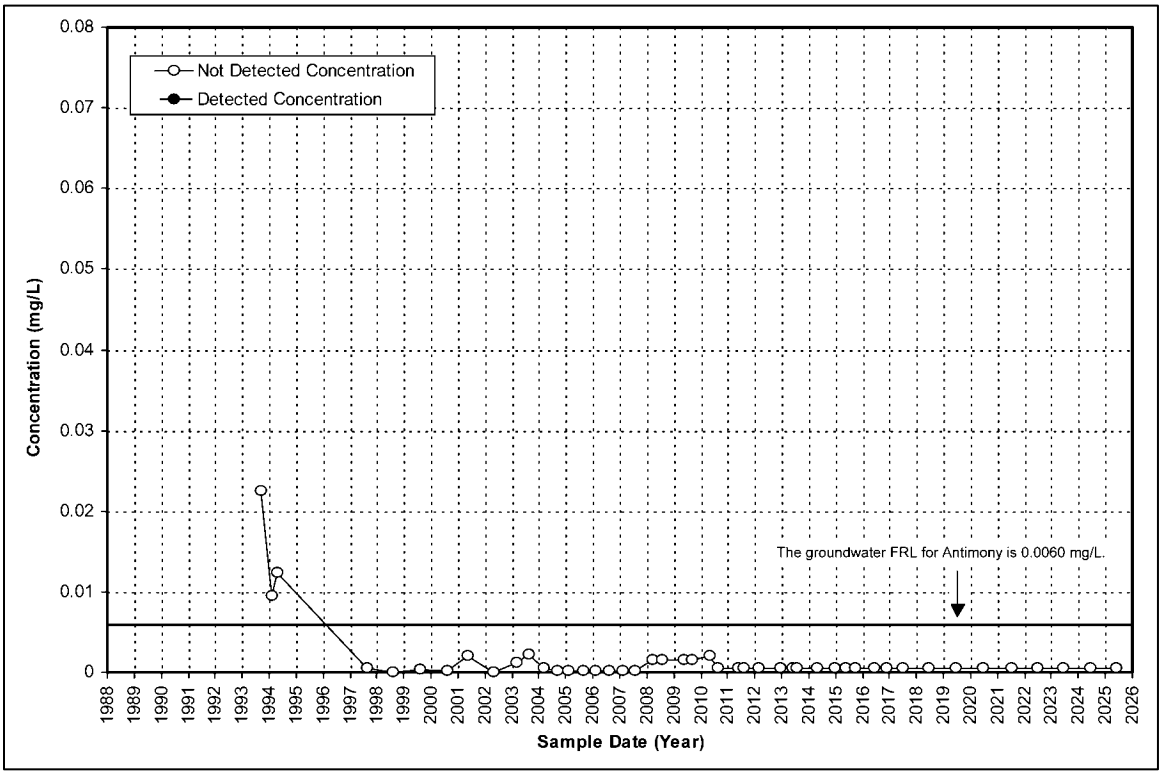


Figure A.4-10. Antimony Concentration Versus Time Plot for Monitoring Well 2899

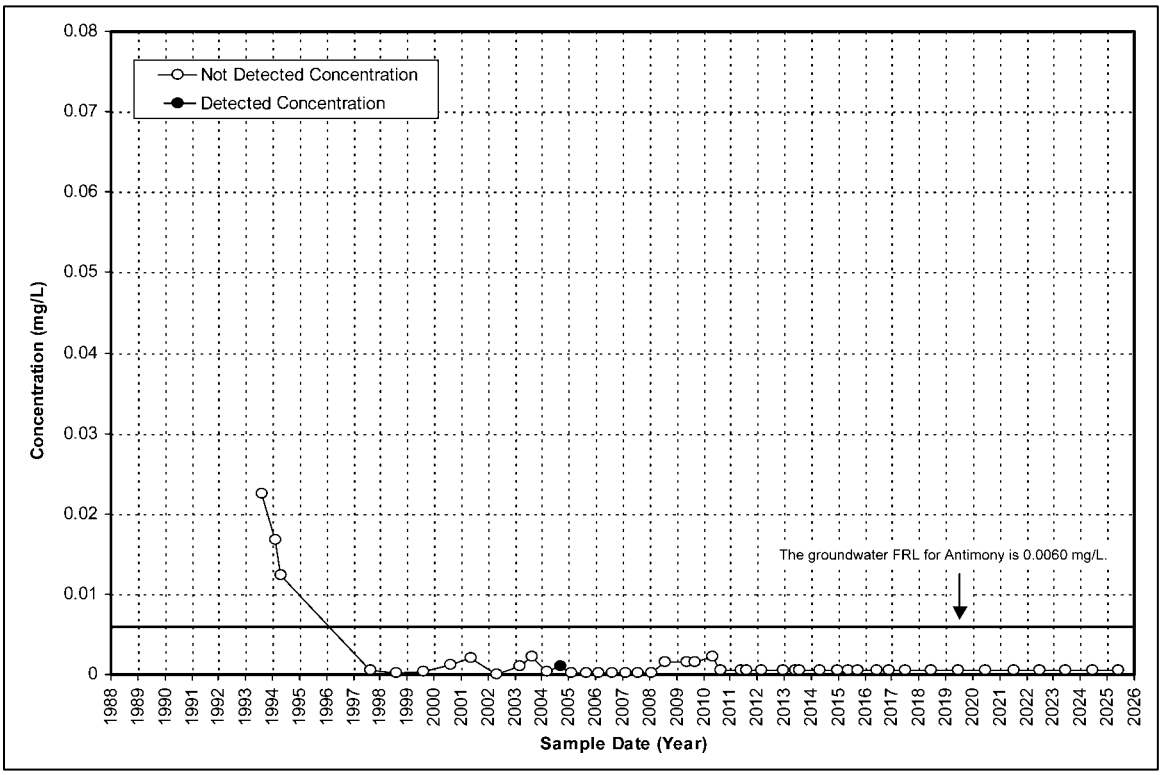


Figure A.4-11. Antimony Concentration Versus Time Plot for Monitoring Well 2900

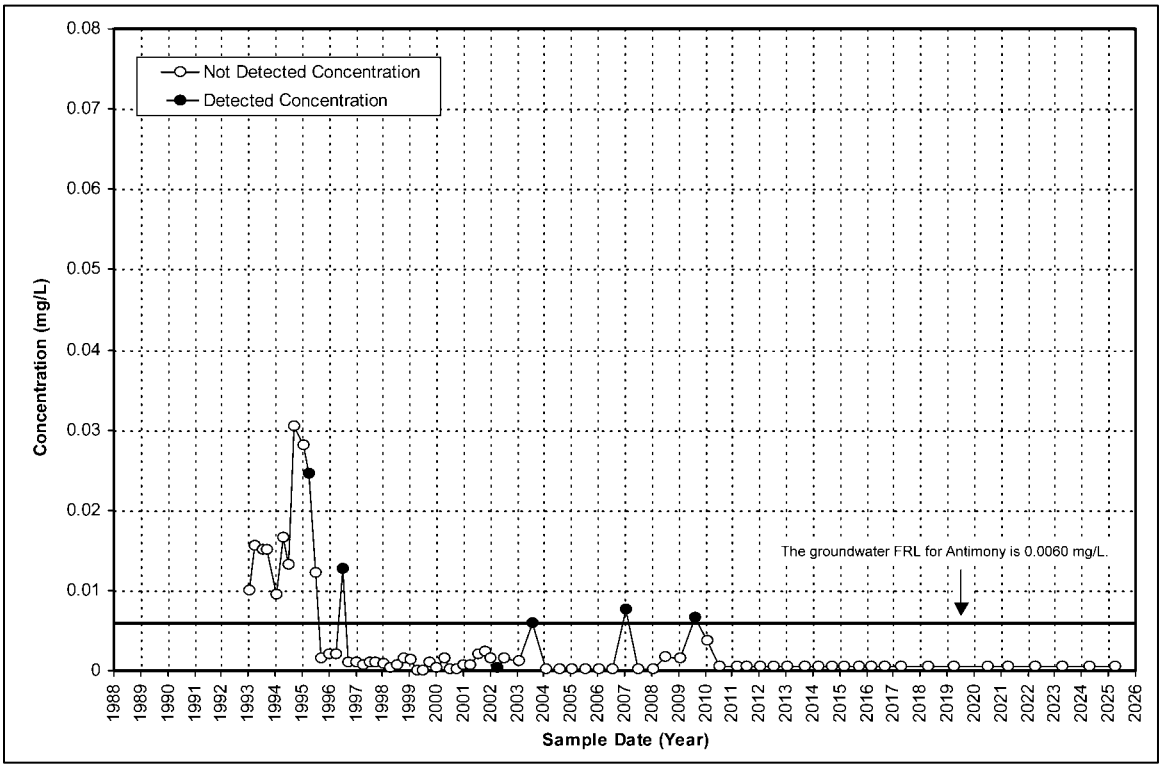


Figure A.4-12. Antimony Concentration Versus Time Plot for Monitoring Well 3070

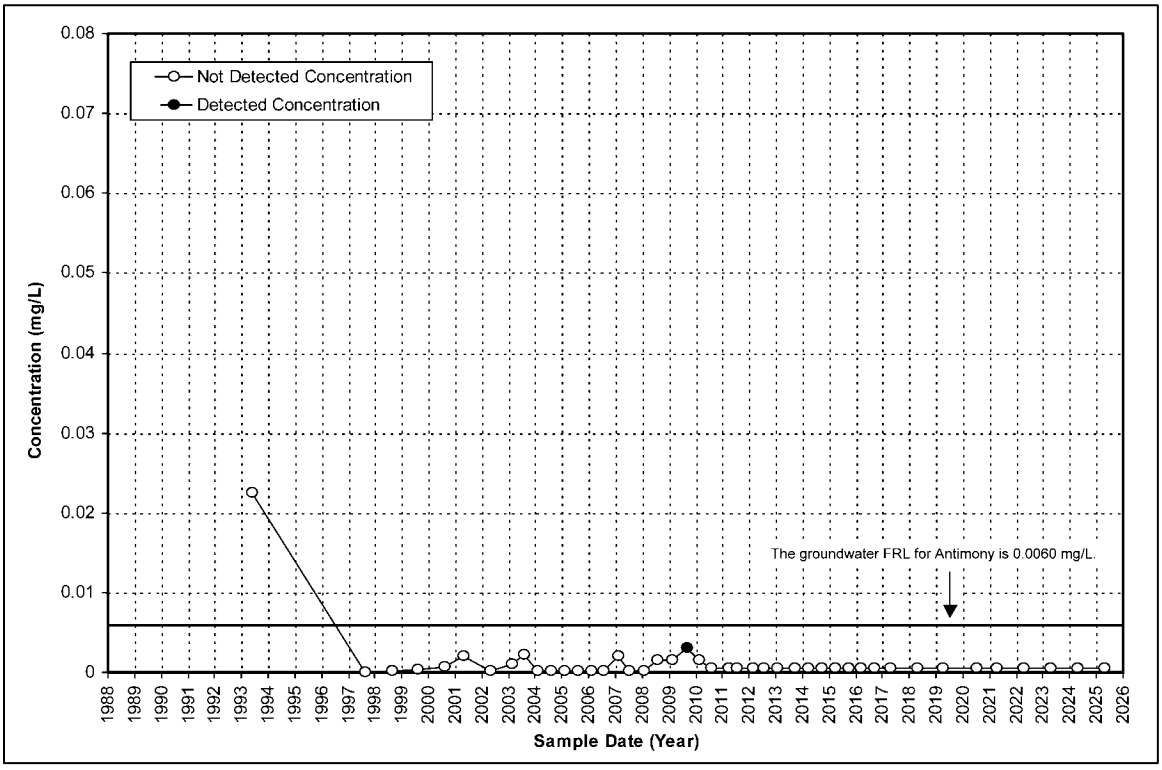


Figure A.4-13. Antimony Concentration Versus Time Plot for Monitoring Well 3093

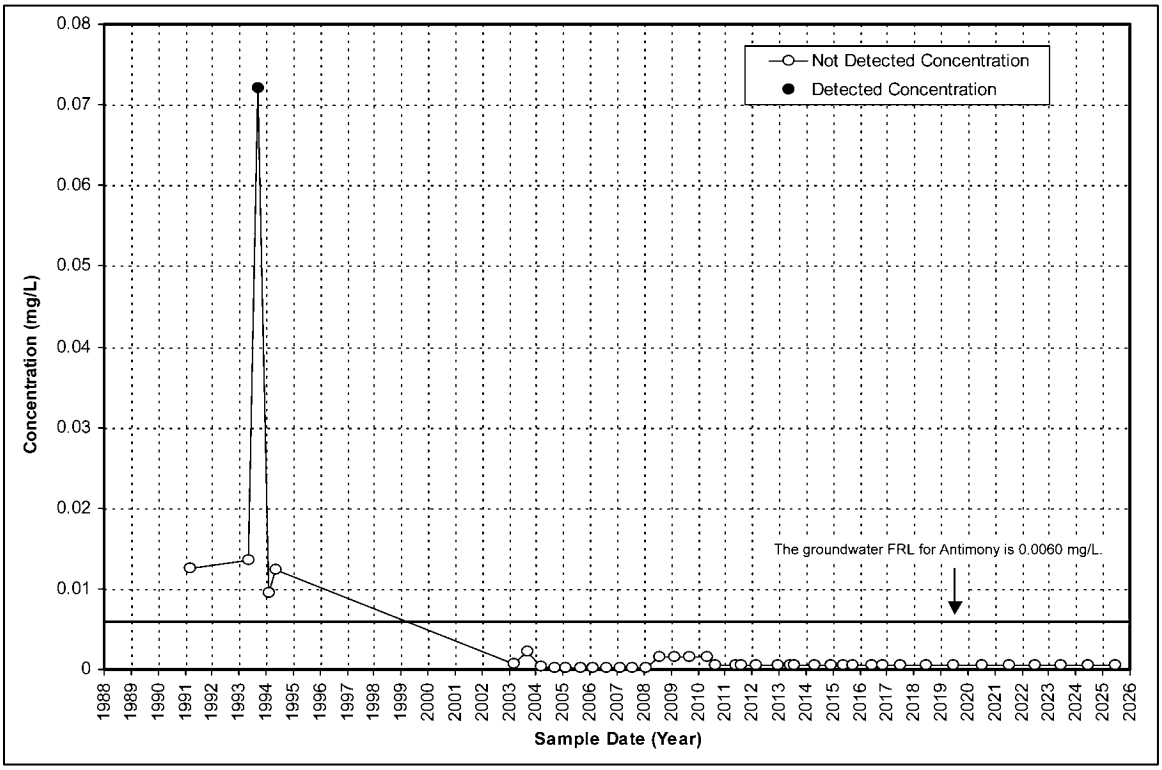


Figure A.4-14. Antimony Concentration Versus Time Plot for Monitoring Well 3128

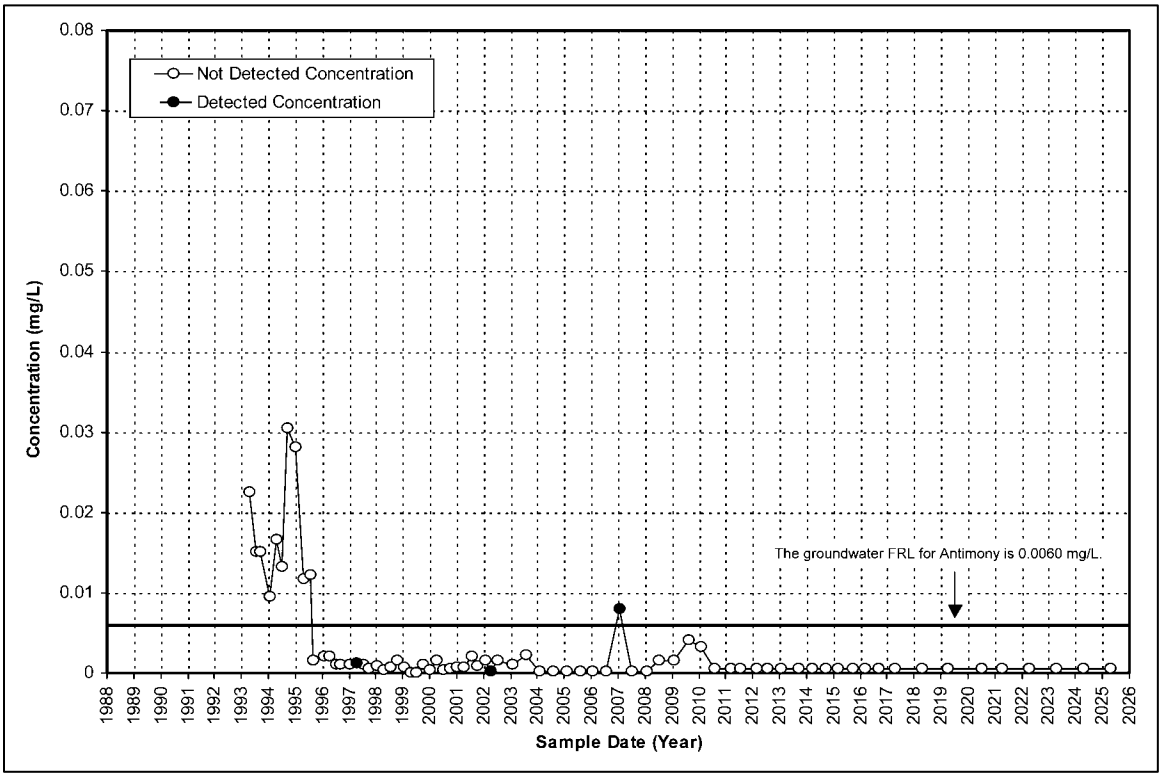


Figure A.4-15. Antimony Concentration Versus Time Plot for Monitoring Well 3398

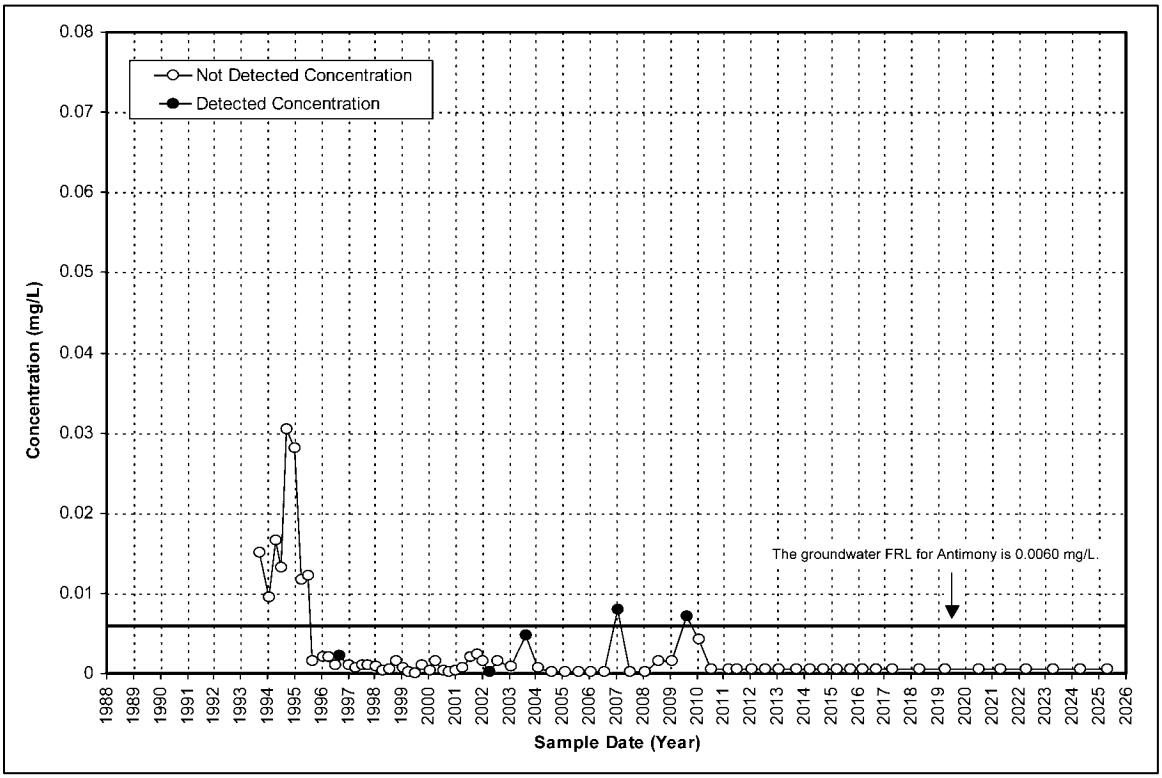


Figure A.4-16. Antimony Concentration Versus Time Plot for Monitoring Well 3424

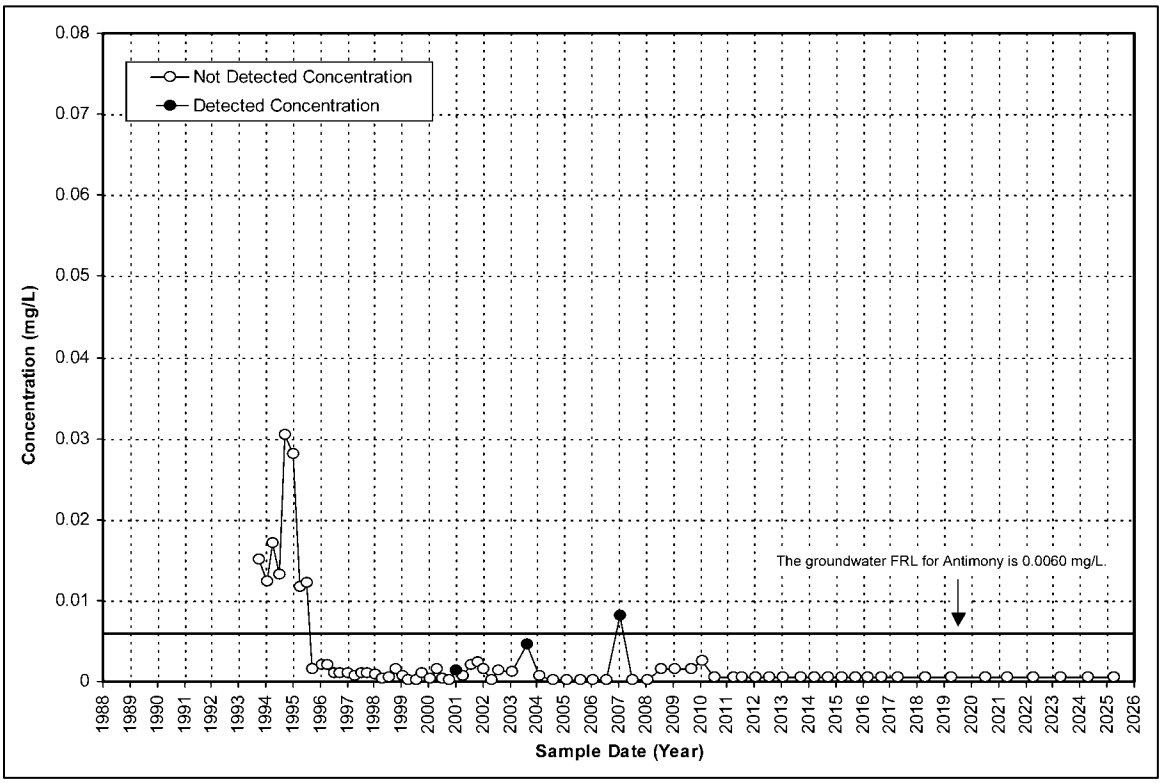


Figure A.4-17. Antimony Concentration Versus Time Plot for Monitoring Well 3426

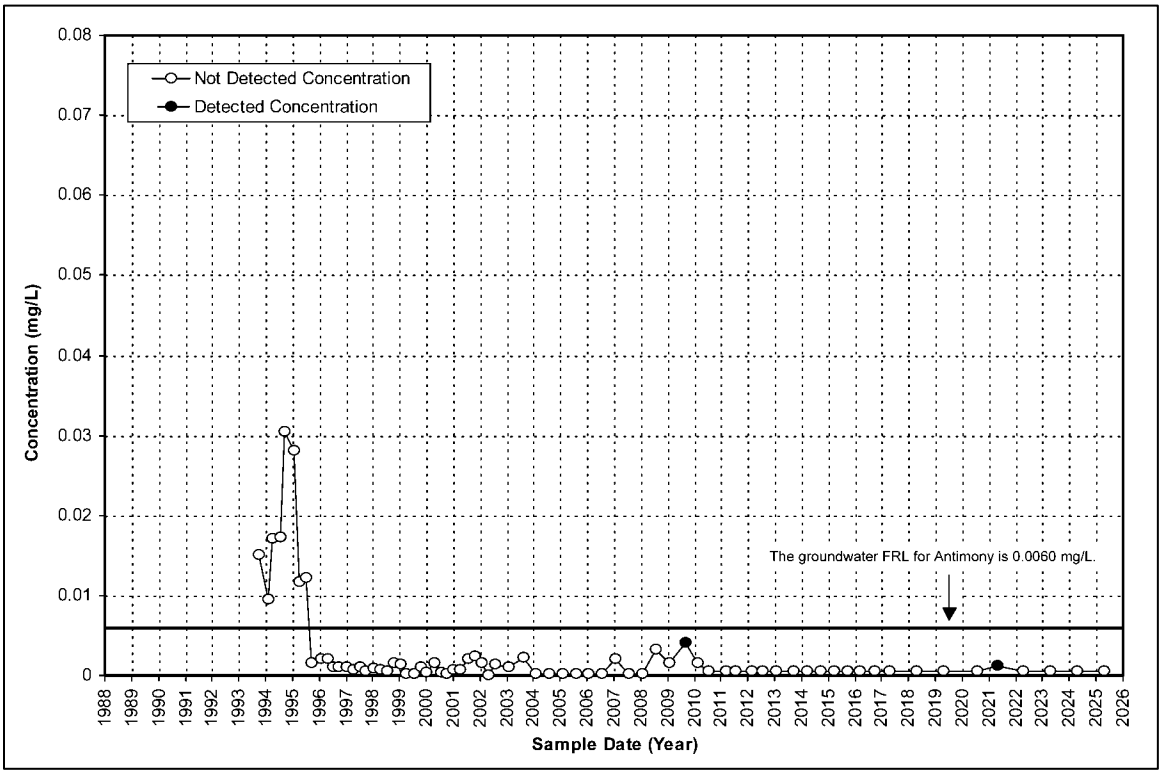


Figure A.4-18. Antimony Concentration Versus Time Plot for Monitoring Well 3429

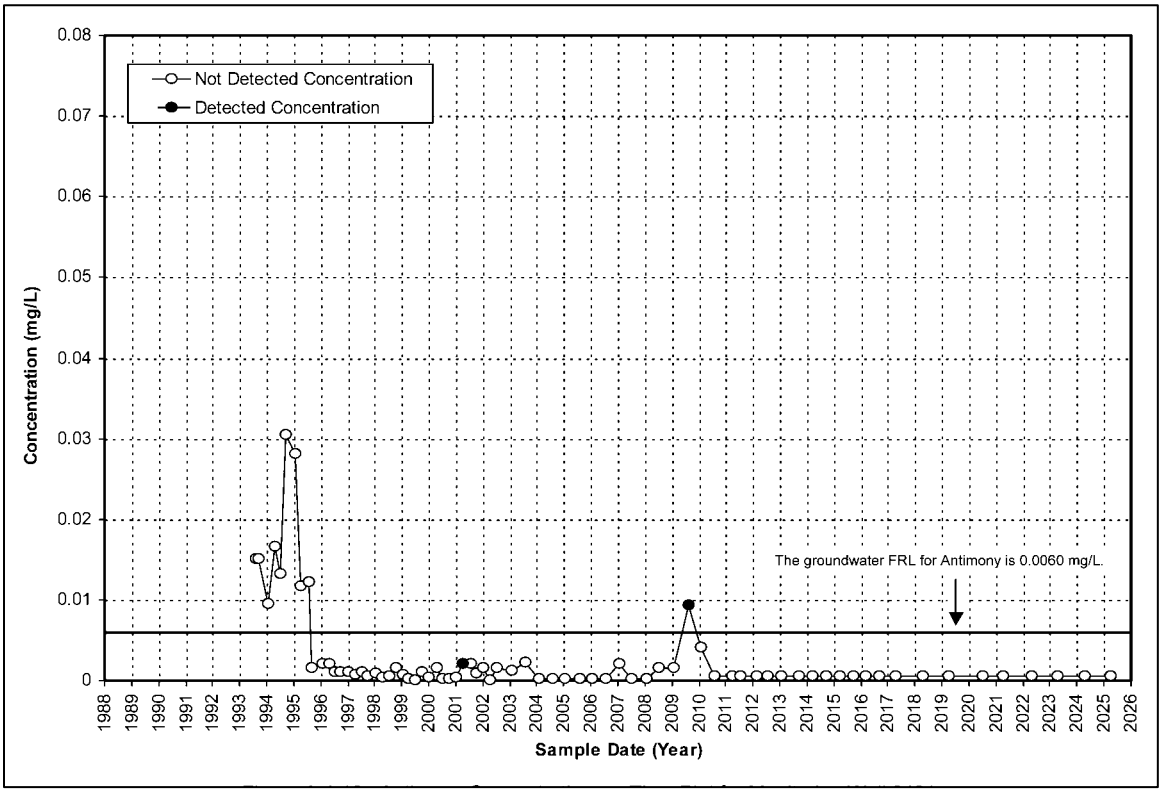


Figure A.4-19. Antimony Concentration Versus Time Plot for Monitoring Well 3431

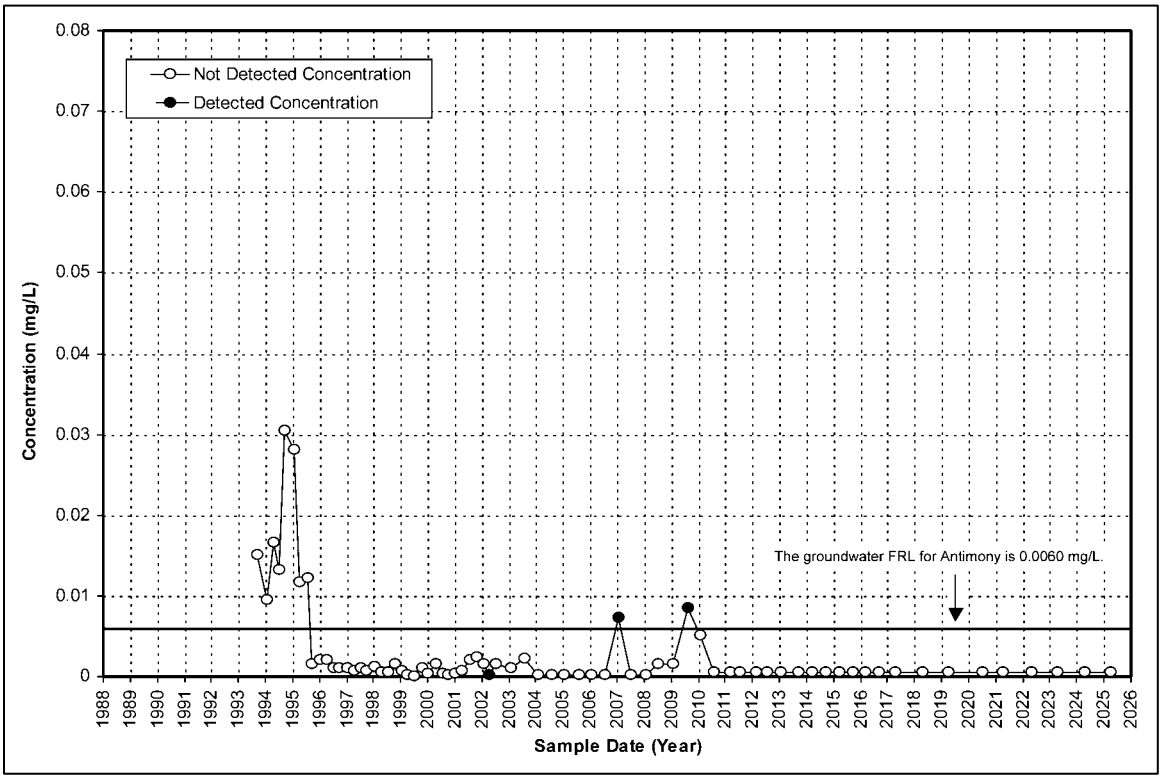


Figure A.4-20. Antimony Concentration Versus Time Plot for Monitoring Well 3432

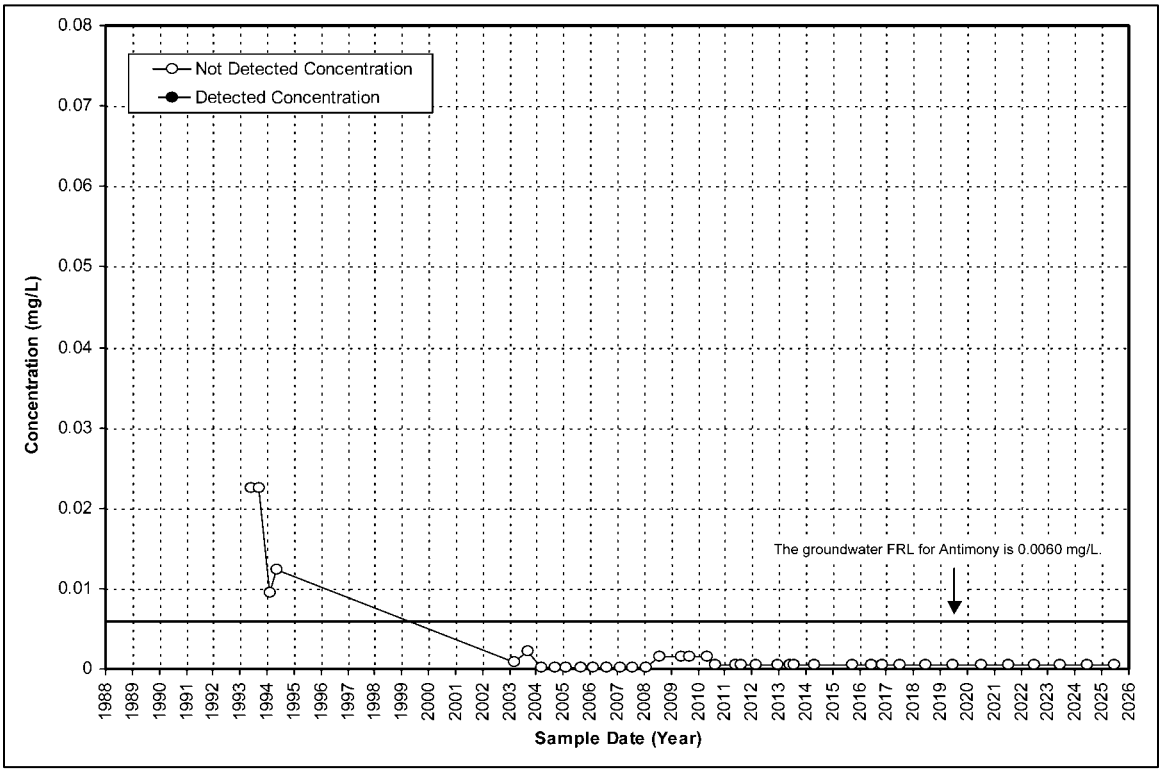


Figure A.4-21. Antimony Concentration Versus Time Plot for Monitoring Well 3636

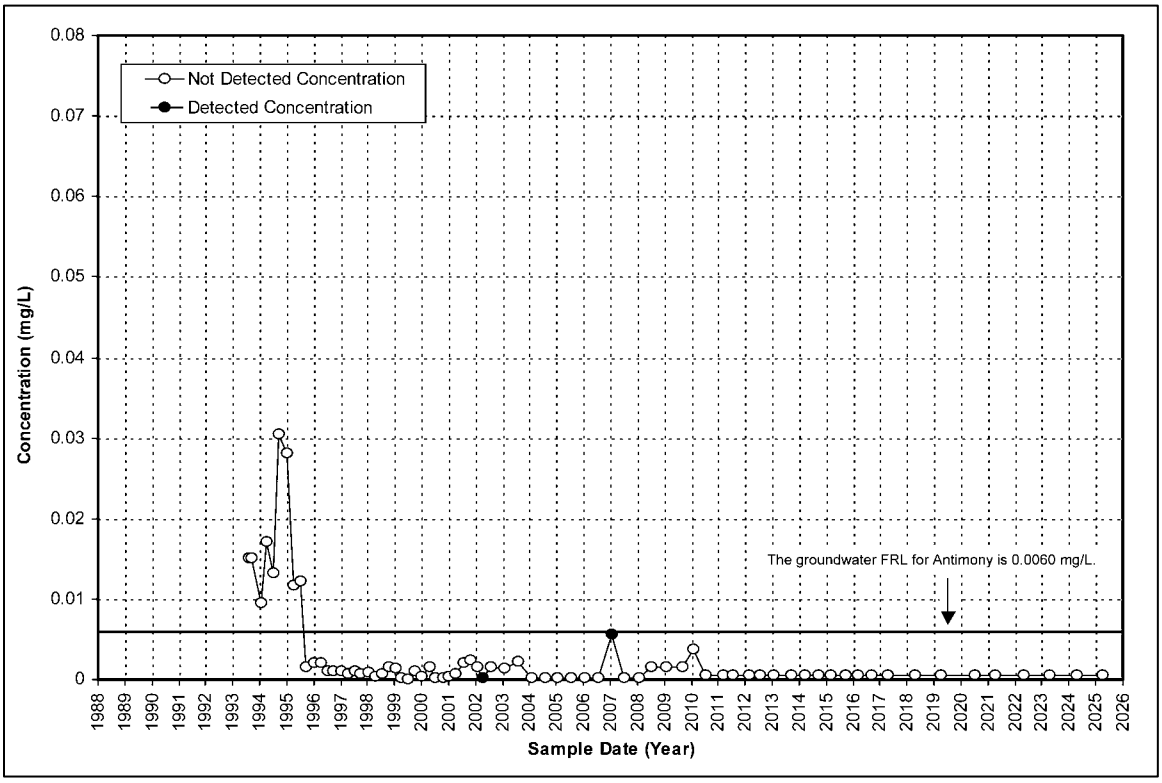


Figure A.4-22. Antimony Concentration Versus Time Plot for Monitoring Well 3733

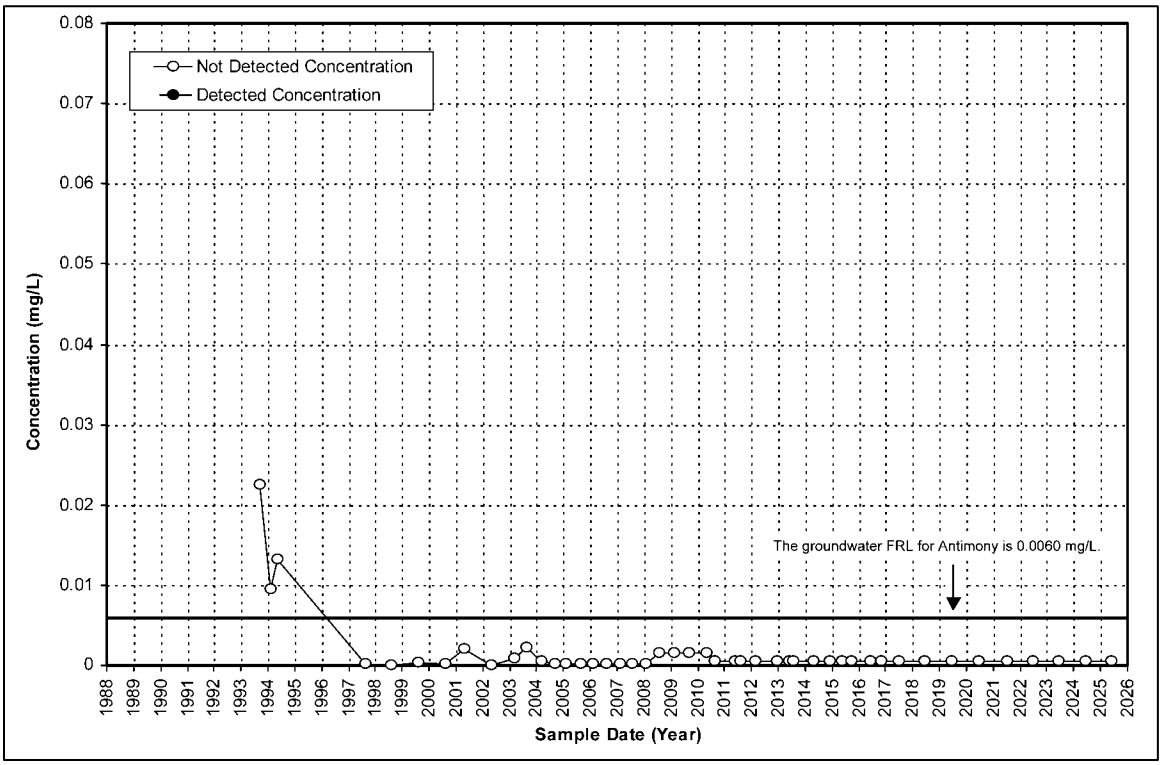


Figure A.4-23. Antimony Concentration Versus Time Plot for Monitoring Well 3898

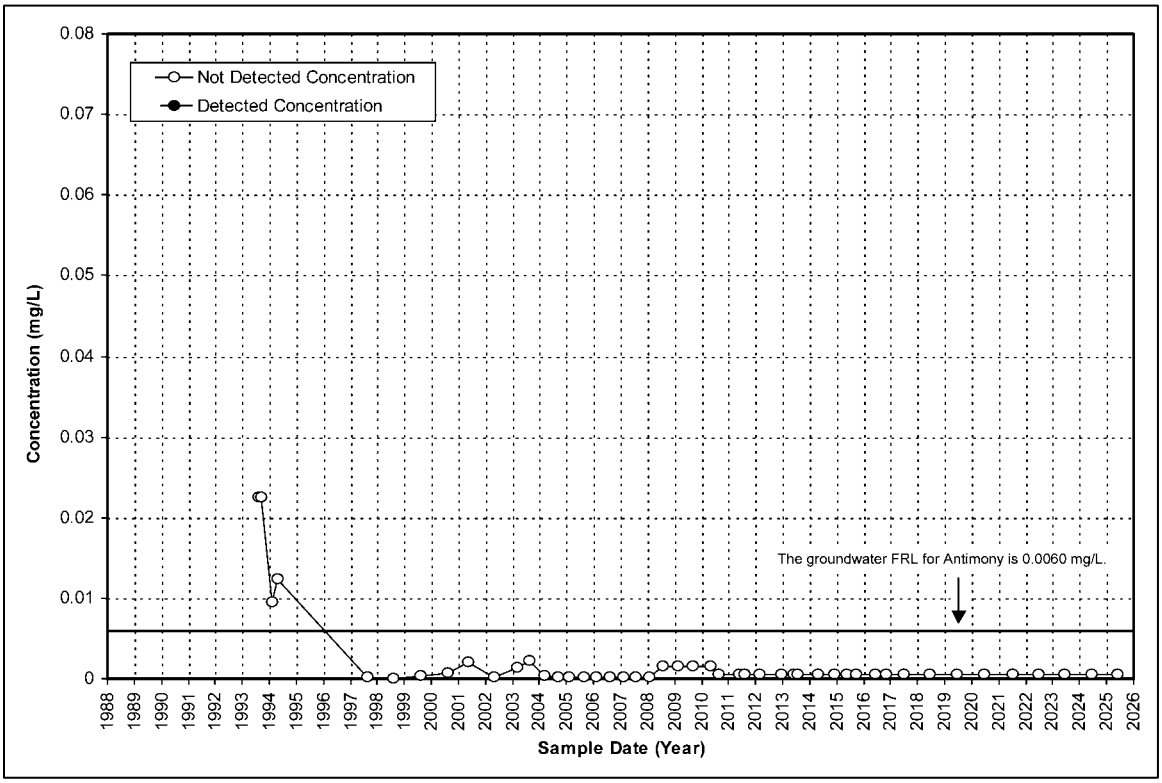


Figure A.4-24. Antimony Concentration Versus Time Plot for Monitoring Well 3899

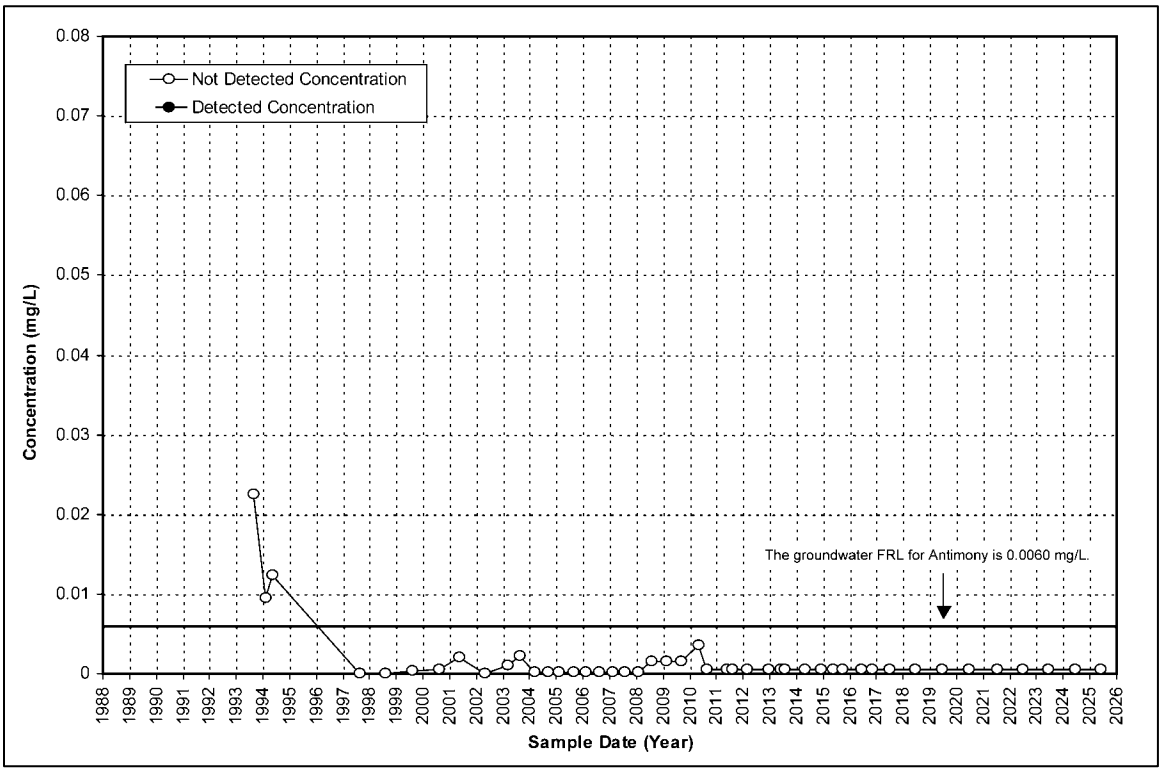


Figure A.4-25. Antimony Concentration Versus Time Plot for Monitoring Well 3900

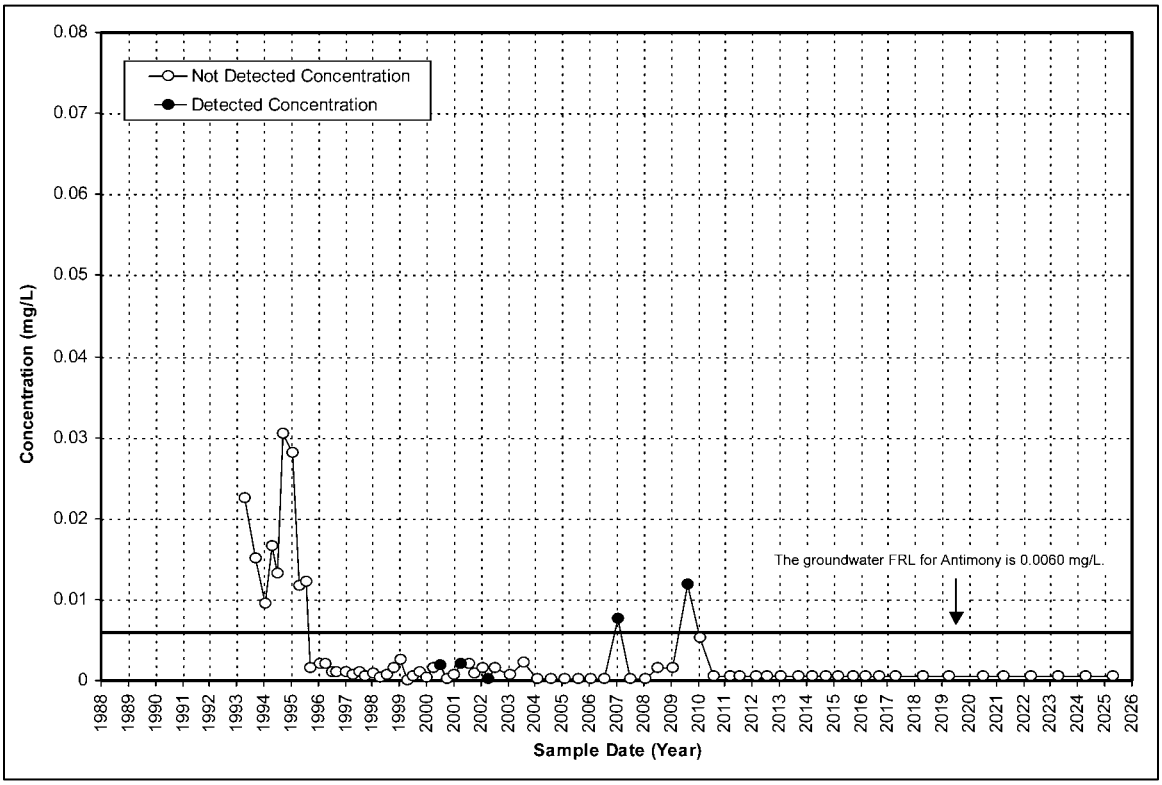


Figure A.4-26. Antimony Concentration Versus Time Plot for Monitoring Well 4398

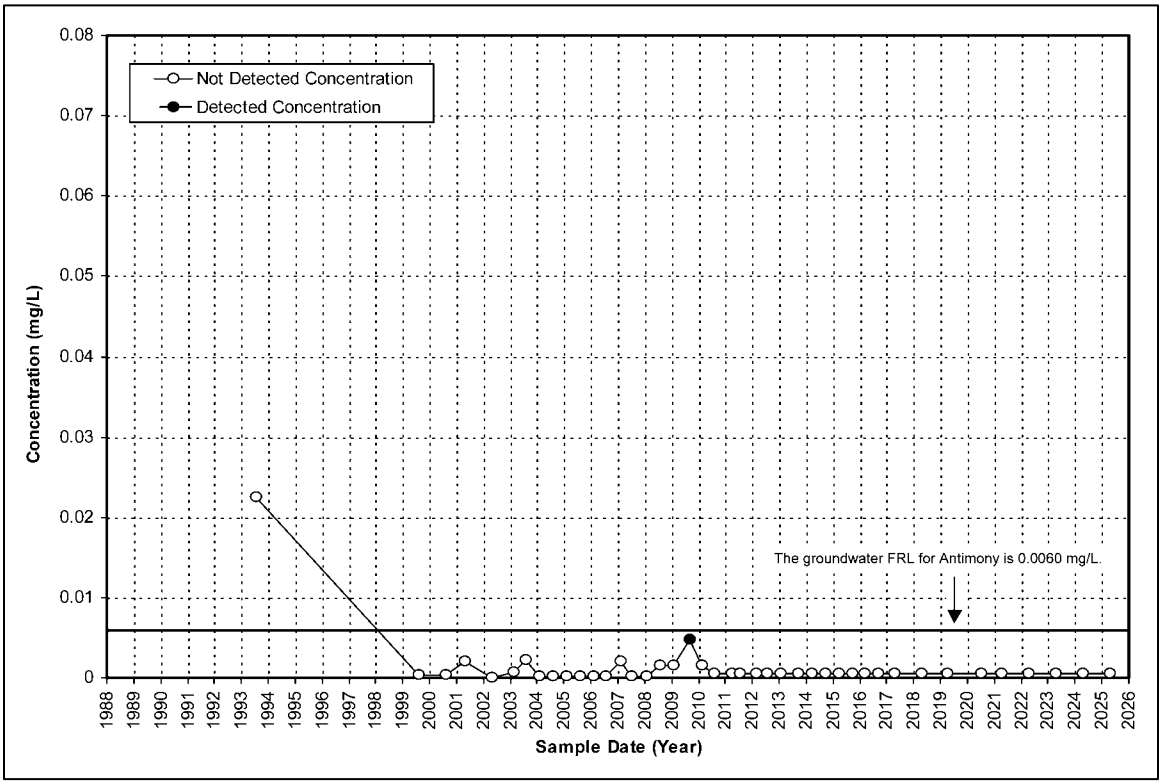


Figure A.4-27. Antimony Concentration Versus Time Plot for Monitoring Well 21063

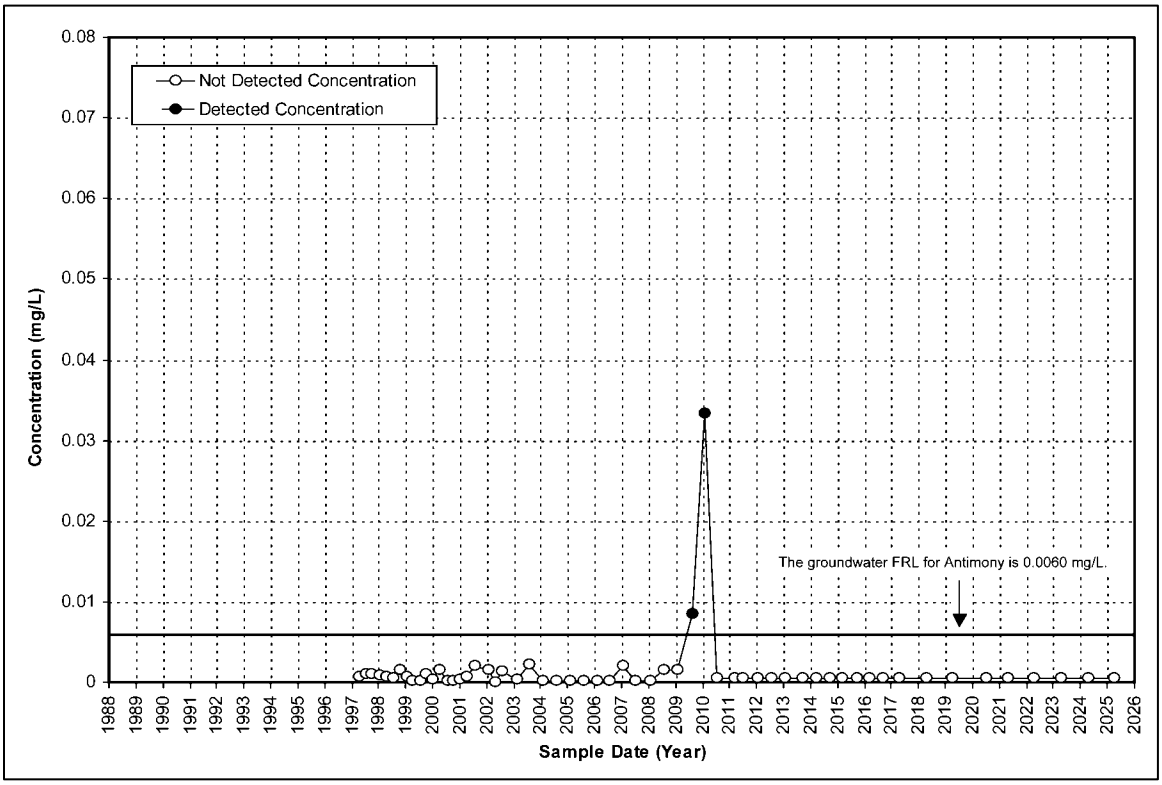


Figure A.4-28. Antimony Concentration Versus Time Plot for Monitoring Well 22198

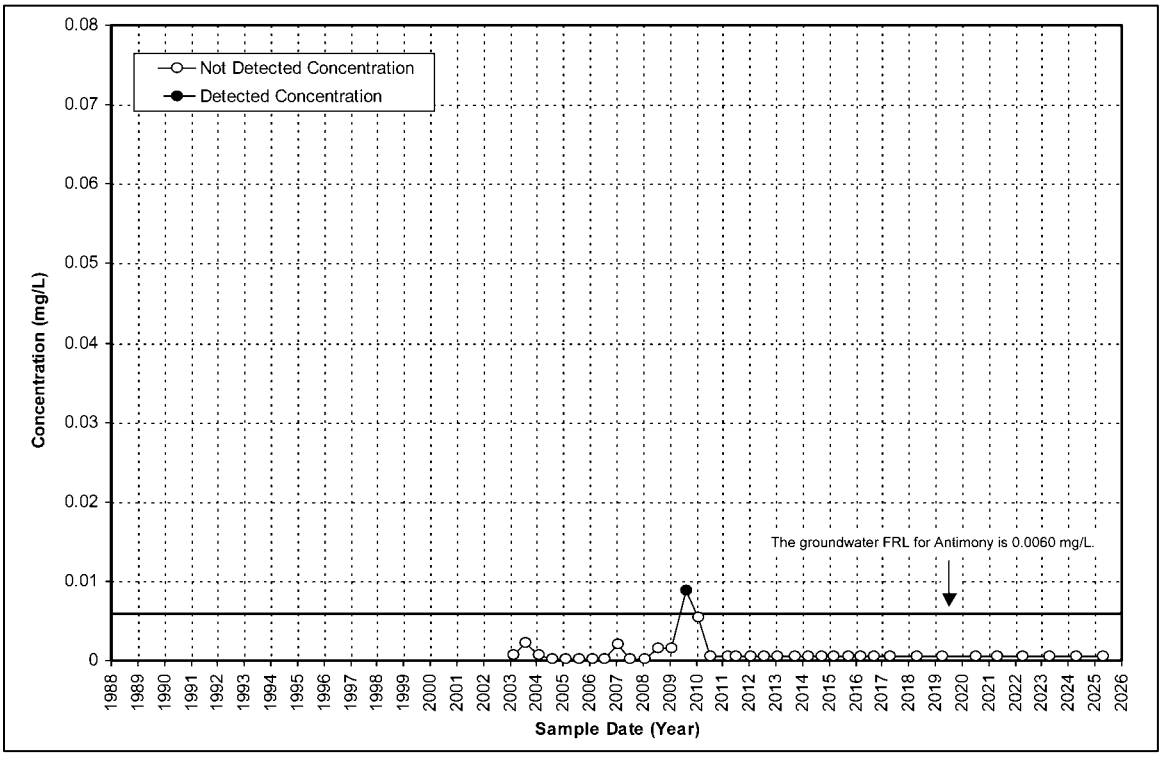


Figure A.4-29. Antimony Concentration Versus Time Plot for Monitoring Well 22199

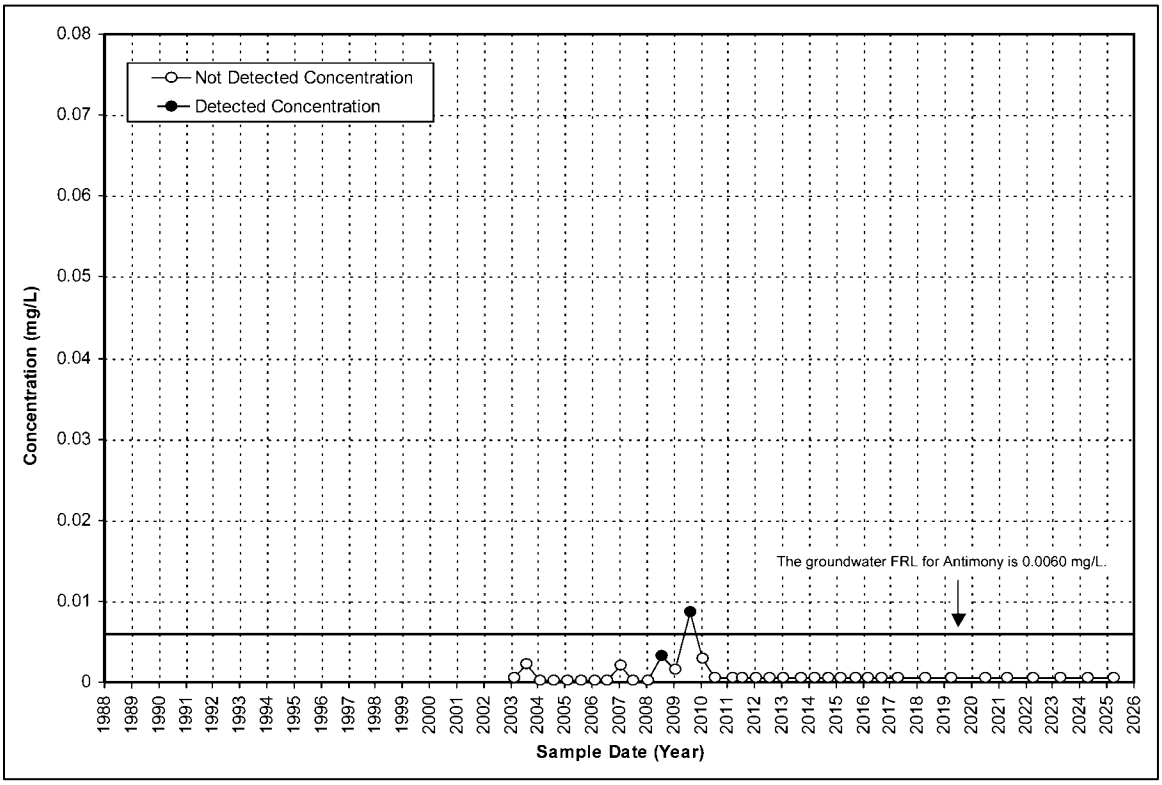


Figure A.4-30. Antimony Concentration Versus Time Plot for Monitoring Well 22204

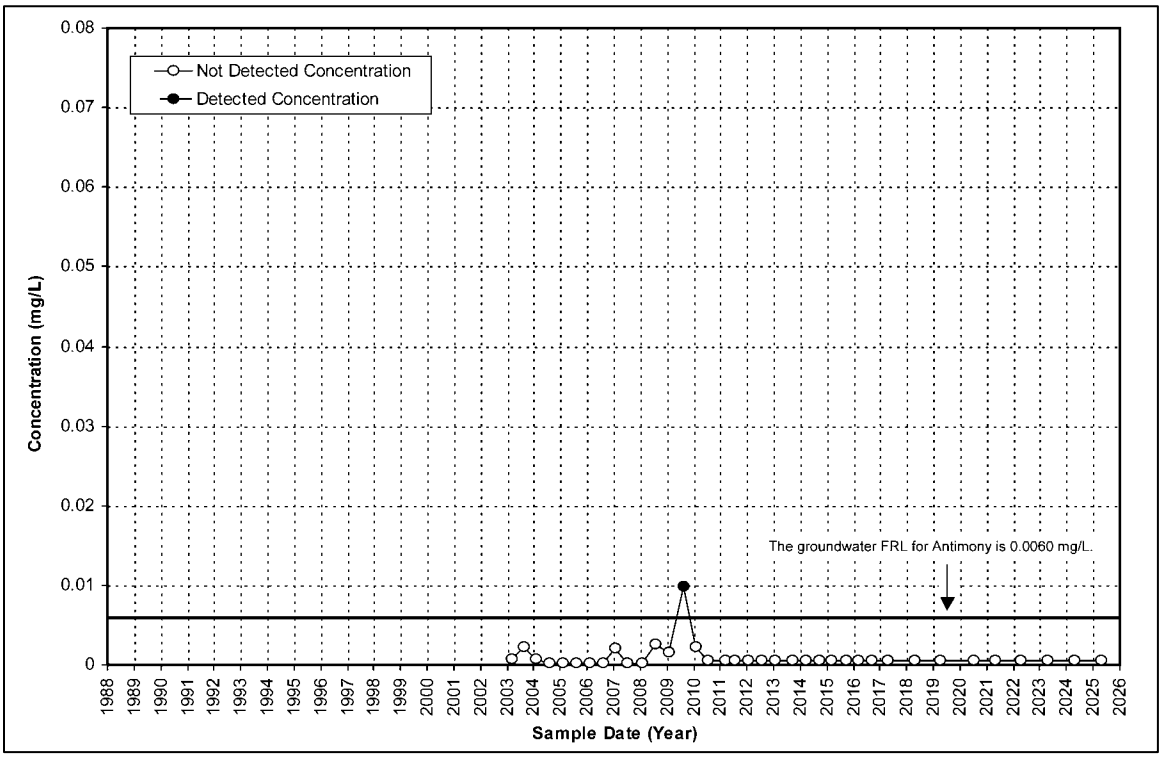


Figure A.4-31. Antimony Concentration Versus Time Plot for Monitoring Well 22205

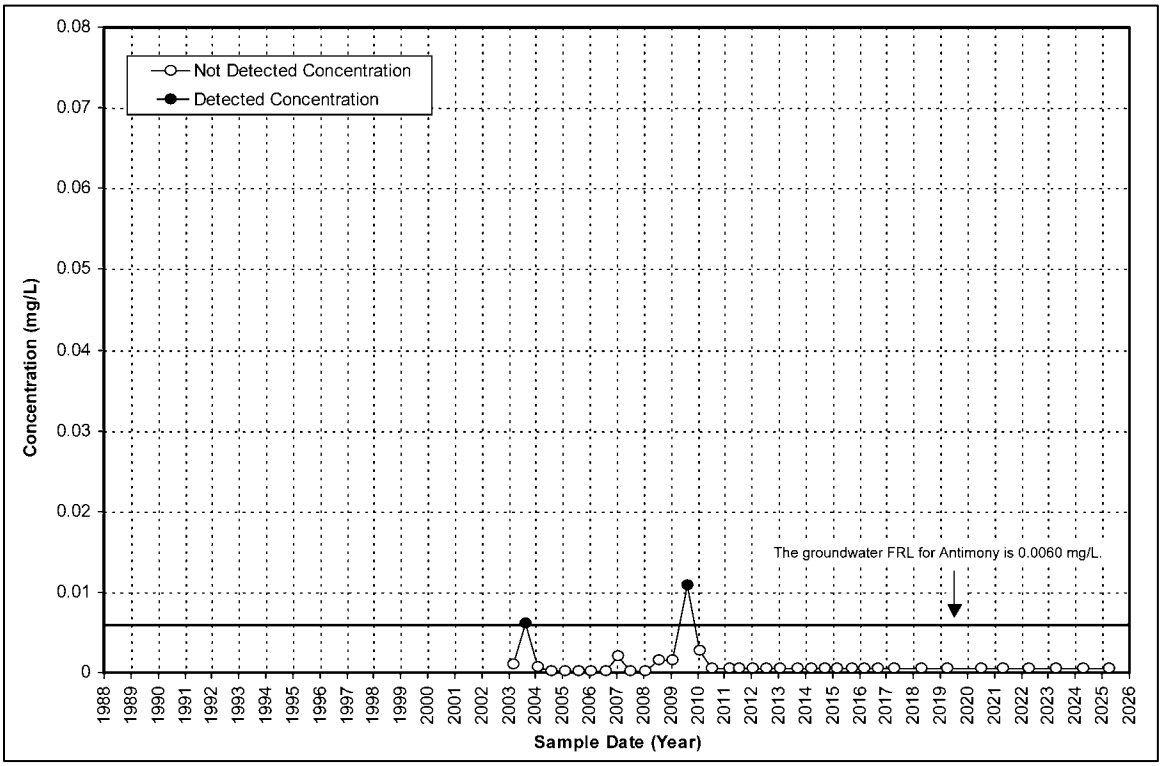


Figure A.4-32. Antimony Concentration Versus Time Plot for Monitoring Well 22208

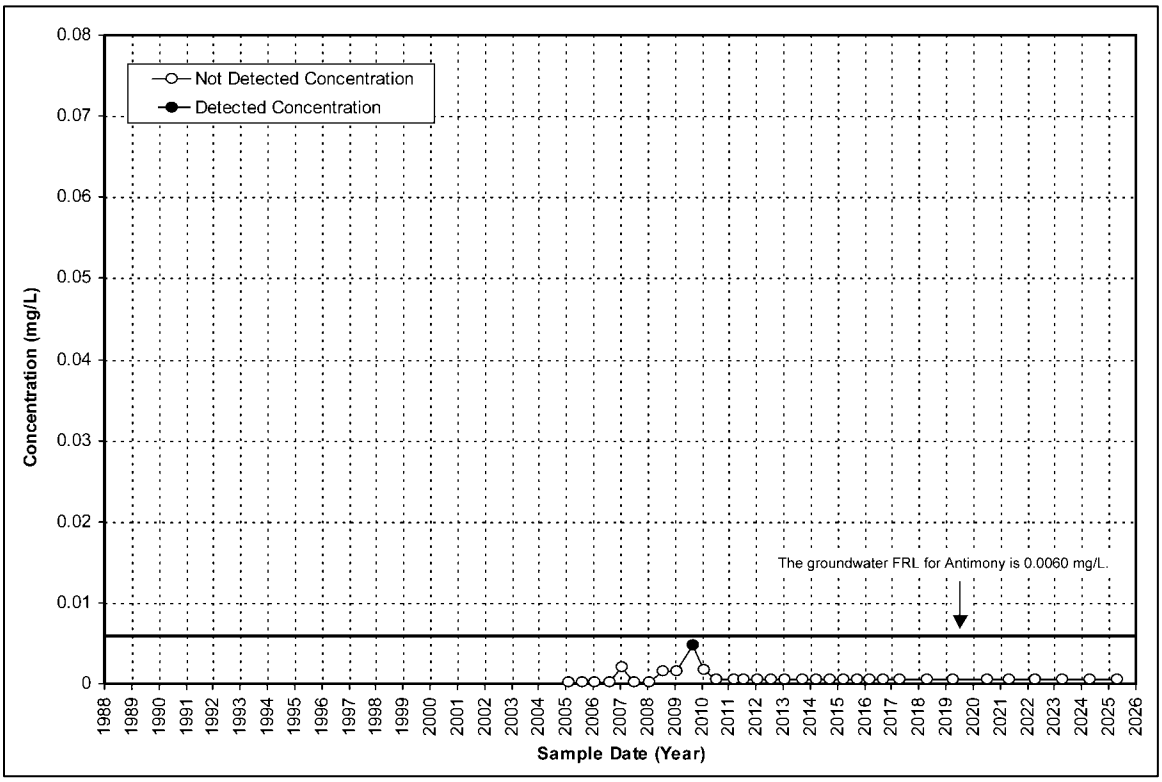


Figure A.4-33. Antimony Concentration Versus Time Plot for Monitoring Well 22210

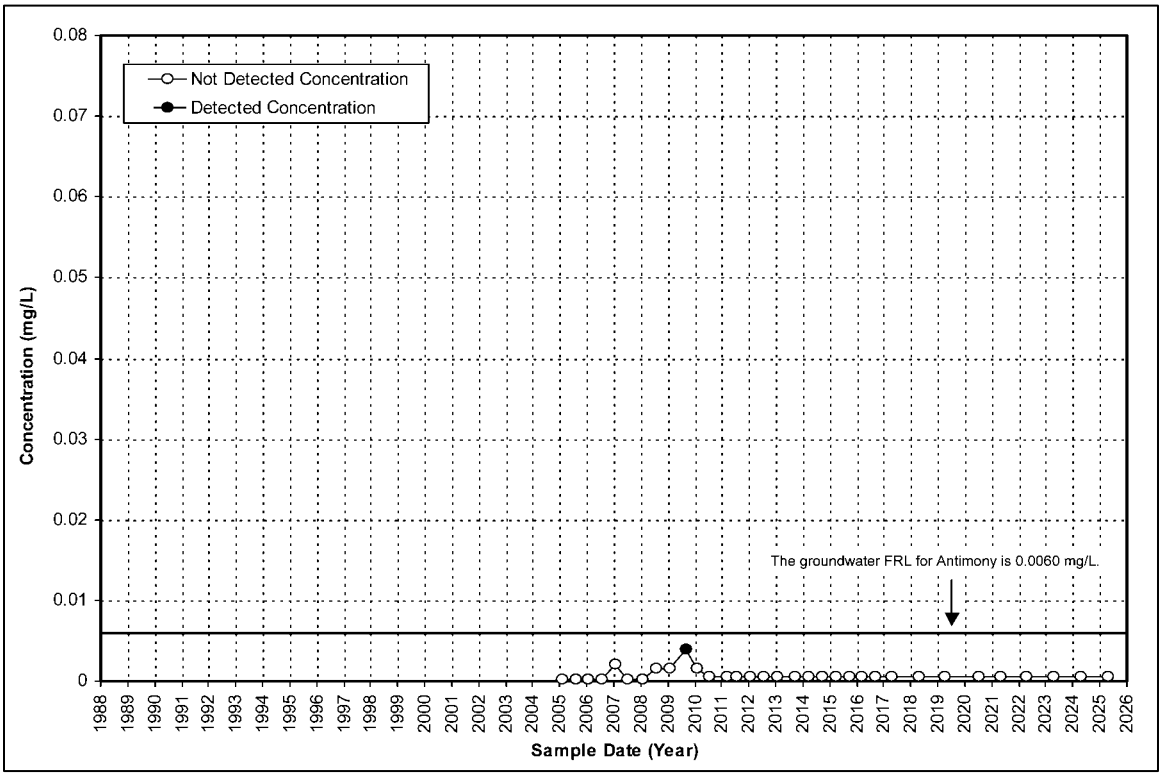


Figure A.4-34. Antimony Concentration Versus Time Plot for Monitoring Well 22211

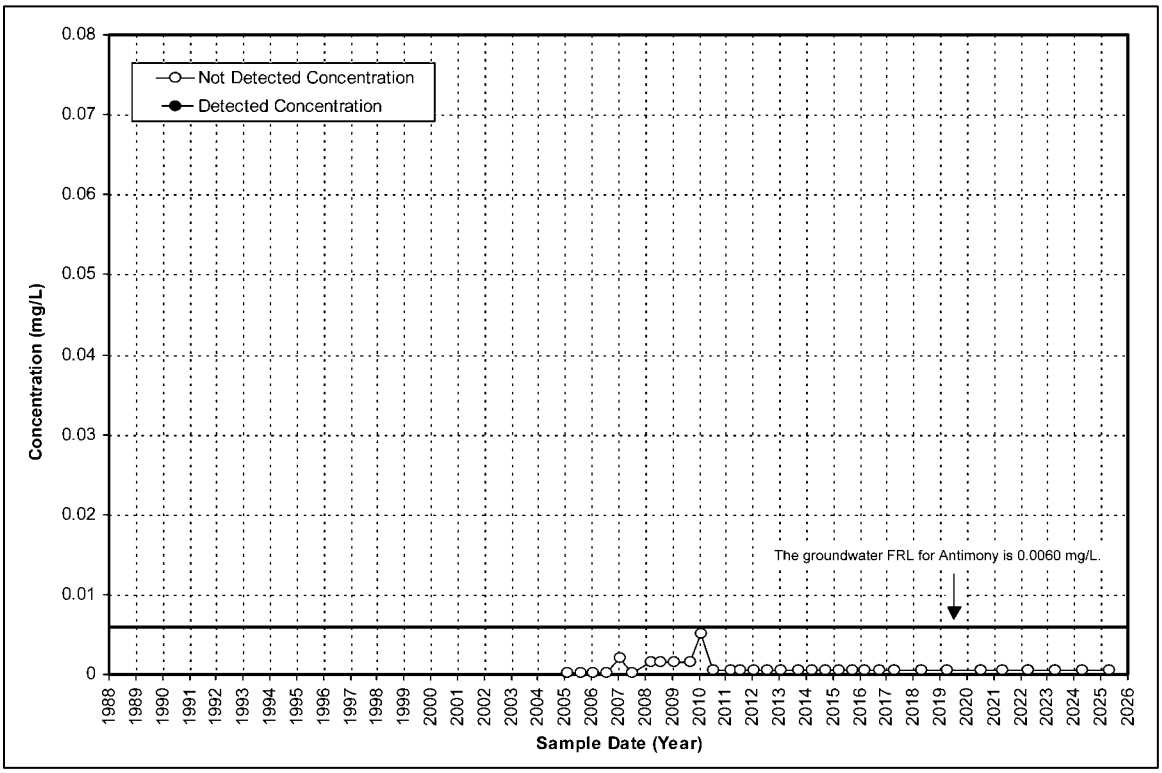


Figure A.4-35. Antimony Concentration Versus Time Plot for Monitoring Well 22214

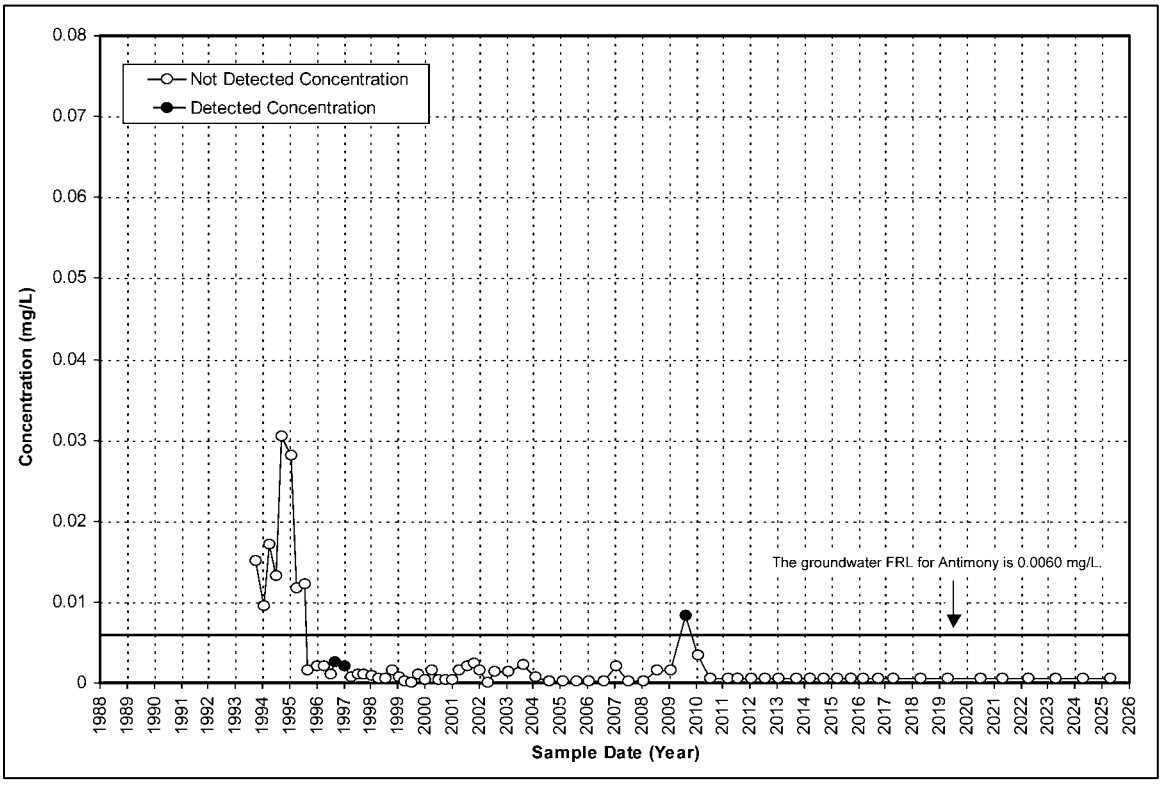


Figure A.4-36. Antimony Concentration Versus Time Plot for Monitoring Well 31217

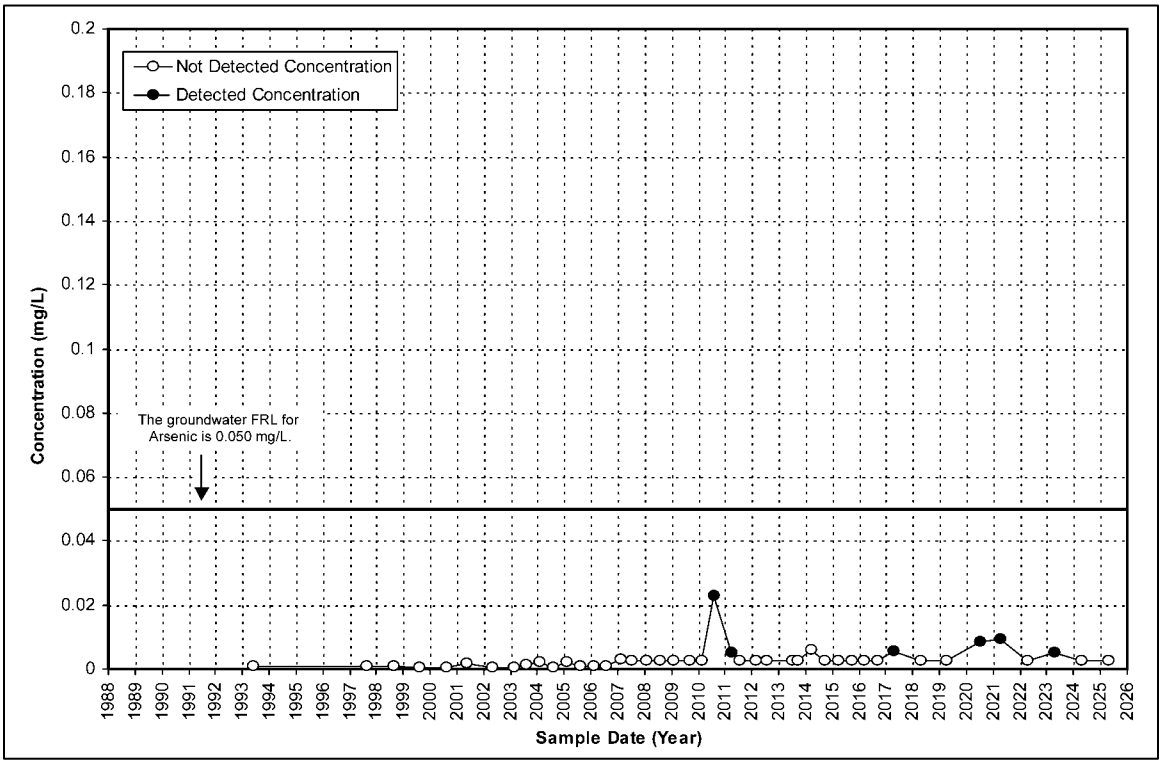


Figure A.4-37. Arsenic Concentration Versus Time Plot for Monitoring Well 2093

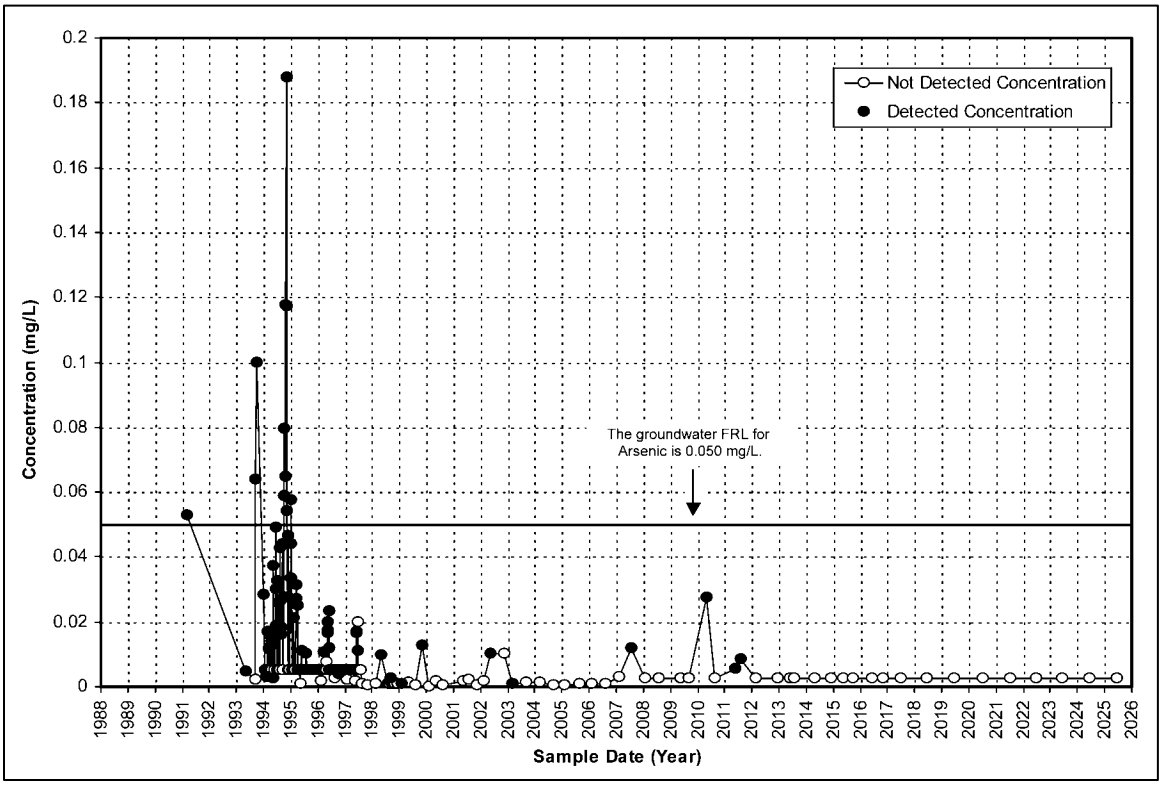


Figure A.4-38. Arsenic Concentration Versus Time Plot for Monitoring Well 2128

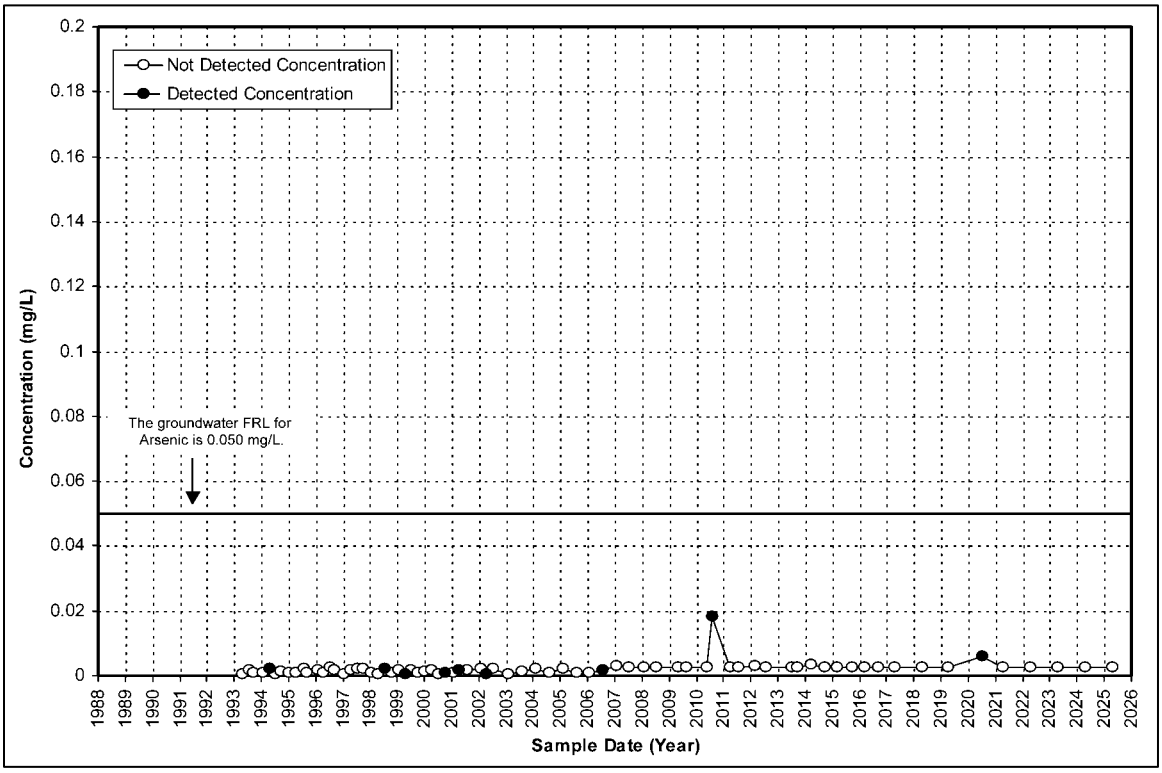


Figure A.4-39. Arsenic Concentration Versus Time Plot for Monitoring Well 2398

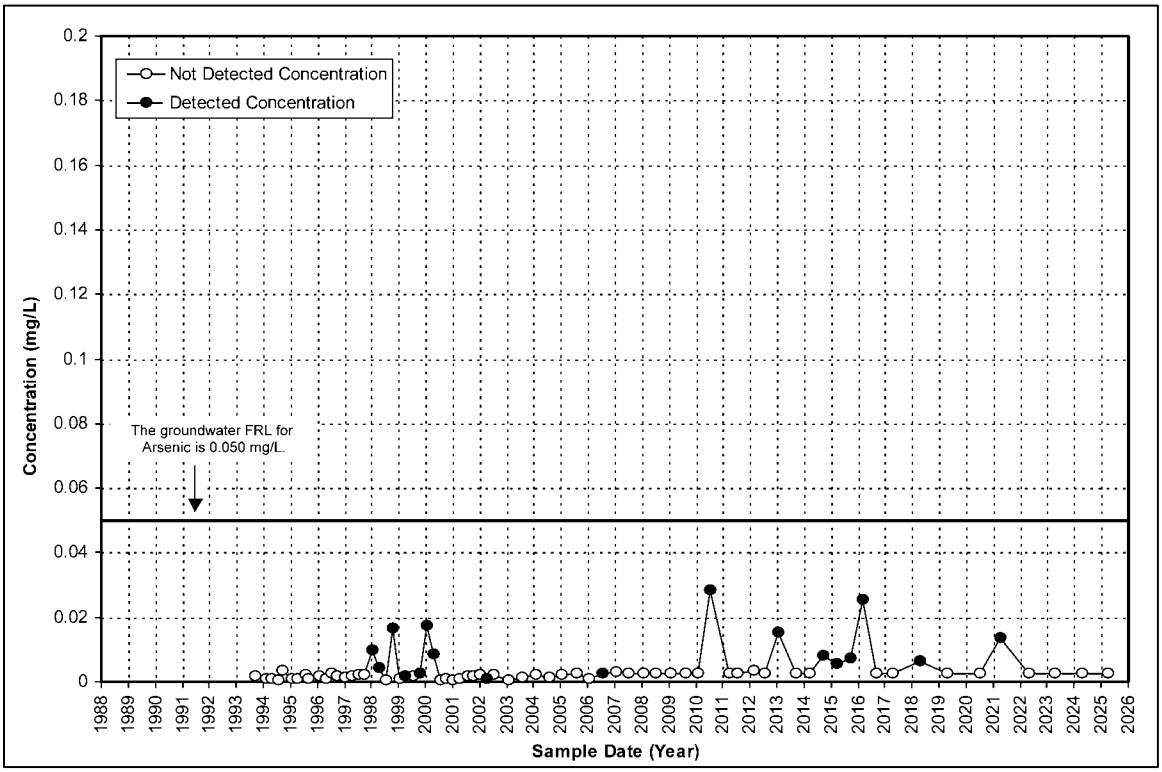


Figure A.4-40. Arsenic Concentration Versus Time Plot for Monitoring Well 2431

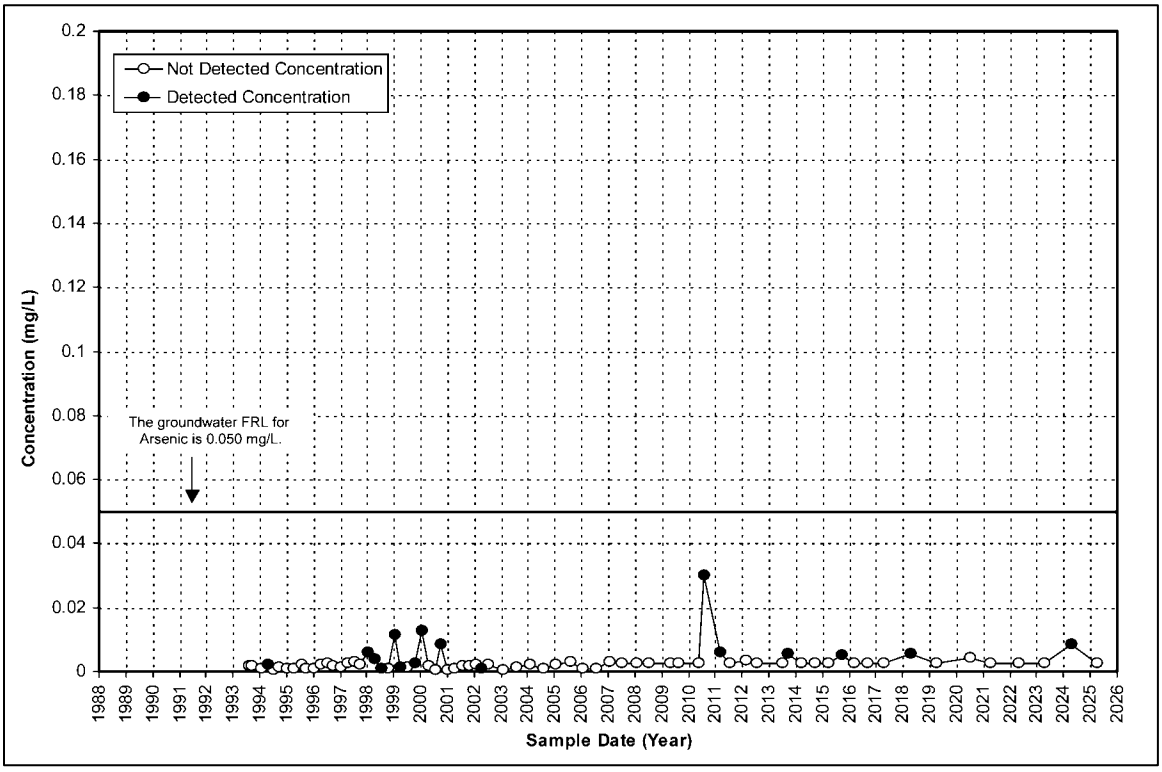


Figure A.4-41. Arsenic Concentration Versus Time Plot for Monitoring Well 2432

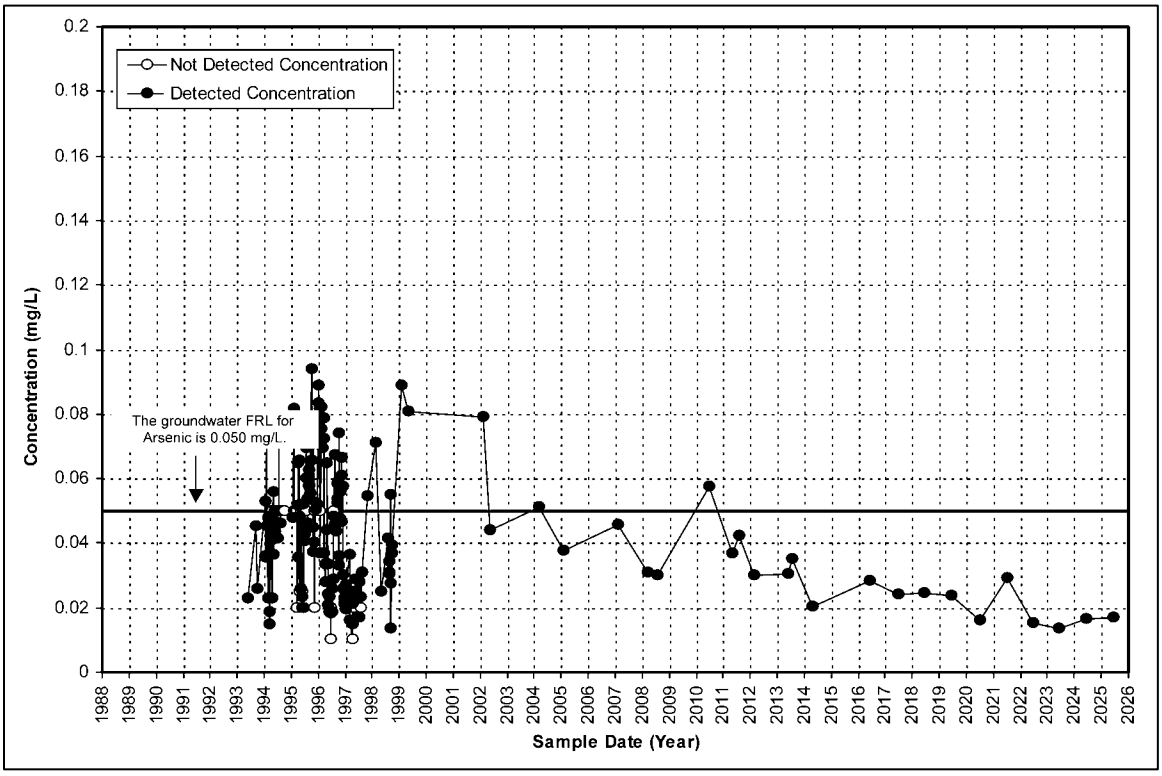


Figure A.4-42. Arsenic Concentration Versus Time Plot for Monitoring Well 2636

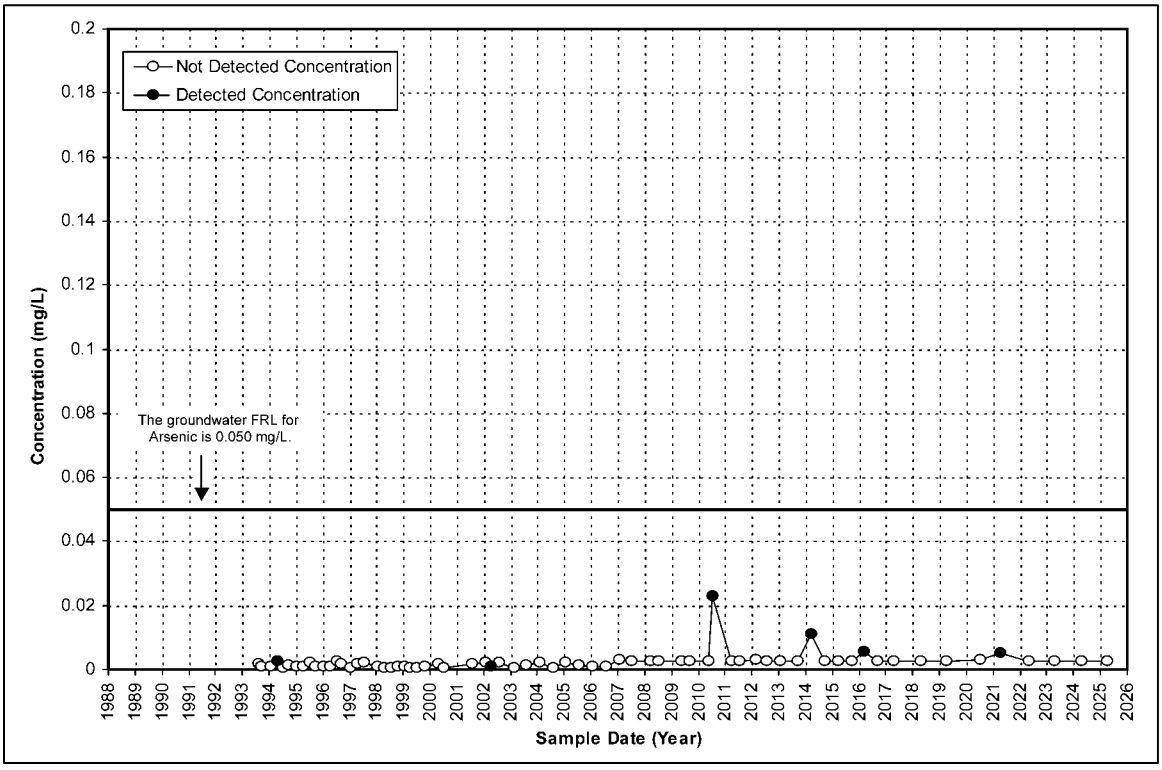


Figure A.4-43. Arsenic Concentration Versus Time Plot for Monitoring Well 2733

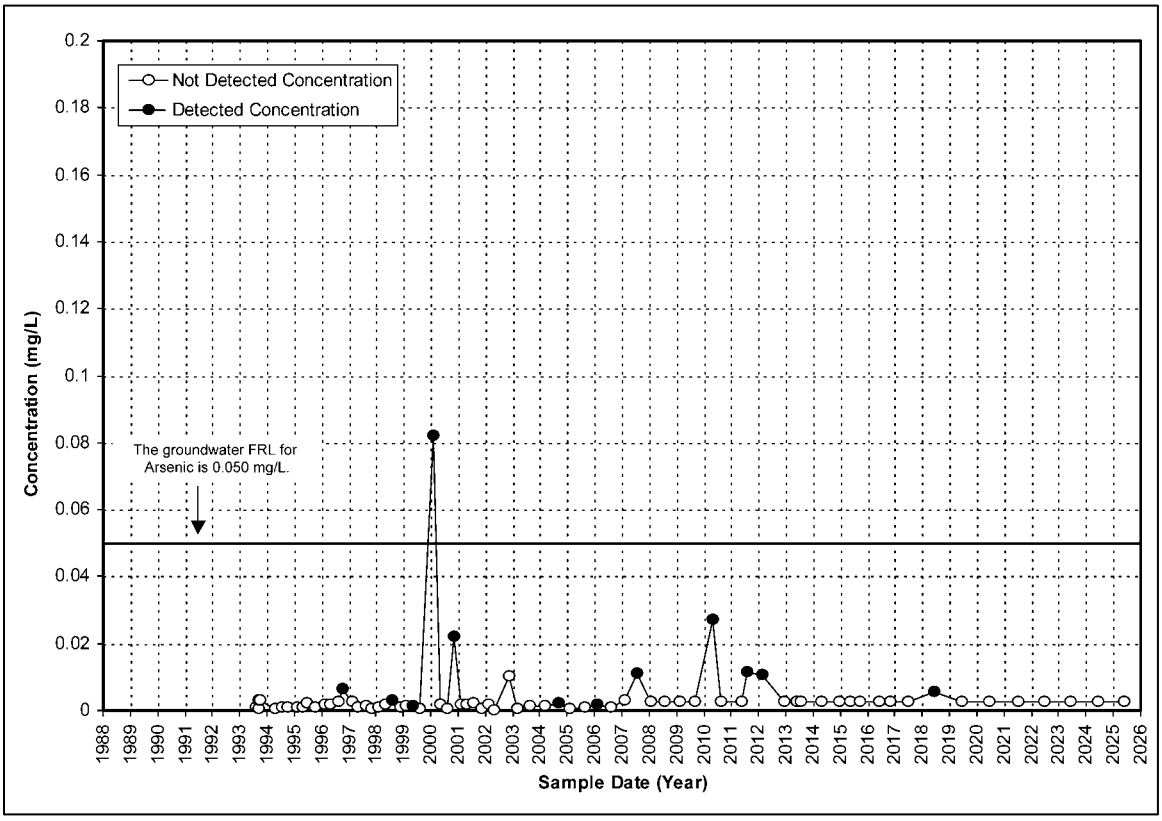


Figure A.4-44. Arsenic Concentration Versus Time Plot for Monitoring Well 2898

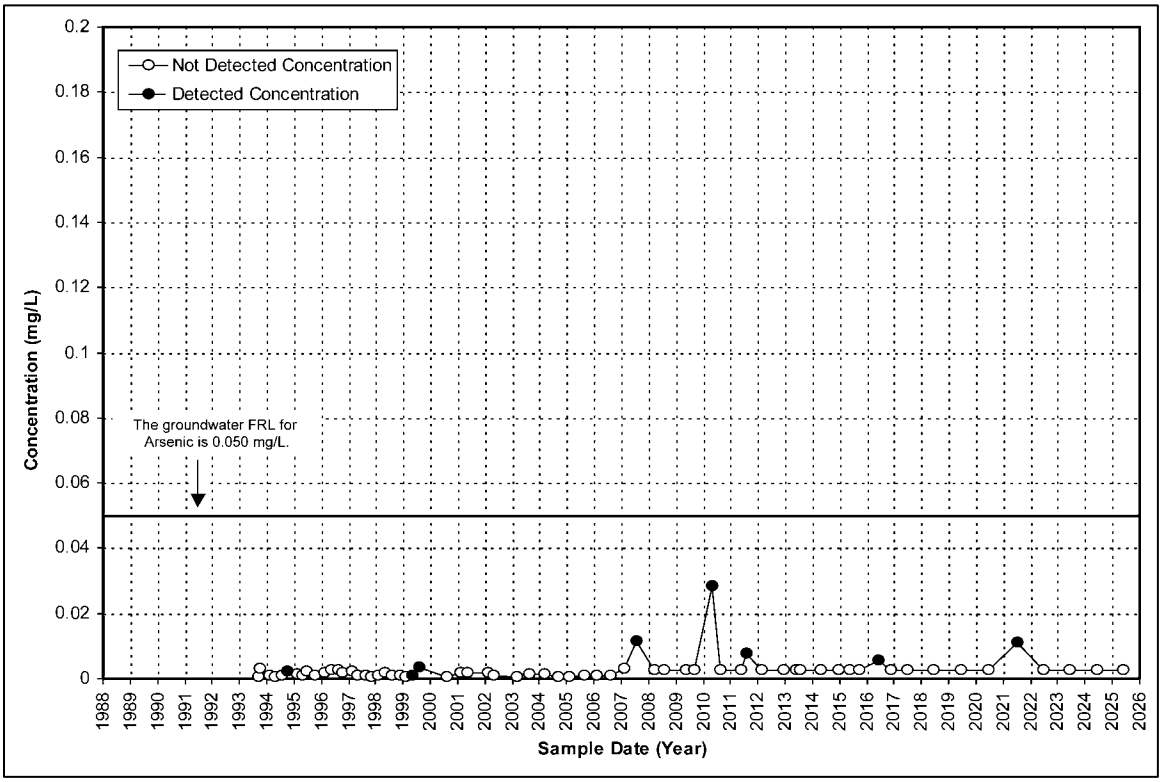


Figure A.4-45. Arsenic Concentration Versus Time Plot for Monitoring Well 2899

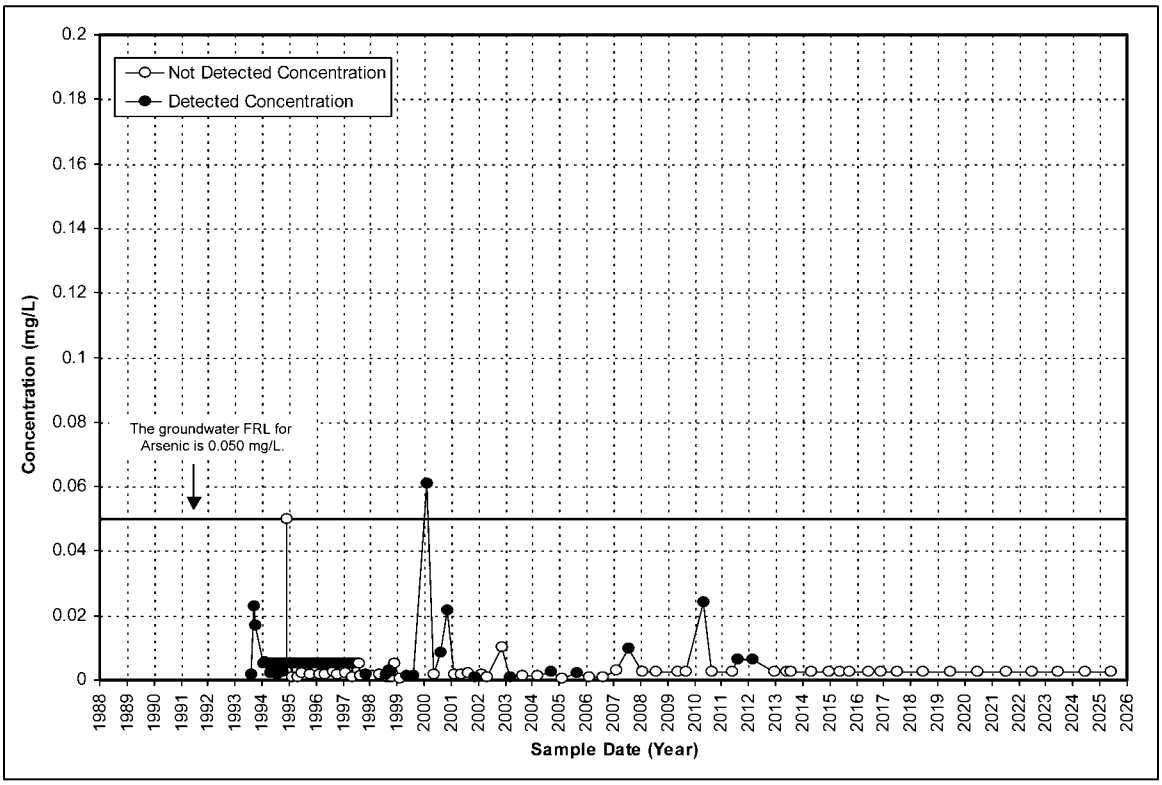


Figure A.4-46. Arsenic Concentration Versus Time Plot for Monitoring Well 2900

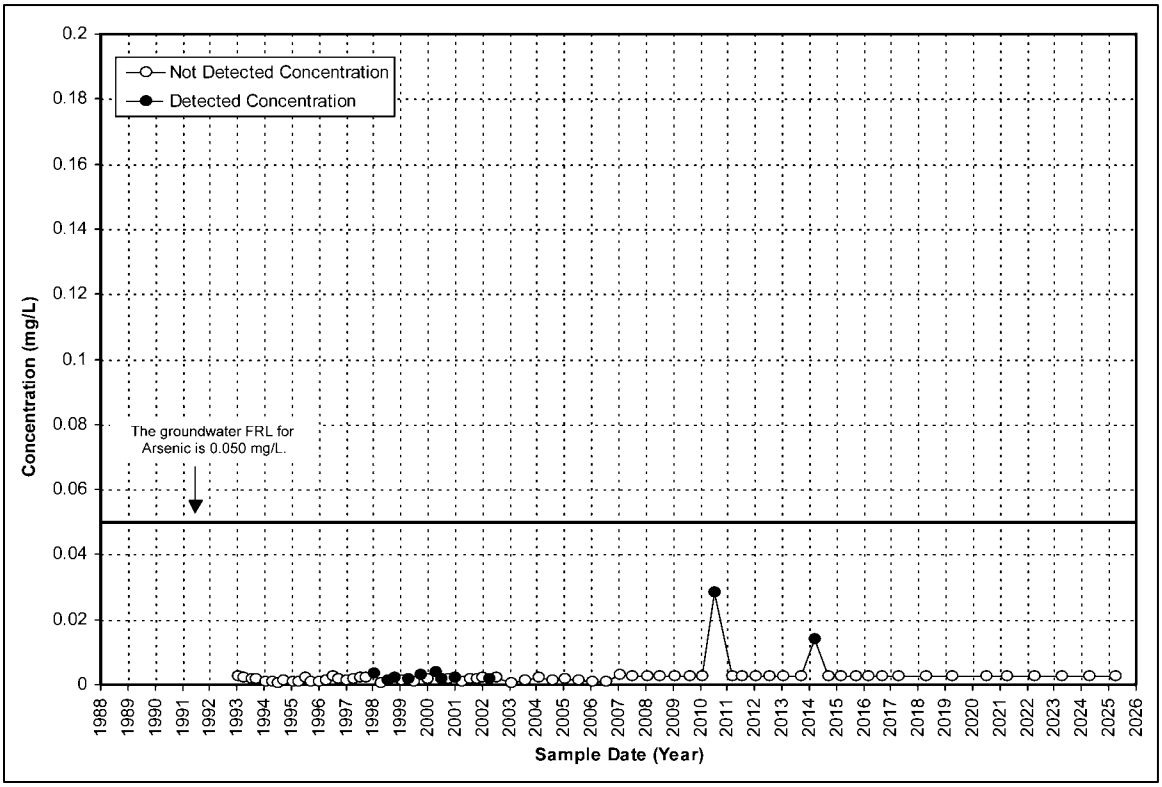


Figure A.4-47. Arsenic Concentration Versus Time Plot for Monitoring Well 3070

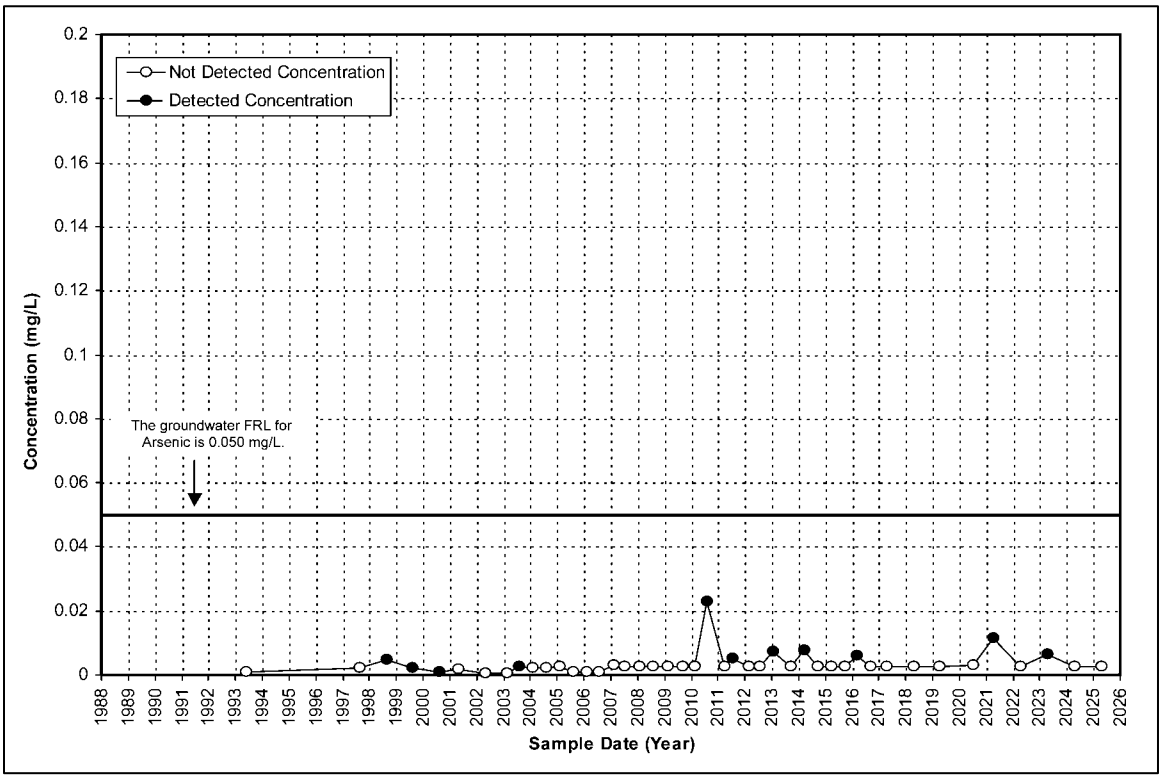


Figure A.4-48. Arsenic Concentration Versus Time Plot for Monitoring Well 3093

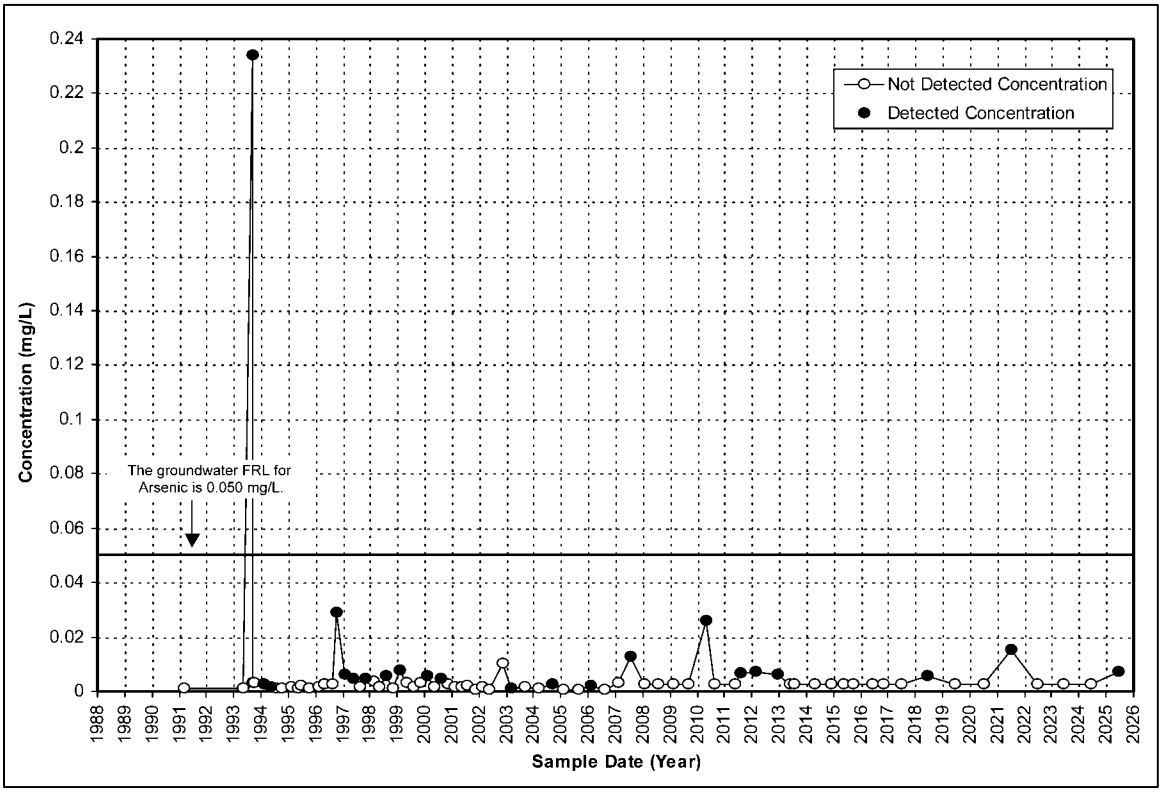


Figure A.4-49. Arsenic Concentration Versus Time Plot for Monitoring Well 3128

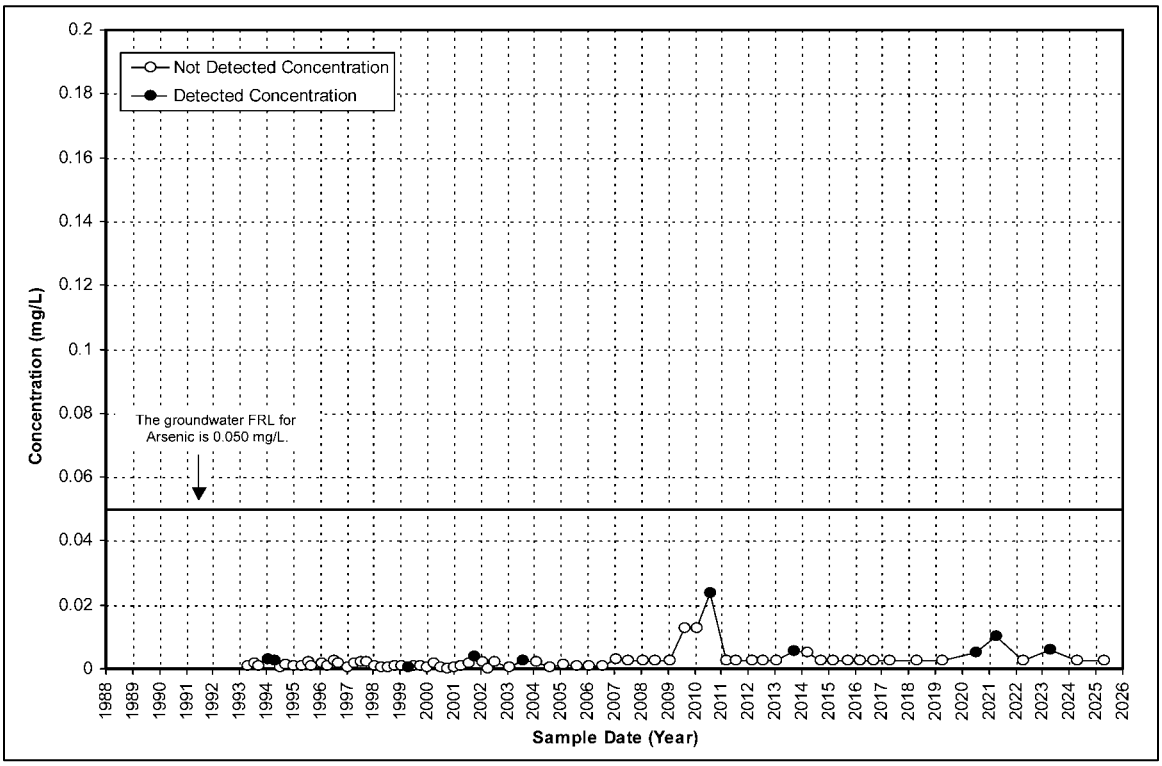


Figure A.4-50. Arsenic Concentration Versus Time Plot for Monitoring Well 3398

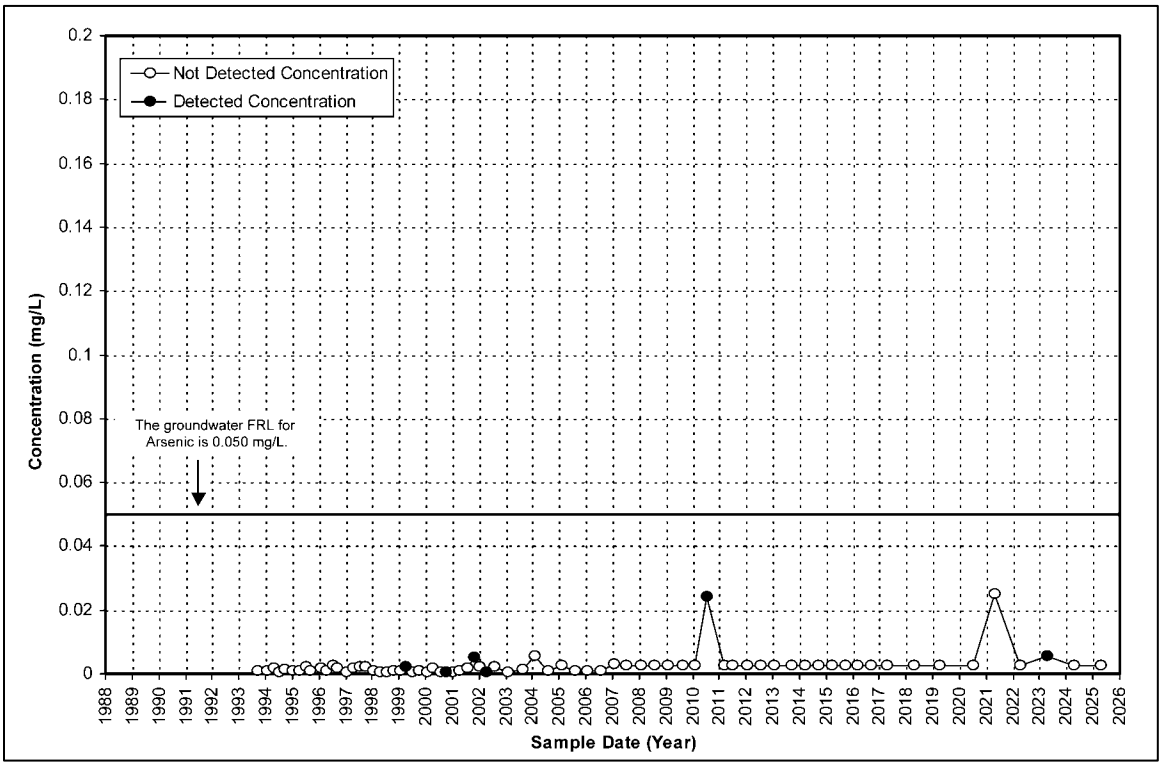


Figure A.4-51. Arsenic Concentration Versus Time Plot for Monitoring Well 3424

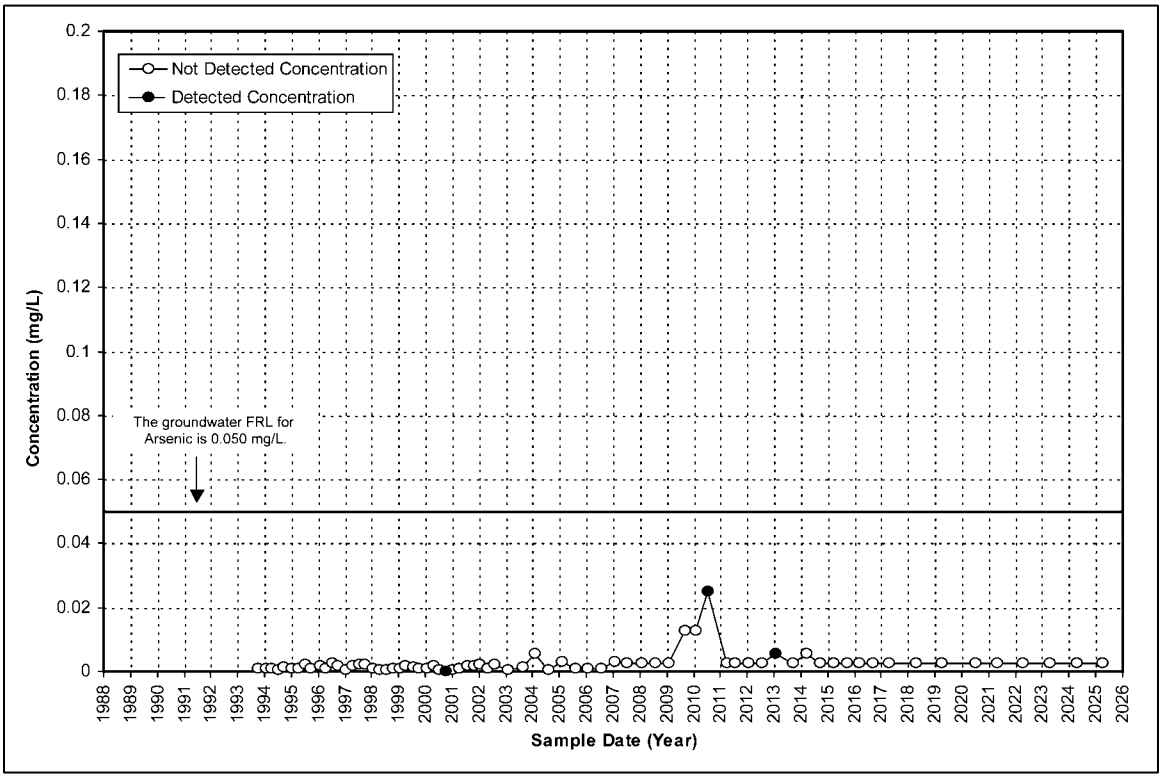


Figure A.4-52. Arsenic Concentration Versus Time Plot for Monitoring Well 3426

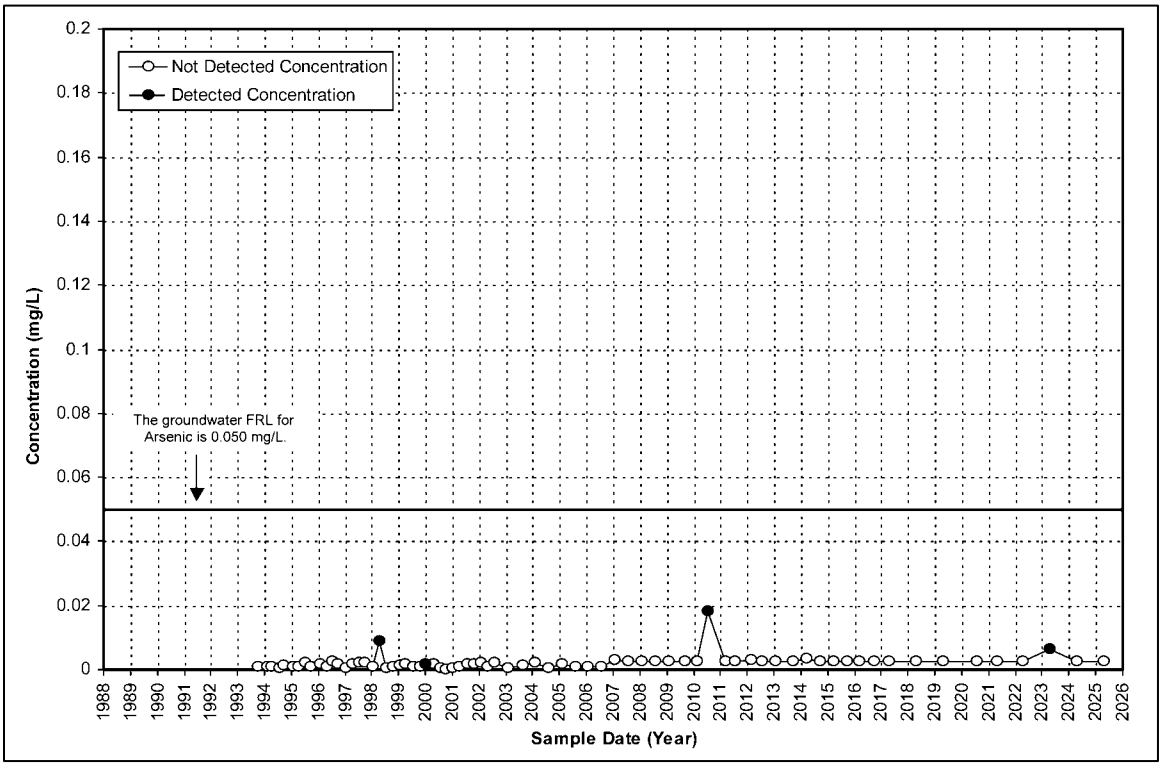


Figure A.4-53. Arsenic Concentration Versus Time Plot for Monitoring Well 3429

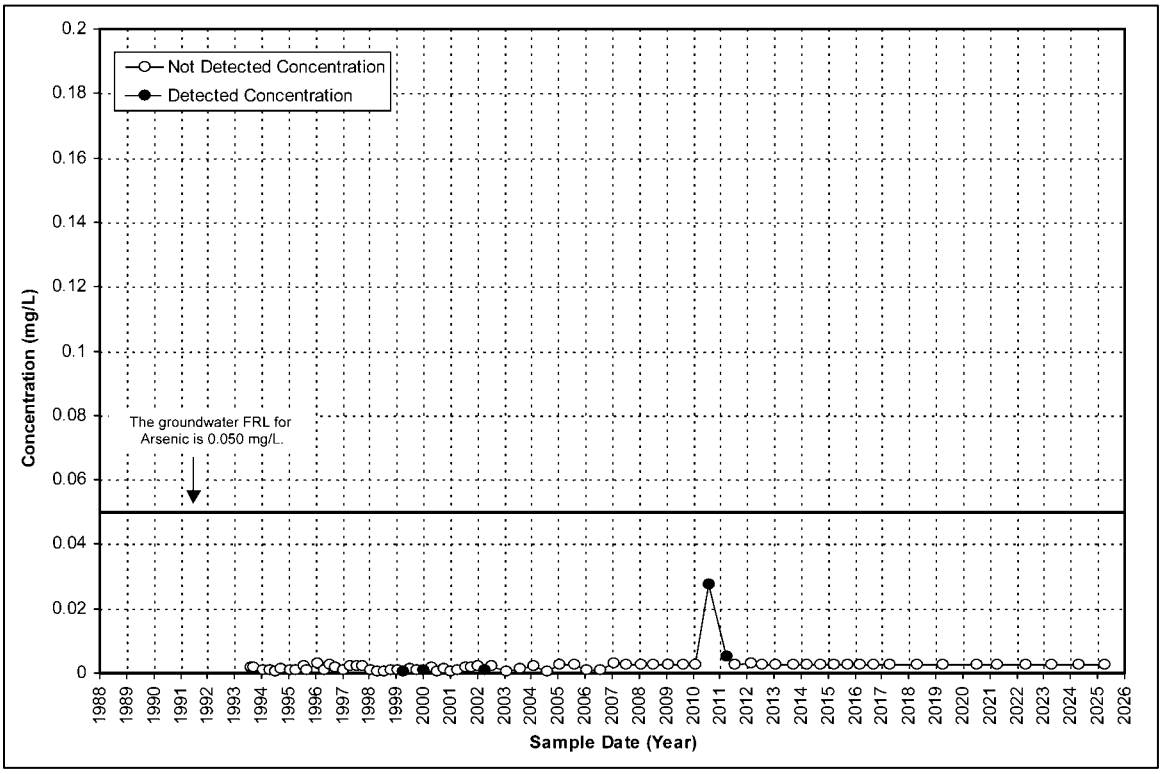


Figure A.4-54. Arsenic Concentration Versus Time Plot for Monitoring Well 3431

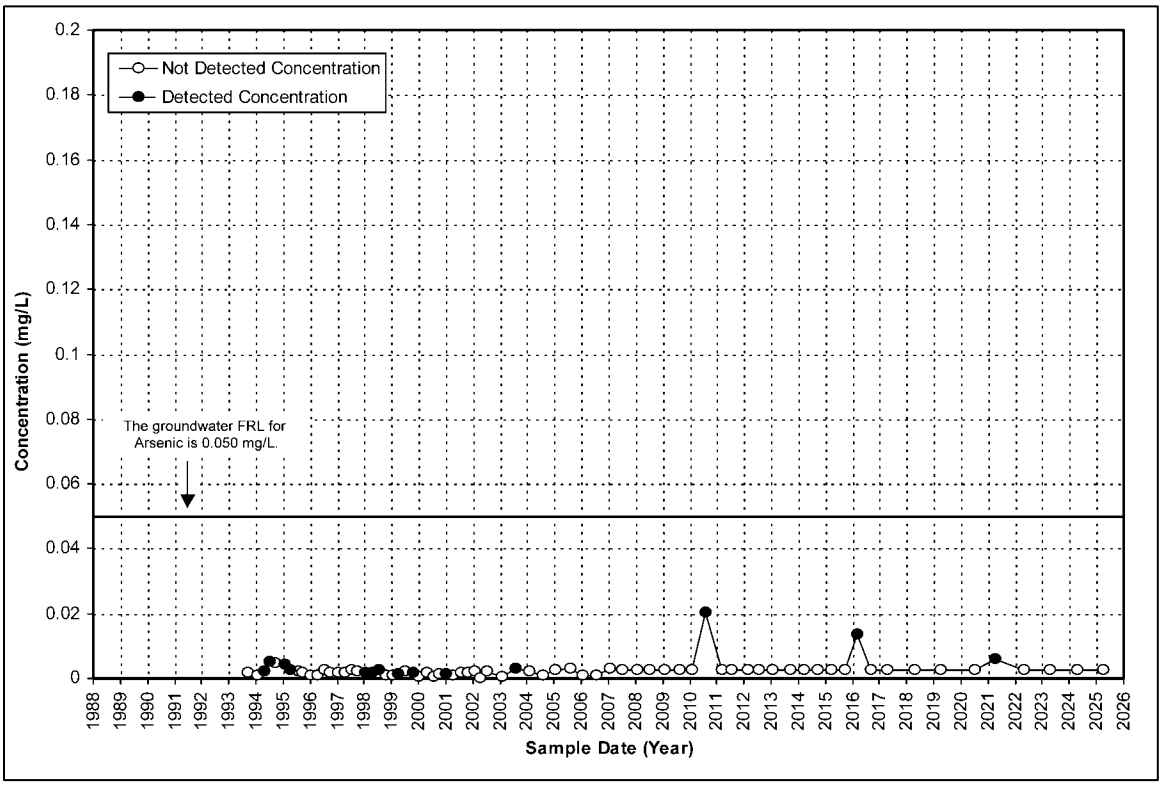


Figure A.4-55. Arsenic Concentration Versus Time Plot for Monitoring Well 3432

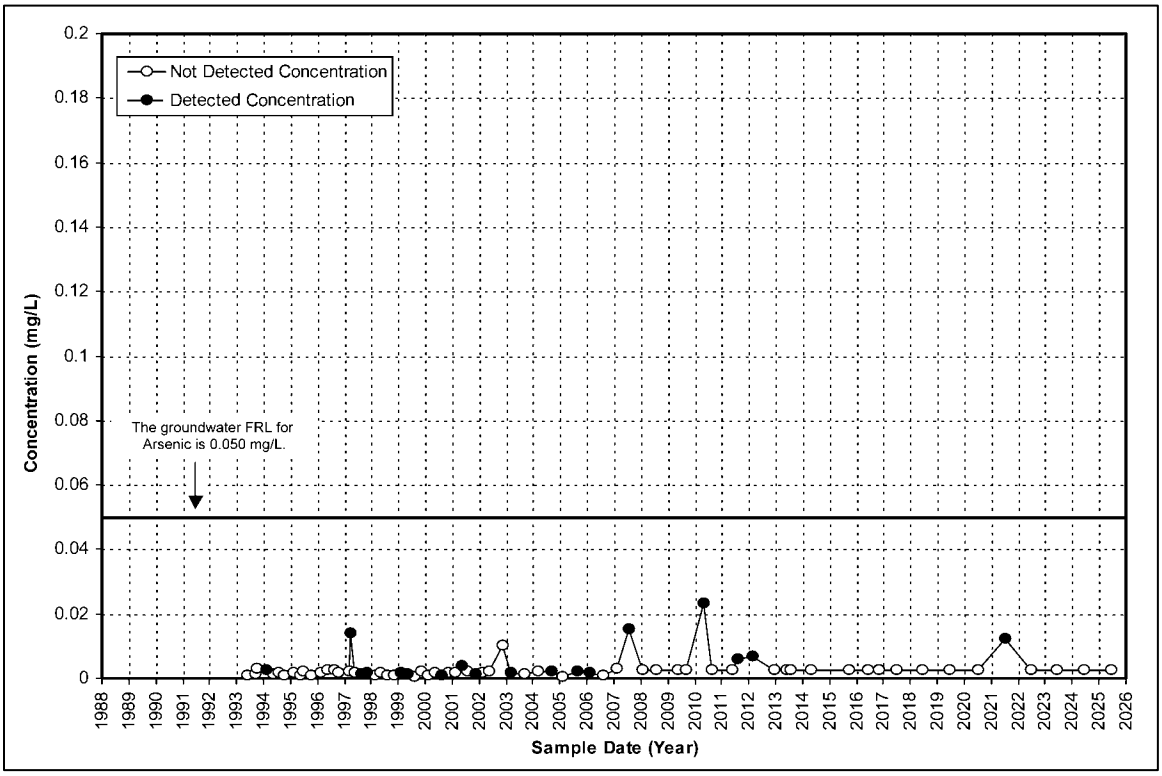


Figure A.4-56. Arsenic Concentration Versus Time Plot for Monitoring Well 3636

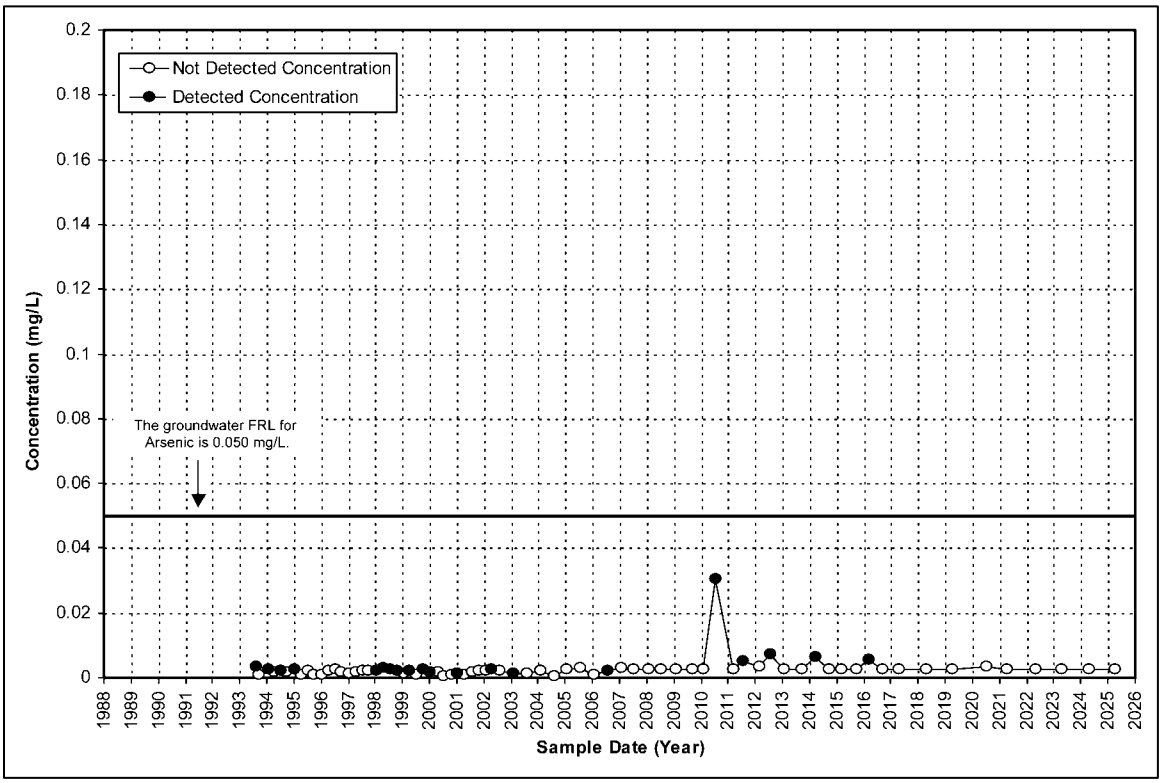


Figure A.4-57. Arsenic Concentration Versus Time Plot for Monitoring Well 3733

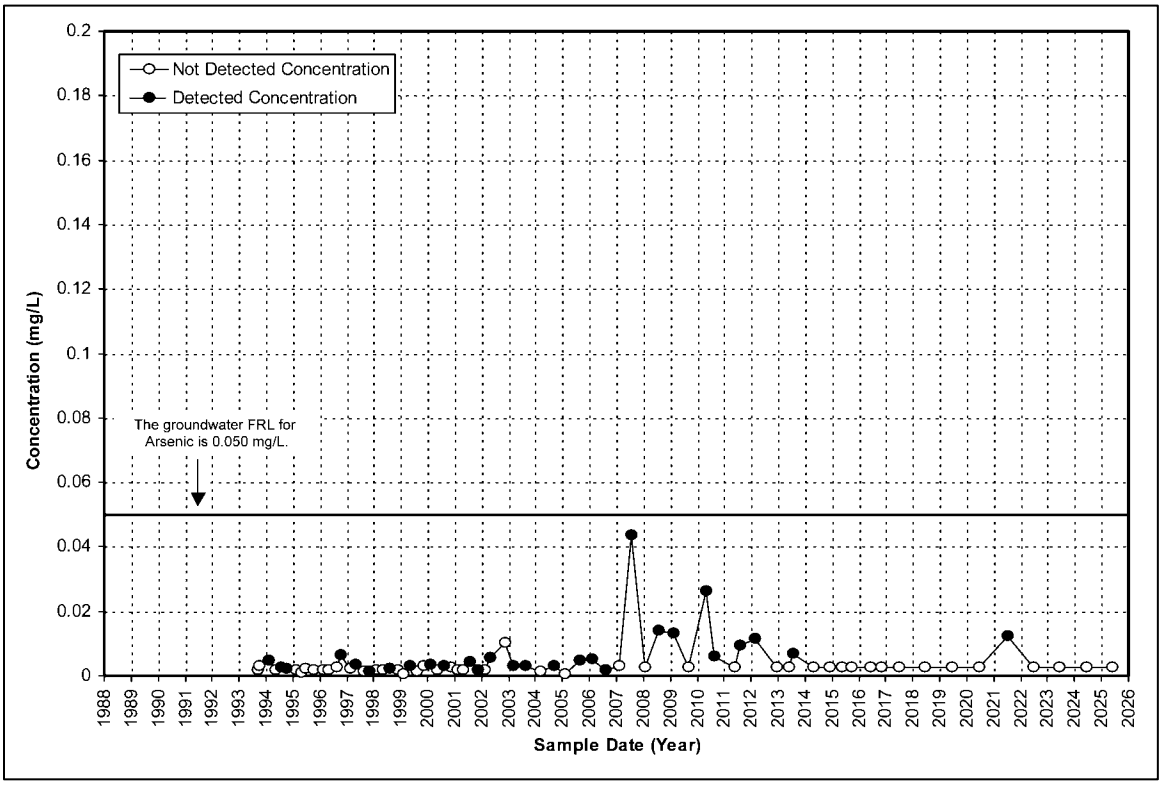


Figure A.4-58. Arsenic Concentration Versus Time Plot for Monitoring Well 3898

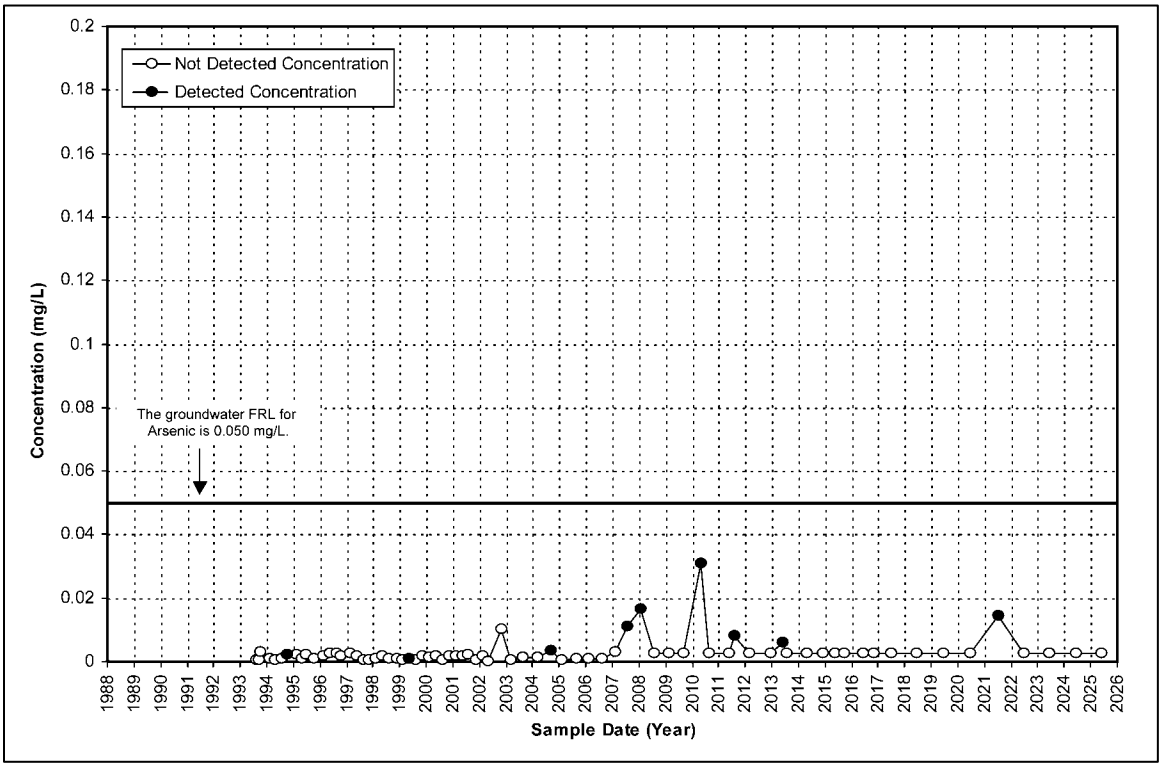


Figure A.4-59. Arsenic Concentration Versus Time Plot for Monitoring Well 3899

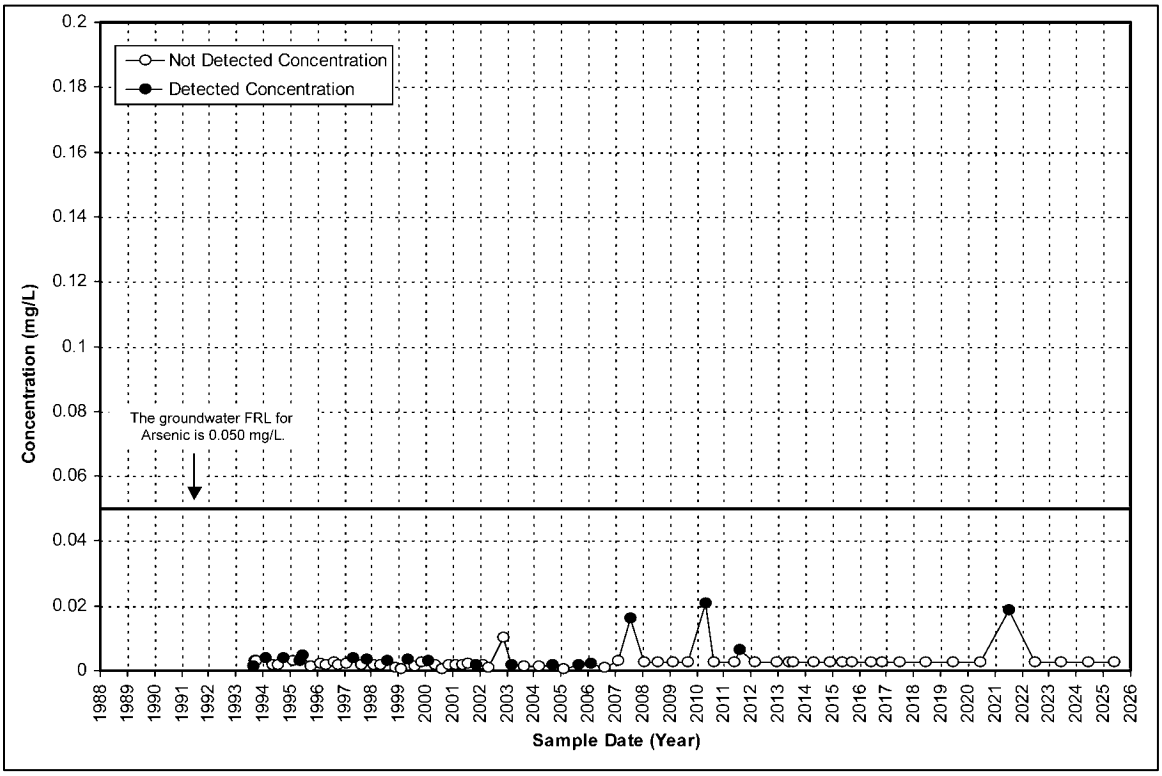


Figure A.4-60. Arsenic Concentration Versus Time Plot for Monitoring Well 3900

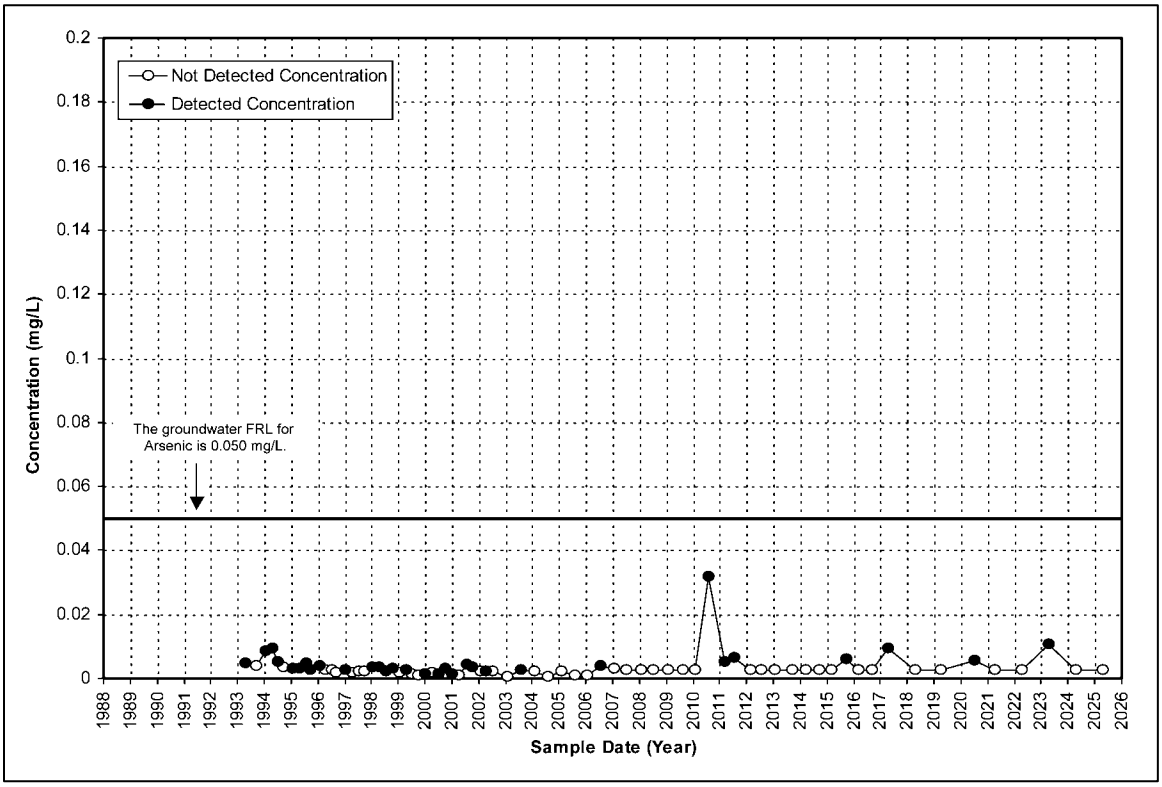


Figure A.4-61. Arsenic Concentration Versus Time Plot for Monitoring Well 4398

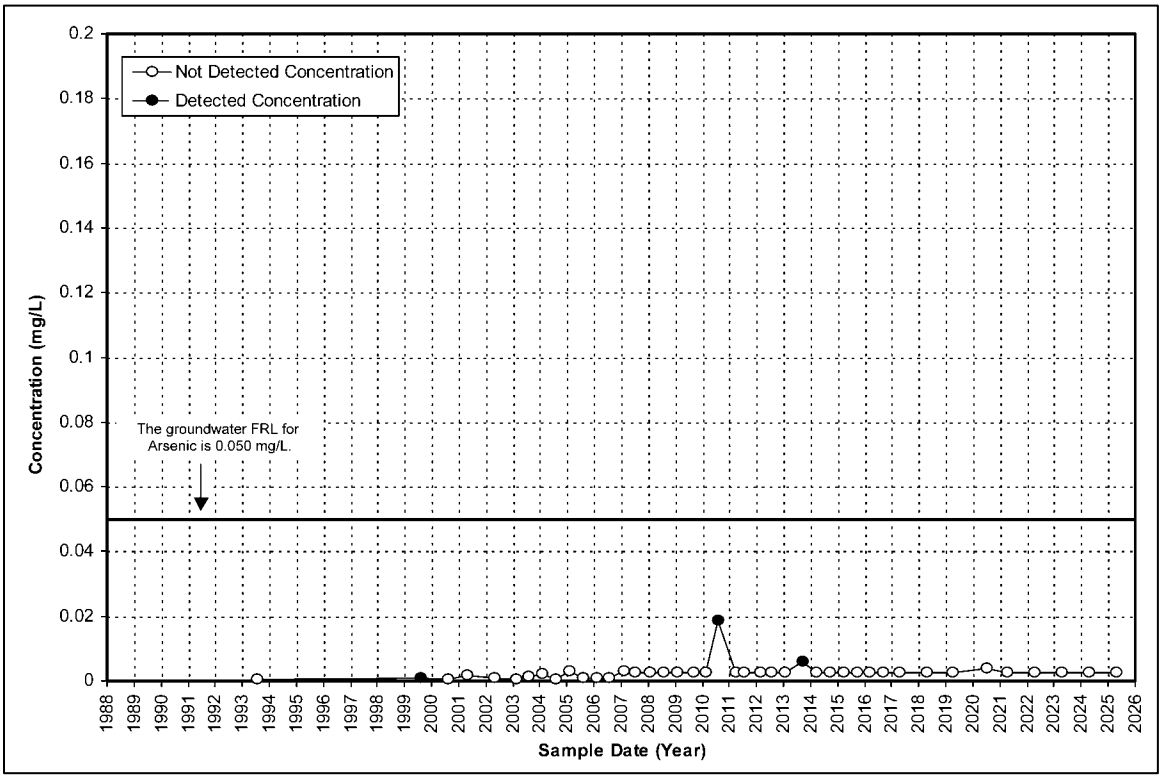


Figure A.4-62. Arsenic Concentration Versus Time Plot for Monitoring Well 21063

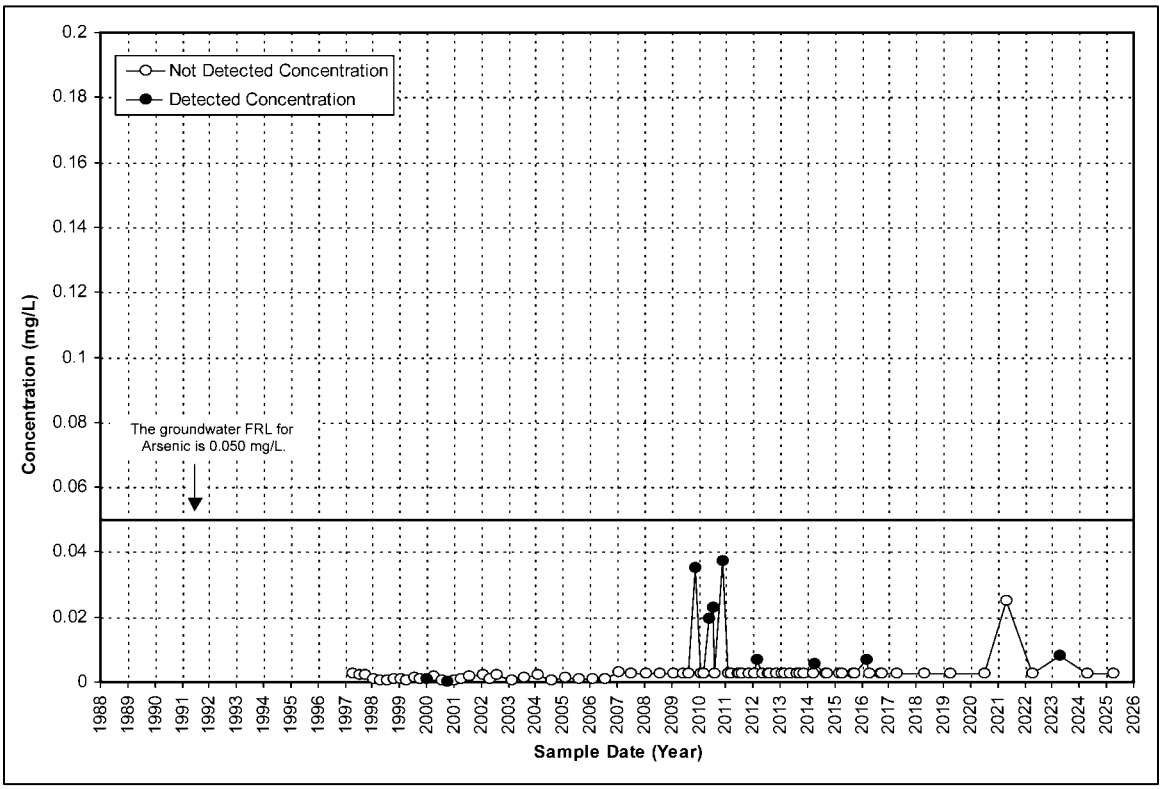


Figure A.4-63. Arsenic Concentration Versus Time Plot for Monitoring Well 22198

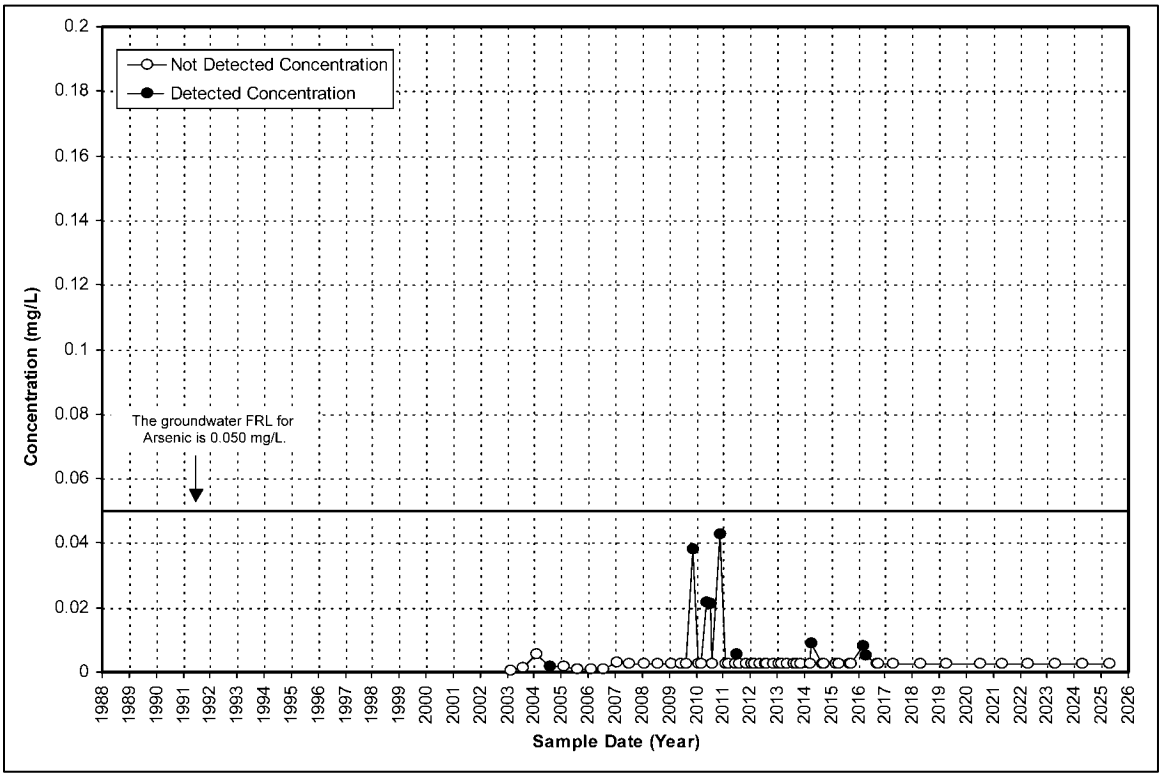


Figure A.4-64. Arsenic Concentration Versus Time Plot for Monitoring Well 22199

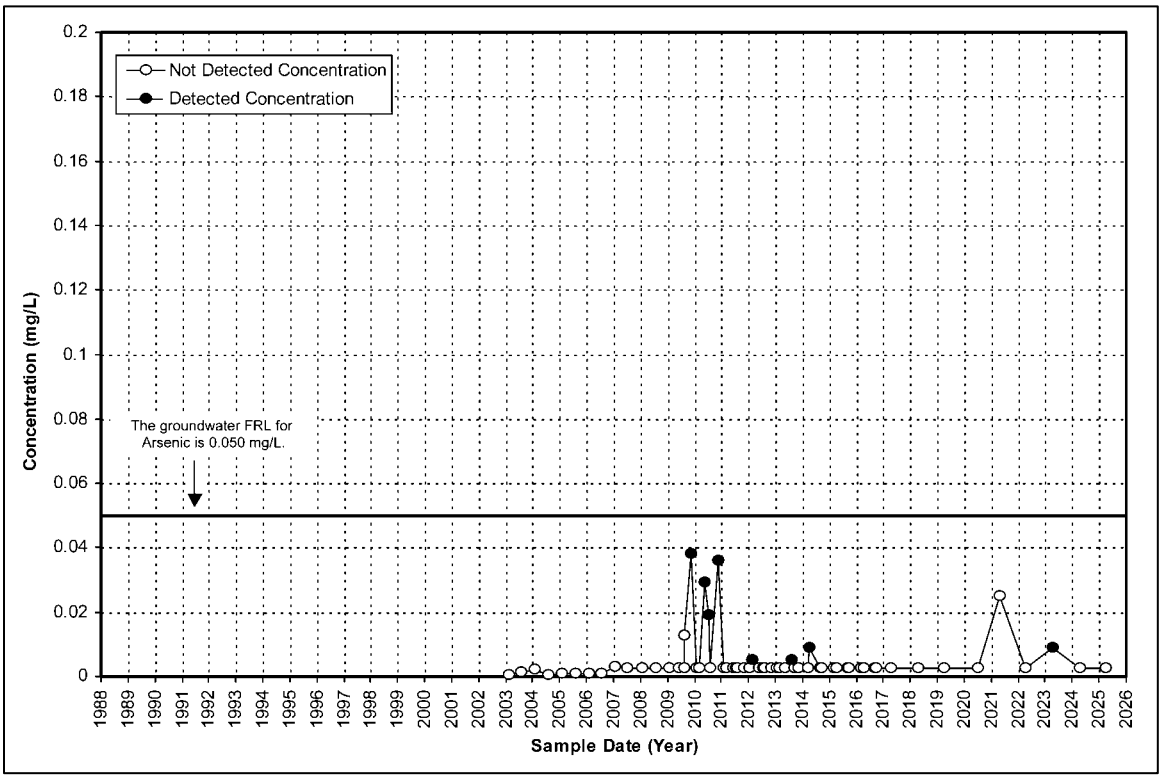


Figure A.4-65. Arsenic Concentration Versus Time Plot for Monitoring Well 22204

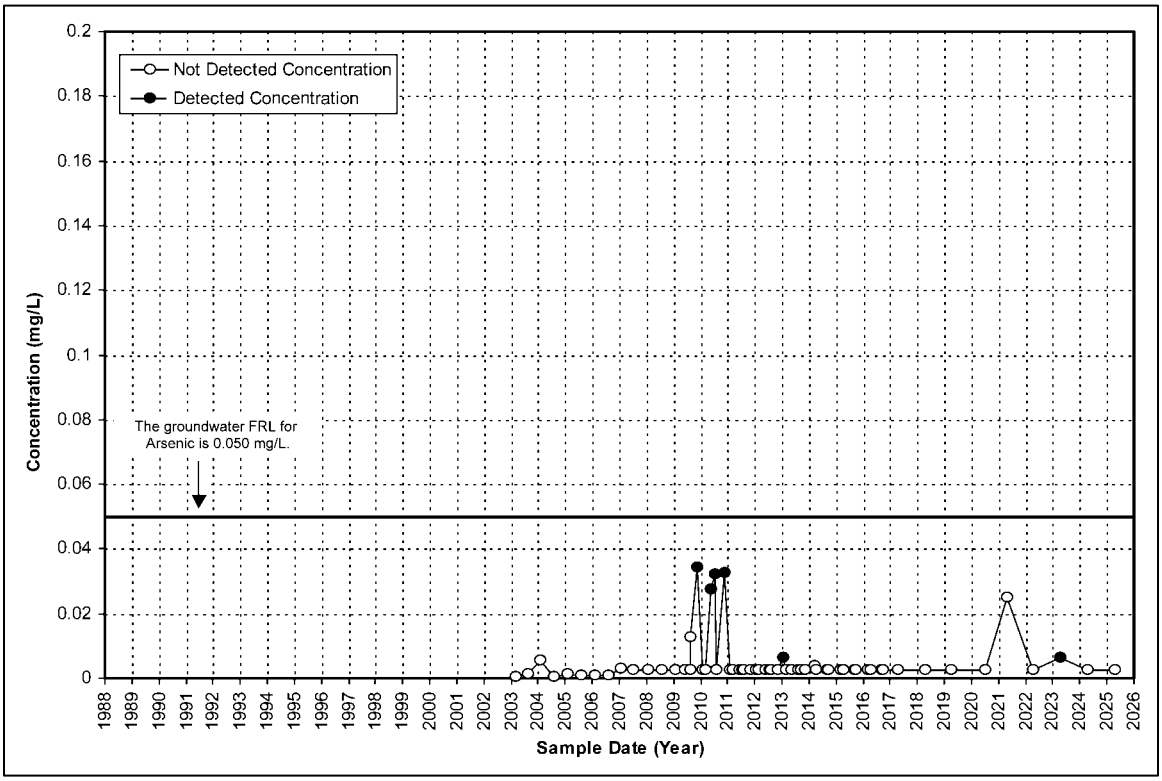


Figure A.4-66. Arsenic Concentration Versus Time Plot for Monitoring Well 22205

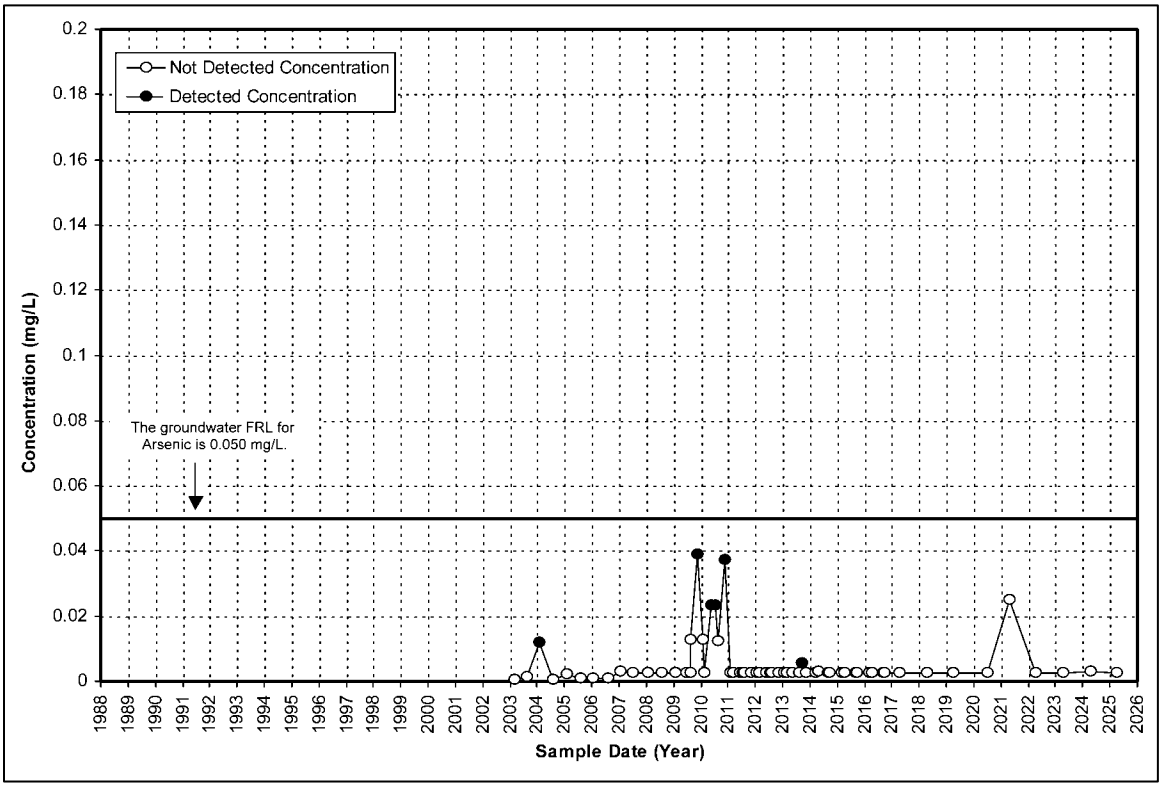


Figure A.4-67. Arsenic Concentration Versus Time Plot for Monitoring Well 22208

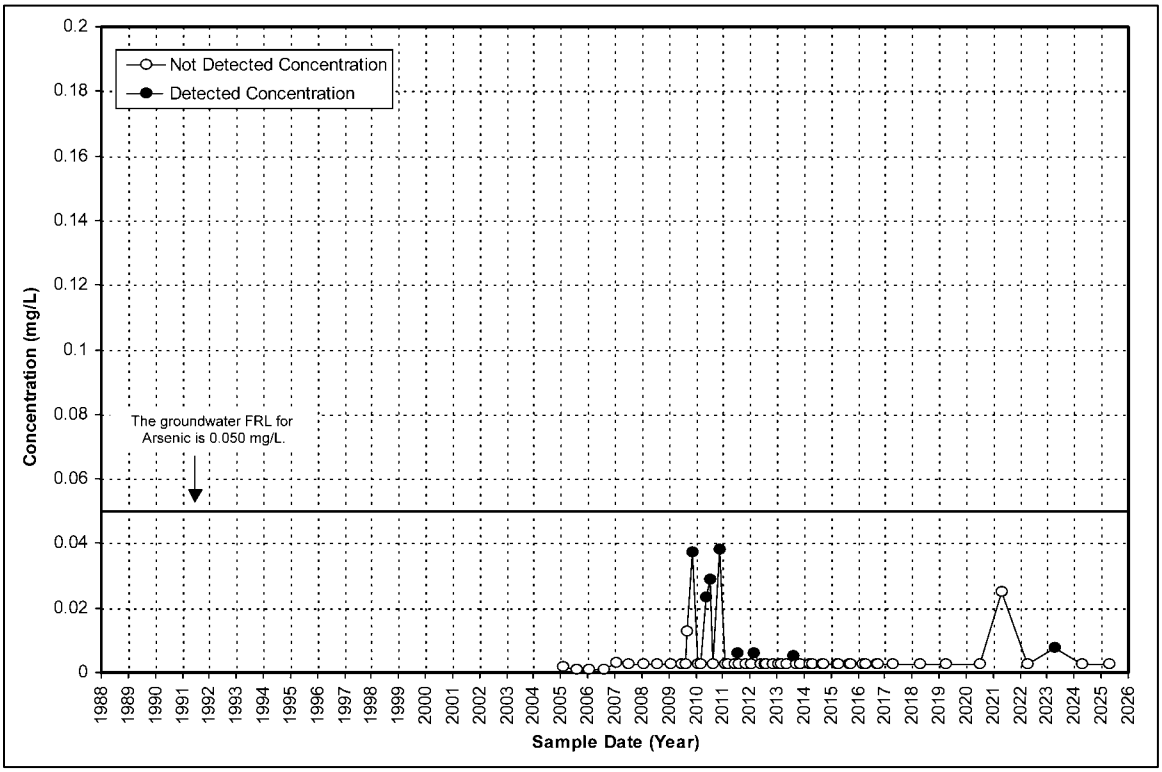


Figure A.4-68. Arsenic Concentration Versus Time Plot for Monitoring Well 22210

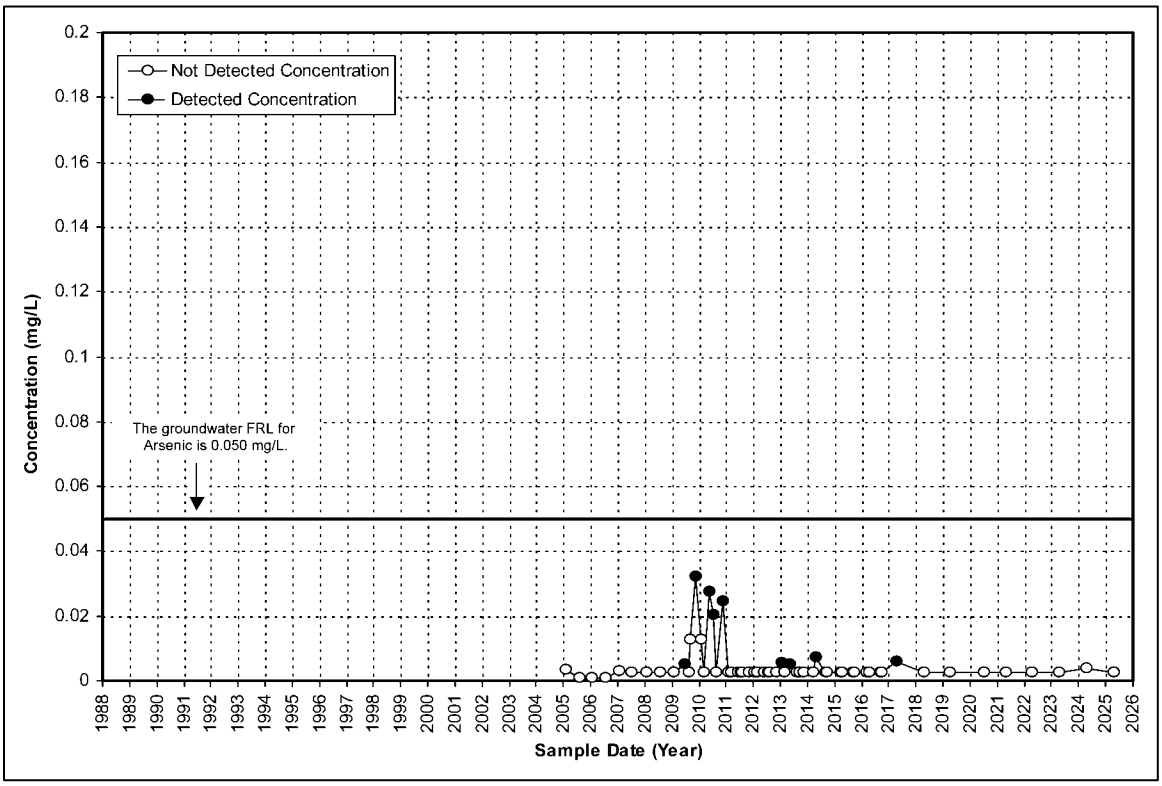


Figure A.4-69. Arsenic Concentration Versus Time Plot for Monitoring Well 22211

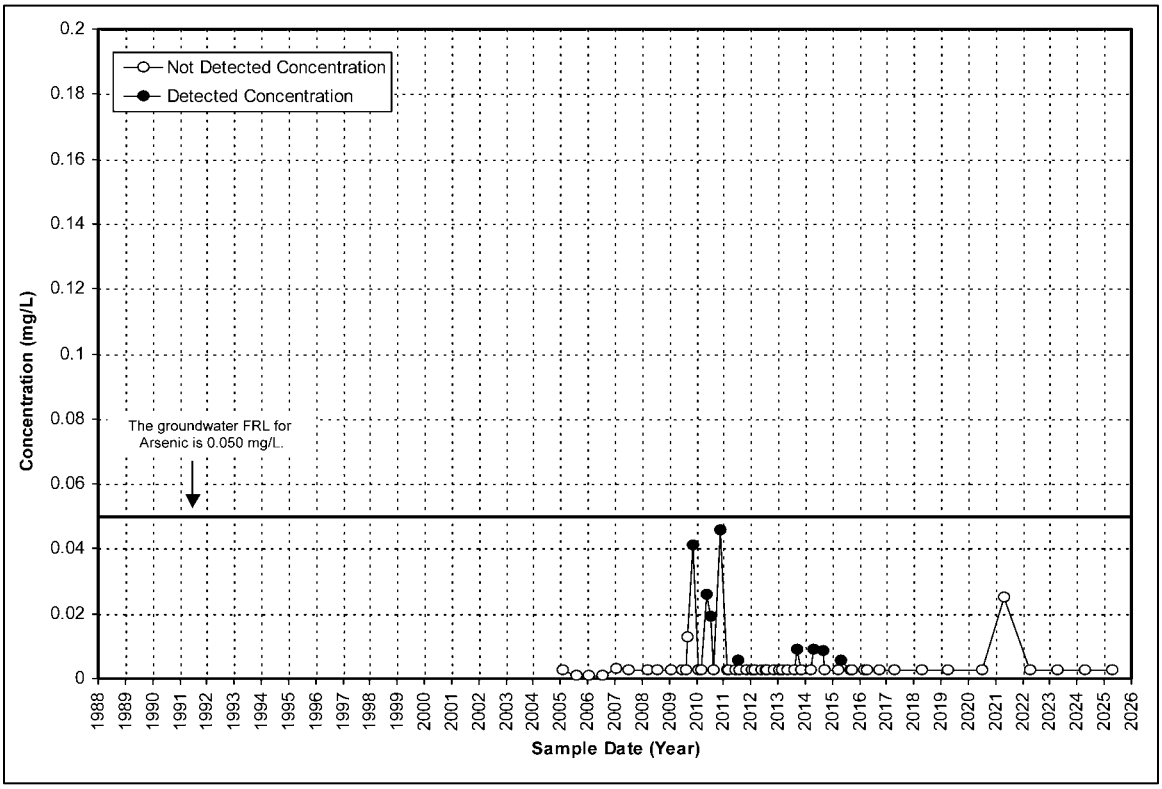


Figure A.4-70. Arsenic Concentration Versus Time Plot for Monitoring Well 22214

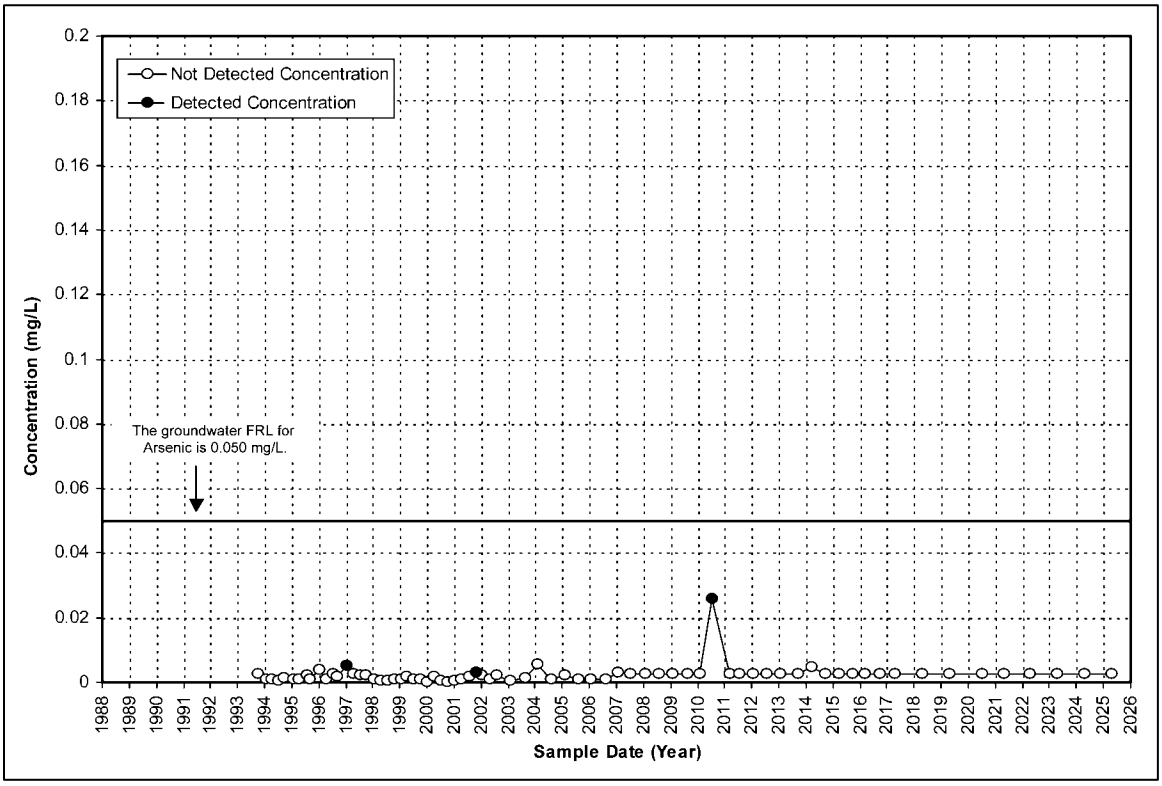


Figure A.4-71. Arsenic Concentration Versus Time Plot for Monitoring Well 31217

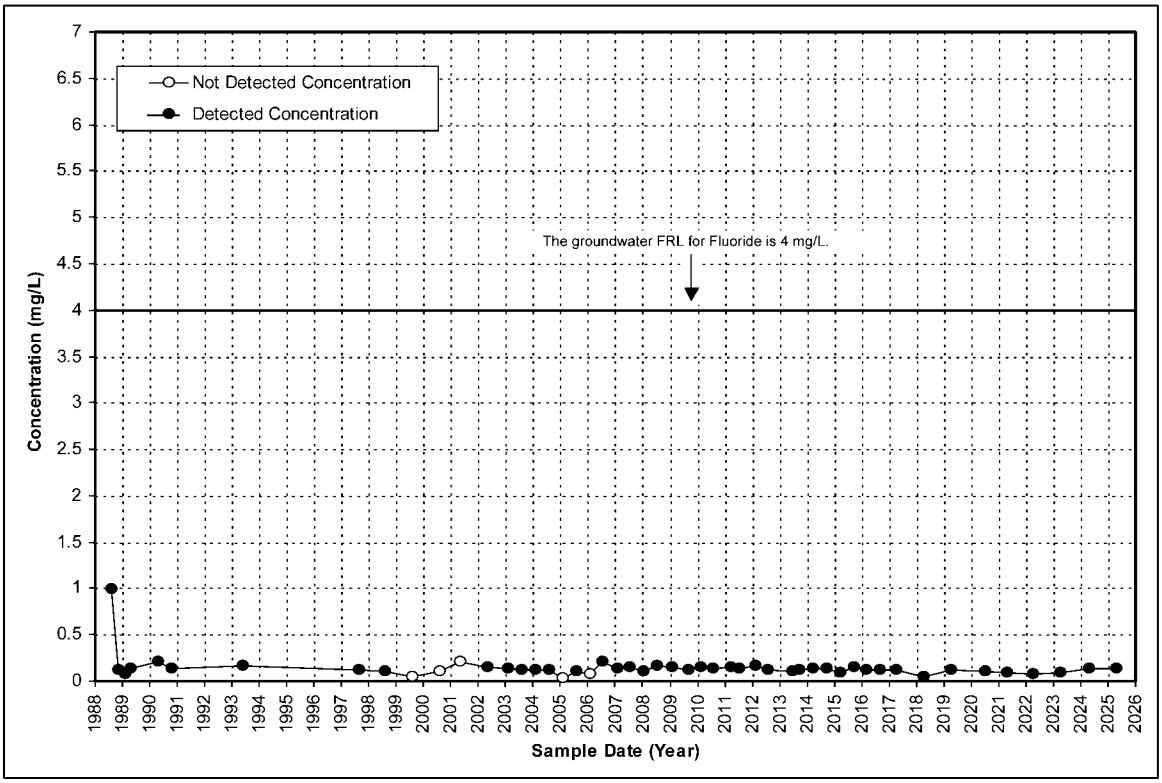


Figure A.4-72. Fluoride Concentration Versus Time Plot for Monitoring Well 2093

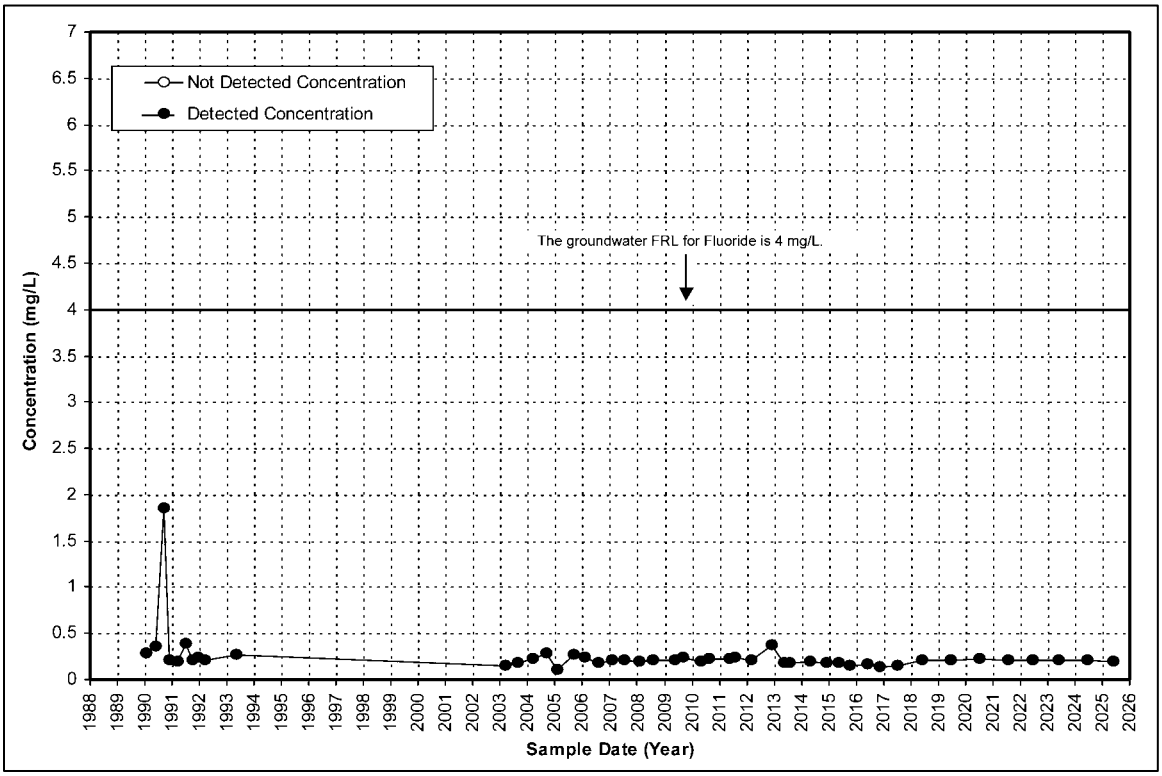


Figure A.4-73. Fluoride Concentration Versus Time Plot for Monitoring Well 2128

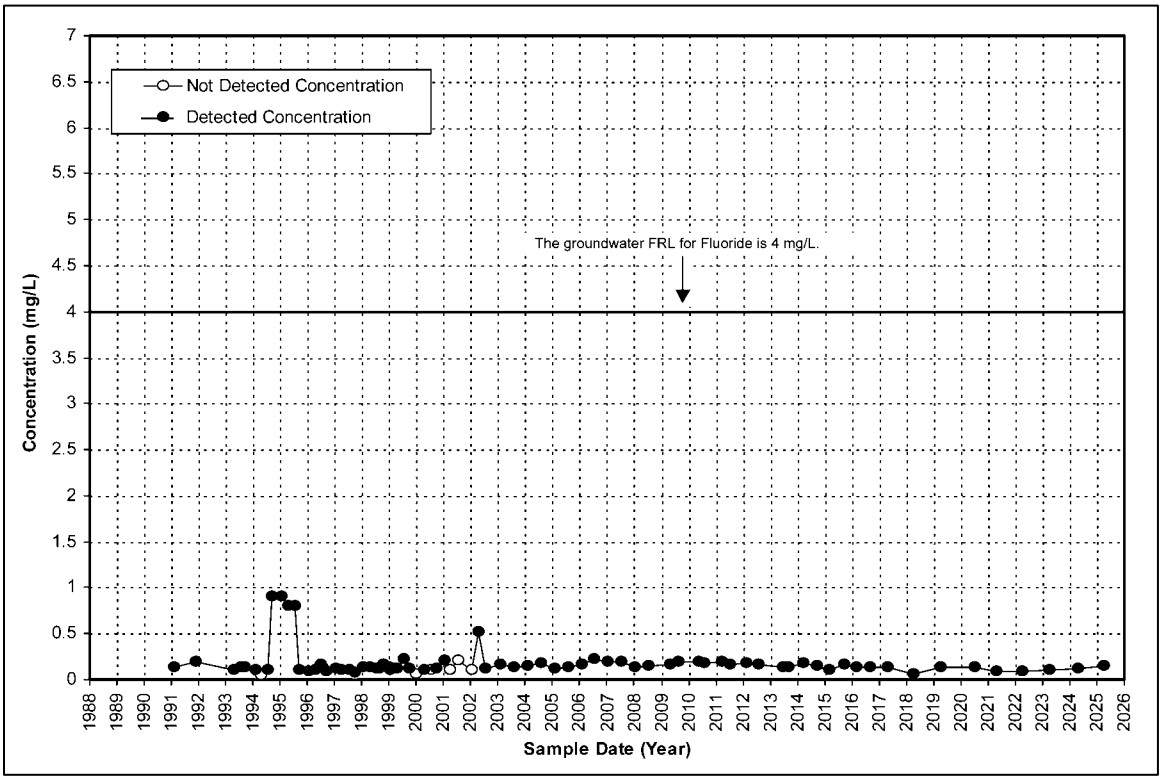


Figure A.4-74. Fluoride Concentration Versus Time Plot for Monitoring Well 2398

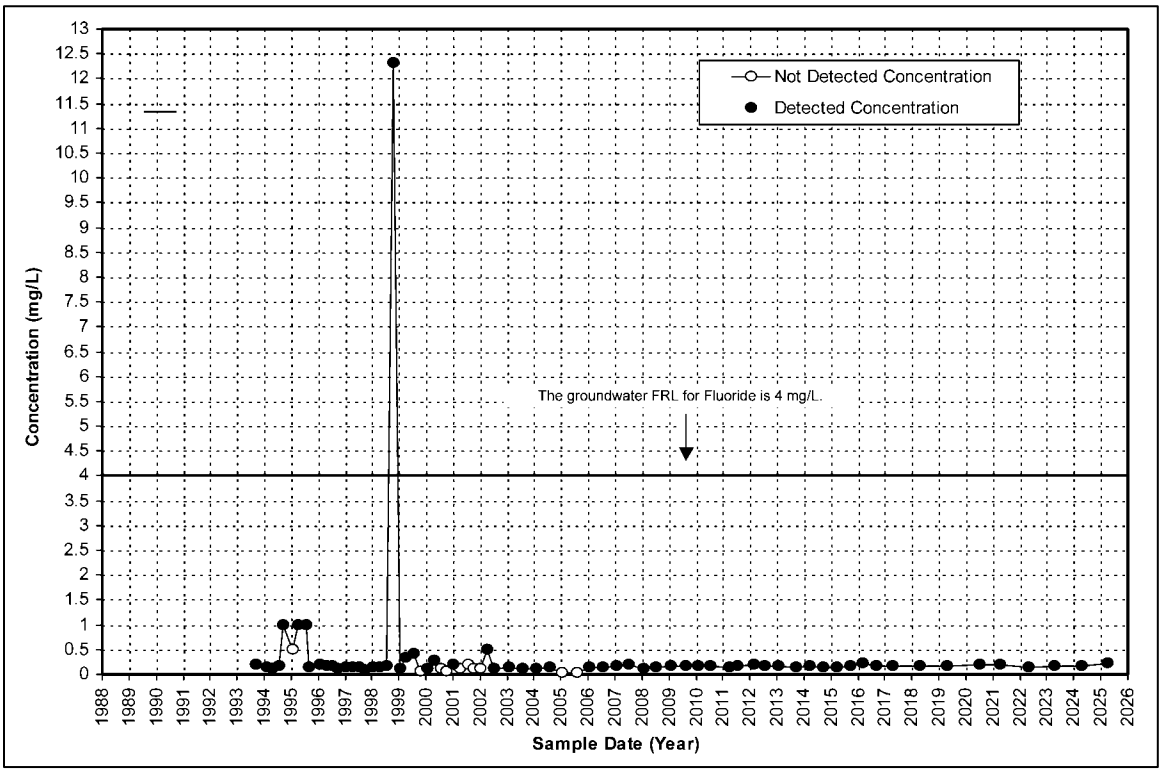


Figure A.4-75. Fluoride Concentration Versus Time Plot for Monitoring Well 2431

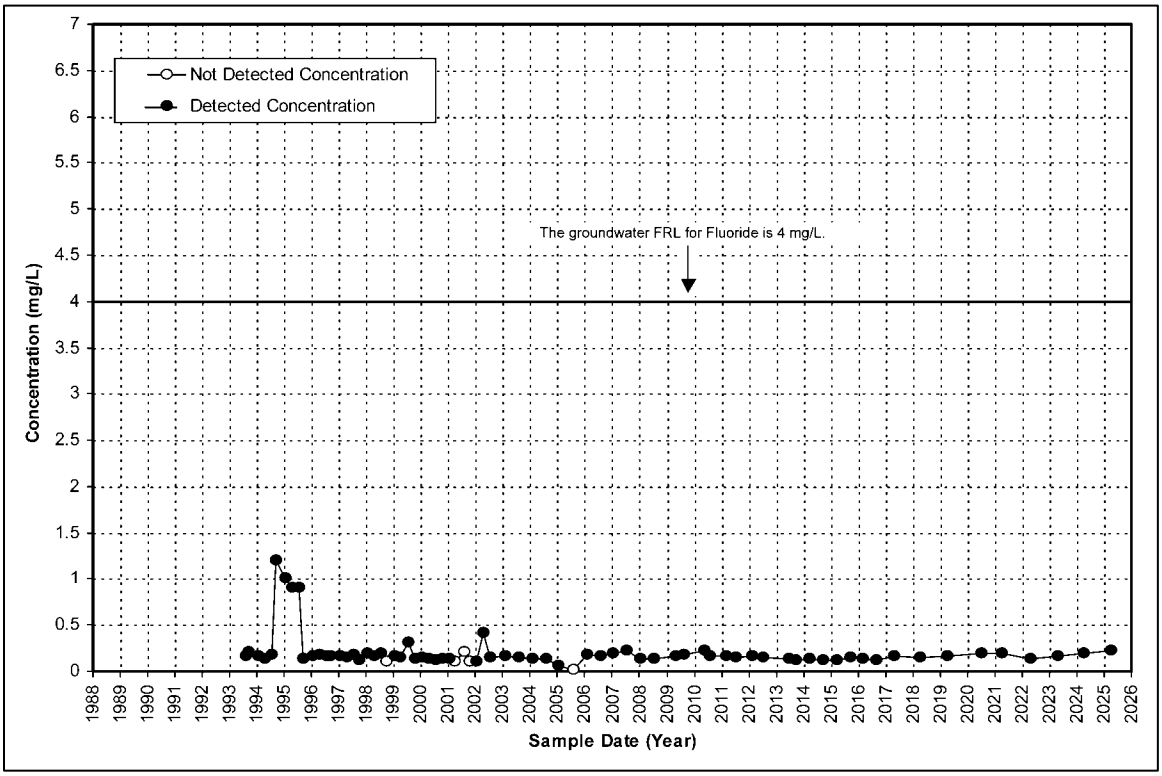


Figure A.4-76. Fluoride Concentration Versus Time Plot for Monitoring Well 2432

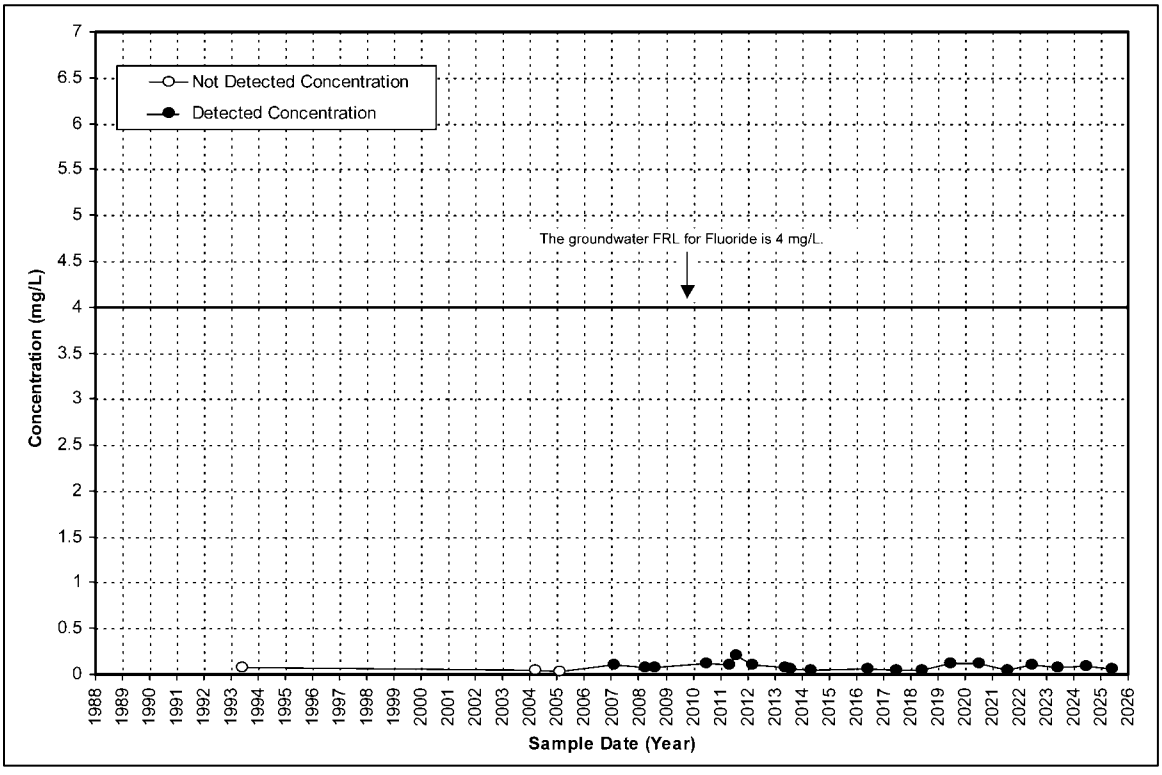


Figure A.4-77. Fluoride Concentration Versus Time Plot for Monitoring Well 2636

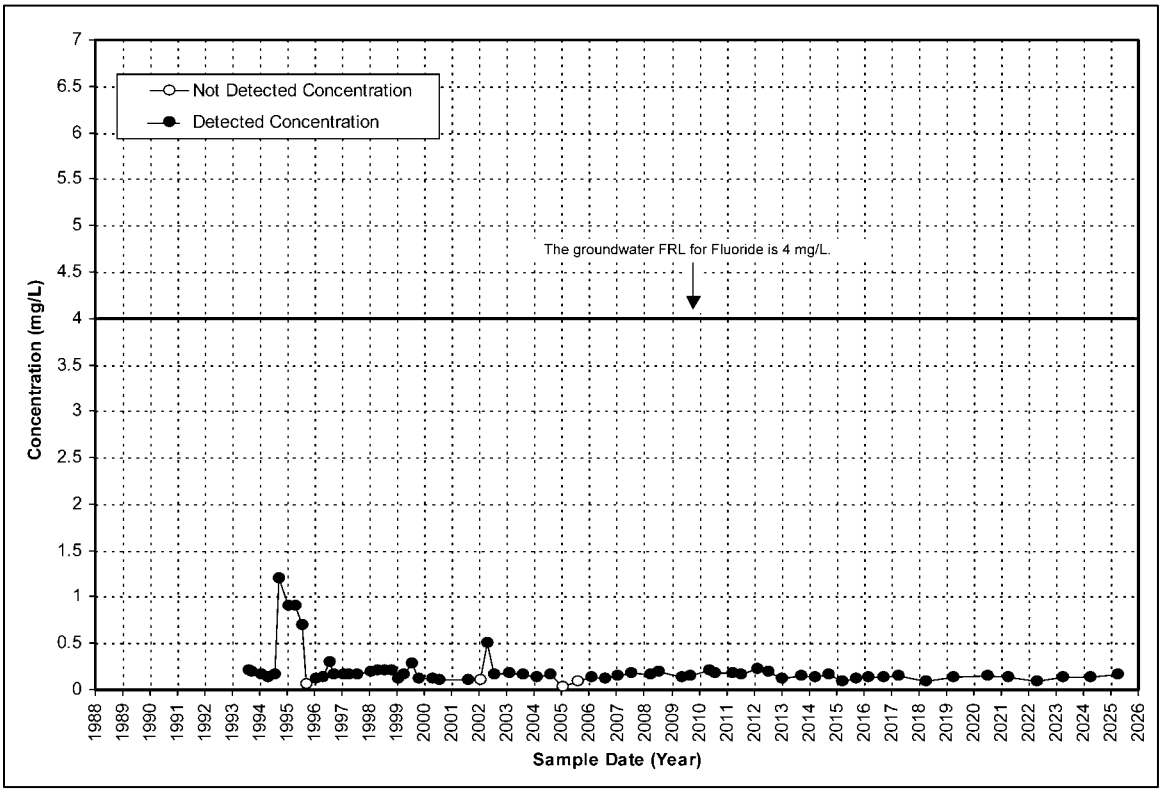


Figure A.4-78. Fluoride Concentration Versus Time Plot for Monitoring Well 2733

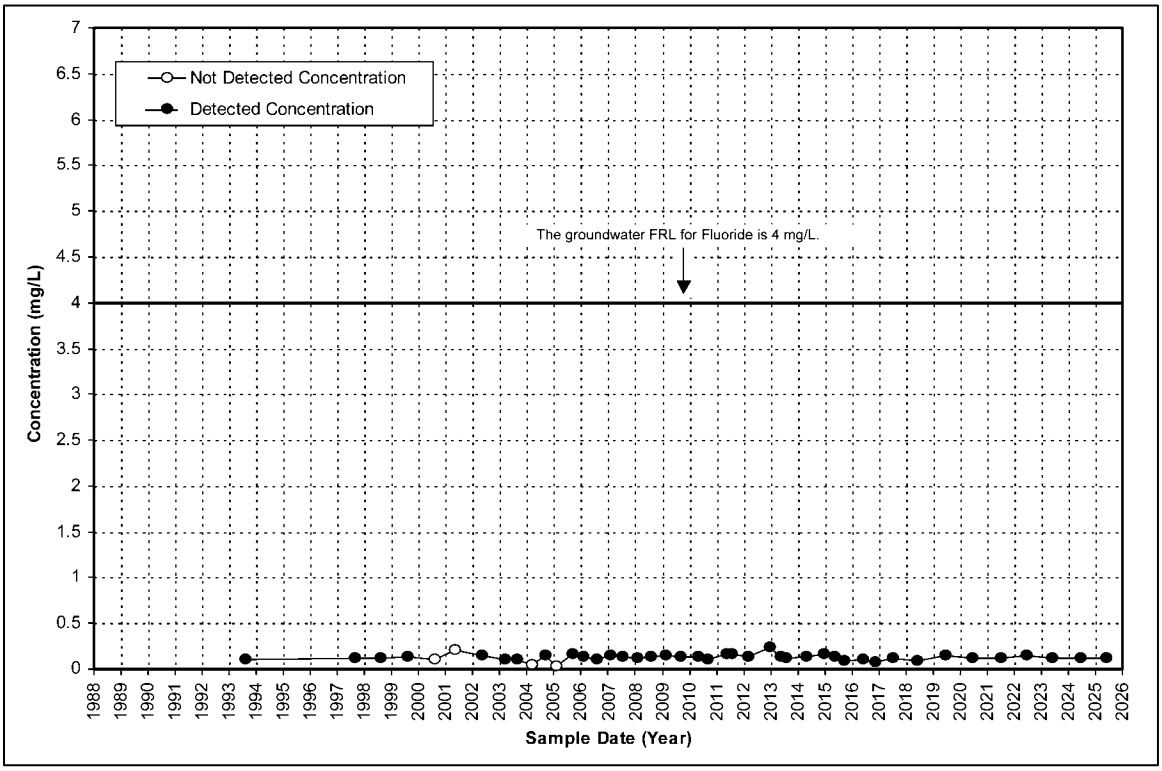


Figure A.4-79. Fluoride Concentration Versus Time Plot for Monitoring Well 2898

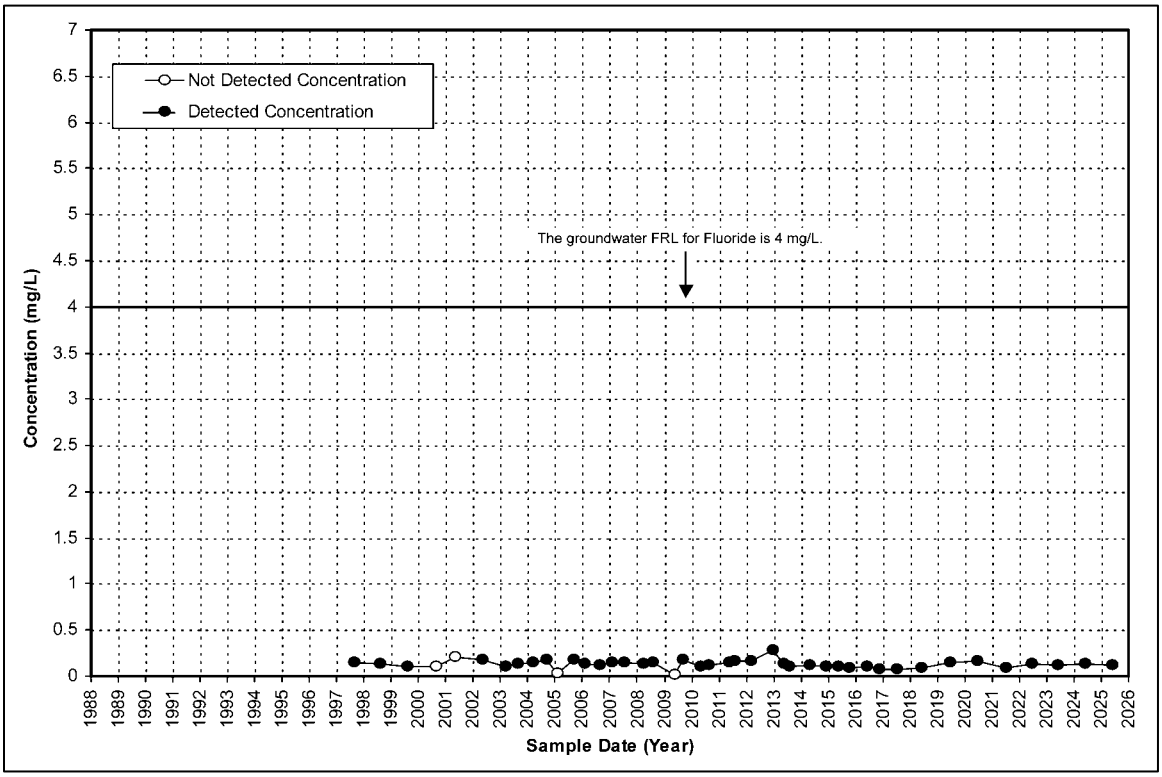


Figure A.4-80. Fluoride Concentration Versus Time Plot for Monitoring Well 2899

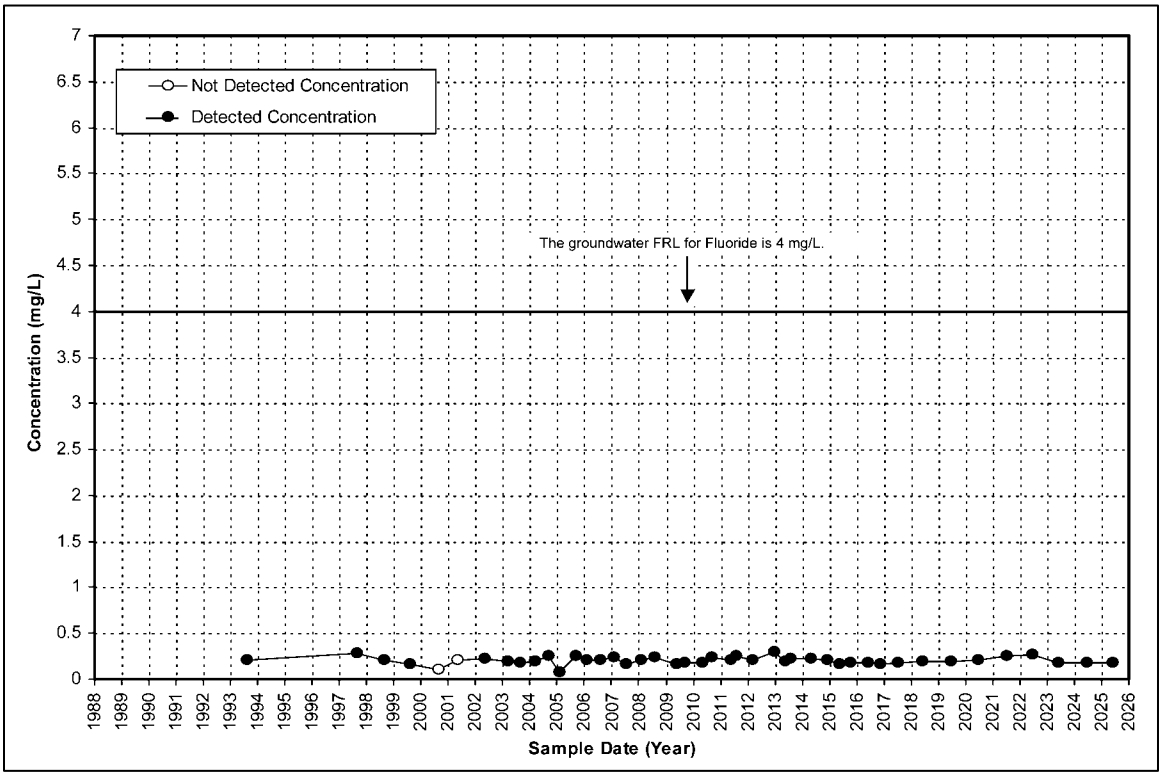


Figure A.4-81. Fluoride Concentration Versus Time Plot for Monitoring Well 2900

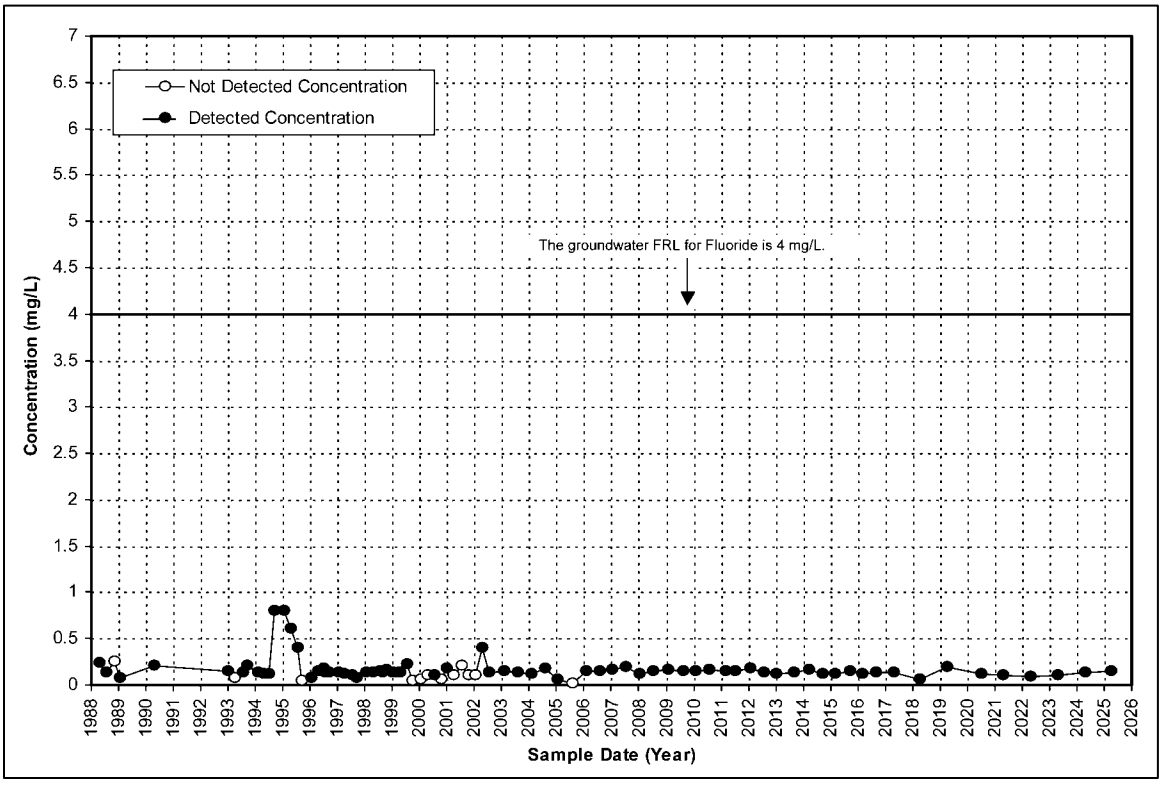


Figure A.4-82. Fluoride Concentration Versus Time Plot for Monitoring Well 3070

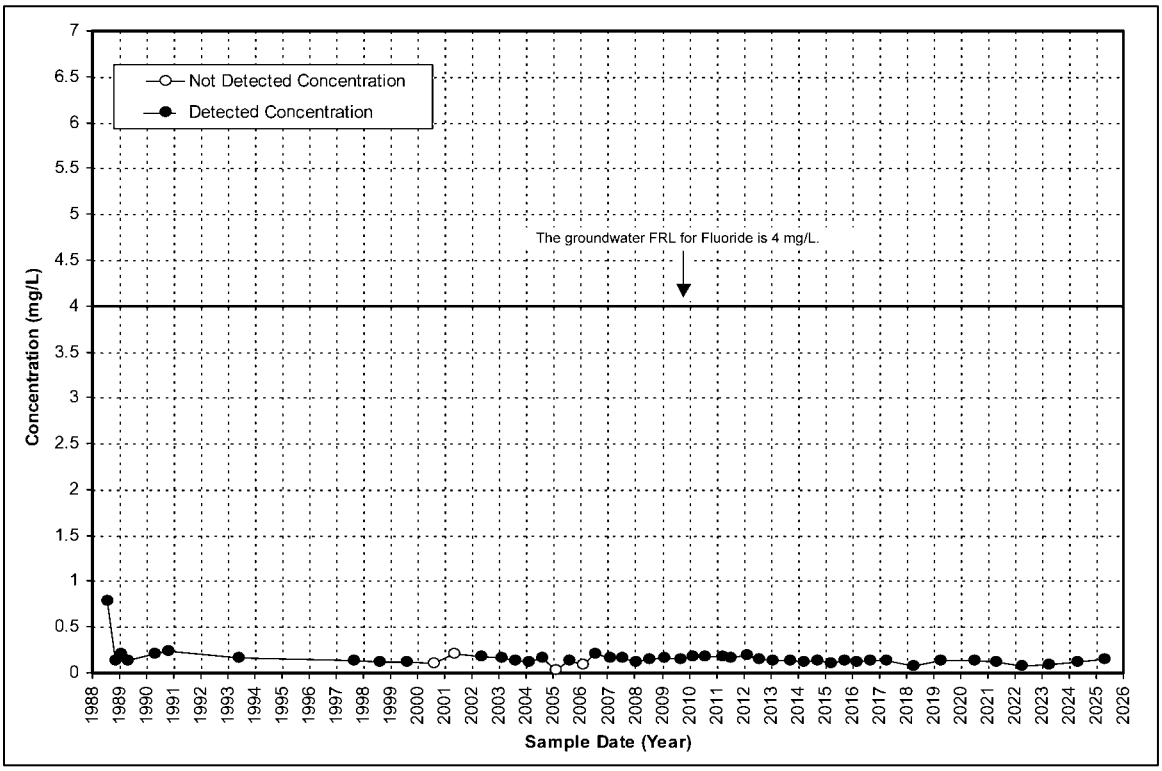


Figure A.4-83. Fluoride Concentration Versus Time Plot for Monitoring Well 3093

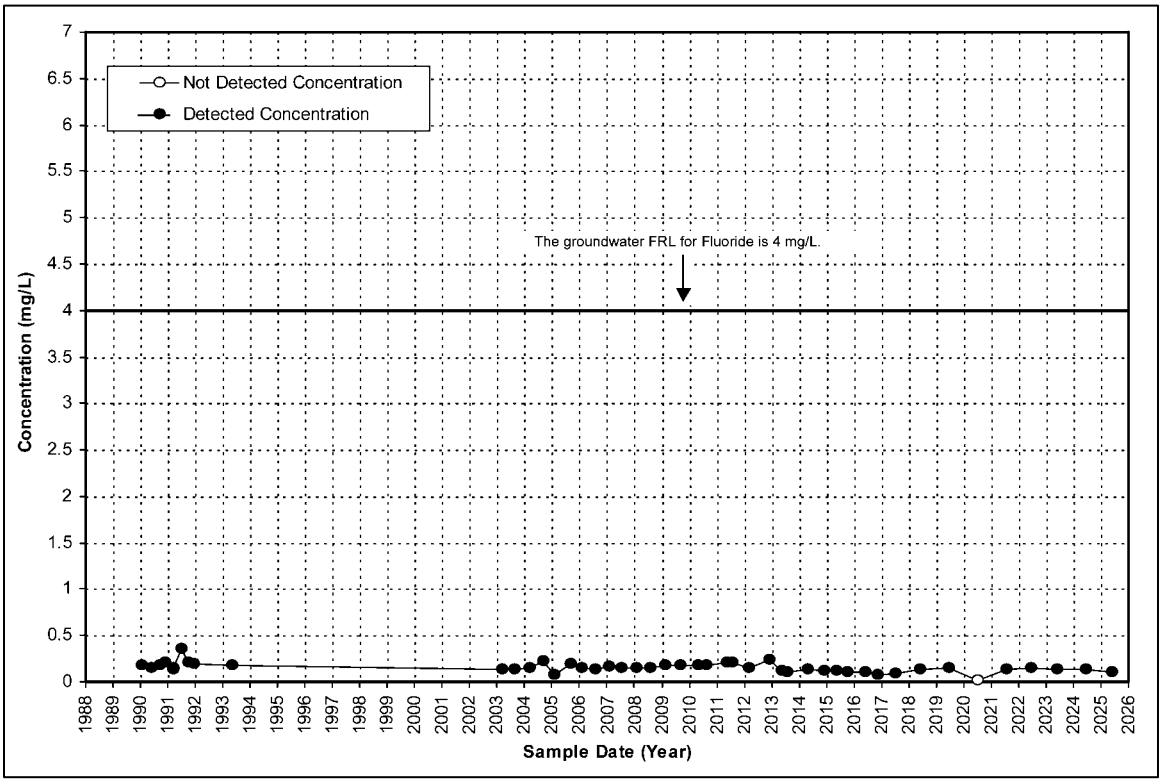


Figure A.4-84. Fluoride Concentration Versus Time Plot for Monitoring Well 3128

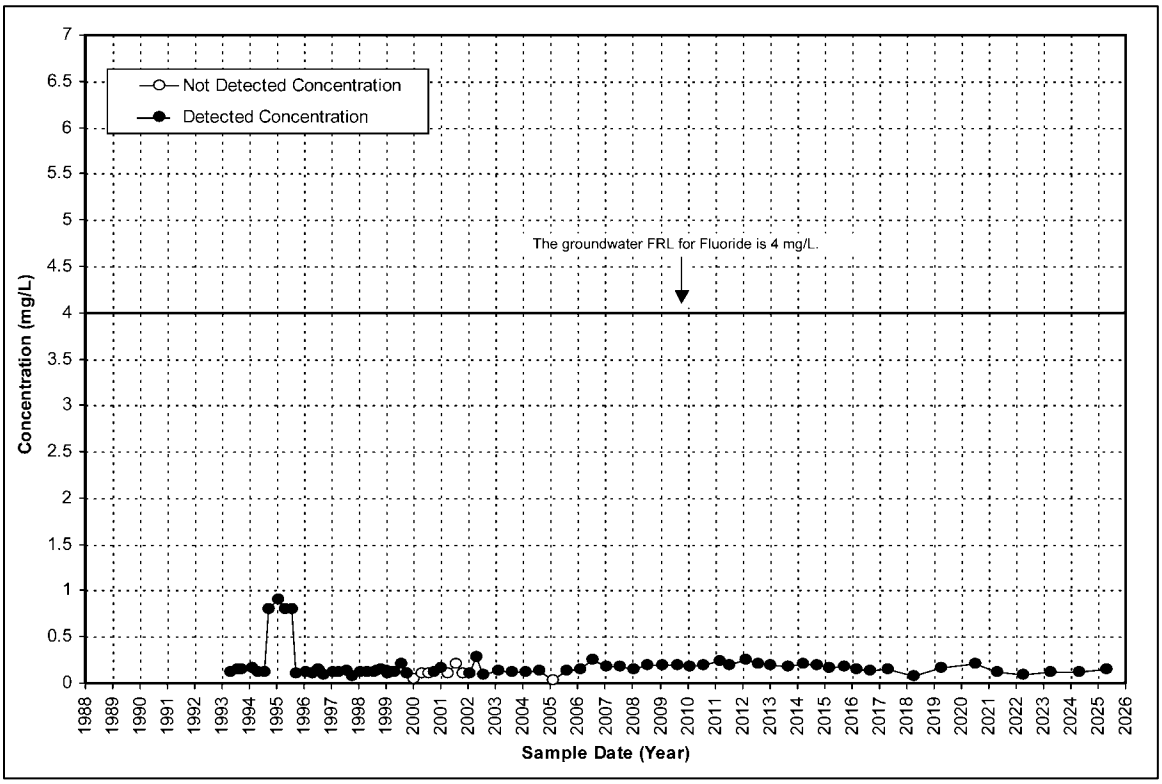


Figure A.4-85. Fluoride Concentration Versus Time Plot for Monitoring Well 3398

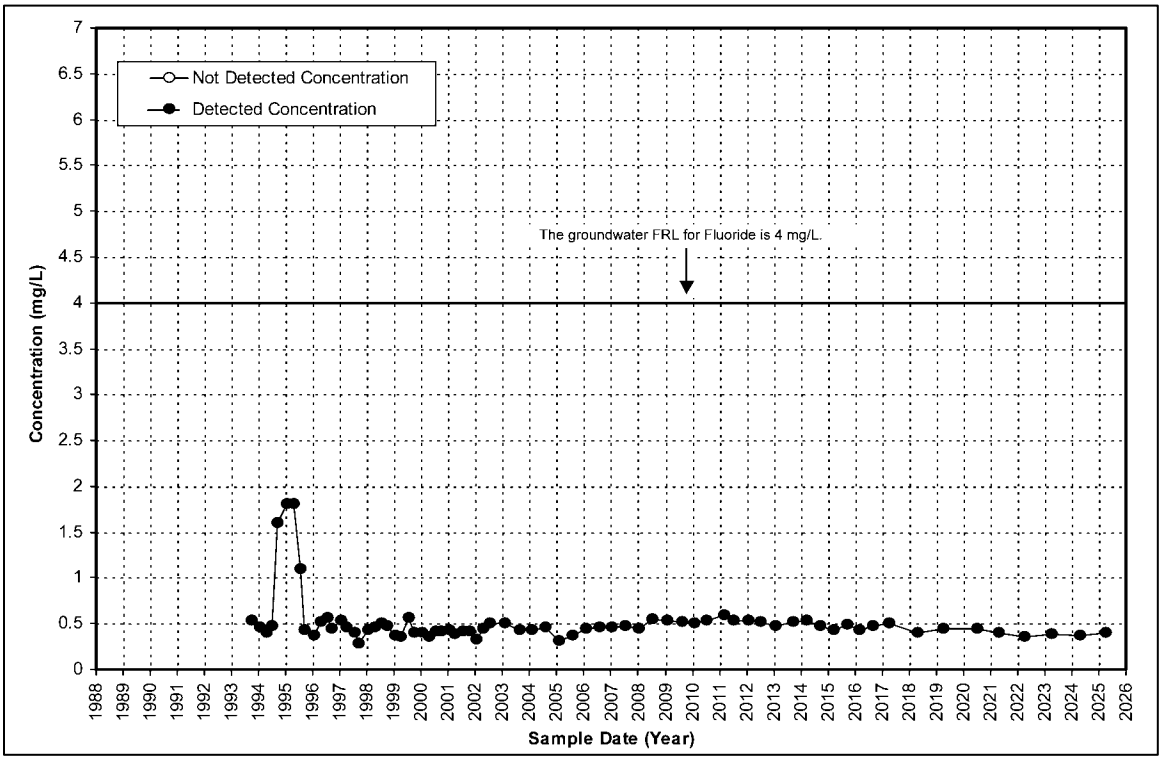


Figure A.4-86. Fluoride Concentration Versus Time Plot for Monitoring Well 3424

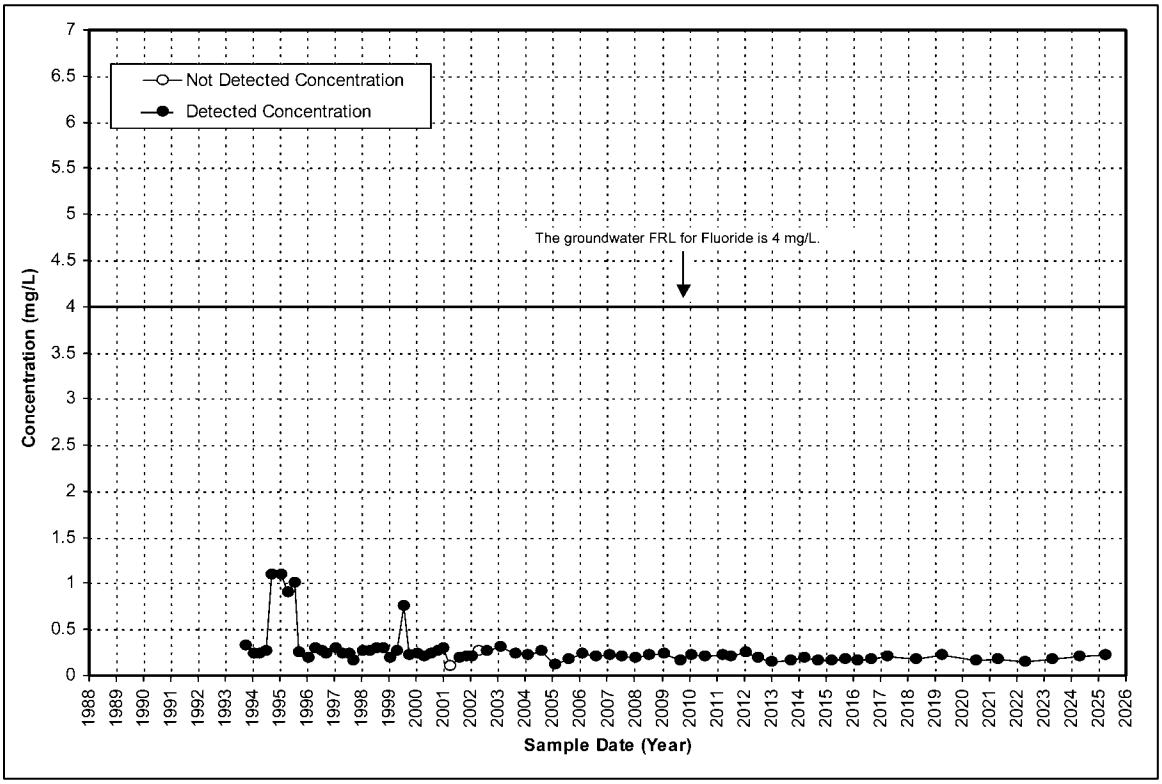


Figure A.4-87. Fluoride Concentration Versus Time Plot for Monitoring Well 3426

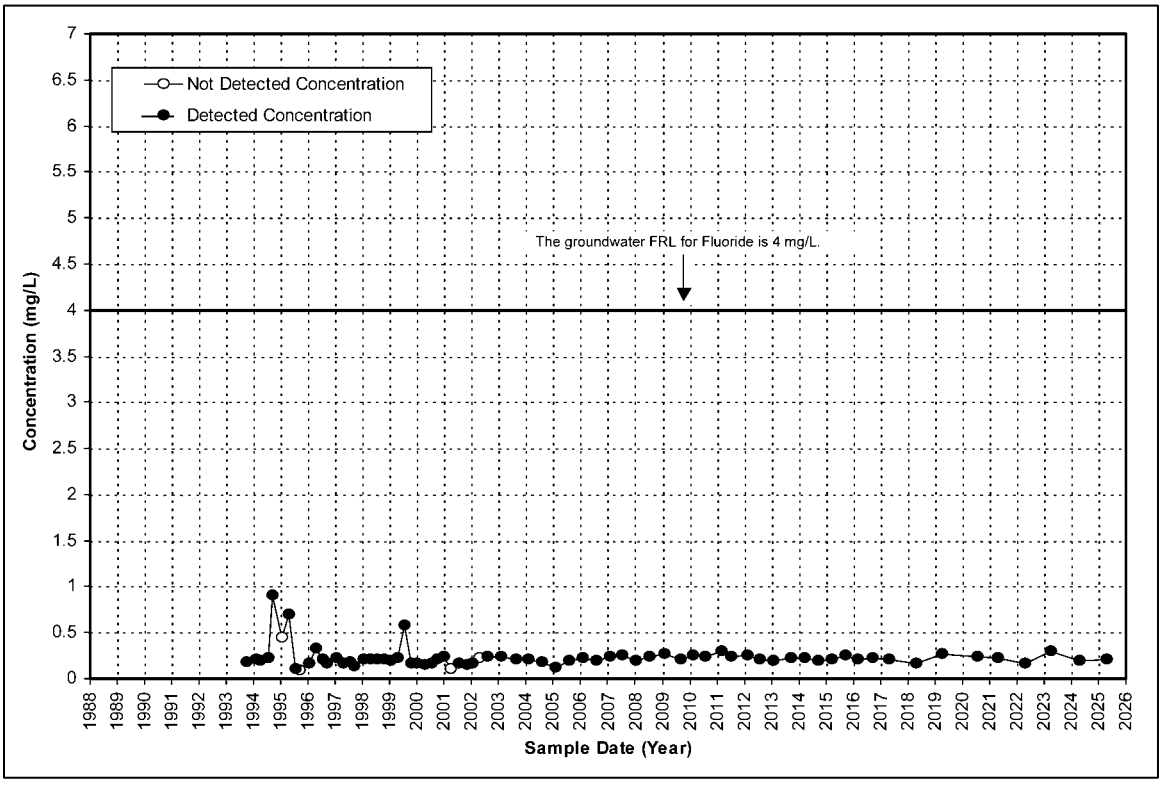


Figure A.4-88. Fluoride Concentration Versus Time Plot for Monitoring Well 3429

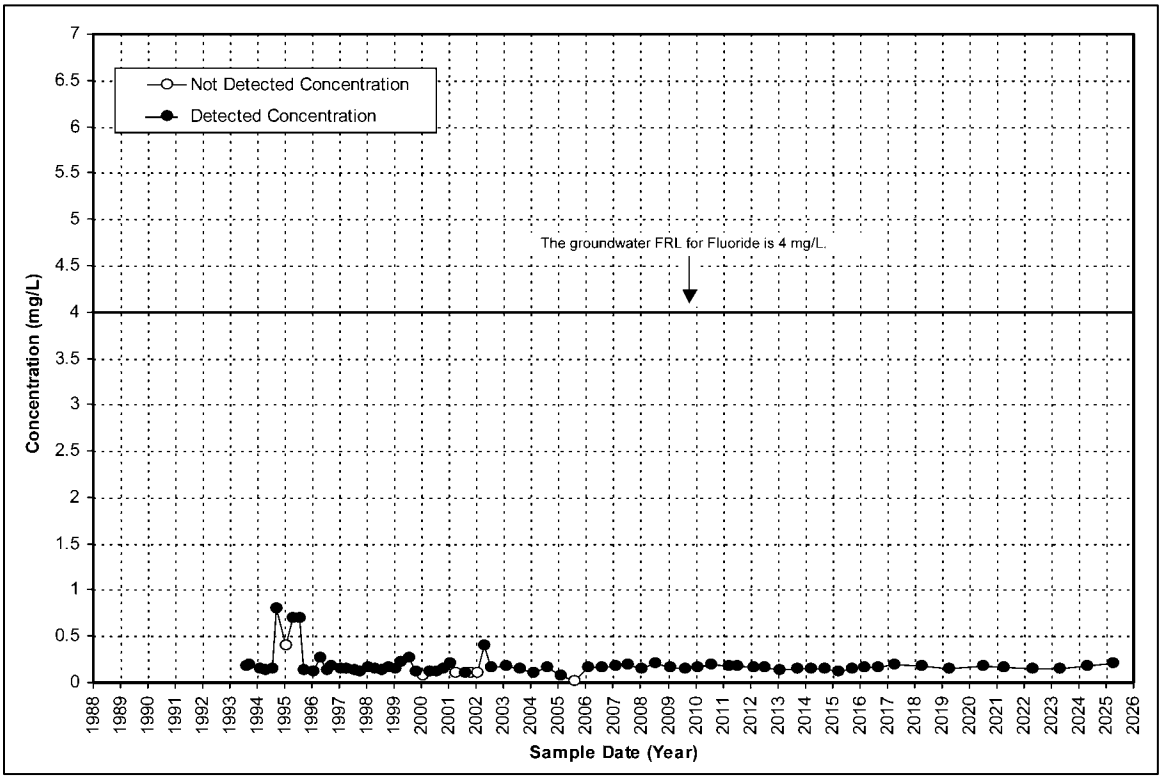


Figure A.4-89. Fluoride Concentration Versus Time Plot for Monitoring Well 3431

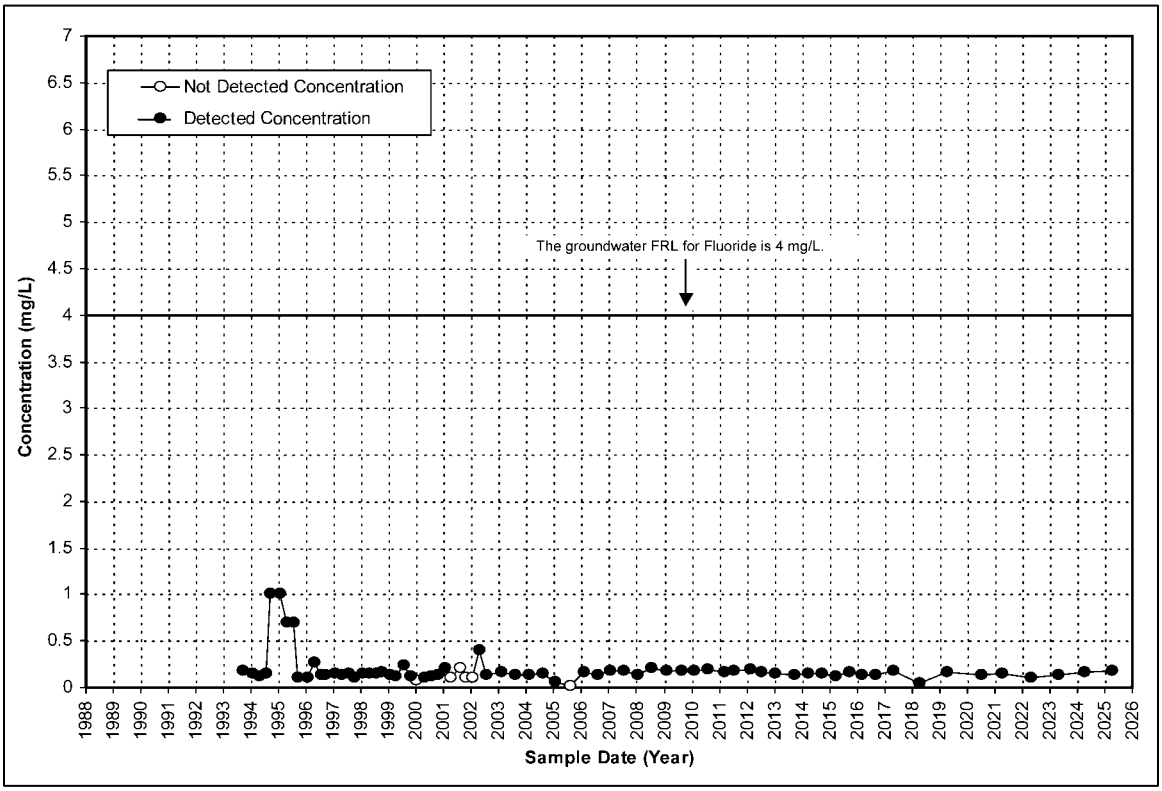


Figure A.4-90. Fluoride Concentration Versus Time Plot for Monitoring Well 3432

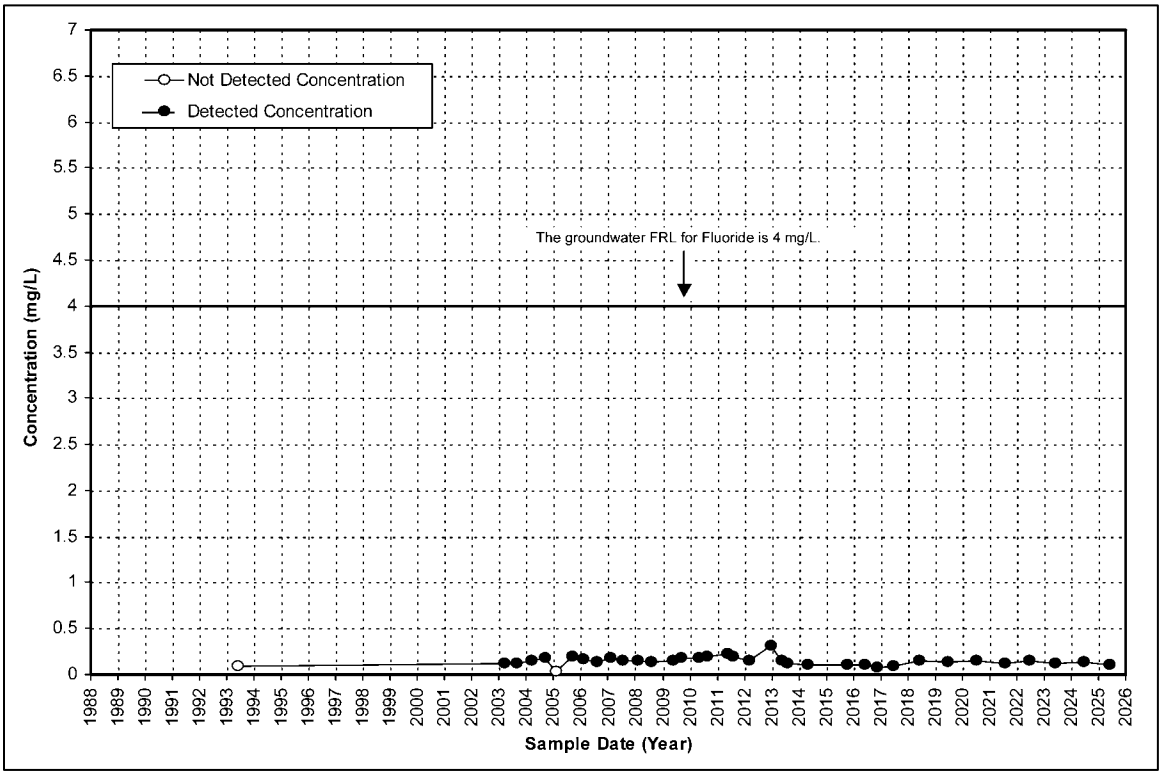


Figure A.4-91. Fluoride Concentration Versus Time Plot for Monitoring Well 3636

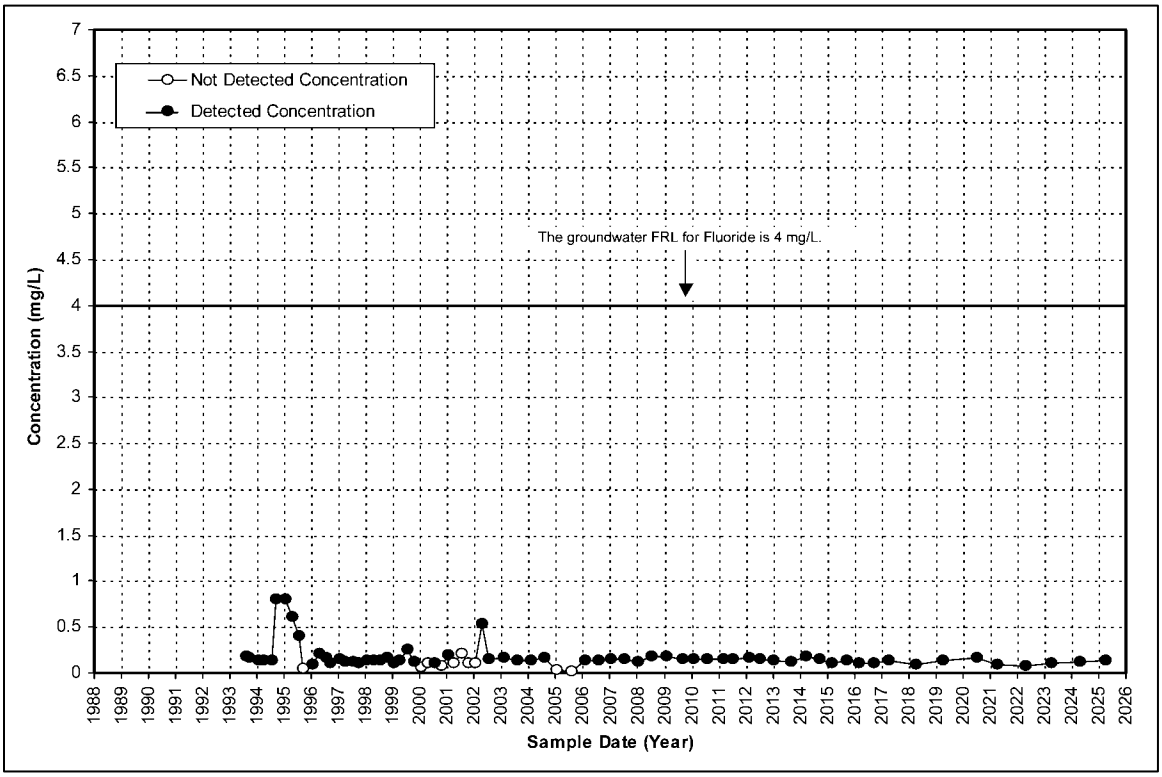


Figure A.4-92. Fluoride Concentration Versus Time Plot for Monitoring Well 3733

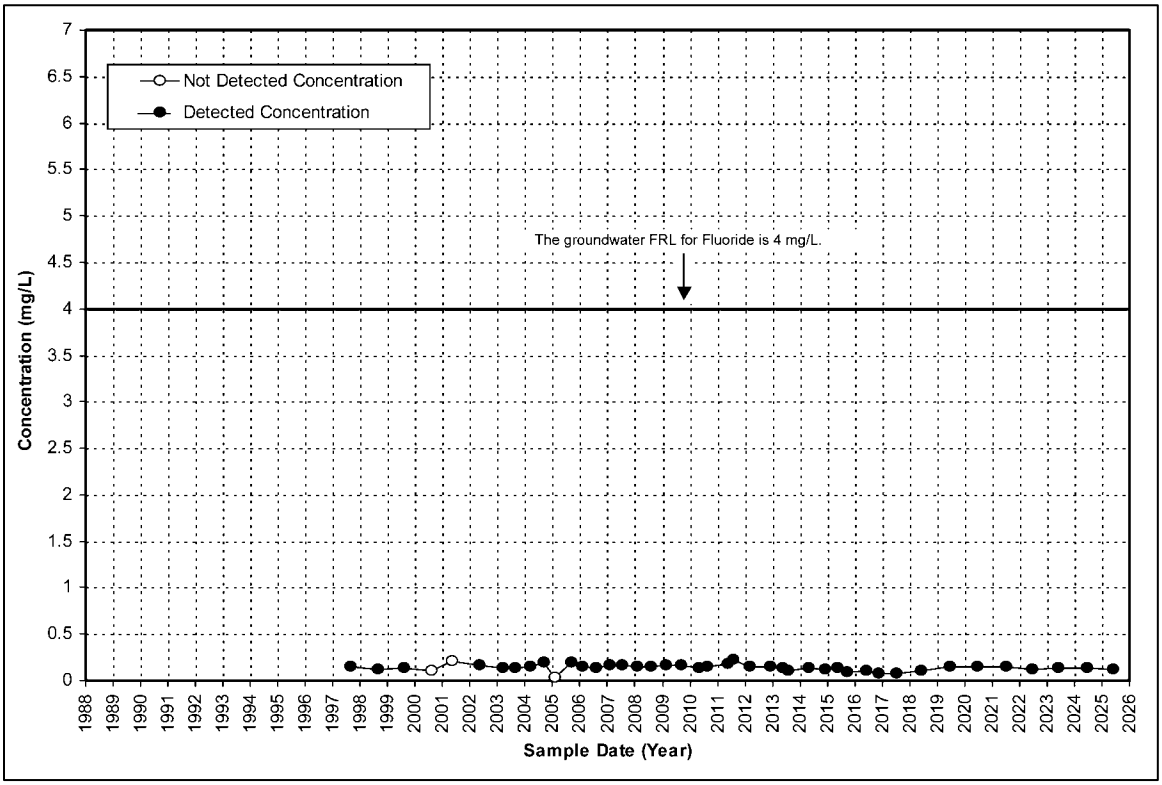


Figure A.4-93. Fluoride Concentration Versus Time Plot for Monitoring Well 3898

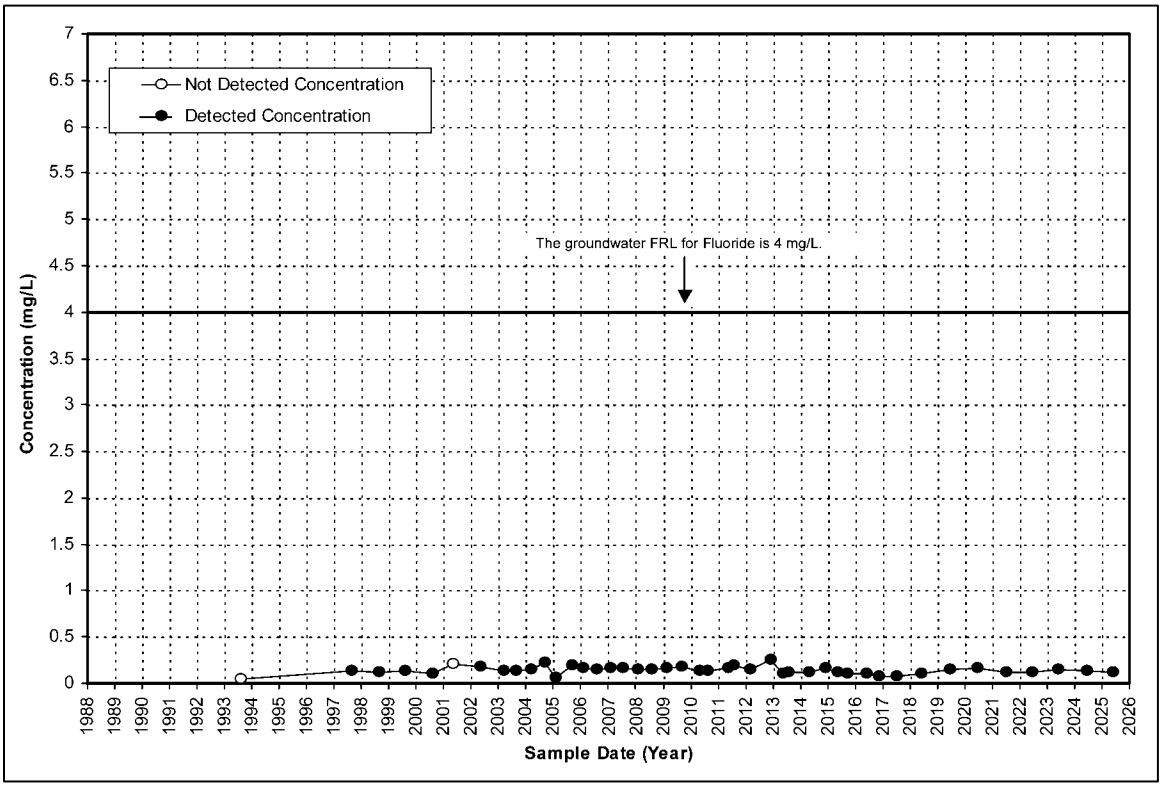


Figure A.4-94. Fluoride Concentration Versus Time Plot for Monitoring Well 3899

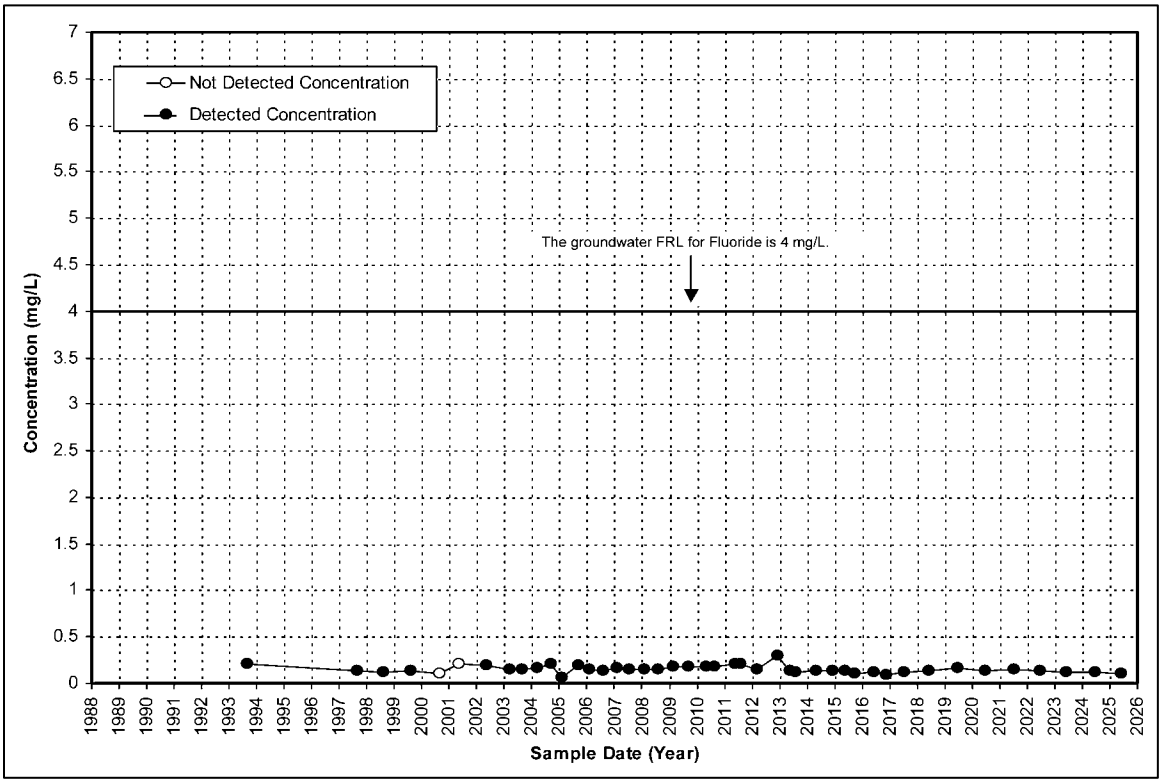


Figure A.4-95. Fluoride Concentration Versus Time Plot for Monitoring Well 3900

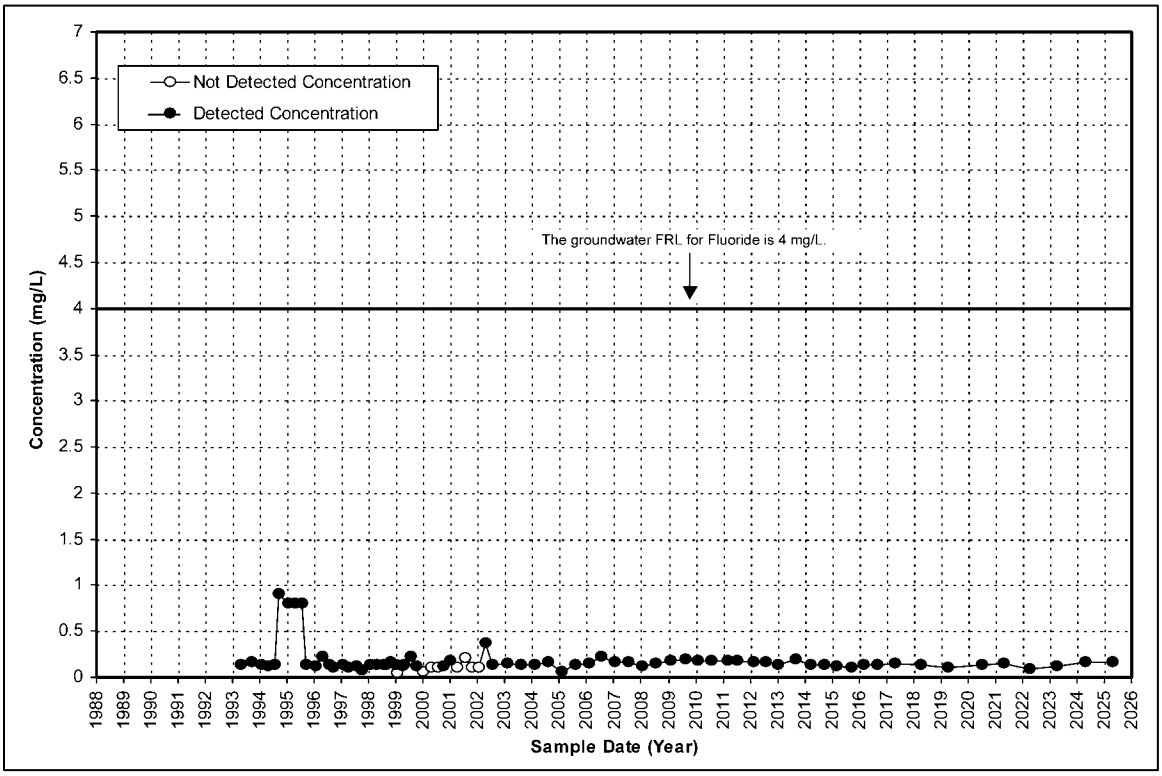


Figure A.4-96. Fluoride Concentration Versus Time Plot for Monitoring Well 4398

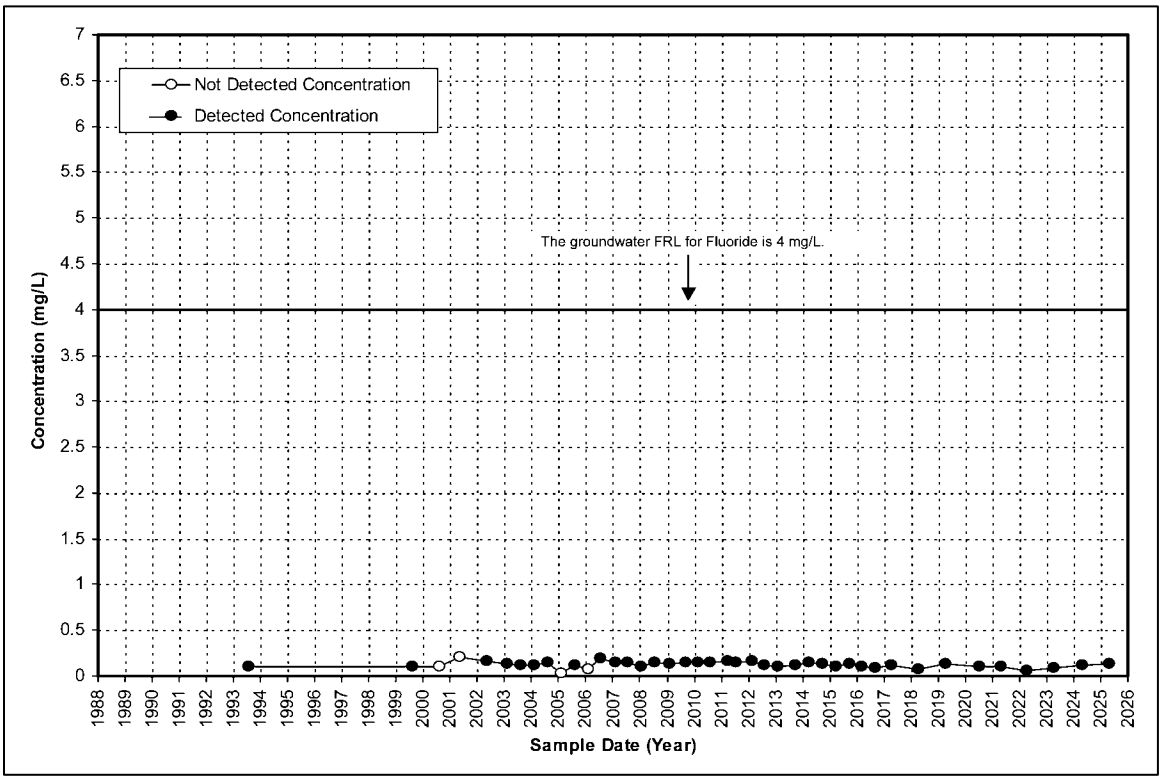


Figure A.4-97. Fluoride Concentration Versus Time Plot for Monitoring Well 21063

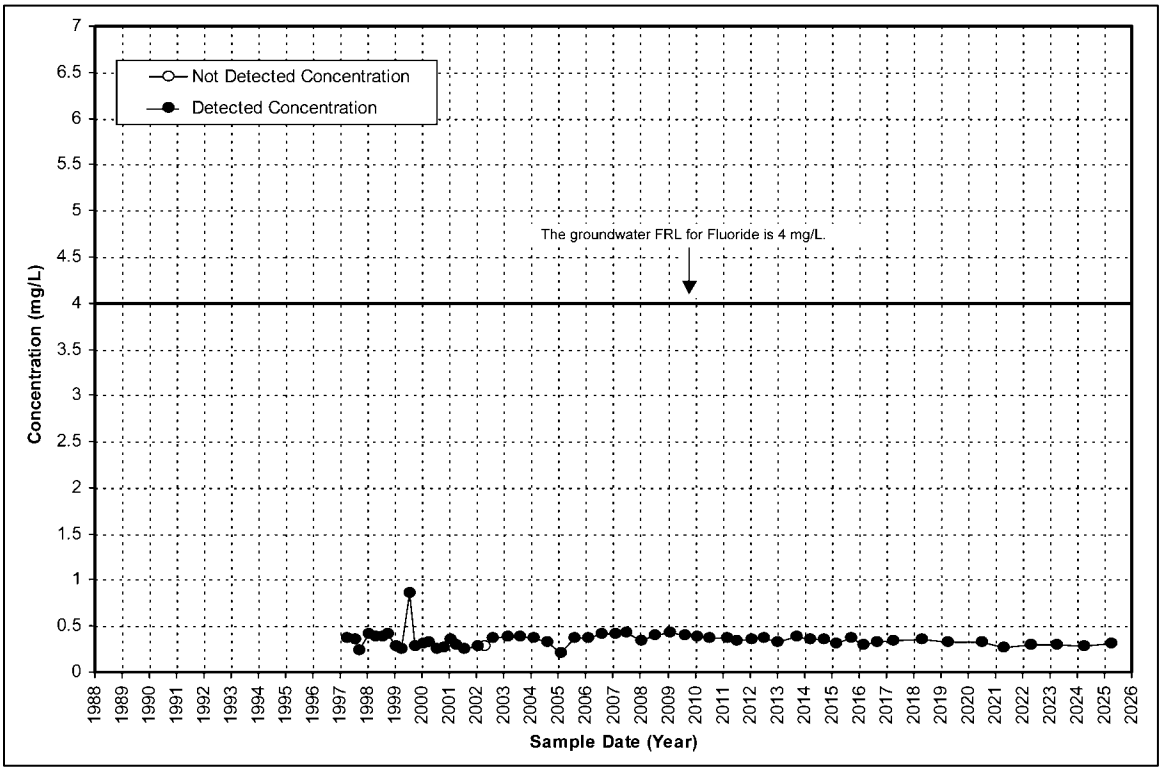


Figure A.4-98. Fluoride Concentration Versus Time Plot for Monitoring Well 22198

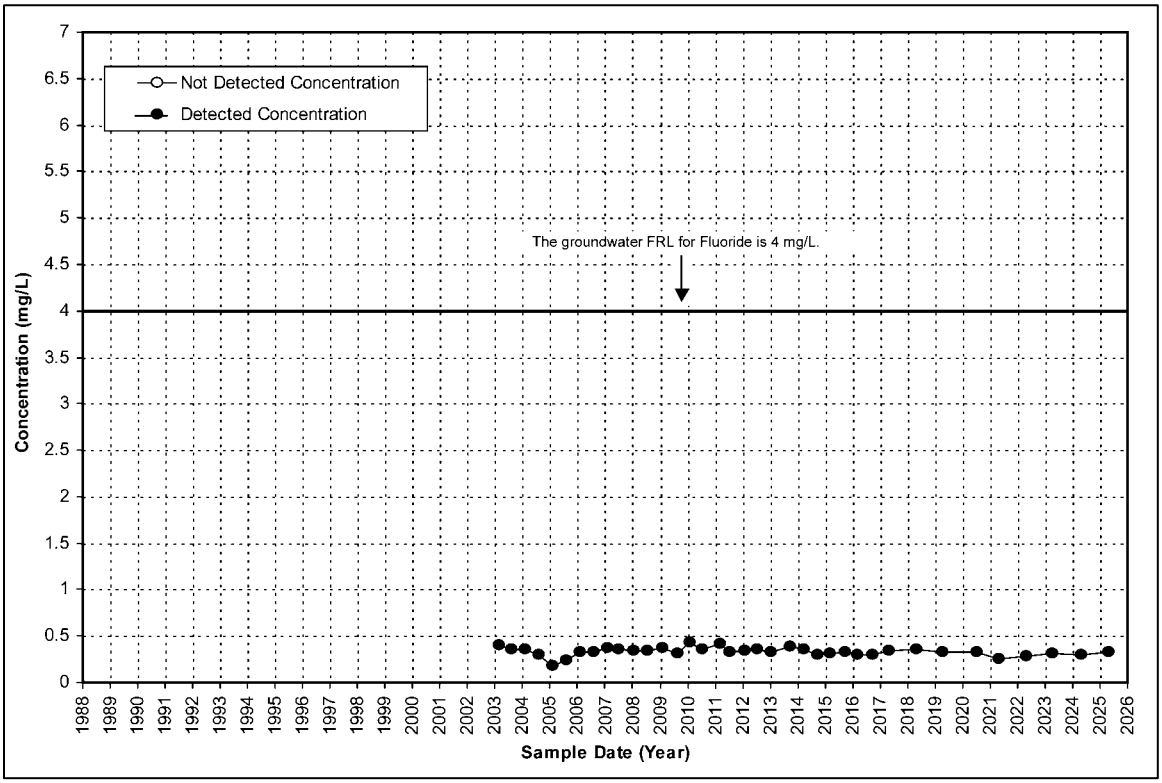


Figure A.4-99. Fluoride Concentration Versus Time Plot for Monitoring Well 22199

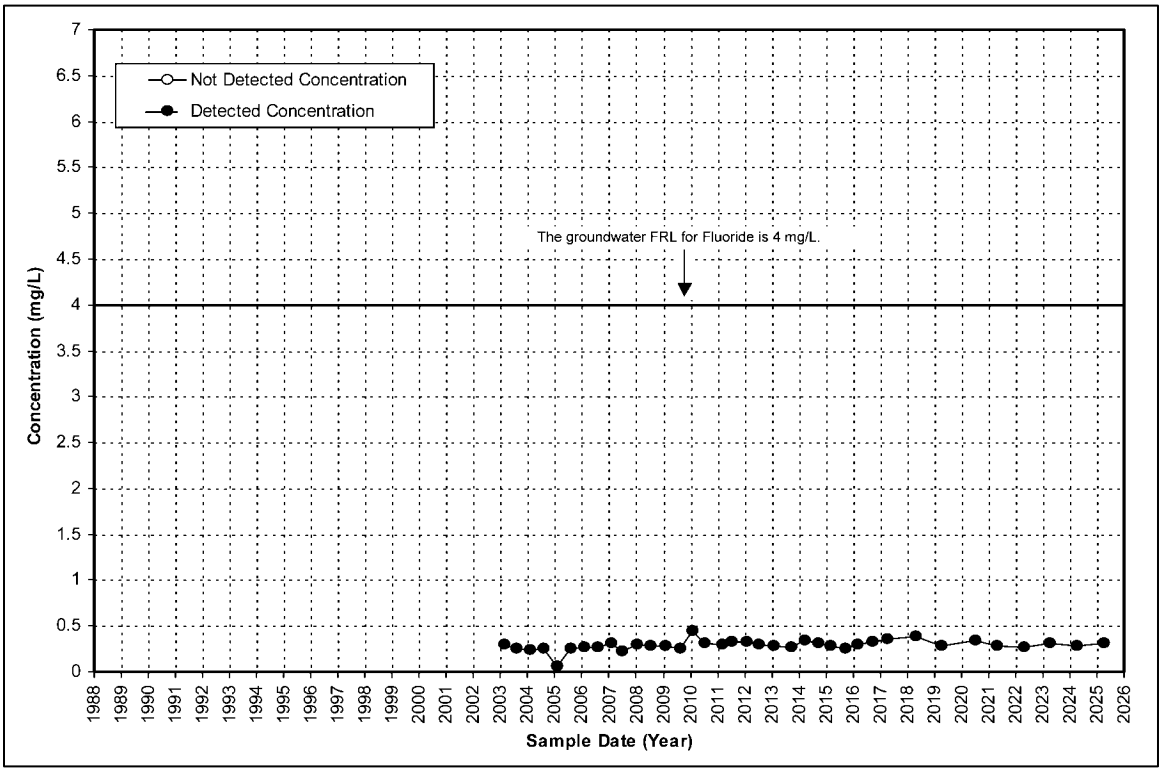


Figure A.4-100. Fluoride Concentration Versus Time Plot for Monitoring Well 22204

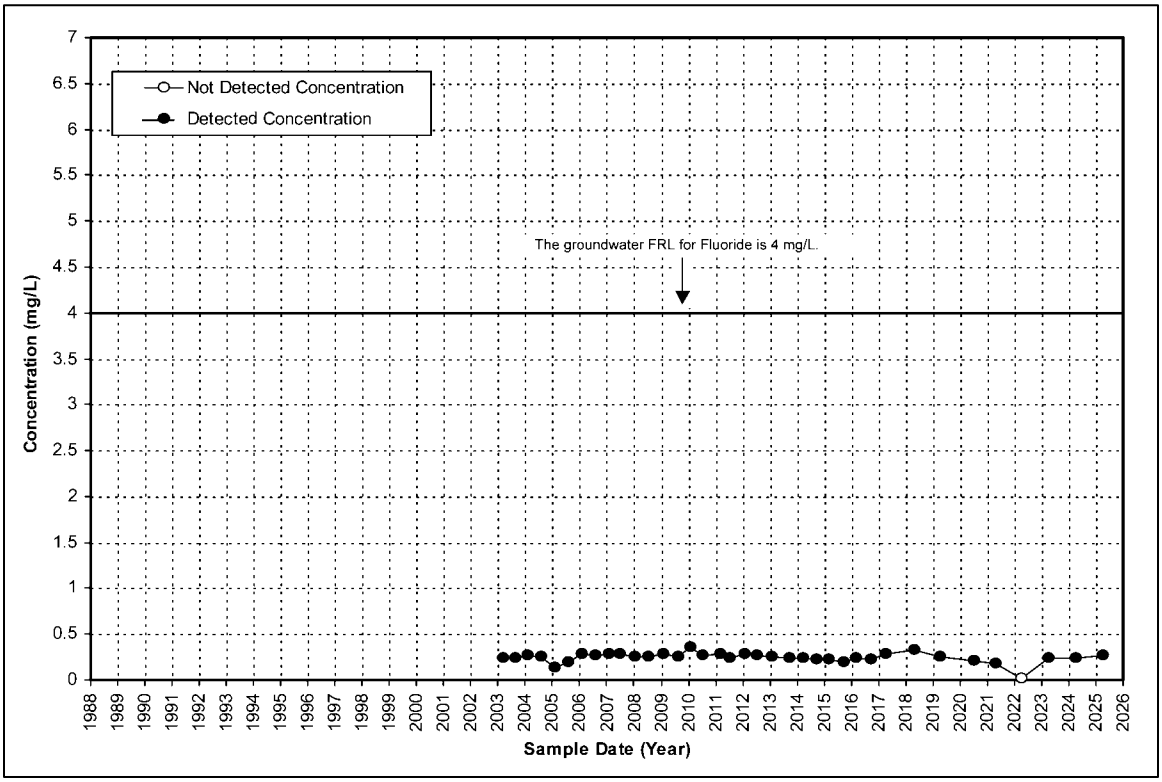


Figure A.4-101. Fluoride Concentration Versus Time Plot for Monitoring Well 22205

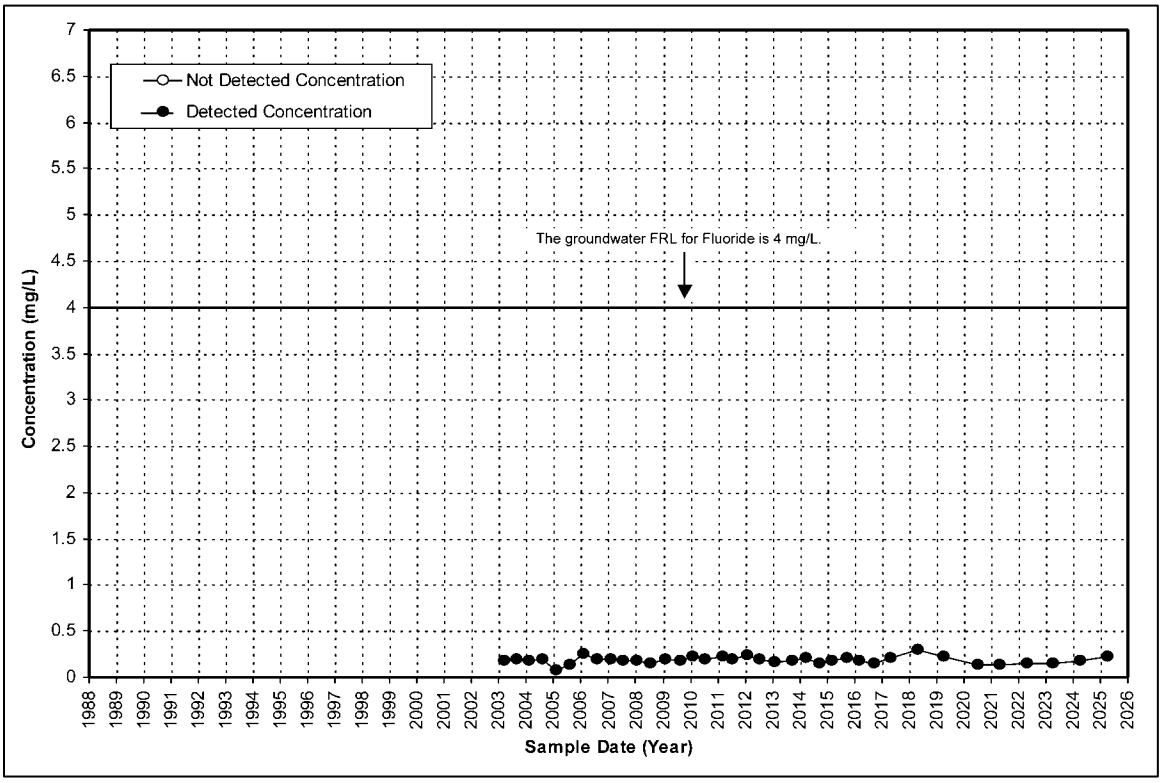


Figure A.4-102. Fluoride Concentration Versus Time Plot for Monitoring Well 22208

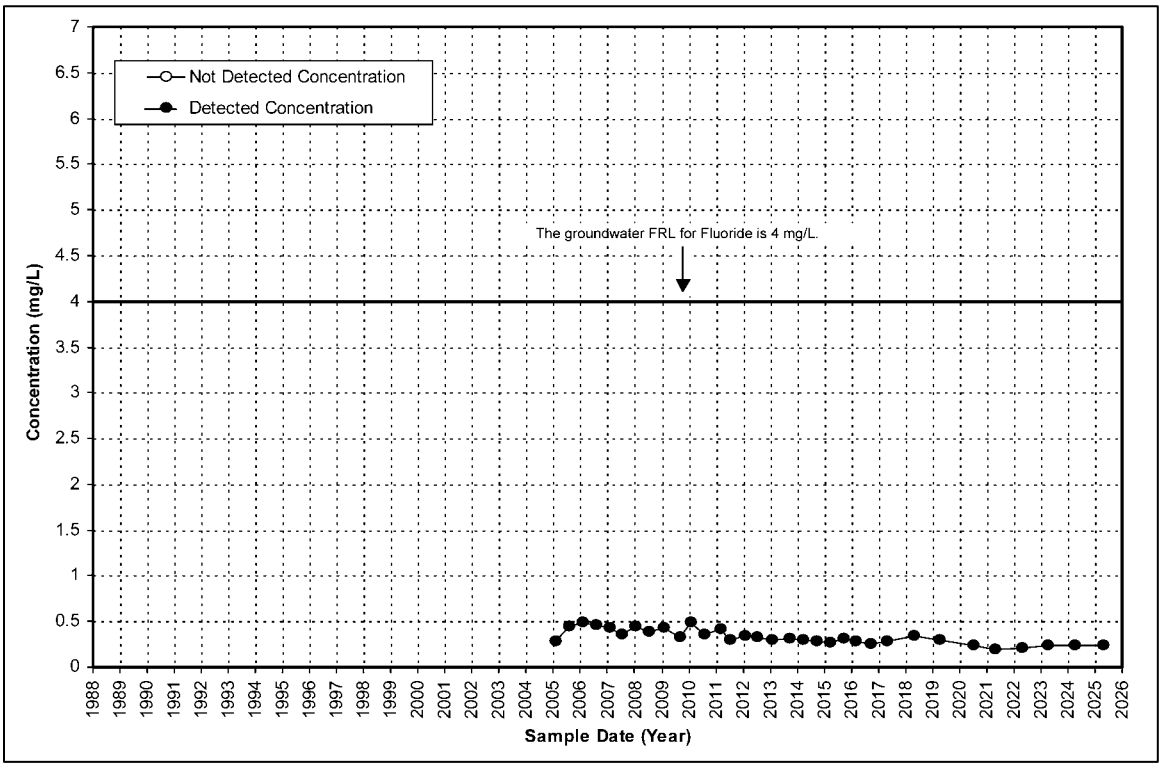


Figure A.4-103. Fluoride Concentration Versus Time Plot for Monitoring Well 22210

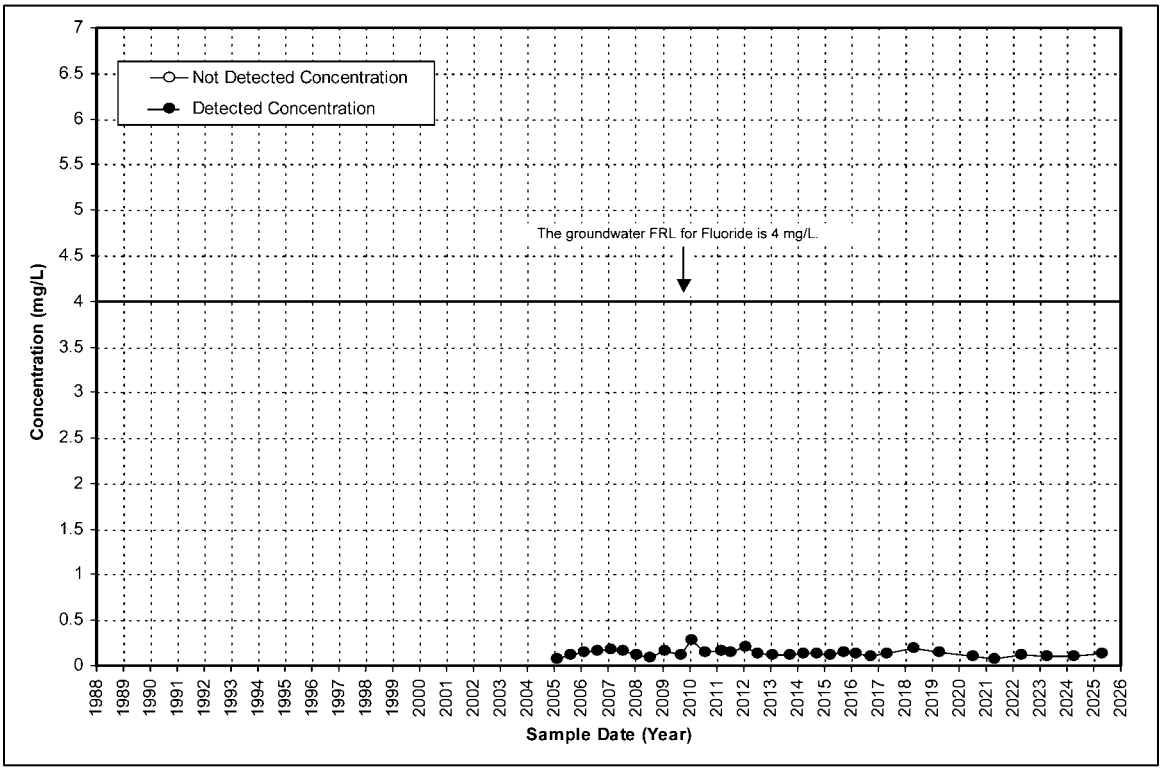


Figure A.4-104. Fluoride Concentration Versus Time Plot for Monitoring Well 22211

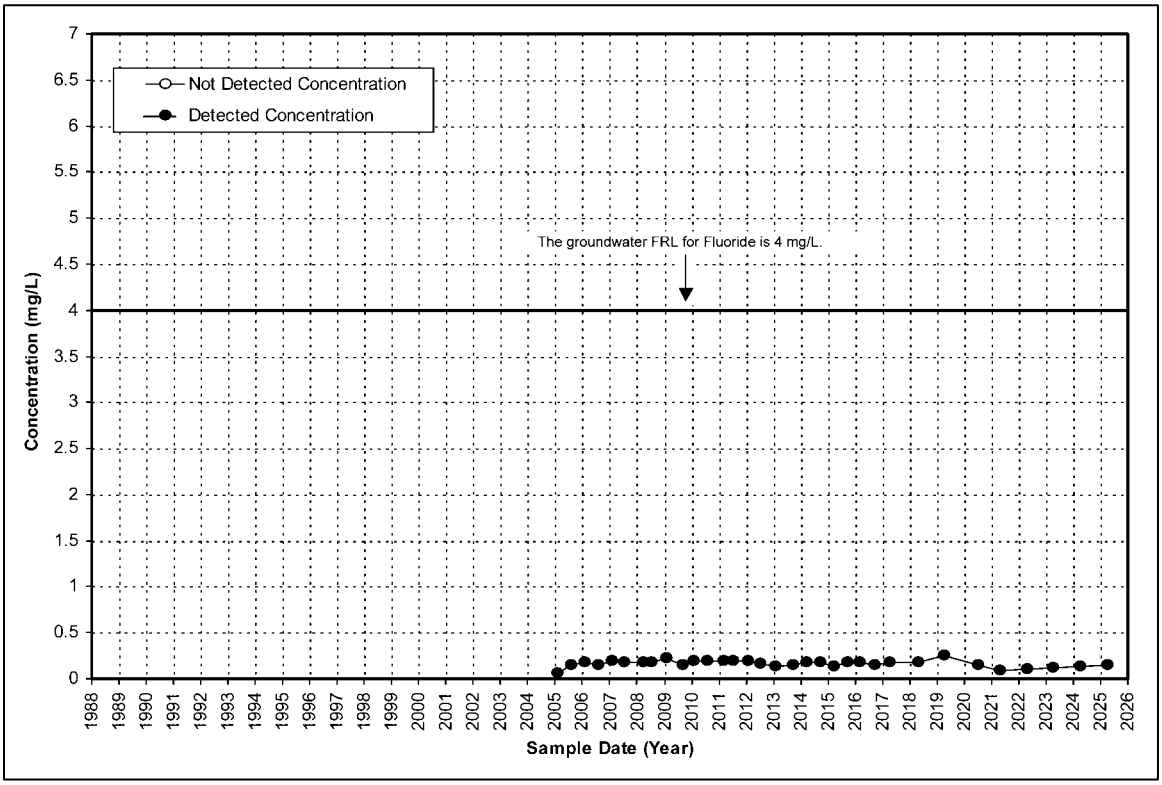


Figure A.4-105. Fluoride Concentration Versus Time Plot for Monitoring Well 22214

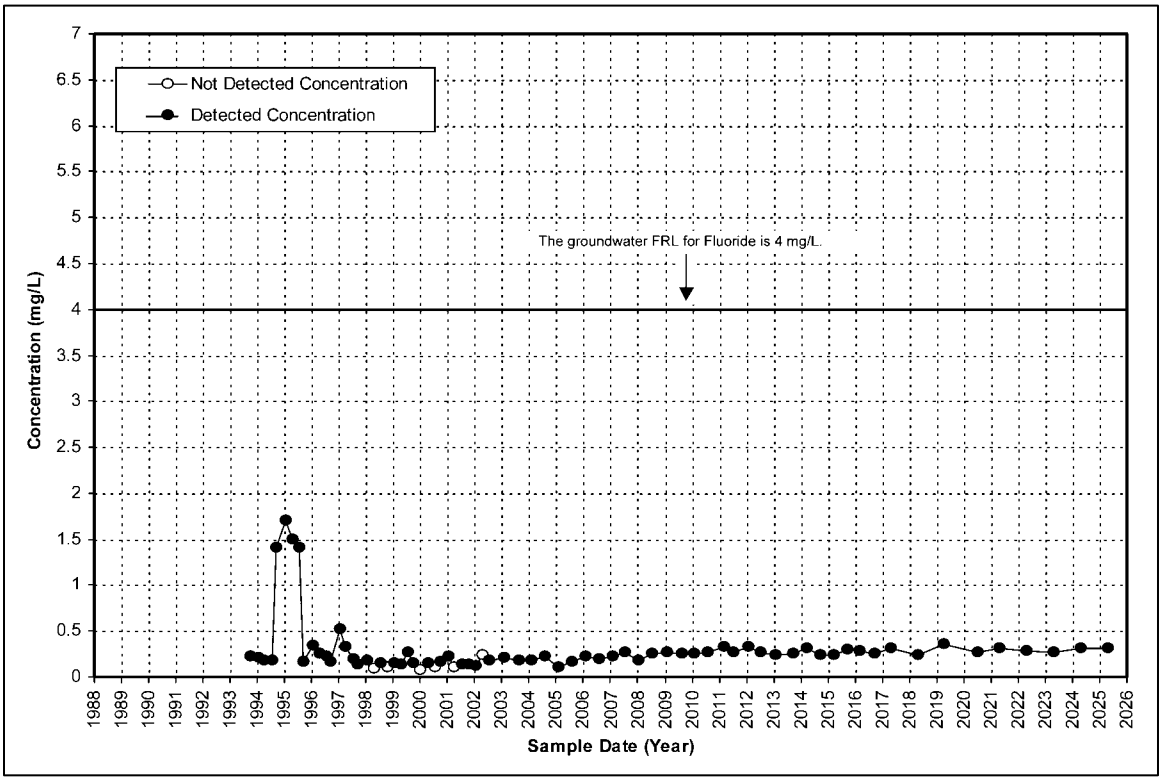


Figure A.4-106. Fluoride Concentration Versus Time Plot for Monitoring Well 31217

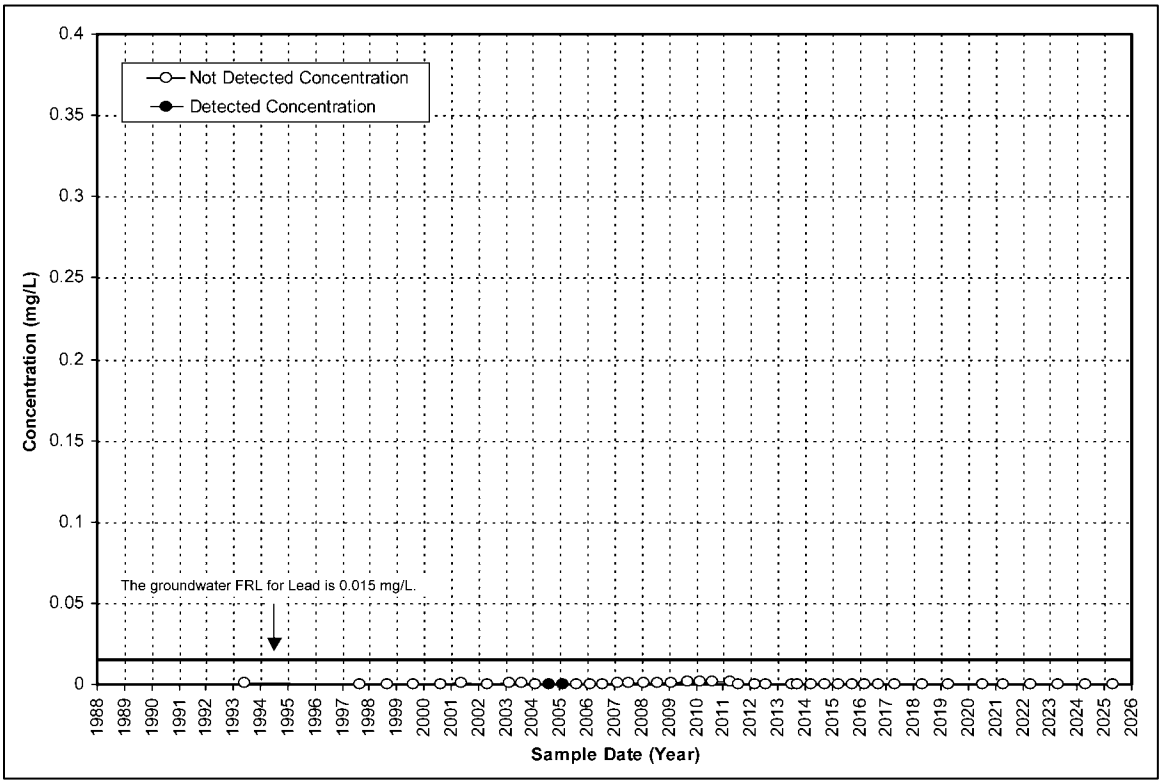


Figure A.4-107. Lead Concentration Versus Time Plot for Monitoring Well 2093

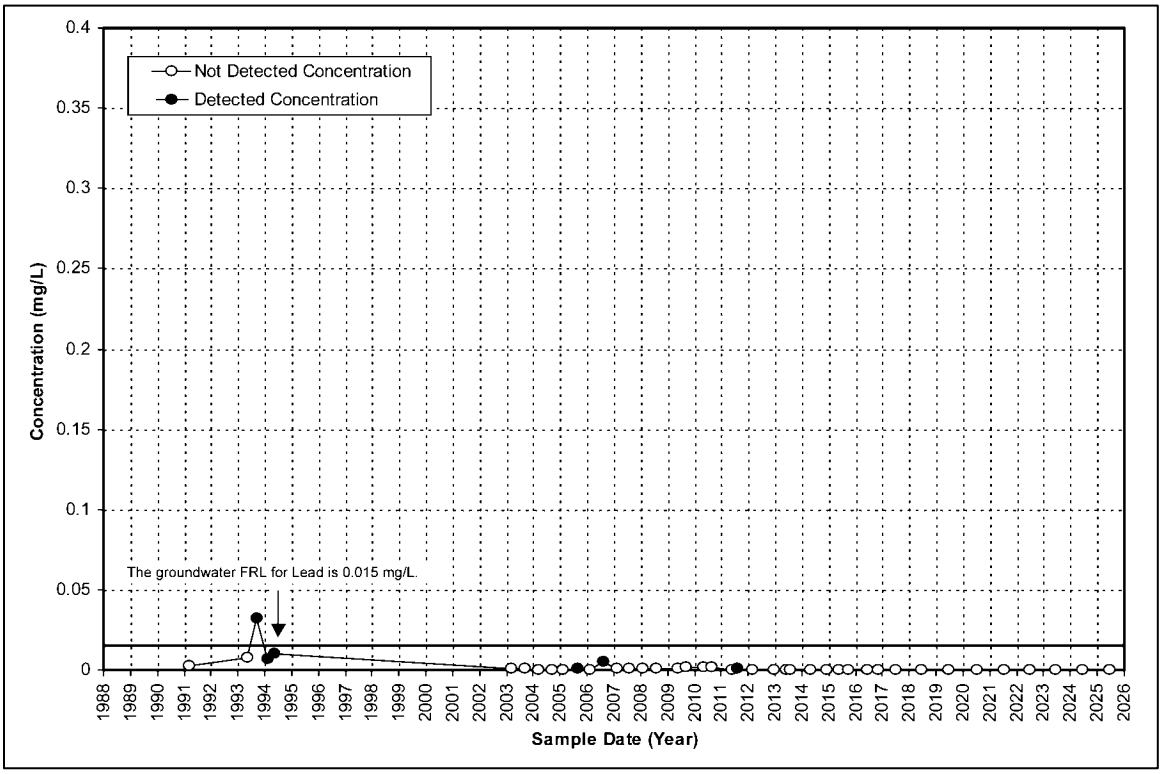


Figure A.4-108. Lead Concentration Versus Time Plot for Monitoring Well 2128

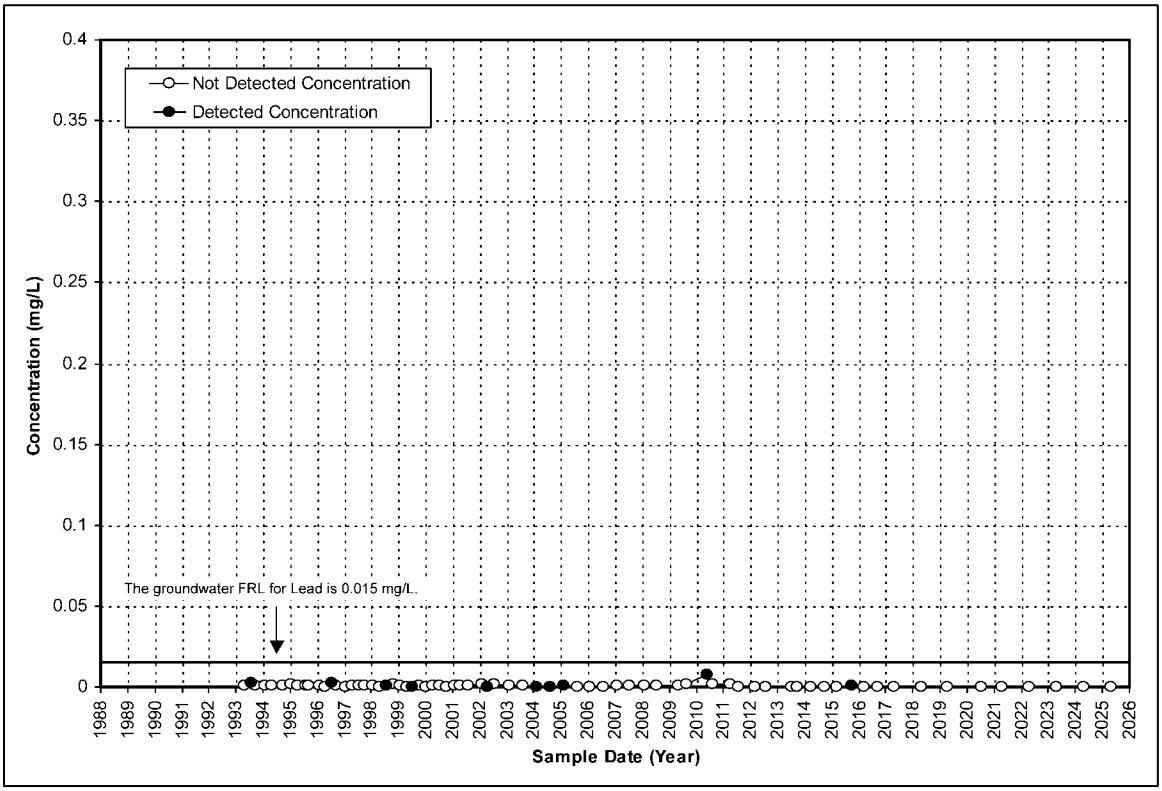


Figure A.4-109. Lead Concentration Versus Time Plot for Monitoring Well 2398

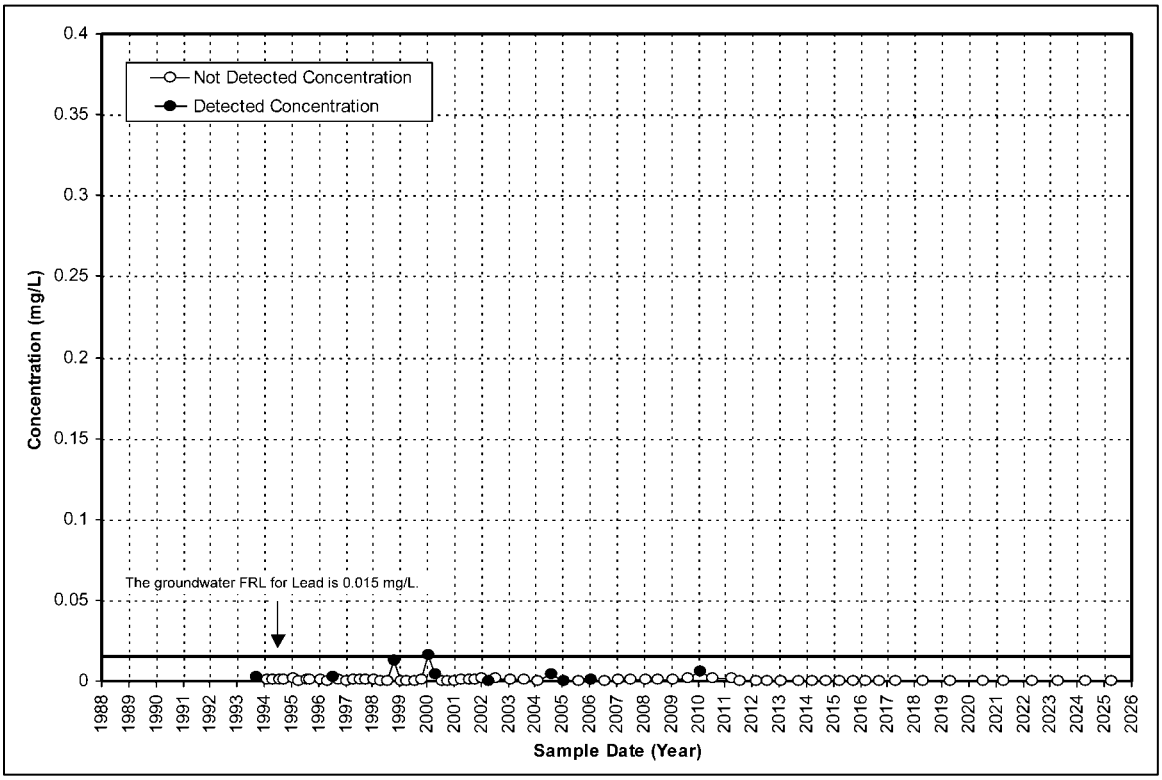


Figure A.4-110. Lead Concentration Versus Time Plot for Monitoring Well 2431

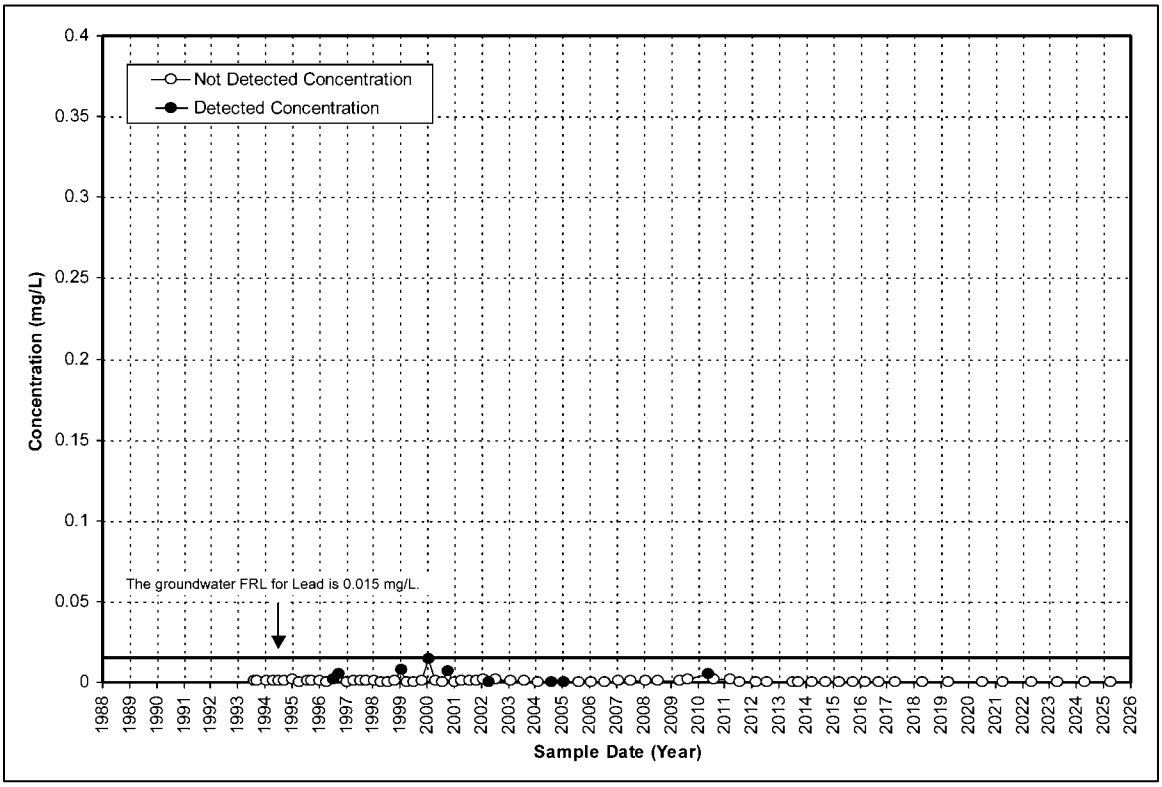


Figure A.4-111. Lead Concentration Versus Time Plot for Monitoring Well 2432

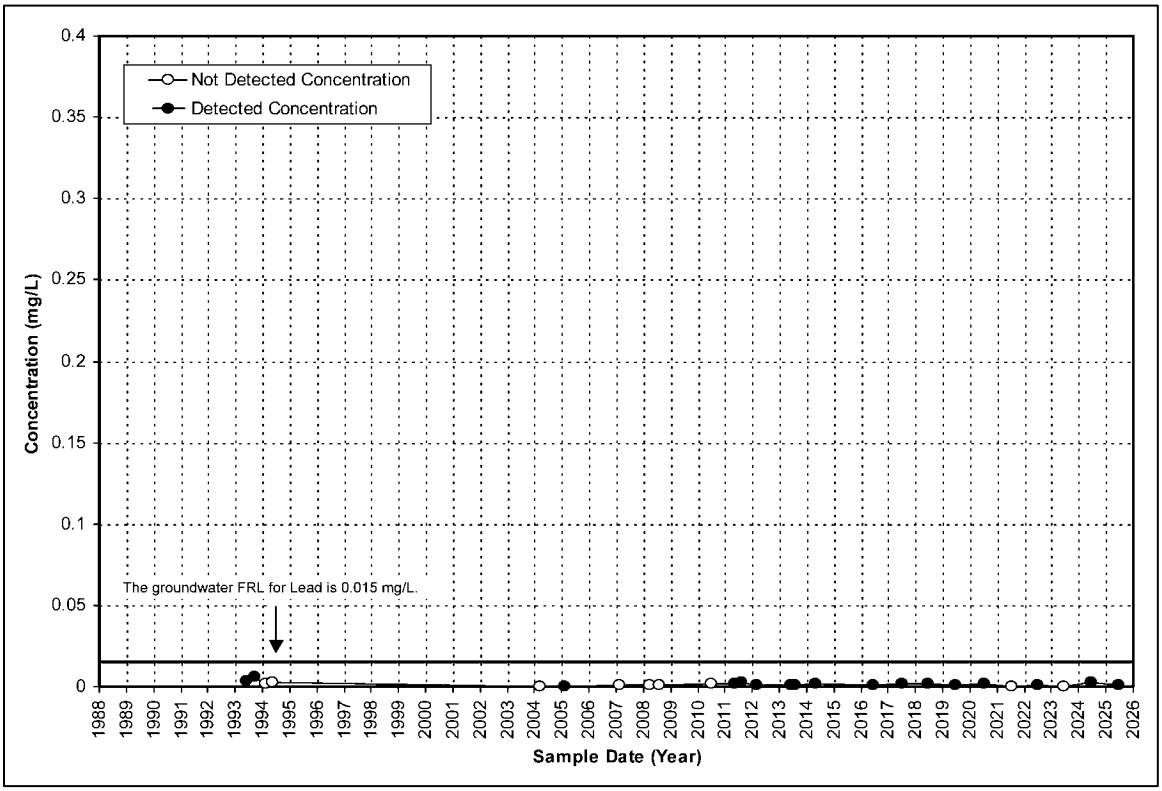


Figure A.4-112. Lead Concentration Versus Time Plot for Monitoring Well 2636

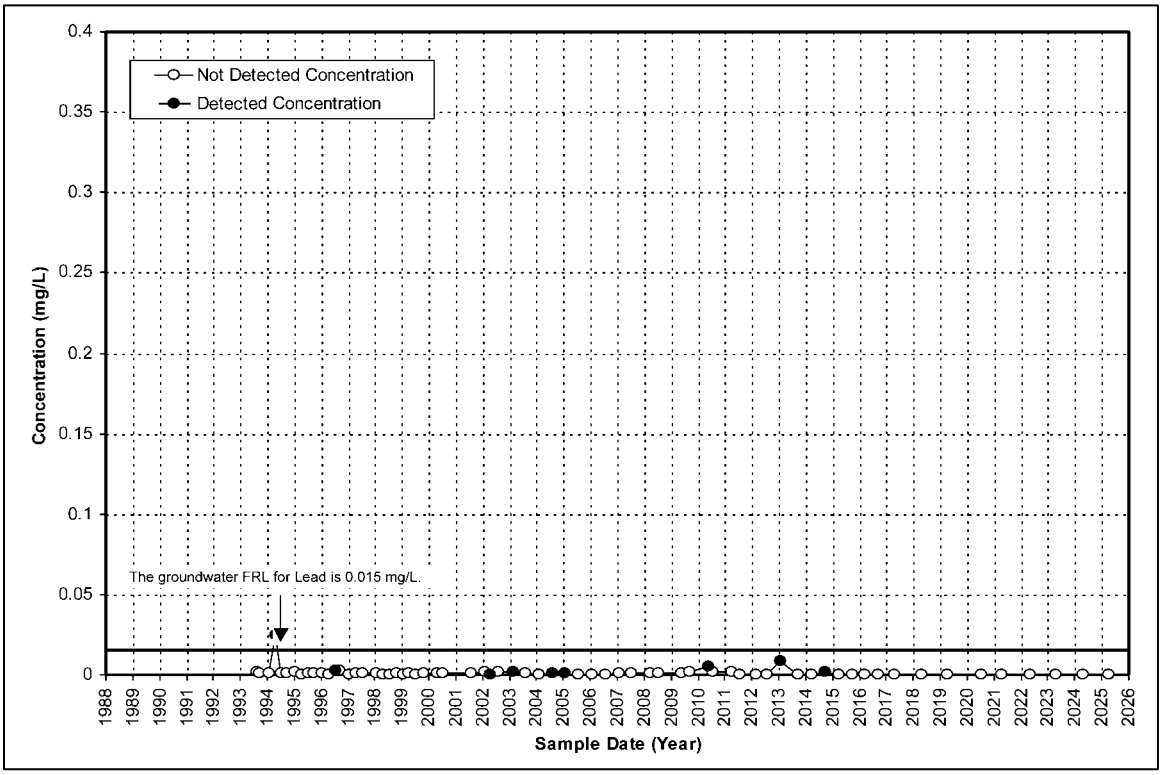


Figure A.4-113. Lead Concentration Versus Time Plot for Monitoring Well 2733

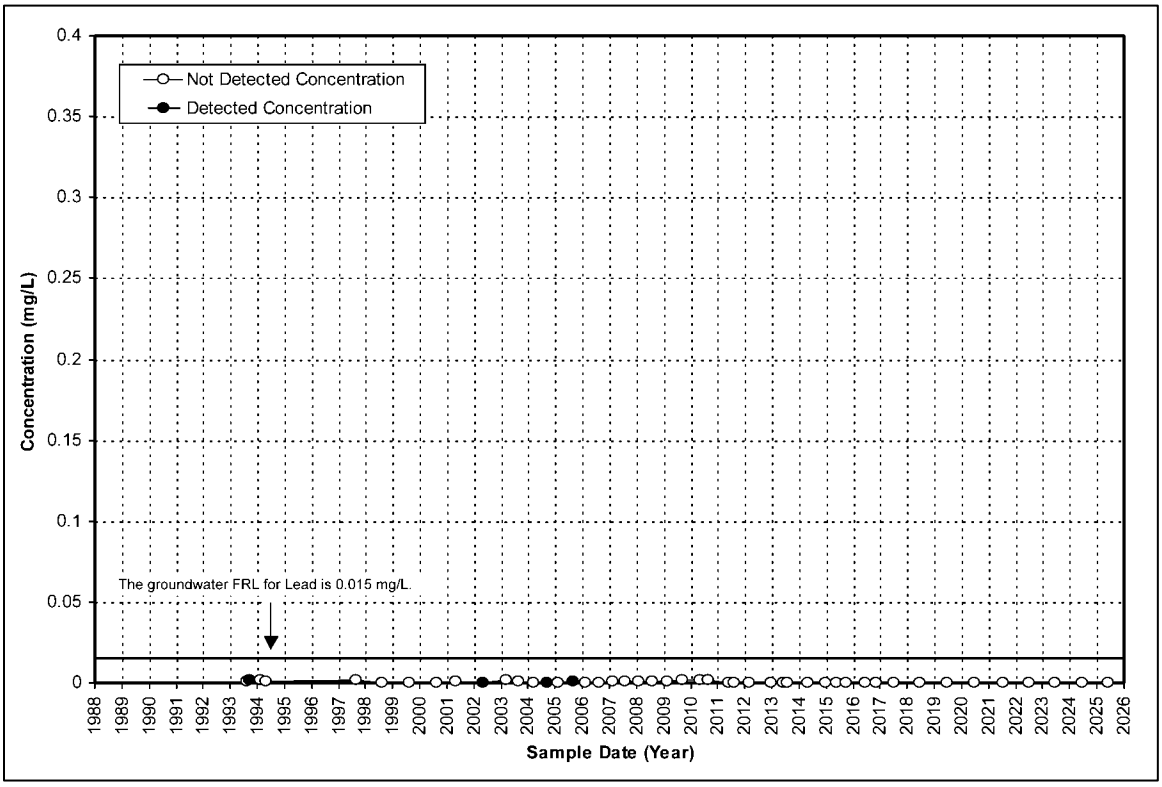


Figure A.4-114. Lead Concentration Versus Time Plot for Monitoring Well 2898

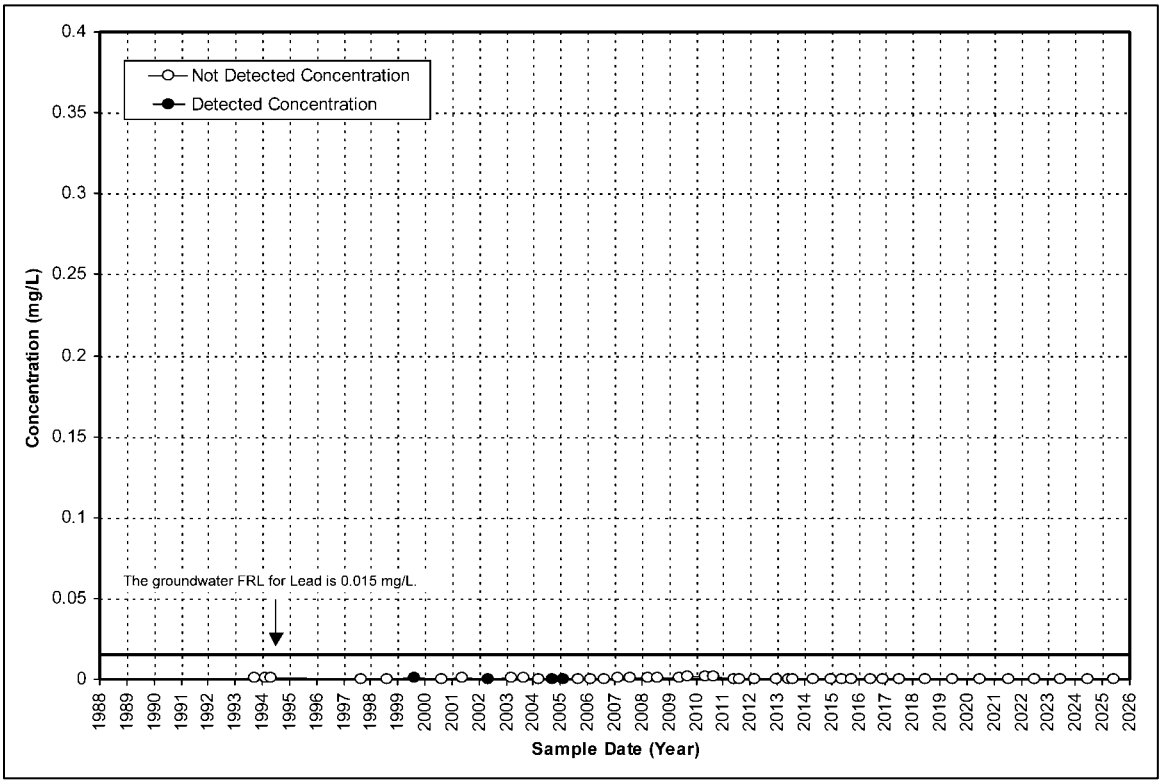


Figure A.4-115. Lead Concentration Versus Time Plot for Monitoring Well 2899

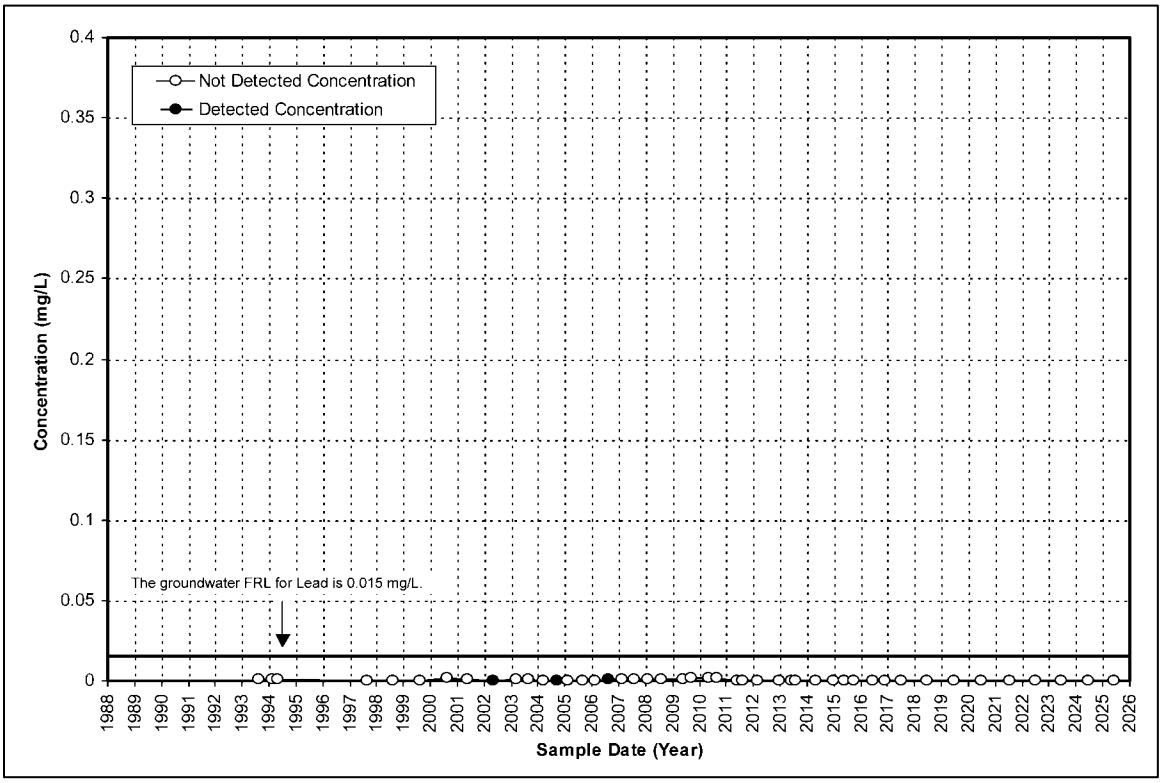


Figure A.4-116. Lead Concentration Versus Time Plot for Monitoring Well 2900

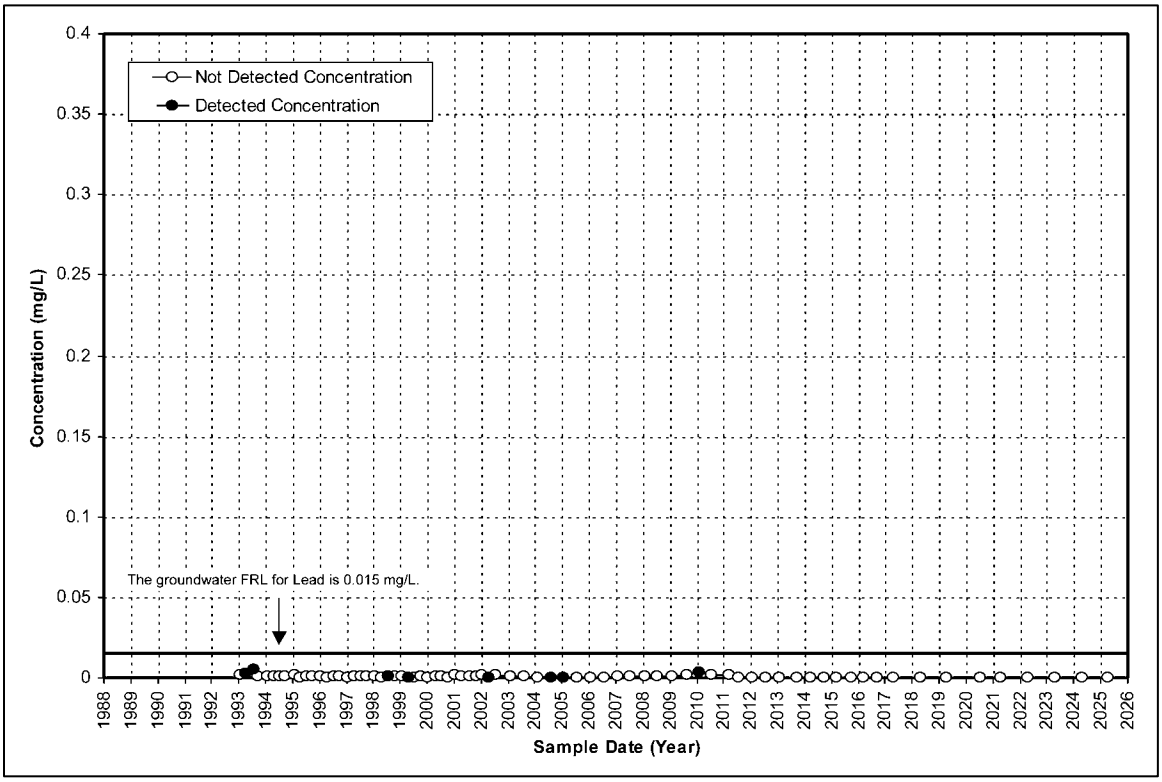


Figure A.4-117. Lead Concentration Versus Time Plot for Monitoring Well 3070

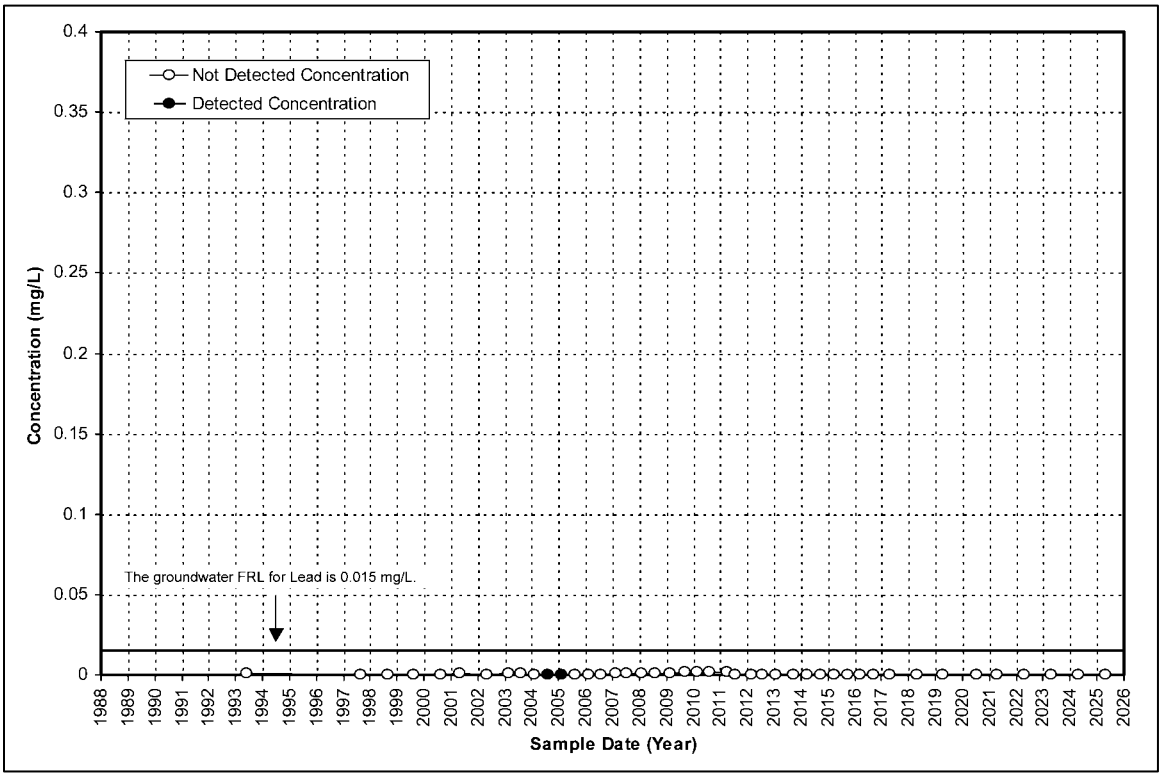


Figure A.4-118. Lead Concentration Versus Time Plot for Monitoring Well 3093

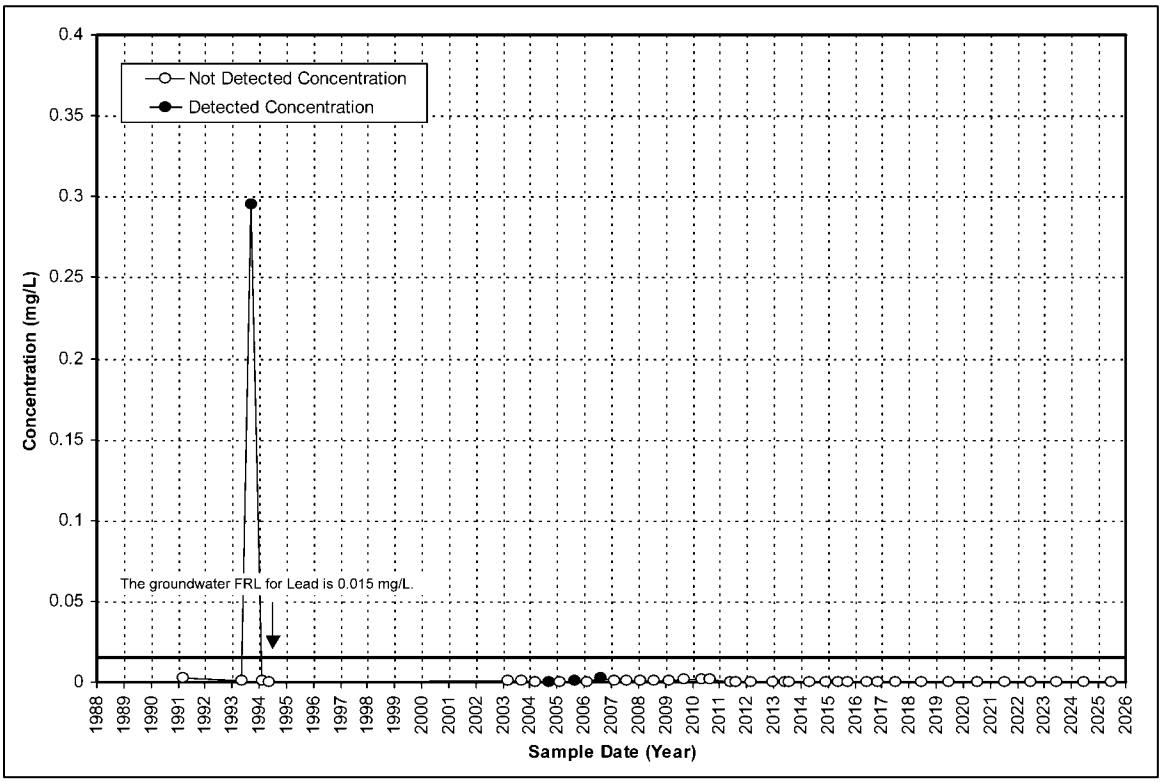


Figure A.4-119. Lead Concentration Versus Time Plot for Monitoring Well 3128

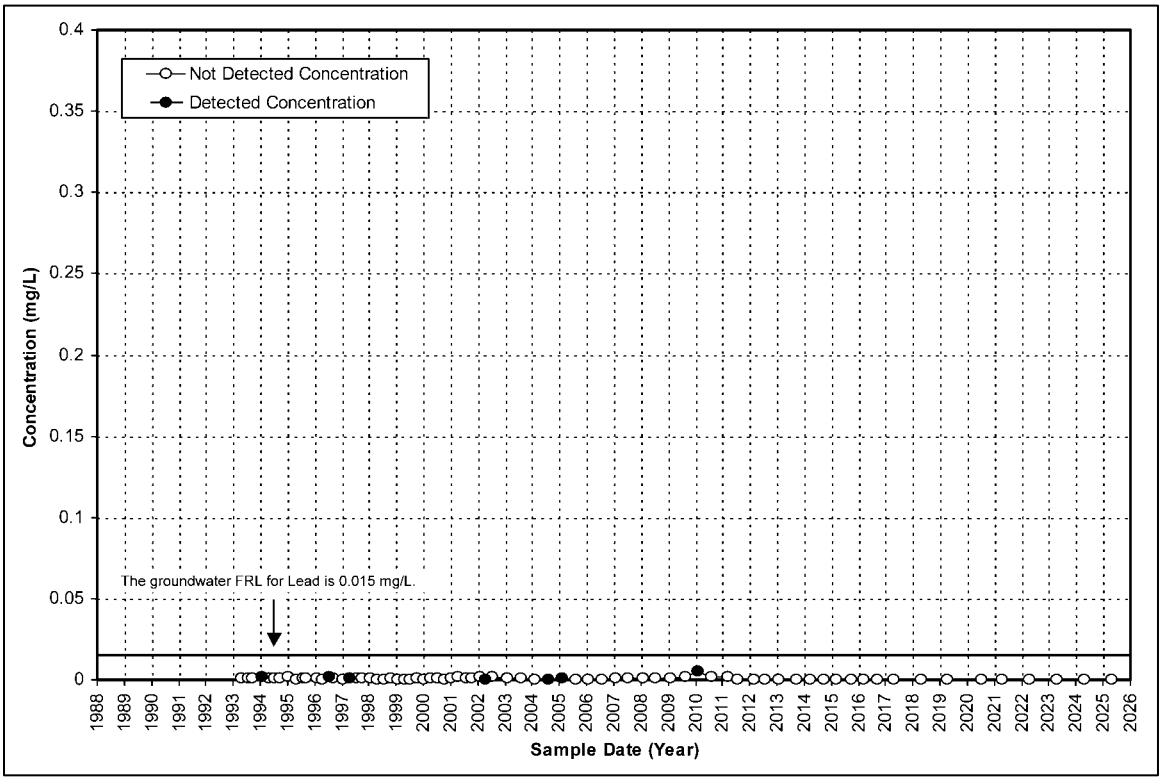


Figure A.4-120. Lead Concentration Versus Time Plot for Monitoring Well 3398

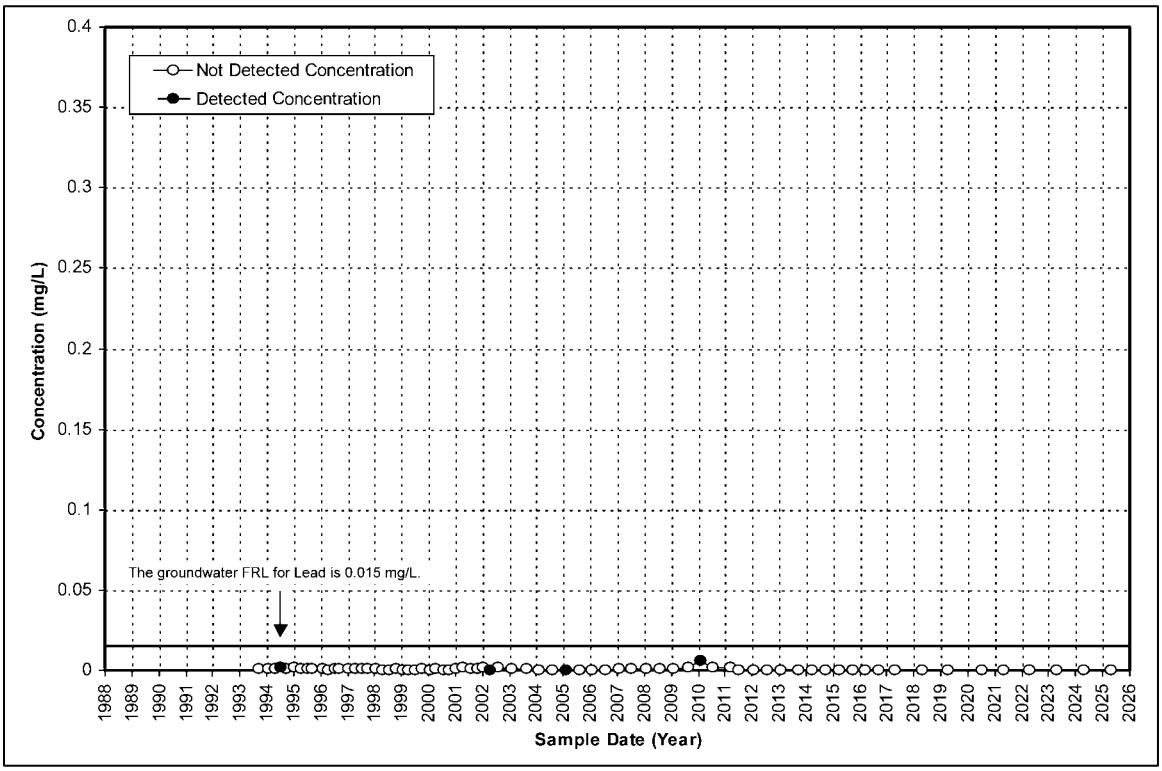


Figure A.4-121. Lead Concentration Versus Time Plot for Monitoring Well 3424

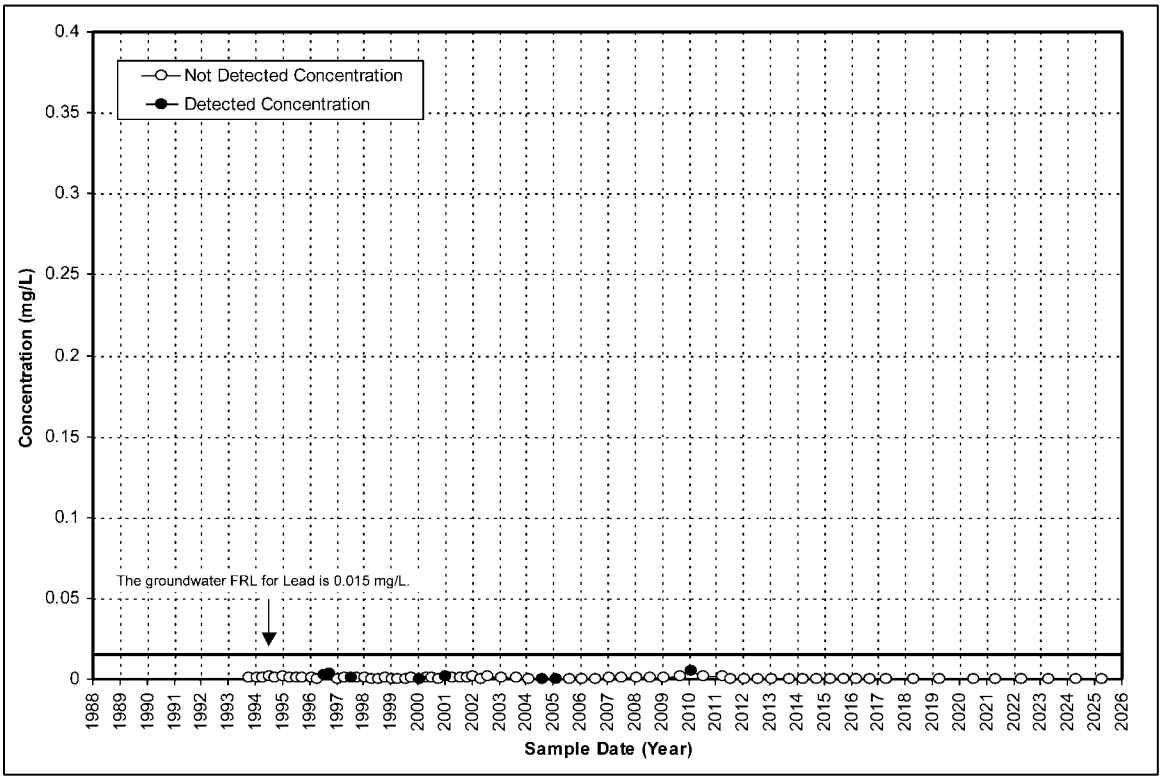


Figure A.4-122. Lead Concentration Versus Time Plot for Monitoring Well 3426

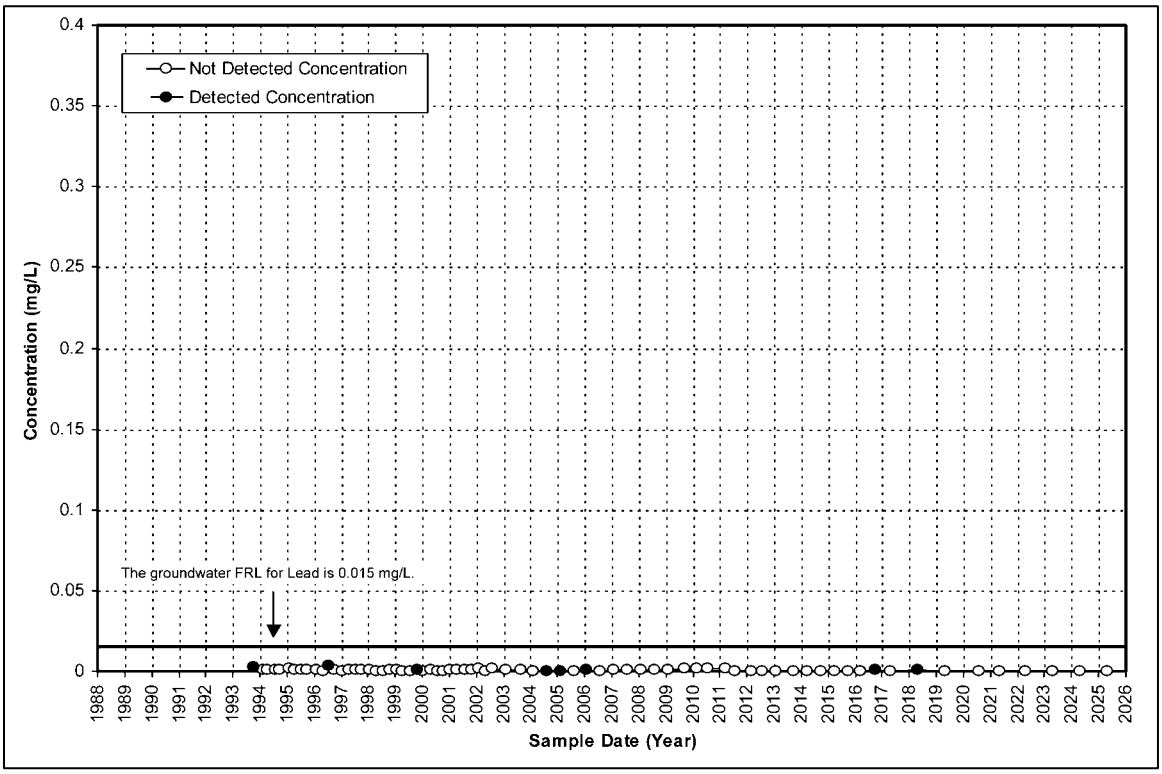


Figure A.4-123. Lead Concentration Versus Time Plot for Monitoring Well 3429

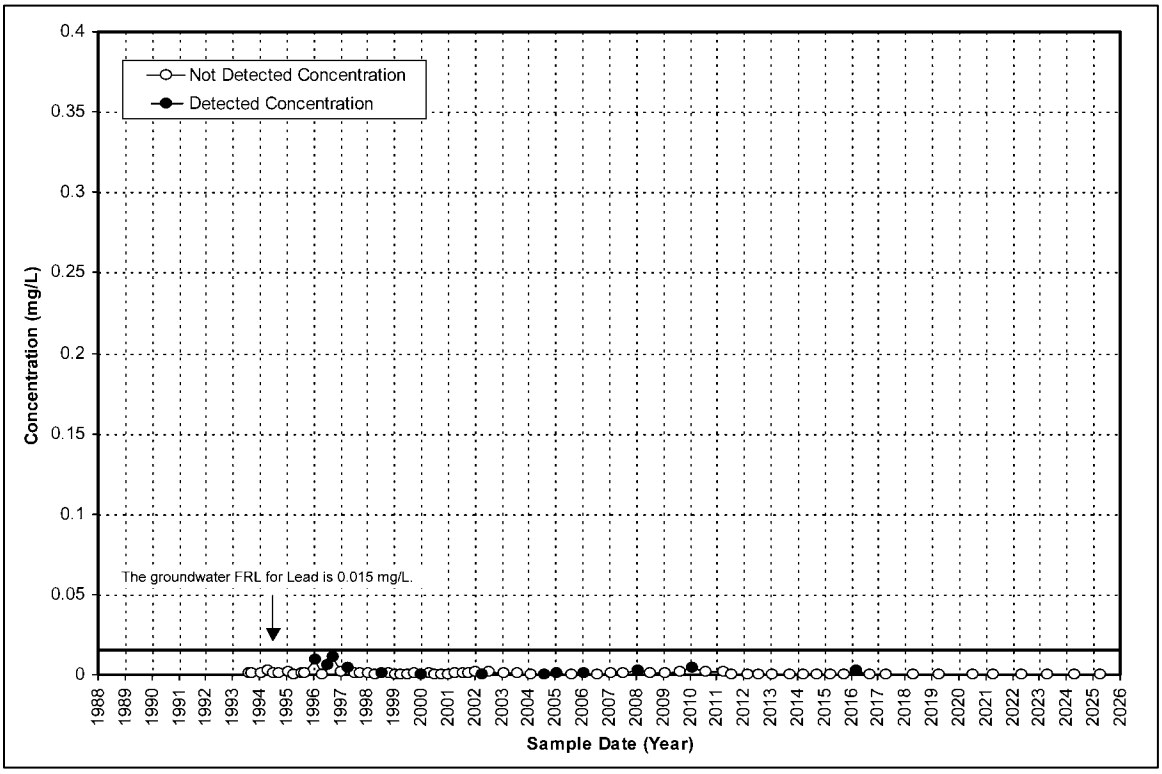


Figure A.4-124. Lead Concentration Versus Time Plot for Monitoring Well 3431

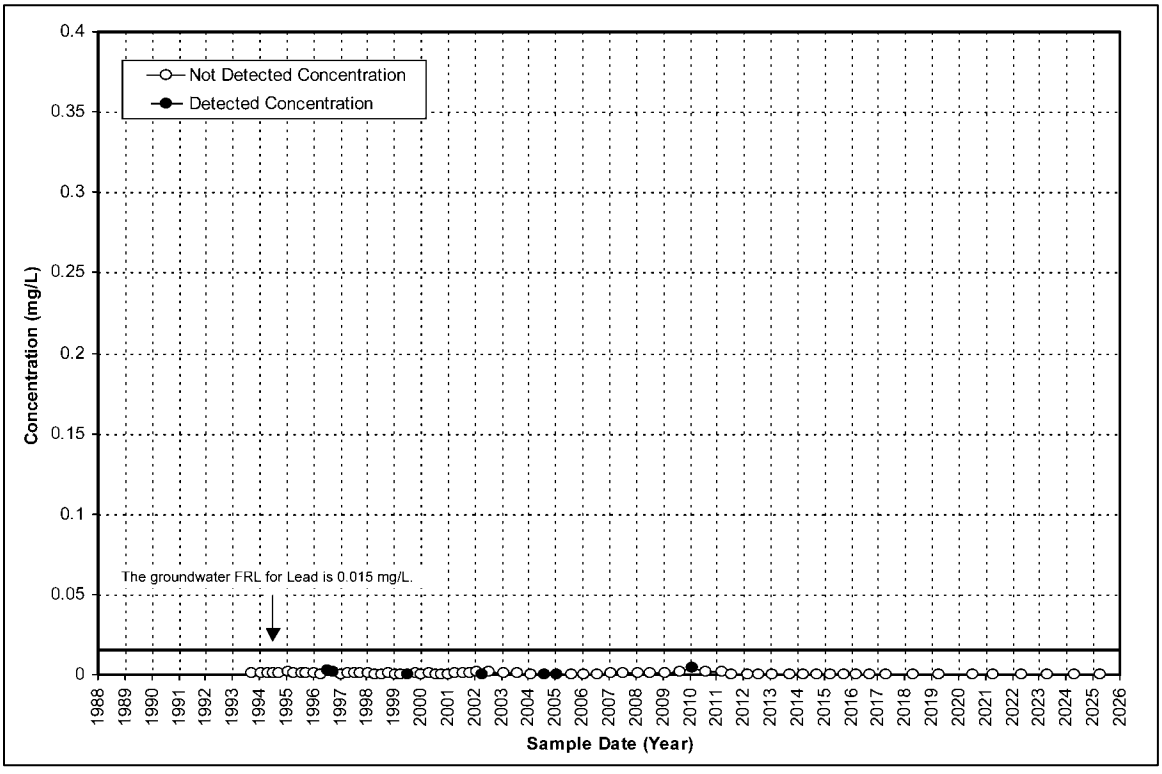


Figure A.4-125. Lead Concentration Versus Time Plot for Monitoring Well 3432

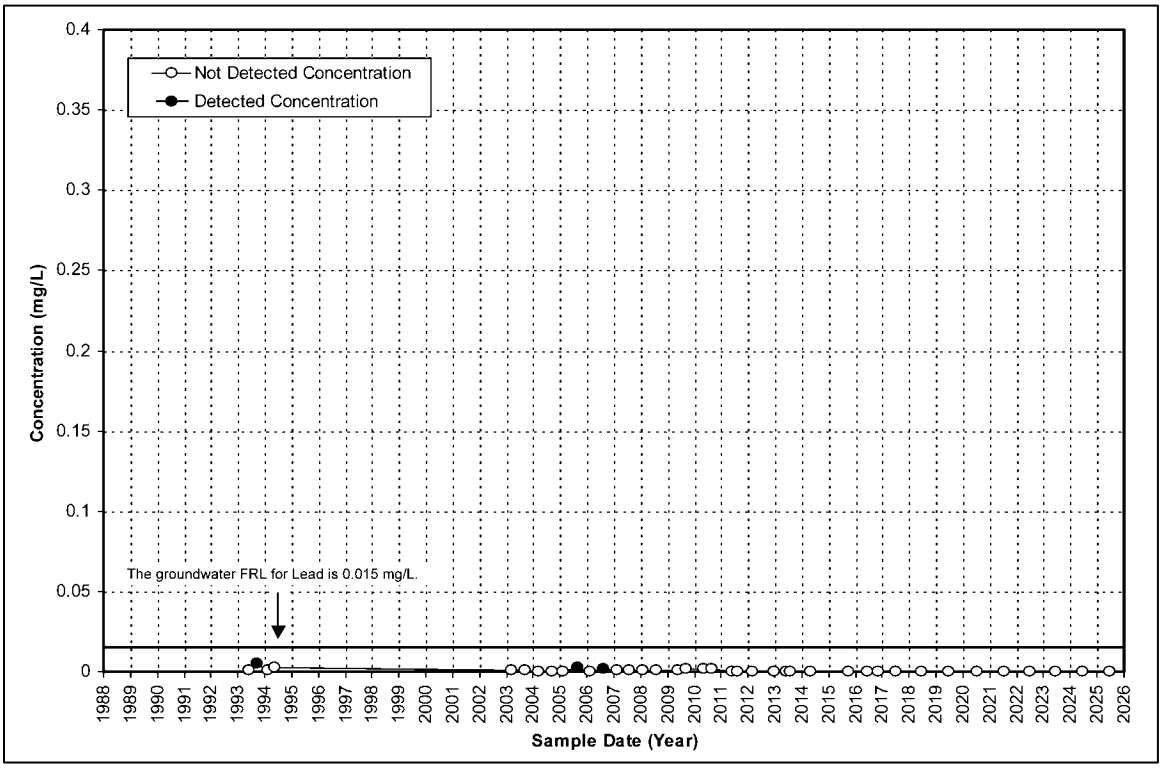


Figure A.4-126. Lead Concentration Versus Time Plot for Monitoring Well 3636

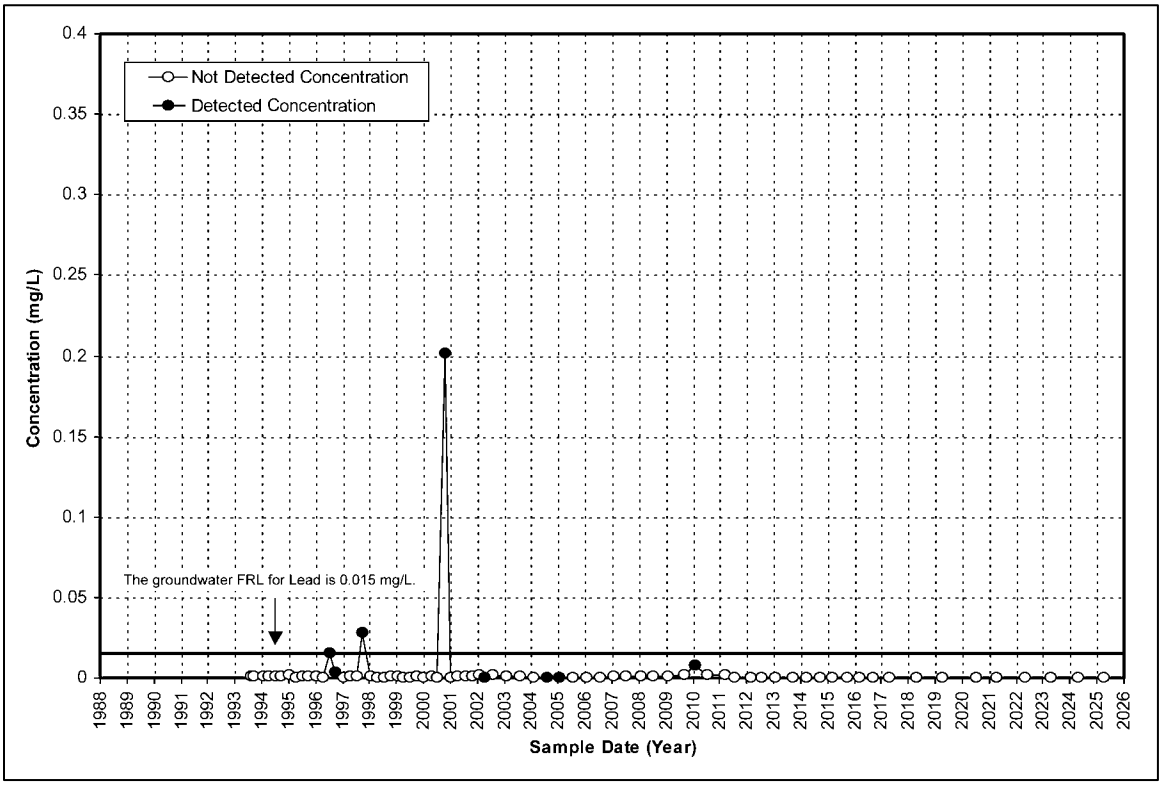


Figure A.4-127. Lead Concentration Versus Time Plot for Monitoring Well 3733

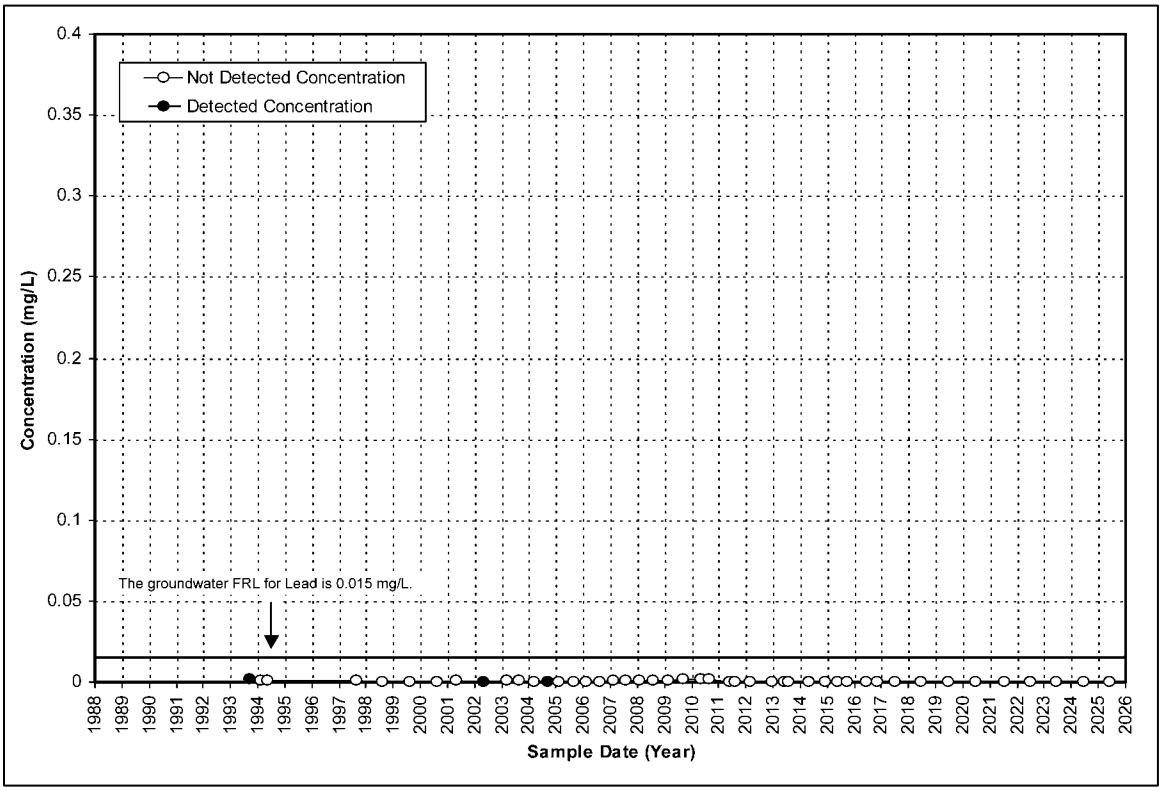


Figure A.4-128. Lead Concentration Versus Time Plot for Monitoring Well 3898

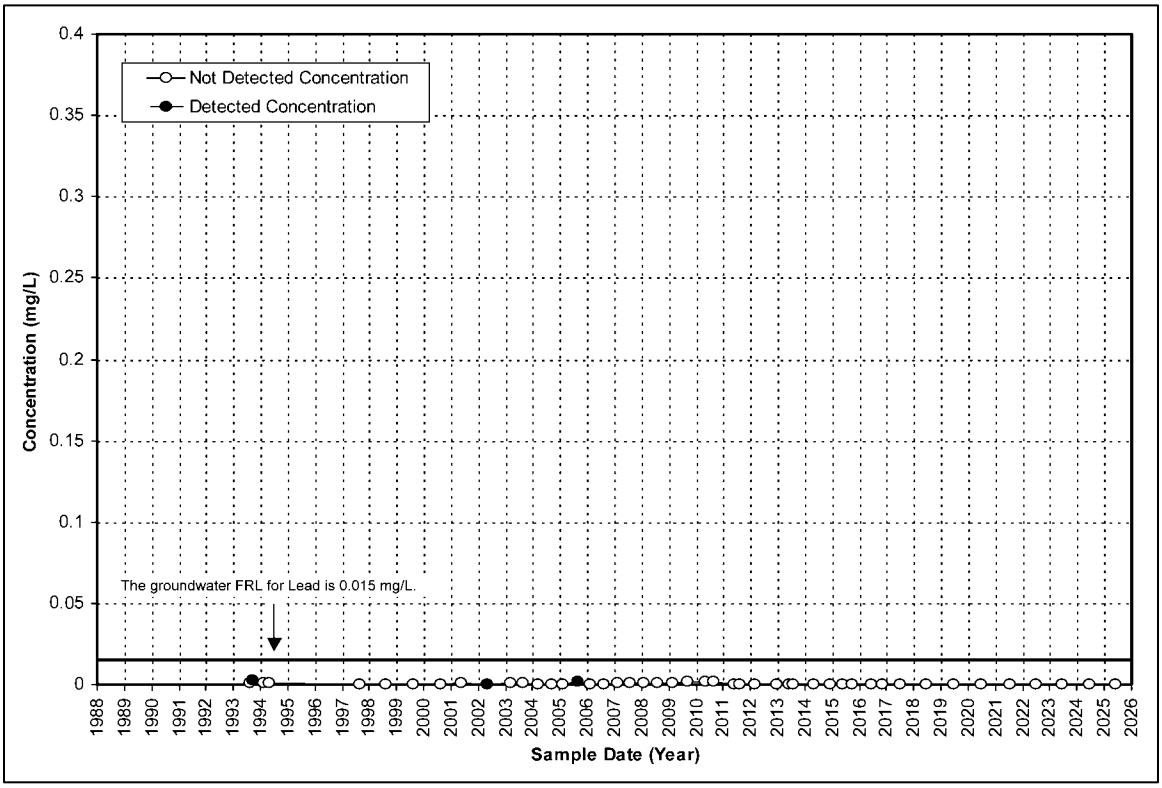


Figure A.4-129. Lead Concentration Versus Time Plot for Monitoring Well 3899

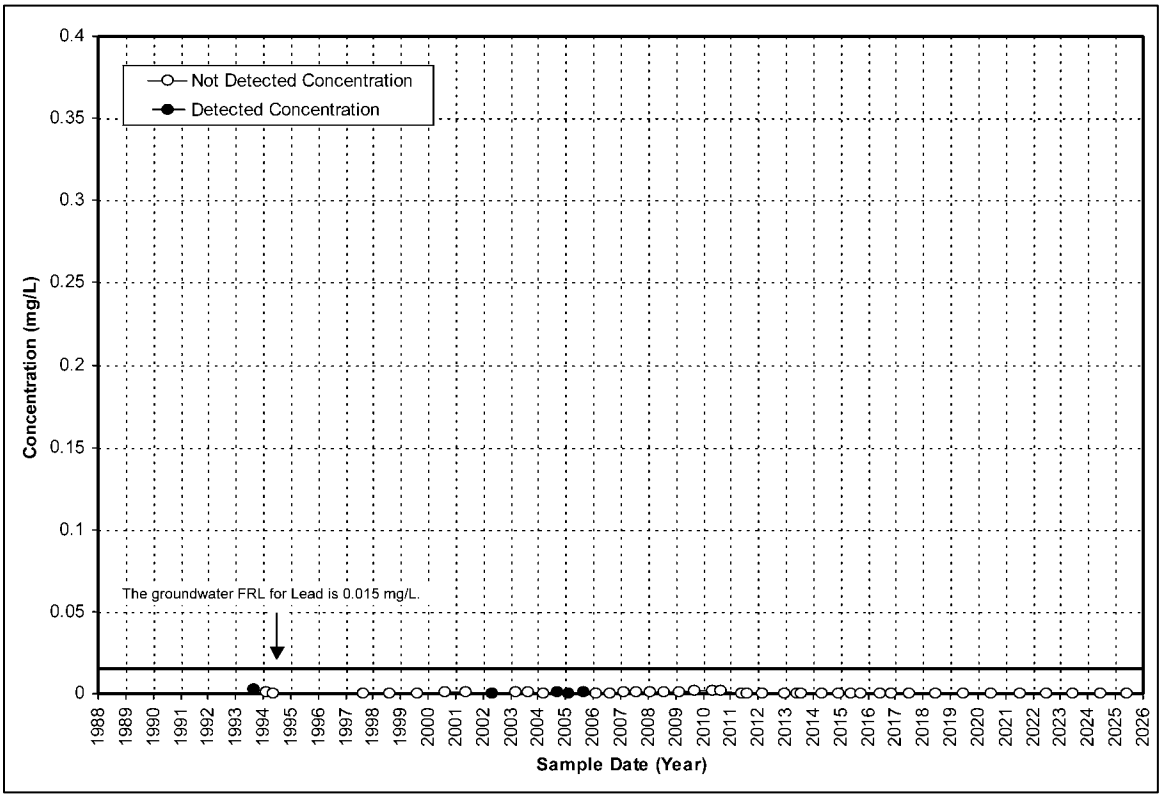


Figure A.4-130. Lead Concentration Versus Time Plot for Monitoring Well 3900

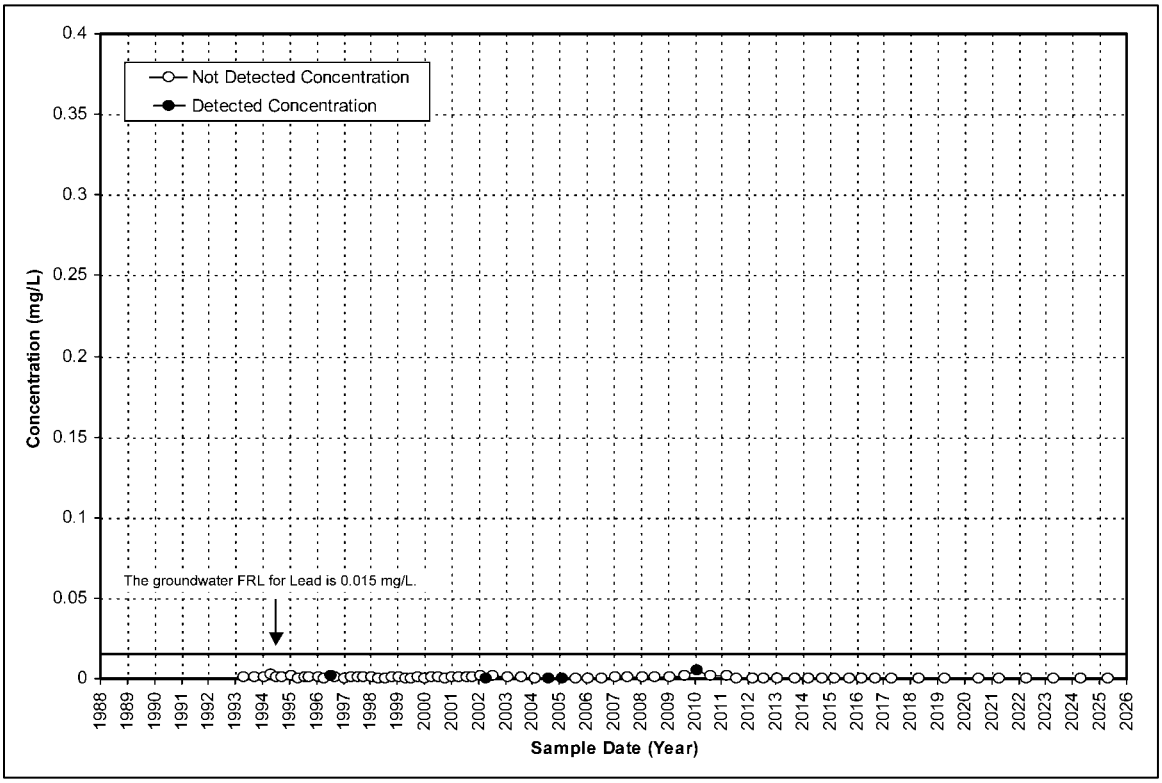


Figure A.4-131. Lead Concentration Versus Time Plot for Monitoring Well 4398

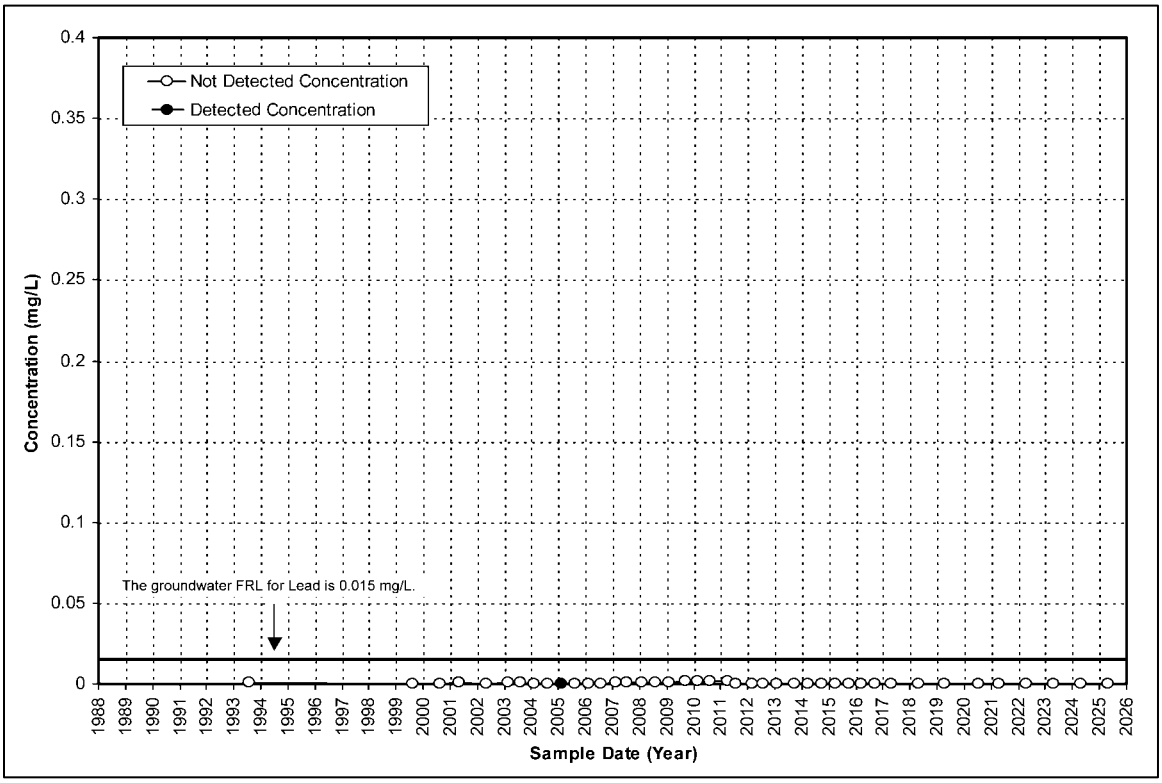


Figure A.4-132. Lead Concentration Versus Time Plot for Monitoring Well 21063

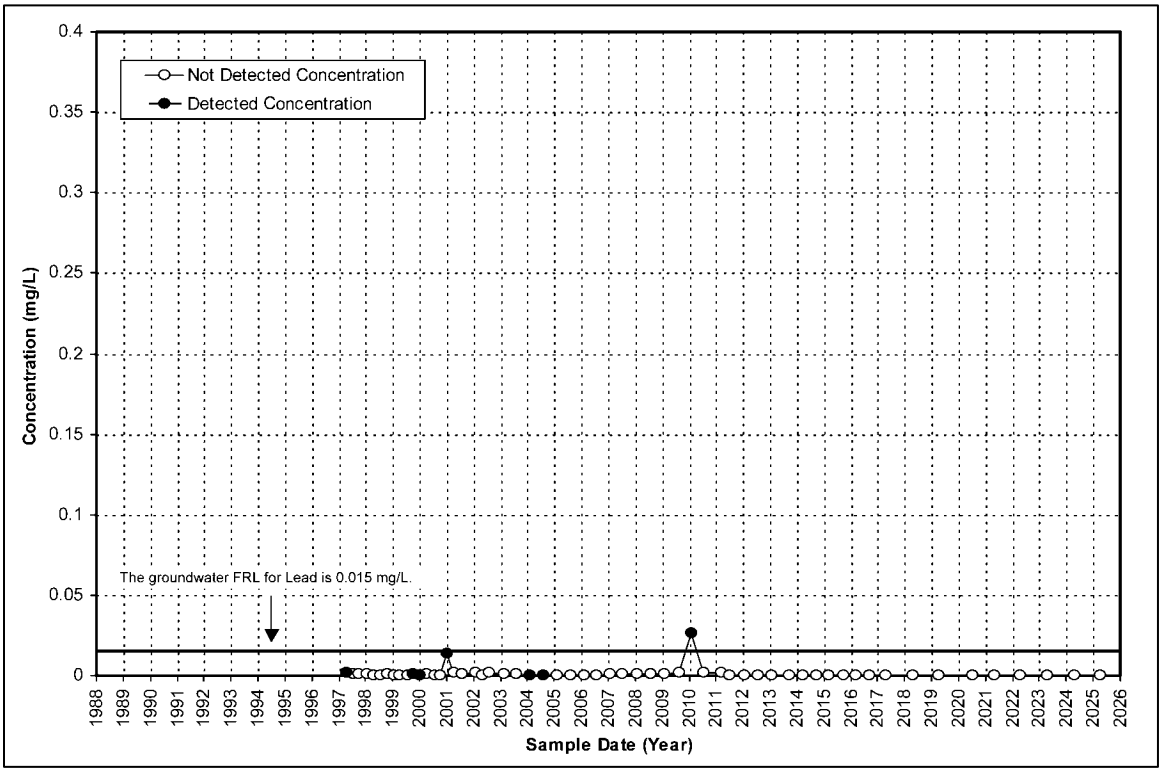


Figure A.4-133. Lead Concentration Versus Time Plot for Monitoring Well 22198

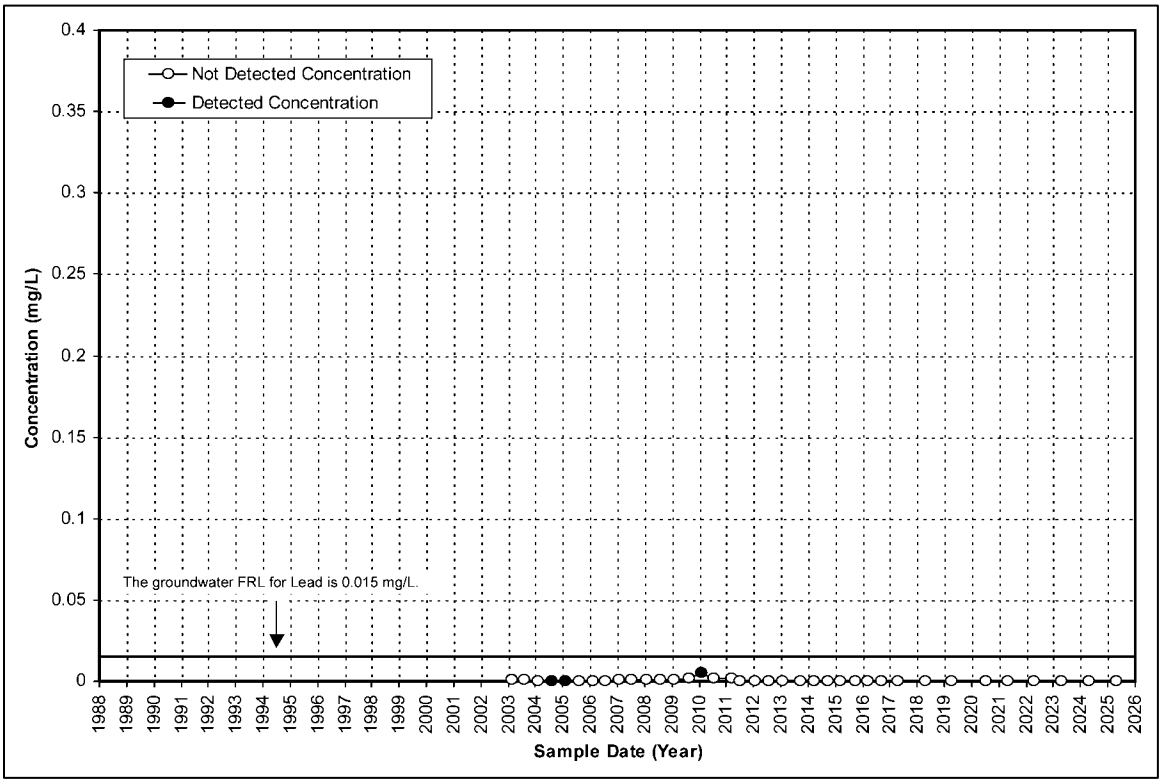


Figure A.4-134. Lead Concentration Versus Time Plot for Monitoring Well 22199

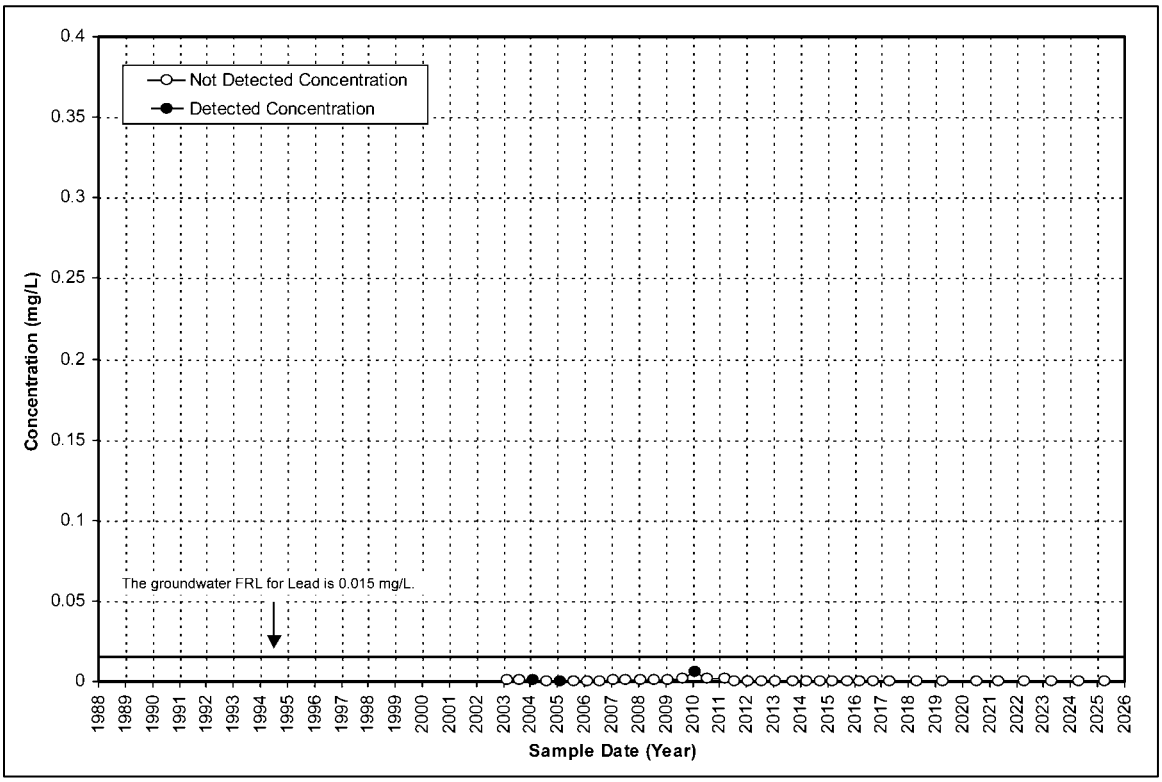


Figure A.4-135. Lead Concentration Versus Time Plot for Monitoring Well 22204

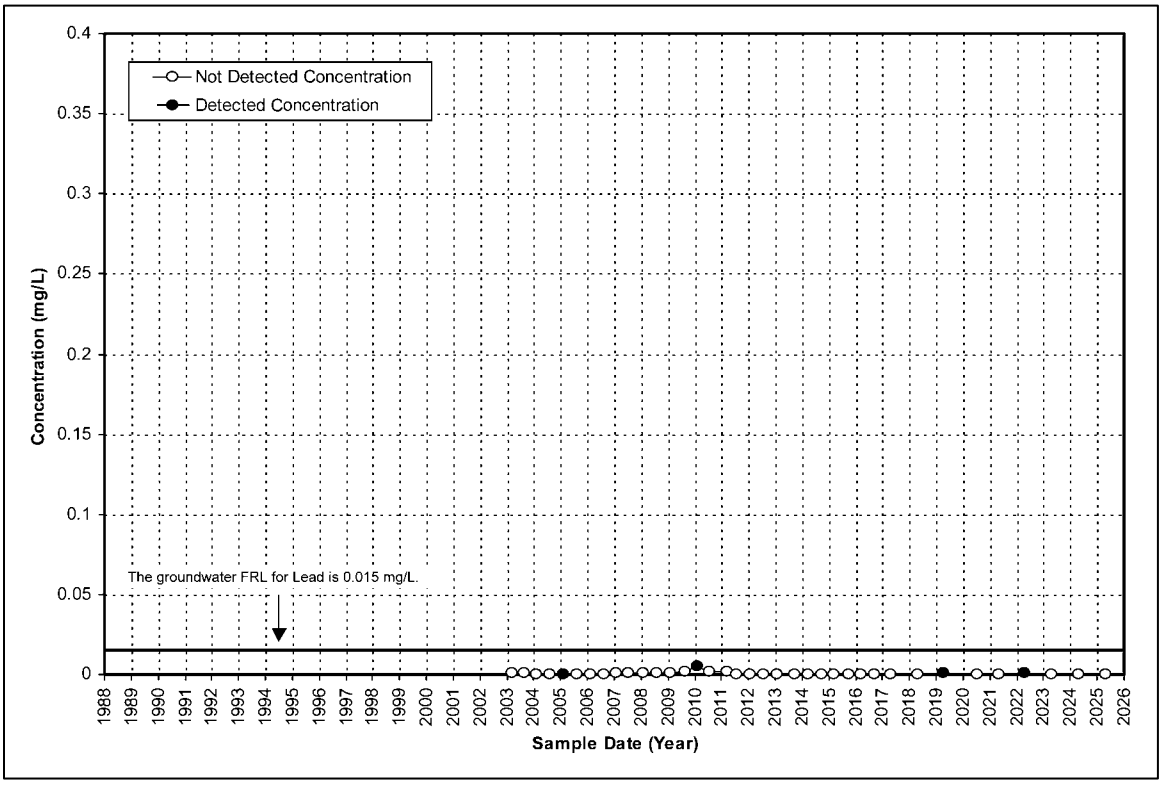


Figure A.4-136. Lead Concentration Versus Time Plot for Monitoring Well 22205

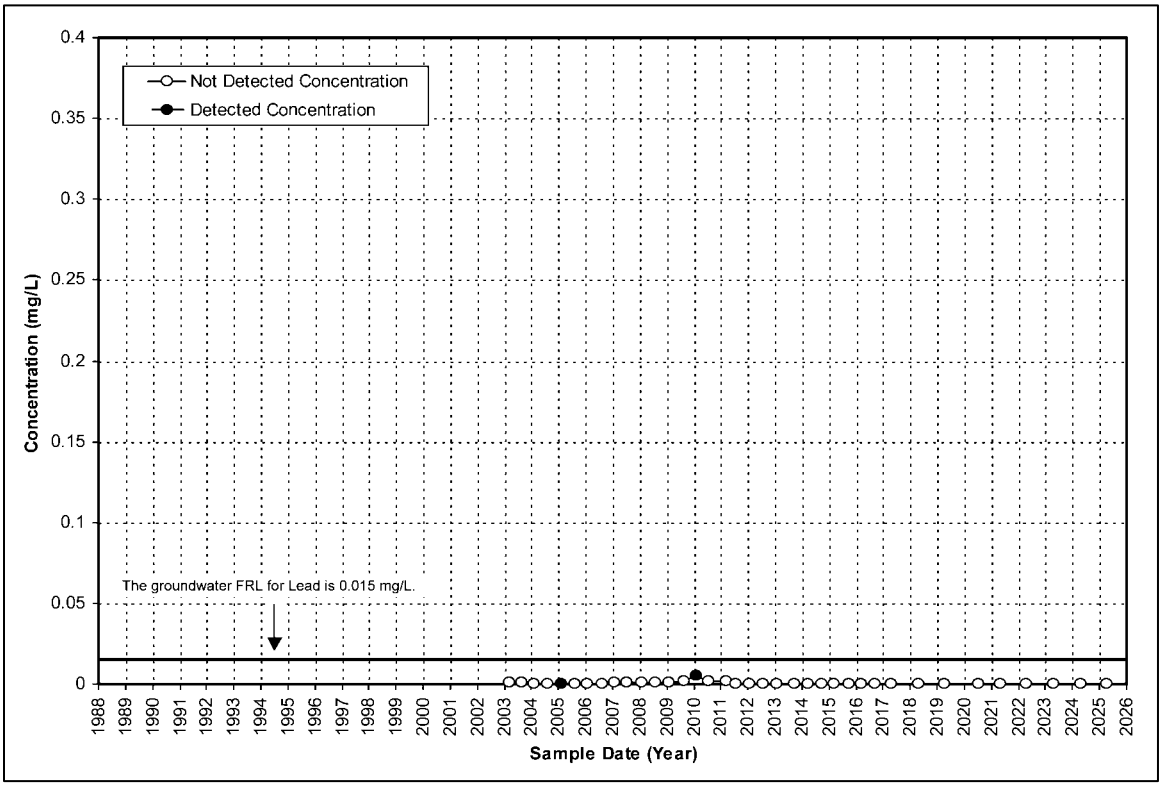


Figure A.4-137. Lead Concentration Versus Time Plot for Monitoring Well 22208

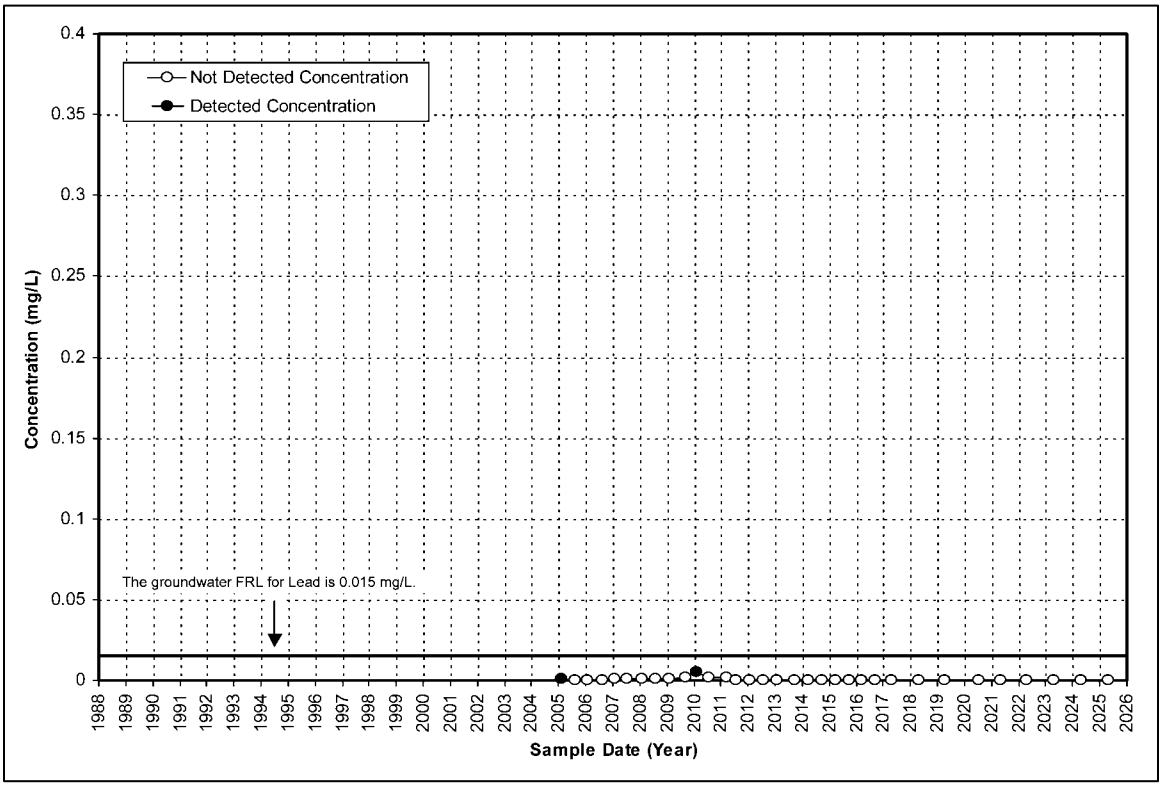


Figure A.4-138. Lead Concentration Versus Time Plot for Monitoring Well 22210

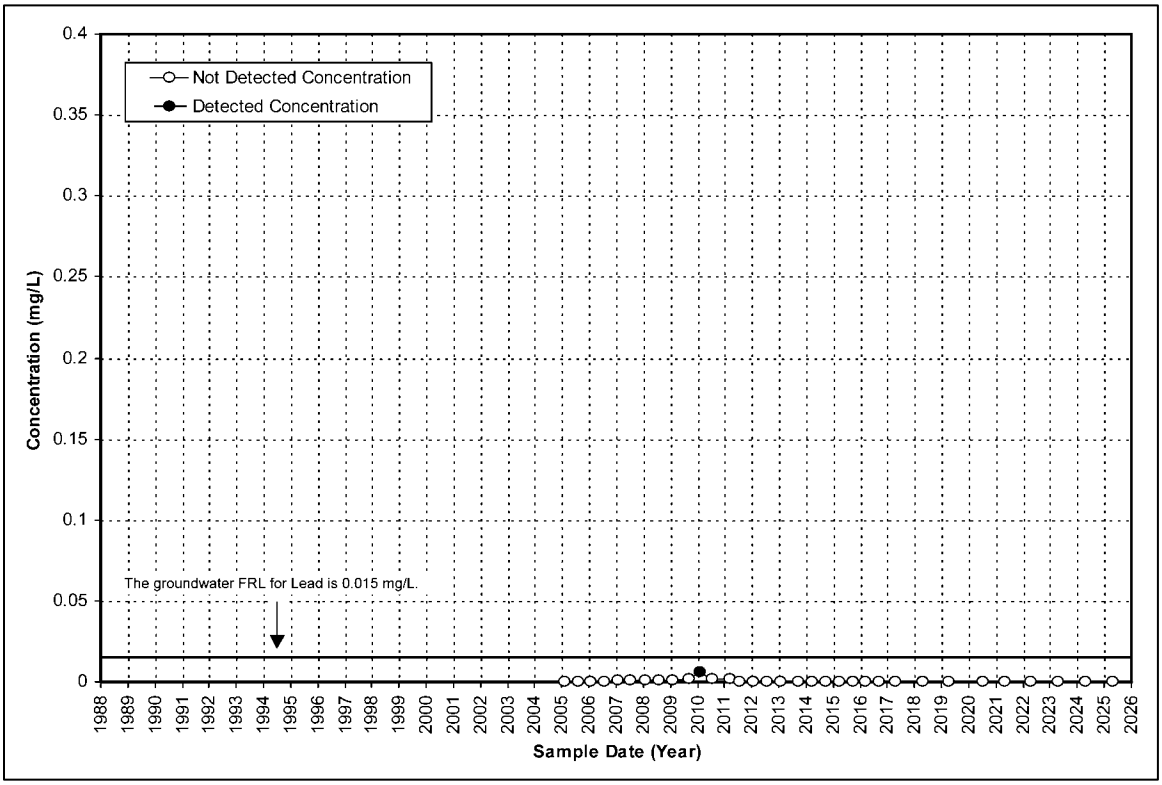


Figure A.4-139. Lead Concentration Versus Time Plot for Monitoring Well 22211

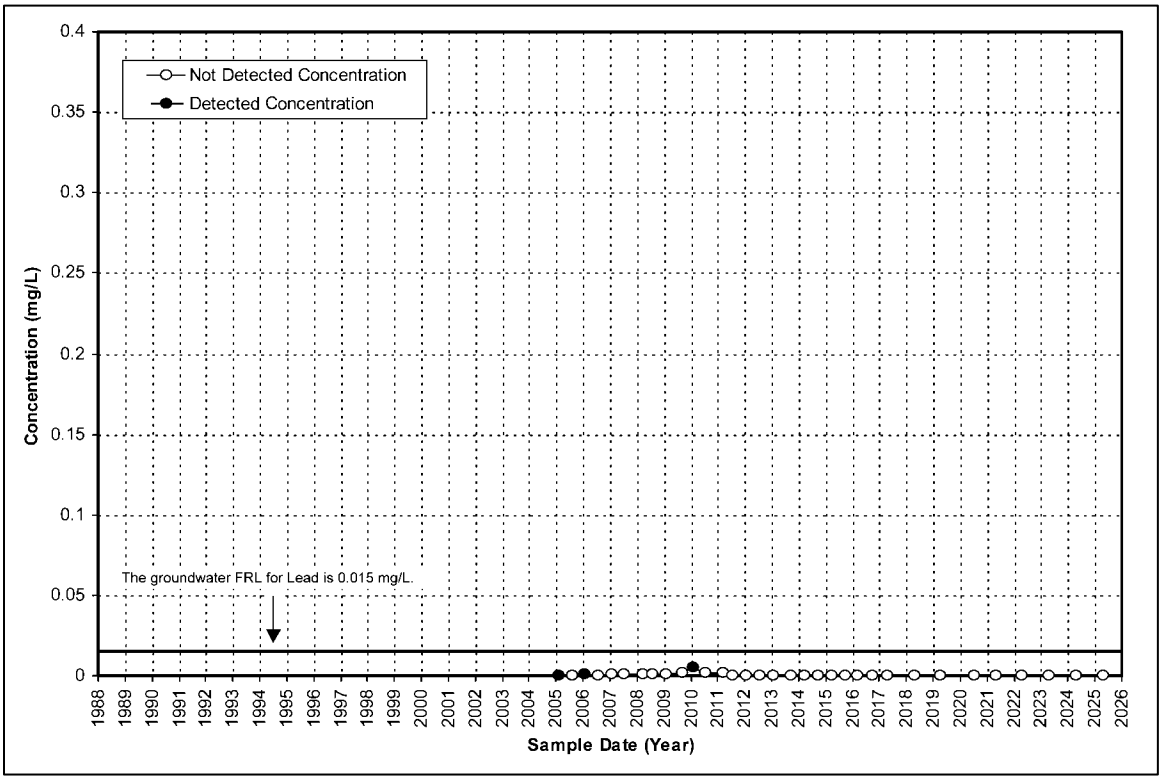


Figure A.4-140. Lead Concentration Versus Time Plot for Monitoring Well 22214

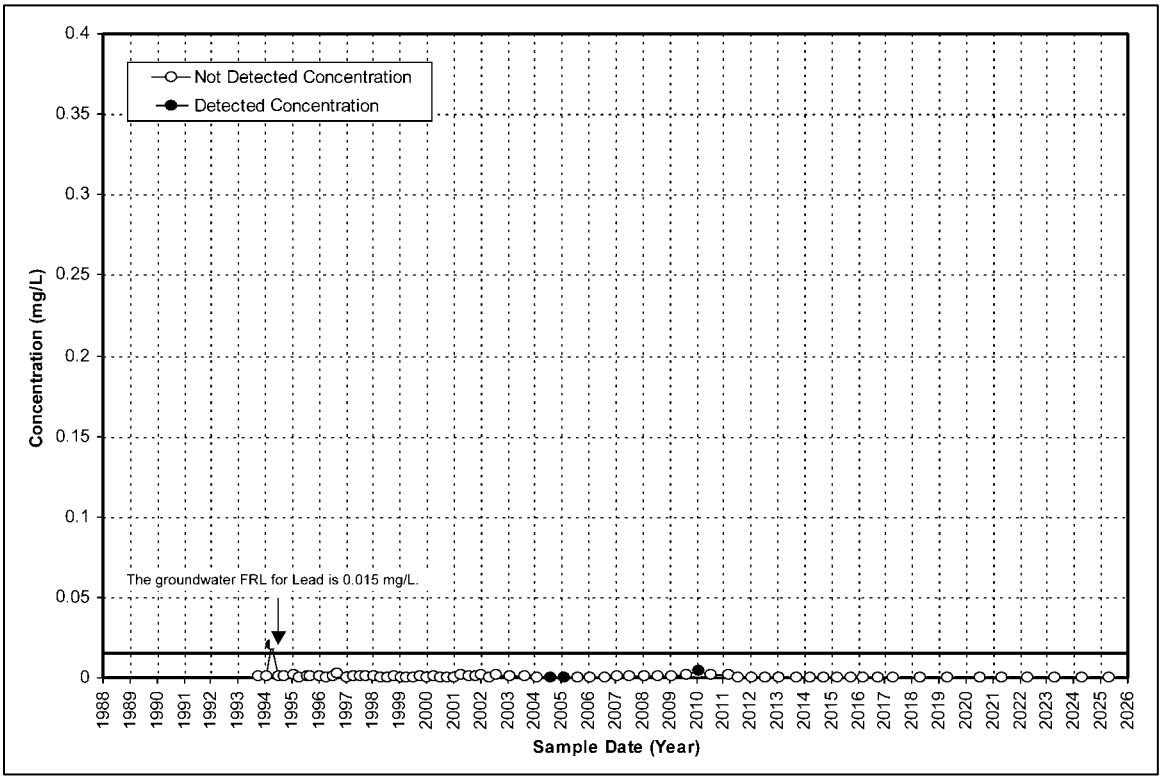


Figure A.4-141. Lead Concentration Versus Time Plot for Monitoring Well 31217

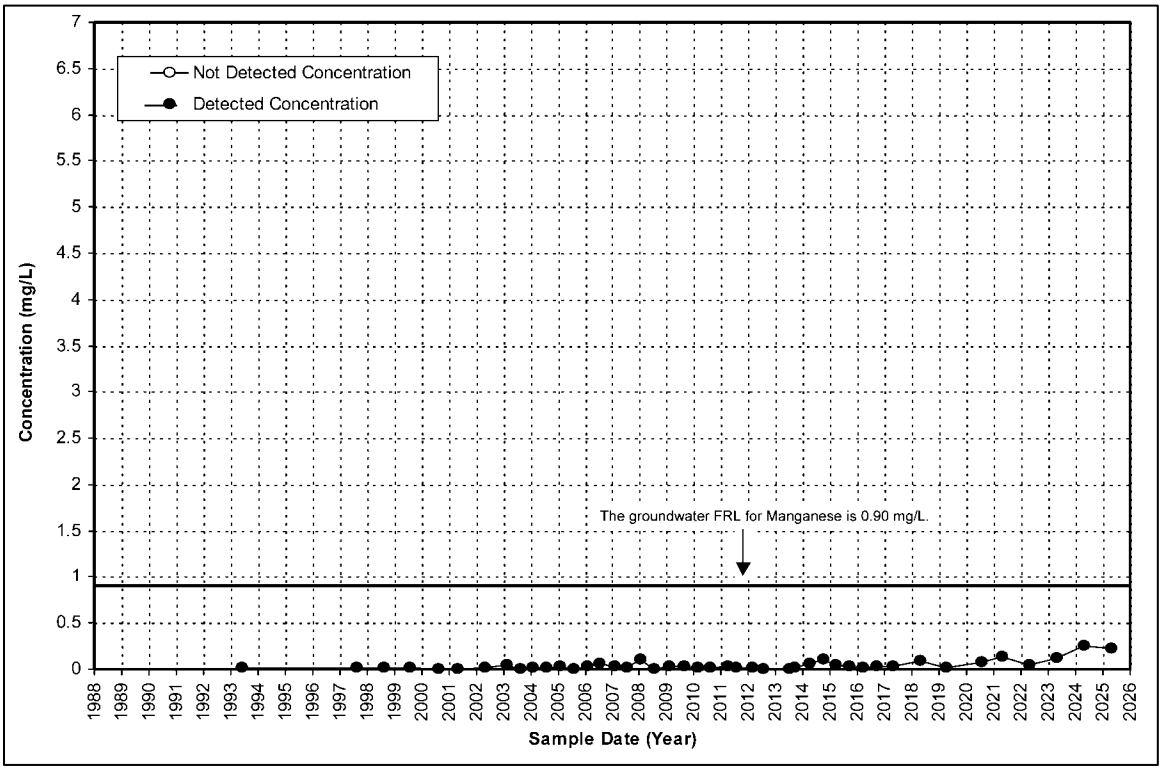


Figure A.4-142. Manganese Concentration Versus Time Plot for Monitoring Well 2093

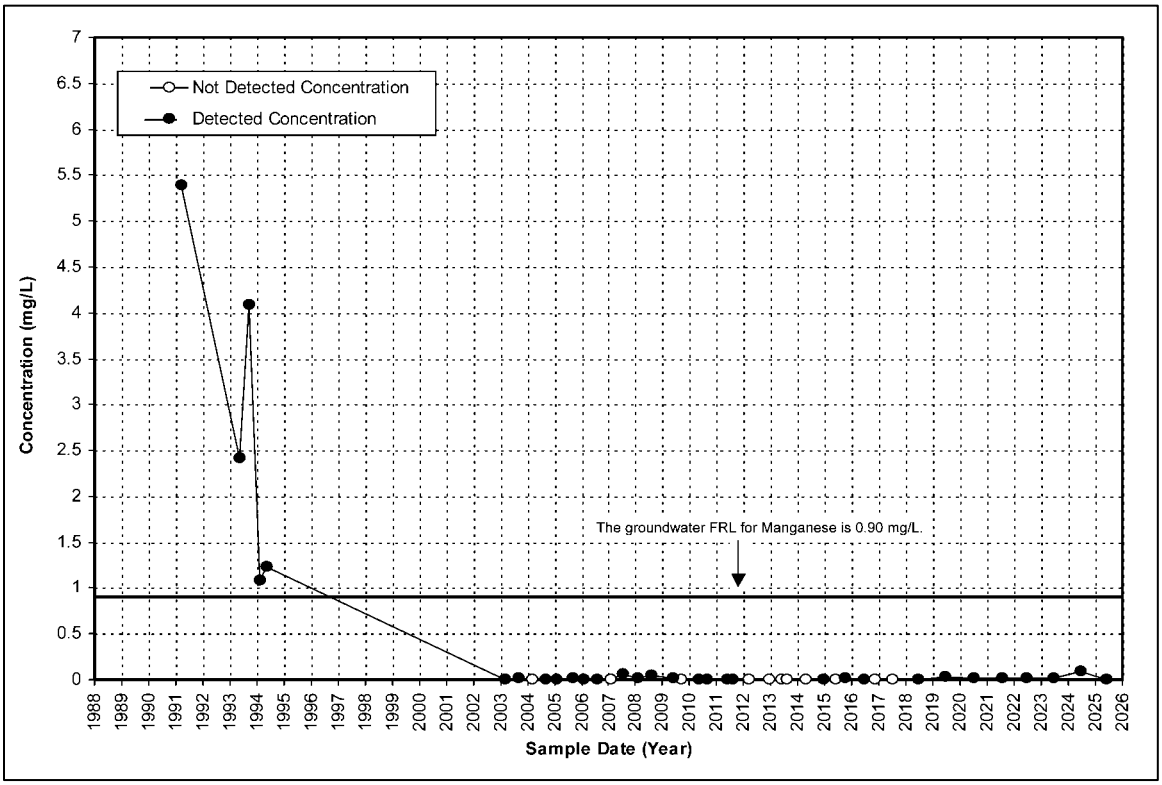


Figure A.4-143. Manganese Concentration Versus Time Plot for Monitoring Well 2128

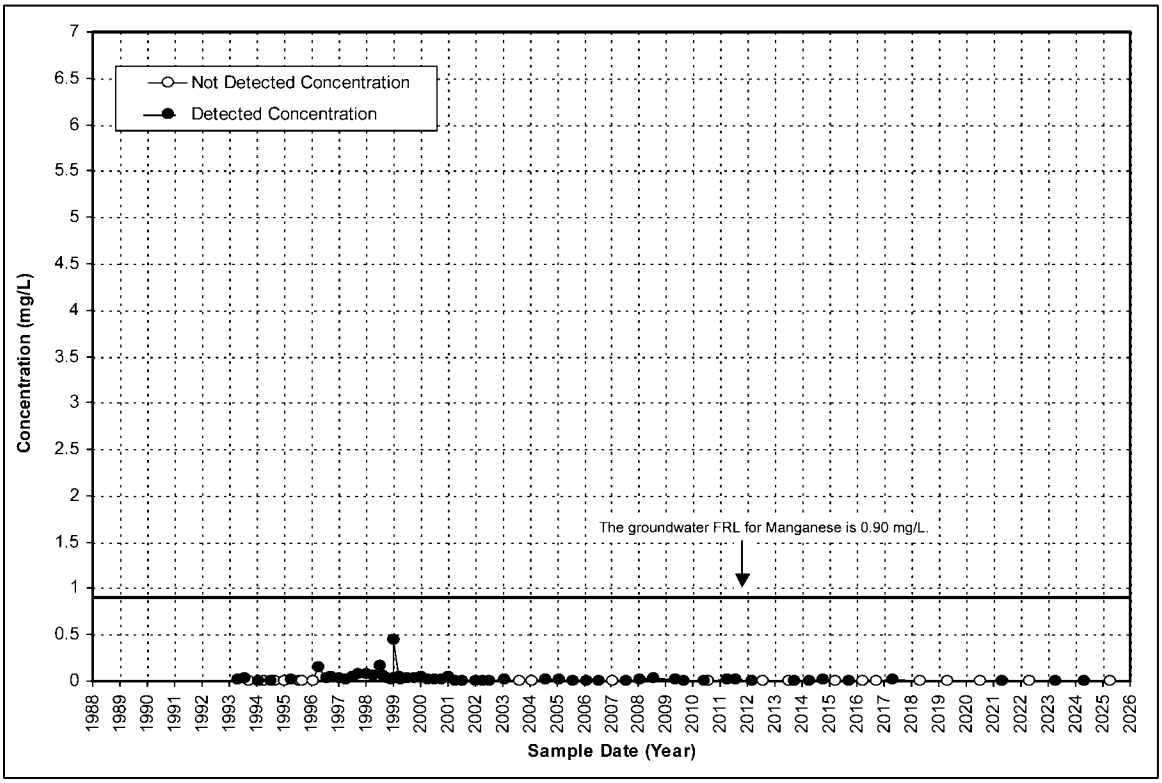


Figure A.4-144. Manganese Concentration Versus Time Plot for Monitoring Well 2398

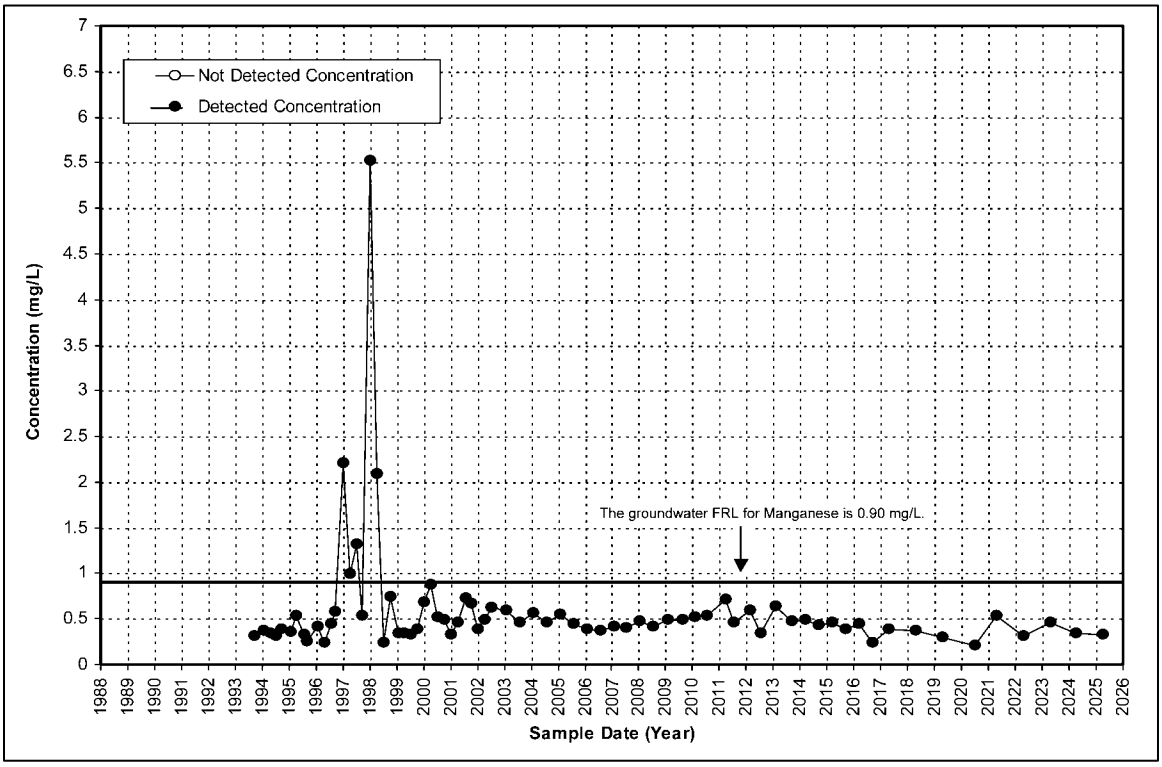


Figure A.4-145. Manganese Concentration Versus Time Plot for Monitoring Well 2431

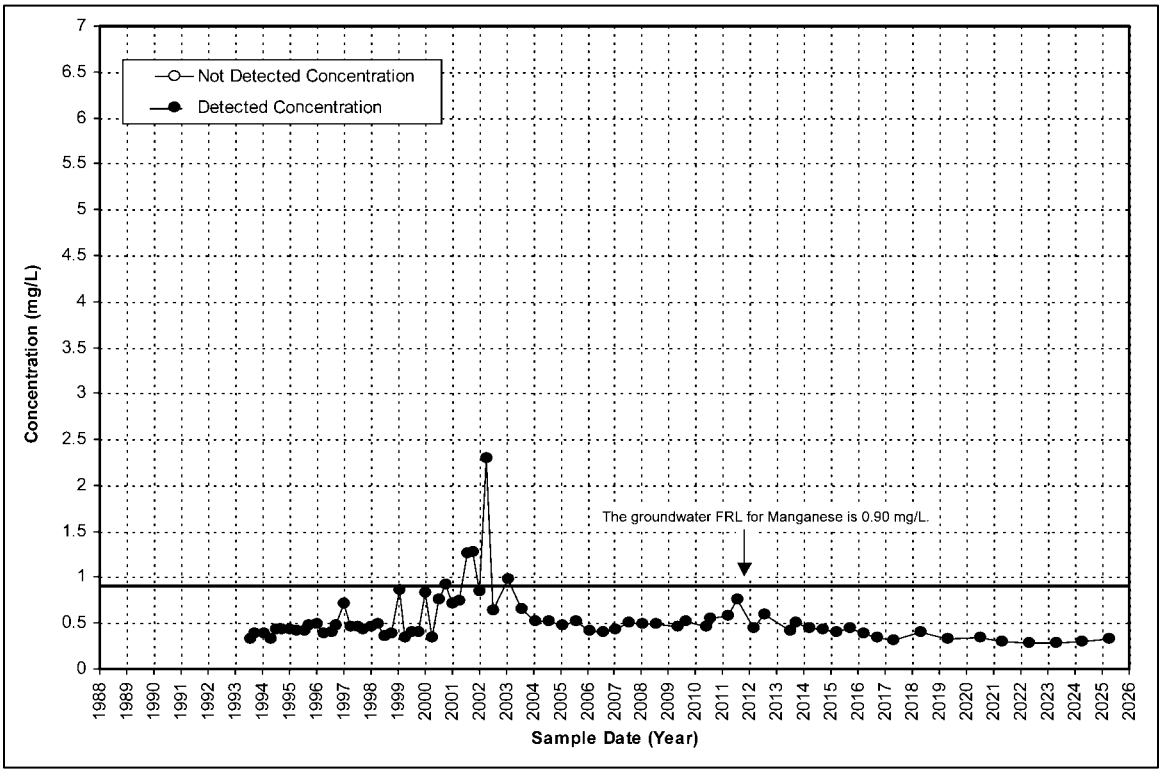


Figure A.4-146. Manganese Concentration Versus Time Plot for Monitoring Well 2432

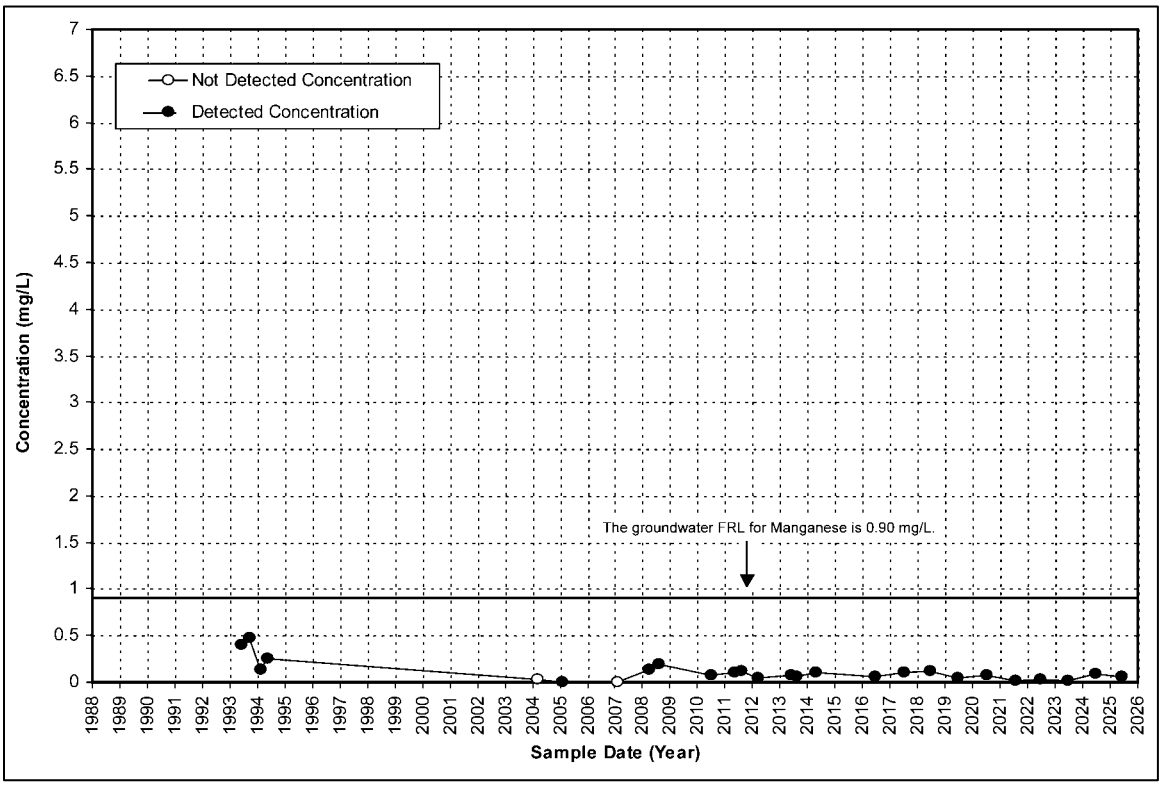


Figure A.4-147. Manganese Concentration Versus Time Plot for Monitoring Well 2636

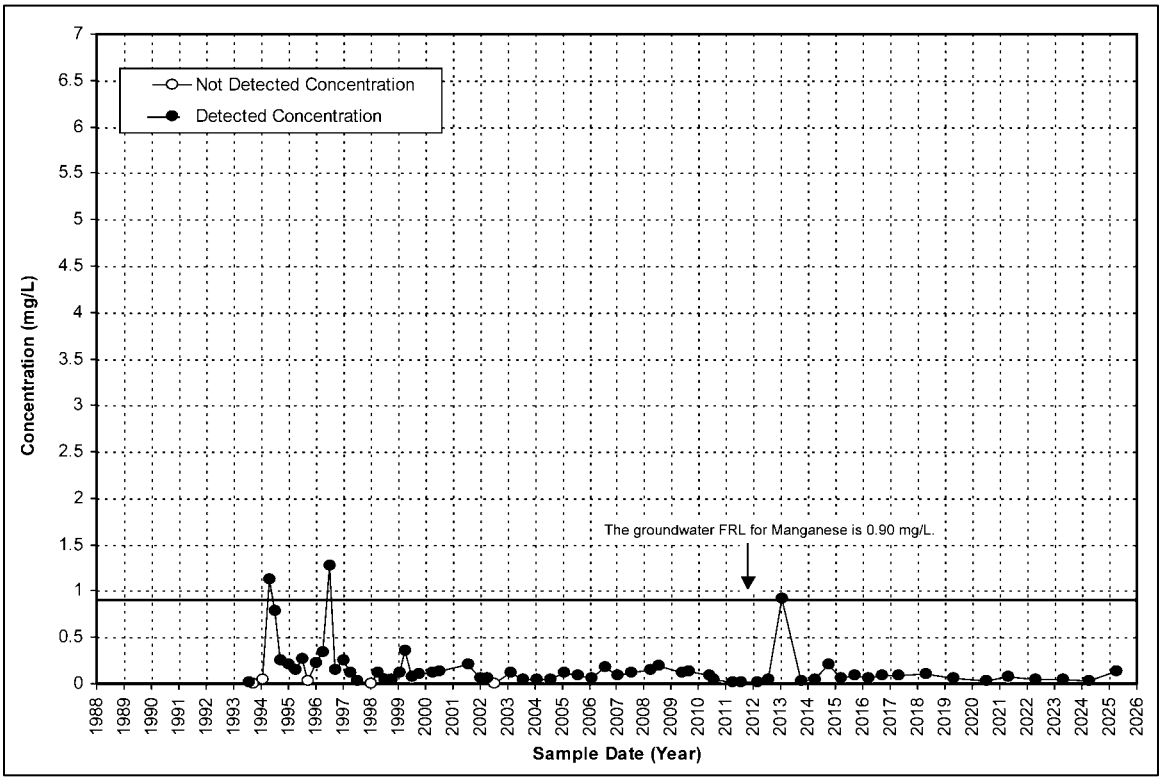


Figure A.4-148. Manganese Concentration Versus Time Plot for Monitoring Well 2733

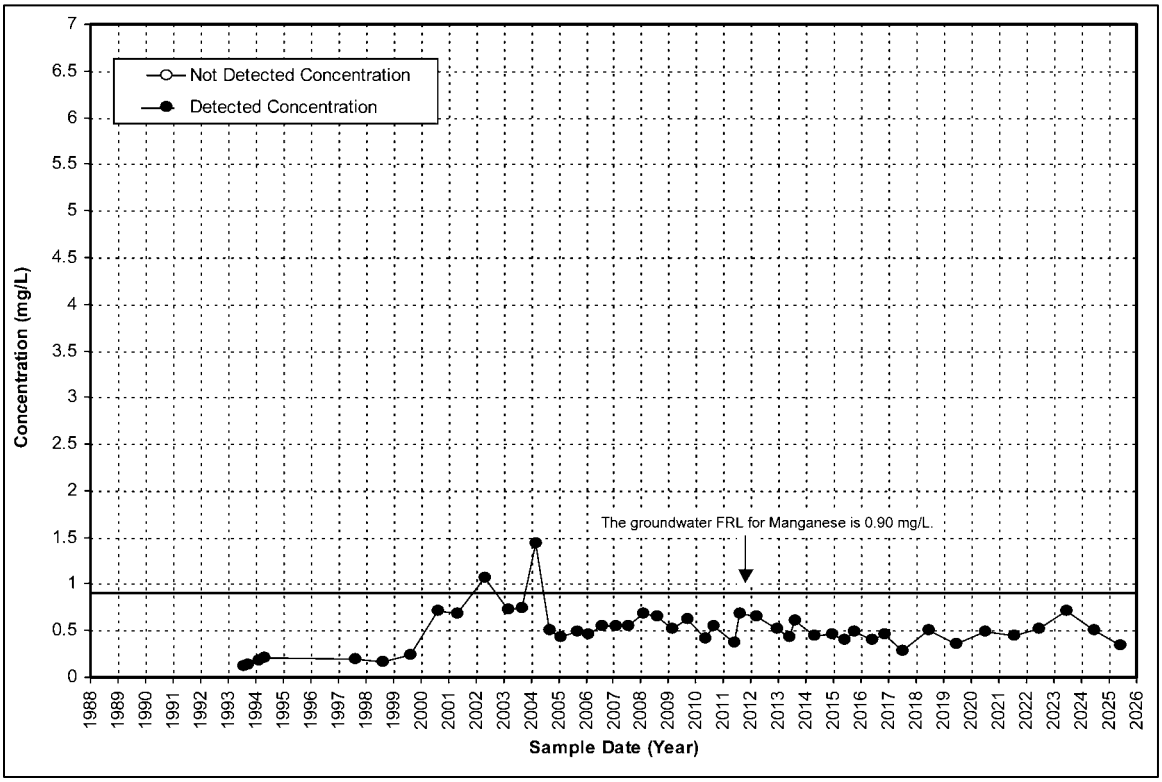


Figure A.4-149. Manganese Concentration Versus Time Plot for Monitoring Well 2898

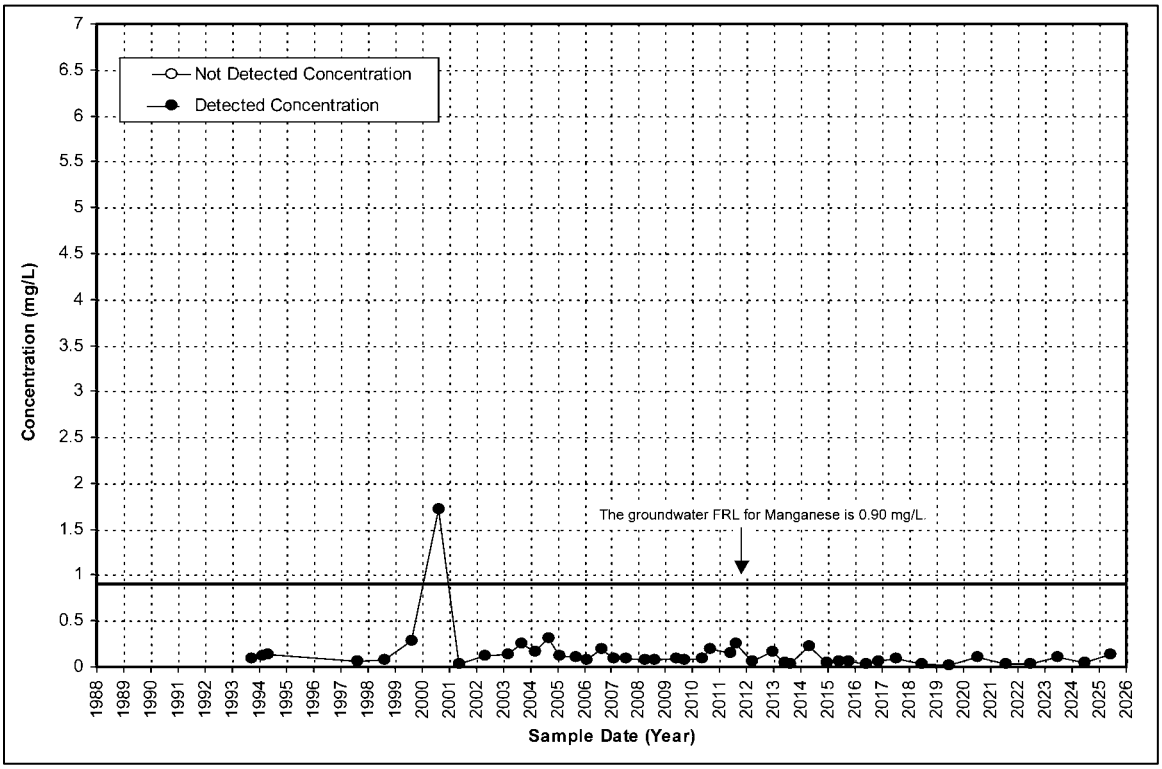


Figure A.4-150. Manganese Concentration Versus Time Plot for Monitoring Well 2899

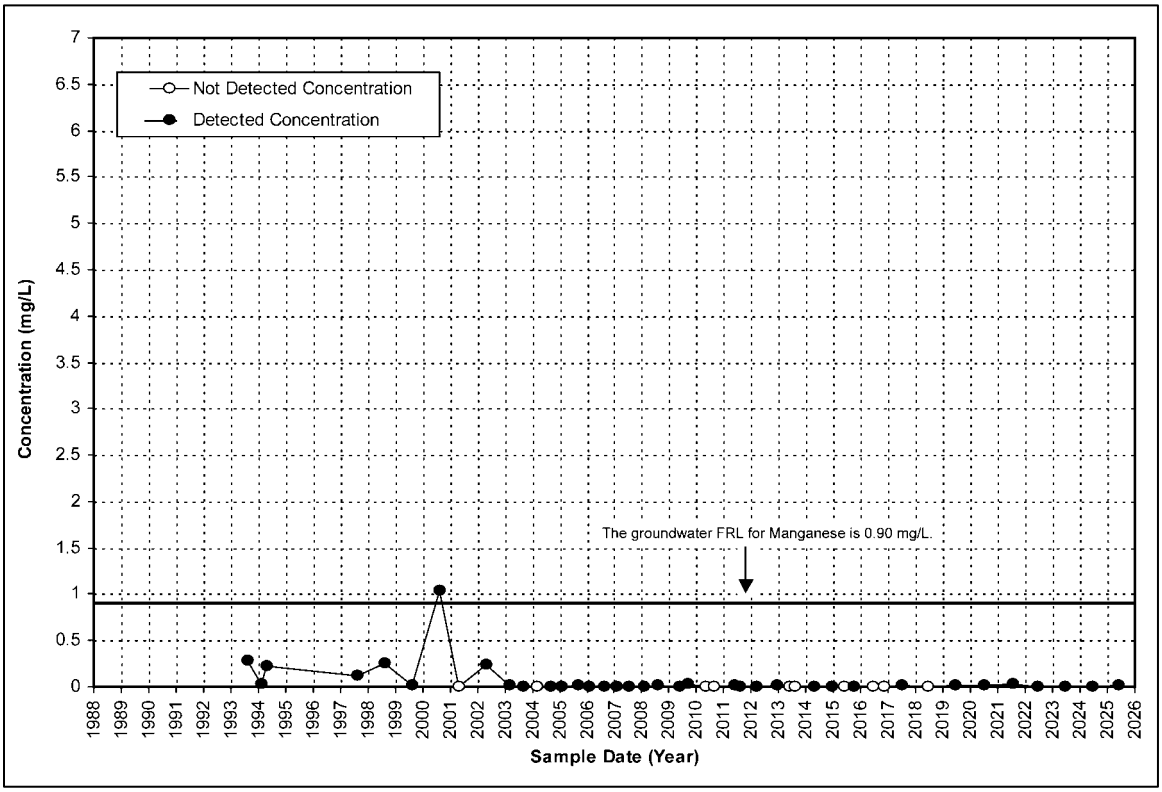


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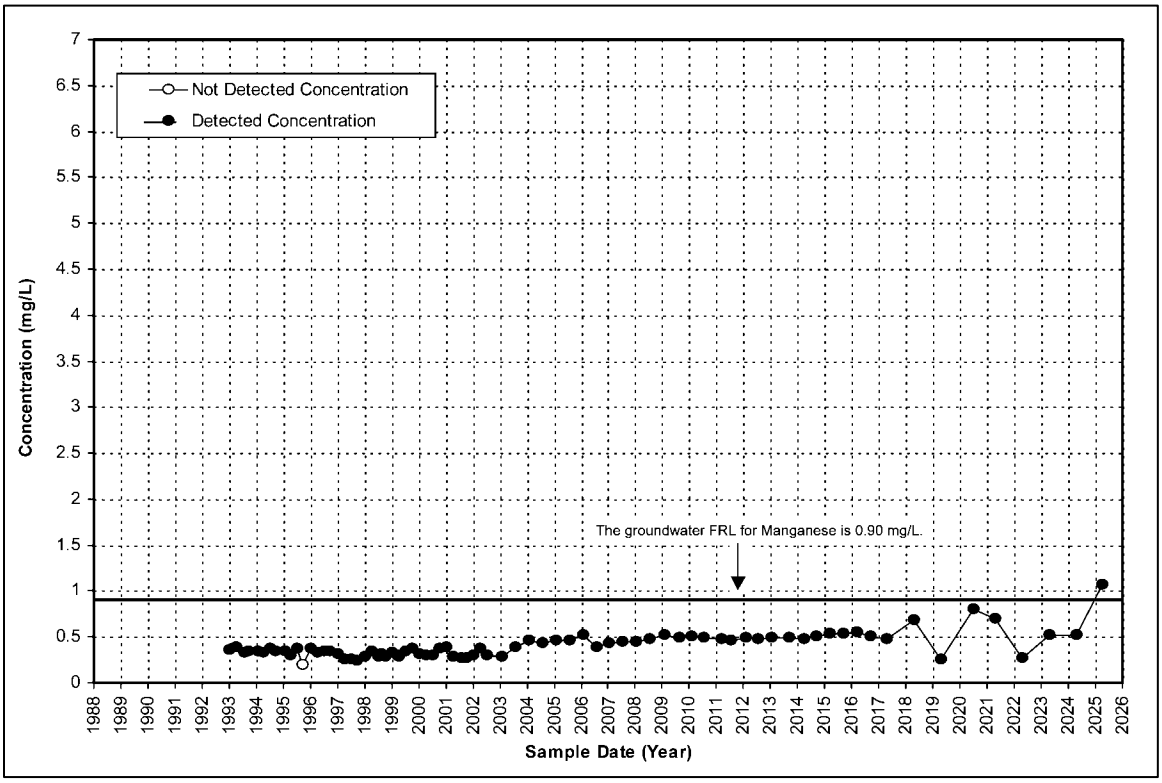


Figure A.4-152. Manganese Concentration Versus Time Plot for Monitoring Well 3070

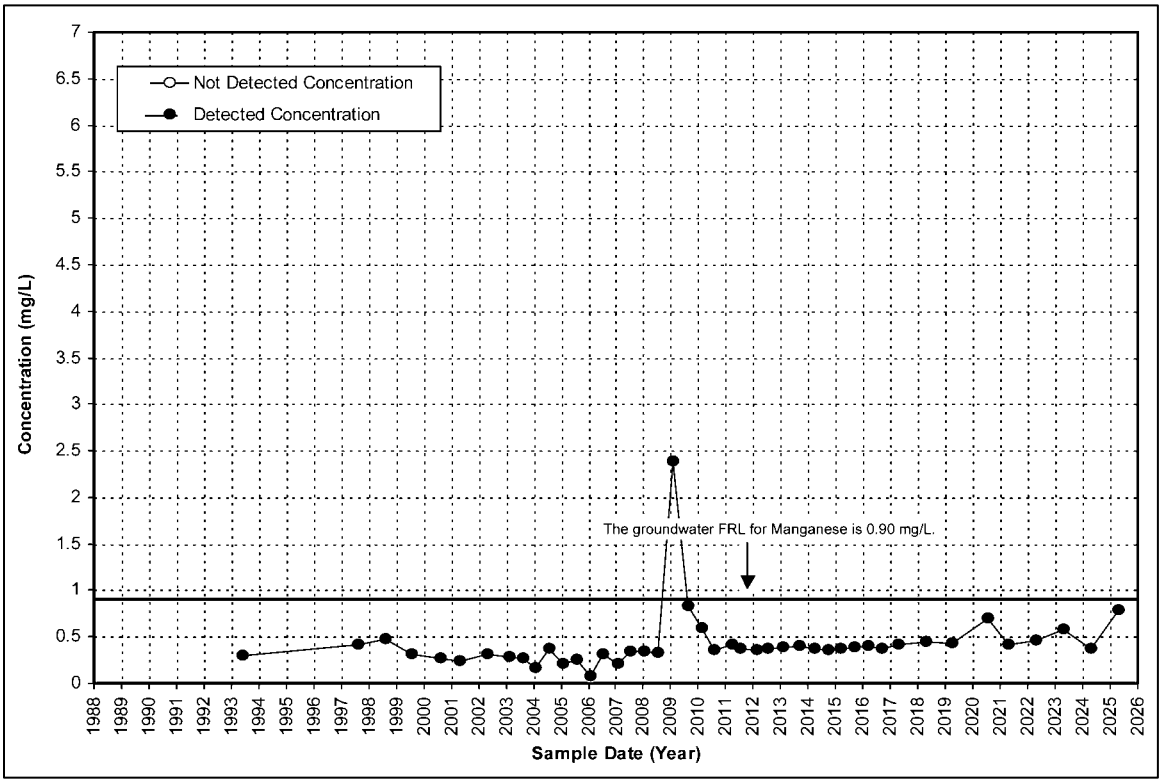


Figure A.4-153. Manganese Concentration Versus Time Plot for Monitoring Well 3093

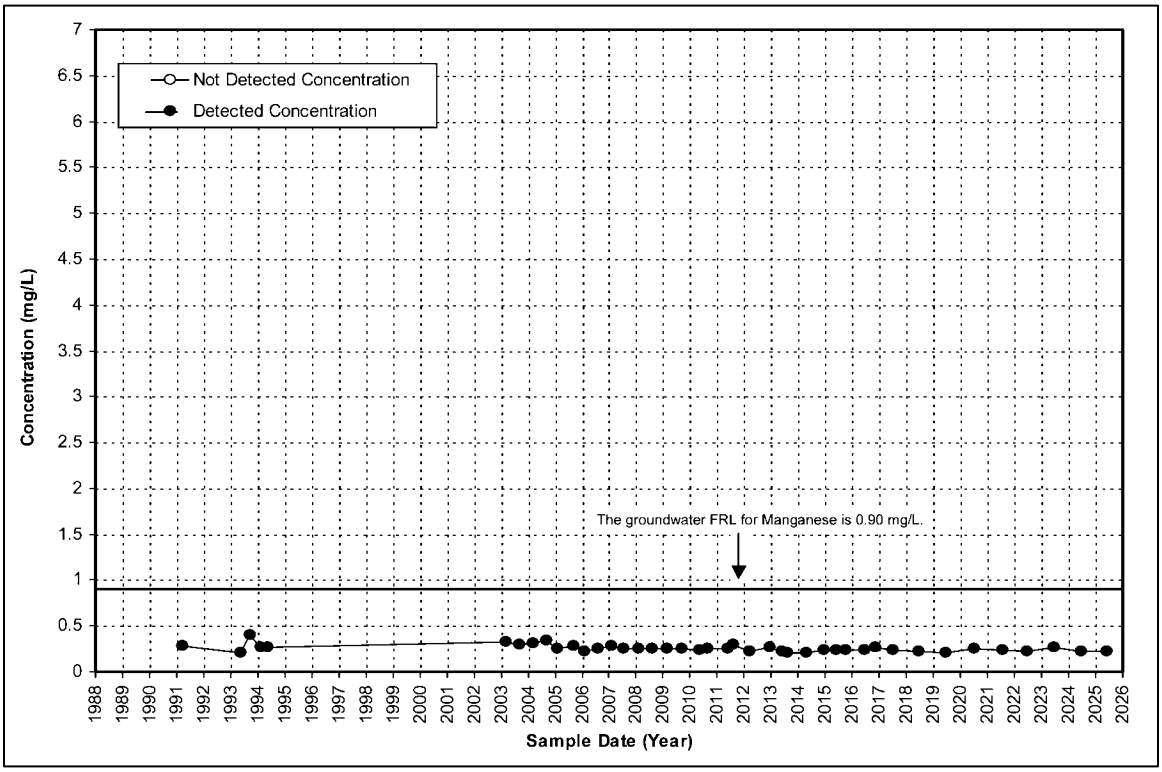


Figure A.4-154. Manganese Concentration Versus Time Plot for Monitoring Well 3128

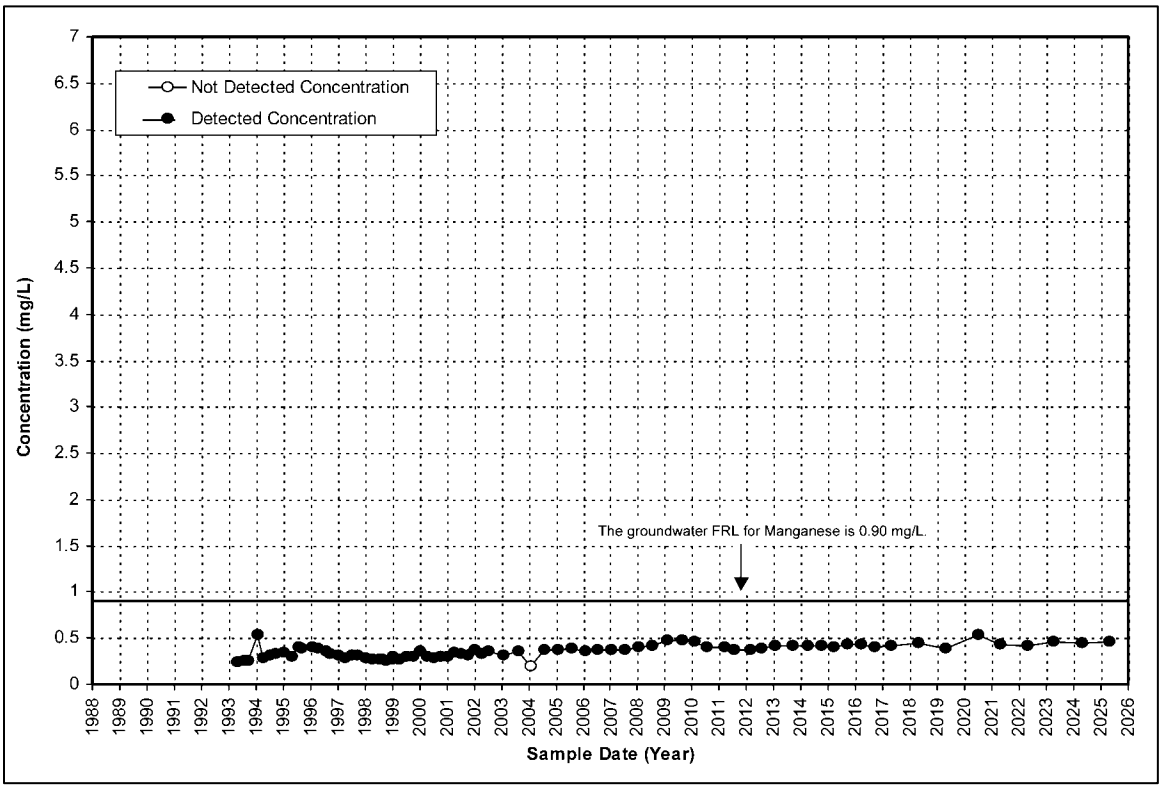


Figure A.4-155. Manganese Concentration Versus Time Plot for Monitoring Well 3398

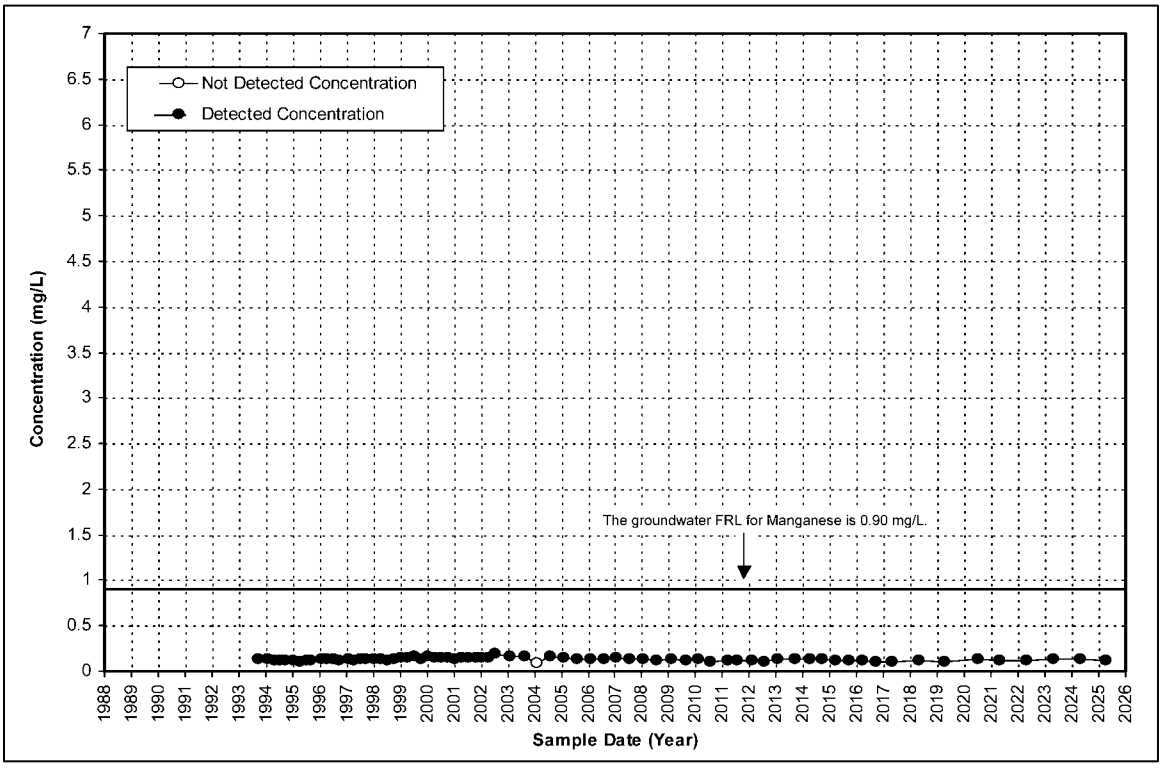


Figure A.4-156. Manganese Concentration Versus Time Plot for Monitoring Well 3424

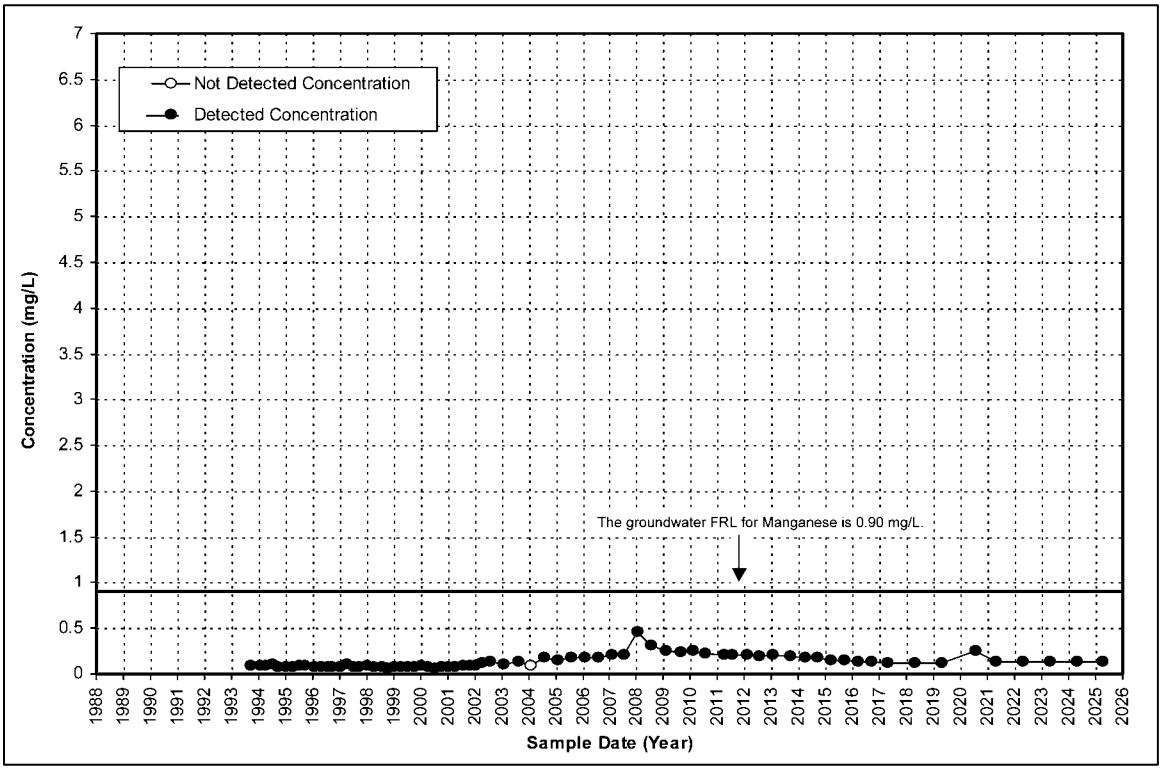


Figure A.4-157. Manganese Concentration Versus Time Plot for Monitoring Well 3426

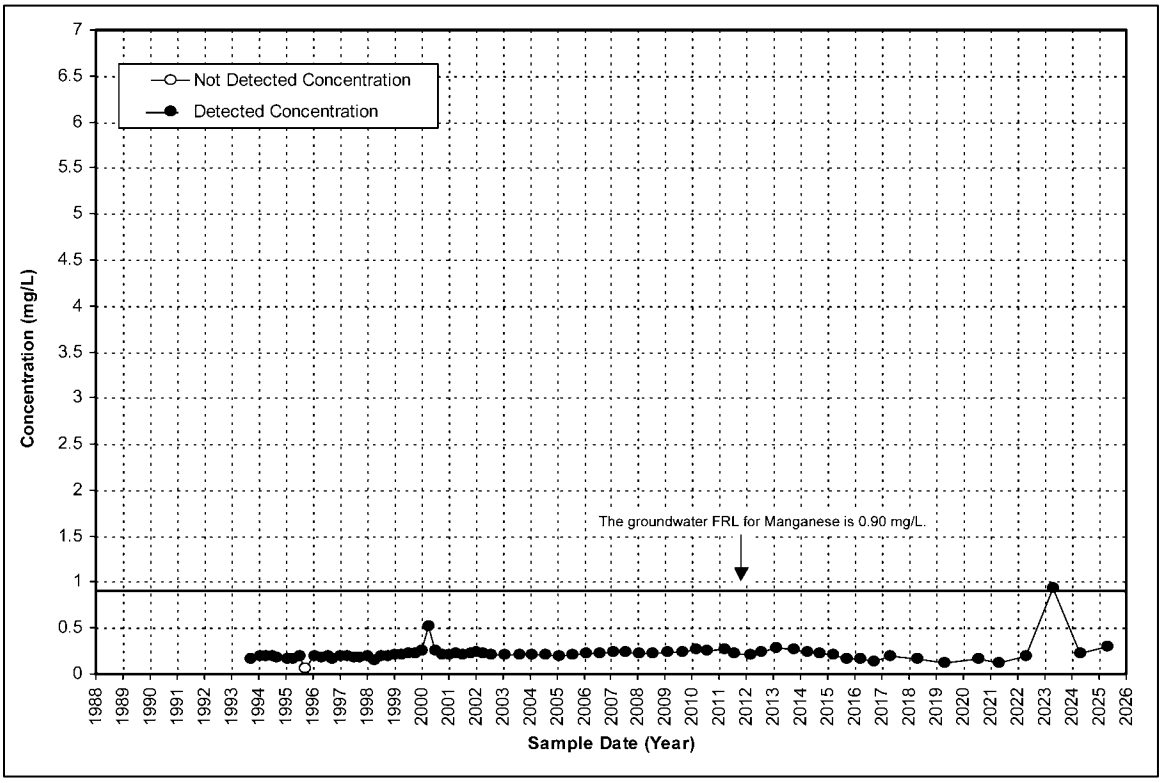


Figure A.4-158. Manganese Concentration Versus Time Plot for Monitoring Well 3429

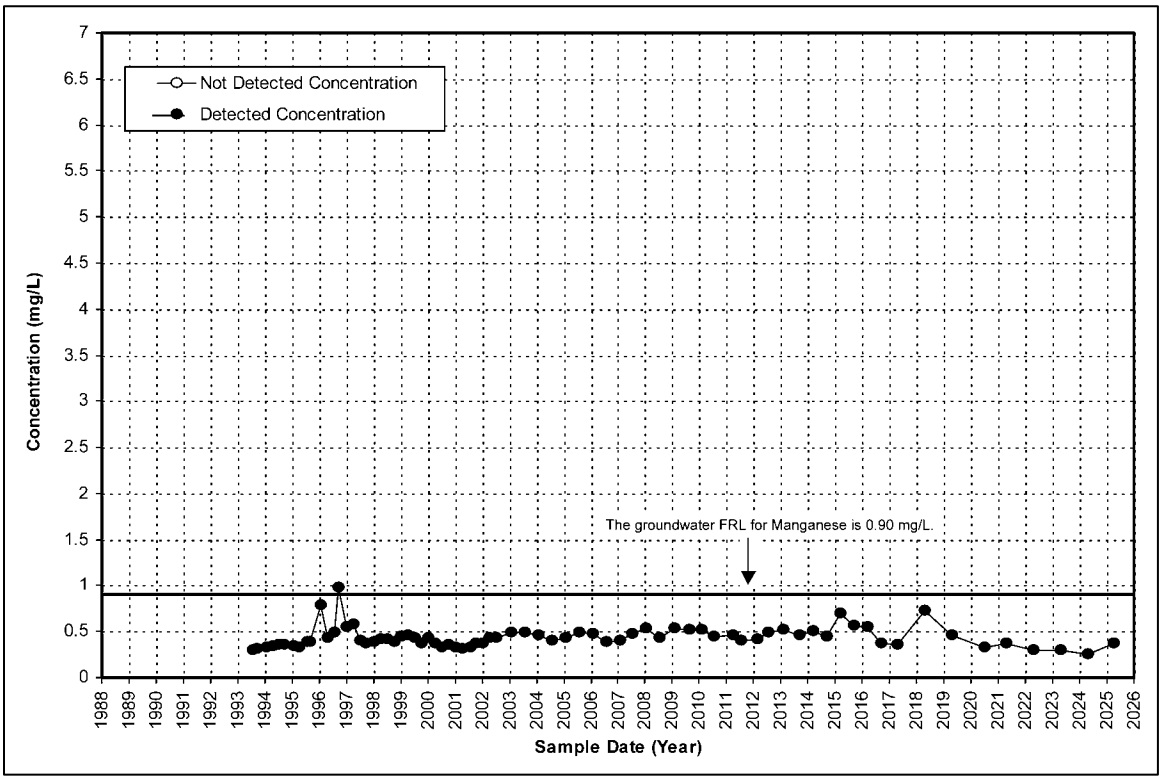


Figure A.4-159. Manganese Concentration Versus Time Plot for Monitoring Well 3431

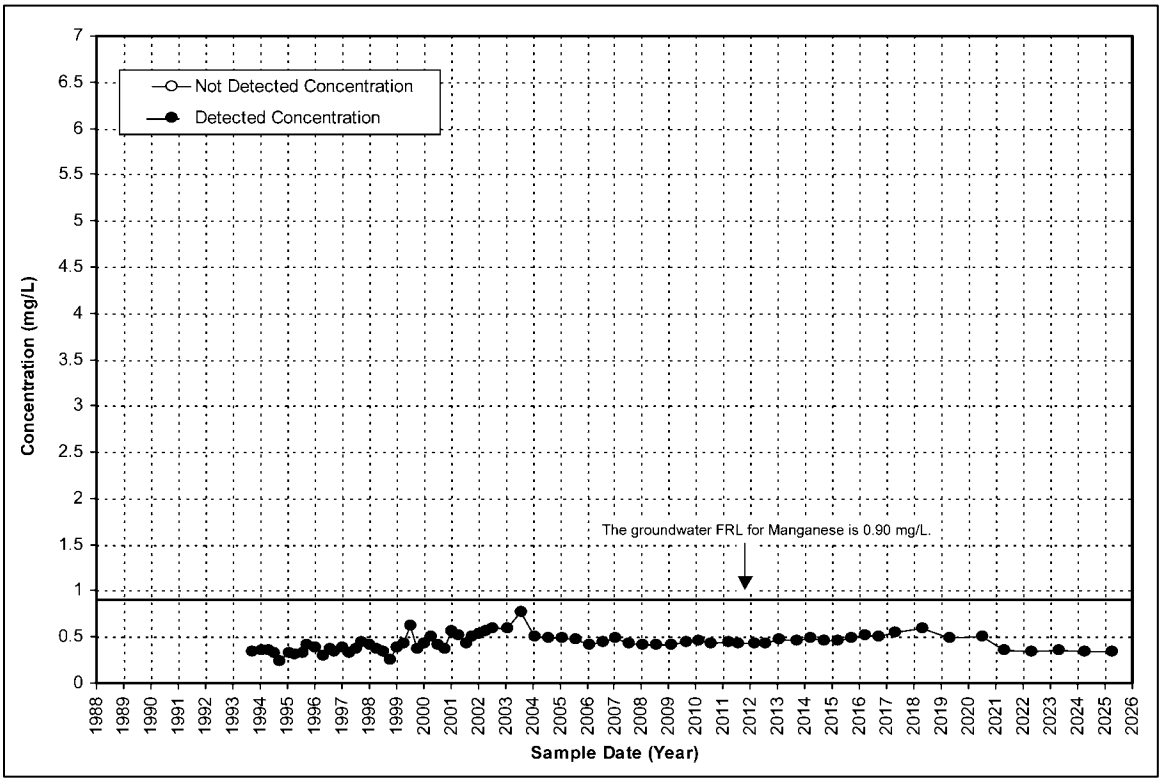


Figure A.4-160. Manganese Concentration Versus Time Plot for Monitoring Well 3432

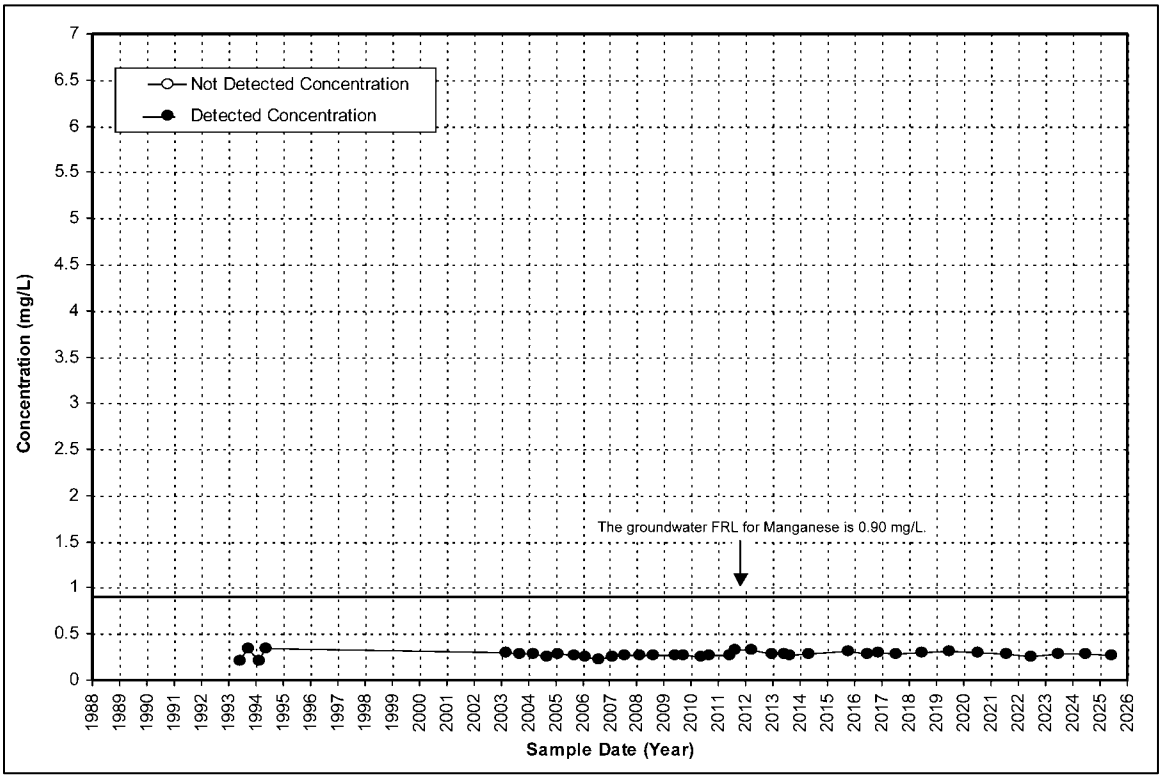


Figure A.4-161. Manganese Concentration Versus Time Plot for Monitoring Well 3636

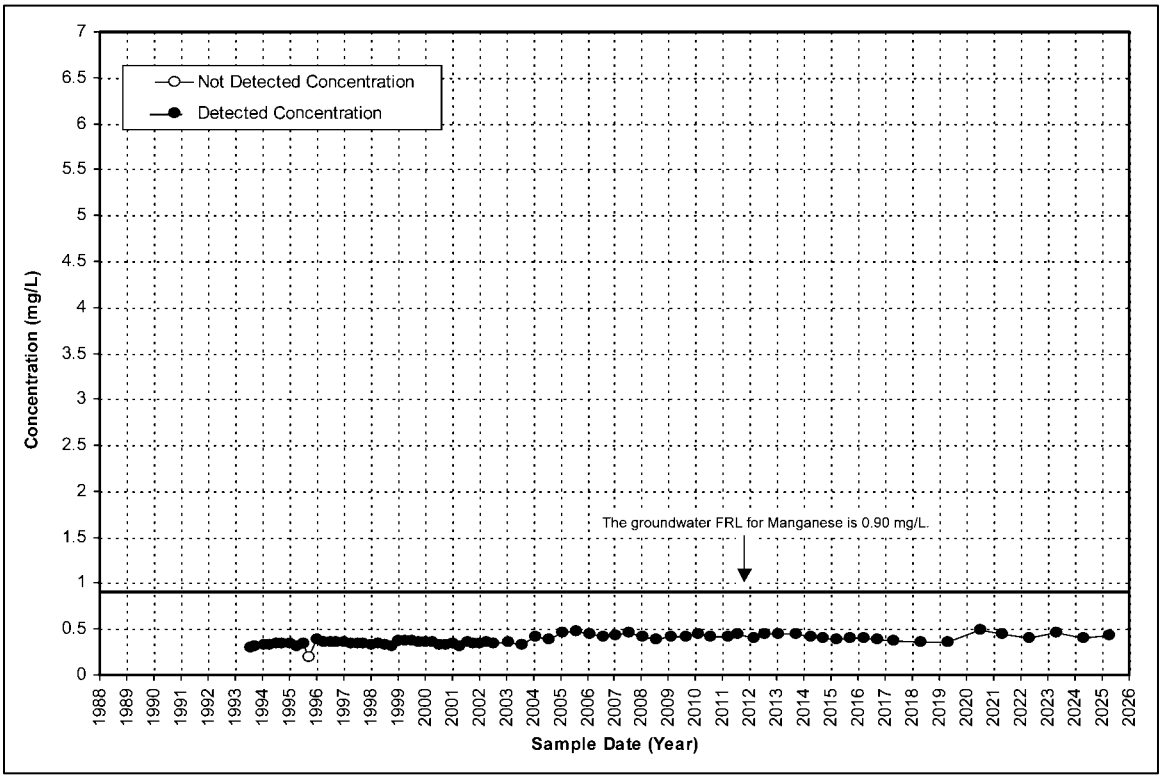


Figure A.4-162. Manganese Concentration Versus Time Plot for Monitoring Well 3733

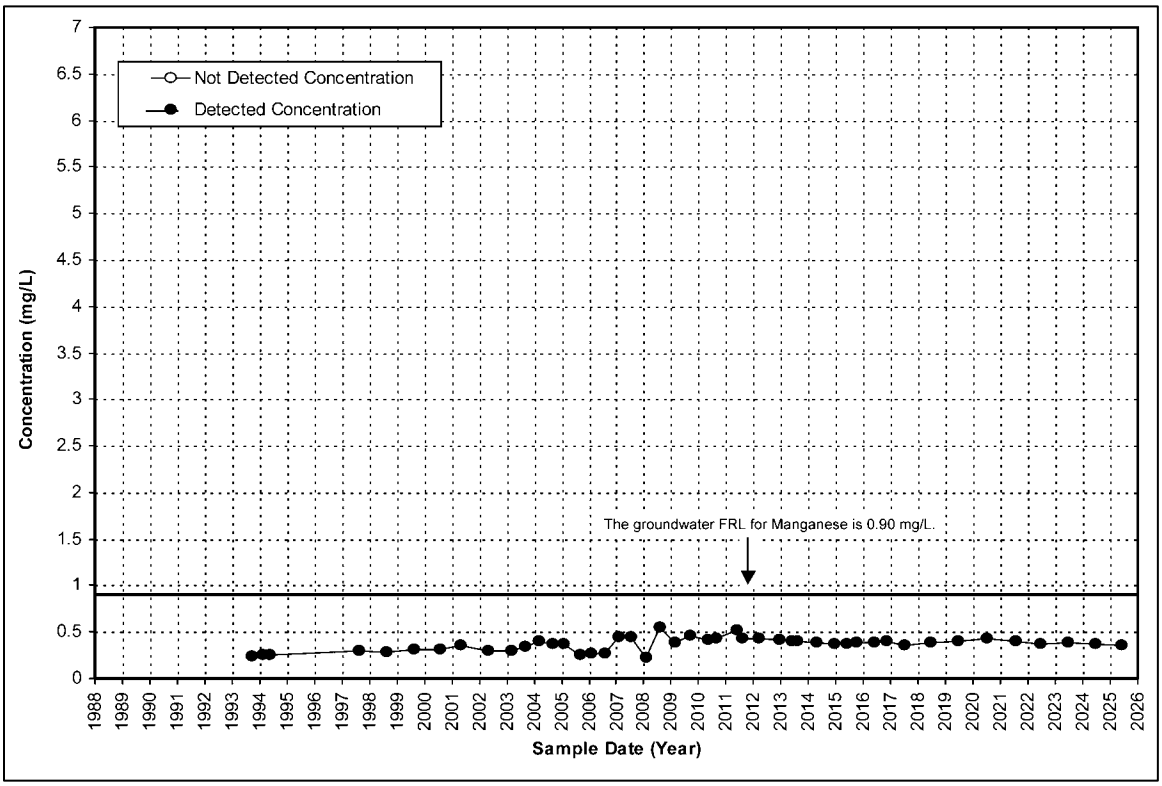


Figure A.4-163. Manganese Concentration Versus Time Plot for Monitoring Well 3898

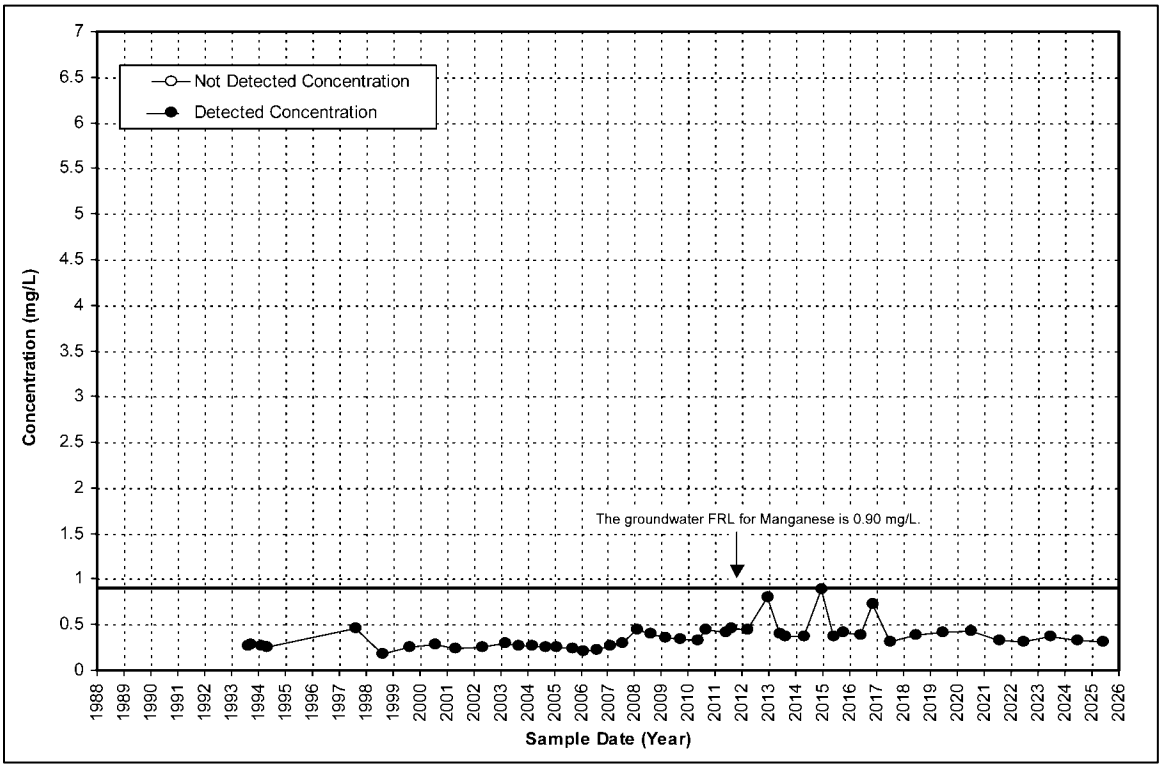


Figure A.4-164. Manganese Concentration Versus Time Plot for Monitoring Well 3899

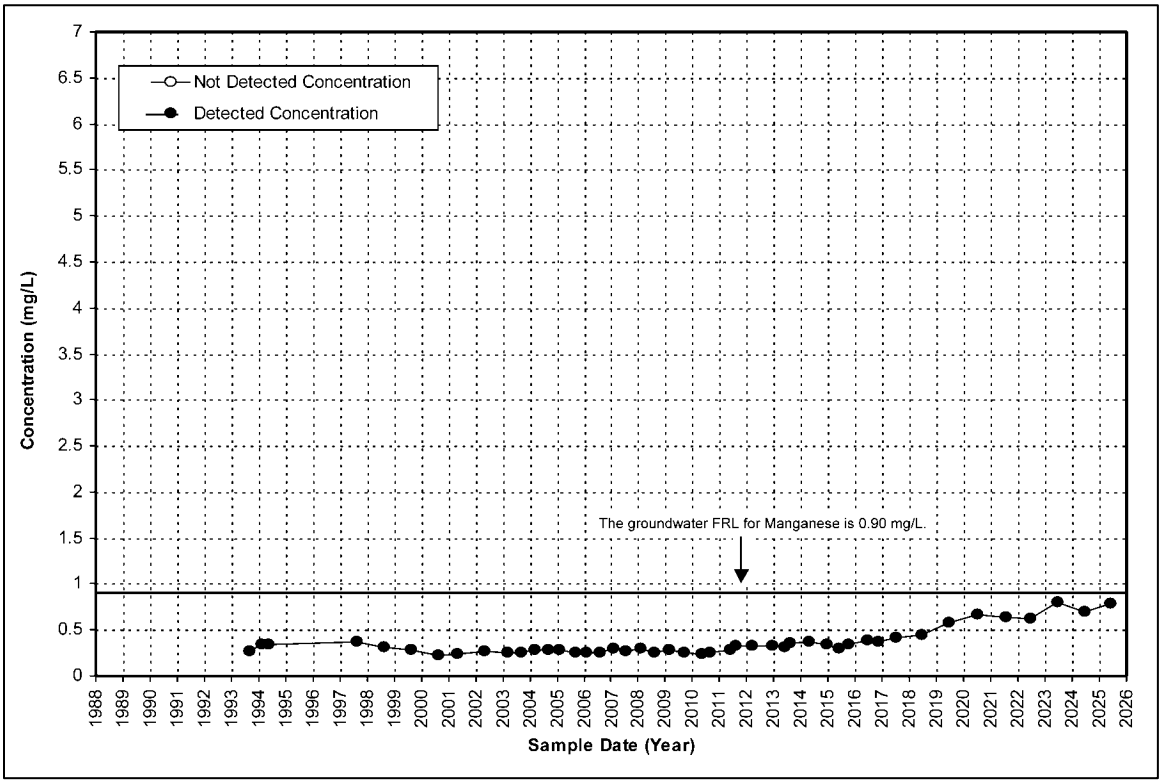


Figure A.4-165. Manganese Concentration Versus Time Plot for Monitoring Well 3900

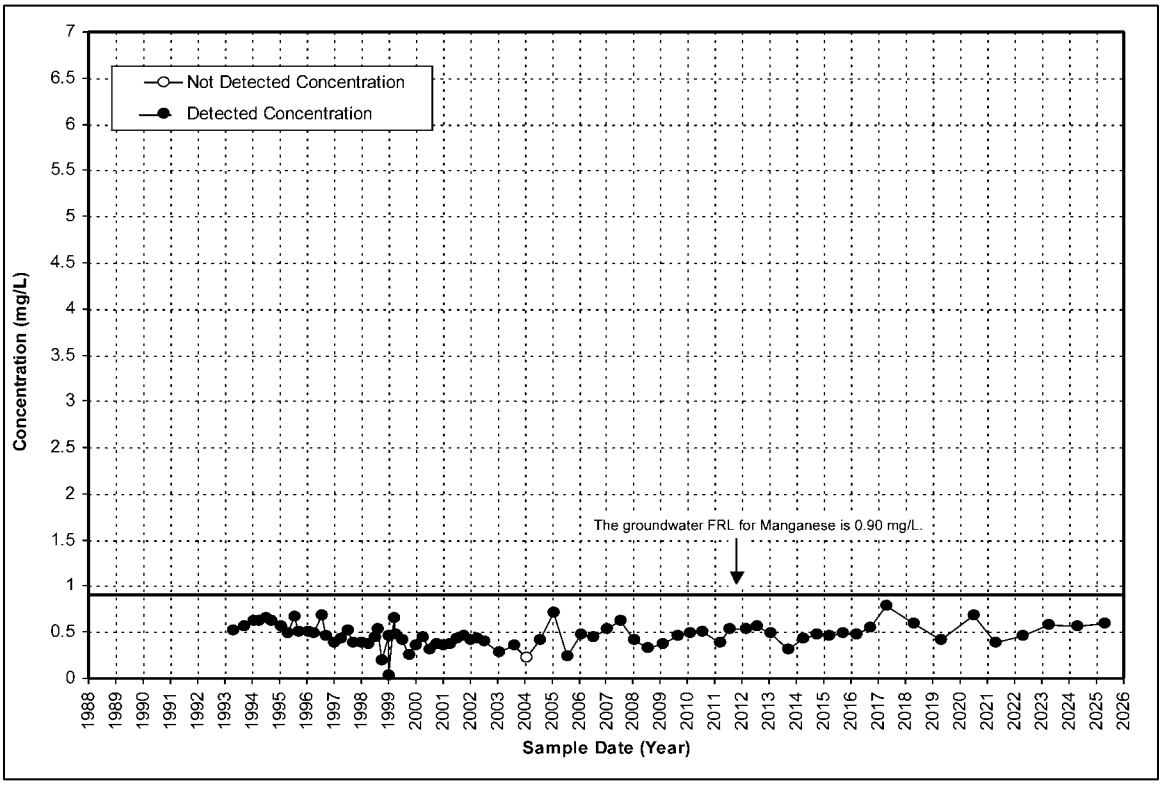


Figure A.4-166. Manganese Concentration Versus Time Plot for Monitoring Well 4398

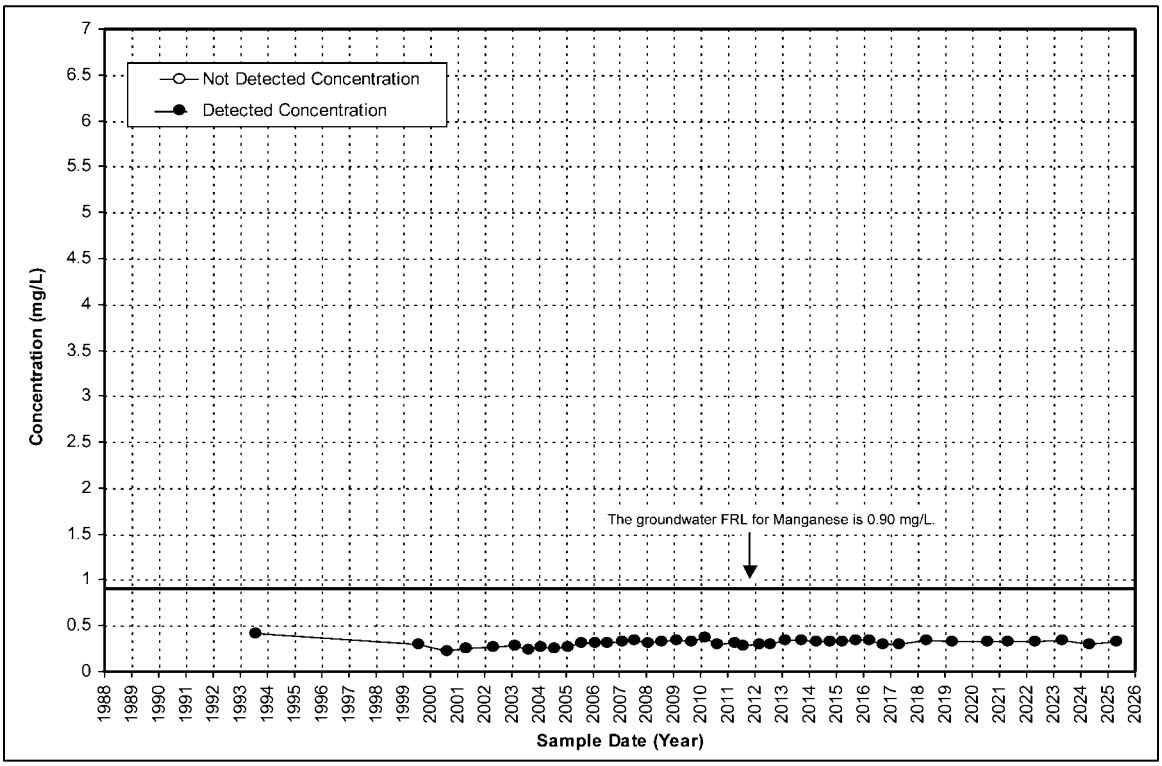


Figure A.4-167. Manganese Concentration Versus Time Plot for Monitoring Well 21063

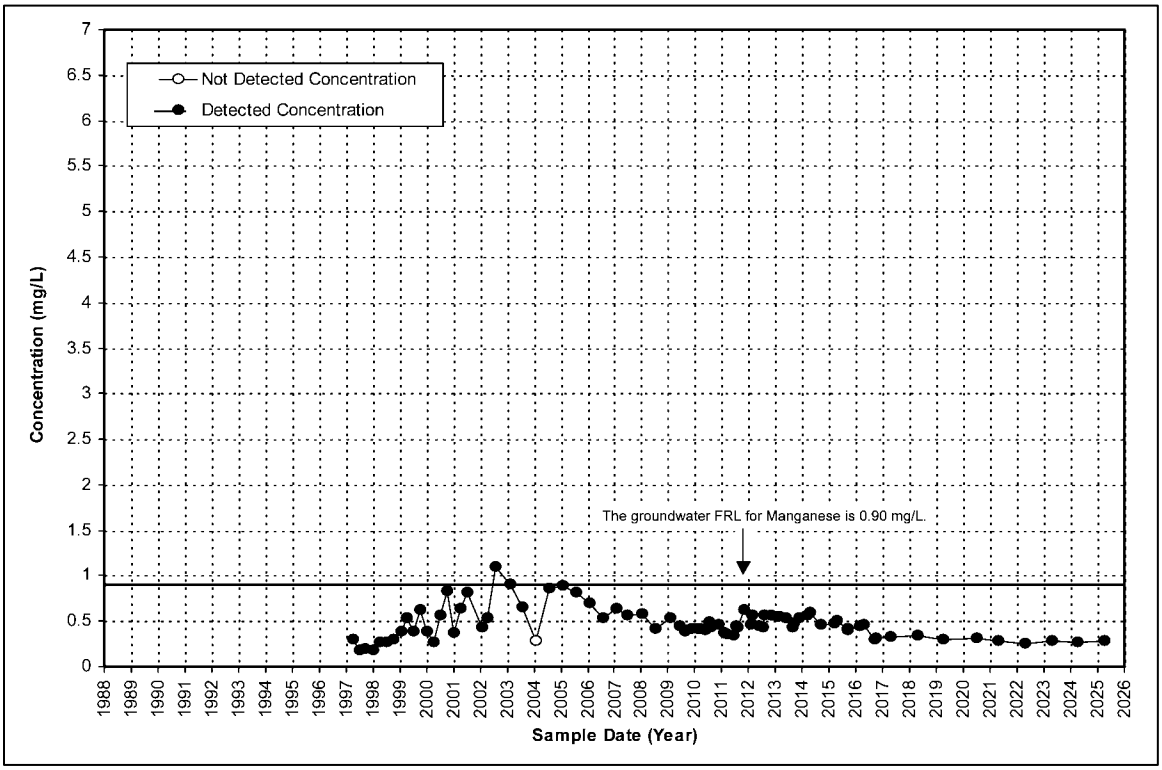


Figure A.4-168. Manganese Concentration Versus Time Plot for Monitoring Well 22198

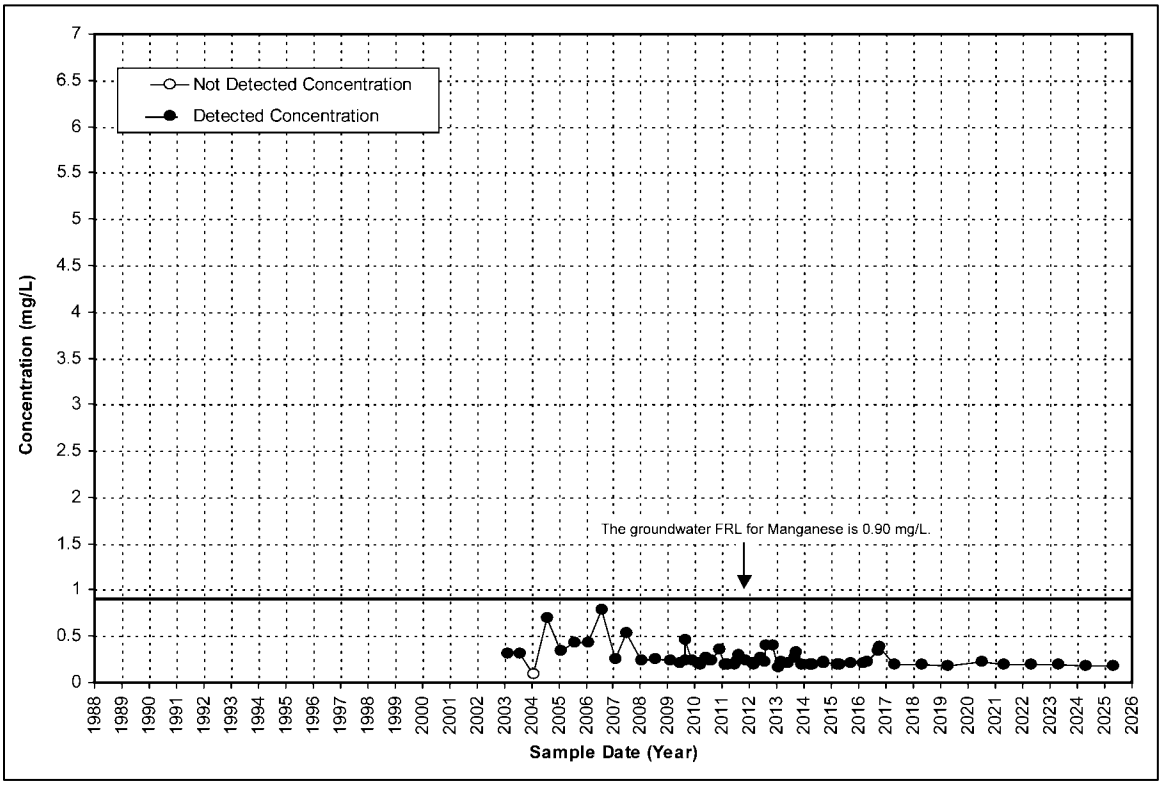


Figure A.4-169. Manganese Concentration Versus Time Plot for Monitoring Well 22199

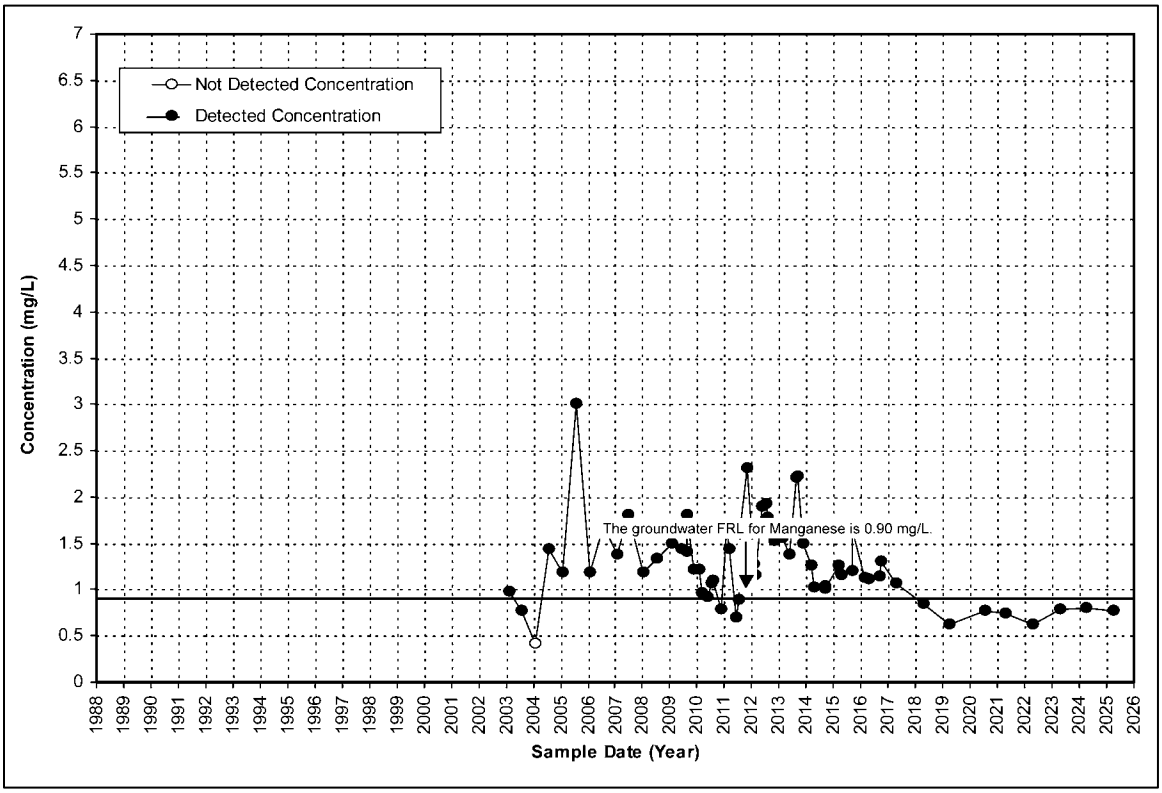


Figure A.4-170. Manganese Concentration Versus Time Plot for Monitoring Well 22204

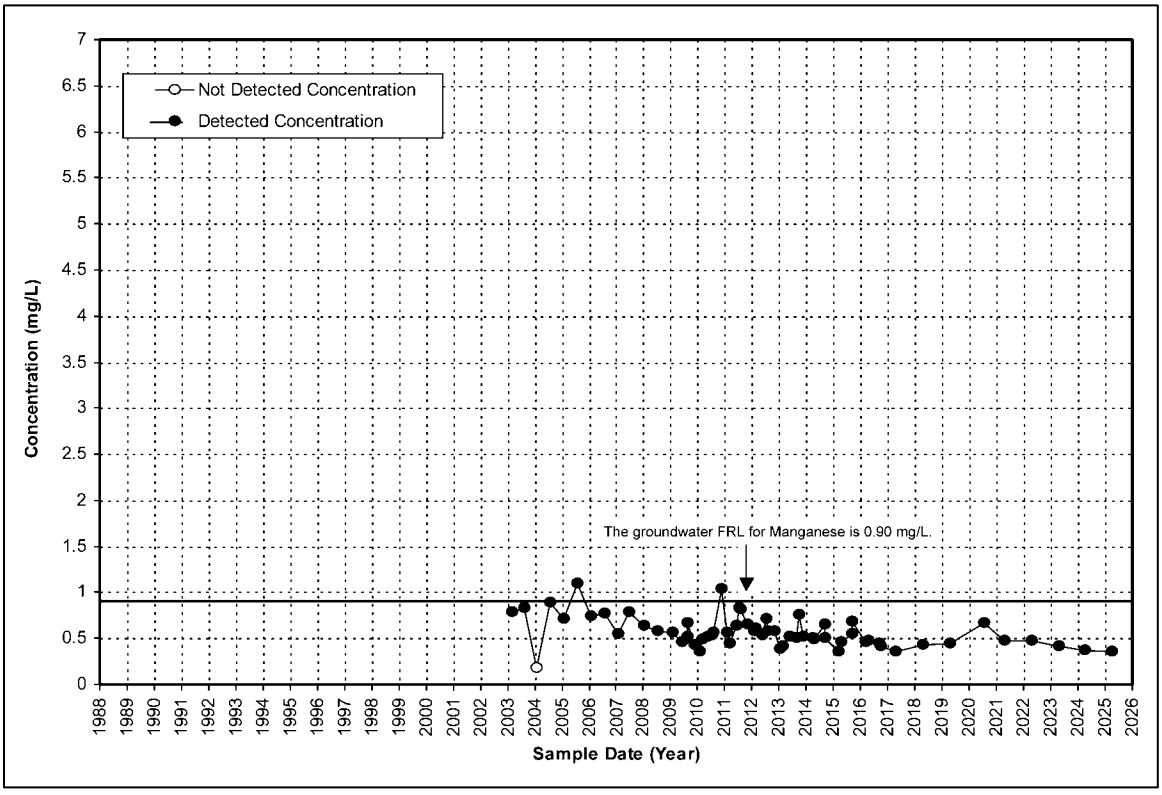


Figure A.4-171. Manganese Concentration Versus Time Plot for Monitoring Well 22205

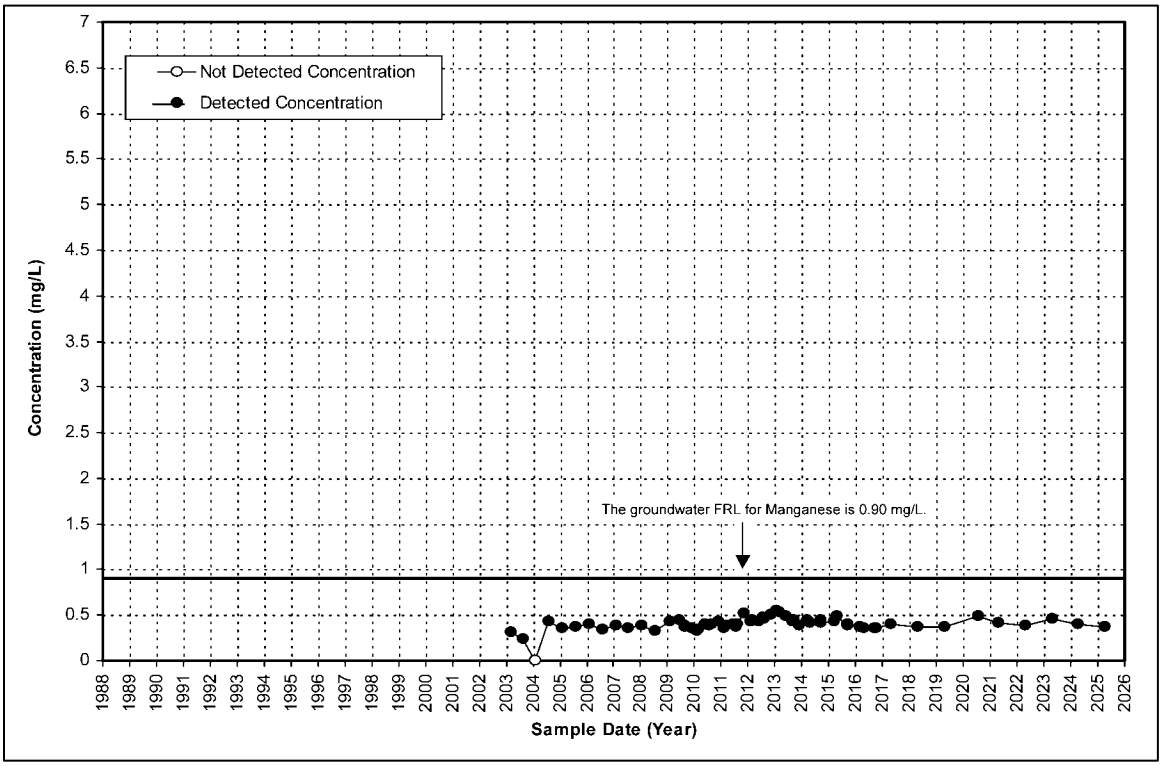


Figure A.4-172. Manganese Concentration Versus Time Plot for Monitoring Well 22208

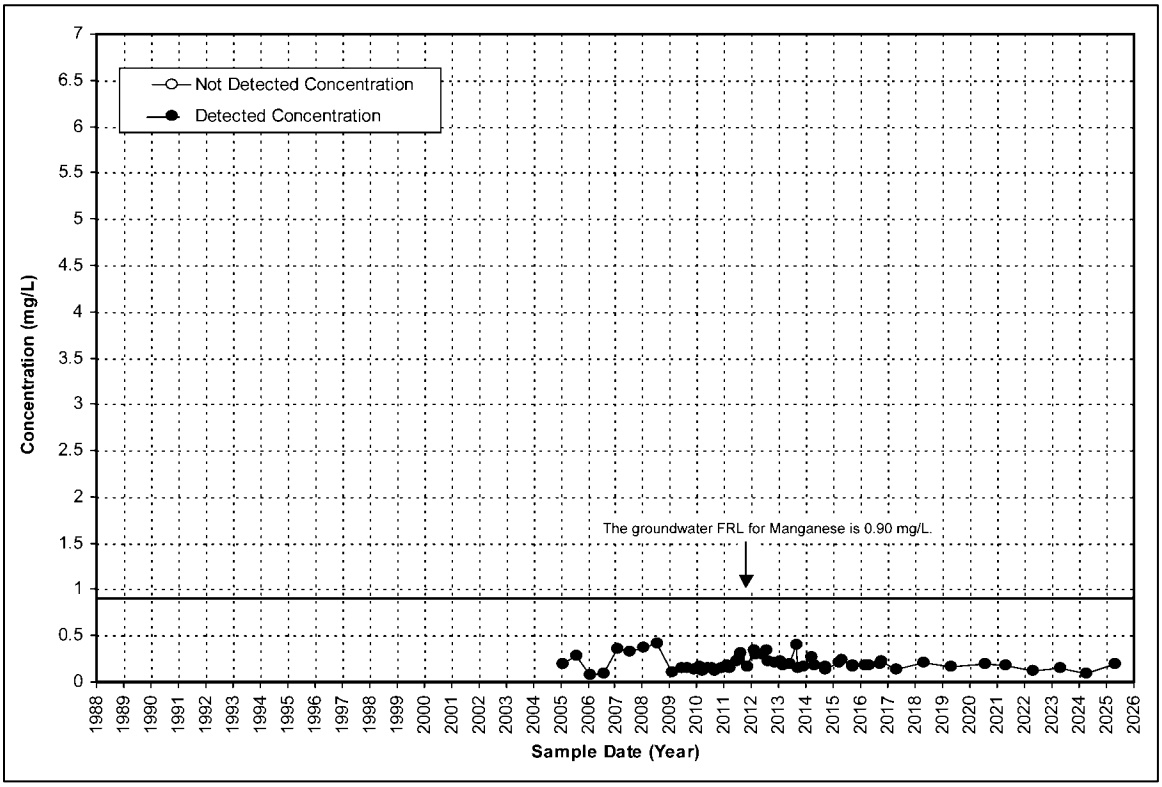


Figure A.4-173. Manganese Concentration Versus Time Plot for Monitoring Well 22210

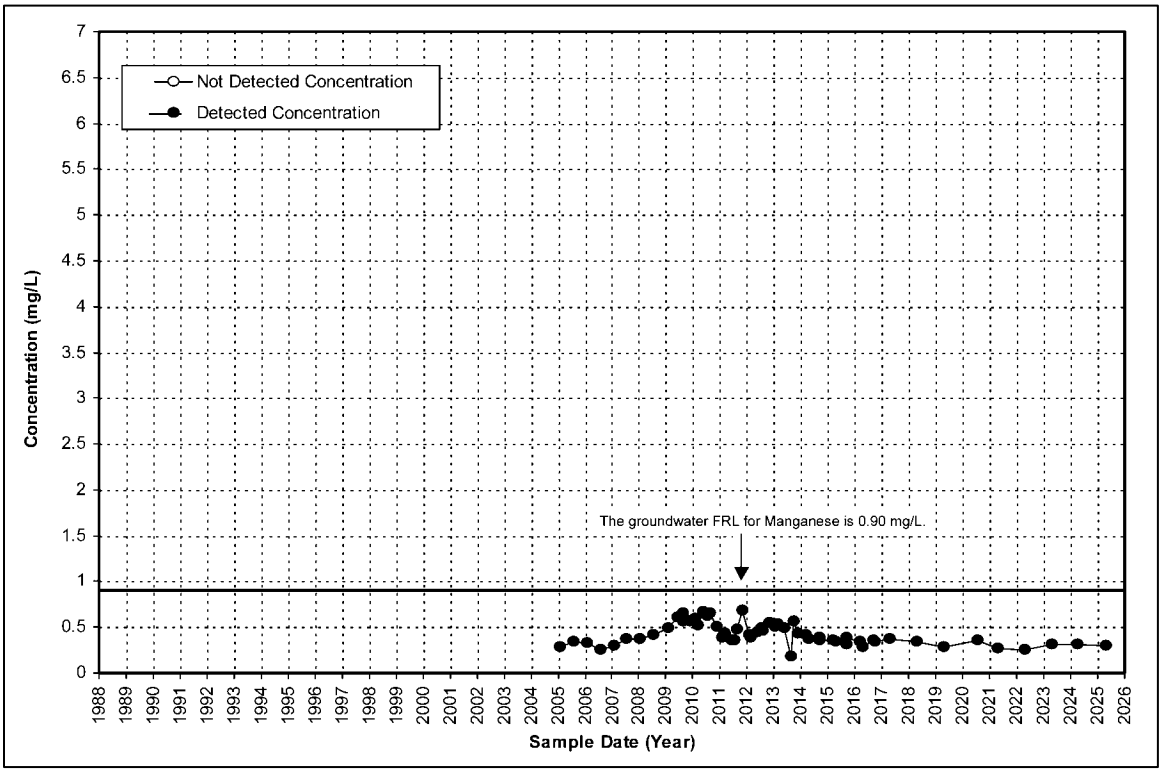


Figure A.4-174. Manganese Concentration Versus Time Plot for Monitoring Well 22211

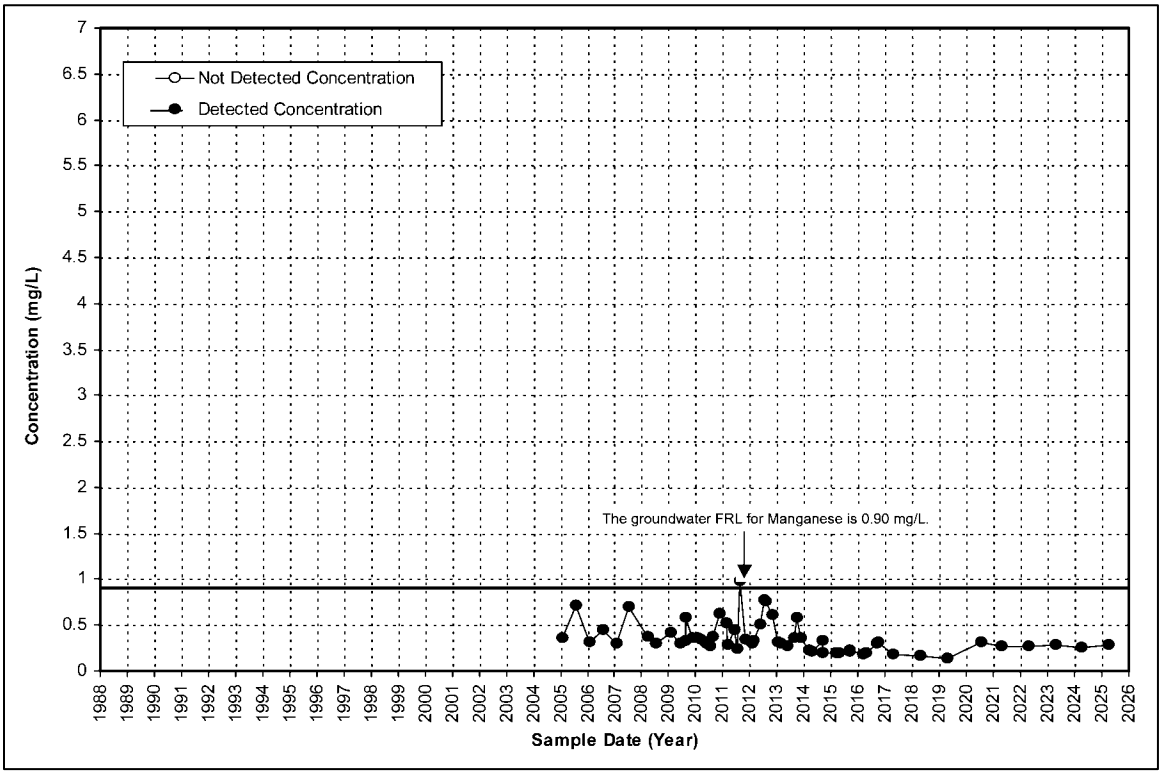


Figure A.4-175. Manganese Concentration Versus Time Plot for Monitoring Well 22214

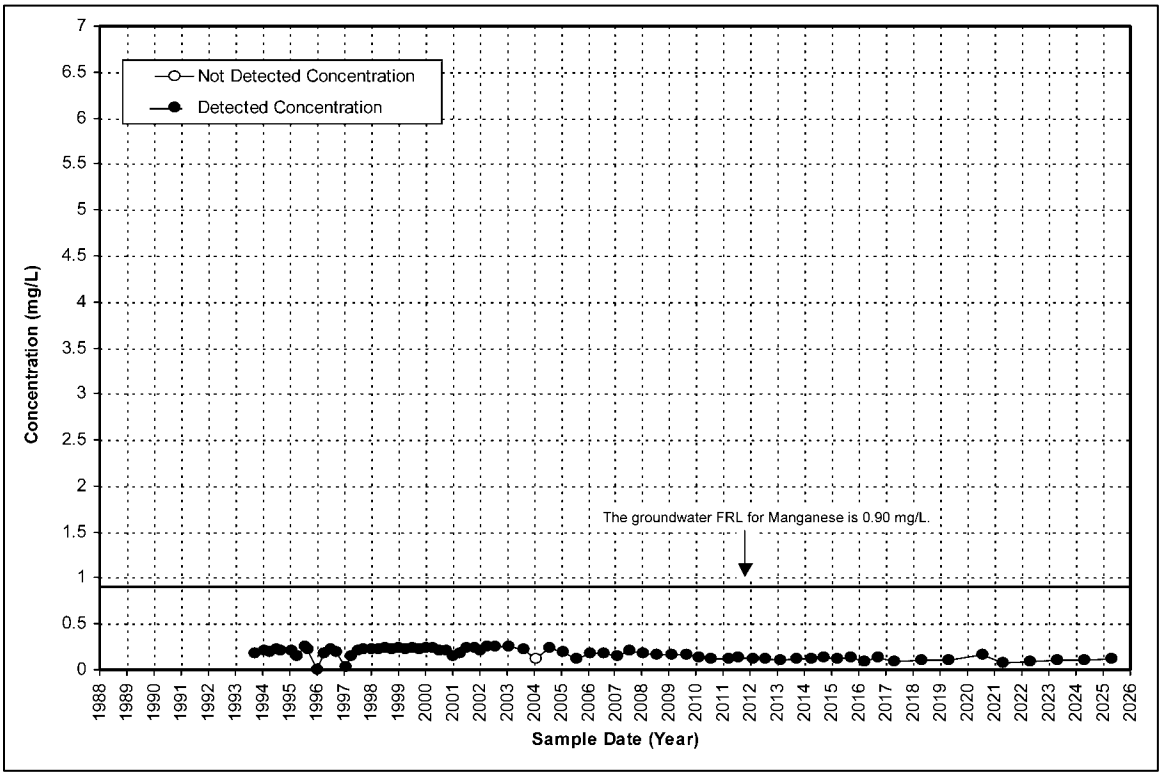


Figure A.4-176. Manganese Concentration Versus Time Plot for Monitoring Well 31217

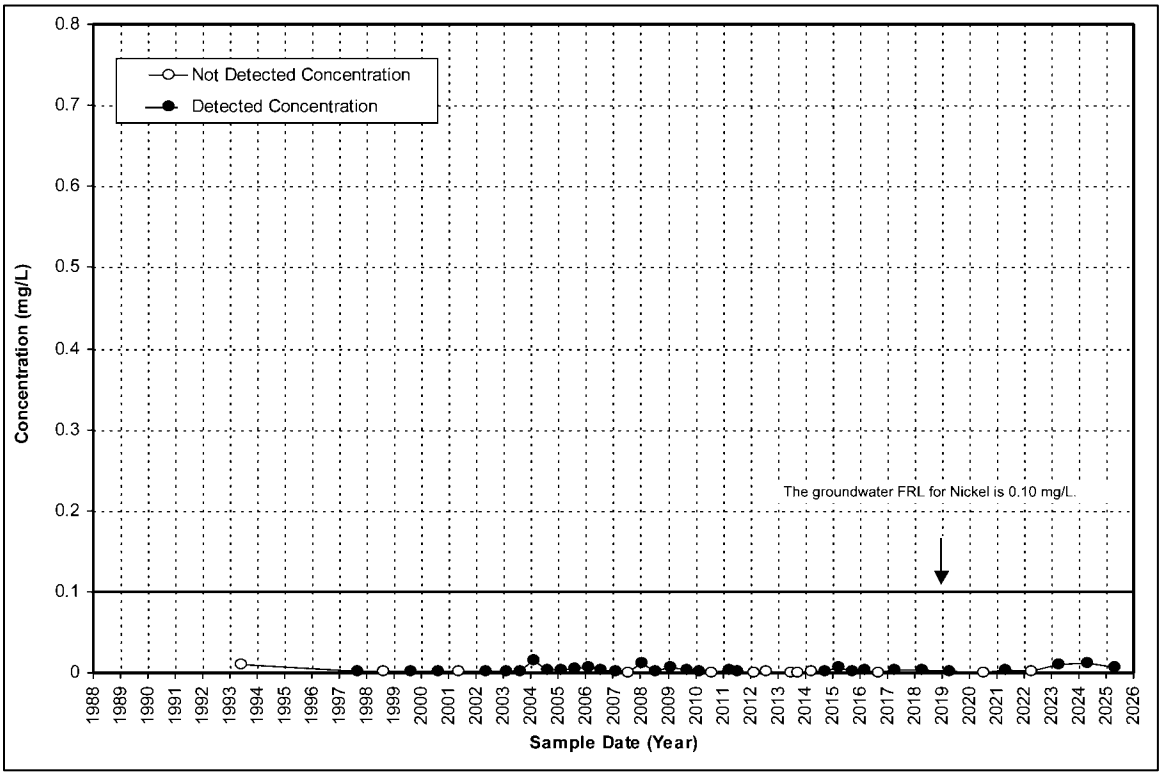


Figure A.4-177. Nickel Concentration Versus Time Plot for Monitoring Well 2093

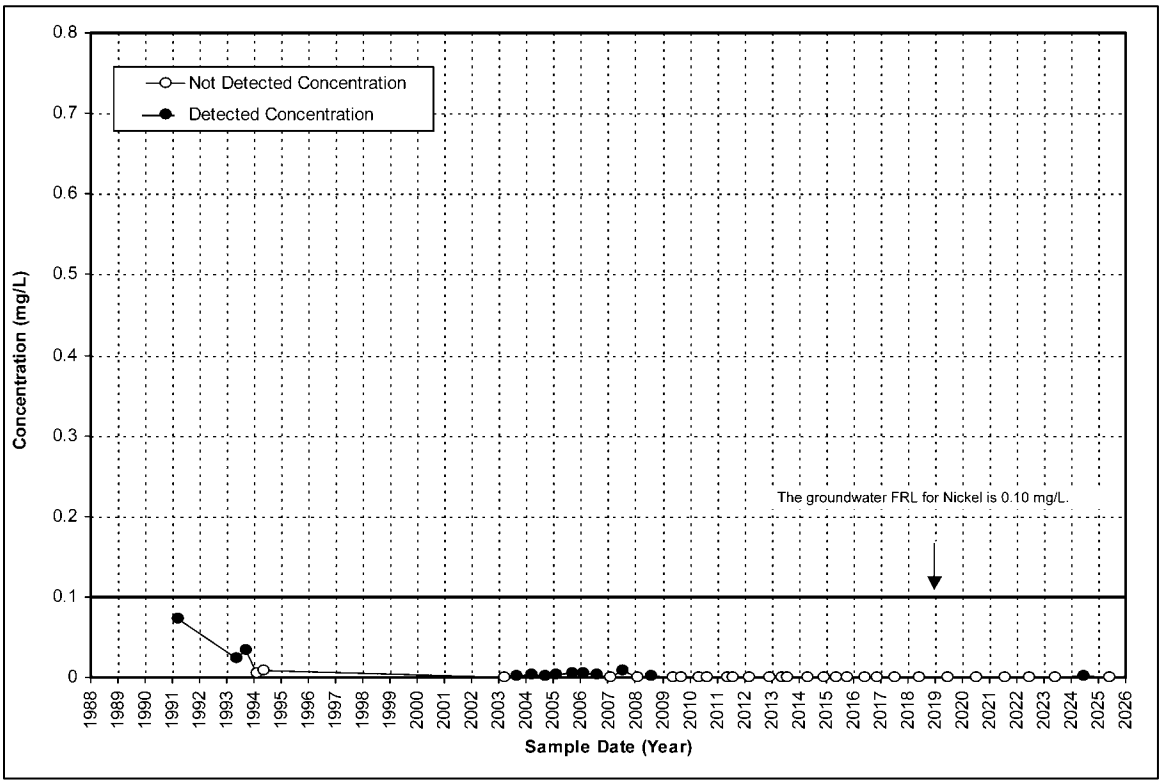


Figure A.4-178. Nickel Concentration Versus Time Plot for Monitoring Well 2128

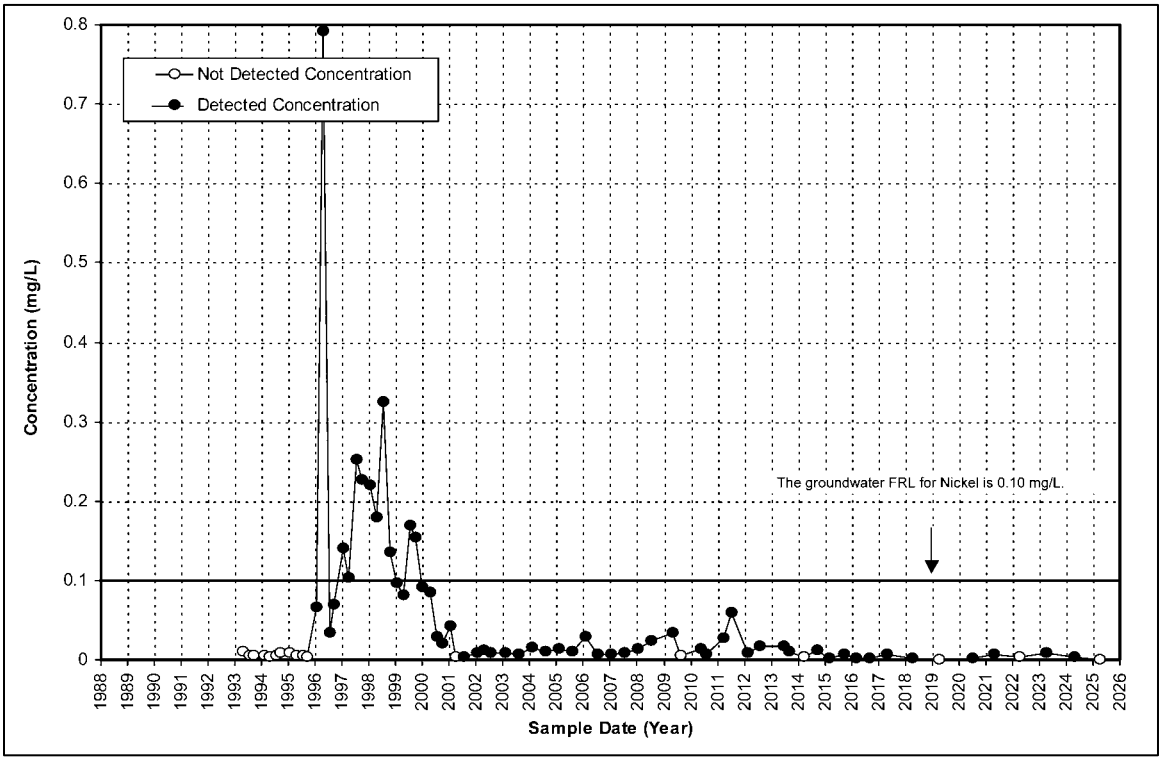


Figure A.4-179. Nickel Concentration Versus Time Plot for Monitoring Well 2398

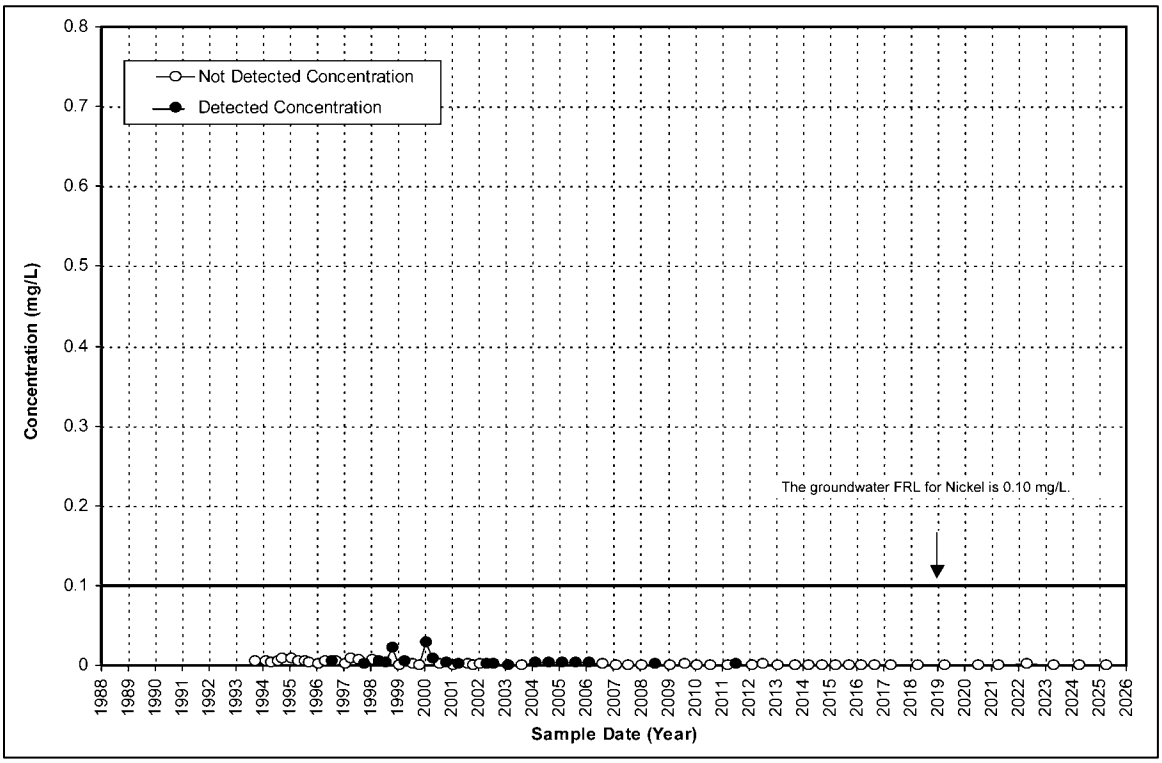


Figure A.4-180. Nickel Concentration Versus Time Plot for Monitoring Well 2431

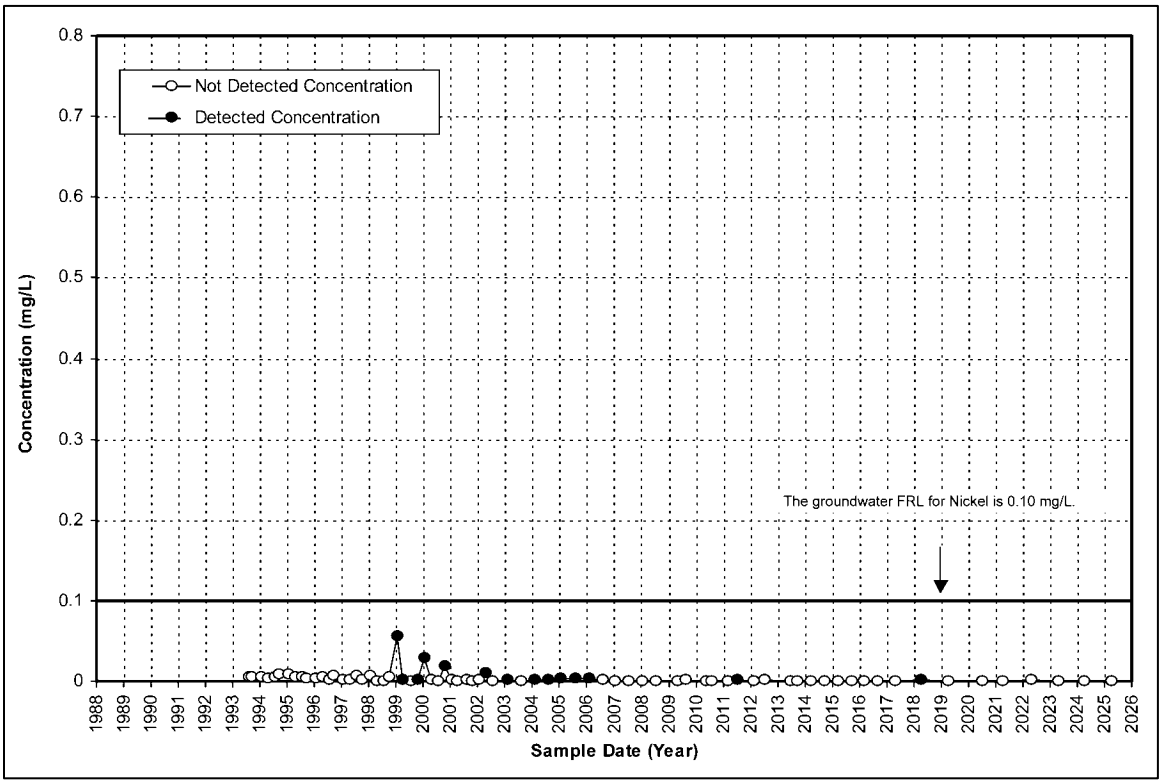


Figure A.4-181. Nickel Concentration Versus Time Plot for Monitoring Well 2432

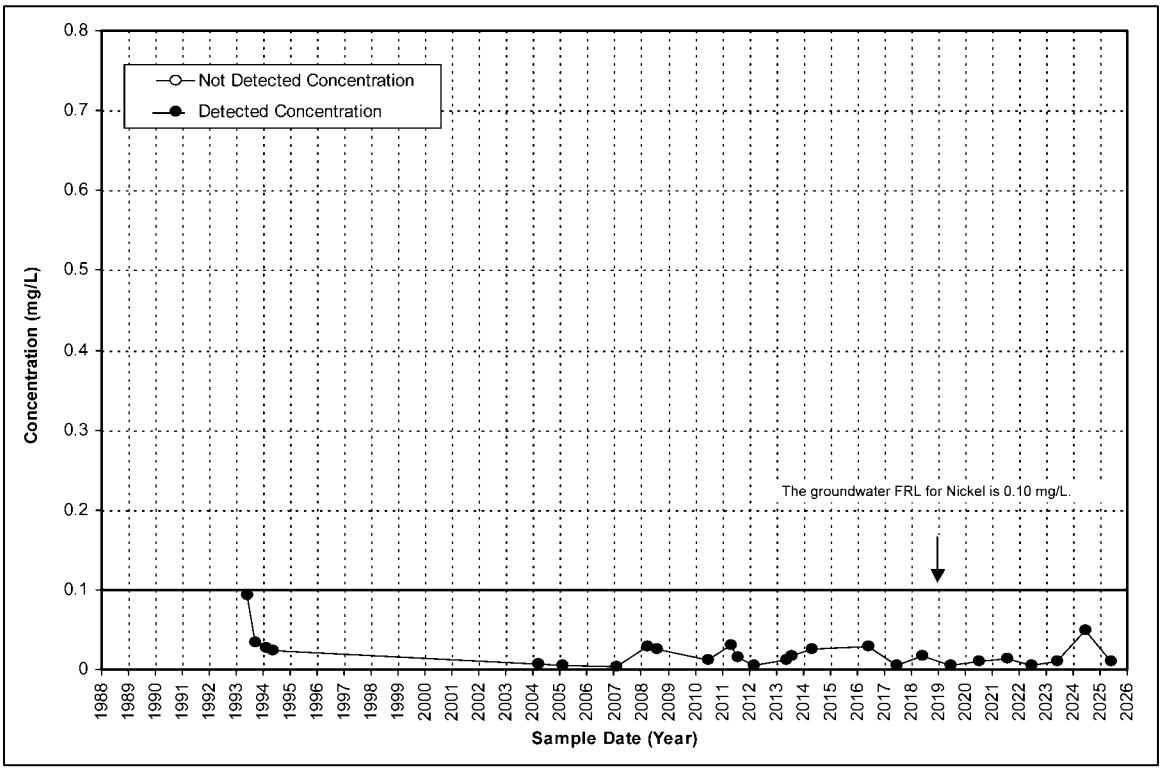


Figure A.4-182. Nickel Concentration Versus Time Plot for Monitoring Well 2636

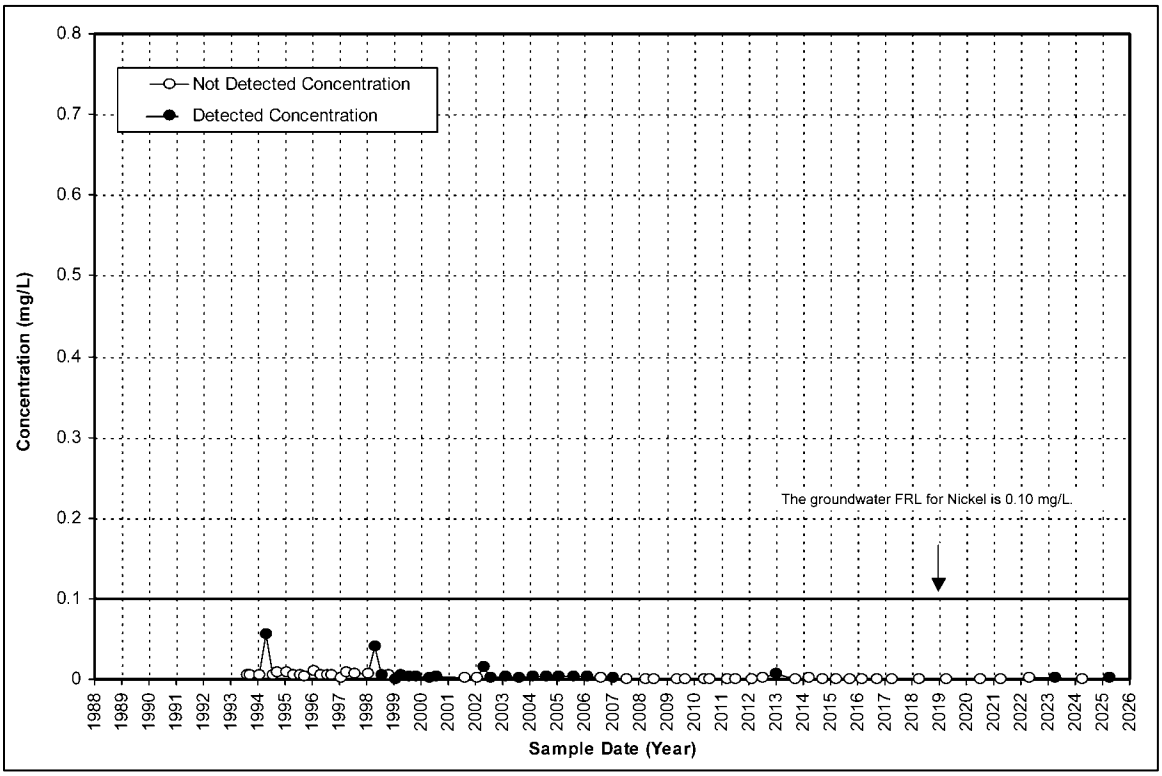


Figure A.4-183. Nickel Concentration Versus Time Plot for Monitoring Well 2733

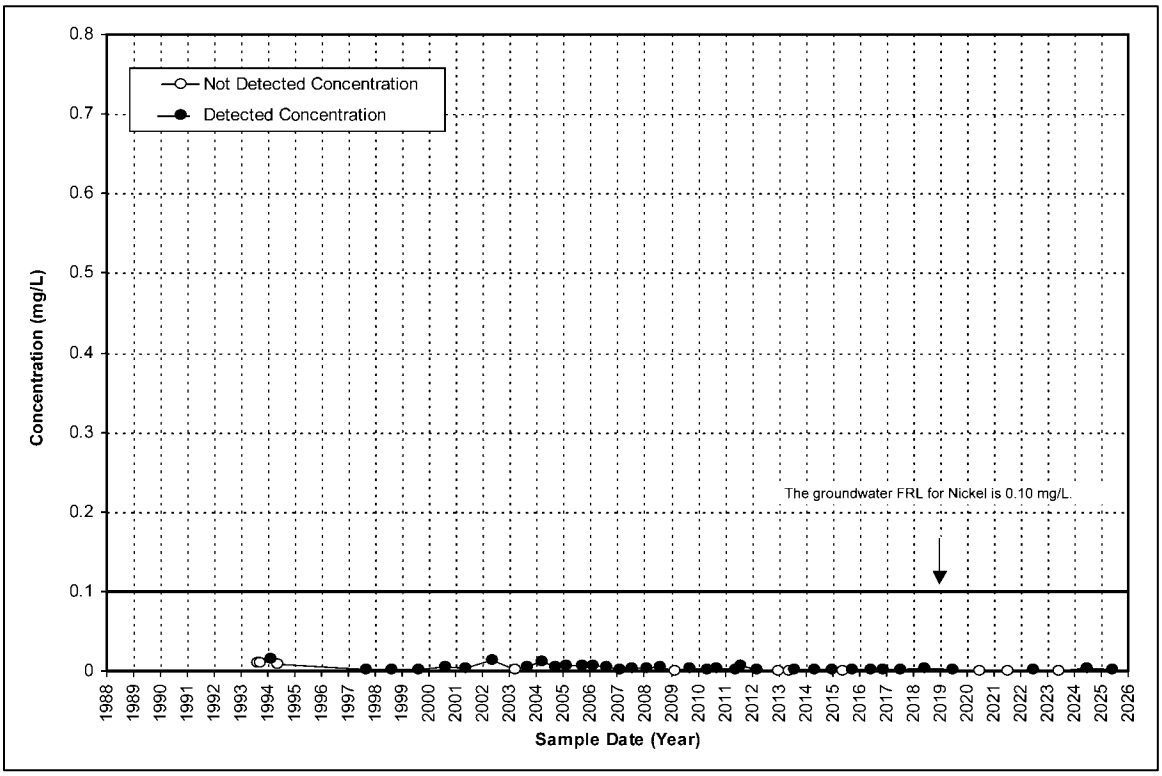


Figure A.4-184. Nickel Concentration Versus Time Plot for Monitoring Well 2898

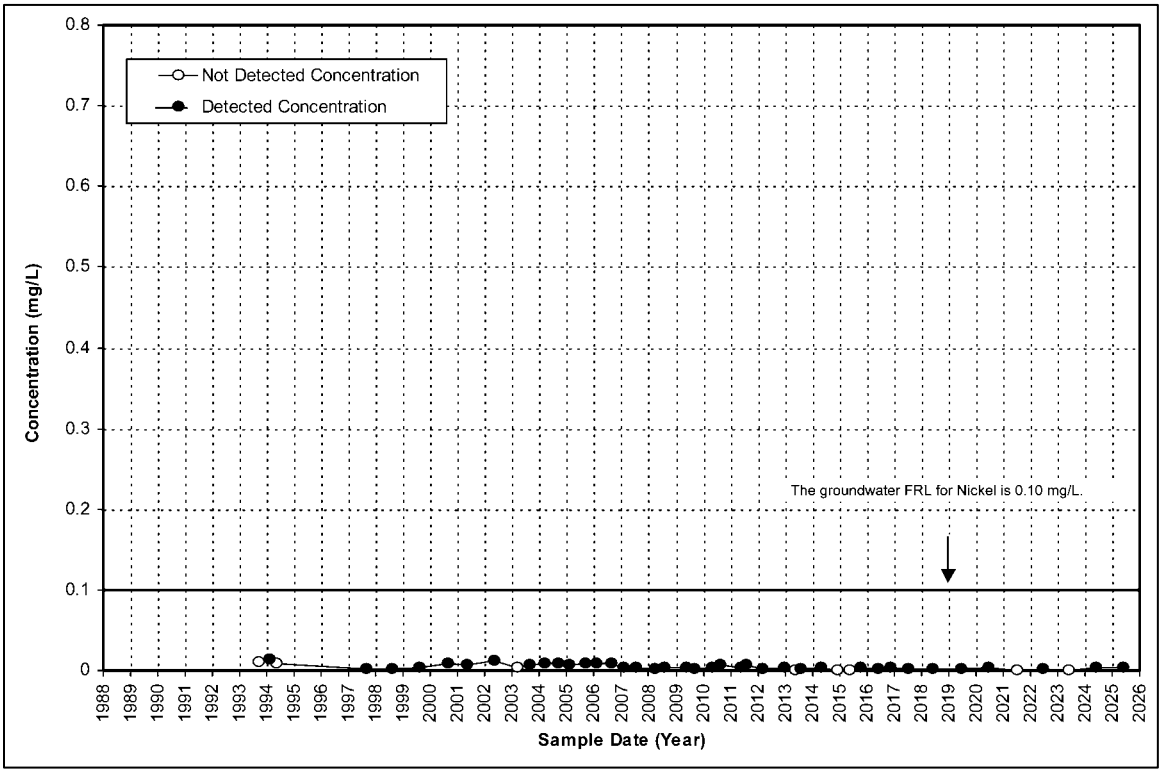


Figure A.4-185. Nickel Concentration Versus Time Plot for Monitoring Well 2899

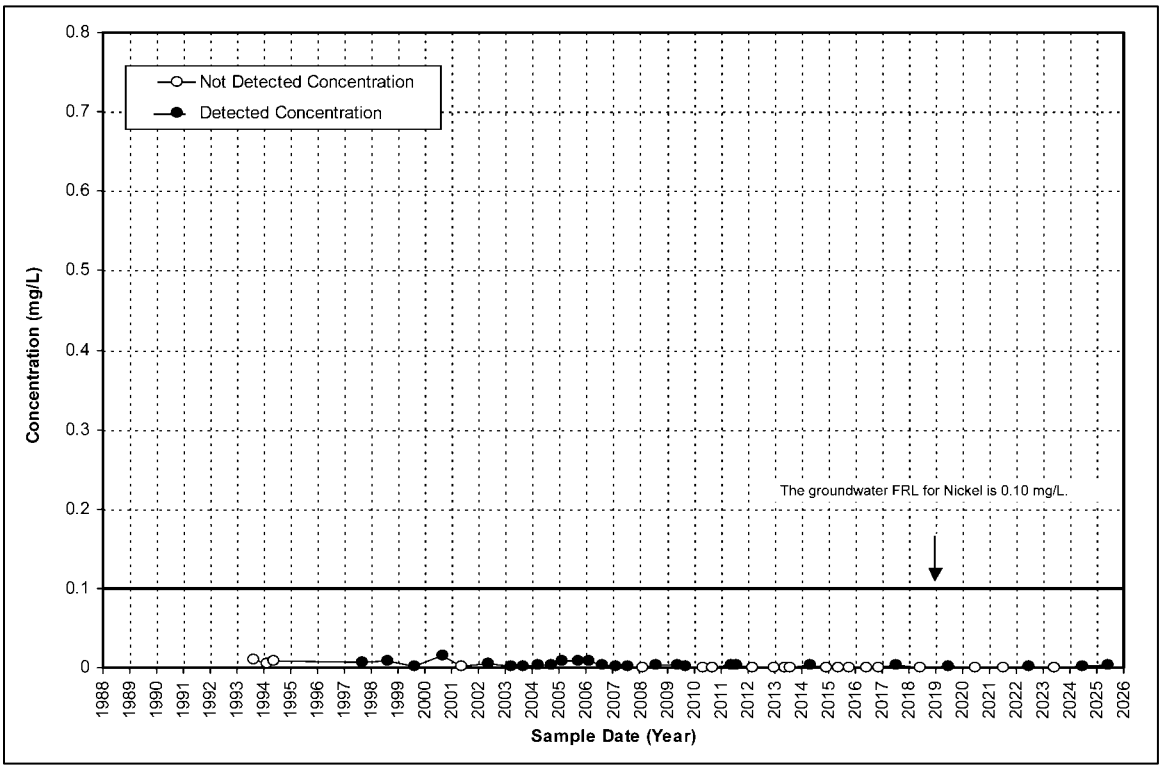


Figure A.4-186. Nickel Concentration Versus Time Plot for Monitoring Well 2900

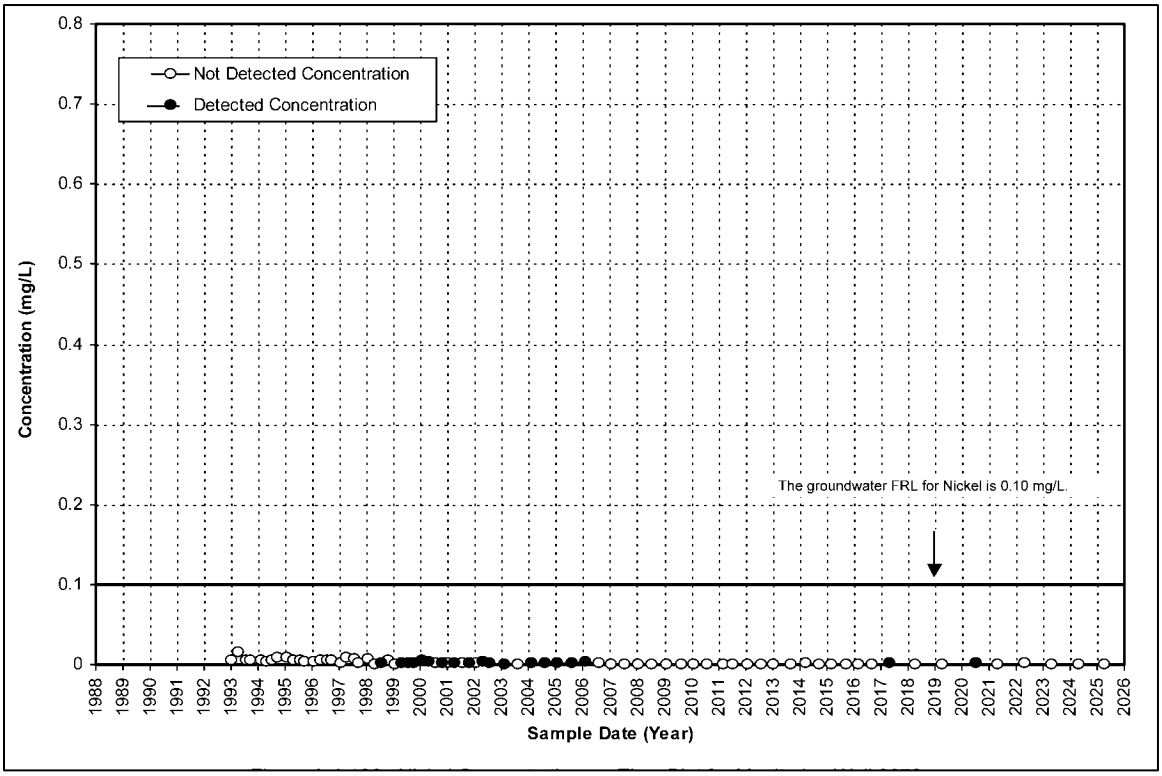


Figure A.4-187. Nickel Concentration Versus Time Plot for Monitoring Well 3070

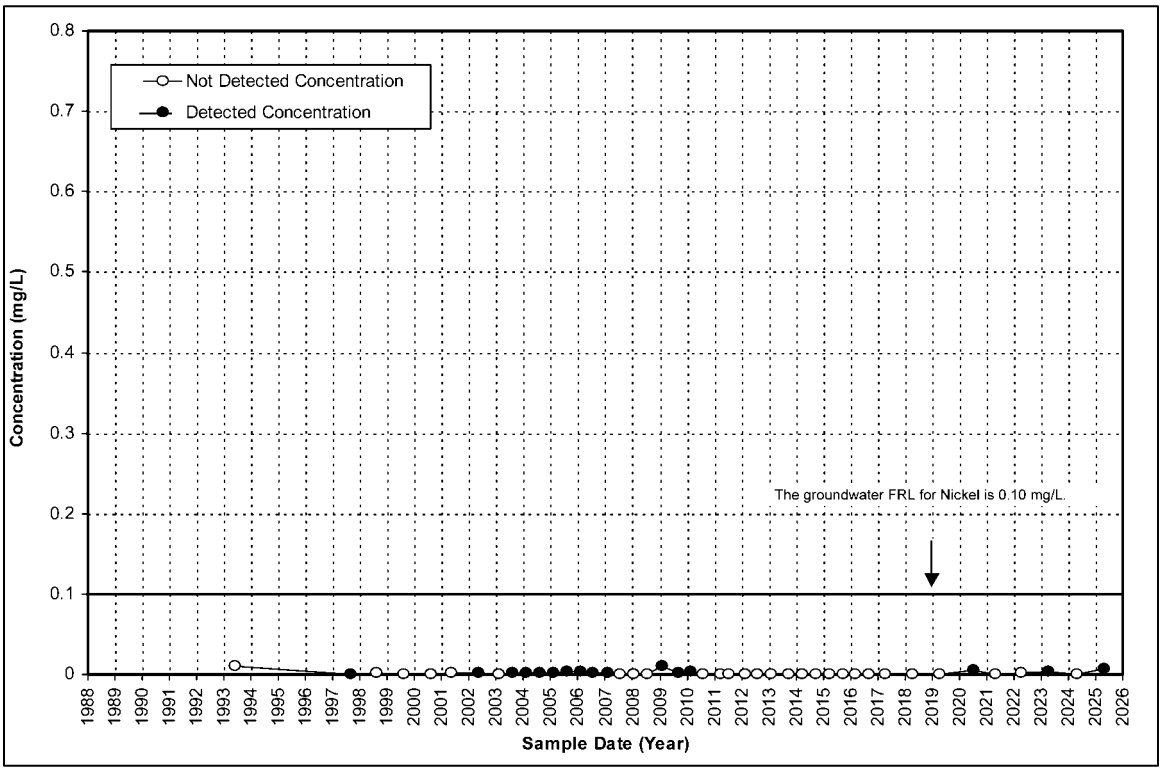


Figure A.4-188. Nickel Concentration Versus Time Plot for Monitoring Well 3093

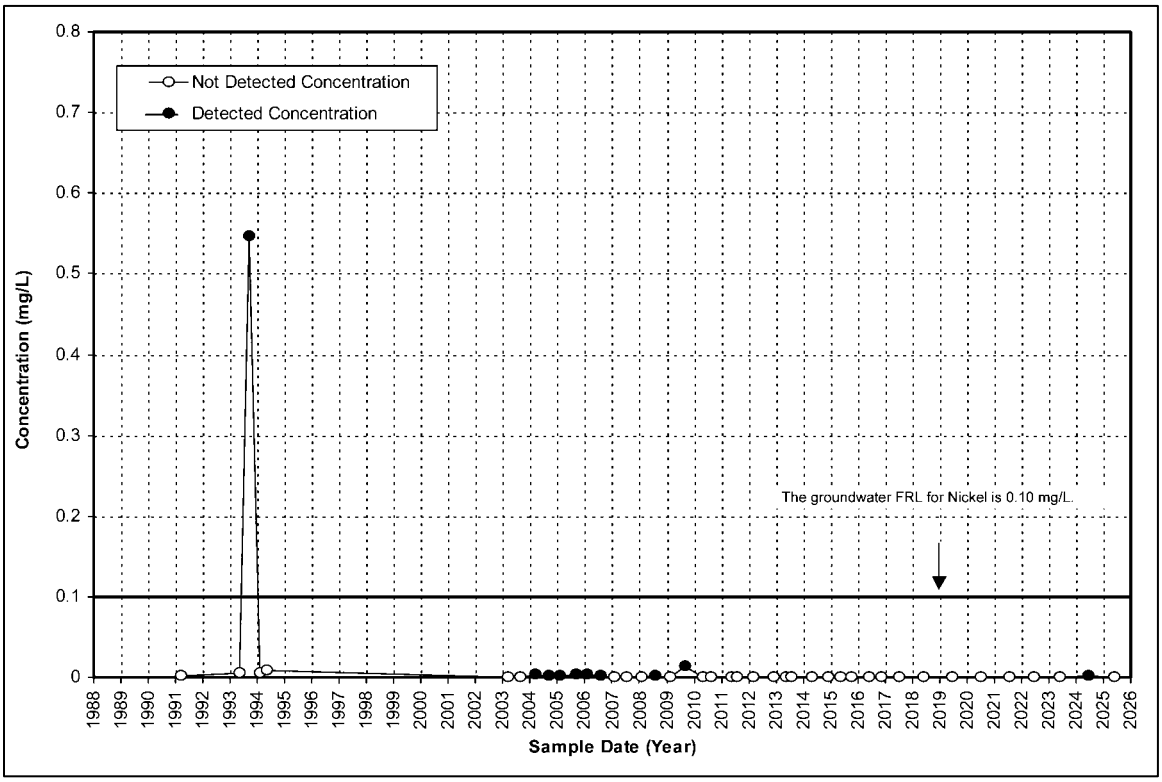


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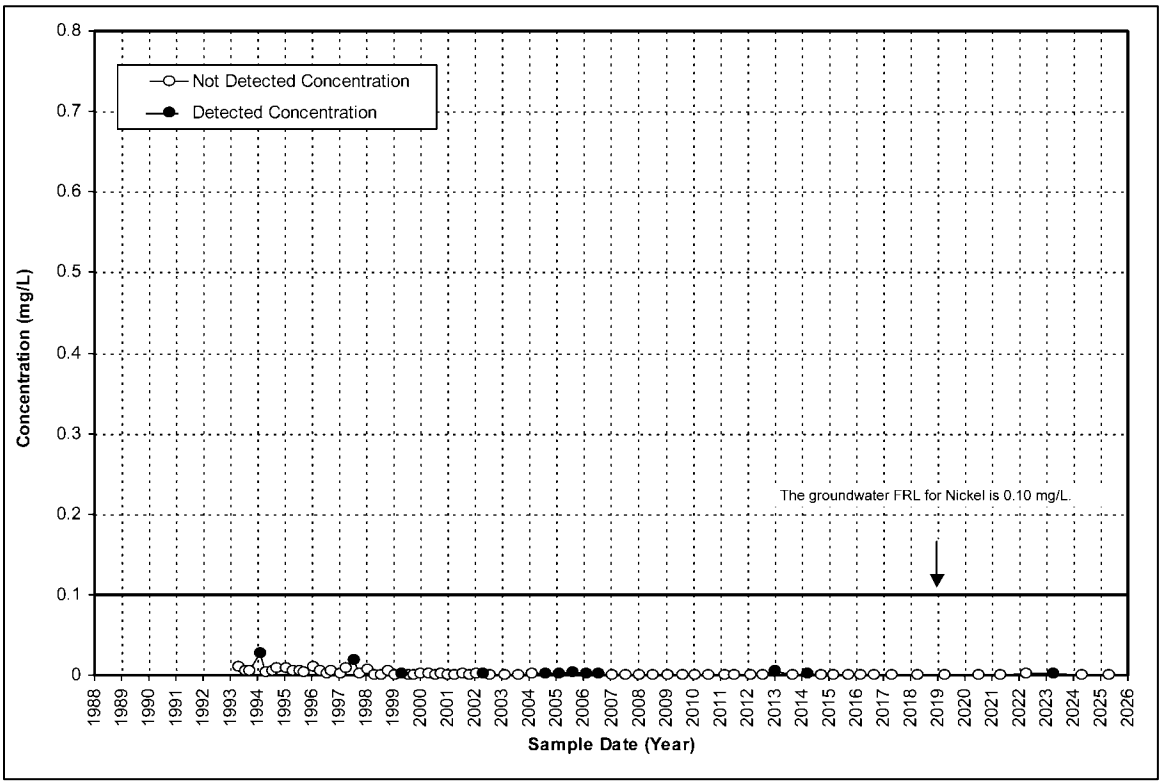


Figure A.4-190. Nickel Concentration Versus Time Plot for Monitoring Well 3398

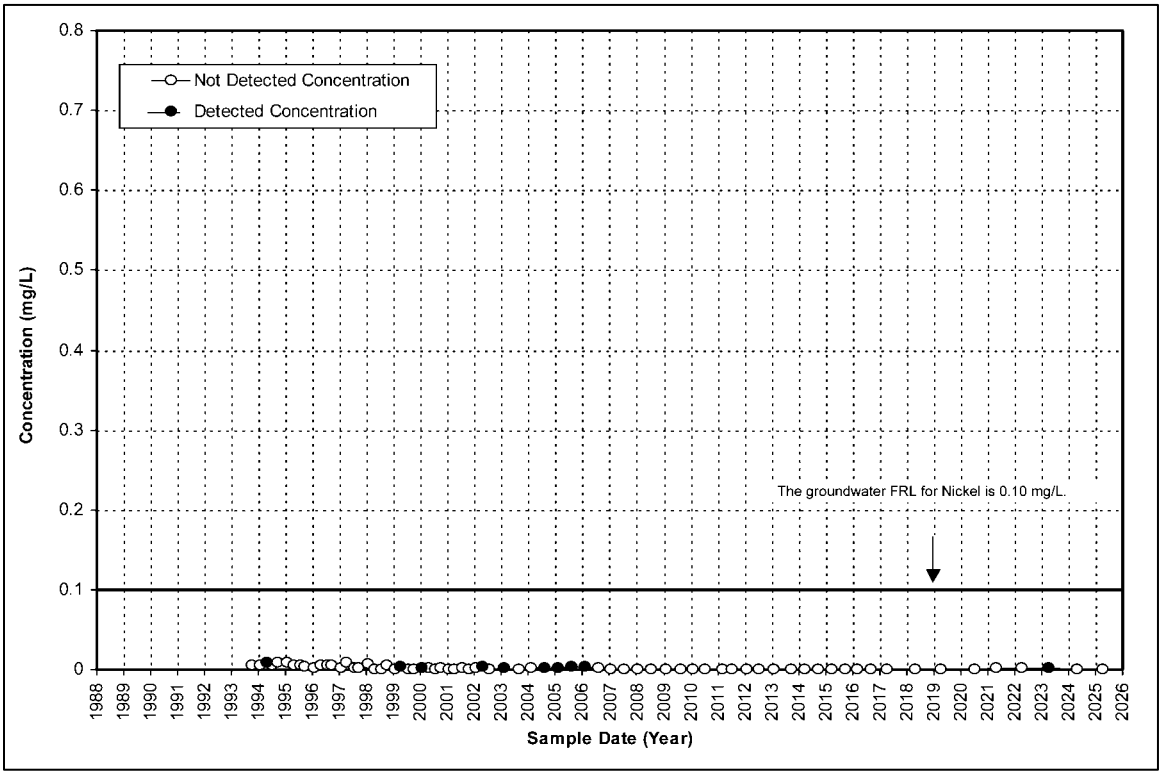


Figure A.4-191. Nickel Concentration Versus Time Plot for Monitoring Well 3424

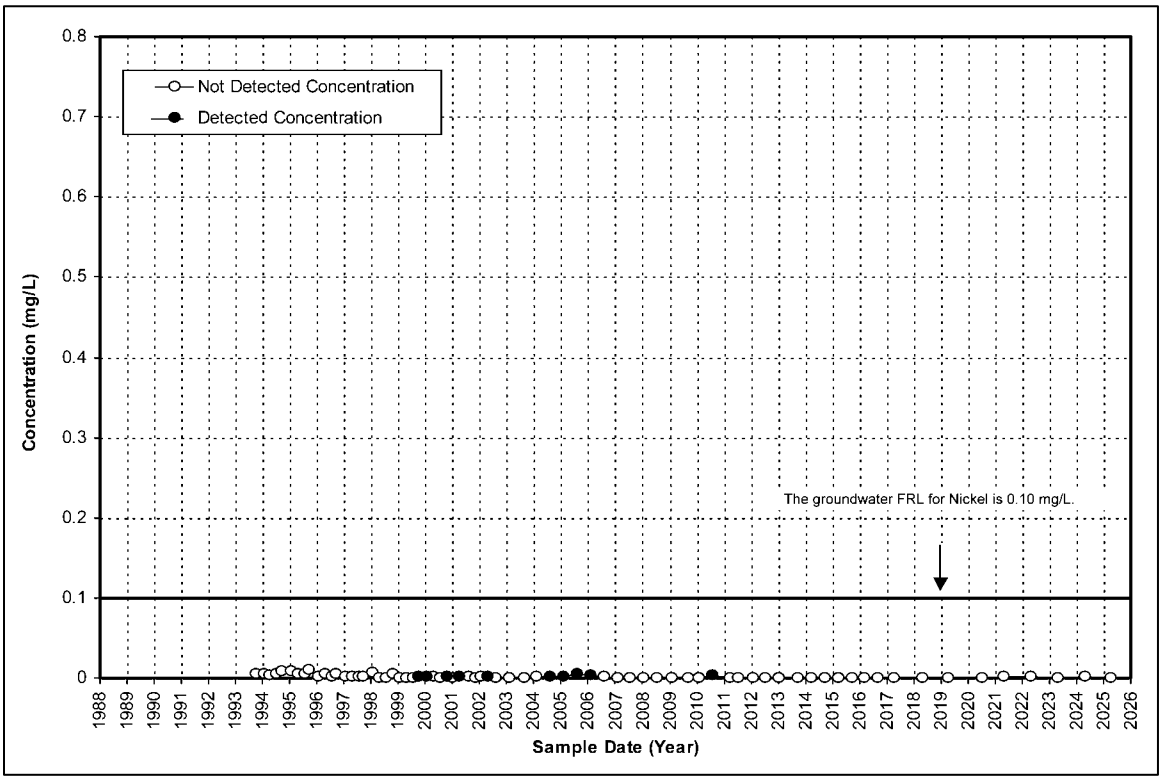


Figure A.4-192. Nickel Concentration Versus Time Plot for Monitoring Well 3426

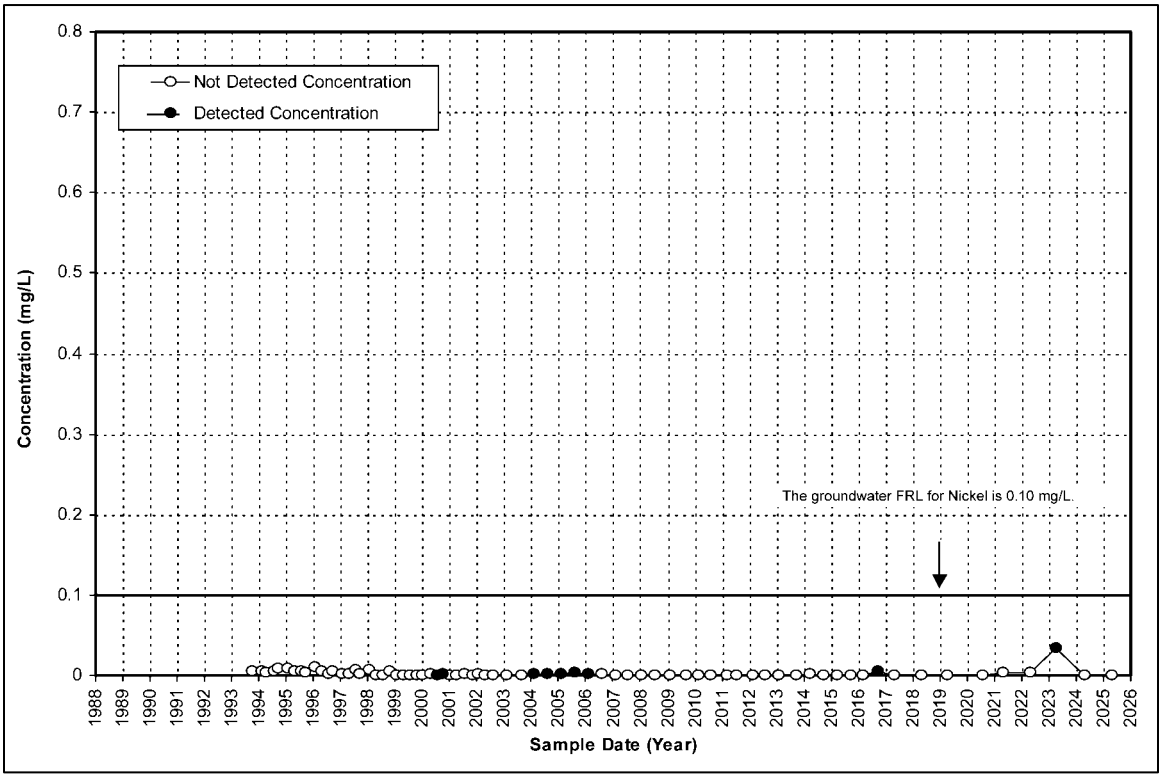


Figure A.4-193. Nickel Concentration Versus Time Plot for Monitoring Well 3429

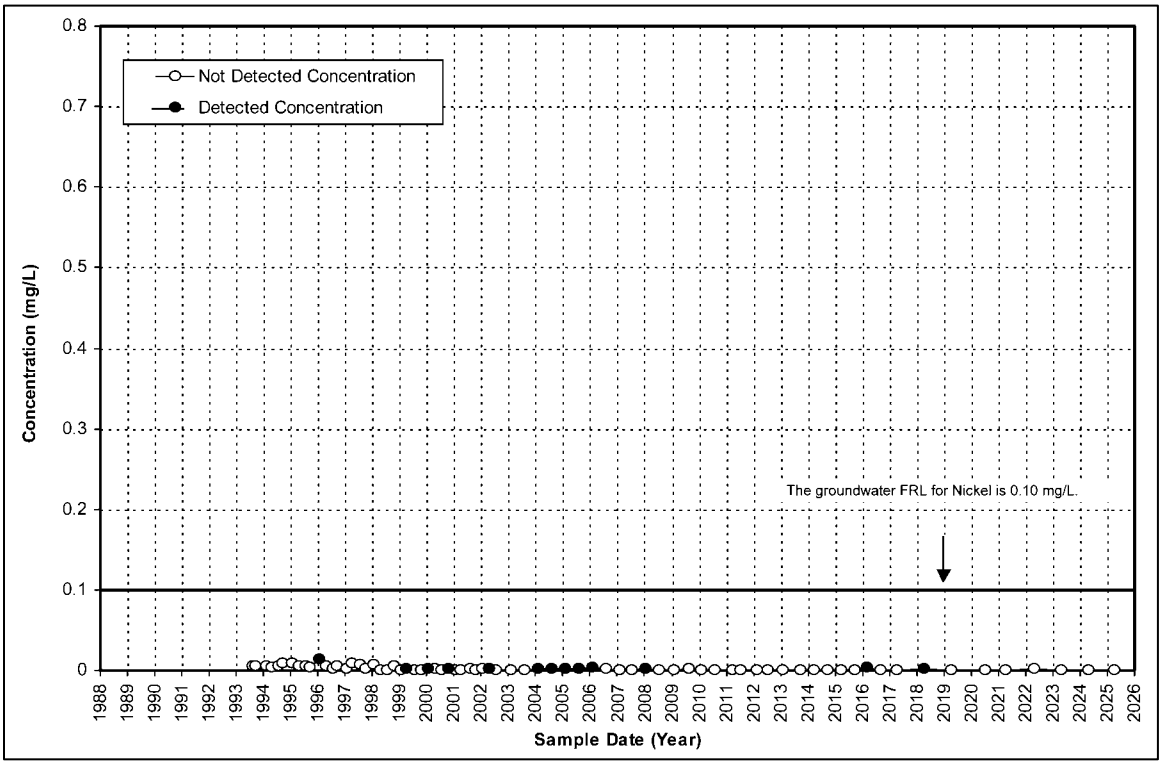


Figure A.4-194. Nickel Concentration Versus Time Plot for Monitoring Well 3431

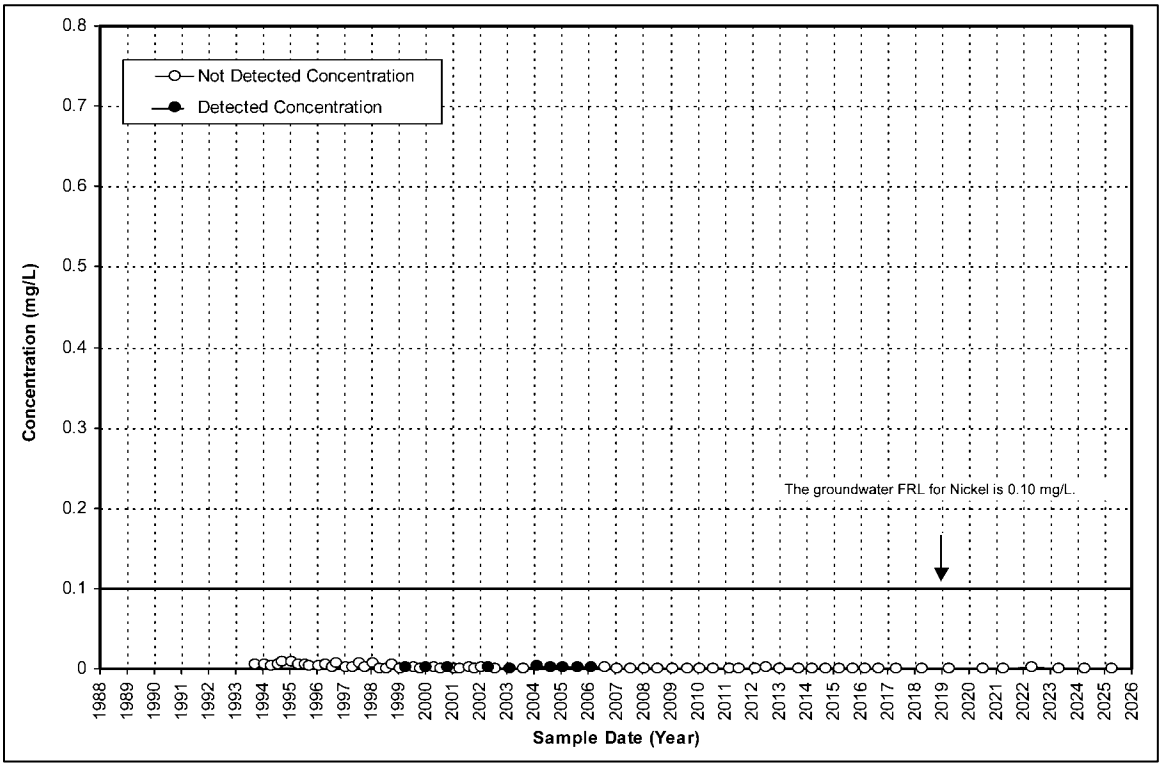


Figure A.4-195. Nickel Concentration Versus Time Plot for Monitoring Well 3432

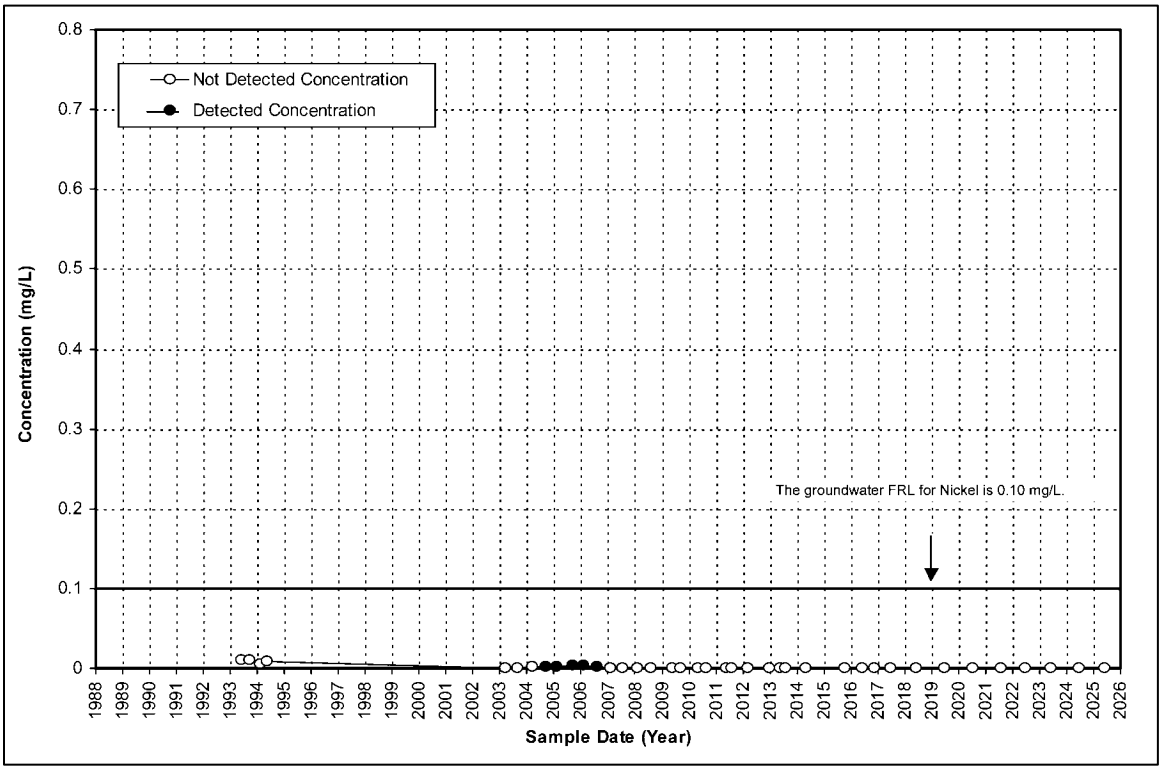


Figure A.4-196. Nickel Concentration Versus Time Plot for Monitoring Well 3636

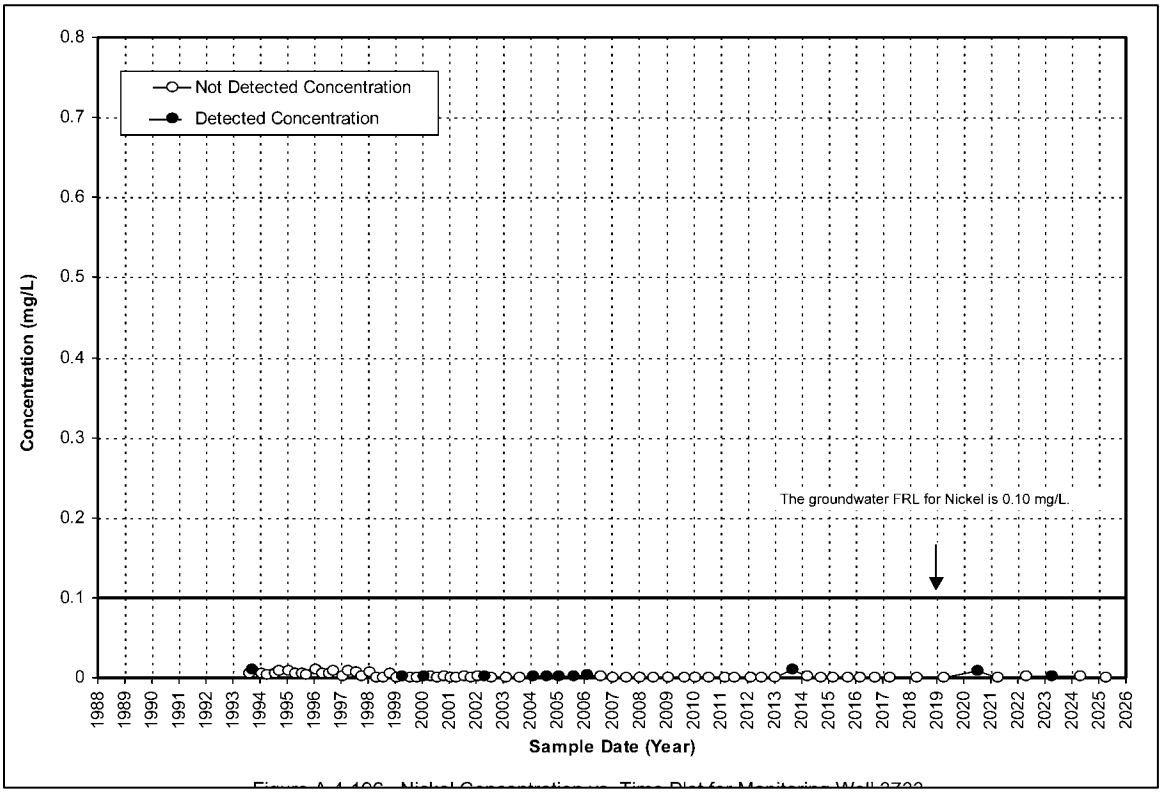


Figure A.4-197. Nickel Concentration Versus Time Plot for Monitoring Well 3733

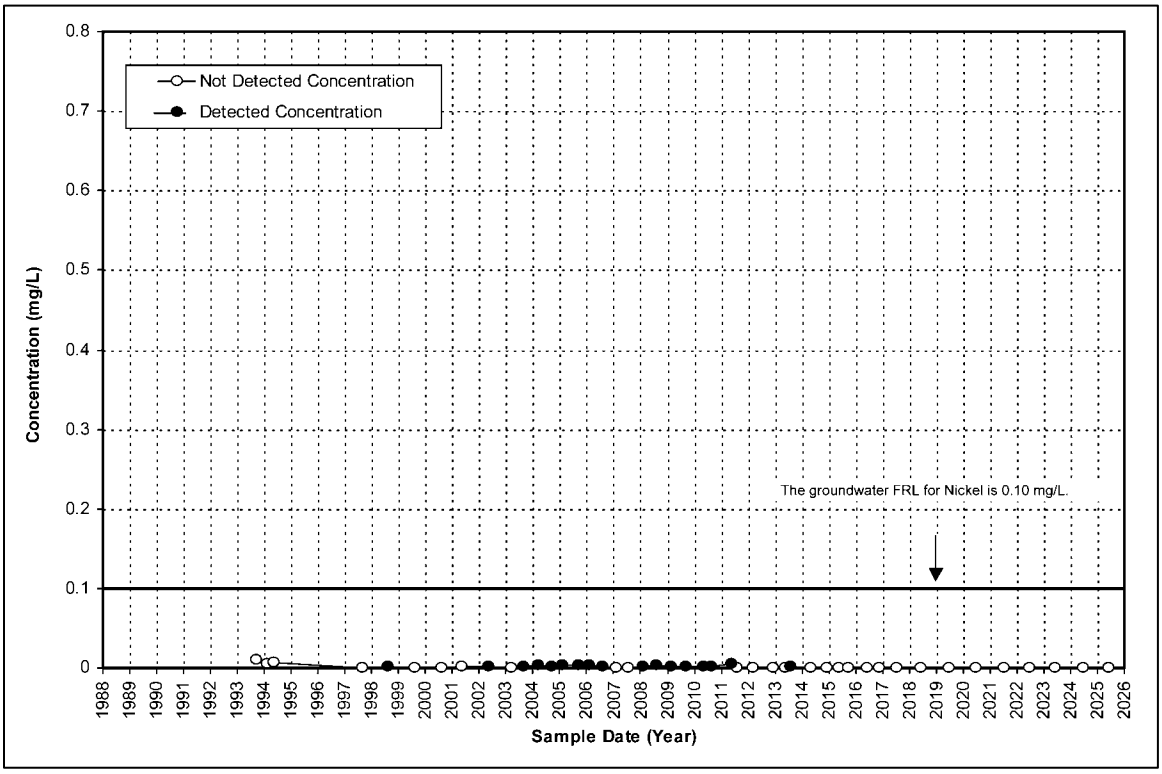


Figure A.4-198. Nickel Concentration Versus Time Plot for Monitoring Well 3898

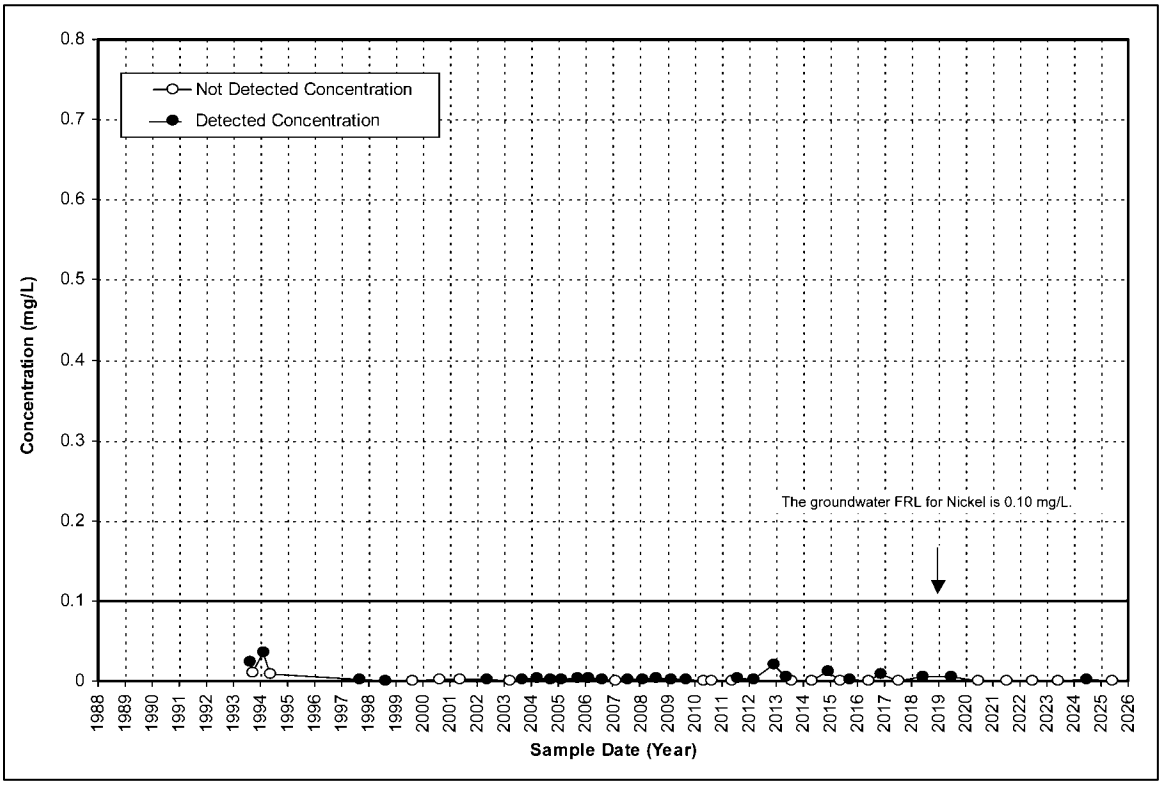


Figure A.4-199. Nickel Concentration Versus Time Plot for Monitoring Well 3899

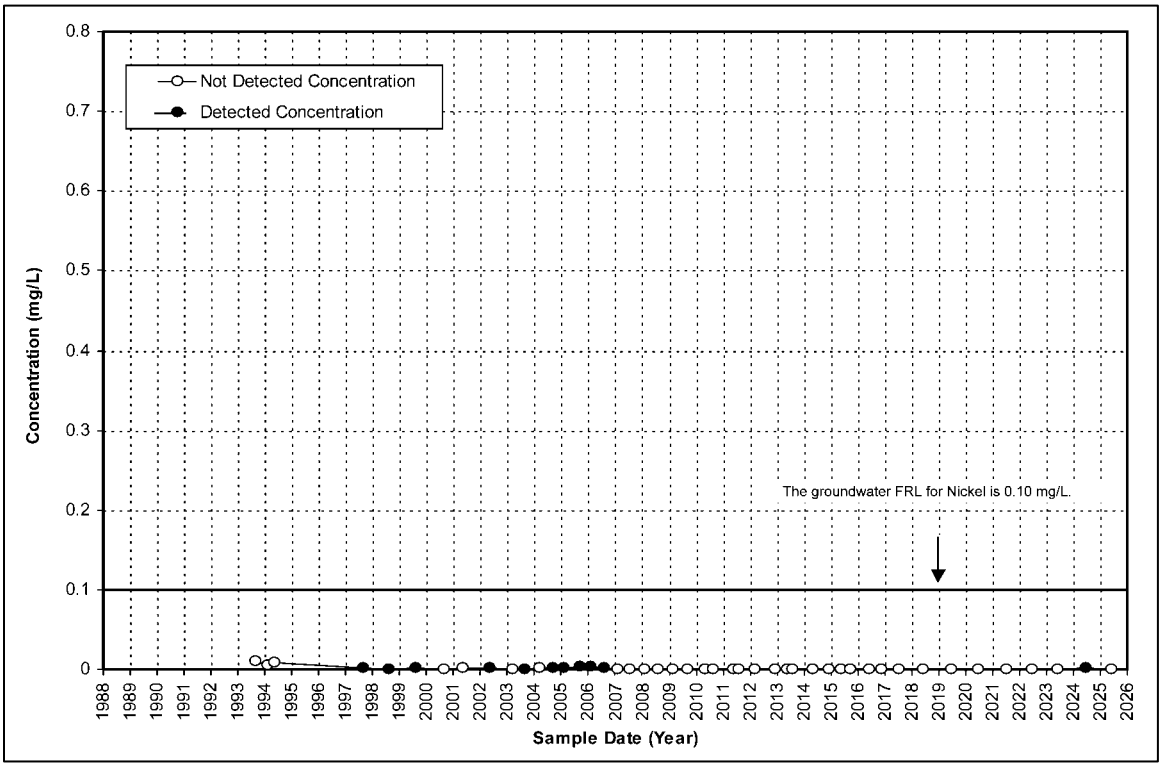


Figure A.4-200. Nickel Concentration Versus Time Plot for Monitoring Well 3900

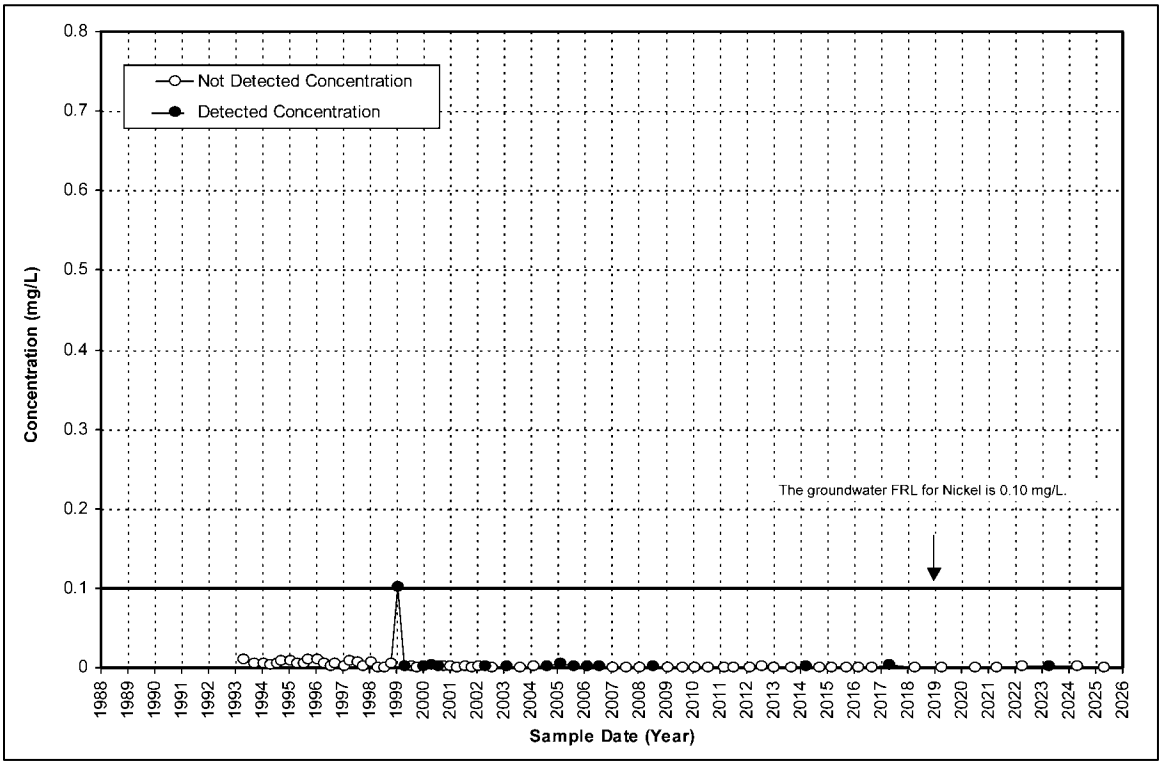


Figure A.4-201. Nickel Concentration Versus Time Plot for Monitoring Well 4398

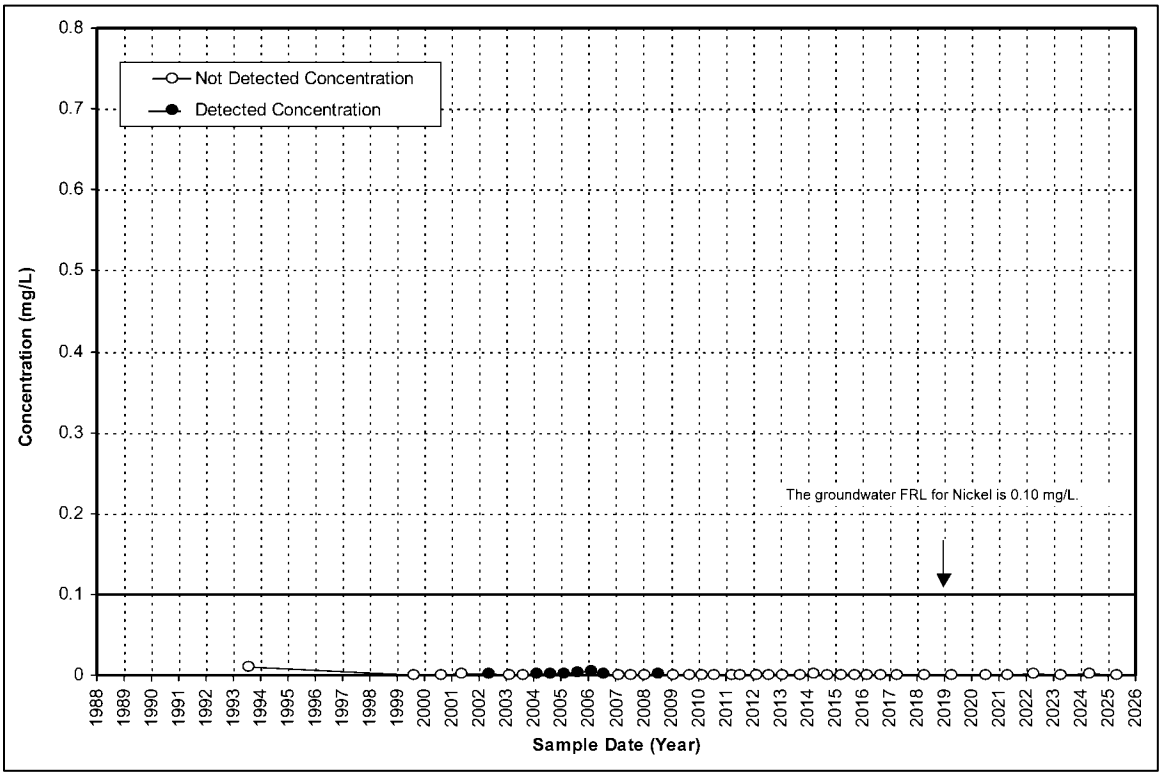


Figure A.4-202. Nickel Concentration Versus Time Plot for Monitoring Well 21063

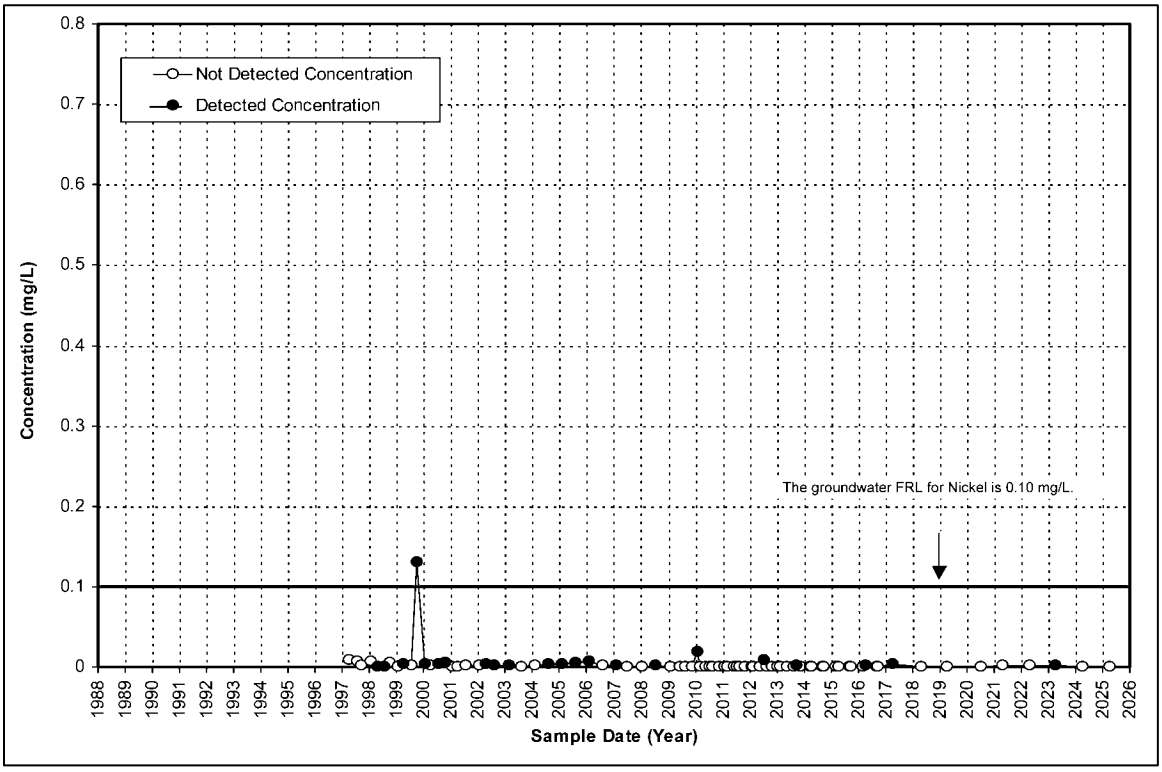


Figure A.4-203. Nickel Concentration Versus Time Plot for Monitoring Well 22198

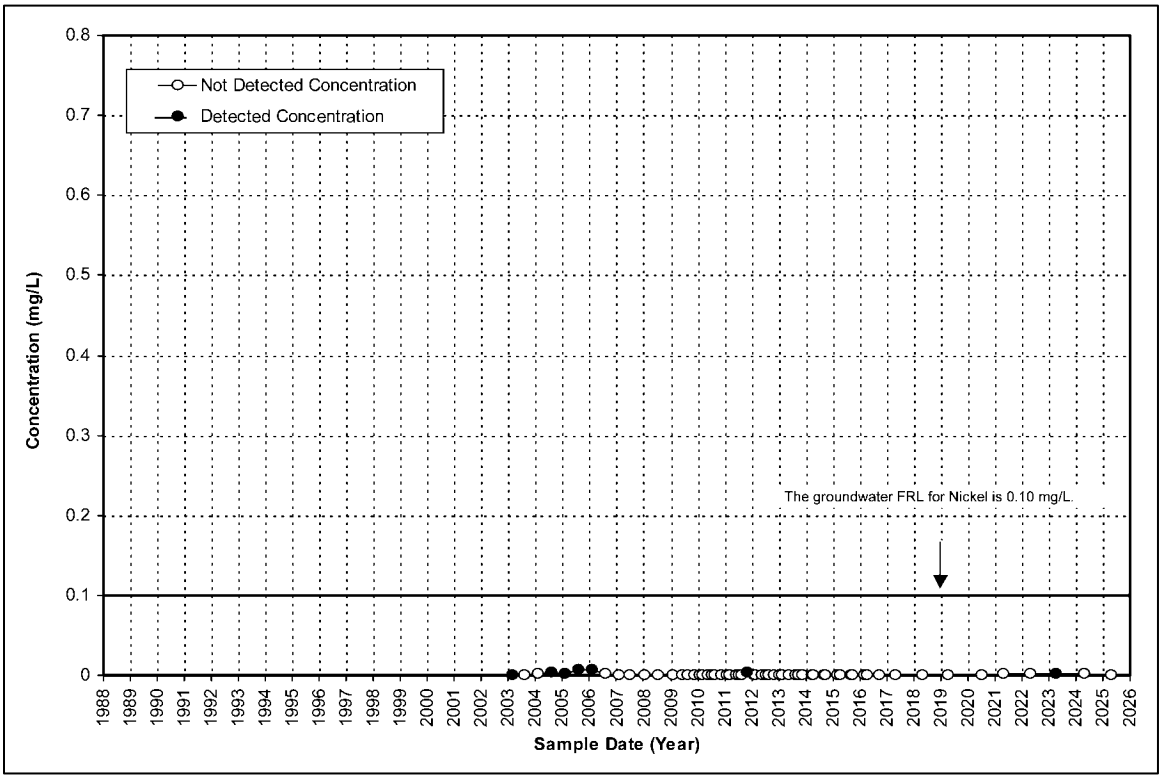


Figure A.4-204. Nickel Concentration Versus Time Plot for Monitoring Well 22199

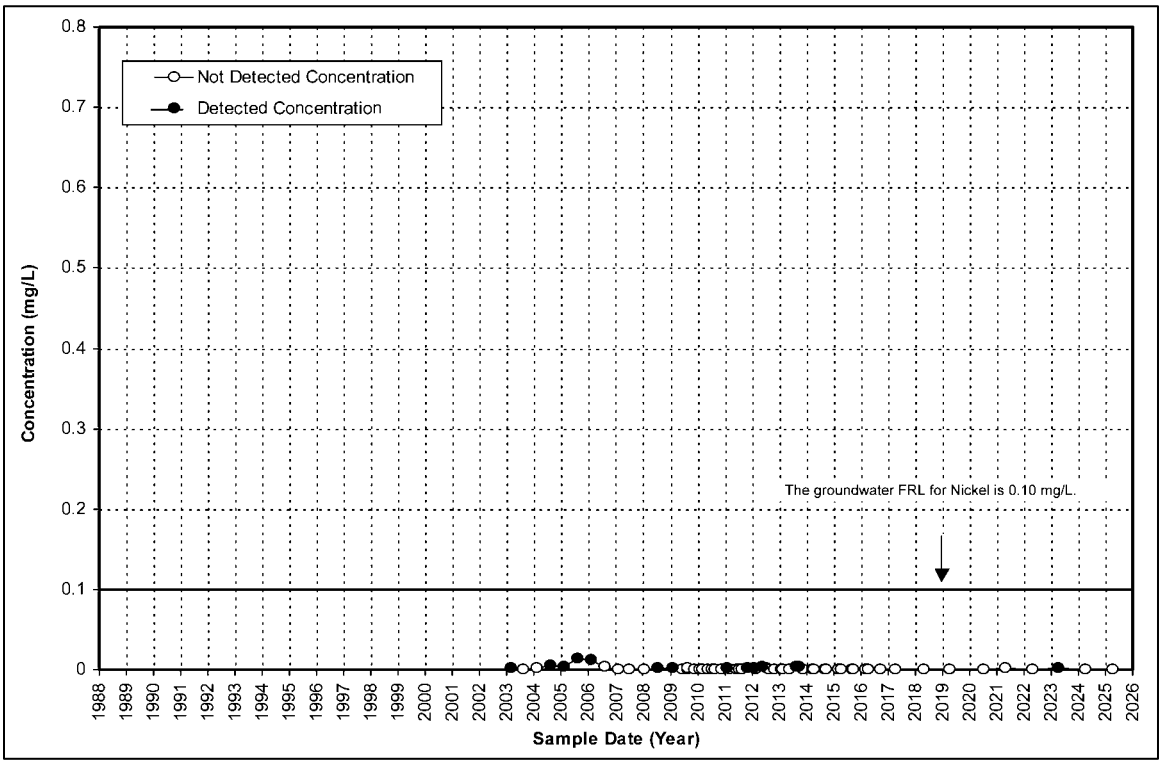


Figure A.4-205. Nickel Concentration Versus Time Plot for Monitoring Well 22204

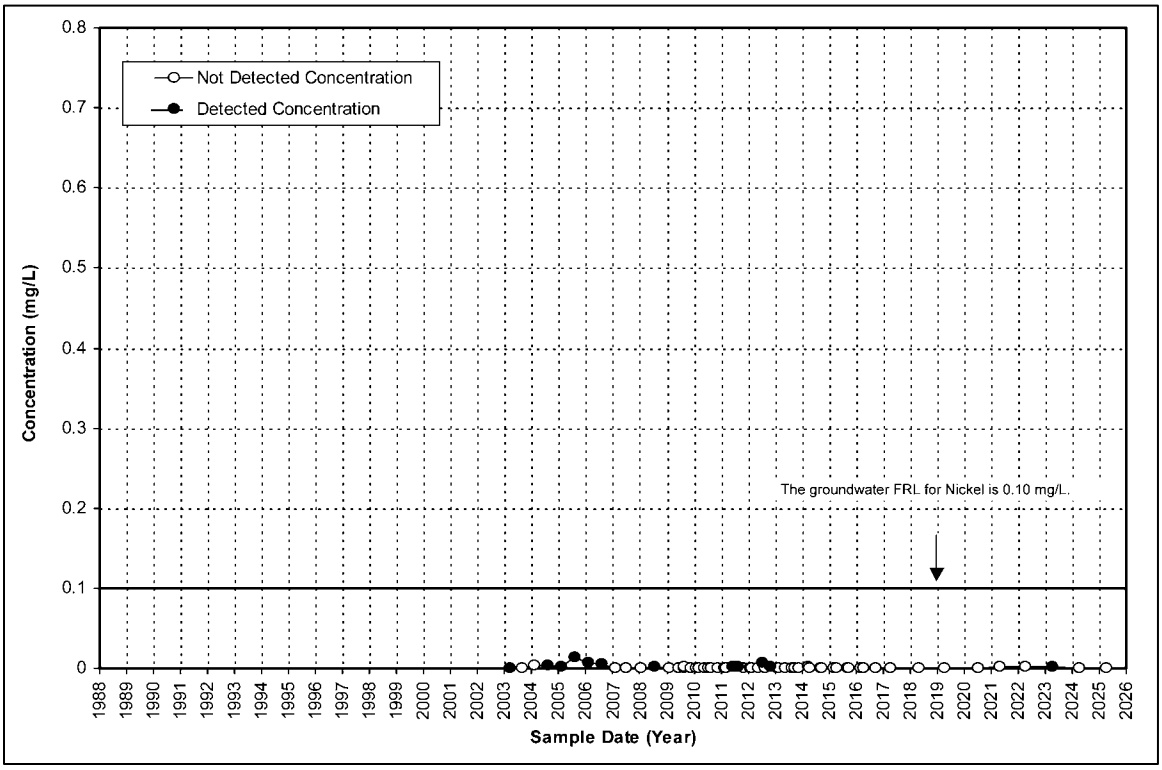


Figure A.4-206. Nickel Concentration Versus Time Plot for Monitoring Well 22205

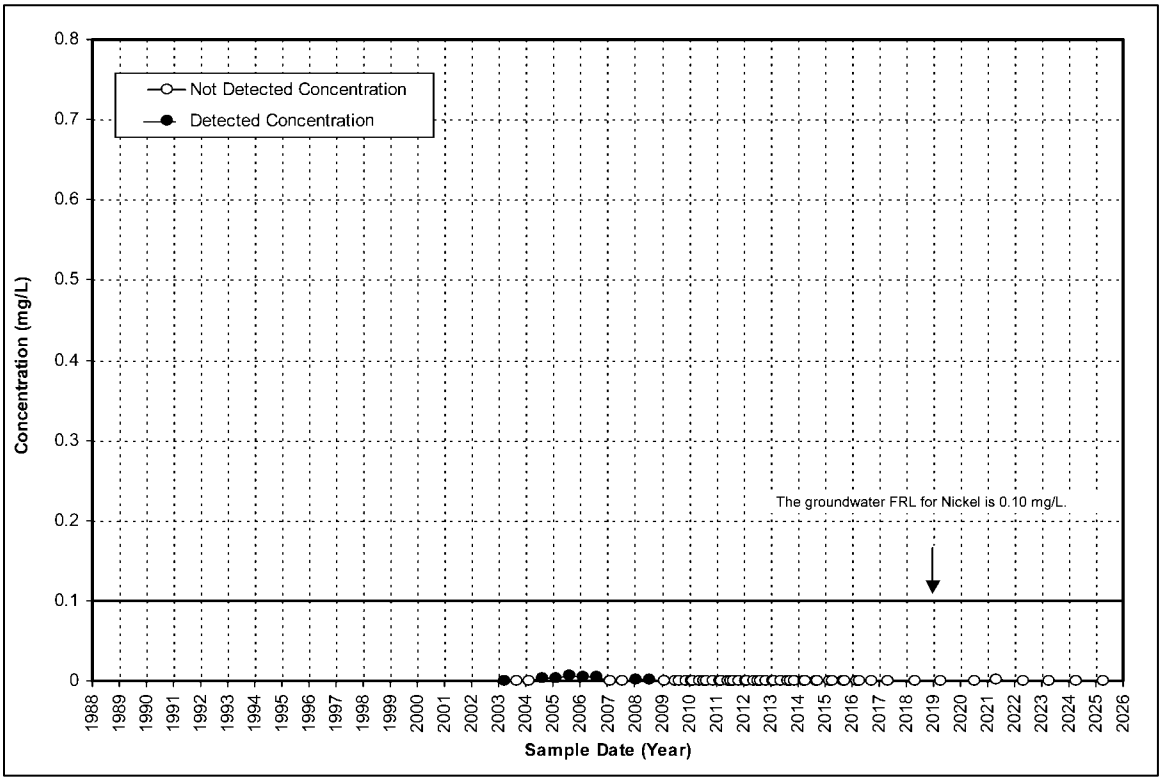


Figure A.4-207. Nickel Concentration Versus Time Plot for Monitoring Well 22208

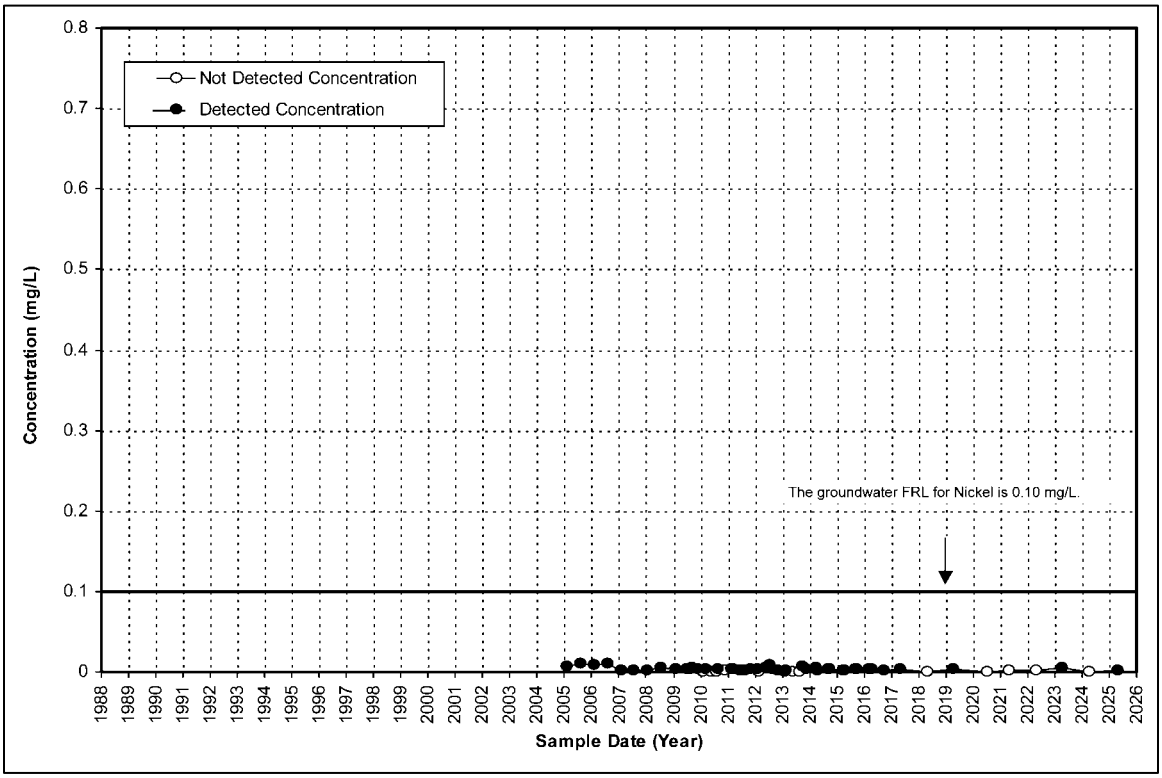


Figure A.4-208. Nickel Concentration Versus Time Plot for Monitoring Well 22210

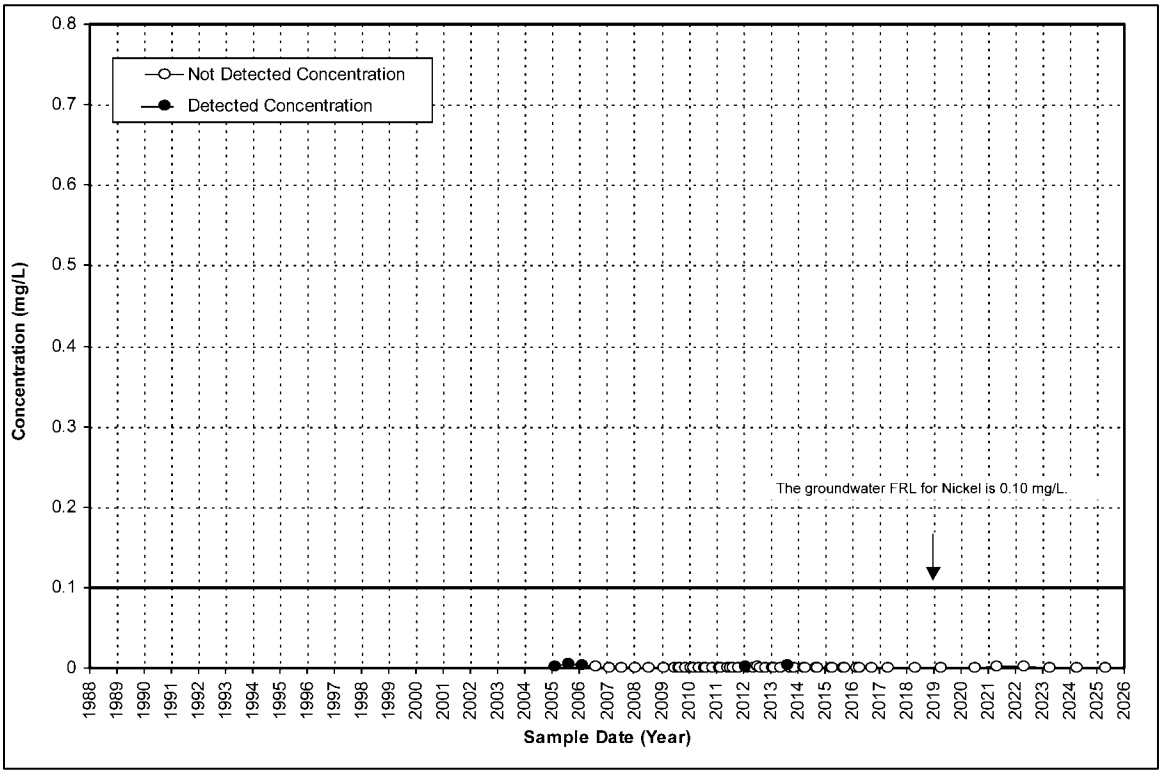


Figure A.4-209. Nickel Concentration Versus Time Plot for Monitoring Well 22211

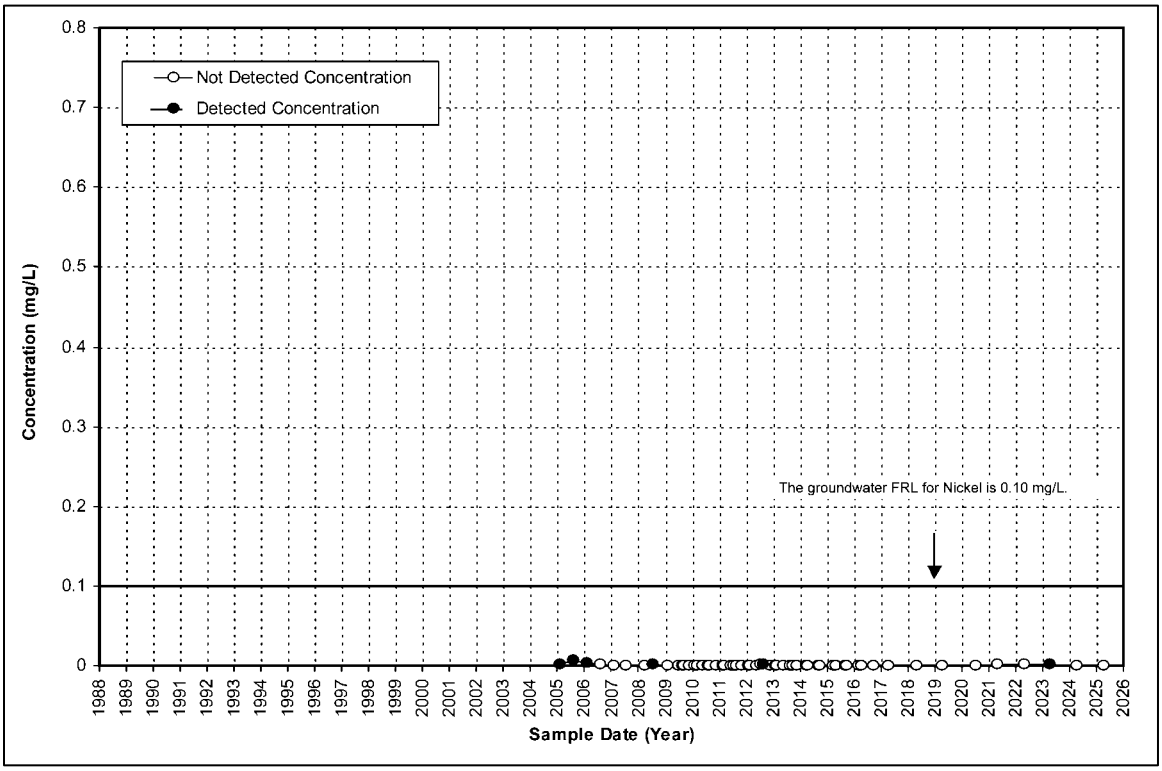


Figure A.4-210. Nickel Concentration Versus Time Plot for Monitoring Well 22214

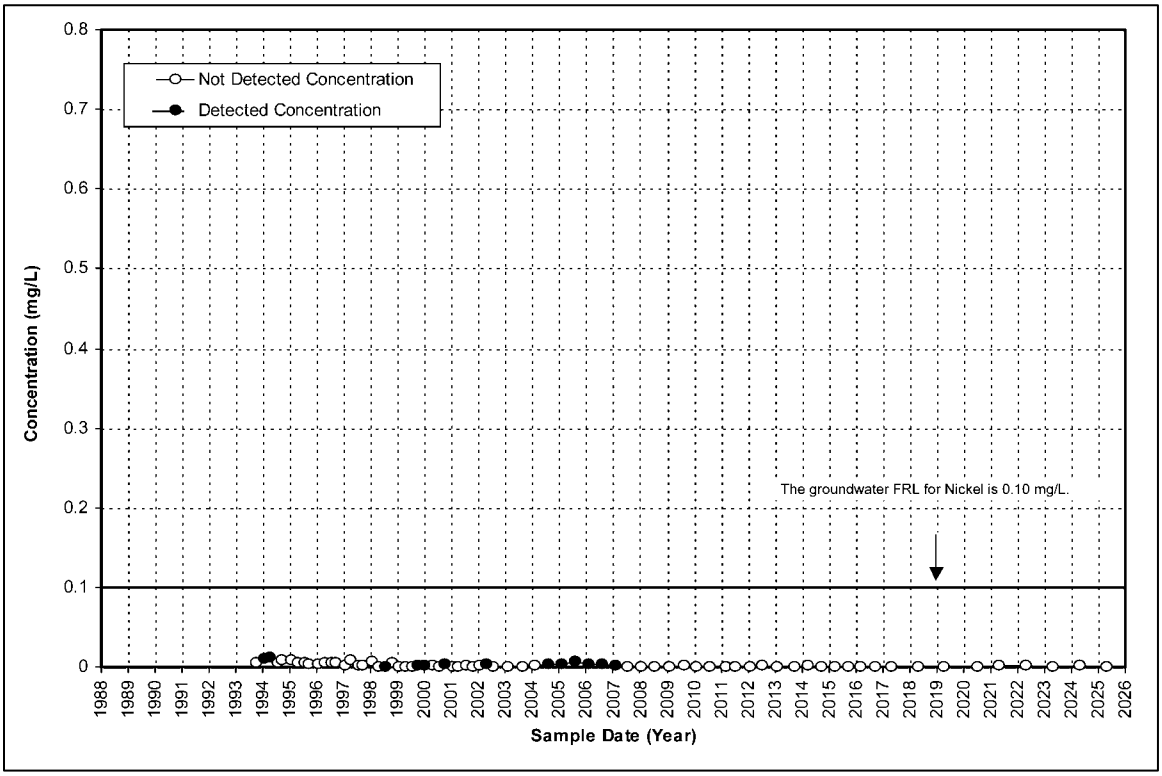


Figure A.4-211. Nickel Concentration Versus Time Plot for Monitoring Well 31217

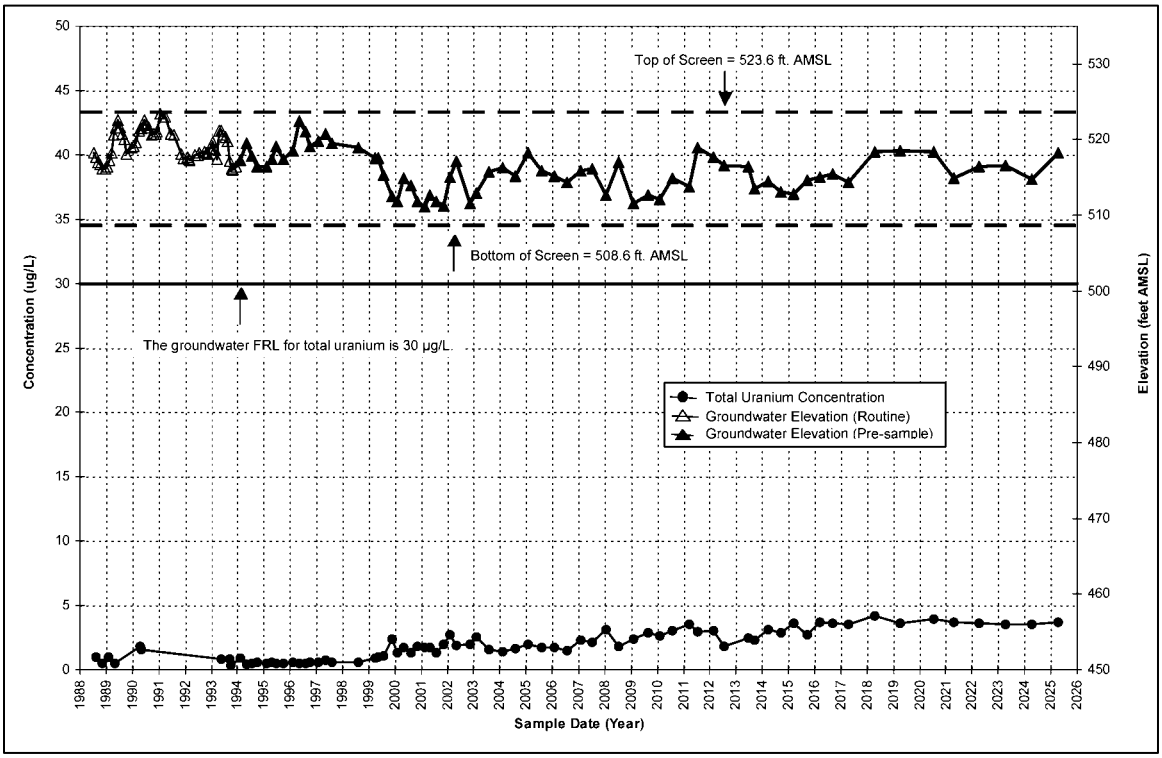


Figure A.4-212. Total Uranium Concentration Versus Time Plot for Monitoring Well 2093

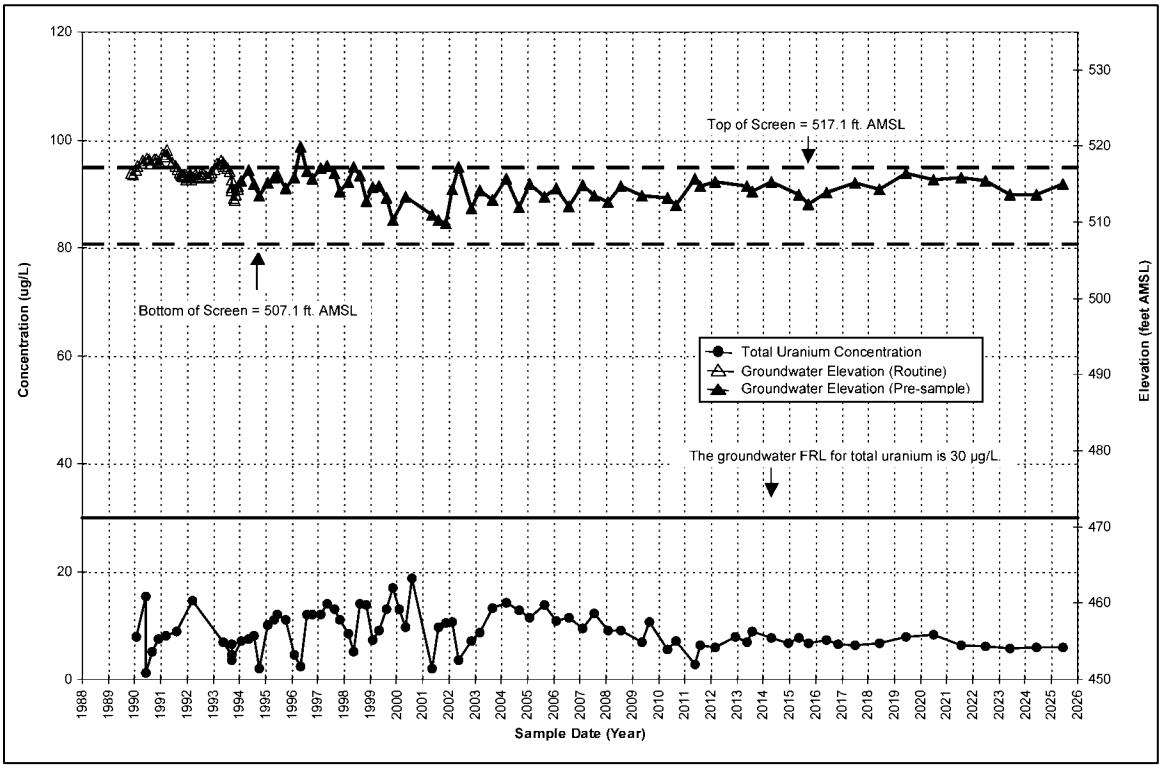


Figure A.4-213. Total Uranium Concentration Versus Time Plot for Monitoring Well 2128

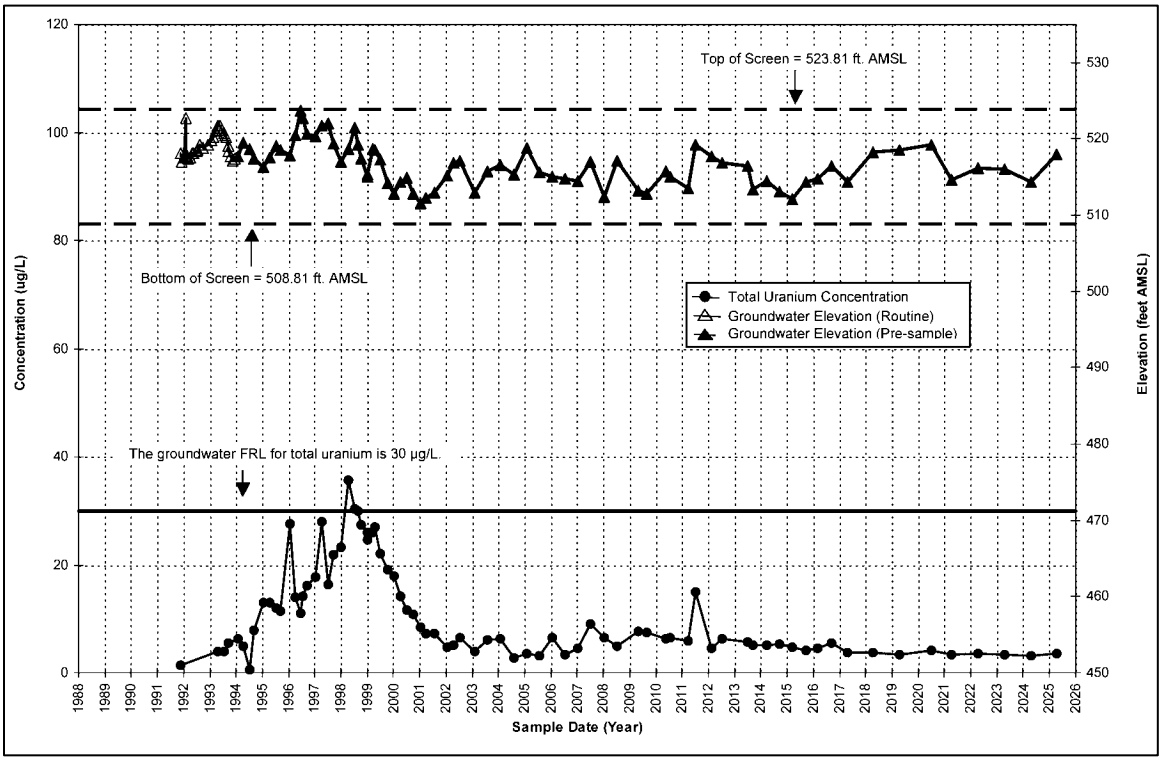


Figure A.4-214. Total Uranium Concentration Versus Time Plot for Monitoring Well 2398

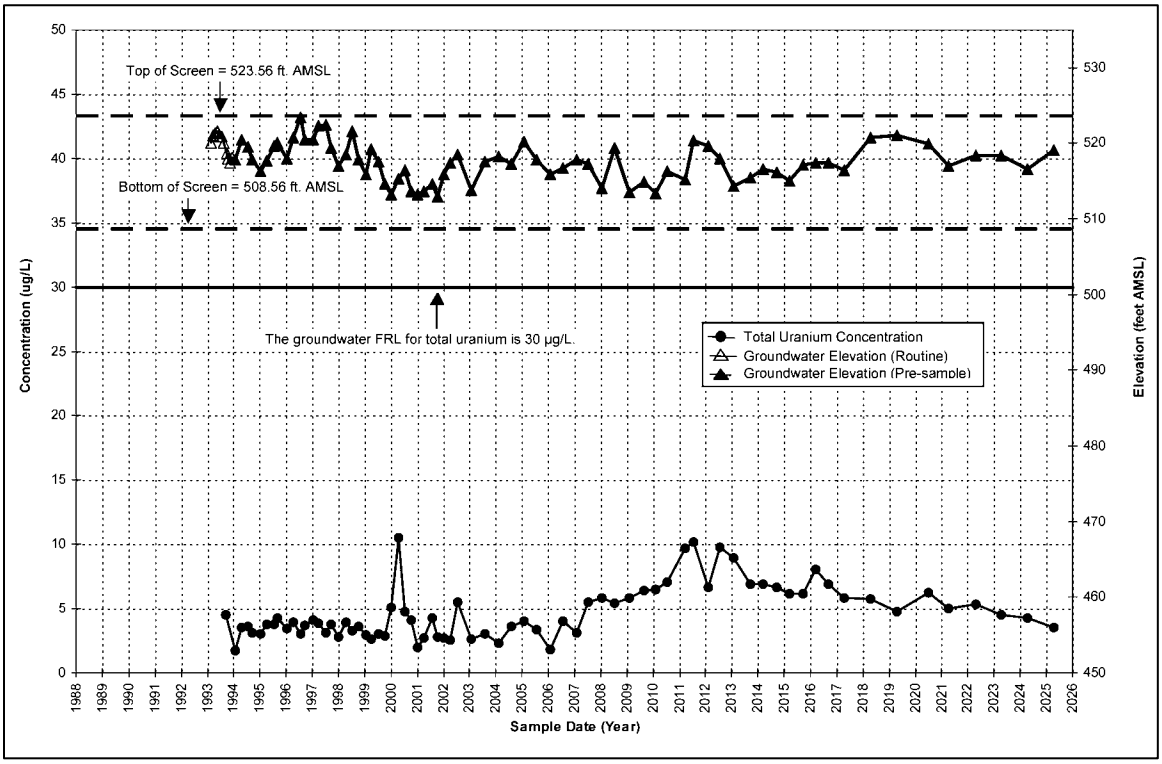


Figure A.4-215. Total Uranium Concentration Versus Time Plot for Monitoring Well 2431

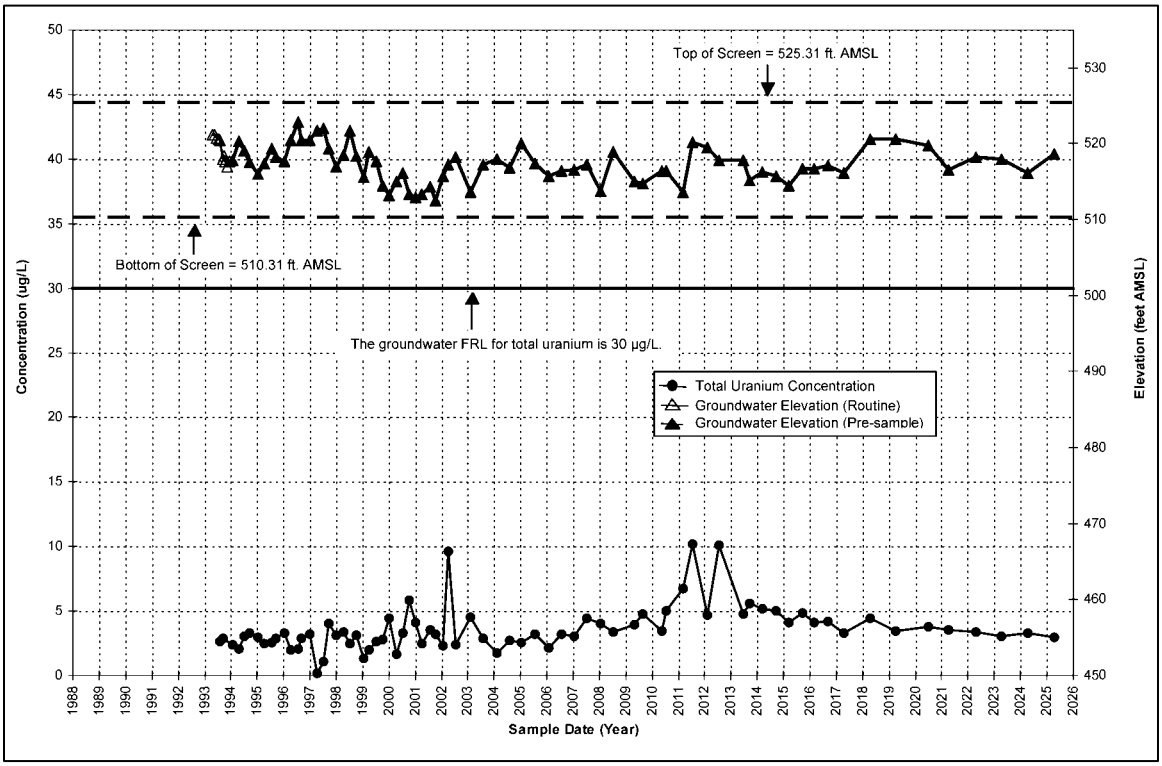


Figure A.4-216. Total Uranium Concentration Versus Time Plot for Monitoring Well 2432

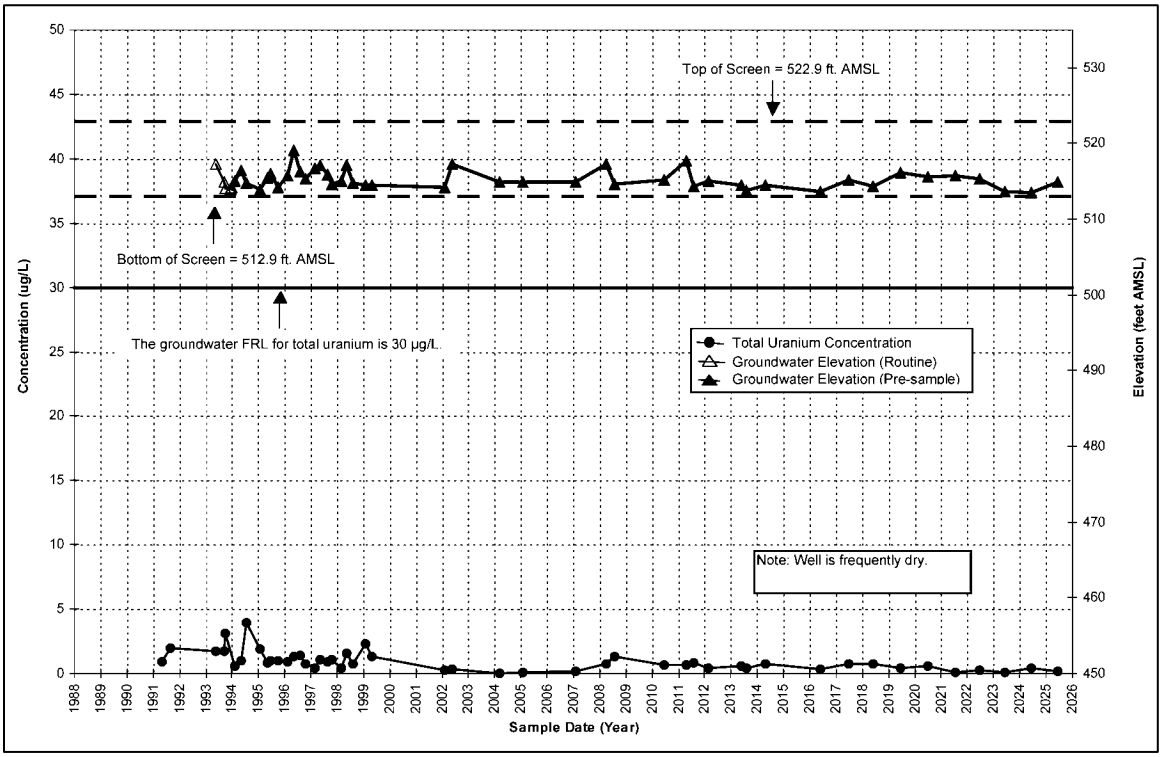


Figure A.4-217. Total Uranium Concentration Versus Time Plot for Monitoring Well 2636

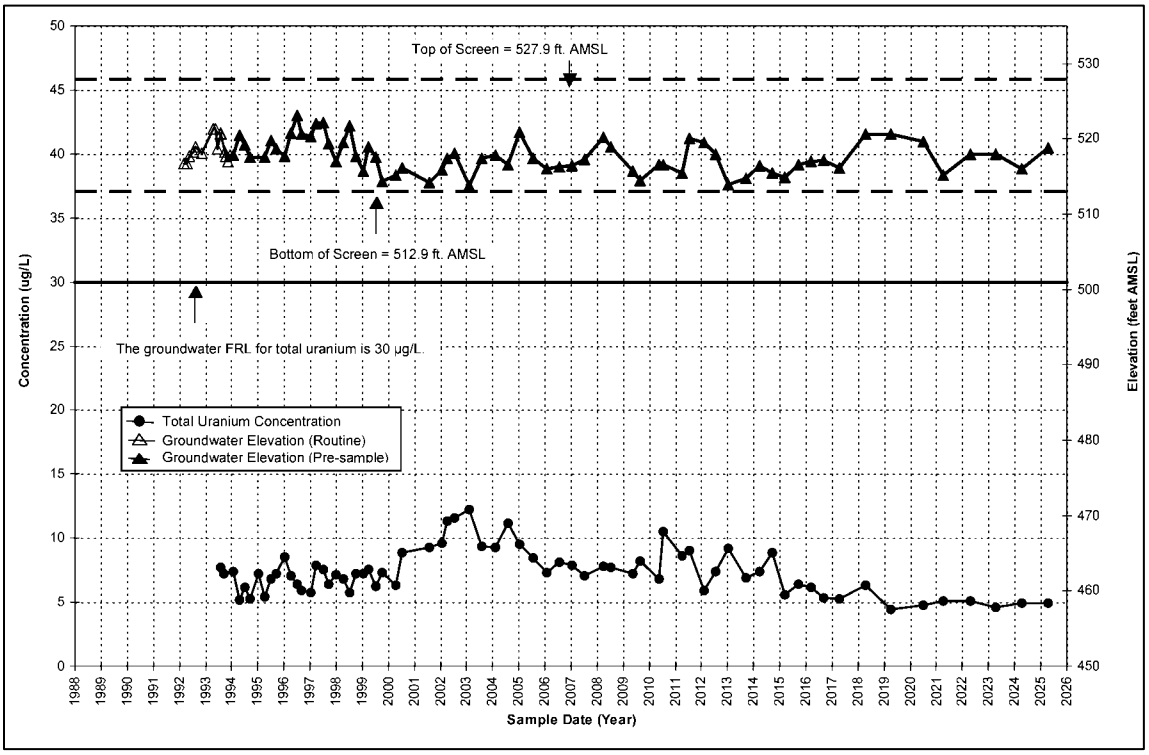


Figure A.4-218. Total Uranium Concentration Versus Time Plot for Monitoring Well 2733

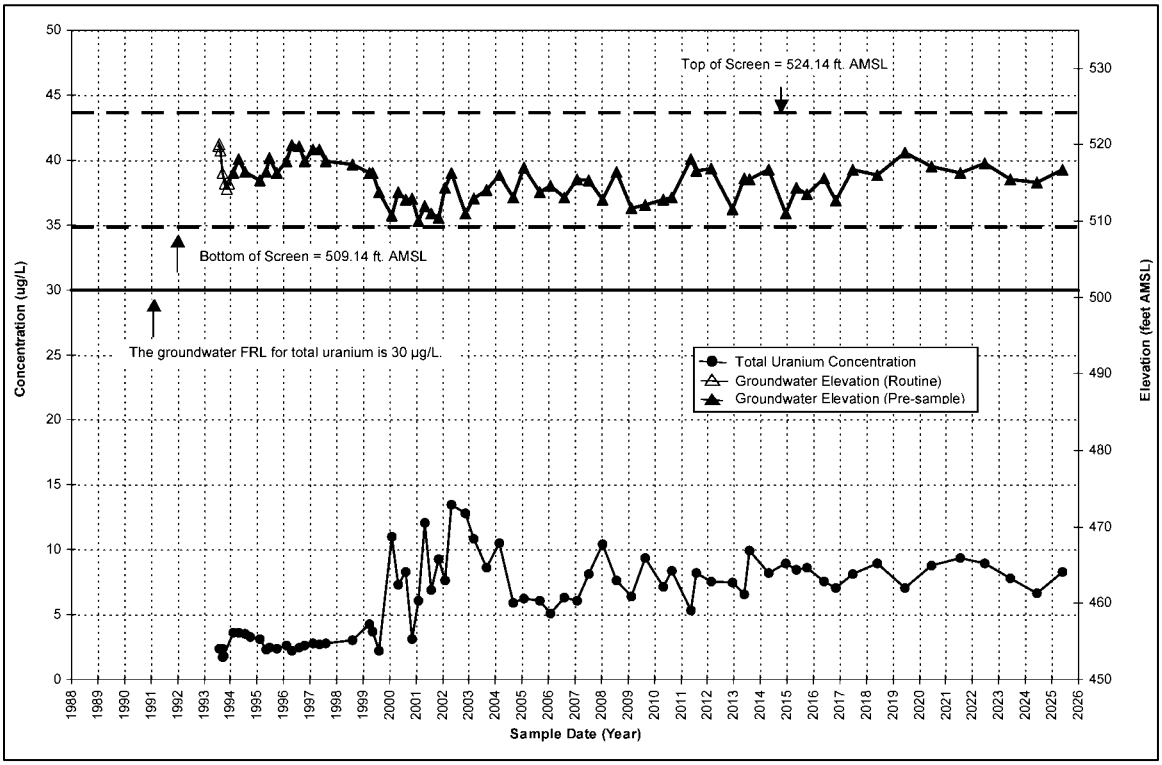


Figure A.4-219. Total Uranium Concentration Versus Time Plot for Monitoring Well 2898

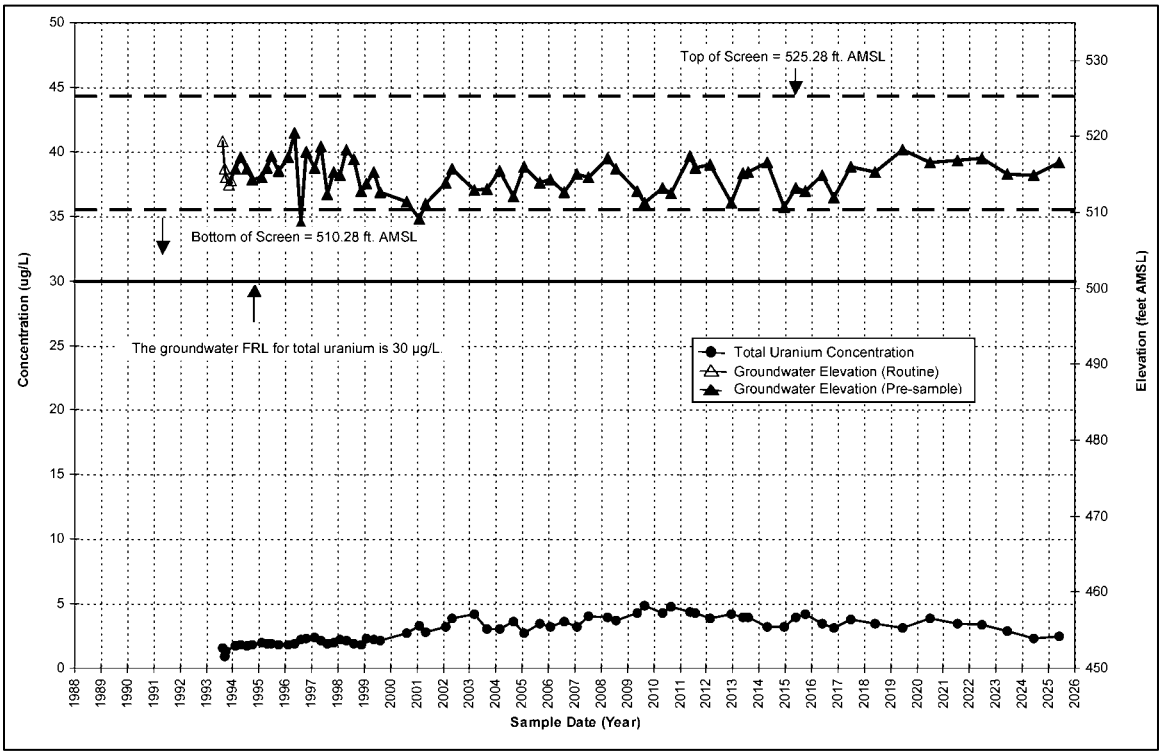


Figure A.4-220. Total Uranium Concentration Versus Time Plot for Monitoring Well 2899

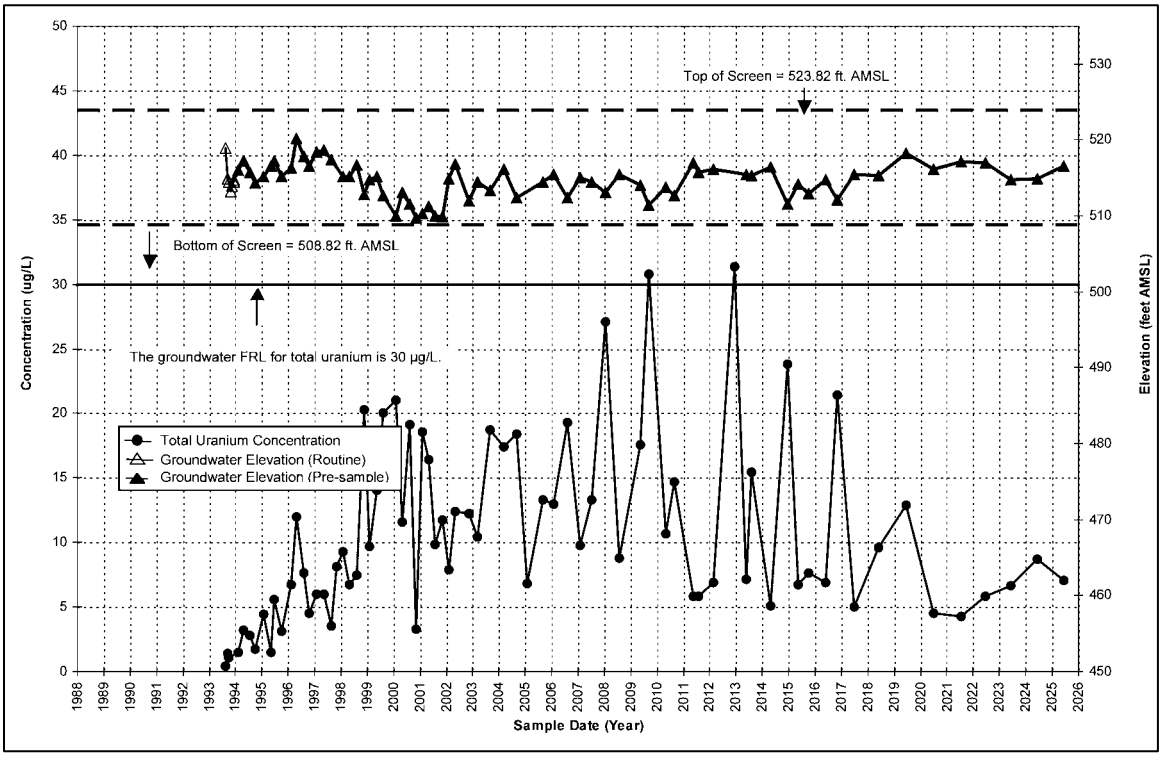


Figure A.4-221. Total Uranium Concentration Versus Time Plot for Monitoring Well 2900

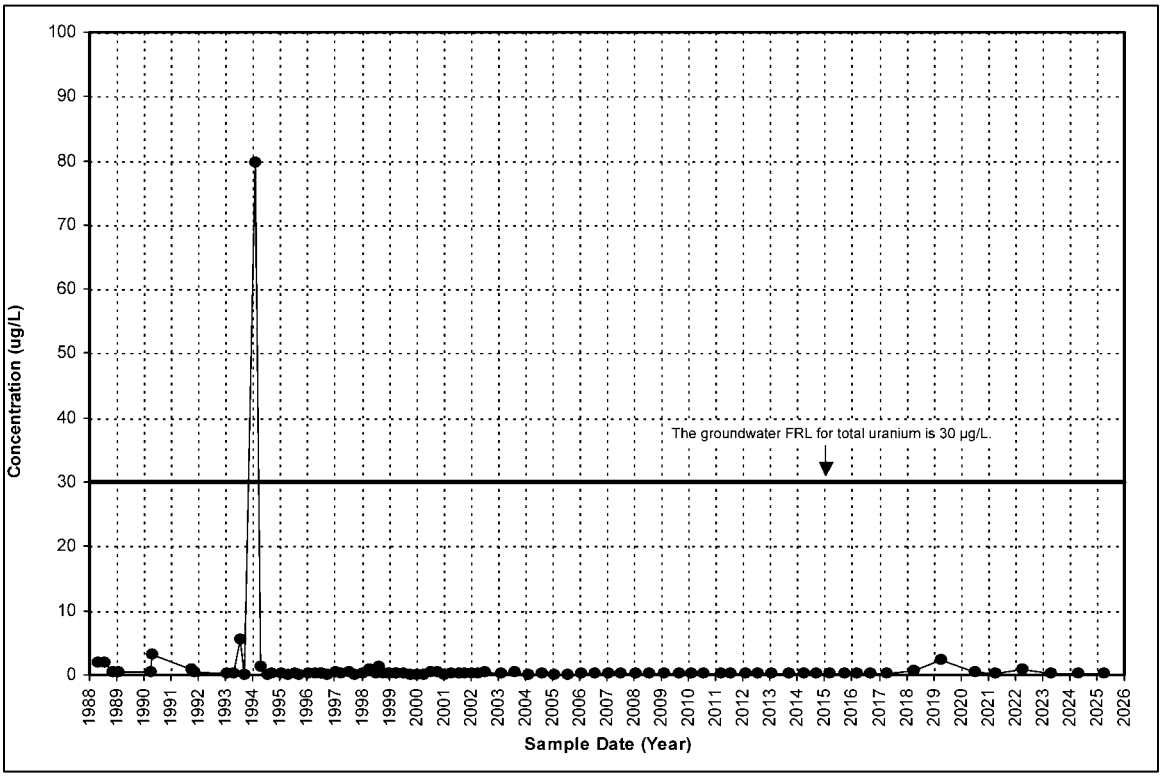


Figure A.4-222. Total Uranium Concentration Versus Time Plot for Monitoring Well 3070

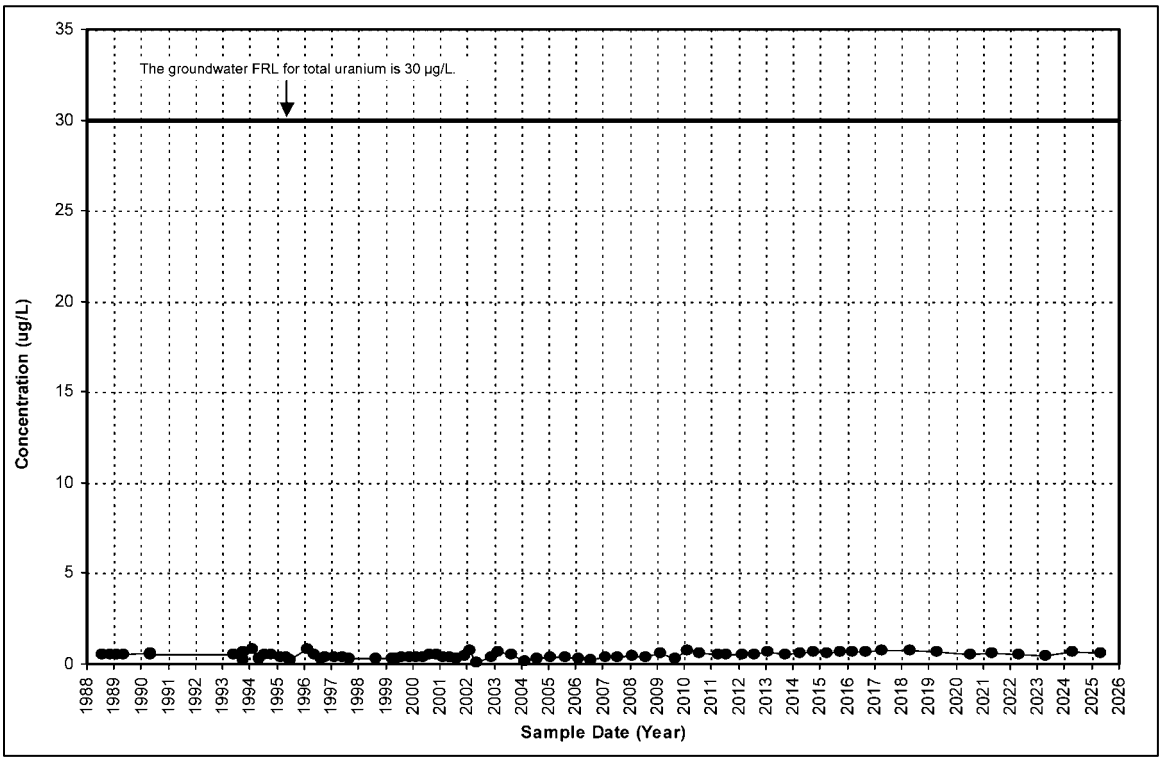


Figure A.4-223. Total Uranium Concentration Versus Time Plot for Monitoring Well 3093

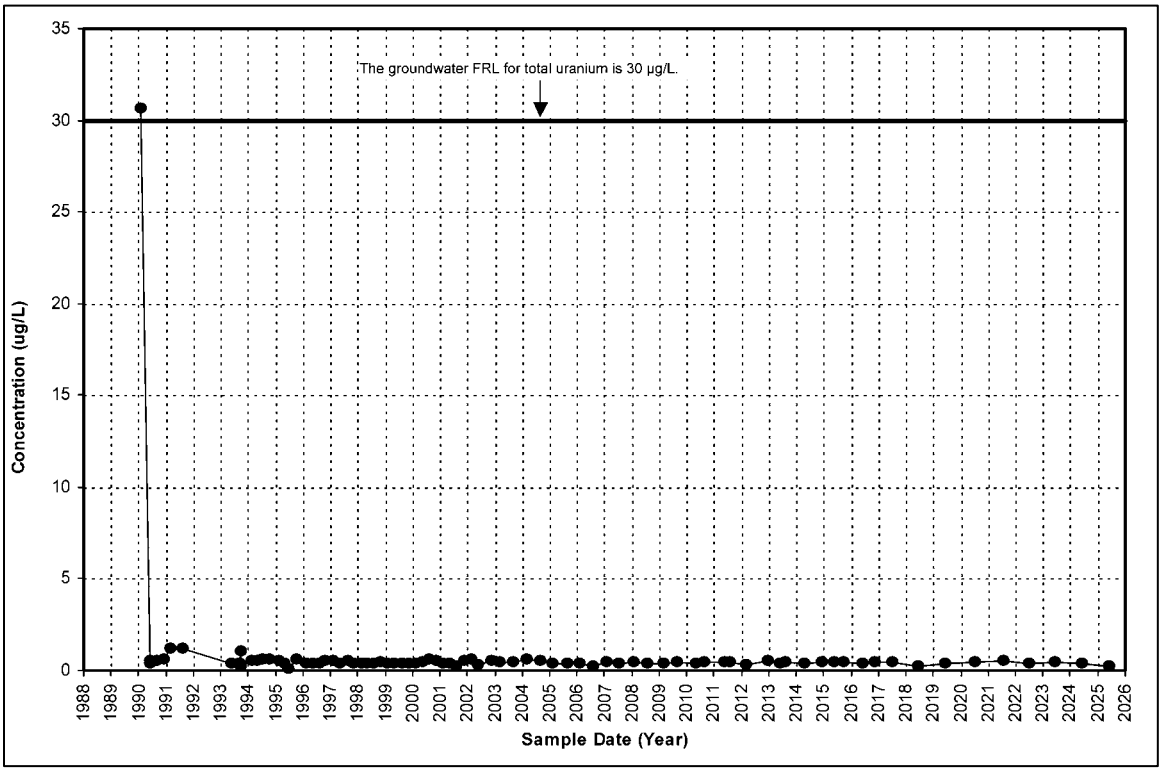


Figure A.4-224. Total Uranium Concentration Versus Time Plot for Monitoring Well 3128

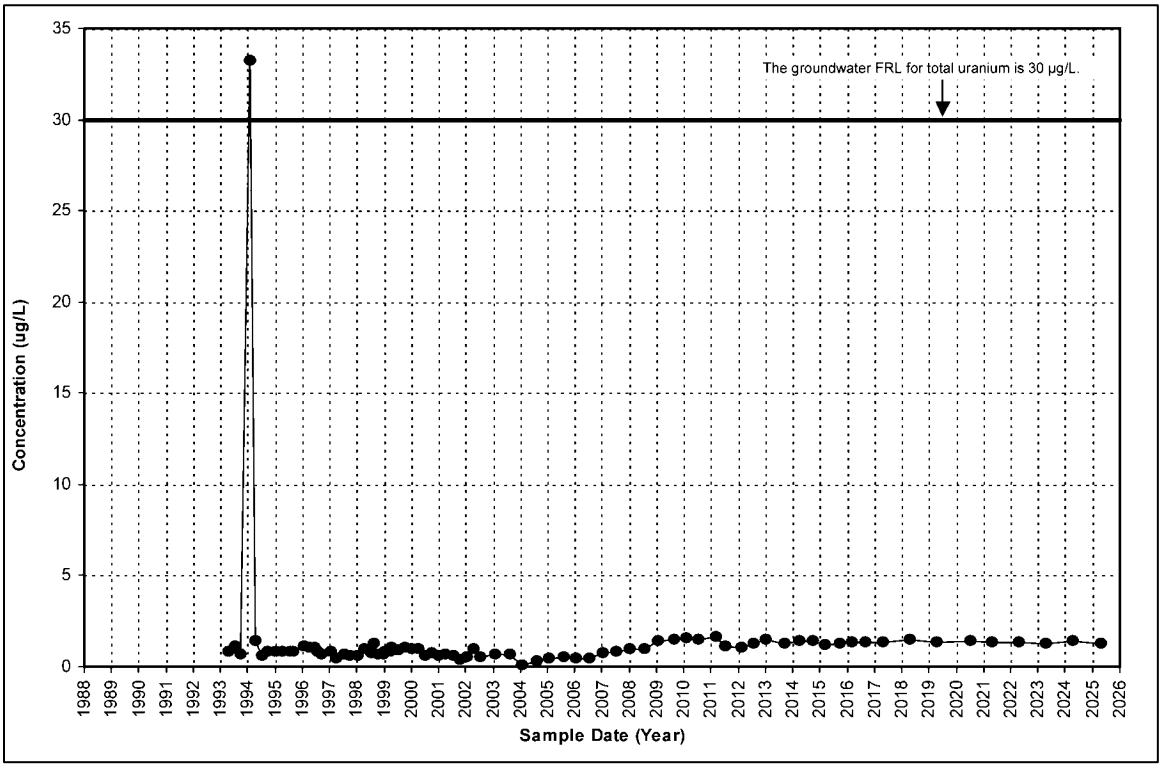


Figure A.4-225. Total Uranium Concentration Versus Time Plot for Monitoring Well 3398

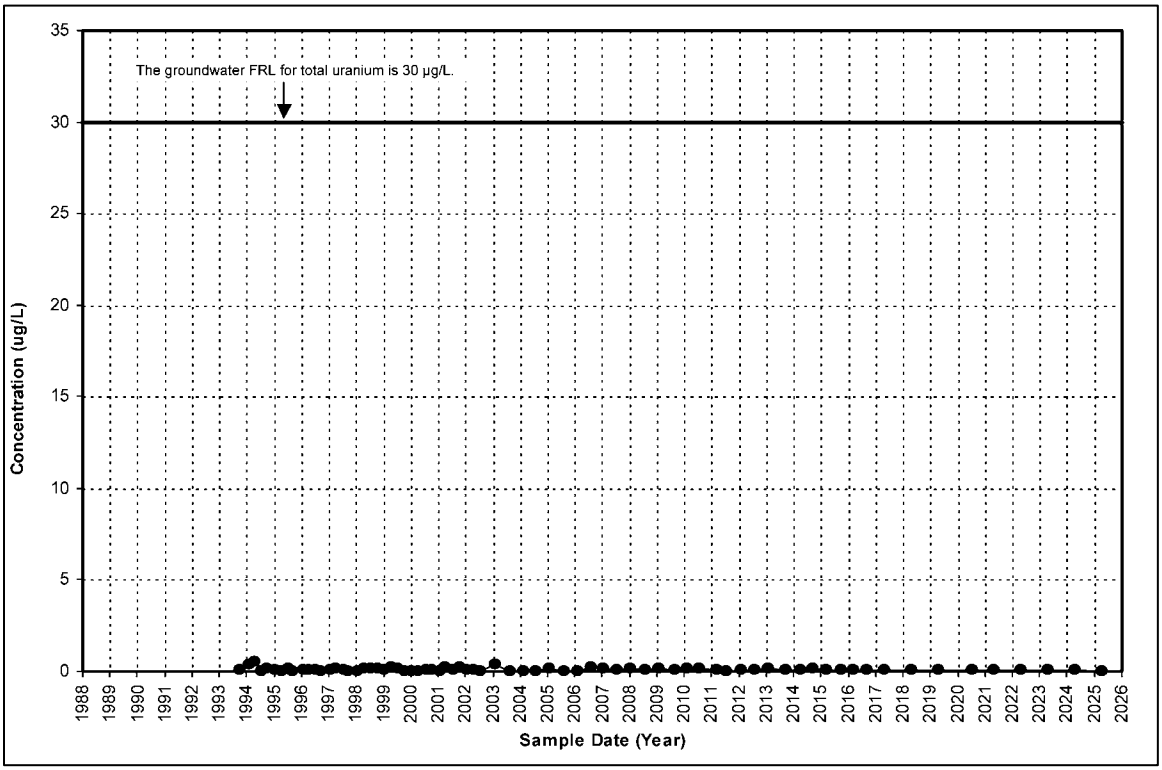


Figure A.4-226. Total Uranium Concentration Versus Time Plot for Monitoring Well 3424

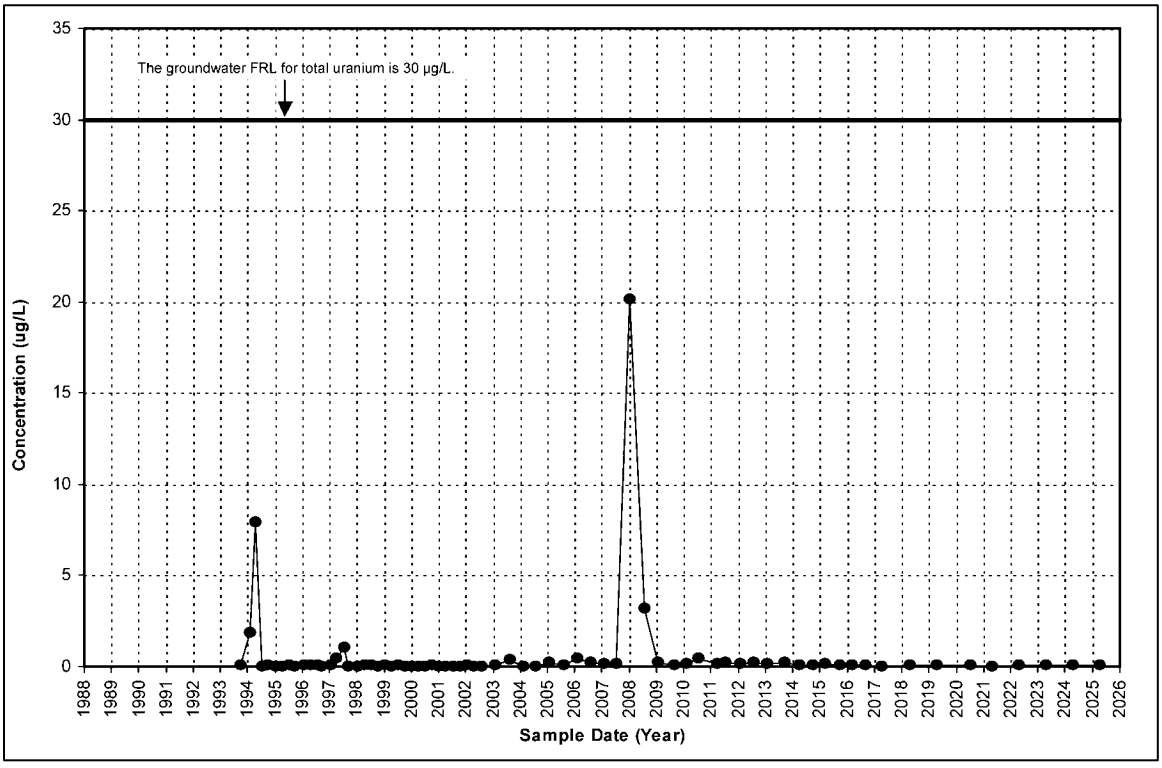


Figure A.4-227. Total Uranium Concentration Versus Time Plot for Monitoring Well 3426

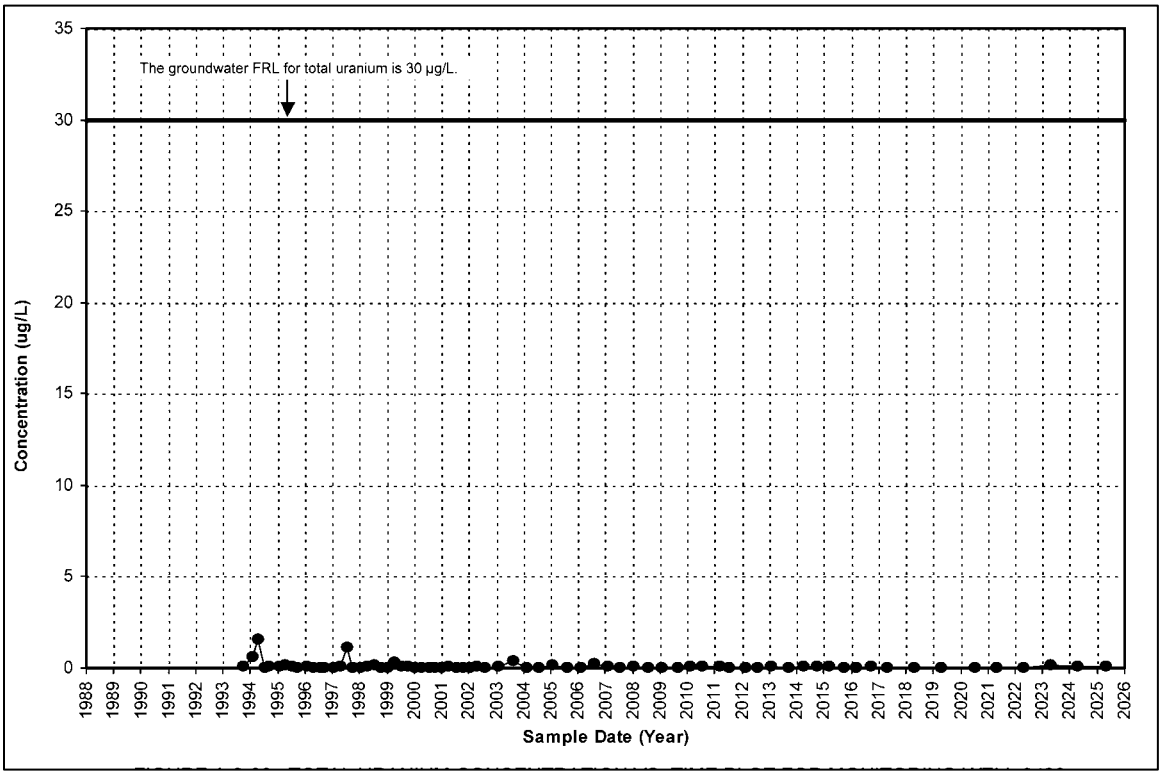


Figure A.4-228. Total Uranium Concentration Versus Time Plot for Monitoring Well 3429

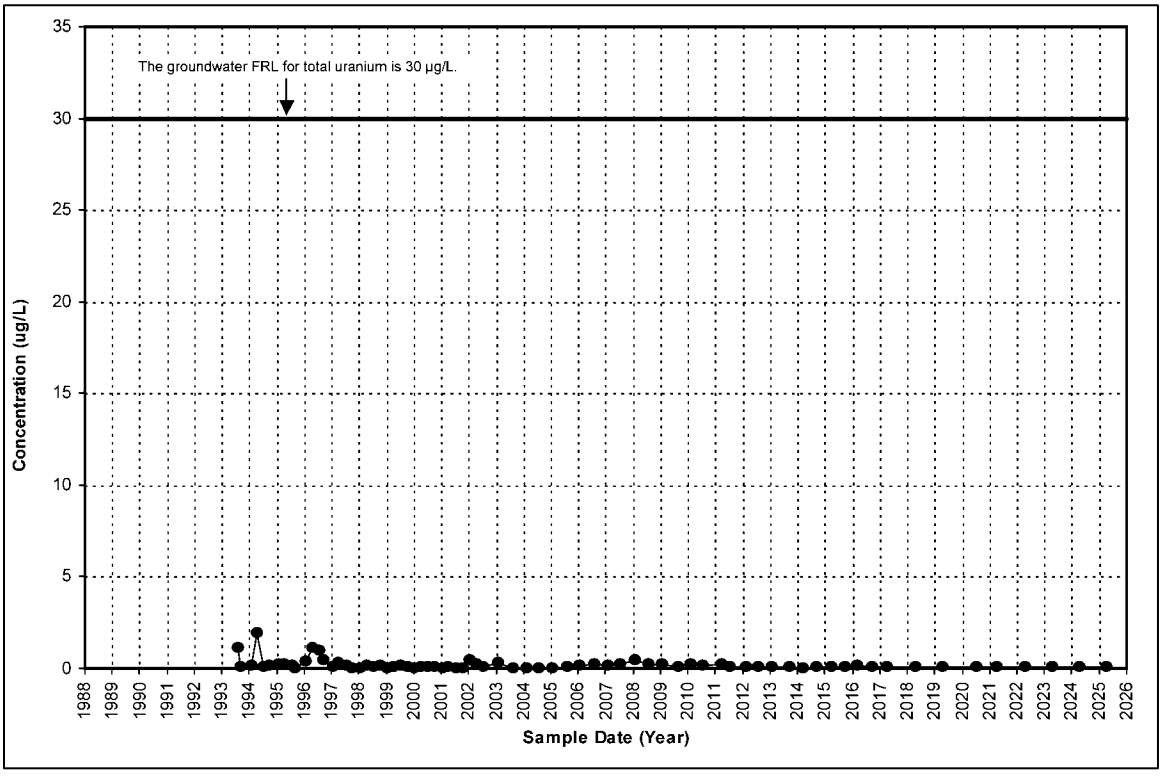


Figure A.4-229. Total Uranium Concentration Versus Time Plot for Monitoring Well 3431

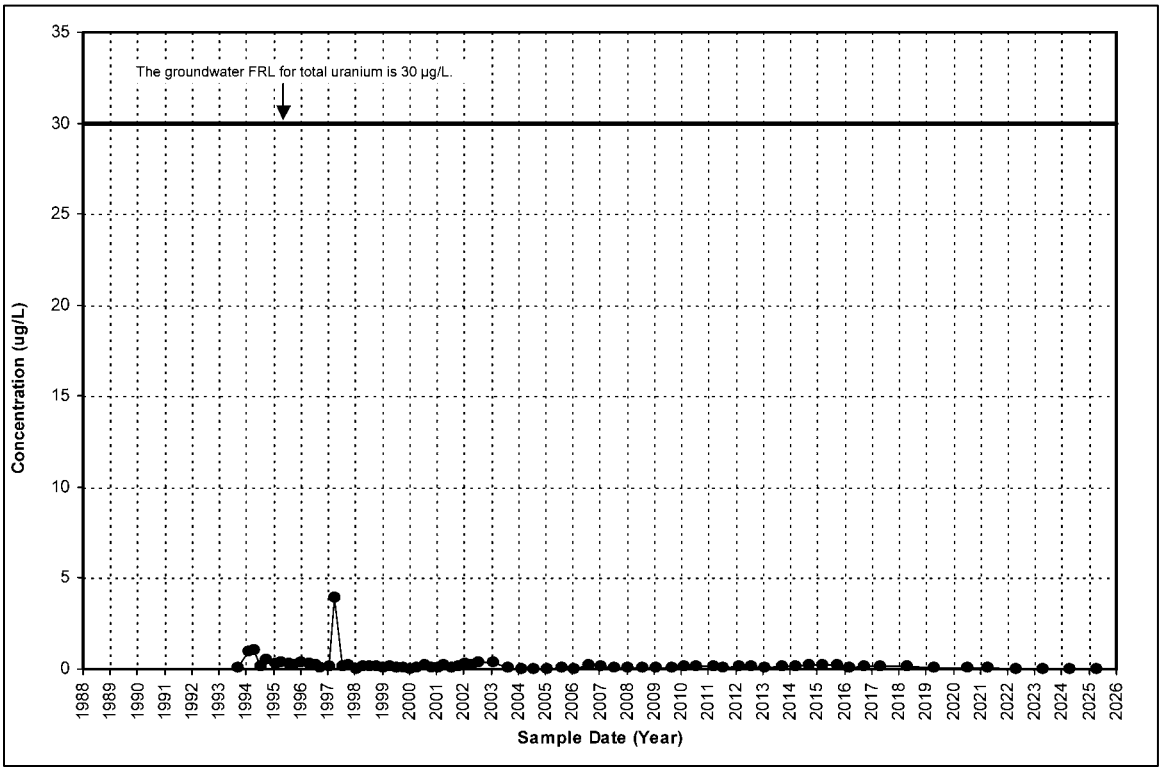


Figure A.4-230. Total Uranium Concentration Versus Time Plot for Monitoring Well 3432

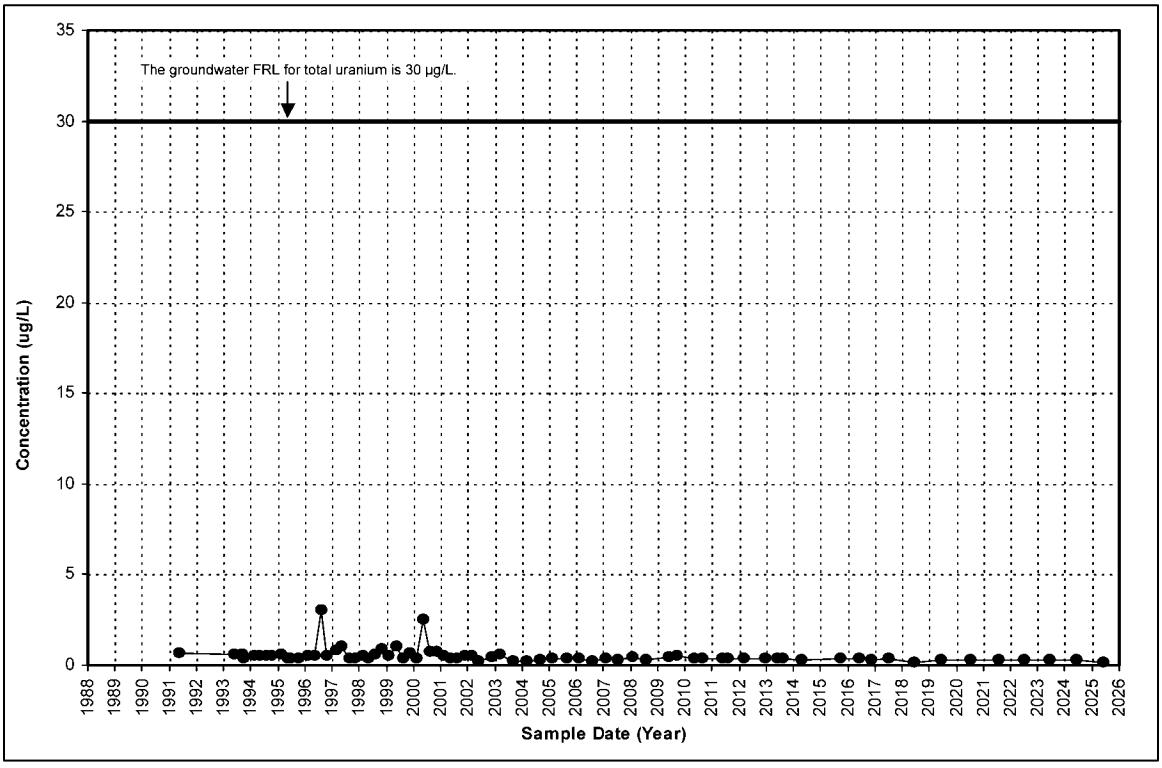


Figure A.4-231. Total Uranium Concentration Versus Time Plot for Monitoring Well 3636

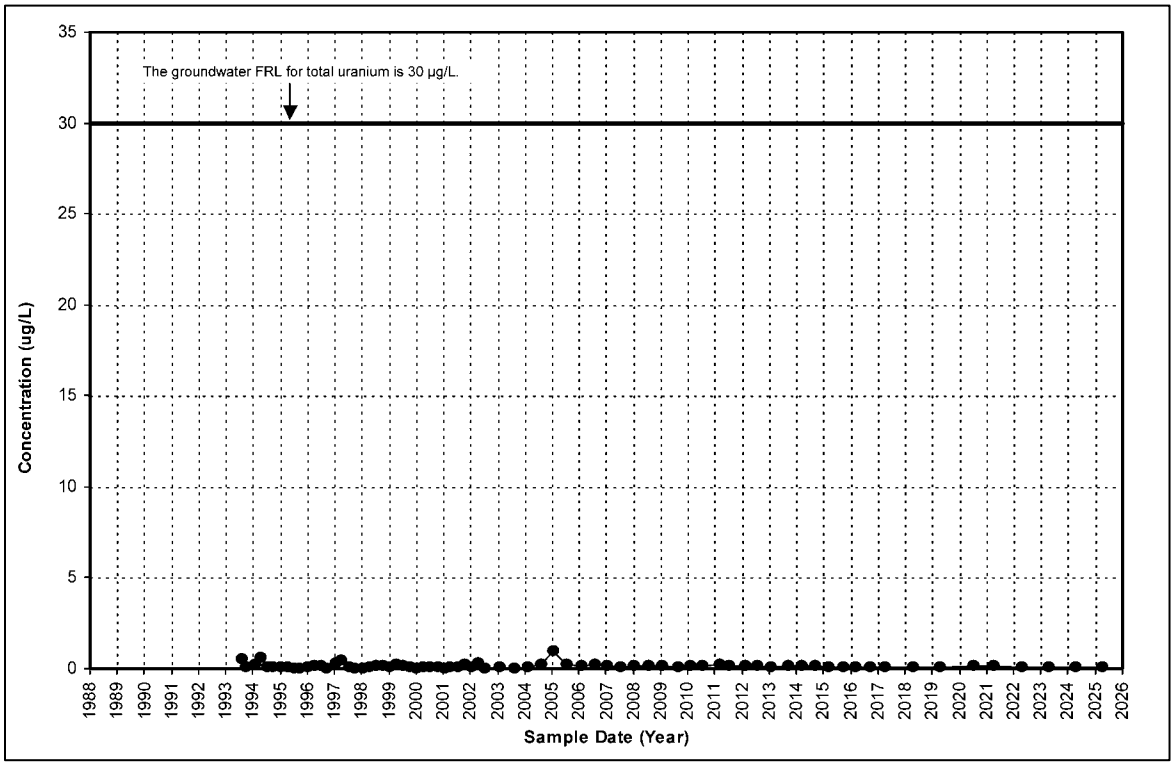


Figure A.4-232. Total Uranium Concentration Versus Time Plot for Monitoring Well 3733

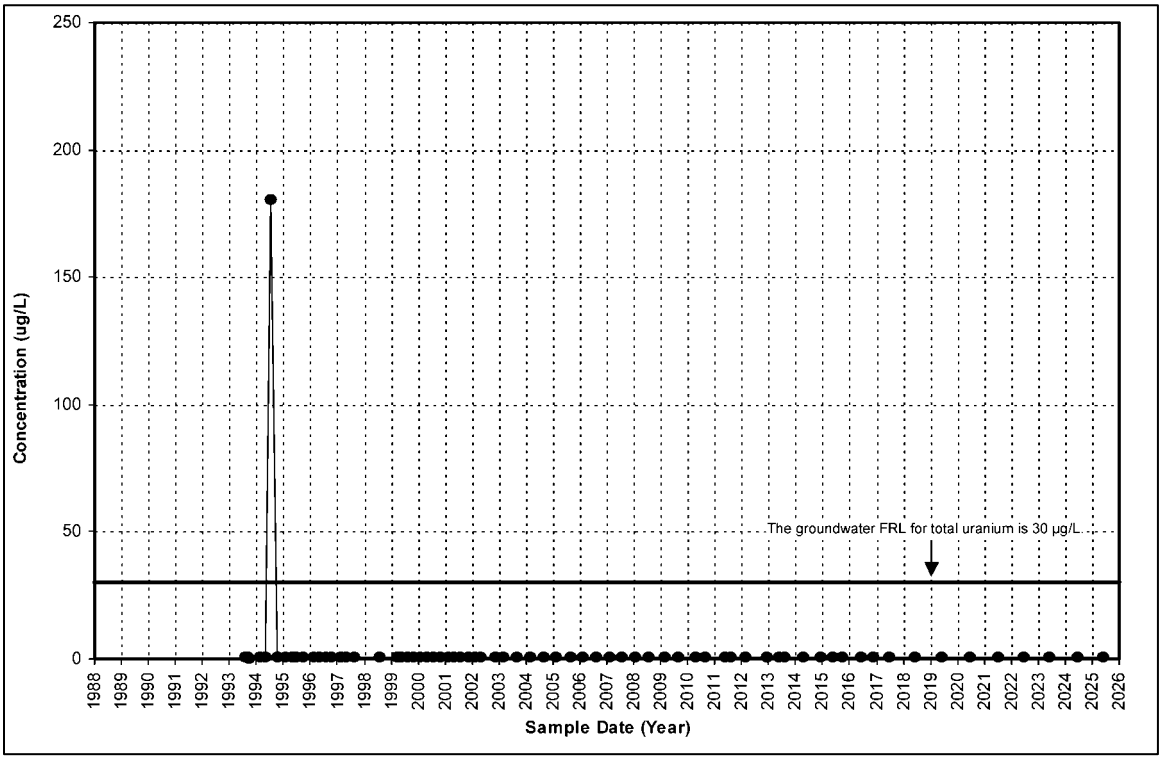


Figure A.4-233. Total Uranium Concentration Versus Time Plot for Monitoring Well 3898

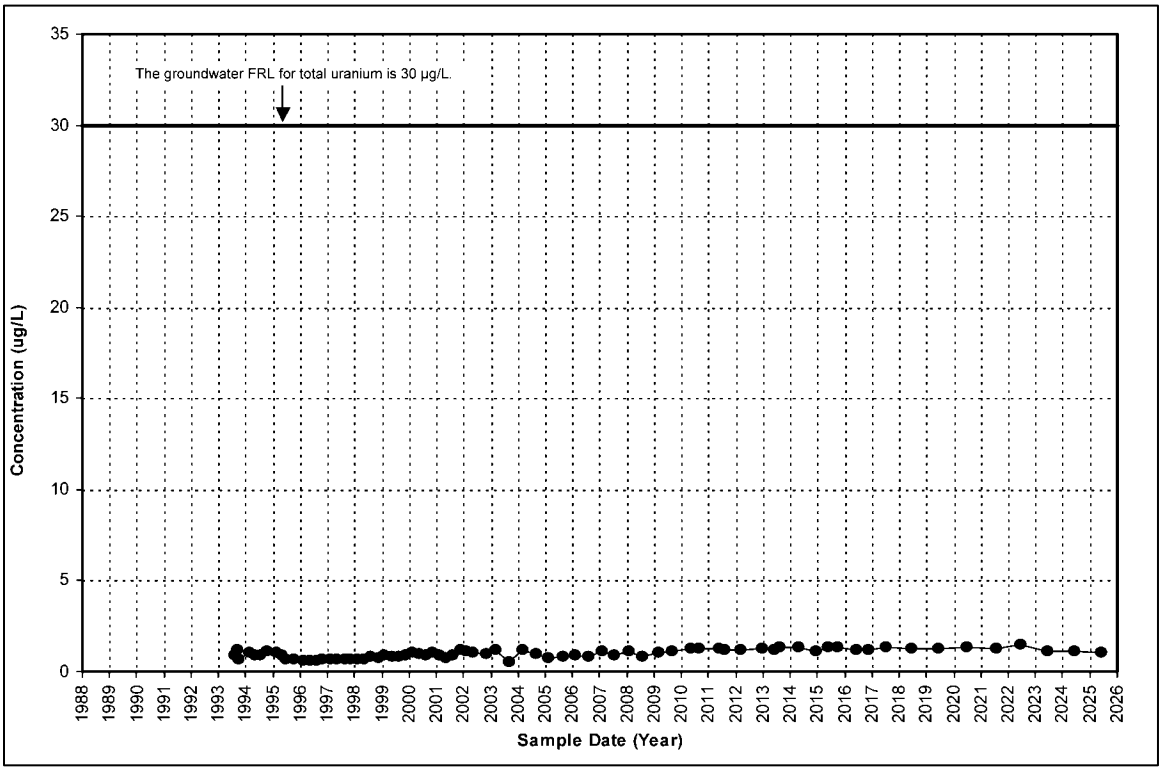


Figure A.4-234. Total Uranium Concentration Versus Time Plot for Monitoring Well 3899

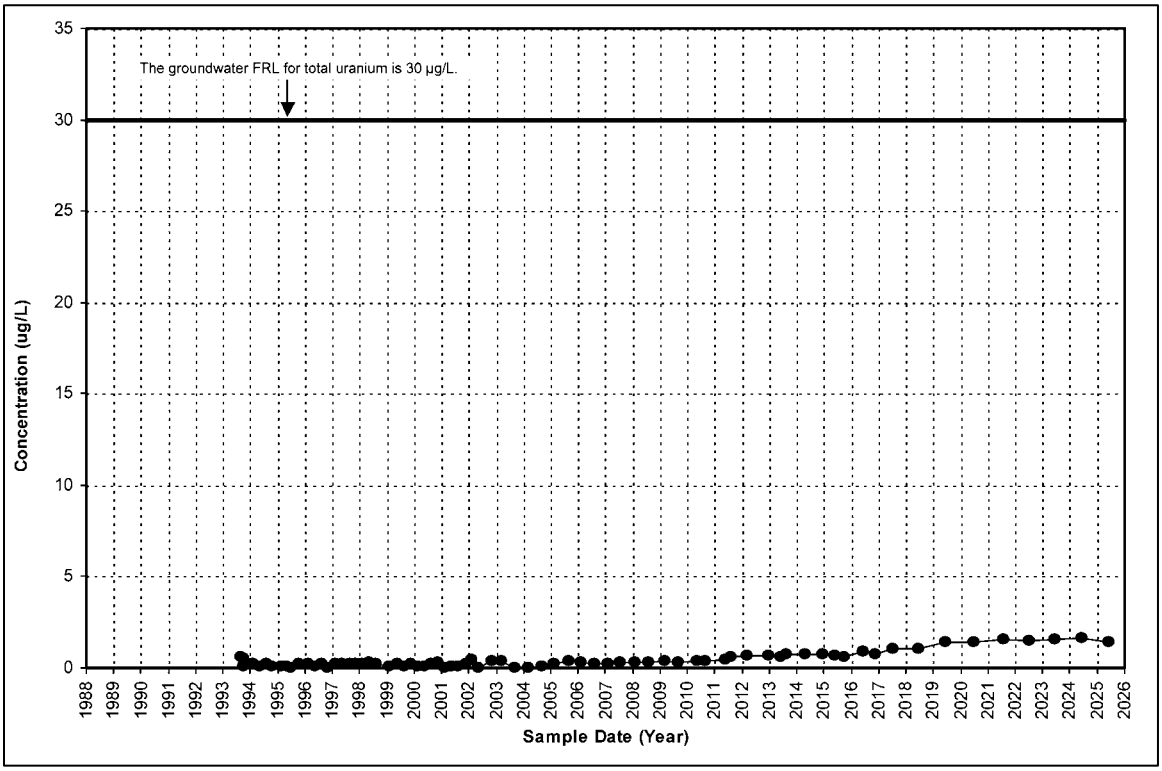


Figure A.4-235. Total Uranium Concentration Versus Time Plot for Monitoring Well 3900

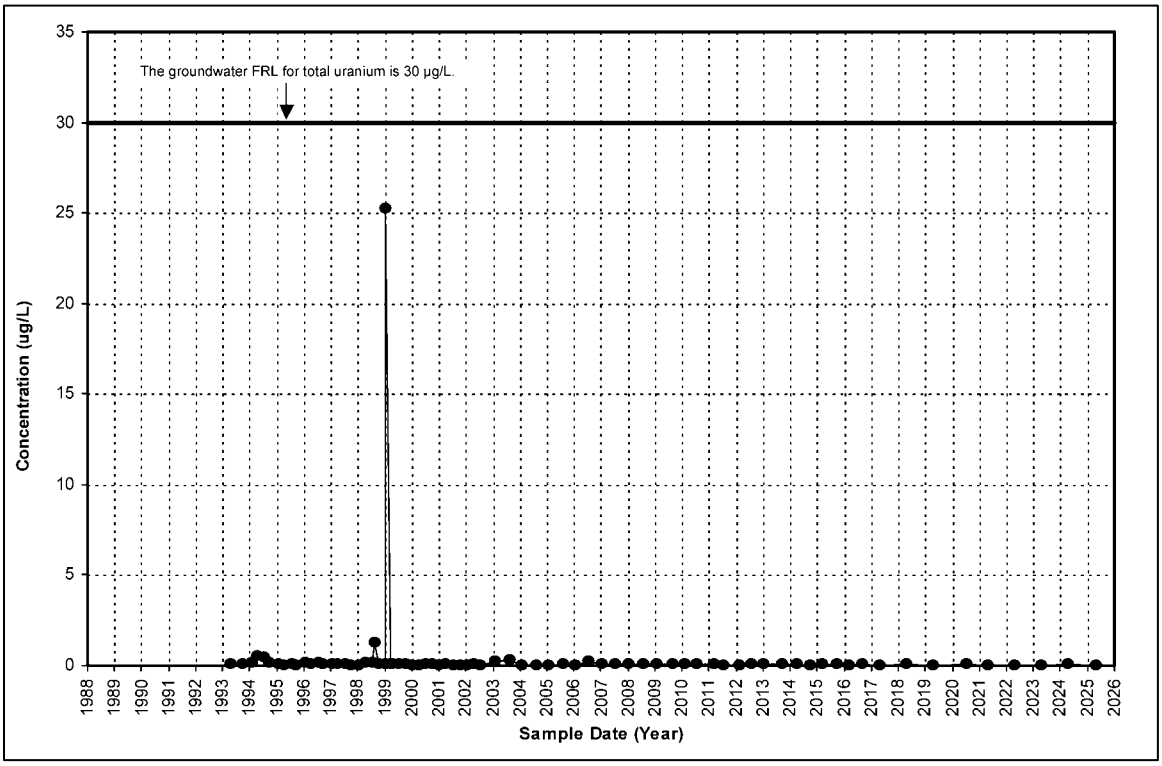


Figure A.4-236. Total Uranium Concentration Versus Time Plot for Monitoring Well 4398

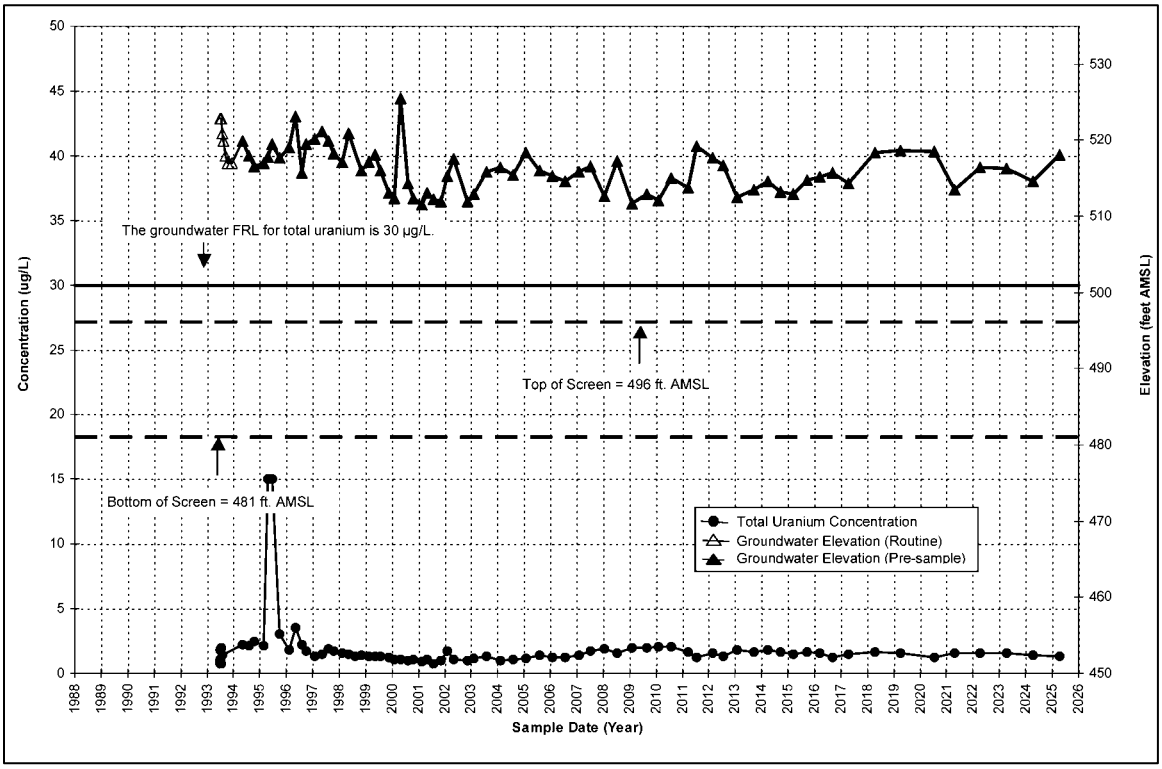


Figure A.4-237. Total Uranium Concentration Versus Time Plot for Monitoring Well 21063

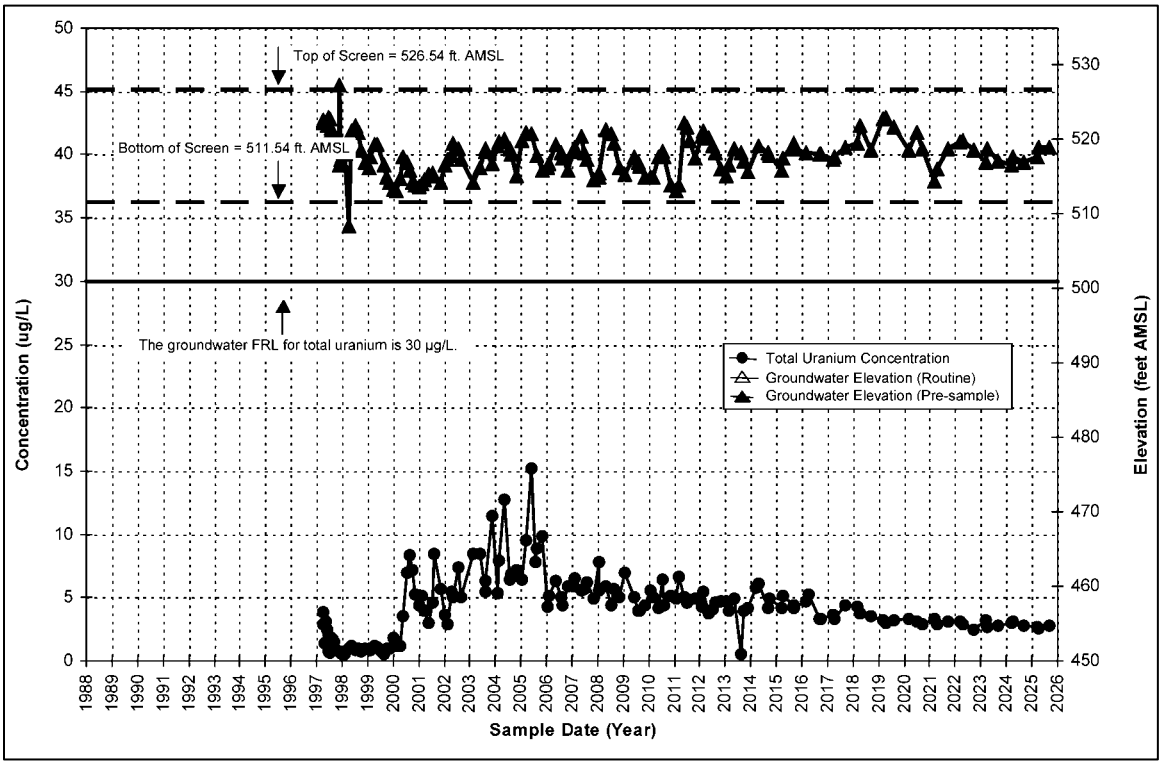


Figure A.4-238. Total Uranium Concentration Versus Time Plot for Monitoring Well 22198

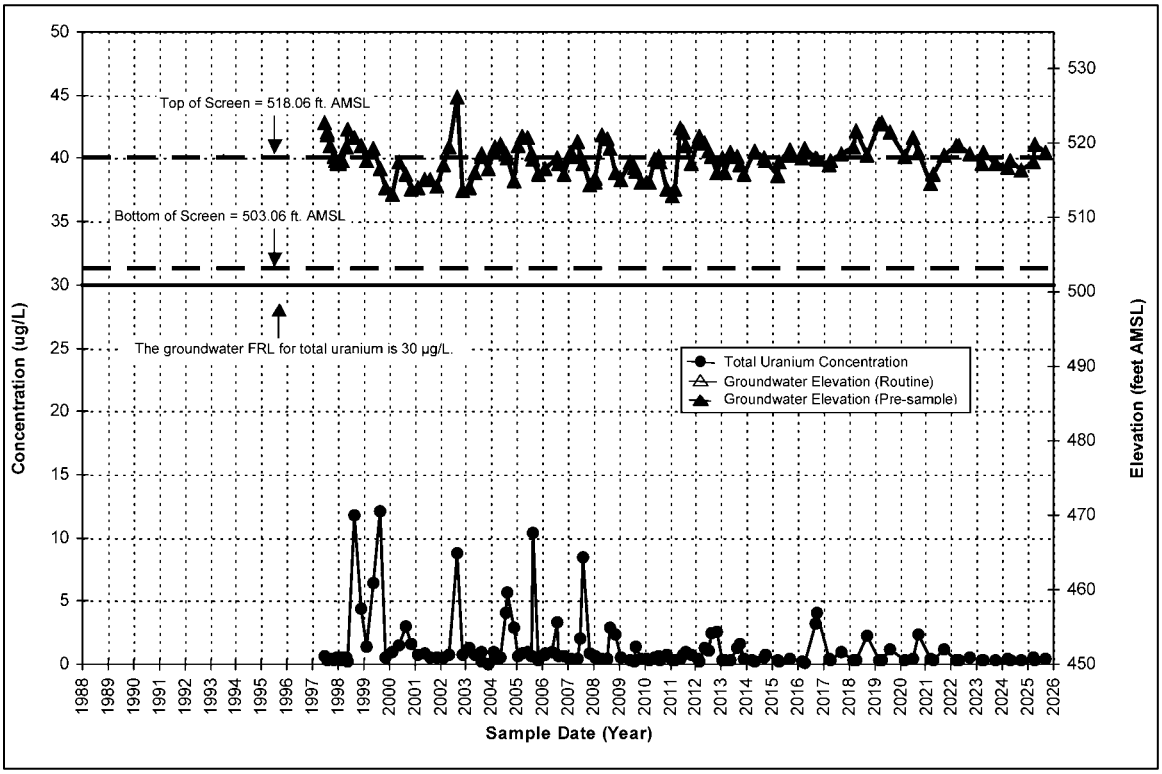


Figure A.4-239. Total Uranium Concentration Versus Time Plot for Monitoring Well 22199

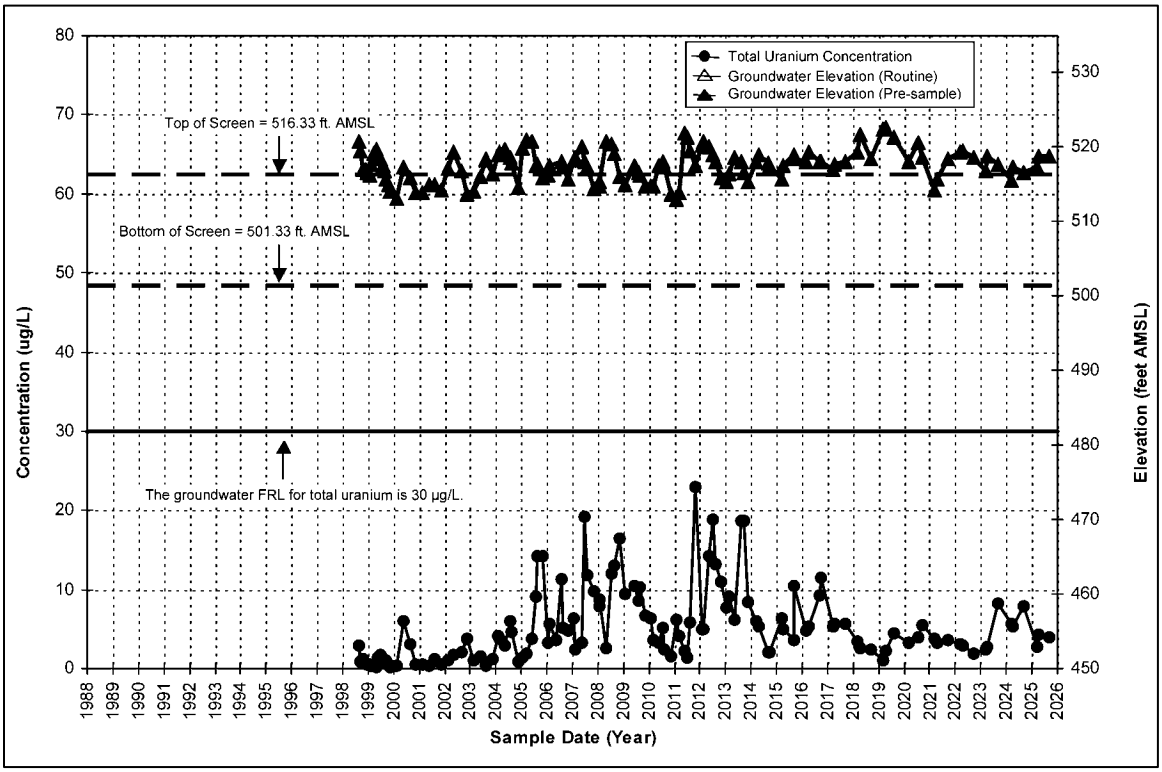


Figure A.4-240. Total Uranium Concentration Versus Time Plot for Monitoring Well 22204

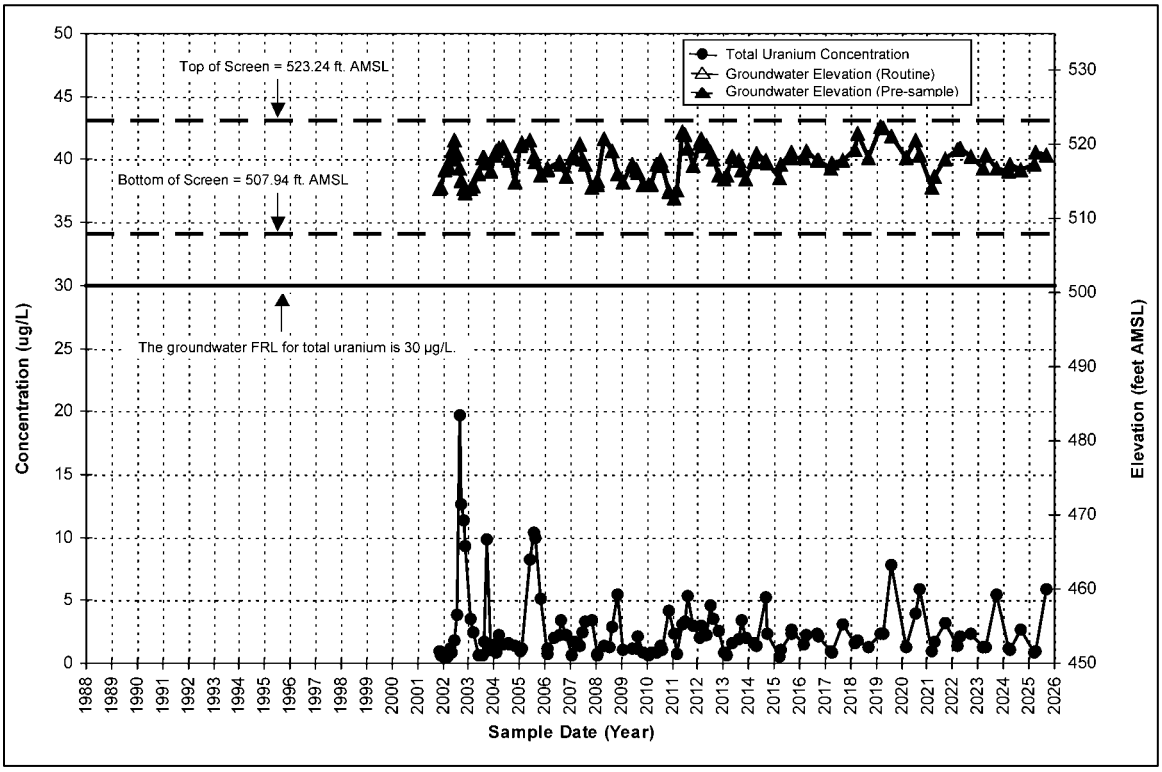


Figure A.4-241. Total Uranium Concentration Versus Time Plot for Monitoring Well 22205

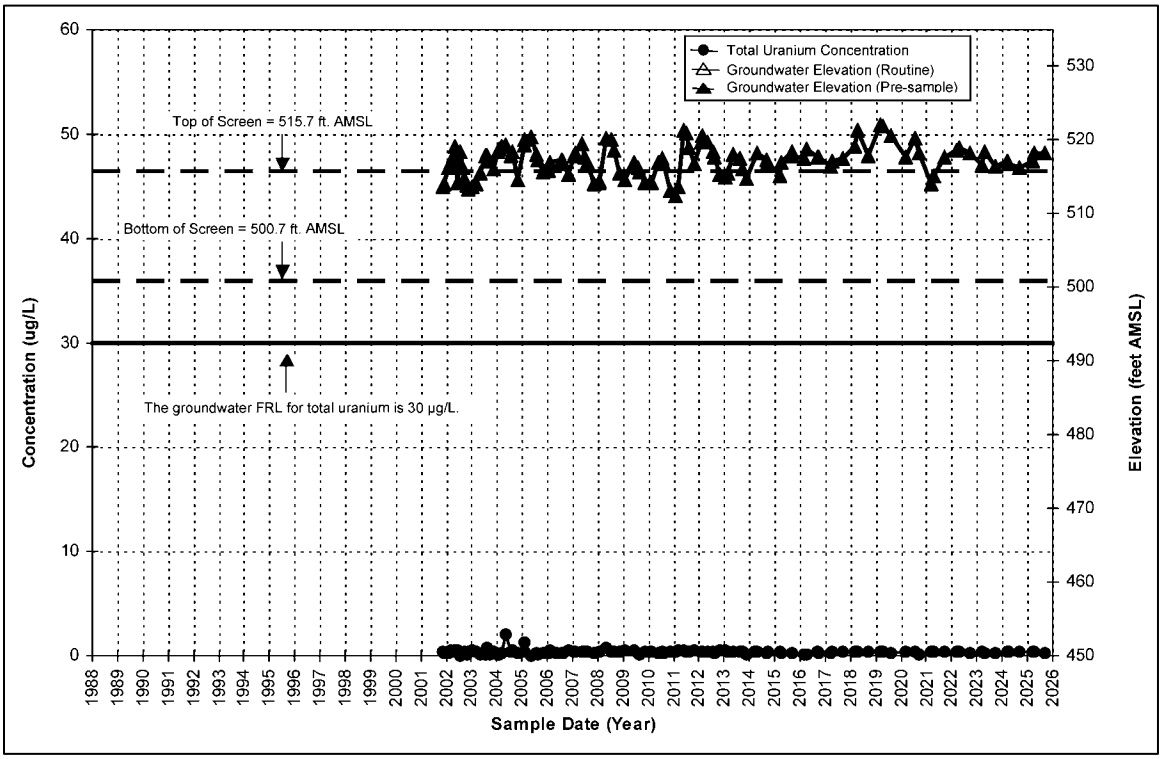


Figure A.4-242. Total Uranium Concentration Versus Time Plot for Monitoring Well 22208

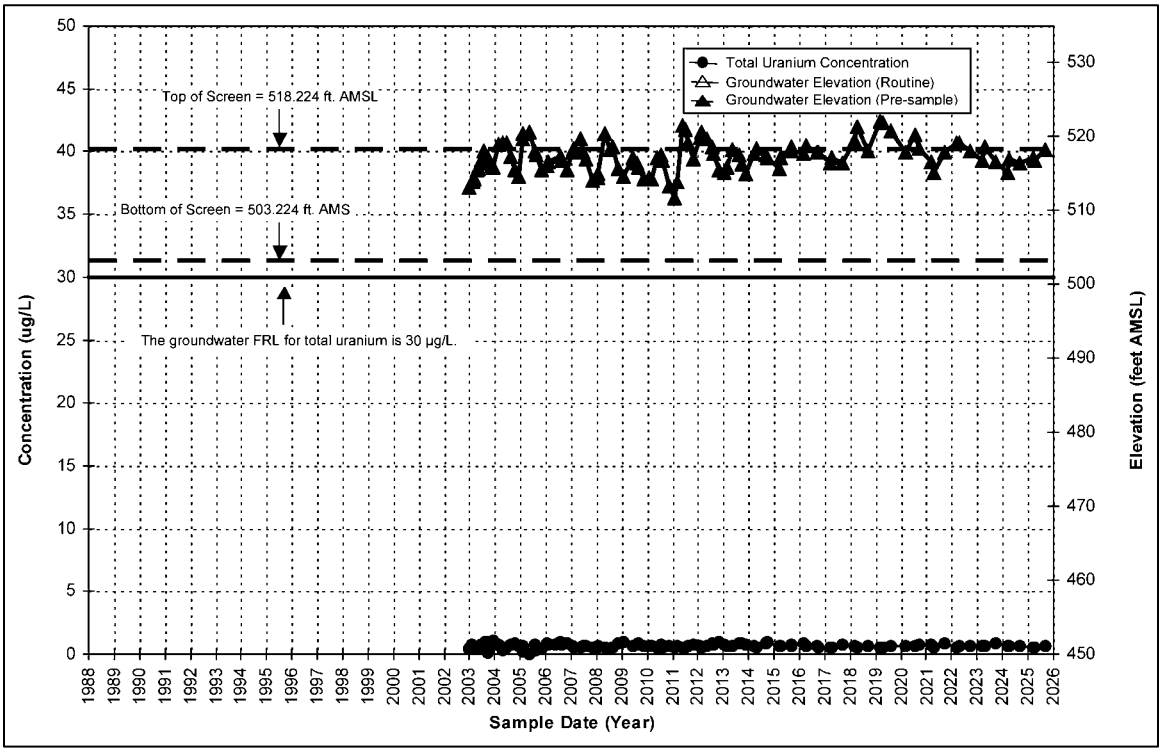


Figure A.4-243. Total Uranium Concentration Versus Time Plot for Monitoring Well 22210

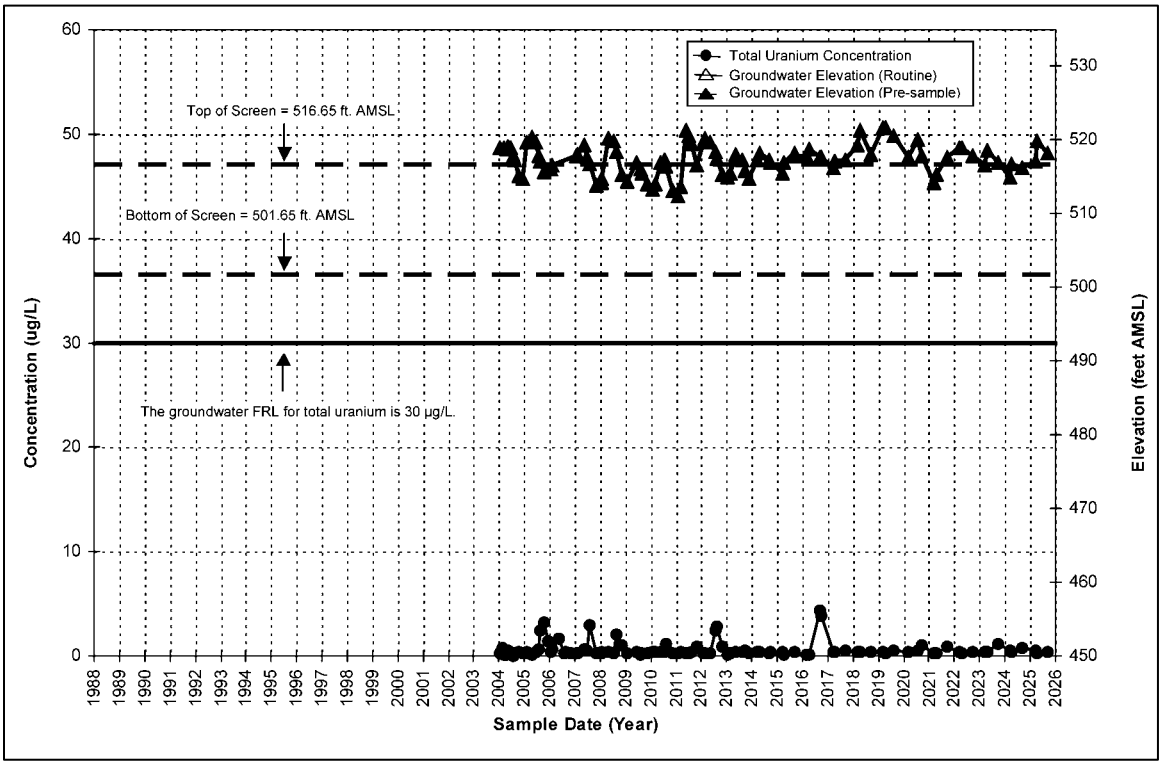


Figure A.4-244 Total Uranium Concentration Versus Time Plot for Monitoring Well 22211

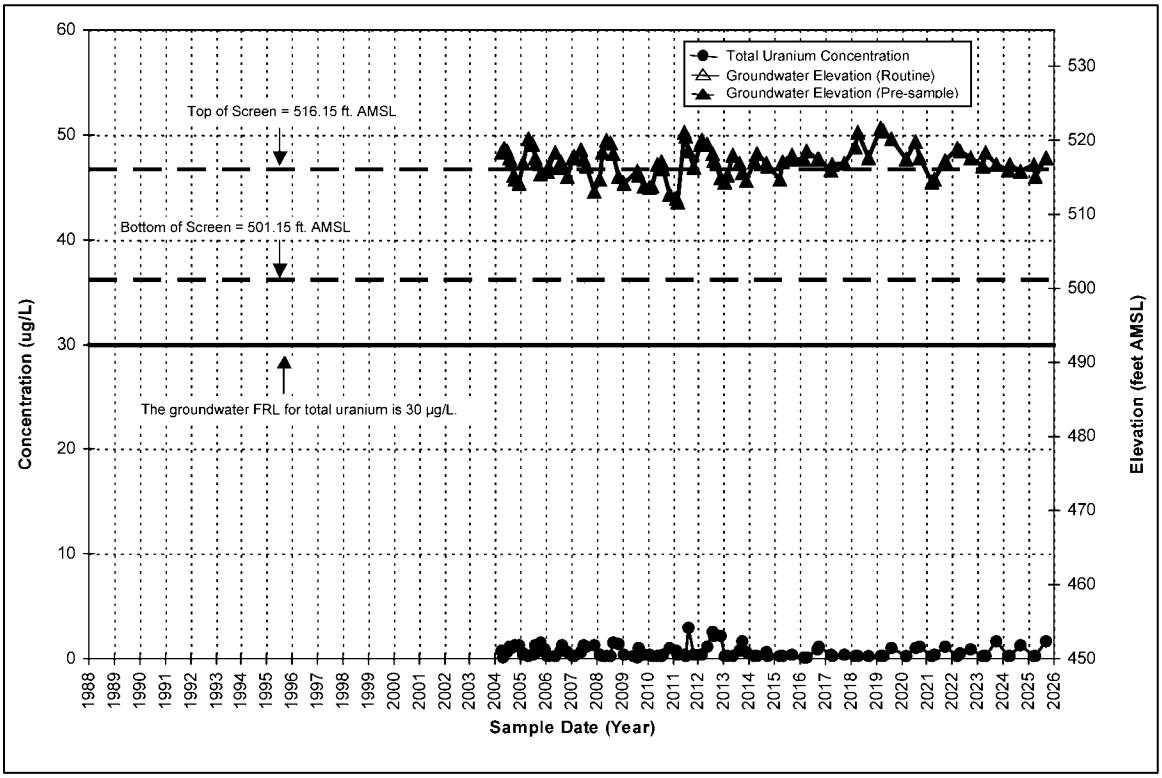


Figure A.4-245. Total Uranium Concentration Versus Time Plot for Monitoring Well 22214

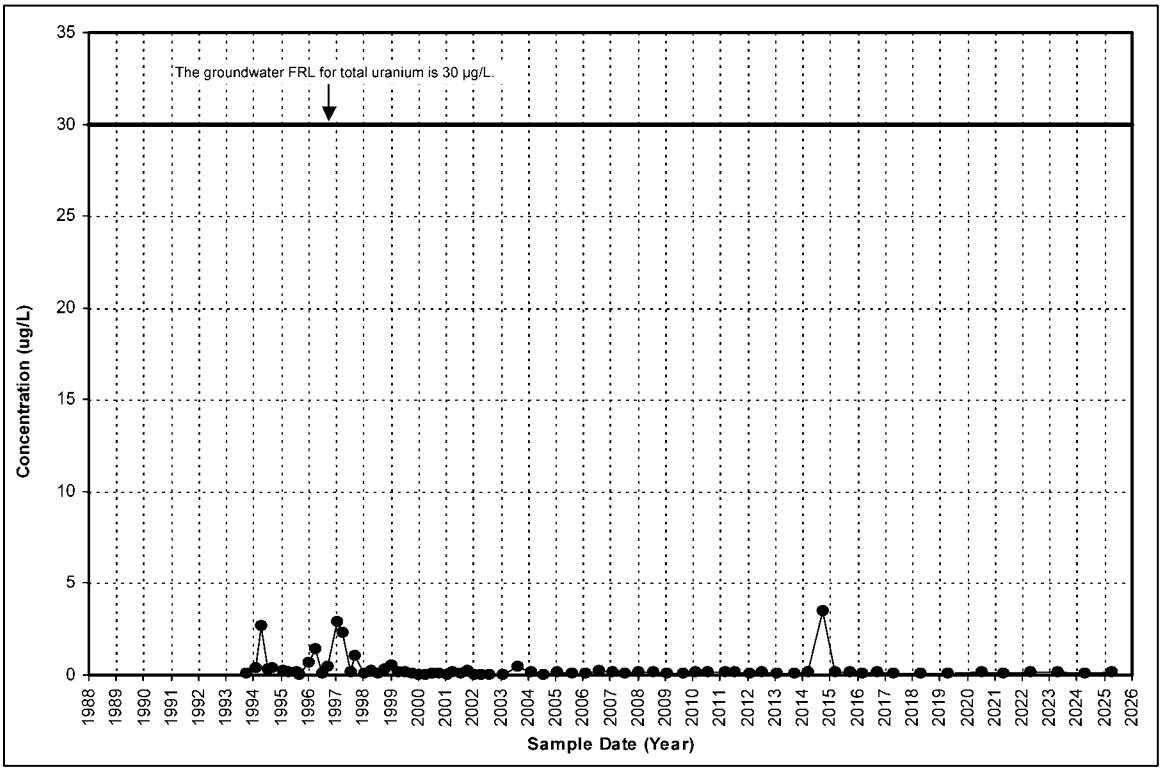


Figure A.4-246. Total Uranium Concentration Versus Time Plot for Monitoring Well 31217

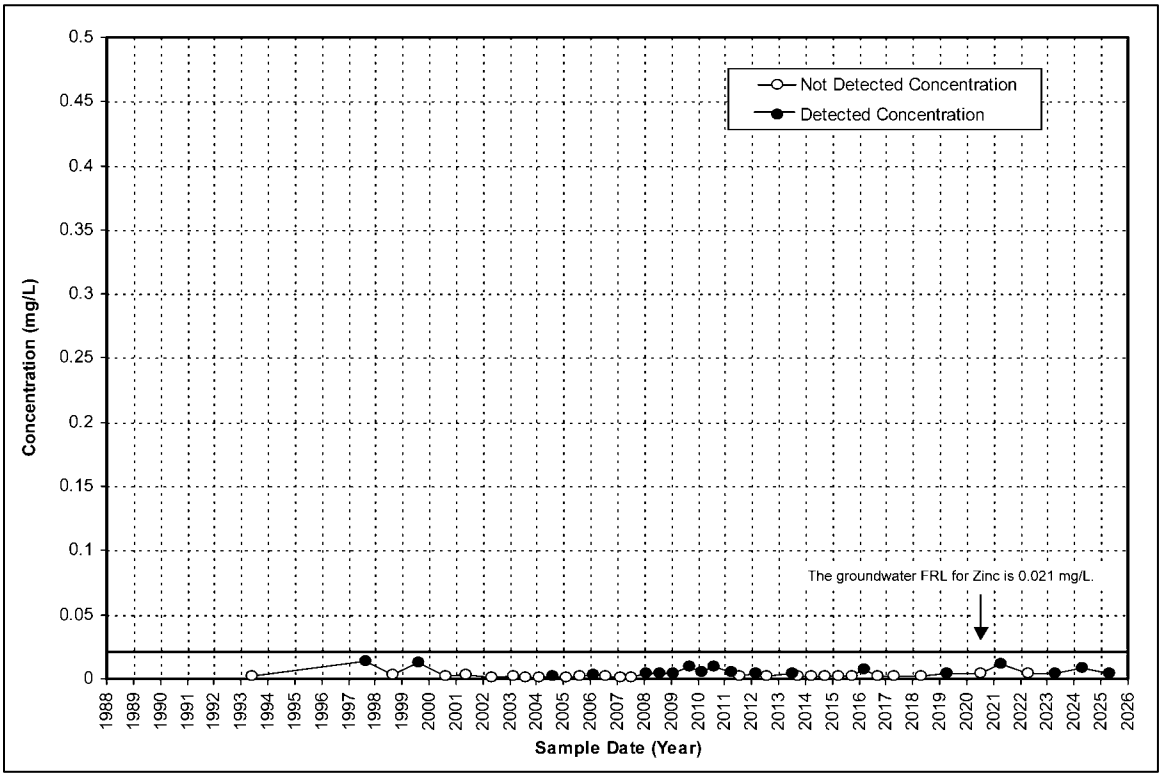


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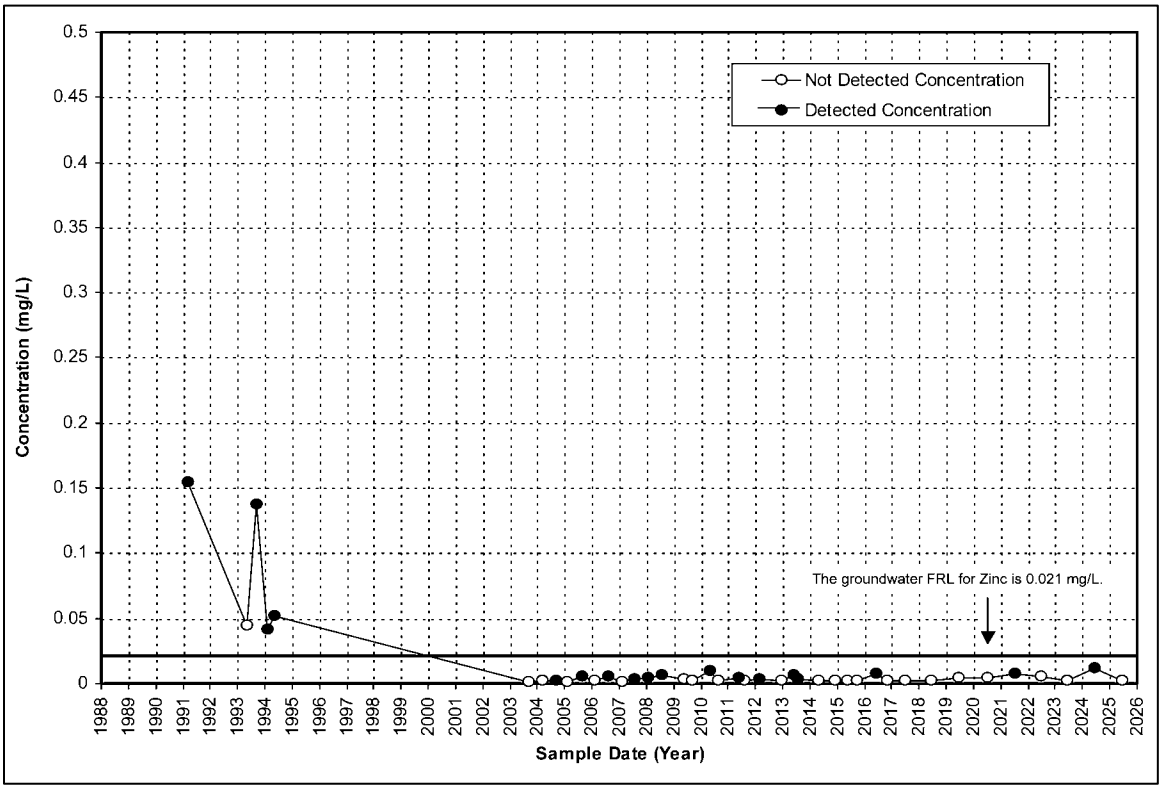


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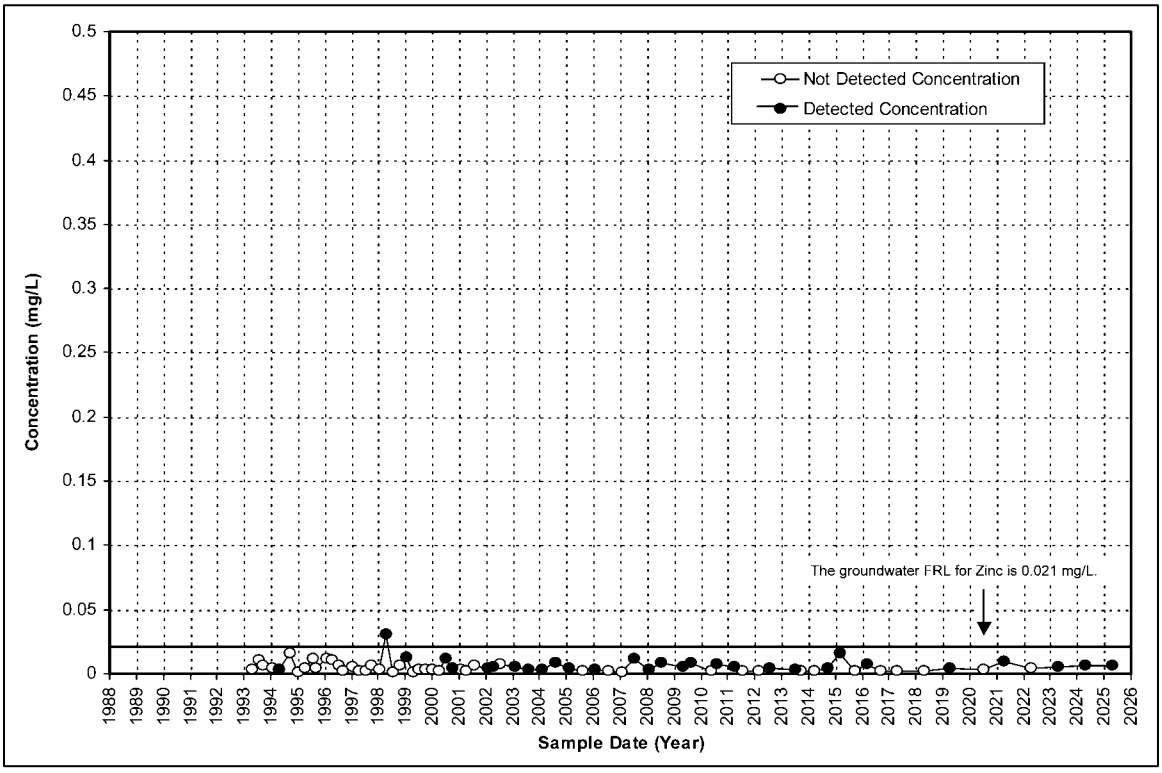


Figure A.4-249. Zinc Concentration Versus Time Plot for Monitoring Well 2398

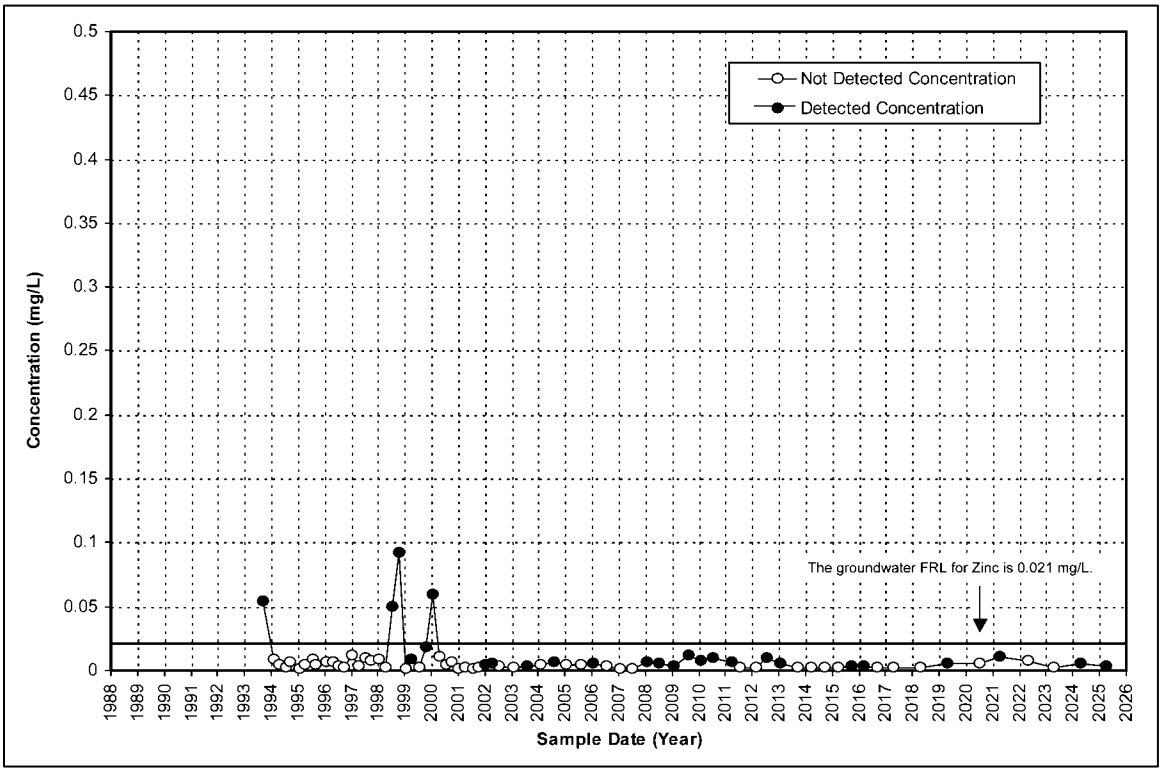


Figure A.4-250. Zinc Concentration Versus Time Plot for Monitoring Well 2431

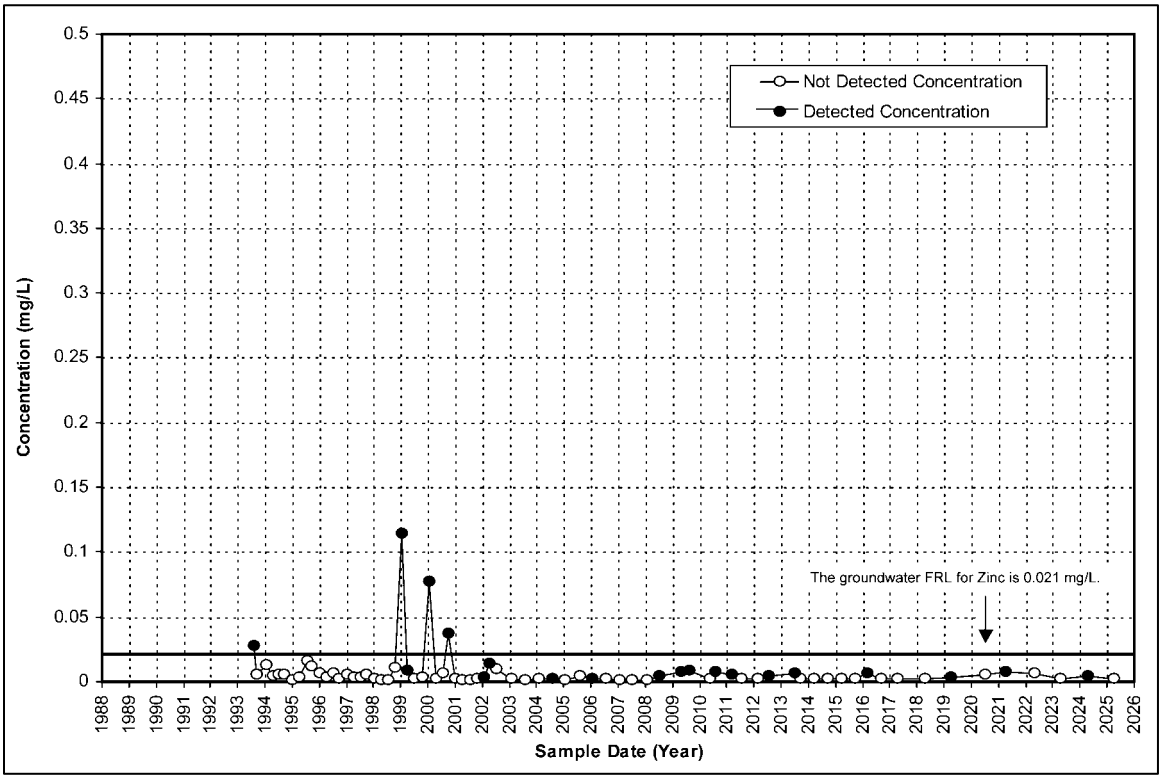


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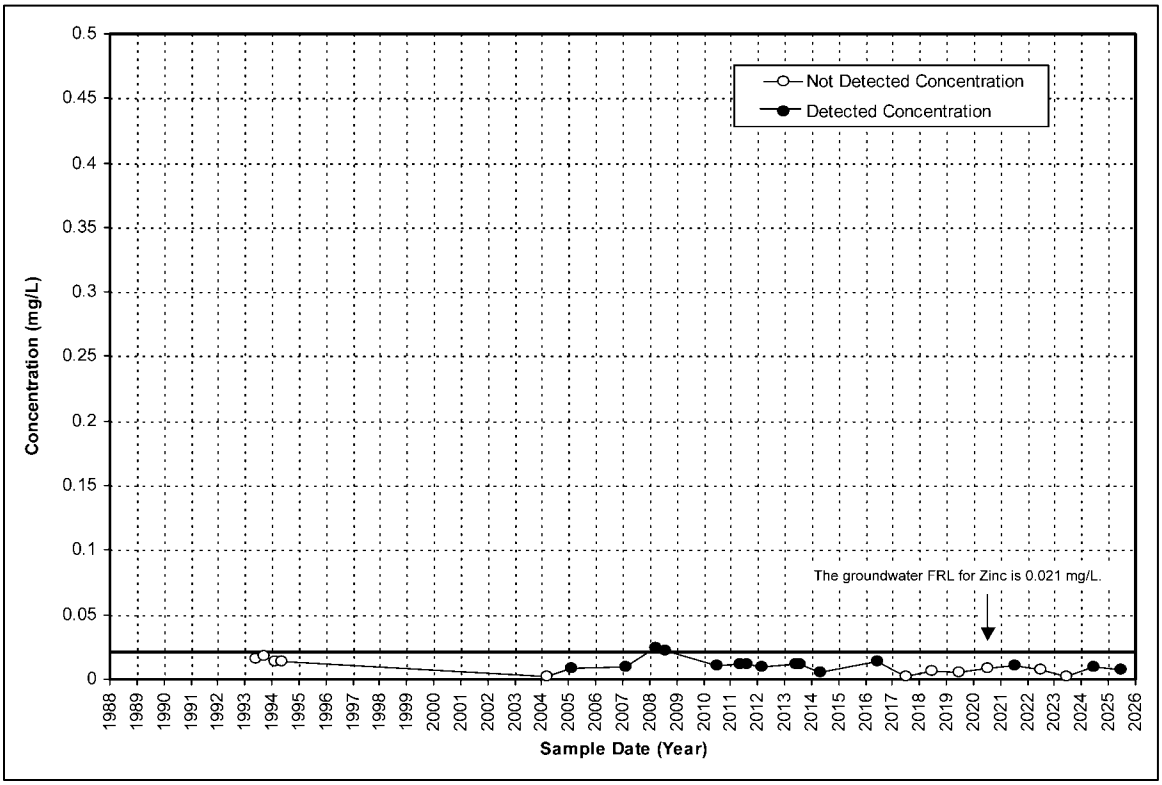


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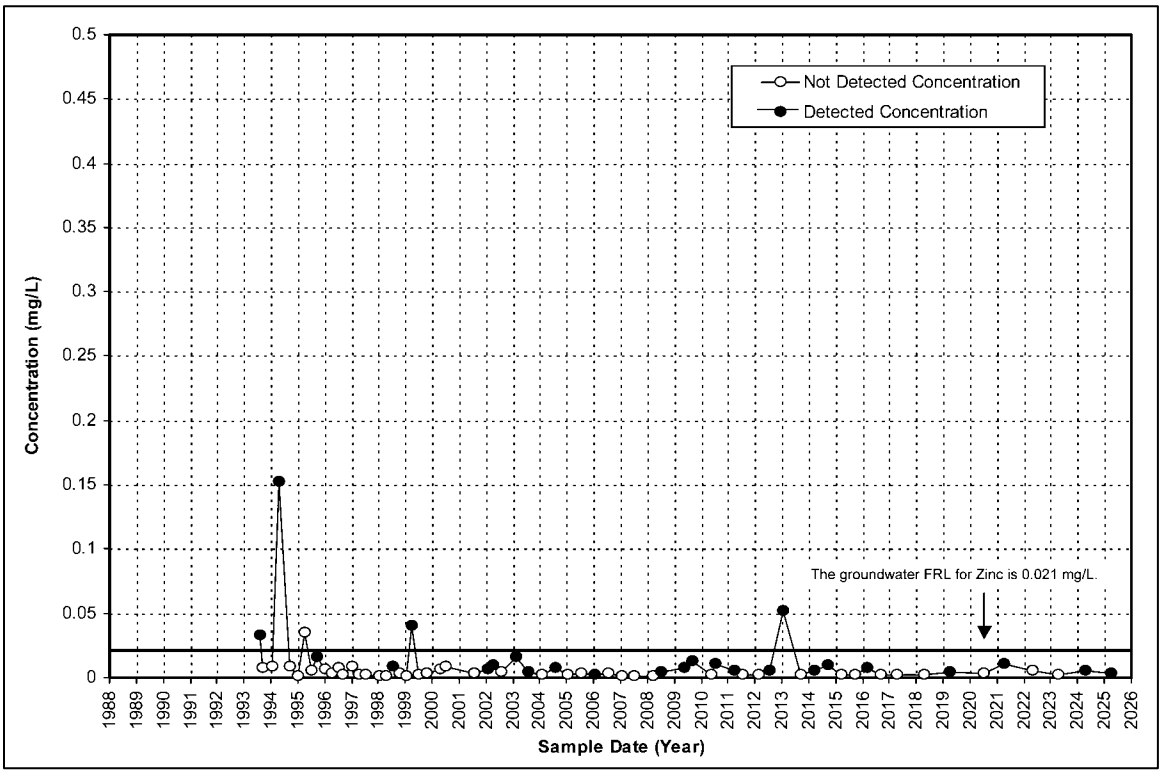


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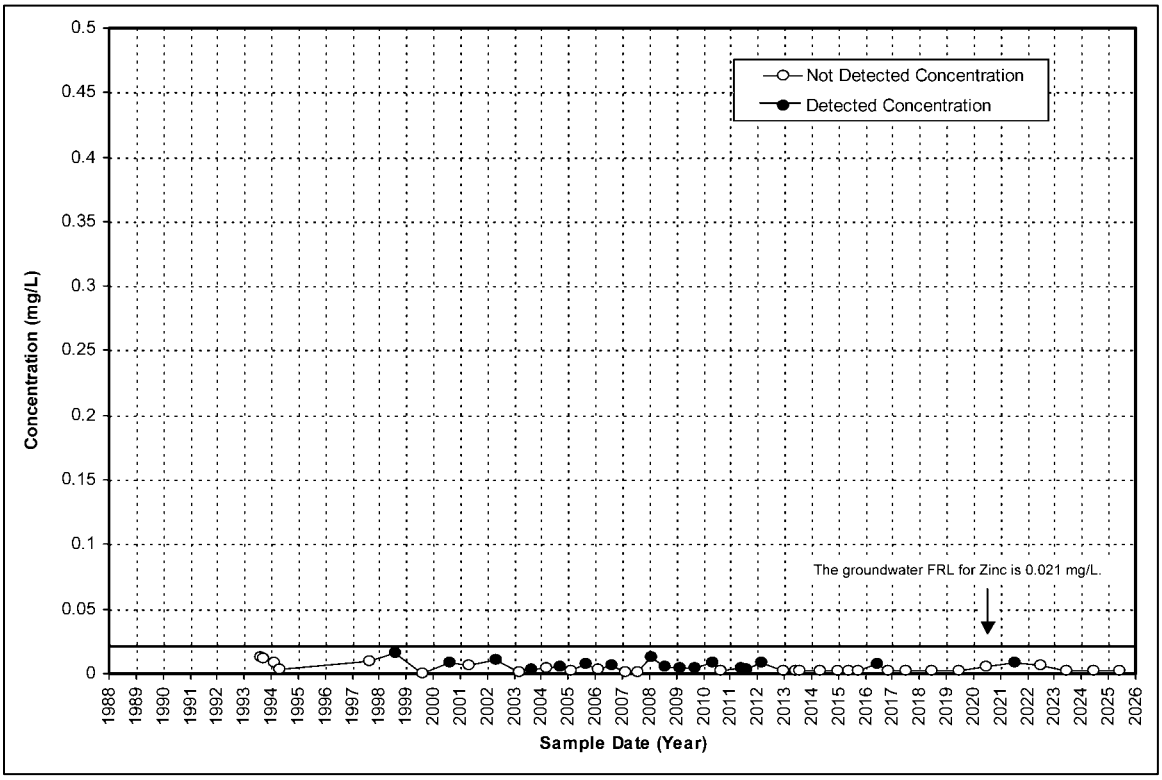


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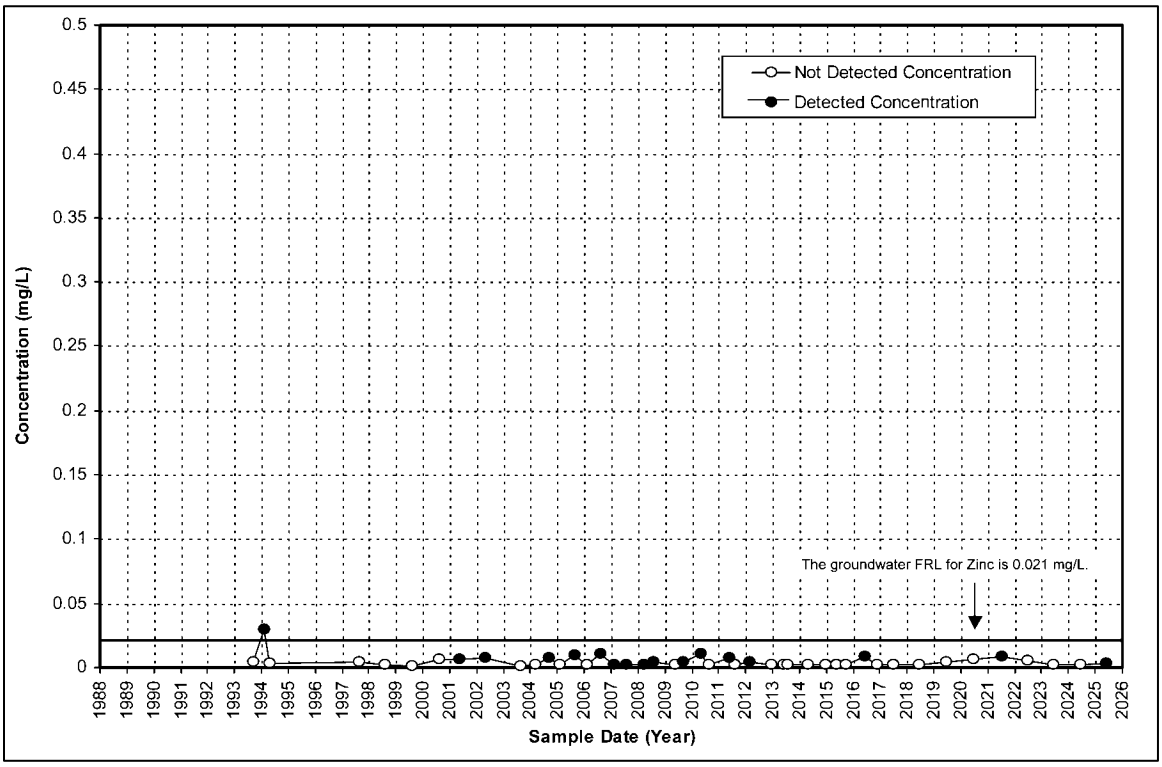


Figure A.4-255. Zinc Concentration Versus Time Plot for Monitoring Well 2899

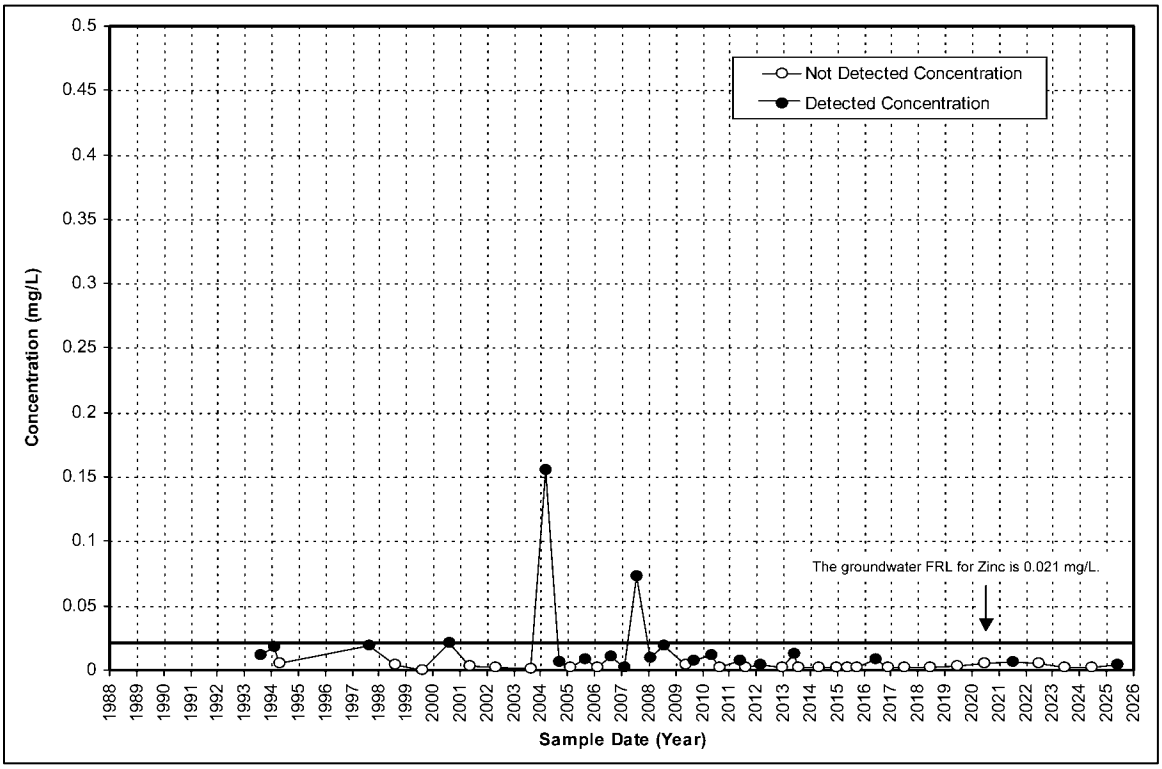


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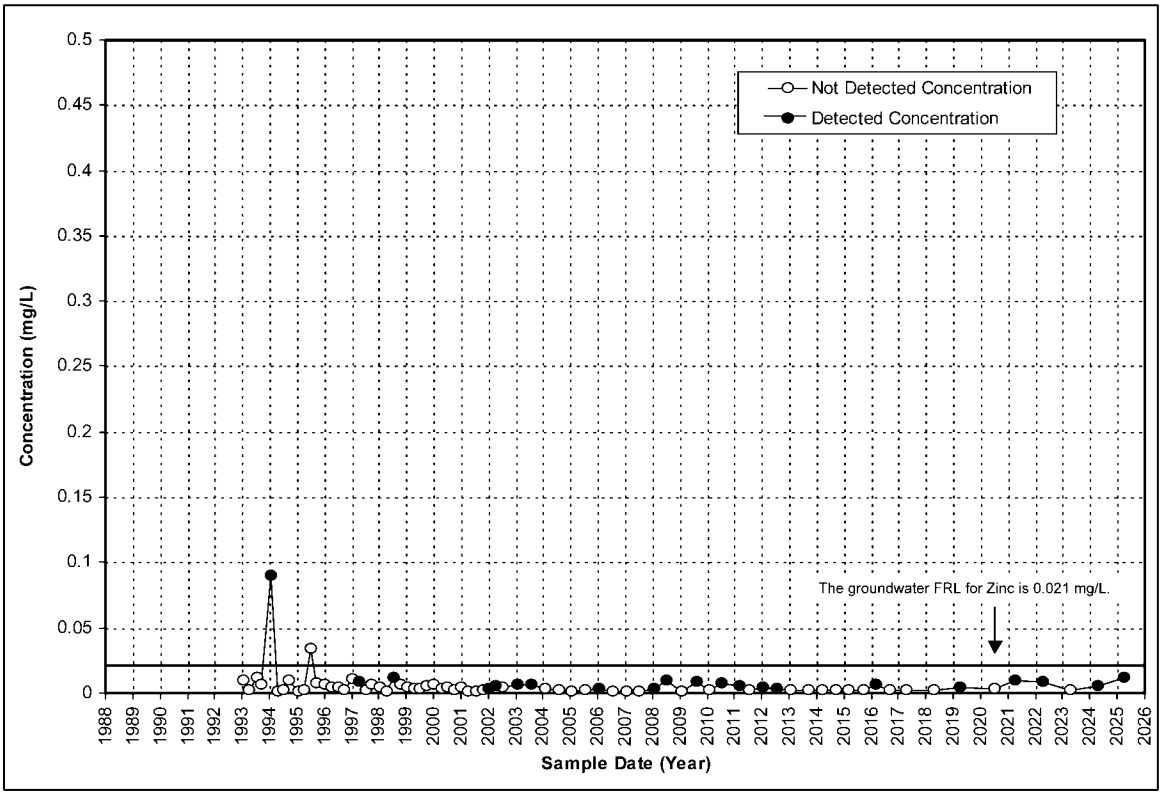


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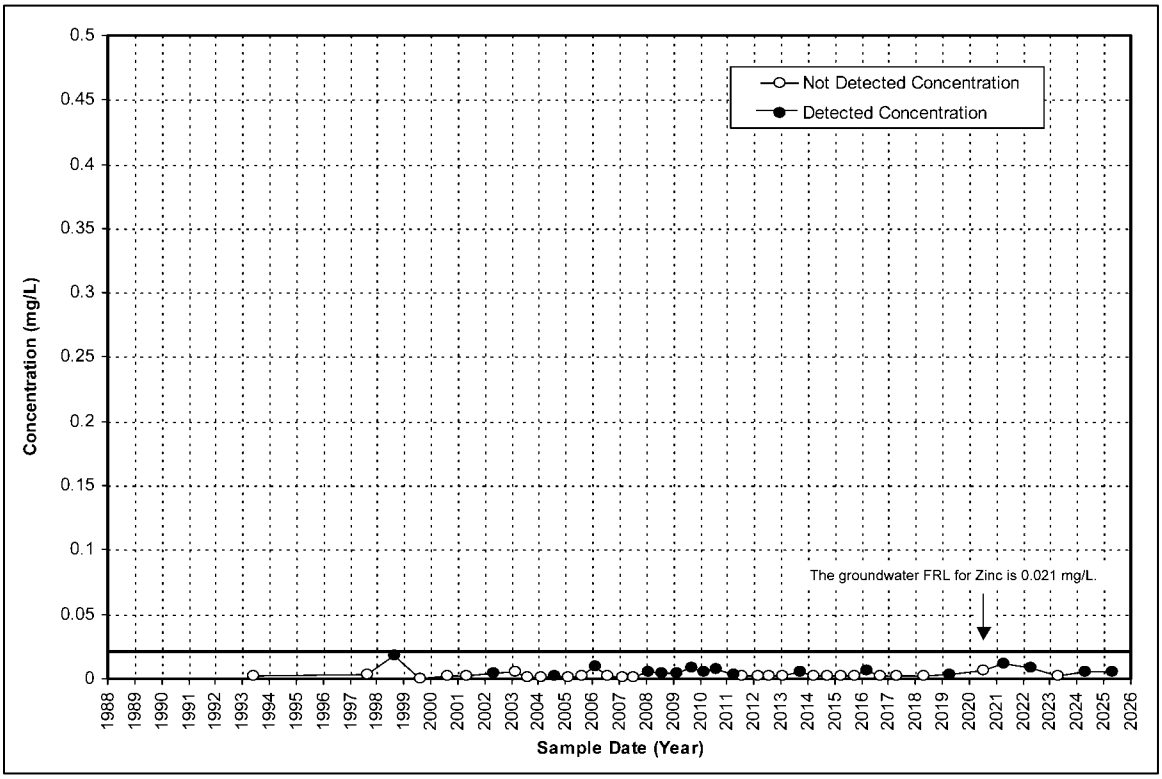


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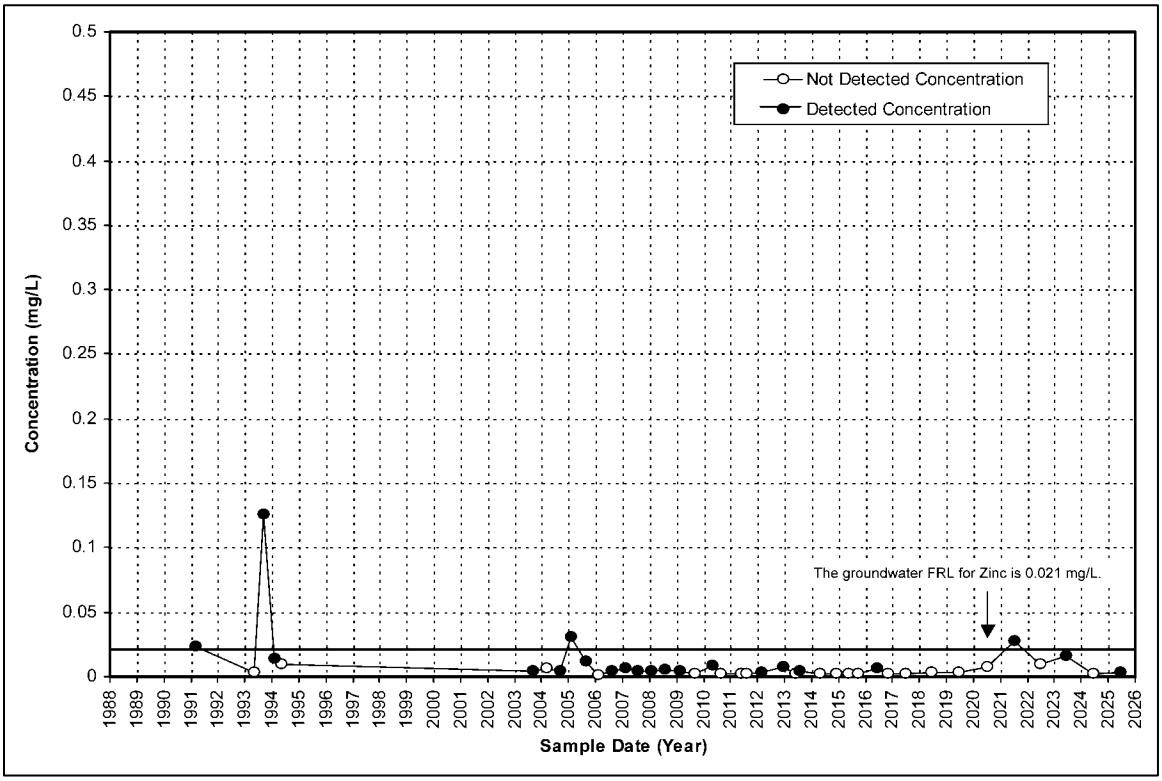


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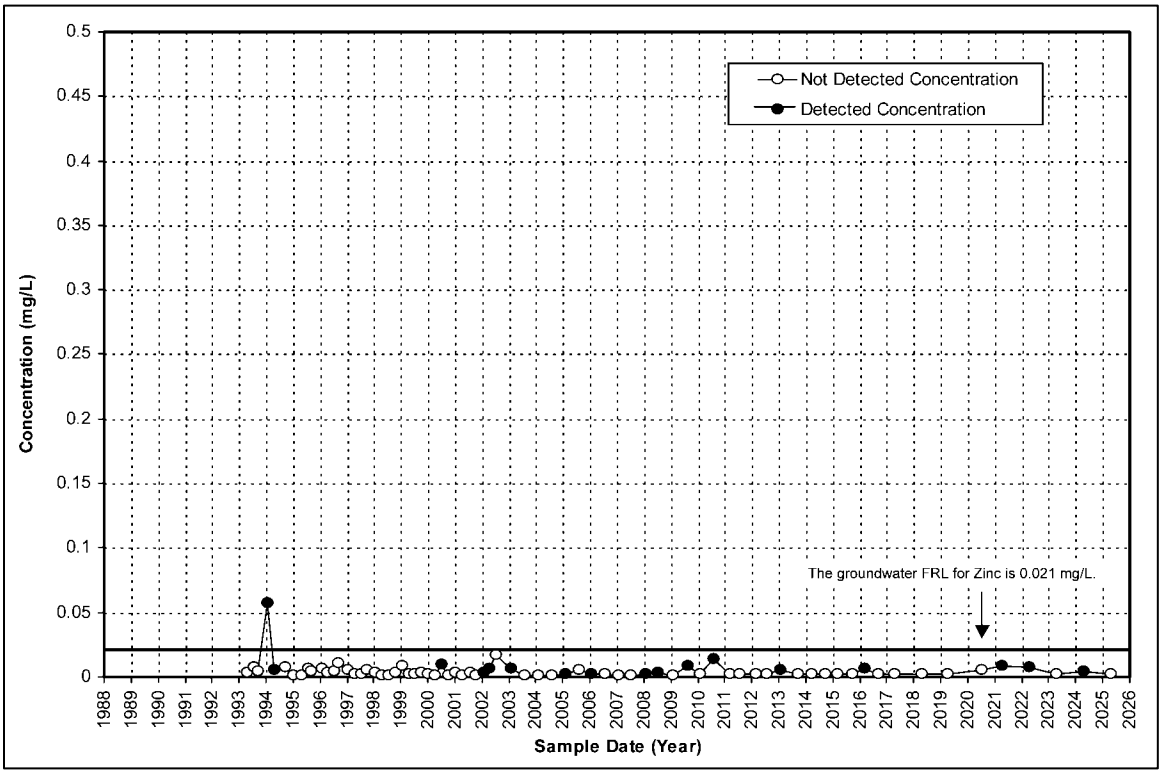


Figure A.4-260. Zinc Concentration Versus Time Plot for Monitoring Well 3398

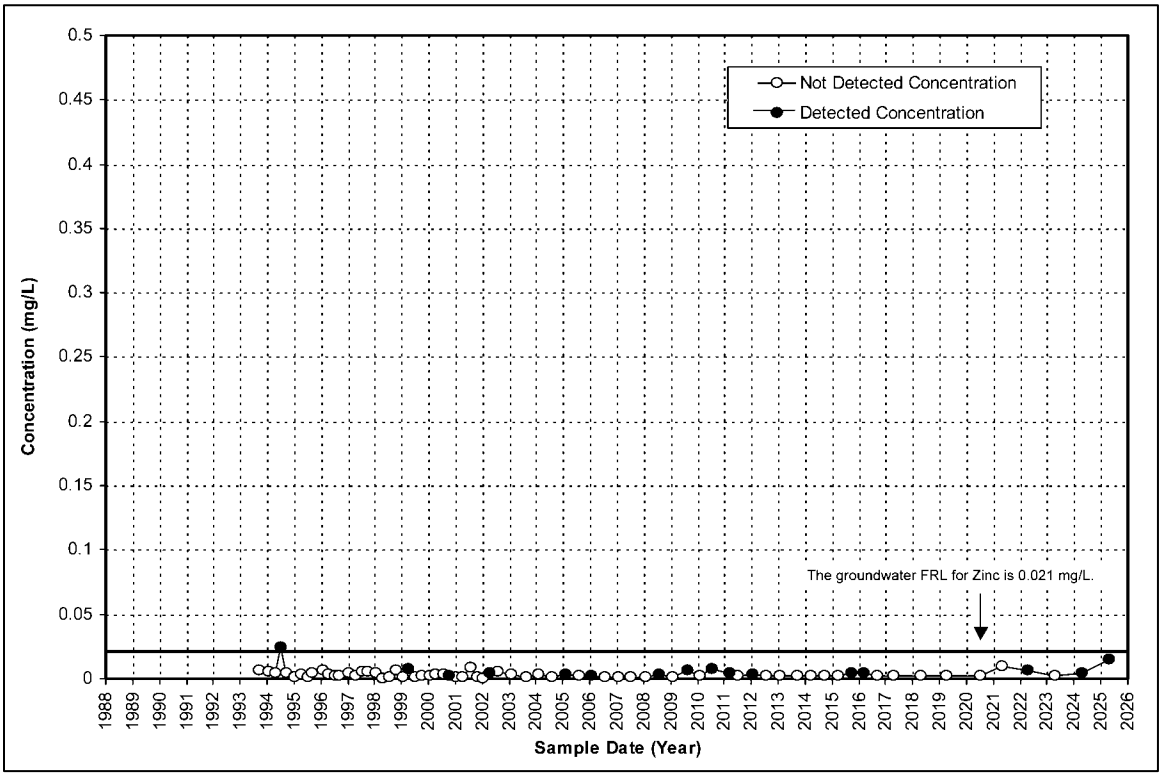


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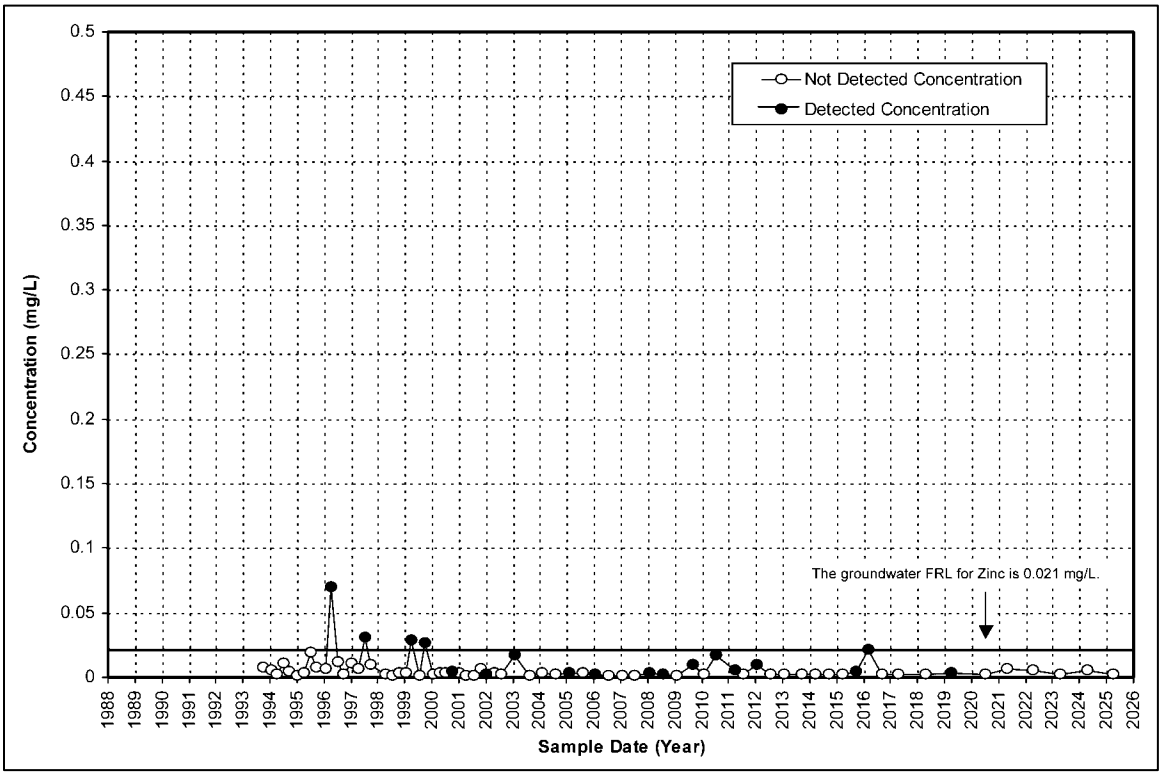


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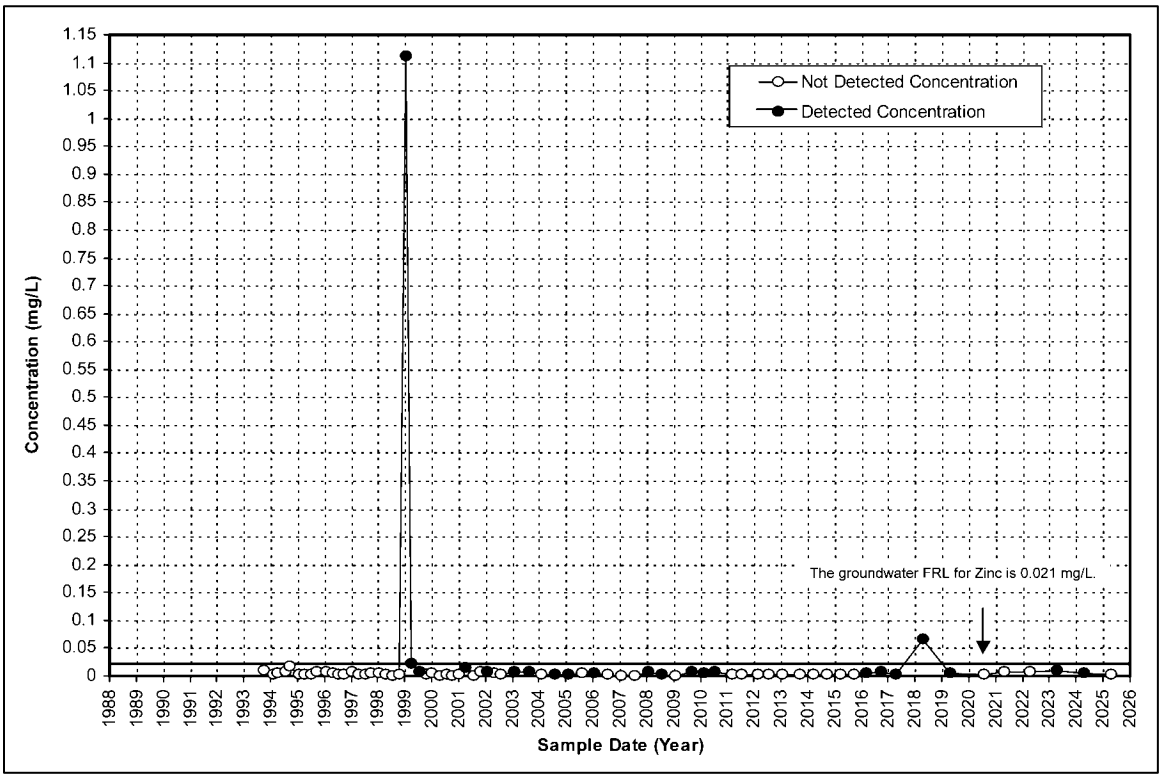


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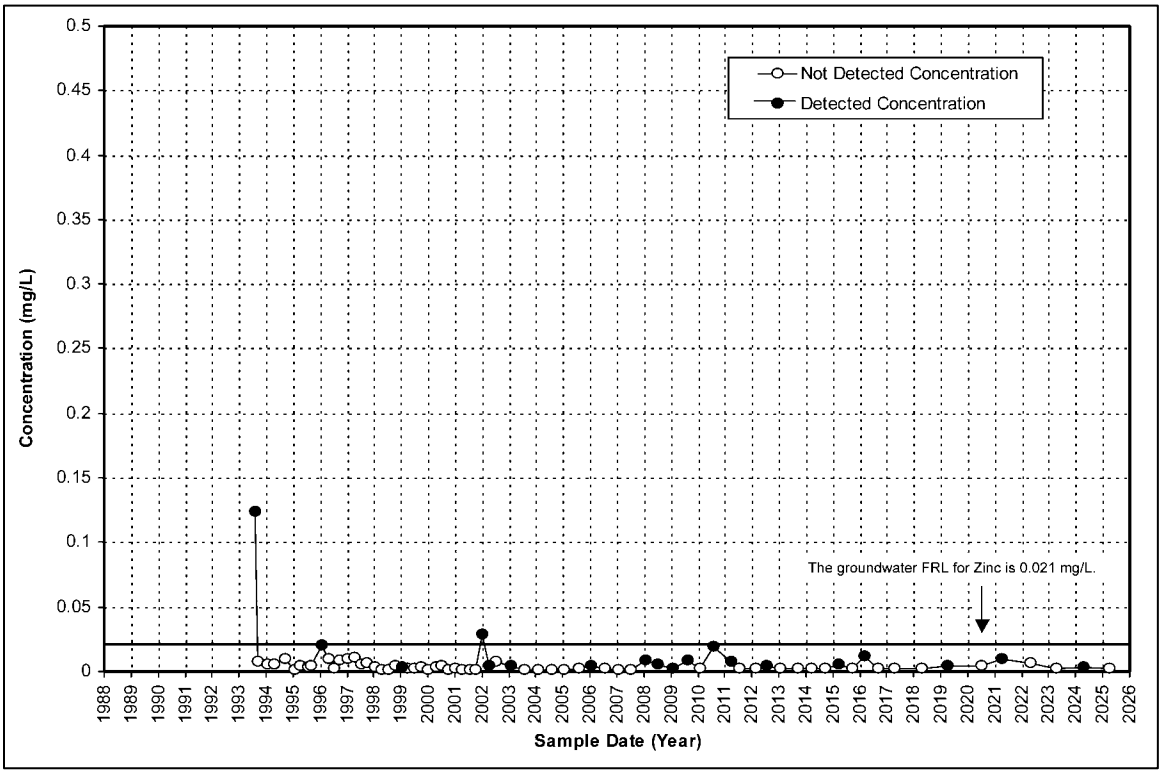


Figure A.4-264. Zinc Concentration Versus Time Plot for Monitoring Well 3431

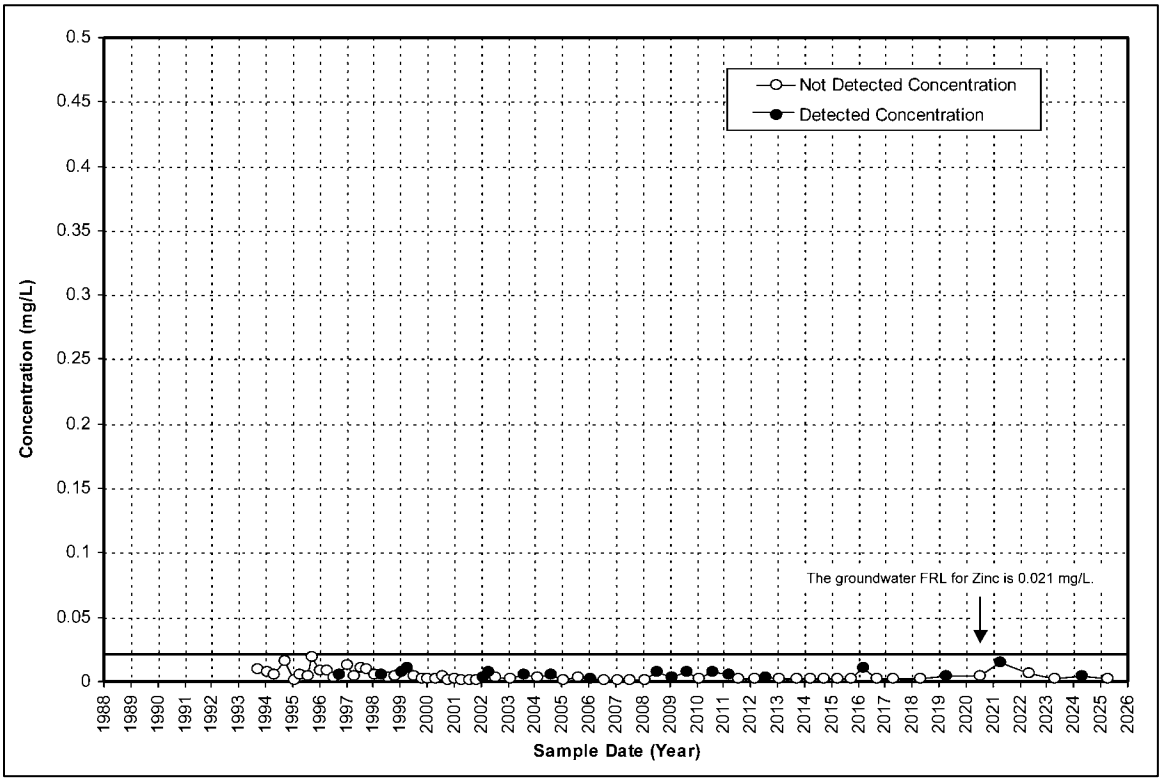


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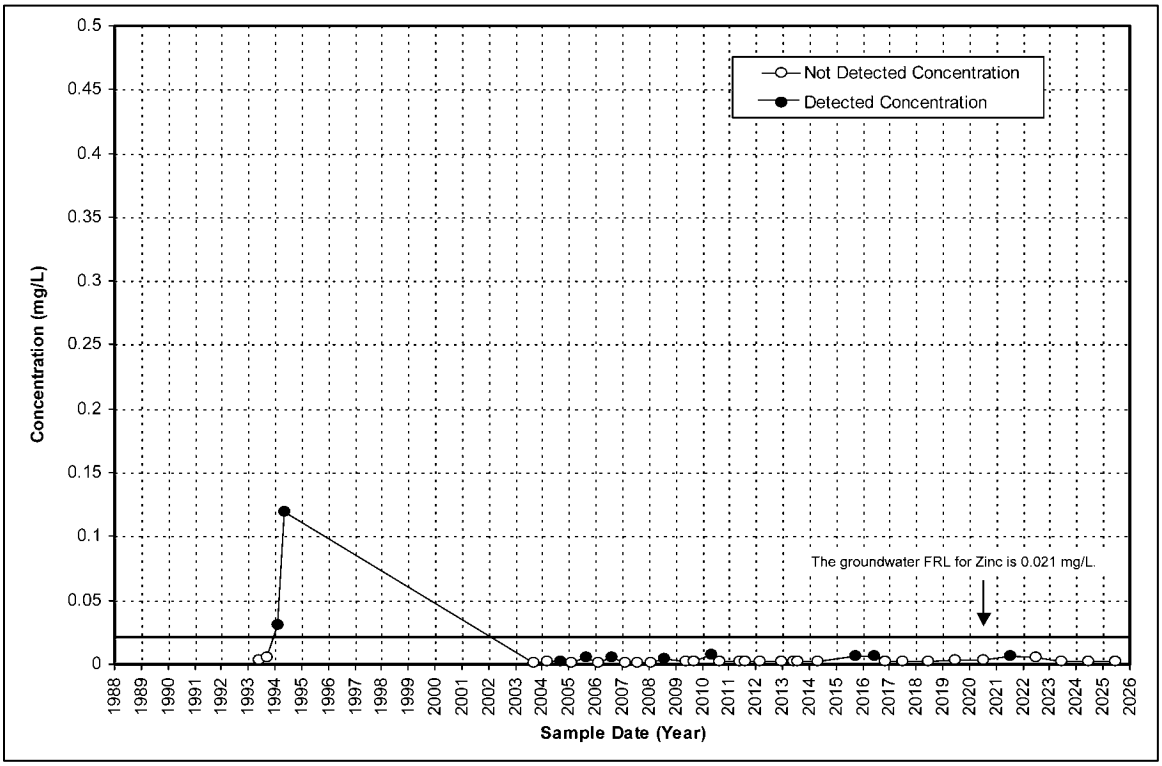


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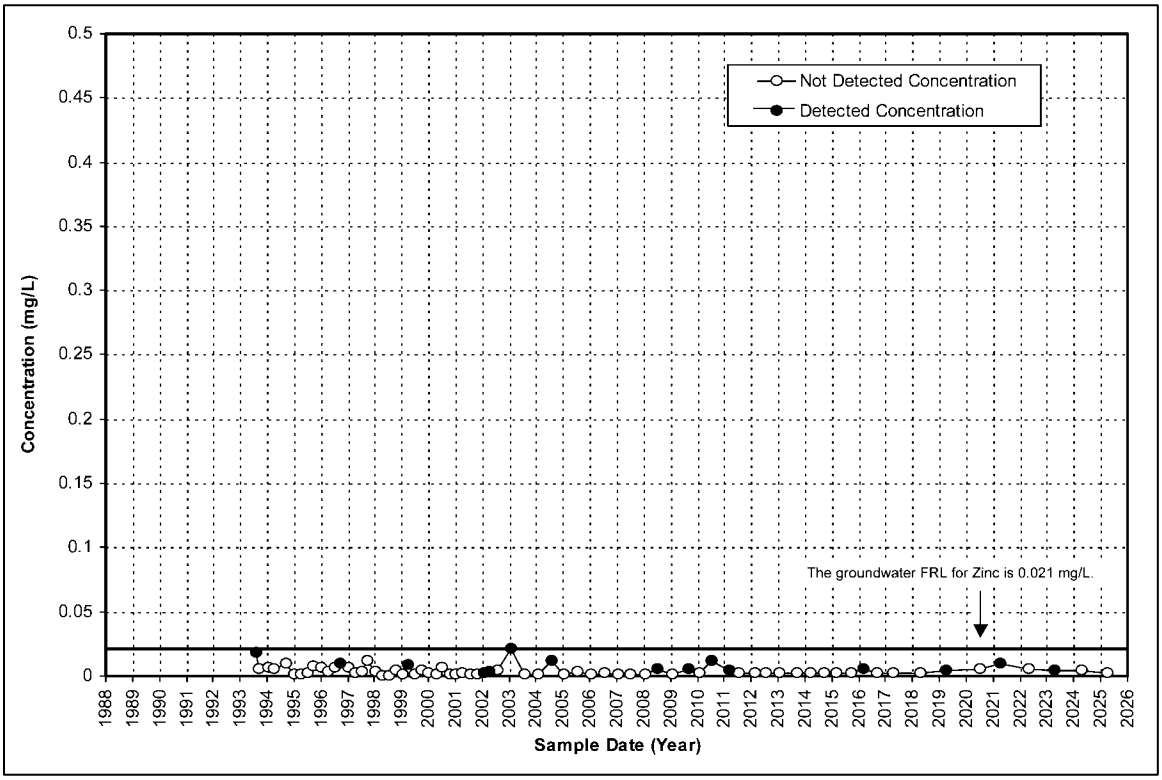


Figure A.4-267. Zinc Concentration Versus Time Plot for Monitoring Well 3733

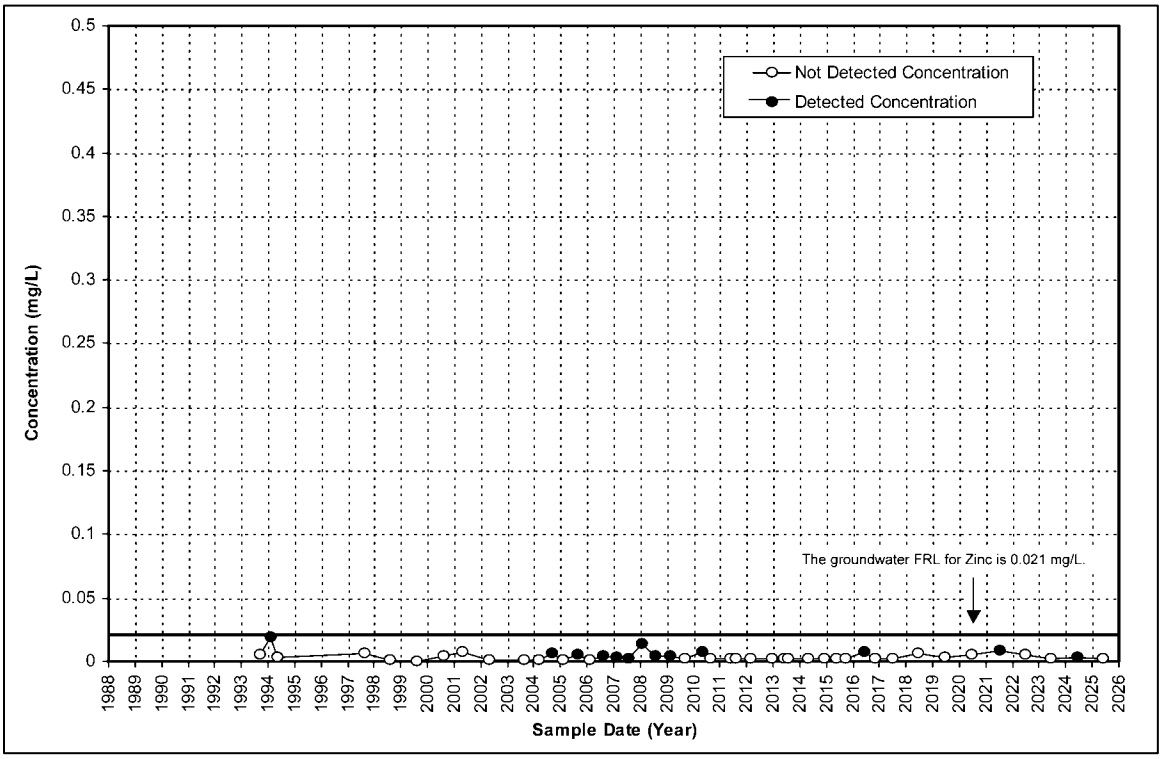


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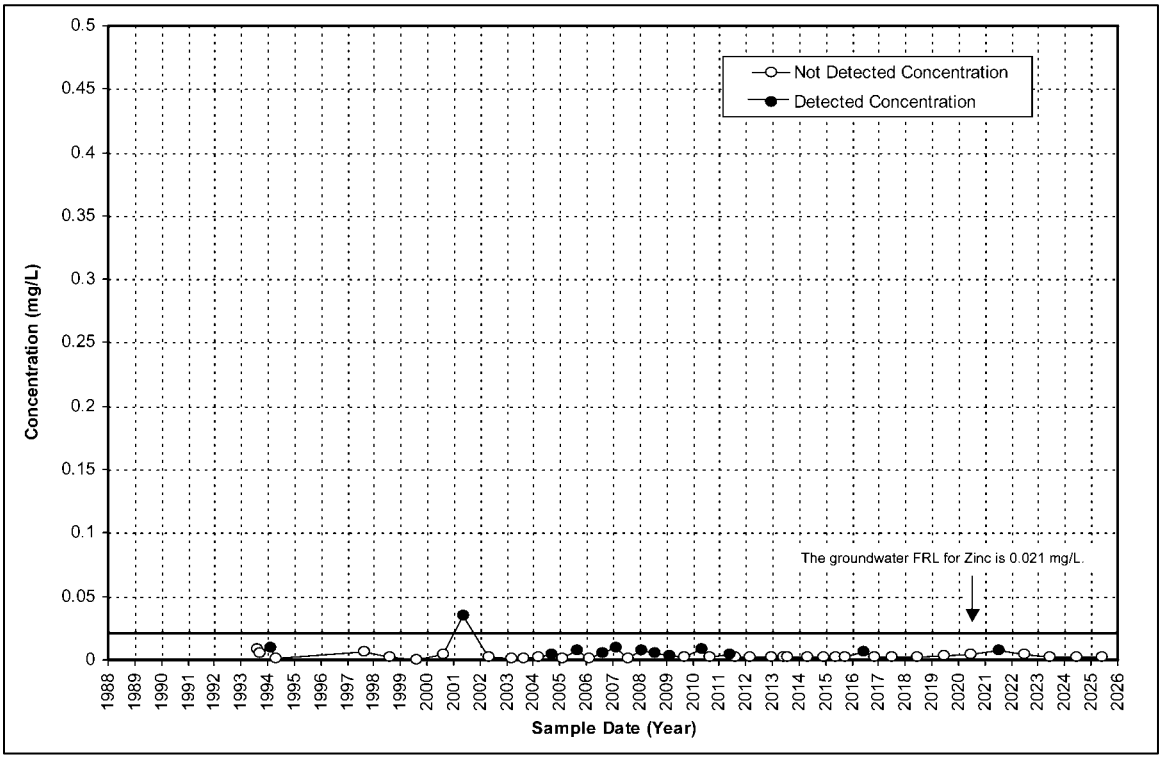


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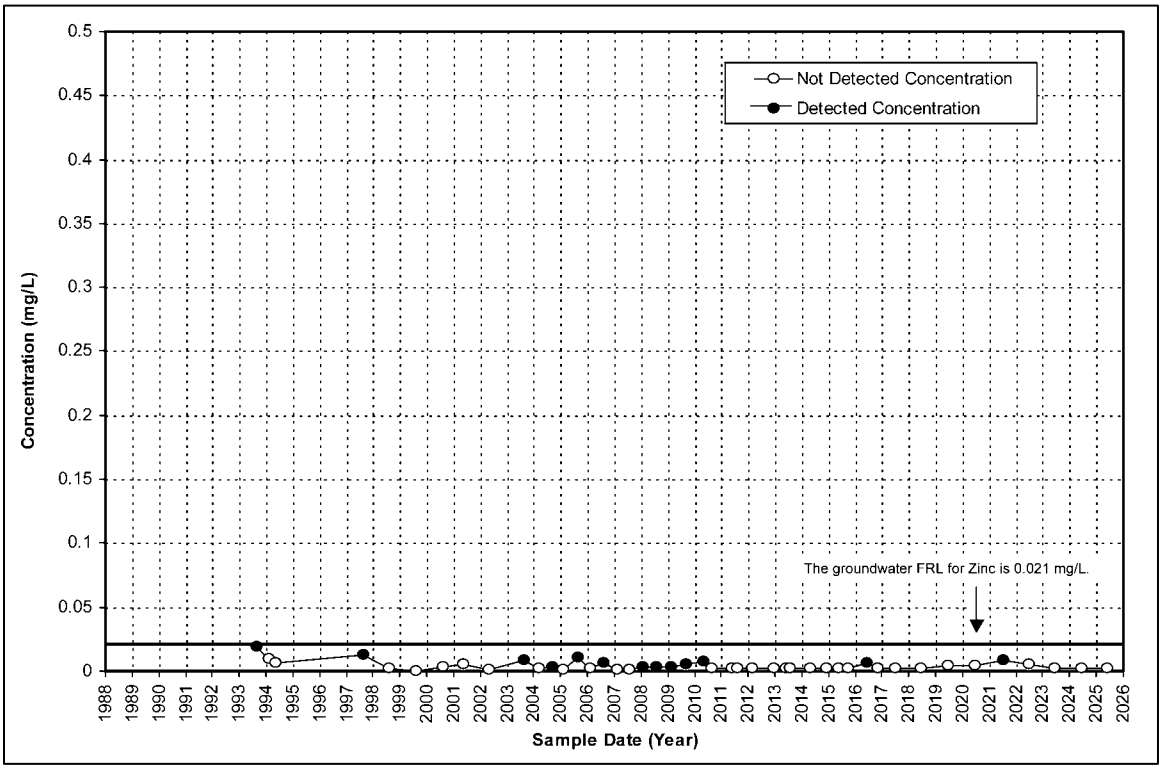


Figure A.4-270. Zinc Concentration Versus Time Plot for Monitoring Well 3900

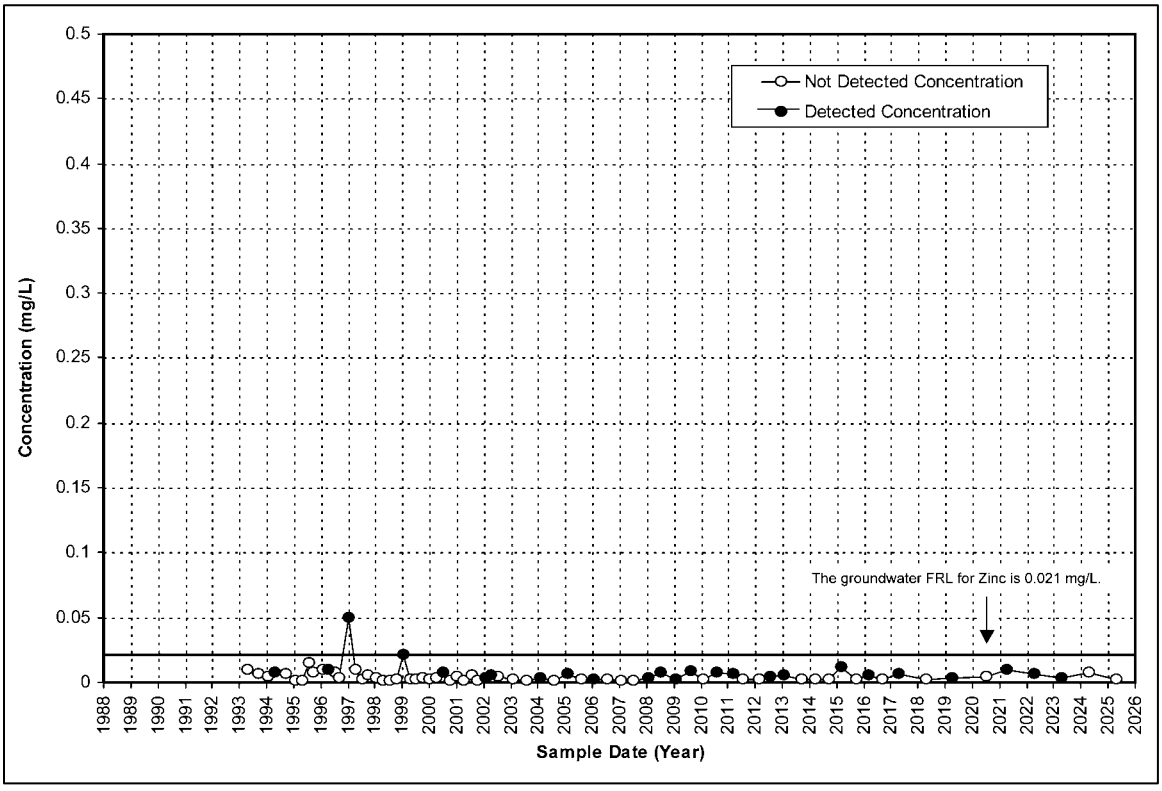


Figure A.4-271. Zinc Concentration Versus Time Plot for Monitoring Well 4398

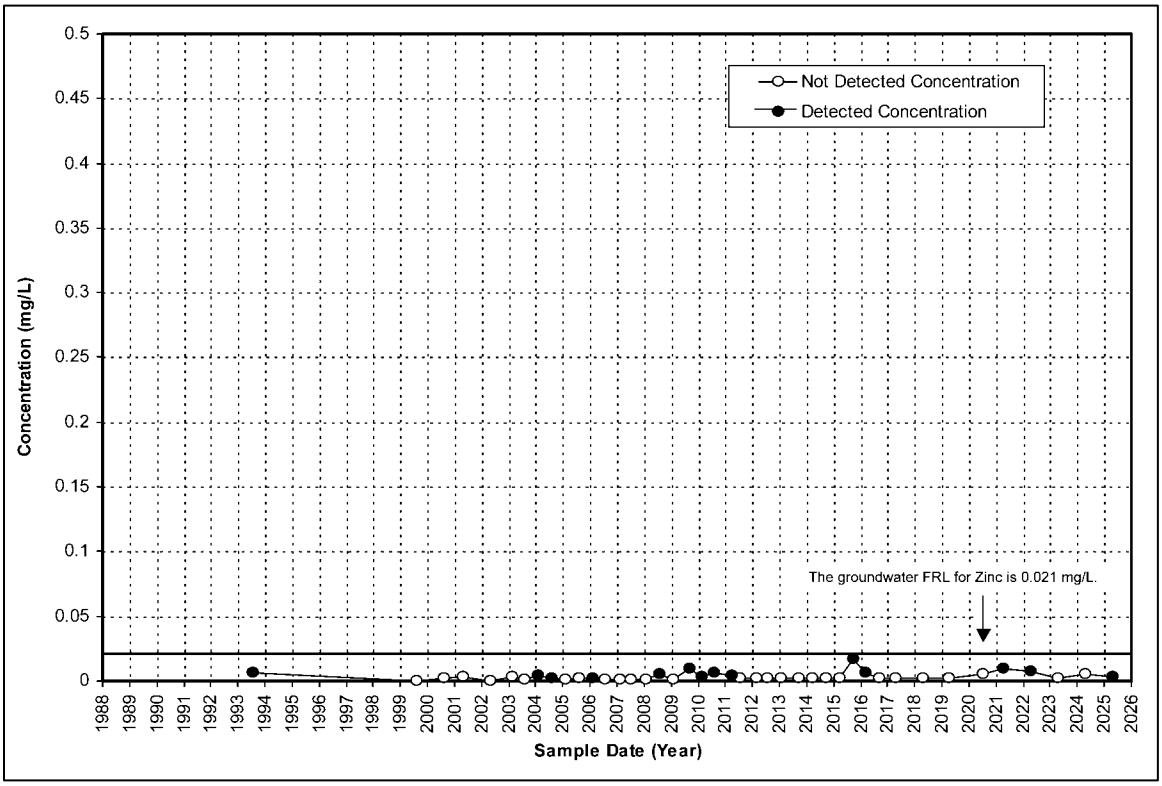


Figure A.4-272. Zinc Concentration Versus Time Plot for Monitoring Well 21063

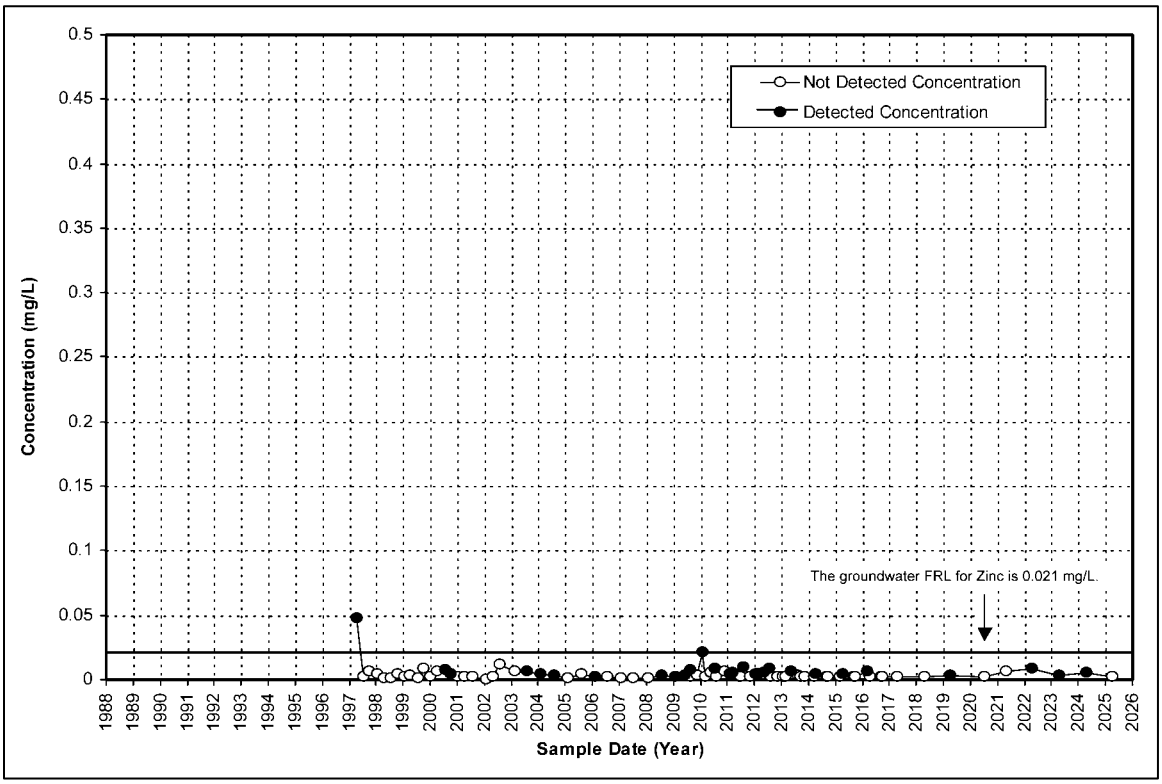


Figure A.4-273. Zinc Concentration Versus Time Plot for Monitoring Well 22198

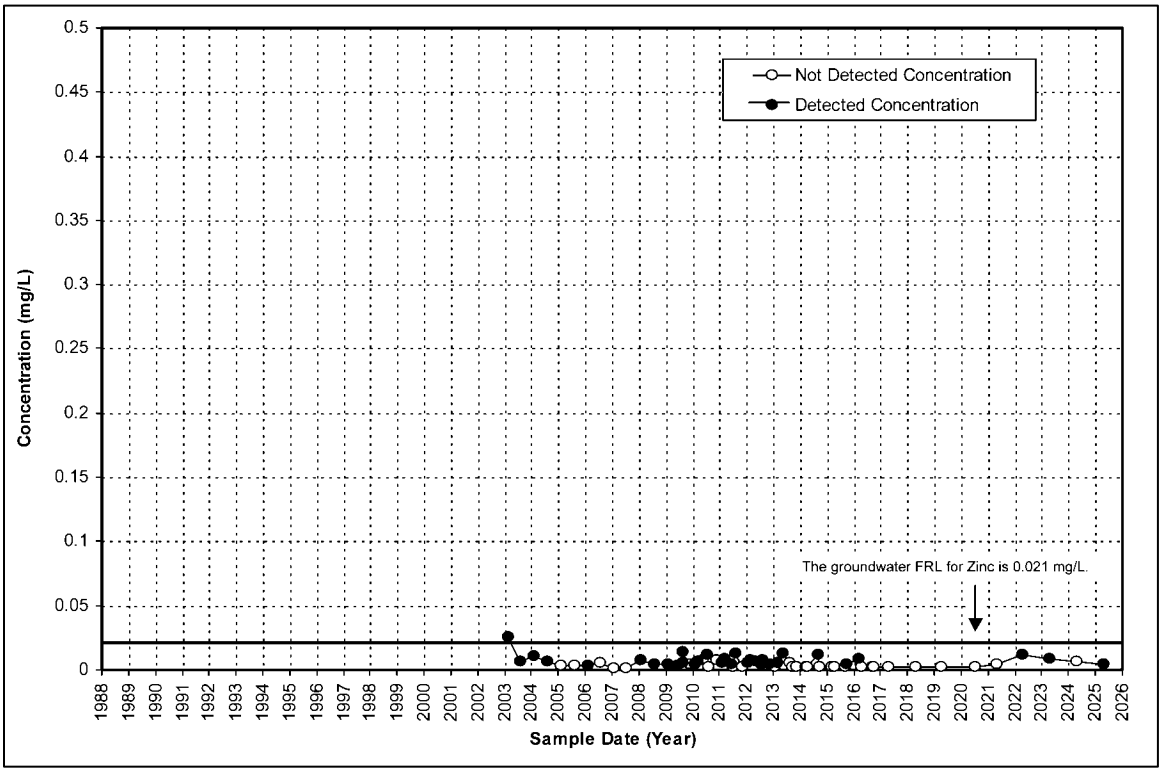


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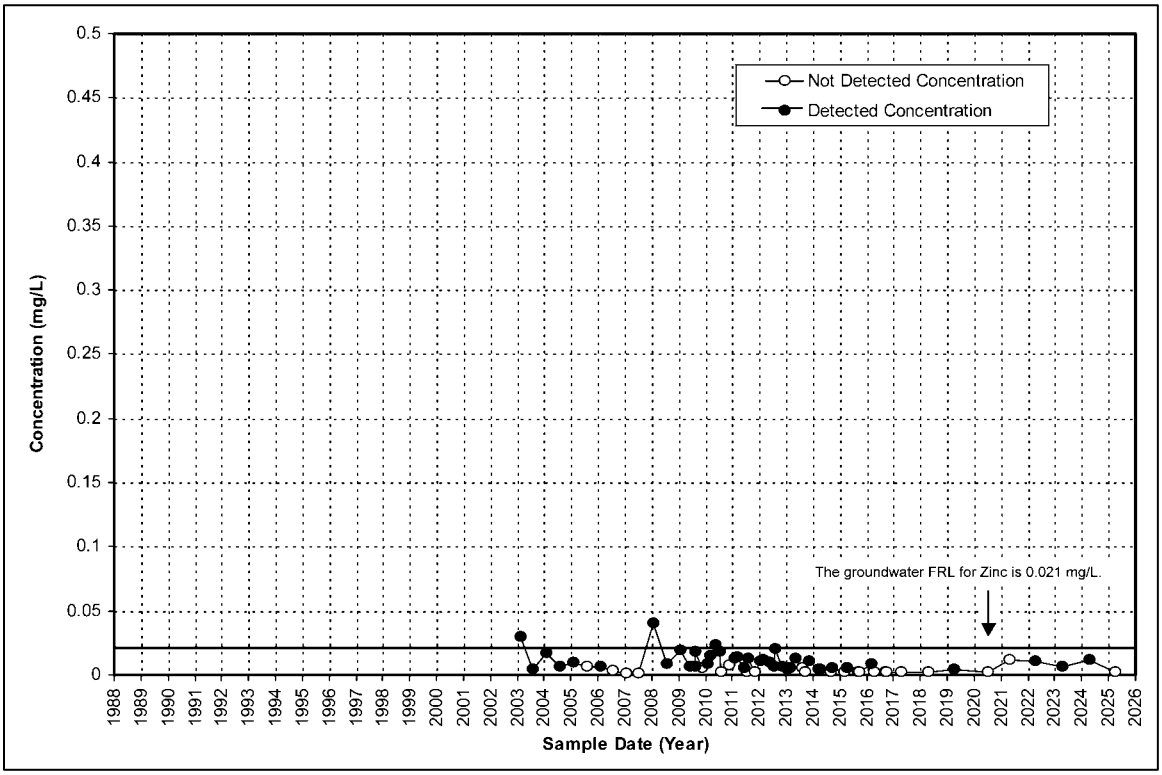


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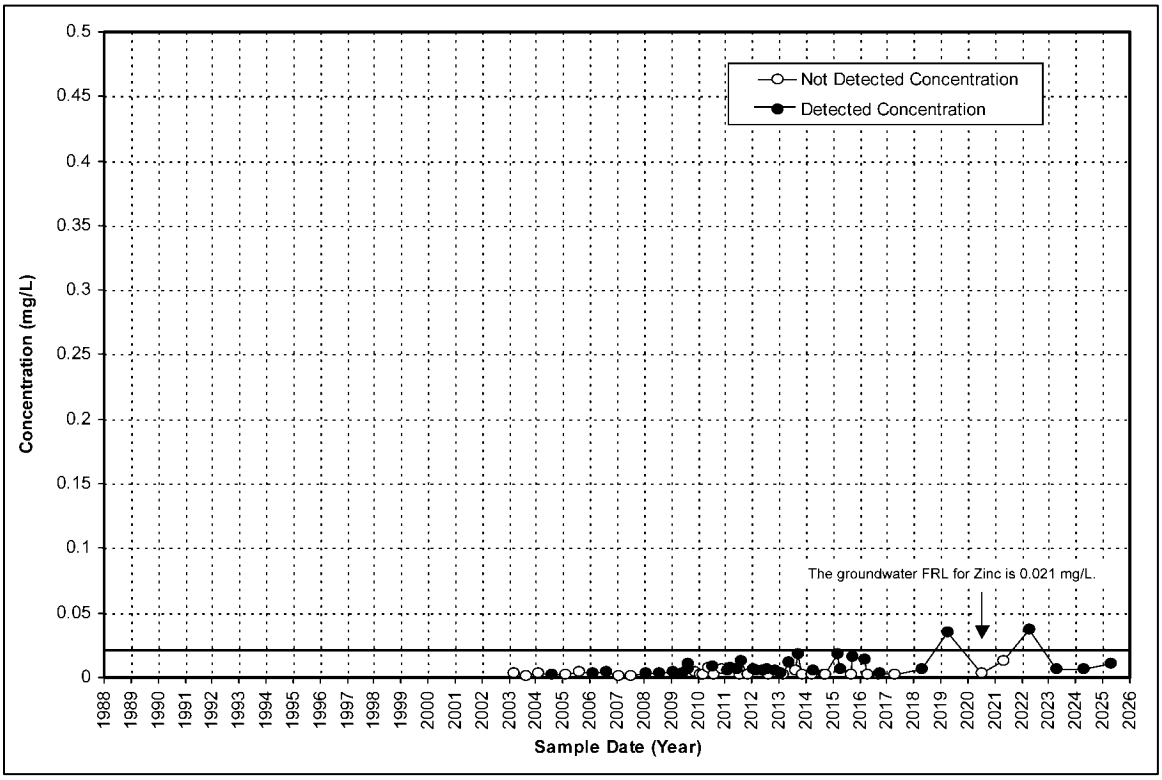


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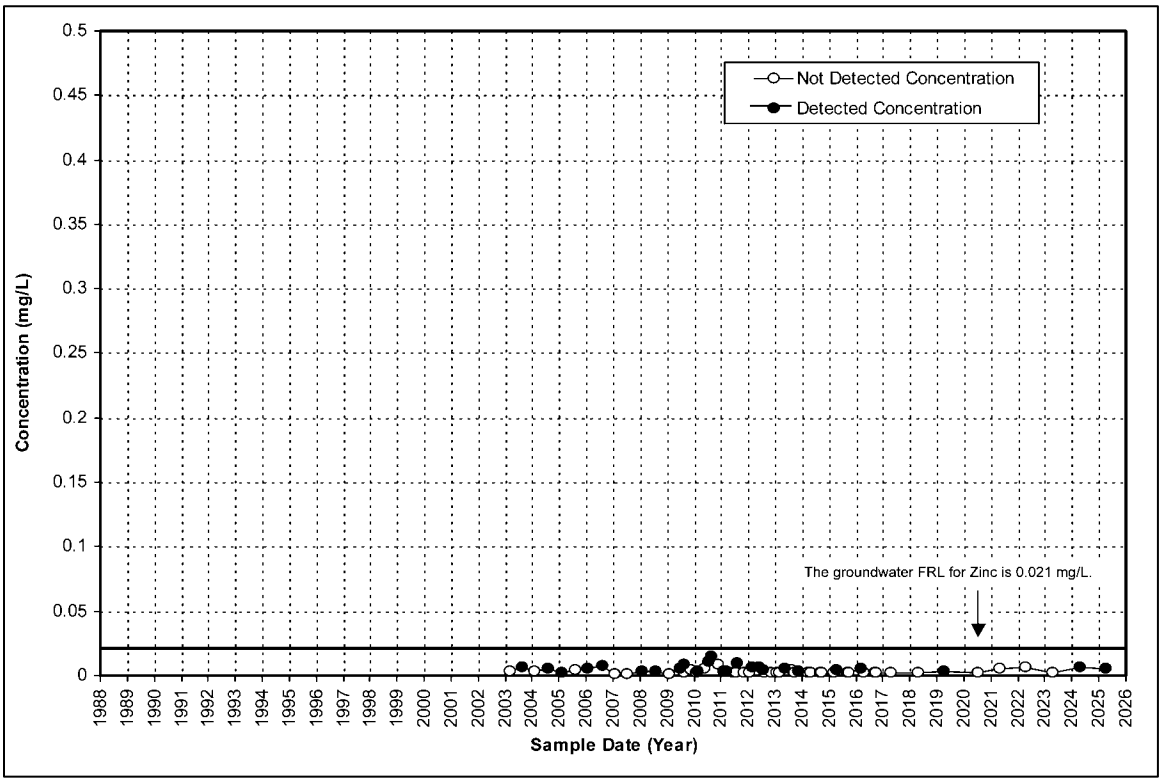


Figure A.4-277. Zinc Concentration Versus Time Plot for Monitoring Well 22208

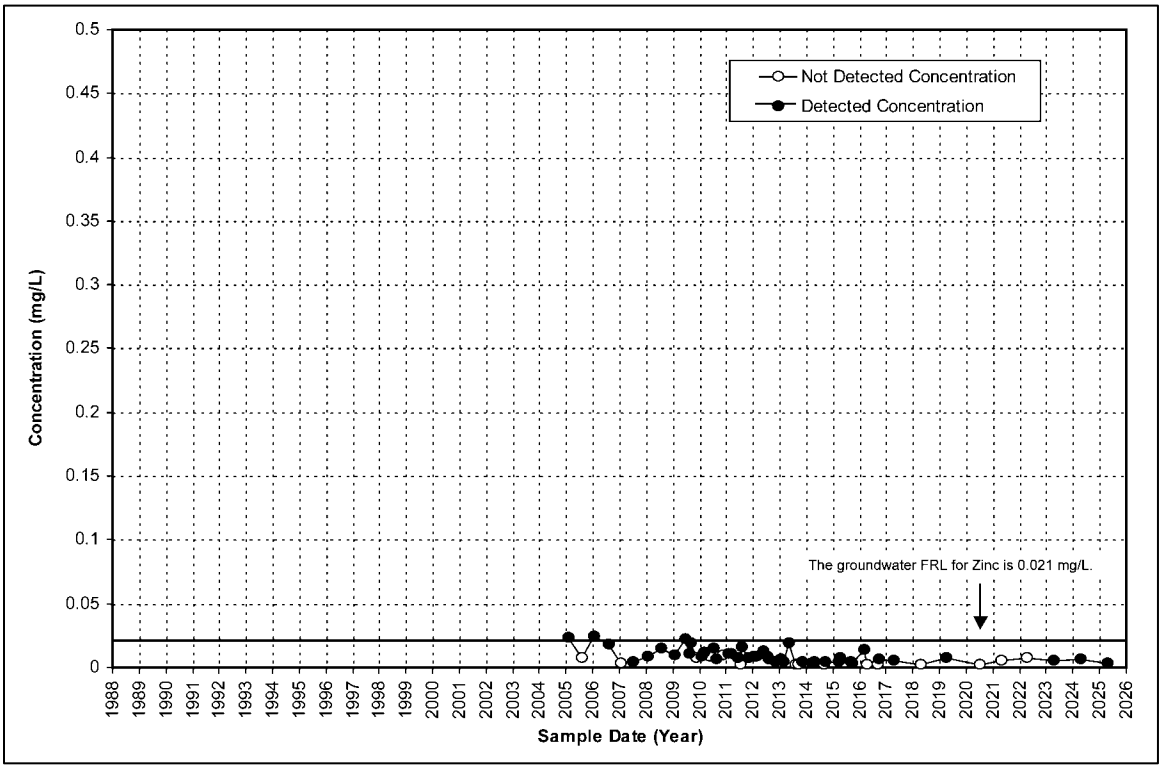


Figure A.4-278. Zinc Concentration Versus Time Plot for Monitoring Well 22210

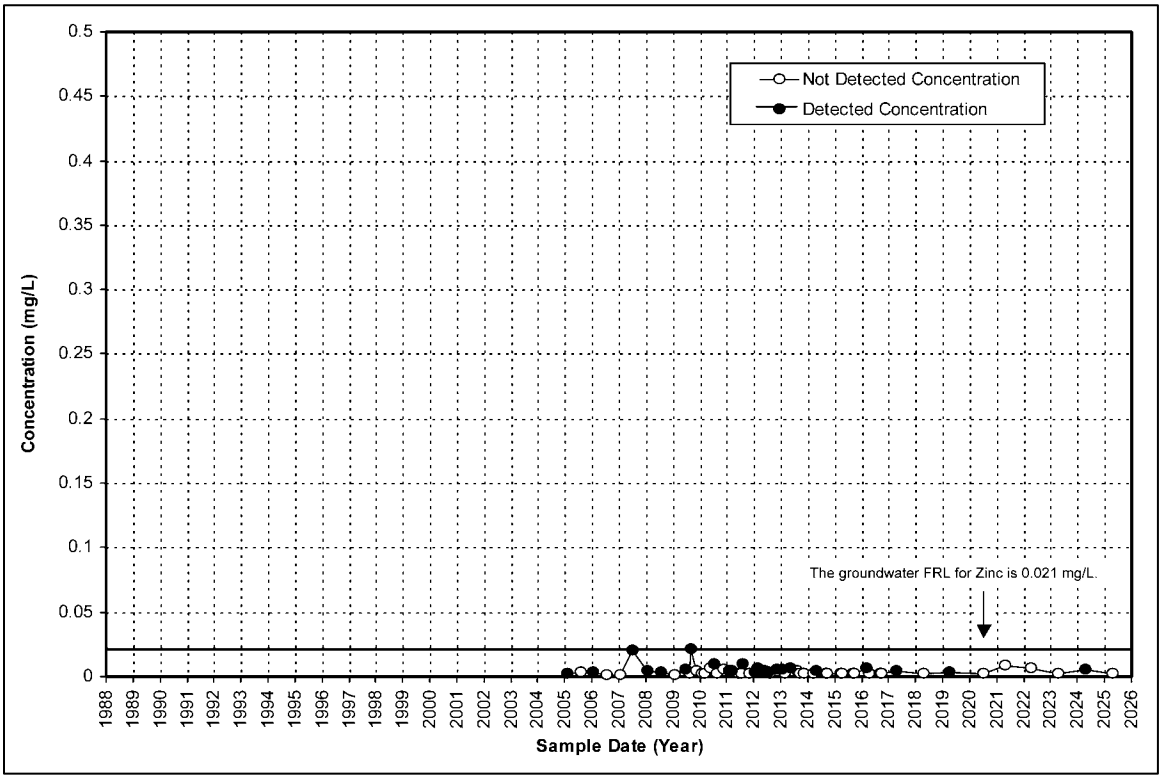


Figure A.4-279. Zinc Concentration Versus Time Plot for Monitoring Well 22211

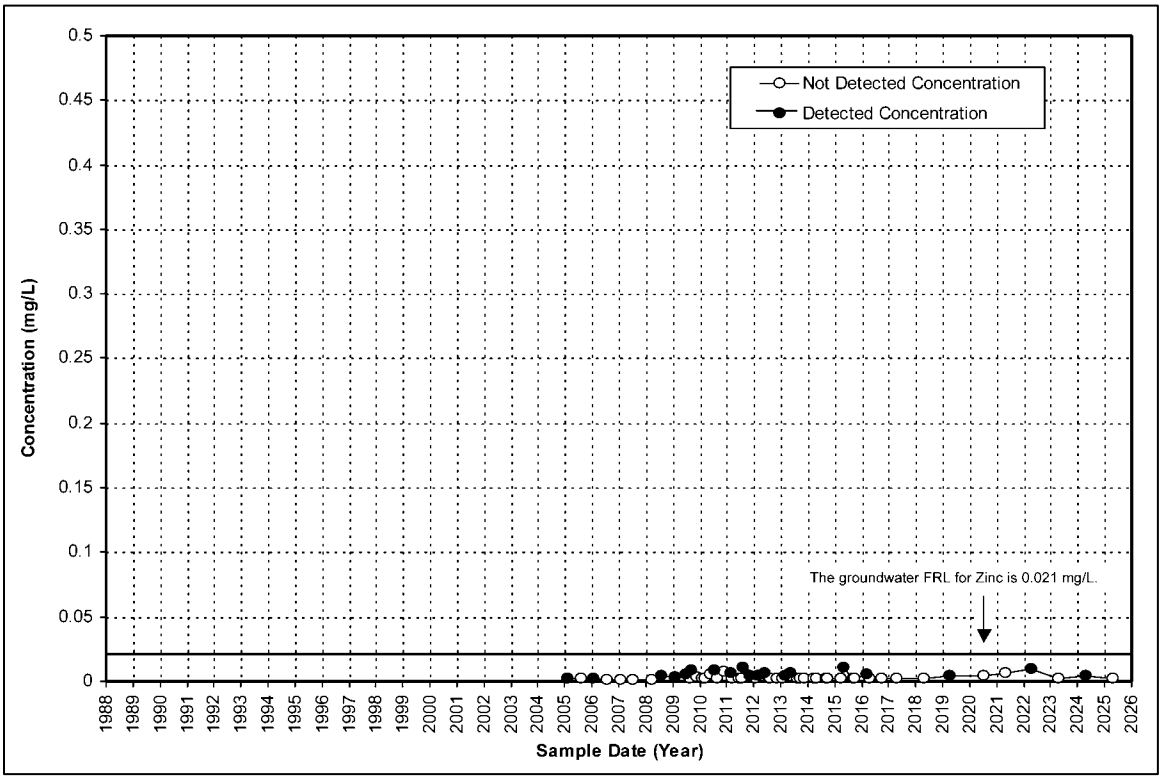


Figure A.4-280. Zinc Concentration Versus Time Plot for Monitoring Well 22214

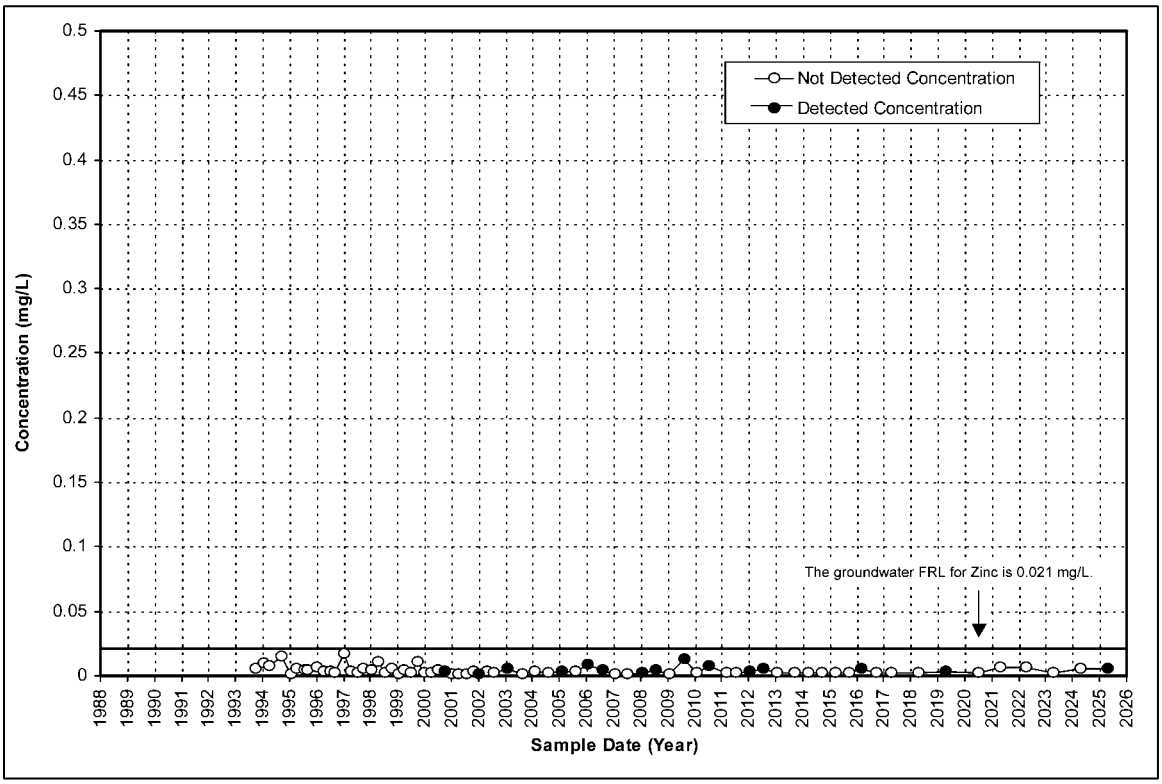


Figure A.4-281. Zinc Concentration Versus Time Plot for Monitoring Well 31217

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Attachment A.5

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Contents

Abbreviations ii
Measurement Abbreviations ii
A.5.0 On-Site Disposal Facility Monitoring Results 1
A.5.1 Flow and Hydraulic Performance 3
A.5.1.1 Overall LCS Volumes 3
A.5.1.2 LDS Accumulation Rates and Volumes 4
A.5.1.3 Liner Efficiencies 8
A.5.1.4 HTW Water Yields 8
A.5.2 Water Quality: Data Presentations and Evaluations 9
A.5.2.1 Semiannual Monitoring Summary Statistics 9
A.5.2.2 Concentration Plots 11
A.5.2.3 Control Charts 11
A.5.2.4 Bivariate Plots 12
A.5.2.5 Upward Concentration Trends in the HTW and GMA Wells 13
A.5.3 Cell Cap Inspections 14
A.5.4 LCS and LDS Camera Inspection 14
A.5.5 Summary of Overall Performance and Findings and Recommendations 15
A.5.6 References 16

Tables

Table A.5-1. OSDF Initiation and Completion Dates 18
Table A.5-2. Rules for Summary Statistics for Cells 1 Through 8 20
Table A.5-3. OSDF Groundwater, Leachate, and LDS Monitoring Summary 21

Figures

Figure A.5-1. Cross Section of OSDF Liner System with HTW at the Drainage Corridor 23
Figure A.5-2. OSDF Footprint and Monitoring Well Locations 24
Figure A.5-3. OSDF Monthly LCS Flow (October 2006 Through December 2025) 25
Figure A.5-4. OSDF Annual LCS Flow (2007 Through 2025) 26
Figure A.5-5. OSDF Statistical Evaluation Process 27

Abbreviations

CAWWT	Converted Advanced Wastewater Treatment
CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
RLCS	redundant leachate collection system
SCL	Shewhart control limit

Measurement Abbreviations

ft	feet
gpad	gallons per acre per day
µg/L	micrograms per liter

A.5.0 On-Site Disposal Facility Monitoring Results

This attachment provides results for the On-Site Disposal Facility (OSDF) leak detection and leachate monitoring program at the Fernald Preserve, Ohio, Site. Monitoring and sampling were conducted in accordance with the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP), Attachment C, "Groundwater/Leak Detection and Leachate Monitoring Plan" (GWLMP) (DOE 2023). The objective of the GWLMP is to meet regulatory requirements for groundwater detection monitoring in the Great Miami Aquifer (GMA) and perched groundwater system and to provide leachate monitoring information.

Facility Description

The OSDF is in the northeast area of the Fernald Preserve. It has a capacity of 2.96 million cubic yards and a maximum height of approximately 65 feet (ft). A security fence surrounds the OSDF and defines a footprint that occupies approximately 100 acres. The facility consists of eight individual cells. All eight cells were completely full and capped by October 2006.

Protection of the GMA and the overlying perched groundwater system includes the following measures for each of the eight cells (refer to Figure A.5-1 for a cross section of the liner system):

- Multilayer composite cap system
- Leachate collection system (LCS)
- Leak detection system (LDS)
- Multilayer composite liner system

The LCS consists of a gravel layer installed beneath the encapsulated waste to collect rainwater and dust suppression water that came in contact with the waste during cell construction and additional moisture that remained in the cell following capping. The LDS is beneath both the LCS and the primary geosynthetic liner system and provides a mechanism for collecting and monitoring leakage through the primary liner layer of the OSDF before any releases to the environment. Both systems drain to the west and extend beyond the synthetic liner systems into valve houses, where leachate is collected in tanks for sampling.

The base of each cell liner also slopes toward the centerline of the cell, and the centerline of the base is sloped toward the west. Leachate moving along the top of a liner would first travel toward the centerline and then west along the centerline to be drained from the cell via piping at the penetration box, which is the lowest elevation point of the cell.

Each cell is monitored below the penetration box with a horizontal till well (HTW), which represents the first monitoring point for a potential release from a cell. HTWs provide monitoring of the perched groundwater quality beneath the point where the LCS and LDS pipes exit the liner system. The GMA is monitored by both an upgradient and a downgradient monitoring well for each cell. Figure A.5-2 identifies the well locations associated with the OSDF. Table A.5-1 identifies specific dates for the following cell activities:

- Sample initiation for each monitoring horizon
- Waste placement initiation

- LDS volume measurement initiation
- Cap geomembrane layer completion
- Cap completion (through seeding)

A construction quality assurance and quality control program was executed for each cell of the OSDF. The synthetic liners and caps of each cell were inspected and tested for defects at the time of installation. Given the attention to quality assurance and quality control during the installation of the OSDF liner system, it is doubtful that a breach in the liner would have gone unnoticed, but it is possible that a breach could develop. Such a breach would provide a potential pathway for leachate migration, but adequate hydraulic head is needed to drive leachate through the breach and clay liner into the underlying horizon. As discussed in this attachment, flow from the facility is monitored to document that the needed hydraulic head to drive leachate through a breach in the liner and into the underlying horizon is not achieved.

The GWLMP summarizes the principal geologic, hydrogeologic, and subsurface contaminant conditions in the OSDF area that had a direct bearing on the development of the monitoring program for the OSDF facility. As discussed in the GWLMP, the conceptual flow path or migration pathway for a leak from the facility involves understanding:

- How each cell was constructed and how a cell transmits leachate from the facility.
- The impact of hydraulic head within the facility in the LDS and the design action leakage rate.
- The nature, thickness, and hydraulic conductivity of glacial clay beneath the facility.
- The residual soil contamination beneath the facility and its possible impact to HTW water quality results.
- The groundwater model evaluations of transport times and modeled flow paths for use in placing monitoring wells for the monitoring network in the GMA.
- The modeled breakthrough travel times through the glacial clay for uranium (the main contaminant of concern) and for technetium-99 (the most mobile contaminant).

Information Organization

The 2025 OSDF leak detection and leachate monitoring information is organized into the following sections:

- Flow and Hydraulic Performance (Section A.5.1)
- Water Quality: Data Presentations and Evaluations (Section A.5.2)
- Cell Cap Inspections (Section A.5.3)
- LCS and LDS Video Inspection (Section A.5.4)
- Summary of Overall Performance and Findings and Recommendations (Section A.5.5)

Subattachments A.5.1 through A.5.8 provide cell-specific information for Cells 1 through 8.

A.5.1 Flow and Hydraulic Performance

A.5.1.1 Overall LCS Volumes

Capacitance probes are used to measure water levels in each LCS tank. The water levels in the tanks are communicated to the Converted Advanced Wastewater Treatment (CAWWT) facility via radio signal. When the water level in the tank reaches 1.86 ft, the tank is approximately 80% full, and the pump automatically starts to pump water from the tank to the leachate lift station. The water in the lift station is pumped to the CAWWT facility backwash basin. To determine the volume of leachate pumped, the change in water level after pumping is converted to gallons using an equation from the tank manufacturer. If communication to the CAWWT facility is not functioning, tanks are pumped manually when tanks are between 40% and 80% full of water. In this case, volumes pumped are recorded manually on the leachate round sheet. Tanks are also pumped manually after each sampling event.

Leachate volumes have been measured since waste placement began. Figure A.5-3 is a graph showing monthly LCS flows from October 2006 through December 2025. Figure A.5-4 is a graph that shows the annual LCS flows from 2007 through 2025.

Leachate volumes shown in both figures are impacted by leachate line closures beginning in 2016 and continuing into 2019. Additional information concerning these closures is summarized in the following table. Contingencies for closing the valves are provided in the GWLMP in the LMICP (DOE 2025). No line closures have occurred since 2019.

From an operational perspective, when the leachate line valves are closed, water begins to collect on the liner of each cell. By design, 1 ft of water should not be allowed to accumulate on the liner. As discussed in the LMICP, 156 days is the current estimated minimum number of days required to accumulate 1 ft of hydraulic head on the primary liner. As shown below, none of the closures between 2016 and 2019 exceeded 156 days.

Leachate Line Closure		Reason for Leachate Line Closure	Days Closed During Calendar Year
Shut Date	Open Date		
July 05, 2016	September 23, 2016[a]	Unplanned power outage	79
September 20, 2017	February 6, 2018[b]	CAWWT facility construction	103 (2017) and 37 (2018)
March 14, 2018	April 15, 2018	CAWWT facility construction	33
August 13, 2019	December 3, 2019[c]	CAWWT backwash basin refurbishment	112

[a] Valves were opened beginning September 23 and ending on September 30, 2016. Days reported are the maximum number of days for any cell.
[b] Valves were opened beginning February 2 and ending on February 6, 2018. Days reported are the maximum number of days for any cell.
[c] Valves were opened beginning December 3 and ending on December 6, 2019. Days reported are the maximum number of days for any cell.

Shutting the valves impacts the volume recorded for the facility over the calendar year. As reported in each annual Site Environmental Report for the year affected by valve closure, the reported leachate volumes either reflect a period that is less than a year, as in 2017, or the volume reported reflects more than a year, as in 2018. The effect of the relatively long period of leachate line closure that extended into the next reporting year affected the reporting of the

leachate volumes for both 2017 and 2018. Leachate accumulation for 2017 reflected approximately 9 months of accumulation (75% of the year), whereas 2018 leachate accumulation reflected approximately 15 months (125% of the year). In 2019, the valves were closed for a planned shutdown to support the CAWWT backwash basin refurbishment as discussed in Appendix A, Attachment A.1. The valves were shut for a period within the calendar year and did not affect the reporting of the volume in the same way as in 2017 and 2018.

Leachate volumes reported for 2019 reflect accumulation over the entire calendar year with the leachate valves being open 253 days (January 1 through August 13, and December 3 through December 31, 2019), during which time a total of 113,350 gallons of leachate were collected and pumped to the CAWWT backwash basin for subsequent treatment at the CAWWT facility. No additional closures of the OSDF leachate lines are planned in the next several years.

Leachate valves were open the entire year of 2025; a total of 89,076 gallons of leachate were collected and pumped to the CAWWT backwash basin for subsequent treatment at the CAWWT facility. Continued monitoring is expected to show that the annual leachate volume continues to decrease.

The volume of precipitation that fell on the OSDF in 2025 was approximately 55.6 million gallons (37.83 inches over 54.1 acres). The facility cap is designed to inhibit water from infiltrating the OSDF. Leachate collected in 2025 (89,076 gallons) represents approximately 0.16% of the 55.6 million gallons. This value indicates that in 2025 the cap was performing as designed to reduce infiltration.

The GWLMP identifies that trend analysis of the LCS flow-monitoring measurements will be conducted for capped cells to provide an indication of changes in system performance. Monthly accumulation volumes for Cells 1 through 8 are plotted and provided in Subattachments A.5.1 through A.5.8. The semilog plots indicate that leachate volumes from the capped cells continue to decline over time, but the rate of decline is decreasing.

A.5.1.2 LDS Accumulation Rates and Volumes

Quantitative measurement of the volumes accumulating in and pumped from the LDS tanks was initiated according to the various dates in Table A.5-1. These measurements began using the same methodology as described above for the LCS. These data are used to determine both accumulation rates (in gallons per acre per day [gpad]) and accumulation volumes (in gallons) for each cell's LDS. As explained below, the method of measuring flow in the LDS (for those cells that still have flow) has changed in response to the decreasing flow.

The GWLMP states that trend analysis of the LDS flow monitoring measurements will be conducted for capped cells to provide an indication of changes in system performance. Monthly accumulation volumes for Cells 1 through 8 are provided and graphically displayed in Subattachments A.5.1 through A.5.8. The graphs indicate that LDS flows are trending asymptotic at or near zero.

Through 2017, capacitance probes were used in the tank of each LDS to measure the water level within the tank. The capacitance probes could measure within hundredths of a foot of water in the bottom of the tank. Measured water levels were used to calculate the accumulation rate for

each cell. Although water would register via the probes, there was often not enough water present to physically obtain a sample. Pump out of the tank would occur automatically if an LDS tank water level reached 80% of its capacity (1.86 ft of water). Pump out also occurred after semiannual sampling was completed to remove any water that remained after sampling, to ensure newer water was sampled for the next semiannual sampling event. From 2017 through 2022, LDS flow rates were estimated by tracking the volume of water removed from the LDS tanks. In 2022, piping modifications in the LDS line were made that provided a smaller 5-gallon container in place of the larger LDS tank to collect a sample from. The 5-gallon containers were sized to collect all LDS flow. Water collected in the 5-gallon container is sampled twice per year. Water collected in the 5-gallon container is monitored to determine whether the low flow response leakage rate of 2 gpad is reached.

In 2025, LDS tanks for all cells (with the exception of Cells 1 and 6) were too dry to collect semiannual samples, resulting in an accumulation rate of 0.0 gpad. The LDS Cells 1 and 6 containers accumulated enough water to collect routine semiannual samples in 2025. The amount of water accumulated in the LDS Cells 1 and 6 containers in 2025 was very low, so the accumulation rate was calculated by noting the volume of water collected in the LDS Cells 1 and 6 containers and the amount of time since they were previously drained (or since LDS Cells 1 and 6 were previously sampled). The calculation for estimated maximum accumulation rates based on LDS container accumulation is summarized in the following table.

Cell	Estimated Volume Collected from LDS (gallons)	Estimated Maximum Accumulation Rate (gpad)
1	2	0.0001
2, 3, 4, 5, 7, and 8	0	0
6	8	0.0977

It should be noted that from 2011 to the first half of 2025 the volume of water in the LDS tank of Cell 1 had been insufficient to collect a sample. During the September 17, 2025, sampling event, the LDS had sufficient volume of water for sample collection. The sampling event occurred following the September 8, 2025, video survey of the OSDF LDS and LCS(Section A.5.4). It is suspected that the action of removing the camera potentially dislodged sediment, allowing water contained within the LDS to flow out of the line. DOE will continue to monitor the LDS. Additional discussion is provided in Subattachment A.5.1.

The *On-Site Disposal Facility Final Design Calculation Package* (DOE 1997) defines a maximum design leakage rate for individual cells of 200 gpad. As a best management practice, the U.S. Department of Energy (DOE) imposed two lower administrative leakage rates:

1. Initial response leakage rate of 20 gpad.
2. Low-flow response leakage rate of 2 gpad.

The highest estimated maximum accumulation rate determined for 2025 (0.0977 gpad in Cell 6) is only 4.9% of the low-flow response leakage rate of 2 gpad.

The 2025 estimated maximum LDS accumulation rates, the percent of the initial response leakage rate, and the percent of the low-flow response leakage rate for each cell are as follows.

Cell	2025 Maximum LDS Accumulation Rate Calculated from Collected Water (gpad)	Percent of Initial Response Leakage Rate	Percent of Low-Flow Response Leakage Rate
1	0.0001	0.0005	0.005
2	0.00	0.0	0.0
3	0.00	0.0	0.0
4	0.00	0.0	0.0
5	0.00	0.0	0.0
6	0.0977	0.49	4.9
7	0.00	0.0	0.0
8	0.00	0.0	0.0

These LDS accumulation rates for 2025 indicate that the liner systems for the cells are performing well and within the specifications outlined in the approved OSDF design. A tabulation of the maximum LDS accumulation rate (gpad) from 2006 to 2025 is provided below. In the tabulation below, beginning in 2023, rates are estimated from volumes removed by draining what was collected in the 5-gallon container, and by what was removed during sampling activities.

Year	Maximum LDS Accumulation Rate (gpad)
2006	13.08
2007	6.54
2008	1.36
2009	0.48
2010	0.21
2011	0.38
2012	0.1
2013	0.07
2014	0.06
2015	0.23
2016	0.33
2017	0.05
2018	0.11
2019	0.322
2020	0.319
2021	0.015
2022	0.0001
2023	0.00465
2024	0.0114
2025	0.0977

The initial response leakage rate of 20 gpad and the low-flow response leakage rate of 2 gpad are administrative criteria for commencing an investigation into the possibility that the cell is not performing as designed. The administrative levels are one-tenth and one-hundredth of the design criterion of 200 gpad, respectively. As shown in the table above, the flow rate has been below the 2 gpad administrative level since 2008, supporting the use of a 2 gpad administrative level. Because all the cells are closed and capped, it is expected that LDS accumulation rates will continue to diminish over time. Rates will continue to be closely tracked to document that the primary liner systems continue to perform as designed.

The maximum accumulation rate measured in the LDS in 2025 (Cell 6) was only 0.0977 gpad. The former LDS tanks held approximately 300 gallons of water, making them oversized for current LDS flow conditions. In the 2018 Site Environmental Report (DOE 2019), DOE reported plans to install tubing at an existing sampling port upstream of the LDS tank to provide a means to divert any future flow into a 5-gallon container. DOE completed these modifications in early 2023.

Over the years, several small, very minor leaks have occurred in the valve house piping that so far have been easily repaired. The liquid is contained within the valve house. The leaks are the result of galvanic corrosion between two different types of metal components of the piping system. Rather than wait for more leaks to develop, and with concurrence from the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA), DOE began replacing the metal pipes in the valve houses with plastic piping in late 2022. Sampling ports described above on the LDS lines were also installed so that a sample from the LDS could be collected in a smaller 5-gallon container. Pipe replacements and the installation of sampling ports on the LDS lines were completed in early 2023.

In late 2021, a small amount of water was observed in valve house 7 in the area where the LCS piping penetrates the valve house wall and enters the valve house. The LCS and LDS pipes enter the valve houses through the east wall of the valve houses. The LCS is a double-walled pipe; the secondary containment system contained no liquid, indicating that the liquid was not coming from the LCS. The amount of liquid in the valve house increased after precipitation events. Sampling of the liquid entering the valve house revealed that the uranium concentration (8.2 micrograms per liter [µg/L]) matched the very low historical total uranium concentrations in the perched groundwater in the area (2.0–8.61 µg/L); therefore, the liquid in the valve house is attributed to water leaking into the valve house from outside the valve house at the point where the LCS line system penetrates through the valve house wall. Any liquid that entered the valve house via this pathway was directed to the LCS tank within the valve house until repairs could be made. The small amount of liquid entering the LCS tanks via this pathway prior to repair temporarily impacted the volume and quality of water collected from the Cell 7 LCS tank. The impact was minimal.

DOE repaired the leak in valve house 7 in summer 2022. Unfortunately, additional small leaks occurred along the inner surface of the same wall in valve house 7 following the repair. The repaired area in valve house 7 did not leak, but other leaks along the east wall developed. It is believed that once the initial leak was fixed, water building up on the outside of the valve house wall found other entry points through the wall. Based on the nature of the leaks observed, it is assumed that water is collecting around the base of the east side of the valve house. During heavy precipitation events, water collects and rises on the outside of the valve house wall until it

finds a way to either go around or through the walls. To address the situation, a discharge line was installed from the sump pump in the valve house to the unused LDS tank in valve house. When the LDS tank is full, water is pumped out and sent to the CAWWT facility for treatment. This approach does not impact the LDS volume measurement due to the aforementioned LDS piping project that was completed in 2023.

A.5.1.3 Liner Efficiencies

Cell-specific apparent liner hydraulic efficiencies are calculated using the following equation:

$$\text{Hydraulic efficiency} = [1 - (\text{Volume}_{LDS}/\text{Volume}_{LCS})] \times 100$$

Apparent liner hydraulic efficiency is a measure of how a cell's liner is performing. This equation considers *all* the LDS volume to be leakage through the primary liner, which is a conservative measure. In the *Report on the 1995 Workshop on Geosynthetic Clay Liners* (EPA 1996), several sources of flow from leak detection layers were identified. These sources include:

- Top liner leakage.
- Construction water and compression water.
- Consolidation water.
- Water from groundwater infiltration.

As stated previously, the LDS in all cells but Cells 1 and 6 were dry in 2025, and no water accumulation occurred in those LDS 5-gallon containers resulting in an LDS volume equal to 0 for the purposes of calculating the liner efficiency. Since 2019, liner efficiencies of only those cells that had LDS volumes greater than 0 are reported (Cells 1 and 6 for 2025). In the following table, Cell 1 is reported slightly less than 100% for the third quarter of 2025. Cell 6 is reported at slightly less than 100% in the first, third, and fourth quarters of 2025. This is because the water collected in the 5-gallon containers was sufficient to calculate a liner efficiency of less than 100%.

Apparent Liner Efficiency (Percent), Quarterly for 2025

Quarter	Cell 1	Cell 6
First	100.00	99.70
Second	100.00	100.00
Third	99.93	99.83
Fourth	100.00	99.79

A.5.1.4 HTW Water Yields

HTW water yields are monitored at each cell to document trends in perched-water purge volumes. In 2025, the HTWs were purged twice (March and September). Average annual purge water yields from the HTWs ranged from 0 gallons beneath Cell 8 to 1,050 gallons beneath Cell 5 as shown in the table. The HTW water yields will continue to be tracked and factored into the OSDF leak detection evaluation, where appropriate. Further information (total volumes pumped, number of months purged, and the average monthly purge volume) is provided in each cell's subattachment.

Horizontal Till Well Purge Events for 2025

Location ID	Cell	First Half Purge March 17, 2025 (gallons)	Second Half Purge September 15, 2025 (gallons)	Annual Total (gallons)	Annual Average (gallons)
12338	Cell 1	180	165	345	173
12339	Cell 2	780	790	1,570	785
12340	Cell 3	645	200	845	423
12341	Cell 4	580	460	1,040	520
12342	Cell 5	1,050	1,050	2,100	1,050
12343	Cell 6	330	200	530	265
12344	Cell 7	820	840	1,660	830
12345	Cell 8	Dry	Dry	Dry	Dry
	Totals	4,385	3,705	8,090	

A.5.2 Water Quality: Data Presentations and Evaluations

The water quality and data presentations and evaluations presented in this report are as follows:

- Semiannual Monitoring Summary Statistics (Section A.5.2.1)
- Concentration Plots (Section A.5.2.2)
  - LCS, LDS, and HTW of each cell
  - HTW and GMA wells of each cell
- Control Charts (Section A.5.2.3)
- Bivariate Plots (Section A.5.2.4)
- Upward Concentration Trends in the HTW and GMA Wells (Section A.5.2.5)

A.5.2.1 Semiannual Monitoring Summary Statistics

Water quality within each cell is sampled in the LCS and LDS. Water quality beneath each cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present results. Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell. With EPA and Ohio EPA concurrence, monitoring changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017 (total uranium, boron, sodium, sulfate, calcium, lithium, magnesium, nitrate + nitrite as nitrogen, potassium, selenium, technetium-99, total dissolved solids, and total organic halogens). All 13 parameters are sampled in the GMA wells; 4 of the 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW for each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 (OAC 3745-27-10) was eliminated beginning in January 2017 with EPA and Ohio EPA concurrence.

Summary statistics for all the parameters monitored semiannually are provided in Subattachments A.5.1 through A.5.8 (Tables A.5.1-1 through A.5.8-1). The information provided in each summary table is based on a standardized quarterly sampling frequency. Baseline data are included in the summary statistics. A discussion of data collected for the OSDF is provided in the GWLMP (Attachment C of the LMICP).

A summary of the statistical process used is illustrated in Figure A.5-5. Table A.5-2 lists the rules that are used to report the data provided in Tables A.5.1-1 through A.5.8-1 in each subattachment. For analytical results below the detection limit, one-half the detection limit was used in calculations of the average, standard deviation, distribution, trend, serial correlation, and outliers. One objective in conducting the summary statistics is to identify the parameters that meet the requirements for control charts (i.e., greater than eight samples, normal or lognormal distribution, no trend, and no serial correlation).

Data used in the summary statistics were "quarterized" (i.e., normalized to quarterly data). The rationale is that during different periods, data were collected at varying time intervals. For example, from October 30, 1997, through December 8, 1997, 15 samples were collected for total uranium from HTW 12338. In all of 1998, only four were collected; in 1999, there were seven; in 2000, there were six; and four each were collected in 2001 through 2003. To summarize, in a 5- to 6-week period in 1997, nearly as much data were collected as were collected from 1998 to 2000. Without normalizing the data, the periods with more sampling activity would carry more weight and, therefore, with respect to the calculations, would be considered more important. Additionally, sampling the same well at too short of an interval (often just 1 day apart in 1997) also violated the statistical assumption of independence. Well data that are collected too closely in time are serially correlated and can distort the statistics underlying the control charts. Even with quarterly sampling, there is often an issue with serial correlation.

Statistical calculations were conducted using ChemStat version 6.3 (a Starpoint Software program, www.pointstar.com). ChemStat software is also used to perform the statistical analysis of groundwater monitoring data at Resource Conservation and Recovery Act facilities.

Dataset distributions were checked using the Shapiro-Wilk test (95% confidence interval) for datasets with fewer than 50 samples and the Shapiro-Francia test (95% confidence interval) for datasets with 50 samples or more. The Mann-Kendall test for trend (95% confidence interval) was used to determine the presence of either an upward or downward concentration trend over time. The rank Von Neumann test (confidence interval of 99%) was used to check for serial correlation.

As discussed in the *Fernald Preserve 2015 Site Environmental Report* (DOE 2016), low flow rates, coupled with LDS collection tanks that are open to the atmosphere, can bias analytical results high for some constituents and low for others. Because of the low-flow conditions, it is uncertain whether an LDS sample collected from a valve house tank truly represents the composition of an LDS sample from within the facility. Collecting water quality samples from the LDS and using the data to statistically demonstrate that the facility is operating as designed does not appear to be the best approach for complying with Ohio Solid Waste Regulations (OAC 3745-27-19[M][5]) for the OSDF. As stated in the GWLMP of the 2023 LMICP (DOE 2023), monitoring accumulation rates from the LDS against established design and agreed-to administrative action rates is a much better approach. It should be noted that the

installation of sampling ports on the LDS lines in late 2022 through early 2023 so that a sample can be directed into a 5-gallon container improved the sample collection process for the LDS beginning in 2023. But it should also be noted that the LDS lines continue to dry up, and in 2025, only Cell 1 and 6 had enough water present to collect a sample.

A.5.2.2 Concentration Plots

Concentration plots for the parameters monitored semiannually in 2025 are presented in Subattachments A.5.1 through A.5.8. The plots are presented with a common vertical *y* scale based on the parameter. Outliers identified in Subattachments A.5.1 through A.5.8 in Tables A.5.1-1 through A.5.8-1 are not plotted on the concentration plots.

Table A.5-3 provides an OSDF groundwater, leachate, and LDS monitoring summary. As shown in Table A.5-3 no new high total uranium concentrations were measured in 2025.

A.5.2.3 Control Charts

Intrawell control charts employ historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared “not in control” if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to interpret control charts: the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with at least eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM (*h*) limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit (*h*) on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit (*h*). This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit (*h*).

Fifteen Shewhart-CUSUM control charts were prepared in 2025 and are presented in Subattachments A.5.1 through A.5.8 for parameters monitored semiannually in the HTW and GMA wells in 2025 that had datasets that achieved control chart criteria (i.e., more than eight samples, normal or lognormal distribution, no trend, and no serial correlation). All of the 15 control charts exhibited "in control" conditions.

A.5.2.4 Bivariate Plots

Bivariate plots are used in an Alternate Source Determination capacity to show that water quality changes observed beneath the facility in HTW and GMA wells are not attributed to facility performance. Sodium and total uranium were selected because this combination provides a good distinction between LCS, LDS, and HTW. This combination was discovered during the Common Ion Study (DOE 2008). Although the sodium–uranium bivariate plot for Cell 8 provides a distinction between the LDS and HTW, the separation shown between the LDS and HTW is not as distinct as it is for the other seven cells; therefore, a sulfate–uranium bivariate plot is also provided for Cell 8. In 2020, the uranium concentration in the LCS of Cell 1 decreased enough to place it in the area of the bivariate plot occupied by HTW samples. An additional bivariate plot of sodium–sulfate is provided for Cell 1 to illustrate that the sodium and sulfate concentrations indicate that the LCS and HTW zones are not mixing. Other combinations may be added in the future, if deemed appropriate.

Bivariate plots are presented for each cell in Subattachments A.5.1 through A.5.8. The bivariate plots illustrate the concentration signatures in each monitoring horizon. Distinct clustering of horizon concentrations indicates that the fluids in the different horizons are not mixing. In response to an Ohio EPA comment on the *Fernald Preserve 2009 Site Environmental Report* (DOE 2010) (Ohio EPA Comment Number 35), the closest points between monitoring horizons were dated until 2018. Beginning with the *Fernald Preserve 2018 Site Environmental Report* (DOE 2019), an arrow is provided on the plots from the first to most recent sample result for each monitoring horizon. The dates of the first and most recent sample plotted are also posted for each sampling horizon.

The bivariate plots for 2025 continue to support the interpretation that chemical signatures for the different monitoring horizons are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in 2025 (HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell not related to cell performance.

In light of the water quality sampling challenges discussed in the 2016 Site Environmental Report (DOE 2017), DOE conducted an assessment to determine whether the continued use of bivariate plots with data from the LDS is still warranted. Assessment results indicated that bivariate plots were a valuable tool for assessing whether the monitoring zones are mixing (Geochemical Consultants 2016). Now that the LDS volume can be more accurately measured following the 2023 completion of the OSDF valve house piping project, and with 6 of 8 cells showing no flow in the LDS, the importance of the bivariate plots to evaluate mixing between the horizons has become a secondary evaluation measure. DOE will continue to assess LDS flow data as a primary function in the evaluation of mixing and the use of bivariate plots as a secondary measure to augment evaluation of OSDF performance when and where appropriate.

A.5.2.5 Upward Concentration Trends in the HTW and GMA Wells

The HTW is beneath the liner penetration box of each cell by design. This area of the liner penetration box is the lowest elevation point of each cell and potentially the weakest point in the cell design. If a leak were to develop, it should be detected beneath the liner penetration box first. Therefore, the water quality in the HTW represents the first line of evidence that a potential leak from the cell might be occurring. A leak would be indicated by an increasing concentration trend in the HTW.

GMA monitoring wells are positioned (and identified) for pre-aquifer-remediation flow conditions defined in the *Remedial Investigation Report for Operable Unit 5* (DOE 1995). Water level data reported in the *Remedial Investigation Report for Operable Unit 5* indicate that, before the start of pumping for the groundwater remediation, groundwater flow directions in the vicinity of the OSDF were generally from west to east.

Groundwater flow beneath the OSDF is currently being influenced by active pumping taking place for the groundwater remediation southwest of the OSDF. Water beneath the OSDF is generally moving in response to this pumping from northeast to southwest. When pumping for the groundwater remedy stops, groundwater flow in the vicinity of the OSDF should once again return to a direction that is generally from west to east, assuming that no other factors external to the site influence groundwater flows. Trends are therefore being tracked in all GMA wells at this time.

An increasing concentration trend in a HTW or GMA monitoring well could be attributed to a possible leak from the OSDF. In addition, increasing concentration trends in the HTW or GMA wells could also be caused by fluctuating ambient concentrations beneath the cells, and not connected to the operation of the facility.

As presented in Subattachments A.5.1 through A.5.8, several parameter datasets have upward concentration trends beneath the OSDF (i.e., HTW and GMA wells). Bivariate plots (uranium–sodium, uranium–sulfate, and sodium–sulfate) indicate separate and distinct chemical signatures for the LCS, LDS, and HTW of all eight cells when considering the latest respective data collected. Additionally, there is no flow in the LDS in 6 of the 8 cells. This indicates that water is not mixing from inside the facility to outside the facility, leading to the conclusion that the facility is not leaking. Therefore, concentration increases observed in the HTW and GMA wells are attributed to fluctuating ambient concentrations beneath the cells and not to cell performance. Additional information is provided in Subattachments A.5.1 through A.5.8.

A.5.3 Cell Cap Inspections

OSDF cell cap inspections are conducted quarterly and include the toe of the side slopes, the drainage features around the base of the cell cap, and the fence line. In 2025, inspections were completed in March, June, September, and December. The annual cap walkdown was completed in March following the OSDF cap prescribed burn. The inspection team typically includes representatives from Ohio EPA, Ohio Department of Health, and site staff. Issues identified during inspections typically include the presence of woody vegetation, the presence of invasive herbaceous vegetation, animal burrows or digging, rocks that surface as topsoil settles, minor erosion, and small discrete sections of limited vegetation growth. The prescribed burn of the OSDF cap allowed greater visibility of these issues. Section 5.1 provides additional information regarding the OSDF cap inspections.

The issues are addressed as follows:

- Woody vegetation is cut and stumps are treated with herbicide
- Herbicide is applied to invasive herbaceous vegetation
- Animal burrows and holes are filled in and reseeded, if necessary
- Rocks greater than 4 inches in diameter are removed

In 2025, there were no visual signs that the integrity of the cap had been compromised.

A.5.4 LCS and LDS Camera Inspection

As required by the GWLMP, a camera inspection of the LCS, redundant leachate collection system (RLCS), and LDS lines was conducted in 2025. The lines have been previously inspected in 2010 and 2015.

Ohio Administrative Code (OAC) 3745-27-19(k)(3) is the driver for the video survey and states that the routine inspection of the pipe network shall be annual until final closure to ensure that clogging or crushing of the pipe during construction has not occurred. Final closure of the OSDF occurred in 2006, therefore, the annual inspection requirement is no longer applicable. However, DOE continued inspections as a best management practice to ensure effective operations of the OSDF leachate and leak detection system.

Previous inspections were conducted in 2010 and 2015. When inspections occur, the LCS, RLCS, and LDS lines are inspected between the valve house and the first 100 ft of the subdrain pipe inside the cell (at a minimum). Since the subdrain pipe is approximately 200 ft from the OSDF valve houses, this results in camera surveys that generally exceed 300 linear feet in length. The portion of the pipe beyond this point inside the cell is considered redundant because gradation for the LCS granular drainage material is designed to limit the level of leachate on the geomembrane liner to less than 1 ft (0.3 meter) without need for a subdrain pipe.

The 2010 video survey revealed notable accumulation of construction pipe bed gravel and scale. Based on the results of that survey, a cleaning of all lines was performed in 2011.

The 2015 video survey found no significant additional scale or infiltration of gravel in the pipes and no change in pipe integrity or signs of structural impacts (i.e., crushing or ovality). The OSDF engineer of record, Geosyntec Consultants, Inc. (Geosyntec), reviewed the camera survey results and concluded that the facility conditions were stable and the video survey interval could be extended to once every 10 years (Geosyntec 2015). Geosyntec also calculated the primary soil consolidation as 95% complete after 8.4 years, indicating that pipe slopes should not change significantly in the future.

The 2025 video survey also found no infiltration of gravel in the pipes and that there was no change in pipe integrity or signs of structural impacts (i.e. crushing or ovality). Scale buildup on the interior of the pipes was identified and estimated to be 5-15% in limited areas but this observation does not appear to impact pipe perforations and/or leachate line performance. It was determined that there was no need to clean out any of the lines. Geosyntec assisted in the review that concluded that the facility conditions remain stable. Several suggestions were made during the review of the 2025 results with the intent of improving the consistency of the surveys between events (e.g., speed at which the camera moves during the survey, the collection of more still photos of certain areas, etc.). DOE is in the process of incorporating these suggestions into the LMICP so that they can be carried forward and used during the next video survey.

A.5.5 Summary of Overall Performance and Findings and Recommendations

Based on LCS and LDS flow data, the engineered cap, liners, and drainage features within the OSDF continue to perform as designed. There was no flow in the LDS of 6 of the 8 cells. Separate and distinct chemical signatures for total uranium and sodium in the LCS, LDS, and HTW of each cell for which data are available (total uranium and sulfate in Cell 8, sodium sulfate in Cell 1) indicate that waters from the different horizons are not mixing, and, therefore, it can be inferred that the primary and secondary liners are not leaking. Water quality constituent concentration increases noted in the HTW and GMA wells are attributed to fluctuating ambient concentrations beneath the OSDF and not to OSDF performance. Surface inspections conducted in 2025, which allowed for enhanced visual observation of the surface soil cap after the successful prescribed burn, showed no visual signs that the integrity of the cap had been compromised in any way. It is therefore recommended that the only action to take at this time concerning the OSDF is to continue monitoring the facility as prescribed in the GWLMP.

Specific Findings:

- LCS volumes continue to diminish with time. Total facility leachate volume in 2025 was 2.3% less than in 2024 (approximately 89,076 gallons in 2025 compared with 91,155 gallons in 2024).
- In 2025, there was not enough water in the LDS of any cell, with the exception of Cell 1 and Cell 6, to collect a water sample.
- It should be noted that from 2011 to 2024 the volume of water in the LDS tank of Cell 1 had been insufficient to collect a sample. In 2025, the LDS had enough water to be sampled once. This occurred right after the line had been video surveyed. It is suspected that the movement of the camera out of the LDS line potentially dislodged sediment, allowing water to flow out of the line. Additional discussion is provided in Subattachment A.5.1.

- The maximum LDS accumulation rate for 2025 (Cell 6) indicates that the liner system is performing as designed. The estimated LDS maximum accumulation rate calculated in 2025 was 0.0977 gpad in Cell 6, approximately 0.49% of the initial response leakage rate of 20 gpad, and 4.9% of the low-flow response leakage rate of 2 gpad.
- Quarterly apparent liner efficiencies were 100% for all cells in 2025 with the exception of Cell 1 and Cell 6. The apparent liner efficiency of Cell 1 ranged from 99.93% (third quarter) to 100% (first, second, and fourth quarter) in 2025. The apparent liner efficiency of Cell 6 ranged from 99.7% (first quarter) to 100% (second quarter) in 2025.
- No sampling location had new high total uranium concentrations in 2025.
- Bivariate plots continue to show that the chemical signatures for uranium, sulfate, and sodium in the LCS, LDS, and HTW are separate and distinct, indicating that:
  - Mixing between the horizons is not occurring; therefore, concentration changes measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.
- In 2025, 15 datasets met the criteria for Shewhart-CUSUM control charts. All control charts exhibited "in control" conditions.
- In 2025, quarterly physical inspections of the OSDF and annual full cap walkdown revealed no visual signs that the integrity of the OSDF cap had been compromised.
- In 2025, a video inspection was conducted of the LCS, RLCS, and LDS lines of the OSDF. No significant infiltration of gravel were observed in the lines. There was no visible change in pipe integrity or signs of structural impacts (i.e. crushing or ovality). Moderate scaling was observed but determined to not have an impact on performance and operation of the leachate collection system. After review of the inspection information, it was determined that there was no need to clean out any of the lines. Several suggestions were made during the review of the 2025 results with the intent of improving the consistency of the surveys between events (e.g., speed at which the camera moves during the survey). DOE will incorporate these changes into the LMICP for use during the future video surveys.

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Table A.5-1. OSDF Initiation and Completion Dates

Cell	Sample Initiation per Horizon[a]	Waste Placement Initiation	LDS Volume Measurement Initiation[b]	Cap Geomembrane Layer Completion[c]	Cap Completion[d]
1	LCS: February 17, 1998 LDS: February 18, 1998 HTW: October 30, 1997 GMA-U: March 31, 1997 GMA-D: March 31, 1997	December 23, 1997	May 1999	August 17, 2001	December 20, 2001
2	LCS: November 23, 1998 LDS: December 14, 1998 HTW: June 29, 1998 GMA-U: June 30, 1997 GMA-D: June 25, 1997	November 12, 1998	May 1999	July 17, 2003	November 12, 2003
3	LCS: October 13, 1999 LDS: August 26, 2002 HTW: July 28, 1998 GMA-U: August 24, 1998 GMA-D: August 24 1998	October 26, 1999	October 1999	July 16, 2004	September 20, 2004
4	LCS: November 4, 2002 LDS: November 4, 2002 HTW: February 26, 2002 GMA-U: November 6, 2001 GMA-D: November 5, 2001	November 08, 2002	November 2002	December 18, 2004	April 29, 2005
5	LCS: November 4, 2002 LDS: November 4, 2002 HTW: February 26, 2002 GMA-U: November 6, 2001 GMA-D: November 5, 2001	November 19, 2002	November 2002	June 22, 2005	August 29, 2005
6	LCS: October 27, 2003 LDS: October 27, 2003 HTW: March 14, 2003 GMA-U: December 16, 2002 GMA-D: December 16, 2002	November 18, 2003	January 2004	October 28, 2005	January 12, 2006

Table A.5-1. OSDF Initiation and Completion Dates (continued)

Cell	Sample Initiation per Horizon[a]	Waste Placement Initiation	LDS Volume Measurement Initiation[b]	Cap Geomembrane Layer Completion[c]	Cap Completion[d]
7	LCS: September 2, 2004 LDS: September 2, 2004 HTW: February 24, 2004 GMA-U: January 21, 2004 GMA-D: January 21, 2004	September 9, 2004	September 2004	July 2006	October 25, 2006
8	LCS: October 18, 2004 LDS: October 18, 2004 HTW: May 19, 2004 GMA-U: March 31, 2004 GMA-D: March 31, 2004 GMA-SW: August 22, 2005 GMA-SE: August 22, 2005	December 2, 2004	December 2004	September 24, 2006	October 25, 2006

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; GMA-D = downgradient Great Miami Aquifer; GMA-SW = southwest Great Miami Aquifer; and GMA-SE = southeast Great Miami Aquifer
[b]Prior to 1999, overall LDS volumes were measured. From 1999 on, LDS volumes were measured by cell.
[c]The cap geomembrane layer is made of high density polyethylene.
[d]Cap completion includes seeding.

Table A.5-2. Rules for Summary Statistics for Cells 1 Through 8

Rules	No. of Detected Samples	Total No. of Samples	Percent of Detects	Minimum [a,b]	Maximum [a,b]	Average	Standard Deviation	Distribution Type	Trend	Serial Correlation	Outliers
Include outliers	Yes	Yes	Yes	No	No	No	No	No	No	No	
Only one result	Yes	Yes	Yes	report "NA"	report value	report "Insufficient"	report "Insufficient"	report "Insufficient"	report "Insufficient"	report "Insufficient"	
Only two results	Yes	Yes	Yes	report value	report value	report "Insufficient"	report "Insufficient"	report "Insufficient"	report "Insufficient"	report "Insufficient"	
All non-detects	Yes	Yes	Yes	report "ND"	report "NA"	report "Insufficient"	report "Insufficient"	report "Insufficient"	report "Insufficient"	report "Insufficient"	
Other rules						Need 3 detections otherwise report "Insuff"	Need 4 detections otherwise report "Insuff"	Need at least 3 samples to report distriburtion	Need at least 4 detects to report trend	Need at least 6 samples to report serial correlation	Need at least 4 samples to report outliers
Other rules						If distribution is "Lognormal," substitute "LogMean"					
Other rules						If distribution is "Undefined," substitute "Median"					

[a]NA=not applicable; ND=not detected

[b]If reported value is a nondetected result, report ND.

Table A.5-3. OSDF Groundwater, Leachate, and LDS Monitoring Summary

Cell (Waste Placement)	Monitoring Location	Monitoring Zone	Date Sampling Started	Total Number of Samples	Range of Total Uranium Concentrations[a,b] (µg/L)	First Half 2025[a,c] (µg/L)	Second Half 2025[a,c] (µg/L)	Historical Trend[d] (Year Last Sampled)
Cell 1 (Dec 1997)	12338C	LCS	Feb 17, 1998	82	ND–206	7.91	15.8	None (2025)
	12338D	LDS	Feb 18, 1998	38	1.50–37.0	DRY	27.9	Up (2025)[e]
	12338	Glacial Till	Oct 30, 1997	91	ND–19.0	6.67	7.45	Up (2025)
	22201	Great Miami Aquifer	Mar 31, 1997	98	ND–12.4	8.41	6.74	Up (2025)
	22198	Great Miami Aquifer	Mar 31, 1997	149	0.540–15.2	2.73	2.80	Down (2025)
Cell 2 (Nov 1998)	12339C	LCS	Nov 23, 1998	78	4.51–686	19.1	23.3	Up (2025)
	12339D	LDS	Dec 14, 1998	29	4.08–25.8[f]	DRY	DRY	None (2013)
	12339	Glacial Till	Jun 29, 1998	102	ND–36.9	14.5	17.1	Up (2025)
	22200	Great Miami Aquifer	Jun 30, 1997	93	ND–4.69	0.237	0.181	Up (2025)
	22199	Great Miami Aquifer	Jun 25, 1997	126	ND–12.1	0.487	0.433	Down (2025)
Cell 3 (Oct 1999)	12340C	LCS	Oct 13, 1999	76	9.27–206	161	154	Up (2025)
	12340D	LDS	Aug 26, 2002	20	8.90–27.7[f]	DRY	DRY	Down (2007)
	12340	Glacial Till	Jul 28, 1998	35	ND–58.5	13.8	14.4	None (2025)
	22203	Great Miami Aquifer	Aug 24, 1998	88	ND–23.6	22.4	9.09	Up (2025)
	22204	Great Miami Aquifer	Aug 24, 1998	121	ND–22.9	4.28	3.98	Up (2025)
Cell 4 (Nov 2002)	12341C	LCS	Nov 04, 2002	62	4.41–234	75.2	81.3	None (2025)
	12341D	LDS	Nov 04, 2002	41	5.74–79.8	DRY	DRY	Up (2022)
	12341	Glacial Till	Feb 26, 2002	75	**2.89**–7.91	**2.89**	3.31	Down (2025)
	22206	Great Miami Aquifer	Nov 06, 2001	79	ND–5.78	0.662	1.31	Up (2025)
	22205	Great Miami Aquifer	Nov 05, 2001	108	0.446–19.7	0.924	5.86	None (2025)
Cell 5 (Nov 2002)	12342C	LCS	Nov 04, 2002	64	3.39–285	106	98.9	None (2025)
	12342D	LDS	Nov 04, 2002	40	2.93–27.1	DRY	DRY	Down (2013)
	12342	Glacial Till	Feb 26, 2002	76	**6.49**–21.1	**6.49**	8.48	Down (2025)
	22207	Great Miami Aquifer	Nov 06, 2001	79	ND–4.48	0.327	0.273	Down (2025)
	22208	Great Miami Aquifer	Nov 05, 2001	107	ND–2.10	0.346	0.310	None (2025)

Table A.5-3. OSDF Groundwater, Leachate, and LDS Monitoring Summary (continued)

Cell (Waste Placement)	Monitoring Location	Monitoring Zone	Date Sampling Started	Total Number of Samples	Range of Total Uranium Concentrations[a,b] (µg/L)	First Half 2025[a,c] (µg/L)	Second Half 2025[a,c] (µg/L)	Historical Trend[d] (Year Last Sampled)
Cell 6 (Nov 2003)	12343C	LCS	Oct 27, 2003	61	8.03–276	99.4	113	Down (2025)
	12343D	LDS	Oct 27, 2003	59	3.1–160	53.6	53.8	Up (2025)
	12343	Glacial Till	Mar 14, 2003	68	ND–24.2	6.44	4.50	None (2025)
	22209	Great Miami Aquifer	Dec 16, 2002	74	ND–2.43	0.422	0.431	None (2025)
	22210	Great Miami Aquifer	Dec 16, 2002	102	ND–1.02	0.520	0.672	None (2025)
Cell 7 (Sep 2004)	12344C	LCS	Sep 02, 2004	57	4.72–355	126	135	Down (2025)
	12344D	LDS	Sep 02, 2004	29	12.2–169[f]	DRY	DRY	Up (2015)
	12344	Glacial Till	Feb 24, 2004	65	0.674–12.1	3.50	4.46	Up (2025)
	22212	Great Miami Aquifer	Jan 21, 2004	67	ND–5.53	0.461	0.470	None (2025)
	22211	Great Miami Aquifer	Jan 21, 2004	92	ND–4.31	0.549	0.327	None (2025)
Cell 8 (Dec 2004)	12345C	LCS	Oct 18, 2004	54	1.51–335	142	150	Down (2025)
	12345D	LDS	Oct 18, 2004	45	9.38–315	DRY	DRY	Up (2021)
	12345	Glacial Till	May 19, 2004	20	3.48–7.30	DRY	DRY	Up (2008)
	22213	Great Miami Aquifer	Mar 31, 2004	66	ND–0.710	0.374	0.491	Up (2025)
	22214	Great Miami Aquifer	Mar 31, 2004	92	ND–2.95	0.296	1.62	None (2025)
	22215	Great Miami Aquifer	Aug 22, 2005	57	ND–16.4	0.483	0.390	None (2025)
	22217[g]	Great Miami Aquifer	Aug 22, 2005	54	ND–18.3	1.91	5.11	None (2025)

Note: The data on this table represent the raw data from the database. However, data presented in the Attachment A.5 subattachments have gone through a statistical processing and analysis. In regard to the statistical processing, the data were quarterized (normalized to one result per quarter) and outliers were removed to arrive at an accurate distribution model. Because of the processing, the total number of samples and range of concentrations on this table might not match the text, tables, and figures in Attachment A.5. The rules used for the statistical processing and analysis in Attachment A.5 are discussed in Section A.5.2.1, and the results are summarized in Table A.5-2.

Note: Uranium concentration versus time graphs can be found in the Attachment A.5 subattachments. See Figures A.5.1-5A and A.5.1-5B for Cell 1; Figures A.5.2-5A and A.5.2-5B for Cell 2; Figures A.5.3-5A and A.5.3-5B for Cell 3; Figures A.5.4-5A and A.5.4-5B for Cell 4; Figures A.5.5-5A and A.5.5-5B for Cell 5; Figures A.5.6-5A and A.5.6-5B for Cell 6; Figures A.5.7-5A and A.5.7-5B for Cell 7; and Figures A.5.8-7A and A.5.8-7B for Cell 8.

[a] **Bold text indicates a new high or low detected in 2025**.
[b] ND = not detected.
[c] Where there are more than two data points for the half year, the higher result is used.
[d] The trends presented here are based on nonparametric Mann-Kendall procedure and come from the tables in Attachment A.5 subattachments for each cell. See Tables A.5.1-1, A.5.2-1, A.5.3-1, A.5.4-1, A.5.5-1, A.5.6-1, A.5.7-1, and A.5.8-1.
[e] Trend includes a sample result from second half of 2025. See Attachment A.5.1 which discusses the impact of the video survey.
[f] Some data are not considered representative of LDS in Cell 2 (December 14, 1998, through May 23, 2000, dataset) due to malfunction in Cell 2 leachate pipeline and resulting mixing of individual flows. It is suspected that some November 2004 samples were switched (i.e., 12339C with 12339D, and 12340C with 12340D). If data from these events were included above, maximum total uranium concentrations would be 71 µg/L for 12339D and 72.4 µg/L for 12340D. It is suspected that samples were switched in 2014 (i.e., 12344D with the field duplicate for 12345C). If the data point from this sampling event was not included above, maximum total uranium concentration for 12344D would be 37.6 µg/L.
[g] Monitoring location 22216 was plugged and abandoned in April 2006. Monitoring location 22217 is its replacement. The results listed for location 22217 also include the results for location 22216.

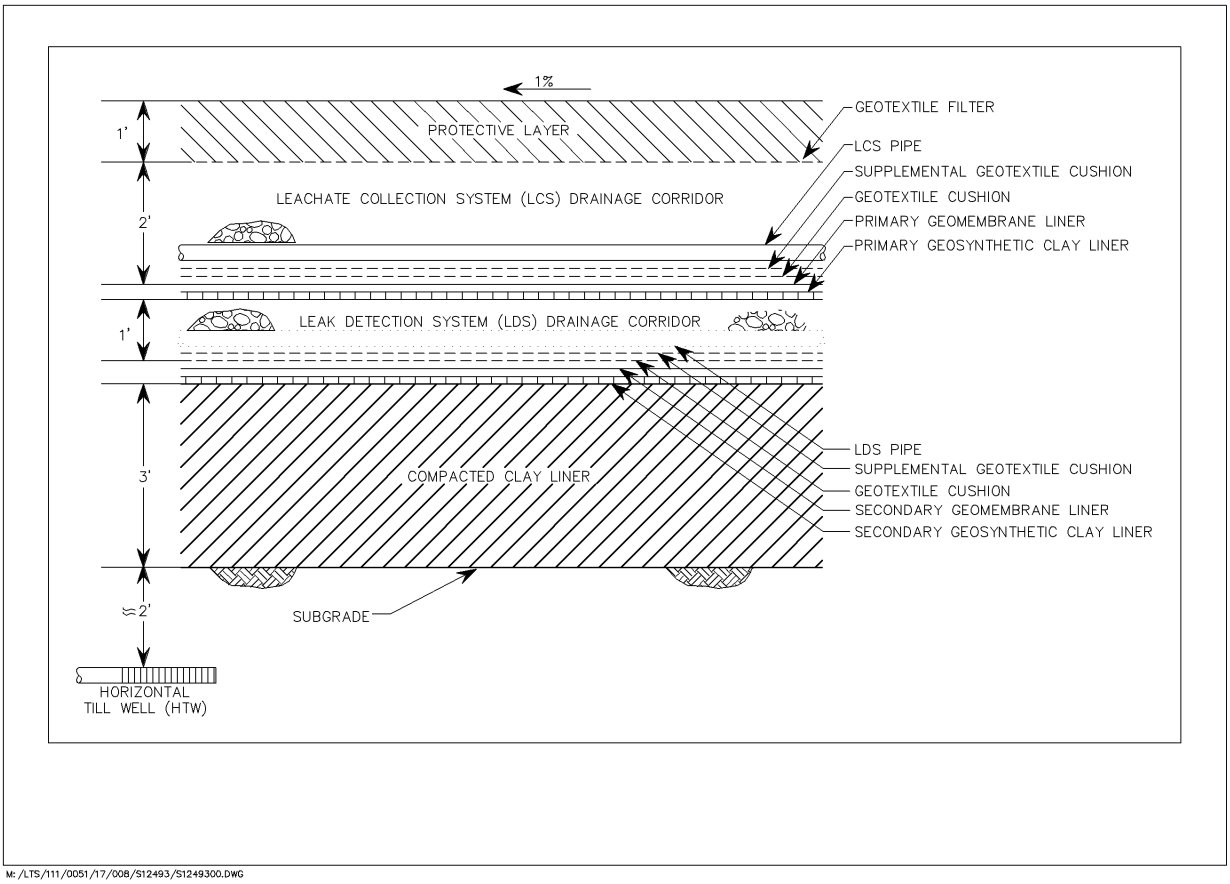


Figure A.5-1. Cross Section of OSDF Liner System with HTW at the Drainage Corridor

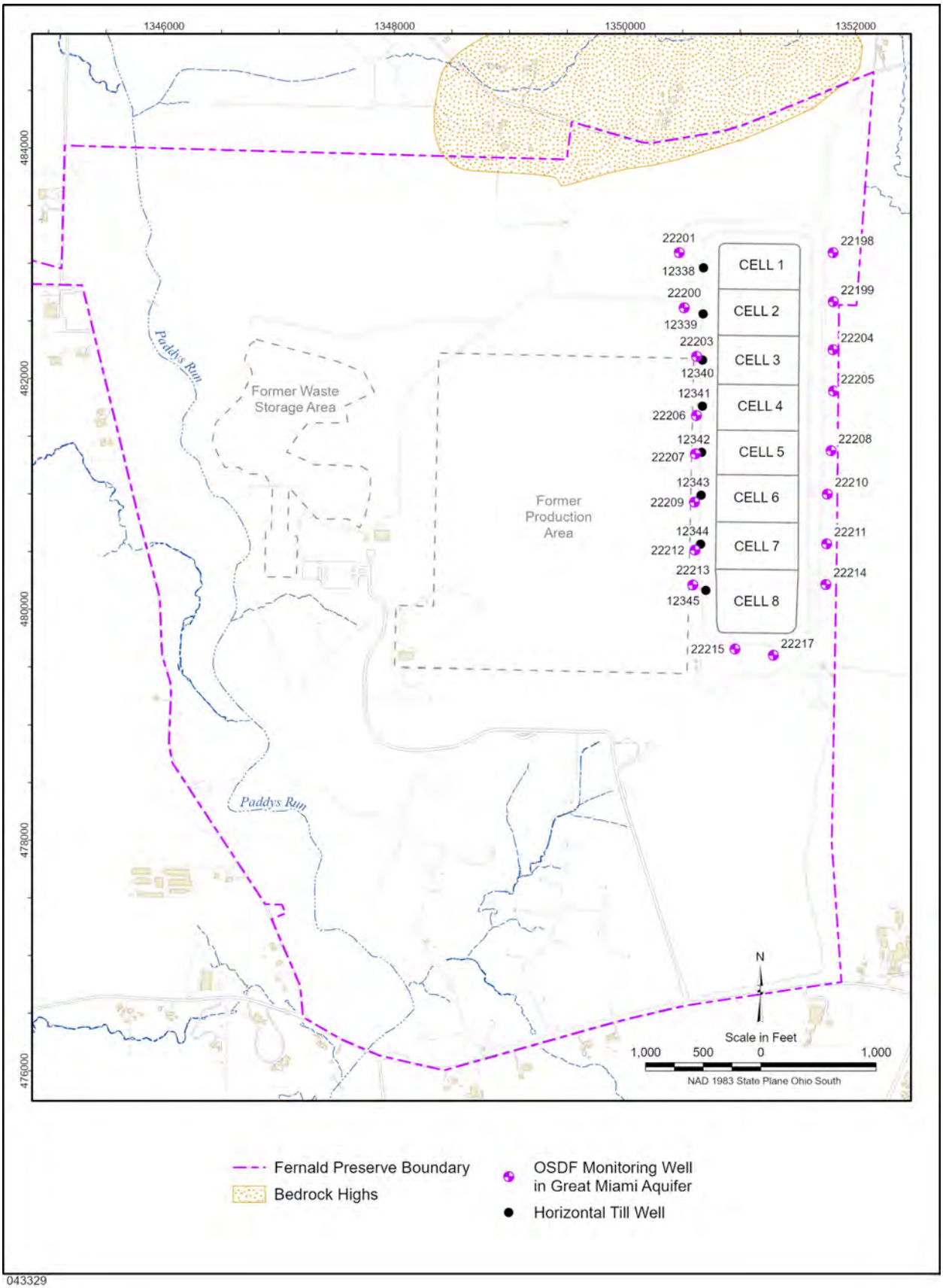


Figure A.5-2. OSDF Footprint and Monitoring Well Locations

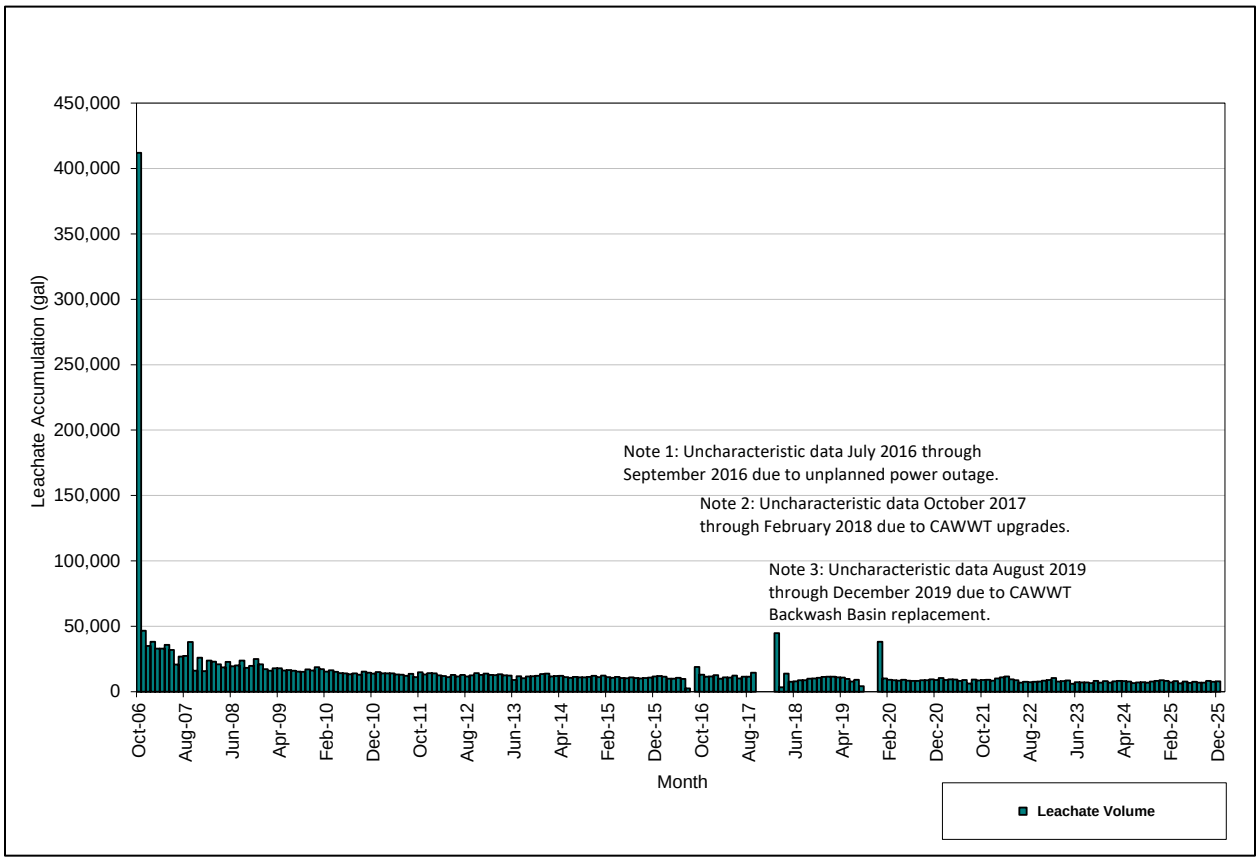


Figure A.5-3. OSDF Monthly LCS Flow (October 2006 Through December 2025)

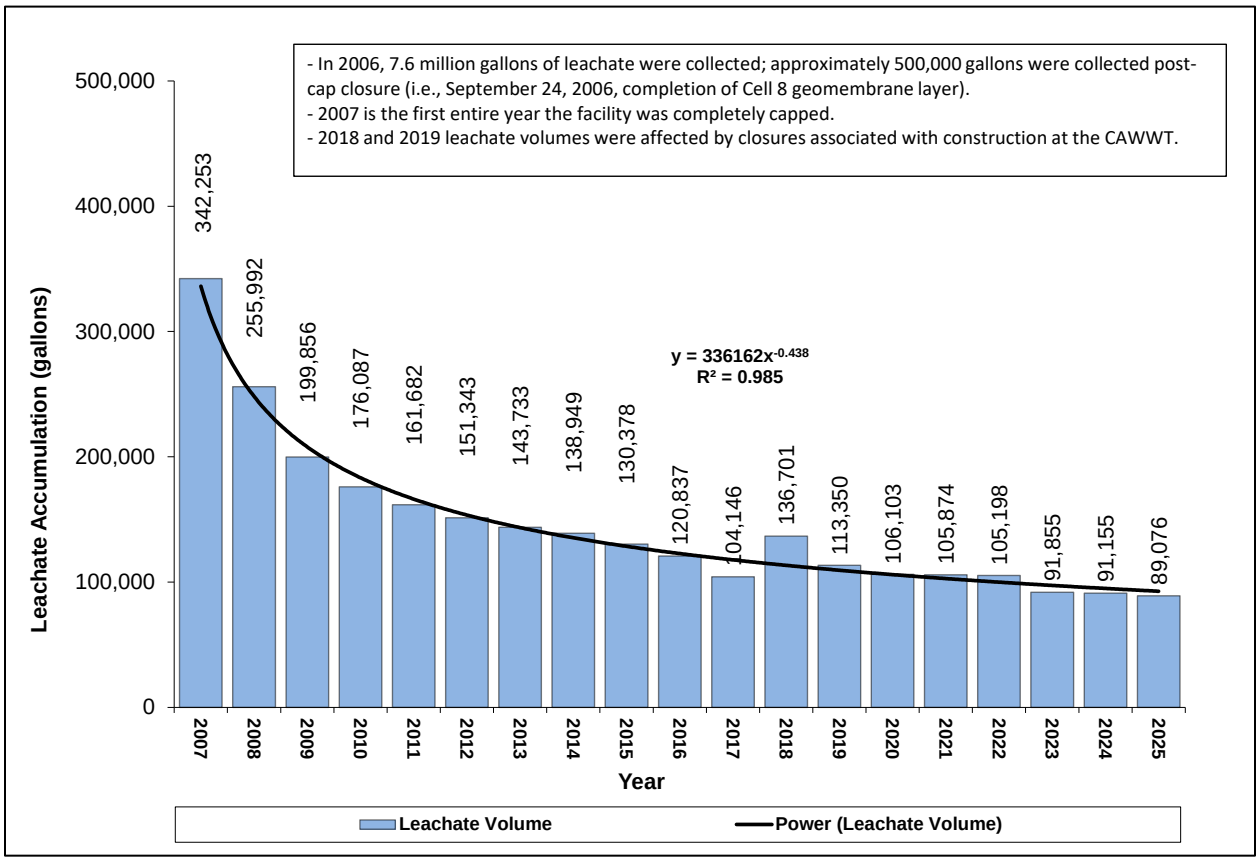


Figure A.5-4. OSDF Annual LCS Flow (2007 Through 2025)

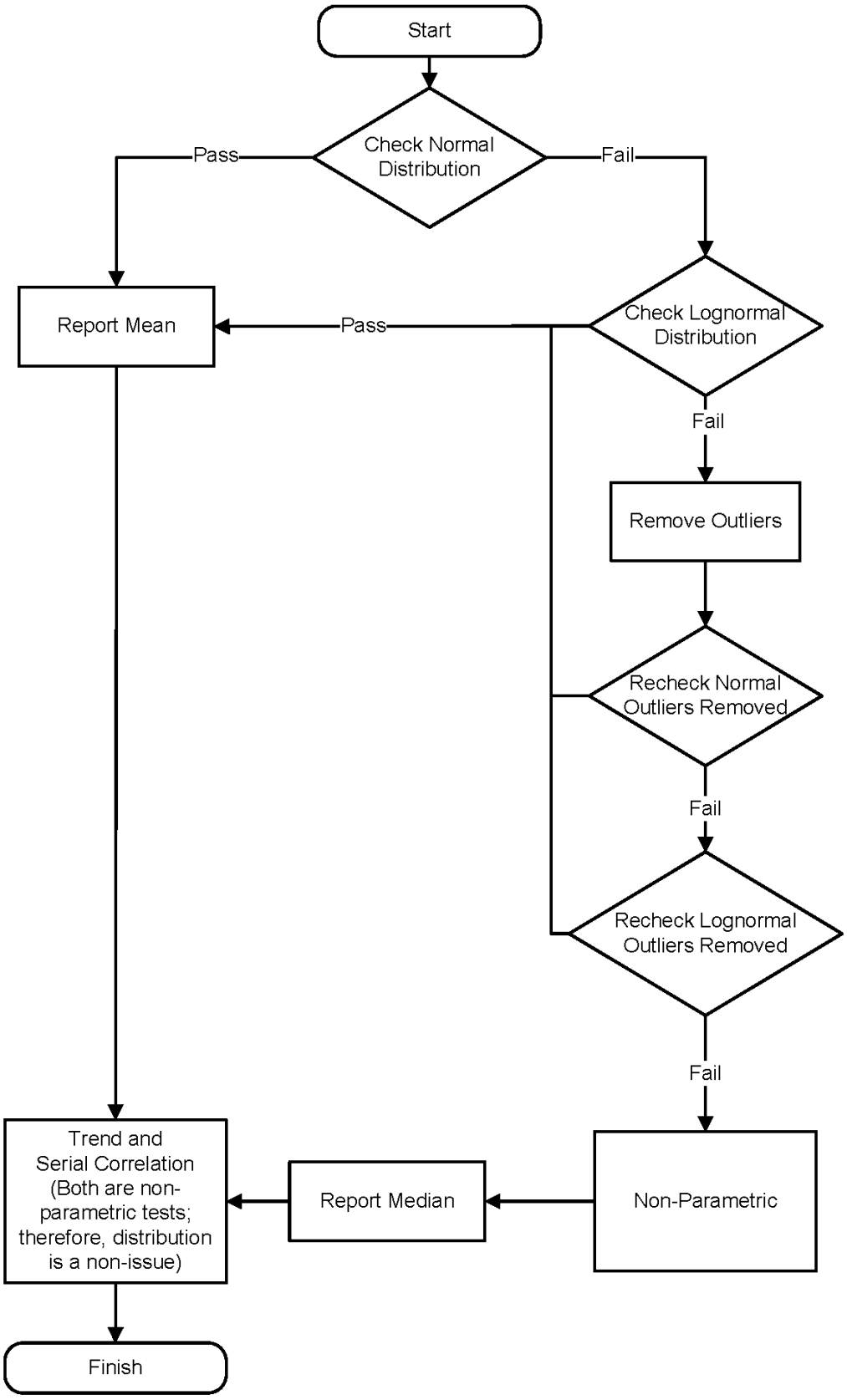


Figure A.5-5. OSDF Statistical Evaluation Process

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Subattachment A.5.1

Cell 1

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.1.1 Water Quality Monitoring Results 1
A.5.1.1.1 LCS and LDS Results 1
A.5.1.1.2 HTW and Monitoring Well Results 2
A.5.1.1.3 Discussion 3
A.5.1.2 Control Charts 3
A.5.1.3 Summary and Conclusions 4
A.5.1.4 References 4

Tables

Table A.5.1-1. Summary Statistics for Cell 1 5
Table A.5.1-2. OSDF Horizontal Till Well 12338 (Cell 1) Water Yield 6

Figures

Figure A.5.1-1. Monthly Accumulation Volumes for Cell 1 LCS 7
Figure A.5.1-2. Monthly Accumulation Volumes for Cell 1 LDS 7
Figure A.5.1-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 1 Upgradient Monitoring Well 22201 8
Figure A.5.1-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 1 Downgradient Monitoring Well 22198 8
Figure A.5.1-5A. Cell 1 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A.5.1-5B. Cell 1 Total Uranium Concentration Versus Time Plot for HTW, Upgradient GMA Well, and Downgradient GMA Well 9
Figure A.5.1-6A. Cell 1 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.1-6B. Cell 1 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.1-7A. Cell 1 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.1-7B. Cell 1 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.1-8A. Cell 1 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.1-8B. Cell 1 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.1-9. Cell 1 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.1-10. Cell 1 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.1-11. Cell 1 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.1-12. Cell 1 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.1-13. Cell 1 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.1-14. Cell 1 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.1-15. Cell 1 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.1-16. Cell 1 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.1-17. Cell 1 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.1-18. Cell 1 Bivariate Plot for Uranium and Sodium 17
Figure A.5.1-19. Cell 1 Bivariate Plot for Sodium and Sulfate 18
Figure A.5.1-20. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22201 19

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	upgradient Great Miami Aquifer
GMA-U	downgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about On-Site Disposal Facility (OSDF) Cell 1:

- Semiannual monitoring summary statistics (Table A.5.1-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.1-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.1-2)
- OSDF horizontal till well (HTW) 12338 water yield (Table A.5.1-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.1-3 and A.5.1-4)
- Plots of concentration versus time (Figures A.5.1-5A through A.5.1-17)
- A bivariate plot for total uranium–sodium (Figure A.5.1-18)
- A bivariate plot for sodium–sulfate (Figure A.5.1-19)
- Control chart (Figure A.5.1-20)

A.5.1.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and the LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining whether the OSDF was operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW for each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.1.1.1 LCS and LDS Results

As shown in Table A.5.1-1 and summarized below, three parameters in 2025 (uranium, sodium, and sulfate) had upward trends in the LCS and LDS based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 1

Parameter	LCS 12338C 2025 Trend[a]	LDS 12338D Trend (Year Last Sampled)
Uranium		Up (2025)
Sodium	Up	Up (2025)
Sulfate	Up	Up (2025)

[a] No entry indicates that the trend was not up.

It should be noted that from 2011 through the first half of 2025, the volume of water in the LDS tank of Cell 1 had been insufficient to collect a sample. During the September 17, 2025, sampling event the LDS had enough water to be sampled. This occurred following the September 8, 2025, LDS and LCS video survey which is planned every 10 years. It is suspected that the action of placing the camera into the lines, surveying to 300 feet within the line, and removing the camera potentially dislodged sediment, allowing water contained within the LDS to flow out of the line. The analytical results from the sampling event include several new maximum concentrations as presented below. It should be noted that the total uranium concentration from this sampling event was not a new maximum despite having an upward Mann-Kendall trend for total uranium in the LDS.

Parameter	Location	Previous High Concentration (mg/L)	New High Concentration (mg/L)	Mann Kendall Trend
Boron	LCS	1.72	2.81	Down
Sodium	LCS	22.0	34.8	Up
Sodium	LDS	896	1,580	Up
Sulfate	LDS	3,500	4,990	Up

A.5.1.1.2 HTW and Monitoring Well Results

As shown in Table A.5.1-1 and summarized below, five parameters (total uranium, boron, magnesium, nitrate + nitrite as nitrogen, and selenium) have upward trends in the HTW or the GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 1

Parameter	HTW 12338[a]	GMA-U[a,b] 22201	GMA-D[a,b] 22198
Total Uranium	Up	Up	
Boron		Up	
Magnesium		Up	
Nitrate + Nitrite as Nitrogen		Up	
Selenium		Up	Up

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.1.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 1 LCS, LDS, and HTW is provided in Figure A.5.1-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot for 2025 shows that the uranium concentrations measured in the LCS were 7.91 micrograms per liter (µg/L) and 15.8 µg/L. These uranium concentrations in the LCS are similar to uranium concentrations measured in the HTW in 2025. In 2025, the uranium concentrations measured in the HTW were 6.67 µg/L and 7.45 µg/L. An additional sodium–sulfate bivariate plot for Cell 1 LCS and HTW is provided in Figure A.5.1-19 for the period April 2014 to September 2025.

Figure A.5.1-19 shows that the chemical signatures for sodium and sulfate in the LCS and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.1.2 Control Charts

Intrawell control charts employ historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits: the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, a "not in control" condition should be based on the CUSUM (*h*) limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit (*h*). This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit (*h*).

As shown in Table A.5.1-1 in gray and summarized below, one parameter in the HTW and GMA wells of Cell 1 meets the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in one control chart (Figure A.5.1-20). The one control chart for Cell 1 indicates "in control" conditions for lithium.

Parameter	Monitoring Point[a]	Well Number	Assessment	Figure Number
Lithium	GMA-U	22201	In Control	A.5.1-20

[a] GMA-U = upgradient Great Miami Aquifer.

A.5.1.3 Summary and Conclusions

- Three parameters monitored semiannually within the facility in 2025 have an upward concentration trend in the LCS and LDS of Cell 1: uranium, sodium, and sulfate. It should be noted that from 2011 to 2024 the volume of water in the LDS tank of Cell 1 had been insufficient to collect a sample. On September 17, 2025, the LDS had enough water to be sampled once. This occurred following the September 8, 2025, video survey of the LDS. It is suspected that the movement of the camera out of the LDS line potentially dislodged sediment, allowing water to flow out of the line.
- As noted above, it is suspected that the movement of the camera out of the LDS line potentially dislodged sediment, allowing water to flow out of the line. This water was sampled, and a few new maximum concentrations were measured including boron (LCS), sodium (LCS and LDS), and sulfate (LDS).
- Although uranium had an up Mann-Kendall trend in the LDS, the concentration measured was not a new maximum high.
- Five parameters have an upward concentration trend beneath the facility in the HTW and GMA wells: total uranium, boron, magnesium, nitrate + nitrite as nitrogen, and selenium. Separate and distinct chemical signatures for sodium and sulfate in the LCS and HTW of Cell 1 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 1 (i.e., HTW and GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- One control chart was constructed for Cell 1 parameters for monitoring horizons beneath the facility (HTW and GMA wells). The control chart for Cell 1 indicates "in control" conditions for lithium.

A.5.1.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.1-1. Summary Statistics for Cell 1

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[d,g]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12338C	85	86	98.8	ND	206	73.3	42.2	Normal	None (2025)	Detected	
	LDS	12338D	38	38	100	1.50	37.0	11.1	7.1	Undefined	Up (2025)	Detected	
	HTW	12338	82	84	97.6	ND	12.7	7.83	3.32	Undefined	Up (2025)	Detected	
	GMA-U	22201	87	91	95.6	ND	12.4	5.35	3.31	Undefined	Up (2025)	Detected	
	GMA-D	22198	102	102	100	0.574	15.2	4.37	2.45	Undefined	Down (2025)	Detected	
Boron (mg/L)	LCS	12338C	86	87	98.8	ND	1.72	0.971	0.303	Undefined	Down (2025)	Detected	2.80(Q1-99), 2.53(Q3-04), 2.81(Q3-05), 2.33(Q4-07)
	LDS	12338D	38	39	97.4	0.169	0.345	0.244	0.043	Normal	None (2025)	Not Detected	0.001(Q3-00), 0.0296(Q1-98)
	HTW	12338	64	67	95.5	ND	0.271	0.135	0.061	Normal	Down (2025)	Detected	
	GMA-U	22201	89	91	97.8	ND	0.158	0.121	0.026	Undefined	Up (2025)	Detected	
	GMA-D	22198	86	90	95.6	ND	0.131	0.0539	0.0155	Ln Normal	Down (2025)	Detected	
Sodium (mg/L)	LCS	12338C	60	60	100	11.7	22.0	19.2	3.5	Undefined	Up (2025)	Detected	29.3(Q3-05), 34.8(Q2-23)
	LDS	12338D	10	10	100	335	1,580	675	379	Ln Normal	Up (2025)	Not Detected	
	HTW	12338	52	52	100	7.44	23.8	13.2	3.9	Ln Normal	Down (2025)	Detected	
	GMA-U	22201	43	43	100	11.1	65.5	37.8	14.4	Undefined	Down (2025)	Detected	
	GMA-D	22198	45	45	100	9.65	18.6	13.0	2.2	Normal	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12338C	72	72	100	603	3,360	1,750	690	Undefined	Up (2025)	Detected	
	LDS	12338D	20	20	100	675	4,990	2,000	1,030	Ln Normal	Up (2025)	Detected	
	HTW	12338	62	62	100	365	907	597	142	Normal	Down (2025)	Detected	
	GMA-U	22201	67	67	100	91.8	735	252	139	Ln Normal	None (2025)	Detected	1,980(Q4-04)
	GMA-D	22198	67	67	100	101	506	154	88	Undefined	Down (2025)	Detected	
Calcium (mg/L)	GMA-U	22201	36	36	100	140	334	199	39	Ln Normal	Down (2025)	Not Detected	
	GMA-D	22198	36	36	100	133	192	151	14	Ln Normal	Down (2025)	Not Detected	
Lithium (mg/L)	GMA-U	22201	43	43	100	0.00665	0.0153	0.0109	0.0024	Normal	None (2025)	Not Detected	
	GMA-D	22198	43	43	100	0.00624	0.0107	0.00917	0.00078	Undefined	None (2025)	Not Detected	
Magnesium (mg/L)	GMA-U	22201	36	36	100	36.1	82.2	50.6	9.1	Ln Normal	Up (2025)	Not Detected	
	GMA-D	22198	36	36	100	36.2	47.8	40.3	2.9	Normal	Down (2025)	Not Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22201	30	36	83.3	ND	1.44	0.384	0.462	Undefined	Up (2025)	Not Detected	
	GMA-D	22198	9	56	16.1	ND	0.550	0.010	0.166	Undefined	Down (2025)	Detected	
Potassium (mg/L)	GMA-U	22201	36	36	100	1.33	3.97	2.78	0.52	Normal	Down (2025)	Detected	
	GMA-D	22198	38	38	100	1.15	3.30	1.50	0.36	Undefined	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22201	5	43	11.6	ND	0.0455	0.00300	0.00825	Undefined	Up (2025)	Detected	
	GMA-D	22198	8	63	12.7	ND	0.0373	0.00300	0.00520	Undefined	Up (2025)	Detected	
Technetium-99 (pCi/L)	GMA-U	22201	1	40	2.5	ND	4.46	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22198	2	41	4.9	ND	8.30	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22201	43	43	100	594	1600	911	185	Ln Normal	Down (2025)	Not Detected	
	GMA-D	22198	43	43	100	552	805	617	63	Undefined	Down (2025)	Not Detected	
Total Organic Halogens (mg/L)	GMA-U	22201	41	91	45.0	ND	0.0367	0.00645	0.00780	Undefined	Down (2025)	Not Detected	0.0780(Q1-97), 0.308(Q2-00)
	GMA-D	22198	23	90	25.6	ND	0.0252	0.00234	0.00571	Undefined	None (2025)	Detected	0.0473(Q2-98), 0.0920(Q2-00), 0.100(Q2-10)

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well, with at least eight samples, Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.

Note 2: Data used in this table has been standardized to quarterly.

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]ND = not detected; NA = not applicable

[c]Averages were determined based on the distribution assumption.

[d]Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.

[e]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[f]Trend based on nonparametric Mann-Kendall procedure.

[g]Serial correlation based on Rank Von Neumann test.

[h]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[i]Q = quarter

Table A.5.1-2. OSDF Horizontal Till Well 12338 (Cell 1) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
1999	5,655	9	628
2000	6,000	6	1,000
2001	4,060	4	1,015
2002	4,060	4	1,015
2003	4,325	4	1,081
2004	3,950	4	988
2005	4,250	4	1,063
2006	4,350	4	1,088
2007	3,625	4	906
2008	3,625	4	906
2009	2,750	4	917
2010	3,405	4	851
2011	3,675	4	919
2012	1,850	4	463
2013	1,235	4	309
2014	1,770	2	885
2015	650	2	325
2016	575	2	288
2017	785	2	393
2018	495	2	248
2019	950	2	475
2020	1,050	2	525
2021	1,100	2	550
2022	780	2	390
2023	900	2	450
2024	470	2	235
2025	345	2	173

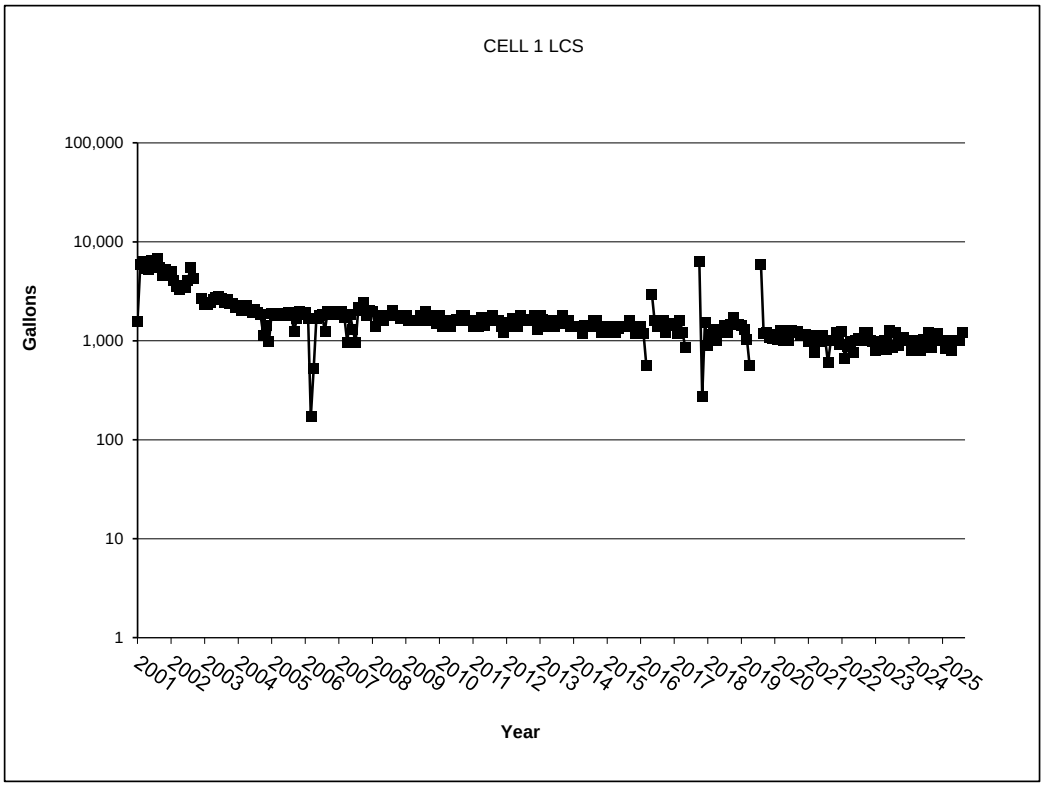


Figure A.5.1-1. Monthly Accumulation Volumes for Cell 1 LCS

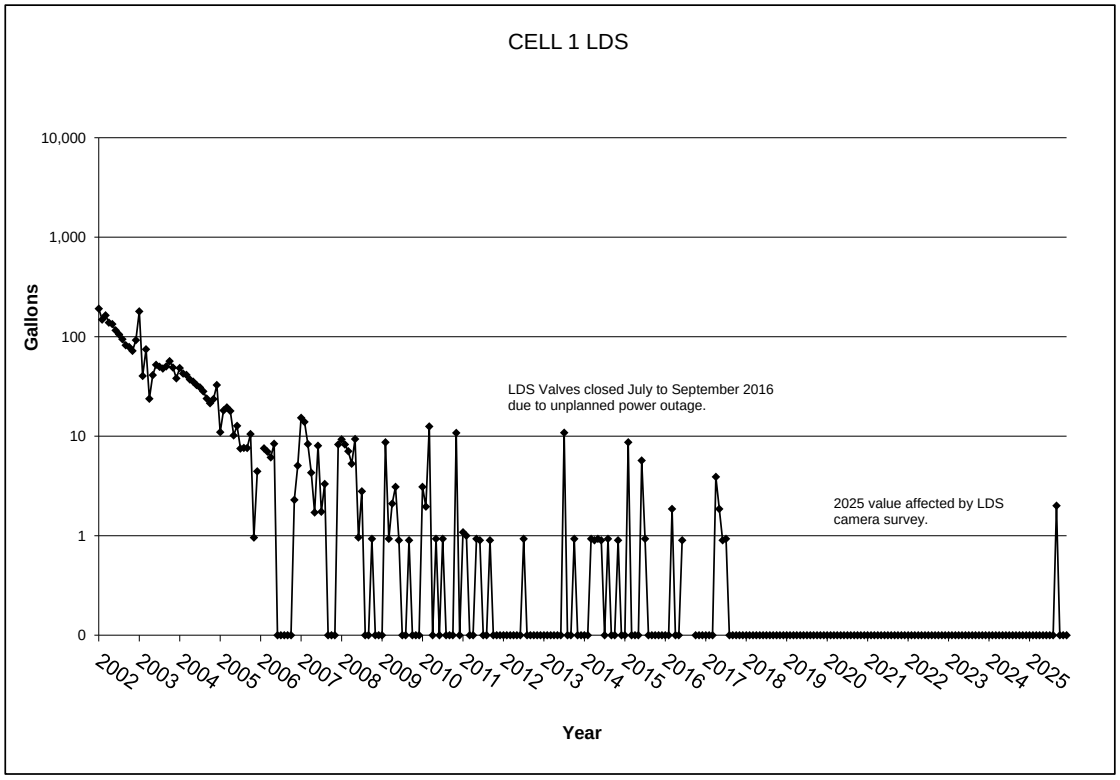


Figure A.5.1-2. Monthly Accumulation Volumes for Cell 1 LDS

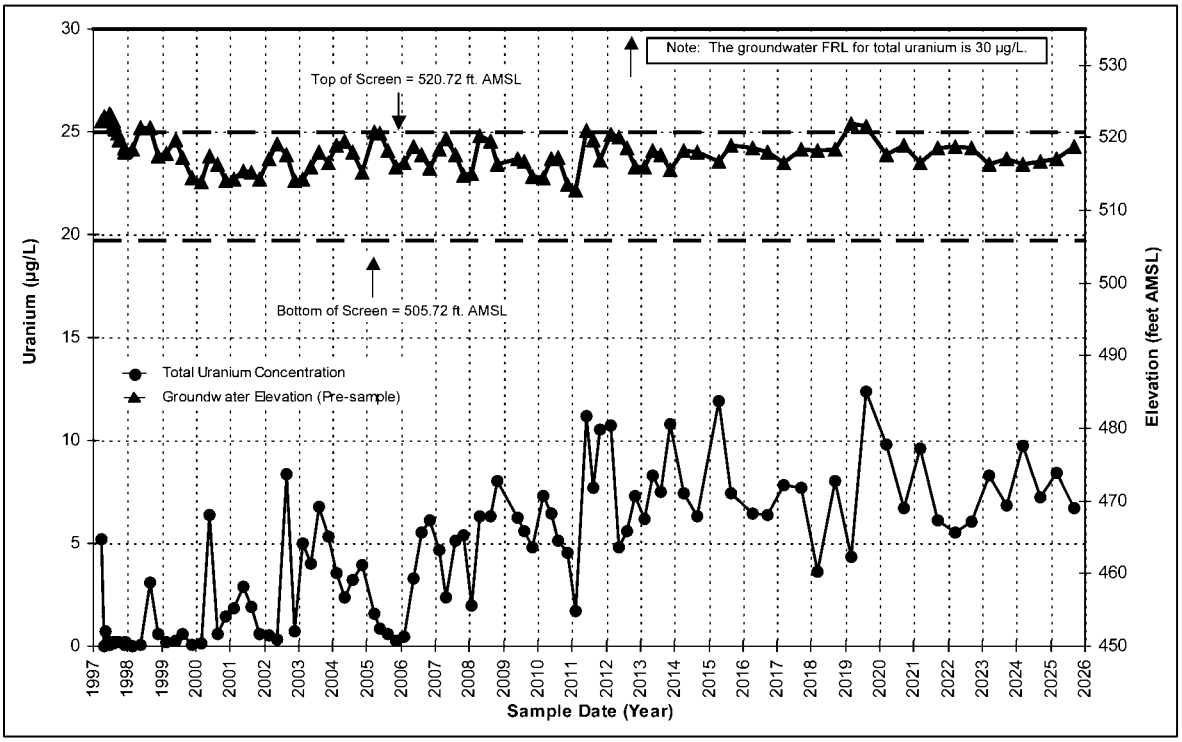


Figure A.5.1-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 1 Upgradient Monitoring Well 22201

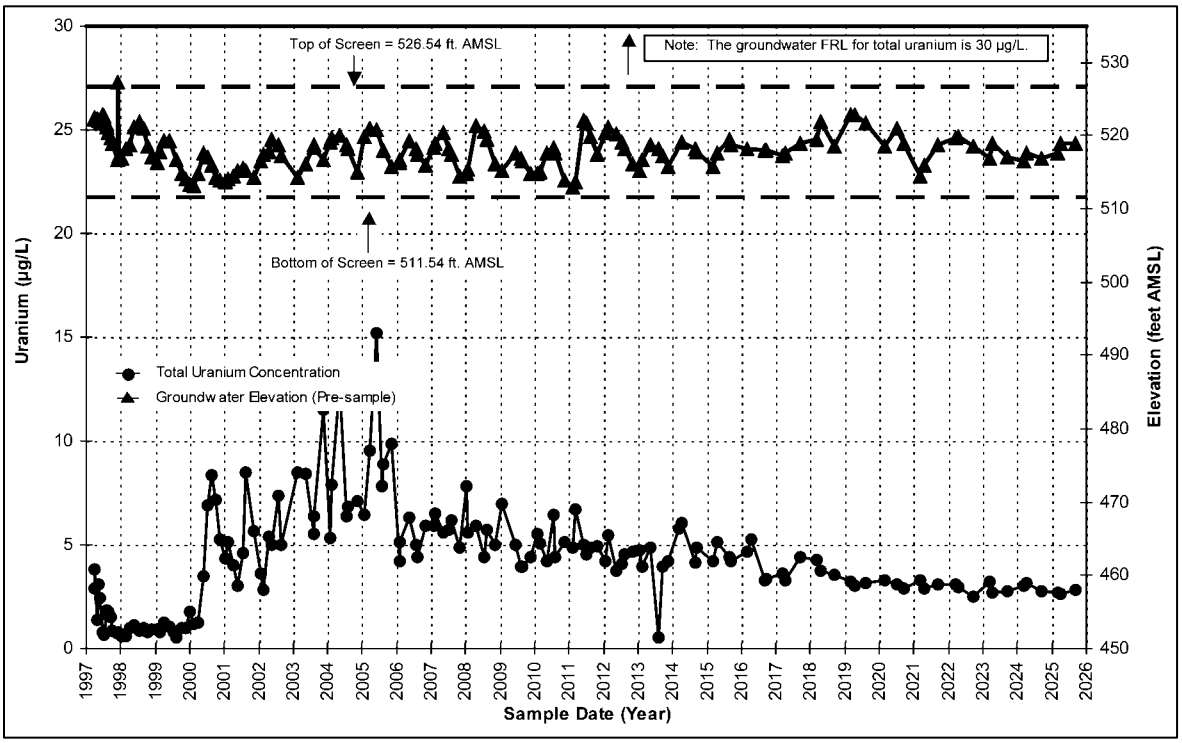


Figure A.5.1-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 1 Downgradient Monitoring Well 22198

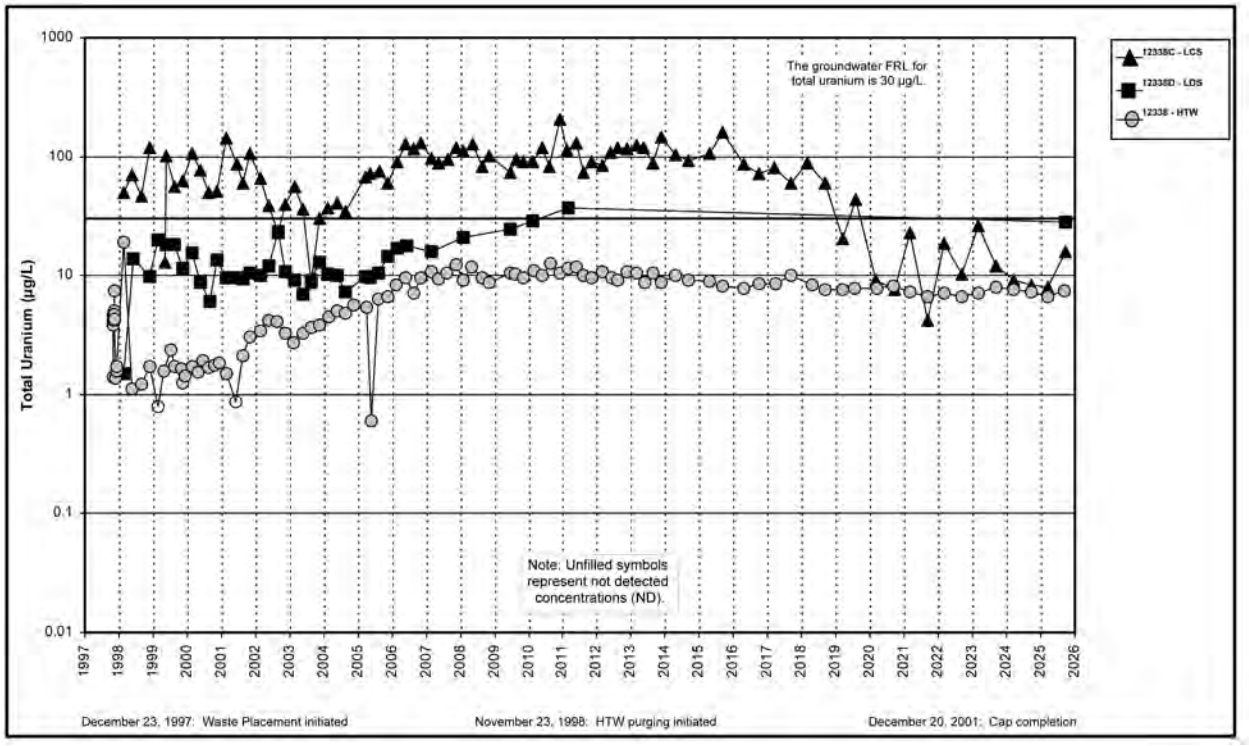


Figure A.5.1-5A. Cell 1 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

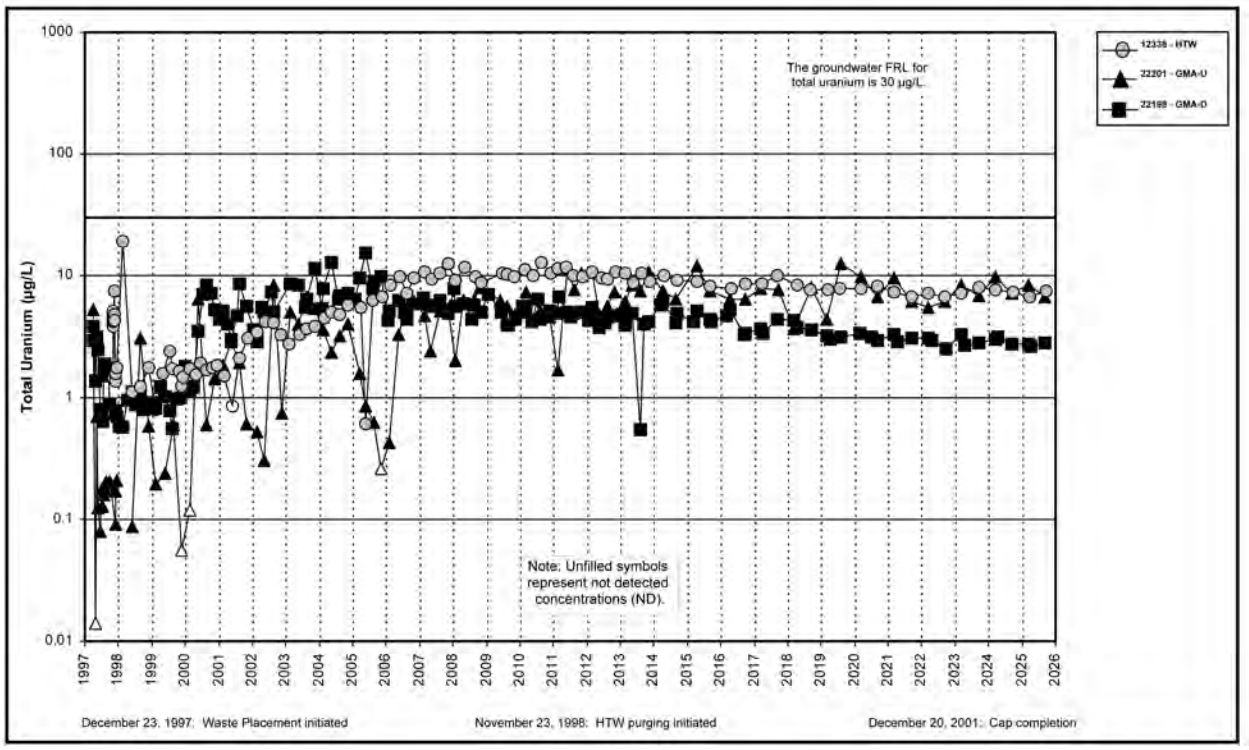


Figure A.5.1-5B. Cell 1 Total Uranium Concentration Versus Time Plot for HTW, Upgradient GMA Well, and Downgradient GMA Well

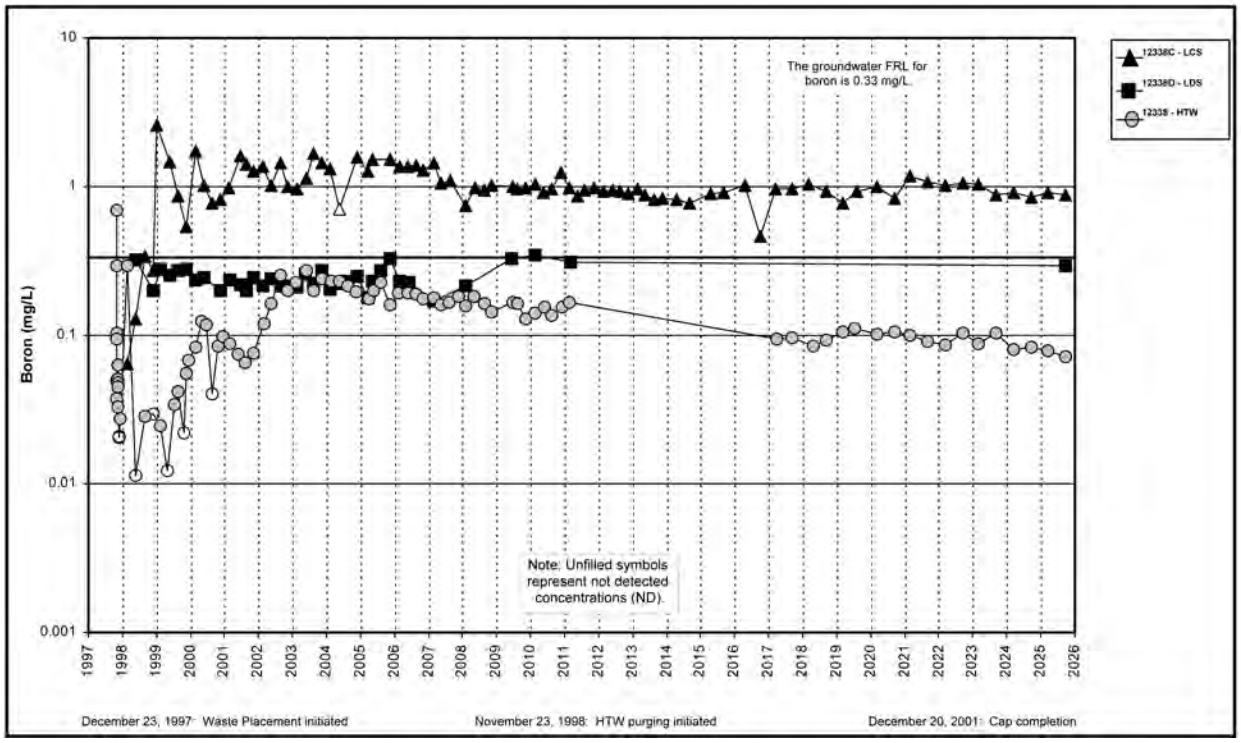


Figure A.5.1-6A. Cell 1 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

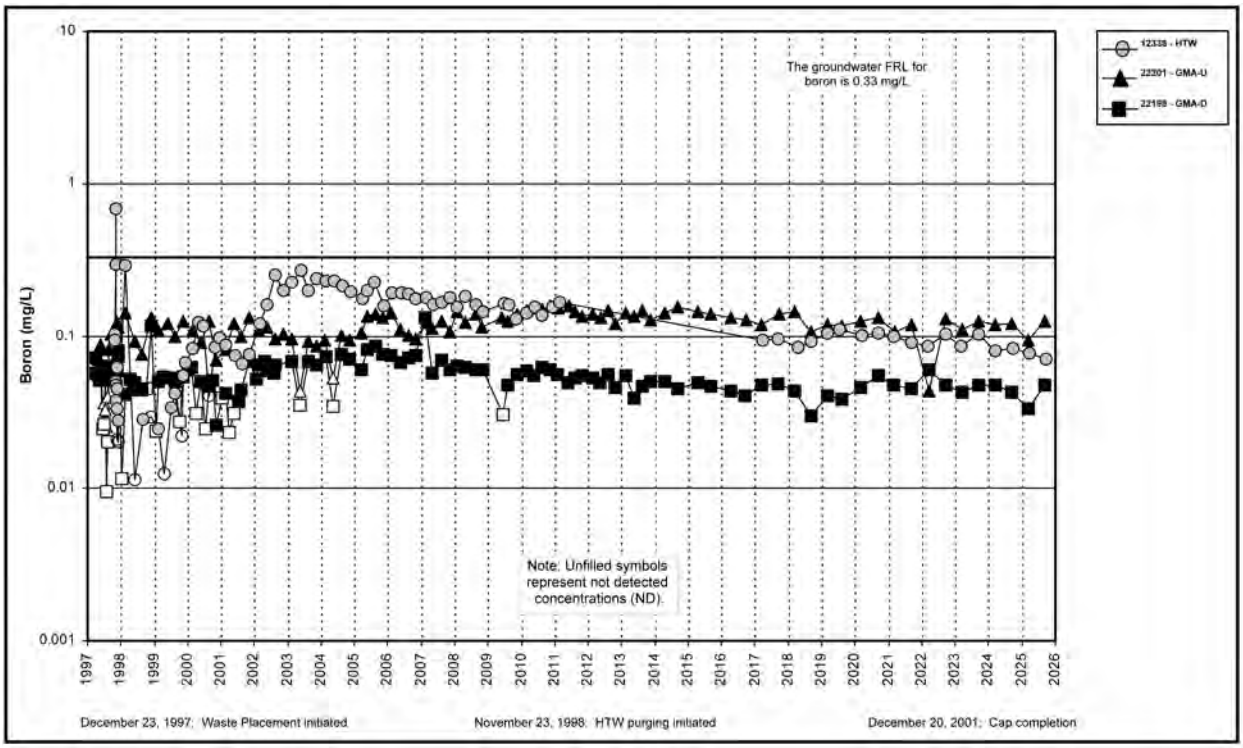


Figure A.5.1-6B. Cell 1 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

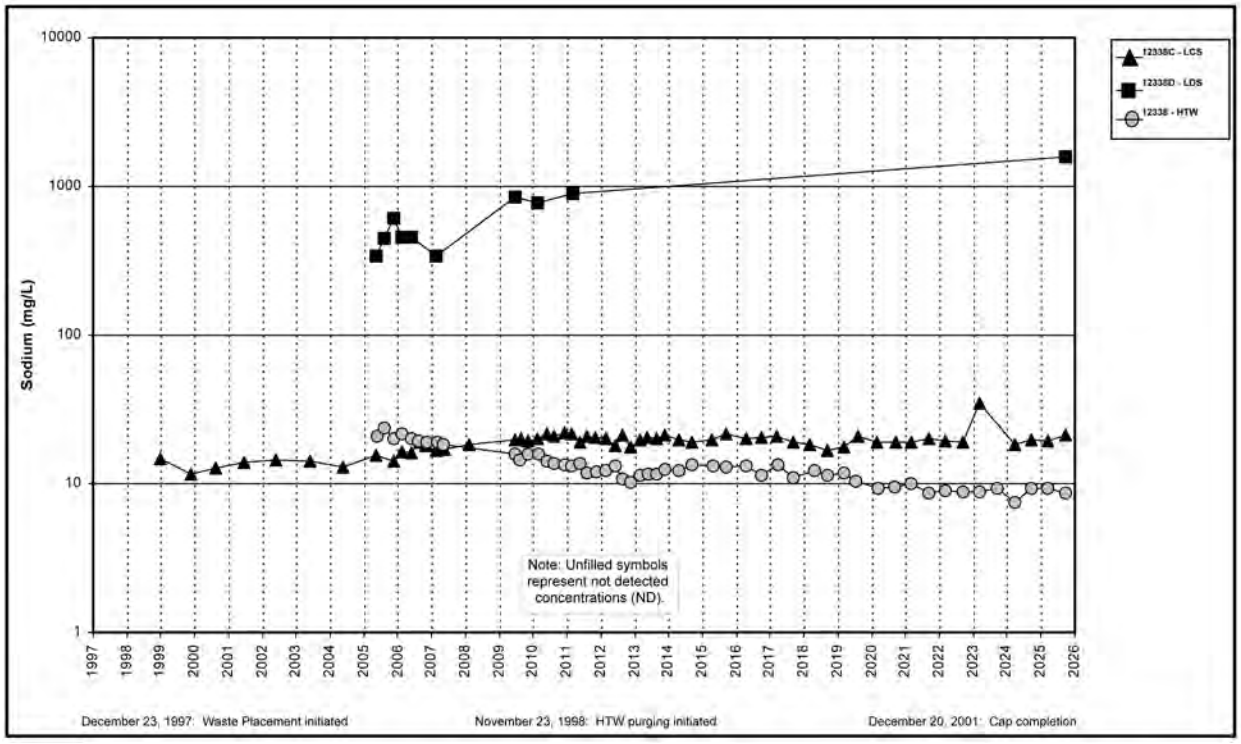


Figure A.5.1-7A. Cell 1 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

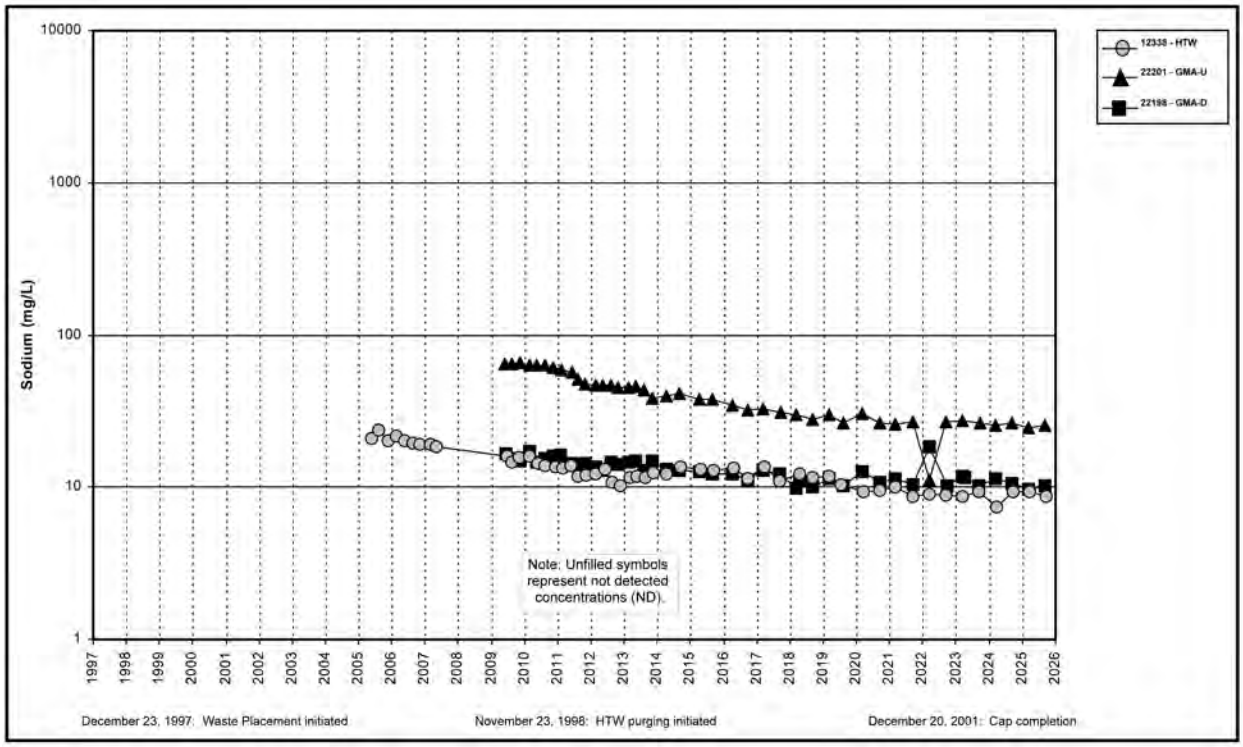


Figure A.5.1-7B. Cell 1 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

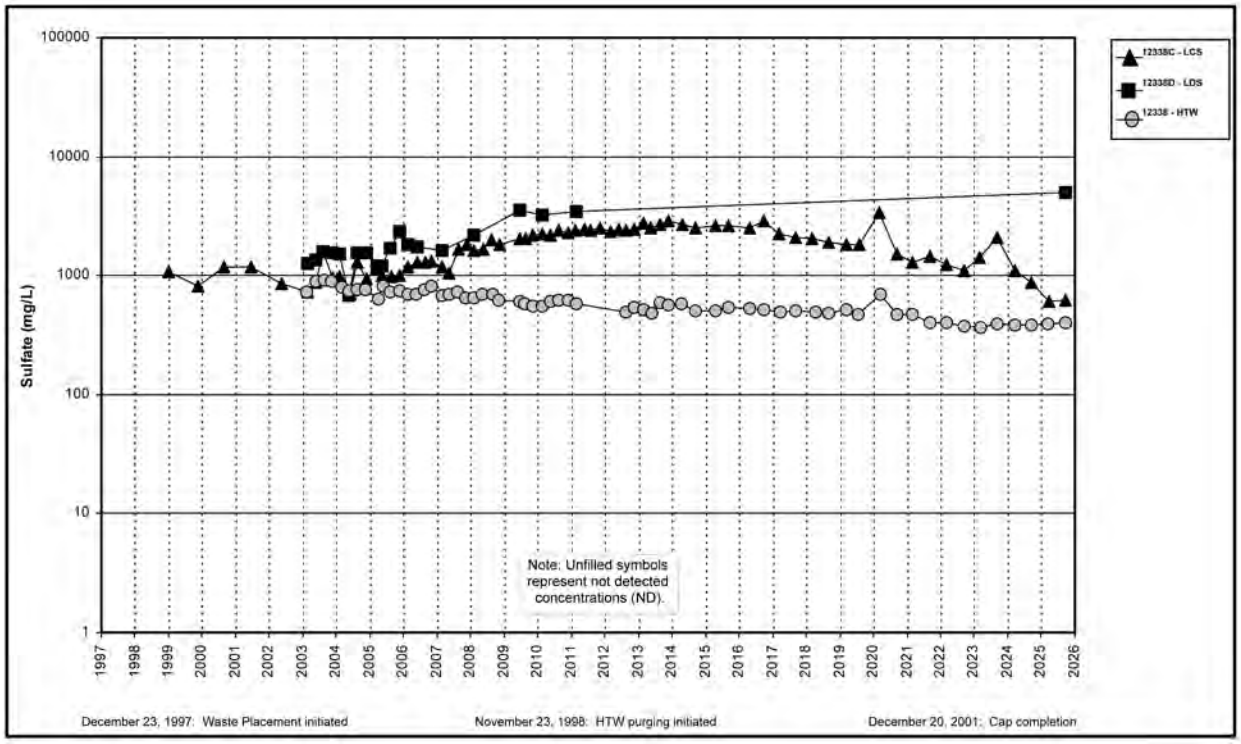


Figure A.5.1-8A. Cell 1 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

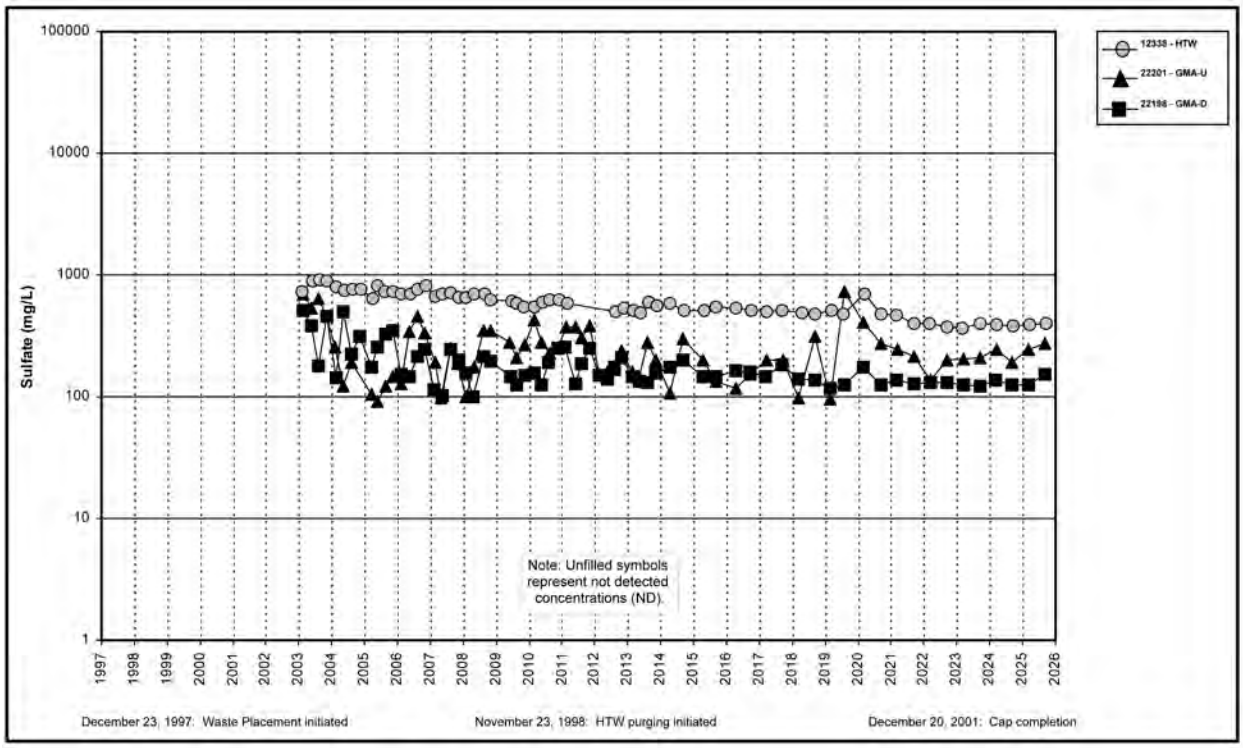


Figure A.5.1-8B. Cell 1 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

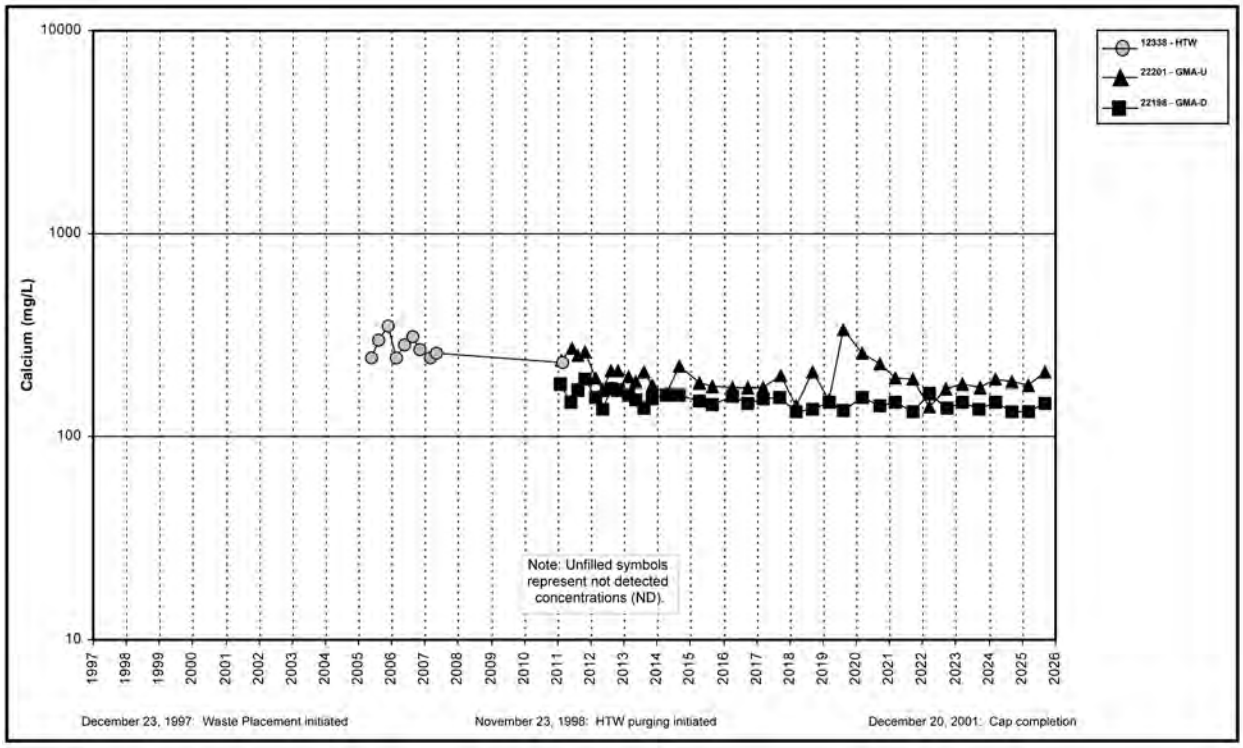


Figure A.5.1-9. Cell 1 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

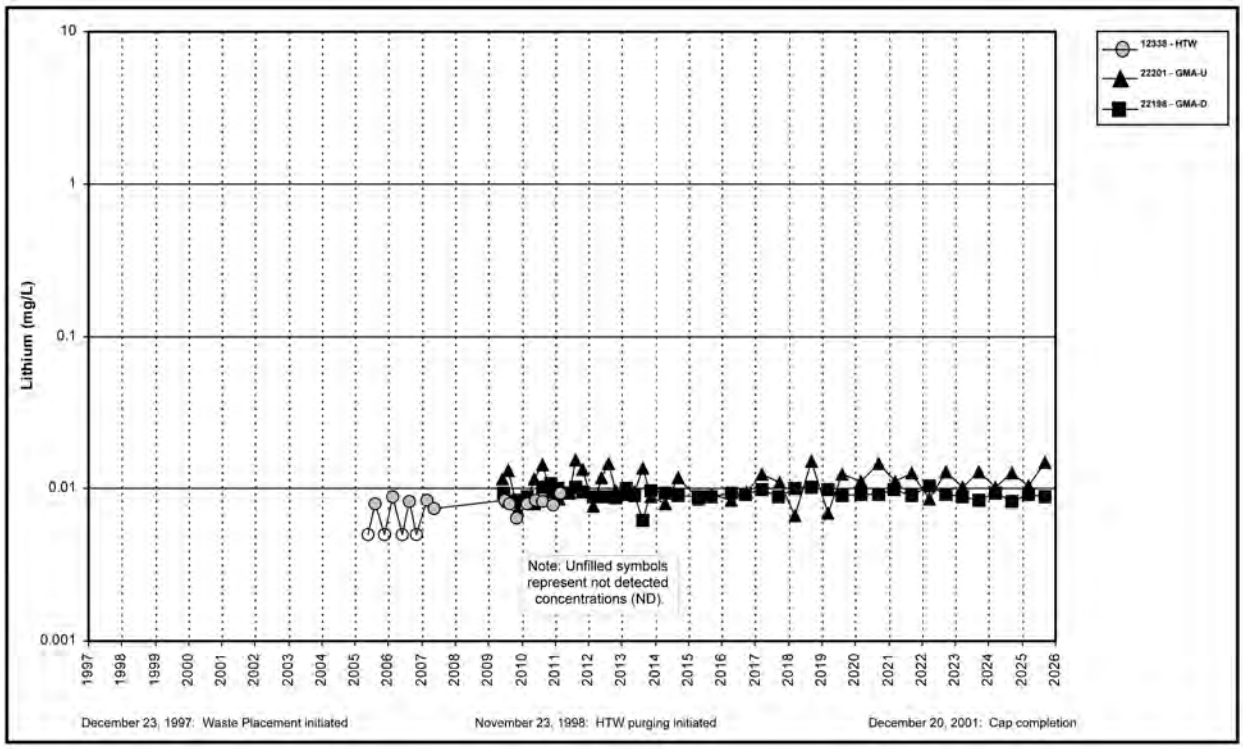


Figure A.5.1-10. Cell 1 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

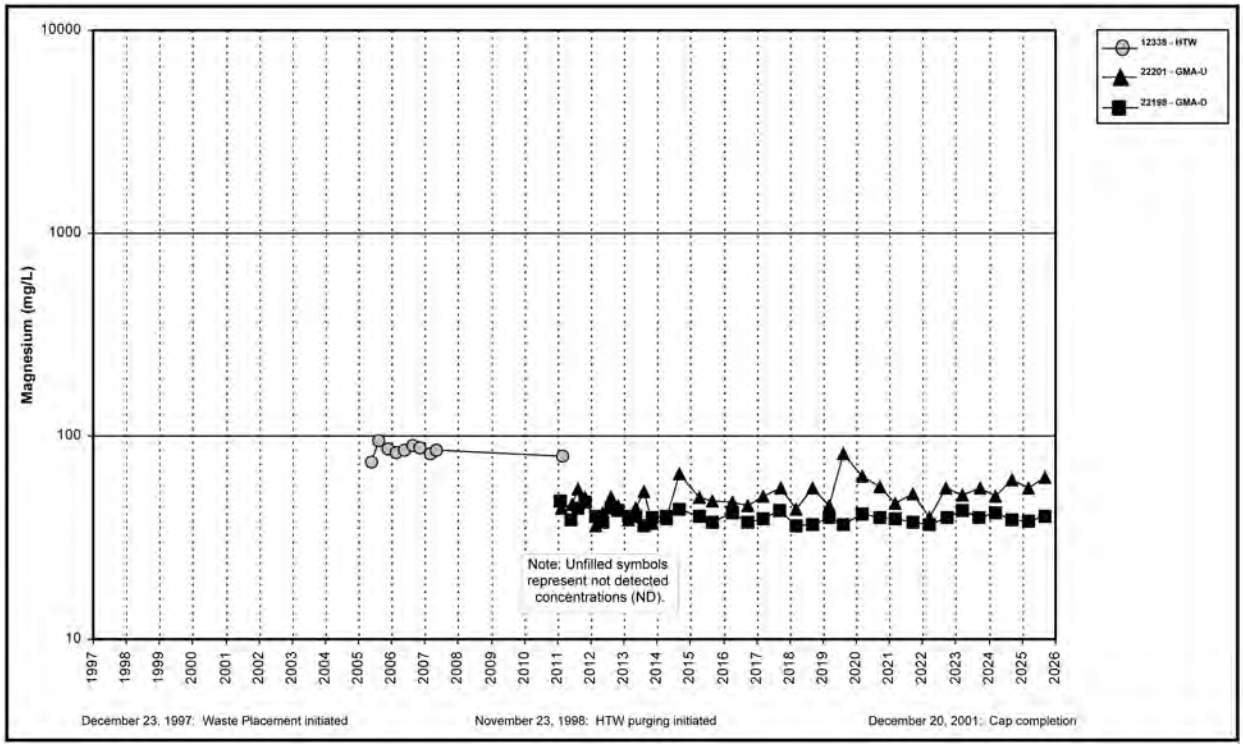


Figure A.5.1-11. Cell 1 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

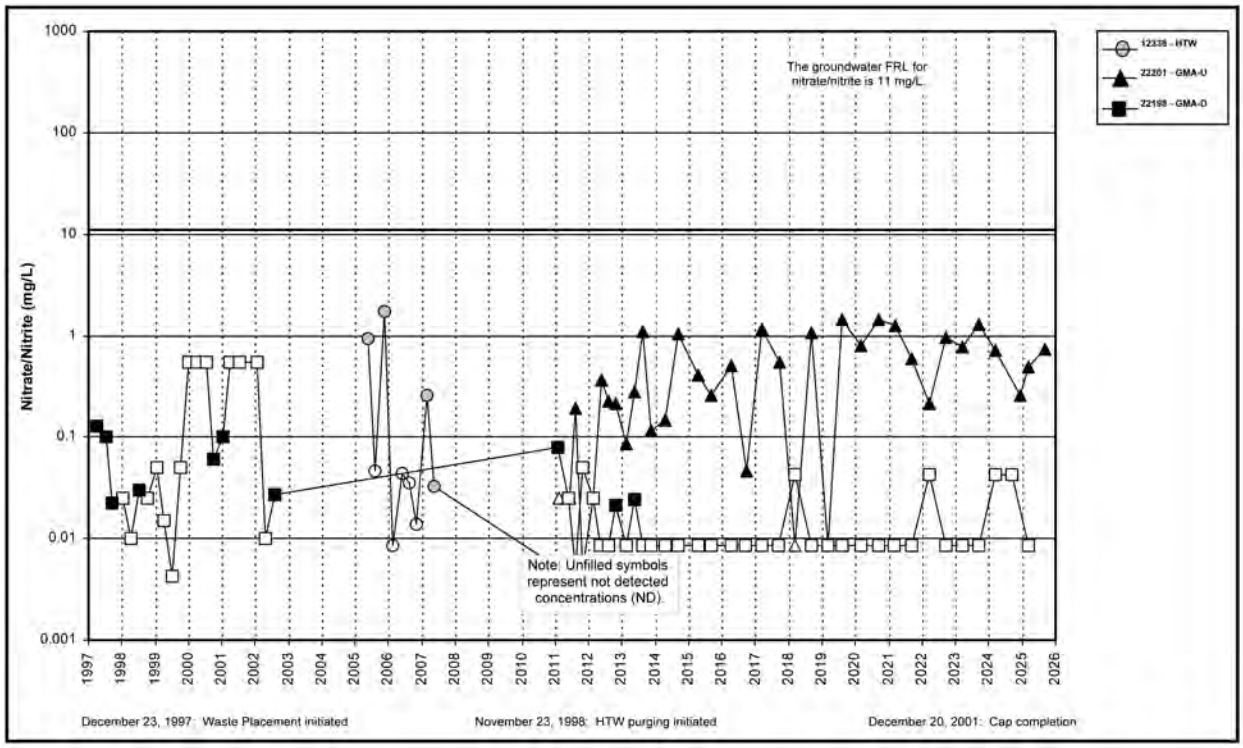


Figure A.5.1-12. Cell 1 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

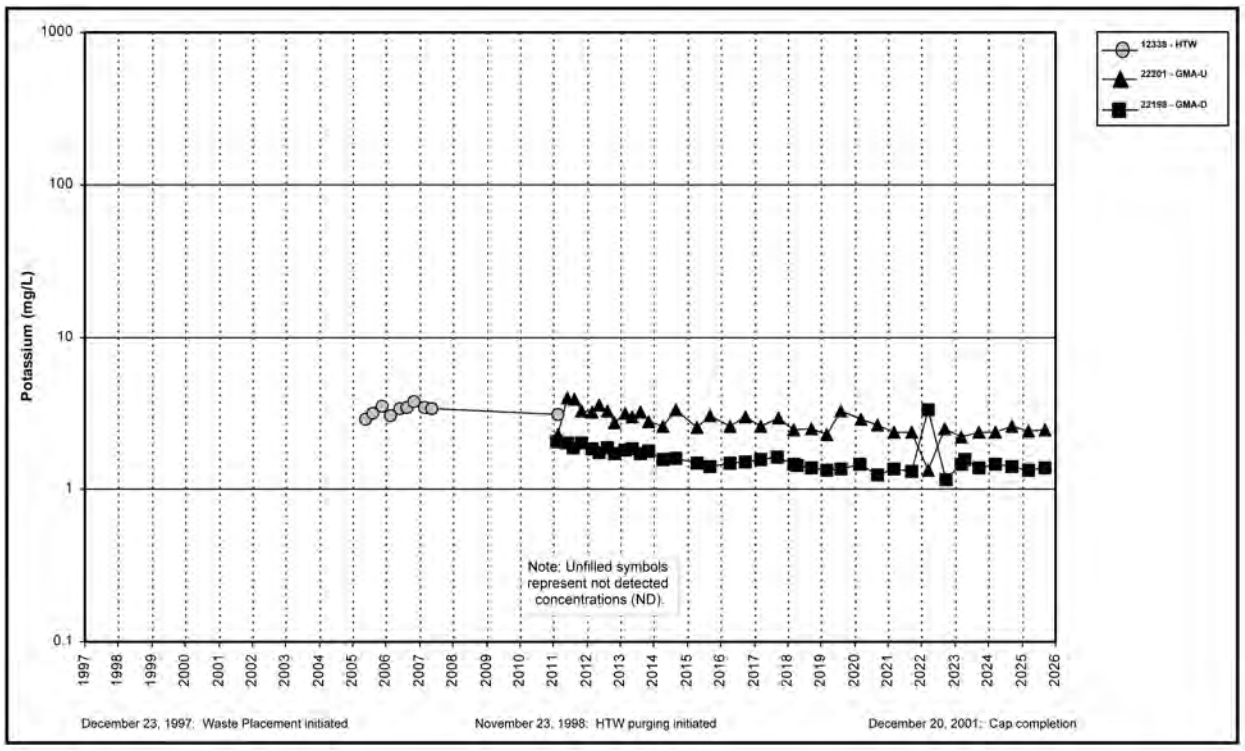


Figure A.5.1-13. Cell 1 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

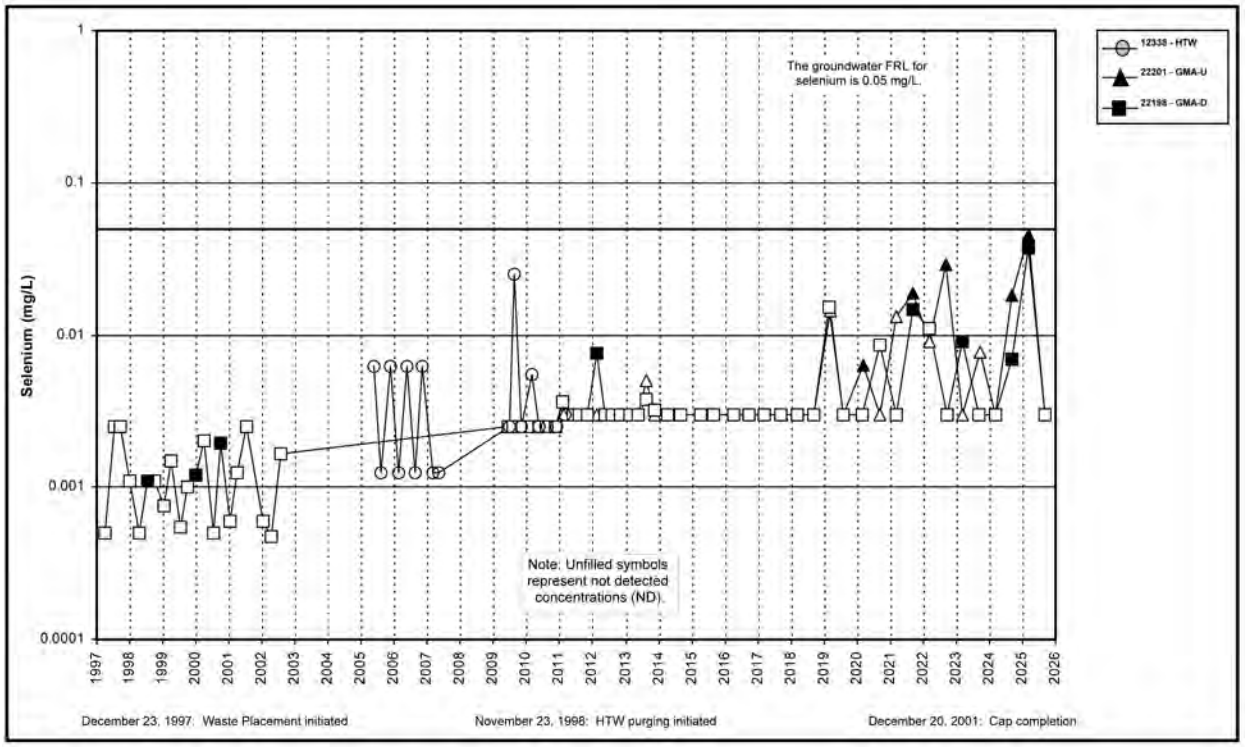


Figure A.5.1-14. Cell 1 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

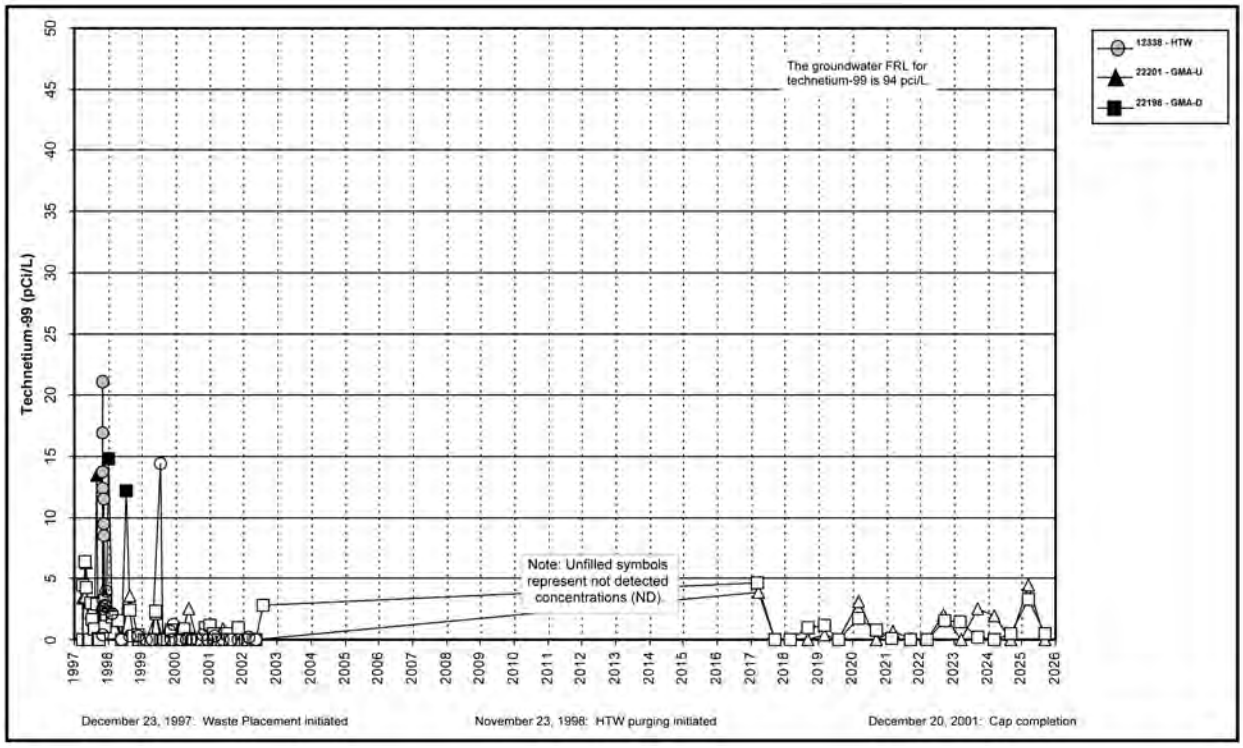


Figure A.5.1-15. Cell 1 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

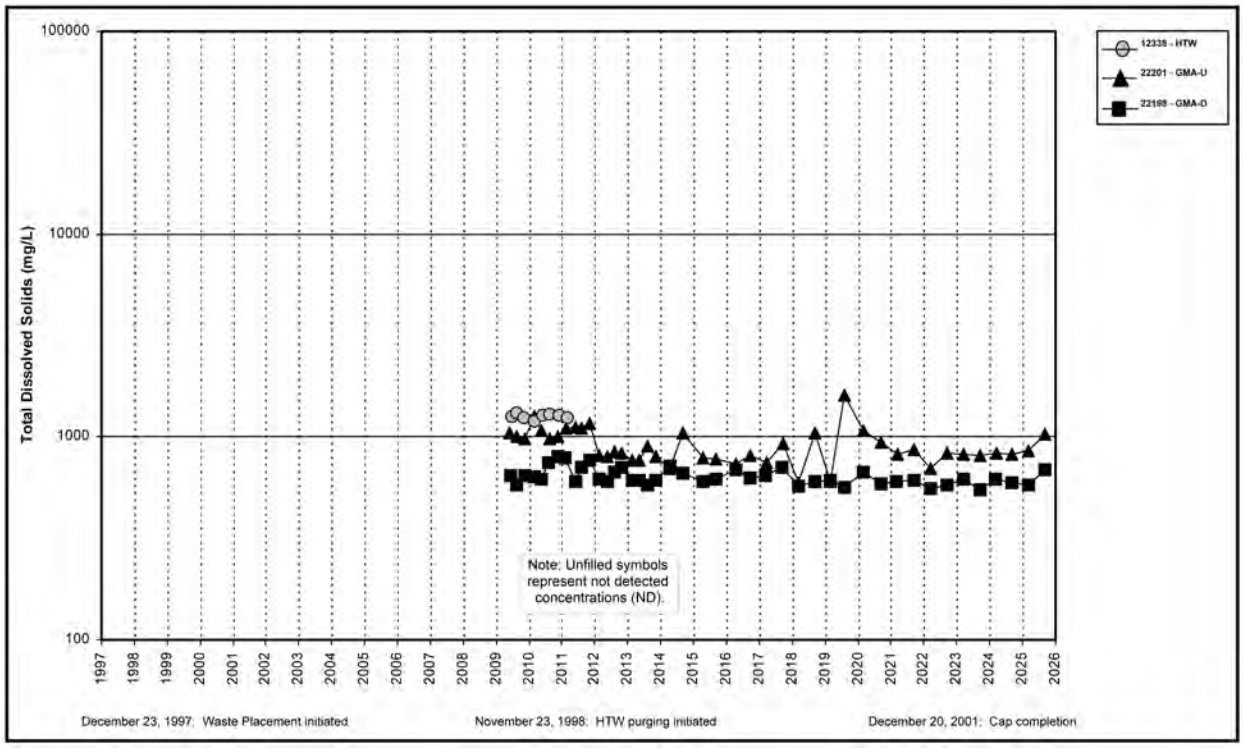


Figure A.5.1-16. Cell 1 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

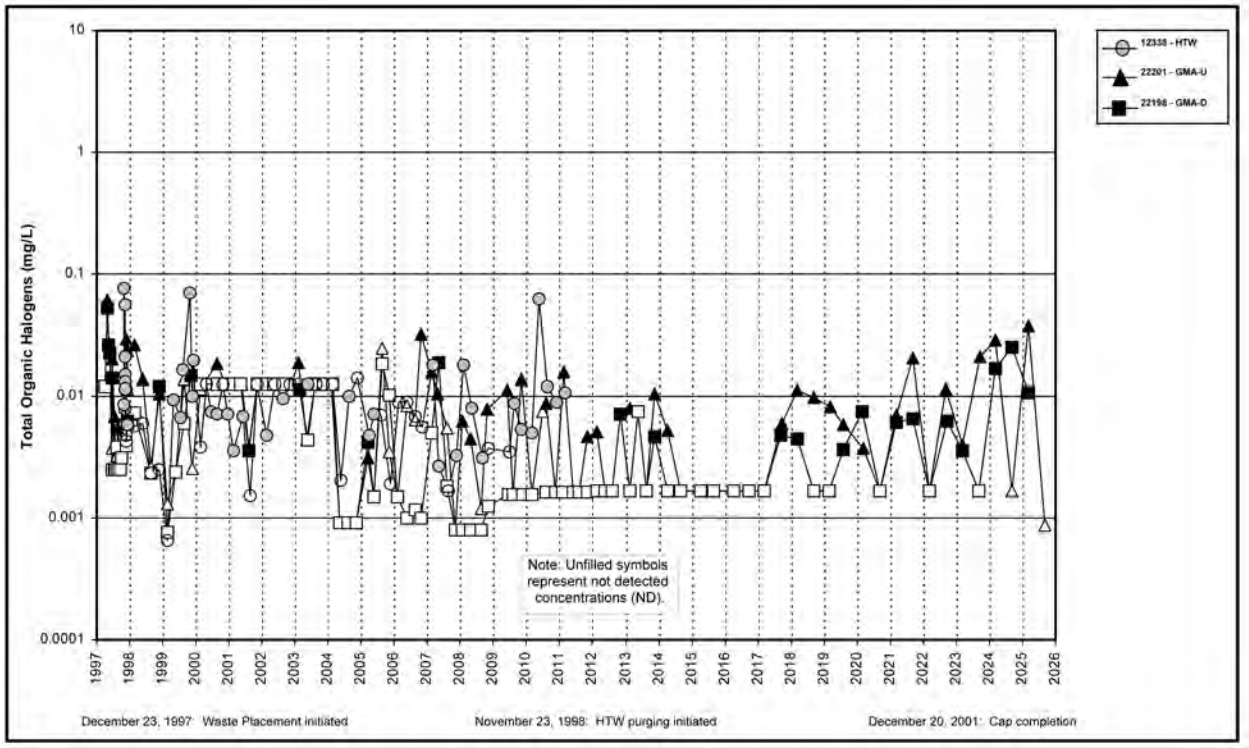


Figure A.5.1-17. Cell 1 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

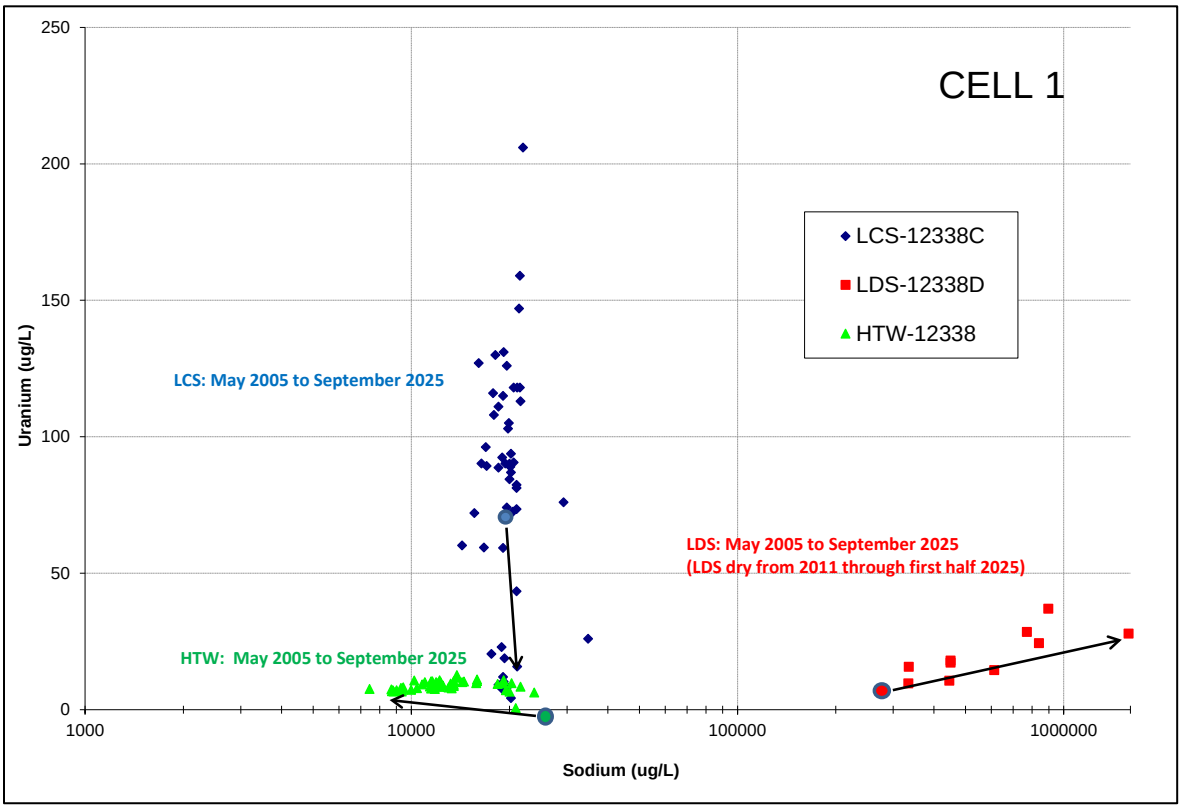


Figure A.5.1-18. Cell 1 Bivariate Plot for Uranium and Sodium

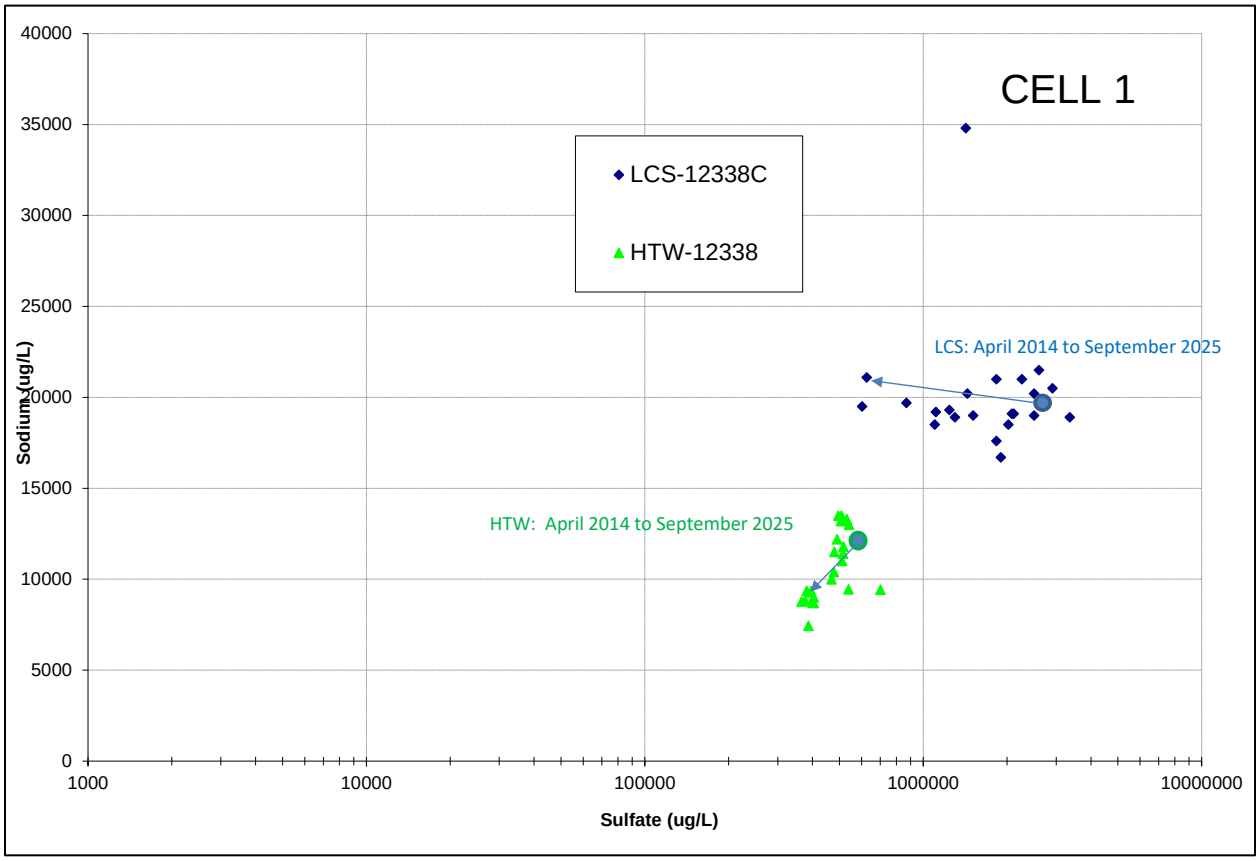


Figure A.5.1-19. Cell 1 Bivariate Plot for Sodium and Sulfate

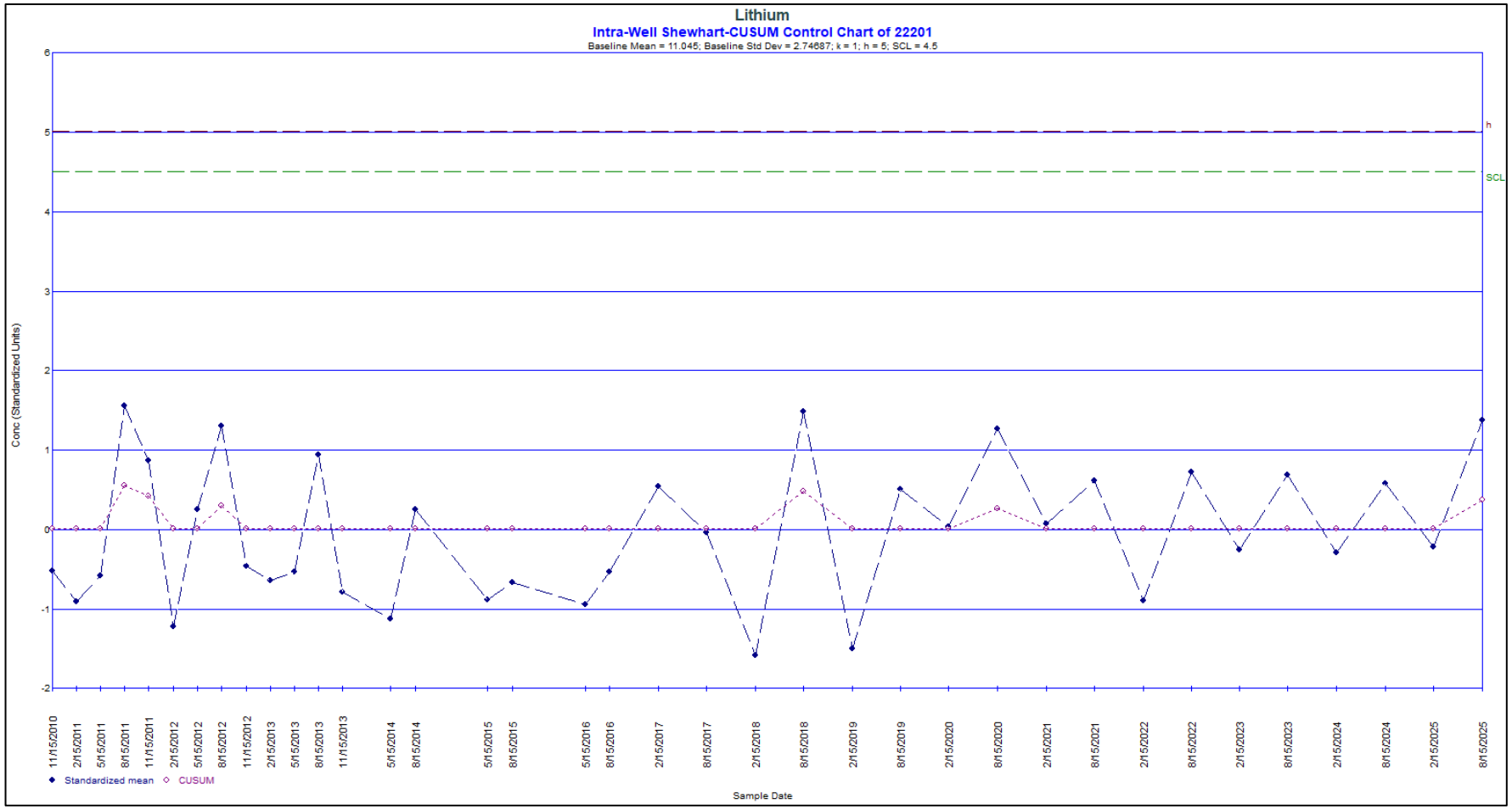


Figure A.5.1-20. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22201

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Subattachment A.5.2

Cell 2

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.2.1 Water Quality Monitoring Results 1
A.5.2.1.1 LCS and LDS Results 1
A.5.2.1.2 HTW and Monitoring Well Results 2
A.5.2.1.3 Discussion 2
A.5.2.2 Control Charts 3
A.5.2.3 Summary and Conclusions 4
A.5.2.4 References 4

Tables

Table A.5.2-1. Summary Statistics for Cell 2 5
Table A.5.2-2. OSDF Horizontal Till Well 12339 (Cell 2) Water Yield 6

Figures

Figure A.5.2-1. Monthly Accumulation Volumes for Cell 2 LCS 7
Figure A.5.2-2. Monthly Accumulation Volumes for Cell 2 LDS 7
Figure A.5.2-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 2 Upgradient Monitoring Well 22200 8
Figure A.5.2-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 2 Downgradient Monitoring Well 22199 8
Figure A.5.2-5A. Cell 2 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A. 5.2-5B. Cell 2 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 9
Figure A.5.2-6A. Cell 2 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.2-6B. Cell 2 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.2-7A. Cell 2 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.2-7B. Cell 2 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.2-8A. Cell 2 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.2-8B. Cell 2 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.2-9. Cell 2 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.2-10. Cell 2 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.2-11. Cell 2 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.2-12. Cell 2 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.2-13. Cell 2 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.2-14. Cell 2 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.2-15. Cell 2 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.2-16. Cell 2 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.2-17. Cell 2 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.2-18. Cell 2 Bivariate Plot for Uranium and Sodium 17
Figure A.5.2-19. Cell 2 Bivariate Plot for Sodium and Sulfate 18
Figure A.5.2-20. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22200 19
Figure A.5.2-21. Intrawell Shewhart-CUSUM Control Chart for Magnesium in Monitoring Well 22200 20
Figure A.5.2-22. Intrawell Shewhart-CUSUM Control Chart for Total Dissolved Solids in Monitoring Well 22199 21

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about On-Site Disposal Facility (OSDF) Cell 2:

- Semiannual monitoring summary statistics (Table A.5.2-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.2-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.2-2)
- OSDF horizontal till well (HTW) 12339 water yield (Table A.5.2-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.2-3 and A.5.2-4)
- Plots of concentration versus time (Figures A.5.2-5A through A.5.2-17)
- A bivariate plot for uranium–sodium (Figure A.5.2-18)
- A bivariate plot for sodium–sulfate (Figure A.5.2-19)
- Control charts (Figure A.5.2-20 through A.5.2-22)

A.5.2.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining whether the OSDF is operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells: 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW for each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.2.1.1 LCS and LDS Results

As shown in Table A.5.2-1 and summarized below, three parameters (total uranium, boron, and sodium) in 2025 have upward trends in the LCS or LDS based on the Mann-Kendall test for trend. No new high concentrations were measured in the LCS of Cell 2 in 2025. The volume of water in the LDS tank of Cell 2 has been insufficient to collect a sample since 2013.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 2

Parameter	LCS 12339C 2025 Trend	LDS 12339D Trend (Year Last Sampled)[a]
Total Uranium	Up	
Boron	Up	Up (2013)
Sodium	Up	Up (2013)

[a] No entry indicates that the trend was not up.

A.5.2.1.2 HTW and Monitoring Well Results

As shown in Table A.5.2-1 and summarized below, five parameters in 2025 (total uranium, boron, lithium, potassium, and selenium) have upward trends in the HTW or the GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 2

Parameter	HTW 12339[a]	GMA-U[a,b] 22200	GMA-D[a,b] 22199
Total Uranium	Up	Up	
Boron		Up	
Lithium			Up
Potassium		Up	
Selenium		Up	Up

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.2.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 2 LCS, LDS, and HTW is provided in Figure A.5.2-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot for 2025 shows that the uranium concentrations measured in the LCS were 19.1 micrograms per liter (µg/L) and 23.3 µg/L. These uranium concentrations in the LCS are similar to uranium concentrations measured in the HTW in 2025 (14.5 µg/L and 17.1 µg/L). Because the concentrations are so similar, an additional bivariate plot for sodium–sulfate is also presented in Figure A.5.2-19 for the period April 2014 to September 2025. Because the LDS has been dry since 2013, it is not shown in Figure A.5.2-19. Figure A.5.2-19 shows that the chemical signatures for sodium and sulfate in the LCS and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.2.2 Control Charts

Intrawell control charts use historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.2-1 in gray and summarized below, three parameters in the HTW or GMA wells of Cell 2 meet the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in three control charts (Figure A.5.2-20 through Figure A.5.2-22). The control charts for Cell 2 indicates "in control" conditions.

Parameter	Monitoring Point[a]	Well Number	Assessment	Figure Number
Lithium	GMA-U	22200	In Control	A.5.2-20
Magnesium	GMA-U	22200	In Control	A.5.2-21
Total Dissolved Solids	GMA-D	22199	In Control	A.5.2-22

[a] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.2.3 Summary and Conclusions

- Three parameters monitored semiannually have an upward concentration trend in the LCS of Cell 2 in 2025: total uranium, boron, and sodium. No new high concentrations were measured in the LCS of Cell 2 in 2025.
- The volume of water in the LDS tank of Cell 2 has been insufficient to collect a sample since 2013.
- Five parameters monitored semiannually in 2025 have an upward concentration trend in the HTW or GMA wells of Cell 2: total uranium, boron, lithium, potassium, and selenium. Separate and distinct chemical signatures for total uranium and sodium in the LCS, LDS, and HTW as well as for sodium and sulfate in the LCS and HTW of Cell 2 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 2 (i.e., HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- Three control charts were constructed for Cell 2 parameters. The control charts exhibit "in control" conditions.

A.5.2.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.2-1. Summary Statistics for Cell 2

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[d,g]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12339C	82	82	100	4.51	686	120	112	Ln Normal	Up (2025)	Detected	
	LDS	12339D	35	35	100	4.08	71.0	14.5	13.2	Undefined	None (2013)	Detected	
	HTW	12339	83	84	98.8	ND	36.9	12.1	6.5	Undefined	Up (2025)	Detected	
	GMA-U	22200	70	90	77.8	ND	4.69	0.312	0.574	Undefined	Up (2025)	Not Detected	
	GMA-D	22199	97	102	95.1	ND	12.1	0.547	2.07	Undefined	Down (2025)	Not Detected	
Boron (mg/L)	LCS	12339C	83	83	100	0.207	4.78	2.70	1.06	Undefined	Up (2025)	Detected	
	LDS	12339D	35	35	100	0.289	2.22	0.422	0.371	Undefined	Up (2013)	Detected	
	HTW	12339	64	67	95.5	ND	0.213	0.0972	0.0495	Undefined	Down (2025)	Detected	
	GMA-U	22200	78	90	86.7	ND	0.105	0.0600	0.0239	Undefined	Up (2025)	Detected	
	GMA-D	22199	81	90	90.0	ND	0.0899	0.0493	0.0145	Normal	None (2025)	Detected	
Sodium (mg/L)	LCS	12339C	59	59	100	3.32	42.8	19.6	6.2	Undefined	Up (2025)	Detected	
	LDS	12339D	10	10	100	664	2,450	1,230	540	Normal	Up (2013)	Detected	
	HTW	12339	52	52	100	29.5	119	42.4	23.1	Undefined	Down (2025)	Detected	
	GMA-U	22200	43	43	100	20.4	32.9	25.9	3.4	Normal	Down (2025)	Detected	
	GMA-D	22199	45	45	100	7.86	19.5	12.4	3.5	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12339C	71	71	100	155	1,960	1,580	300	Undefined	None (2025)	Detected	
	LDS	12339D	18	18	100	2,290	13,000	4,800	2,680	Ln Normal	Up (2013)	Detected	
	HTW	12339	62	62	100	292	850	529	137	Normal	Down (2025)	Detected	
	GMA-U	22200	67	67	100	61.1	434	127	90	Undefined	Down (2025)	Not Detected	
	GMA-D	22199	67	67	100	101	540	160	83	Undefined	Down (2025)	Not Detected	
Calcium (mg/L)	GMA-U	22200	36	36	100	115	205	136	22	Undefined	Down (2025)	Not Detected	
	GMA-D	22199	36	36	100	125	193	142	17	Undefined	None (2025)	Not Detected	
Lithium (mg/L)	GMA-U	22200	43	43	100	0.00345	0.00587	0.00423	0.00052	Ln Normal	None (2025)	Not Detected	
	GMA-D	22199	43	43	100	0.0065	0.0101	0.00770	0.00072	Ln Normal	Up (2025)	Detected	
Magnesium (mg/L)	GMA-U	22200	36	36	100	33.1	54.9	40.9	4.5	Ln Normal	None (2025)	Not Detected	
	GMA-D	22199	36	36	100	35.6	54.8	40.4	4.4	Undefined	Down (2025)	Not Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22200	5	36	13.9	ND	0.200	0.00850	0.0378	Undefined	None (2025)	Not Detected	
	GMA-D	22199	2	36	5.6	ND	0.0425	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Potassium (mg/L)	GMA-U	22200	36	36	100	1.50	2.33	1.94	0.23	Normal	Up (2025)	Detected	
	GMA-D	22199	38	38	100	1.23	1.75	1.43	0.11	Normal	Down (2025)	Not Detected	
Selenium (mg/L)	GMA-U	22200	7	43	16.3	ND	0.0374	0.00300	0.00581	Undefined	Up (2025)	Detected	
	GMA-D	22199	4	43	9.3	ND	0.0397	0.00300	0.00679	Undefined	Up (2025)	Detected	
Technitium-99 (pCi/L)	GMA-U	22200	0	39	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22199	0	39	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22200	43	43	100	497	857	613	90	Undefined	None (2025)	Not Detected	
	GMA-D	22199	43	43	100	520	820	640	70	Ln Normal	None (2025)	Not Detected	
Total Organic Halogens (mg/L)	GMA-U	22200	35	90	38.9	ND	0.177	0.00453	0.0237	Undefined	Down (2025)	Detected	
	GMA-D	22199	22	90	24.4	ND	0.0775	0.00312	0.0112	Undefined	Down (2025)	Detected	

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well, with at least eight samples, Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.

Note 2: Data used in this table has been standardized to quarterly.

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = Upgradient Great Miami Aquifer; and GMA-D = Downgradient Great Miami Aquifer

[b]ND = not detected; NA = not applicable

[c]Averages were determined based on the distribution assumption.

[d]Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.

[e]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Undefined: Normal and Ln Normal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[f]Trend based on nonparametric Mann-Kendall procedure.

[g]Serial correlation based on Rank Von Neumann test.

[h]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[i]Q = quarter

Table A.5.2-2. OSDF Horizontal Till Well 12339 (Cell 2) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
1999	5,725	7	818
2000	5,750	6	958
2001	3,395	4	849
2002	3,625	4	906
2003	3,370	4	843
2004	3,220	4	805
2005	3,275	4	819
2006	3,175	4	1,088
2007	3,325	4	831
2008	3,050	4	763
2009	2,400	4	800
2010	3,275	4	819
2011	3,200	4	800
2012	3,110	4	778
2013	2,945	4	736
2014	1,605	2	803
2015	1,450	2	725
2016	1,535	2	768
2017	1,600	2	800
2018	1,605	2	803
2019	1,580	2	790
2020	1,645	2	823
2021	1,610	2	805
2022	1,620	2	810
2023	1,500	2	750
2024	1,330	2	665
2025	1,570	2	785

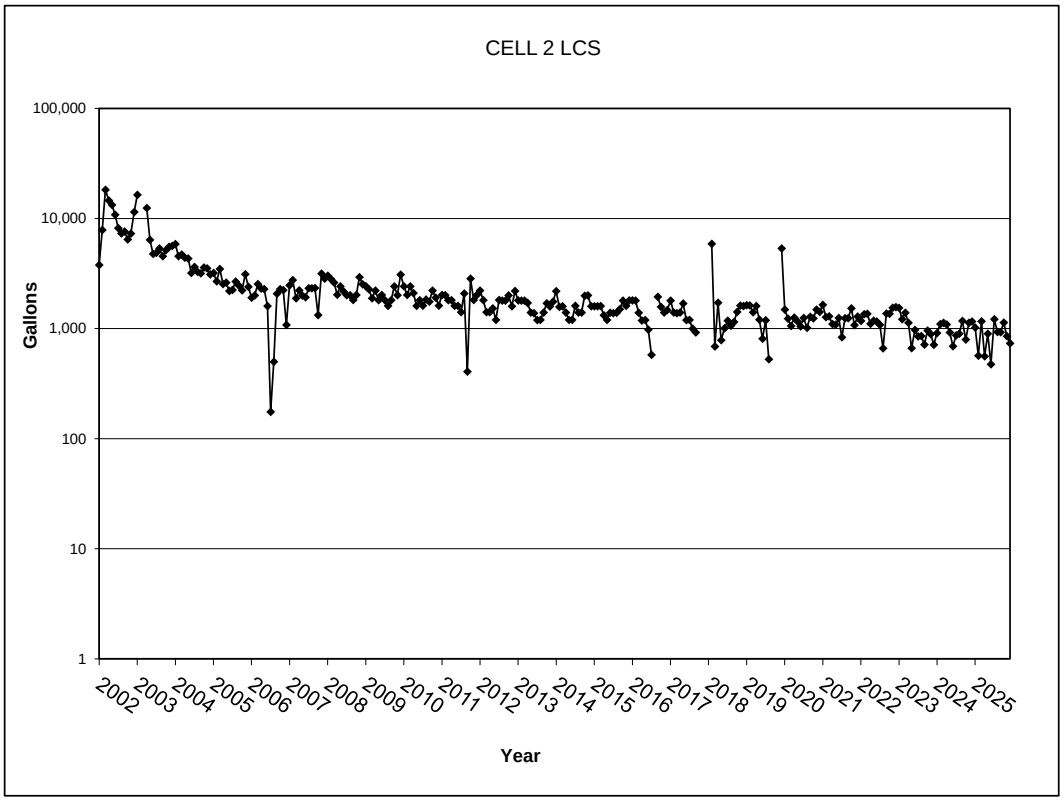


Figure A.5.2-1. Monthly Accumulation Volumes for Cell 2 LCS

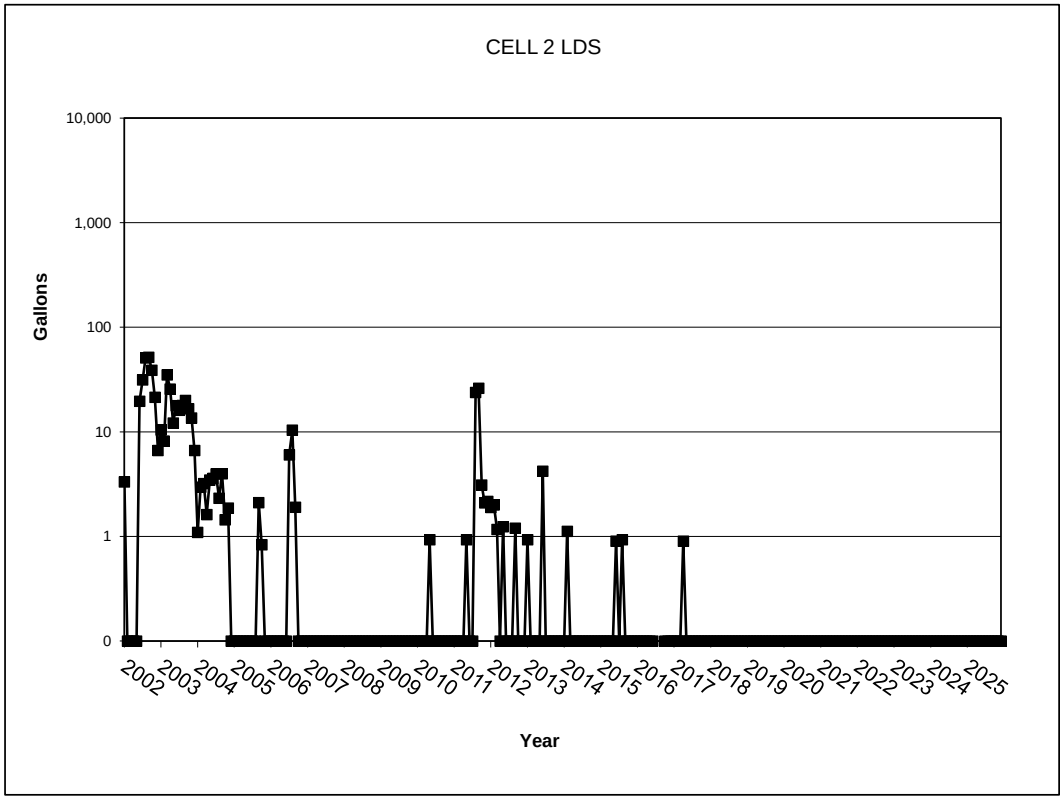


Figure A.5.2-2. Monthly Accumulation Volumes for Cell 2 LDS

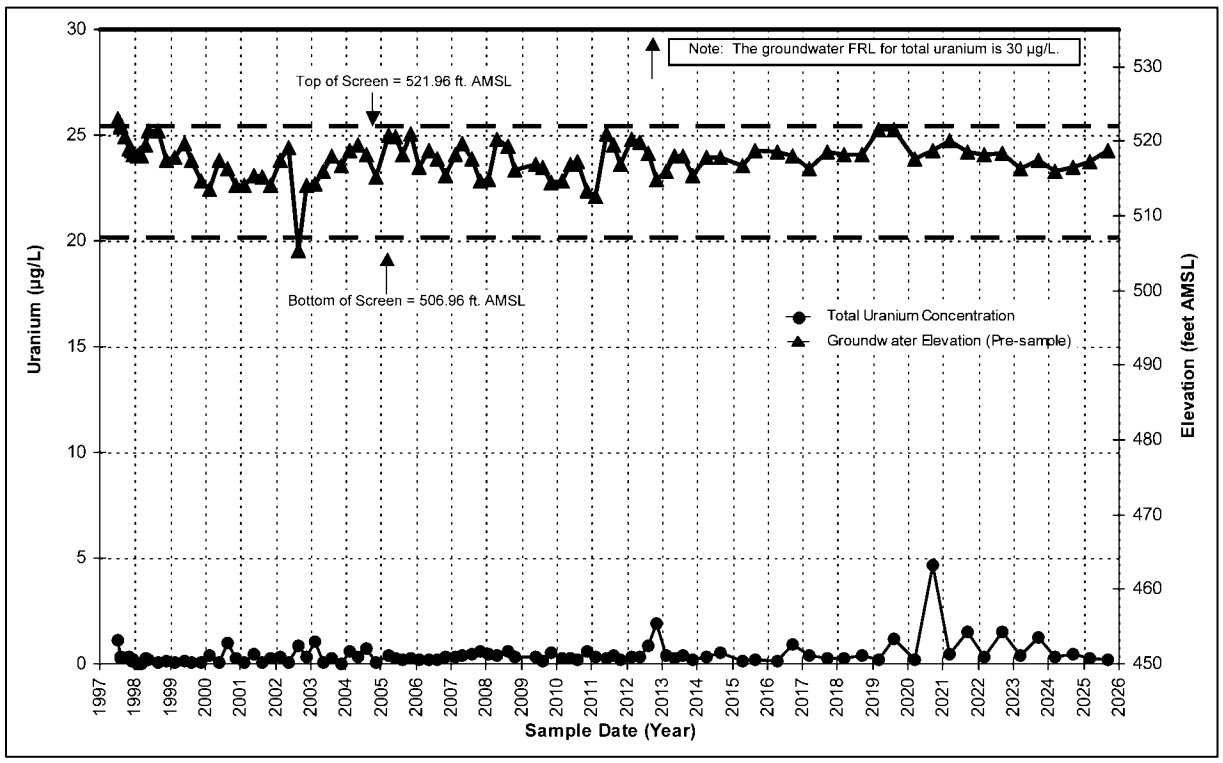


Figure A.5.2-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 2 Upgradient Monitoring Well 22200

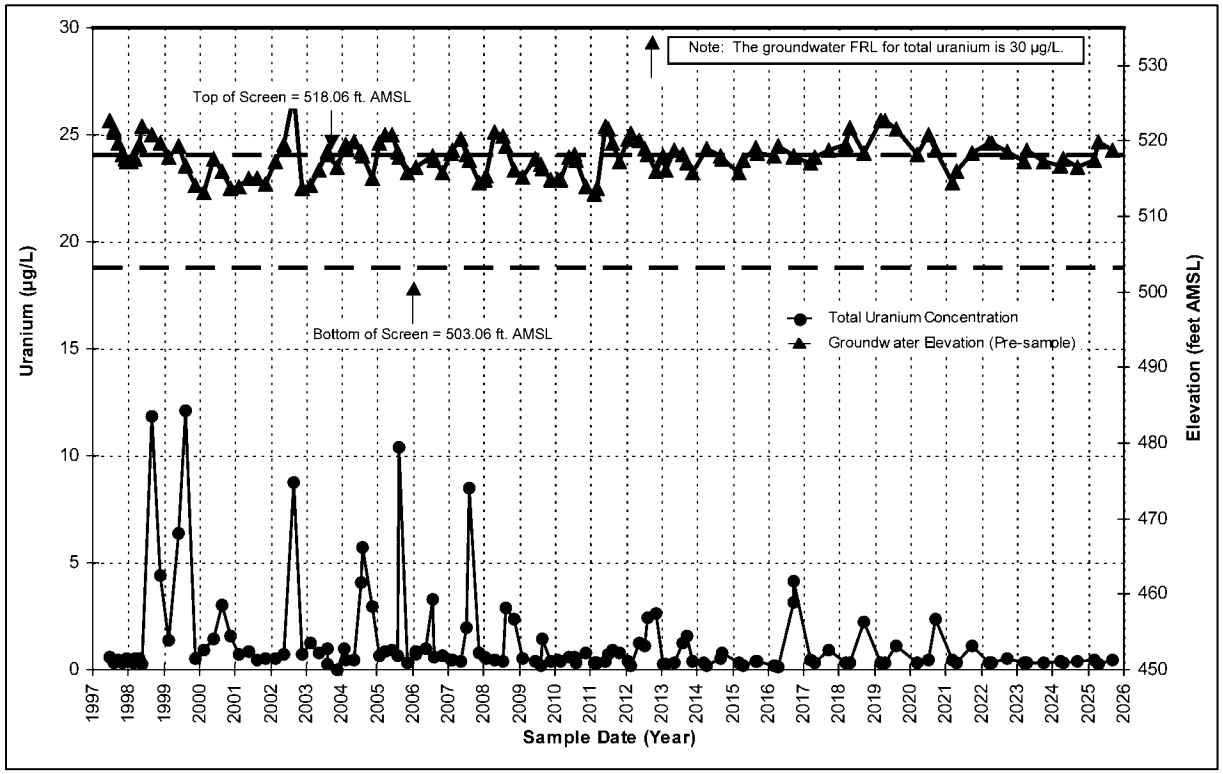


Figure A.5.2-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 2 Downgradient Monitoring Well 22199

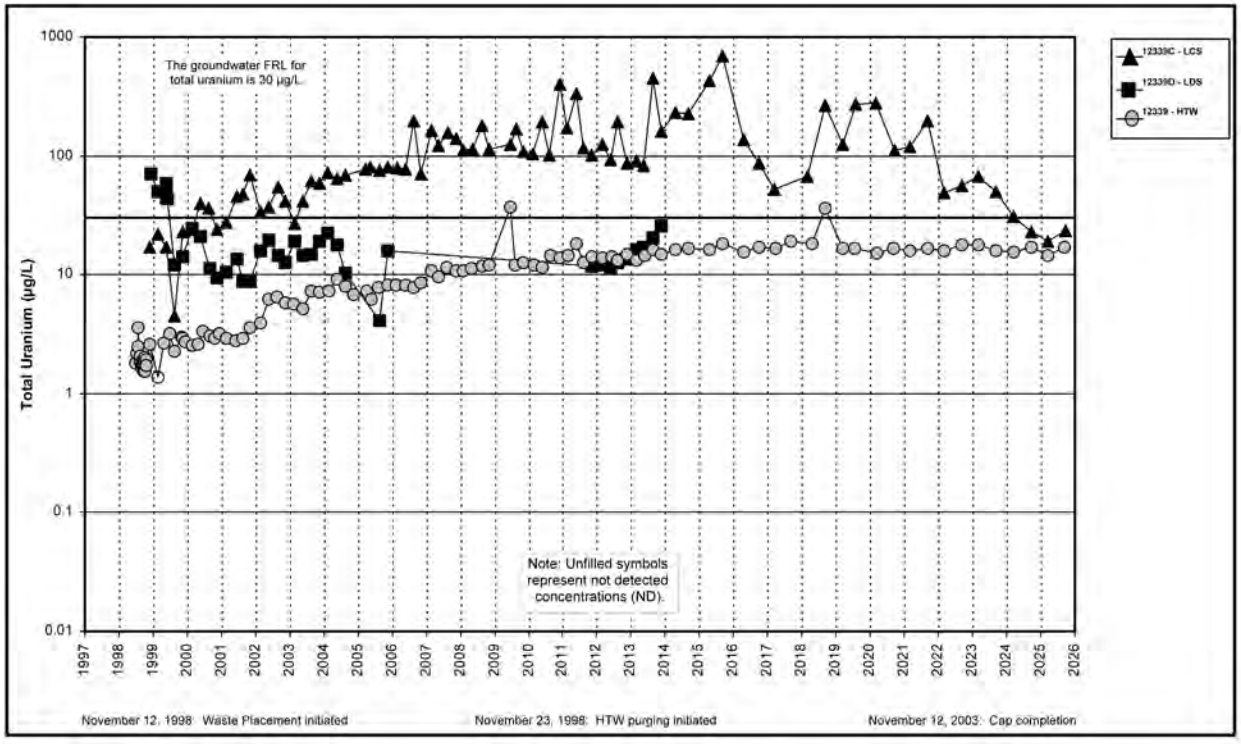


Figure A.5.2-5A. Cell 2 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

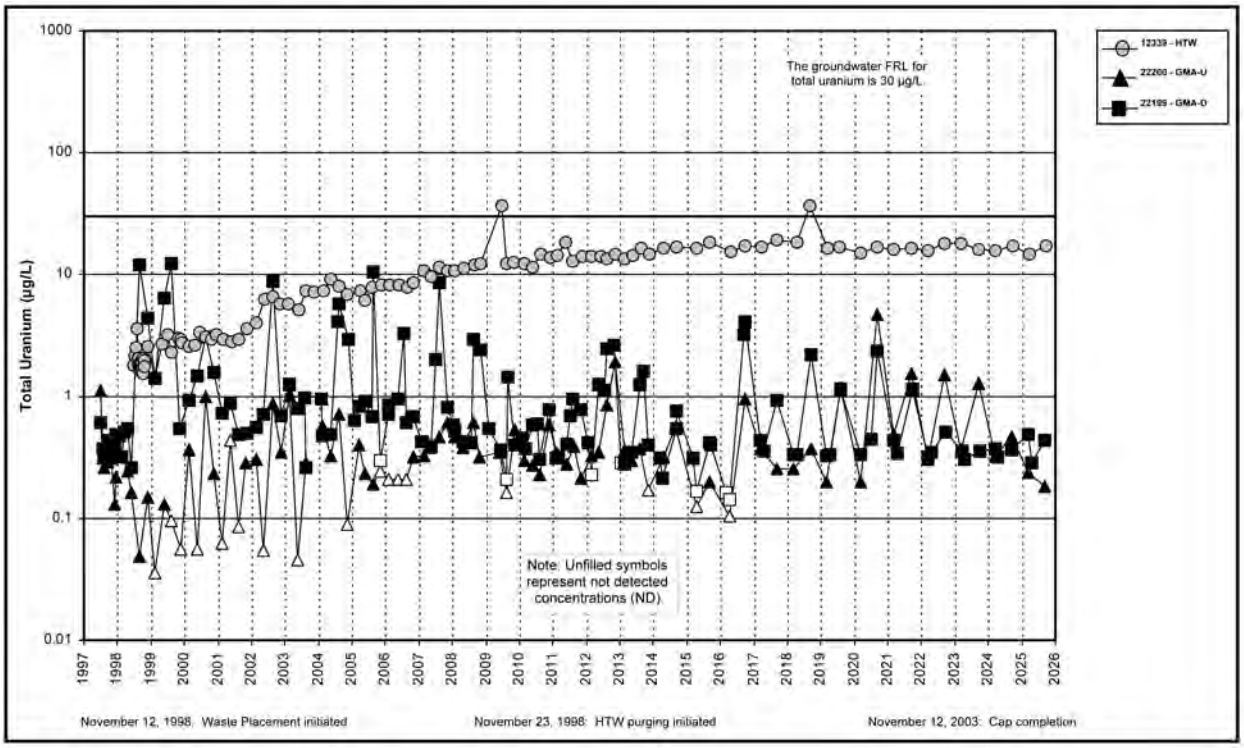


Figure A. 5.2-5B. Cell 2 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

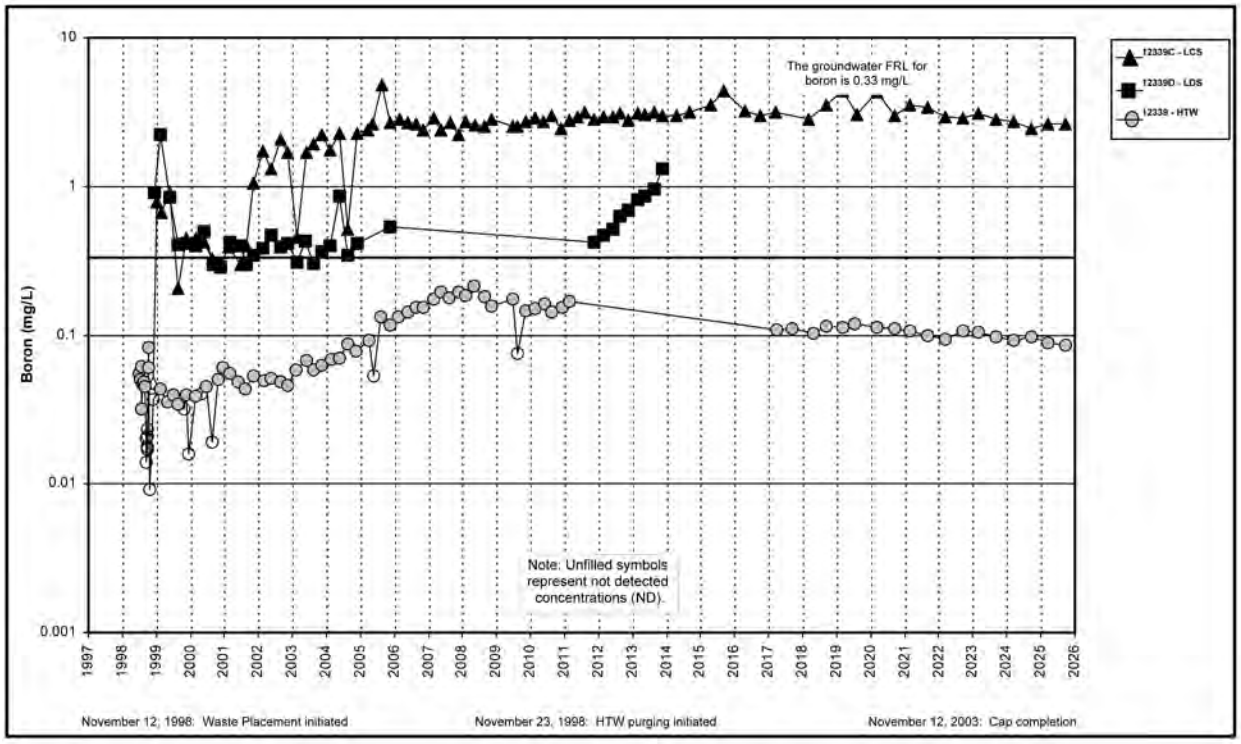


Figure A.5.2-6A. Cell 2 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

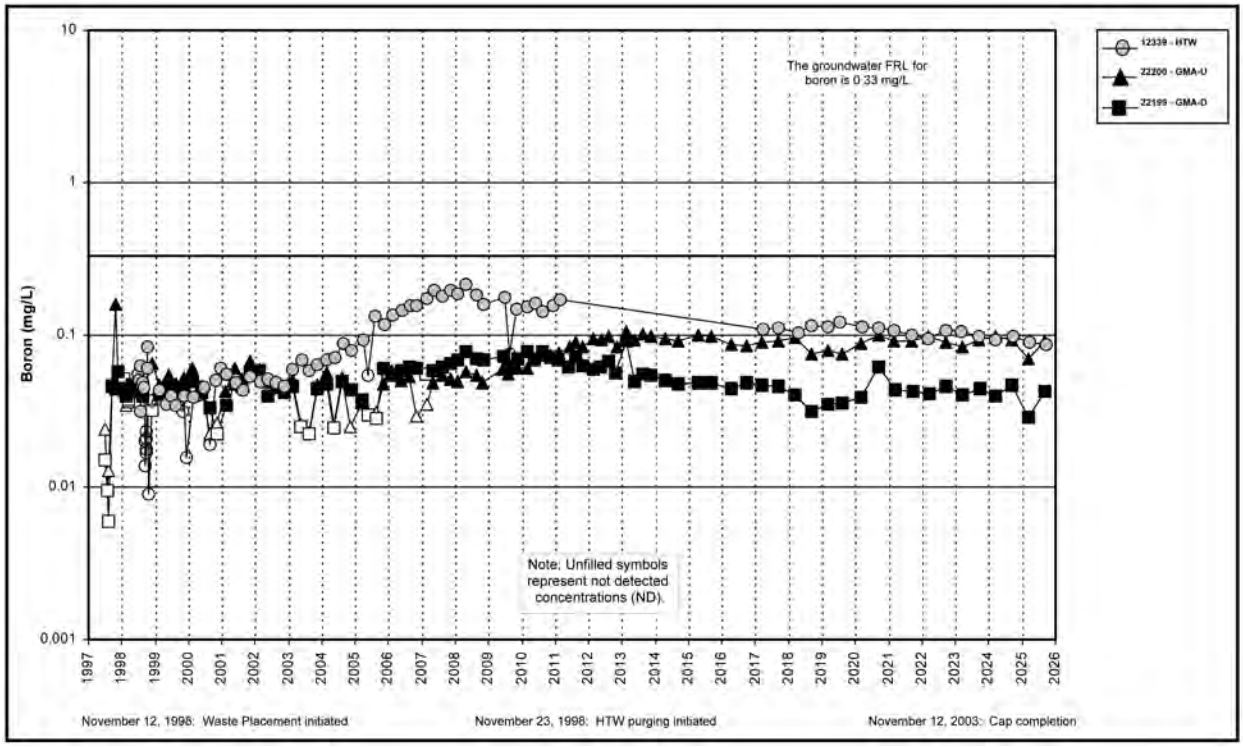


Figure A.5.2-6B. Cell 2 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

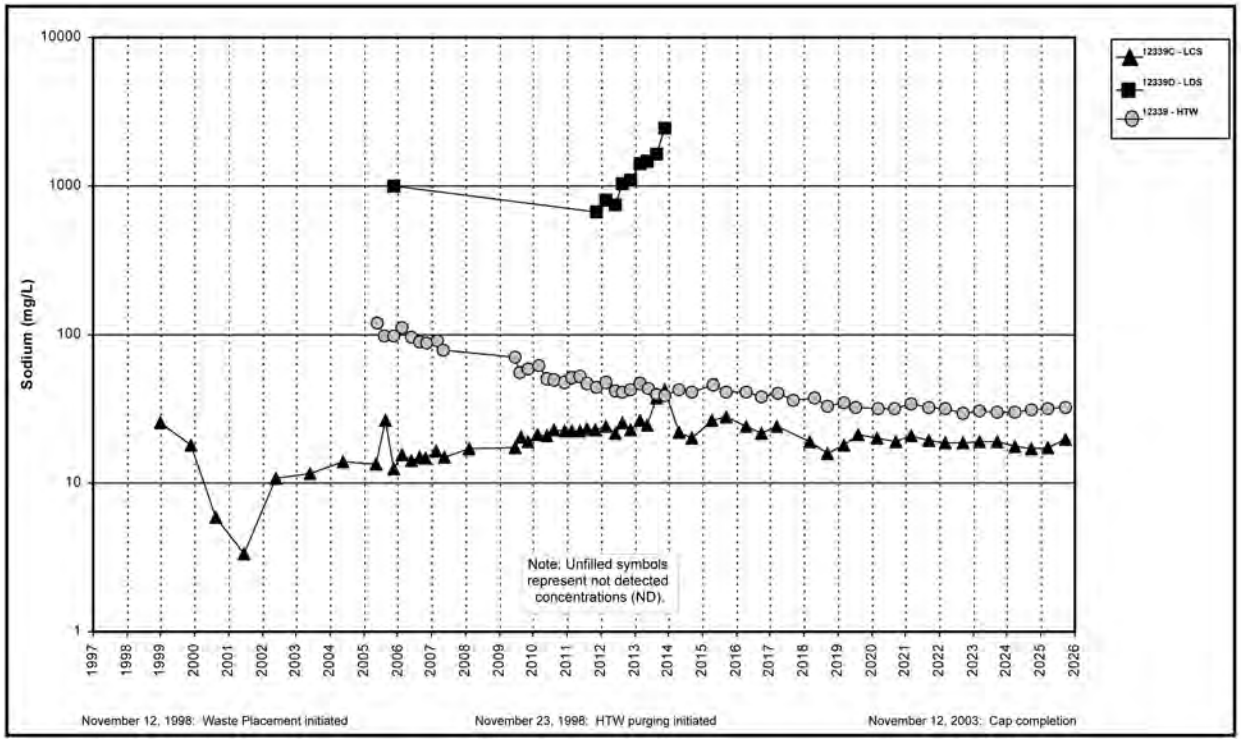


Figure A.5.2-7A. Cell 2 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

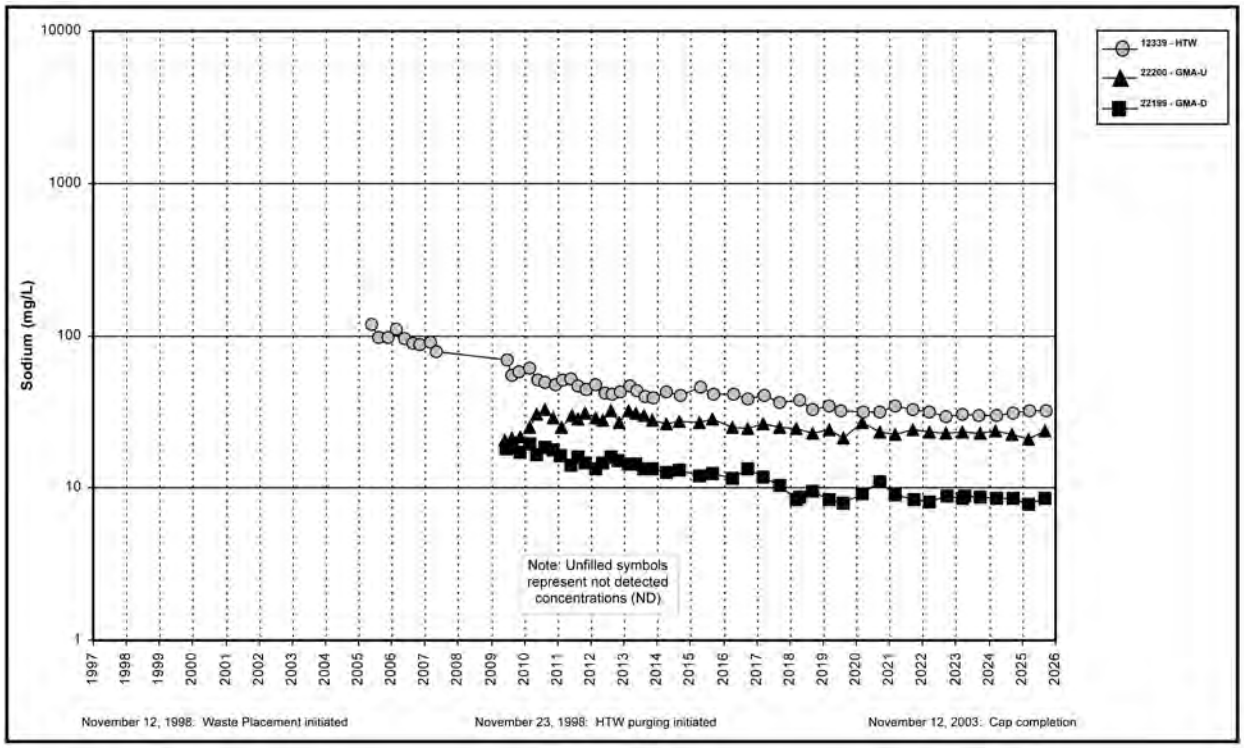


Figure A.5.2-7B. Cell 2 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

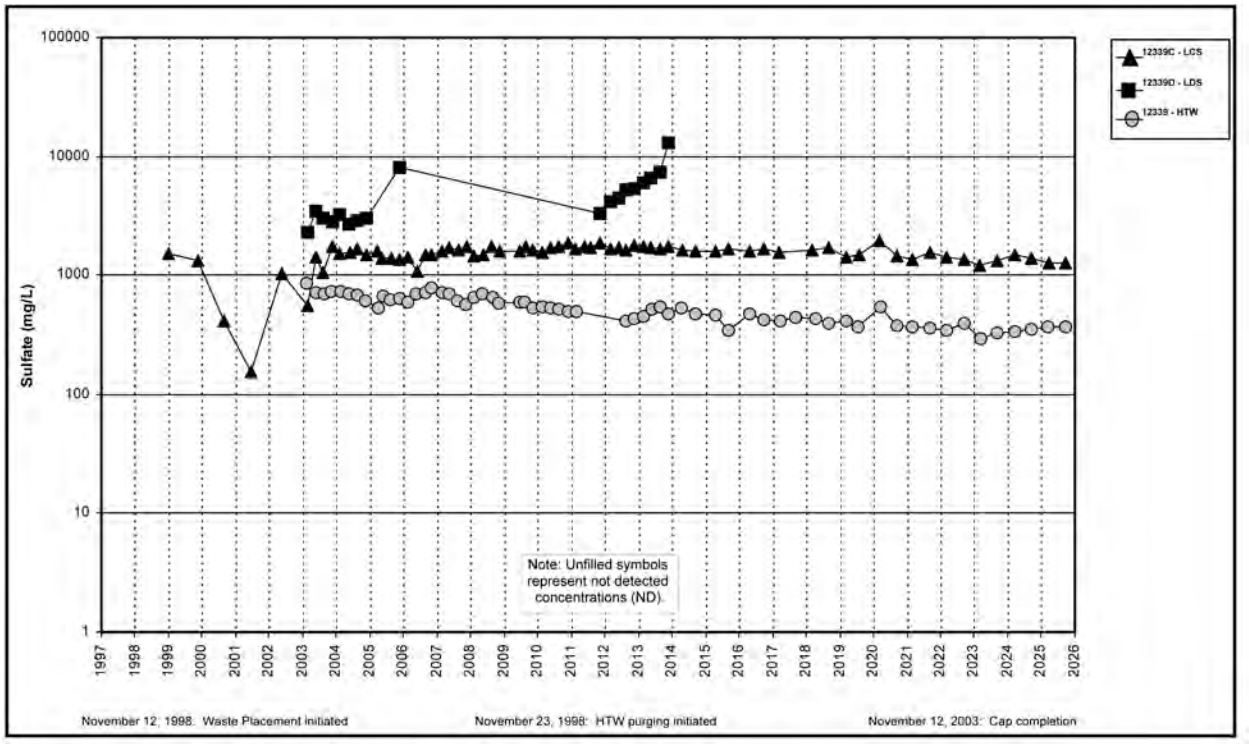


Figure A.5.2-8A. Cell 2 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

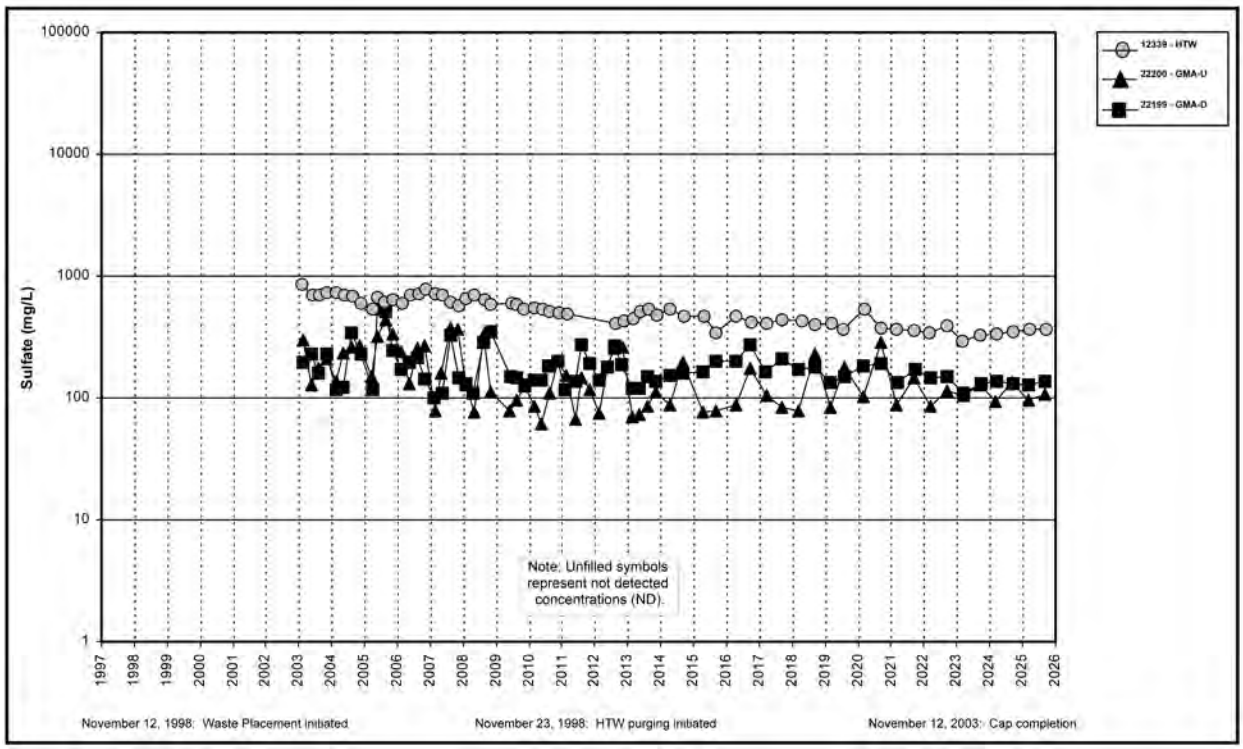


Figure A.5.2-8B. Cell 2 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

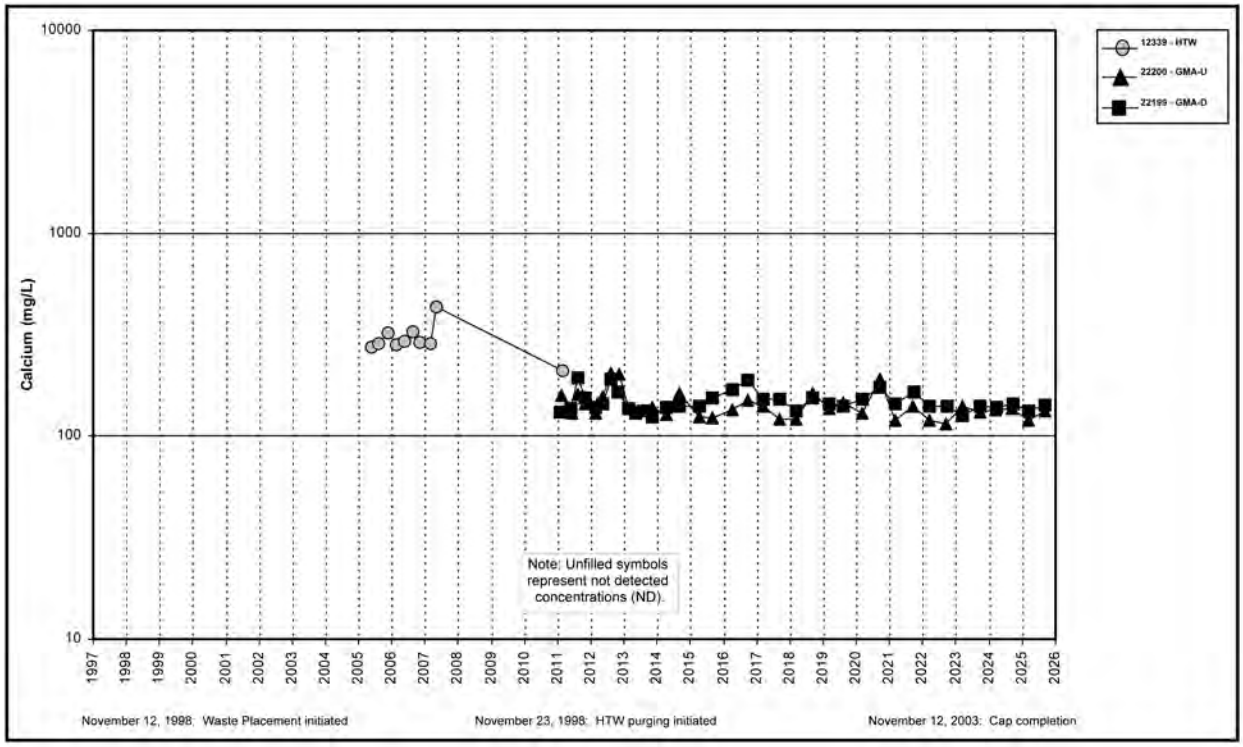


Figure A.5.2-9. Cell 2 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

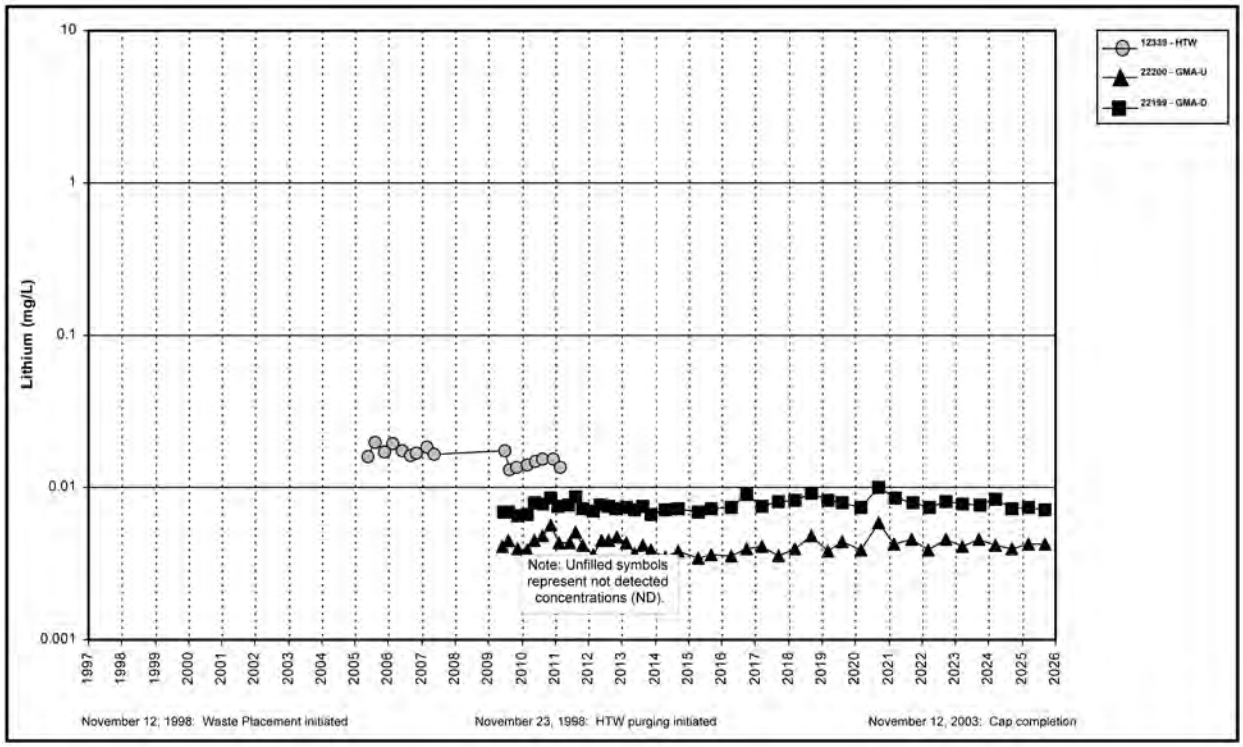


Figure A.5.2-10. Cell 2 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

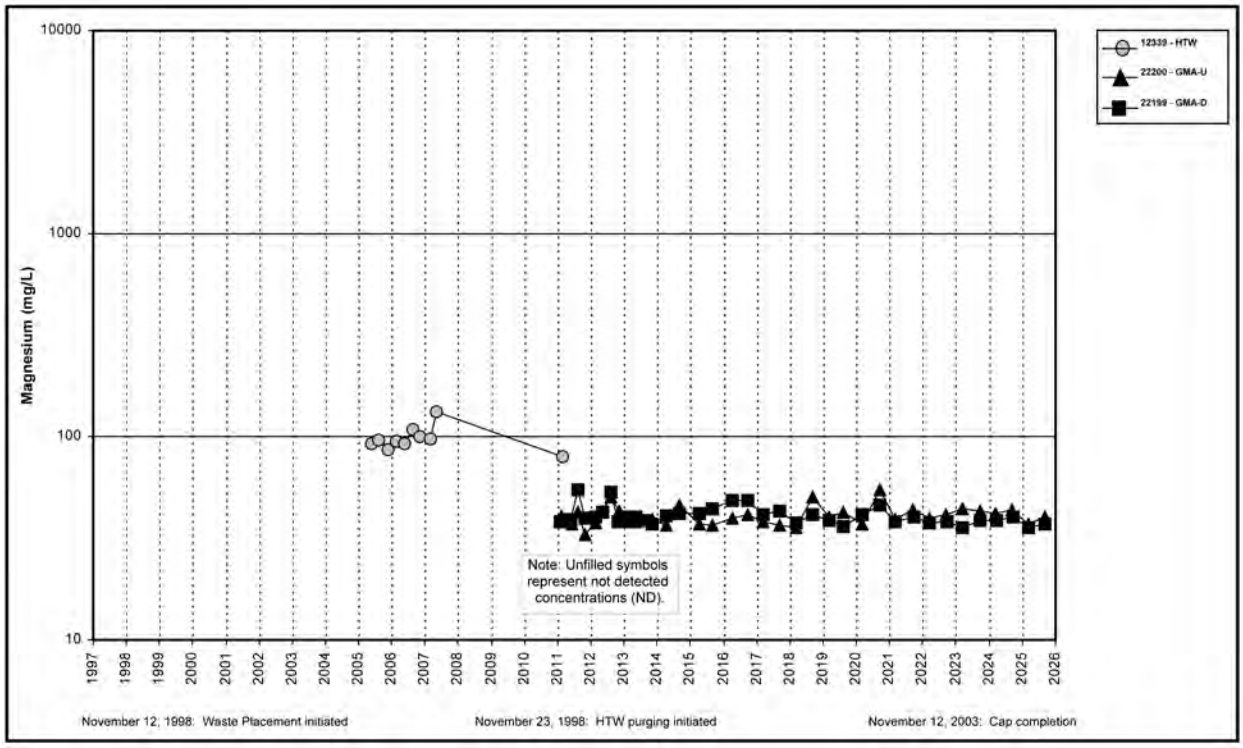


Figure A.5.2-11. Cell 2 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

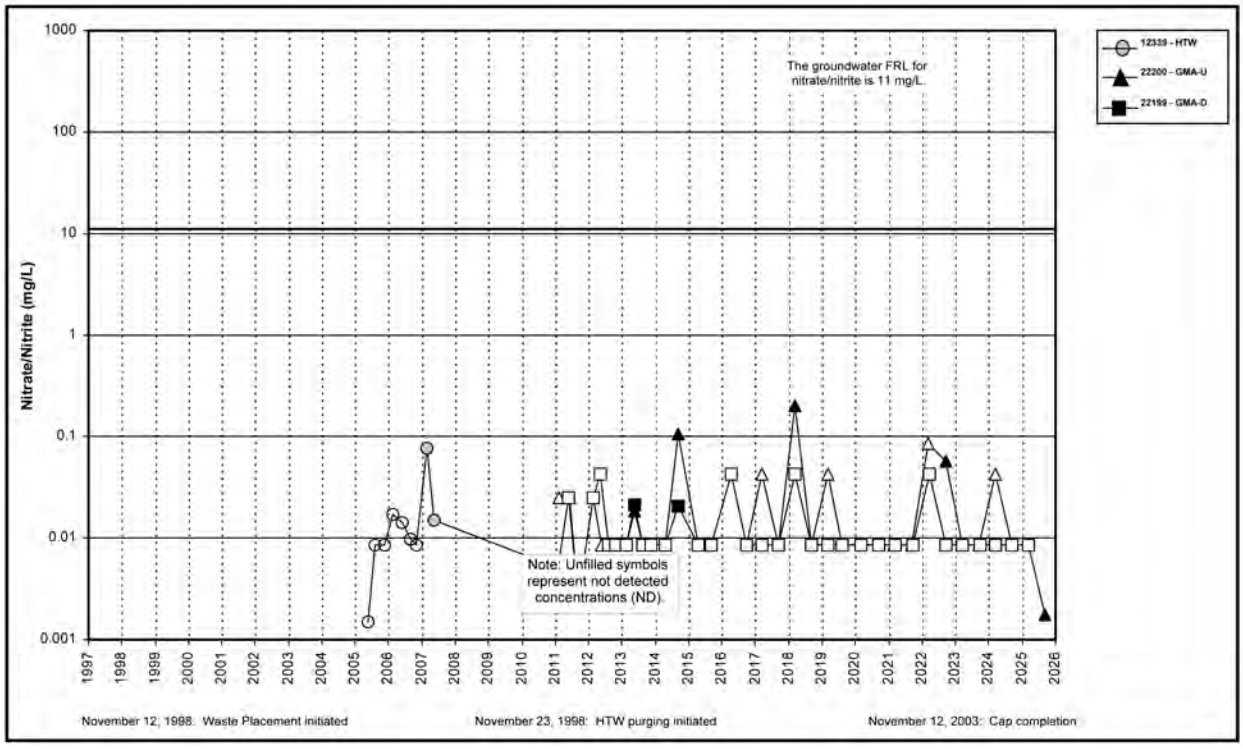


Figure A.5.2-12. Cell 2 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

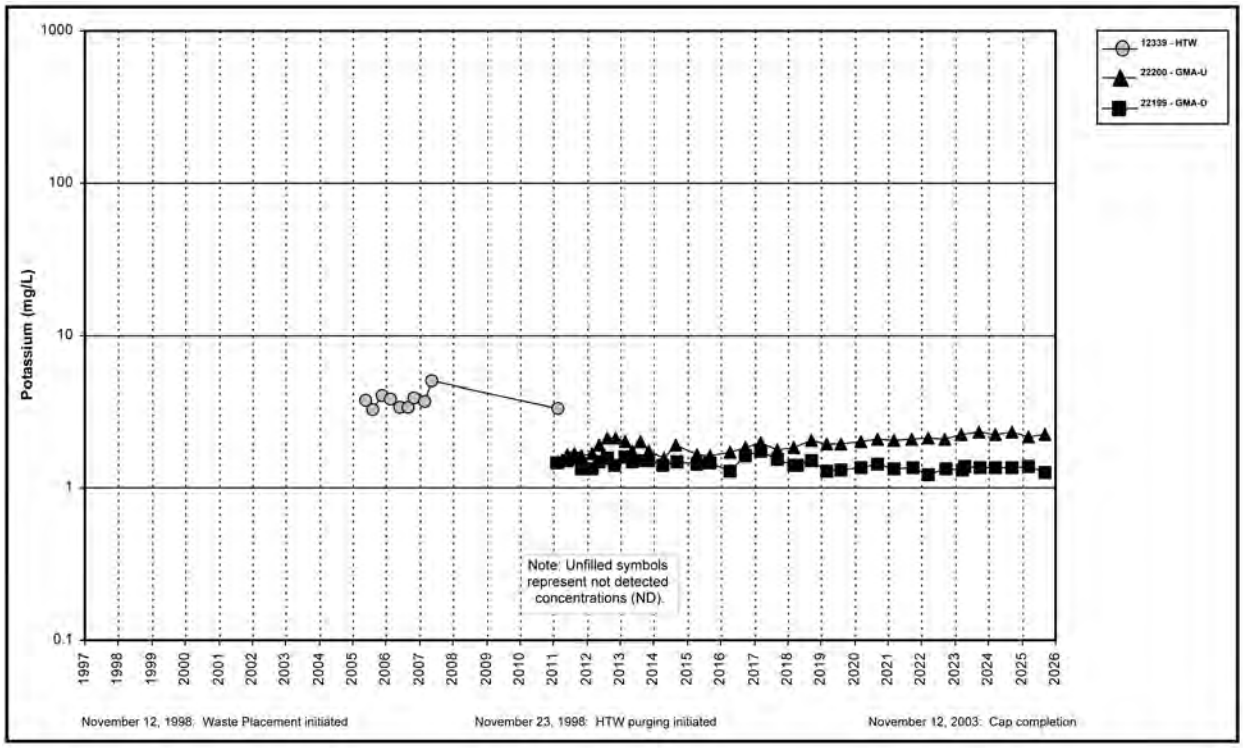


Figure A.5.2-13. Cell 2 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

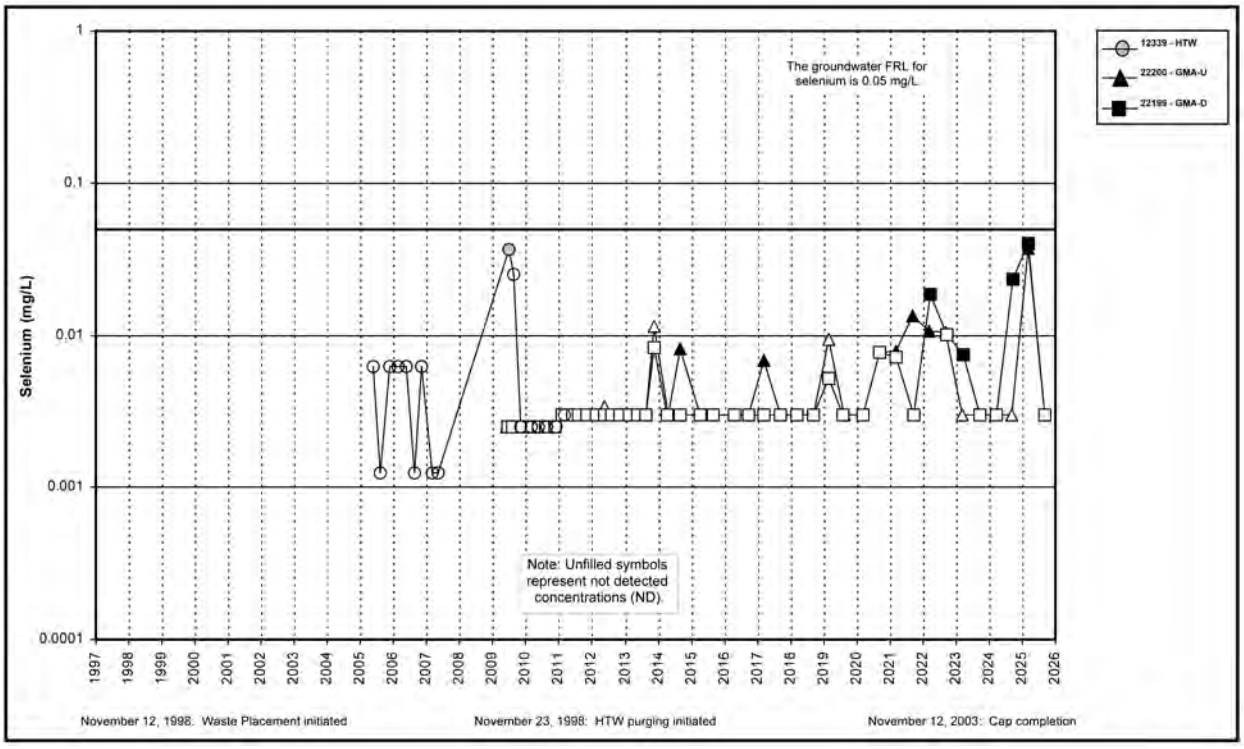


Figure A.5.2-14. Cell 2 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

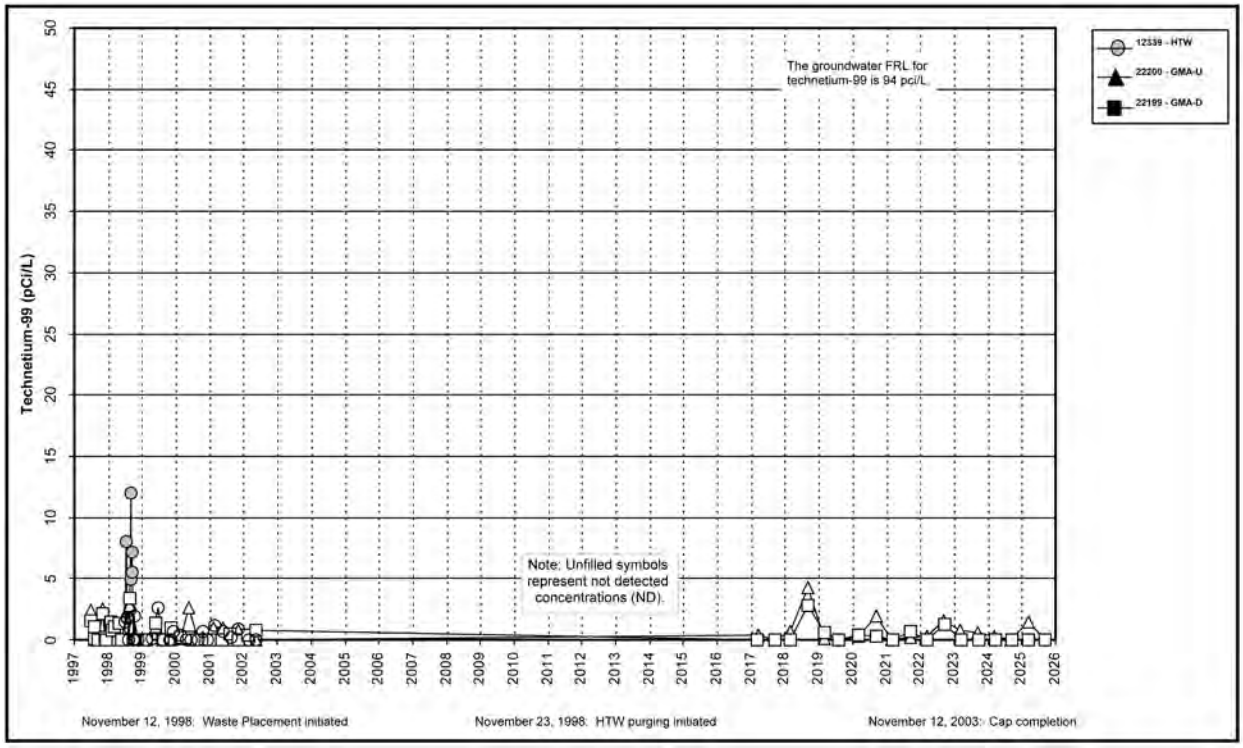


Figure A.5.2-15. Cell 2 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

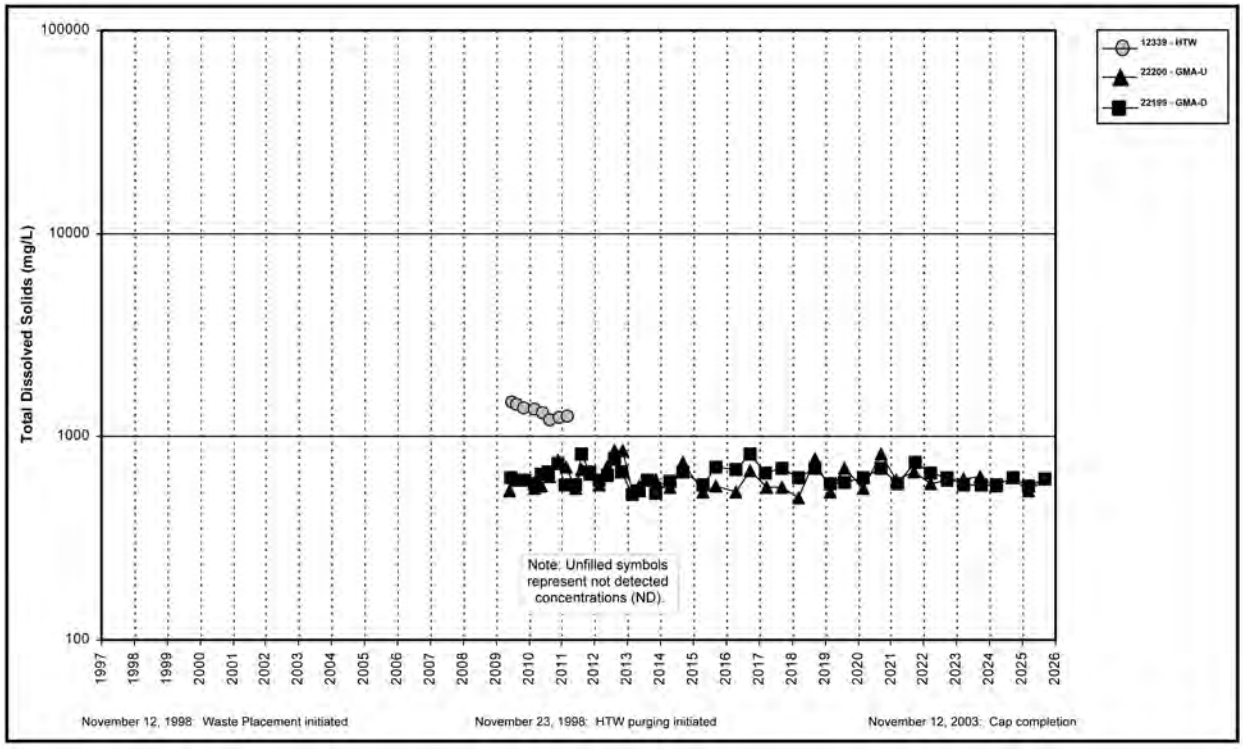


Figure A.5.2-16. Cell 2 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

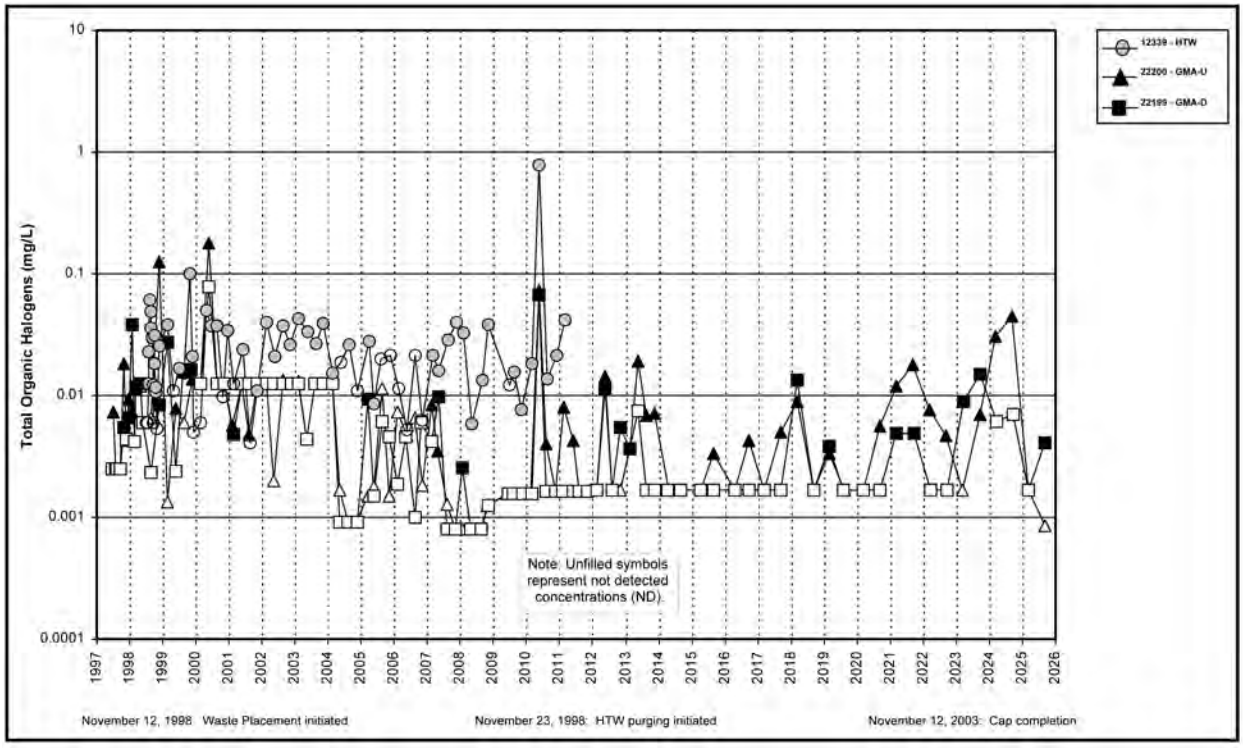


Figure A.5.2-17. Cell 2 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

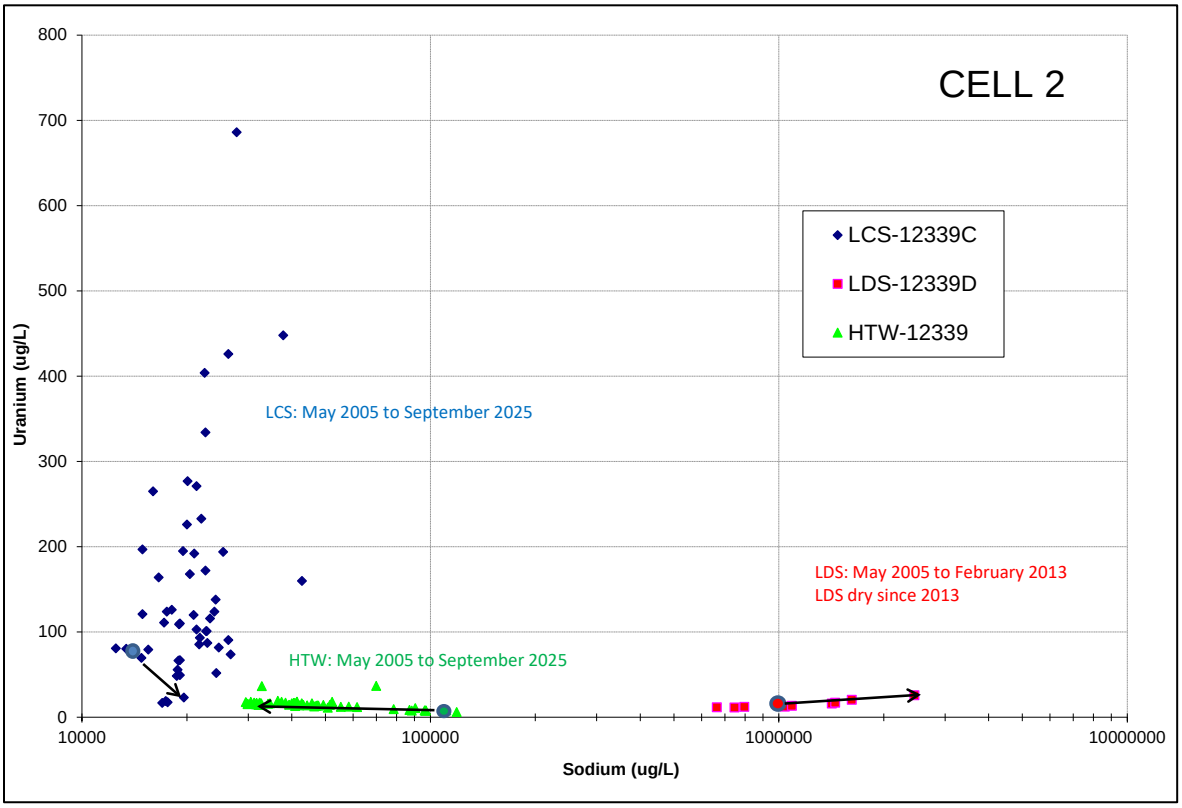


Figure A.5.2-18. Cell 2 Bivariate Plot for Uranium and Sodium

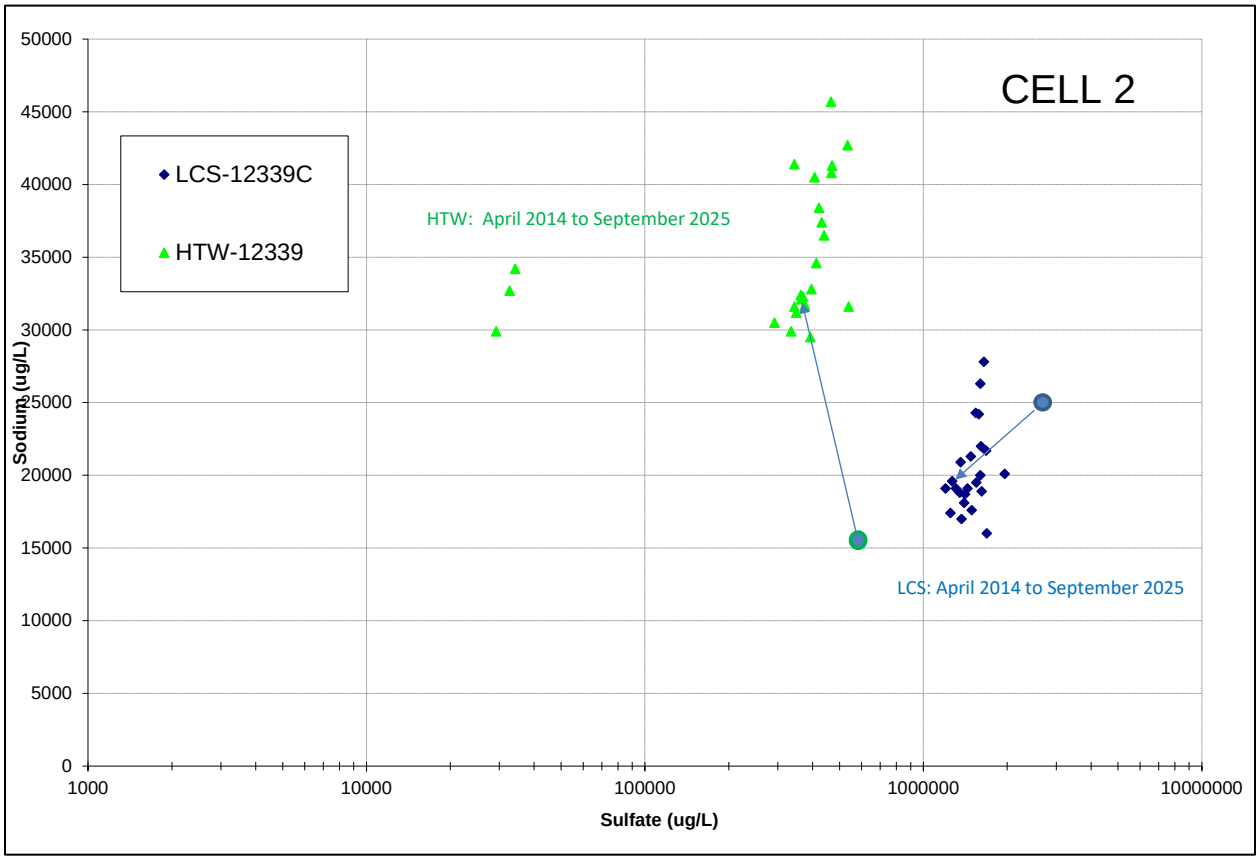


Figure A.5.2-19. Cell 2 Bivariate Plot for Sodium and Sulfate

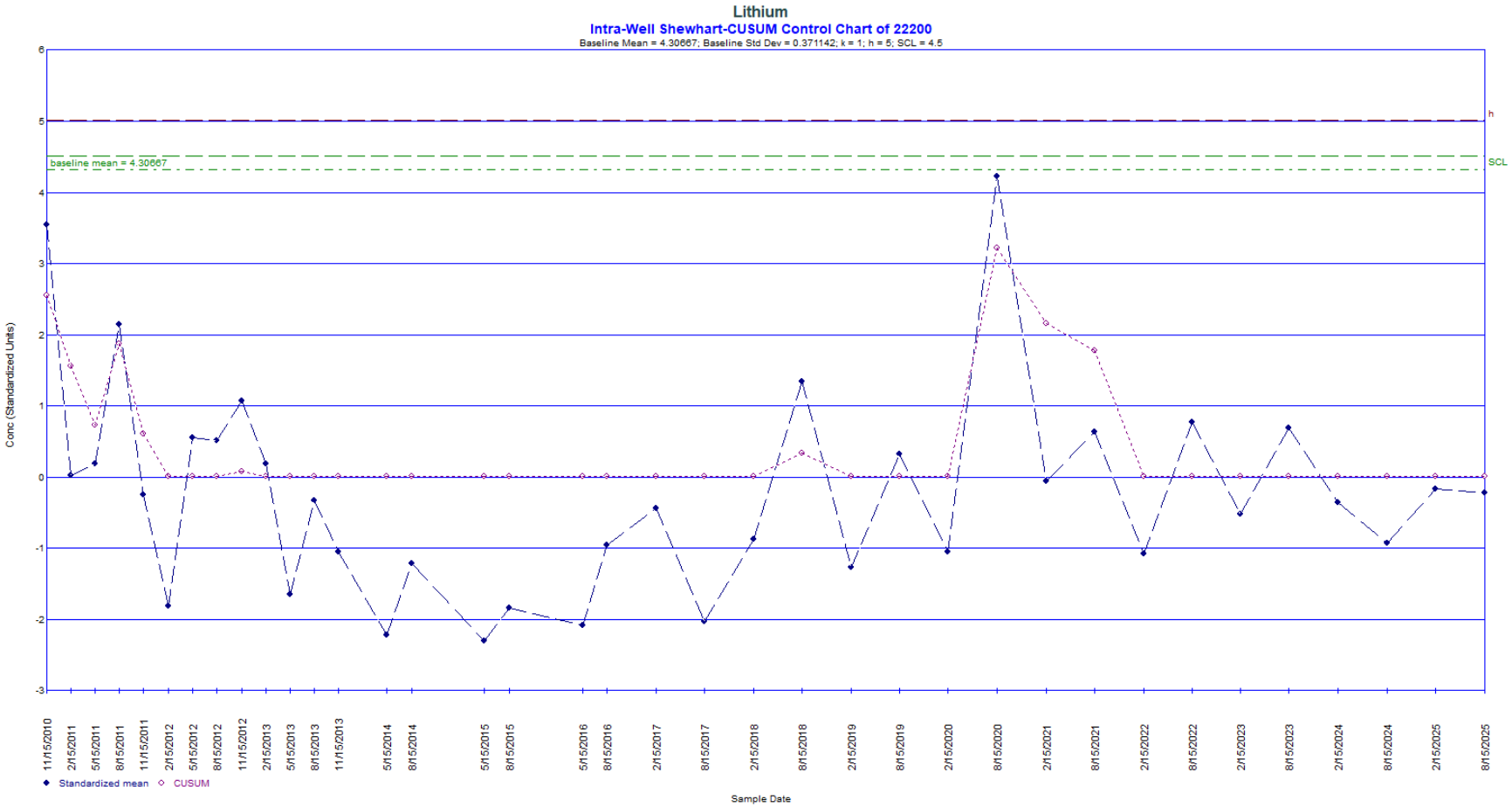


Figure A.5.2-20. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22200

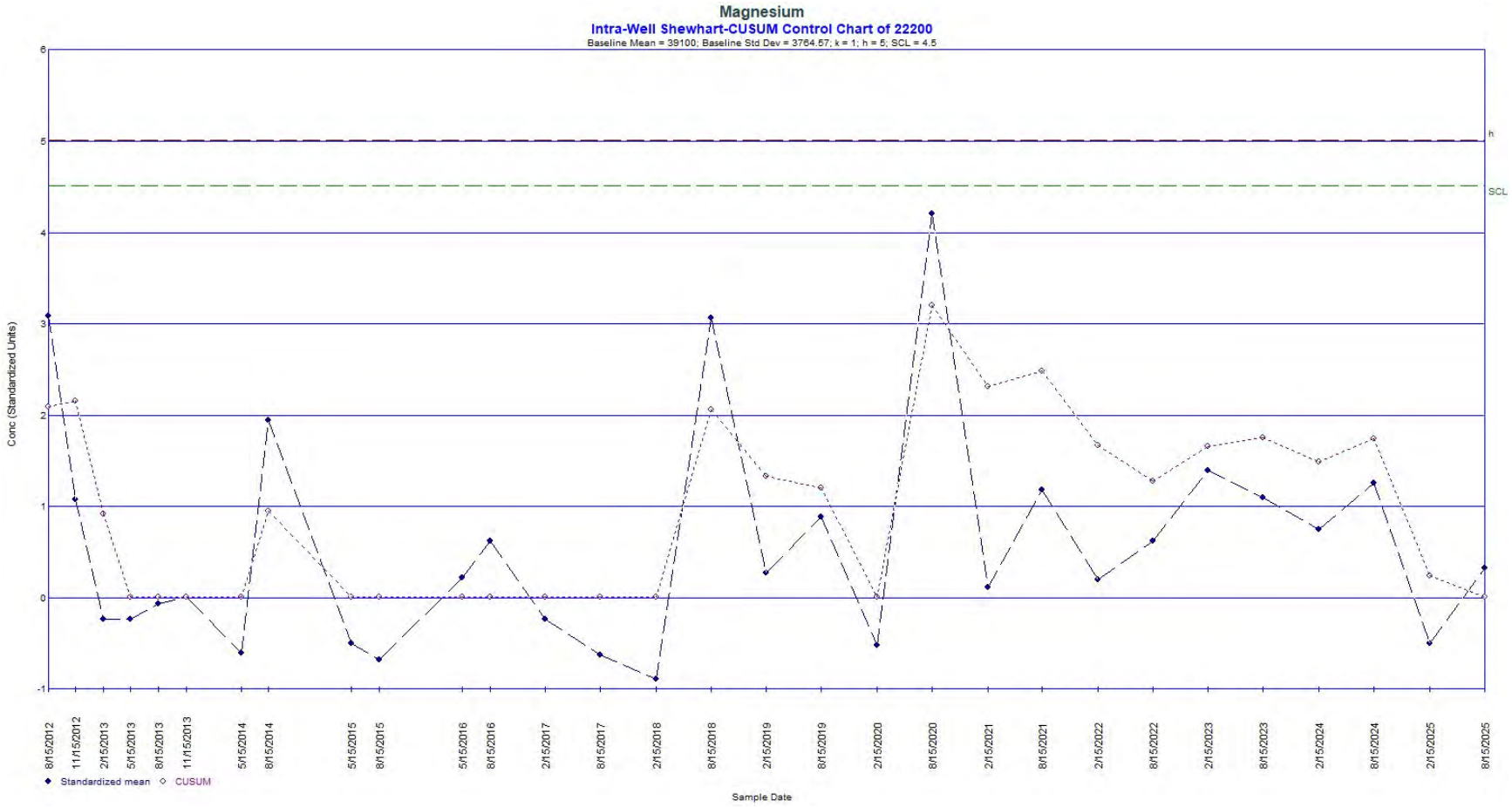


Figure A.5.2-21. Intrawell Shewhart-CUSUM Control Chart for Magnesium in Monitoring Well 22200

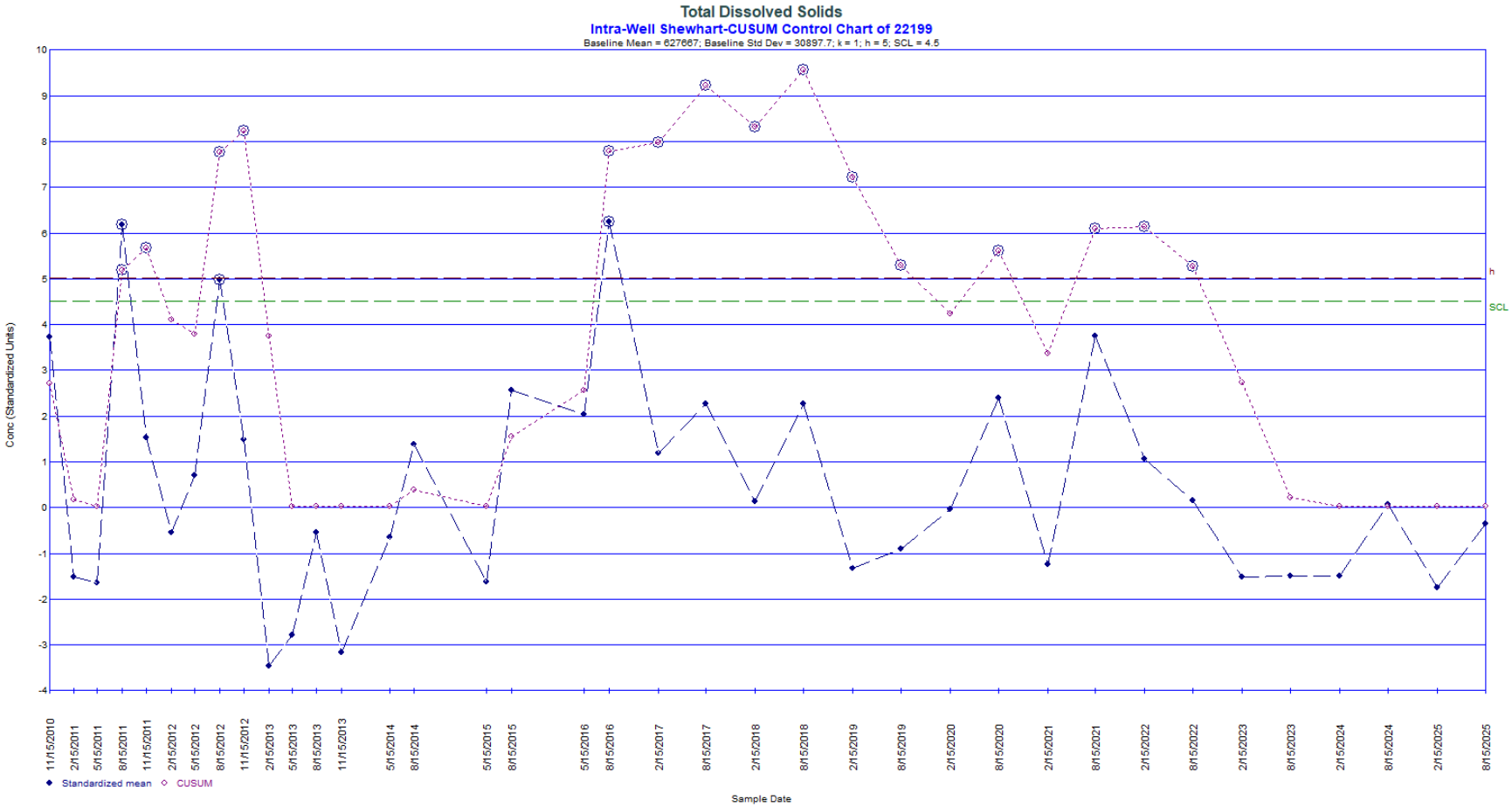


Figure A.5.2-22. Intrawell Shewhart-CUSUM Control Chart for Total Dissolved Solids in Monitoring Well 22199

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Subattachment A.5.3

Cell 3

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.3.1 Water Quality Monitoring Results 1
A.5.3.1.1 LCS and LDS Results 1
A.5.3.1.2 HTW and Monitoring Well Results 2
A.5.3.1.3 Discussion 2
A.5.3.2 Control Charts 3
A.5.3.3 Summary and Conclusions 4
A.5.3.4 References 4

Tables

Table A.5.3-1. Summary Statistics for Cell 3 5
Table A.5.3-2. OSDF Horizontal Till Well 12340 (Cell 3) Water Yield 6

Figures

Figure A.5.3-1. Monthly Accumulation Volumes for Cell 3 LCS 7
Figure A.5.3-2. Monthly Accumulation Volumes for Cell 3 LDS 7
Figure A.5.3-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 3 Upgradient Monitoring Well 22203 8
Figure A.5.3-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 3 Downgradient Monitoring Well 22204 8
Figure A.5.3-5A. Cell 3 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A.5.3-5B. Cell 3 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 9
Figure A.5.3-6A. Cell 3 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.3-6B. Cell 3 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.3-7A. Cell 3 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.3-7B. Cell 3 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.3-8A. Cell 3 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.3-8B. Cell 3 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.3-9. Cell 3 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.3-10. Cell 3 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.3-11. Cell 3 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.3-12. Cell 3 Nitrate + Nitrate as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.3-13. Cell 3 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.3-14. Cell 3 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.3-15. Cell 3 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.3-16. Cell 3 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.3-17. Cell 3 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.3-18. Cell 3 Bivariate Plot for Uranium and Sodium 17
Figure A.5.3-19. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22204 18

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about the On-Site Disposal Facility (OSDF) Cell 3:

- Semiannual monitoring summary statistics (Table A.5.3-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.3-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.3-2)
- OSDF horizontal till well (HTW) 12340 water yield (Table A.5.3-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.3-3 and A.5.3-4)
- Plots of concentration versus time (Figures A.5.3-5A through A.5.3-17)
- A bivariate plot for uranium–sodium (Figure A.5.3-18)
- Control chart (Figures A.5.3-19)

A.5.3.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining if the OSDF is operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW of each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.3.1.1 LCS and LDS Results

As shown in Table A.5.3-1 and summarized below, four parameters (total uranium, boron, sodium, and sulfate) in 2025 have upward trends in the LCS based on the Mann-Kendall test for trend. No new high concentrations were measured in the LCS of Cell 3 in 2025. Since 2007, the volume of water in the LDS tank of Cell 3 has been insufficient to collect a sample.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 3

Parameter	LCS 12340C 2025 Trend	LDS 12340D Trend (Year Last Sampled)[a]
Total Uranium	Up	Down (2007)
Boron	Up	Down (2007)
Sodium	Up	
Sulfate	Up	Down (2007)

[a] No entry indicates that the trend was not up.

A.5.3.1.2 HTW and Monitoring Well Results

As shown in Table A.5.3-1 and summarized here, eight parameters (total uranium, boron, calcium, lithium, magnesium, nitrate + nitrite as nitrogen, selenium, and total dissolved solids) have upward trends in the HTW or the GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 3

Parameter	HTW 12340[a]	GMA-U 22203[b]	GMA-D 22204[a,b]
Total Uranium		Up	Up
Boron	Up	Up	Up
Calcium		Up	
Lithium		Up	
Magnesium		Up	
Nitrate + Nitrite as Nitrogen		Up	
Selenium		Up	Up
Total Dissolved Solids		Up	

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.3.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 3 LCS, LDS, and HTW is provided in Figure A.5.3-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot shows that the chemical signatures for uranium and sodium in the LCS, LDS, and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends and new high uranium concentrations measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.3.2 Control Charts

Intrawell control charts use historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.3-1 in gray shading and as summarized below, one parameter in the HTW and GMA wells of Cell 3 meets the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in one control chart (Figure A.5.3-19). The control chart for Cell 3 exhibited "in control" conditions.

Parameter	Monitoring Point[a]	Well Number	Assessment	Figure Number
Lithium	GMA-D	22204	In Control	A.5.3-19

[a] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.3.3 Summary and Conclusions

- Four parameters monitored semiannually in 2025 have an upward concentration trend in the LCS of Cell 3: total uranium, boron, sodium, and sulfate. No new high concentrations were measured in the LCS of Cell 3 in 2025.
- The volume of water in the LDS tank of Cell 3 has been insufficient to collect a sample since 2007.
- Eight parameters monitored semiannually have an upward concentration trend in the HTW or GMA wells of Cell 3: total uranium, boron, calcium, lithium, magnesium, nitrate + nitrite as nitrogen, selenium, and total dissolved solids. Separate and distinct chemical signatures for total uranium and sodium in the LCS, LDS, and HTW of Cell 3 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 3 (i.e., HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- One control chart was constructed for Cell 3 parameters. The control chart exhibits "in control" conditions.

A.5.3.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.3-1. Summary Statistics for Cell 3

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[d,g]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12340C	80	80	100	9.35	206	90.5	43.4	Normal	Up (2025)	Detected	
	LDS	12340D	21	21	100	8.90	27.7	17.0	5.0	Normal	Down (2007)	Not Detected	72.4 (Q4-04)
	HTW	12340	83	83	100	3.89	29.3	18.7	5.6	Undefined	None (2025)	Detected	58.5 (Q3-09), 42.1 (Q3-16)
	GMA-U	22203	82	85	96.6	0.118	23.6	5.35	5.68	Ln Normal	Up (2025)	Detected	
	GMA-D	22204	96	97	99.0	ND	22.9	3.81	4.40	Undefined	Up (2025)	Detected	
Boron (mg/L)	LCS	12340C	80	81	98.8	ND	9.19	4.35	1.75	Undefined	Up (2025)	Detected	
	LDS	12340D	20	21	95.2	ND	0.557	0.128	0.149	Undefined	Down (2007)	Detected	
	HTW	12340	66	66	100	0.0481	0.259	0.140	0.112	Normal	Up (2025)	Detected	0.960 (Q3-06)
	GMA-U	22203	74	85	87.1	ND	0.0870	0.0508	0.0168	Normal	Up (2025)	Detected	
	GMA-D	22204	77	85	90.6	ND	0.0887	0.0456	0.0145	Normal	Up (2025)	Detected	
Sodium (mg/L)	LCS	12340C	60	60	100	4.35	49.9	27.6	7.4	Undefined	Up (2025)	Detected	
	LDS	12340D	9	9	100	263	344	315	27	Normal	None (2007)	Not Detected	
	HTW	12340	52	52	100	10.2	74.1	31.4	17.8	Ln Normal	Down (2025)	Detected	
	GMA-U	22203	43	43	100	15.4	30.7	19.6	3.9	Undefined	Down (2025)	Detected	
	GMA-D	22204	45	45	100	7.88	20.5	11.7	3.8	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12340C	72	72	100	26.1	2,650	1,900	510	Undefined	Up (2025)	Detected	
	LDS	12340D	19	19	100	112	2,510	1,250	700	Undefined	Down (2007)	Not Detected	
	HTW	12340	62	62	100	352	958	614	156	Normal	Down (2025)	Detected	
	GMA-U	22203	67	67	100	64.2	738	262	144	Ln Normal	None (2025)	Detected	4,020 (Q3-12)
	GMA-D	22204	67	67	100	186	779	412	157	Ln Normal	Down (2025)	Detected	
Calcium (mg/L)	GMA-U	22203	36	36	100	135	290	184	36	Ln Normal	Up (2025)	Not Detected	
	GMA-D	22204	36	36	100	134	365	215	55	Ln Normal	Down (2025)	Detected	
Lithium (mg/L)	GMA-U	22203	43	43	100	0.00577	0.0233	0.0105	0.0057	Undefined	Up (2025)	Not Detected	
	GMA-D	22204	43	43	100	0.00694	0.0102	0.00863	0.00087	Normal	None (2025)	Not Detected	
Magnesium (mg/L)	GMA-U	22203	36	36	100	32.5	65.6	49.2	9.3	Normal	Up (2025)	Not Detected	
	GMA-D	22204	36	36	100	37.2	66.6	49.2	8.1	Normal	Down (2025)	Not Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22203	22	36	61.1	ND	0.277	0.0616	0.0961	Undefined	Up (2025)	Detected	
	GMA-D	22204	2	36	5.6	ND	0.0425	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Potassium (mg/L)	GMA-U	22203	36	36	100	2.07	3.50	2.54	0.33	Ln Normal	Down (2025)	Not Detected	
	GMA-D	22204	38	38	100	1.17	3.07	1.89	0.52	Ln Normal	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22203	7	43	16.3	ND	0.0479	0.00300	0.00735	Undefined	Up (2025)	Detected	
	GMA-D	22204	5	43	11.6	ND	0.0178	0.00300	0.00314	Undefined	Up (2025)	Detected	
Technitium-99 (pCi/L)	GMA-U	22203	1	34	2.9	ND	8.44	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22204	0	34	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22203	43	43	100	524	1,410	776	190	Ln Normal	Up (2025)	Detected	
	GMA-D	22204	43	43	100	487	1,530	933	223	Normal	Down (2025)	Not Detected	
Total Organic Halogens (mg/L)	GMA-U	22203	46	85	54.1	ND	0.213	0.00516	0.0242	Undefined	None (2025)	Detected	
	GMA-D	22204	19	85	22.4	ND	0.0270	0.00166	0.00544	Undefined	Down (2025)	Detected	0.165 (Q2-00)

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well, with at least eight samples, Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.

Note 2: Data used in this table has been standardized to quarterly.

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]ND = not detected; NA = not applicable

[c]Averages were determined based on the distribution assumption.

[d]Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.

[e]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[f]Trend based on nonparametric Mann-Kendall procedure.

[g]Serial correlation based on Rank Von Neumann test.

[h]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[i]Q = quarter

Table A.5.3-2. OSDF Horizontal Till Well 12340 (Cell 3) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
1999	4,880	11	444
2000	1,090	6	182
2001	1,050	4	263
2002	1,200	4	300
2003	1,770	4	443
2004	2,875	4	719
2005	3,330	4	833
2006	3,115	4	779
2007	2,895	4	724
2008	2,875	4	719
2009	2,100	4	700
2010	2,650	4	663
2011	2,600	4	650
2012	2,150	4	538
2013	2,725	4	681
2014	1,455	2	728
2015	1,050	2	525
2016	1,445	2	723
2017	1,425	2	713
2018	1,400	2	700
2019	1,475	2	738
2020	1,550	2	775
2021	1,435	2	718
2022	1,400	2	700
2023	1,450	2	725
2024	1,070	2	535
2025	845	2	423

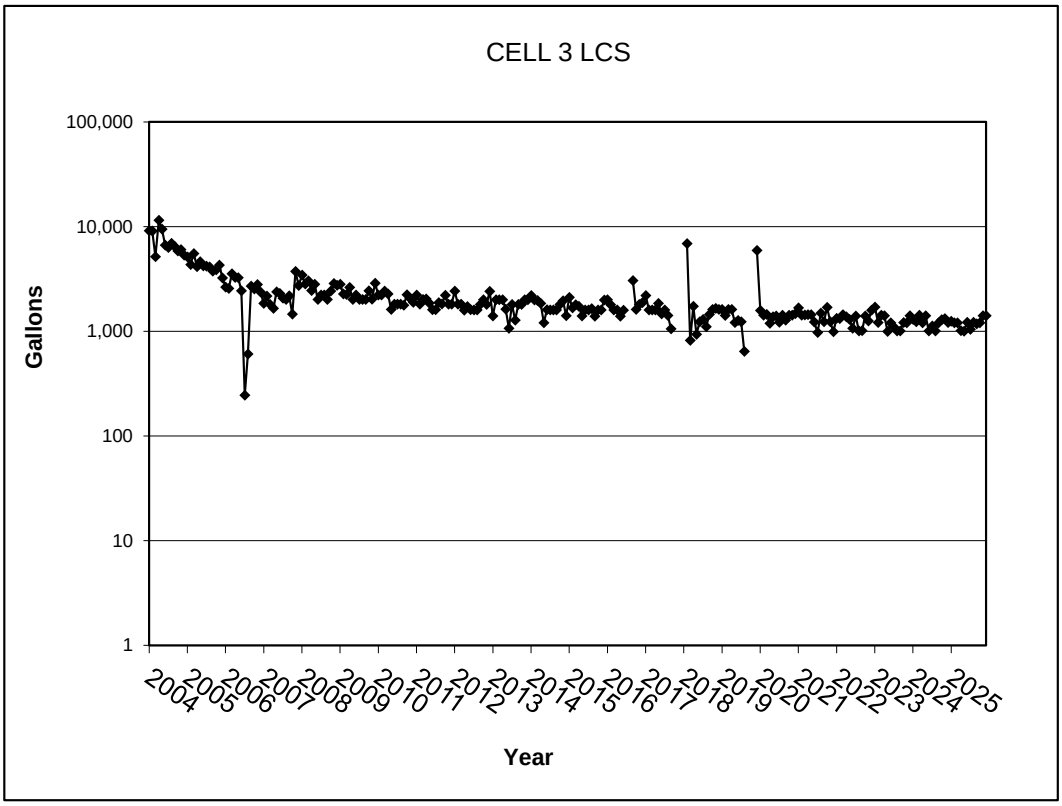


Figure A.5.3-1. Monthly Accumulation Volumes for Cell 3 LCS

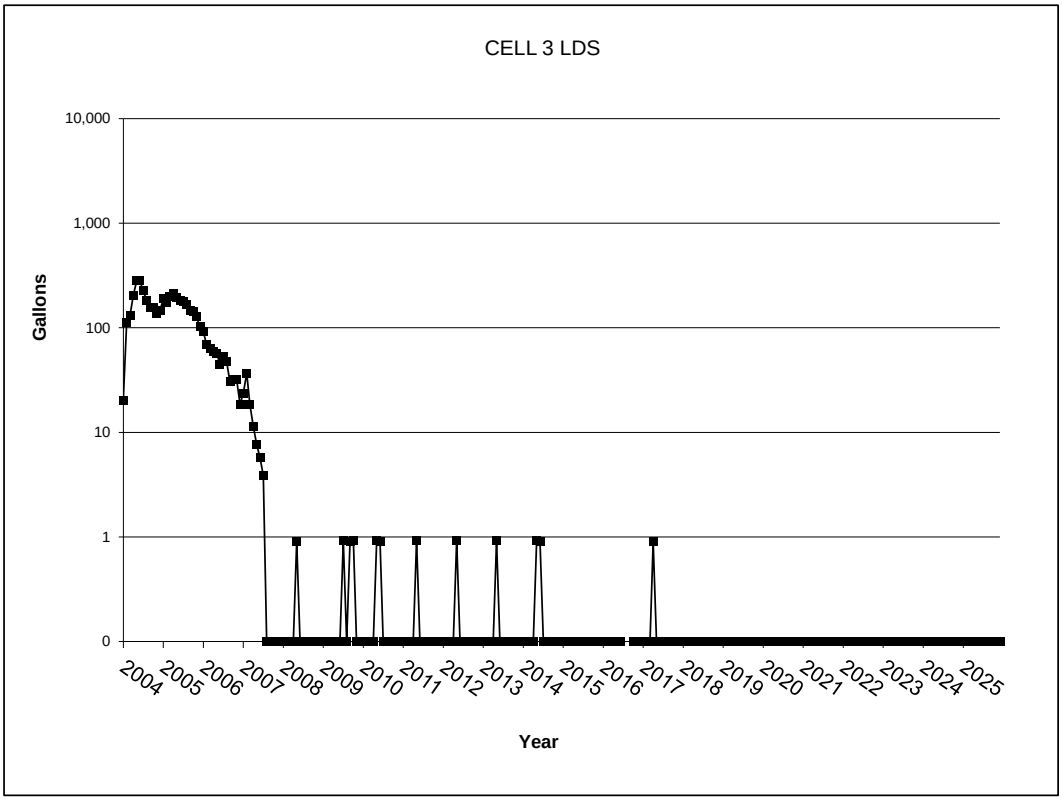


Figure A.5.3-2. Monthly Accumulation Volumes for Cell 3 LDS

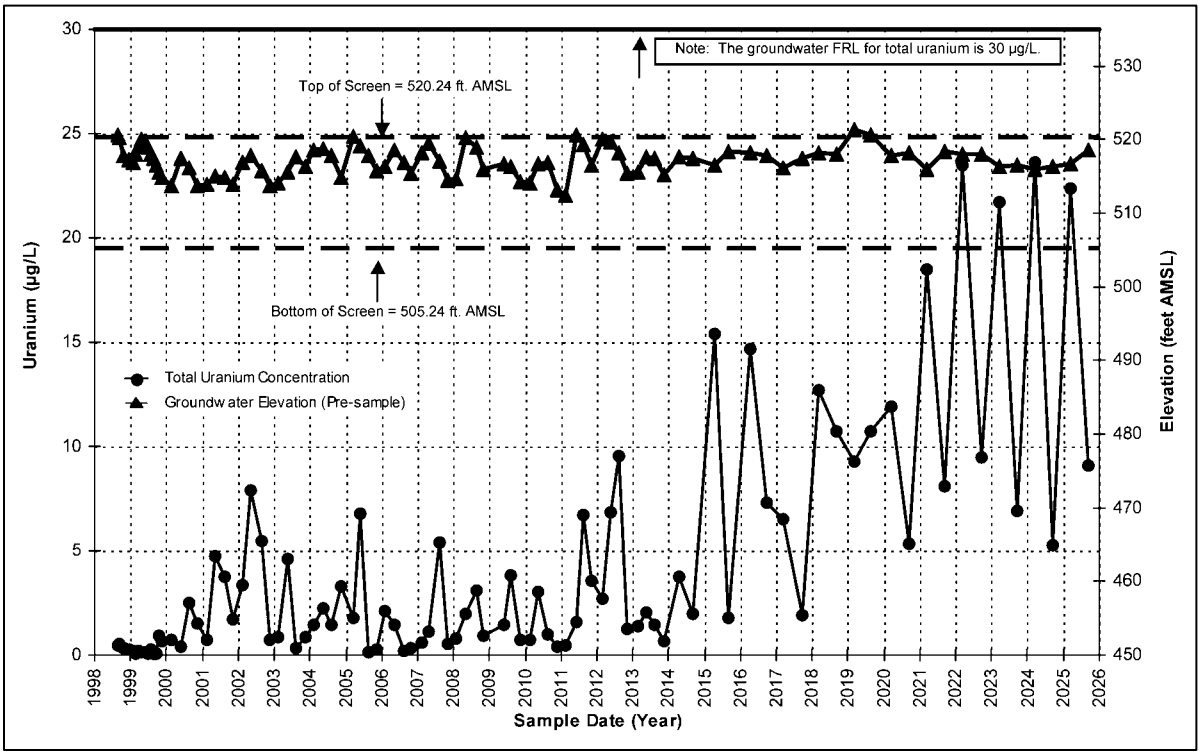


Figure A.5.3-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 3 Upgradient Monitoring Well 22203

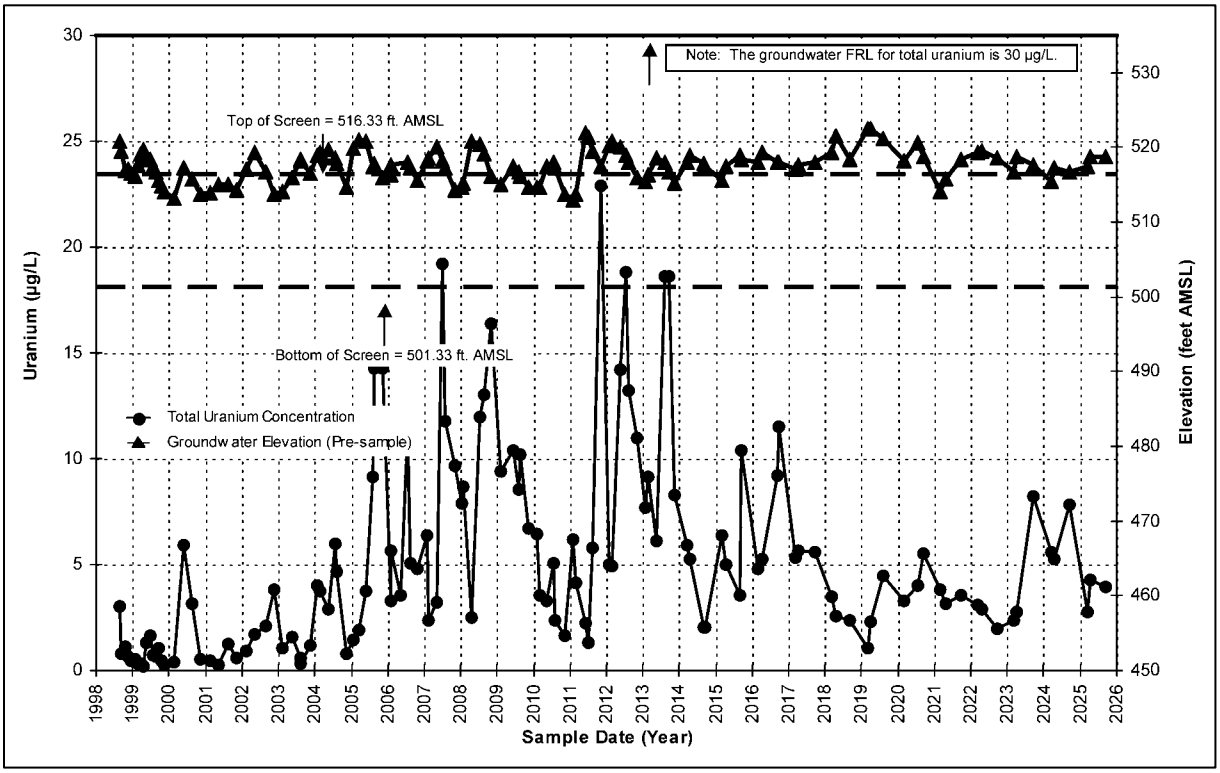


Figure A.5.3-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 3 Downgradient Monitoring Well 22204

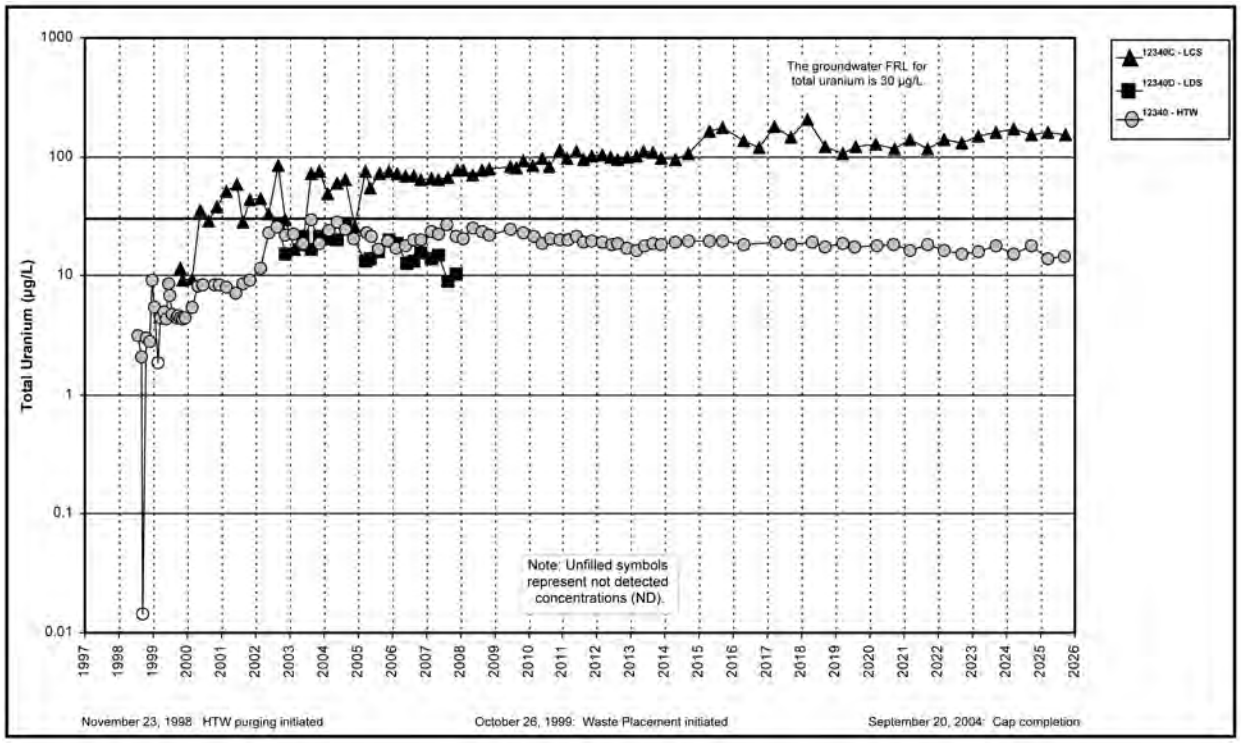


Figure A.5.3-5A. Cell 3 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

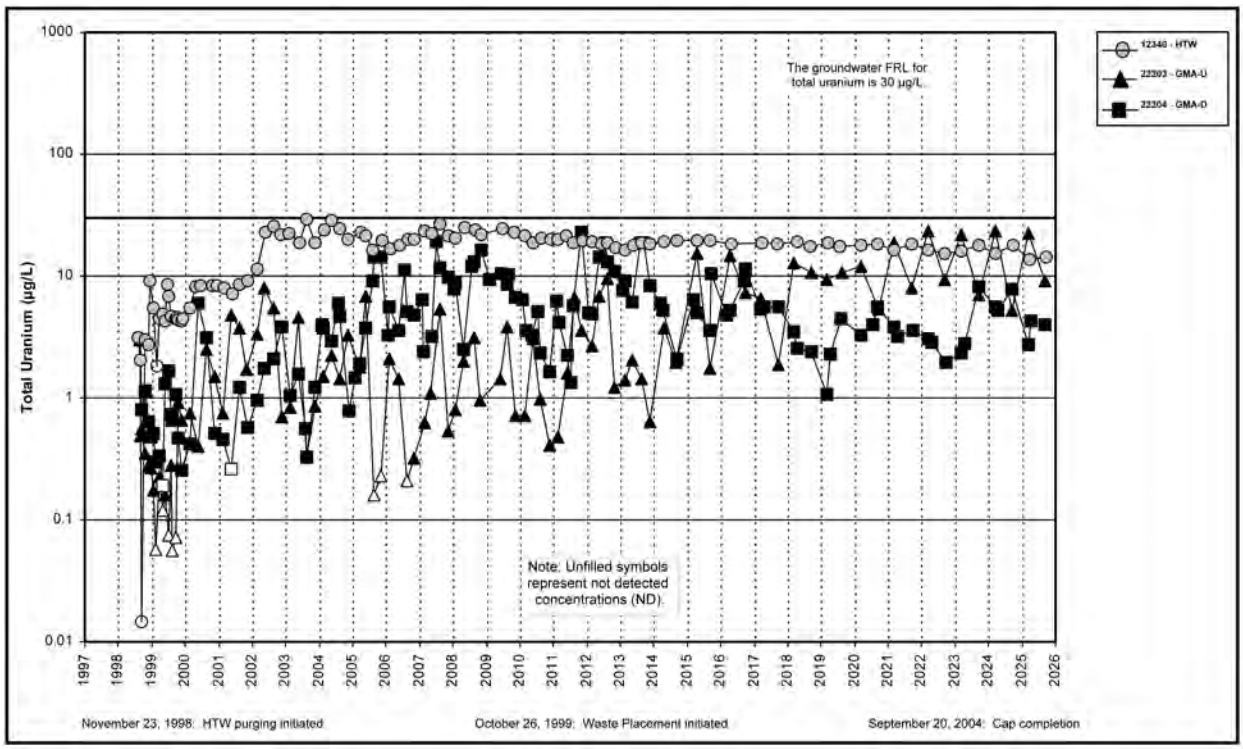


Figure A.5.3-5B. Cell 3 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

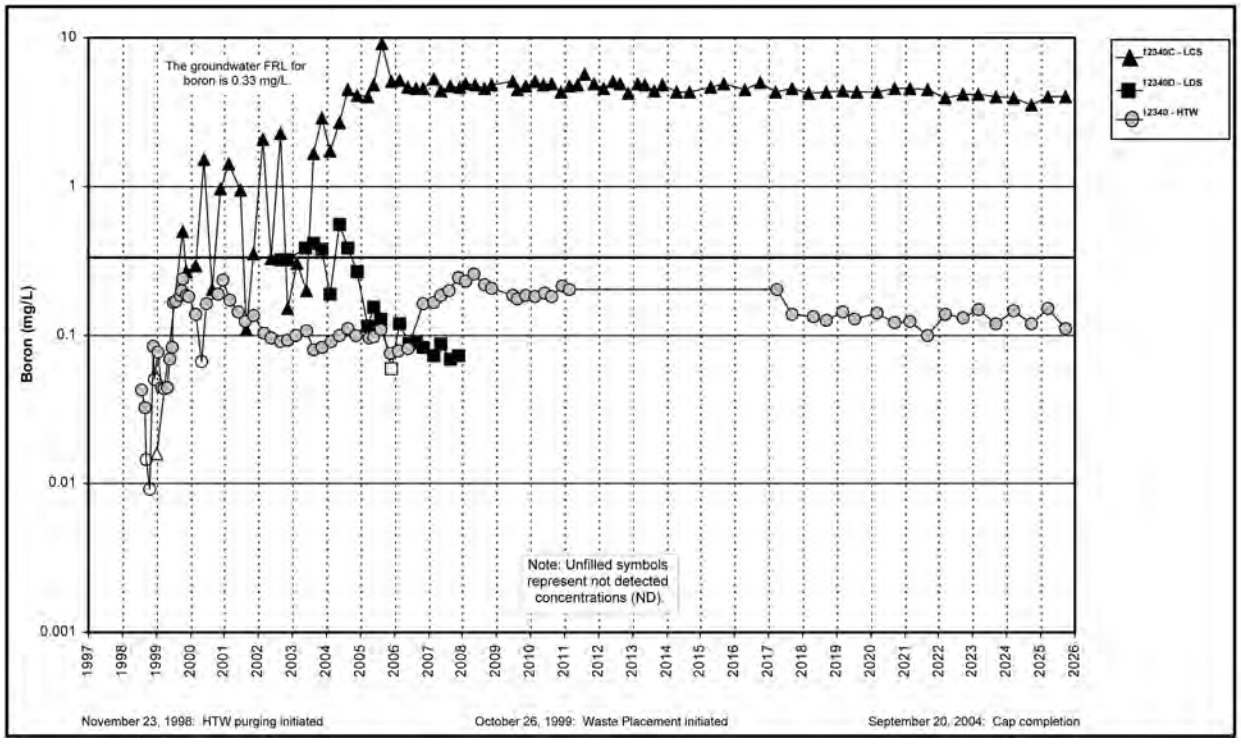


Figure A.5.3-6A. Cell 3 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

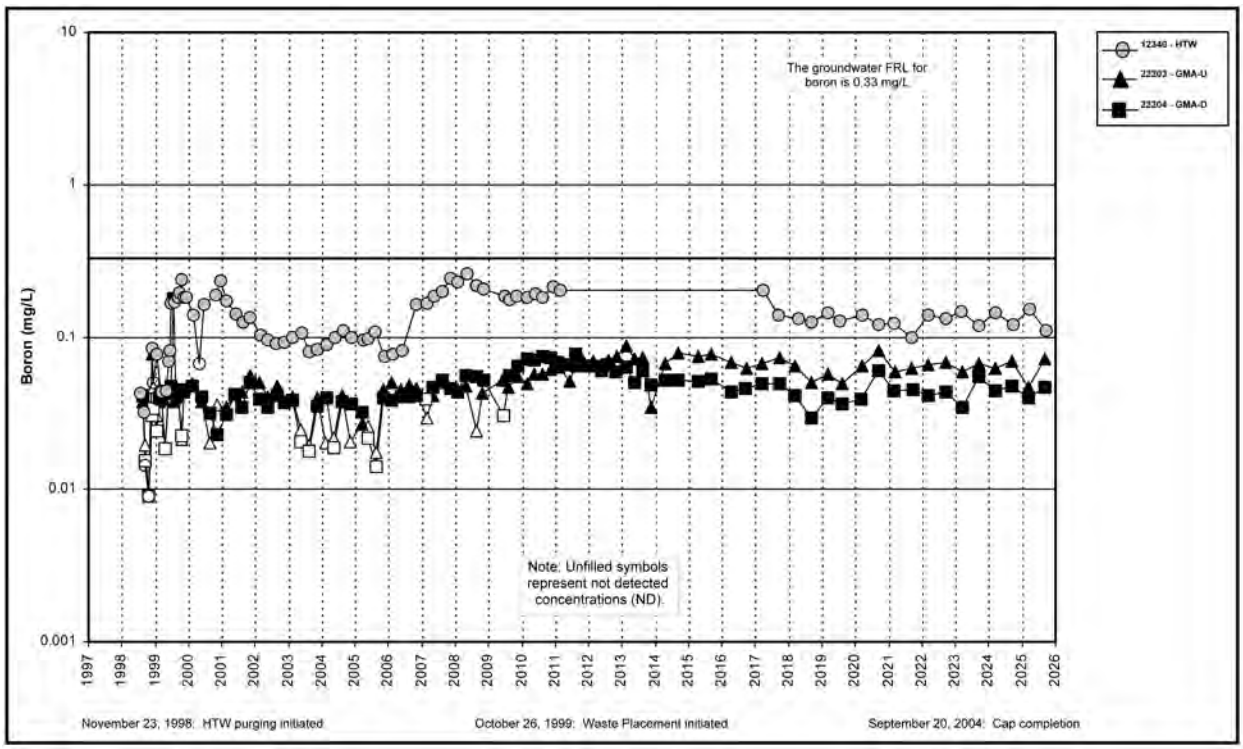


Figure A.5.3-6B. Cell 3 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

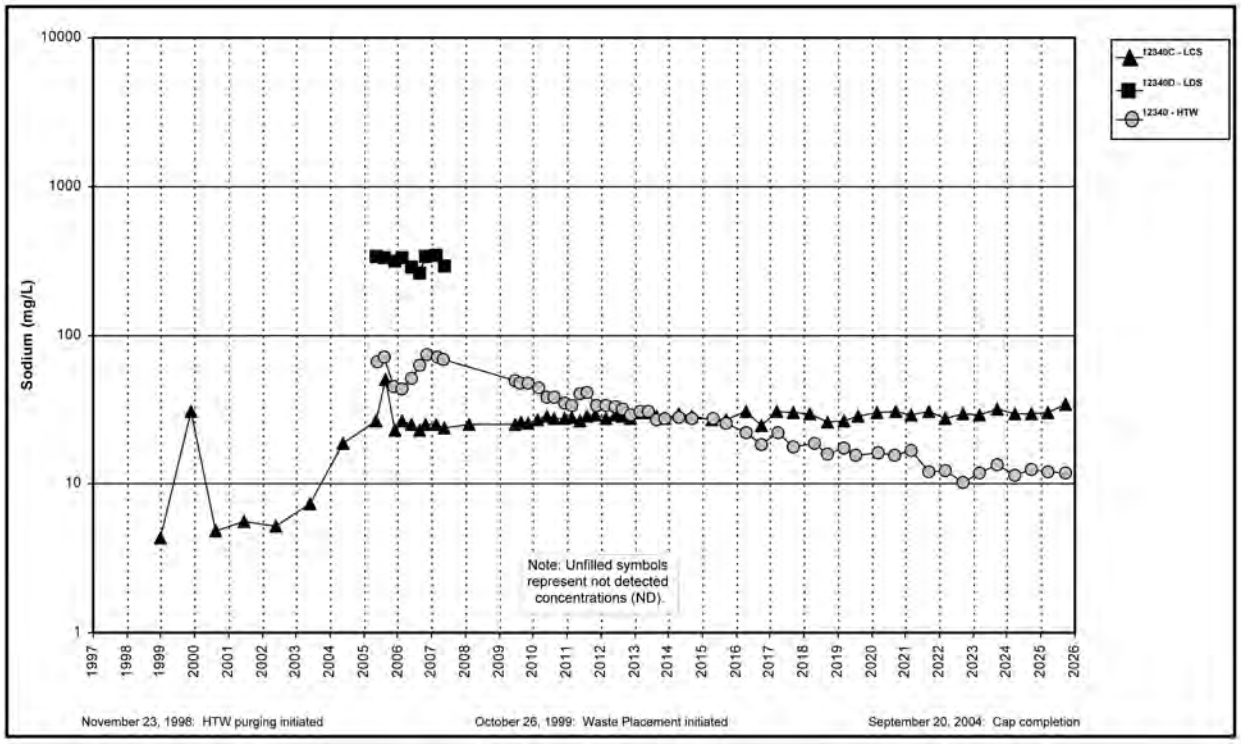


Figure A.5.3-7A. Cell 3 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

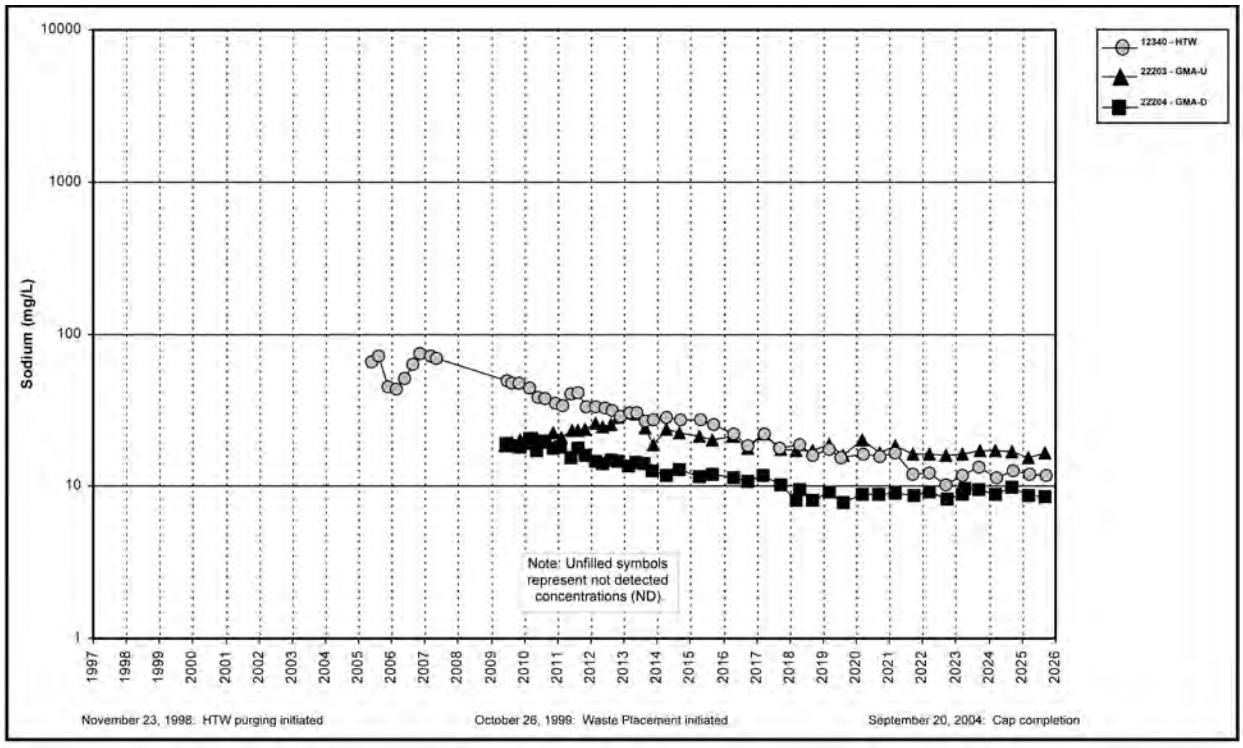


Figure A.5.3-7B. Cell 3 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

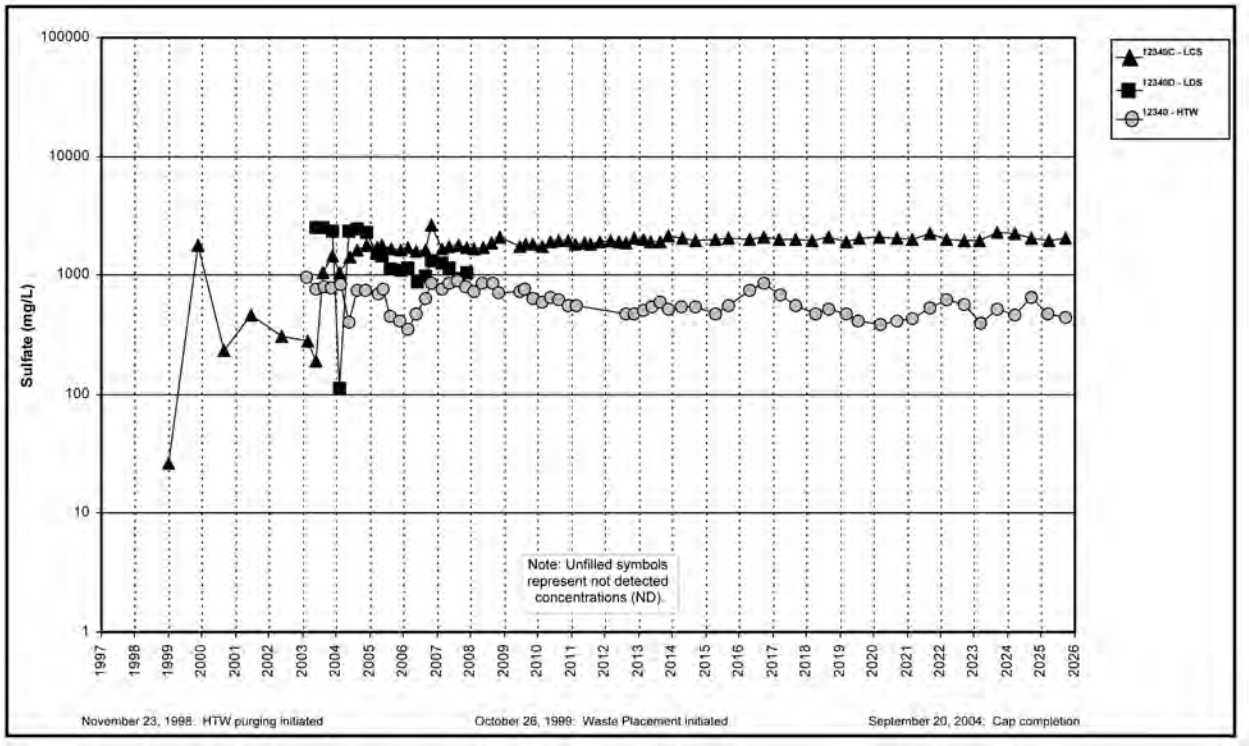


Figure A.5.3-8A. Cell 3 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

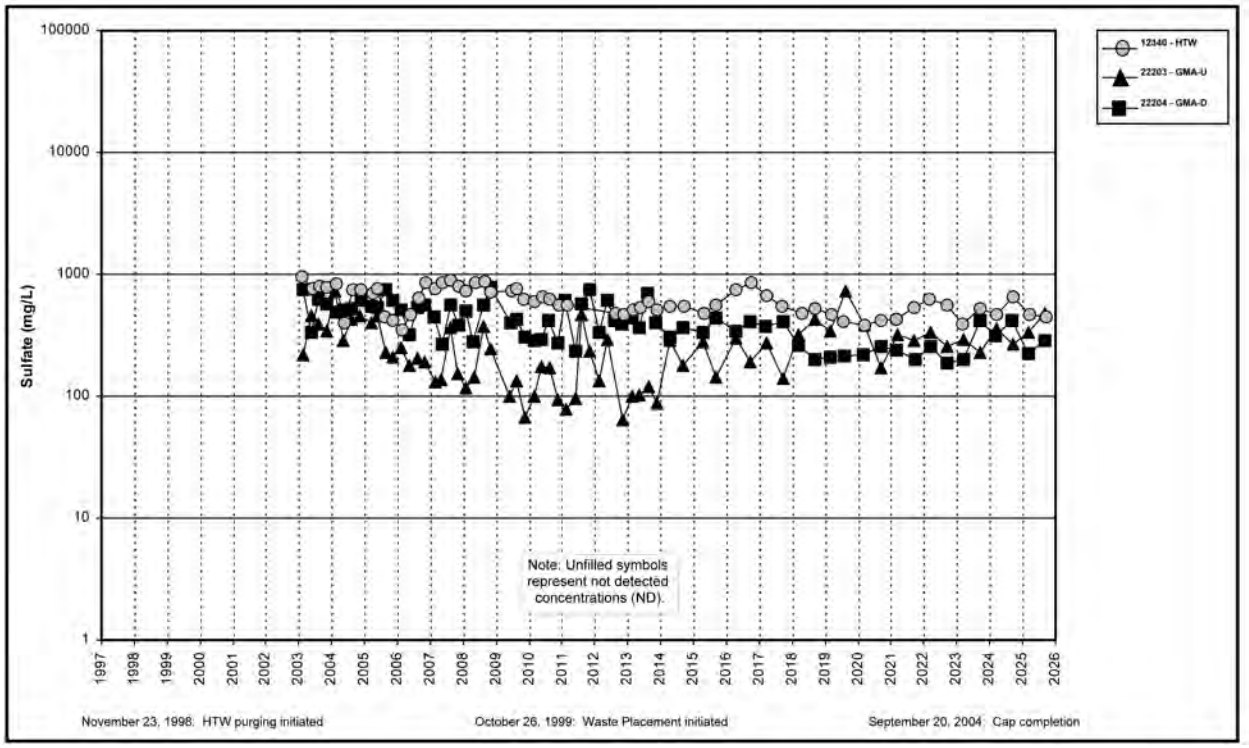


Figure A.5.3-8B. Cell 3 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

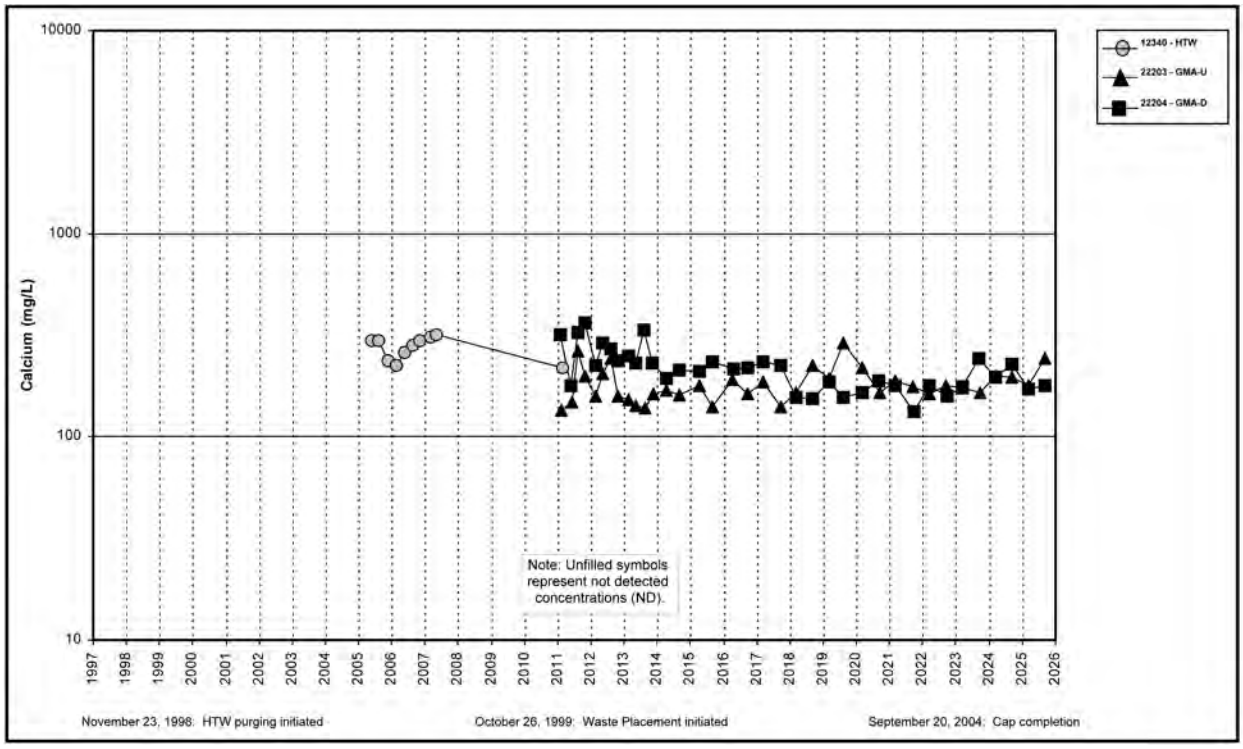


Figure A.5.3-9. Cell 3 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

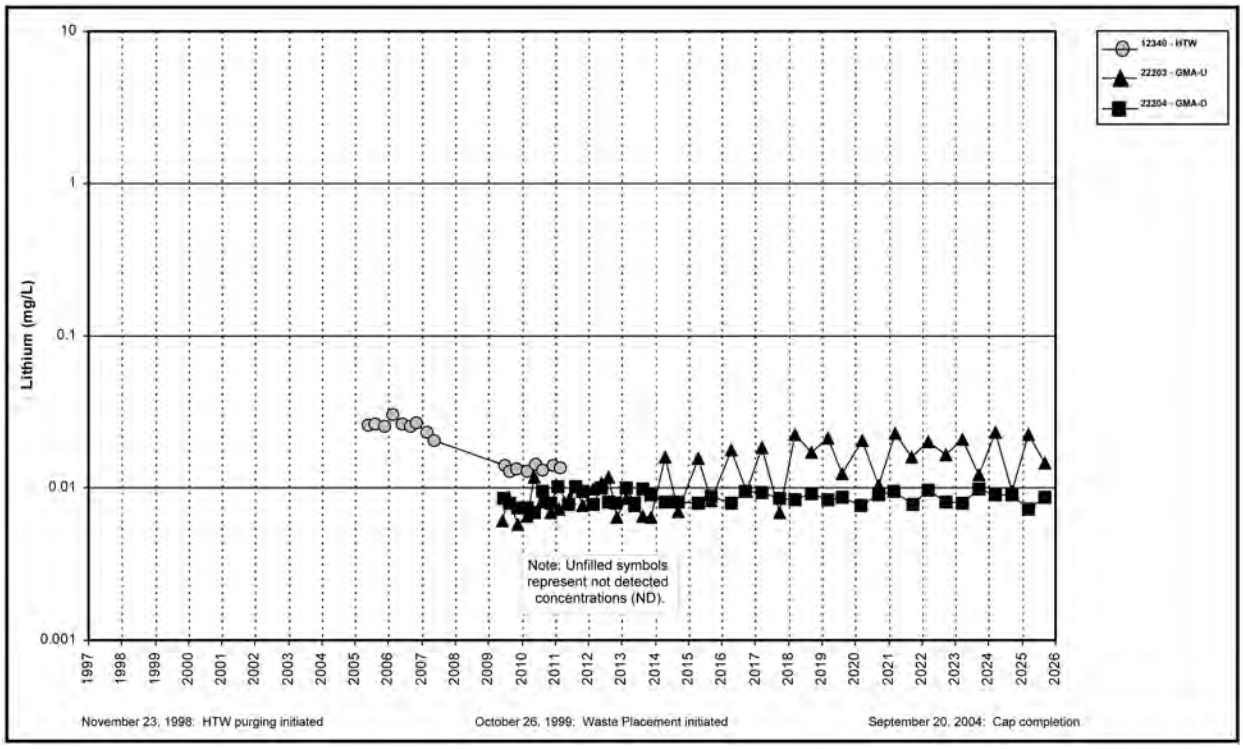


Figure A.5.3-10. Cell 3 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

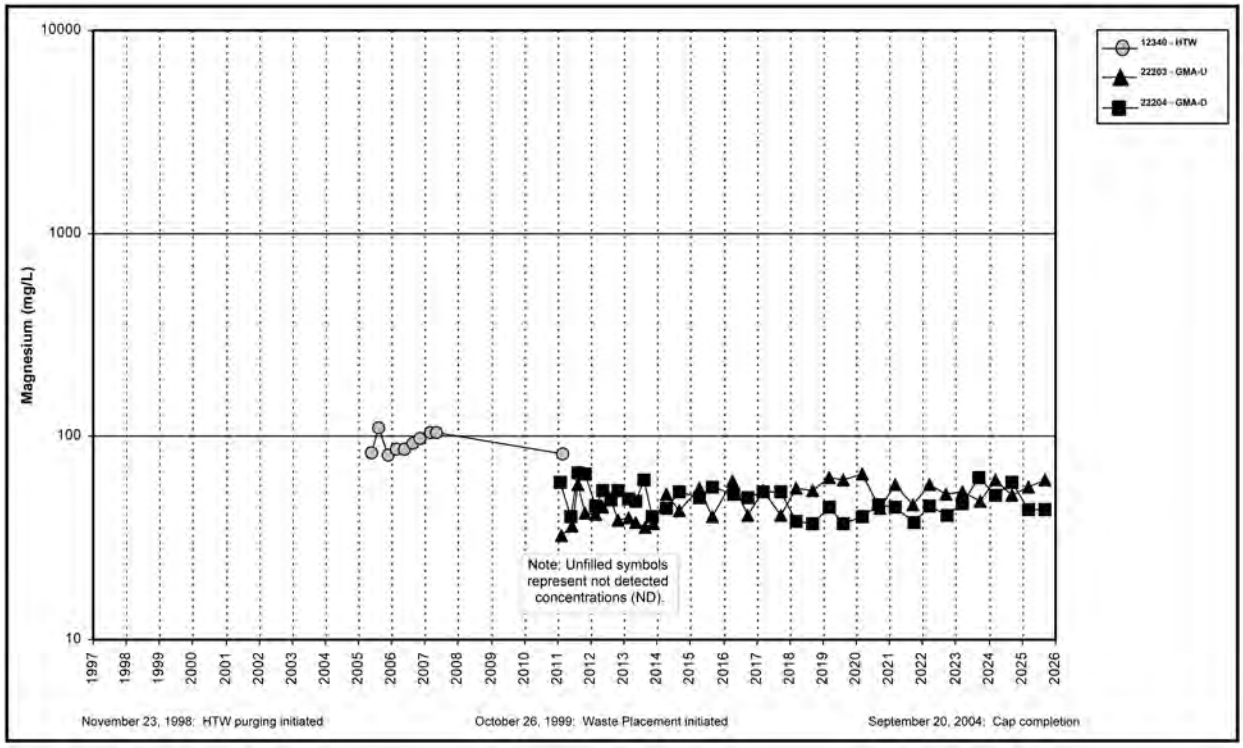


Figure A.5.3-11. Cell 3 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

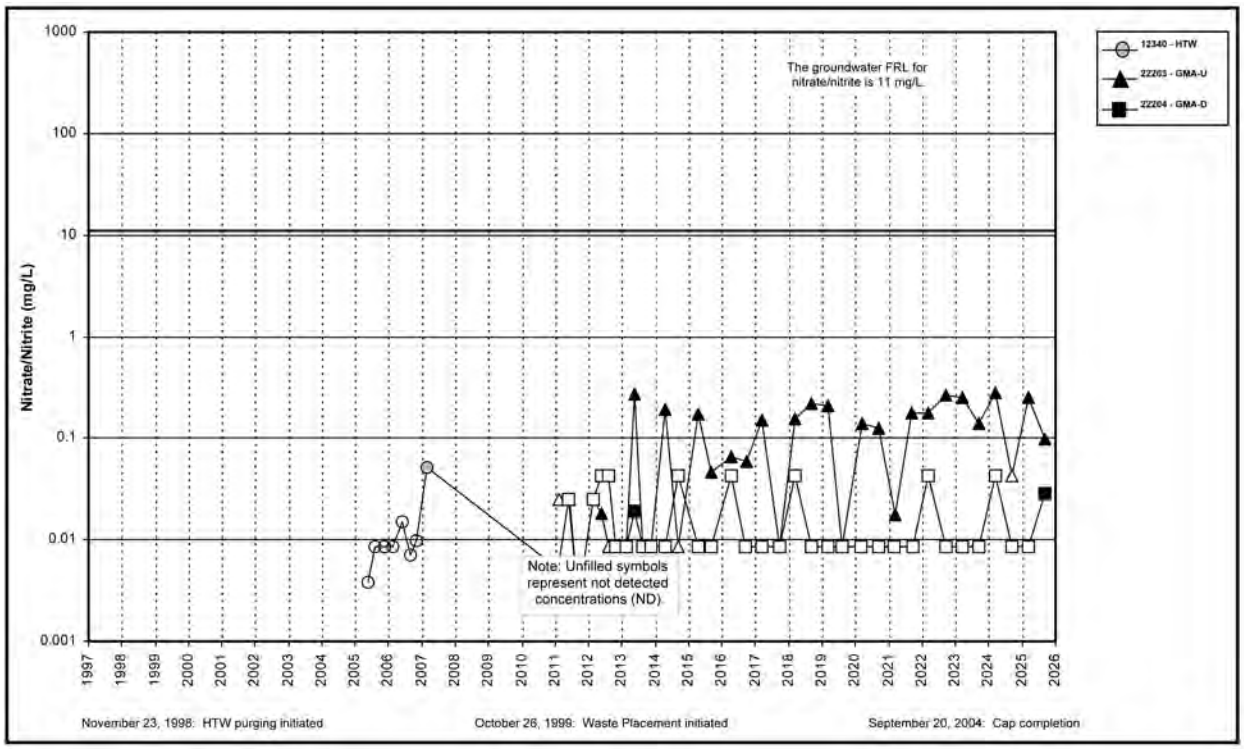


Figure A.5.3-12. Cell 3 Nitrate + Nitrate as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

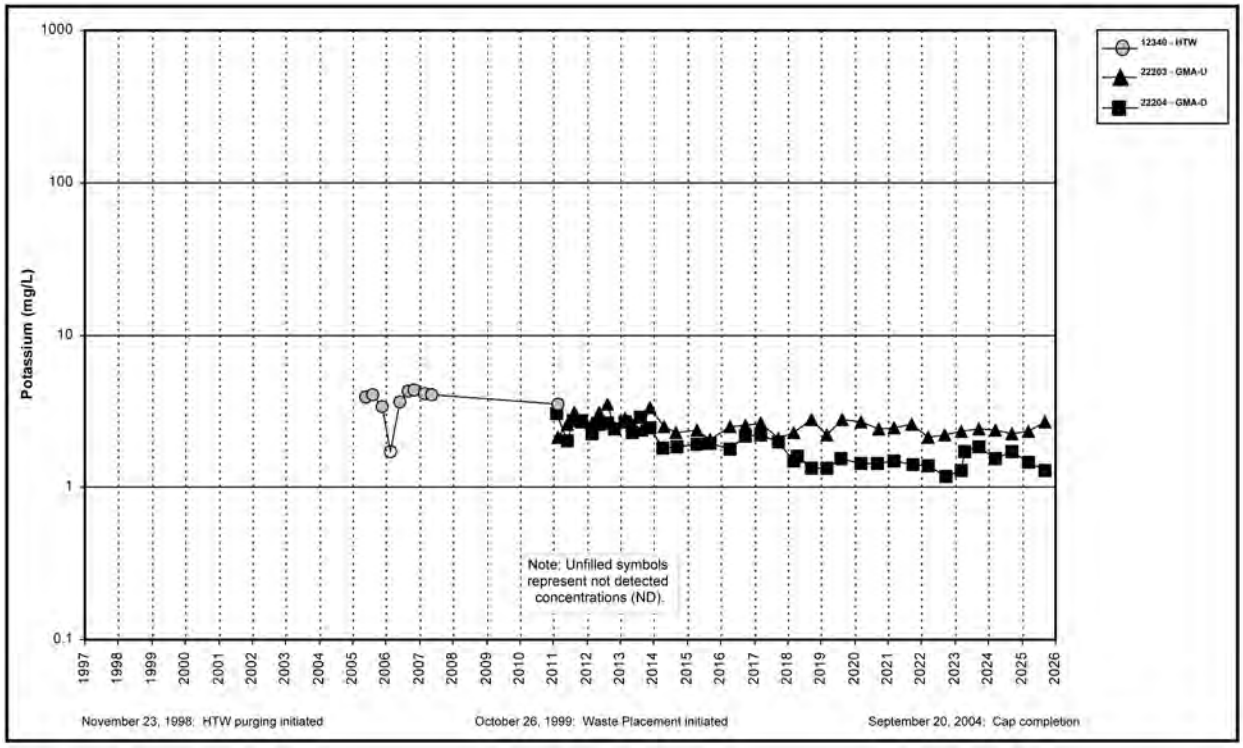


Figure A.5.3-13. Cell 3 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

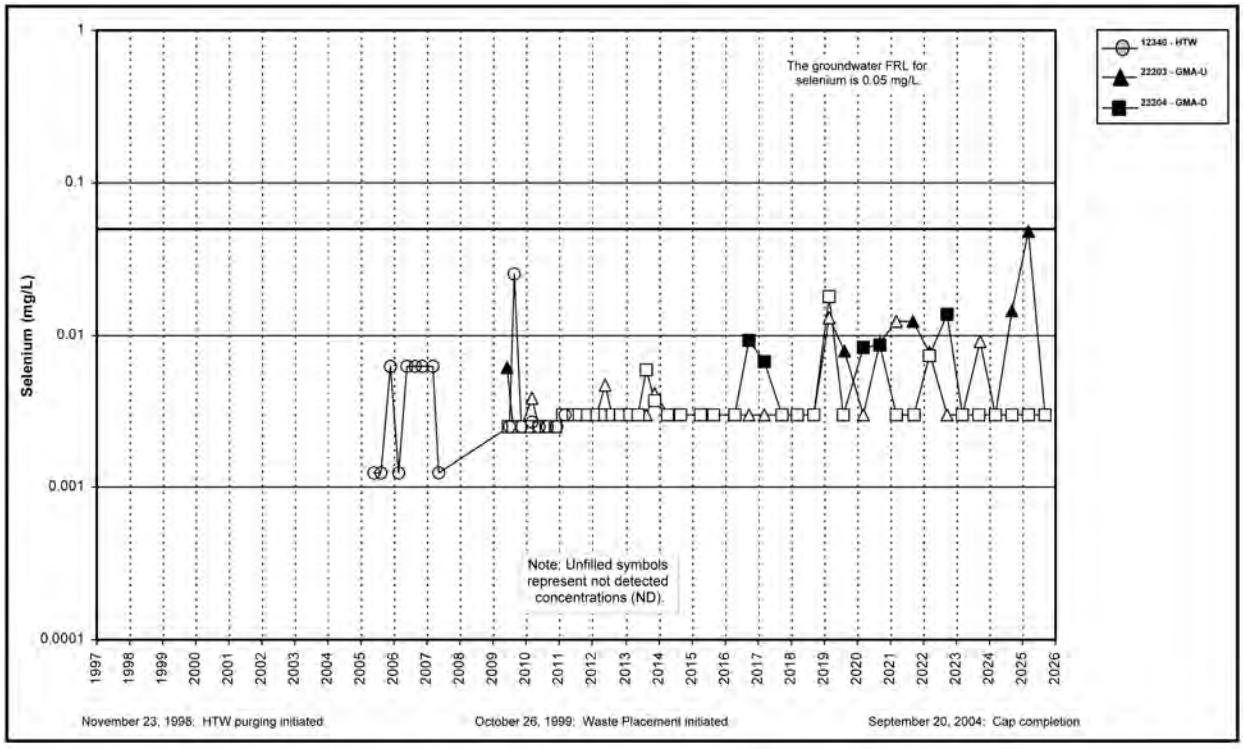


Figure A.5.3-14. Cell 3 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

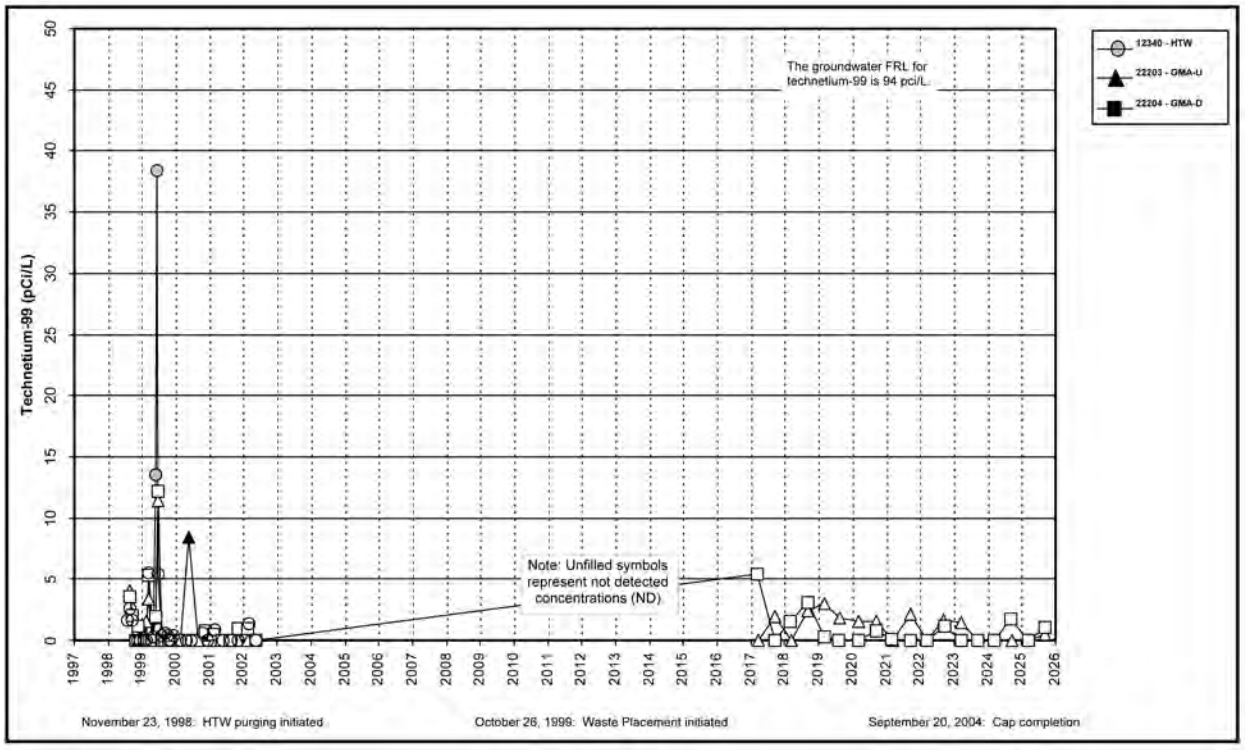


Figure A.5.3-15. Cell 3 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

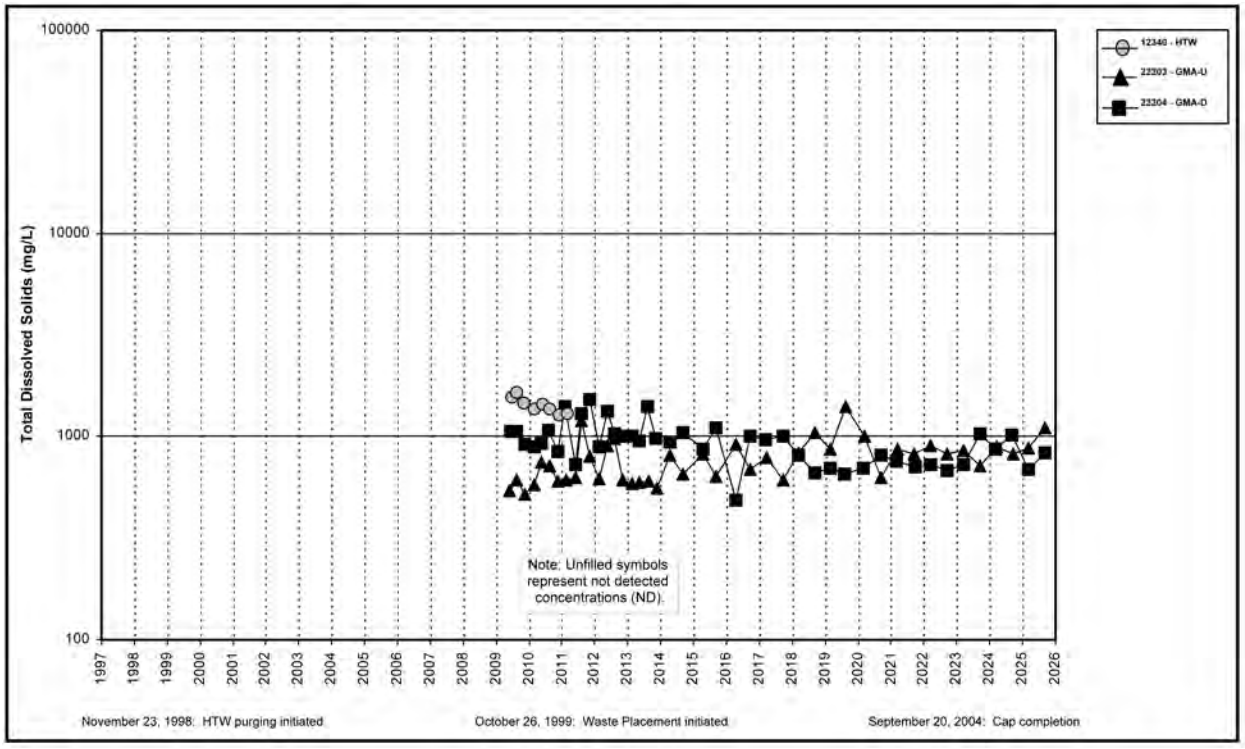


Figure A.5.3-16. Cell 3 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

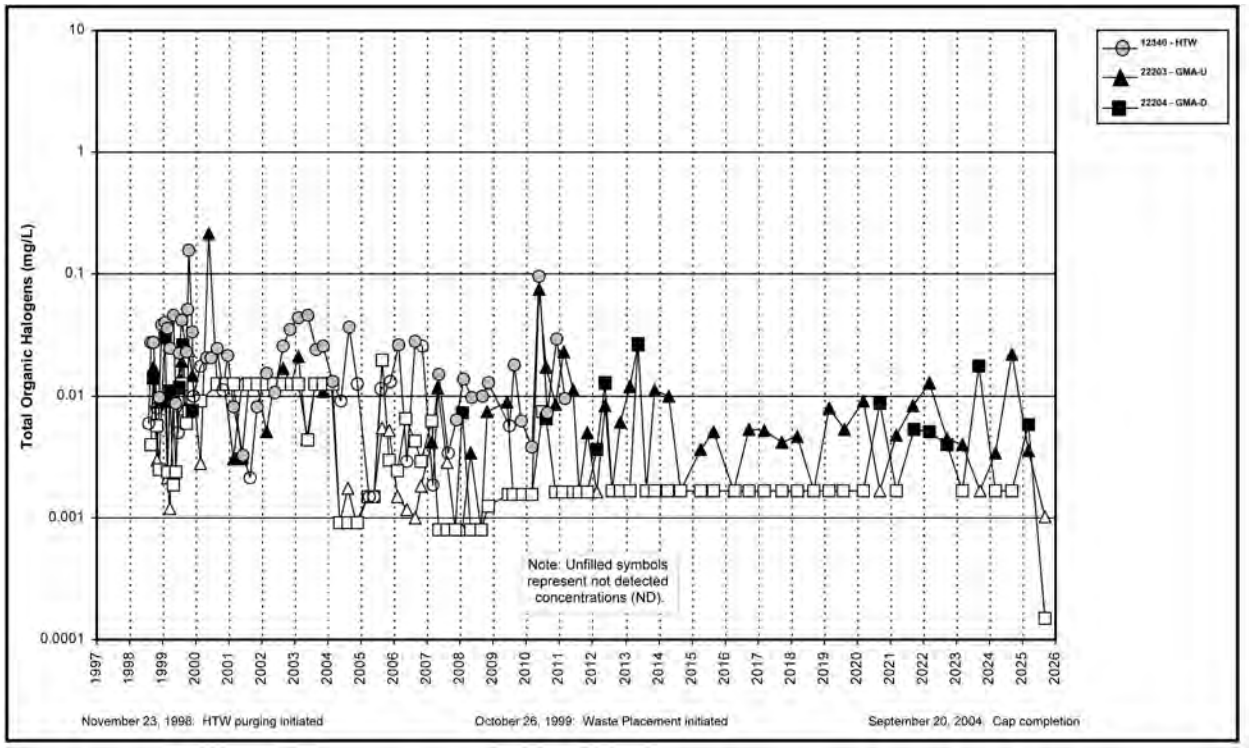


Figure A.5.3-17. Cell 3 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

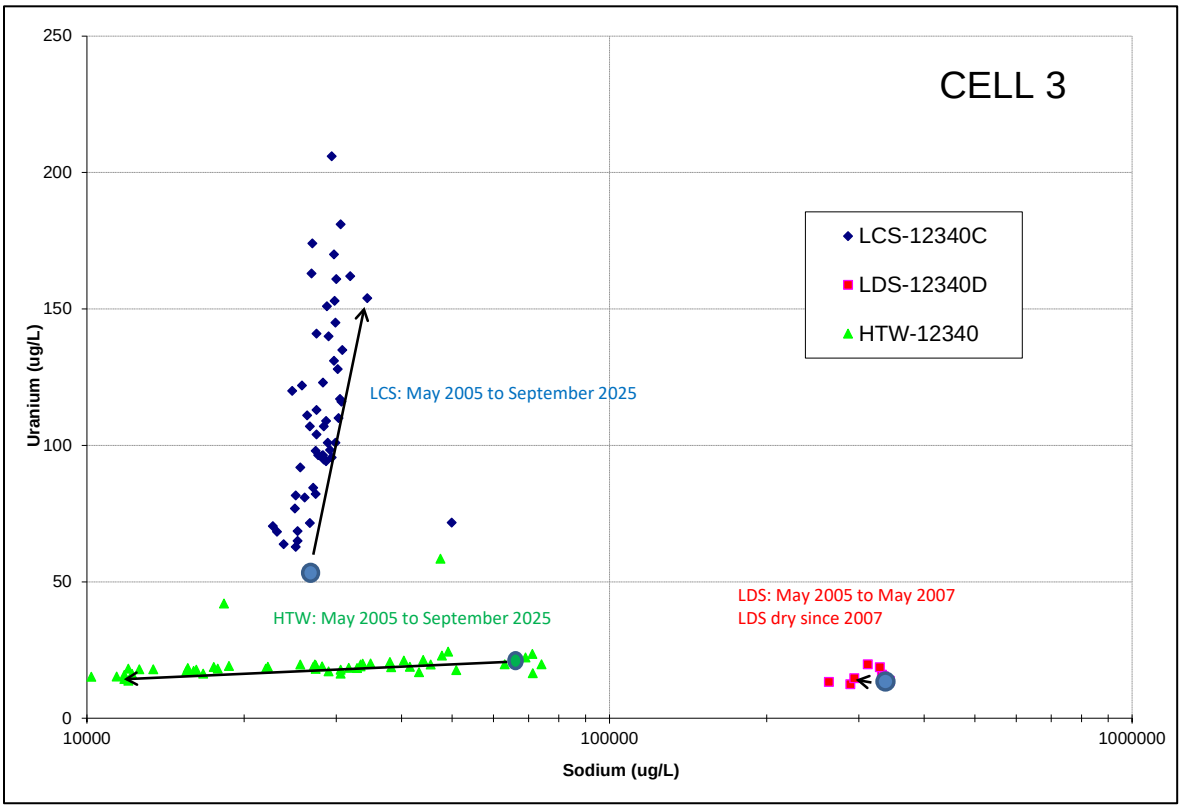


Figure A.5.3-18. Cell 3 Bivariate Plot for Uranium and Sodium

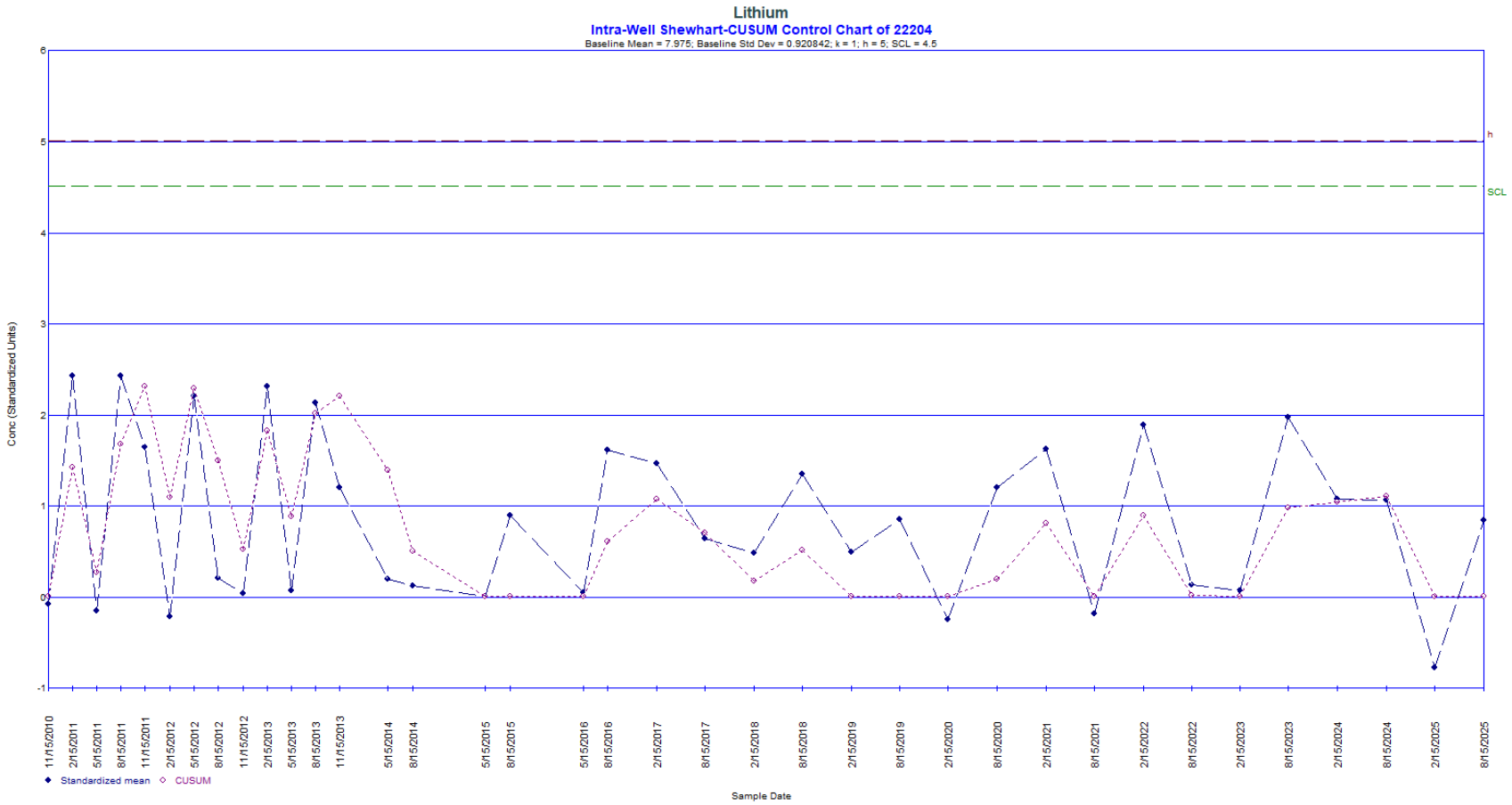


Figure A.5.3-19. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22204

Subattachment A.5.4

Cell 4

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.4.1 Water Quality Monitoring Results 1
A.5.4.1.1 LCS and LDS Results 1
A.5.4.1.2 HTW and Monitoring Well Results 2
A.5.4.1.3 Discussion 2
A.5.4.2 Control Charts 2
A.5.4.3 Summary and Conclusions 4
A.5.4.4 References 4

Tables

Table A.5.4-1. Summary Statistics for Cell 4 5
Table A.5.4-2. OSDF Horizontal Till Well 12341 (Cell 4) Water Yield 6

Figures

Figure A.5.4-1. Monthly Accumulation Volumes for Cell 4 LCS 7
Figure A.5.4-2. Monthly Accumulation Volumes for Cell 4 LDS 7
Figure A.5.4-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 4 Upgradient Monitoring Well 22206 8
Figure A.5.4-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 4 Downgradient Monitoring Well 22205 8
Figure A.5.4-5A. Cell 4 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A.5.4-5B. Cell 4 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 9
Figure A.5.4-6A. Cell 4 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.4-6B. Cell 4 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.4-7A. Cell 4 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.4-7B. Cell 4 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.4-8A. Cell 4 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.4-8B. Cell 4 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.4-9. Cell 4 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.4-10. Cell 4 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.4-11. Cell 4 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.4-12. Cell 4 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.4-13. Cell 4 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.4-14. Cell 4 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.4-15. Cell 4 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.4-16. Cell 4 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.4-17. Cell 4 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.4-18. Cell 4 Bivariate Plot for Uranium and Sodium 17
Figure A.5.4-19. Intrawell Shewhart-CUSUM Control Chart for Total Uranium in Monitoring Well 22205 18
Figure A.5.4-20. Intrawell Shewhart-CUSUM Control Chart for Magnesium in Monitoring Well 22205 19

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about the On-Site Disposal Facility (OSDF) Cell 4:

- Semiannual monitoring summary statistics (Table A.5.4-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.4-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.4-2)
- OSDF horizontal till well (HTW) 12341 water yield (Table A.5.4-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.4-3 and A.5.4-4)
- Plots of concentration versus time (Figures A.5.4-5A through A.5.4-17)
- A bivariate plot for uranium–sodium (Figure A.5.4-18)
- Control charts (Figures A.5.4-19 and A.5.4-20)

A.5.4.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining if the OSDF is operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW of each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.4.1.1 LCS and LDS Results

As shown in Table A.5.4-1 and summarized below, two parameters (sodium and sulfate) have upward trends in the LCS or LDS based on the Mann-Kendall test for trend.

From 2012 to 2016, the volume of water in the LDS tank of Cell 4 was insufficient to collect a sample. From 2016 to 2019, enough water was present in the LDS tank of Cell 4 to sample it twice a year. The volume of water in the LDS tank of Cell 4 was insufficient to collect a sample in 2020. In 2021, enough water was present in the LDS tank of Cell 4 to collect a sample in the second half of the year. In 2022, enough water was present in the LDS tank of Cell 4 to collect a sample in the first half of 2022. No new high concentrations were measured in the LCS of Cell 4 in 2025. Since 2022, the volume of water in the LDS tank of Cell 4 has been insufficient to collect a sample.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 4

Parameter	LCS 12341C 2025 Trend[a]	LDS 12341D Trend (Year Last Sampled)
Sodium	Up	Up (2022)
Sulfate	Up	Up (2022)

A.5.4.1.2 HTW and Monitoring Well Results

As shown in Table A.5.4-1 and summarized below, seven parameters (total uranium, boron, sodium, sulfate, lithium, magnesium, and selenium) have upward trends in the HTW or GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 4

Parameter	HTW 12341[a]	GMA-U 22206[a,b]	GMA-D 22205[a,b]
Total Uranium		Up	
Boron		Up	Up
Sodium		Up	
Sulfate	Up		
Lithium			Up
Magnesium		Up	
Selenium		Up	Up

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer; HTW = Horizontal Till Well.

A.5.4.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 4 LCS, LDS, and HTW is provided in Figure A.5.4-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot shows that the chemical signatures for uranium and sodium in the LCS, LDS, and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.4.2 Control Charts

Intrawell control charts use historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the

monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.4-1 in gray shading and as summarized below, two parameters in the HTW or GMA wells of Cell 4 meet the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in two control charts (Figure A.5.4-19 and Figure A.5.4-20).

All of the control charts for Cell 4 exhibit "in control" conditions.

Parameter	Monitoring Point[a]	Well Number	Assessment	Figure Number
Uranium	GMA-D	22205	In Control	A.5.4-19
Magnesium	GMA-U	22205	In Control	A.5.4-20

[a] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.4.3 Summary and Conclusions

- Two parameters in 2024 (sodium and sulfate) have upward trends in the LCS or LDS based on the Mann-Kendall test for trend.
- No new high concentrations were measured in the LCS of Cell 4 in 2025. The LDS has not had sufficient water to collect a sample since 2022.
- Seven parameters monitored semiannually have an upward concentration in the HTW or GMA wells of Cell 4: total uranium, boron, sodium, sulfate, lithium, magnesium, and selenium. Separate and distinct chemical signatures for total uranium and sodium in the LCS, LDS, and HTW of Cell 4 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 4 (i.e., HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- Two control charts were constructed for Cell 4 parameters. All control charts exhibit "in control" conditions.

A.5.4.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.4-1. Summary Statistics for Cell 4

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,o]	Standard Deviation[d]	Distribution Type[d,e]	Trend[g,i] (Year Last Sampled)	Serial Correlation[g,k]	Outliers[h,j]
Total Uranium (µg/L)	LCS	12341C	66	66	100	4.41	234	87.7	33.6	Undefined	None (2025)	Detected	
	LDS	12341D	42	42	100	5.74	79.8	15.1	14.8	Undefined	Up (2022)	Detected	
	HTW	12341	71	71	100	2.89	7.89	5.16	1.20	Normal	Down (2025)	Detected	
	GMA-U	22206	68	72	94.4	ND	4.67	1.33	0.92	Ln Normal	Up (2025)	Not Detected	
	GMA-D	22205	84	84	100	0.525	12.1	2.45	2.23	Ln Normal	None (2025)	Not Detected	
Boron (mg/L)	LCS	12341C	66	66	100	0.0626	1.93	0.836	0.255	Undefined	Down (2025)	Detected	
	LDS	12341D	42	42	100	0.415	3.74	0.708	0.777	Undefined	Up (2022)	Detected	
	HTW	12341	51	54	94.4	0.0284	1.24	0.0769	0.198	Undefined	Down (2025)	Detected	
	GMA-U	22206	67	72	93.1	ND	0.0817	0.0486	0.0142	Normal	Up (2025)	Detected	
	GMA-D	22205	65	72	90.3	ND	0.0807	0.0460	0.0138	Normal	Up (2025)	Detected	
Sodium (mg/L)	LCS	12341C	56	56	100	22.0	117	55.2	12.4	Undefined	Up (2025)	Detected	
	LDS	12341D	28	28	100	307	4,440	504	799	Undefined	Up (2022)	Detected	
	HTW	12341	52	52	100	13.1	18.1	15.0	1.0	Ln Normal	Down (2025)	Detected	
	GMA-U	22206	43	43	100	12.3	22.3	16.8	2.8	Ln Normal	Up (2025)	Detected	
	GMA-D	22205	45	45	100	8.22	22.2	13.4	4.5	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12341C	66	66	100	140	3,940	2,810	750	Undefined	Up (2025)	Detected	
	LDS	12341D	42	42	100	1,470	25,500	2,660	4,100	Undefined	Up (2022)	Detected	
	HTW	12341	62	62	100	153	531	310	115	Undefined	Up (2025)	Detected	
	GMA-U	22206	67	67	100	90.4	559	172	102	Undefined	Down (2025)	Detected	3,720 (Q3-12)
	GMA-D	22205	67	67	100	199	535	329	74	Normal	None (2025)	Detected	
Calcium (mg/L)	GMA-U	22206	36	36	100	131	217	148	21	Undefined	Down (2025)	Not Detected	
	GMA-D	22205	36	36	100	163	268	211	24	Normal	Down (2025)	Detected	
Lithium (mg/L)	GMA-U	22206	43	43	100	0.00729	0.0175	0.0113	0.0026	Normal	Down (2025)	Detected	
	GMA-D	22205	43	43	100	0.00665	0.0167	0.00832	0.00891	Undefined	Up (2025)	Detected	
Magnesium (mg/L)	GMA-U	22206	36	36	100	30.2	43.8	36.2	3.5	Normal	Up (2025)	Not Detected	
	GMA-D	22205	36	36	100	40.1	63.2	51.1	5.6	Normal	None (2025)	Not Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22206	3	36	8.3	ND	0.0850	0.0180	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22205	5	36	13.9	ND	0.0818	0.00850	0.0183	Undefined	None (2025)	Not Detected	
Potassium (mg/L)	GMA-U	22206	36	36	100	2.69	4.39	3.53	0.42	Normal	Down (2025)	Detected	
	GMA-D	22205	38	38	100	1.29	3.22	2.17	0.46	Normal	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22206	6	43	14.0	ND	0.0435	0.00300	0.00783	Undefined	Up (2025)	Detected	
	GMA-D	22205	8	43	18.6	ND	0.0447	0.00300	0.00714	Undefined	Up (2025)	Detected	
Technitium-99 (pCi/L)	GMA-U	22206	1	33	3.0	ND	8.54	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22205	0	33	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22206	43	43	100	551	877	616	79	Undefined	None (2025)	Not Detected	
	GMA-D	22205	43	43	100	726	1,180	913	107	Normal	Down (2025)	Detected	
Total Organic Halogens (mg/L)	GMA-U	22206	29	72	40.3	ND	0.0640	0.00397	0.00919	Undefined	None (2025)	Detected	
	GMA-D	22205	18	72	25.0	ND	0.0142	0.00166	0.00394	Undefined	None (2025)	Detected	0.0340 (Q2-13)

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well with at least eight samples, Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria

Note 2: Data used in this table has been standardized to quarterly.

[a] LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b] ND = not detected; NA = not applicable

[c] Averages were determined based on the distribution assumption.

[d] Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.

[e] Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[i] Trend based on nonparametric Mann-Kendall procedure.

[k] Serial correlation based on Rank Von Neumann test.

[j] Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[o] Q = quarter

Table A.5.4-2. OSDF Horizontal Till Well 12341 (Cell 4) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
2002	21,115	9	2,346
2003	3,950	6	658
2004	2,935	5	587
2005	2,500	4	625
2006	2,475	4	619
2007	2,425	4	606
2008	2,220	4	555
2009	2,150	4	717
2010	2,575	4	644
2011	2,350	4	588
2012	2,240	4	560
2013	2,460	4	615
2014	1,140	2	570
2015	975	2	488
2016	1,025	2	513
2017	1,175	2	588
2018	1,155	2	578
2019	1,045	2	523
2020	1,000	2	500
2021	1,160	2	580
2022	1,120	2	560
2023	1,050	2	525
2024	1,110	2	555
2025	1,040	2	520

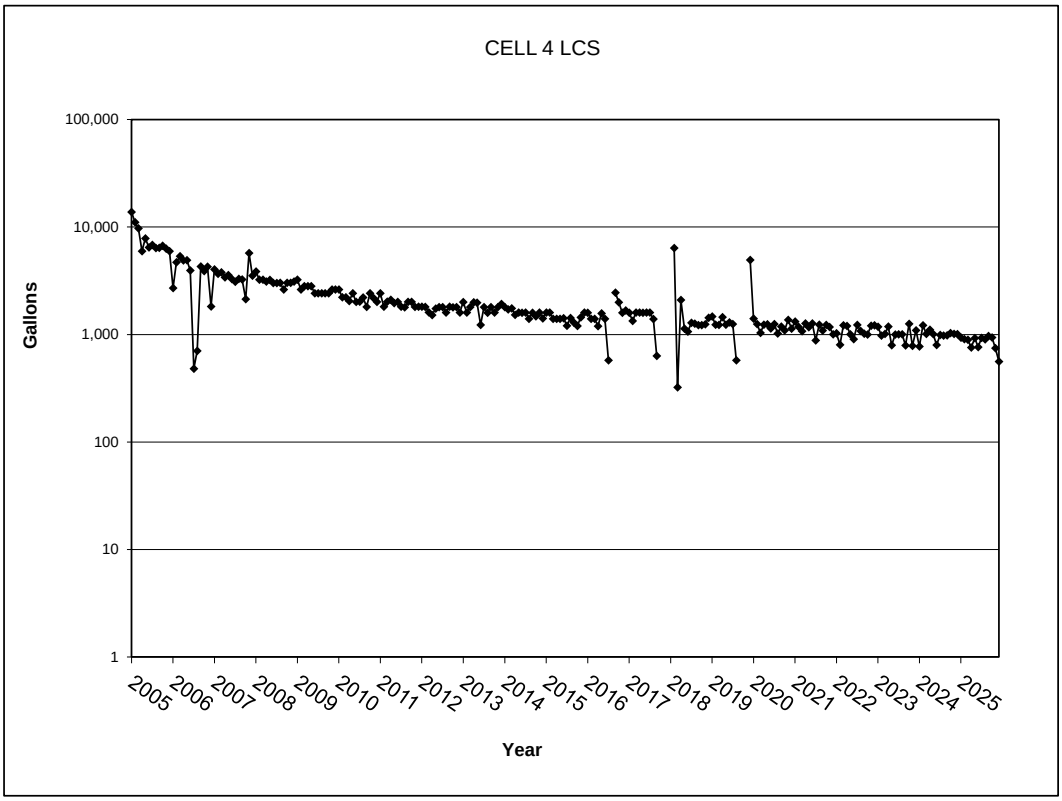


Figure A.5.4-1. Monthly Accumulation Volumes for Cell 4 LCS

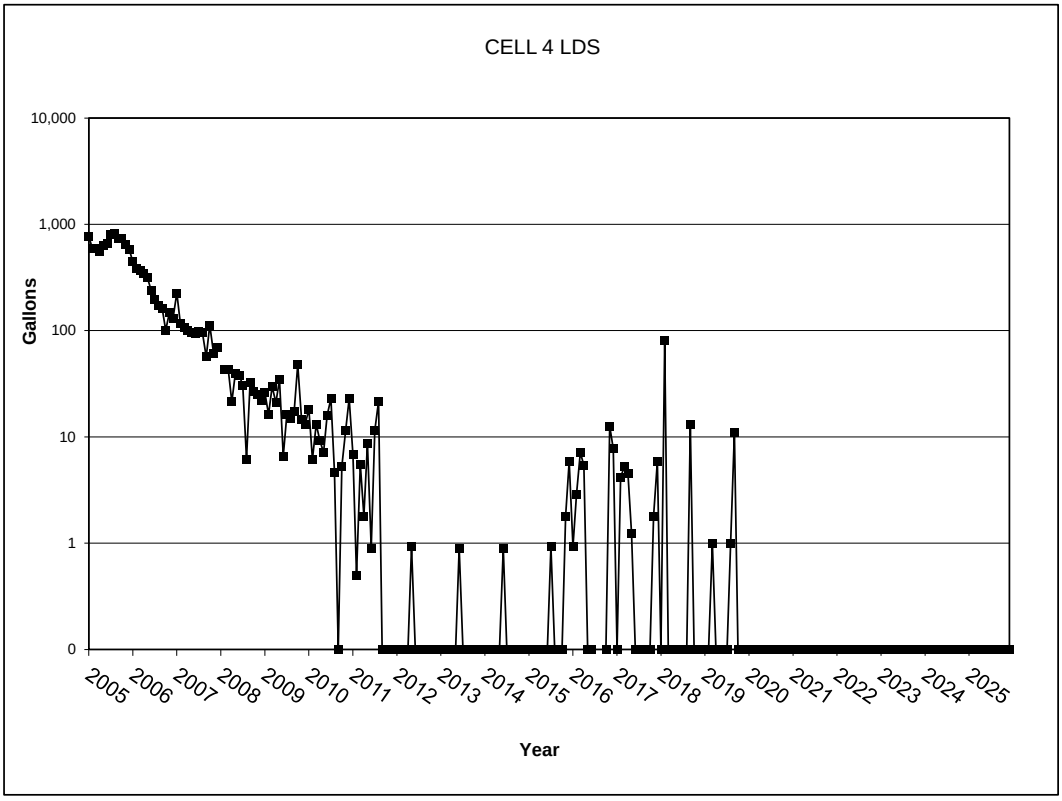


Figure A.5.4-2. Monthly Accumulation Volumes for Cell 4 LDS

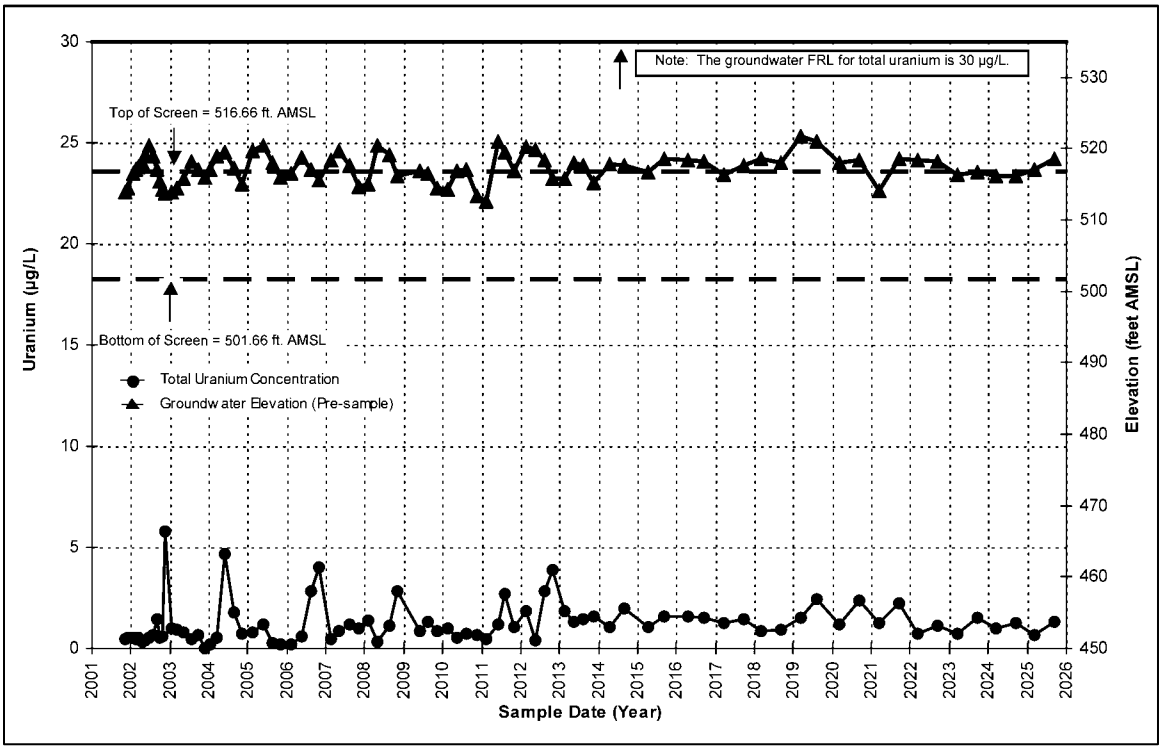


Figure A.5.4-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 4 Upgradient Monitoring Well 22206

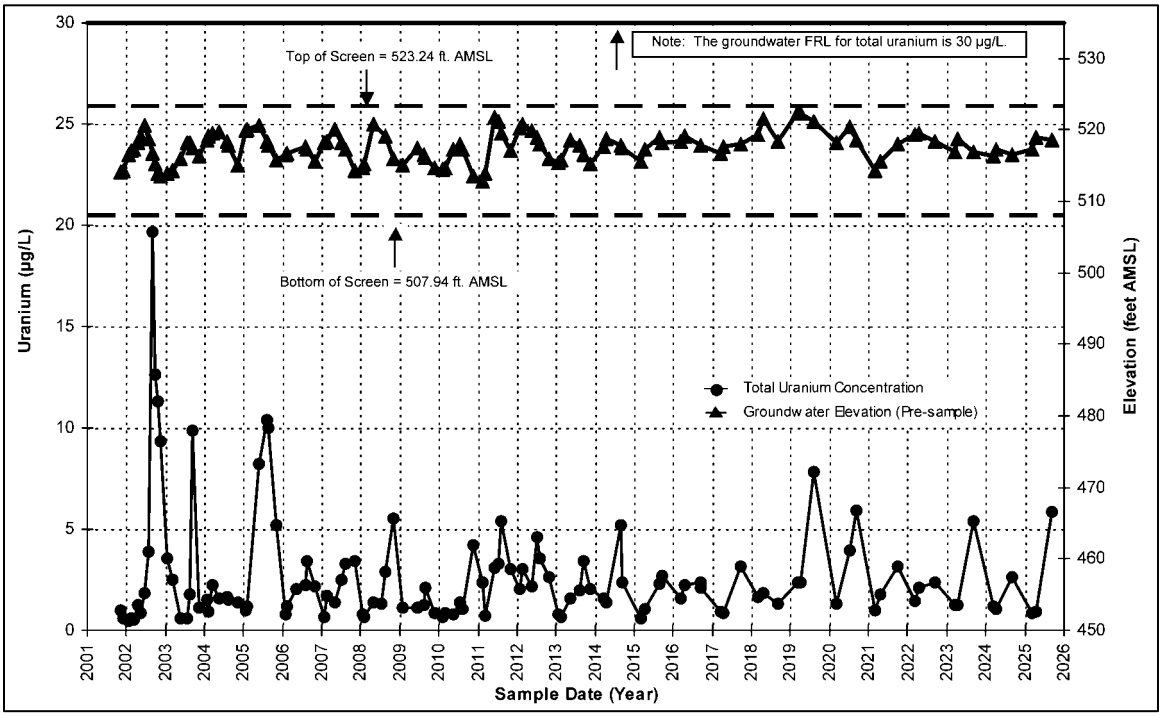


Figure A.5.4-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 4 Downgradient Monitoring Well 22205

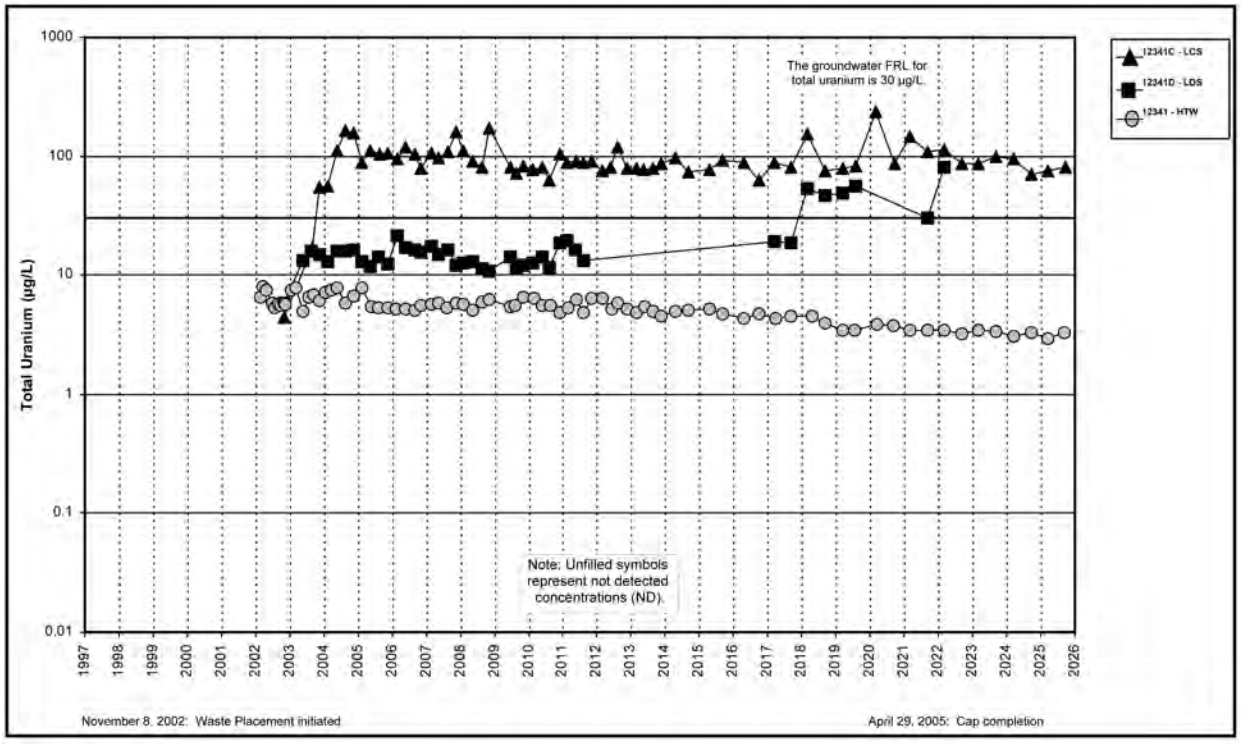


Figure A.5.4-5A. Cell 4 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

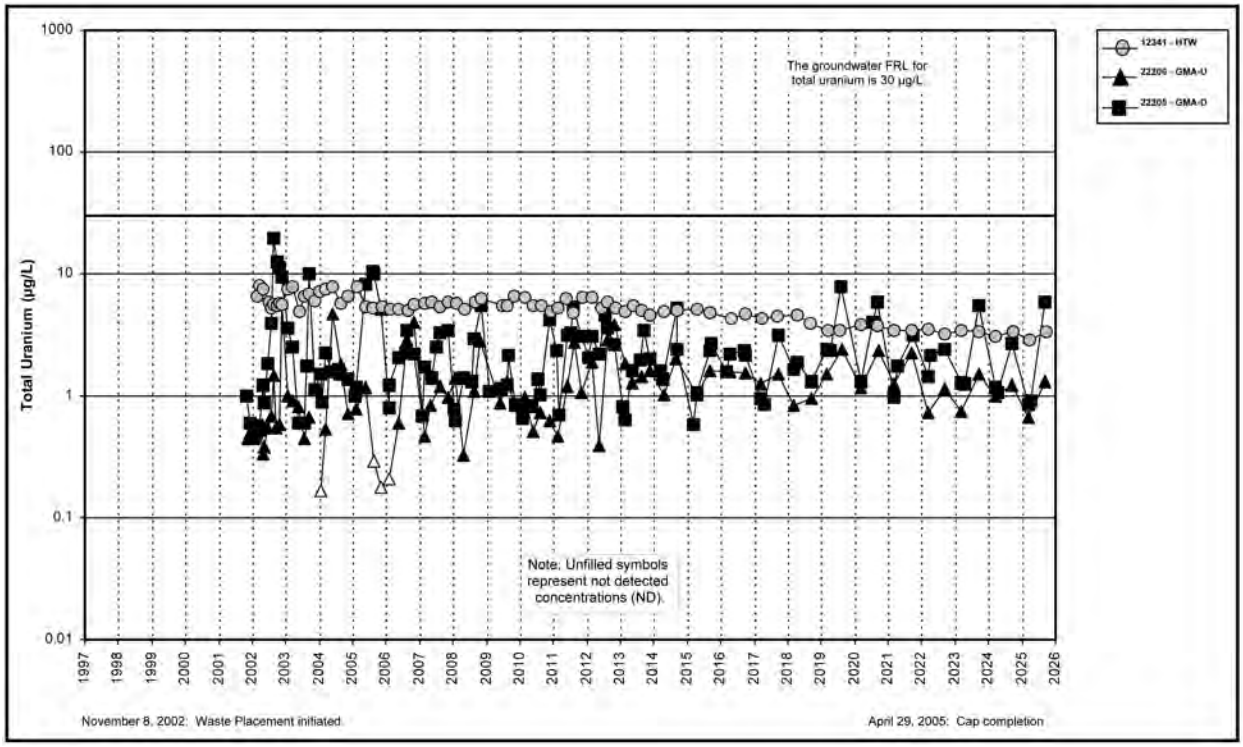


Figure A.5.4-5B. Cell 4 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

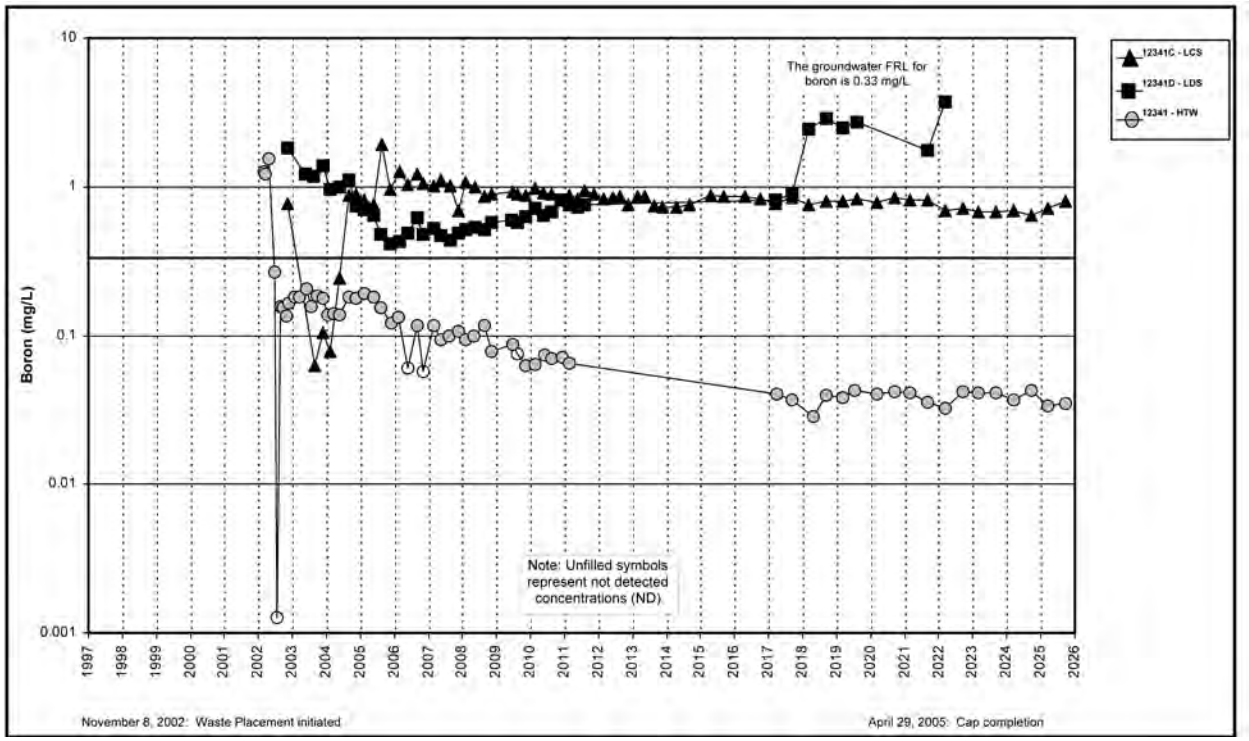


Figure A.5.4-6A. Cell 4 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

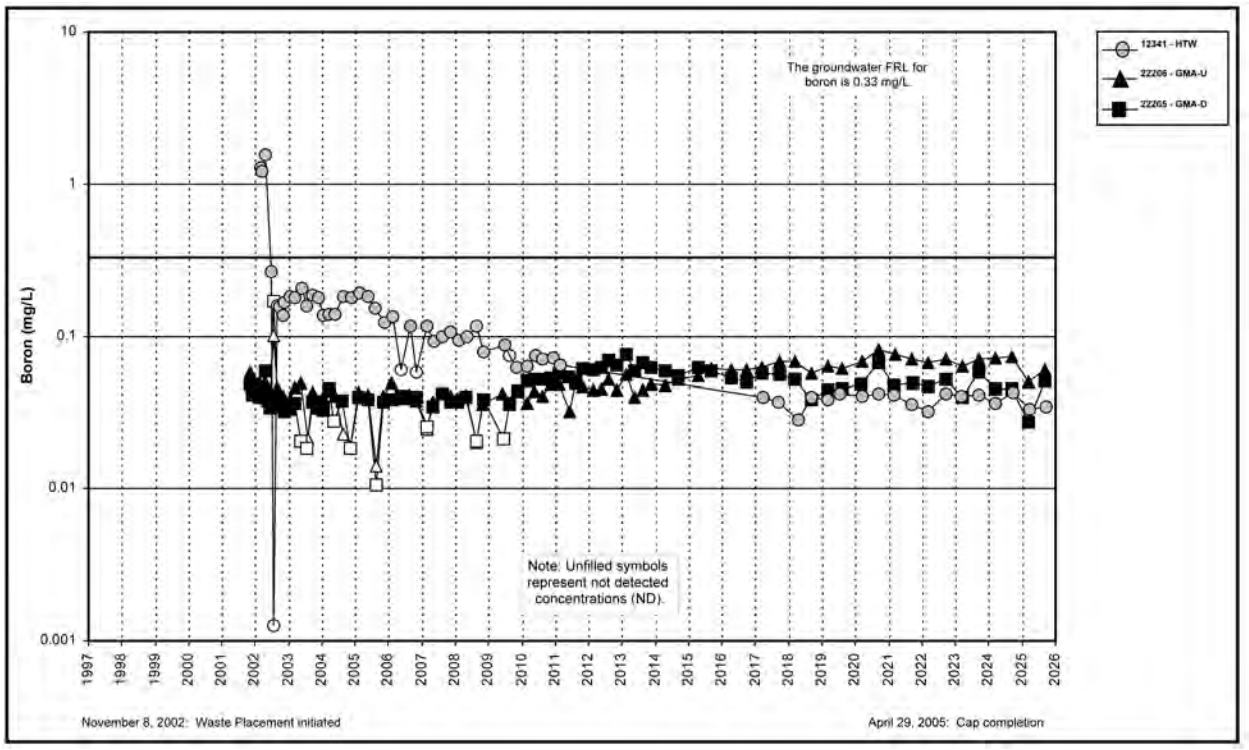


Figure A.5.4-6B. Cell 4 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

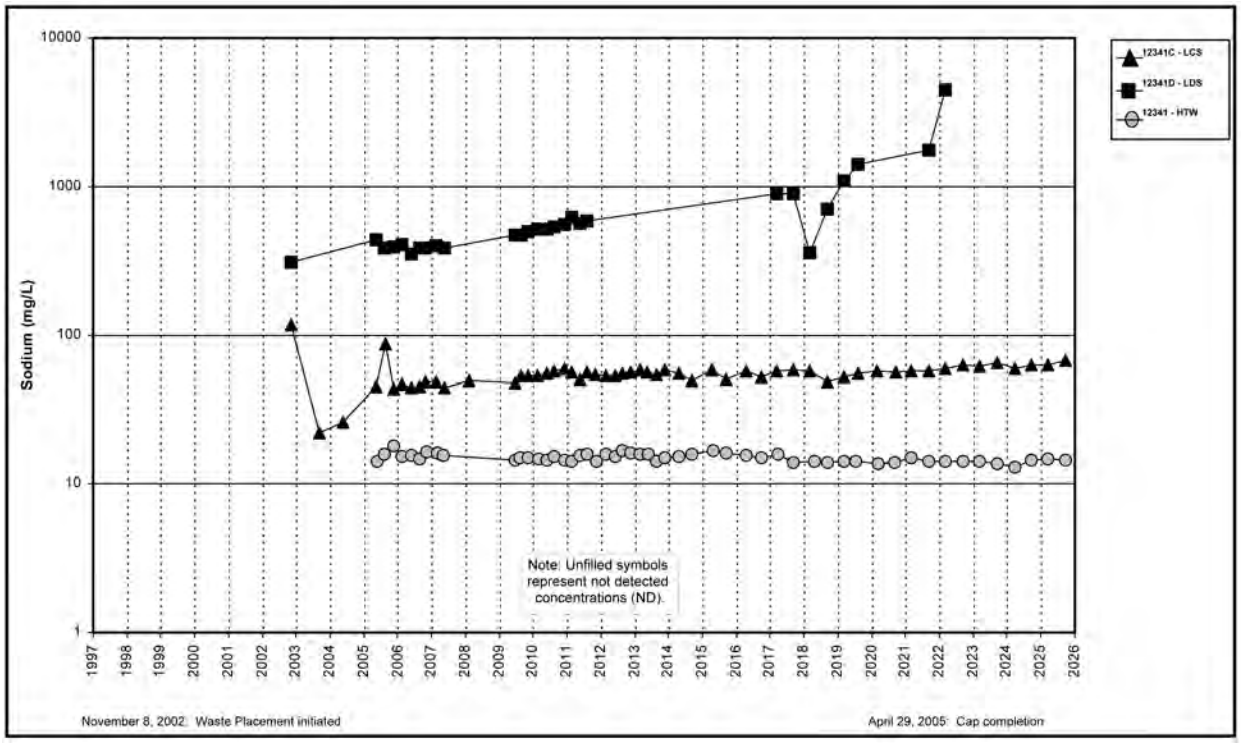


Figure A.5.4-7A. Cell 4 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

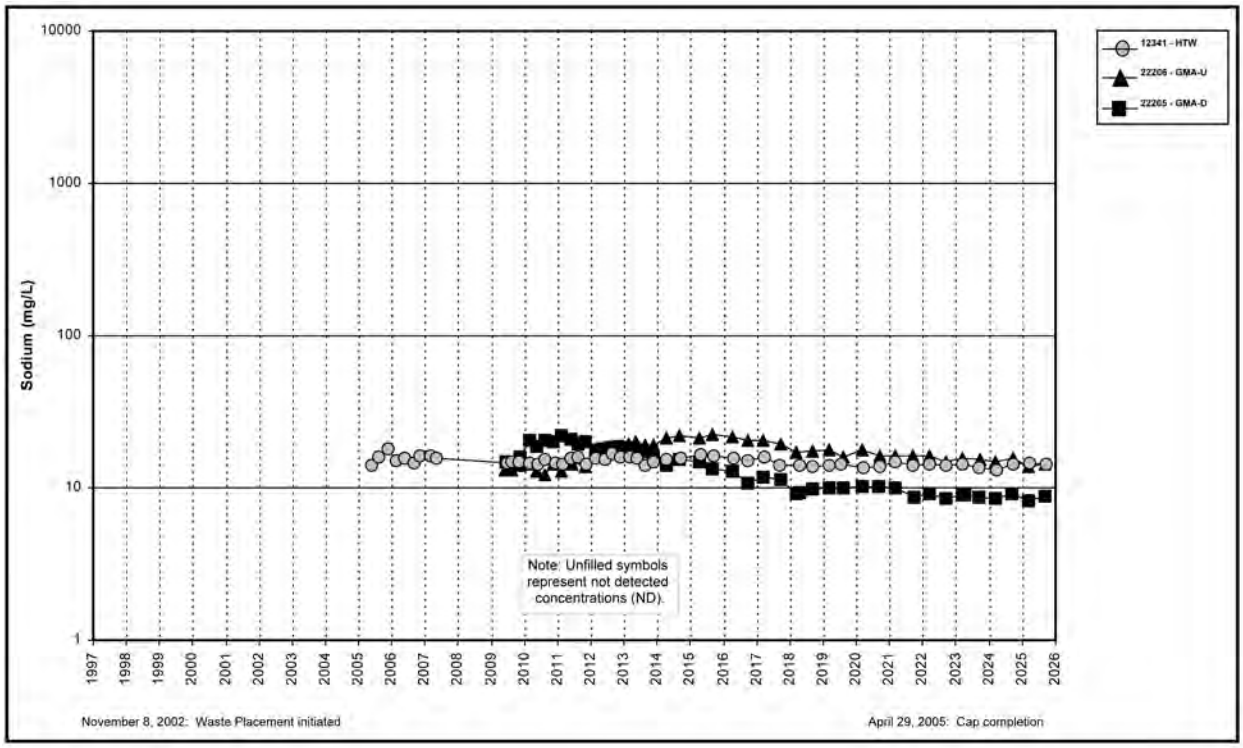


Figure A.5.4-7B. Cell 4 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

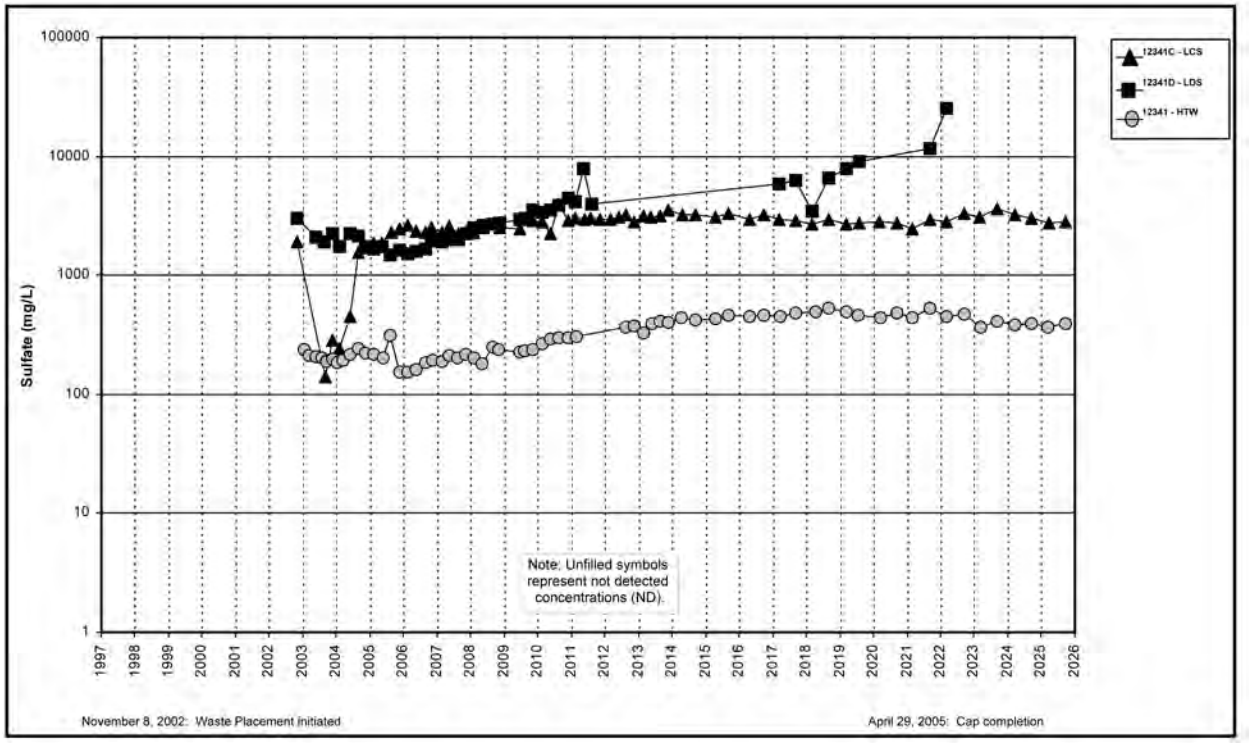


Figure A.5.4-8A. Cell 4 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

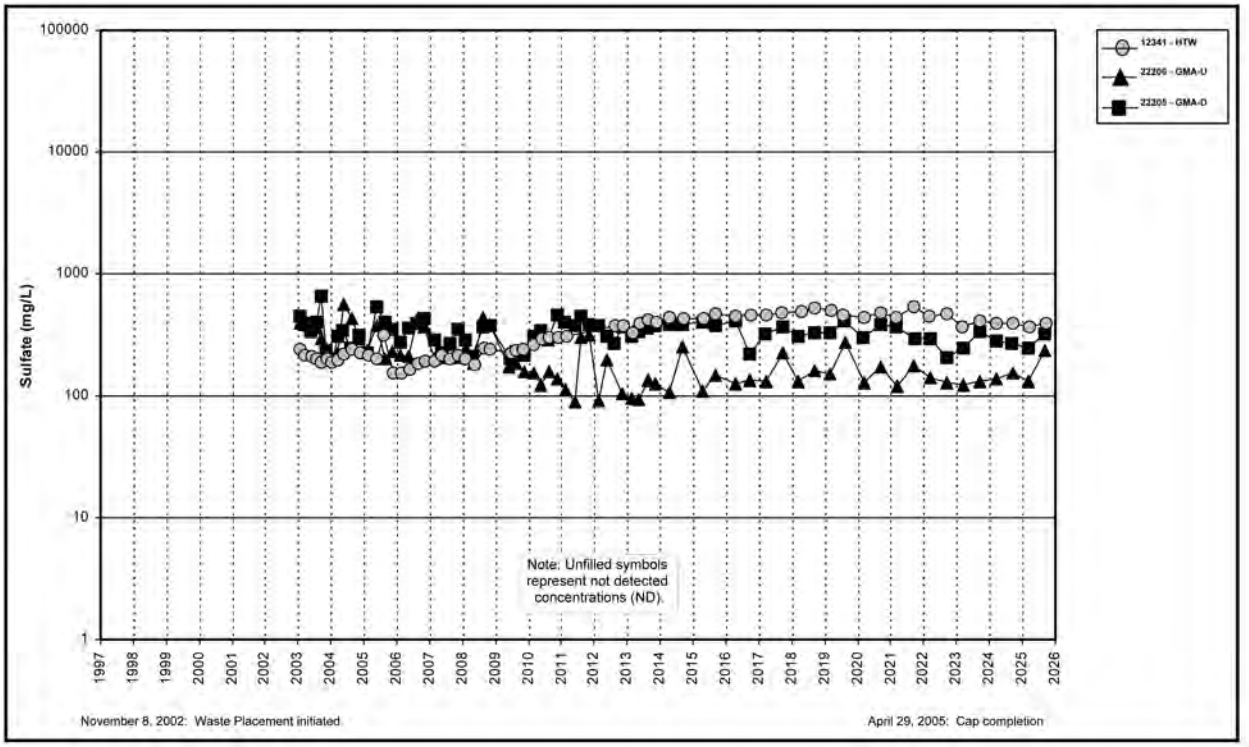


Figure A.5.4-8B. Cell 4 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

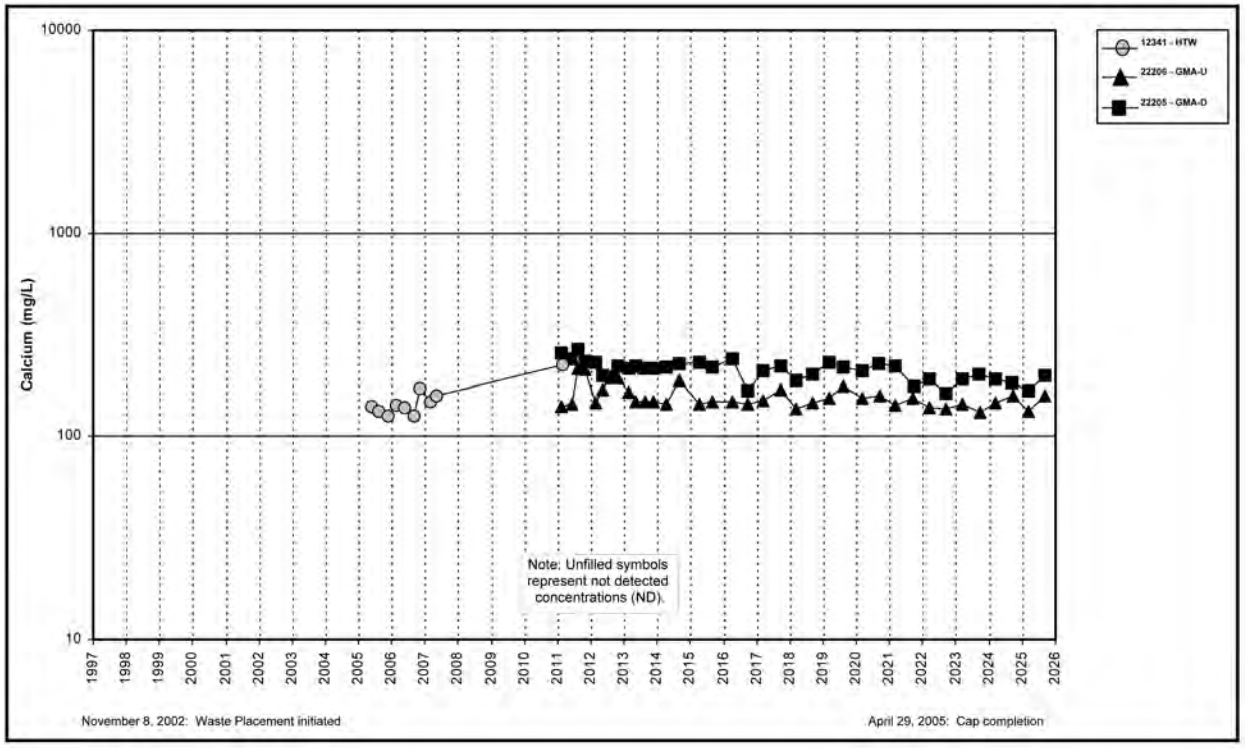


Figure A.5.4-9. Cell 4 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

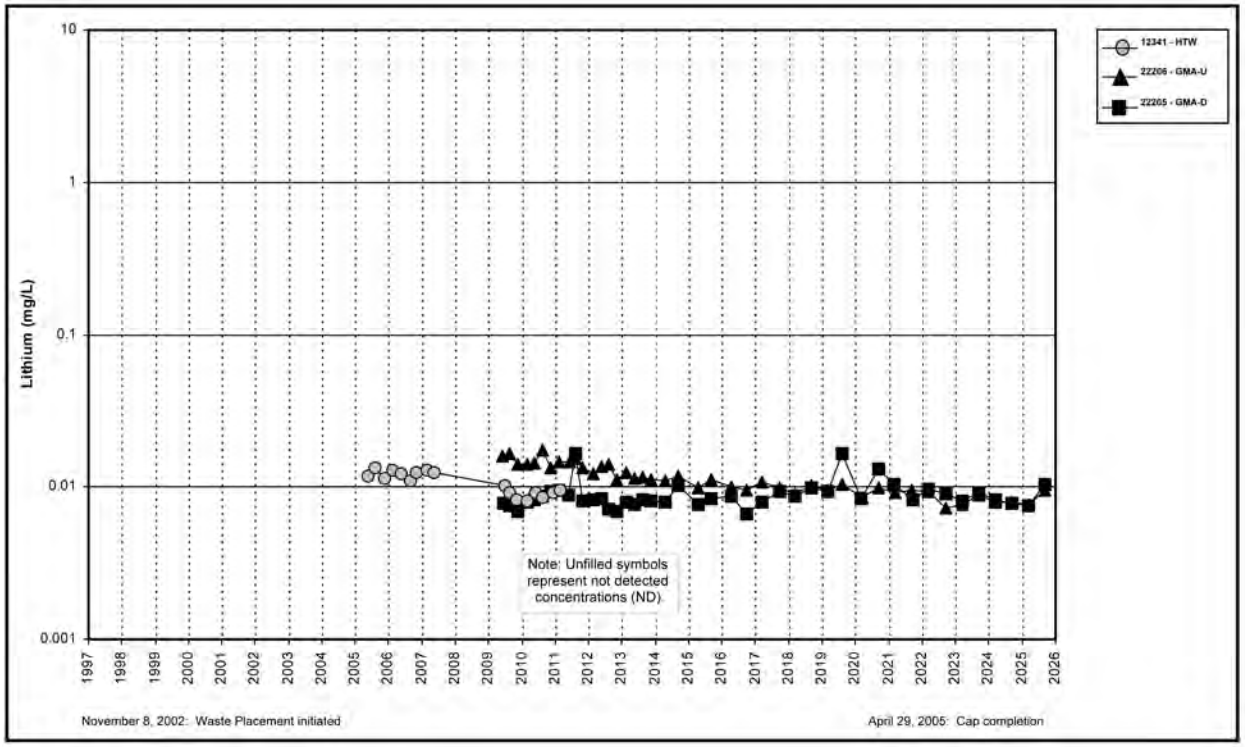


Figure A.5.4-10. Cell 4 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

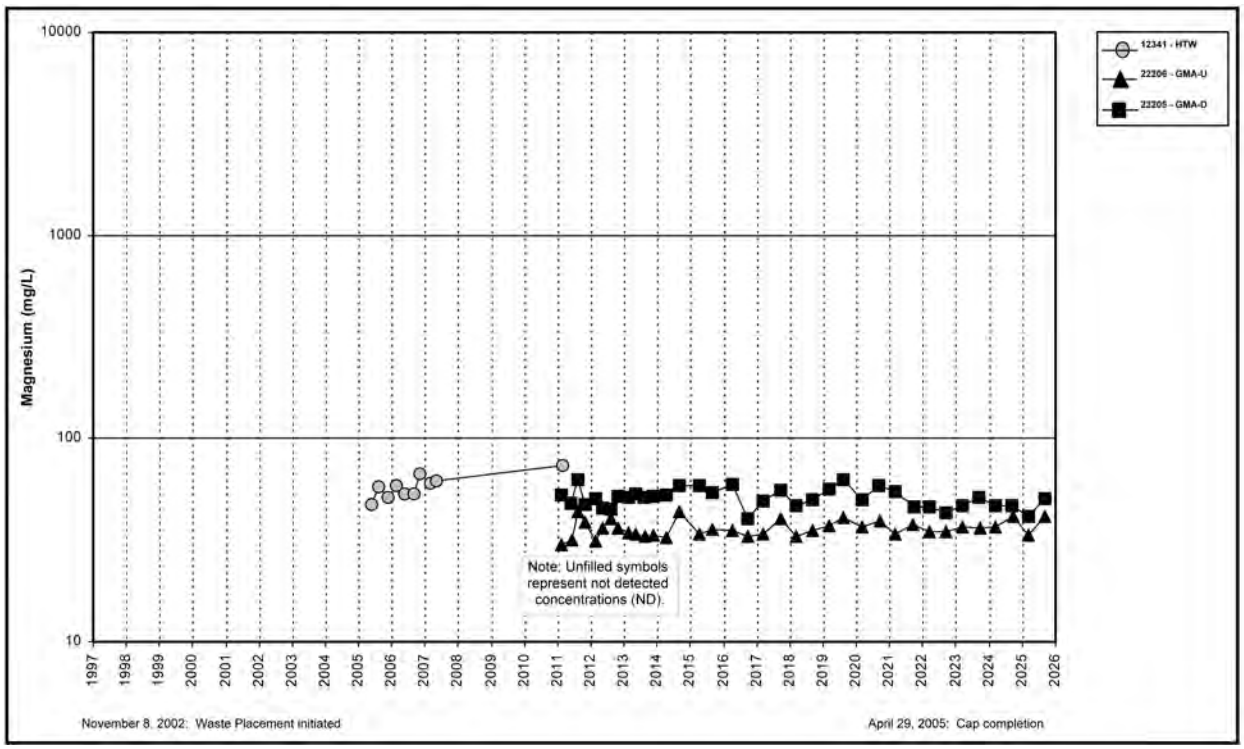


Figure A.5.4-11. Cell 4 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

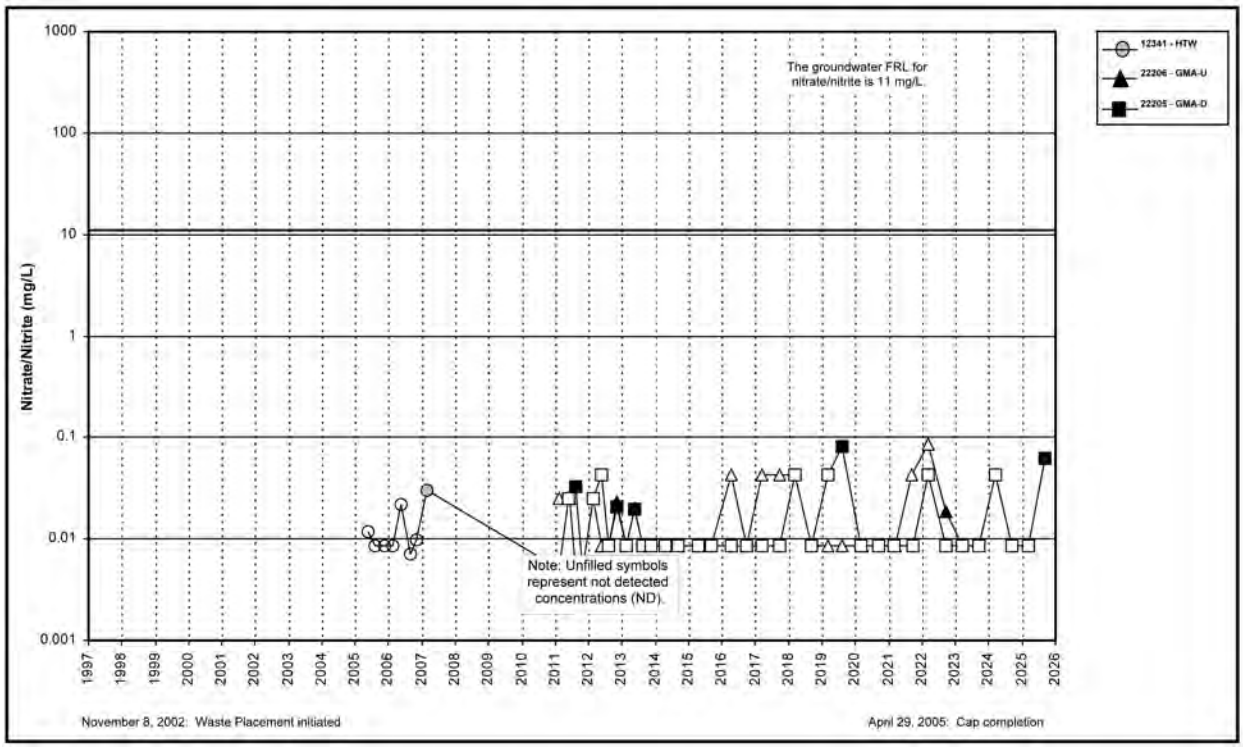


Figure A.5.4-12. Cell 4 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

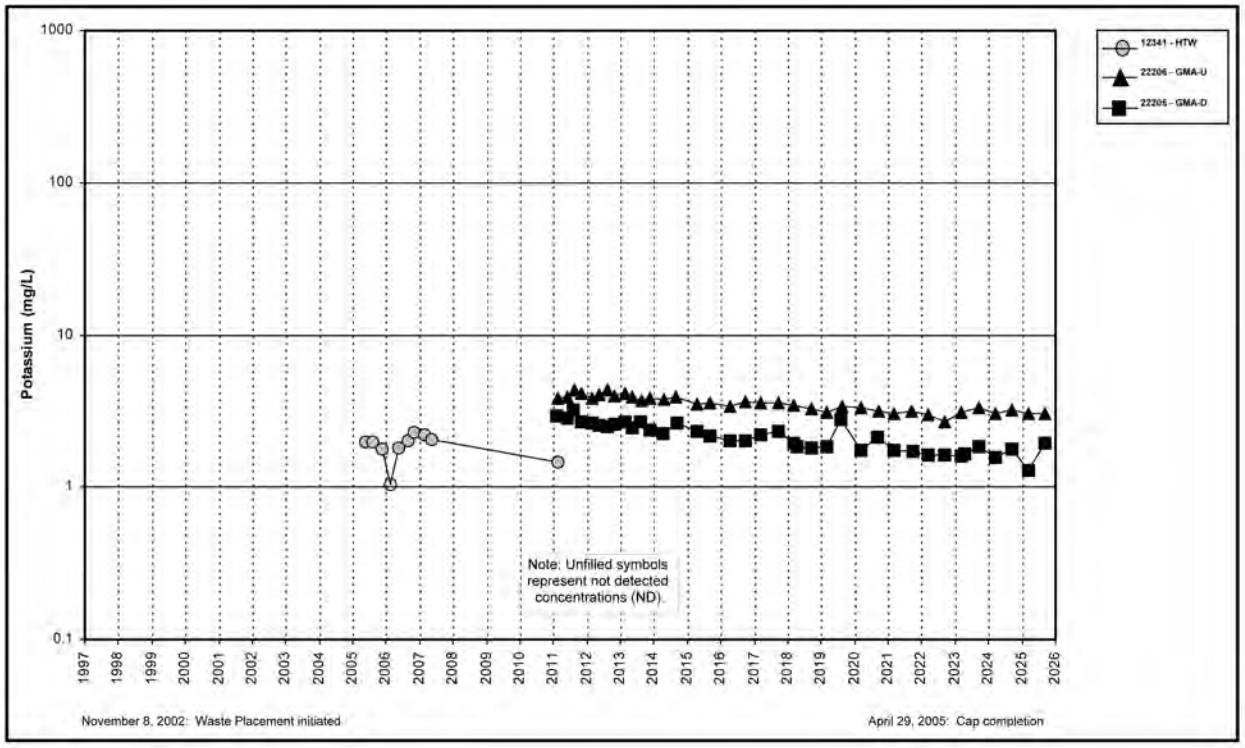


Figure A.5.4-13. Cell 4 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

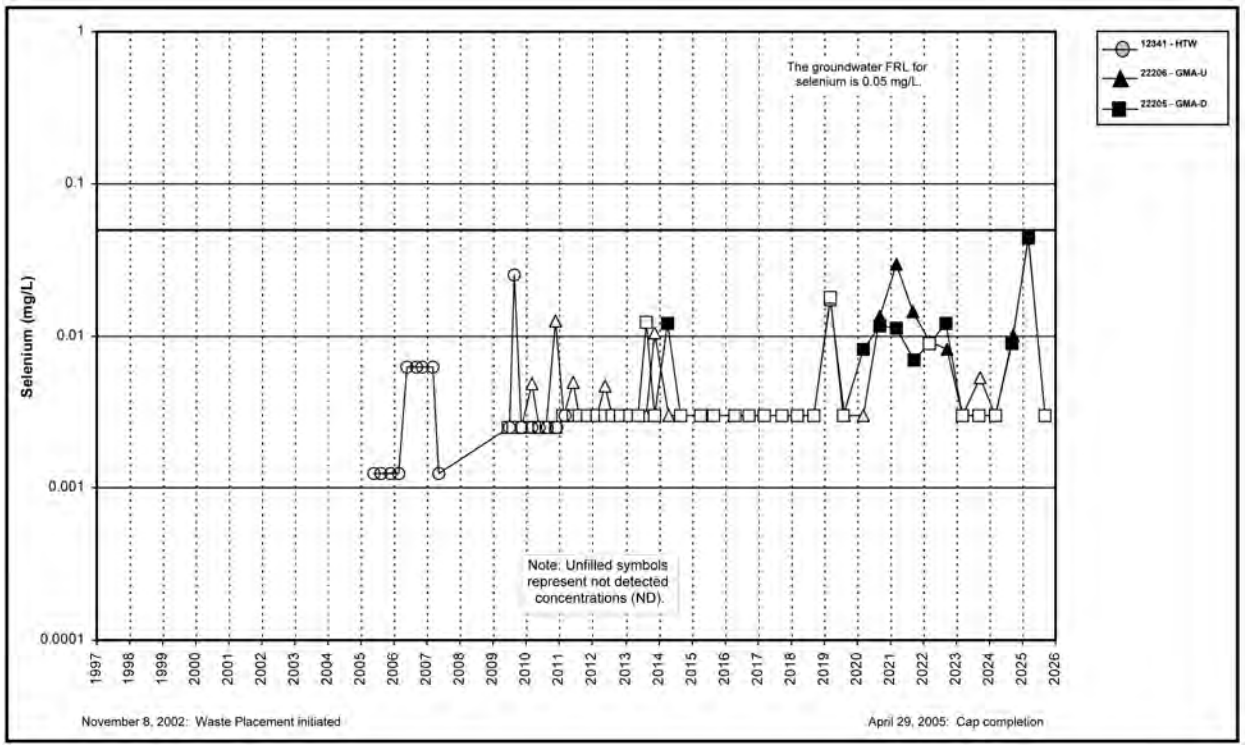


Figure A.5.4-14. Cell 4 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

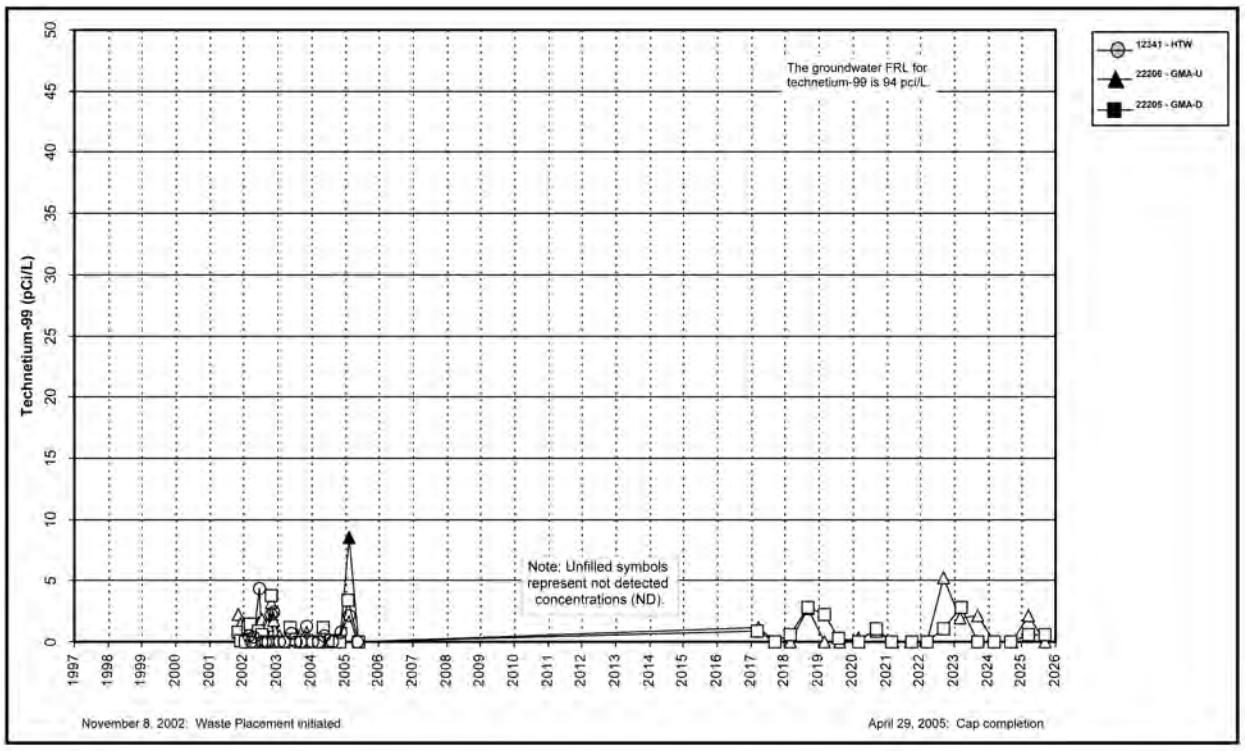


Figure A.5.4-15. Cell 4 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

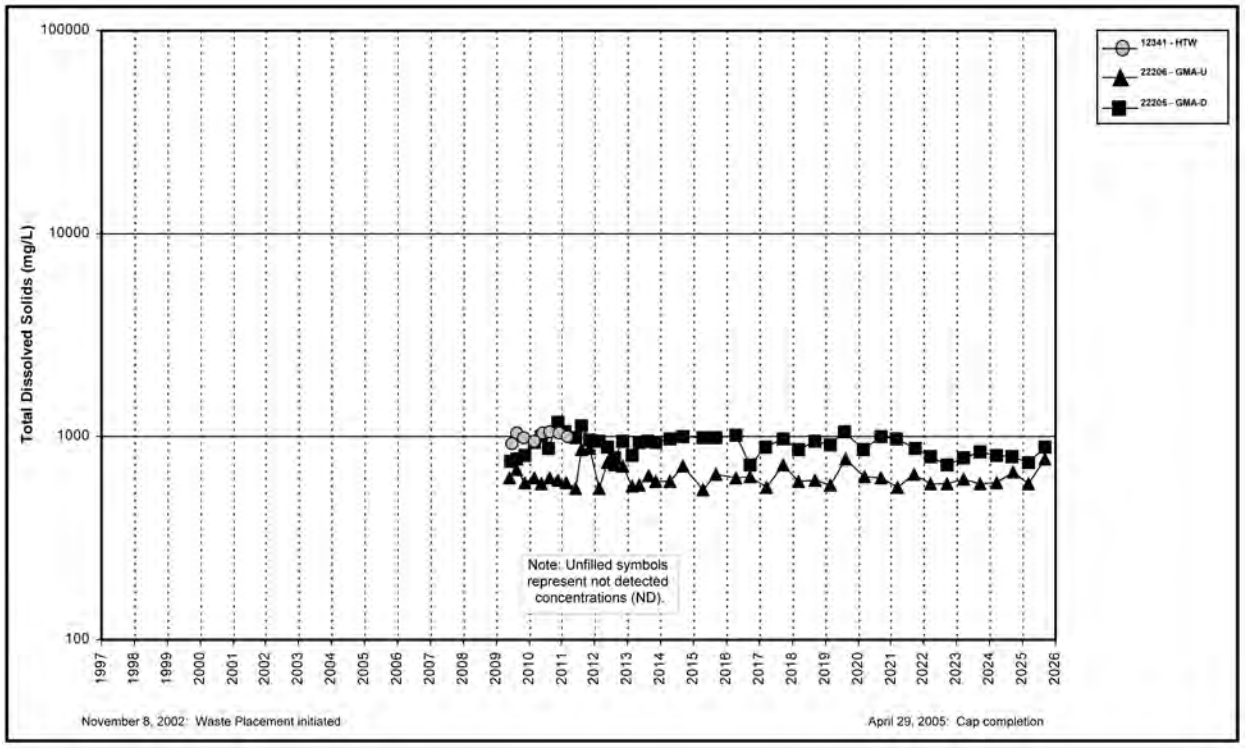


Figure A.5.4-16. Cell 4 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

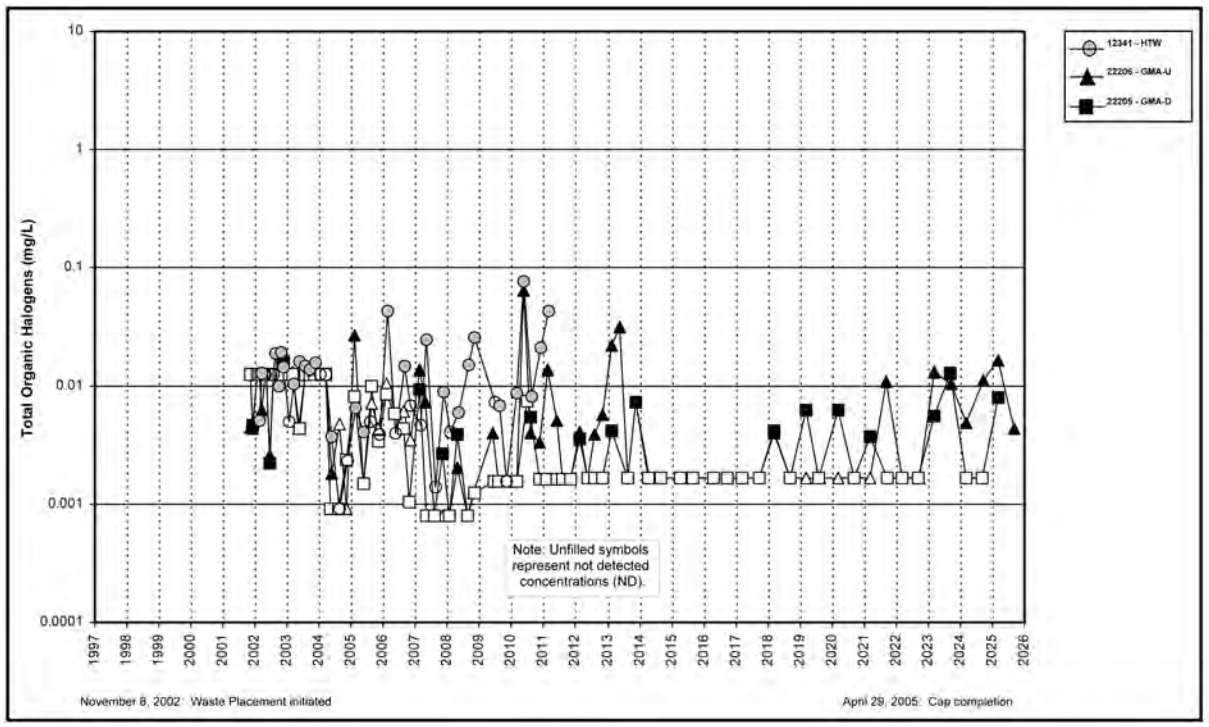


Figure A.5.4-17. Cell 4 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

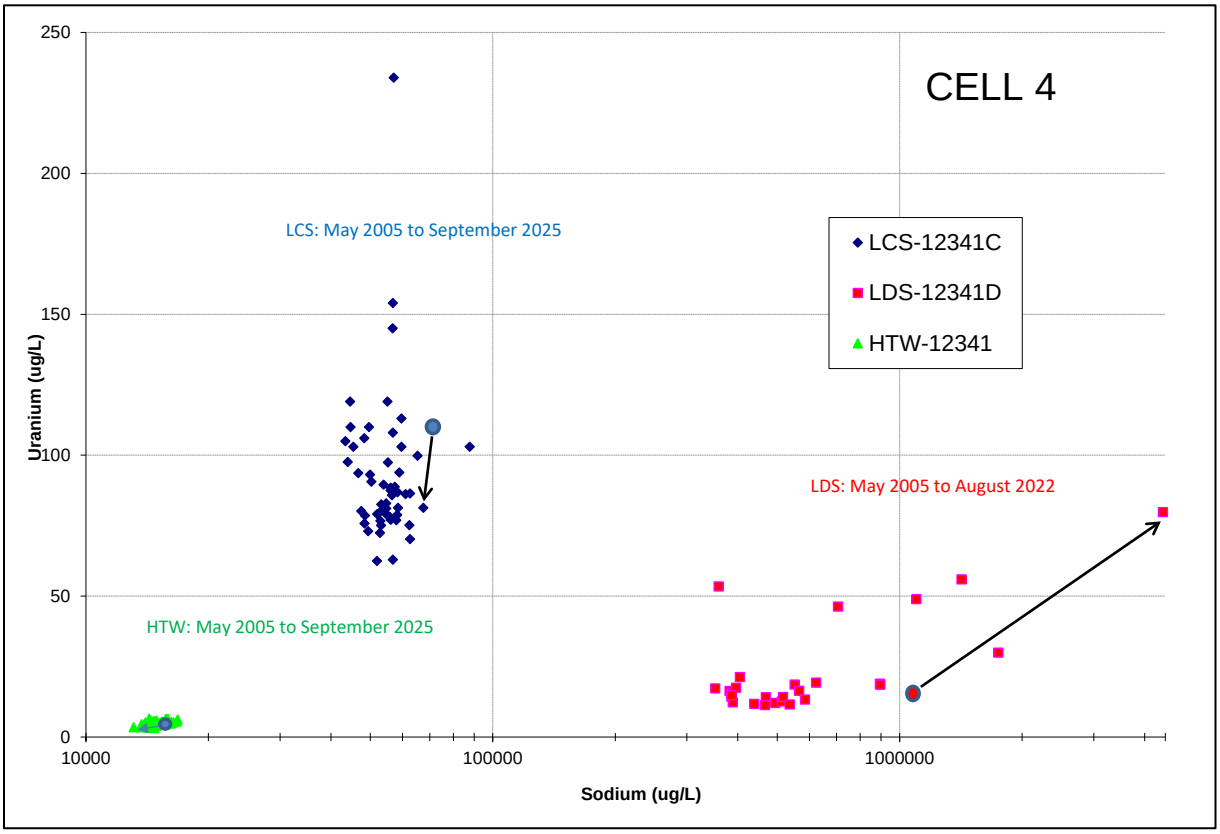


Figure A.5.4-18. Cell 4 Bivariate Plot for Uranium and Sodium

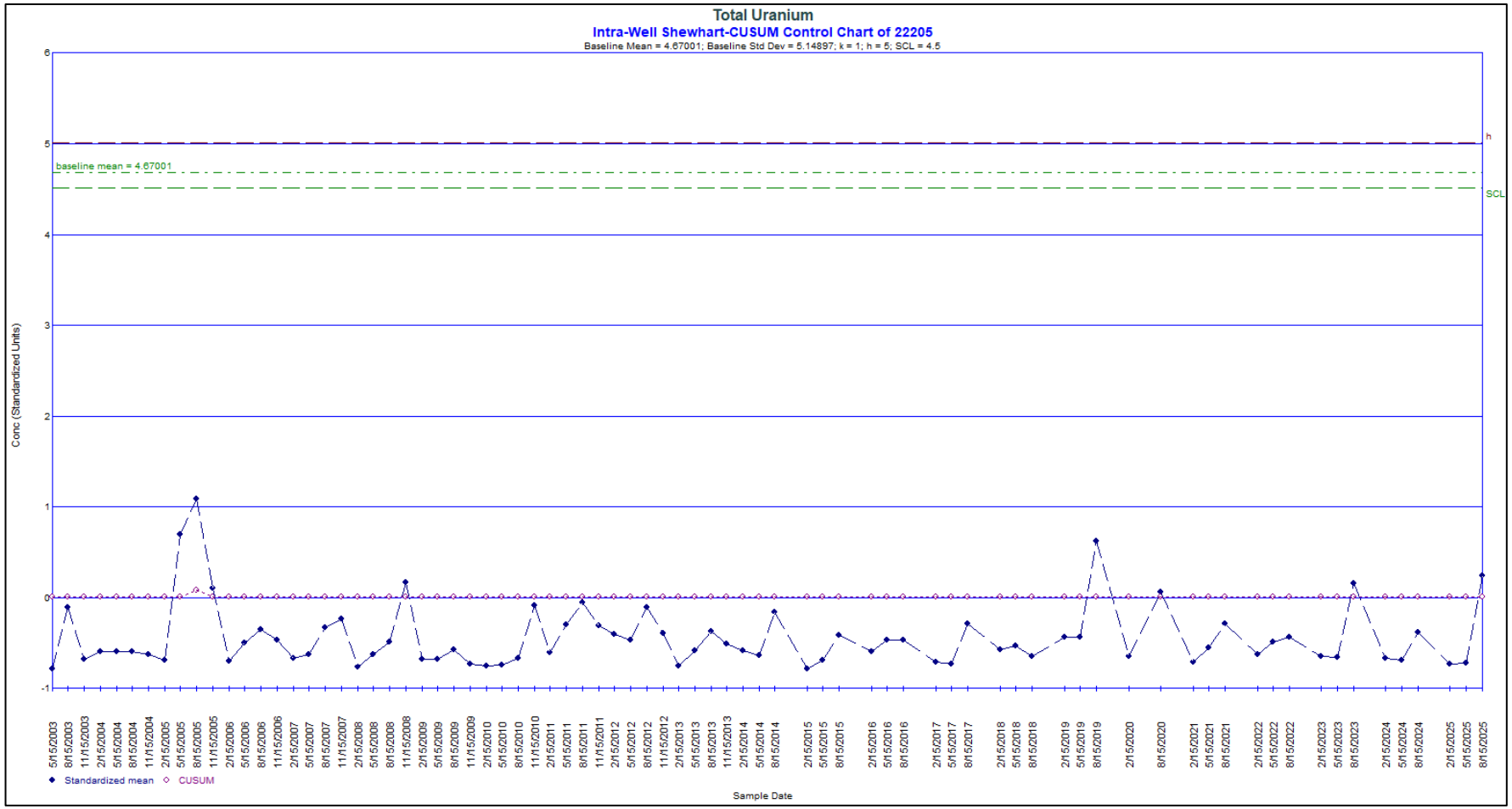


Figure A.5.4-19. Intrawell Shewhart-CUSUM Control Chart for Total Uranium in Monitoring Well 22205

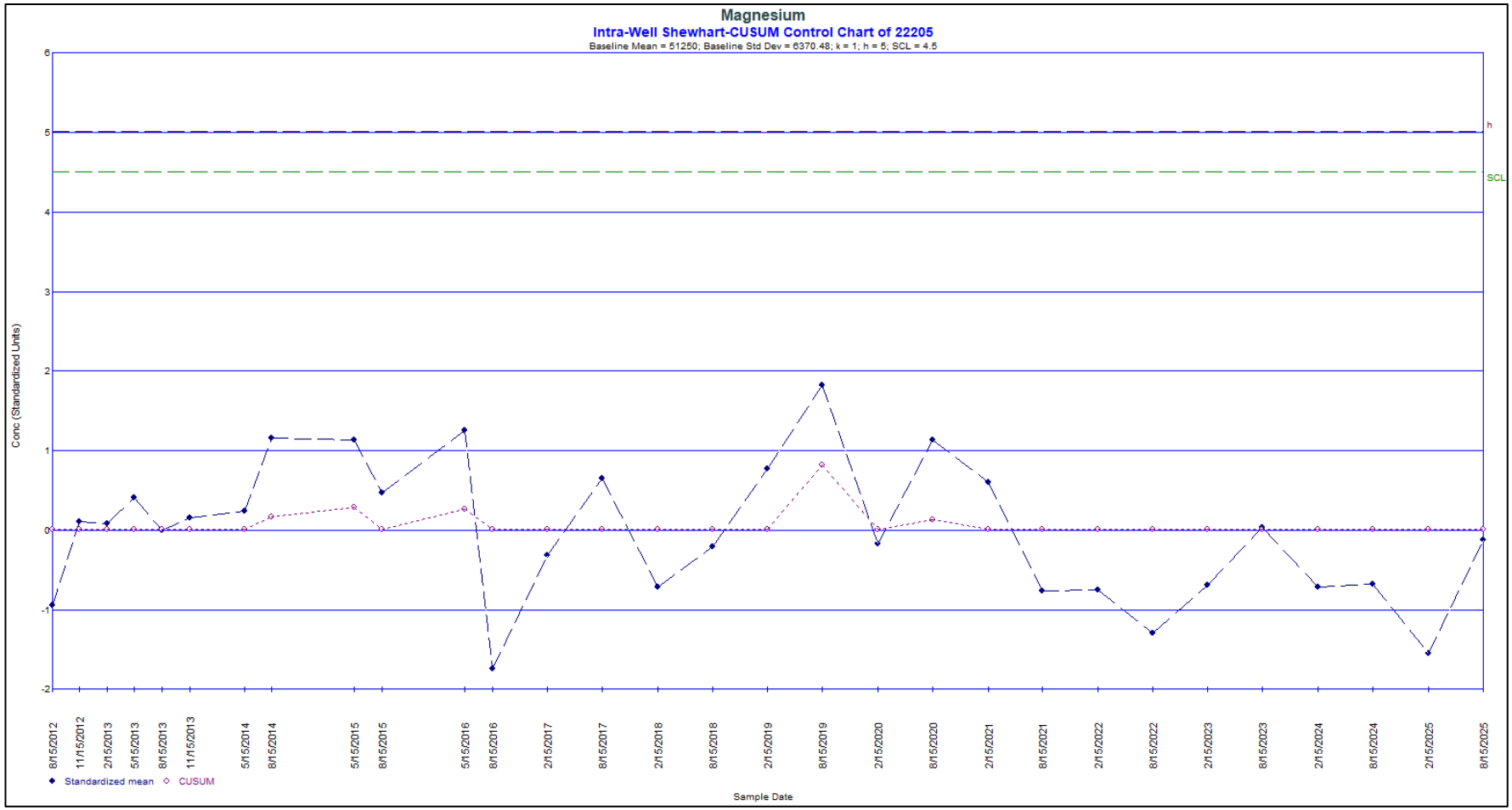


Figure A.5.4-20. Intrawell Shewhart-CUSUM Control Chart for Magnesium in Monitoring Well 22205

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Subattachment A.5.5

Cell 5

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.5.1 Water Quality Monitoring Results 1
A.5.5.1.1 LCS and LDS Results 1
A.5.5.1.2 HTW and Monitoring Well Results 2
A.5.5.1.3 Discussion 2
A.5.5.2 Control Charts 2
A.5.5.3 Summary and Conclusions 3
A.5.5.4 References 4

Tables

Table A.5.5-1. Summary Statistics for Cell 5 5
Table A.5.5-2. OSDF Horizontal Till Well 12342 (Cell 5) Water Yield 6

Figures

Figure A.5.5-1. Monthly Accumulation Volumes for Cell 5 LCS 7
Figure A.5.5-2. Monthly Accumulation Volumes for Cell 5 LDS 7
Figure A.5.5-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 5 Upgradient Monitoring Well 22207 8
Figure A.5.5-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 5 Downgradient Monitoring Well 22208 8
Figure A.5.5-5A. Cell 5 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A.5.5-5B. Cell 5 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 9
Figure A.5.5-6A. Cell 5 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.5-6B. Cell 5 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.5-7A. Cell 5 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.5-7B. Cell 5 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.5-8A. Cell 5 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.5-8B. Cell 5 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.5-9. Cell 5 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.5-10. Cell 5 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.5-11. Cell 5 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.5-12. Cell 5 Nitrate + Nitrate as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.5-13. Cell 5 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.5-14. Cell 5 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.5-15. Cell 5 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.5-16. Cell 5 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.5-17. Cell 5 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.5-18. Cell 5 Bivariate Plot for Uranium and Sodium 17
Figure A.5.5-19. Intrawell Shewhart-CUSUM Control Chart for Calcium in Monitoring Well 22207 18
Figure A.5.5-20. Intrawell Shewhart-CUSUM Control Chart for Uranium in Monitoring Well 22208 19

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about the On-Site Disposal Facility (OSDF) Cell 5:

- Semiannual monitoring summary statistics (Table A.5.5-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.5-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.5-2)
- OSDF horizontal till well (HTW) 12342 water yield (Table A.5.5-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.5-3 and A.5.5-4)
- Plots of concentration versus time (Figures A.5.5-5A through A.5.5-17)
- A bivariate plot for uranium–sodium (Figure A.5.5-18)
- Control charts (Figures A.5.5-19 and A.5.5-20)

A.5.5.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining if the OSDF was operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW of each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.5.1.1 LCS and LDS Results

As shown in Table A.5.5-1 and summarized below, one parameter (sulfate) had an upward trend in the LCS based on the Mann-Kendall test for trend in 2025. No new high concentrations were measured in the LCS of Cell 5 in 2025. Since 2013, the volume of water in the LDS tank of Cell 5 was insufficient to collect a sample.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 5

Parameter	LCS 12342C 2025 Trend	LDS 12342D Trend (Year Last Sampled)
Sulfate	Up	Up (2013)

A.5.5.1.2 HTW and Monitoring Well Results

As shown in Table A.5.5-1 and summarized below, six parameters (boron, sodium, sulfate, magnesium, potassium, and selenium) have upward trends in the HTW or GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 5

Parameter	HTW 12342[a]	GMA-U 22207[a,b]	GMA-D 22208[a,b]
Boron		Up	Up
Sodium		Up	
Sulfate	Up		
Magnesium		Up	
Potassium		Up	
Selenium			Up

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer; HTW = horizontal till well.

A.5.5.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 5 LCS, LDS, and HTW is provided in Figure A.5.5-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot shows that the chemical signatures for uranium and sodium in the LCS, LDS, and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.5.2 Control Charts

Intrawell control charts use historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared “not in control” if future concentrations exceed the baseline control

limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.5-1 in gray shading and as summarized below, two parameters in the HTW or GMA wells of Cell 5 met the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in two control charts (Figures A.5.5-19 and A.5-20) which exhibit "in control" conditions.

Parameter	Monitoring Point[a]	Well Number	Assessment	Figure Number
Calcium	GMA-U	22207	In Control	A.5.5-19
Uranium	GMA-D	22208	In Control	A.5.5-20

[a] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.5.3 Summary and Conclusions

- One parameter (sulfate) had an upward trend in the LCS in 2025 based on the Mann-Kendall test for trend. No new high concentrations were measured in the LCS of Cell 5 in 2025.
- Since 2013, the volume of water in the LDS tank of Cell 5 has been insufficient to collect a sample.
- Six parameters monitored semiannually have an upward concentration trend in the HTW or GMA wells of Cell 5: boron, sodium, sulfate, magnesium, potassium, and selenium. Separate and distinct chemical signatures for total uranium and sodium in the LCS, LDS, and HTW of Cell 5 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 5 (i.e., HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- Two control charts were constructed for Cell 5 parameters. All exhibit "in control" conditions.

A.5.5.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.5-1. Summary Statistics for Cell 5

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[e,f] (Year Last Sampled)	Serial Correlation[f,g]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12342C	68	68	100	3.39	285	122	44	Undefined	None (2025)	Detected	
	LDS	12342D	40	40	100	2.93	27.1	15.6	5.2	Normal	Down (2013)	Detected	
	HTW	12342	71	71	100	6.49	19.2	8.90	2.20	Undefined	Down (2025)	Detected	
	GMA-U	22207	61	72	84.7	ND	0.631	0.314	0.120	Ln Normal	Down (2025)	Not Detected	2.39(Q3-02)
	GMA-D	22208	73	84	86.9	ND	0.710	0.367	0.222	Normal	None (2025)	Not Detected	2.10(Q2-04); 0.800(Q1-05); 0.006(Q2-05); 0.710(Q2-08)
Boron (mg/L)	LCS	12342C	66	68	97.1	ND	1.59	0.751	0.250	Undefined	None (2025)	Detected	
	LDS	12342D	40	40	100	0.202	1.20	0.398	0.272	Undefined	None (2013)	Detected	
	HTW	12342	52	54	96.3	ND	0.221	0.0858	0.0402	Undefined	Down (2025)	Detected	
	GMA-U	22207	67	72	93.1	ND	0.0912	0.0424	0.0154	Undefined	Up (2025)	Detected	
	GMA-D	22208	66	72	91.7	ND	0.0618	0.0376	0.0116	Normal	Up (2025)	Detected	
Sodium (mg/L)	LCS	12342C	55	56	98.2	57.0	79.7	68.5	4.7	Normal	Down (2025)	Detected	16.4(Q2-03), 19.7(Q2-04), 22.2(Q2-05), 108(Q3-05)
	LDS	12342D	27	27	100	84.6	808	432	137	Normal	Up (2013)	Detected	
	HTW	12342	52	52	100	16.6	33.6	25.0	5.0	Undefined	Down (2025)	Detected	
	GMA-U	22207	43	43	100	13.0	23.1	16.6	2.4	Ln Normal	Up (2025)	Detected	
	GMA-D	22208	45	45	100	8.99	17.9	14.3	2.9	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12342C	68	68	100	218	5,910	3,650	1,230	Undefined	Up (2025)	Detected	
	LDS	12342D	40	40	100	1,130	6,100	2,160	1,030	Ln Normal	Up (2013)	Detected	
	HTW	12342	62	62	100	101	578	382	126	Undefined	Up (2025)	Detected	
	GMA-U	22207	67	67	100	97.8	470	165	85	Undefined	Down (2025)	Detected	770(Q2-05), 552(Q3-04)
	GMA-D	22208	67	67	100	98.1	671	344	108	Normal	Down (2025)	Detected	
Calcium (mg/L)	GMA-U	22207	36	36	100	124	167	152	11	Normal	None (2025)	Not Detected	
	GMA-D	22208	36	36	100	107	285	205	36	Normal	Down (2025)	Detected	
Lithium (mg/L)	GMA-U	22207	43	43	100	0.00642	0.0165	0.0135	0.0029	Undefined	None (2025)	Detected	
	GMA-D	22208	43	43	100	0.00659	0.00985	0.00804	0.00087	Normal	None (2025)	Detected	0.00425(Q1-17)
Magnesium (mg/L)	GMA-U	22207	36	36	100	26.1	38.5	34.2	2.9	Undefined	Up (2025)	Detected	
	GMA-D	22208	36	36	100	39.1	66.4	51.8	6.7	Normal	Down (2025)	Detected	24.3(Q1-17)
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22207	2	36	5.6	ND	0.425	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22208	4	36	11.1	ND	0.0500	0.00850	0.0146	Undefined	None (2025)	Not Detected	
Potassium (mg/L)	GMA-U	22207	36	36	100	2.75	4.82	3.80	0.57	Normal	Up (2025)	Detected	
	GMA-D	22208	38	38	100	2.15	3.53	2.89	0.36	Normal	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22207	4	43	9.3	ND	0.0427	0.00300	0.00675	Undefined	Up (2025)	Detected	
	GMA-D	22208	7	43	16.3	ND	0.0157	0.00300	0.00373	Undefined	Up (2025)	Not Detected	0.043(Q2-25)
Technitium-99 (pCi/L)	GMA-U	22207	0	33	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22208	1	33	3.0	ND	6.40	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22207	43	43	100	552	770	636	46	Normal	None (2025)	Detected	987(Q4-09)
	GMA-D	22208	43	43	100	456	1,290	904	163	Normal	Down (2025)	Detected	
Total Organic Halogens (mg/L)	GMA-U	22207	28	72	38.9	ND	0.0470	0.00376	0.00710	Undefined	None (2025)	Detected	
	GMA-D	22208	20	72	27.8	ND	0.0260	0.00259	0.00513	Undefined	Down (2025)	Detected	

Note 1: Shading indentifies a horizontal till well or Great Miami Aquifer well, with at least eight samples, Normal or Ln Normal distribution, no trends (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.

Note 2: Data used in this table has been standardized to quarterly.

[a] LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b] ND = not detected, NA = not applicable

[c] Averages were determined based on the distribution assumption

[d] Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test

[e] Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[f] Trend based on nonparametric Mann-Kendall procedure

[g] Serial correlation based on Rank Von Neumann test

[h] Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[i] Q = quarter

Table A.5.5-2. OSDF Horizontal Till Well 12342 (Cell 5) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
2002	35,815	10	3,582
2003	6,200	6	1,033
2004	5,425	5	1,085
2005	4,270	4	1,068
2006	3,710	4	928
2007	4,250	4	1,063
2008	4,225	4	1,056
2009	3,225	4	1,075
2010	4,325	4	1,081
2011	4,225	4	1,056
2012	4,200	4	1,050
2013	4,200	4	1,050
2014	2,100	2	1,050
2015	2,100	2	1,050
2016	2,100	2	1,050
2017	2,100	2	1,050
2018	2,100	2	1,050
2019	2,100	2	1,050
2020	2,100	2	1,050
2021	2,100	2	1,050
2022	2,100	2	1,050
2023	2,100	2	1,050
2024	2,075	2	1,038
2025	2,100	2	1,050

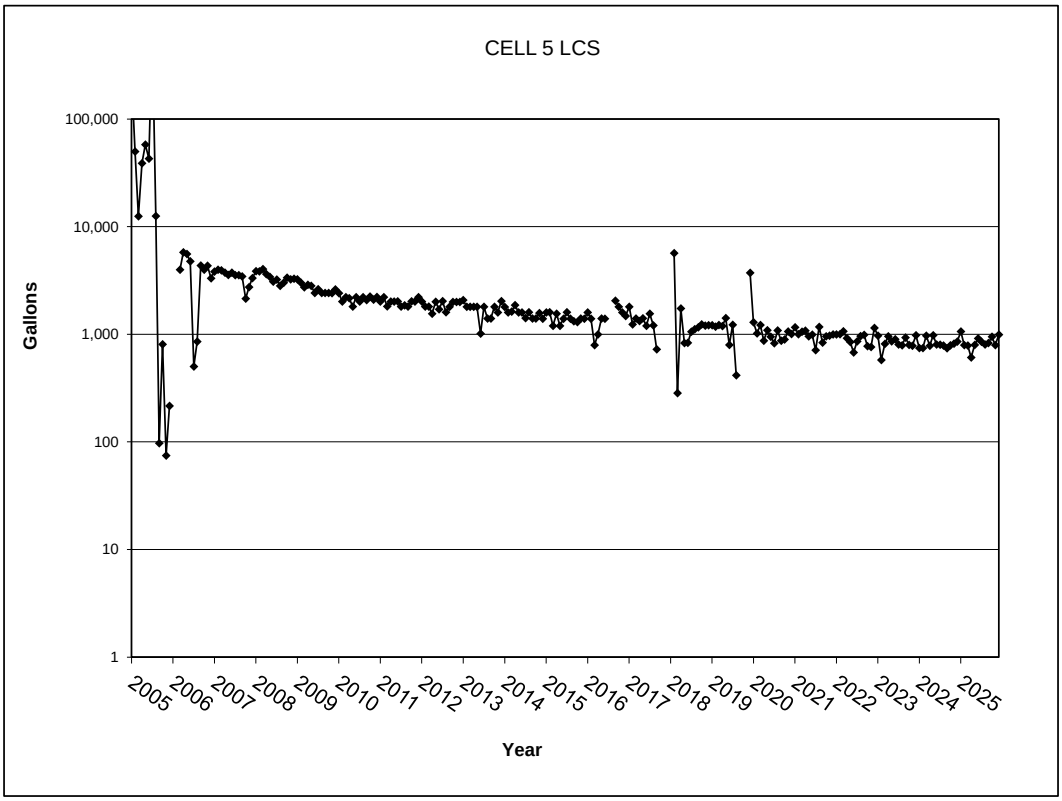


Figure A.5.5-1. Monthly Accumulation Volumes for Cell 5 LCS

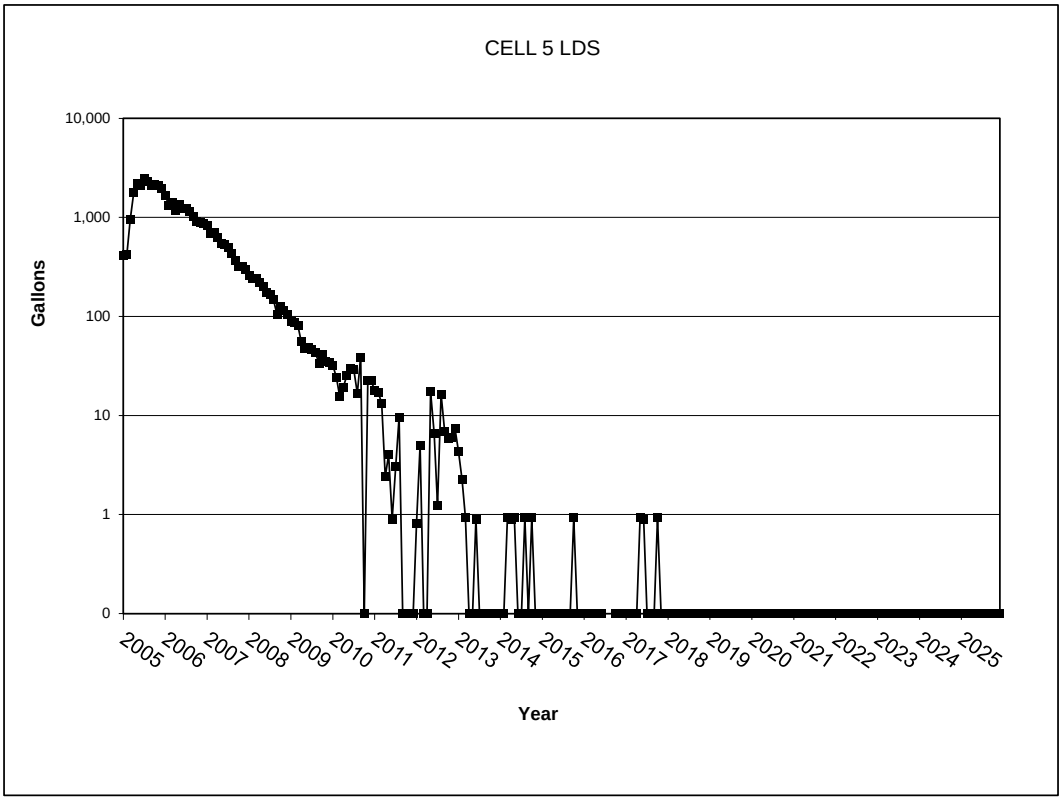


Figure A.5.5-2. Monthly Accumulation Volumes for Cell 5 LDS

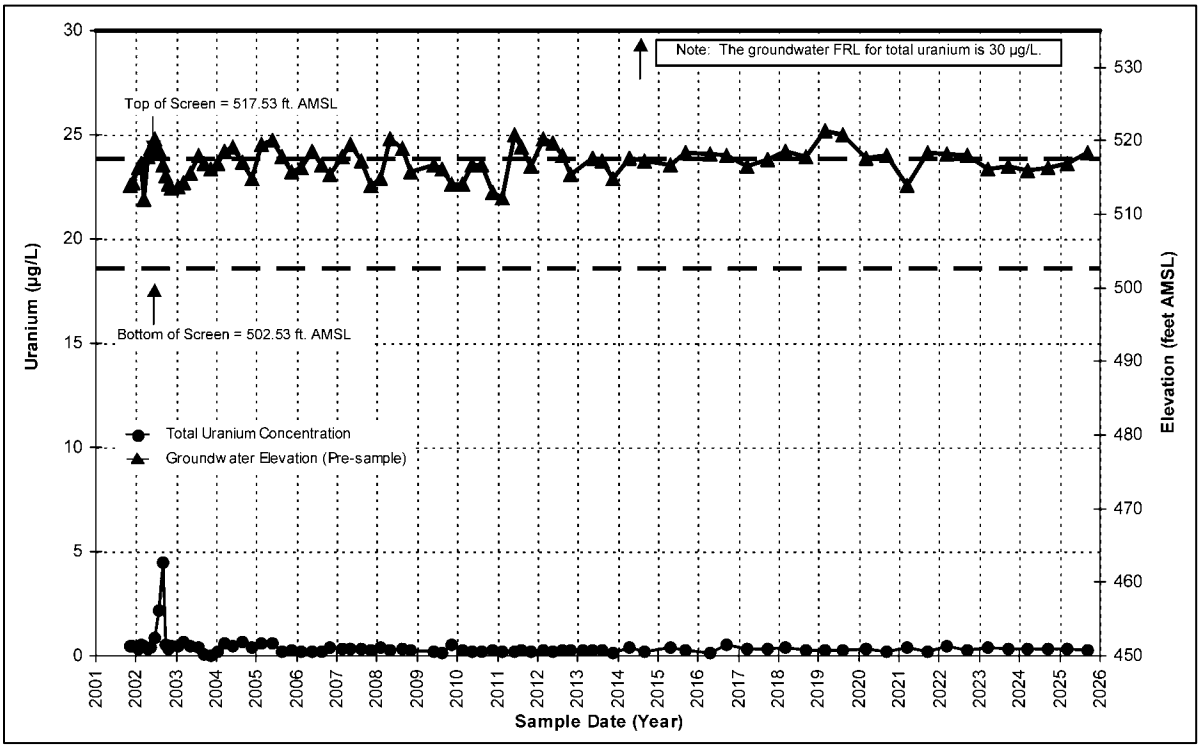


Figure A.5.5-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 5 Upgradient Monitoring Well 22207

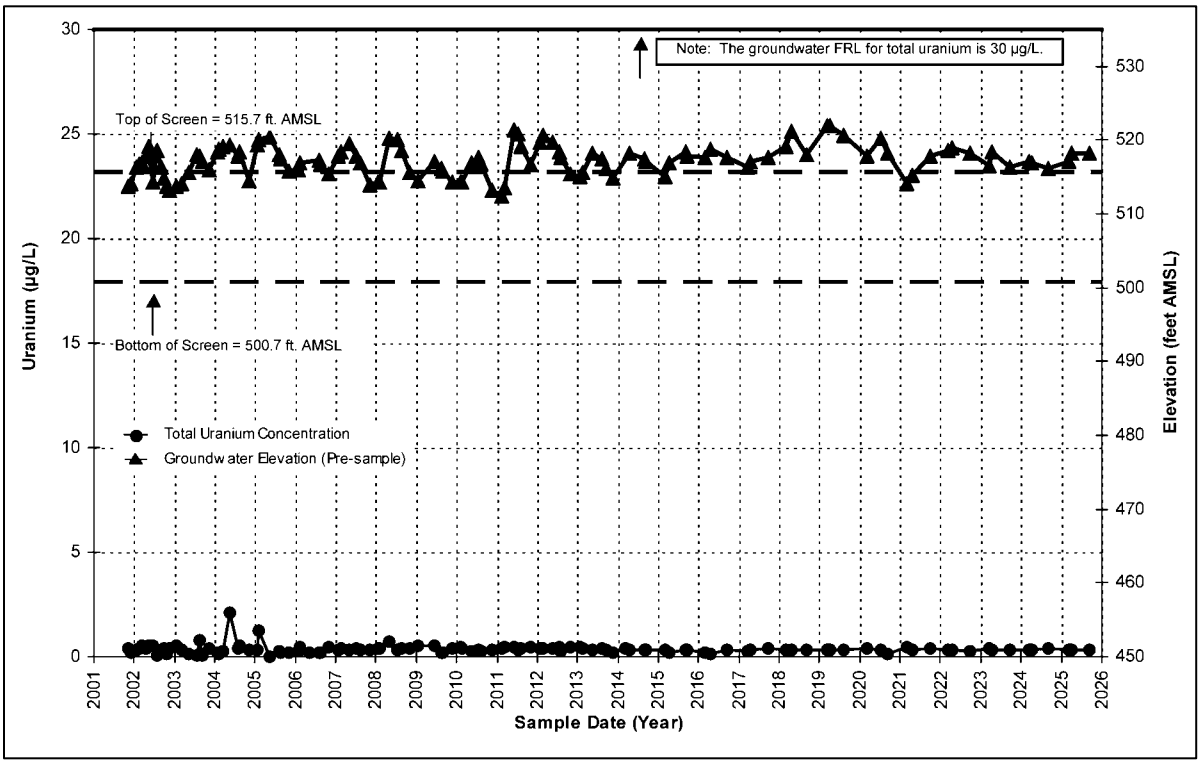


Figure A.5.5-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 5 Downgradient Monitoring Well 22208

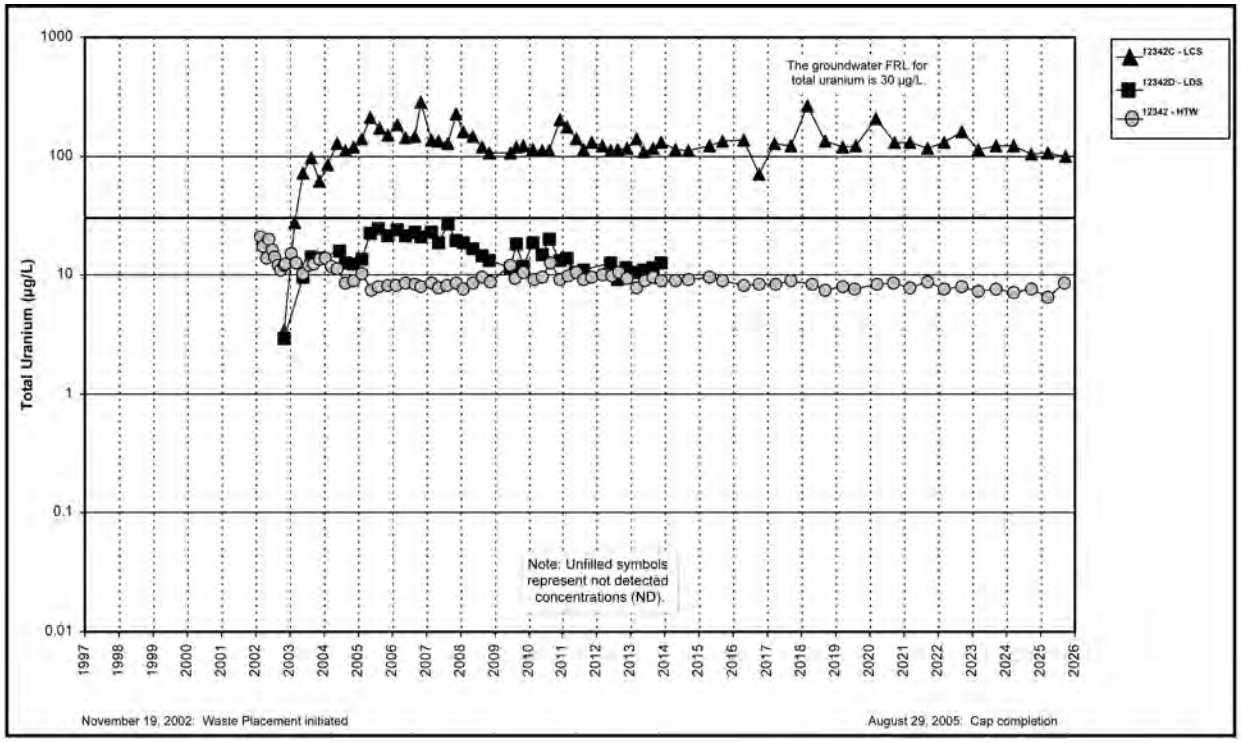


Figure A.5.5-5A. Cell 5 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

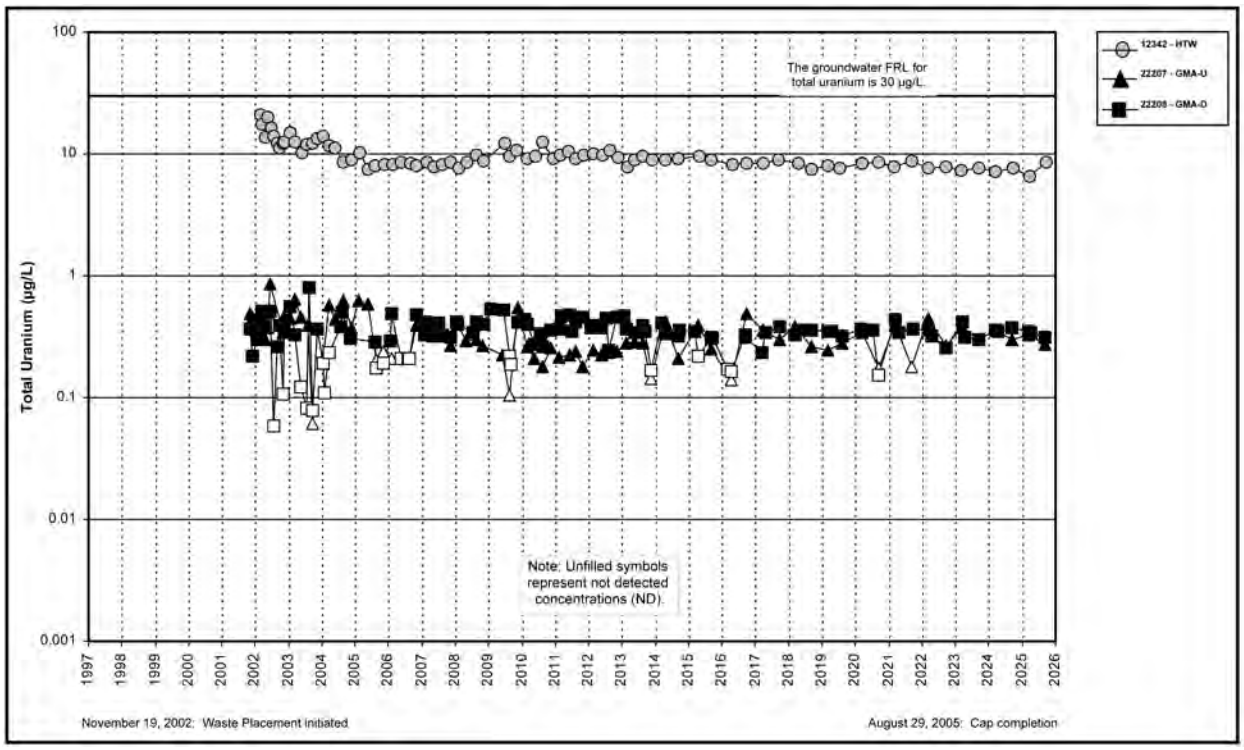


Figure A.5.5-5B. Cell 5 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

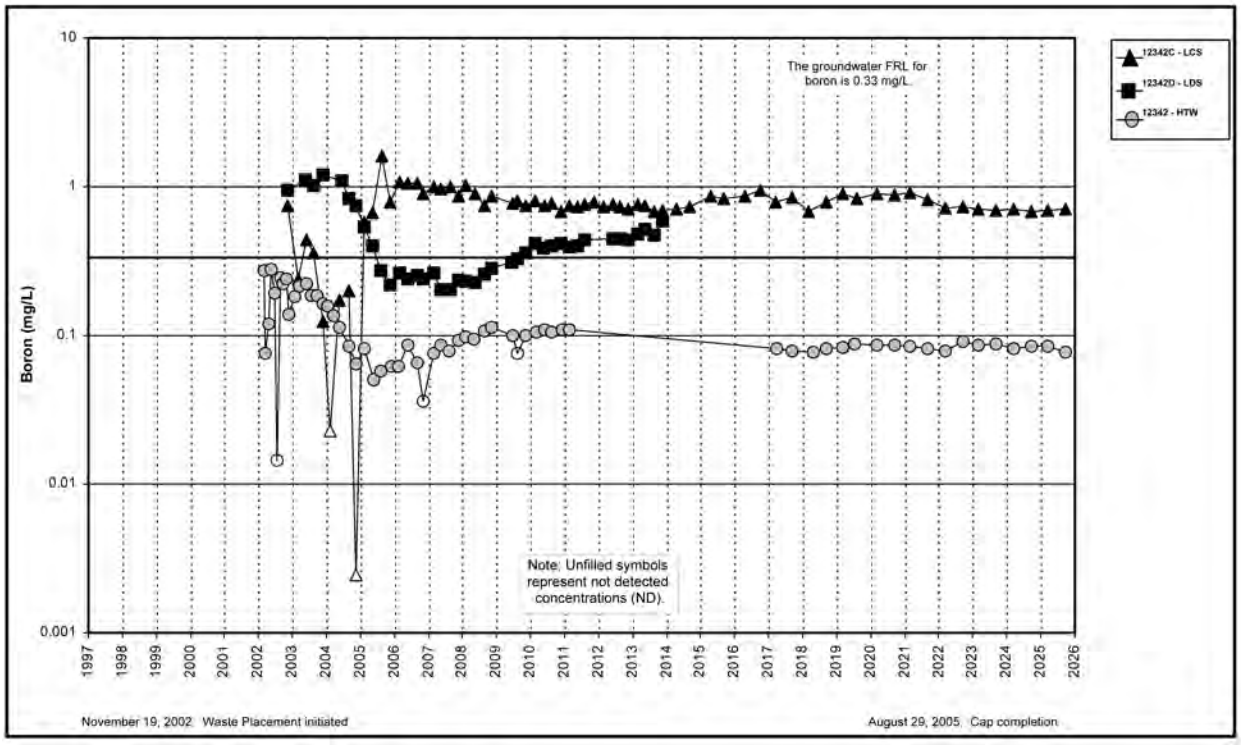


Figure A.5.5-6A. Cell 5 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

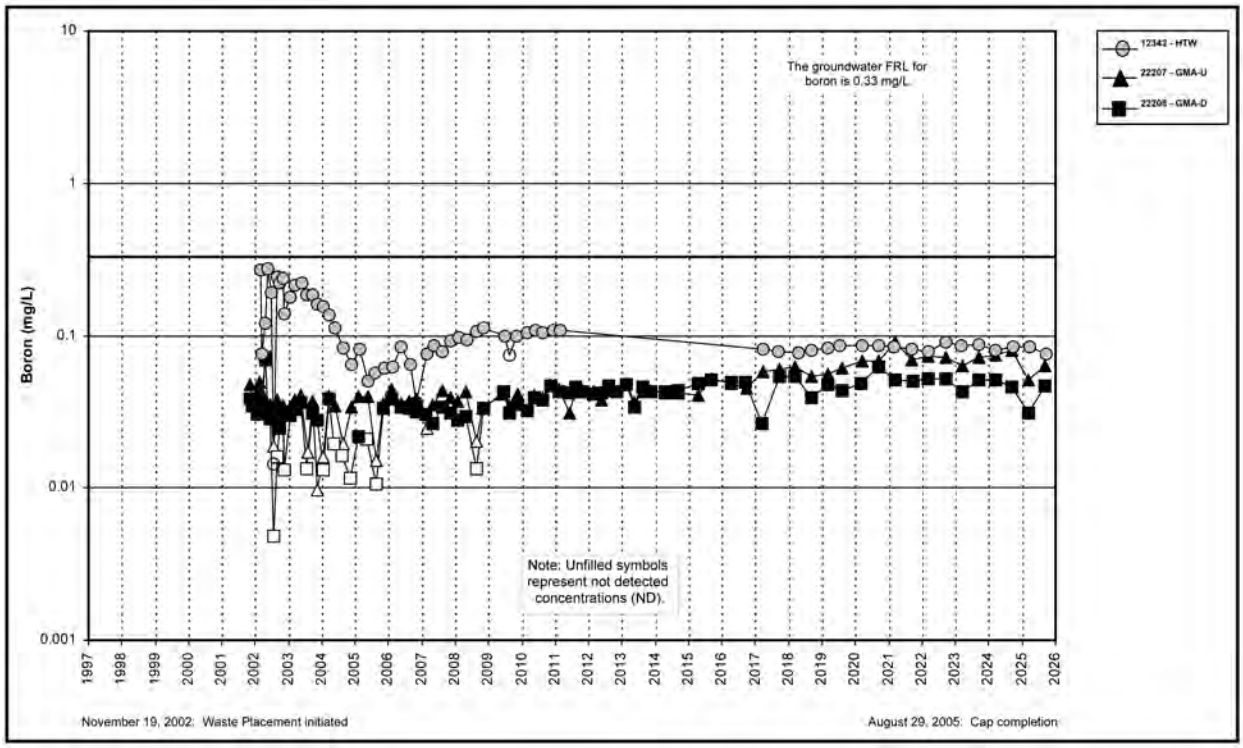


Figure A.5.5-6B. Cell 5 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

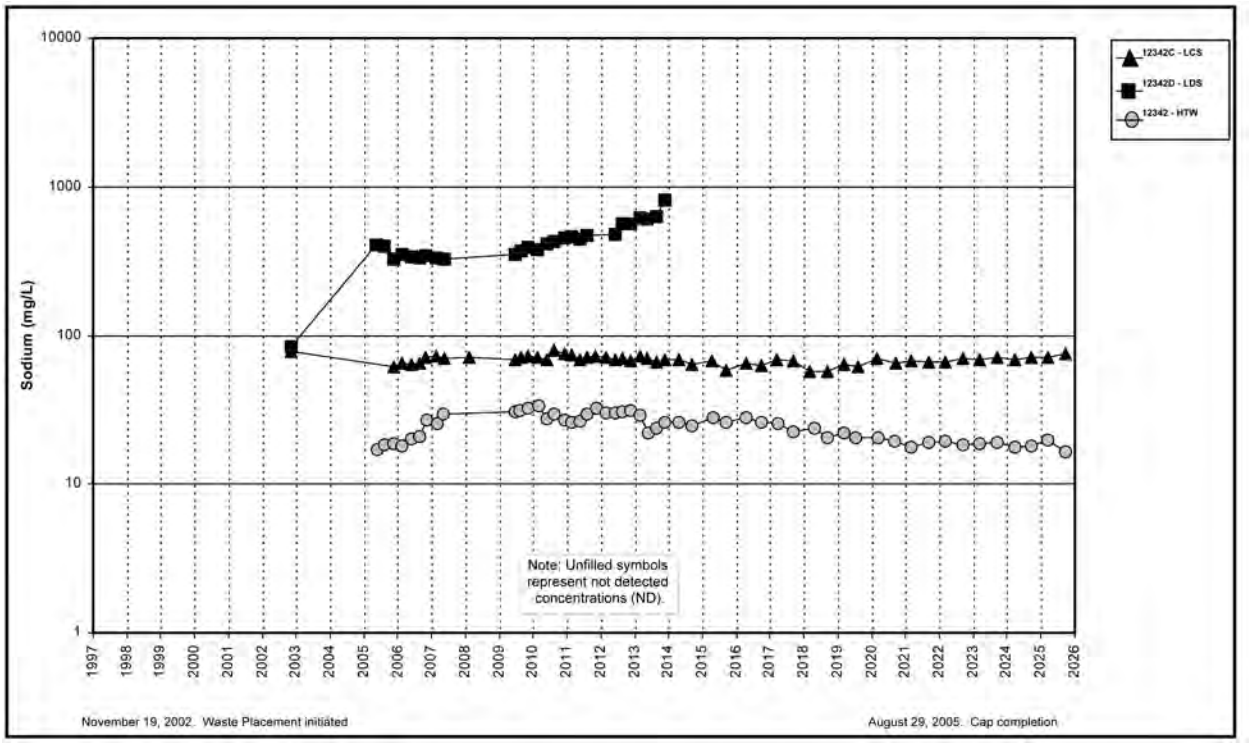


Figure A.5.5-7A. Cell 5 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

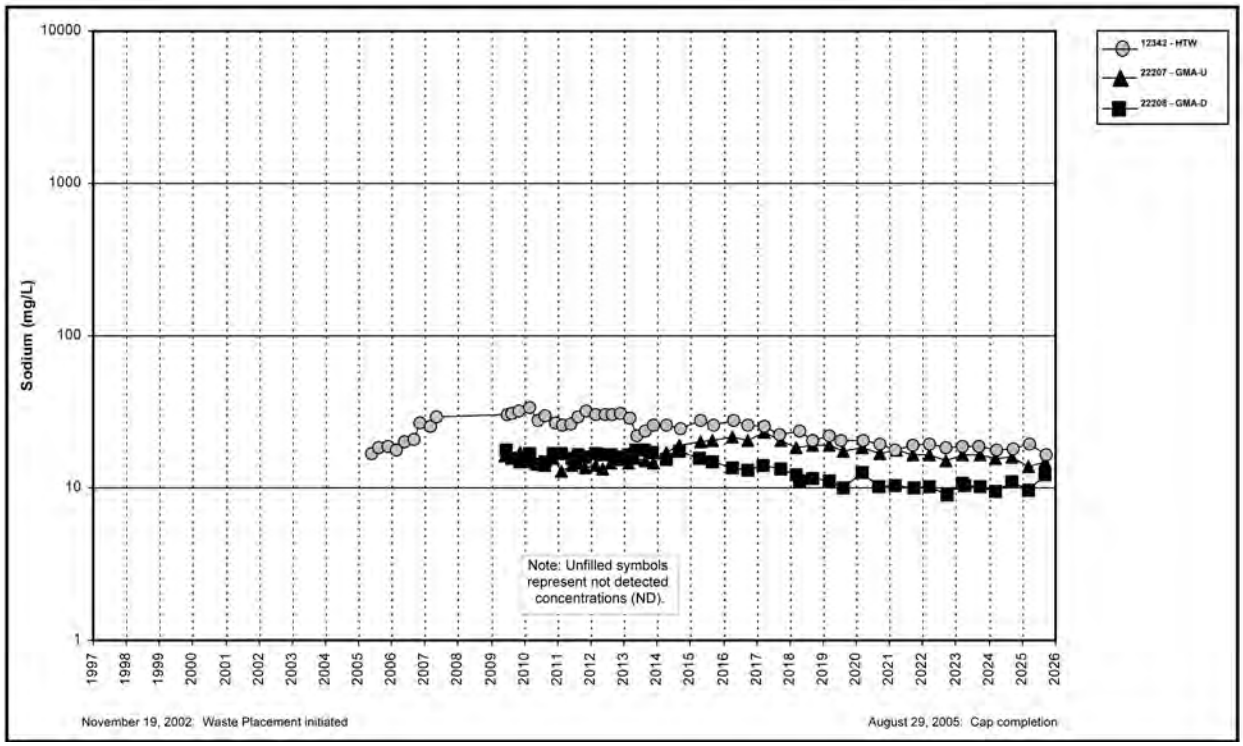


Figure A.5.5-7B. Cell 5 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well



Figure A.5.5-8A. Cell 5 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

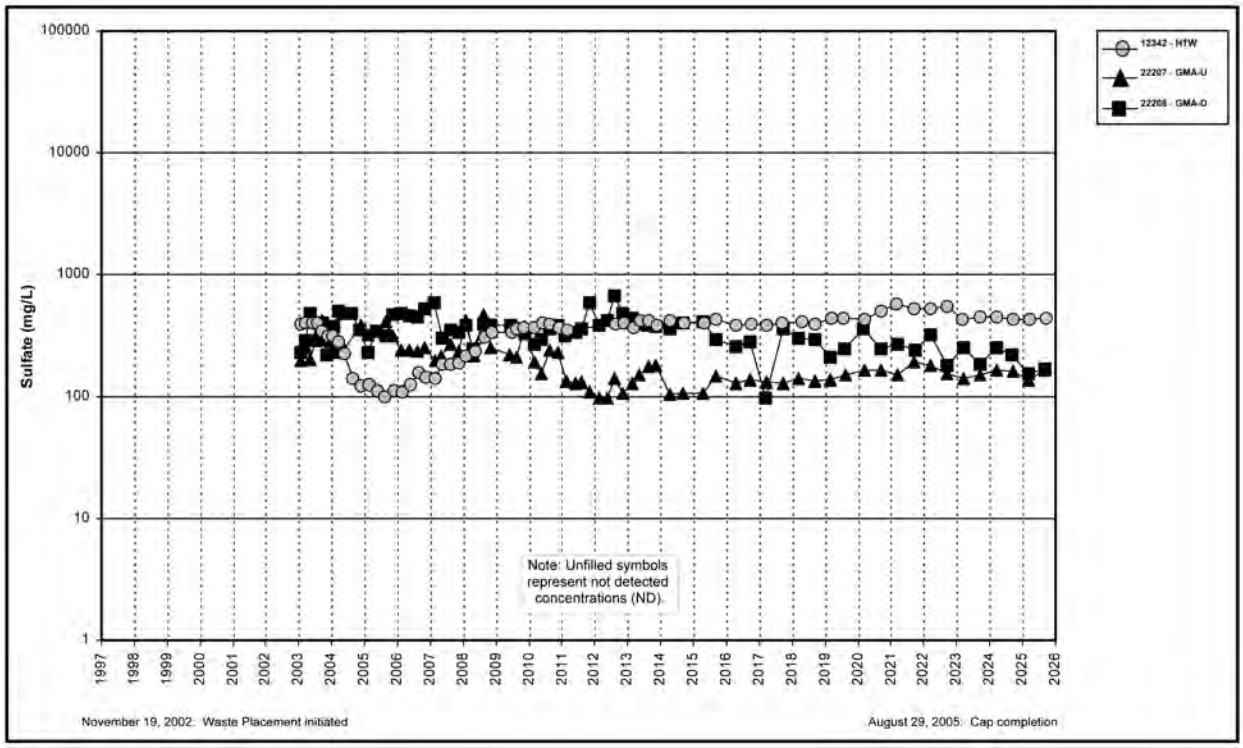


Figure A.5.5-8B. Cell 5 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

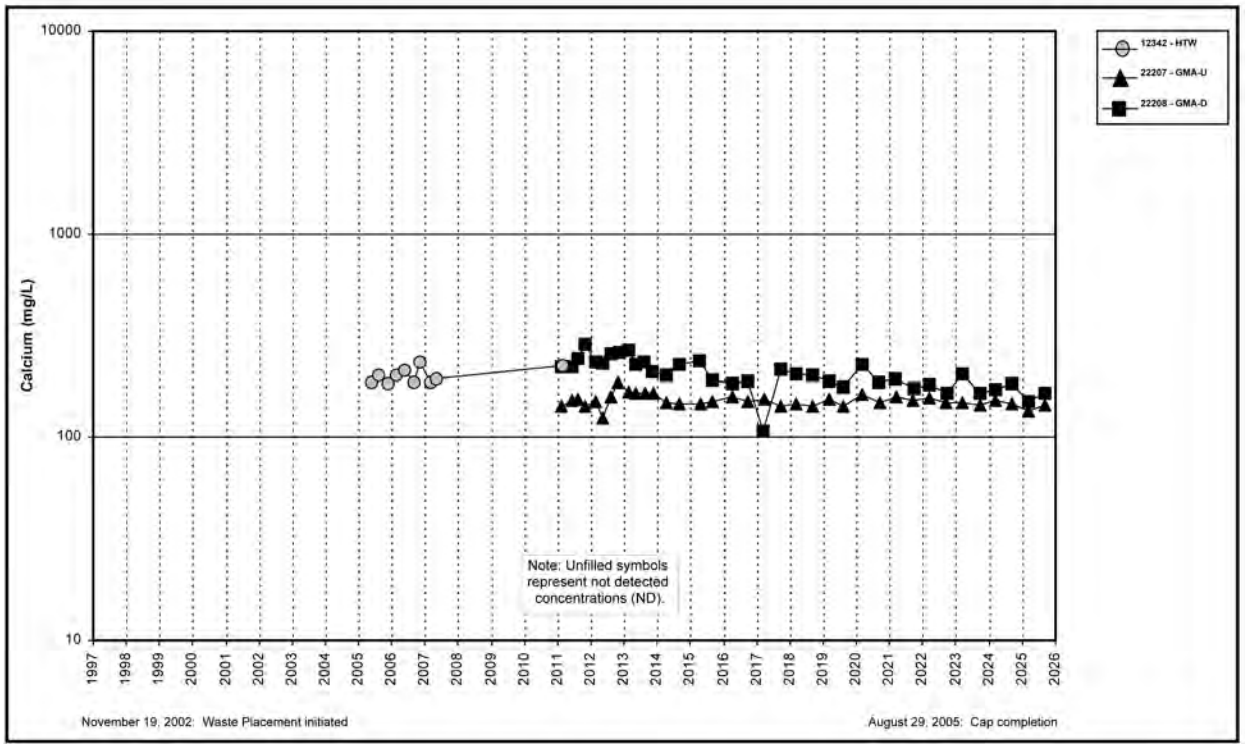


Figure A.5.5-9. Cell 5 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

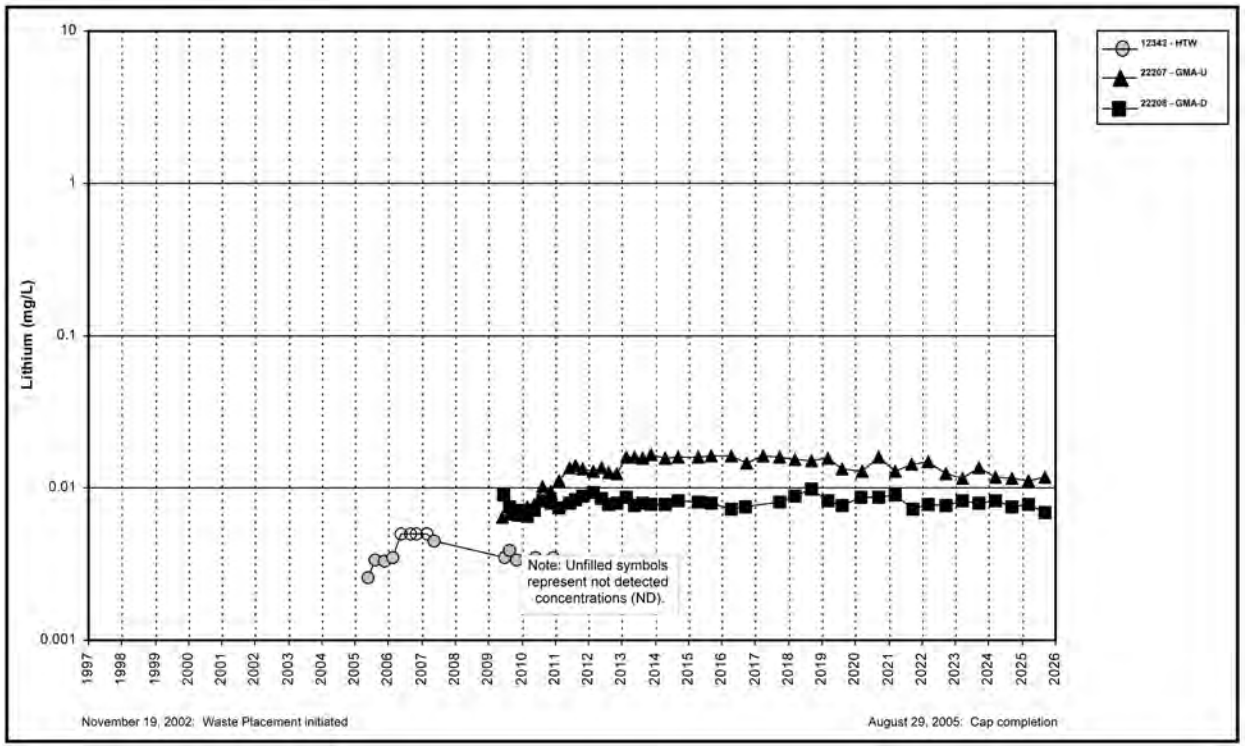


Figure A.5.5-10. Cell 5 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

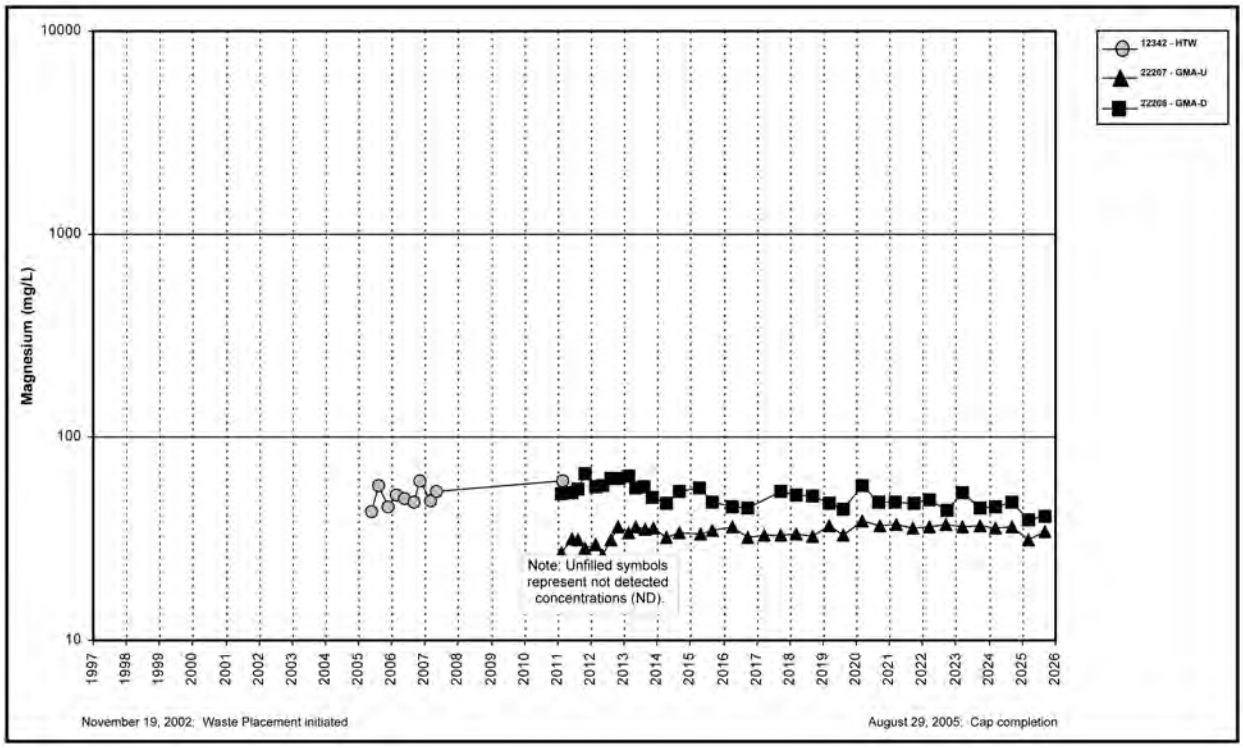


Figure A.5.5-11. Cell 5 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

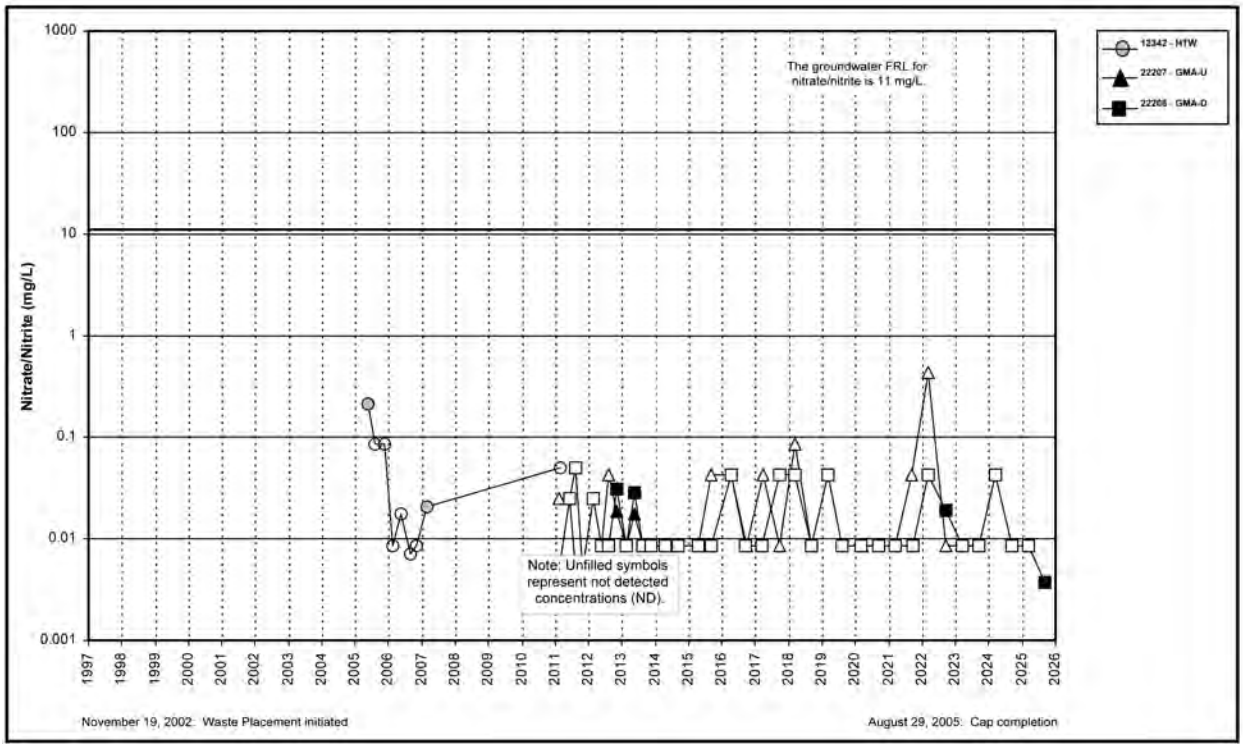


Figure A.5.5-12. Cell 5 Nitrate + Nitrate as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

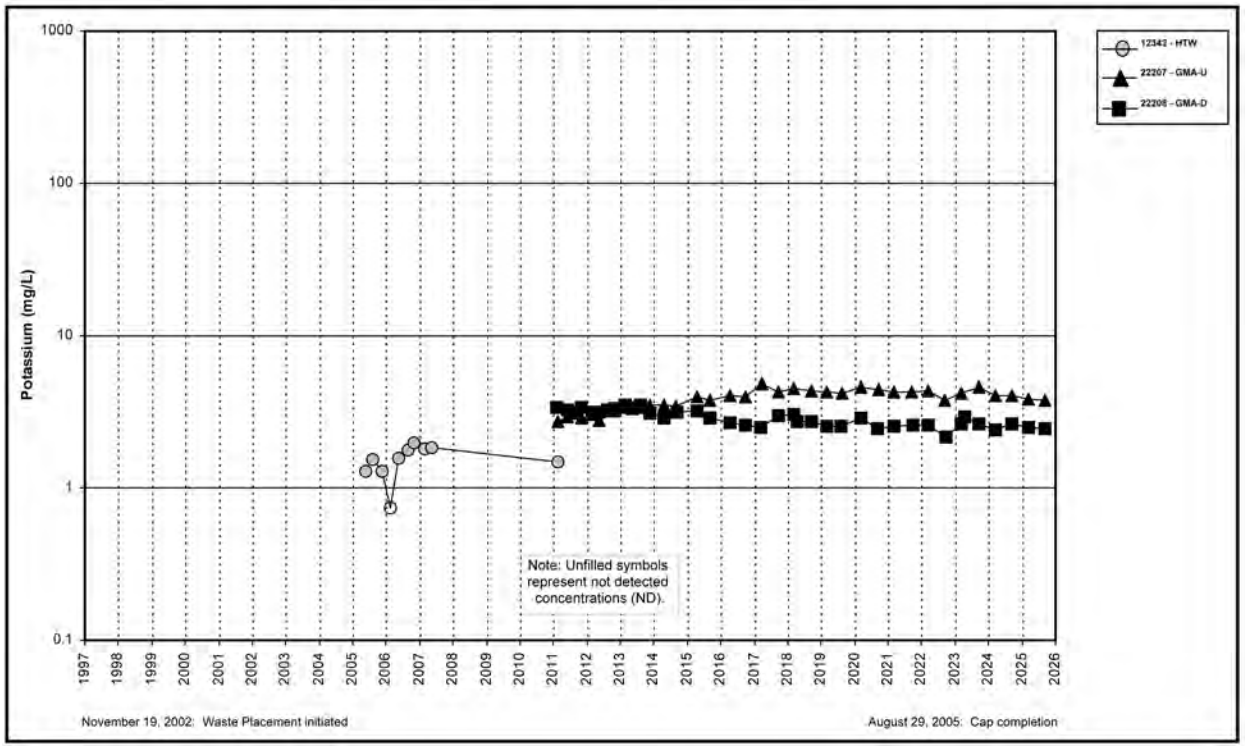


Figure A.5.5-13. Cell 5 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

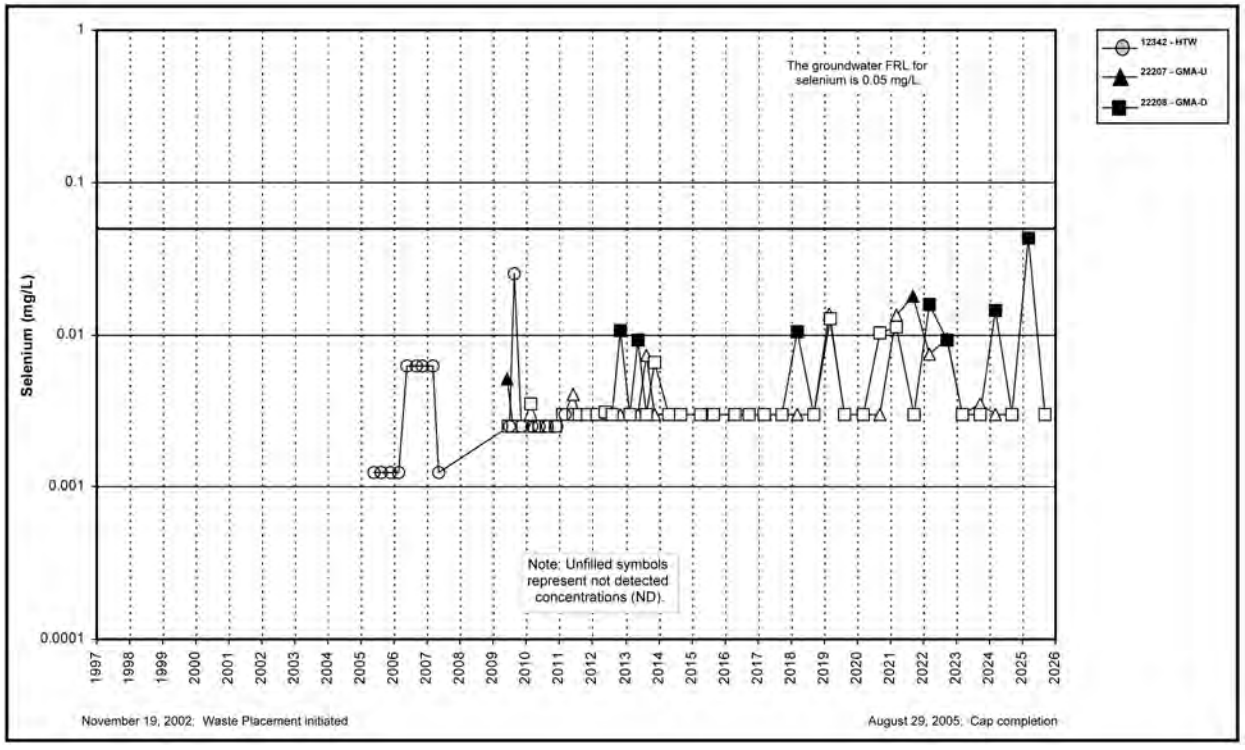


Figure A.5.5-14. Cell 5 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

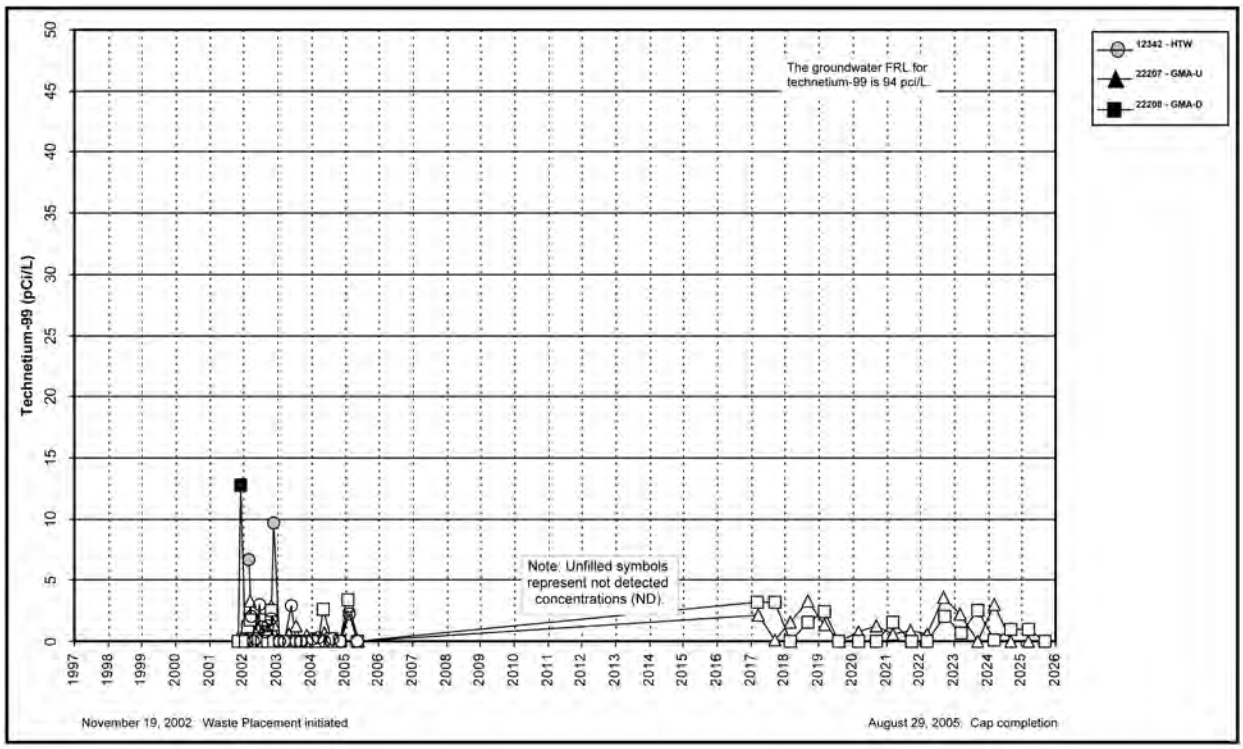


Figure A.5.5-15. Cell 5 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

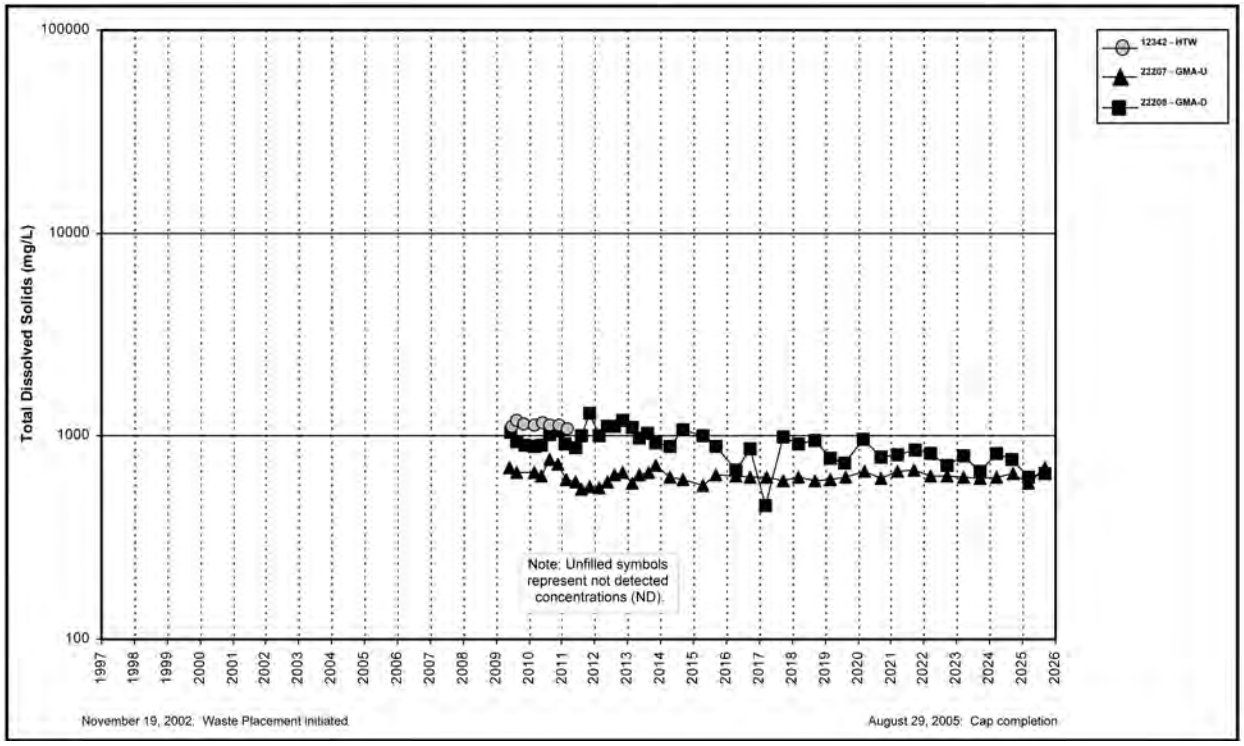


Figure A.5.5-16. Cell 5 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

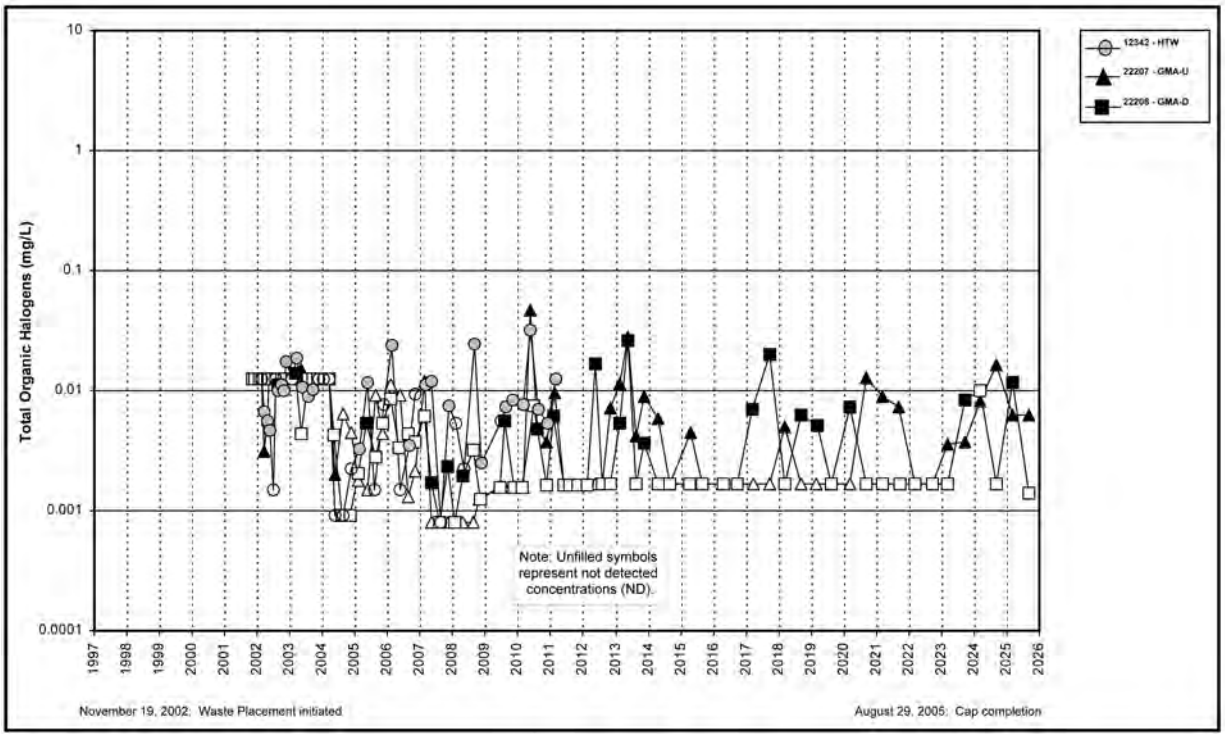


Figure A.5.5-17. Cell 5 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

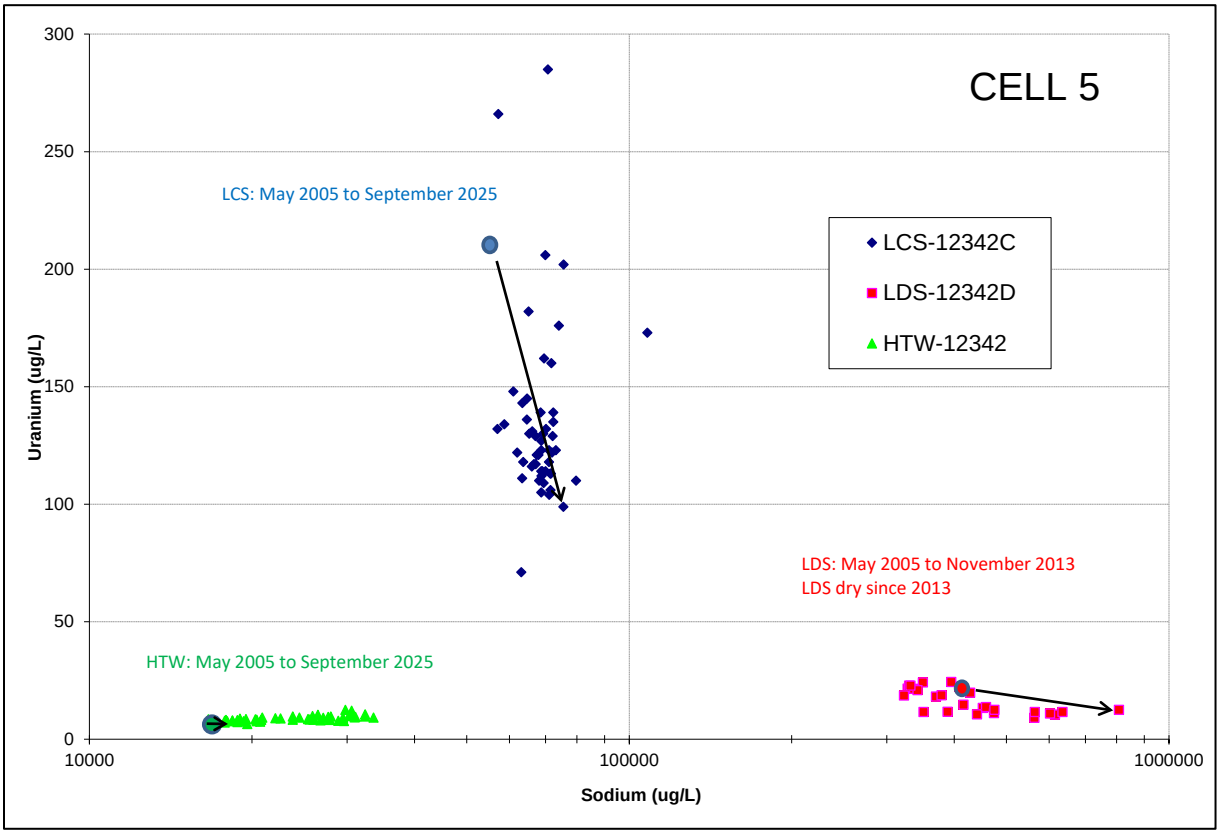


Figure A.5.5-18. Cell 5 Bivariate Plot for Uranium and Sodium

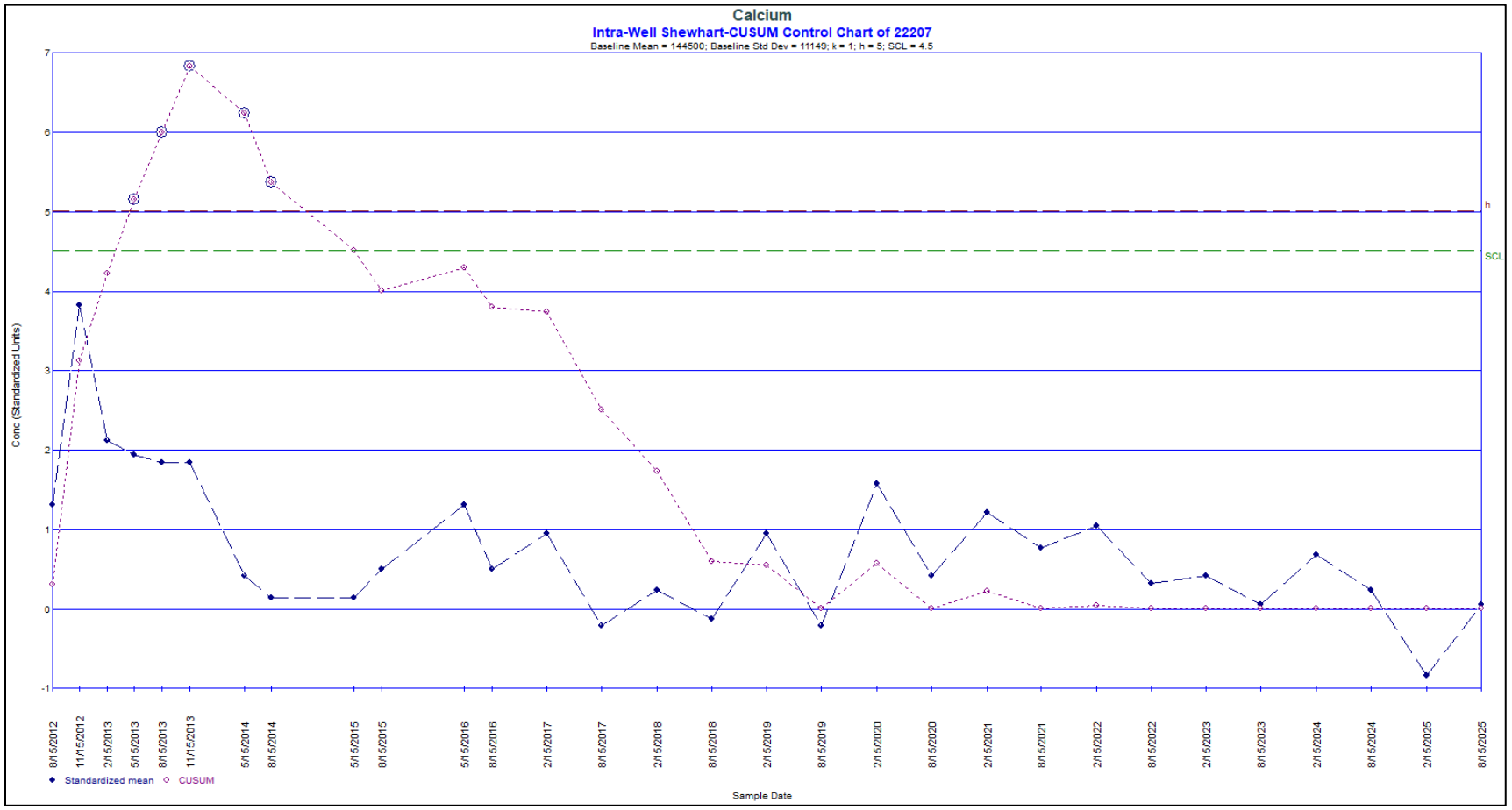


Figure A.5.5-19. Intrawell Shewhart-CUSUM Control Chart for Calcium in Monitoring Well 22207

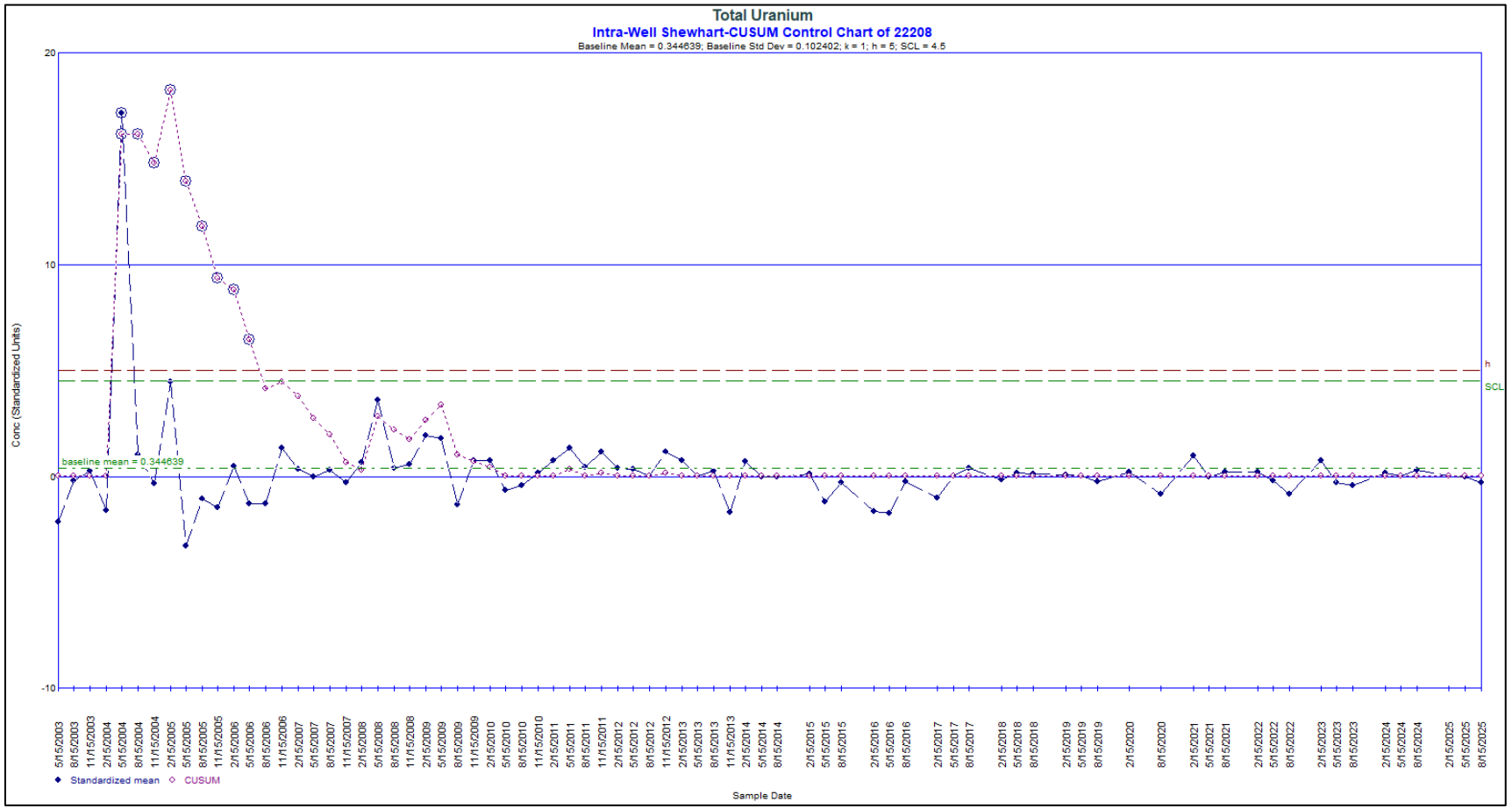


Figure A.5.5-20. Intrawell Shewhart-CUSUM Control Chart for Uranium in Monitoring Well 22208

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Subattachment A.5.6

Cell 6

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.6.1 Water Quality Monitoring Results 1
A.5.6.1.1 LCS and LDS Results 1
A.5.6.1.2 HTW and Monitoring Well Results 2
A.5.6.1.3 Discussion 2
A.5.6.2 Control Charts 2
A.5.6.3 Summary and Conclusions 4
A.5.6.4 References 4

Tables

Table A.5.6-1. Summary Statistics for Cell 6 5
Table A.5.6-2. OSDF Horizontal Till Well 12343 (Cell 6) Water Yield 6

Figures

Figure A.5.6-1. Monthly Accumulation Volumes for Cell 6 LCS 7
Figure A.5.6-2. Monthly Accumulation Volumes for Cell 6 LDS 7
Figure A.5.6-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 6 Upgradient Monitoring Well 22209 8
Figure A.5.6-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 6 Downgradient Monitoring Well 22210 8
Figure A.5.6-5A. Cell 6 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A.5.6-5B. Cell 6 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 9
Figure A.5.6-6A. Cell 6 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.6-6B. Cell 6 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.6-7A. Cell 6 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.6-7B. Cell 6 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.6-8A. Cell 6 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.6-8B. Cell 6 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.6-9. Cell 6 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.6-10. Cell 6 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.6-11. Cell 6 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.6-12. Cell 6 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.6-13. Cell 6 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.6-14. Cell 6 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.6-15. Cell 6 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.6-16. Cell 6 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.6-17. Cell 6 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.6-18. Cell 6 Bivariate Plot for Uranium and Sodium 17
Figure A.5.6-19. Intrawell Shewhart-CUSUM Control Chart for Uranium in Monitoring Well 22210 18
Figure A.5.6-20. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22210 19
Figure A.5.6-21. Intrawell Shewhart-CUSUM Control Chart for Potassium in Monitoring Well 22209 20
Figure A.5.6-22. Intrawell Shewhart-CUSUM Control Chart for Total Dissolved Solids in Monitoring Well 22209 21

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about the On-Site Disposal Facility (OSDF) Cell 6:

- Semiannual monitoring summary statistics (Table A.5.6-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.6-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.6-2)
- OSDF horizontal till well (HTW) 12343 water yield (Table A.5.6-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.6-3 and A.5.6-4)
- Plots of concentration versus time (Figures A.5.6-5A through A.5.6-17)
- A bivariate plot for uranium–sodium (Figure A.5.6-18)
- Control charts (Figures A.5.6-19 through A.5.6-22)

A.5.6.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining if the OSDF was operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW of each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.6.1.1 LCS and LDS Results

As shown in Table A.5.6-1 and summarized below, four parameters (total uranium, boron, sodium, and sulfate) in 2025 have upward trends in the LCS or LDS based on the Mann-Kendall test for trend. No new high concentrations were measured in the LCS of Cell 6 in 2025. In 2025, sufficient water was present in the LDS tank of Cell 6 to collect samples for both semiannual sampling events.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 6

Parameter	LCS 12343C 2025 Trend[a]	LDS 12343D 2025 Trend
Total Uranium		Up
Boron		Up
Sodium	Up	Up
Sulfate	Up	Up

[a] No entry indicates that the trend was not up.

A.5.6.1.2 HTW and Monitoring Well Results

As shown in Table A.5.6-1 and summarized below, five parameters (boron, sulfate, lithium, magnesium, and selenium) have upward trends in the HTW or GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 6

Parameter	HTW 12343[a]	GMA-U 22209[a,b]	GMA-D 22210[a,b]
Boron		Up	Up
Sulfate	Up		
Lithium		Up	
Magnesium		Up	
Selenium		Up	Up

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer; HTW = horizontal till well.

A.5.6.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 6 LCS, LDS, and HTW is provided in Figure A.5.6-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot shows that the chemical signatures for uranium and sodium in the LCS, LDS, and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.6.2 Control Charts

Intrawell control charts use historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background

data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.6-1 in gray shading and as summarized below, four parameters in the HTW or GMA wells of Cell 6 (total uranium, lithium, potassium, and total dissolved solids) meet the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in four control charts (Figures A.5.6-19 through A.5.6-22). All of the control charts exhibit "in control" conditions.

Parameter	Monitoring Point[a]	Well Number	Assessment	Figure Number
Total Uranium	GMA-D	22210	In Control	A.5.6-19
Lithium	GMA-D	22210	In Control	A.5.6-20
Potassium	GMA-U	22209	In Control	A.5.6-21
Total Dissolved Solids	GMA-U	22209	In Control	A.5.6-22

[a] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.6.3 Summary and Conclusions

- Four parameters monitored semiannually have an upward concentration trend in the LCS or LDS of Cell 6: total uranium, boron, sodium, and sulfate. No new high concentrations were measured in the LCS of Cell 6 in 2025.
- Sufficient water was present in the LDS tank of Cell 6 to sample the tank twice in 2025. No new high concentrations were measured in the LDS of Cell 6 in 2025.
- Five parameters monitored semiannually have an upward concentration trend in the HTW or GMA wells of Cell 6: boron, sulfate, lithium, magnesium, and selenium. Separate and distinct chemical signatures for uranium and sodium in the LCS, LDS, and HTW of Cell 6 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 6 (i.e., HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- Four control charts were constructed for Cell 6 parameters. All control charts exhibit "in control" conditions.

A.5.6.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.6-1. Summary Statistics for Cell 6

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[d,g]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12343C	64	64	100	43.3	276	122	32	Undefined	Down (2025)	Detected	
	LDS	12343D	63	63	100	3.10	160	29.8	39.3	Undefined	Up (2025)	Detected	
	HTW	12343	64	64	100	4.50	16.9	10.8	2.5	Normal	None (2025)	Detected	24.2 (Q1-07); 21.4 (Q2-11)
	GMA-U	22209	62	68	91.2	ND	1.64	0.473	0.207	Undefined	None (2025)	Not Detected	2.43(Q2-06), 2.1(Q3-08), 1.64(Q3-11)
	GMA-D	22210	78	80	97.5	ND	0.994	0.658	0.129	Normal	None (2025)	Not Detected	0.019 (Q2-05)
Boron (mg/L)	LCS	12343C	64	64	100	0.244	1.04	0.710	0.158	Normal	Down (2025)	Detected	0.0566 (Q1-04); 1.37 (Q3-05)
	LDS	12343D	63	63	100	0.289	1.22	0.416	0.155	Undefined	Up (2025)	Detected	2.38 (Q3-04)
	HTW	12343	43	47	91.5	ND	0.124	0.0891	0.0194	Undefined	None (2025)	Detected	
	GMA-U	22209	63	68	92.6	ND	0.113	0.0394	0.0152	Undefined	Up (2025)	Detected	
	GMA-D	22210	65	68	95.6	ND	0.0616	0.0384	0.0095	Normal	Up (2025)	Detected	
Sodium (mg/L)	LCS	12343C	55	55	100	44.5	107	73.2	13.5	Normal	Up (2025)	Detected	23.6 (Q2-04); 23.1 (Q2-05)
	LDS	12343D	52	52	100	91.3	1,190	506	189	Undefined	Up (2025)	Detected	
	HTW	12343	51	51	100	13.6	66.0	36.6	15.5	Normal	Down (2025)	Detected	
	GMA-U	22209	43	43	100	14.5	26.8	18.5	2.5	Normal	None (2025)	Detected	
	GMA-D	22210	45	45	100	10.1	20.4	16.5	2.9	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12343C	64	64	100	491	5,200	3,560	1,090	Undefined	Up (2025)	Detected	
	LDS	12343D	62	62	100	1,300	10,800	3,790	1,890	Ln Normal	Up (2025)	Detected	
	HTW	12343	58	59	98.3	333	716	493	84	Normal	Up (2025)	Detected	192 (Q1-03)
	GMA-U	22209	67	67	100	2.07	406	158	63	Undefined	Down (2025)	Detected	
	GMA-D	22210	67	67	100	127	392	267	73	Normal	None (2025)	Detected	578 (Q1-07)
Calcium (mg/L)	GMA-U	22209	36	36	100	136	184	151	11	Normal	None (2025)	Detected	242 (Q3-11); 231 (Q3-13)
	GMA-D	22210	36	36	100	162	239	196	22	Undefined	Down (2025)	Detected	
Lithium (mg/L)	GMA-U	22209	43	43	100	0.00486	0.0107	0.00673	0.00170	Undefined	Up (2025)	Detected	
	GMA-D	22210	43	43	100	0.00571	0.00865	0.00731	0.00059	Normal	None (2025)	Not Detected	
Magnesium (mg/L)	GMA-U	22209	36	36	100	27.0	43.4	33.8	3.2	Normal	Up (2025)	Detected	55.4 (Q3-13)
	GMA-D	22210	36	36	100	41.5	58.3	49.8	4.5	Normal	Down (2025)	Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22209	4	37	10.8	ND	0.425	0.00850	0.0806	Undefined	None (2025)	Not Detected	0.500 (Q3-03)
	GMA-D	22210	2	36	5.6	ND	0.0425	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Potassium (mg/L)	GMA-U	22209	36	36	100	2.92	3.78	3.28	0.17	Normal	None (2025)	Not Detected	2.31 (Q1-22)
	GMA-D	22210	38	38	100	2.54	3.62	3.10	0.28	Normal	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22209	6	43	14.0	ND	0.0236	0.00300	0.00391	Undefined	Up (2025)	Detected	
	GMA-D	22210	6	43	14.0	ND	0.0147	0.00300	0.00290	Undefined	Up (2025)	Detected	
Technitium-99 (pCi/L)	GMA-U	22209	1	29	3.4	ND	8.61	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22210	1	29	3.4	ND	6.61	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22209	43	43	100	550	720	634	40	Normal	None (2025)	Not Detected	876 (Q3-11)
	GMA-D	22210	43	43	100	666	1,020	891	100	Undefined	Down (2025)	Detected	
Total Organic Halogens (mg/L)	GMA-U	22209	23	68	33.8	ND	0.0208	0.00166	0.00465	Undefined	None (2025)	Detected	0.0365 (Q3-06); 0.0377 (Q1-11); 0.0432 (Q1-13)
	GMA-D	22210	23	68	33.8	ND	0.0230	0.00302	0.00433	Undefined	None (2025)	Detected	0.0590 (Q2-10)

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well, with at least eight samples, Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.

Note 2: Data used in this table has been standardized to quarterly.

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]ND = not detected; NA = not applicable

[c]Averages were determined based on the distribution assumption.

[d]Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.

[e]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[f]Trend based on nonparametric Mann-Kendall procedure.

[g]Serial correlation based on Rank Von Neumann test.

[h]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[i]Q = quarter

Table A.5.6-2. OSDF Horizontal Till Well 12343 (Cell 6) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
2003	9,940	10	994
2004	760	6	127
2005	925	5	185
2006	565	4	141
2007	355	4	89
2008	510	4	128
2009	550	4	183
2010	935	4	234
2011	1,175	4	294
2012	1,065	4	266
2013	1,130	4	283
2014	475	2	238
2015	725	2	363
2016	600	2	300
2017	720	2	360
2018	815	2	408
2019	690	2	345
2020	740	2	370
2021	690	2	345
2022	720	2	360
2023	650	2	325
2024	650	2	325
2025	530	2	265

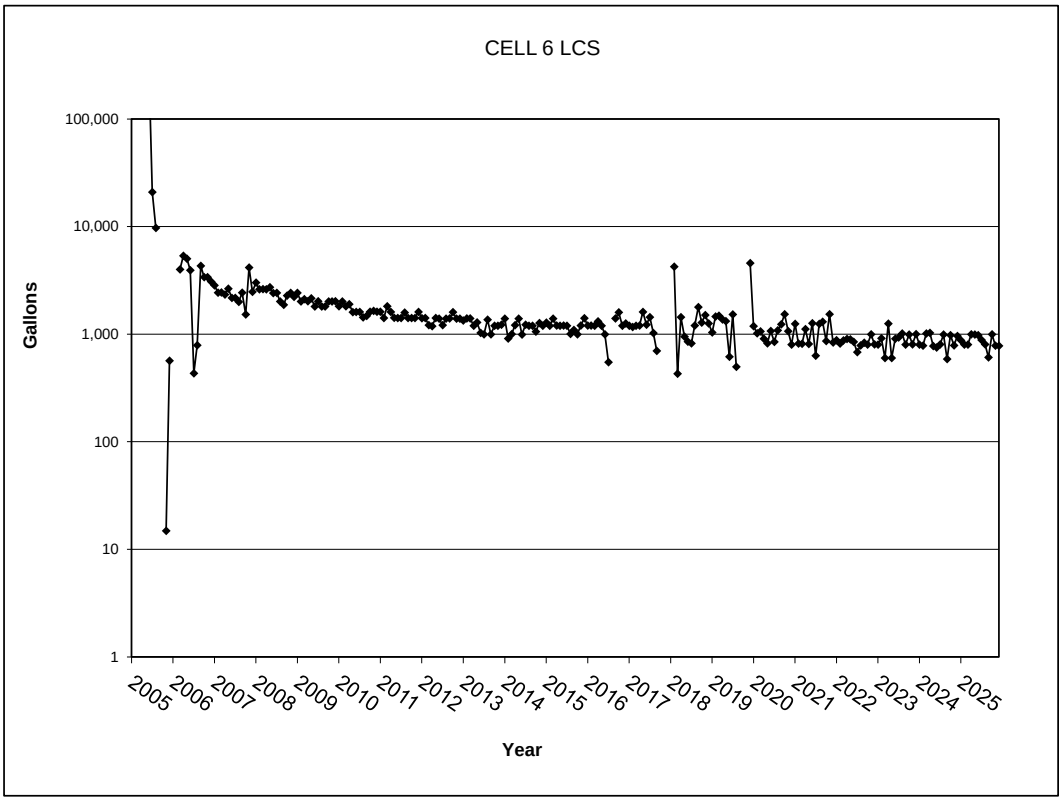


Figure A.5.6-1. Monthly Accumulation Volumes for Cell 6 LCS

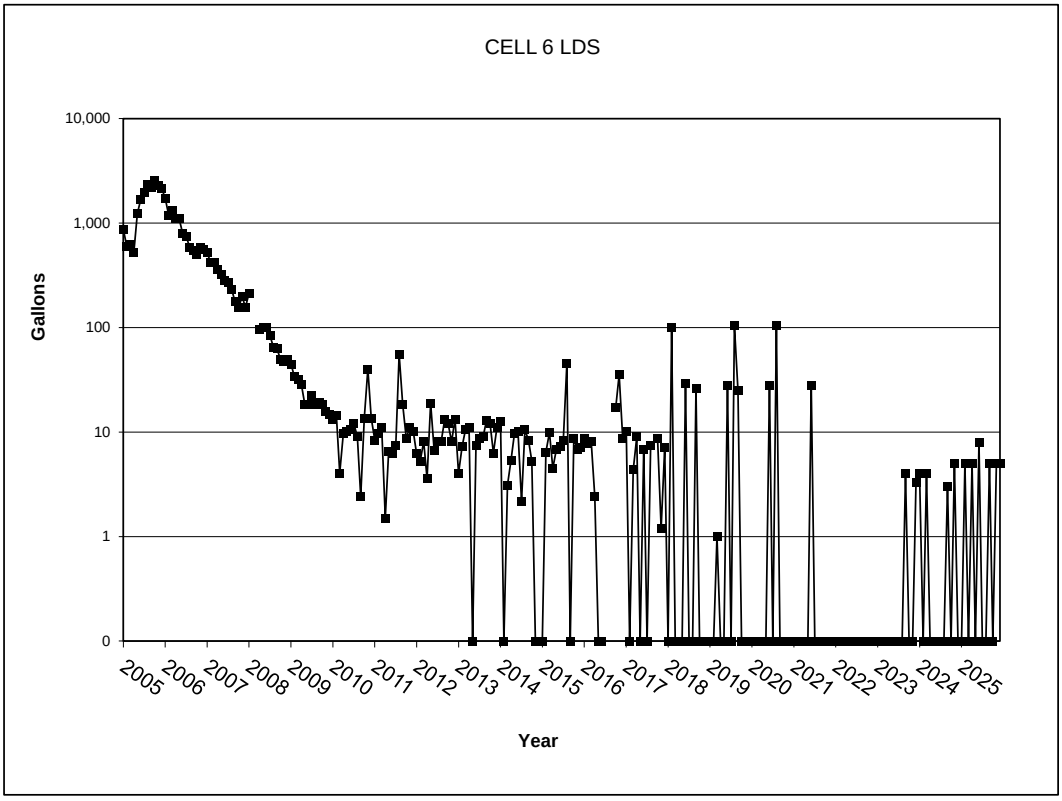


Figure A.5.6-2. Monthly Accumulation Volumes for Cell 6 LDS

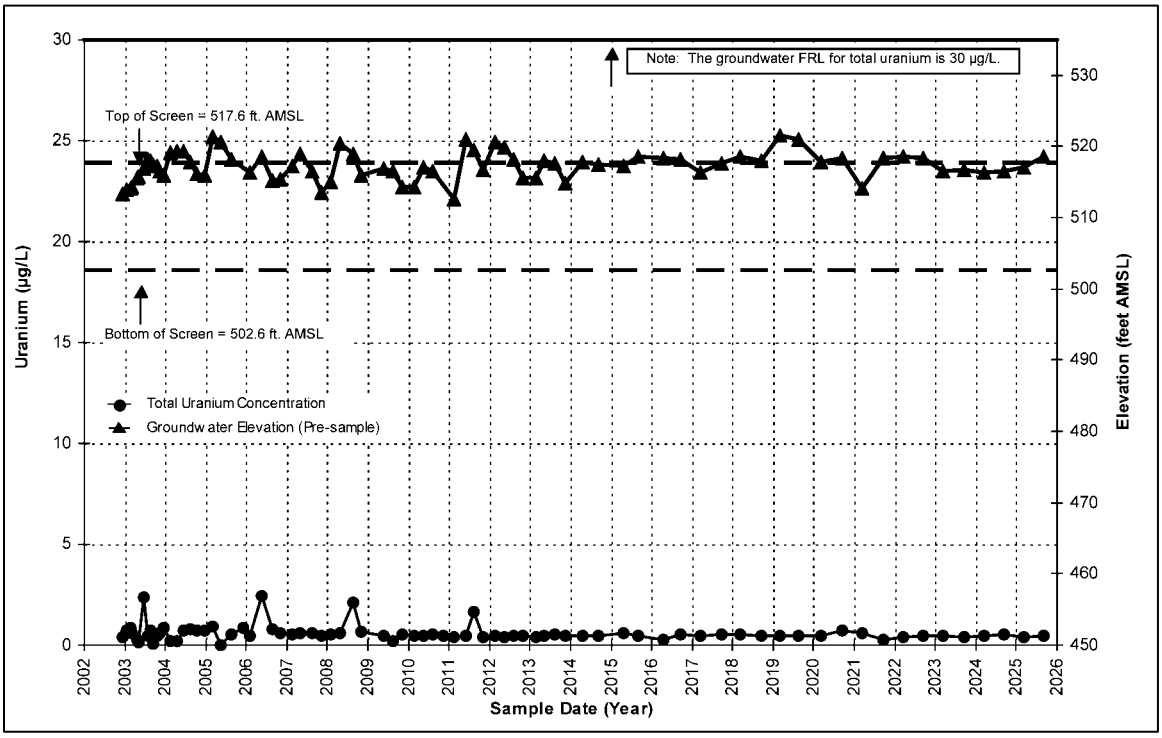


Figure A.5.6-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 6 Upgradient Monitoring Well 22209

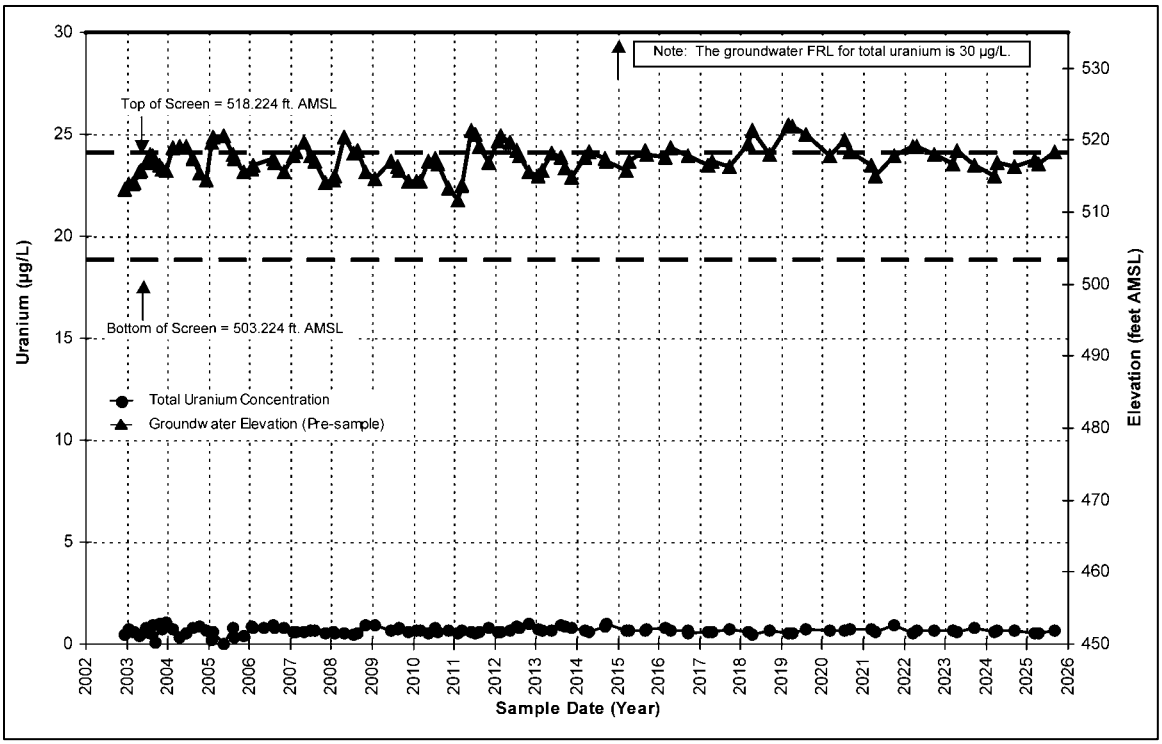


Figure A.5.6-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 6 Downgradient Monitoring Well 22210

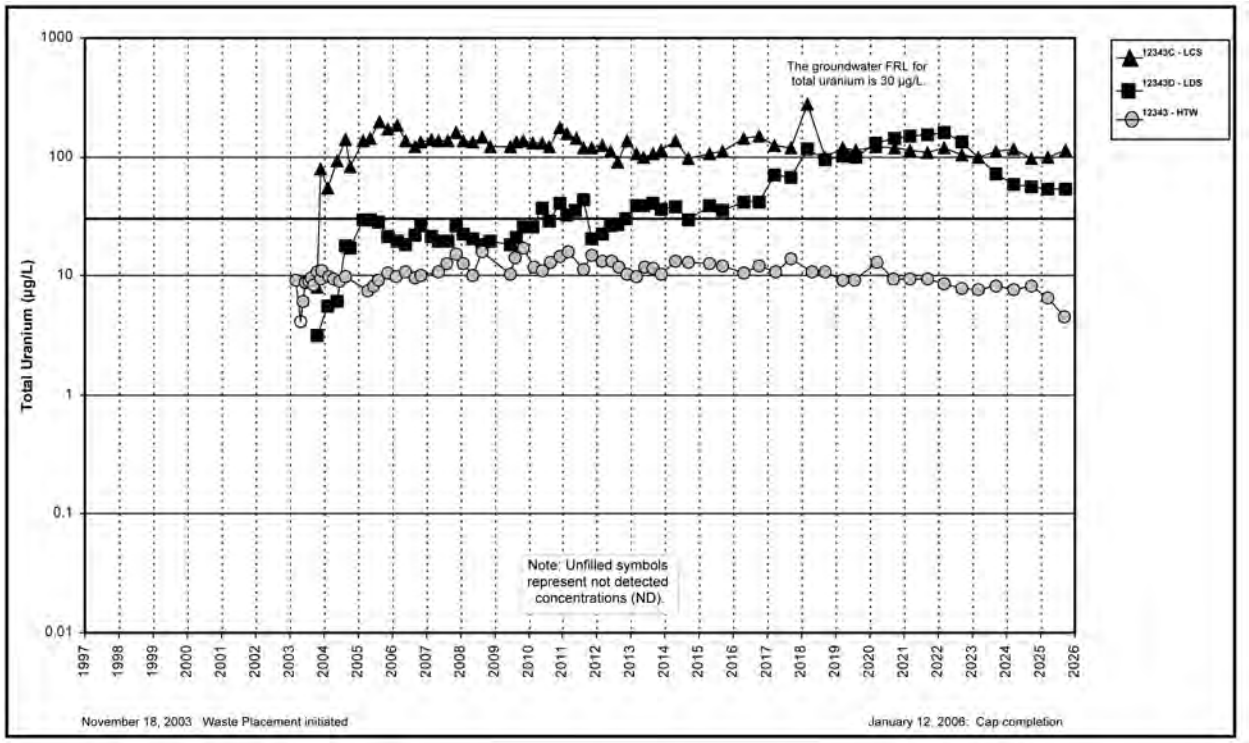


Figure A.5.6-5A. Cell 6 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

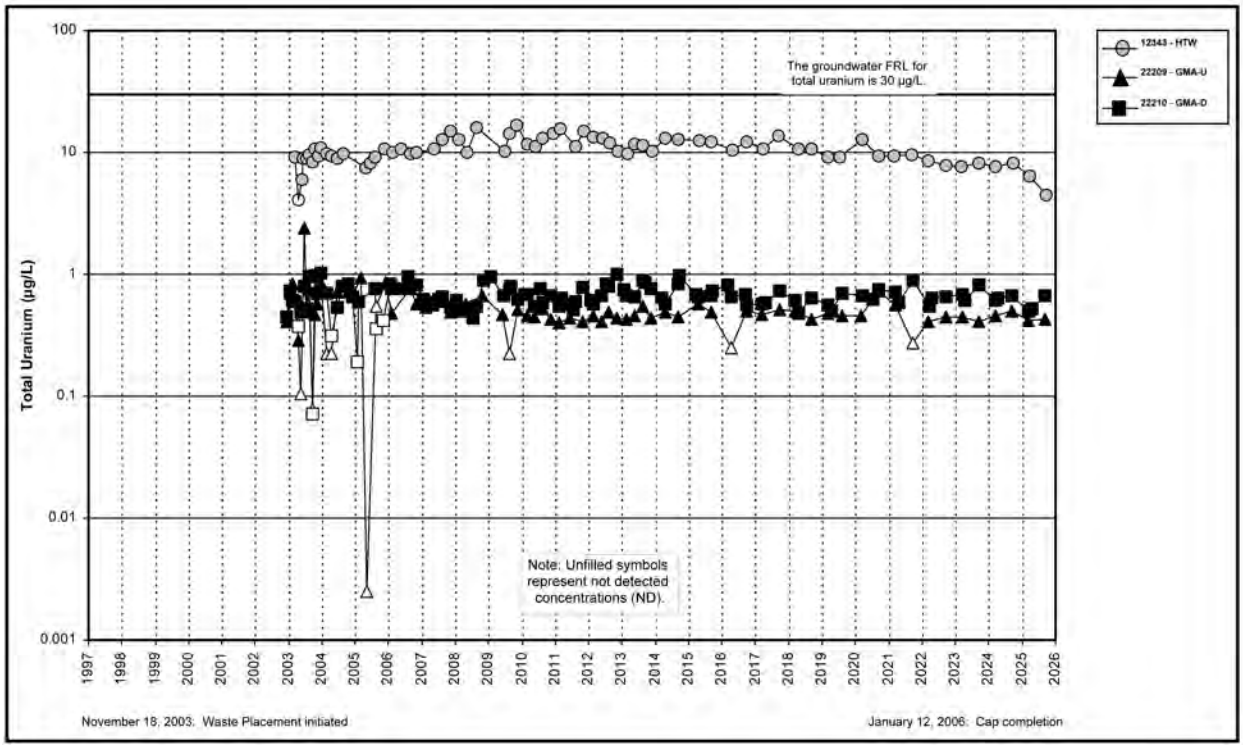


Figure A.5.6-5B. Cell 6 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

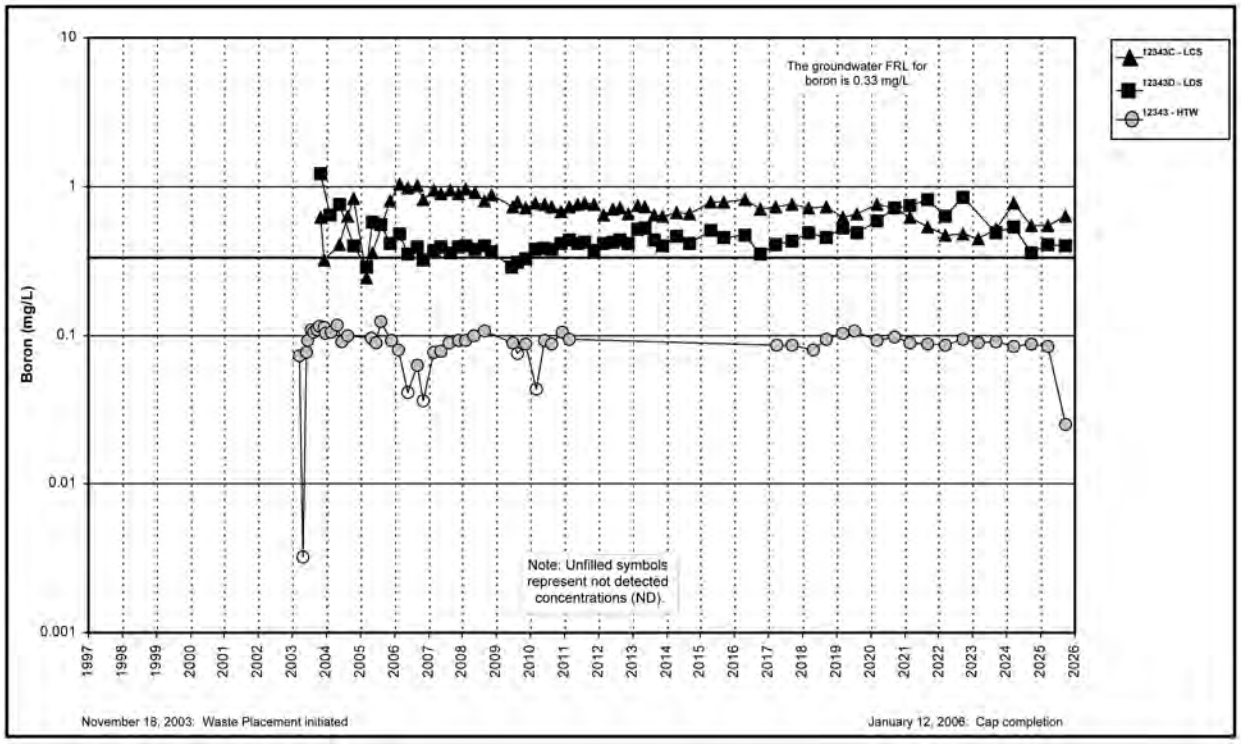


Figure A.5.6-6A. Cell 6 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

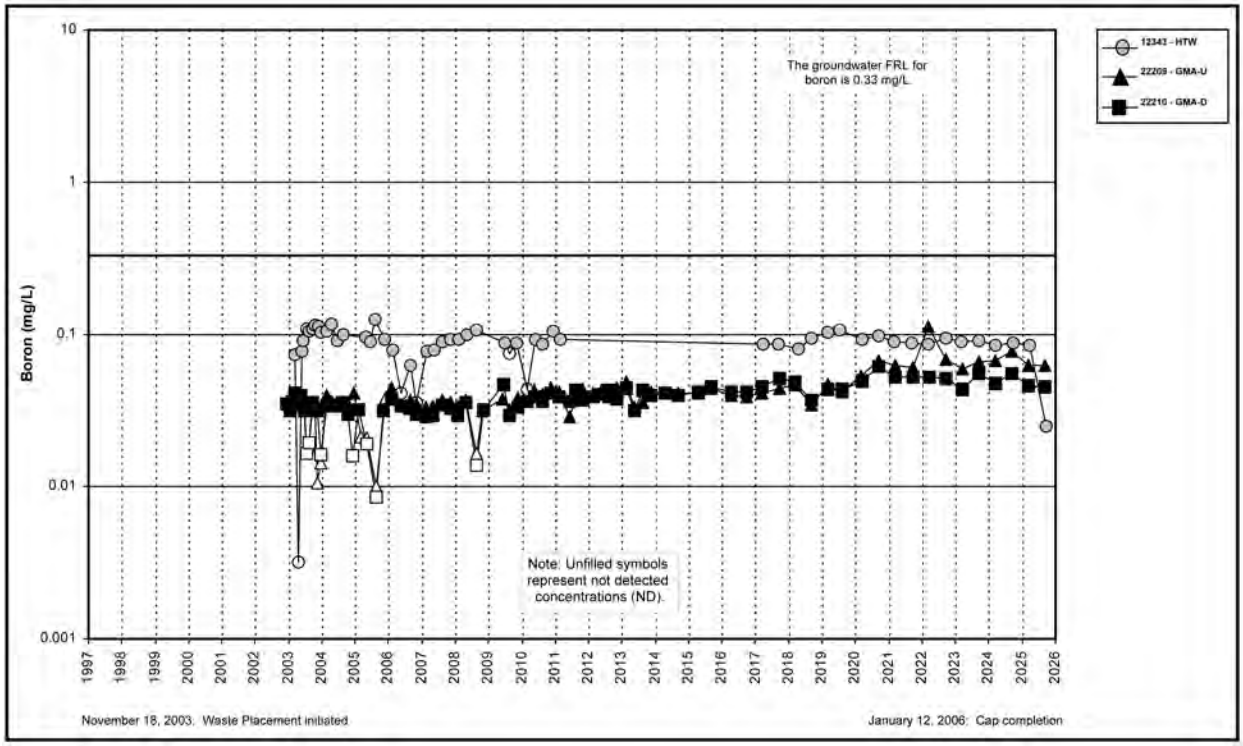


Figure A.5.6-6B. Cell 6 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

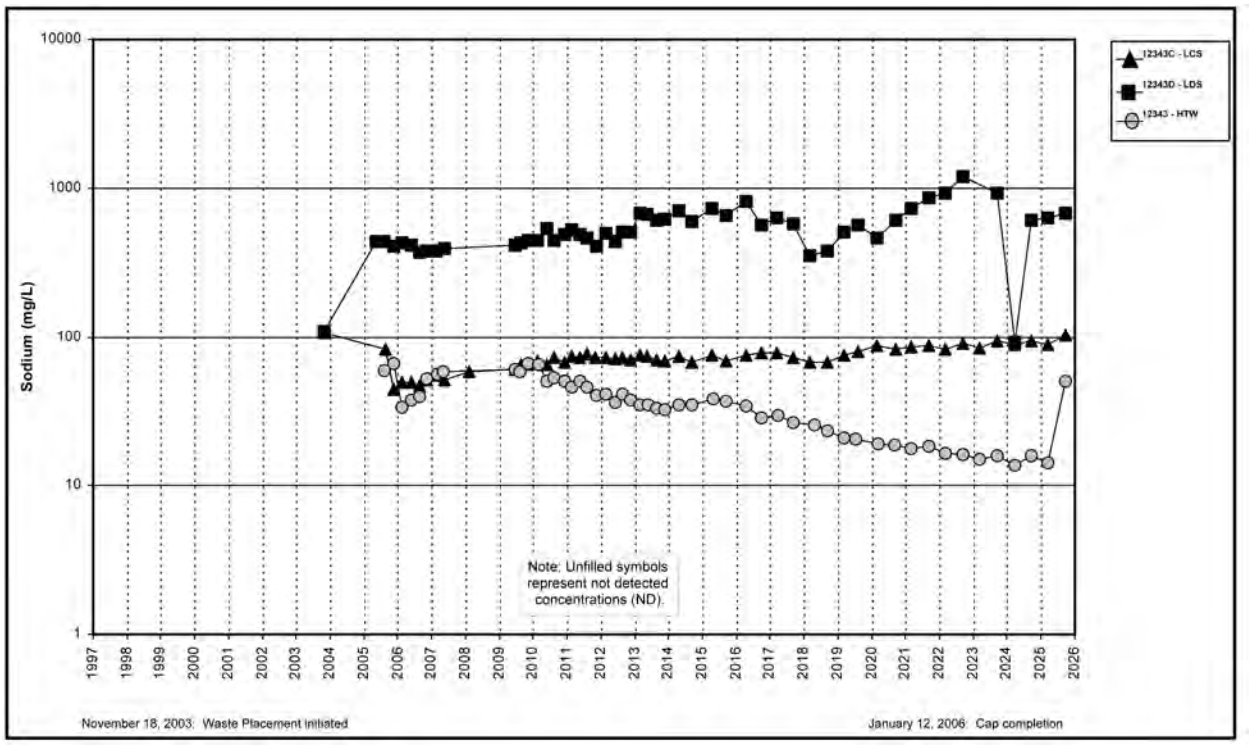


Figure A.5.6-7A. Cell 6 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

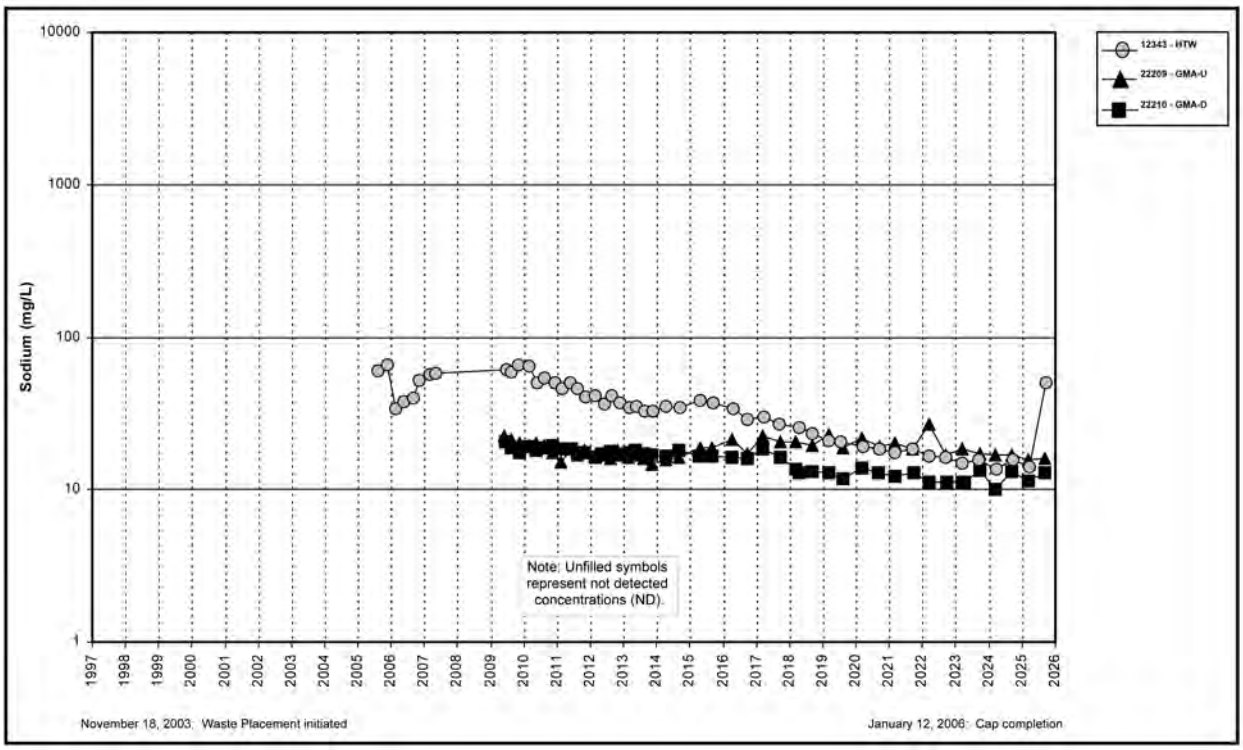


Figure A.5.6-7B. Cell 6 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

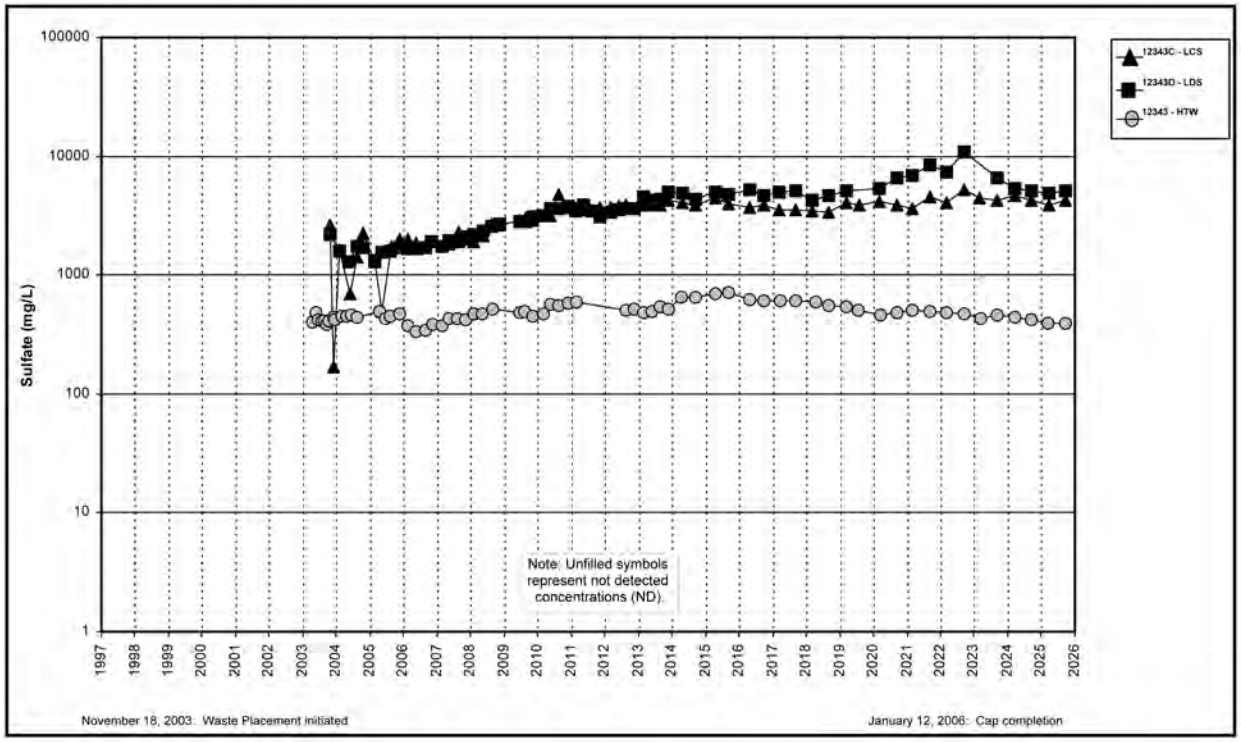


Figure A.5.6-8A. Cell 6 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW



Figure A.5.6-8B. Cell 6 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

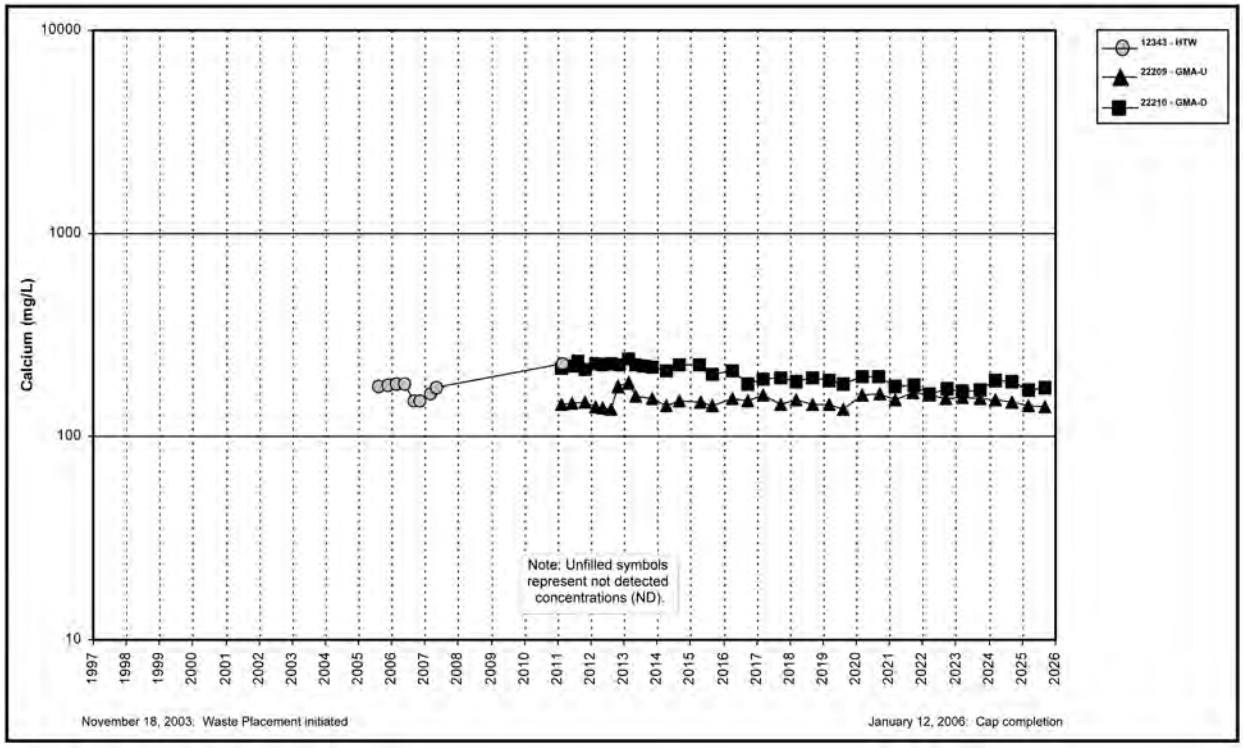


Figure A.5.6-9. Cell 6 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

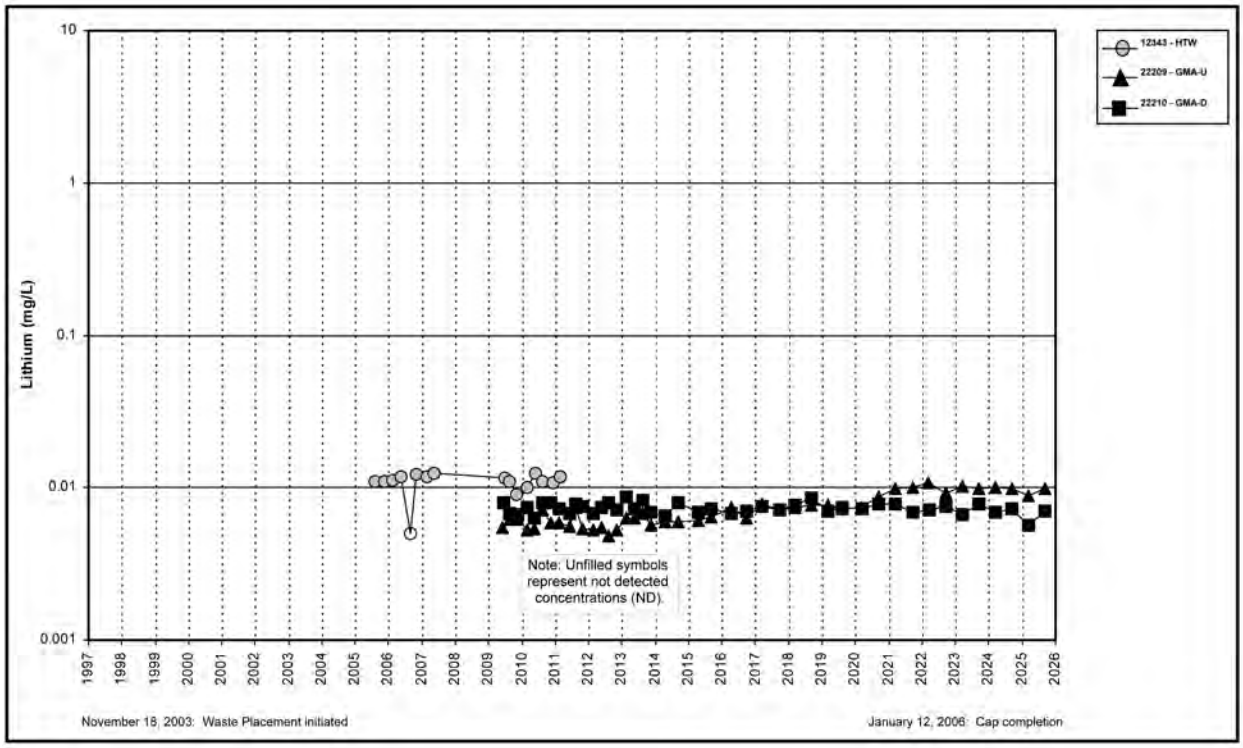


Figure A.5.6-10. Cell 6 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

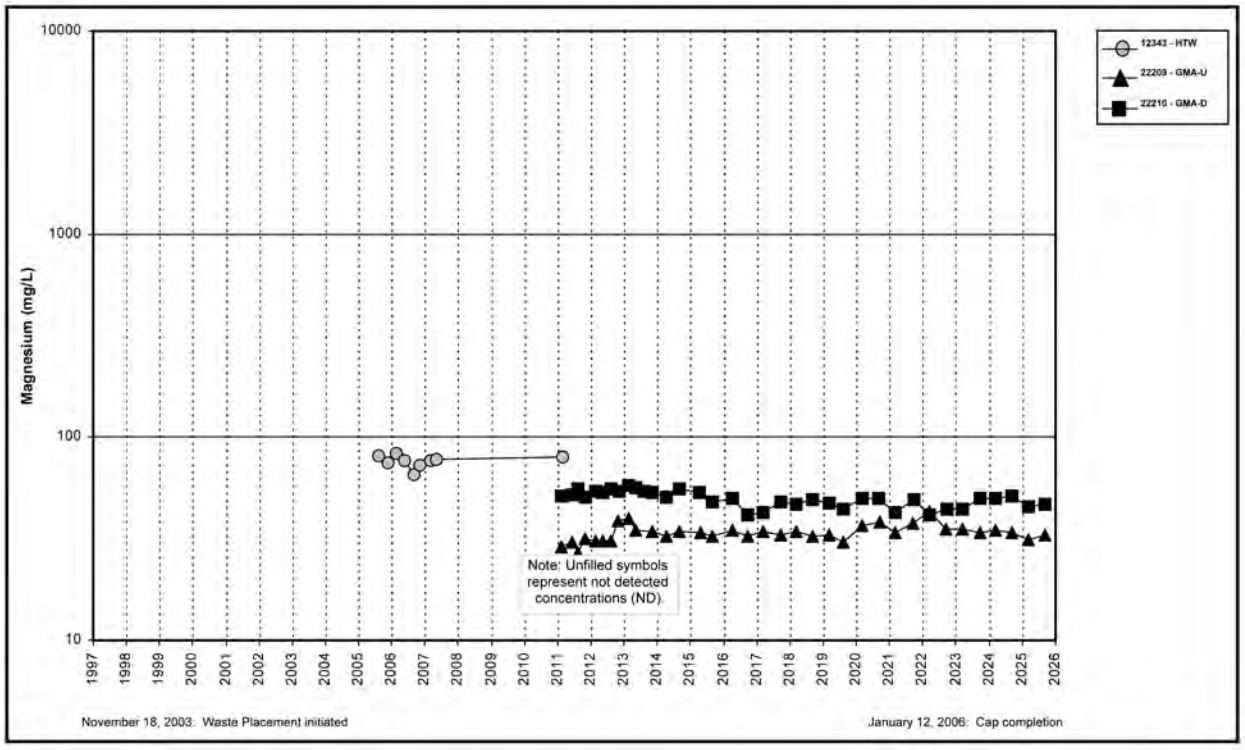


Figure A.5.6-11. Cell 6 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

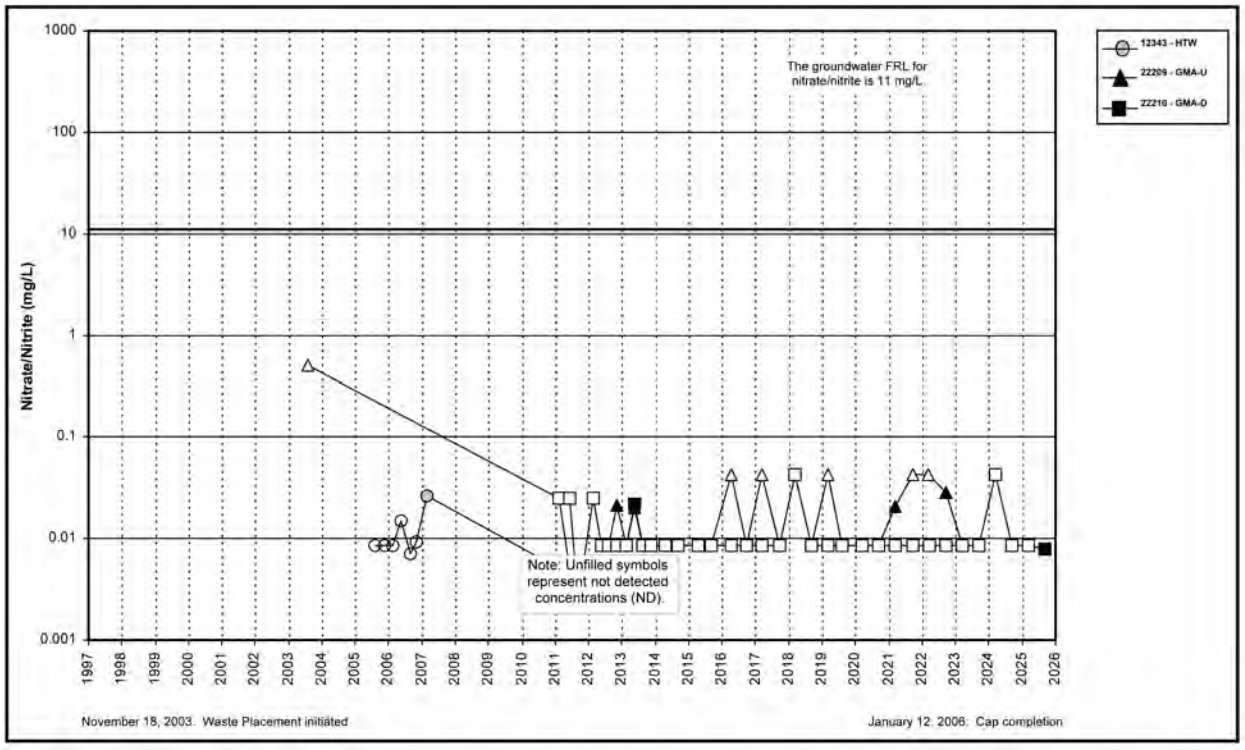


Figure A.5.6-12. Cell 6 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

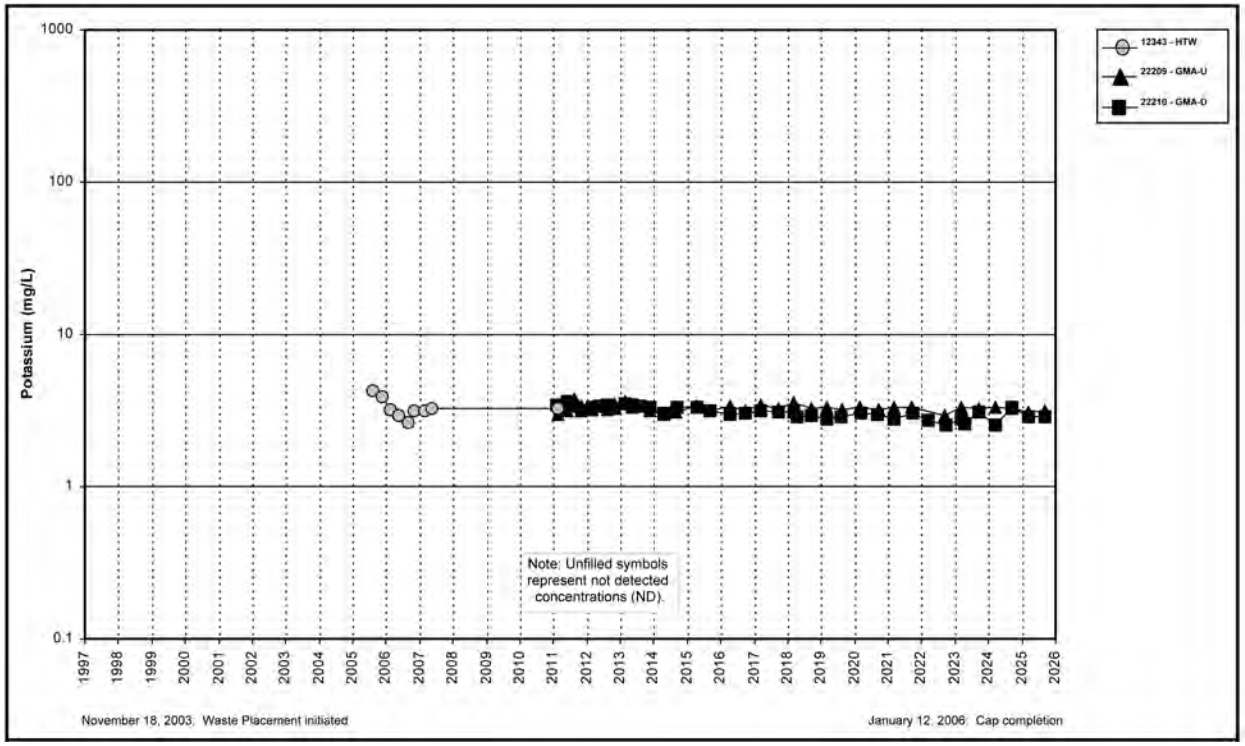


Figure A.5.6-13. Cell 6 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

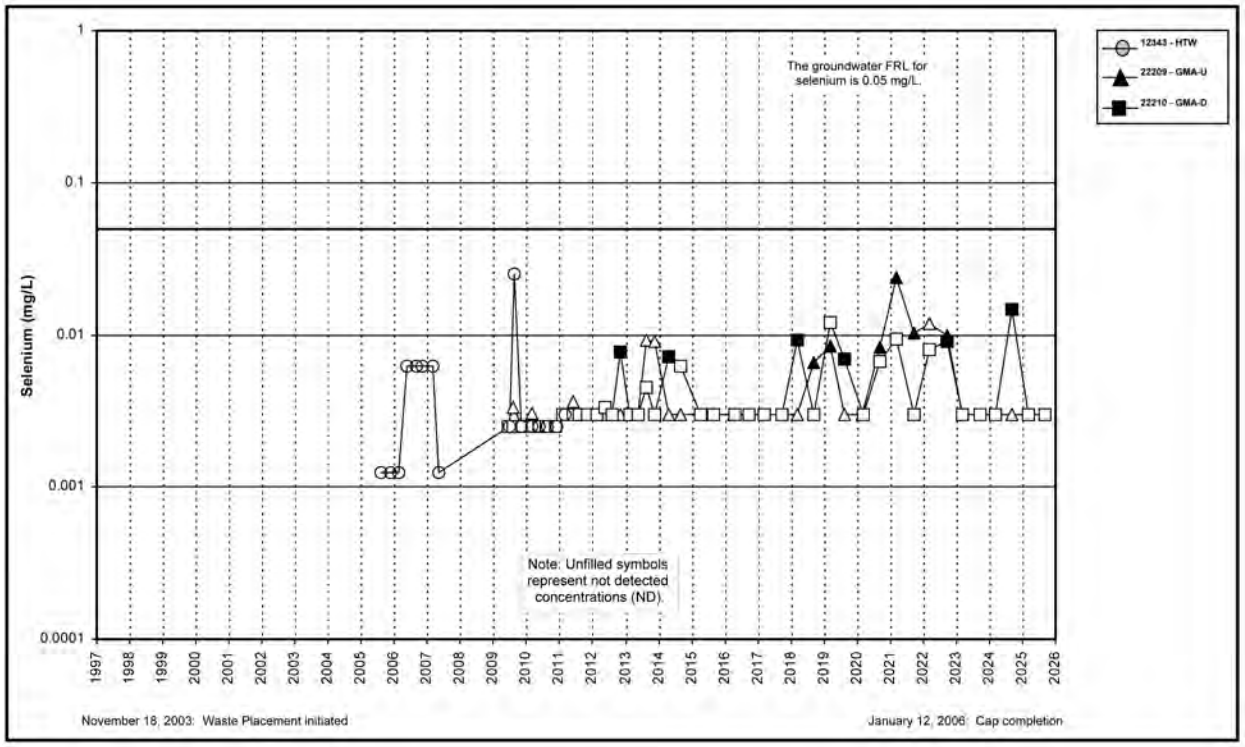


Figure A.5.6-14. Cell 6 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

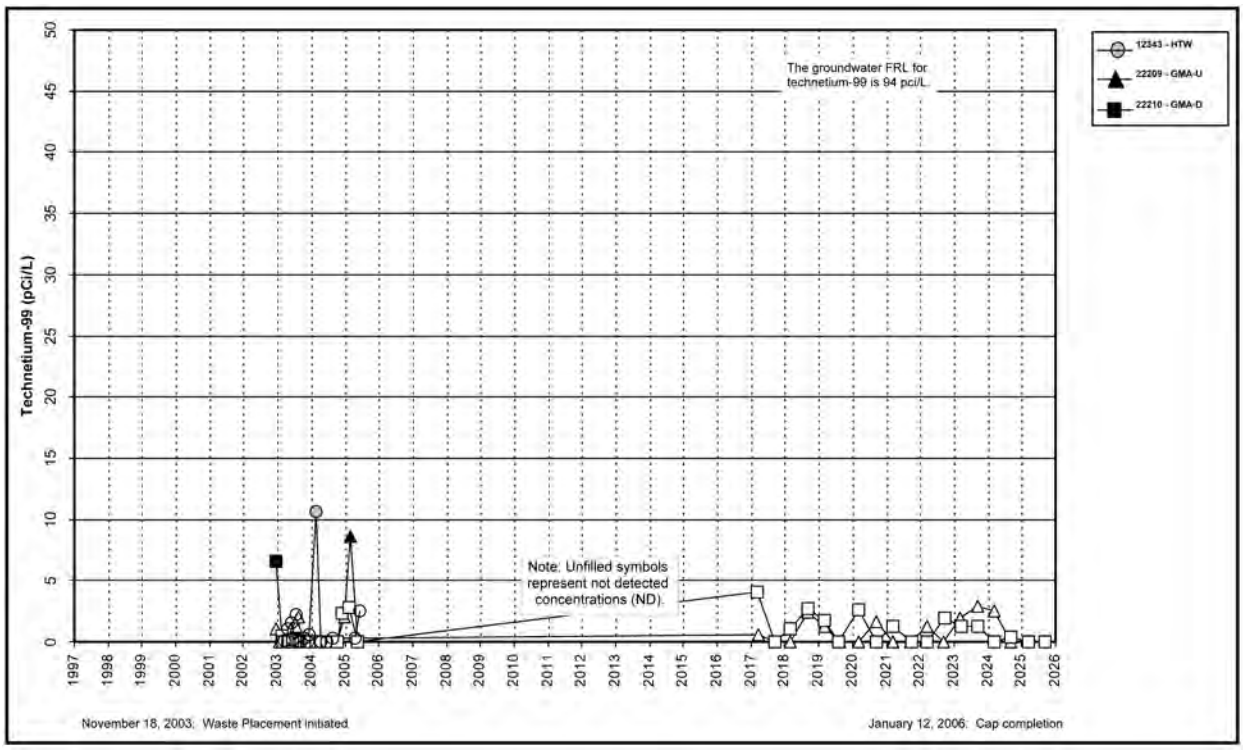


Figure A.5.6-15. Cell 6 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

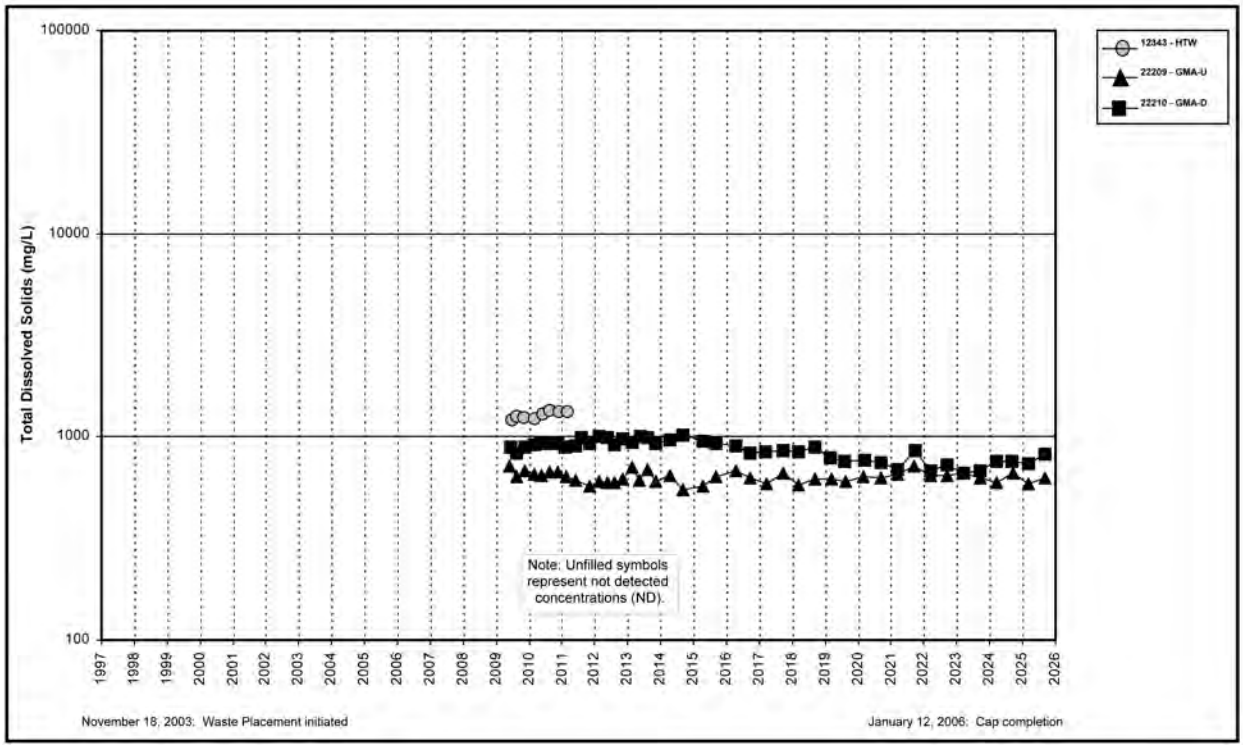


Figure A.5.6-16. Cell 6 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

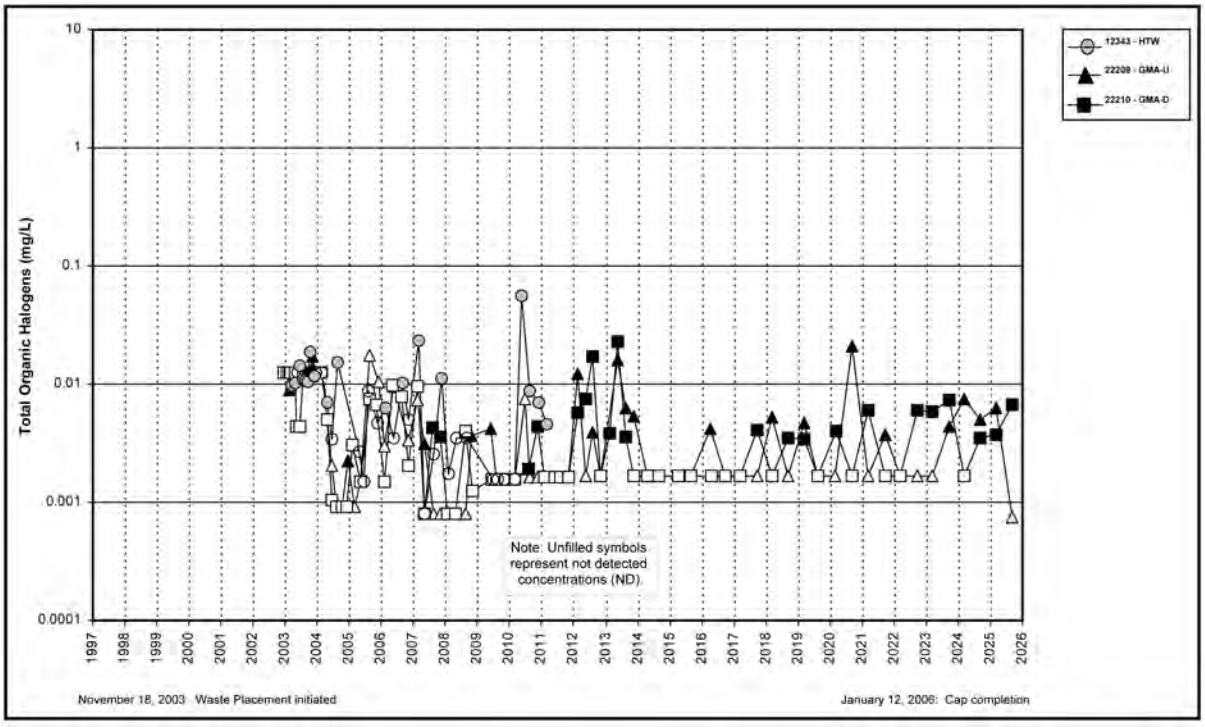


Figure A.5.6-17. Cell 6 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

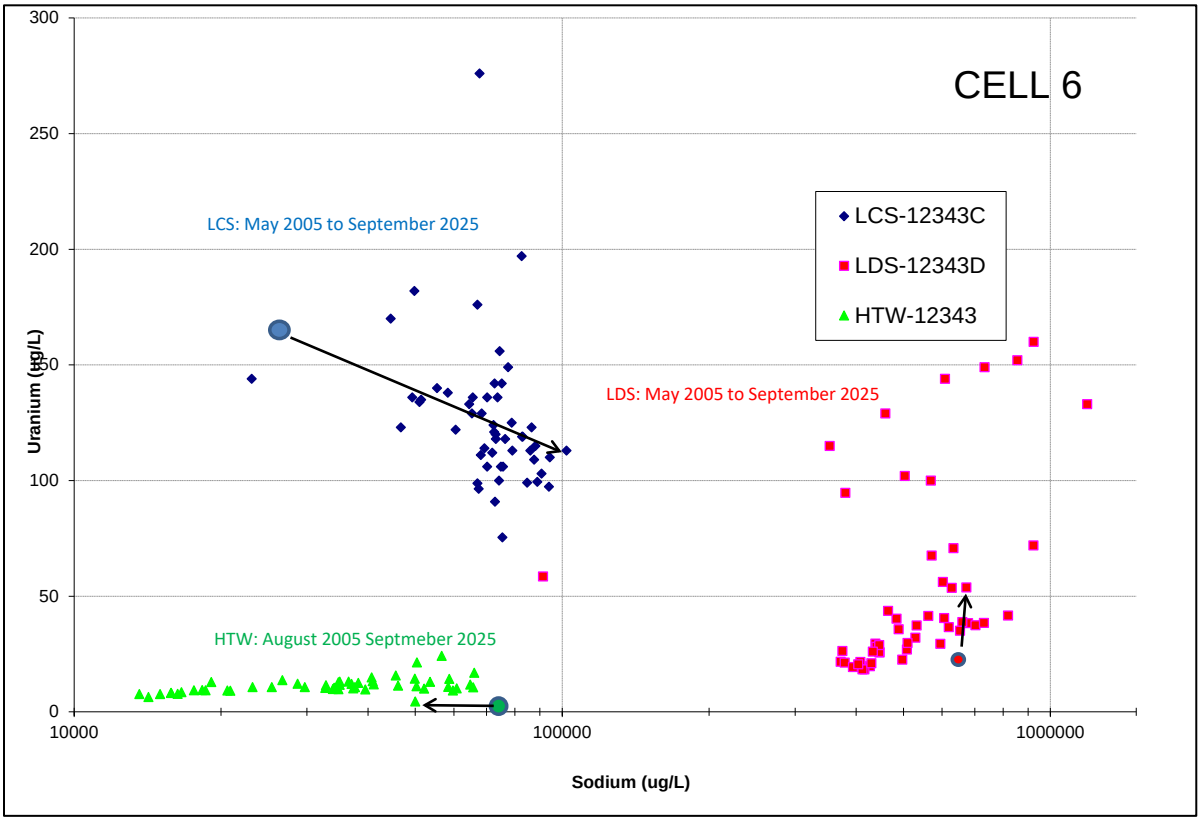


Figure A.5.6-18. Cell 6 Bivariate Plot for Uranium and Sodium

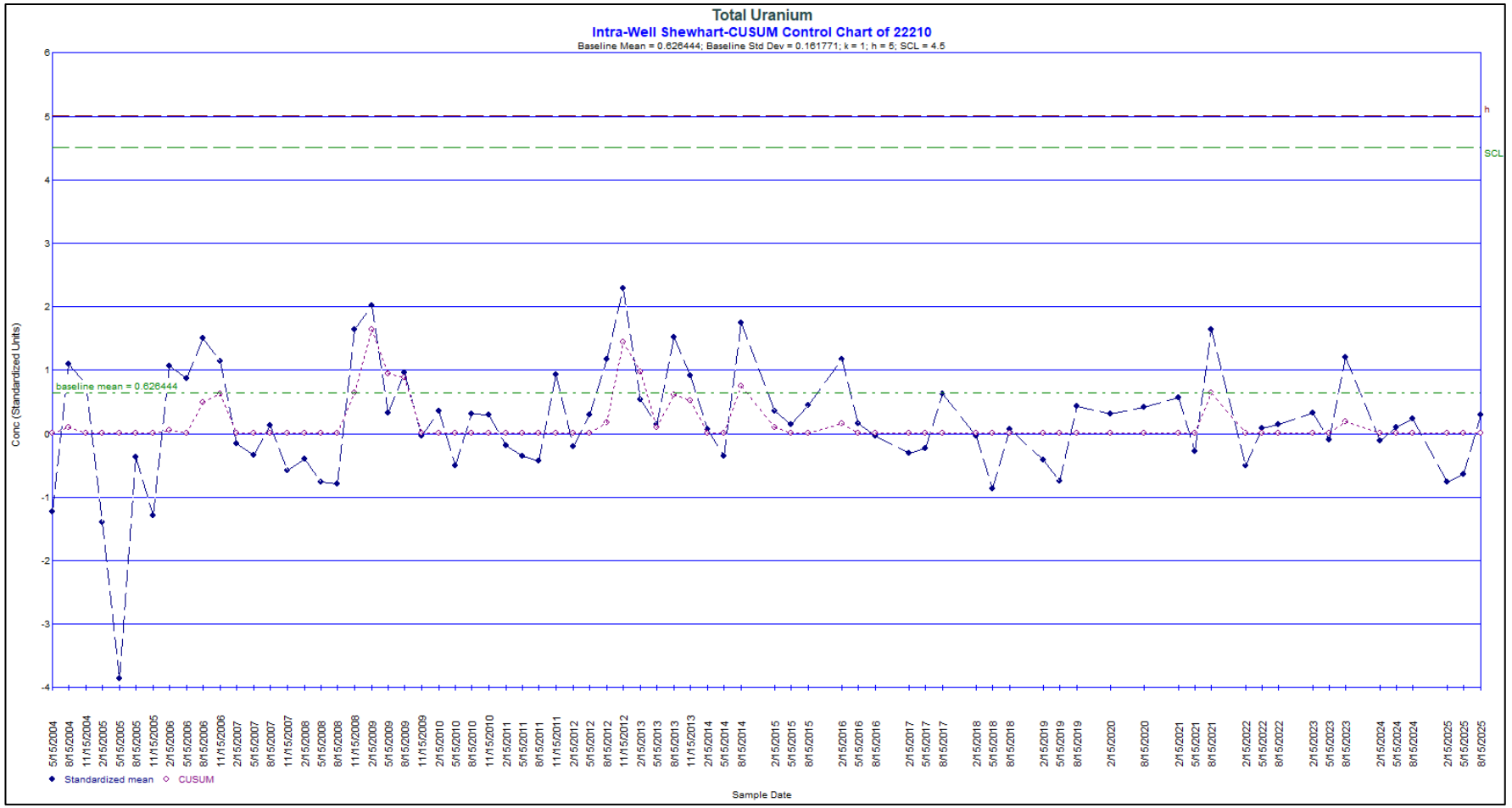


Figure A.5.6-19. Intrawell Shewhart-CUSUM Control Chart for Uranium in Monitoring Well 22210

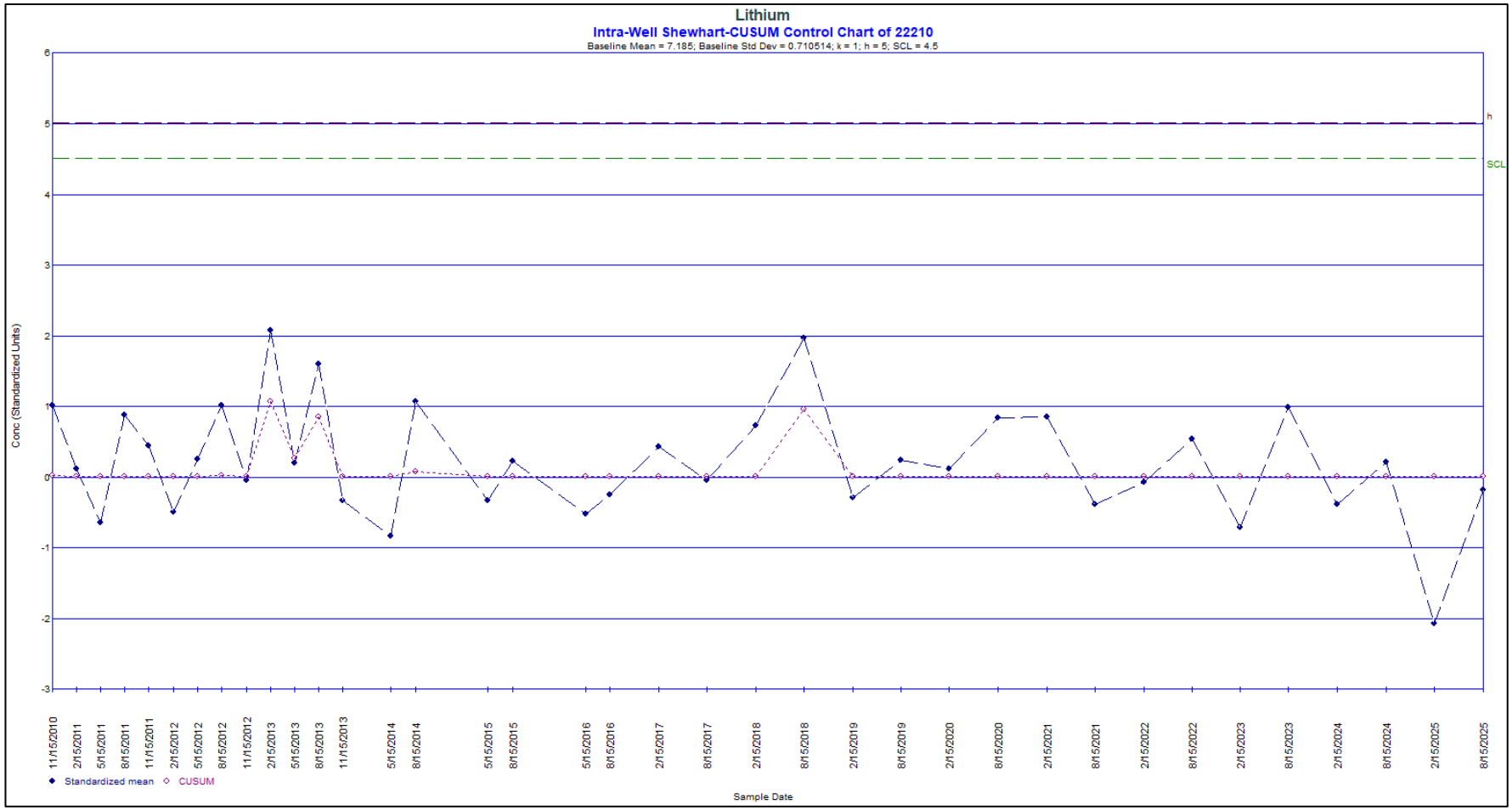


Figure A.5.6-20. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22210

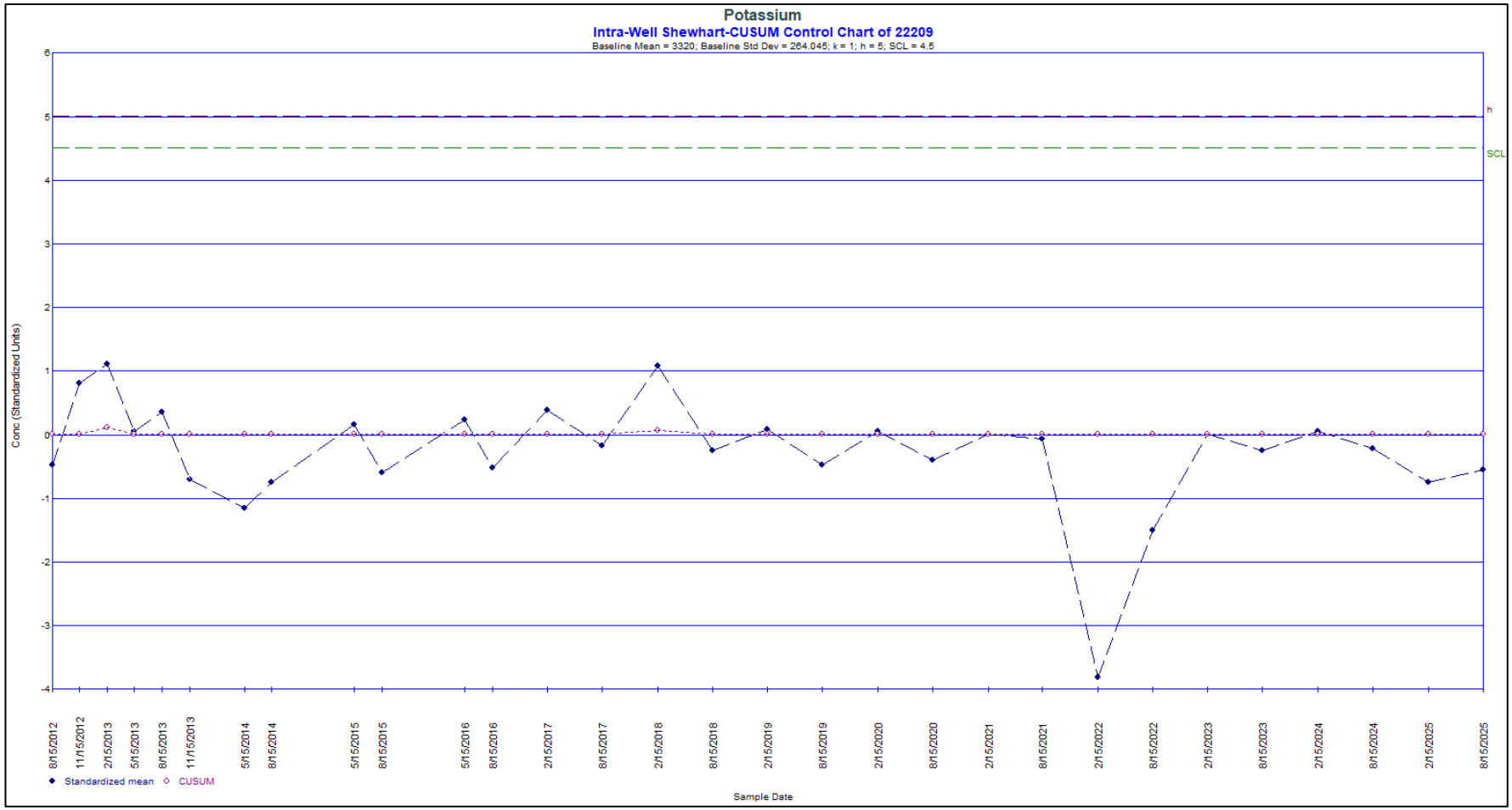


Figure A.5.6-21. Intrawell Shewhart-CUSUM Control Chart for Potassium in Monitoring Well 22209

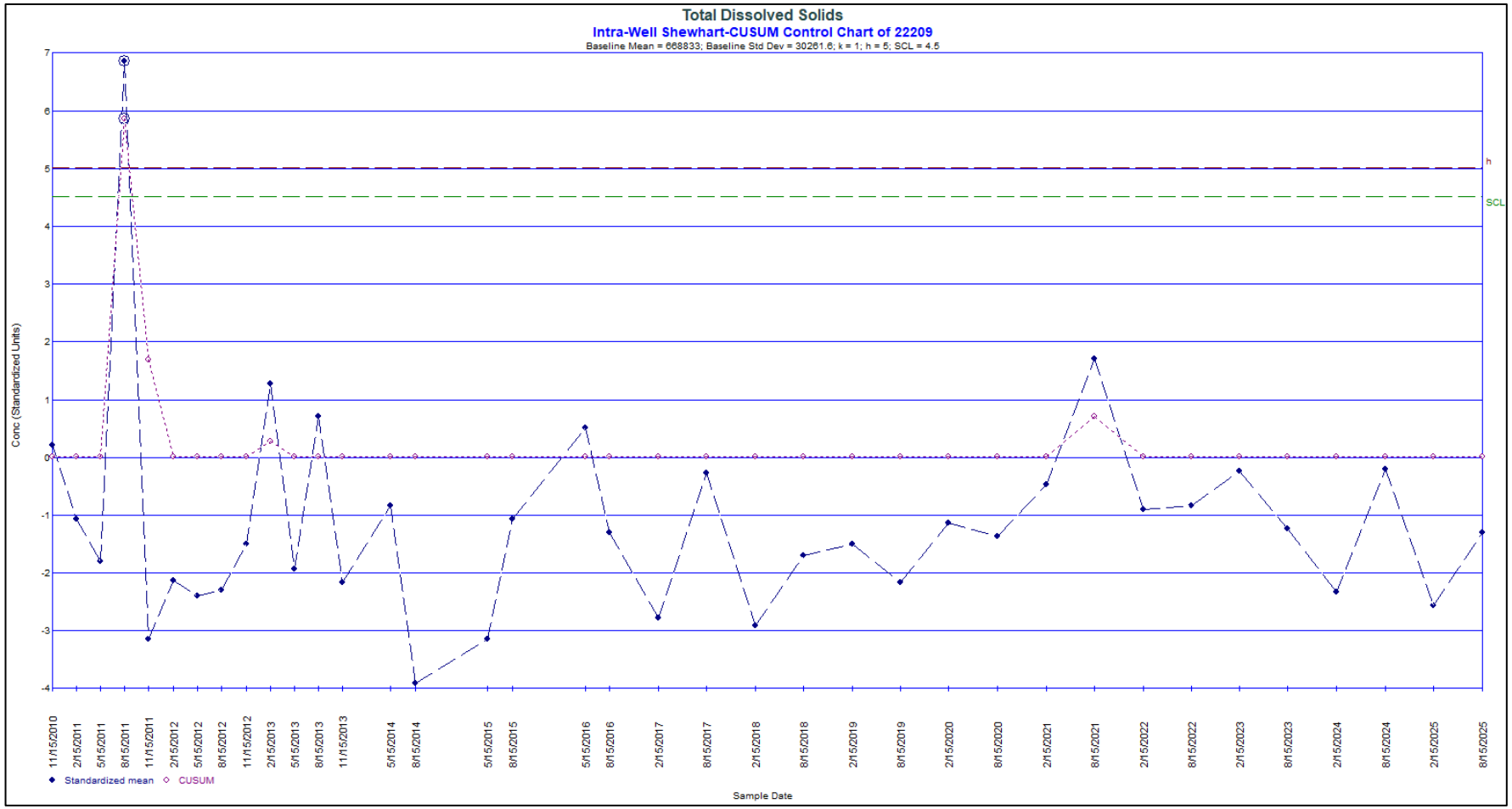


Figure A.5.6-22. Intrawell Shewhart-CUSUM Control Chart for Total Dissolved Solids in Monitoring Well 22209

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Subattachment A.5.7

Cell 7

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.7.1 Water Quality Monitoring Results 1
A.5.7.1.1 LCS and LDS Results 1
A.5.7.1.2 HTW and Monitoring Well Results 2
A.5.7.1.3 Discussion 2
A.5.7.2 Control Charts 2
A.5.7.3 Summary and Conclusions 3
A.5.7.4 References 4

Tables

Table A.5.7-1. Summary Statistics for Cell 7 5
Table A.5.7-2. OSDF Horizontal Till Well 12344 (Cell 7) Water Yield 6

Figures

Figure A.5.7-1. Monthly Accumulation Volumes for Cell 7 LCS 7
Figure A.5.7-2. Monthly Accumulation Volumes for Cell 7 LDS 7
Figure A.5.7-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 7 Upgradient Monitoring Well 22212 8
Figure A.5.7-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 7 Downgradient Monitoring Well 22211 8
Figure A.5.7-5A. Cell 7 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 9
Figure A.5.7-5B. Cell 7 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 9
Figure A.5.7-6A. Cell 7 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 10
Figure A.5.7-6B. Cell 7 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 10
Figure A.5.7-7A. Cell 7 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.7-7B. Cell 7 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 11
Figure A.5.7-8A. Cell 7 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.7-8B. Cell 7 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 12
Figure A.5.7-9. Cell 7 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.7-10. Cell 7 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 13
Figure A.5.7-11. Cell 7 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14
Figure A.5.7-12. Cell 7 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 14

Figure A.5.7-13. Cell 7 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.7-14. Cell 7 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 15
Figure A.5.7-15. Cell 7 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.7-16. Cell 7 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 16
Figure A.5.7-17. Cell 7 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well 17
Figure A.5.7-18. Cell 7 Bivariate Plot for Uranium and Sodium 17
Figure A.5.7-19. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22211 18

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about the On-Site Disposal Facility (OSDF) Cell 7:

- Semiannual monitoring summary statistics (Table A.5.7-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.7-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.7-2)
- OSDF horizontal till well (HTW) 12344 water yield (Table A.5.7-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.7-3 and A.5.7-4)
- Plots of concentration versus time (Figures A.5.7-5A through A.5.7-17)
- A bivariate plot for uranium–sodium (Figure A.5.7-18)
- Control chart (Figure A.5.7-19)

A.5.7.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining if the OSDF is operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW of each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code*3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.7.1.1 LCS and LDS Results

As shown in Table A.5.7-1 and summarized below, two parameters (sodium and sulfate) in 2025 have upward concentration trends in the LCS or LDS based on the Mann-Kendall test for trend. The volume of water in the LDS tank of Cell 7 was insufficient to collect a sample in 2012 and 2013. Enough water was present to collect a sample in 2014 and 2015, but since 2015, the volume of water in the LDS tank of Cell 7 has been insufficient to collect a sample.

One new high concentration was measured in the LCS or LDS of Cell 7 in 2025 (sodium in the LCS). The previous maximum concentration was 138 micrograms (µg/L). The new maximum concentration is 151 µg/L. DOE will continue monitoring.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 7

Parameter	LCS 12344C 2025 Trend	LDS 12344D Trend (Year Last Sampled)
Sodium	Up	Up (2015)
Sulfate	Up	Up (2015)

A.5.7.1.2 HTW and Monitoring Well Results

As shown in Table A.5.7-1 and summarized below, six parameters (total uranium, boron, sodium, sulfate, lithium, and selenium) have upward concentration trends in the HTW or GMA wells based on the Mann-Kendall test for trend.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 7

Parameter	HTW 12344[a]	GMA-U 22212[a,b]	GMA-D 22211[a,b]
Total Uranium	Up		
Boron	Up	Up	Up
Sodium	Up		
Sulfate	Up		
Lithium		Up	
Selenium		Up	Up

[a] No entry indicates that the trend was not up.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer.

A.5.7.1.3 Discussion

The uranium–sodium bivariate plot for the Cell 7 LCS, LDS, and HTW is provided in Figure A.5.7-18. On the figure, the first sample ever collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. The plot shows that the chemical signatures for uranium and sodium in the LCS, LDS, and HTW are separate and distinct, indicating that mixing between the horizons is not occurring; therefore, upward concentration trends measured beneath the cells in GMA wells are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.7.2 Control Charts

Intrawell control charts use historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a

control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.7-1 in gray shading and as summarized below, one parameter in the HTW or GMA wells of Cell 7 (lithium) meets the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in one control chart (Figure A.5.7-19). The control chart exhibits "in control" conditions.

Parameter	Monitoring Point[a]	Monitoring Well	Assessment	Figure Number
Lithium	GMA-D	22211	In Control	A.5.7-19

[a] GMA-D = downgradient Great Miami Aquifer.

A.5.7.3 Summary and Conclusions

- Two parameters monitored semiannually in 2025 have an upward concentration trend in the LCS of Cell 7: sodium and sulfate.
- One new high concentration was measured in the LCS or LDS of Cell 7 in 2025 (sodium in the LCS). The previous maximum concentration was 138 µg/L. The new maximum concentration is 151 µg/L. No action is recommended at this time other than continued monitoring.
- Since 2015, the volume of water in the LDS tank of Cell 7 has been insufficient to collect a sample.

- Six parameters monitored semiannually have an upward concentration trend in the HTW or GMA wells of Cell 7: total uranium, boron, sodium, sulfate, lithium, and selenium. Separate and distinct chemical signatures for total uranium and sodium in the LCS, LDS, and HTW of Cell 7 indicate that water is not mixing between the horizons. Therefore, upward concentration trends beneath Cell 7 (i.e., HTW or GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance.
- One control chart was constructed for Cell 7 parameters. The control chart exhibits "in control" conditions.

A.5.7.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. "Ground Water Monitoring Program for a Sanitary Landfill Facility," *Ohio Administrative Code.*

Table A.5.7-1. Summary Statistics for Cell 7

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[g,h]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12344C	61	61	100	4.72	264	147	51	Normal	Down (2025)	Detected	355 (Q3-07)
	LDS	12344D	31	31	100	12.2	37.6	25.7	6.2	Normal	Up (2015)	Detected	169 (Q2-14)
	HTW	12344	61	61	100	2.00	12.1	3.82	1.74	Undefined	Up (2025)	Detected	
	GMA-U	22212	57	63	90.5	ND	0.634	0.422	0.100	Undefined	None (2025)	Not Detected	1.64 (Q1-04); 4.46 (Q1-05); 1.70 (Q1-07); 1.73 (Q3-10); 5.53 (Q3-11)
	GMA-D	22211	71	75	94.7	ND	4.06	0.351	0.615	Undefined	None (2025)	Not Detected	
Boron (mg/L)	LCS	12344C	61	61	100	0.0625	1.35	1.03	0.35	Undefined	Down (2025)	Detected	
	LDS	12344D	31	31	100	0.168	2.10	0.360	0.425	Undefined	Up (20215)	Detected	
	HTW	12344	37	45	82.2	ND	0.0435	0.0255	0.0085	Normal	Up (2025)	Detected	0.0750 (Q3-09)
	GMA-U	22212	61	63	96.8	ND	0.0765	0.0399	0.0114	Undefined	Up (2025)	Detected	
	GMA-D	22211	60	63	95.2	ND	0.0622	0.0341	0.0110	Undefined	Up (2025)	Detected	
Sodium (mg/L)	LCS	12344C	54	54	100	18.1	151	99.4	29.3	Undefined	Up (2025)	Detected	
	LDS	12344D	24	24	100	186	1,590	587	374	Undefined	Up (2015)	Detected	
	HTW	12344	49	49	100	19.8	54.1	34.6	8.2	Undefined	Up (2025)	Detected	
	GMA-U	22212	43	43	100	15.5	27.0	20.0	2.7	Normal	Down (2025)	Detected	
	GMA-D	22211	45	45	100	10.1	19.2	13.1	2.5	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12344C	61	61	100	122	5,470	3,850	1,340	Undefined	Up (2025)	Detected	
	LDS	12344D	31	31	100	1,280	7,370	1,770	1,850	Undefined	Up (2015)	Detected	
	HTW	12344	56	56	100	80.4	765	570	253	Undefined	Up (2025)	Detected	
	GMA-U	22212	63	63	100	96.6	316	172	46	Ln Normal	Down (2025)	Detected	352 (Q1-05); 362 (Q1-07); 471 (Q2-10); 556 (Q3-10); 731 (Q3-11)
	GMA-D	22211	63	63	100	117	572	283	119	Ln Normal	Down (2025)	Detected	3,640 (Q3-12); 4,220 (Q1-24)
Calcium (mg/L)	GMA-U	22212	36	36	100	140	177	151	10	Undefined	None (2025)	Not Detected	377 (Q3-11)
	GMA-D	22211	36	36	100	136	263	182	35	Ln Normal	Down (2025)	Detected	
Lithium (mg/L)	GMA-U	22212	43	43	100	0.00474	0.00892	0.00594	0.00108	Undefined	Up (2025)	Detected	
	GMA-D	22211	43	43	100	0.00555	0.00930	0.00698	0.00081	Normal	None (2025)	Not Detected	
Magnesium (mg/L)	GMA-U	22212	36	36	100	28.6	41.5	34.3	2.3	Undefined	None (2025)	Not Detected	54.6 (Q3-11)
	GMA-D	22211	36	36	100	34.6	64.7	46.2	7.8	Ln Normal	Down (2025)	Not Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22212	4	36	11.1	ND	0.0431	0.00850	0.0131	Undefined	None (2025)	Not Detected	
	GMA-D	22211	5	36	13.9	ND	0.119	0.00650	0.0220	Undefined	None (2025)	Not Detected	
Potassium (mg/L)	GMA-U	22212	36	36	100	3.05	3.81	3.45	0.17	Normal	Down (2025)	Not Detected	4.81 (Q3-11)
	GMA-D	22211	38	38	100	2.34	3.65	2.88	0.30	Normal	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22212	8	43	18.6	ND	0.0292	0.00300	0.00542	Undefined	Up (2025)	Detected	
	GMA-D	22211	4	43	9.3	ND	0.0147	0.00300	0.00303	Undefined	Up (2025)	Detected	
Technitium-99 (pCi/L)	GMA-U	22212	1	28	3.6	ND	11.0	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22211	1	28	3.6	ND	9.38	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22212	43	43	100	519	854	642	55	Undefined	None (2025)	Detected	1,130 (Q2-10); 1,270 (Q3-10); 1,510 (Q3-11)
	GMA-D	22211	43	43	100	583	1,350	797	205	Undefined	Down (2025)	Detected	
Total Organic Halogens (mg/L)	GMA-U	22212	23	63	36.5	ND	0.0166	0.00240	0.00312	Undefined	None (2025)	Not Detected	0.0500 (Q2-10); 0.0190 (Q2-13)
	GMA-D	22211	22	63	34.9	ND	0.0230	0.00166	0.00474	Undefined	None (2025)	Not Detected	0.0540 (Q2-10)

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well, with at least eight samples, Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.
Note 2: Data used in this table has been standardized to quarterly.
[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer
[b]ND = not detected; NA = not applicable
[c]Averages were determined based on the distribution assumption.
[d]Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.
[e]Data distribution based on the Shapiro-Wilk statistic
Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.
LN Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption
Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.
[f]Trend based on nonparametric Mann-Kendall procedure.
[g]Serial correlation based on Rank Von Neumann test
[h]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).
[i]Q = quarter

Table A.5.7-2. OSDF Horizontal Till Well 12344 (Cell 7) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
2004	2,380	6	264
2005	2,475	5	495
2006	2,375	4	594
2007	1,300	4	325
2008	2,800	4	700
2009	825	4	275
2010	675	4	169
2011	675	4	169
2012	815	4	204
2013	1,125	4	281
2014	455	2	228
2015	650	2	325
2016	665	2	333
2017	720	2	360
2018	955	2	478
2019	1,520	2	760
2020	960	2	480
2021	960	2	480
2022	1,830	2	915
2023	1,325	2	663
2024	1,400	2	700
2025	1,660	2	830

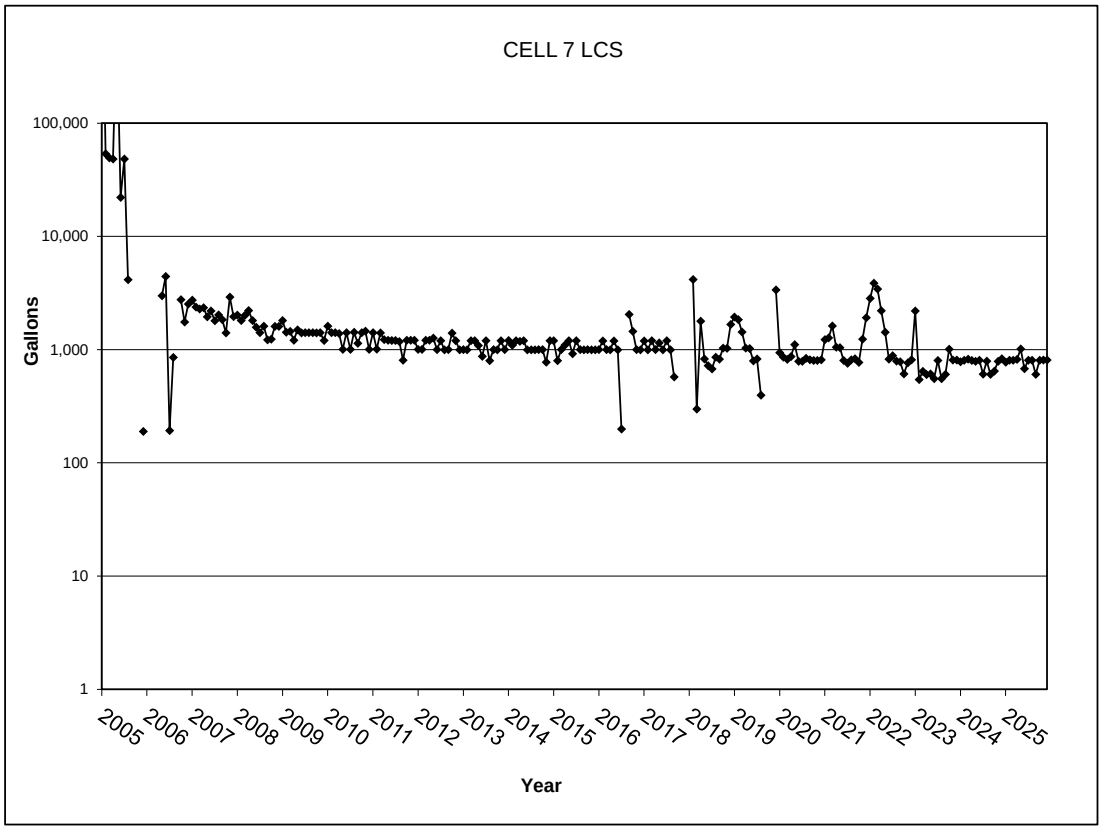


Figure A.5.7-1. Monthly Accumulation Volumes for Cell 7 LCS

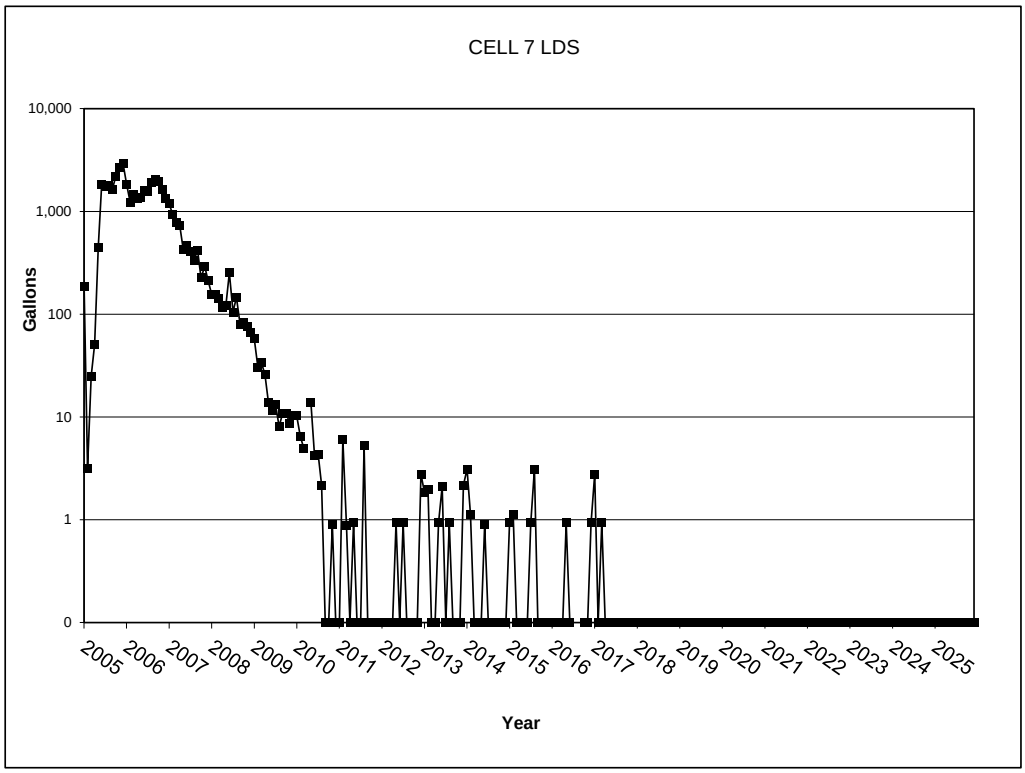


Figure A.5.7-2. Monthly Accumulation Volumes for Cell 7 LDS

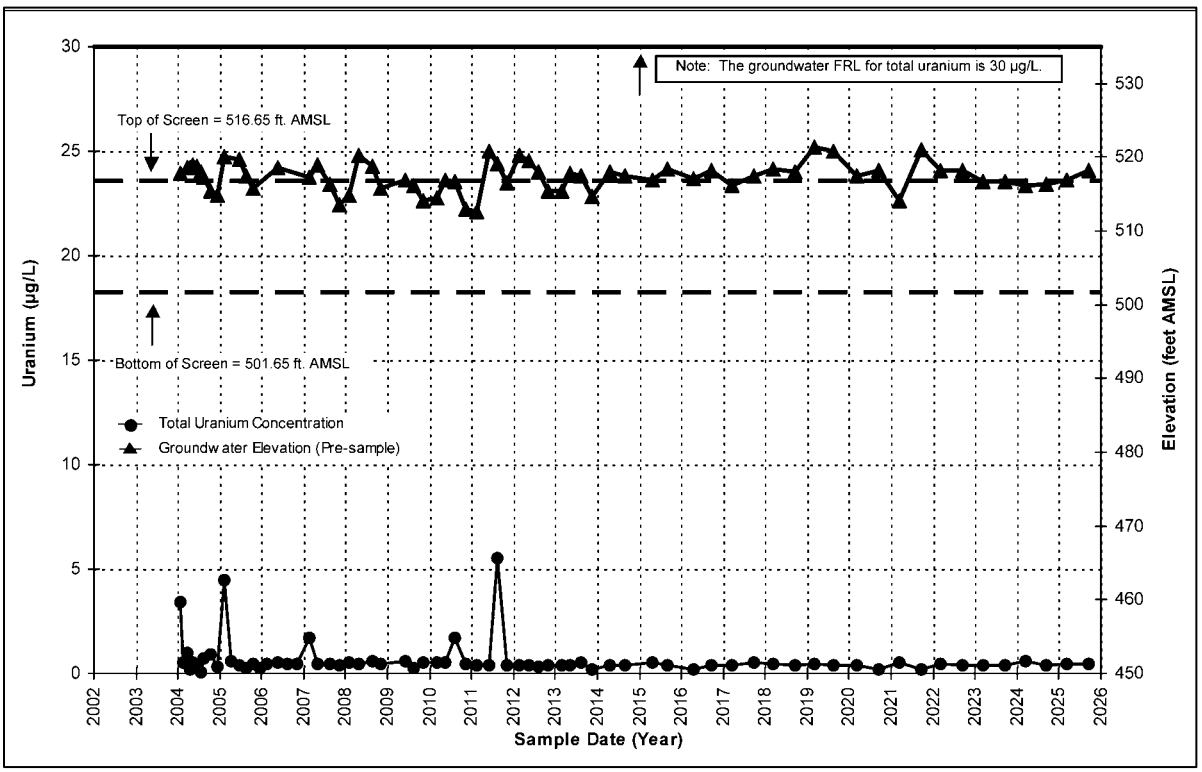


Figure A.5.7-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 7 Upgradient Monitoring Well 22212

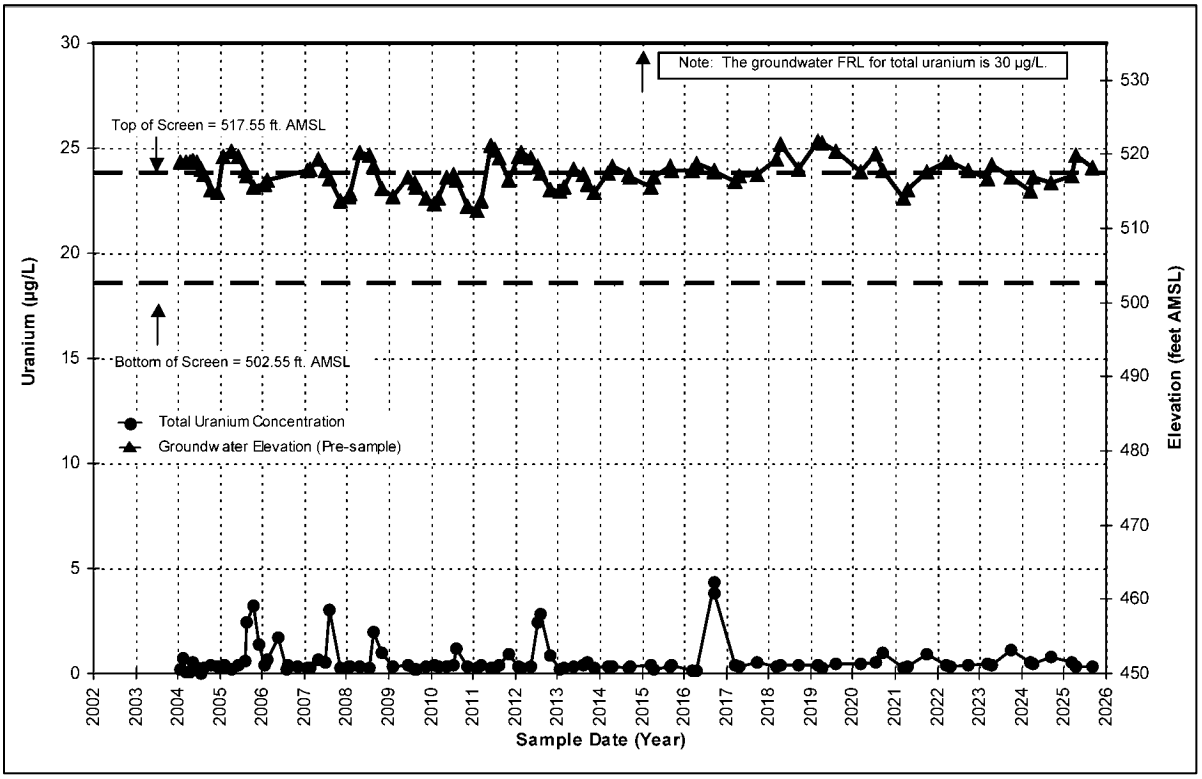


Figure A.5.7-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 7 Downgradient Monitoring Well 22211

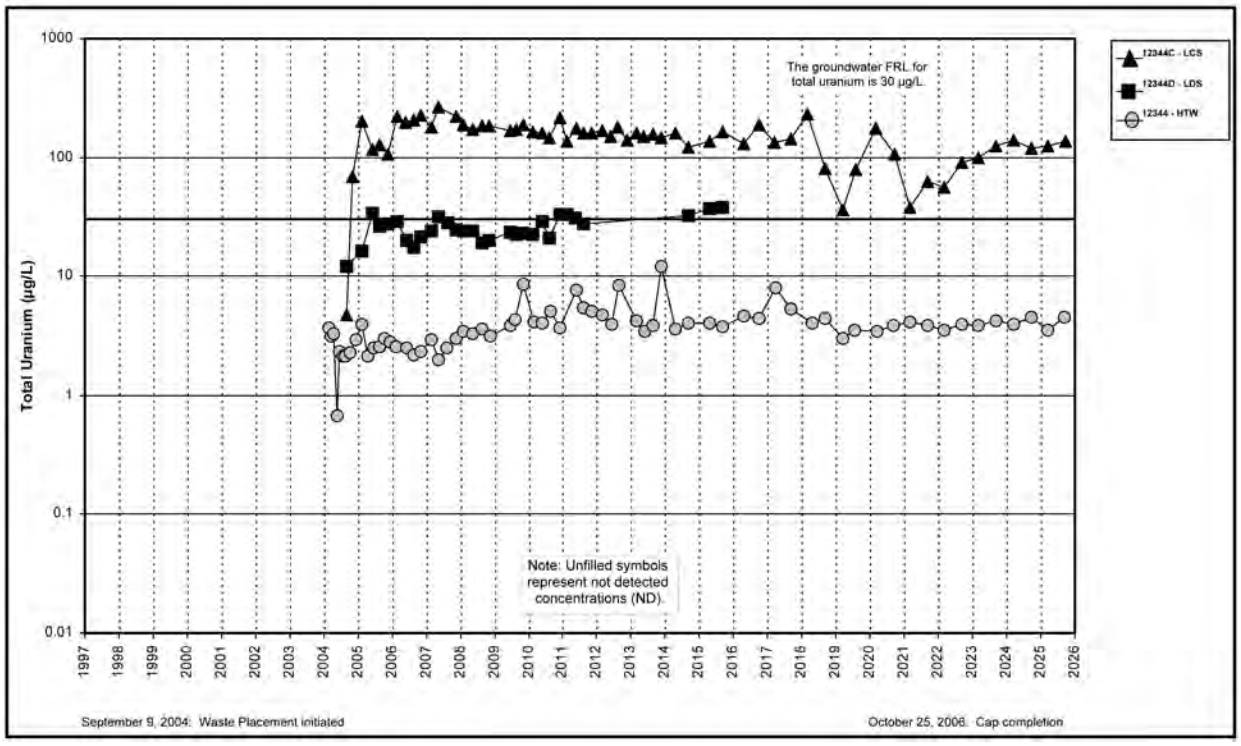


Figure A.5.7-5A. Cell 7 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

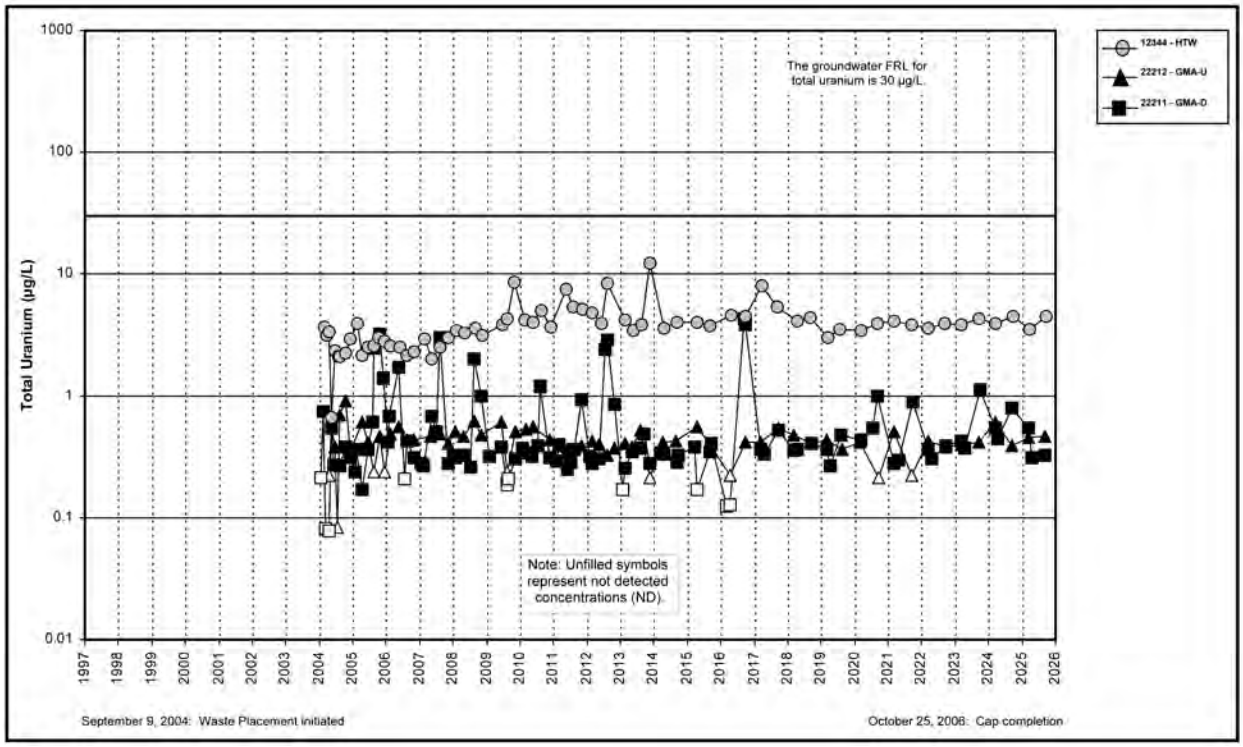


Figure A.5.7-5B. Cell 7 Total Uranium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

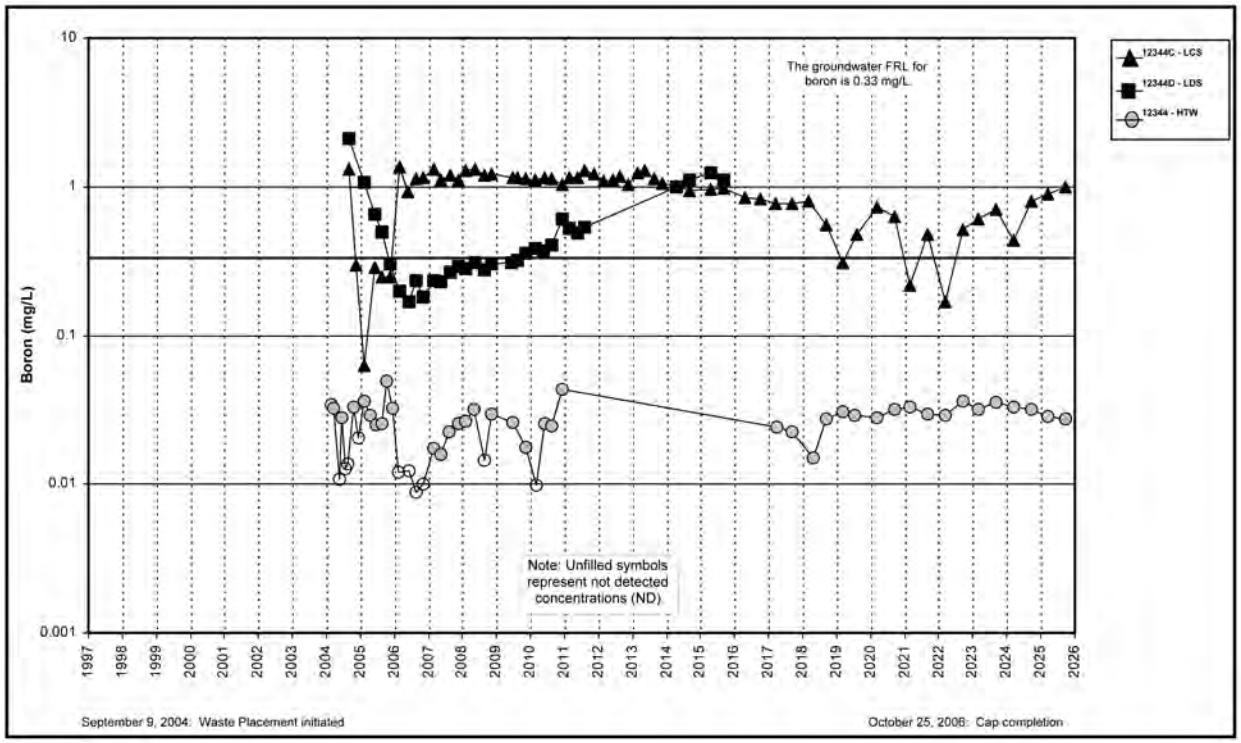


Figure A.5.7-6A. Cell 7 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

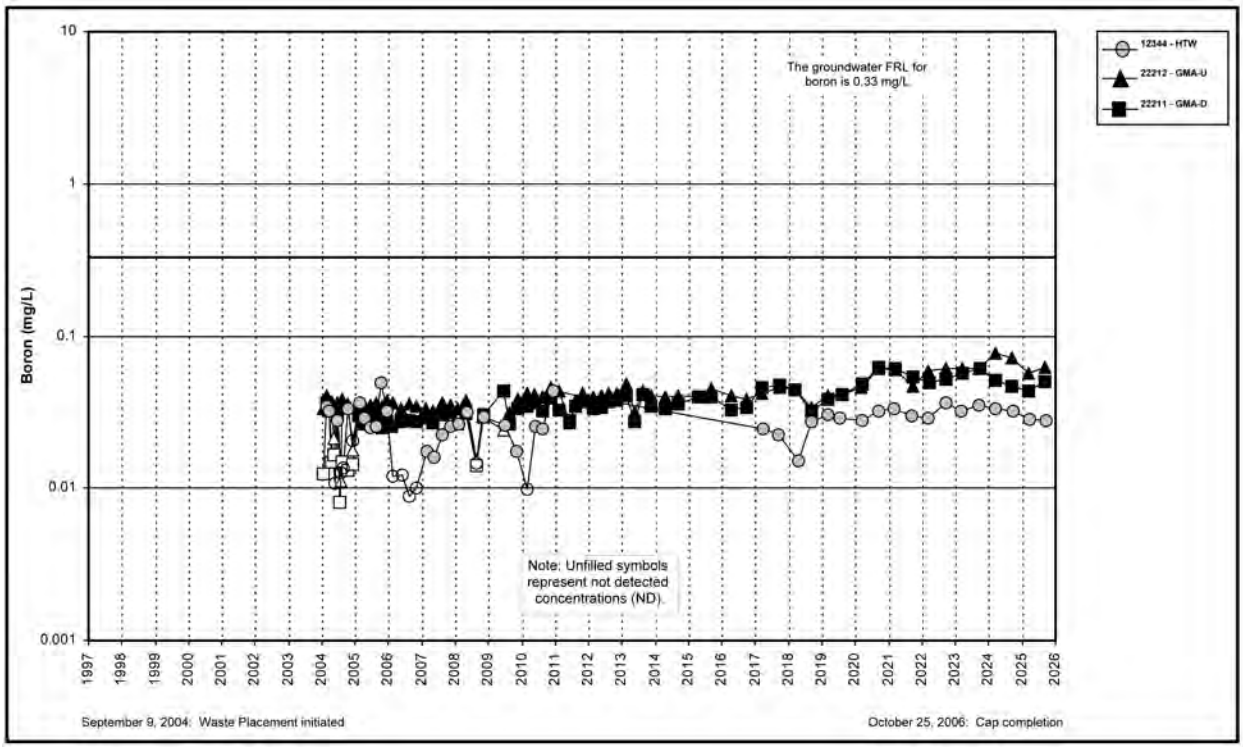


Figure A.5.7-6B. Cell 7 Boron Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

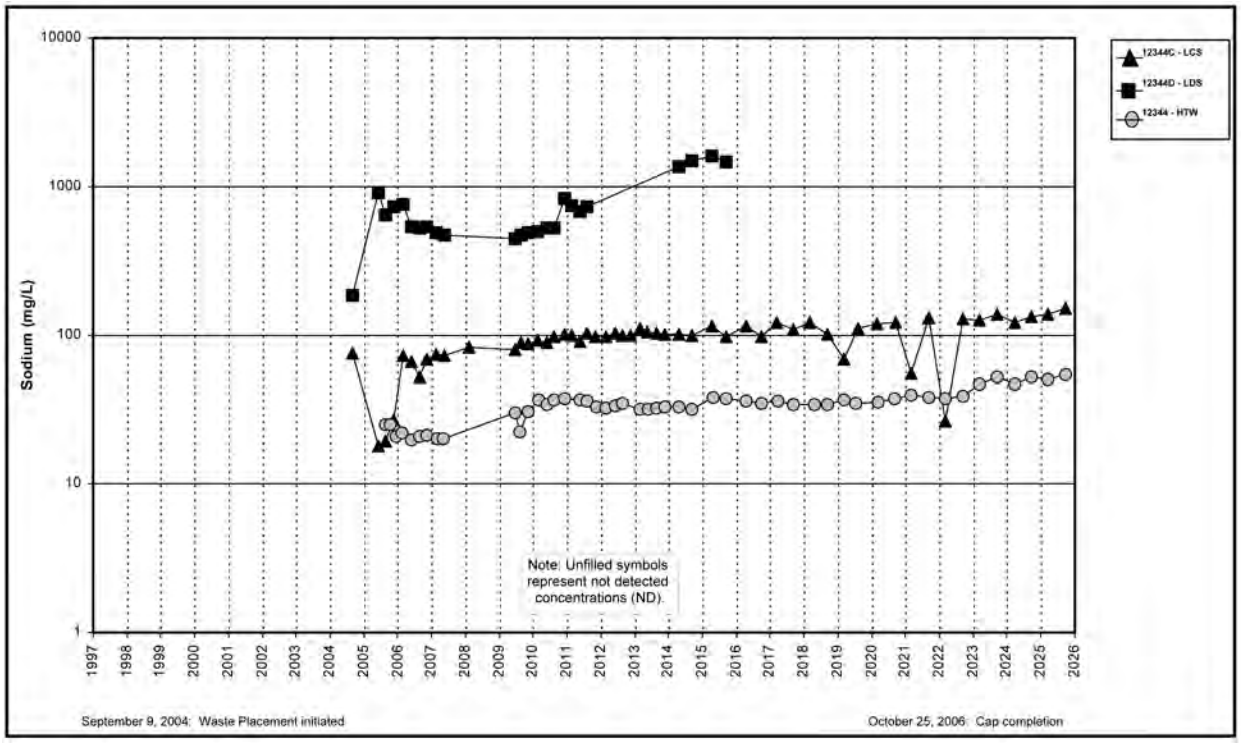


Figure A.5.7-7A. Cell 7 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

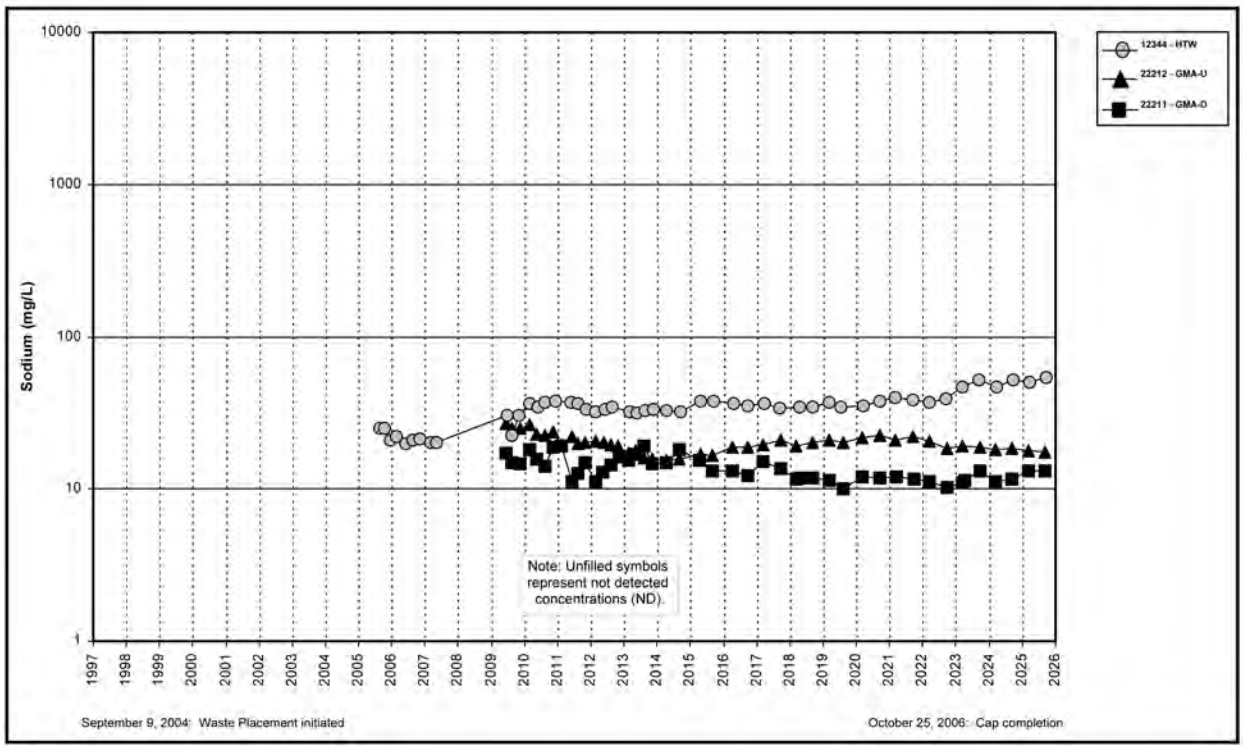


Figure A.5.7-7B. Cell 7 Sodium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

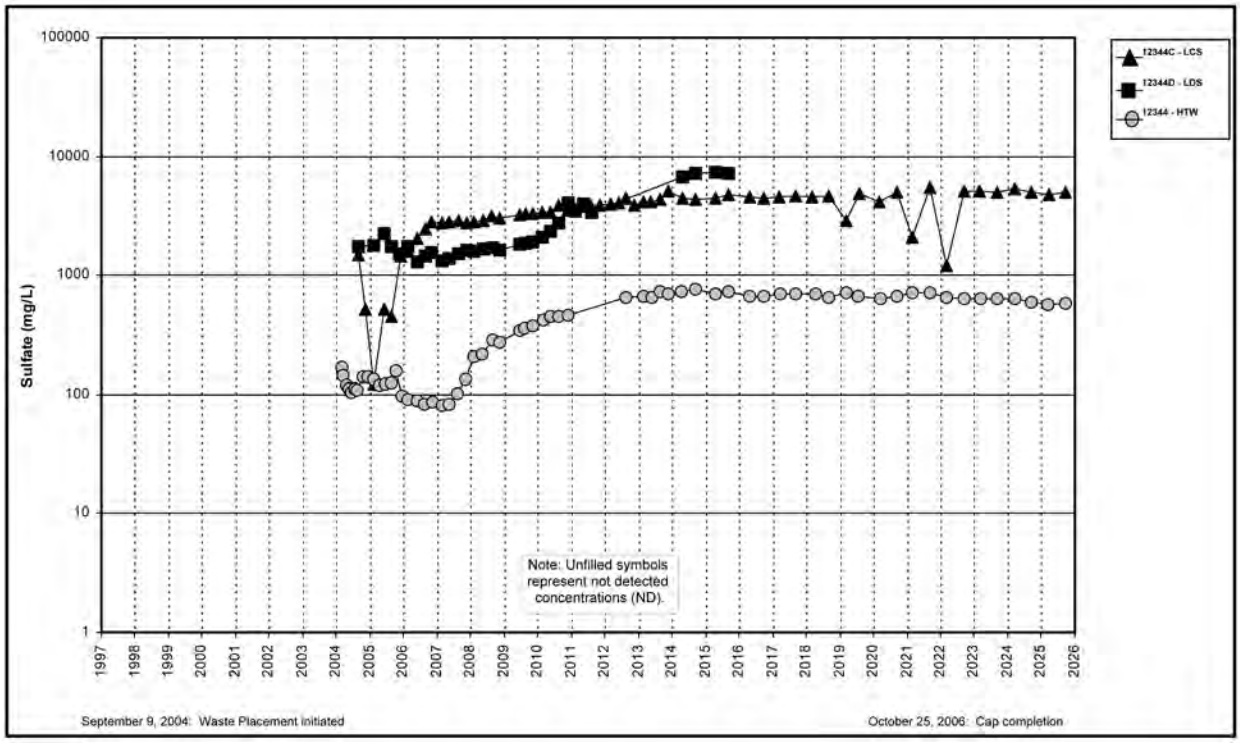


Figure A.5.7-8A. Cell 7 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

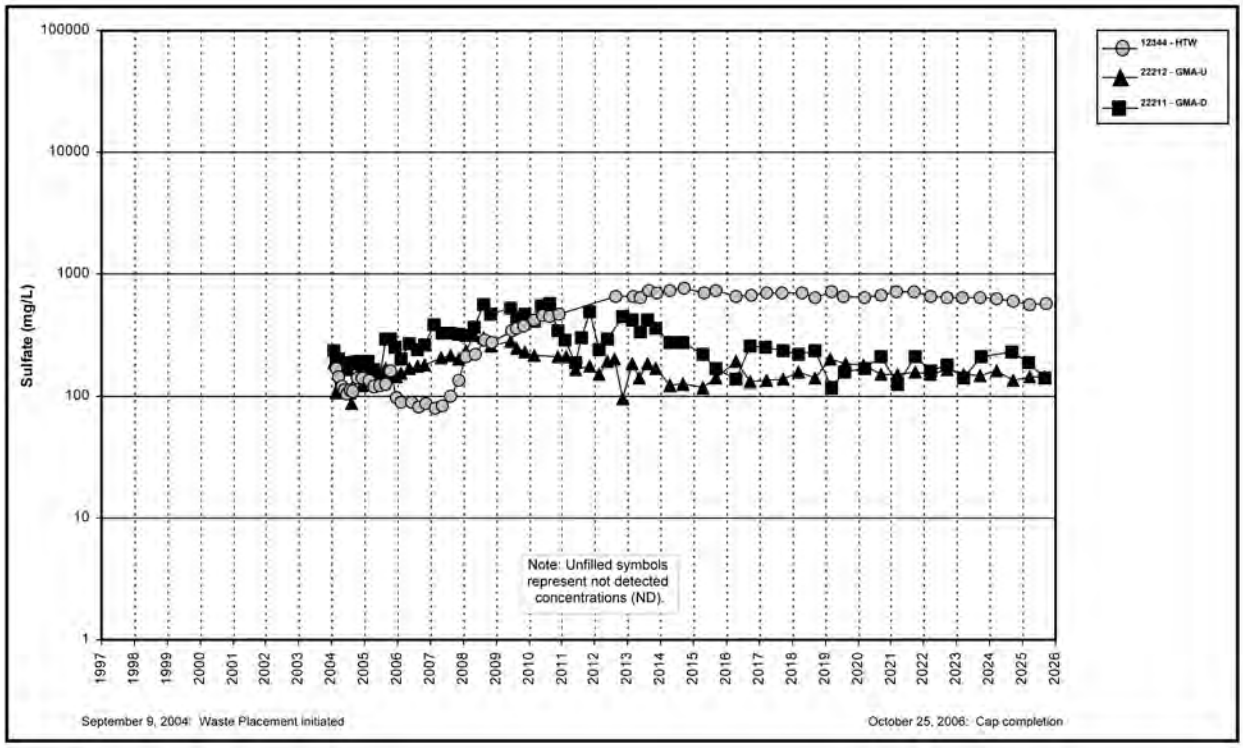


Figure A.5.7-8B. Cell 7 Sulfate Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

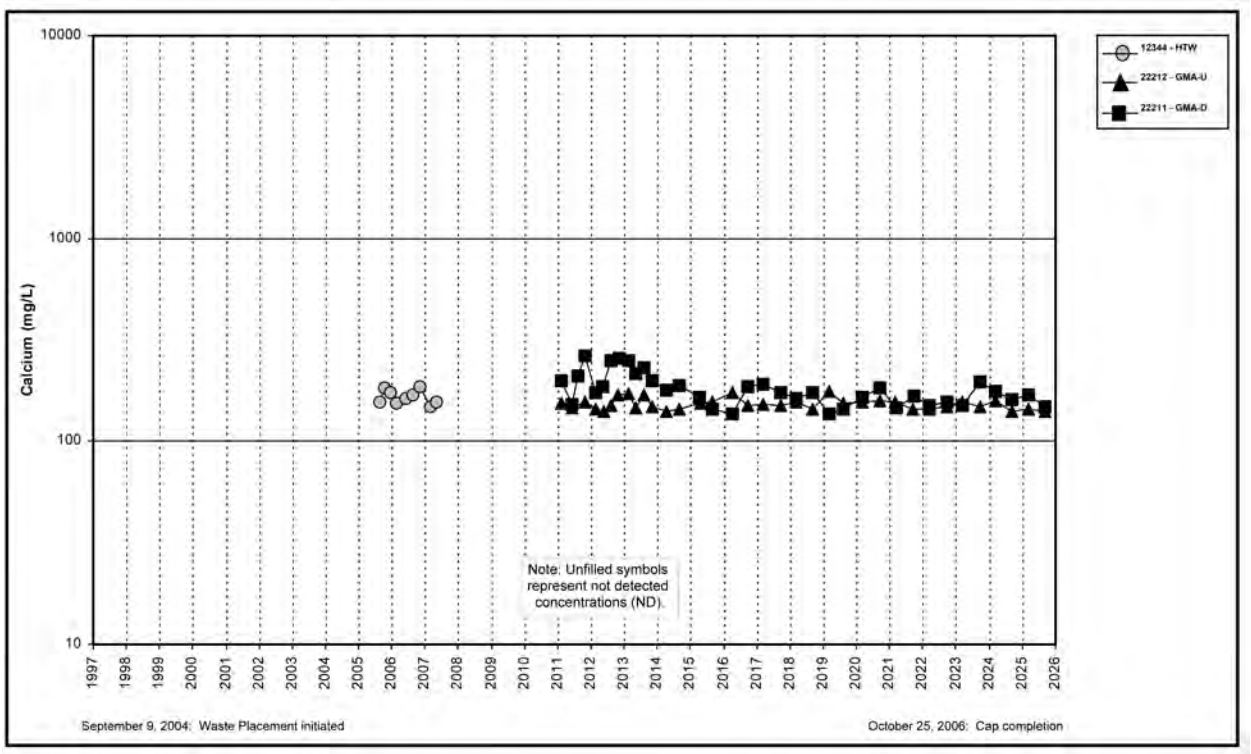


Figure A.5.7-9. Cell 7 Calcium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

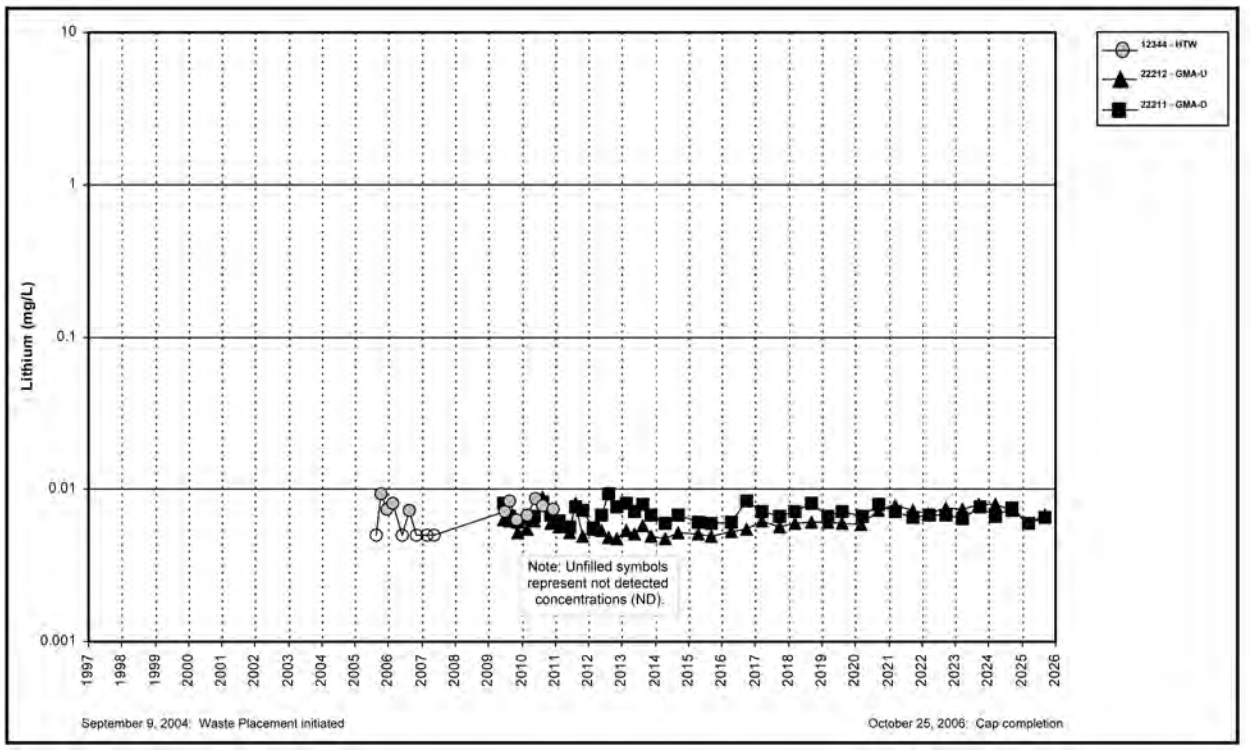


Figure A.5.7-10. Cell 7 Lithium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

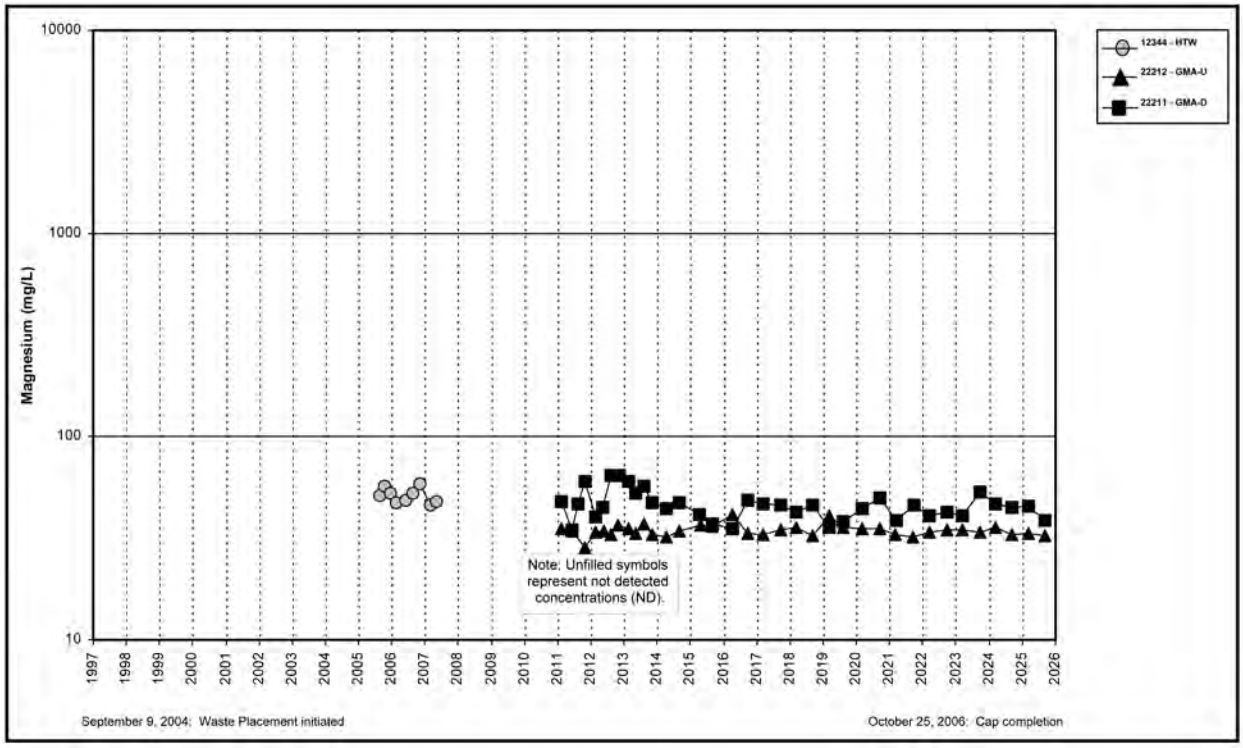


Figure A.5.7-11. Cell 7 Magnesium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

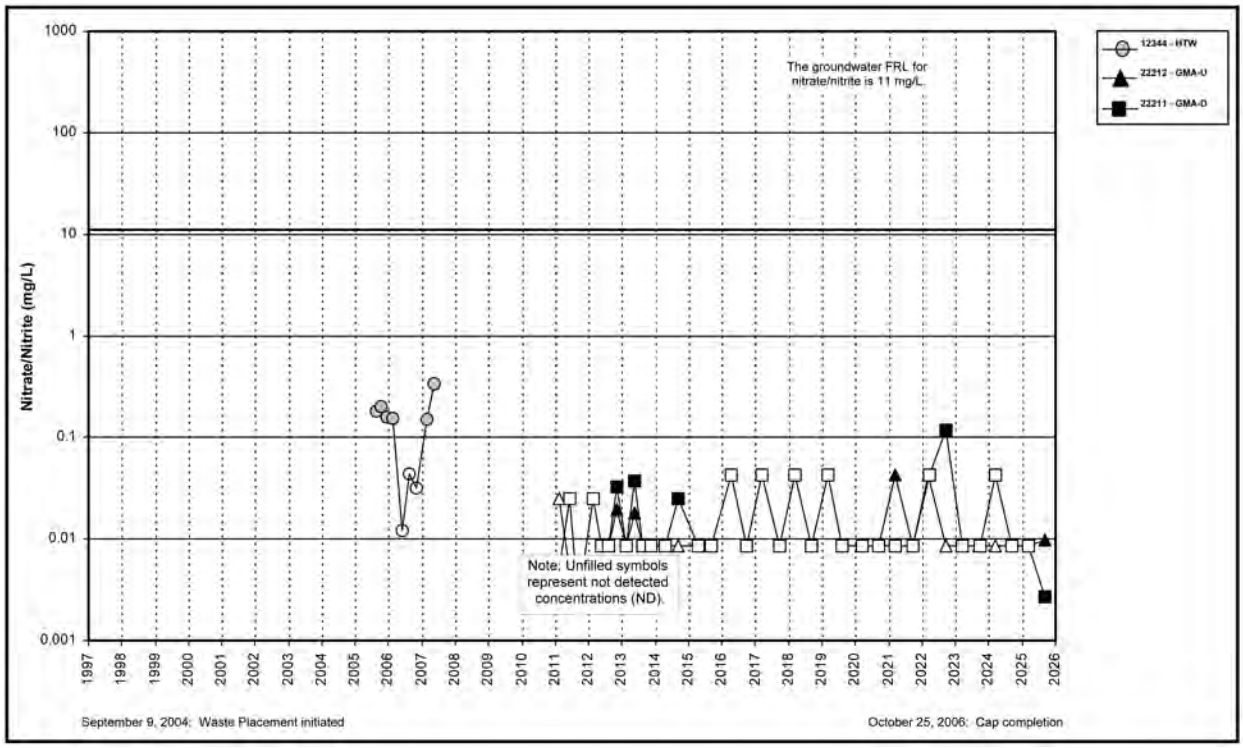


Figure A.5.7-12. Cell 7 Nitrate + Nitrite as Nitrogen Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

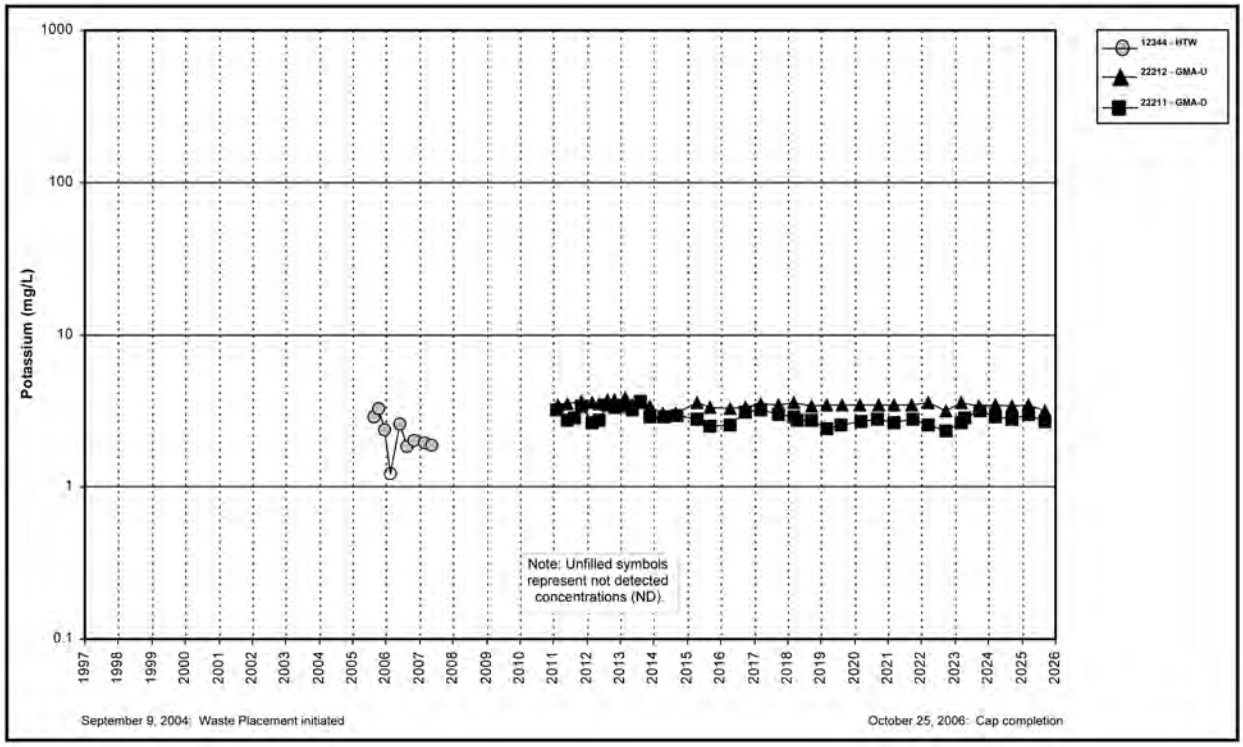


Figure A.5.7-13. Cell 7 Potassium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

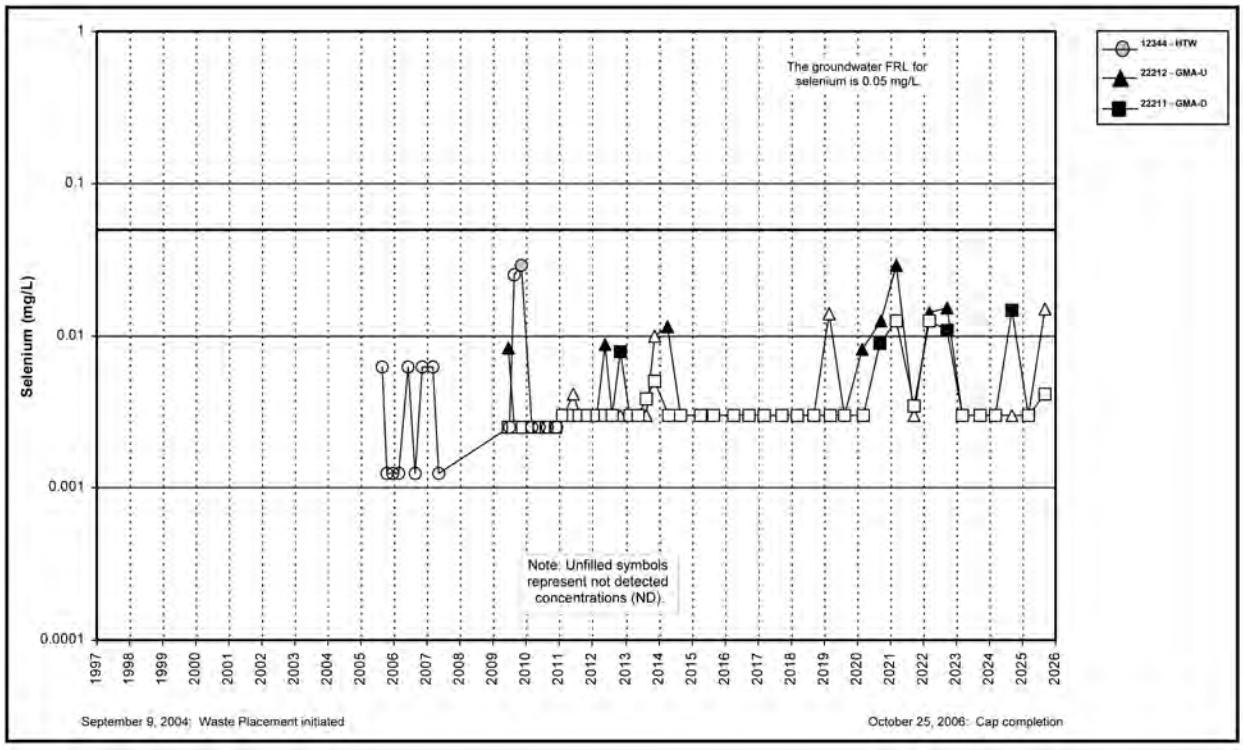


Figure A.5.7-14. Cell 7 Selenium Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

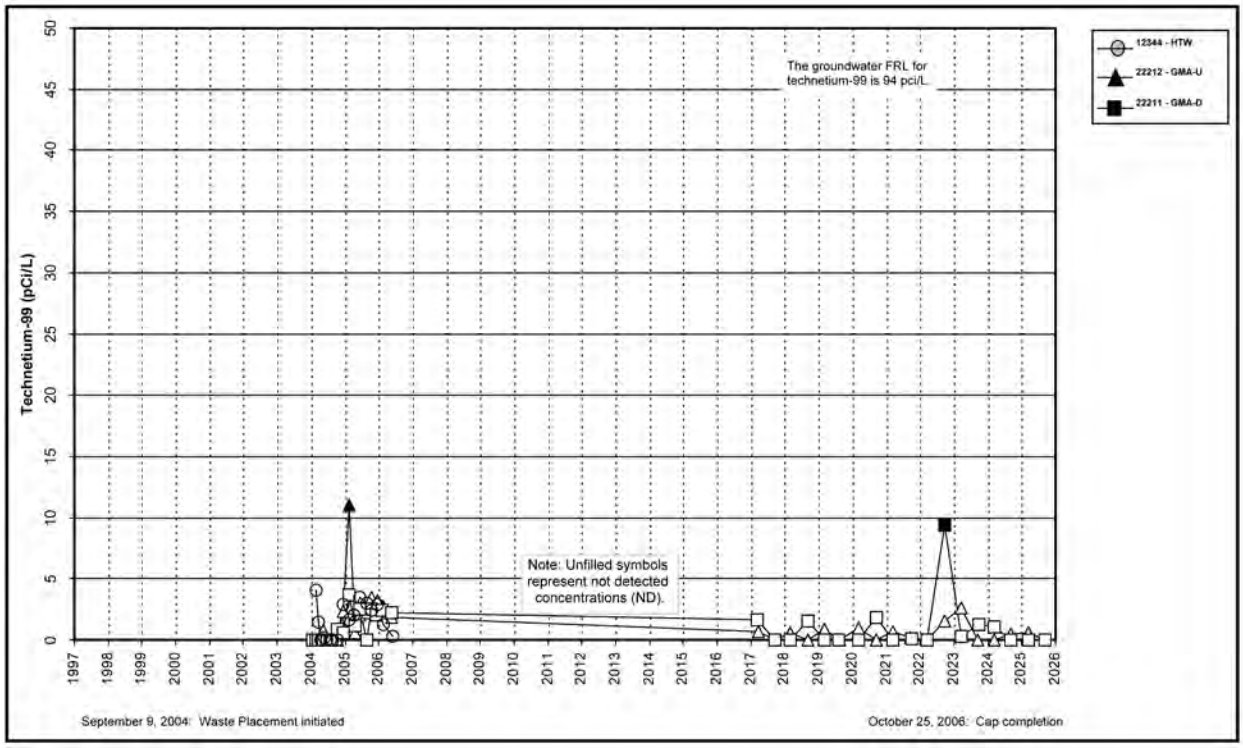


Figure A.5.7-15. Cell 7 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

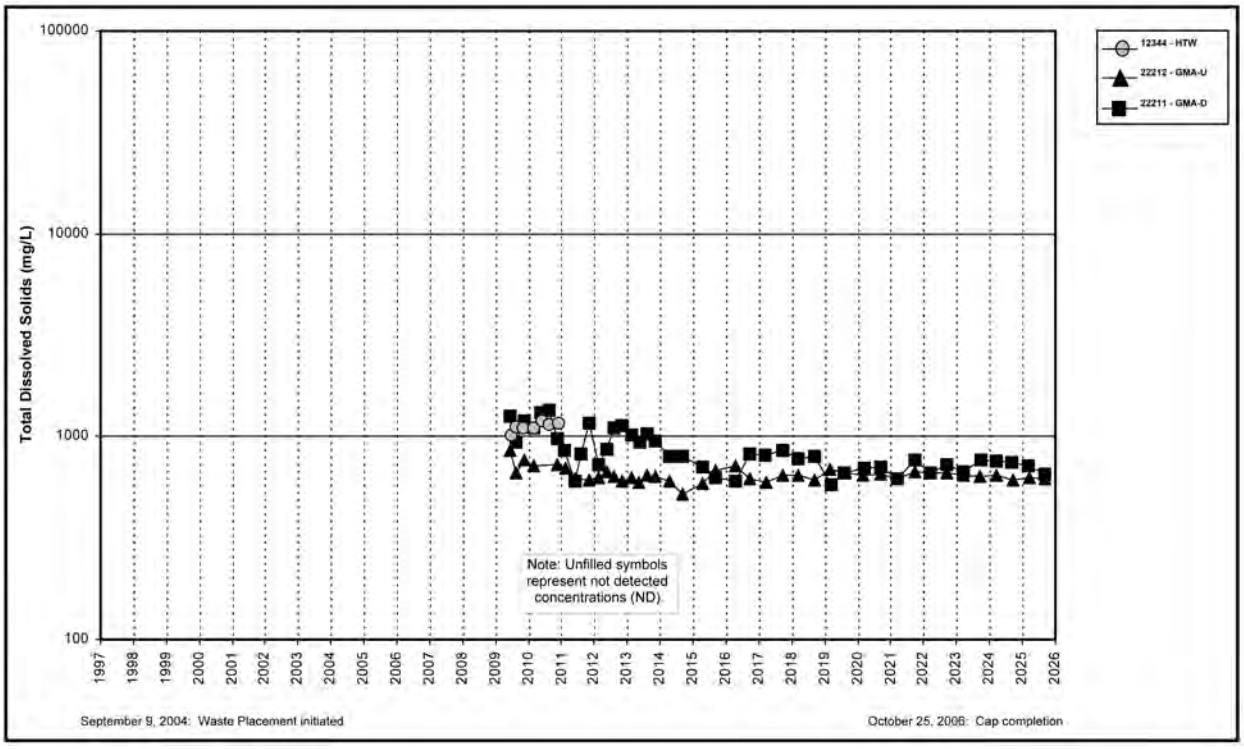


Figure A.5.7-16. Cell 7 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

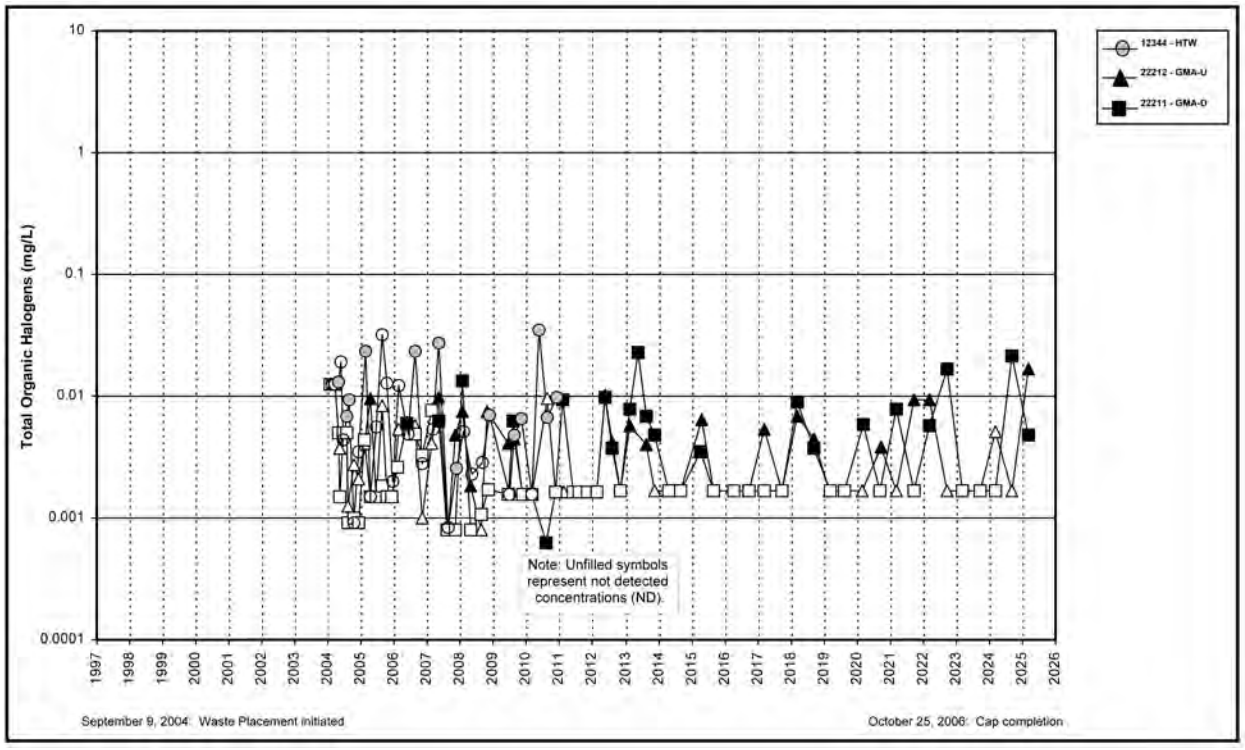


Figure A.5.7-17. Cell 7 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U Well, and GMA-D Well

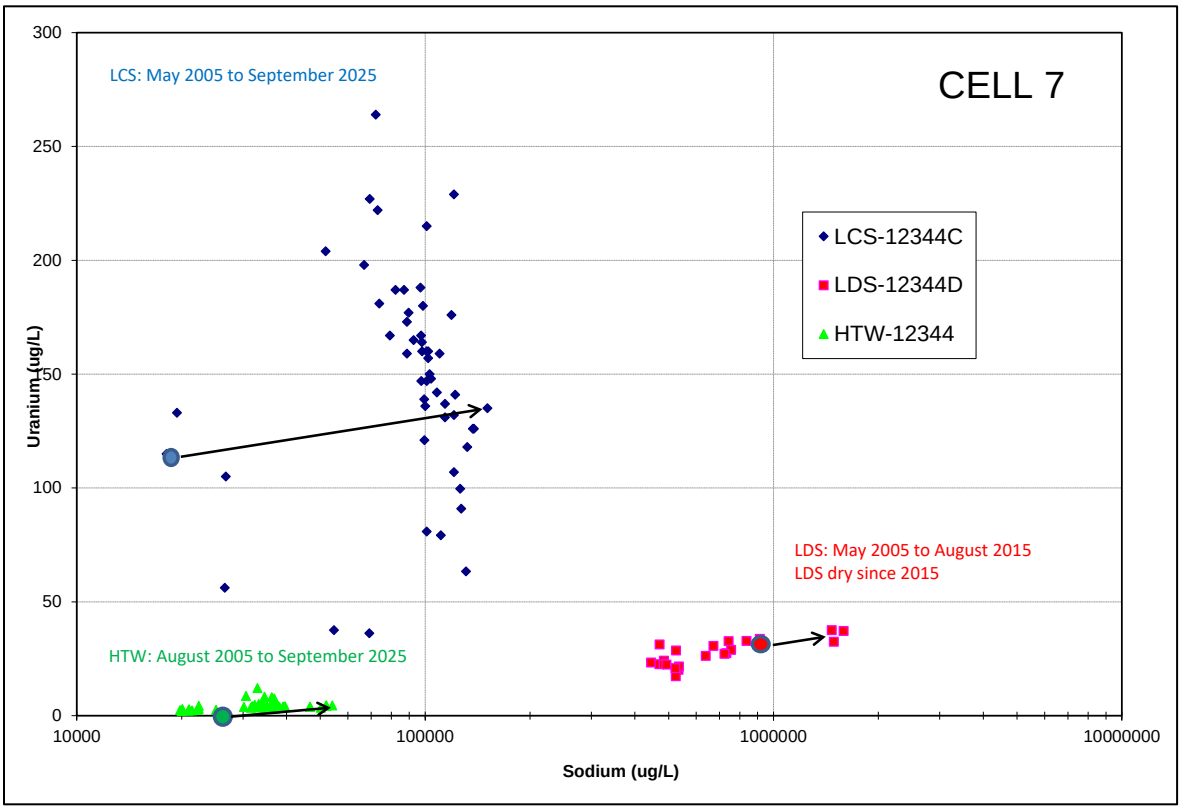


Figure A.5.7-18. Cell 7 Bivariate Plot for Uranium and Sodium

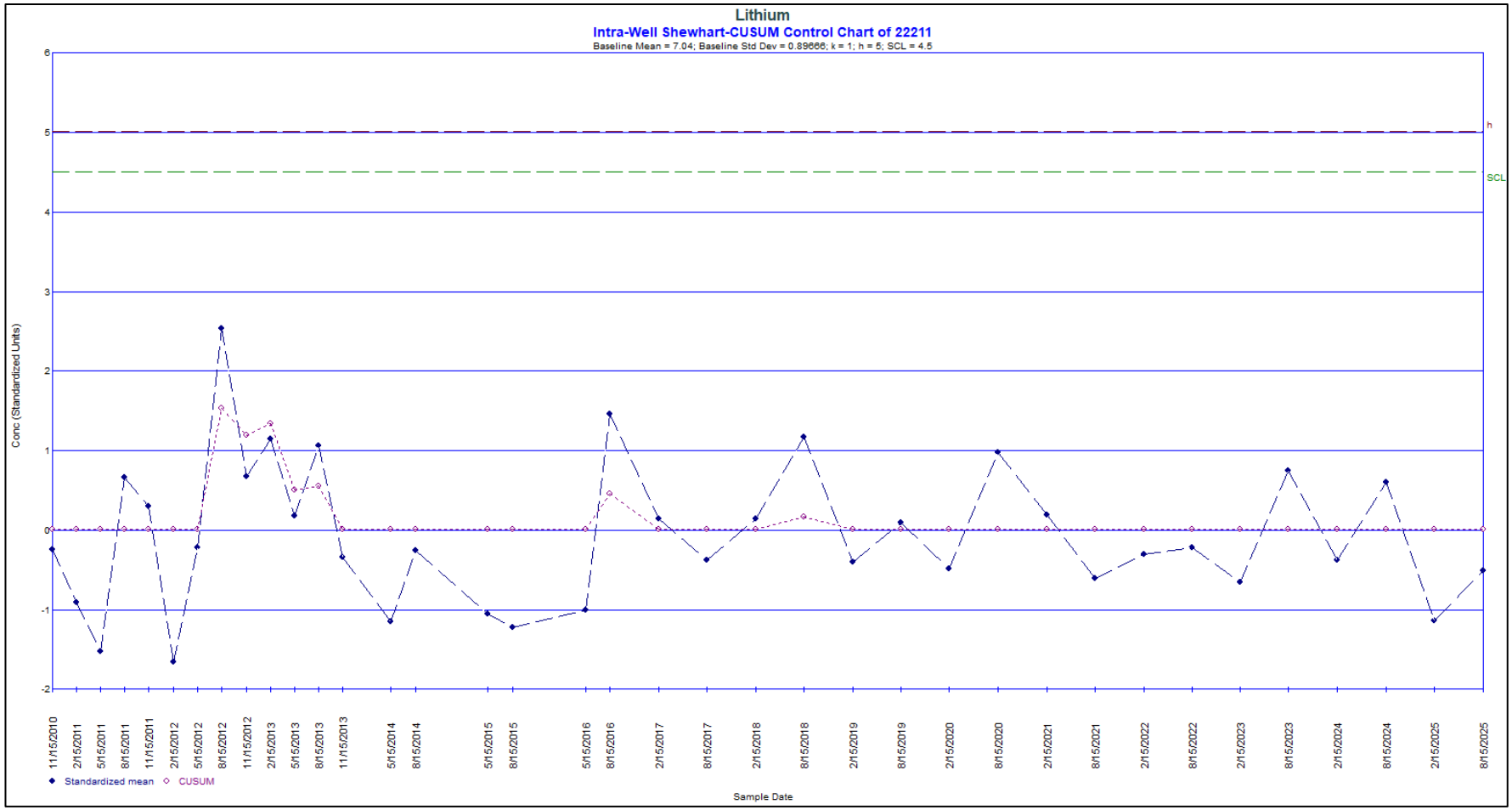


Figure A.5.7-19. Intrawell Shewhart-CUSUM Control Chart for Lithium in Monitoring Well 22211

Subattachment A.5.8

Cell 8

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Contents

Abbreviations iii
Measurement Abbreviations iii
A.5.8.1 Water Quality Monitoring Results 1
A.5.8.1.1 LCS and LDS Results 1
A.5.8.1.2 HTW and Monitoring Well Results 2
A.5.8.1.3 Discussion 2
A.5.8.2 Control Charts 3
A.5.8.3 Summary and Conclusions 4
A.5.8.4 References 4

Tables

Table A.5.8-1. Summary Statistics for Cell 8 5
Table A.5.8-2. OSDF Horizontal Till Well 12345 (Cell 8) Water Yield 7

Figures

Figure A.5.8-1. Monthly Accumulation Volumes for Cell 8 LCS 8
Figure A.5.8-2. Monthly Accumulation Volumes for Cell 8 LDS 8
Figure A.5.8-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Upgradient Monitoring Well 22213 9
Figure A.5.8-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Downgradient Monitoring Well 22214 9
Figure A.5.8-5. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Downgradient Monitoring Well 22215 10
Figure A.5.8-6. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Downgradient Monitoring Well 22216/22217 10
Figure A.5.8-7A. Cell 8 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW 11
Figure A.5.8-7B. Cell 8 Total Uranium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 11
Figure A.5.8-8A. Cell 8 Boron Concentration Versus Time Plot for LCS, LDS, and HTW 12
Figure A.5.8-8B. Cell 8 Boron Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 12
Figure A.5.8-9A. Cell 8 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW 13
Figure A.5.8-9B. Cell 8 Sodium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 13
Figure A.5.8-10A. Cell 8 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW 14
Figure A.5.8-10B. Cell 8 Sulfate Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 14
Figure A.5.8-11. Cell 8 Calcium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 15

Figure A.5.8-12. Cell 8 Lithium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 15
Figure A.5.8-13. Cell 8 Magnesium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 16
Figure A.5.8-14. Cell 8 Nitrate + Nitrate as Nitrogen Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 16
Figure A.5.8-15. Cell 8 Potassium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 17
Figure A.5.8-16. Cell 8 Selenium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 17
Figure A.5.8-17. Cell 8 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 18
Figure A.5.8-18. Cell 8 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 18
Figure A.5.8-19. Cell 8 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells 19
Figure A.5.8-20. Cell 8 Bivariate Plot for Uranium and Sodium 19
Figure A.5.8-21. Cell 8 Bivariate Plot for Uranium and Sulfate 20
Figure A.5.8-22. Intrawell Shewhart-CUSUM Control Chart for Boron in Monitoring Well 12345 21

Abbreviations

CUSUM	Shewhart-cumulative sum
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GMA	Great Miami Aquifer
GMA-D	downgradient Great Miami Aquifer
GMA-SE	southeast Great Miami Aquifer
GMA-SW	southwest Great Miami Aquifer
GMA-U	upgradient Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
SCL	Shewhart control limit

Measurement Abbreviations

amsl	above mean sea level
ft	feet
mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

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This subattachment provides the following information about the On-Site Disposal Facility (OSDF) Cell 8:

- Semiannual monitoring summary statistics (Table A.5.8-1)
- Leachate collection system (LCS) monthly accumulation volumes (Figure A.5.8-1)
- Leak detection system (LDS) monthly accumulation volumes (Figure A.5.8-2)
- OSDF horizontal till well (HTW) 12345 water yield (Table A.5.8-2)
- Great Miami Aquifer (GMA) water levels and total uranium concentration versus time (Figures A.5.8-3 through A.5.8-6)
- Plots of concentration versus time (Figures A.5.8-7A through A.5.8-19)
- Bivariate plots for uranium–sodium and uranium–sulfate (Figures A.5.8-20 and A.5.8-21)
- Control chart (Figure A.5.8-22)

A.5.8.1 Water Quality Monitoring Results

Water quality within the cell is sampled in the LCS and LDS. Water quality beneath the cell is sampled in the HTW and GMA wells. Concentration versus time plots, bivariate plots, and control charts are used to help interpret and present the results.

Until 2014, quarterly water quality monitoring occurred in the LCS, LDS, HTW, and GMA wells of each cell for the purpose of determining if the OSDF is operating as designed. With U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) concurrence, the U.S. Department of Energy (DOE) changed from a quarterly sampling frequency to a semiannual sampling frequency at the start of 2014.

With EPA and Ohio EPA concurrence, DOE reduced the number of parameters sampled from 24 to 13 beginning in January 2017. All 13 parameters are sampled in the GMA wells; 4 of 13 parameters (total uranium, boron, sodium, and sulfate) are sampled in the LCS, LDS, and HTW of each cell. The annual sampling in the LCS of each cell for the abbreviated list of Appendix I parameters and polychlorinated biphenyls listed in *Ohio Administrative Code* 3745-27-10 was also eliminated beginning in January 2017 with EPA and Ohio EPA concurrence (DOE 2017).

A.5.8.1.1 LCS and LDS Results

As shown in Table A.5.8-1, and summarized below, two parameters (sodium and sulfate) in 2025 have upward concentration trends in the LCS based on the Mann-Kendall test for trend. Since 2021, the volume of water in the LDS tank of Cell 8 has been insufficient to collect a sample.

Two new high concentrations were measured in the LCS of Cell 8 in 2025 (boron and sodium). The new high boron concentration measured in the LCS of Cell 8 in 2025 was 0.845 milligrams per liter (mg/L), which is up from 0.817 mg/L. The new high sodium concentration measured in the LCS of Cell 8 in 2025 was 164 mg/L, which is up from 157 mg/L.

Parameters with Upward Concentration Trends in the LCS and LDS of Cell 8

Parameter	LCS 12345C 2025 Trend	LDS 12345D Trend (Last Year Sampled)
Sodium	Up	Up (2021)
Sulfate	Up	Up (2021)

A.5.8.1.2 HTW and Monitoring Well Results

As shown in Table A.5.8-1 and summarized below, eight parameters sampled in 2025 (total uranium, boron, sodium, sulfate, lithium, selenium, total dissolved solids, and total organic halogens) have upward concentration trends in the HTW or GMA wells based on the Mann-Kendall test for trend. Cell 8 is unique in that it has four GMA wells (upgradient GMA [GMA-U], downgradient GMA [GMA-D], southwest GMA [GMA-SW], and southeast GMA [GMA-SE]). The Cell 8 HTW has not contained enough water to collect a sample since 2008.

Parameters with Upward Concentration Trends in the HTW and GMA Wells of Cell 8

Parameter	HTW 12345[a,b] (Year Last Sampled)	GMA-U 22213[a,b]	GMA-D 22214[a,b]	GMA-SW 22215[a,b]	GMA-SE 22217[a,b]
Total Uranium	Up (2008)	Up			
Boron		Up	Up	Up	Up
Sodium			Up		
Sulfate	Up (2008)			Up	
Lithium				Up	
Selenium		Up	Up	Up	Up
Total Dissolved Solids				Up	
Total Organic Halogens		Up	Up		Up

[a] No entry indicates that the trend was not up. Selenium, total dissolved solids, and total organic halogens are not HTW parameters.
[b] GMA-D = downgradient Great Miami Aquifer; GMA-SE = southeast Great Miami Aquifer; GMA-SW = southwest Great Miami Aquifer; GMA-U = upgradient Great Miami Aquifer; HTW = horizontal till well.

A.5.8.1.3 Discussion

Two bivariate plots are used to illustrate that the LCS, LDS, and HTW of Cell 8 have separate and distinct chemical signatures. A uranium–sodium bivariate plot for the Cell 8 LCS, LDS, and HTW is provided in Figure A.5.8-20, and a uranium–sulfate bivariate plot for the Cell 8 LCS, LDS, and HTW is provided in Figure A.5.8-21. On the figures, the first sample collected from the monitoring horizon is circled. An arrow leads from the first sample to the location of the most recent sample. Both plots show that the chemical signatures for uranium and sodium and for uranium and sulfate in the LCS are separate and distinct from the signatures seen in the LDS and HTW. The uranium–sulfate plot illustrates more clearly than the uranium–sodium plot that

the chemical signatures in the LDS and HTW are also separate and distinct. Separate and distinct chemical signatures in the LCS, LDS, and HTW indicate that water is not mixing between the horizons. Therefore, the increasing concentrations measured beneath Cell 8 (i.e., HTW and GMA wells) are attributed to fluctuating ambient concentrations beneath the cell and are not related to cell performance.

A.5.8.2 Control Charts

Intrawell control charts employ historical measurements from a compliance point as background. The *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance* (EPA 2009) defines the process of creating a Shewhart-cumulative sum (CUSUM) control chart. Appropriate background data are used to define a baseline for the well. The baseline parameters for the chart, estimates of the mean, and standard deviation are obtained from the background data. These baseline measurements characterize the expected background concentrations at the monitoring point. As future concentrations are measured, the baseline parameters are used to standardize the newly gathered data. After these measurements are standardized and plotted, a control chart is declared "not in control" if future concentrations exceed the baseline control limit. This is indicated on the control chart when either the Shewhart or CUSUM plot traces begin to exceed a control limit. The limit is based on the rationale that if the monitoring point remains unchanged from the baseline condition, new standardized observations should not deviate substantially from the baseline mean. If a change occurs, the standardized values will deviate significantly from the baseline and tend to exceed the control limit. Usually, two parameters are used to compute standardized limits—the decision value (*h*) and the Shewhart control limit (SCL).

A minimum of eight samples are recommended for use in ChemStat software to define the baseline for a control chart. Therefore, only sample sets with greater than eight samples were selected for control charts. By default, the ChemStat software plots both a CUSUM control limit (*h*) and an SCL on the control chart. The software recommends a value of 5 for the CUSUM control limit and a value of 4.5 for the SCL.

EPA Statistical Analysis Unified Guidance (EPA 2009) suggests that, to simplify the interpretation of the control chart, an out-of-control condition should be based on the CUSUM *(h)* limit alone. Plotting the SCL is not needed. However, the ChemStat software, by default, plots both the SCL and CUSUM control limit *(h)* on the charts. To address this issue, the SCL was defined as 5 to equal the recommended CUSUM control limit *(h)*. This combined limit is identified as *h*CL on the control charts. For interpretation purposes, the *h*CL value will be regarded as the CUSUM control limit *(h)*.

As shown in Table A.5.8-1 in gray shading and as summarized below, one parameter in the HTW or GMA wells of Cell 8 meets the criteria for control charts (i.e., at least eight samples, normal or lognormal distribution, no trend, and no serial correlation), resulting in one control chart (Figure A.5.8-22) that exhibits "in control" conditions.

Parameter	Monitoring Point[a]	Monitoring Well	Assessment	Figure Number
Boron	HTW	12345	In Control	A.5.8-22

A.5.8.3 Summary and Conclusions

- Two parameters monitored semiannually have an upward concentration trend in the LCS of Cell 8 in 2025: sodium and sulfate. Since 2021 the LDS has not had sufficient water to collect a sample.
- Two new high concentrations were measured in the LCS of Cell 8 in 2025 (boron and sodium). The new high boron concentration measured in the LCS of Cell 8 in 2025 was 0.845 mg/L, which is up from 0.817 mg/L. The new high sodium concentration measured in the LCS of Cell 8 in 2025 was 164 mg/L, which is up from 157 mg/L.
- Since 2008, the Cell 8 HTW has not contained enough water to collect a sample.
- Eight parameters monitored semiannually are increasing in either the HTW or GMA wells of Cell 8 (total uranium, boron, sodium, sulfate, lithium, selenium, total dissolved solids, and total organic halogens). The chemical signatures for uranium–sodium and uranium–sulfate in the LCS of Cell 8 are separate and distinct from the signatures seen in the LDS and HTW. The signature for uranium–sodium in the HTW is also separate and distinct from the LDS signature, but low total uranium concentrations in both horizons have the clusters closer than what is seen in the other seven cells. The signature for uranium–sulfate in the HTW is separate and distinct from the LDS signature. Separate and distinct chemical signatures in the LCS, LDS, and HTW indicate that water is not mixing between the horizons. Concentration increases in the HTW and GMA wells of Cell 8 are attributed to fluctuating ambient concentrations beneath the cell and not to cell performance. The HTW of Cell 8 has been dry since the third quarter of 2008, providing additional evidence that the secondary liner is not leaking.
- One control chart was constructed for Cell 8 parameters. The control chart exhibited “in control” conditions.

A.5.8.4 References

DOE (U.S. Department of Energy), 2017. *Fernald Preserve 2016 Site Environmental Report*, LMS/FER/S15232, Office of Legacy Management, May.

EPA (U.S. Environmental Protection Agency), 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance*, EPA 530/R-09-007, March.

OAC 3745-27-10. “Ground Water Monitoring Program for a Sanitary Landfill Facility,” *Ohio Administrative Code.*

Table A.5.8-1. Summary Statistics for Cell 8

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[d,g]	Outliers[h,i]
Total Uranium (µg/L)	LCS	12345C	60	60	100	35.2	227	165	46.0	Normal	Down (2025)	Detected	1.51 (Q4-04); 335 (Q1-11)
	LDS	12345D	47	47	100	9.38	315	25.1	57.4	Undefined	Up (2021)	Detected	
	HTW	12345	16	16	100	3.67	7.30	5.02	0.990	Normal	Up (2008)	Not Detected	
	GMA-U	22213	55	63	87.3	ND	0.717	0.0396	0.113	Undefined	Up (2025)	Detected	
	GMA-D	22214	72	75	96.0	ND	2.37	0.393	0.498	Undefined	None (2025)	Not Detected	
	GMA-SW	22215	52	57	91.2	ND	16.4	0.480	2.35	Undefined	None (2025)	Not Detected	
	GMA-SE	22217	53	53	100	0.898	18.3	5.92	4.08	Undefined	None (2025)	Detected	
Boron (mg/L)	LCS	12345C	60	60	100	0.0681	0.845	0.622	0.163	Undefined	None (2025)	Detected	
	LDS	12345D	47	47	100	0.582	9.20	1.37	1.70	Undefined	Up (2021)	Detected	
	HTW	12345	15	15	100	0.0683	0.0978	0.0834	0.0079	Normal	None (2008)	Not Detected	
	GMA-U	22213	60	63	95.2	ND	0.0619	0.0394	0.0093	Undefined	Up (2025)	Detected	
	GMA-D	22214	61	63	96.8	ND	0.0524	0.0294	0.0086	Undefined	Up (2025)	Detected	
	GMA-SW	22215	55	57	96.5	ND	0.0746	0.0356	0.0089	Undefined	Up (2025)	Detected	
	GMA-SE	22217	51	53	96.2	ND	0.0447	0.0298	0.0073	Normal	Up (2025)	Detected	
Sodium (mg/L)	LCS	12345C	52	52	100	16.8	164	118	36	Undefined	Up (2025)	Detected	
	LDS	12345D	38	38	100	72.8	4,590	631	775	Ln Normal	Up (2021)	Detected	
	HTW	12345	7	7	100	277	385	334	45	Normal	Down (2008)	Not Detected	
	GMA-U	22213	43	43	100	18.3	30.3	22.6	3.5	Undefined	Down (2025)	Detected	
	GMA-D	22214	45	45	100	9.83	16.8	12.3	1.4	Normal	Up (2025)	Detected	
	GMA-SW	22215	43	43	100	13.5	26.0	18.5	2.4	Normal	None (2025)	Detected	
	GMA-SE	22217	43	43	100	11.0	17.6	13.4	1.7	Undefined	Down (2025)	Detected	
Sulfate (mg/L)	LCS	12345C	60	60	100	146	4,190	3,030	1,020	Undefined	Up (2025)	Detected	
	LDS	12345D	47	47	100	1,730	36,300	3,940	6,413	Undefined	Up (2021)	Detected	
	HTW	12345	15	15	100	95.5	152	116	18	Normal	Up (2008)	Detected	
	GMA-U	22213	63	63	100	90.2	284	177	51	Normal	None (2025)	Detected	
	GMA-D	22214	63	63	100	76.1	457	204	91	Ln Normal	Down (2025)	Detected	
	GMA-SW	22215	56	57	98.2	ND	911	255	157	Undefined	Up (2025)	Detected	
	GMA-SE	22217	53	53	100	113	1,320	335	200	Ln Normal	Down (2025)	Detected	
Calcium (mg/L)	GMA-U	22213	36	36	100	136	186	154	12	Undefined	Up (2025)	Detected	
	GMA-D	22214	36	36	100	89.8	230	142	35	Ln Normal	Down (2025)	Detected	
	GMA-SW	22215	36	36	100	155	211	186	15	Normal	None (2025)	Detected	425 (Q2-11); 446 (Q3-11); 127 (Q4-13); 305 (Q1-19)
	GMA-SE	22217	36	36	100	121	334	188	47	Ln Normal	Down (2025)	Detected	
Lithium (mg/L)	GMA-U	22213	43	43	100	0.00434	0.00728	0.00549	0.00059	Normal	None (2025)	Detected	
	GMA-D	22214	43	43	100	0.00372	0.00858	0.00531	0.00109	Ln Normal	None (2025)	Detected	
	GMA-SW	22215	43	43	100	0.00467	0.00828	0.00599	0.00079	Normal	Up (2025)	Detected	
	GMA-SE	22217	43	43	100	0.00432	0.00799	0.00596	0.00092	Normal	None (2025)	Detected	
Magnesium (mg/L)	GMA-U	22213	36	36	100	31.3	42.0	35.6	2.7	Normal	Down (2025)	Detected	
	GMA-D	22214	36	36	100	22.0	53.2	34.9	7.9	Normal	None (2025)	Detected	
	GMA-SW	22215	36	36	100	32.5	48.8	42.3	4.5	Normal	None (2025)	Detected	74.5 (Q2-11); 62.3 (Q3-11); 66.8 (Q1-19)
	GMA-SE	22217	36	36	100	27.5	63.3	42.7	8.1	Normal	None (2025)	Detected	
Nitrate + Nitrite, as Nitrogen (mg/L)	GMA-U	22213	0	36	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-D	22214	2	36	5.6	ND	0.0500	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-SW	22215	3	36	8.3	ND	0.0850	0.0199	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-SE	22217	8	36	22.2	ND	0.0850	0.0085	0.0179	Undefined	None (2025)	Not Detected	
Potassium (mg/L)	GMA-U	22213	36	36	100	3.30	4.14	3.64	0.18	Normal	Down (2025)	Detected	
	GMA-D	22214	38	38	100	2.14	3.23	2.53	0.26	Normal	None (2025)	Detected	
	GMA-SW	22215	36	36	100	3.09	3.87	3.45	0.19	Normal	Down (2025)	Not Detected	4.73 (Q2-11); 5.01 (Q3-11); 2.30 (Q4-13)
	GMA-SE	22217	36	36	100	2.36	4.09	2.99	0.38	Normal	Down (2025)	Detected	
Selenium (mg/L)	GMA-U	22213	4	43	9.3	ND	0.026	0.00300	0.00500	Undefined	Up (2025)	Detected	
	GMA-D	22214	6	43	14.0	ND	0.0249	0.00300	0.00488	Undefined	Up (2025)	Detected	
	GMA-SW	22215	10	43	23.3	ND	0.0278	0.00300	0.00529	Undefined	Up (2025)	Detected	

Table A.5.8-1. Summary Statistics for Cell 8 (continued)

Parameter	Horizon[a]	Location	Number of Detected Samples	Total Number of Samples	Percent Detects	Minimum[b]	Maximum[b]	Average[c,d]	Standard Deviation[d]	Distribution Type[d,e]	Trend[d,f] (Year Last Sampled)	Serial Correlation[d,g]	Outliers[f,i]
	GMA-SE	22217	5	43	11.6	ND	0.0201	0.00300	0.00439	Undefined	Up (2025)	Detected	
Technitium-99 (pCi/L)	GMA-U	22213	6	54	11.1	ND	24.8	0.302	3.99	Undefined	Down (2025)	Detected	
	GMA-D	22214	4	54	7.41	ND	11.8	0.0300	2.27	Undefined	None (2025)	Not Detected	
	GMA-SW	22215	0	48	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
	GMA-SE	22217	0	44	0	ND	NA	Insufficient	Insufficient	Insufficient	Insufficient	Insufficient	
Total Dissolved Solids (mg/L)	GMA-U	22213	43	43	100	429	843	657	82	Undefined	Down (2025)	Detected	
	GMA-D	22214	43	43	100	386	1,020	619	145	Normal	None (2025)	Detected	
	GMA-SW	22215	43	43	100	457	1,800	816	243	Undefined	Up (2025)	Detected	
	GMA-SE	22217	43	43	100	514	1,550	859	235	Ln Normal	Down (2025)	Detected	
Total Organic Halogens (mg/L)	GMA-U	22213	18	63	28.6	ND	0.0560	0.00166	0.00841	Undefined	Up (2025)	Not Detected	
	GMA-D	22214	16	63	25.4	ND	0.0590	0.00166	0.00841	Undefined	Up (2025)	Not Detected	
	GMA-SW	22215	18	57	31.6	ND	0.0460	0.00166	0.00735	Undefined	None (2025)	Not Detected	
	GMA-SE	22217	20	53	37.7	ND	0.0730	0.00166	0.0105	Undefined	Up (2025)	Not Detected	

Note 1: Shading identifies a horizontal till well or Great Miami Aquifer well with at least eight samples. Normal or Ln Normal distribution, no trend (None), and no serial correlation (Not Detected). These wells achieve control chart criteria.

Note 2: Data used in this table has been standardized to quarterly.

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]ND = not detected; NA = not applicable

[c]Averages were determined based on the distribution assumption.

[d]Insufficient is used for Distribution Type, Trend, or Serial Correlation whenever there is not enough data to run the test.

[e]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Ln Normal assumption.

Ln Normal: Ln Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the Normal assumption.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25 percent detected values. "Average" is defined as the Median of the data.

[f]Trend based on nonparametric Mann-Kendall procedure.

[g]Serial correlation based on Rank Von Neumann test.

[i]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

Q = quarter

Table A.5.8-2. OSDF Horizontal Till Well 12345 (Cell 8) Water Yield

Year	Total Volume Purged (gallons)	Number of Months Purged	Average Volume Purged (gallons)
2004	4,020	5	804
2005	1,050	6	175
2006	3,375	4	844
2007	1,000	4	250
2008	135	4	34
2009	0	2	0
2010	0	2	0
2011	0	2	0
2012	0	2	0
2013	0	2	0
2014	0	2	0
2015	0	2	0
2016	0	2	0
2017	0	2	0
2018	0	2	0
2019	0	2	0
2020	0	2	0
2021	0	2	0
2022	0	2	0
2023	0	2	0
2024	0	2	0
2025	0	2	0

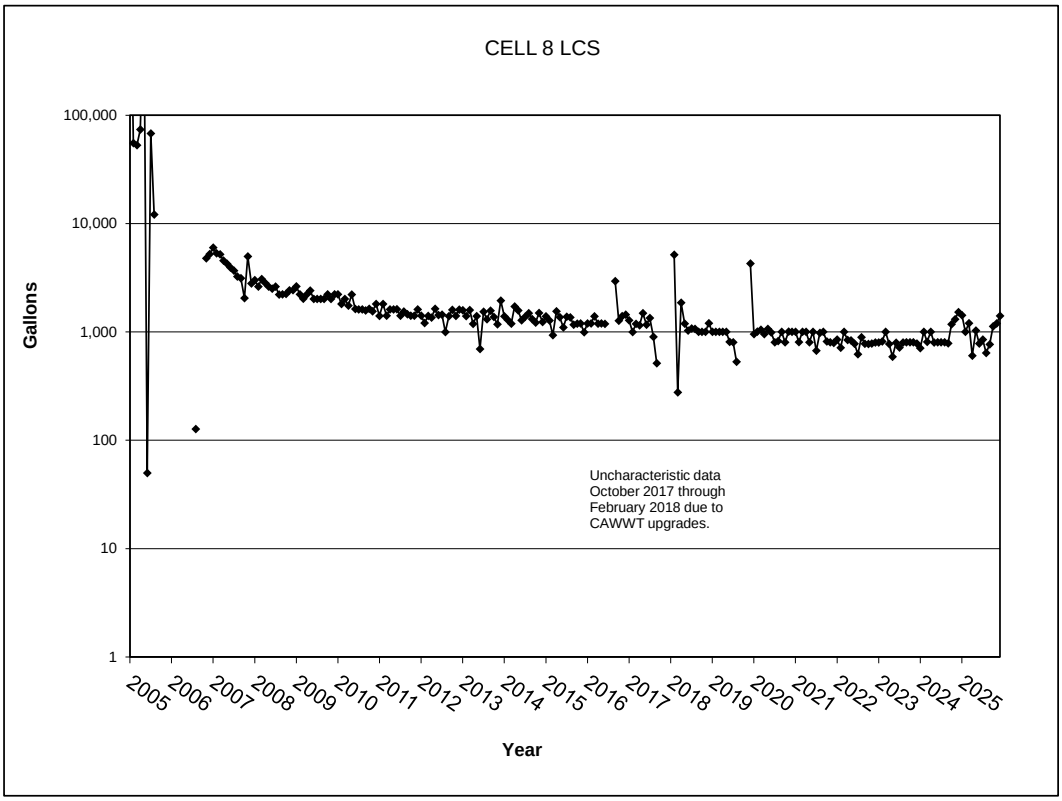


Figure A.5.8-1. Monthly Accumulation Volumes for Cell 8 LCS

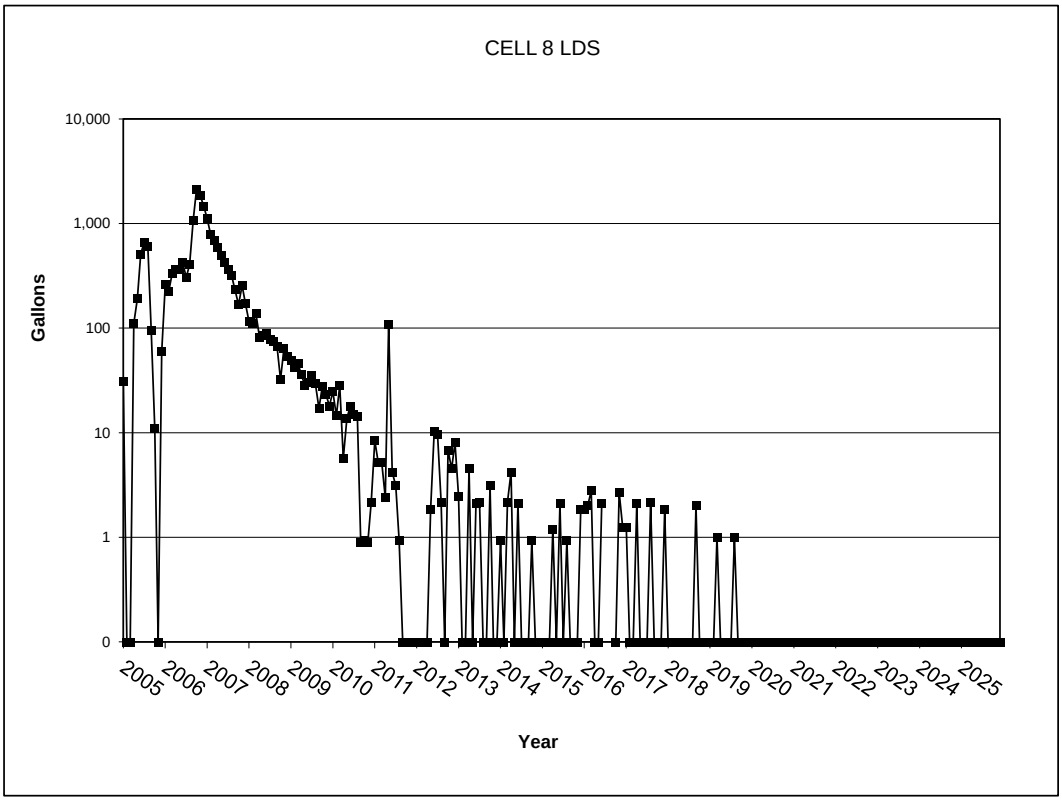


Figure A.5.8-2. Monthly Accumulation Volumes for Cell 8 LDS

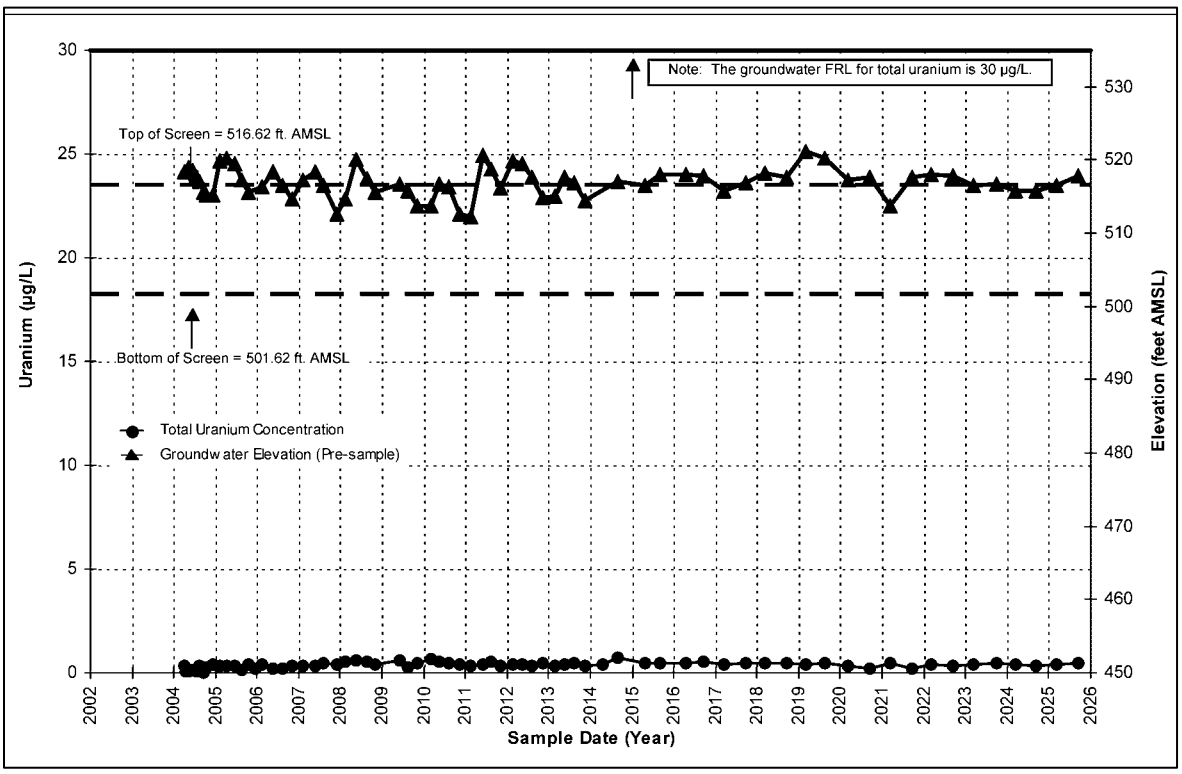


Figure A.5.8-3. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Upgradient Monitoring Well 22213

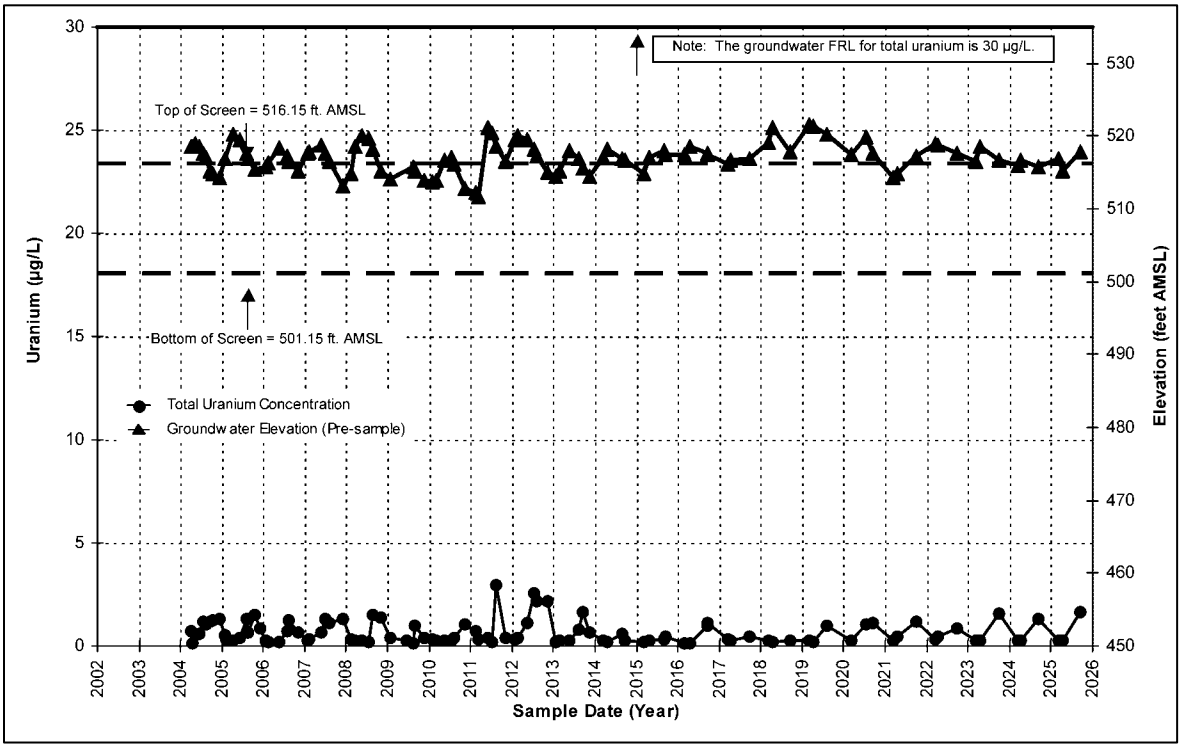


Figure A.5.8-4. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Downgradient Monitoring Well 22214

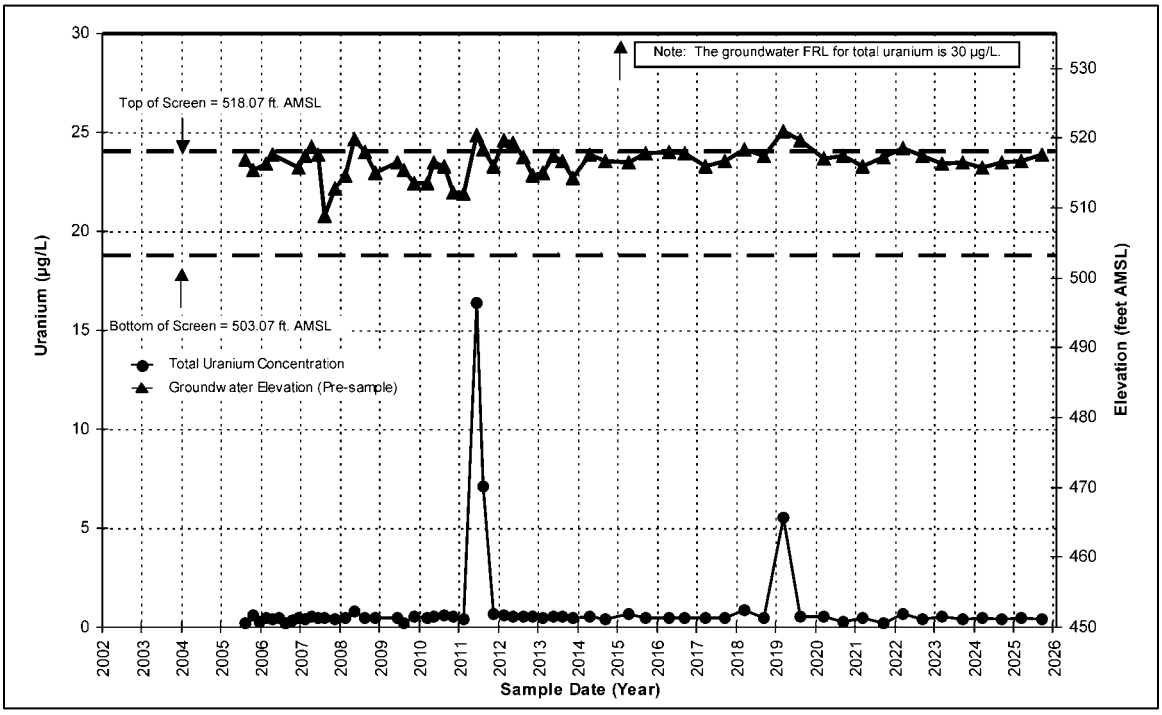


Figure A.5.8-5. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Downgradient Monitoring Well 22215

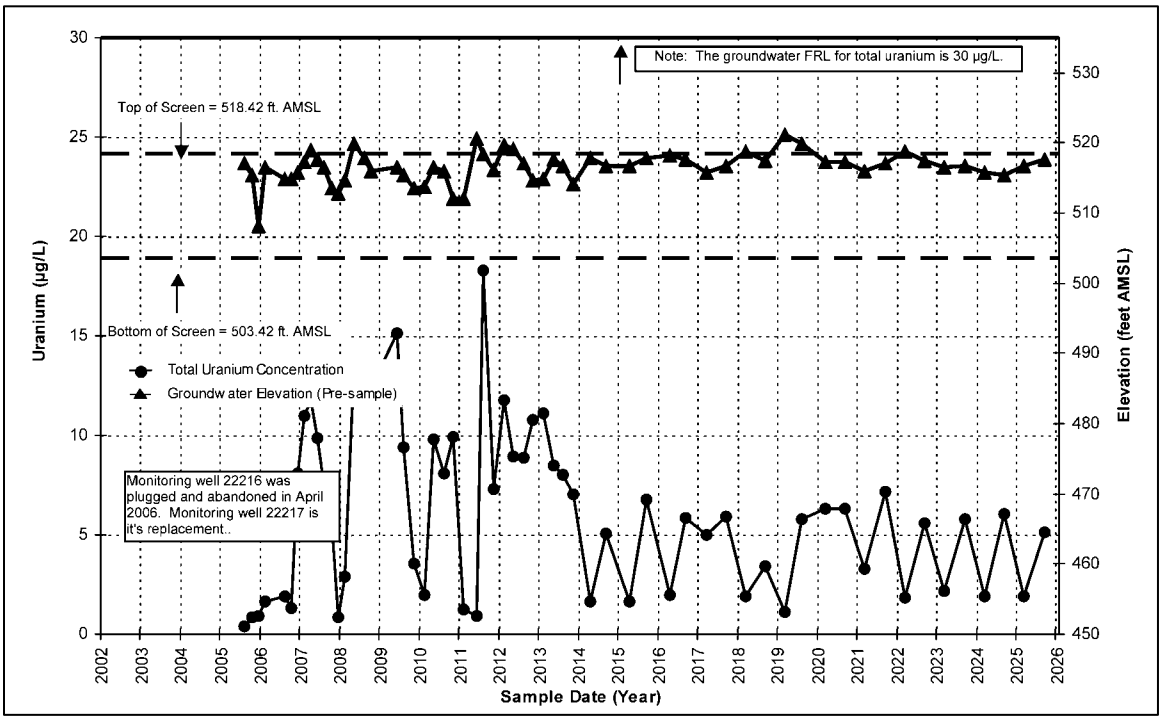


Figure A.5.8-6. Total Uranium Concentration and Groundwater Elevation Versus Time Plot for Cell 8 Downgradient Monitoring Well 22216/22217

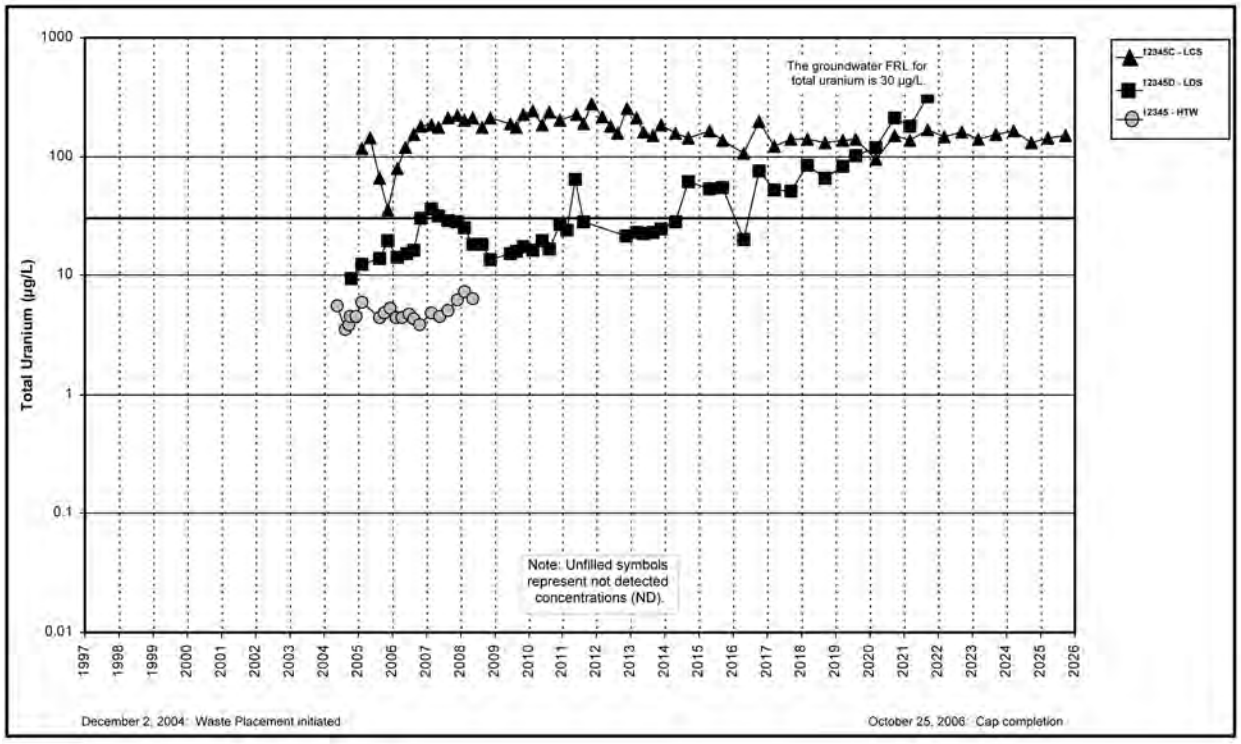


Figure A.5.8-7A. Cell 8 Total Uranium Concentration Versus Time Plot for LCS, LDS, and HTW

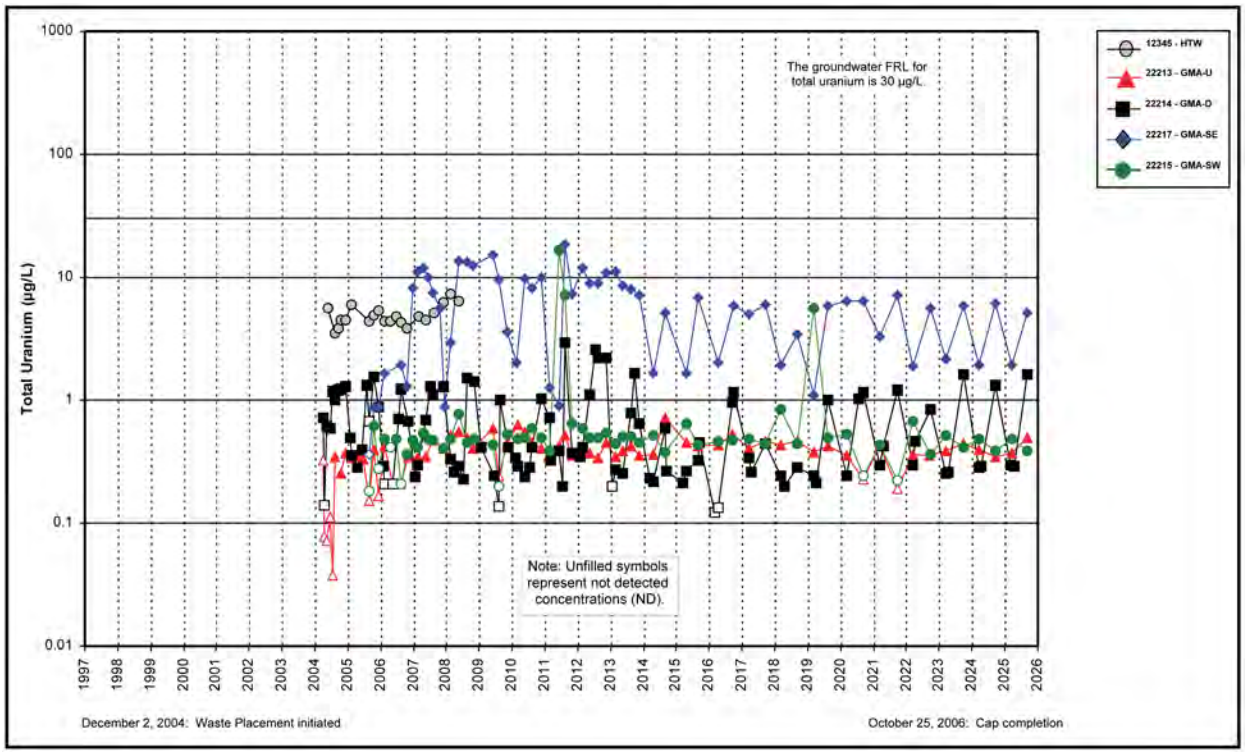


Figure A.5.8-7B. Cell 8 Total Uranium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

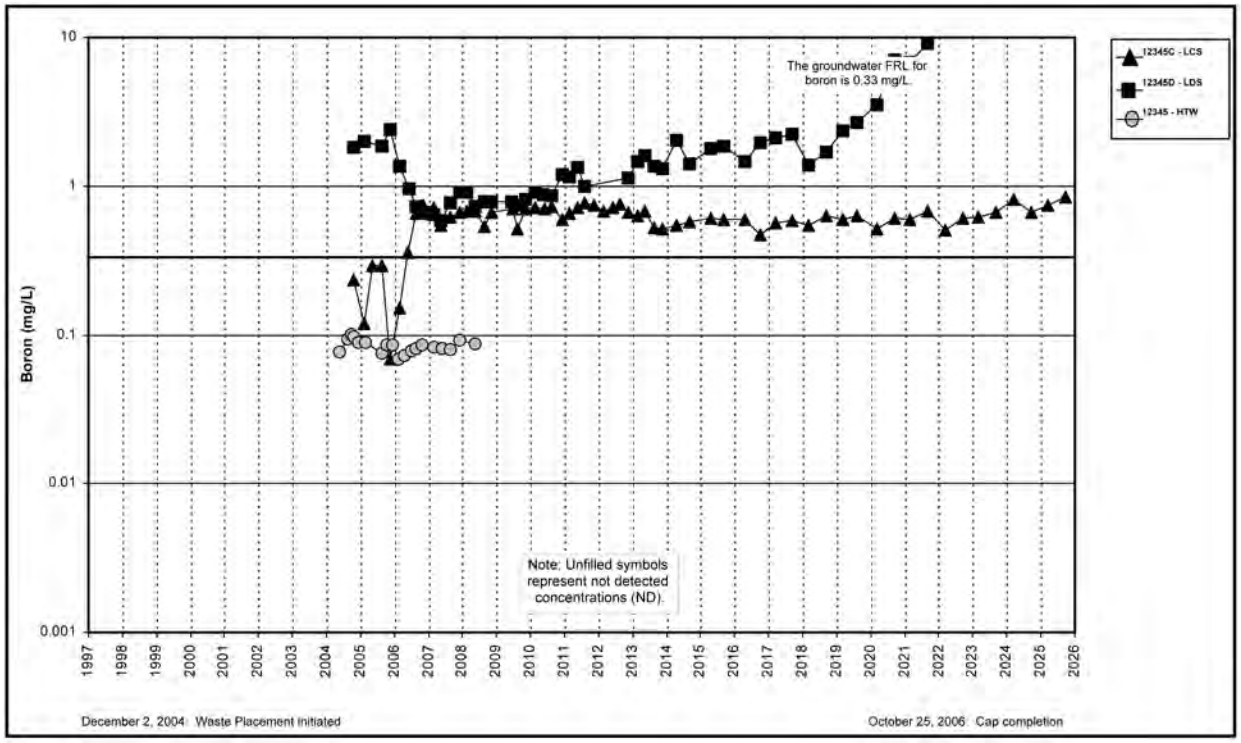


Figure A.5.8-8A. Cell 8 Boron Concentration Versus Time Plot for LCS, LDS, and HTW

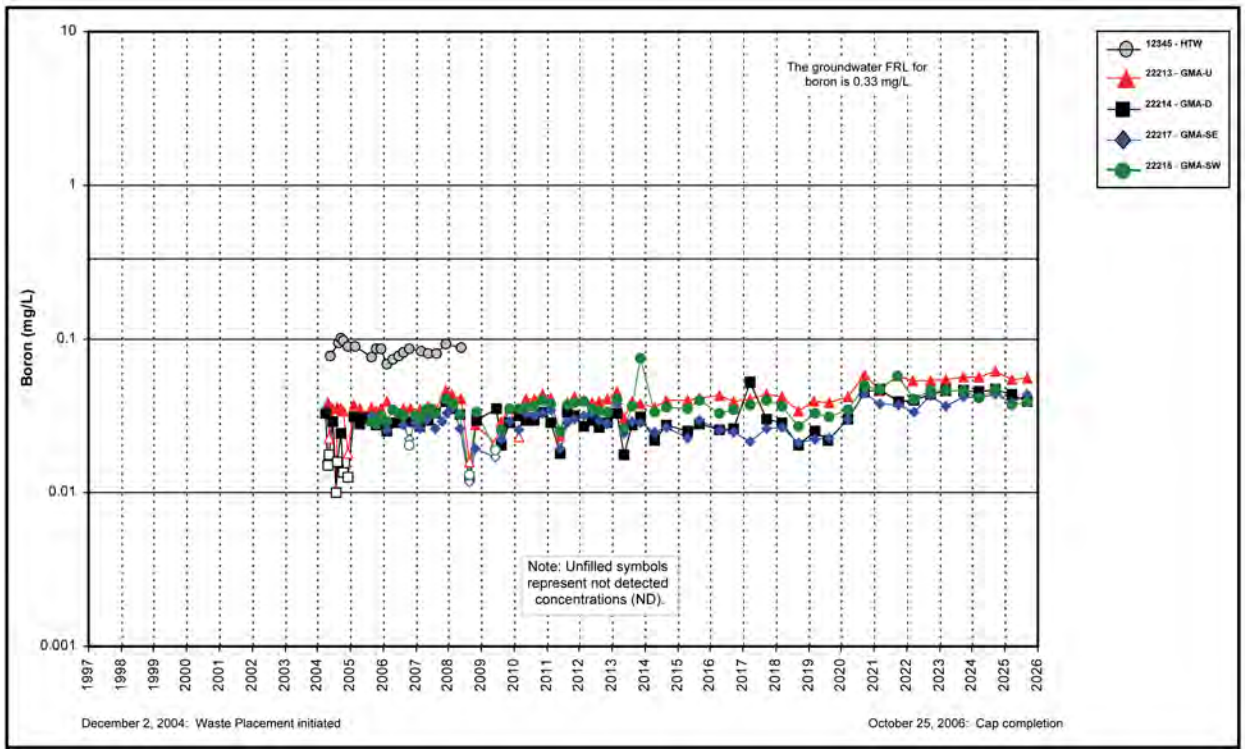


Figure A.5.8-8B. Cell 8 Boron Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

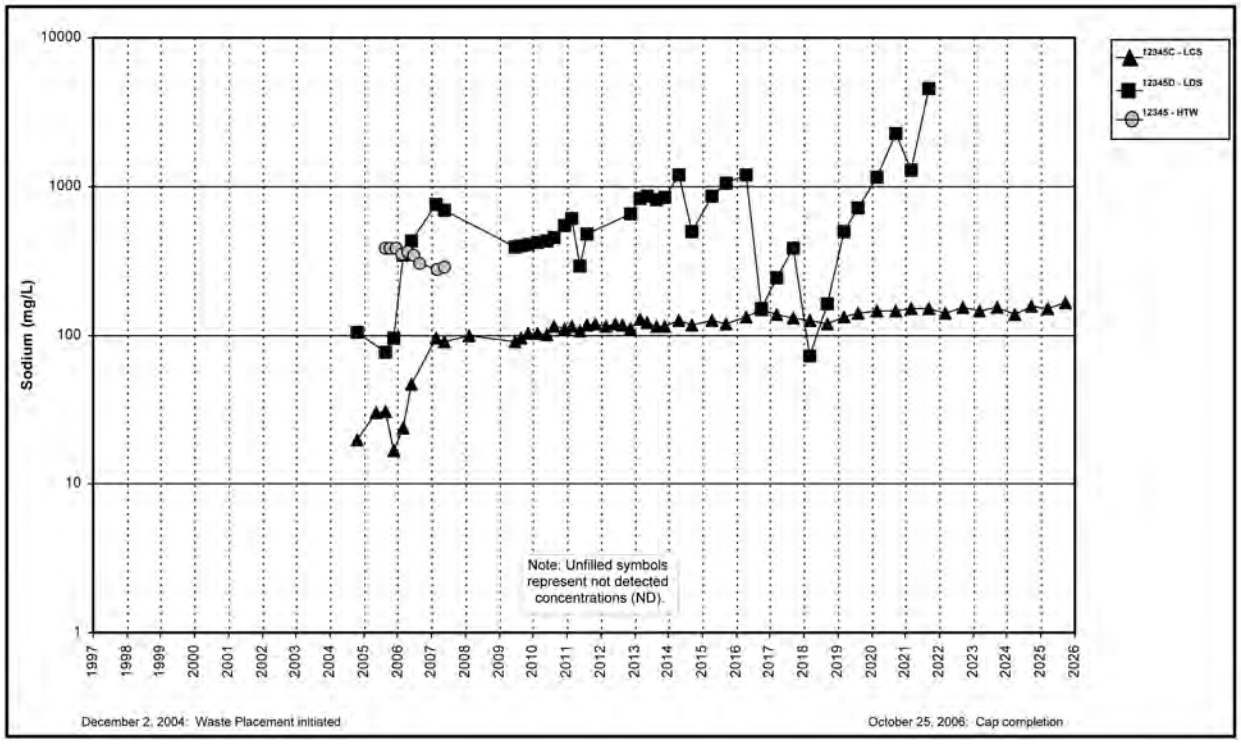


Figure A.5.8-9A. Cell 8 Sodium Concentration Versus Time Plot for LCS, LDS, and HTW

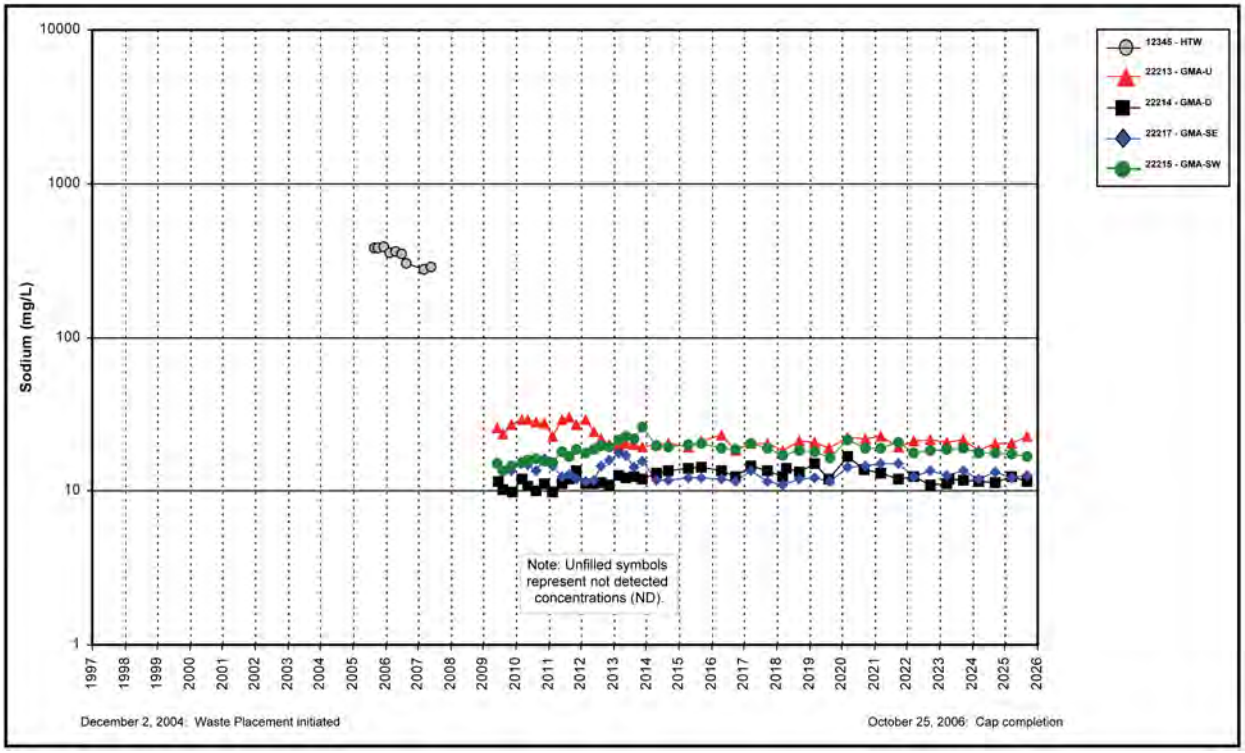


Figure A.5.8-9B. Cell 8 Sodium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

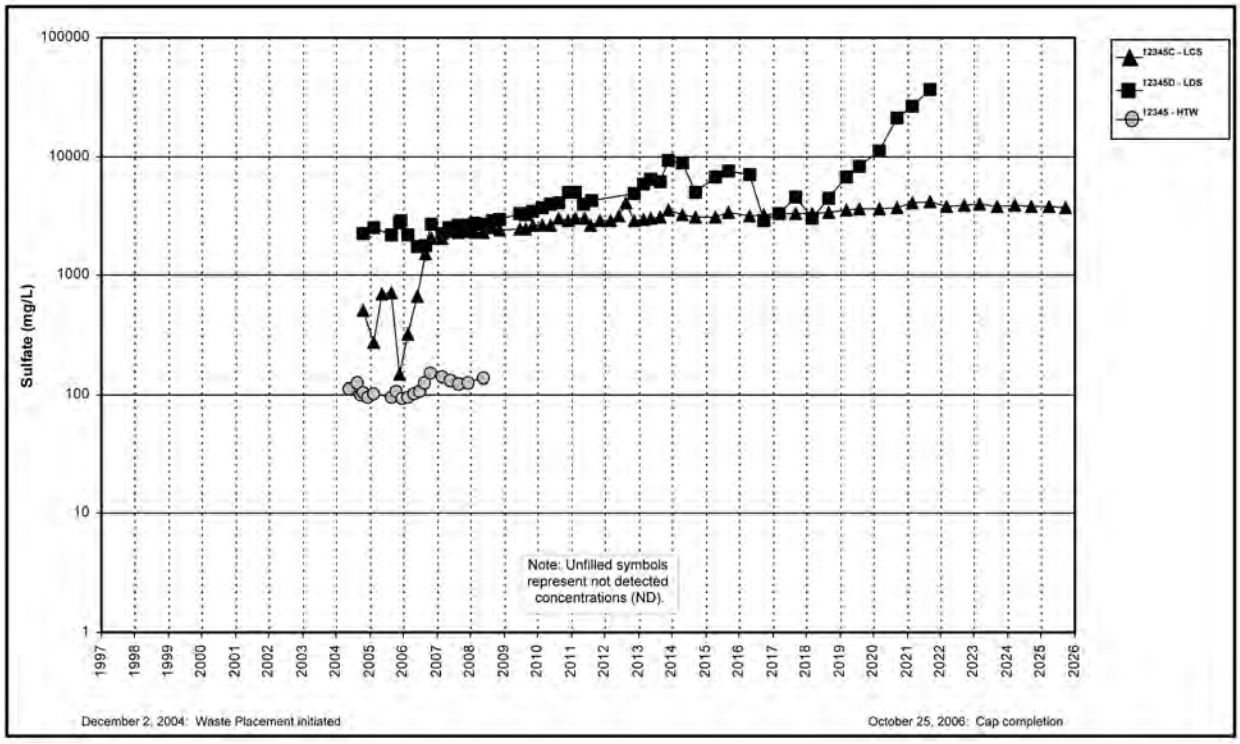


Figure A.5.8-10A. Cell 8 Sulfate Concentration Versus Time Plot for LCS, LDS, and HTW

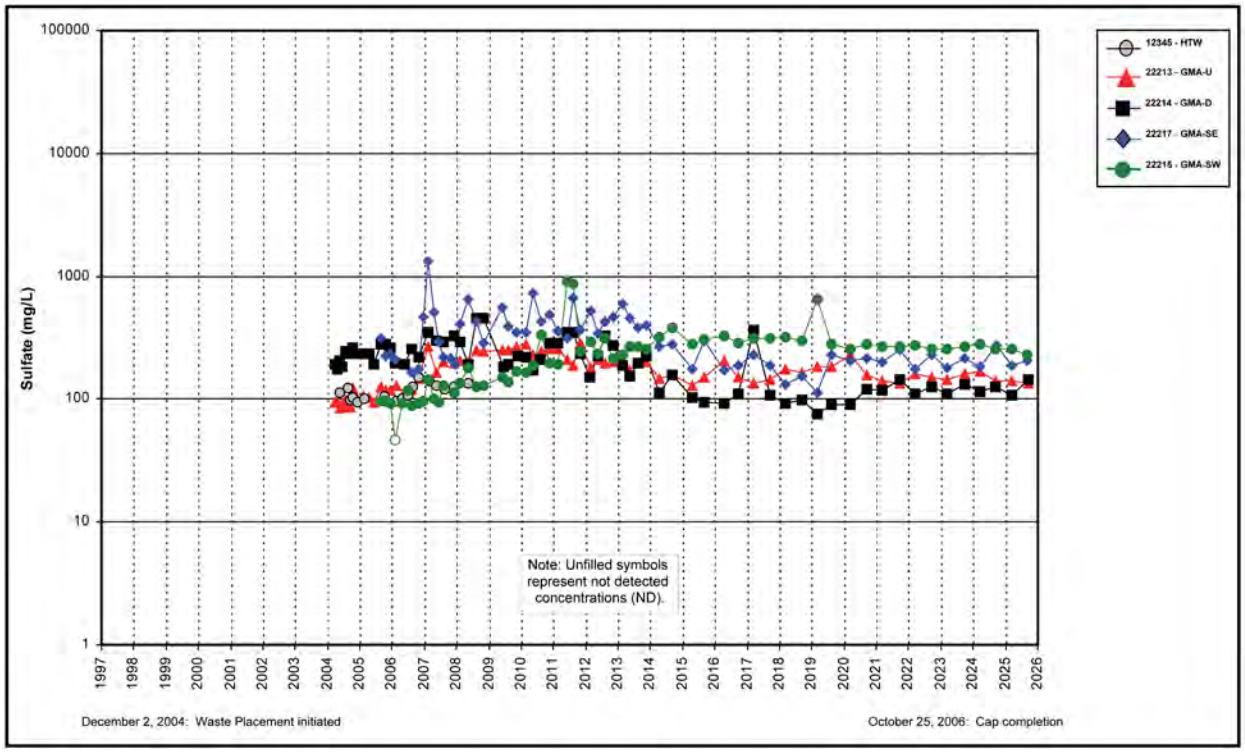


Figure A.5.8-10B. Cell 8 Sulfate Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

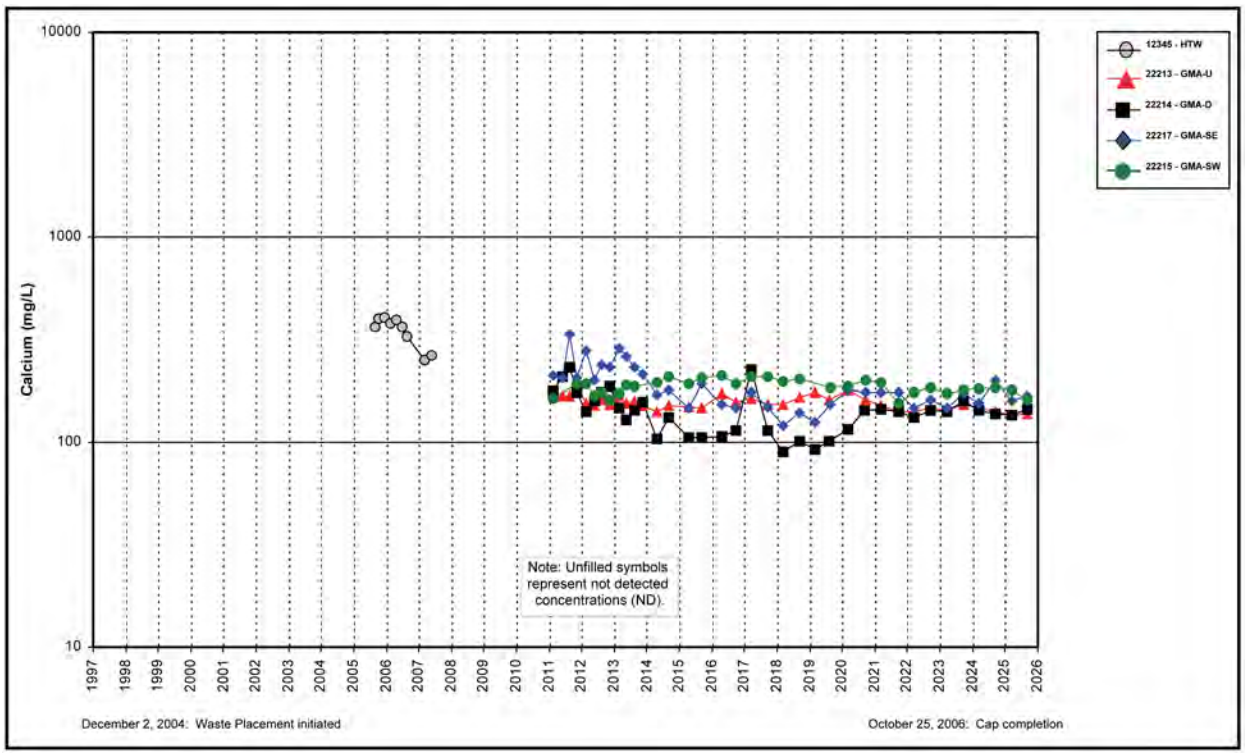


Figure A.5.8-11. Cell 8 Calcium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

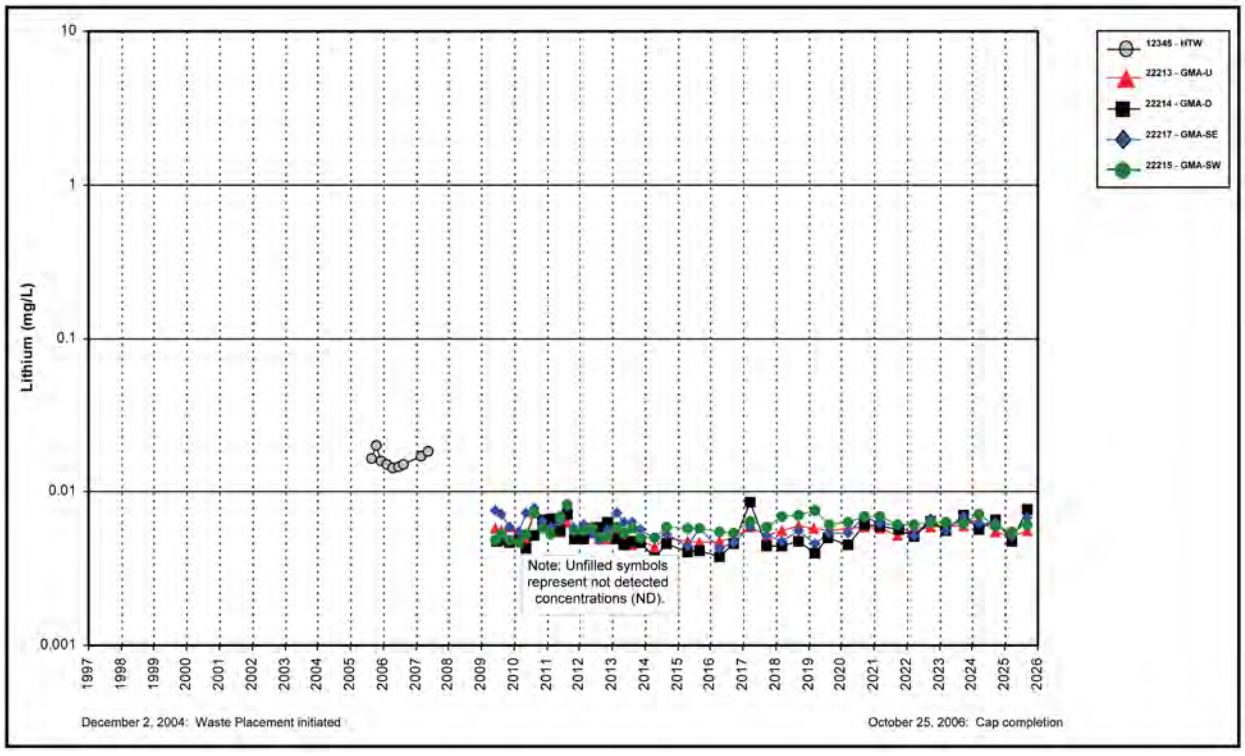


Figure A.5.8-12. Cell 8 Lithium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

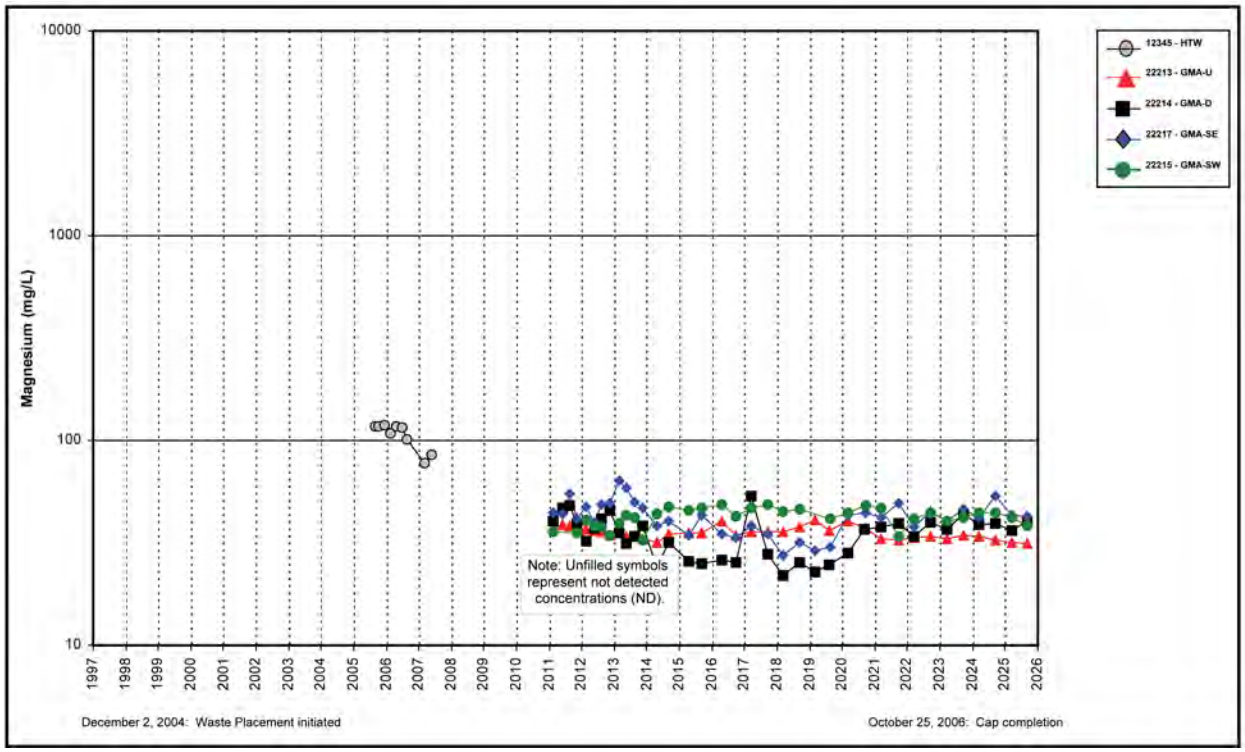


Figure A.5.8-13. Cell 8 Magnesium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

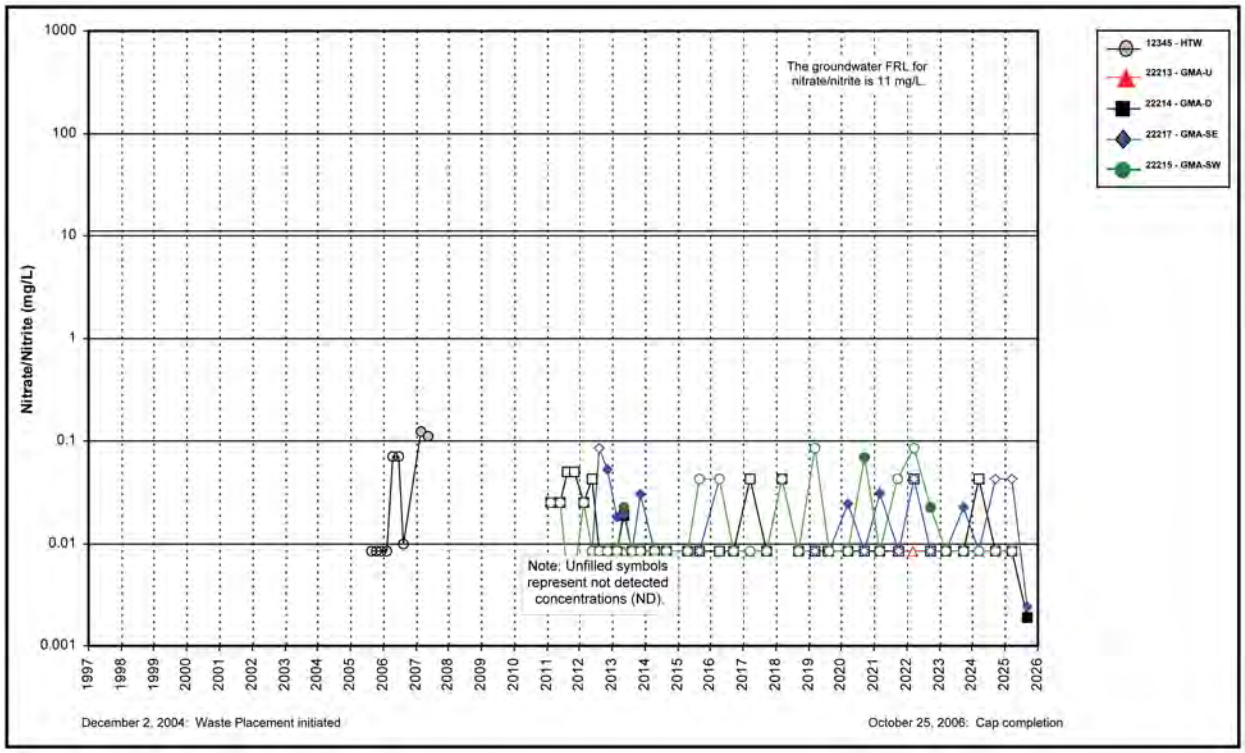


Figure A.5.8-14. Cell 8 Nitrate + Nitrate as Nitrogen Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

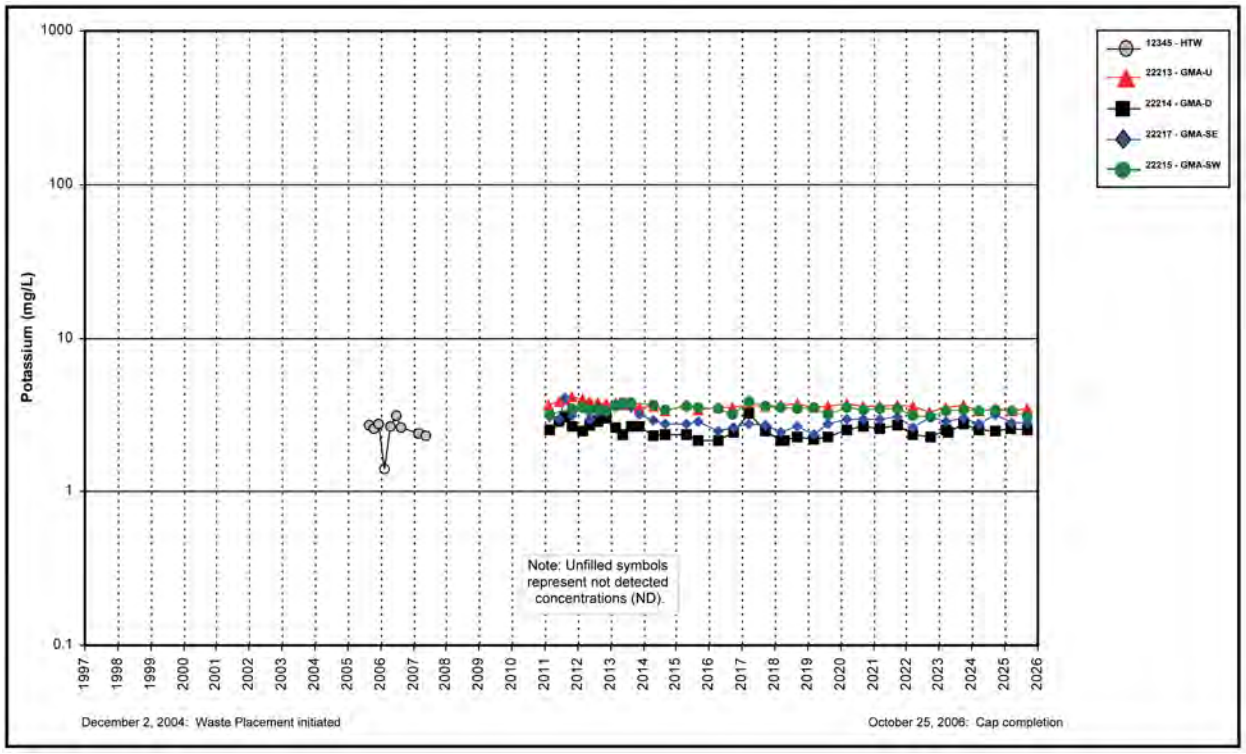


Figure A.5.8-15. Cell 8 Potassium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

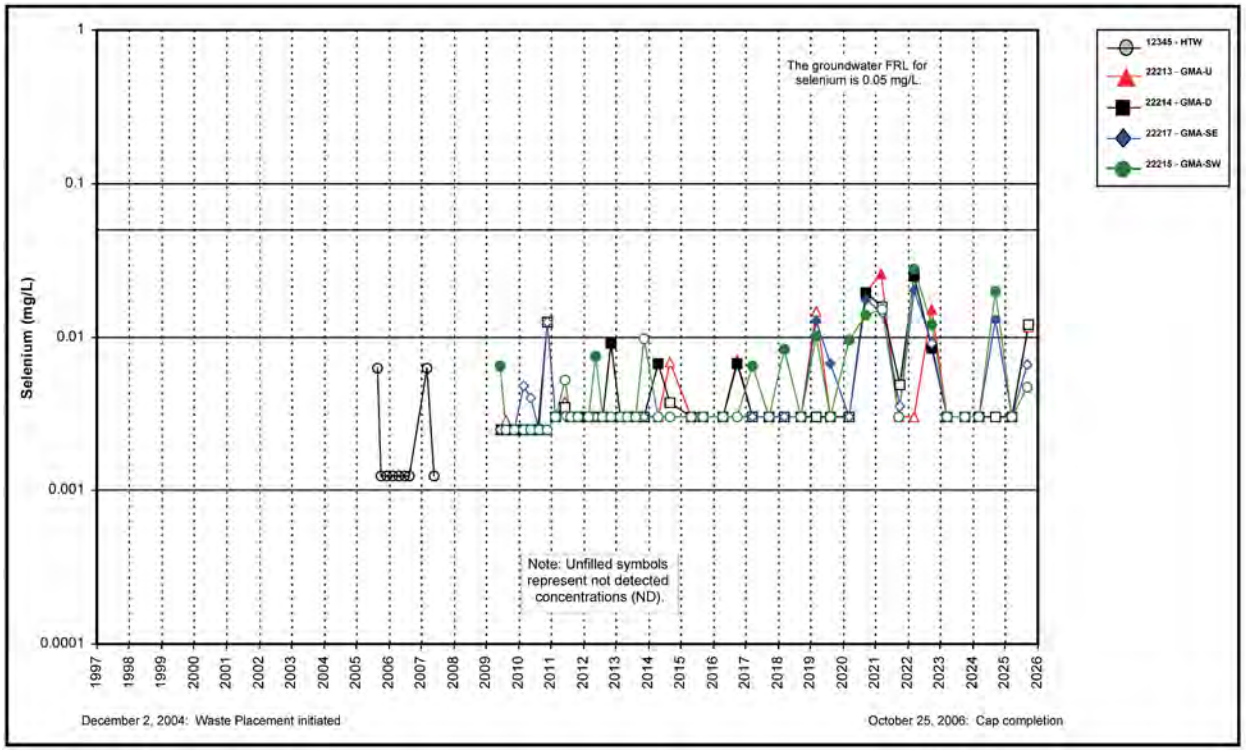


Figure A.5.8-16. Cell 8 Selenium Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

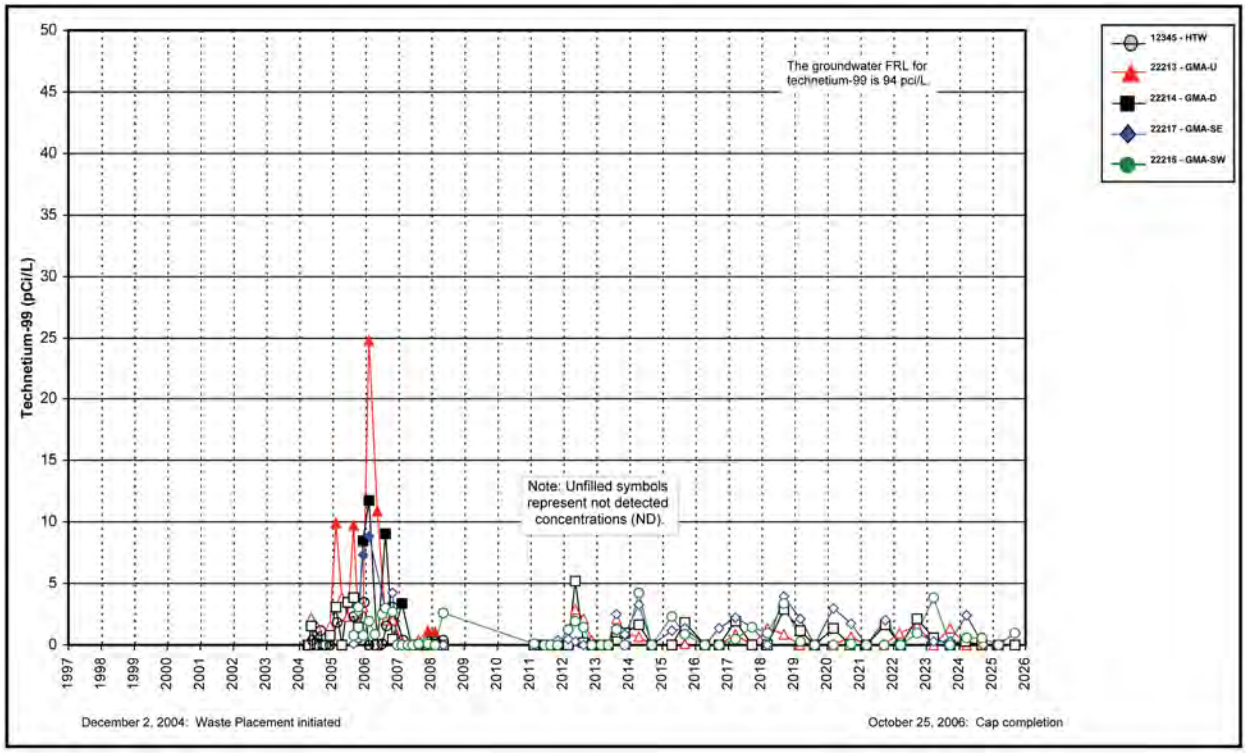


Figure A.5.8-17. Cell 8 Technetium-99 Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

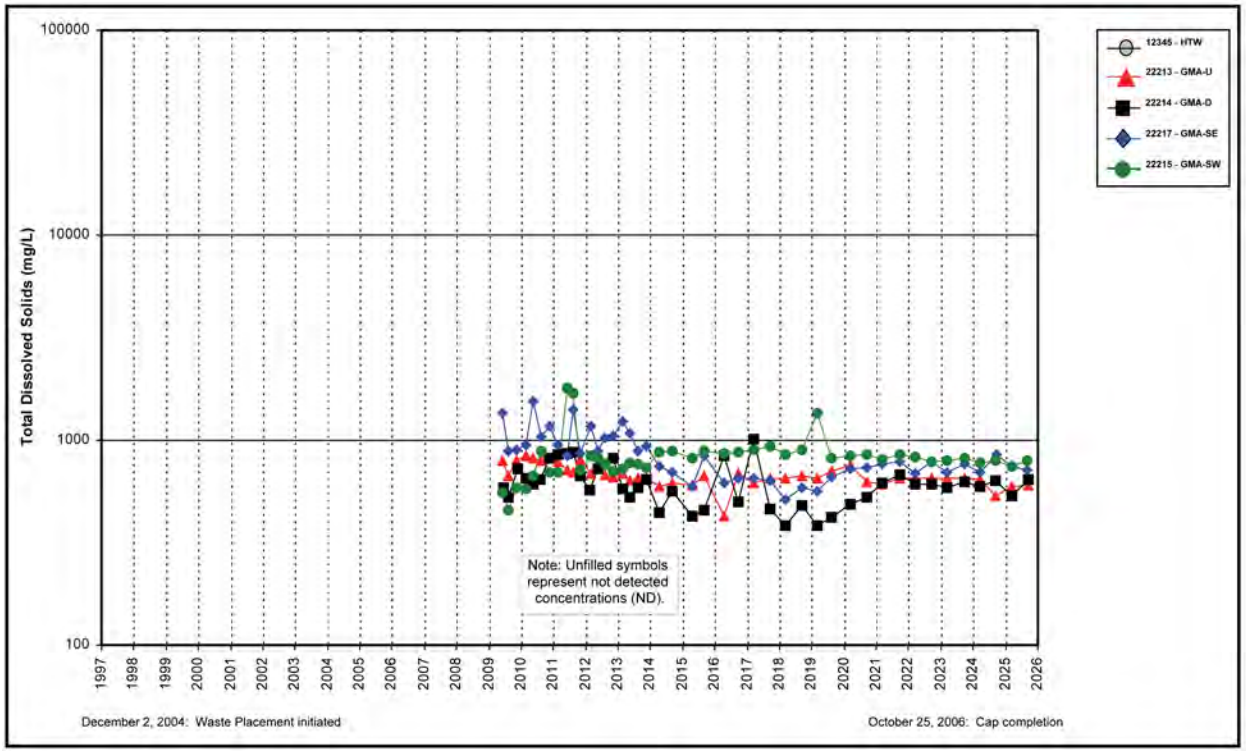


Figure A.5.8-18. Cell 8 Total Dissolved Solids Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

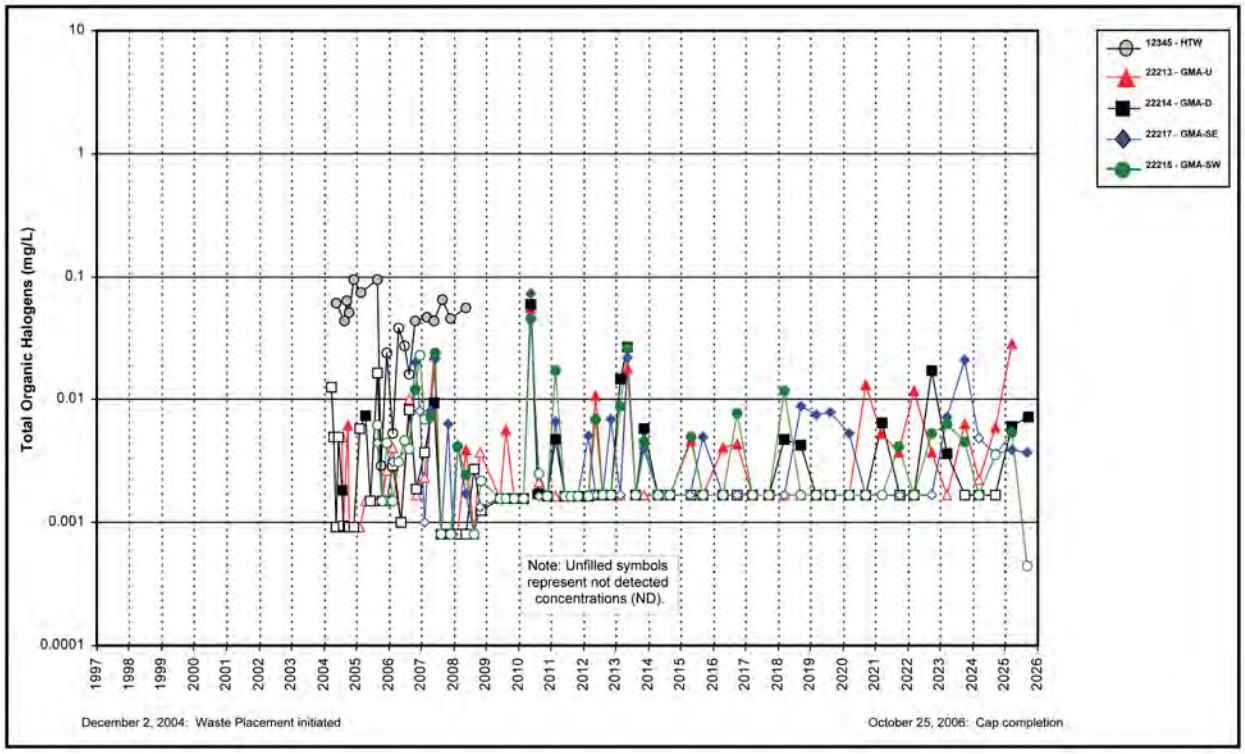


Figure A.5.8-19. Cell 8 Total Organic Halogens Concentration Versus Time Plot for HTW, GMA-U, GMA-D, GMA-SE, and GMA-SW Wells

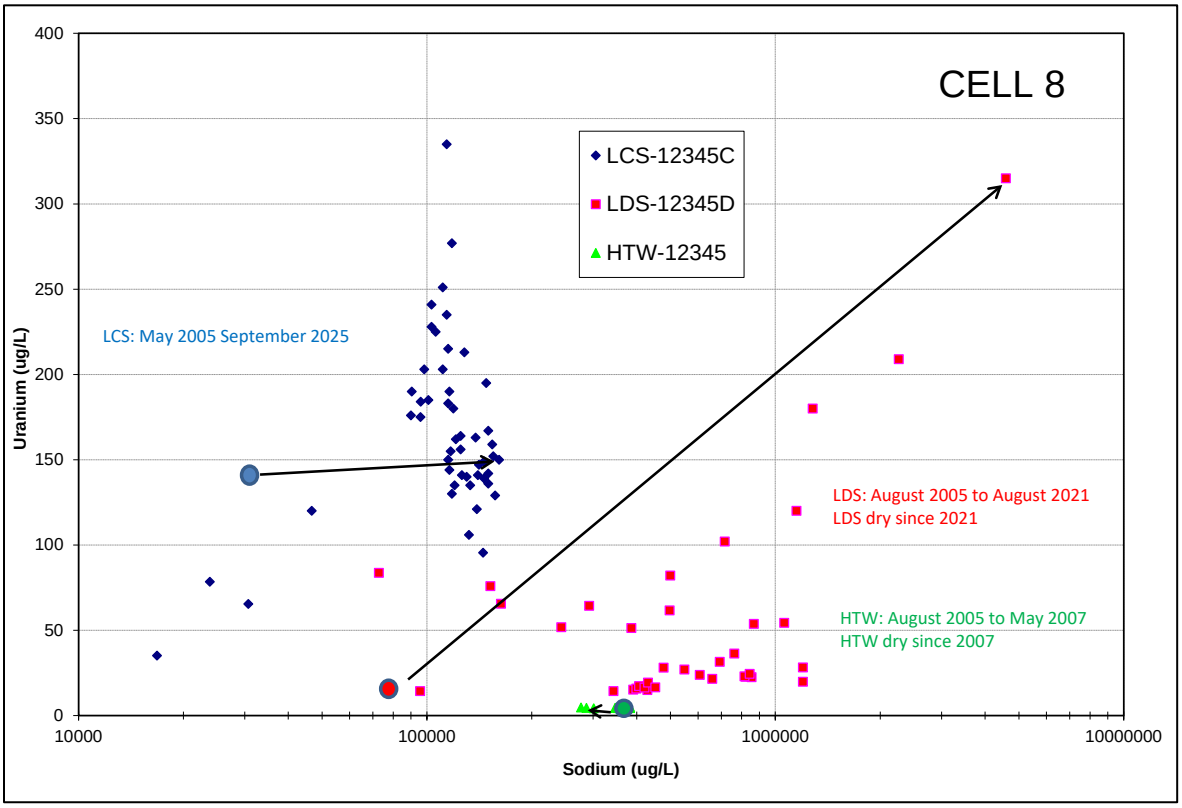


Figure A.5.8-20. Cell 8 Bivariate Plot for Uranium and Sodium

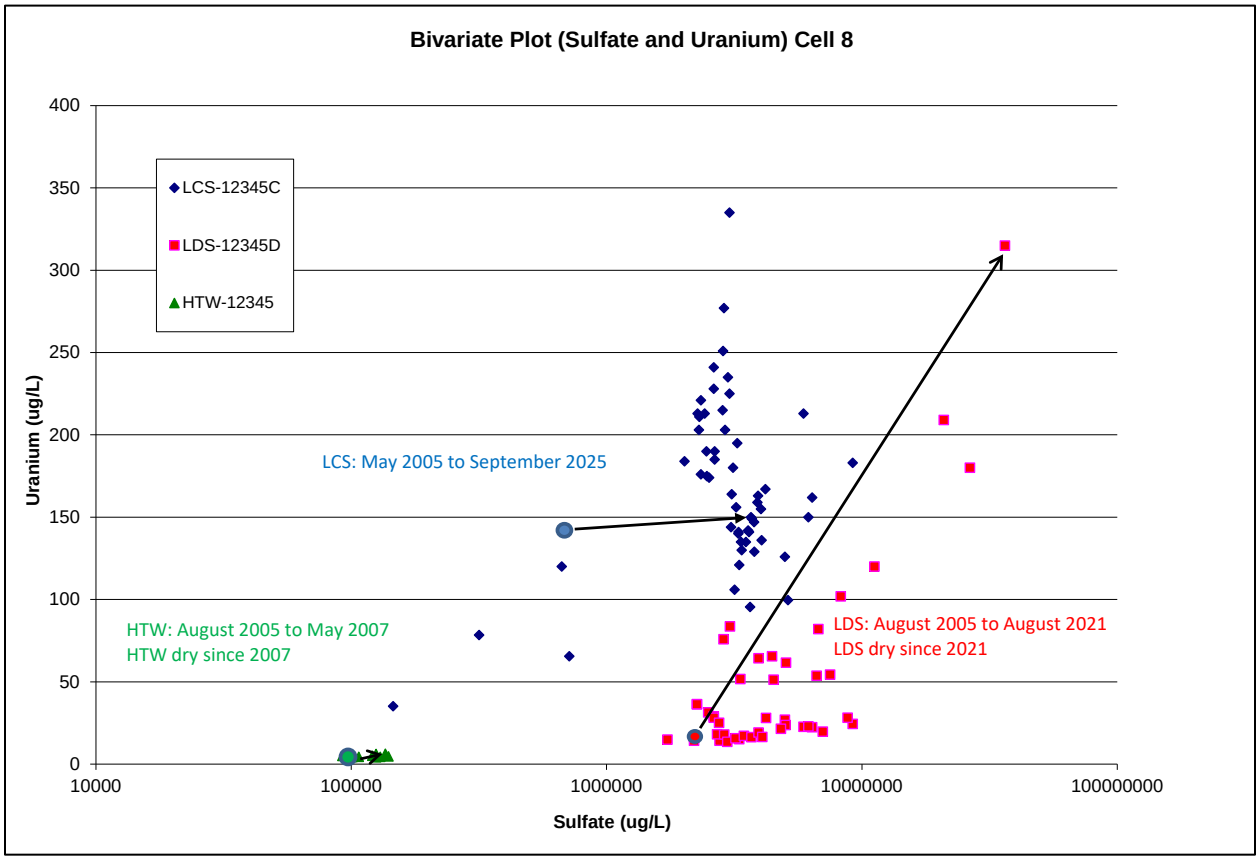


Figure A.5.8-21. Cell 8 Bivariate Plot for Uranium and Sulfate

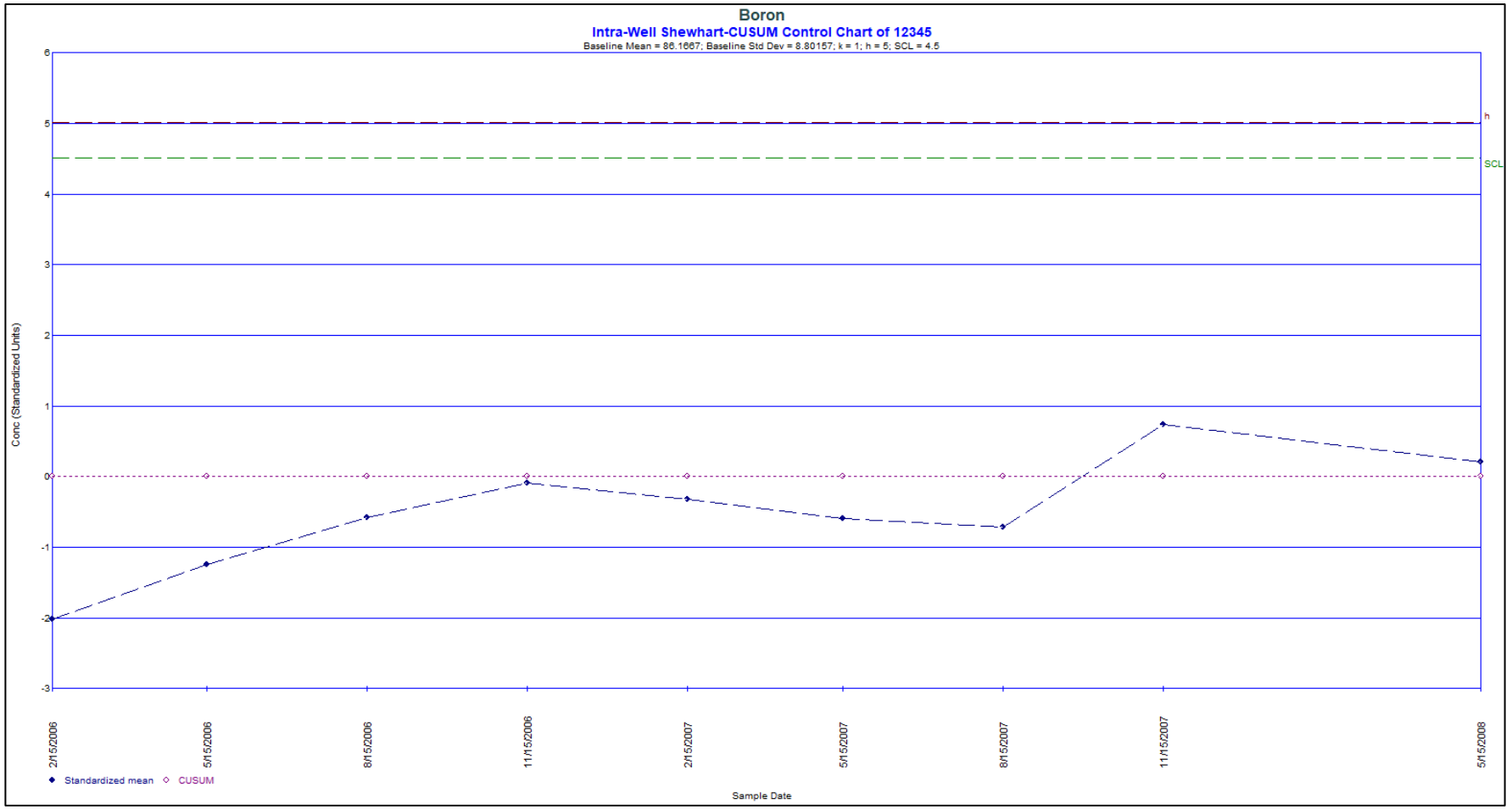


Figure A.5.8-22. Intrawell Shewhart-CUSUM Control Chart for Boron in Monitoring Well 12345

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Appendix B

Supplemental Surface Water and Effluent Information

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Contents

Abbreviations ..... B-ii
Measurement Abbreviations ..... B-ii
B.1.0 Surface Water and Effluent B-1
B.1.1 Surveillance Monitoring B-1
B.1.2 FFCA/OU5 ROD Compliance B-2
B.1.3 Controlled and Uncontrolled Stormwater Runoff Areas B-2
B.1.4 Surface Water West of Waste Pit 3 ..... B-2
B.2.0 References B-7

Table

Table B-1. Summary Statistics and Trend Analysis for Constituents with 2025 Results Above Great Miami River Surface Water FRLs B-9

Figures

Figure B-1. IEMP/NPDES Surface Water and Effluent Sample Locations B-10
Figure B-2. Total Uranium Concentration Versus Time Plot for Location SWD-09 (Former Waste Storage Area) B-11
Figure B-3. Total Uranium Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3) for Cross-Media Impact Evaluation B-11
Figure B-4. Total Uranium Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area) for Cross-Media Impact Evaluation B-12
Figure B-5. Total Uranium Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units) for Cross-Media Impact Evaluation B-12
Figure B-6. Total Uranium Concentration Versus Time Plot for Location STRM 4005 (Drainage to Paddys Run) B-13
Figure B-7. Total Uranium Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary) B-13
Figure B-8. Thorium-228 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area) for Cross-Media Impact Evaluation B-14
Figure B-9. Thorium-232 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area) for Cross-Media Impact Evaluation B-14
Figure B-10. Thorium-232 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units) for Cross-Media Impact Evaluation B-15
Figure B-11. 2025 Monthly Average Total Uranium Concentration in Water Discharged from PF 4001 to the Great Miami River B-16
Figure B-12. Current Surface Water Basins and Runoff Flow Direction B-17

Abbreviations

DOE	U.S. Department of Energy
FFCA	Federal Facility Compliance Agreement
FRL	final remediation level
GMA	Great Miami Aquifer
IEMP	Integrated Environmental Monitoring Plan
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
OU5	Operable Unit 5
ROD	Record of Decision

Measurement Abbreviations

mg/L	milligrams per liter
µg/L	micrograms per liter
pCi/L	picocuries per liter

B.1.0 Surface Water and Effluent

This appendix presents additional surface water and effluent data in support of Section 4.0 of this *Fernald Preserve 2025 Site Environmental Report* and provides an evaluation for surface water and effluent at the Fernald Preserve, Ohio, Site, including an assessment of potential cross-media impacts to the groundwater exposure pathway. Surface water data are available through the U.S. Department of Energy (DOE) Office of Legacy Management's Geospatial Environmental Mapping System (GEMS) database at https://gems.lm.doe.gov/#.

Surface water and effluent samples are collected as required by the Integrated Environmental Monitoring Plan (IEMP), which is Attachment D of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2025). Figure B-1 shows all IEMP surface water monitoring locations. The following information is discussed in this appendix:

- Surveillance monitoring (Section B.1.1)
- Federal Facility Compliance Agreement (FFCA)/*Final Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996) compliance (Section B.1.2)
- Controlled and uncontrolled areas (Section B.1.3)

Routine National Pollutant Discharge Elimination System (NPDES) permit sampling is not discussed in this appendix because it is discussed in detail in Section 4.0, "Surface Water and Effluent Pathway," of this Site Environmental Report.

B.1.1 Surveillance Monitoring

Surveillance monitoring is the comparison of surface water and effluent analytical results to determine the effects of remediation activities on the surface water exposure pathway. Monitoring locations are identified on Figure B-1. Concentration versus time plots are presented in Figures B-2 through B-10. Surveillance monitoring also includes an assessment of the effects surface water may have on the groundwater pathway (referred to as cross-media impacts). As shown in Table B-1, there was one exceedance of the total uranium surface water FRL (530 µg/L) in 2025. The surface water FRL is applicable outside the mixing zone of the Great Miami River. Figures B-2 through B-7 are plots of the total uranium concentration versus time for all surface water sampling locations sampled in 2025. The total uranium surface water FRL exceedances occurred at sampling location SWD-09. Figure B-2 is a plot of the total uranium concentration versus time for sampling location SWD-09. Concentrations display a cycle of high to low each year. The historical high was 2,087 µg/L, measured in December 2016. The highest total uranium concentration in 2025, 799 µg/L, was at this location. The overall statistical trends (Mann-Kendall) with a 95% confidence interval at SWD-09 is "Down."

One of the objectives of the IEMP surveillance monitoring program is to provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer (GMA). To conduct this assessment, sampling locations were selected to evaluate contaminant concentrations in surface water just upstream from those areas where site drainages have eroded through the protective glacial overburden (e.g., the storm sewer outfall ditch, Pilot Plant Drainage Ditch, and certain reaches of Paddys Run). In areas where the glacial overburden is absent (Figure B-1), a direct pathway exists for contaminants to reach the aquifer.

Key sampling locations associated with these areas of direct infiltration are SWD-04, SWD-05, and SWD-08 (Figures B-3 through B-5 and Figures B-8 through B-10).

Because it is the primary contaminant at the site, total uranium is used as an indicator to evaluate the impact of surface water on the GMA. A conservative assumption is used in this assessment, which considers the total uranium concentration (and all other constituent concentrations) in the surface water to be at the same concentration when the water reaches the GMA through infiltration. However, the more likely scenario is that the total uranium concentration (and all other constituent concentrations) would decrease to some degree through dilution and adsorption to sediment particles as the water infiltrates through the ground and mixes with the groundwater in the GMA. The groundwater final remediation levels (FRLs) are used in this cross-media impact assessment.

The results of the cross-media impact assessment for 2025 indicate that two, SWD-04 (Figure B-3) and SWD-05 (Figure B-4), of the three surface water locations evaluated had results that exceeded the total uranium groundwater FRL of 30 micrograms per liter (µg/L). All locations are within capture of the groundwater remediation system. Sampling at these locations will continue, and results of these samples will continue to provide an assessment of the cross-media impacts.

B.1.2 FFCA/OU5 ROD Compliance

The Operable Unit 5 (OU5) Record of Decision (ROD) and subsequent *Explanation of Significant Differences for Operable Unit 5* (DOE 2001) stipulate compliance with a monthly flow-weighted average total uranium concentration discharge limit of 30 µg/L at the Great Miami River via PF 4001. In addition to the concentration limitation, the OU5 ROD stipulated that the total mass discharged during a year not exceed 600 pounds.

During 2025, the total uranium concentrations were monitored daily at PF 4001 to demonstrate compliance with these limitations. The Fernald Preserve was in compliance with the total mass limitation, as uranium discharges totaled 283 pounds, which is below the 600-pound limit. The Fernald Preserve was in compliance with the monthly flow-weighted concentration limit every month in 2025, as identified in Figure B-11.

B.1.3 Controlled and Uncontrolled Stormwater Runoff Areas

In 2025, there were no previously uncontrolled areas that were added to the Fernald Preserve controlled stormwater system (Figure B-12). At the conclusion of remediation in October 2006, control of stormwater runoff was no longer required. The only stormwater collected for treatment is that which falls on the controlled pad of the Converted Advanced Wastewater Treatment facility.

B.1.4 Surface Water West of Waste Pit 3

In response to an Ohio Environmental Protection Agency (Ohio EPA) comment on the 2022 Site Environmental Report (DOE 2023), DOE committed to providing additional discussion on the uranium concentrations measured in SWD-09, which is west of Waste Pit 3. The impacted area is a series of small puddles due west of the center of Waste Pit 3, which generally drain south to a depression near the production-era former cement pond. Surface water in the area west of

Waste Pit 3 was first sampled in late 2006 in support of sitewide surface water sampling to support the site's residual risk assessment. Ohio EPA collected a sample on November 22, 2006, which produced a total uranium result of approximately 714 µg/L. Subsequent sampling and analysis by DOE showed that most concentrations were between 650 and 880 µg/L. The result was unexpected as it exceeded the surface water FRL of 530 µg/L. This comparison seemed reasonable at the time as the only surface water FRL at the site but it was identified in the OU5 ROD (DOE 1996) as being applicable to the Great Miami River outside the mixing zone (i.e., not onsite). The impacted area at peak water retention is approximately 0.5 acre because the area is typically dry for several months of the year which coincides with increased evaporation and low precipitation that occurs in late summer and early fall. Uranium concentrations indicate that the highest concentrations are at the northern end of the swale and dimmish to the south. There is no direct outlet of this drainage swale to Paddys Run. The soils in the area are generally poorly draining based on the 1993 site wetland delineation.

Based on the *Sitewide Excavation Plan* (DOE 1998), the area is in soil certification Area 6. The *Sitewide Excavation Plan* requires that each area of the site undergoes predesign, excavation, and precertification activities, including real-time instrumentation and physical sampling and analysis. Based on the results of the precertification activities, the area is either further remediated and precertified a second time or can be certified. The certification process is extensive sampling and analysis, statistical analysis of the data, and assessment of the certification criteria. The *Certification Report for Area 6 Waste Pits 1, 2, and 3, the Burn Pit, the Clearwell, and the Areas West and North of the Waste Pits* (DOE 2007a), which documents the precertification and certification process of the area indicates that the subject area did not require further remediation prior to certification. The area underwent a rigorous soil certification process and all the certification samples from the impacted area were well below the soil certification FRL. Consistent with the *Sitewide Excavation Plan*, DOE determined that the area met certification criteria. The area would be certified clean when EPA and Ohio EPA concurred that the certification criteria had been met; however, because of the elevated total uranium concentrations in the puddles west of Waste Pit 3, the regulators withheld approval of the certification report.

In late 2006, DOE initiated a leachability study of the impacted area which tested total uranium of the soil matrix as well as the uranium that has leached into the aqueous phase to produce a leachability constant similar to what was done in the *Operable Unit 5 Feasibility Study* (DOE 1994, Appendix F) and documented in the *Operable Unit 5 K_l Sampling and Analysis Results Report* (DOE 1995). Preliminary results of the total uranium in the soil demonstrated that residual uranium soil concentrations are consistent with the results from the certification efforts in the area (DOE 2007d). The results of the leachability study (DOE 2007d; DOE 2007e) indicated that:

> *"…the residual surface uranium in this area (approximately 30-foot by 30-foot) is the source of the elevated uranium in the surface water. The K_l values demonstrate that the uranium chemistry in this area is about four times more leachable in water than the majority of the Fernald site, however, the uranium in this area is about 5 times less leachable than the areas in the former production area that were considered 'high-leach' areas. The area underwent a rigorous certification effort to show that the soil FRL of 82 mg/kg was attained in this area and the total uranium results determined on the four soil samples collected for this leachability study corroborated this certification process.*

However, this study demonstrated that certified soil samples with uranium concentrations as low as 48 mg/kg can produce water concentrations that are above one of the surface water FRLs. The area immediate to the west where a 6" excavation was conducted shows very low residual uranium concentrations (i.e., near background range in soil). Based on this information, there is unlikely to be any other unknown source of uranium contamination in the area."

It should be noted that the OU5 ROD (DOE 1996) specifically applies the surface water FRL to the Great Miami River mixing zone, which is offsite. Two sections from the ROD that illustrate this point are as follows:

(1) ROD Section 9.2, "Remedial Action Objectives and Clean-Up Levels," states:

"*The remedial action objectives include eliminating or reducing to acceptable levels the potential for human or ecological receptors to come into contact with contaminated environmental media and prevention of off-property migration of contaminants in excess of the contaminant-specific FRLs.*"

(2) ROD Section 10.0, "Statutory Determinations," specifically Section 10.1.4, "Surface Water," states:

"*Surface water resources of the site (Paddys Run and the Great Miami River) will not require direct remediation as a consequence of the selected remedy. Paddys Run is a pathway for contaminant migration and the Great Miami River a receiving body for treated water discharges from the FEMP's water treatment operations. Final remediation levels are established for surface water to delineate protective requirements for the discharge of treated storm water, groundwater, and remediation wastewater to the Great Miami River and to control runoff to Paddys Run. These final remediation levels are protective of surface water receptors (represented by recreational users of the river and consumers of meat and milk products derived from cattle that directly consume surface water) at a cumulative incremental life cancer risk of between 1 X* 10^{-4} *and a hazardous index of less than 1."*

Based on the ROD language, it is clear the intent from a protectiveness standpoint is that contaminant concentrations within Great Miami River are of concern for protection of surface water receptors. Additionally, it should be noted that based on the site's institutional controls, the fact that the area is onsite and public access is restricted, there are no recreational users of surface water and cattle grazing is prohibited. Because the area is within capture of the groundwater remediation system, and site institutional controls restrict public access to the area, there is a negligible risk to the public from the total uranium concentrations in the ponded water or the groundwater in this area. Therefore, a direct comparison between these surface water locations and the surface water FRL of 530 µg/L identified in the OU5 ROD is not appropriate. Because the regulators and stakeholders expressed concern about the area, DOE committed (DOE 2007b) to a maintenance activity to remove the top 6 inches of soil of the certified area suspected of being the source of the higher leachability uranium and to continue monitoring the surface water. The area was graded to reduce or eliminate future ponding, treated with lime (to further reduce leachability), and vegetated (DOE 2007c). Following the maintenance activity and DOE's action to continue monitoring the surface water in the area, EPA and Ohio EPA

approved the area's certification report (*Certification Report for Area 6 Waste Pits 1, 2, and 3, the Burn Pit, the Clearwell, and the Areas West and North of the Waste Pits* [DOE 2007a]) in late 2007 (EPA 2007; Ohio EPA 2007).

To monitor the area, DOE established weekly surface water monitoring at two locations in late 2007: SWD-09, the area of the highest total uranium concentration locations which diminished southward, and SWD-05 (south of SWD-09, near the former cement pond). As reported in the 2015 Site Environmental Report (DOE 2016), groundwater modeling was conducted in 2014 to determine the potential impact to model-predicted cleanup times if uranium-contaminated groundwater is infiltrating into the aquifer from the swale. A model worst-case scenario was based on the highest total uranium concentration measured in ponded water within the swale and high modeled infiltration rates. The uranium concentration of the infiltrating water was modeled at a concentration of 1,900 parts per billion (highest total uranium concentration measured in surface water in the swale as of 2014). In addition, the conservative groundwater modeling scenario took no credit for uranium attenuation in glacial till or alluvium. Modeled infiltration of water into the subsurface was increased from 6 inches per year (modeled infiltration rate in areas where glacial overburden is present) to 50 inches per year (modeled infiltration rate used in select areas of the model known to be near areas of aquifer recharge). Modeling these extreme conservative conditions of high uranium concentration and high infiltration had no impact to model-predicted cleanup times in the aquifer.

The highest total uranium concentrations at SWD-09 are generally measured in the winter, a time when soil generally becomes resaturated after drying out in the summer and fall due to the higher evaporation and evapotranspiration rates occurring at that time of year. The concentration may reflect the first flush phenomenon where the recently resaturated soil is yielding a higher concentration to the puddle at SWD-09. The Mann-Kendall trend for all the data for both locations indicate the overall dataset is trending down. DOE will continue to monitor the locations to understand any changes to the area and to assist in verifying cross-media impacts.

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Ohio EPA (Ohio Environmental Protection Agency), 2007. *Approval Responses to the Additional Ohio EPA Comments on Revision 0 and the Final Certification Rpt for A6 WPs 1,2,3, the Burn Pit, The Clearwell, and the Areas West and North of the WP's*, letter from T. Schneider, Project Manager, to J. Reising, DOE Director, November 7, 2007.

Table B-1. Summary Statistics and Trend Analysis for Constituents with 2025 Results Above Great Miami River Surface Water FRLs

Location[a]	Constituent	Number of Samples[b,c,d]	Number of Samples Above FRL[b,c,d]	Number of Samples Above FRL for 2025[c,d]	FRL[e] (µg/L)	Maximum FRL Exceedance 2025 (µg/L)	Minimum[b,c,d] (µg/L)	Maximum[b,c,d] (µg/L)	Average[b,c,d] (µg/L)	Standard Deviation[b,c,d] (µg/L)	Trend[b,c,d] (µg/L)
SWD-09	Uranium	518	298	1	530	799	3.40	2,087	634	369	Down

[a] Refer to Figure B-1.
[b] Based on samples collected from January 3, 2007, through December 31, 2025.
[c] If more than one sample is collected per surface water location per day (e.g., duplicate, grab, composite), then only one sample is counted.
[d] Rejected data qualified with laboratory qualifiers R or Z were not included in the count, the summary statistics, or Mann-Kendall test for trend.
[e] FRL = final remediation level. From OU5 ROD, Table 9−5. FRL is applicable outside the mixing zone in the Great Miami River.

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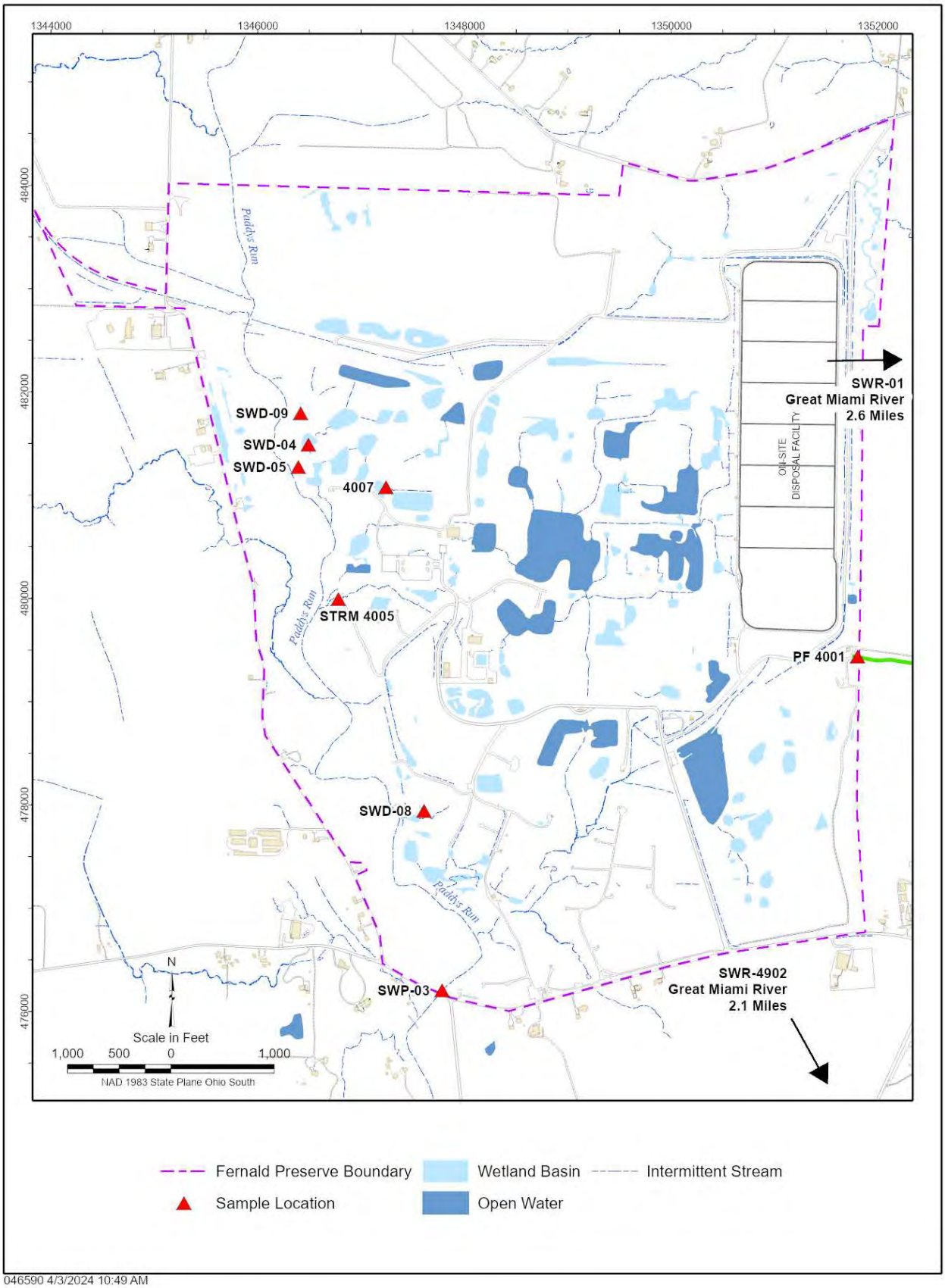


Figure B-1. IEMP/NPDES Surface Water and Effluent Sample Locations

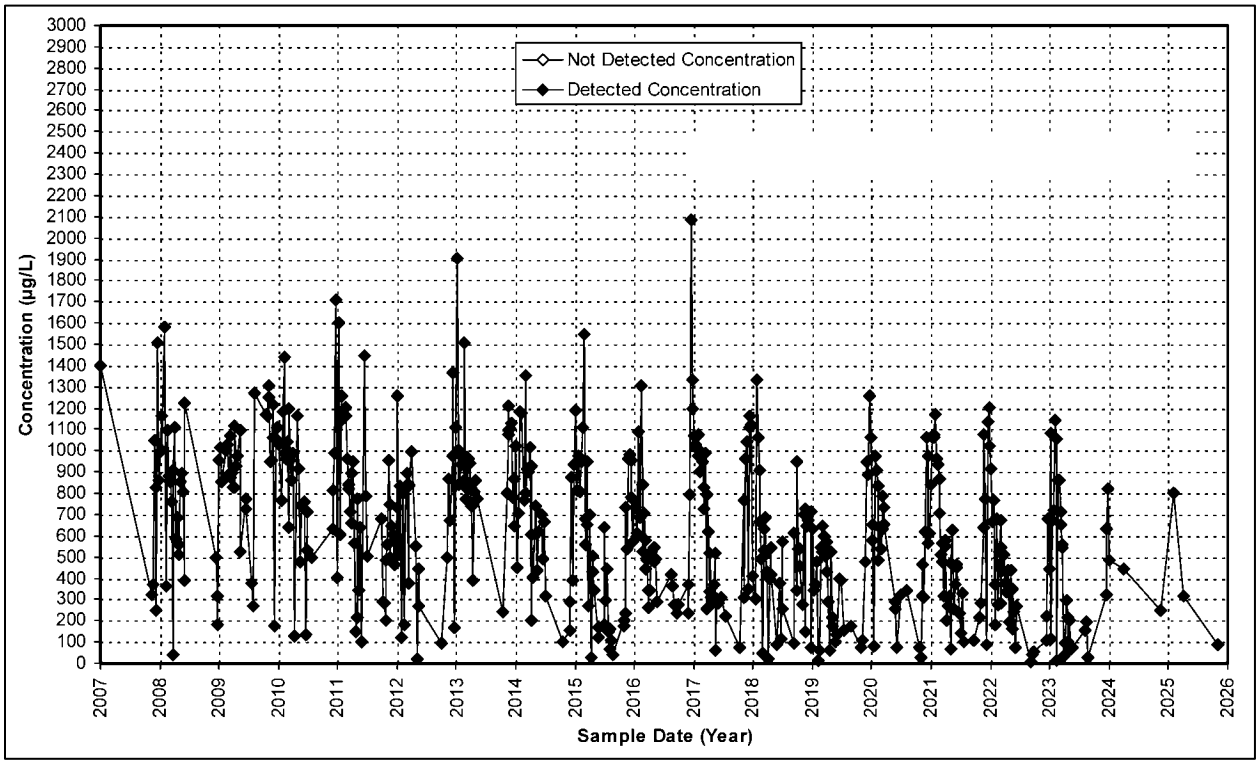


Figure B-2. Total Uranium Concentration Versus Time Plot for Location SWD-09 (Former Waste Storage Area)

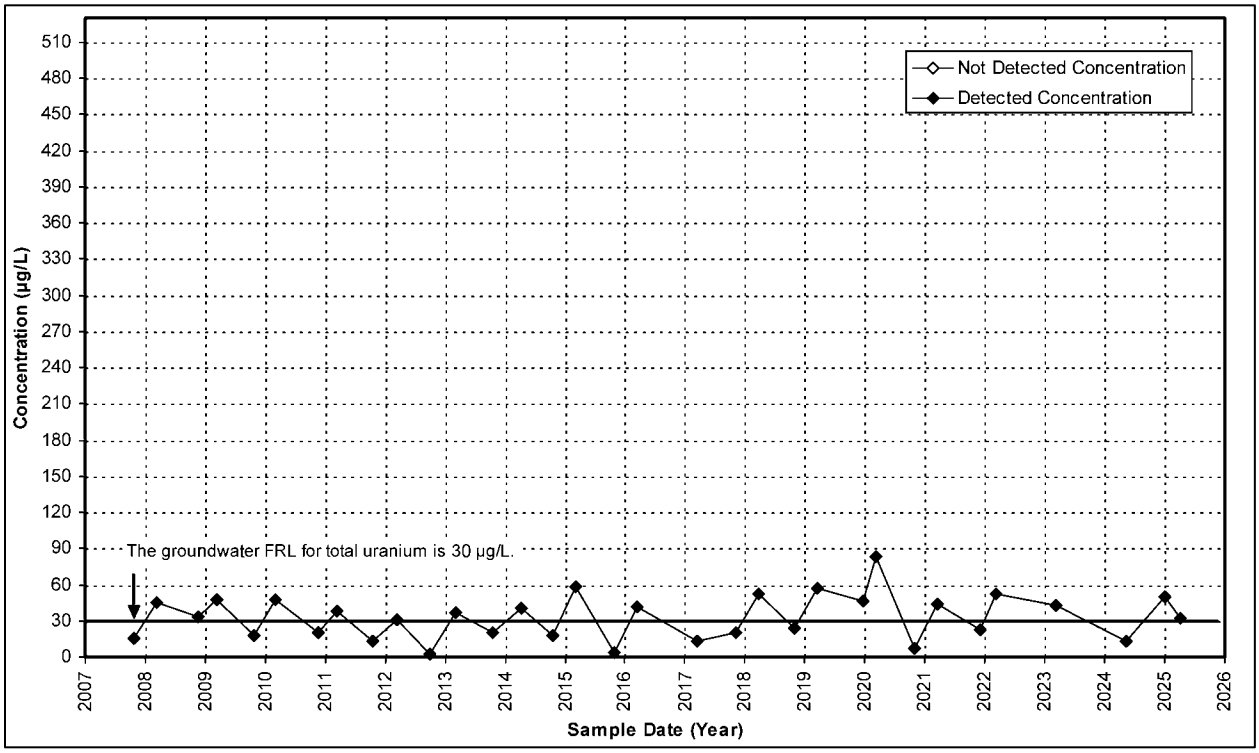


Figure B-3. Total Uranium Concentration Versus Time Plot for Location SWD-04 (Former Waste Pit 3) for Cross-Media Impact Evaluation

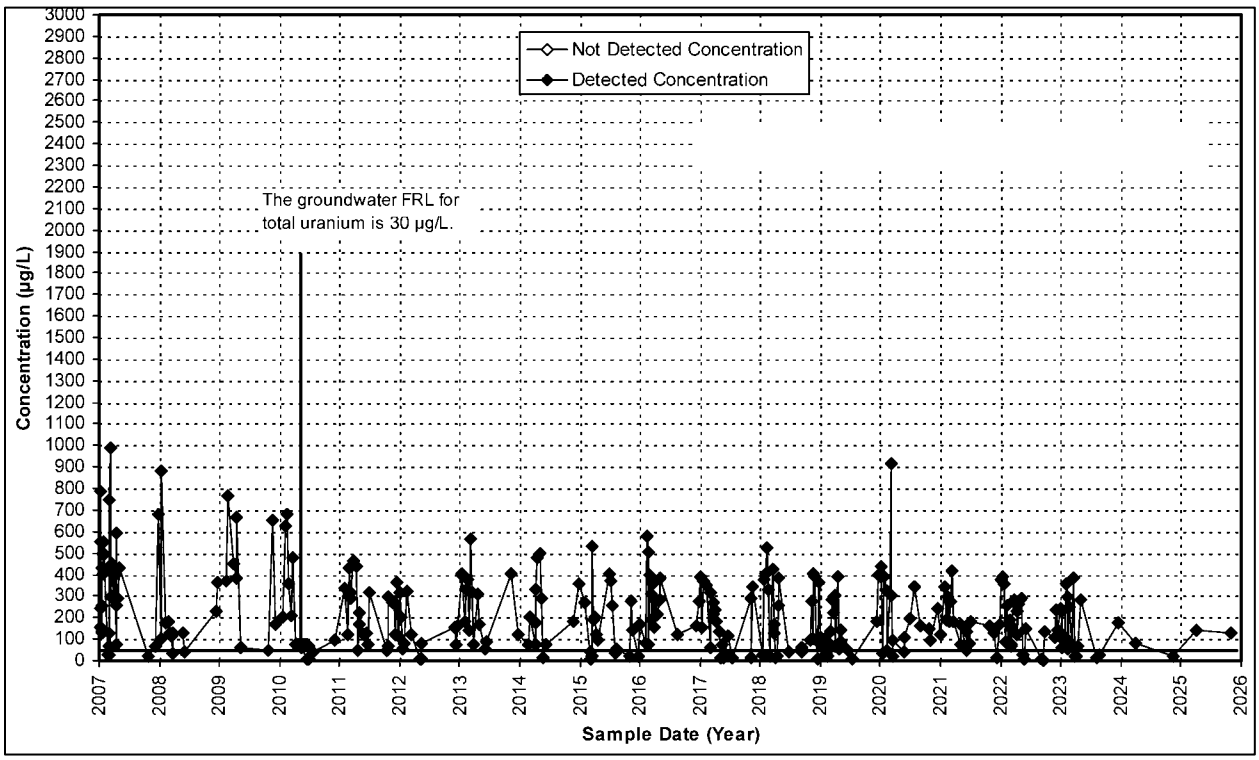


Figure B-4. Total Uranium Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area) for Cross-Media Impact Evaluation

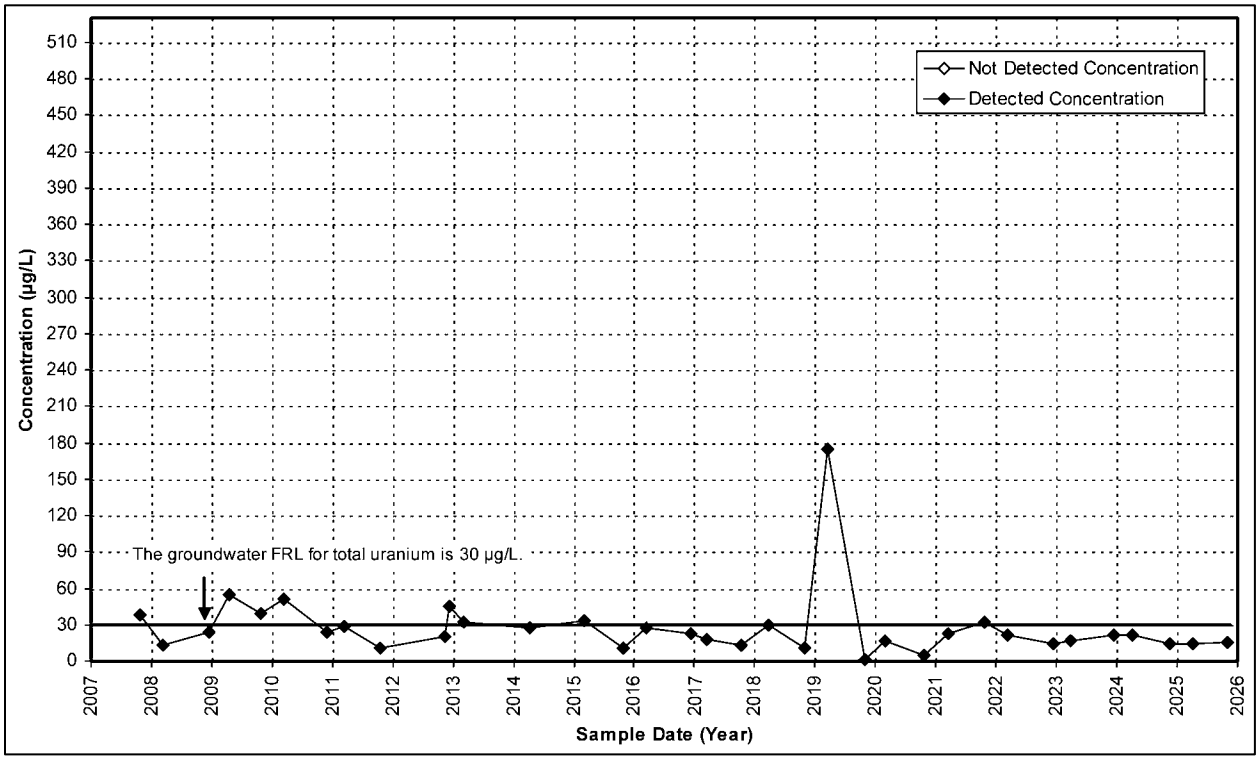


Figure B-5. Total Uranium Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units) for Cross-Media Impact Evaluation

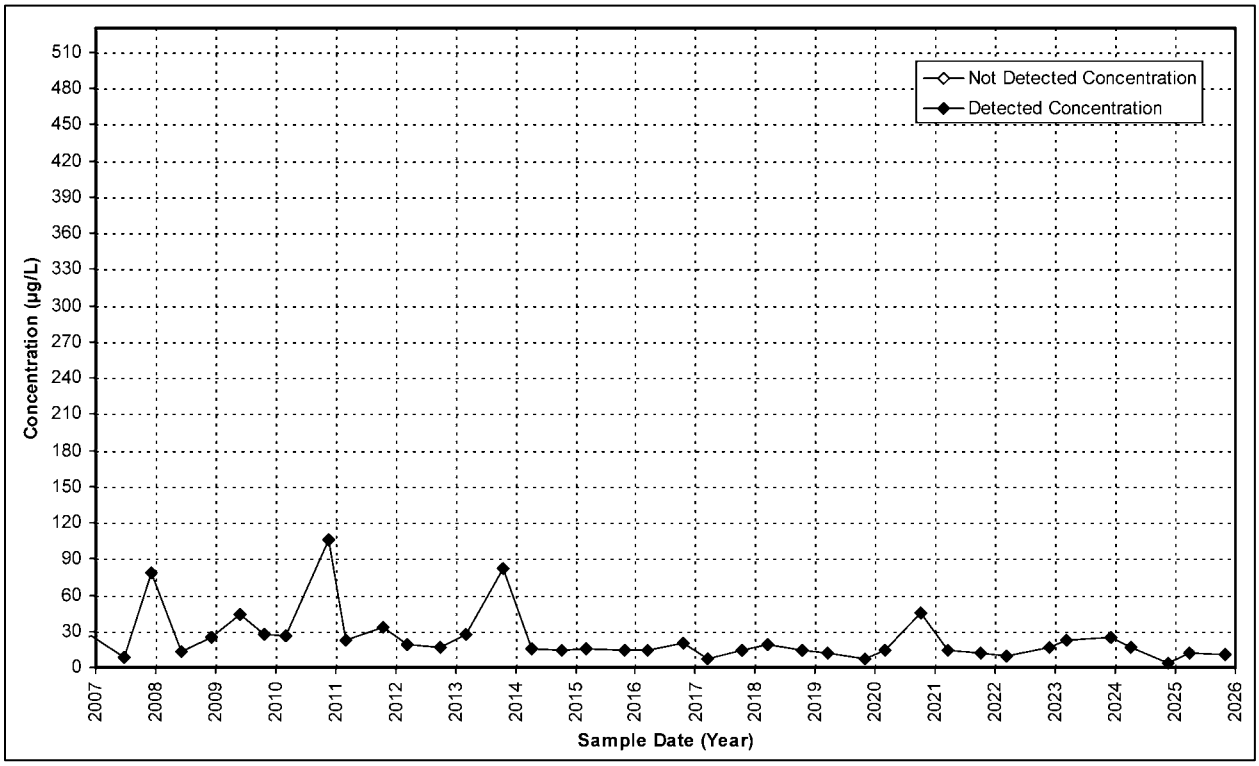


Figure B-6. Total Uranium Concentration Versus Time Plot for Location STRM 4005 (Drainage to Paddys Run)

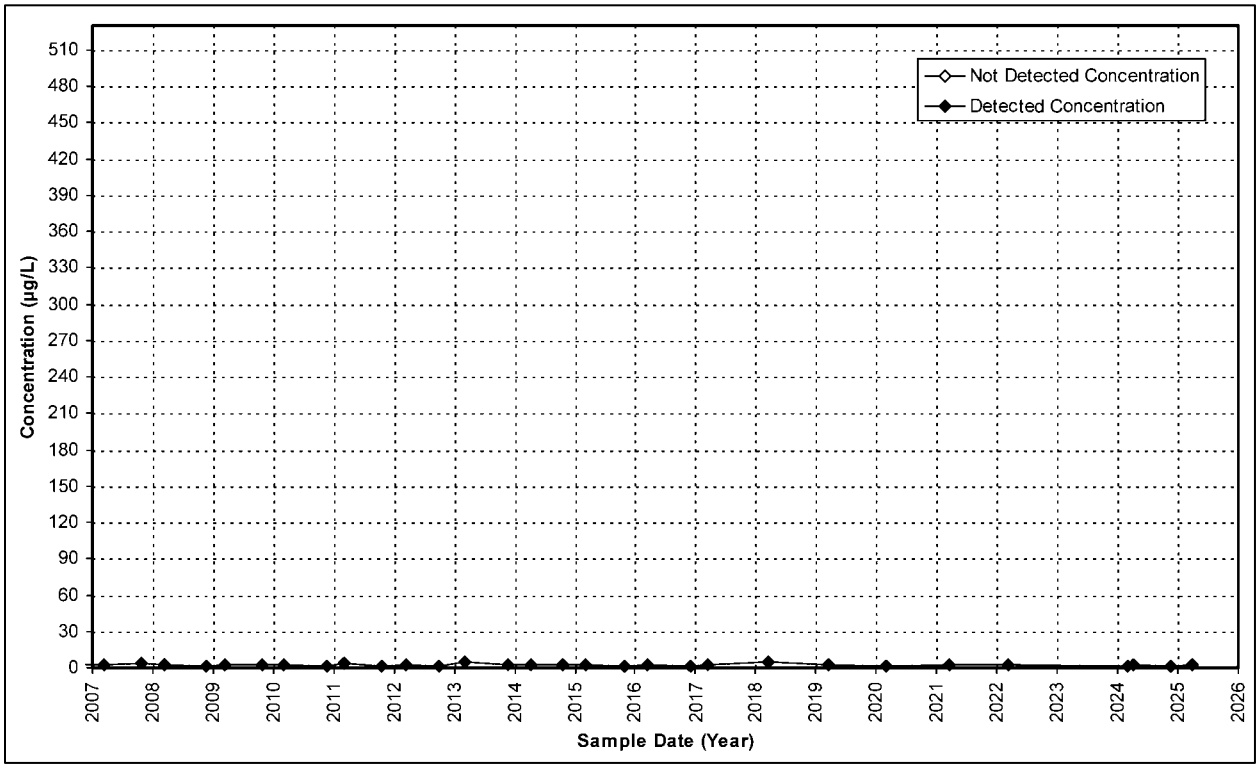


Figure B-7. Total Uranium Concentration Versus Time Plot for Location SWP-03 (Paddys Run at Downstream Property Boundary)

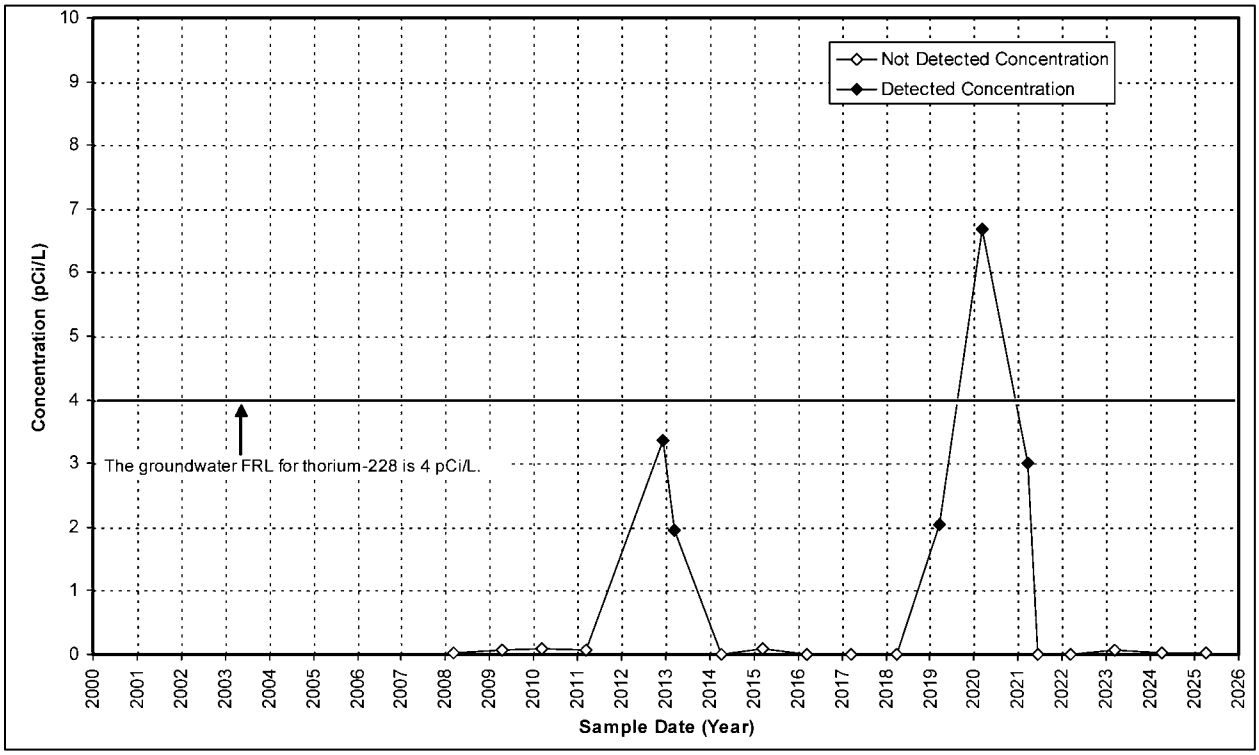


Figure B-8. Thorium-228 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area) for Cross-Media Impact Evaluation

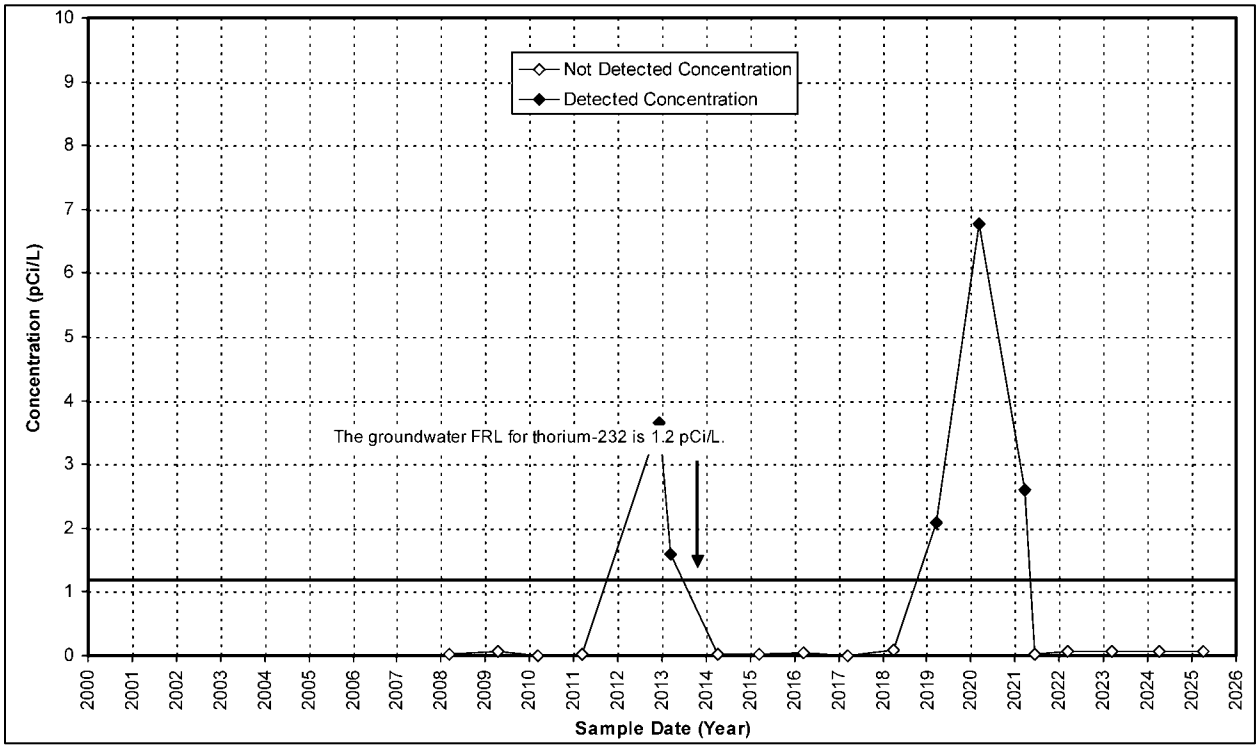


Figure B-9. Thorium-232 Concentration Versus Time Plot for Location SWD-05 (Former Waste Storage Area) for Cross-Media Impact Evaluation

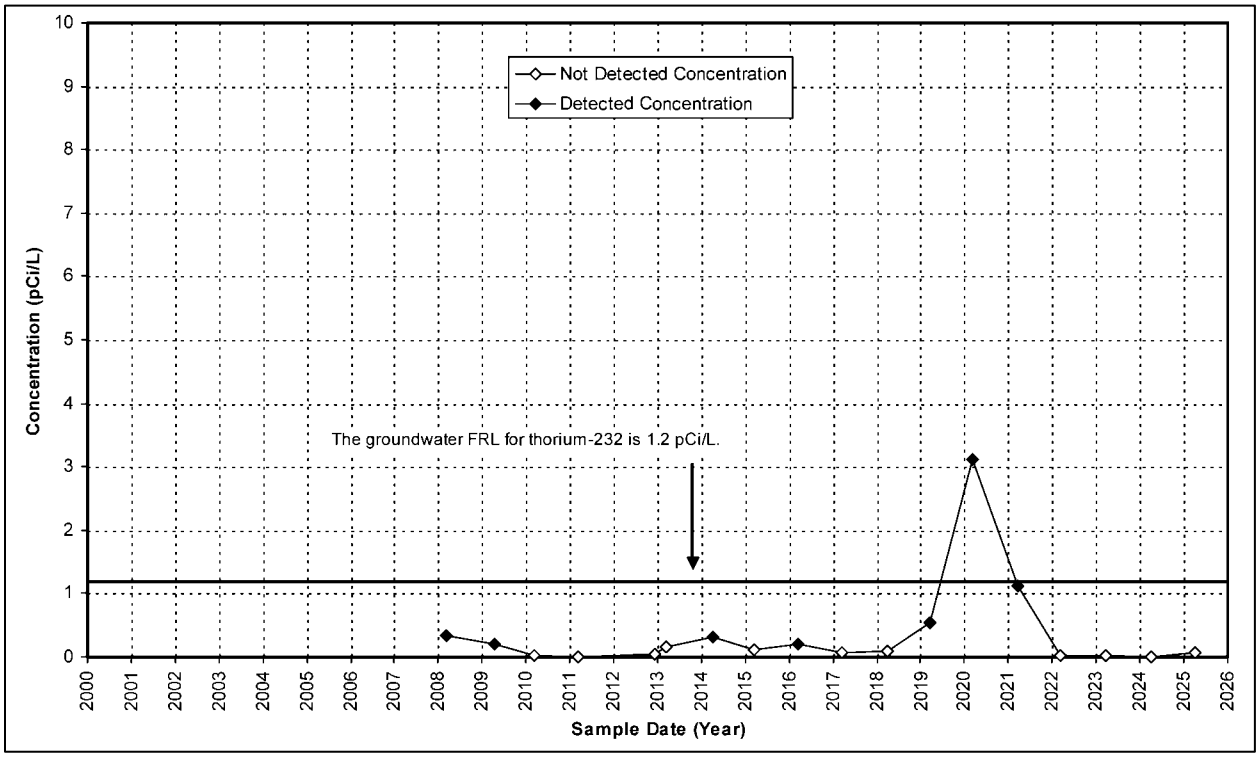


Figure B-10. Thorium-232 Concentration Versus Time Plot for Location SWD-08 (Former Southern Waste Units) for Cross-Media Impact Evaluation

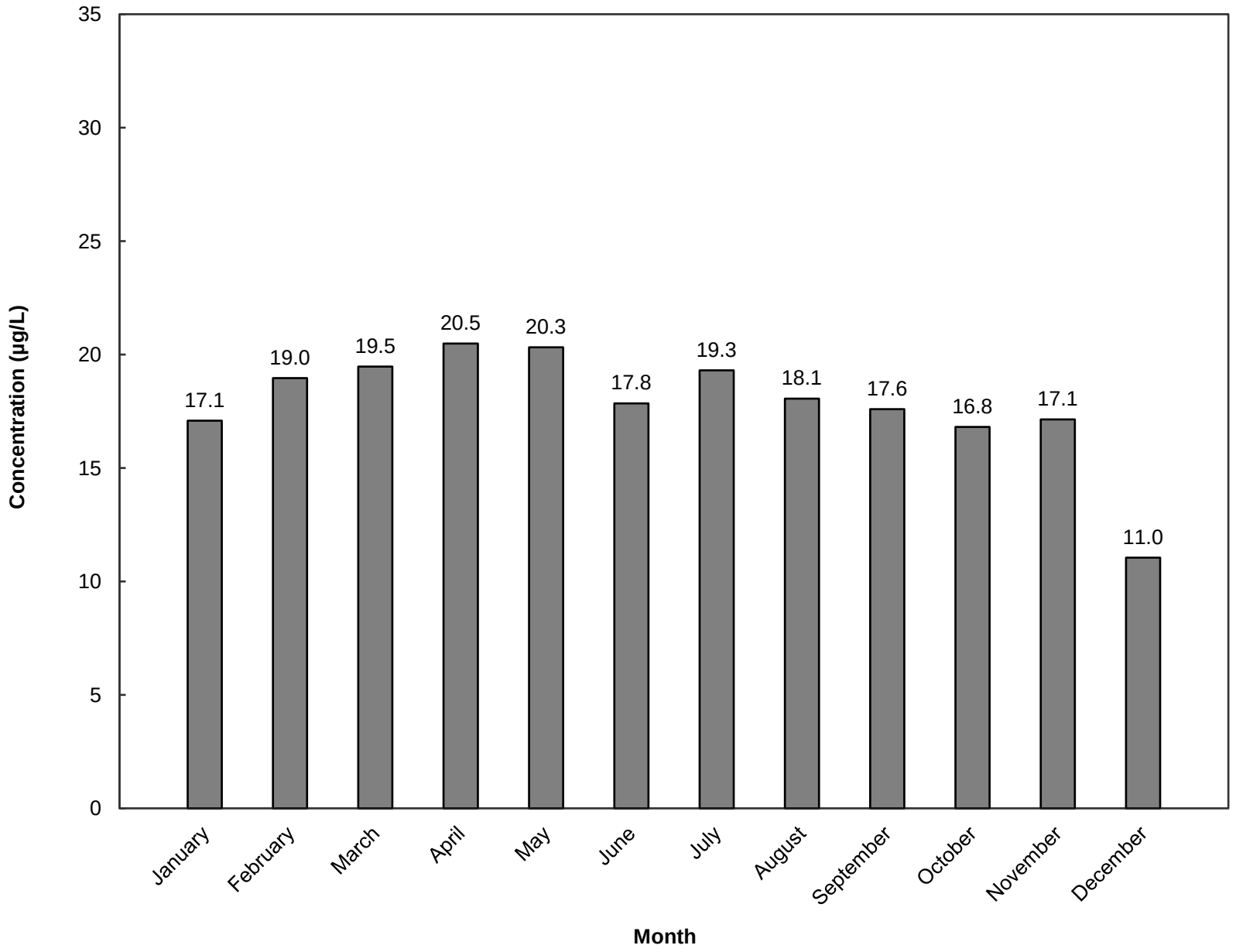


Figure B-11. 2025 Monthly Average Total Uranium Concentration in Water Discharged from PF 4001 to the Great Miami River

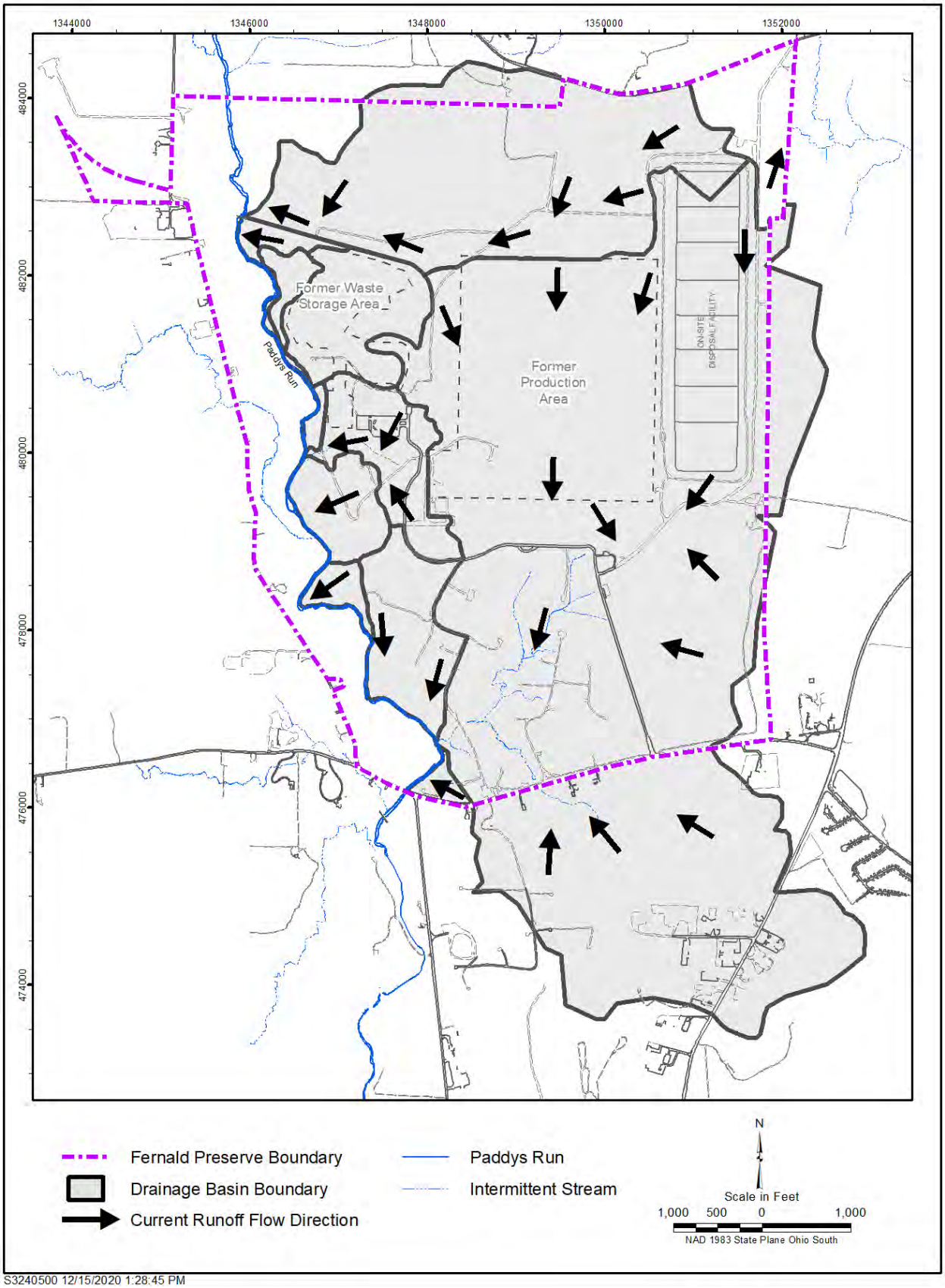


Figure B-12. Current Surface Water Basins and Runoff Flow Direction

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Appendix C

Inspections and Natural Resource Management

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Contents

Abbreviations ..... C-iii
C.1.0 Introduction C-1
C.2.0 On-Site Disposal Facility C-1
C.2.1 Inspections C-1
C.2.2 Vegetation Monitoring C-2
C.3.0 Ecological Monitoring for Natural Resource Management C-2
C.3.1 Floristic Inventory Method C-3
C3.1.1 Floristic Inventory Results C-4
C.3.2 Proposed Grid System Monitoring Method C-5
C.4.0 References C-6

Tables

Table C-1. OSDF Vegetation Monitoring Results for Cells 7 and 8 ..... C-7
Table C-2. 2025 Prairie Floristic Inventory C-9
Table C-3. Comparison of Remediation Areas Ecological Monitoring Metrics C-13

Figures

Figure C-1A. Top of OSDF Cell 8, South and North Perspectives C-14
Figure C-1B. Top of OSDF Cell 8, East and West Perspectives C-14
Figure C-2A. Top of OSDF Cell 5, South and North Perspectives C-15
Figure C-2B. Top of OSDF Cell 5, East and West Perspectives C-15
Figure C-3A. Top of OSDF Cell 1, South and North Perspectives C-16
Figure C-3B. Top of OSDF Cell 1, East and West Perspectives C-16
Figure C-4A. OSDF Survey Marker No. 01 and No. 02 ..... C-17
Figure C-4B. OSDF Survey Marker No. 03 and No. 04 ..... C-17
Figure C-5. OSDF Southwest Gate and South Gate, North and Northeast Perspectives C-18
Figure C-6A. OSDF East Fence, North Perspective C-18
Figure C-6B. OSDF East Fence, West and North-Northwest Perspectives C-19
Figure C-7. OSDF East Fence, North Perspective C-19
Figure C-8. OSDF Former North Gate, Southwest Perspective and North Fence, West Perspective C-20
Figure C-9. OSDF Northwest Gate, North-Northeast Perspective and West Fence South-Southeast Perspective C-20
Figure C-10. OSDF Valve Houses 8 Through 1, North Perspective, and OSDF Valve House 1, West-Northwest Perspective C-21
Figure C-11. OSDF Cell 1 Wells, Northeast Perspective C-21
Figure C-12. OSDF Valve House and Wells Cell 2 ..... C-22
Figure C-13. OSDF Valve House and Wells Cell 3 ..... C-22
Figure C-14. OSDF Valve House and Wells, Cell 4 ..... C-23
Figure C-15. OSDF Valve House and Wells, Cell 5 ..... C-23
Figure C-16. OSDF Valve House and Wells, Cell 6 ..... C-24
Figure C-17. OSDF Valve House and Wells, Cell 7 ..... C-24
Figure C-18. OSDF Valve House and Wells, Cell 8 ..... C-25

Figure C-19. Area-Based Approach Ecological Monitoring Areas (2015 Through 2020) C-26
Figure C-20. Ecological Restoration Management Areas (2021 to Present) C-27

Abbreviations

CC	coefficient of conservatism
DOE	U.S. Department of Energy
FQAI	Floristic Quality Assessment Index
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
NRRP	Natural Resource Restoration Plan
OSDF	On-Site Disposal Facility
PCCIP	Post-Closure Care and Inspection Plan
RAMP	Restored Area Maintenance Plan

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C.1.0 Introduction

This appendix presents required annual photographs of the On-Site Disposal Facility (OSDF) and data collected as part of natural resource management, including OSDF vegetation monitoring, at the Fernald Preserve, Ohio, Site.

C.2.0 On-Site Disposal Facility

C.2.1 Inspections

The Fernald Preserve *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP), Volume II, *Institutional Controls Plan*, and Attachment B, "On-site Disposal Facility Post-Closure Care and Inspection Plan," (PCCIP) (DOE 2025a) identify the inspection processes for the site and OSDF, respectively. The 2025 site and OSDF inspection details and findings are presented in Section 5.0, "Inspections and Natural Resource Management."

Requirements concerning annual photographs of the OSDF, photographs of any significant inspection findings, and subsequent notification of the regulators are discussed in the PCCIP. There were no significant findings in 2025. Only those photographs required in the PCCIP, which are outlined below, are reported in this appendix:

- Annual photographs of survey monuments and other permanent features; inner and outer drainages; fences, gates, etc.; general vegetation; and panoramic sequence of views of the OSDF (Figure C-1A through C-18).
- Any evidence of erosion (e.g., gullies, rivulets, rills) that the inspector considers significant and documents in the inspection notes.
- Any evidence of burrowing animals.
- Any off-OSDF features that may affect the OSDF in the future and that the inspector considers significant and documents in the inspection notes.
- Any evidence of ponded water.
- Erosion protection material (riprap).
- Evidence of leachate seeps.
- Damaged monitoring wells.

Because there are minimal to no changes to OSDF features photographed from year to year, DOE is proposing to reduce the frequency of photographs not related to inspection findings (i.e., Figure C-1A through C-18) to every 5 years to align with the CERCLA five-year review; the next set of photographs will be taken in 2030. Photographs related to significant inspection findings will continue to be taken and reported in the Site Environmental Report, when necessary.

C.2.2 Vegetation Monitoring

OSDF vegetation monitoring is required in accordance with Section 3.5, "OSDF Inspection and Maintenance," in Volume II of the LMICP (DOE 2025). The U.S. Department of Energy (DOE) and the regulatory agencies agree that the goal is not necessarily to establish a functioning prairie on the OSDF cap, but rather to maintain 90% average total cover with 50% native vegetation. Monitoring to determine the percent cover and species of vegetation on one-third of the OSDF cap is completed annually so that the entire cap is monitored over a 3-year period. Cells 7 and 8 were monitored in 2025. Each individual cell cap is divided into a grid 4 blocks wide (east to west) and 3 blocks long (north to south). Within each grid block, a 1-meter-square quadrat is randomly located, resulting in 12 vegetation monitoring locations for each cell cap. Total cover and species richness data are collected for each quadrat. From this information, total cap cover, native species composition, and relative frequency of native species are calculated. Both average total cover and native species exceeded the goals for Cells 7 and 8 (Table C-1).

DOE has been monitoring the OSDF cell cap since 2006 using the methodology described above. The OSDF cell cap 3-year rotation concluded with the 2025 monitoring event. DOE plans to complete a floristic inventory of the entire OSDF cap in 2026. Beginning in 2027, DOE proposes to use the monitoring method discussed in Section C.3.2 to monitor the vegetation of the cap to track progress towards the goals of maintaining 90% average total cover and 50% native vegetation, as well as to determine and prioritize any maintenance needed for the vegetative cap.

C.3.0 Ecological Monitoring for Natural Resource Management

Monitoring of ecologically restored areas was required as part of the natural resource damage settlement (Consent Decree, State of Ohio 2008) among DOE, the Ohio Environmental Protection Agency, and the U.S. Department of the Interior which is represented by the U.S. Fish and Wildlife Service (Fernald Natural Resource Trustees). The Fernald Preserve Natural Resource Restoration Plan (NRRP) (State of Ohio 2008) specified ecological restoration monitoring requirements and established the ecological restoration monitoring program at the Fernald site. The *Fernald Preserve, Ohio, Restored Area Maintenance Plan* (RAMP) (DOE 2012) was an additional document required by the NRRP. The RAMP established a maintenance program for ecologically restored areas across the site. The NRRP called for a 10-year review of the RAMP by the Fernald Natural Resource Trustees. That review was conducted in 2020 and resulted in the development of the "Fernald Preserve, Ohio, Site Natural Resource Management Plan." In 2022, DOE provided a detailed status of the commitments for ecological restoration, monitoring, and maintenance at the site (DOE 2022). In 2023, the Fernald Natural Resource Trustees agreed that DOE had completed ecological restoration of the Fernald Preserve in accordance with the requirements identified in the Consent Decree and the NRRP (Ohio EPA 2023; USFWS 2023). DOE communicated that long-term stewardship of site restoration will continue pursuant to the "Fernald Preserve, Ohio, Site Natural Resource Management Plan," which is included as Appendix A of Volume I of the Fernald Preserve LMICP (DOE 2025a).

Prior to 2021, a two-tier ecological monitoring program was used to assess restoration efforts. Implementation monitoring was used to evaluate vegetation establishment following seeding and planting projects. Functional monitoring was used to assess the progress of the development of a

restored community (prairie, wetland, forest) by comparing floristic quality parameters to those of baseline and reference sites (DOE 2002). Reference sites are offsite communities that represent an ideal end-state for site restoration projects.

Prior to 2015, functional monitoring was conducted on a sitewide community basis, with wetland monitoring completed one year, prairie monitoring the next, and forest monitoring the third year. From 2015 through 2020, a management-area approach was implemented to ensure that restored areas were maintained on a 3-year rotation (Figure C-26). Functional monitoring in prairie and woodland areas consisted of establishing 15 random 1 square meter quadrats that were surveyed for herbaceous vegetation during the growing season (April through September). Surveys were divided into three rounds of five quadrats for each designated monitoring sub-area to ensure coverage throughout the growing season. For each quadrat, species richness and cover data were recorded for herbaceous vegetation. Additional 1,000 square meter plots were used to collect woody data from each forest community. Species abundance and size data using diameter at breast height measurements were collected for woody vegetation in forest communities. Wetland communities were surveyed via fixed grids as described in the *Fernald Preserve Wetland Mitigation Monitoring Plan* (DOE 2009).

In 2020, a review of 10 years of data showed that NRRP goals for native species were mostly met, there had been much improvement over baseline conditions, and comparison to reference sites were sometimes met. Based on this review, the Fernald Natural Resource Trustees agreed that a shift from management-area monitoring back to a community-focused approach for ecological monitoring is more appropriate.

C.3.1 Floristic Inventory Method

The community-focused monitoring involves the development of floristic inventories for each restoration community. Floristic inventories are compiled by conducting a series of walkdowns to survey the vegetation within a particular community type throughout the growing season. The result is a comprehensive list of vascular plant species within a community type for a given year. Figure C-19 shows the breakdown of community types for which floristic inventories are completed. Remediation wetland areas, remediation prairie areas, and remediation successional areas are all located in areas of the site where extensive ground disturbance took place. They are characterized by having little to no topsoil or nearby established vegetation in place when ecological restoration efforts began. Perimeter wetland areas, perimeter successional areas, restoration forest areas, and existing forest areas are all located in areas where little or no ground disturbance took place. Topsoil was usually still in place at the time ecological restoration efforts began. Each community type is evaluated on a 3-year rotation. In 2021 and 2024, wetland communities were evaluated using the floristic inventory method. In 2022 and 2025, remediation area communities across the site were evaluated using the same method. Remediation areas were divided into remediation successional areas, where the long-term management goal is to allow natural forest succession to take place, and remediation prairie areas, where restored prairies will be maintained as prairie communities through vegetation management. The results of the 2025 monitoring are discussed in Section C.3.1. Existing forest areas, restoration forest areas, and perimeter successional areas were monitored in 2023 and will be monitored a second time in 2026.

C3.1.1 Floristic Inventory Results

The year 2025 is the second time the floristic inventory monitoring method has been used for remediation prairie and remediation successional areas. Monitoring areas were surveyed in three rounds during the year so that the entire growing season was included. For each survey, the entire area was examined and each species observed was recorded. Native and non-native species richness and species composition, average coefficient of conservatism (mean CC), and Floristic Quality Assessment Index (FQAI) were calculated from the data. Processes for calculating monitoring parameters for all communities are described in the *Fernald Preserve, Fernald, Ohio, Ecological Monitoring Methods Plan and Procedures* (DOE 2025b). The latest Ohio FQAI database (Gara 2013) was used to determine nativity status and CC values.

The floristic inventory for plants identified in 2025 is presented in Table C-2. This table presents a remediation prairie and remediation successional area communities species list that allows for a comparison of the areas. Remediation successional areas had higher native species percent, average CC, and FQAI scores than remediation prairie areas. Table C-3 provides a multiyear comparison of mean CC value, FQAI, and percent native species for the two remediation areas monitored in 2025 (Figure C-20). For the data presented from the years 2009 to 2020, a species list was compiled from the ecological monitoring data collected during those years. The species list was used to calculate mean CC, FQAI, and percent native species. While FQAI is included in Table C-3, this value is influenced by the size of the surveyed area. The floristic inventory method requires visual surveys of much larger areas than the monitoring method used prior to 2021. Because of this, FQAI is more useful when comparing the data collected in 2022 to the data collected in 2025 than it will be for comparing historical data from prior to 2021. Mean CC is also useful for comparing 2022 and 2025 data, and it is a more appropriate index for historical comparisons using previous methods. Spyreas (2016) has shown that mean CC values are useful for comparison when there is variability in plot size and sampling intensity, as well as species misidentification. Mean CC will also be useful for comparisons to future floristic inventories. Species nativity will have value for historical comparisons; however, this could also be influenced slightly by the larger survey areas. Species nativity will also be useful for future comparisons.

Several species of interest were observed in remediation prairie areas in 2025. Native plants with CC values of 6–10 have very specific habitat requirements and are indicative of healthy communities. Sixteen high CC value (6 and above) species were observed in the remediation prairie areas (Table C-2).

Four species new to the Fernald Preserve were observed in the remediation successional area during monitoring in 2025: gaura (*Gaura biennis*), floating manna grass (*Glyceria septentrionalis*), rough-leaved sunflower (*Helianthus strumosus*), and smooth-tongue beardtongue (*Penstemon laevigatus*). Twenty-eight high CC value (6 and higher) species were observed in the remediation successional area (Table C-2). Of these, the species listed represent a mixture of species expected in both prairie and forested areas.

Of the 31 high CC species (6 or higher) observed in 2025, 28 species were observed in the remediation successional area and 16 were observed in the remediation prairie areas. The higher number of high CC species in the remediation successional area is likely a reflection of this area starting to transition from prairie to forest habitat. Plant species from both habitat types are present in the successional areas, resulting in higher species diversity. Vegetation management in the

prairie areas lends to maintaining one habitat type, resulting in a decreased number of plant species, while maintaining native species percent goals. The transition from prairie to forest is also reflected in the occurrence of woody vegetation in the monitored areas. Sixty-six total woody species were observed in the monitored areas in 2025, 13 were high CC. Of the total, 58 (12 high CC) occurred in the remediation successional areas, while only 41 (5 high CC) occurred in the remediation prairie areas. As forest succession progresses, woody vegetation is expected to increase in diversity and abundance. These differences suggest that both the remediation successional areas and the remediation prairie areas are moving in the direction of their respective management goals.

Table C-3 shows a small increase in mean CC from 2010 to 2025 in the remediation prairie areas and a greater increase in remediation successional areas. FQAI scores for both remediation areas continue to increase, with a greater increase occurring in the remediation successional areas. The FQAI value increases from 2020 to 2022 were most likely a reflection of the larger monitoring area used for the floristic inventory method rather than true increases in habitat quality; however, a more modest increase between 2022 and 2025 suggests that at least some of the increase is due to succession and habitat development. Native species percent in both areas has remained relatively stable since 2009. These results suggest that the remediation areas continue to meet Natural Resource Management Plan (DOE 2025a) goals and habitats are continuing to improve.

C.3.2 Proposed Grid System Monitoring Method

The last 3 years of monitoring metrics comparison tables presented in the Site Environmental Reports demonstrate that the mean CC values, FQAI values, and the percent native species for ecologically restored areas are at their highest, or near highest, values since completion of restoration. This indicates that habitat quality in these restored areas continues to improve.

To better support this continuing ecological development across the site, DOE is planning to adopt a new monitoring method to focus more on natural resource management. This method will allow a more detailed look at smaller areas over a longer monitoring cycle of 5 to 8 years as opposed to the current 3-year cycle. The method will use a grid system of small units (i.e., 100 ft × 100 ft) monitored within a predetermined area and will continue to incorporate floristic inventories, pairing the inventories with an assessment of the presence of invasive species and cover, as well as general habitat structure (tree canopy density, etc.). Also included in the monitoring method will be surveys of wildlife use within the monitored areas (e.g., amphibians, birds, and insects). These more detailed, area-focused assessments will allow more efficient identification and prioritization of maintenance needs (e.g., prescribed burns for invasive species management) to support the long-term natural resource management goals in accordance with the Natural Resource Management Plan, LMICP, Volume I, Appendix A. DOE plans to implement the grid system monitoring method in 2027. This methodology will integrate the OSDF vegetated cap to track progress towards the goals of maintaining 90% total vegetation consisting of 50% native vegetation as well as ensuring prioritization of OSDF vegetative cap maintenance needs in the same manner as other areas of the site.

C.4.0 References

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Table C-1. OSDF Vegetation Monitoring Results for Cells 7 and 8

	Cell 7	Cell 8
Total Species	22	20
Native Species	18	15
Non-native Species	4	5
Native Species (Percent)	82%	75%
Relative Frequency of Native Species (Percent)	71%	66%
Average Coefficient of Conservatism (CC), range between 0-10	2.82	2.45
Floristic Quality Assessment Index	13.22	10.96
Average Total Cover (Percent)	98%	98%

				Relative Frequency	
Scientific Name	**Common Name**	**Type**	**CC**	**Cell 7**	**Cell 8**
Ambrosia artemisiifolia	COMMON RAGWEED	forb	0	50.0%	66.7%
Andropogon gerardii	BIG BLUESTEM	grass	5	91.7%	50.0%
Asclepias syriaca	COMMON MILKWEED	forb	1	25.0%	16.7%
Aster pilosus	AWL ASTER	forb	1	8.3%	
Baptisia australis	BLUE FALSE INDIGO	forb	6	8.3%	
Bouteloua curtipendula	SIDE-OATS GRAMA GRASS	grass	8	16.7%	
Carex species	SEDGE SPECIES	sedge	1	8.3%	8.3%
Chamaecrista fasciculata	PARTRIDGE-PEA	forb	3		8.3%
Elymus canadensis	CANADA WILD RYE	grass	6	33.3%	41.7%
Erigeron species	FLEABANE SPECIES	forb	0	8.3%	8.3%
Eupatorium altissimum	TALL BONESET	forb	0	16.7%	
Euphorbia nutans	EYEBANE	forb	0	8.3%	
Helianthus tuberosus	JERUSALEM-ARTICHOKE	forb	3		8.3%
Lespedeza capitata	ROUND-HEADED BUSH-CLOVER	forb	5	8.3%	
Monarda fistulosa	WILD BERGAMOT	forb	3		25.0%
Napaea dioica	GLADE-MALLOW	forb	4		8.3%
Panicum virgatum	SWITCH GRASS	grass	4	16.7%	25.0%
Ratibida pinnata	GRAY-HEADED CONEFLOWER	forb	5	83.3%	50.0%
Schizachyrium scoparium	LITTLE BLUESTEM	grass	5	8.3%	
Solidago canadensis	CANADA GOLDENROD	forb	1	50.0%	33.3%
Solidago rigida	STIFF GOLDENROD	forb	8	16.7%	8.3%
Sorghastrum nutans	INDIAN GRASS	grass	5	75.0%	58.3%
Bromus inermis	HUNGARIAN BROME	grass	0	41.7%	50.0%
Medicago lupulina	BLACK MEDICK	forb	0	41.7%	
Poa species	BLUEGRASS SPECIES	grass	1	91.7%	75.0%
Saponaria officinalis	SOAPWORT	forb	0		8.3%
Setaria viridis	GREEN FOXTAIL GRASS	grass	0		25.0%
Trifolium pratense	RED CLOVER	forb	0	41.7%	58.3%

Shaded species are non-native.

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Table C-2. 2025 Prairie Floristic Inventory

	Remediation Praire Areas	Remediation Successional Areas
Total Species	212	252
Native Species	147	180
Non-native Species	65	72
Native Species (percent)	69%	71%
Average Coefficient of Conservatism (CC), range between 0-10	2.09	2.36
Floristic Quality Assessment Index (FQAI)	30.43	37.50

Scientific Name	Common Name	Type	Coefficient of Conservatism	Remediation Praire Areas	Remediation Successional Areas
Acalypha rhomboidea	RHOMBIC THREE-S. MERCURY	forb	0	X	
Acer negundo	BOX ELDER	tree	3	X	X
Acer rubrum	RED MAPLE	tree	2		X
Acer saccharinum	SILVER MAPLE	tree	3	X	X
Achillea millefolium	YARROW	forb	1	X	X
Agalinis tenuifolia	SLENDER FOXGLOVE	forb	4	X	
Agrimonia parviflora	SMALL-FLOWERED AGRIMONY	forb	2	X	X
Alisma subcordatum	SOUTHERN WATER-PLANTAIN	forb	2	X	X
Ambrosia artemisiifolia	COMMON RAGWEED	forb	0	X	X
Amorpha fruticosa	FALSE INDIGO	forb	3	X	X
Ampelamus albidus	SAND-VINE	vine	1		X
Andropogon gerardii	BIG BLUESTEM	grass	5	X	X
Andropogon virginicus	COMMON BROOM-SEDGE	grass	3	X	X
Apocynum cannabinum	INDIAN HEMP	forb	1	X	X
Asclepias incarnata	SWAMP MILKWEED	forb	4	X	X
Asclepias syriaca	COMMON MILKWEED	forb	1	X	X
Asclepias tuberosa	BUTTERFLY-WEED	forb	4	X	X
Asimina triloba [a]	PAWPAW	small tree	6	X	
Aster ericoides	WHITE HEATH ASTER	forb	2		X
Aster lanceolatus	EASTERN LINED ASTER	forb	3	X	X
Aster lateriflorus	CALICO ASTER	forb	2	X	X
Aster novae-angliae	NEW ENGLAND ASTER	forb	2	X	X
Aster pilosus	AWL ASTER	forb	1	X	X
Aster racemosus	SMALL-HEADED ASTER	forb	2	X	X
Baptisia australis [a]	BLUE FALSE INDIGO	forb	6	X	X
Baptisia lactea [a]	WHITE FALSE INDIGO	forb	8	X	X
Bidens frondosa	DEVIL'S BEGGAR'S-TICK	forb	2	X	X
Boehmeria cylindrica	FALSE NETTLE	forb	4	X	
Bouteloua curtipendula [a]	SIDE-OATS GRAMA GRASS	grass	8	X	X
Calamagrostis canadensis	CANADA BLUEJOINT	grass	4	X	X
Calystegia sepium	HEDGE BINDWEED	forb	1	X	X
Campsis radicans	TRUMPET-CREEPER	vine	1	X	X
Carex amphibola	E. NARROW-LEAVED SEDGE	sedge	5		X
Carex annectens	YELLOW FOX SEDGE	sedge	3	X	X
Carex blanda	COMMON WOOD SEDGE	sedge	1	X	X
Carex brevior [a]	TUFTED-FESCUE SEDGE	sedge	8		X
Carex cephalophora	OVAL-HEADED SEDGE	sedge	5	X	X
Carex comosa	BEARDED SEDGE	sedge	2	X	X
Carex cristatella	CRESTED SEDGE	sedge	3	X	X
Carex festucacea [a]	FESCUE SEDGE	sedge	7		X
Carex frankii	FRANK'S SEDGE	sedge	2	X	X
Carex granularis	MEADOW SEDGE	sedge	3	X	X
Carex grisea	NARROW-LEAVED SEDGE	sedge	4	X	
Carex hirtifolia	HAIRY-LEAVED SEDGE	sedge	3		X
Carex hystericina	PORCUPINE SEDGE	sedge	5	X	
Carex leavenworthii	LEAVENWORTH'S SEDGE	sedge	3	X	X
Carex lupulina	HOP SEDGE	sedge	3		X
Carex lurida	BOTTLEBRUSH SEDGE	sedge	3	X	X
Carex molesta	TROUBLESOME SEDGE	sedge	3		X
Carex normalis	LARGE STRAW SEDGE	sedge	4	X	X
Carex scoparia	POINTED BROOM SEDGE	sedge	3	X	X
Carex shortiana	SHORT'S SEDGE	sedge	2	X	X
Carex tribuloides	BLUNT BROOM SEDGE	sedge	4	X	X
Carex vulpinoidea	FOX SEDGE	sedge	1	X	X
Carpinus caroliniana	BLUE-BEECH	small tree	5		X
Carya cordiformis	BITTERNUT HICKORY	tree	5	X	X
Carya ovata [a]	SHAGBARK HICKORY	tree	6		X
Cephalanthus occidentalis [a]	BUTTONBUSH	shrub	6	X	X
Cercis canadensis	REDBUD	small tree	3	X	X
Chaerophyllum procumbens	WILD CHERVIL	forb	4		X
Chamaecrista fasciculata	PARTRIDGE-PEA	forb	3	X	X
Cirsium discolor	FIELD THISTLE	forb	4	X	X
Claytonia virginica	SPRING-BEAUTY	forb	2	X	
Conyza canadensis	HORSEWEED	forb	0	X	X
Cornus drummondii	ROUGH-LEAVED DOGWOOD	shrub	3	X	X
Cornus racemosa	GRAY DOGWOOD	shrub	1	X	
Corylus americana	AMERICAN HAZEL	shrub	4	X	
Crataegus crus-galli	COCKSPUR	small tree	3	X	
Cyperus esculentus	YELLOW NUT-SEDGE	sedge	0	X	X
Desmodium canadense	CANADA TICK-TREFOIL	forb	4	X	X
Desmanthus illinoensis	PRAIRIE BUNDLE-FLOWER	forb	3		X
Desmodium paniculatum	SHOWY TICK-TREFOIL	forb	3	X	X
Diospyros virginiana	PERSIMMON	tree	4		X
Echinacea purpurea [a]	PURPLE CONEFLOWER	forb	6	X	X
Eleocharis erythropoda	RED-FOOTED SPIKE-RUSH	sedge	4	X	X
Eleocharis obtusa	BLUNT SPIKE-RUSH	sedge	1	X	X
Elymus canadensis [a]	CANADA WILD RYE	grass	6	X	X

Table C-2. 2025 Prairie Florist Inventory (continued)

Epilobium coloratum	PURPLE-LEAVED WILLOW-HERB	forb	1		X
Equisetum arvense	FIELD HORSETAIL	fern	0		X
Equisetum hyemale	SCOURING-RUSH	fern	2	X	X
Erechtites hieracifolia	PILEWORT	forb	2	X	X
Erigeron annuus	DAISY FLEABANE	forb	0	X	X
Erigeron philadelphicus	PHILADELPHIA FLEABANE	forb	2	X	X
Erigeron strigosus	ROUGH FLEABANE	forb	1	X	X
Eryngium yuccifolium [a]	RATTLESNAKE-MASTER	forb	7	X	X
Euonymus atropurpureus	BURNING-BUSH	shrub	3		X
Eupatorium altissimum	TALL BONESET	forb	0	X	X
Eupatorium coelestinum	MISTFLOWER	forb	3		X
Eupatorium maculatum [a]	SPOTTED JOE-PYE WEED	forb	6		X
Eupatorium perfoliatum	COMMON BONESET	forb	3	X	X
Eupatorium purpureum	PURPLE JOE-PYE WEED	forb	5		X
Eupatorium rugosum	WHITE SNAKEROOT	forb	3	X	X
Eupatorium serotinum	LATE-FLOWERING BONESET	forb	2	X	X
Euphorbia nutans	EYEBANE	forb	0	X	
Euthamia graminifolia	FLAT-TOPPED GOLDENROD	forb	2	X	X
Fraxinus pennsylvanica	GREEN ASH	tree	3	X	X
Galium aparine	CLEAVERS	forb	0	X	X
Gaura biennis [b]	GAURA	forb	1		X
Geranium carolinianum	CAROLINA CRANE'S-BILL	forb	3	X	X
Geum canadense	WHITE AVENS	forb	2	X	X
Geum laciniatum	ROUGH AVENS	forb	2	X	
Gleditsia triacanthos	HONEY LOCUST	tree	4	X	X
Glyceria septentrionalis [a,b]	FLOATING MANNA GRASS	grass	6		X
Hackelia virginiana	VIRGINIA STICKSEED	forb	2		X
Helianthus strumosus [b]	ROUGH-LEAVED SUNFLOWER	forb	4		X
Heliopsis helianthoides	SMOOTH OXEYE	forb	5	X	X
Hibiscus laevis [a]	HALBERD-LEAVED ROSE-MALLOW	forb	7	X	
Hibiscus moscheutos	SWAMP ROSE-MALLOW	forb	4	X	
Hypericum prolificum	SHRUBBY ST. JOHN'S-WORT	shrub	3		X
Impatiens capensis	SPOTTED TOUCH-ME-NOT	forb	2		X
Ipomoea lacunosa	WHITE MORNING-GLORY	forb	4		X
Iris versicolor [a]	NORTHERN BLUE FLAG	forb	6		X
Juglans nigra	BLACK WALNUT	tree	5	X	X
Juncus effusus	SOFT RUSH	forb	1	X	X
Juncus interior	INLAND RUSH	forb	4	X	X
Juncus tenuis	PATH RUSH	forb	1	X	X
Juncus torreyi	TORREY'S RUSH	forb	3	X	
Juniperus virginiana	EASTERN RED CEDAR	tree	3	X	X
Leersia oryzoides	RICE CUT GRASS	grass	1	X	X
Leersia virginica	WHITE GRASS	grass	4		X
Lespedeza capitata	ROUND-HEADED BUSH-CLOVER	forb	5		X
Leucospora multifida	LEUCOSPORA	forb	5	X	X
Liquidambar styraciflua [a]	SWEETGUM	tree	6		X
Liriodendron tulipifera [a]	TULIP TREE	tree	6		X
Lobelia cardinalis	CARDINAL-FLOWER	forb	5		X
Lobelia siphilitica	GREAT BLUE LOBELIA	forb	3	X	
Ludwigia alternifolia	SEEDBOX	forb	3		X
Ludwigia palustris	WATER-PURSLANE	forb	3	X	X
Lycopus americanus	AMERICAN WATER-HOREHOUND	forb	3	X	X
Mentha arvensis	FIELD MINT	forb	2	X	
Mimulus ringens	COMMON MONKEY-FLOWER	forb	4	X	X
Monarda fistulosa	WILD BERGAMOT	forb	3	X	X
Oenothera biennis	COMMON EVENING-PRIMROSE	forb	1	X	
Oxalis stricta	COMMON YELLOW WOOD-SORREL	forb	0		X
Panicum capillare	WITCH GRASS	grass	1	X	X
Panicum clandestinum	DEER'S-TONGUE PANIC GRASS	grass	2	X	X
Panicum virgatum	SWITCH GRASS	grass	4	X	X
Parthenocissus quinquefolia	VIRGINIA CREEPER	vine	2	X	X
Penstemon digitalis	FOXGLOVE BEARD-TONGUE	forb	2	X	X
Penstemon laevigatus [b]	SMOOTH BEARD-TONGUE	forb	3		X
Phyla lanceolata	FOG-FRUIT	forb	3	X	X
Phytolacca americana	POKEWEED	forb	1	X	
Platanus occidentalis [a]	SYCAMORE	tree	7	X	X
Podophyllum peltatum	MAYAPPLE	forb	4		X
Populus deltoides	EASTERN COTTONWOOD	tree	3	X	X
Prunella vulgaris	SELF-HEAL	forb	0	X	X
Prunus americana	AMERICAN PLUM	small tree	3	X	
Prunus munsoniana	MUNSON'S PLUM	small tree	3		X
Prunus serotina	BLACK CHERRY	tree	3		X
Pycnanthemum tenuifolium	NARROW-LEAVED MOUNTAIN-MINT	forb	4	X	X
Quercus alba	WHITE OAK	tree	6		X
Quercus bicolor [a]	SWAMP WHITE OAK	tree	7	X	X
Quercus imbricaria	SHINGLE OAK	tree	5		X
Quercus macrocarpa	BUR OAK	tree	6		X
Quercus muehlenbergii	CHINQUAPIN OAK	tree	7		X
Quercus palustris	PIN OAK	tree	5		X
Quercus rubra	RED OAK	tree	6	X	X
Quercus shumardii [a]	SHUMARD OAK	tree	7		X
Ratibida pinnata	GRAY-HEADED CONEFLOWER	forb	5	X	X
Rhus aromatica var. aromatica	FRAGRANT SUMAC	shrub	3	X	
Rhus glabra	SMOOTH SUMAC	shrub	2	X	X
Rhus typhina	STAGHORN SUMAC	shrub	2		X
Robinia pseudoacacia	BLACK LOCUST	tree	0	X	
Rosa palustris	SWAMP ROSE	shrub	5		X
Rubus allegheniensis	COMMON BLACKBERRY	shrub	1	X	X
Rubus occidentalis	BLACK RASPBERRY	shrub	1		X
Rudbeckia hirta	BLACK-EYED SUSAN	forb	1	X	X
Rudbeckia triloba	THREE-LOBED CONEFLOWER	forb	5		X
Ruellia strepens	SMOOTH RUELLIA	forb	5		X
Sabatia angularis	ROSE-PINK	forb	4		X
Salix exigua	SANDBAR WILLOW	shrub	1	X	X

Table C-2. 2025 Prairie Florist Inventory (continued)

Salix nigra	BLACK WILLOW	tree	2	X	X
Sambucus canadensis	COMMON ELDERBERRY	shrub	3		X
Schizachyrium scoparium	LITTLE BLUESTEM	grass	5	X	X
Schoenoplectus tabernaemontani	SOFT-STEMMED BULRUSH	sedge	2	X	X
Scirpus atrovirens	GREEN BULRUSH	sedge	1	X	X
Scirpus cyperinus	WOOL-GRASS	sedge	1	X	X
Scirpus pendulus	DROOPING BULRUSH	sedge	2	X	X
Senna hebecarpa	NORTHERN WILD SENNA	forb	4	X	
Silphium laciniatum	COMPASS PLANT	forb	8	X	X
Silphium perfoliatum [a]	CUP-PLANT	forb	6	X	X
Silphium terebinthinaceum [a]	PRAIRIE DOCK	forb	8	X	
Sisyrinchium angustifolium	STOUT BLUE-EYED-GRASS	forb	2		X
Smilax rotundifolia	COMMON GREENBRIER	vine	4		X
Solidago canadensis	CANADA GOLDENROD	forb	1	X	X
Solidago rigida [a]	STIFF GOLDENROD	forb	8	X	X
Sorghastrum nutans	INDIAN GRASS	grass	5	X	X
Sparganium eurycarpum	GIANT BUR-REED	forb	4	X	
Spartina pectinata	PRAIRIE CORD GRASS	grass	5	X	X
Symphoricarpos orbiculatus	CORALBERRY	shrub	3	X	X
Teucrium canadense	AMERICAN GERMANDER	forb	3		X
Tilia americana [a]	AMERICAN BASSWOOD	tree	6		X
Toxicodendron radicans	POISON-IVY	vine	1	X	X
Tradescantia ohiensis	OHIO SPIDERWORT	forb	5	X	X
Ulmus rubra	SLIPPERY ELM	tree	3	X	X
Utricularia vulgaris [a]	COMMON BLADDERWORT	forb	6		X
Valerianella umbilicata	BEAKED CORN-SALAD	forb	2	X	X
Verbena hastata	BLUE VERVAIN	forb	4	X	X
Verbena stricta	HOARY VERVAIN	forb	3	X	
Verbena urticifolia	WHITE VERVAIN	forb	3	X	X
Vernonia gigantea	TALL IRONWEED	forb	2	X	X
Veronica anagallis-aquatica [a]	WATER SPEEDWELL	forb	6		X
Viburnum prunifolium	BLACK-HAW	shrub	4	X	X
Viola rafinesquii	FIELD PANSY	forb	2	X	
Viola sororia	COMMON BLUE VIOLET	forb	1		X
Vitis vulpina	FROST GRAPE	vine	3	X	X
Alliaria petiolata	**GARLIC MUSTARD**	forb	0		X
Allium vineale	**FIELD GARLIC**	forb	0	X	X
Alopecurus pratensis	**MEADOW FOXTAIL**	grass	0		X
Amaranthus cruentus	**RED AMARANTH**	forb	0		X
Artemisia annua	**ANNUAL WORMWOOD**	forb	0		X
Artemsia vulgaris	**COMMON MUGWORT**	forb	0		X
Barbarea vulgaris	**YELLOW ROCKET**	forb	0	X	X
Bromus inermis	**HUNGARIAN BROME**	grass	0	X	X
Carduus nutans	**NODDING THISTLE**	forb	0	X	X
Catalpa speciosa	**NORTHERN CATALPA**	tree	0	X	X
Centaurium pulchellum	**BRANCHING CENTAURY**	forb	0		X
Chrysanthemum leucanthemum	**OX-EYE DAISY**	forb	0	X	
Cichorium intybus	**CHICORY**	forb	0	X	X
Cirsium arvense	**CANADA THISTLE**	forb	0	X	X
Cirsium vulgare	**BULL THISTLE**	forb	0	X	X
Conium maculatum	**POISON-HEMLOCK**	forb	0	X	X
Convolvulus arvensis	**FIELD BINDWEED**	forb	0	X	
Coronilla varia	**CROWN-VETCH**	forb	0	X	X
Crataegus species	**HAWTHORN SPECIES**	small tree	0		X
Daucus carota	**QUEEN-ANNE'S-LACE**	forb	0	X	X
Dianthus armeria	**DEPTFORD-PINK**	forb	0	X	X
Dipsacus fullonum	**WILD TEASEL**	forb	0	X	X
Dipsacus laciniatus	**CUT-LEAVED TEASEL**	forb	0	X	X
Duchesnea indica	**INDIAN-STRAWBERRY**	forb	0	X	
Echinacea pallida	**PALE PURPLE CONEFLOWER**	forb	0	X	X
Echinochloa crusgalli	**BARNYARD GRASS**	grass	0	X	X
Elaeagnus umbellata	**AUTUMN-OLIVE**	small tree	0	X	X
Festuca elatior	**TALL FESCUE**	grass	0	X	X
Glechoma hederacea	**GROUND IVY**	forb	0	X	X
Hedera helix	**ENGLISH IVY**	vine	0		X
Hordeum jubatum	**SQUIRREL-TAIL BARLEY**	grass	0	X	
Lamium purpuream	**PURPLE DEAD-NETTLE**	forb	0	X	X
Lepidium campestre	**FIELD PEPPER-GRASS**	forb	0		X
Lespedeza cuneata	**CHINESE BUSH-CLOVER**	forb	0	X	X
Liatris pycnostachya	**THICK-SPIKED BLAZING-STAR**	forb	0	X	X
Lolium multiflorum	**ITALIAN RYEGRASS**	grass	0	X	X
Lonicera japonica	**JAPANESE HONEYSUCKLE**	vine	0	X	X
Lonicera maackii	**AMUR HONEYSUCKLE**	shrub	0	X	X
Lonicera morrowii	**MORROW'S HONEYSUCKLE**	shrub	0	X	
Lotus corniculatus	**BIRD'S-FOOT TREFOIL**	forb	0	X	X
Lysimachia nummularia	**MONEYWORT**	forb	0		X
Lythrum salicaria	**PURPLE LOOSESTRIFE**	forb	0		X
Medicago lupulina	**BLACK MEDICK**	forb	0	X	X
Melilotus alba	**WHITE SWEET-CLOVER**	forb	0	X	X
Melilotus officinalis	**YELLOW SWEET-CLOVER**	forb	0	X	X
Mollugo verticillata	**CARPET-WEED**	forb	0	X	
Morus alba	**WHITE MULBERRY**	tree	0	X	X
Narcissus pseudonarcissus	**DAFFODIL**	forb	0		X
Pastinaca sativa	**WILD PARSNIP**	forb	0		X
Phalaris arundinacea	**REED CANARY GRASS**	grass	0	X	X
Phragmites australis subsp. australis	**GIANT REED**	grass	0	X	
Pinus nigra	**AUSTRIAN PINE**	tree	0	X	X
Pinus strobus	**WHITE PINE**	tree	0		X
Plantago lanceolata	**ENGLISH PLANTAIN**	forb	0	X	X
Plantago major	**COMMON PLANTAIN**	forb	0	X	X
Poa annual	**ANNUAL BLUEGRASS**	grass	0	X	X

Table C-2. 2025 Prairie Florist Inventory (continued)

Polygonum persicaria	**LADY'S THUMB**	forb	0	X	X
Pyrus callieryana	**CALLIERY PEAR**	small tree	0	X	X
Rhamnus cathartica	**EUROPEAN BUCKTHORN**	small tree	0		X
Rosa multiflora	**MULTIFLORA ROSE**	shrub	0	X	X
Rumex crispus	**CURLY DOCK**	forb	0	X	X
Saponaria officinalis	**SOAPWORT**	forb	0	X	X
Schoenoplectus mucronatus	**RICEFIELD BULRUSH**	sedge	0	X	
Senecio glabellus	**BUTTERWEED**	forb	0	X	
Setaria faberi	**GIANT FOXTAIL GRASS**	grass	0	X	X
Setaria glauca	**YELLOW FOXTAIL GRASS**	grass	0	X	X
Setaria viridis	**GREEN FOXTAIL GRASS**	grass	0	X	X
Sida spinosa	**PRICKLY SIDA**	forb	0		X
Solanum carolinense	**HORSE NETTLE**	forb	0	X	X
Sorghum halepense	**JOHNSON GRASS**	grass	0	X	
Taraxacum officinale	**COMMON DANDELION**	forb	0	X	X
Thlaspi arvense	**FIELD PENNY CRESS**	forb	0	X	X
Torilis arvensis	**FIELD HEDGE-PARSLEY**	forb	0	X	X
Tragogpogon dubius	**FIELD GOAT'S-BEARD**	forb	0	X	
Trifolium hybridum	**ALSIKE CLOVER**	forb	0	X	X
Trifolium pratense	**RED CLOVER**	forb	0	X	X
Trifolium repens	**WHITE CLOVER**	forb	0		X
Typha angustifolia	**NARROW-LEAVED CAT-TAIL**	forb	0	X	X
Typha x glauca	**HYBRID CAT-TAIL**	forb	0	X	X
Verbascum blattaria	**MOTH MULLEIN**	forb	0	X	X
Verbascum thapsus	**COMMON MULLEIN**	forb	0	X	X
Veronica arvensis	**CORN SPEEDWELL**	forb	0		X
Xanthium strumarium	**COMMON COCKLEBUR**	forb	0	X	X

Highlighted species are non-native; X indicates the species is present in the monitoring area.

[a] Indicates a species with CC value higher than 6.

[b] First time observation at the site.

Table C-3. Comparison of Remediation Areas Ecological Monitoring Metrics

Time Period	Mean Coefficient of Conservatism		Floristic Quality Assessment Index		Native Species	
	Remediation Prairie Areas	Remediation Successional Areas	Remediation Prairie Areas	Remediation Successional Areas	Remediation Prairie Areas	Remediation Successional Areas
2010	1.8	1.5	20.0	14.7	64%	52%
2013	1.7	1.4	20.1	13.6	60%	49%
2015 to 2017[a]	1.6	1.8	15.6	21.7	59%	61%
2018 to 2020[a]	1.6	1.7	14.3	20.7	59%	63%
2022[b]	1.0	2.3	28.0	33.6	67%	70%
2025[b]	2.1	2.4	30.4	37.5	69%	71%

[a] Monitoring rotated among site management areas over a 3-year period.
[b] Floristic inventory monitoring method used.





Figure C-1A. Top of OSDF Cell 8, South and North Perspectives





Figure C-1B. Top of OSDF Cell 8, East and West Perspectives





Figure C-2A. Top of OSDF Cell 5, South and North Perspectives





Figure C-2B. Top of OSDF Cell 5, East and West Perspectives





Figure C-3A. Top of OSDF Cell 1, South and North Perspectives





Figure C-3B. Top of OSDF Cell 1, East and West Perspectives





Figure C-4A. OSDF Survey Marker No. 01 and No. 02





Figure C-4B. OSDF Survey Marker No. 03 and No. 04

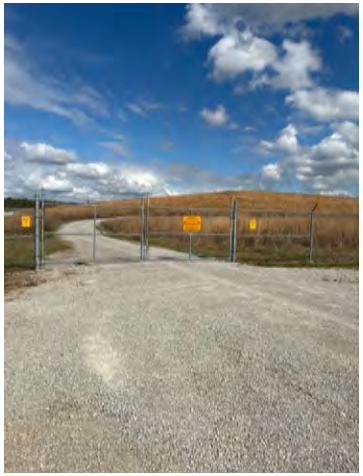




Figure C-5. OSDF Southwest Gate and South Gate, North and Northeast Perspectives





Figure C-6A. OSDF East Fence, North Perspective





Figure C-6B. OSDF East Fence, West and North-Northwest Perspectives



Figure C-7. OSDF East Fence, North Perspective





Figure C-8. OSDF Former North Gate, Southwest Perspective and North Fence, West Perspective





Figure C-9. OSDF Northwest Gate, North-Northeast Perspective and West Fence South-Southeast Perspective





Figure C-10. OSDF Valve Houses 8 Through 1, North Perspective, and OSDF Valve House 1, West-Northwest Perspective



Figure C-11. OSDF Cell 1 Wells, Northeast Perspective

Figure C-12. OSDF Valve House and Wells Cell 2

Figure C-13. OSDF Valve House and Wells Cell 3





Figure C-14. OSDF Valve House and Wells, Cell 4





Figure C-15. OSDF Valve House and Wells, Cell 5



Figure C-16. OSDF Valve House and Wells, Cell 6



Figure C-17. OSDF Valve House and Wells, Cell 7

Figure C-18. OSDF Valve House and Wells, Cell 8

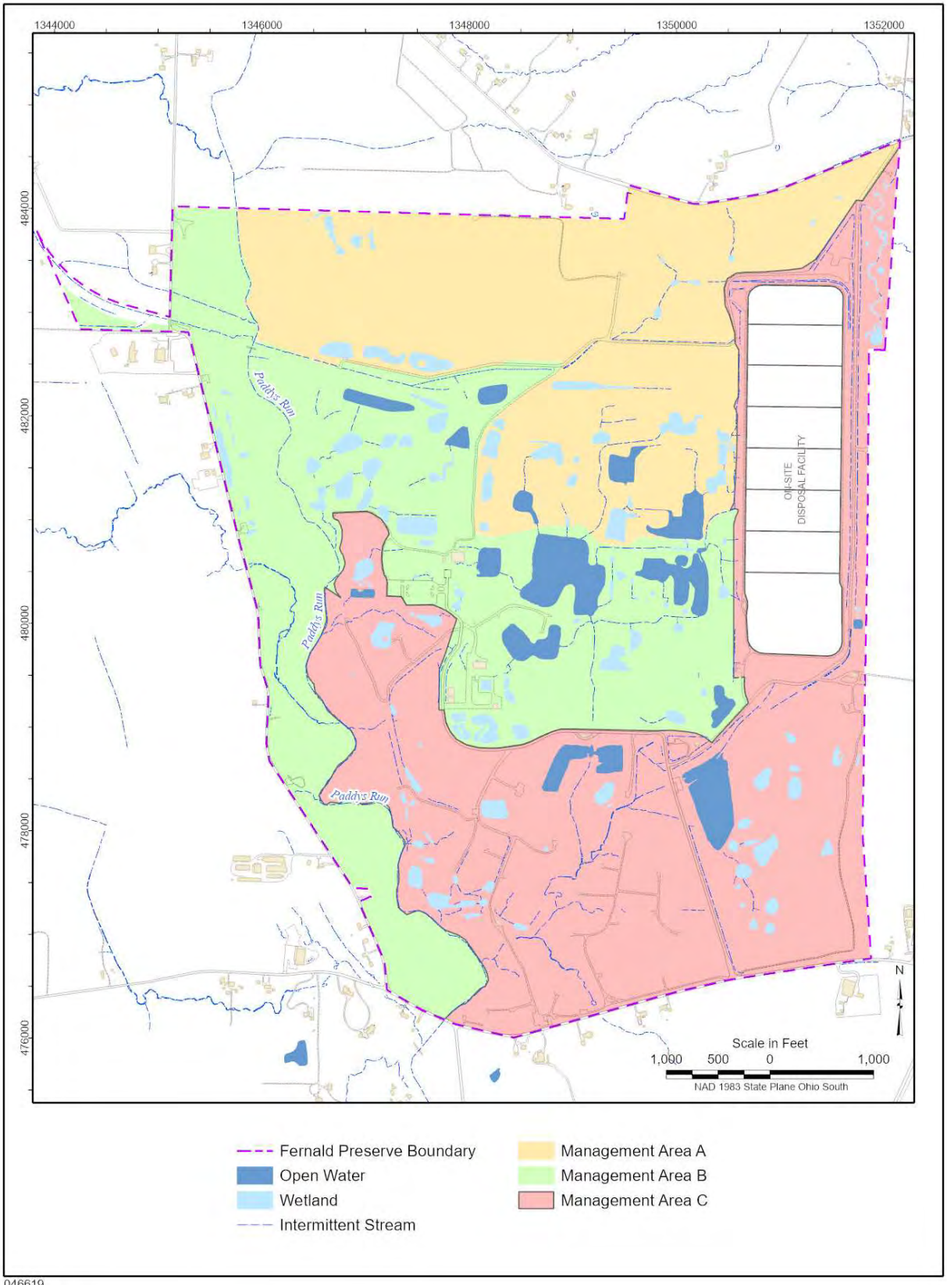


Figure C-19. Area-Based Approach Ecological Monitoring Areas (2015 Through 2020)

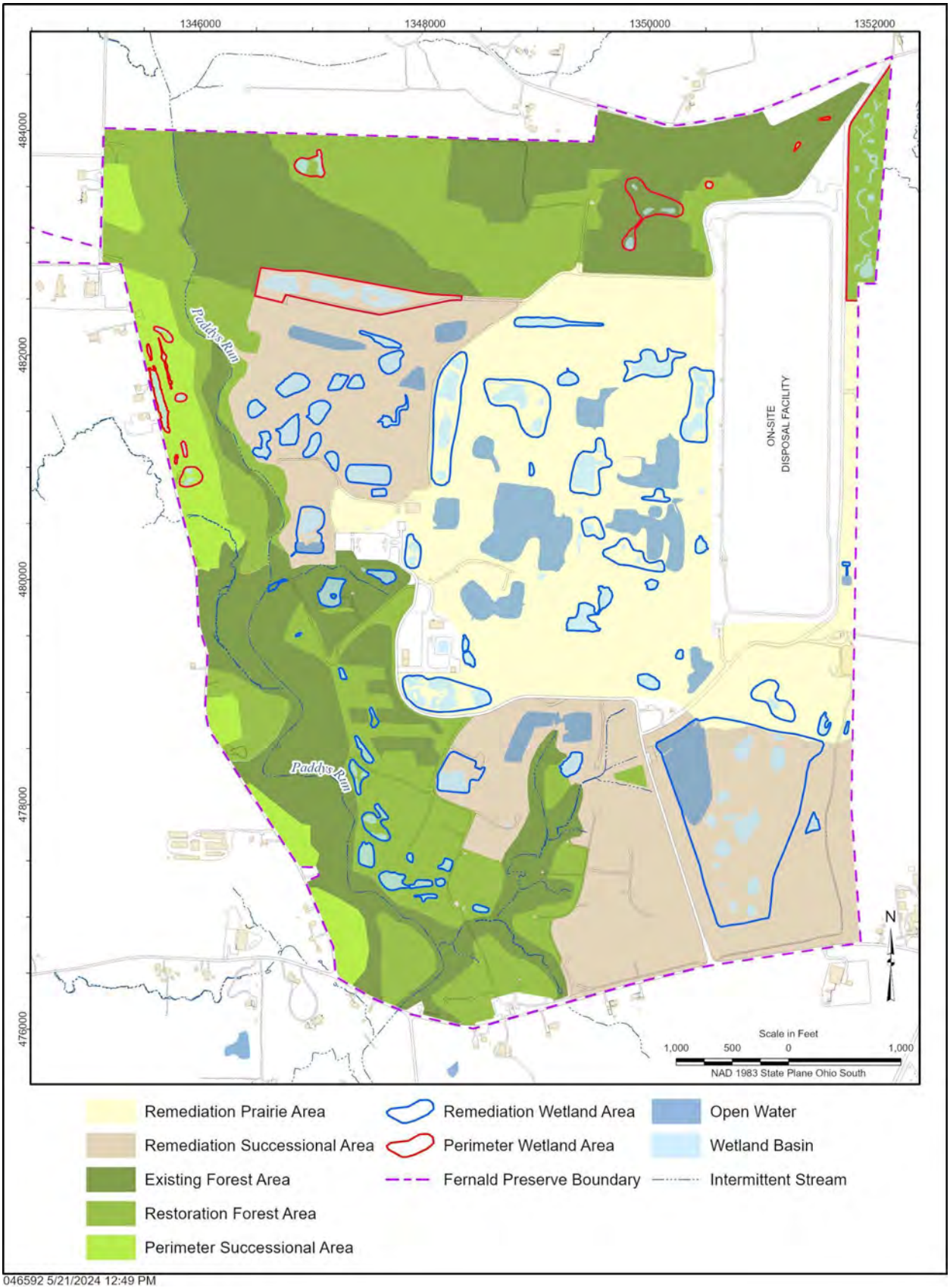


Figure C-20. Ecological Restoration Management Areas (2021 to Present)

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