Volume II

Institutional Controls Plan

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Emergency Contact

Legacy Management 24-hour
Monitored Security Telephone Number

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Contents

Figures

Tables

Appendixes

Attachments

Abbreviations

AR	Administrative Record
CAWWT	Converted Advanced Wastewater Treatment facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CIP	Community Involvement Plan
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FRL	final remediation level
GEMS	Geospatial Environmental Mapping System
GPS	global positioning system
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
IEMP	Integrated Environmental Monitoring Plan
IRAR	*Interim Remedial Action Report for Operable Unit 5*
IRDP	Integrated Remedial Design Package
IRRA	*Interim Residual Risk Assessment Report*
LCS	leachate collection system
LDS	leak detection system
LM	Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
OMMP	Operations and Maintenance Master Plan
ORC	Ohio Revised Code
OSDF	On-Site Disposal Facility
OU	operable unit
PCCIP	Post-Closure Care and Inspection Plan

ppb	parts per billion
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SEP	Sitewide Excavation Plan
USC	*United States Code*
USFWS	U.S. Fish and Wildlife Service
WAC	waste acceptance criteria
WCS	Waste Control Specialists, LLC

Executive Summary

This *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) was developed to document the planning process and the requirements for the long-term care, or legacy management, of the Fernald Preserve. The LMICP is a two-volume document with supporting documents included as attachments to Volume II. Volume I provides planning details for management of the Fernald Preserve that go beyond those identified as institutional controls in Volume II. Primarily, Volume II is a requirement of Title 42 *United States Code* Section 103, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), providing institutional controls that will ensure that the cleanup remedies implemented at the Fernald Preserve will protect human health and the environment. The format and content of Volume II follows U.S. Environmental Protection Agency (EPA) requirements for institutional controls. Once approved, Volume II becomes enforceable under CERCLA authority.

Volume I is the Legacy Management Plan. This plan is not a required document under the CERCLA process, and it is not a legally enforceable document. It provides the U.S. Department of Energy (DOE) Office of Legacy Management (LM) with a plan for managing the Fernald Preserve and fulfilling DOE's commitment to maintain the Fernald Preserve following closure. The plan discusses how DOE, specifically LM, will approach the legacy management of the Fernald Preserve. It describes the surveillance and maintenance of the entire site, including the On-Site Disposal Facility (OSDF). It explains how the public will continue to participate in the future of the Fernald Preserve. Also included in the Legacy Management Plan is a discussion of records and information management. The plan concludes with a discussion on funding for legacy management of the site.

Volume II is the Institutional Controls Plan. The plan is required under the CERCLA remediation process when a physical remedy does not allow for full, unrestricted use, or when hazardous materials are left onsite. The plan is a legally enforceable CERCLA document and is part of the remedy for the site (an EPA requirement). The plan outlines the institutional controls that are established for and enforced across the entire site, including the OSDF, to ensure that human health and the environment continue to be protected following the implementation of the remedy.

The plan has five attachments that lend support to and provide details regarding the established institutional controls. The attachments provide further information on the continuing groundwater remediation (pump-and-treat) system (Attachment A), the OSDF cap and cover system (Attachment B), the leak detection and leachate management systems for the OSDF (Attachment C), the environmental monitoring that will continue following closure (Attachment D), and the CERCLA-required Community Involvement Plan (Attachment E). The Community Involvement Plan explains in detail how DOE will ensure that the public has appropriate opportunities for involvement in post-closure activities.

The LMICP was first approved in August 2006. It is anticipated that the LMICP revisions will be finalized by January each year, to correspond with calendar year monitoring and reporting. EPA and Ohio Environmental Protection Agency comments will be addressed between October and January.

The future LMICP schedule will be as follows:

- Each June, the annual Site Environmental Report will be submitted. It will make recommendations based on the previous year's monitoring information.
- Each September, an annual review of the LMICP will be completed. The requirement to complete a full revision of the LMICP will be assessed with the regulators each year and, at a minimum, it is expected that a full revision of the LMICP will be required at least every 5 years. Based on the number and types of changes required each September, either a revised document or variance for each change required to the existing document will be submitted. The variance process established in the *Fernald Preserve Quality Assurance Project Plan* (DOE 2014) will be followed.
- Each January, the revised document or approved variances to the existing document will be finalized to correspond with the monitoring and reporting schedule.

1.0 Introduction

The U.S. Department of Energy (DOE) manages the federally owned Fernald Preserve, owned by the federal government, which is situated on a 1,050-acre tract of land approximately 18 miles northwest of Cincinnati, Ohio. The Fernald Preserve is located near the unincorporated communities of Ross, Fernald, Shandon, New Baltimore, and New Haven. Land use in the area consists primarily of residential areas, farming, gravel excavation operations, light industry, and parks.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the primary driver for the environmental remediation of the Fernald Preserve. The site was divided into five operable units (OUs), and a remedial investigation and feasibility study (RI/FS) was conducted for each unit. Based on the results of the RI/FSs, Records of Decision (RODs) were issued outlining the selected remedy for each OU.

- **ROD for OU1, Waste Pits Area:** The remedy for OU1 included removing all material from the waste pits, stabilizing the material by drying it, and shipping it offsite for disposal. OU1 field activities ended June 2005.
- **ROD for OU2, Other Waste Units:** The remedy for OU2 included removing material from the various units, disposing of material that met the onsite waste acceptance criteria (WAC) in the On-Site Disposal Facility (OSDF), and shipping all other material offsite for disposal. The WAC were developed by DOE and regulators, with input from the stakeholders and the public, to strictly control the type of waste disposed of onsite. The WAC are documented in the *Waste Acceptance Criteria Attainment Plan for the On-site Disposal Facility* (DOE 1998a). OU2 field activities ended November 2003.
- **Final ROD for OU3, Production Area:** The OU3 remedy included decontaminating and decommissioning all contaminated structures and buildings, recycling waste materials whenever possible, disposing of material that met the onsite WAC in the OSDF, and shipping all other material offsite for disposal. OU3 field activities ended October 2006.
- **ROD for OU4, Silos 1–4:** The OU4 remedy included removing and treating all material from the silos, dismantling the silos, and shipping the waste materials and silo debris offsite for disposal.

  Pneumatic retrieval, conditioning, and packaging of Silo 3 material was initiated March 23, 2005. A total of 1,416 containers were filled via pneumatic retrieval through October 21, 2005, when mechanical retrieval was initiated. Retrieval and packaging of Silo 3 material was completed March 21, 2006. A total of 2,297 containers were filled (including 50 containers of material generated during safe shutdown of the facility) and transported to Envirocare of Utah for disposal.

  Bulk processing in the Silos 1 and 2 Remediation Facility was completed March 19, 2006. A total of 3,776 containers of treated material from Silo 1 and 2 (including 80 containers produced through direct loadout in support of the safe shutdown of the facility) were packaged and shipped to the Waste Control Specialists, LLC (WCS) facility in Andrews, Texas, for disposal. On May 29, 2008, the State of Texas granted a byproduct license to WCS, which allowed the canisters of Silos 1 and 2 waste to be permanently disposed of at WCS. Final permanent disposal of Silos 1 and 2 treated waste materials began on October 7, 2009. The last container was placed on November 2, 2009.

- **ROD for OU5, Environmental Media:** OU5 includes all environmental media, such as soil, sediment, surface water, groundwater, and vegetation. The *Site-Wide Excavation Plan* (SEP) (DOE 1998b) describes the remediation of soils, which includes the excavation of soils that exceed the risk-based final remediation levels (FRLs) for a list of constituents of concern as listed in the SEP. The OU5 ROD describes the approved remediation method of pump-and-treat for groundwater until levels of uranium in groundwater are less than 30 parts per billion (ppb). In the original ROD, the FRL for uranium in groundwater was 20 ppb. After the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA) approved the change, the FRL was raised to 30 ppb, as written in the *Explanation of Significant Differences for Operable Unit 5* (DOE 2001). OU5 field activities related to care and maintenance of the OSDF and aquifer restoration are ongoing.

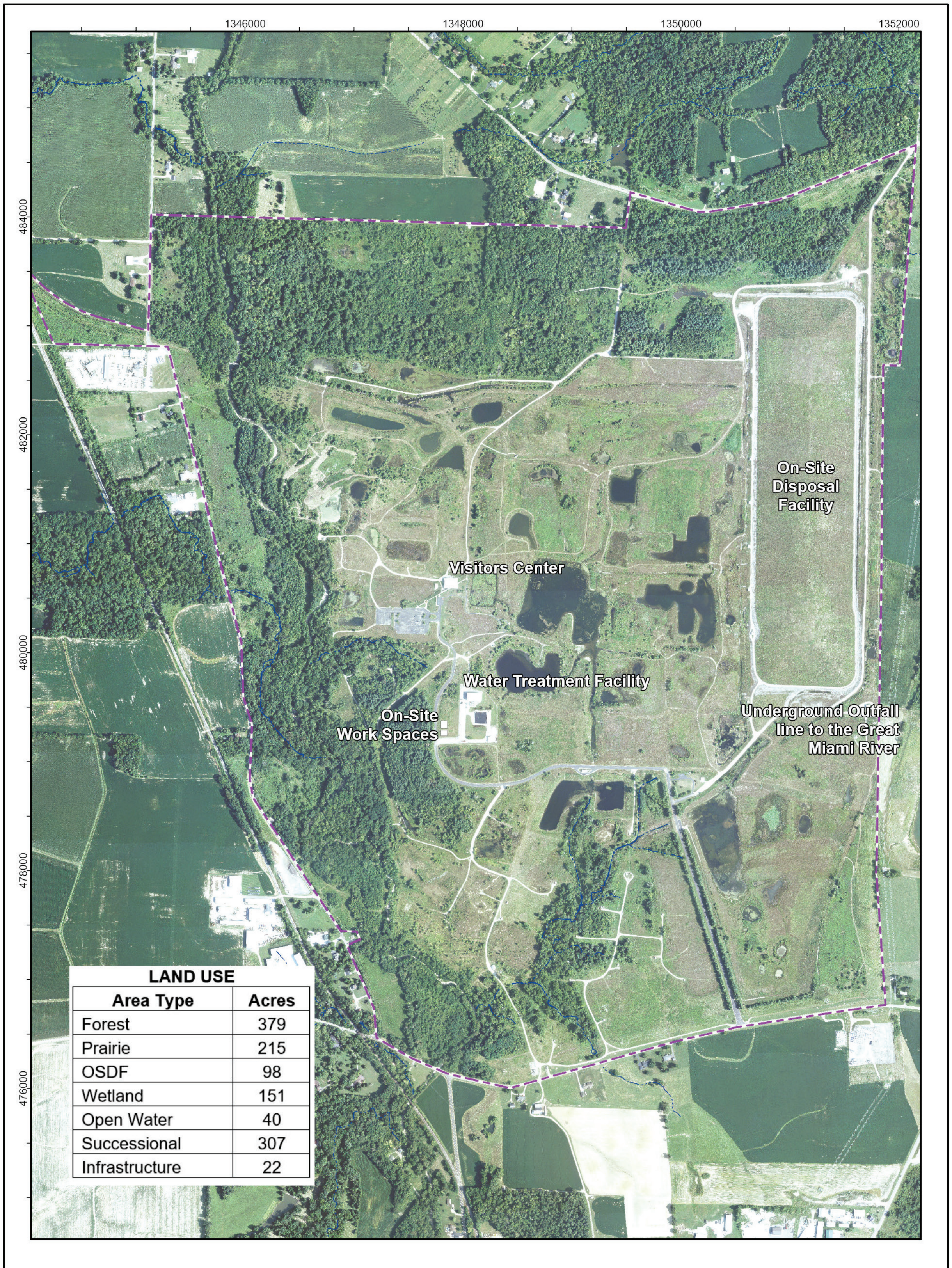
A list of the RODs and all associated documents is included in Appendix A of this volume.

The Declaration of Physical Completion, or closure, occurred on October 29, 2006. The construction of the OSDF and all site cleanup activities—with the exception of the ongoing actions necessary to achieve the final cleanup of the Great Miami Aquifer—were completed. Once the aquifer is restored, the Converted Advanced Wastewater Treatment (CAWWT) and associated infrastructure will be decommissioned and dismantled, and the utility corridors and the CAWWT footprint will be remediated (see Volume I, Figure 3). Modeling results indicate that the projected date of completion of the pump-and-treat operation of the aquifer restoration is 2035.

Ecological restoration followed remediation and was the final step to completing the cleanup of the site. Ecological restoration activities at the site were also being implemented to address wetland mitigation requirements under the Clean Water Act and to stabilize and revegetate areas impacted during remediation. Approximately 900 acres of the Fernald Preserve have been ecologically restored, having been graded following excavations, amended, seeded, planted, or otherwise enhanced to create ecosystems comparable to native presettlement southwestern Ohio.

The OSDF, located on the eastern side of the Fernald Preserve, is complete. The OSDF consists of eight disposal cells, the footprint of which covers an area of approximately 75 acres. A buffer area and a perimeter fence are established around the disposal facility, and the total fenced OSDF area is approximately 98 acres. A few additional facilities remain onsite. These include the Visitors Center (former Silos Warehouse), CAWWT and supporting infrastructure, extraction wells and associated piping and utilities, the outfall line to the Great Miami River, the former Dissolved Oxygen Building, the Restoration storage shed, the onsite work spaces (constructed in 2022), and the former Communications Building. Several public amenities have been added to the site since opening to the public in 2008. These include a program shelter located adjacent to the Visitors Center, a 7-mile trail system, several observation decks, a wetland boardwalk, and a wildlife observation blind. Figure 1 shows the Fernald Preserve's land use.

The DOE Office of Environmental Management (EM) was responsible for the remediation of the Fernald Site. Post-remediation responsibilities have transitioned to the DOE Office of Legacy Management (LM). LM is responsible for the post-remediation operations (including decontaminating and dismantling the aquifer remediation infrastructure), maintenance, and enforcement of institutional controls at the site.



Area Type	Acres
Forest	379
Prairie	215
OSDF	98
Wetland	151
Open Water	40
Successional	307
Infrastructure	22

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Figure 1. Fernald Preserve Land Use

1.1 Purpose and Organization of this Institutional Controls Plan

This Institutional Controls Plan outlines the institutional controls established and enforced since remediation was completed, with the exception of the groundwater remediation at the Fernald Preserve. This Institutional Control Plan documents DOE's approach to maintaining institutional controls as required by EPA under CERCLA. The institutional controls outlined in this plan are designed to ensure the continued protection of human health and the environment following closure of the site. LM is responsible for monitoring, maintaining, reporting on, and implementing institutional controls at the Fernald Preserve. This Institutional Control Plan will be reviewed annually to determine if revisions are required. All revisions will be subject to regulatory agency review and will be made available to the public. This plan will also be reviewed every 5 years in conjunction with the CERCLA Five-Year Review, and revisions will be made as necessary. Revisions can always be made on an as-needed basis if the results of site and OSDF inspections and monitoring require them.

In addition, changes to any of the support plans attached to this Institutional Control Plan may trigger revisions to the plan. The approved Institutional Control Plan is part of the CERCLA remedy for the Fernald Preserve.

The documents attached to this Institutional Control Plan provide further detail and more subject-specific information regarding institutional controls and other post-closure activities. These documents include:

- Attachment A—Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment (OMMP).
- Attachment B—OSDF Post-Closure Care and Inspection Plan (PCCIP).
- Attachment C—Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP).
- Attachment D—Integrated Environmental Monitoring Plan (IEMP).
- Attachment E—Community Involvement Plan (CIP).

1.2 Summary of Attachments

The OMMP (Attachment A) establishes the design logic and priorities for the major flow and water treatment decisions needed to maintain compliance with the Fernald Preserve's National Pollutant Discharge Elimination System (NPDES) permit and ROD (OU5) surface water discharge limits. The OMMP is designed to guide and coordinate the extraction, collection, conveyance, treatment, and discharge of all groundwater and leachate (from the OSDF). A summary of the information in the OMMP is included in Section 3.4, "Groundwater Remedy and Monitoring."

The PCCIP (Attachment B) addresses the inspection, monitoring, and maintenance activities necessary to ensure the continued proper performance of the OSDF. Key concepts addressed include ownership, access controls and restrictions, deed and use restrictions, environmental monitoring, OSDF cap and buffer area inspections, custodial maintenance, contingency repair, corrective actions, emergency notifications, reporting, and public involvement. Additional details from this plan are included in Section 3.5.1, "OSDF Inspection and Maintenance."

The GWLMP (Attachment C) specifies the frequencies and parameters being monitored in four horizons for each cell of the OSDF. These horizons are the leachate collection system (LCS), the leak detection system (LDS), perched water in the glacial overburden, and the Great Miami Aquifer (both upgradient and downgradient of each cell). Cell-specific data from these four horizons are evaluated holistically to verify the integrity of the cells. To date, the data from this comprehensive leak detection program indicate that the liner systems for all the cells are performing within the specifications established in the OSDF design documentation. The GWLMP will be reviewed with the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) annually. Any modifications to the plan will be based on analysis of the data collected from the ongoing leak detection sampling. The GWLMP governs the post-closure leak detection and leachate monitoring program for the OSDF. Further details from the GWLMP are included in Section 3.5.2, "Leak Detection/Leachate Monitoring."

The IEMP (Attachment D) directs environmental monitoring program elements that support site remediation activities. The document outlines all regulatory requirements for sitewide monitoring, reporting, and remedy performance tracking activated by the applicable or relevant and appropriate requirements identified in the remedy selection documents. The various elements of environmental monitoring that are addressed in the IEMP include groundwater monitoring (Section 3.0), and surface water and treated effluent (Section 4.0). Section 6.0 provides a review and summary of the various programs and reporting requirements.

The CIP (Attachment E) documents how DOE will ensure that the public has appropriate opportunities for involvement in site-related decisions, including site controls, management, and monitoring.

1.3 Definition and Purpose of Institutional Controls

Institutional controls are important to help minimize the potential for exposure to, and the release of, residual contaminants, ensuring the protection of human health and the environment. Institutional controls are also important in helping to protect engineered remedies by providing a means to ensure that the remedy remains effective, is not showing signs of failure, and is not being vandalized or damaged by outside elements (natural or human) in any way. Section 1.4 describes the types of institutional controls at the site.

EPA, in *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating, and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups* (EPA 2000), has defined institutional controls as administrative or legal controls (i.e., non-engineered) that help to minimize the potential for human exposure to contamination or protect the integrity of a remedy. Institutional controls work by limiting land or resource use by providing information to modify or guide human behavior at the site.

DOE has defined institutional controls as mechanisms designed to appropriately limit access to or uses of land and facilities, to protect cultural and natural resources, to maintain the physical security of DOE facilities, and to prevent or limit inadvertent human and environmental exposure to residual contaminants. Institutional controls include methods to preserve knowledge and to inform current and future generations of hazards and risks (DOE 2000).

Although the DOE and EPA definitions differ slightly—DOE includes physical controls, such as fences and gates, as institutional controls—they both focus on the goal of protecting human health and the environment from residual hazards.

1.4 Types of Institutional Controls

The types of institutional controls being used at the Fernald Preserve, which are outlined in this plan, serve two functions: (1) to eliminate the disturbance and monitor the use of the Fernald Preserve and (2) to minimize human and environmental exposure to residual contaminants, as described below. The site was divided into two subsections for institutional control purposes: the Fernald Preserve and the OSDF. The OSDF includes the disposal facility and its buffer area. This area is enclosed by a fence and gates that are locked at all times, unless authorized personnel require access. The Fernald Preserve is all of the remaining property onsite. The Fernald Preserve Visitors Center and associated trails and overlooks are accessible to the unescorted public. The two sections of the site are treated separately because of the greater restrictions that apply to the OSDF.

- **Controls to Eliminate Disturbance and Unauthorized Use of the Fernald Preserve (Section 2.0):** Describes institutional controls, applicable to both the Fernald Preserve and the OSDF, that are designed to limit access and land use. These controls focus on ensuring that the Fernald Preserve remains in a configuration consistent with the designated land use and that unauthorized uses of the Fernald Preserve do not occur. These include proprietary controls; governmental controls; and the prevention of unauthorized use by means of informational devices, security, physical barriers, and routine inspections. As part of the informational devices, the Visitors Center was established to house site information. Also discussed are the methods of controlling, restricting, or prohibiting recreational activities. (Refer to Table 1 and Table 2 for a summary of these controls.)
- **Controls to Minimize Human and Environmental Exposure to Residual Contaminants (Section 3.0)**: Describes the institutional controls (i.e., monitoring and sampling) used to ensure the continued protection of human health and the environment. These controls focus on maintaining engineered systems and infrastructure that are designed to protect human health and the environment. This category also includes the use of the Visitors Center to provide educational information on the site remedy and measures required to monitor and maintain the remedy. These include routine inspections, permits, continuing groundwater remedial activities, routine maintenance and monitoring, and leachate management practices.

1.5 Agency Requirements for Institutional Controls

The need for institutional controls is described in the OU2 and OU5 RODs (Appendix B). Page 9–16 of the OU5 ROD states: "One element of the selected remedy that will be used to ensure protectiveness is institutional controls, including continued access controls at the site during the remediation period, alternative water supplies to affected residential and industrial wells, continued federal ownership of the disposal facility and necessary buffer zones, and deed restrictions to preclude residential and agricultural uses of the remaining regions of the Fernald Environmental Management Project (FEMP) property." The intent of the Institutional Control Plan is to describe the institutional controls, both physical and administrative, used at the Fernald Preserve. This Institutional Control Plan was submitted to EPA and Ohio EPA under the OU5 ROD as a primary document and is part of the remedy for the Fernald Preserve.

Table 1. Controls on Disturbance and Use of the Fernald Preserve

Control	Requirement	Frequency	Scope
Proprietary Controls 1. Establish points of contact	1. LM guidance	1. Initially and when updates are needed	1. Provide primary and backup points of contact for emergencies. Points of contact will be updated in the Legacy Management Plan as needed. The LM 24-hour emergency line is (877) 695-5322.
2. Ownership	2. OU2 ROD OU5 ROD LM guidance	2. Not applicable	2. The federal government will maintain ownership of site property. Management is the responsibility of LM.
Governmental Controls 1. Notations on land records or real estate restrictive license	1. OU2 ROD OU5 ROD	1. Annual verification	1. If management of portions of the Fernald Preserve (outside of the disposal facility area) is transferred to another federal entity at any time, all zoning and real estate restrictions will be communicated to the appropriate parties, and proper notifications will be provided as required.
Preventing Unauthorized Use of the Fernald Preserve 1. Informational devices	1. OU2 ROD OU5 ROD	1. Not applicable	1. Informational devices • The Visitors Center provides information onsite remediation, site restrictions, ongoing maintenance and monitoring, and residual risks. • In order to maintain the integrity of the site, access may need to be limited or restricted in some areas. Signs indicating restricted access will require monitoring and maintenance to ensure their legibility and integrity.
2. Security of the site	2. OU2 ROD OU5 ROD	2. Daily	2. Security • There will be routine patrols of the Fernald Preserve and perimeter postings to prevent unauthorized access and use of the site. • Site facilities and structures will be locked when personnel are not present during non-business hours. • Some site facilities and structures will be fenced and locked at all times, and only authorized access will be permitted.
3. Routine site inspections	3. OU2 ROD OU5 ROD	3. Annually	3. Formal inspections will be conducted to ensure that infrastructure, signs and postings, fences and gates, perimeter areas, and access points are in a secure and safe configuration, and to prevent unauthorized use of the site.

Table 2. Controls on Disturbance and Use of the On-Site Disposal Facility

Control	Requirement	Frequency	Scope
Proprietary Controls 1. Establish points of contact	1. OAC 3745-27-11(B)(3) OAC 3745-66-18(c)(3) OAC 3745-68-10 40 CFR 258.61(c)(2) 40 CFR 265.118(c)(3) 40 CFR 264.118(b)(3)	1. Initially and when updates are needed	1. Provide primary and backup points of contact to ensure authorized and emergency access. Points of contact are provided in Table 8 of the PCCIP. Updates will be provided as needed. The LM 24-hour emergency number is (877) 695-5322.
2. Ownership	2. OU2 ROD OU5 ROD	2. Not applicable	2. The federal government will maintain property ownership of the area comprising the OSDF and associated buffer areas. Management is the responsibility of LM.
Governmental Controls 1. Notations on land records or real estate restrictive license	1. OU2 ROD OU5 ROD	1. Annual review	1. If real estate restrictions are in place, annually verify that they are still in place. Restrictions will be provided in the deed, and proper notifications will be provided as required.
Preventing Unauthorized Use of the Fernald Preserve 1. Informational devices	1. OU2 ROD	1. Not applicable	1. Signs and postings include information on restrictions, access information, contact information, and emergency information.
2. Engineered barriers	2. OU2 ROD	2. Not applicable	2. Access to the OSDF is physically restricted by means of fences, gates, and locks.
3. Routine OSDF inspections	3. OU2 ROD OU5 ROD	3. Quarterly	3. Inspect the OSDF as specified in the PCCIP.

1.6 Updates to the Institutional Controls Plan

The future LMICP schedule will be as follows:

- Each June, the annual Site Environmental Report will be submitted. The report will make recommendations based on the previous year's monitoring information.
- Each September, an annual review of the LMICP will be completed. The requirement to complete a full revision of the LMICP will be assessed with the regulators each year and, at a minimum, it is expected that a full revision of the LMICP will be required at least every 5 years. Based on the number and types of changes required each September, either a revised document or variance for each change required to the existing document will be submitted. The variance process established in the *Fernald Preserve Quality Assurance Project Plan* (DOE 2014) will be followed.
- Each January, the revised document or approved variances to the existing document will be finalized to correspond with the monitoring and reporting schedule.

Upon EPA and Ohio EPA approval, it is anticipated that the LMICP will be finalized by January each year to correspond with calendar-year monitoring and reporting. Between October and January, EPA and Ohio EPA comments will be addressed.

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2.0 Controls to Eliminate Disturbance and Unauthorized Use of the Fernald Preserve

2.1 Fernald Preserve

The primary institutional controls established to eliminate disturbance and unauthorized use of the Fernald Preserve include continued federal ownership, real estate restrictions (if necessary), and using access controls and inspections to prevent unauthorized use of the Fernald Preserve. The institutional controls established to eliminate disturbance and unauthorized use of the Fernald Preserve are discussed in the following subsections and are summarized in Table 1.

2.1.1 Proprietary Controls and Points of Contact

Proprietary controls are controls that originate from the responsibilities associated with the ownership of property. These controls are established to ensure that the Fernald Preserve remains in a configuration consistent with the designated land use and that unauthorized uses do not occur. In the case of the Fernald Preserve, the federal government will maintain ownership, as stated in the OU2 ROD. . If an onsite emergency occurs, if unacceptable behavior is observed, or if someone has questions, the points of contact identified on the perimeter signs detailed in Section 2.1.3.1 should be contacted.

The actions and items listed below are prohibited to ensure the ongoing protection of the site and anyone using the site. DOE will consider adding prohibited actions and items on a case-by-case basis. Updates to site postings will be reviewed annually. A list of prohibited actions and items is posted at the site entrance, and it applies to all unauthorized personnel (Figure 2).

Figure 2. Fernald Preserve Prohibited Activities and Items

An interim residual risk assessment was performed to evaluate post-closure risks associated with the Fernald Preserve. The risk assessment was carried out in two phases. Phase I focused on the development of a Geographic Information System–based risk assessment tool to evaluate the final land-use receptors identified in the OU5 ROD (i.e., undeveloped park user, expanded trespasser, and offsite farm resident) using certification data available in early 2006. This phase was completed in early 2007, and subsequent planning activities determined that there was no long-term need to maintain this tool for future risk-assessment work. Phase II produced the *Interim Residual Risk Assessment Report*, which was released as Revision 1 in July 2007 (DOE 2007). This report demonstrates that the incremental lifetime cancer risk to six receptors (undeveloped park user, museum visitor, museum worker, groundskeeper, building maintenance personnel, and construction workers) that visit or work at the site is less than 1×10^{-4} lifetime cancer risk, which is consistent with CERCLA guidance. The receptors are exposed to residual contamination in the air, soil, and surface-water pathways. These calculations are reviewed during each CERCLA five-year review. All pathways will be evaluated after the completion and certification of the groundwater remedial actions.

Land-use restriction changes that substantially alter the Environmental Covenants and/or the RODs need to be approved by Ohio EPA and EPA, respectively.

2.1.2 Governmental Controls

A part of the governmental controls at the Fernald Preserve will be the use of real estate notations and restrictions, should they become necessary (i.e., another organization would have the responsibility of managing the property). Notations on land records or similar restrictive real estate licenses will be in place for the Fernald Preserve and offsite property that is impacted by Fernald Preserve activities. LM will ensure that real estate notations remain in place as long as they are needed. In addition, if the management of any part of the site is transferred from DOE to another federal entity, DOE will ensure that the controls remain in place. According to the OU2 and OU5 RODs, LM will annually review deed restrictions, if implemented, to ensure that they remain in effect with the local authorities. A review of notations or real estate restrictions and other institutional controls was also part of the most-recent CERCLA Five-Year Review Report that was approved in 2021 (DOE 2021).

If DOE leases or transfers the management of the property to an entity other than DOE, the appropriate regulatory approvals will be secured, and restrictions and limitations will be communicated and implemented (e.g., zoning restrictions). In such cases, DOE will work with the agency to ensure that institutional controls for the active site will remain effective. This may be documented in a Memorandum of Understanding or other appropriate instrument. A description of the various types of institutional controls pertaining to the ownership or transfer of DOE land is included in the *Institutional Controls in RCRA and CERCLA Response Actions at Department of Energy Facilities* (DOE 2000).

2.1.3 Preventing Unauthorized Use of the Fernald Preserve

2.1.3.1 Informational Devices

Signs posted along the perimeter of the Fernald Preserve are designed to discourage public access to the site at locations other than the Willey Road entrance. Perimeter signs delineate the site property boundary (Figure 3).

Figure 3. Perimeter Sign

Additional information signs are posted at vehicle access points (Figure 4).

Figure 4. Vehicle Access Point Sign

The site configuration includes postings at access points and other strategic locations, indicating prohibited activities and site contact information (Figure 5).

DOE opened a Visitors Center onsite in the former Silos Warehouse, which was refurbished. The Visitors Center was completed in the summer of 2008. It contains information on and context for the history of production and remediation of the Fernald Preserve, including information regarding onsite restrictions, ongoing maintenance and monitoring, and residual risks. The Visitors Center also houses a computer (so that visitors may access electronic copies of documents and records), a meeting place, and other educational information as appropriate. A primary goal of the Visitors Center is to fulfill an informational and educational function within the community. The information in the Visitors Center serves as an institutional control, makes visitors aware of the Fernald Preserve's history and current condition, and helps prevent unsafe disturbances and uses of the site.

The Visitors Center is maintained and operated under the direction of LM. With stakeholder input, DOE will periodically evaluate the use of the Visitors Center and the programming provided there. The conceptual design of the Visitors Center was completed by the University of Cincinnati, with input from stakeholders. DOE will continue to obtain stakeholder input on decisions regarding changes to the Visitors Center or its ongoing operation. In 2019, a site Master Plan (DOE 2019a) was developed to help guide future decisions regarding land use, public amenities, and interpretive services. Public input was sought in 2018 via an online survey and several workshops.

The OU3 ROD required that all site structures be removed, including the former Silos Warehouse. Realizing that certain structures needed to remain at the Fernald Preserve to support the continued management of the site, DOE reconciled the OU3 ROD via a fact sheet (DOE 2006a). The fact sheet identified several other buildings, structures, and materials that were to remain onsite to support long-term use and included the Former Dissolved Oxygen Building, Former Communication Building, Restoration Storage Shed, a concrete pad for the Visitors Center parking area, and the former railroad trestle (Figure 5). Clean concrete and railroad ballast were also identified for reuse during site restoration.

The structures subject to the OU3 ROD reconciliation were those that were present solely to support the legacy management of the site. Other facilities at the site, under the authority of OU5, are required for the continued implementation of the ongoing groundwater remedy, the maintenance of the OSDF, and environmental monitoring. Construction of onsite workspace was initiated in 2022 to provide office and workspace for site field personnel. The new facilities consist of a trailer complex and adjacent garage. The new workspaces are near the existing CAWWT facility.

2.1.3.2 Security of Site Facilities and Infrastructure

During non-business hours, site facilities and structures will be locked when personnel are not present. A gate installed at the main site access location, the south Willey Road Entrance, will be open during the day to allow for public access. Other access points (for example, those along Paddys Run Road) are protected with access controls consisting of signage shown in Figure 3, cables, and gates mounted on posts. Some site infrastructure, such as the OSDF restricted area, the electrical substation, and the CAWWT, have fences constructed around them and will remain locked to prevent unauthorized access. Controls also include enforcing the land use restrictions, maintaining fences and other infrastructure (as needed), and replacing or updating postings as needed to ensure the site's security (Figure 5).

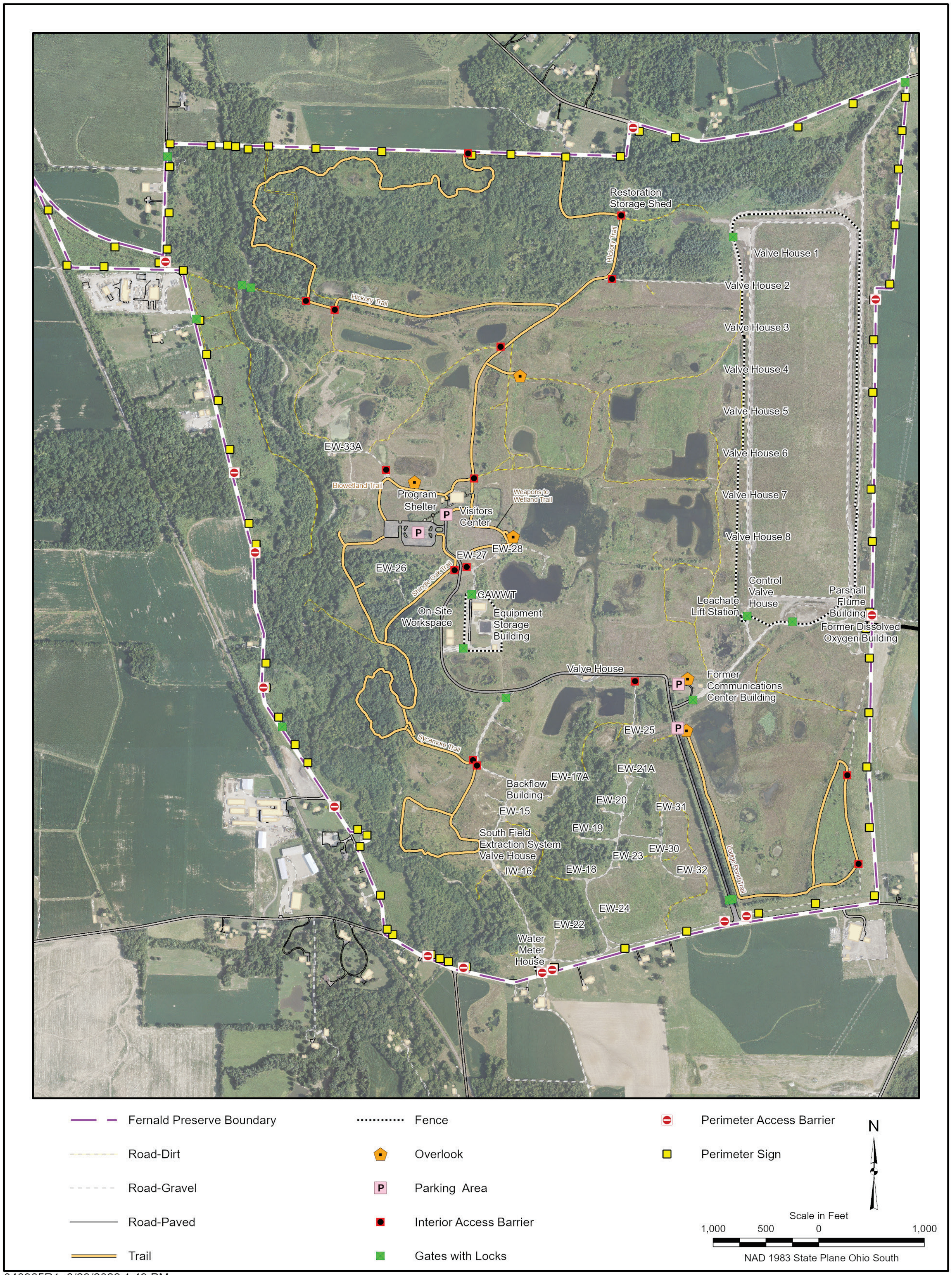

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Figure 5. Fernald Preserve Site Configuration

An onsite LM presence is responsible for routine patrols and inspections of the Fernald Preserve. The patrols will ensure that no unauthorized use of the site is occurring and that facilities and structures are secure. Field personnel are instructed to report unauthorized activities to their supervisor.

The public also plays a role in ensuring the security and safety of the site. The Visitors Center and trail system (see Section 2.1.3.1) attracts a public presence on the site. The final site configuration includes posting contact information at access points and other strategic locations (visible to the public); members of the community may call anytime they notice anything out of the ordinary or suspicious, or if they just have questions.

2.1.3.3 Routine Inspection of Property

Routine inspection of the Fernald Preserve is integral to ensuring that institutional controls are maintained. Field walkdowns are conducted annually, and site infrastructure and informational devices are inspected quarterly. Additional area-specific walkthroughs occur more frequently as activities warrant (e.g., maintenance projects, ecological monitoring). Trails and overlooks are inspected weekly to ensure they are safe for public use. A key component of the various inspections is to verify that no unauthorized access or use of the site is taking place. Section 3.2 describes the site inspection process in more detail.

The CAWWT and the groundwater restoration systems are also inspected. Details of this process are included in Attachment A.

DOE has a voting membership with the Ohio Utility Protection Service. With this membership, DOE will be notified any time an entity will be digging within a quarter-mile of the site. DOE will then be able to contact the contractor or company doing the work to ensure that they are not impacting the Fernald Preserve property.

The LM site manager is responsible for the management and monitoring of the post-closure site, along with other duties, including managing the organization of and conducting formal inspections of site property. LM exercises a portion of this responsibility through various subcontracts.

2.2 OSDF

The primary institutional controls for the disturbance and use of the OSDF include continued federal ownership, real estate restrictions (if necessary), and the prevention of unauthorized use of the OSDF and its associated buffer area. Engineered barriers, such as fencing, gates, and locks, are also important institutional controls (Figure 5). The institutional controls for the OSDF are summarized in Table 2. The table includes descriptions of the institutional controls, places where the institutional controls are referred to, and the requirements that drive the institutional controls. The OSDF will continue to be inspected quarterly, as specified in the PCCIP.

2.2.1 Proprietary Controls and Points of Contact

Proprietary controls are controls that originate from the responsibilities associated with the ownership of property. The first is that the federal government will maintain ownership of the OSDF property in perpetuity, as stated in the OU2 ROD. The management of the OSDF (along with the management of the Fernald Preserve) transferred from EM to LM; the OSDF and the site will always remain under federal ownership. The second is that primary and secondary points of contact have been established for emergency purposes, to ensure authorized access, and to ensure open communication.

2.2.2 Governmental Controls

A fundamental part of governmental controls will be the use of real estate notations and restrictions. Notations on land records or similar restrictive real estate licenses are in place for the land occupied by the OSDF. LM will ensure that real estate notations remain in place. DOE will also maintain the responsibility of managing and maintaining the OSDF and all other activities needed to ensure that remedies remain effective. Any contracted support employees required to implement specific aspects of maintenance and monitoring will be made aware of all restrictions regarding the use and disturbance of the OSDF.

2.2.3 Preventing Unauthorized Use

Physical barriers to restrict access to the OSDF and its surrounding buffer area include exclusion fencing, gates, and locks, which will be maintained (Figure 5). Signs and postings include information on restrictions, access information, contact information, and emergency information. The following weather-resistant signs are located around the OSDF (Figure 6).

Figure 6. OSDF Fence Sign

Signs on the access gates to the OSDF contain slightly different information (Figure 7).

Figure 7. OSDF Gate Sign

Calls to the 24-hour DOE emergency telephone number will be recorded. Additionally, local agencies have agreed to notify DOE in the event of an emergency or breach of site security or integrity.

The final configuration of the OSDF includes monuments installed at the corners of the engineered disposal facility, and markers placed on the top and the east and west toes of the cell caps (indicating the boundaries between the cell caps). The corner monuments consist of concrete cylinders 12 inches in diameter and 48 inches long. They are installed to a depth of 42 inches, with 6 inches of concrete remaining above the surface. A brass plate with pertinent identification and location information is flush-mounted to the top surface of the concrete. The individual cell cap markers are brass plates with pertinent identification and location information attached to a brass rod and flush-mounted to the ground surface. Cell cap boundaries are also identified with signs on the OSDF perimeter fence.

3.0 Controls to Minimize Human and Environmental Exposure to Residual Contaminants

The preliminary interim residual risk assessment performed for the second CERCLA Five-Year Review of the Fernald Preserve showed that the remedy is protective of human health and the environment. Section 6.4.4, “Review of Post-Remedial Action Contaminant Toxicity Assumptions,” in the *Second Five-Year Review Report for the Fernald Closure Project* (DOE 2006b) explains the assessment process for residual constituents. Table 6–3, “Comparison of the CRARE [Comprehensive Remedial Action Risk Evaluation] and Present Risk for All Pathways,” illustrates that the risks are below CERCLA limits. This preliminary interim residual risk assessment has been replaced by the final *Interim Residual Risk Assessment Report* (IRRA) (DOE 2007) as discussed in Section 2.0.

The *Third Five-Year Review Report for the Fernald Preserve* (DOE 2011) examined updated EPA risk values for 2010 and compared them to values used in the 2007 IRRA to identify values that had changed and determine if those changed values had produced significant changes in human-health risk to the receptors evaluated in the IRRA. Results presented in the *Third Five-Year Review Report for the Fernald Preserve* (DOE 2011) indicated a slight decrease in human-health risk relative to the IRRA, and the risk assumptions remained valid for the OU5 post-remedial conditions.

The *Fourth Five-Year Review for the Fernald Preserve* (DOE 2016) was completed in a similar manner to the third Five-Year Review. Updated toxicity values published in 2015 were used to calculate human health risk using IRRA concentrations. Additionally, EPA exposure factors were reviewed, and updated values were used in the calculations. The overall result of this effort demonstrated a slightly lower risk than what was reported in the third Five-Year Review report. Again, the risk assumptions remain valid for the OU5 post-remedial conditions.

The *Fifth Five-Year Review for the Fernald Preserve* (DOE 2021) was completed in a similar manner to the third and fourth Five-Year Reviews. Updated toxicity values published in 2015 were used to calculate human health risk using IRRA concentrations. Additionally, EPA exposure factors were reviewed, and updated values were used in the calculations. The overall result of this effort indicated a slight decrease in incremental lifetime cancer risk and a slight increase in hazard index due to a new reported reference dose for benzo(a)pyrene. The risk assumptions remain valid for the OU5 post-remedial conditions.

Institutional controls have been established for the Fernald Preserve to minimize the potential for human and environmental exposure to residual contaminants, ensuring that it is below acceptable limits. These controls include the site inspection, inspection and maintenance of engineered systems and infrastructure designed to protect human health and the environment, and monitoring and sampling to ensure continued protection from exposure. Sections 3.2 through 3.4 and Table 3 provide additional information about these controls.

3.1 Uncertified Areas and Subgrade Utility Corridors

The SEP (DOE 1998b) defined the overall approach for soil and at- and below-grade debris in accordance with the OU2 ROD (DOE 1995), OU3 ROD (DOE 1996a), and OU5 ROD (DOE 1996b). Remediation of the sitewide soil and sediment was accomplished on a geographic area basis. The SEP identified 10 general remediation areas. The general steps for excavation of each remediation area include predesign investigation, remedial design, remedial action (including material handling and disposal), precertification, certification, and post-remediation activities. Individual designs for the area-specific excavations were submitted and approved by EPA and Ohio EPA in the form of Integrated Remedial Design Packages (IRDPs). The IRDPs presented area-specific contamination data. As needed, additional sampling and analysis (documented in Project-Specific Plans) was conducted to supplement data from the remedial investigation concerning the nature and extent of contamination. Based on the extent of contamination, the IRDP presented a detailed design of the area-specific remediation elements and the lessons learned during previous phases of the site-wide remediation process. Certification of the completed remediation for each remediation area followed a process defined in the SEP and included processes for FRL and hot spot attainment. Upon analytical confirmation that FRLs (and any other requirements) were achieved, Certification Reports were prepared as a final-step area-specific remediation deliverable. The Certification Reports primarily documented the remedial actions that occurred, described the certification process, presented all data supporting the certification attainment and described access controls implemented to prevent recontamination. The *Interim Remedial Action Report for Operable Unit 5* [(IRAR) DOE 2008] provides a list of all 55 Certification Reports. Following certification, final grading and restoration of the site was guided by the Natural Resources Restoration Plan (State of Ohio 2008).

By the end of 2006, the contaminant sources at the Fernald Preserve were removed and soil and on-property sediments were certified as defined in the SEP, with the exception of those areas indicated in Figure 8. The IRAR recognized that the Great Miami Aquifer restoration activities would continue beyond the 2006 baseline closure date; therefore, the IRAR was written to address completion of soil restoration activities and closure of the OSDF, but remains open until groundwater actions are complete. The IRAR for Operable Unit 5 (DOE 2008) states:

> The closeout report is considered "interim" for the following reasons:
>
> - Aquifer restoration activities must continue until the affected portions of the Great Miami Aquifer have been remediated to Operable Unit 5 FRLs.
> - Final surface water and sediment certification in the Great Miami River cannot be completed until final discharges to the river from the groundwater remedy have been completed.
> - Soil remediation is complete in all areas, except for necessary future soil remediation beneath the required remaining groundwater infrastructure.
> - The OSDF is subject to a 30-year monitoring requirement after closure.

Table 3. Controls to Minimize Human and Environmental Exposure to Residual Contaminants at the Fernald Preserve

Control	Requirement	Frequency	Scope
Fernald Preserve Inspections	OU2 ROD OU5 ROD	• Field walkdowns conducted annually, with portions of the site inspected when access is optimal. • Point-specific institutional controls inspected quarterly and onsite trail inspections conducted weekly. • Frequency will be reevaluated through the CERCLA Five-Year Review process.	• Inspect infrastructure in place for protection against human exposure to contaminants, such as fences and postings, to ensure their proper condition and function. • Ensure that there is no removal of soil by wind or water erosion. Inspect water control structures, swales, and discharge points. • Inspect access control grating on the 60-inch Main Drainage Corridor culvert. • Conduct an inspection to ensure that prohibited activities, such as digging, off-road travel, camping, or hunting are not taking place onsite. • Identify exposed debris.
Surface Water Discharge Inspections	NPDES Construction Stormwater Pollution Prevention Plan	• Monitoring conducted daily (discharge to Great Miami River). • Evaluations conducted annually, at a minimum. • Inspections conducted weekly and within 24 hours of 0.5 inch of rain during construction projects with storm water controls.	• Monitor discharge to the Great Miami River. • Inspect construction activities in accordance with the Construction Stormwater Pollution Prevention Plan.
Groundwater Remedy Sampling and Monitoring	IEMP	Frequency of sampling and monitoring of groundwater is dependent upon the effectiveness of the remediation efforts and will vary over time.	Monitor groundwater to ensure that the remedy is functioning properly until remedy certification is complete. Details are provided in the IEMP.

Figure 8 identifies the subgrade utility corridors and the two remaining uncertified areas: CAWWT and South Field Valve House footprints. Certification of these areas will be completed following completion of the aquifer remediation. The uncertified portion of the subgrade utility corridor consists of the utility itself (e.g., fiber optic cable, underground electric, or piping) and associated bedding material (e.g., sand). The soil and at- and below-grade structures associated with CAWWT and South Field Valve House footprints will also require certification. Any soil or debris originating in these two uncertified areas (CAWWT and South Field Valve House footprints) and subsurface soils in the subgrade utility corridors cannot be moved to certified areas. Project-specific requirements along with the inspection process described below ensure that uncertified soil is not disturbed.

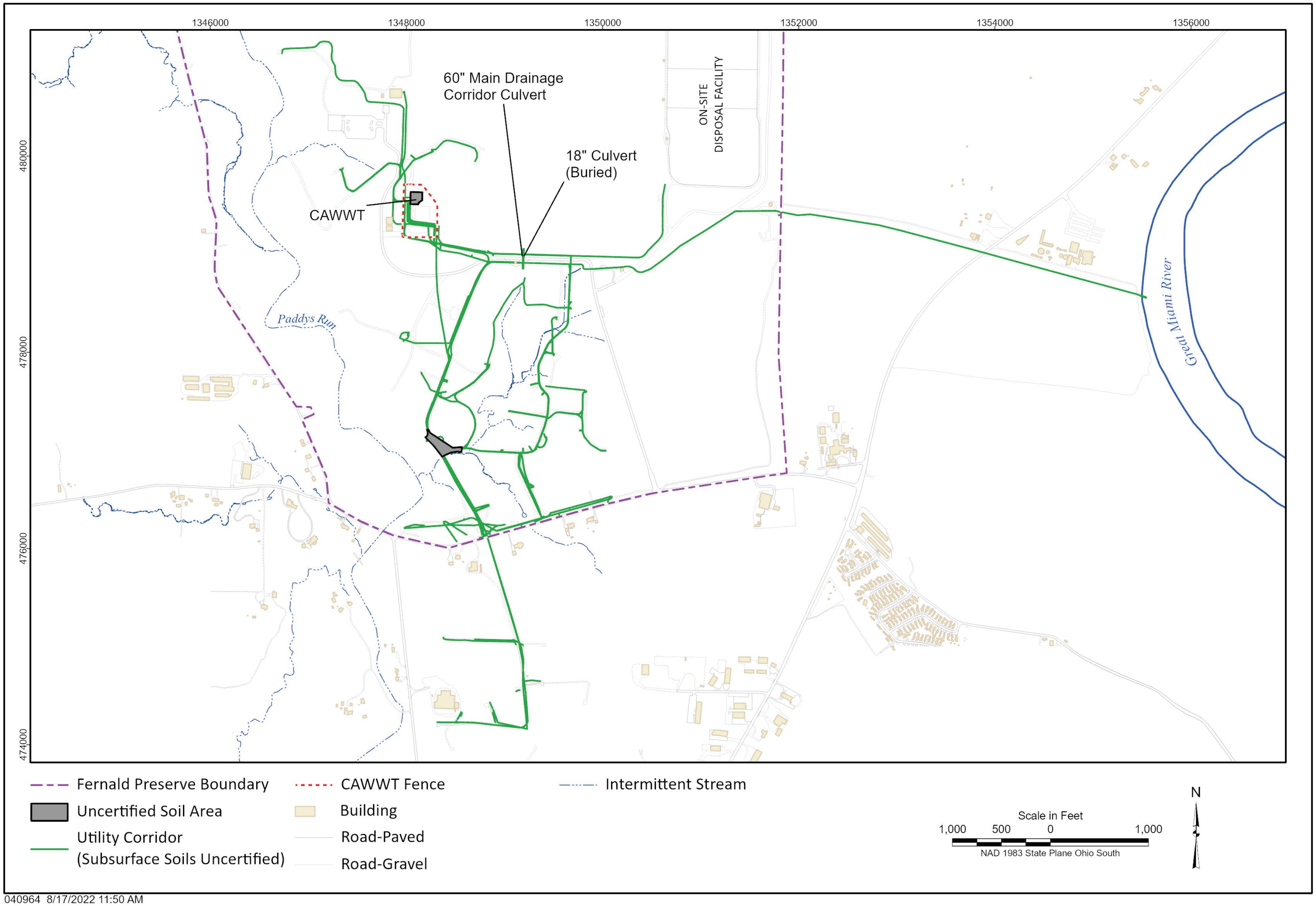

Figure 8. Uncertified Areas and Subgrade Utility Corridors

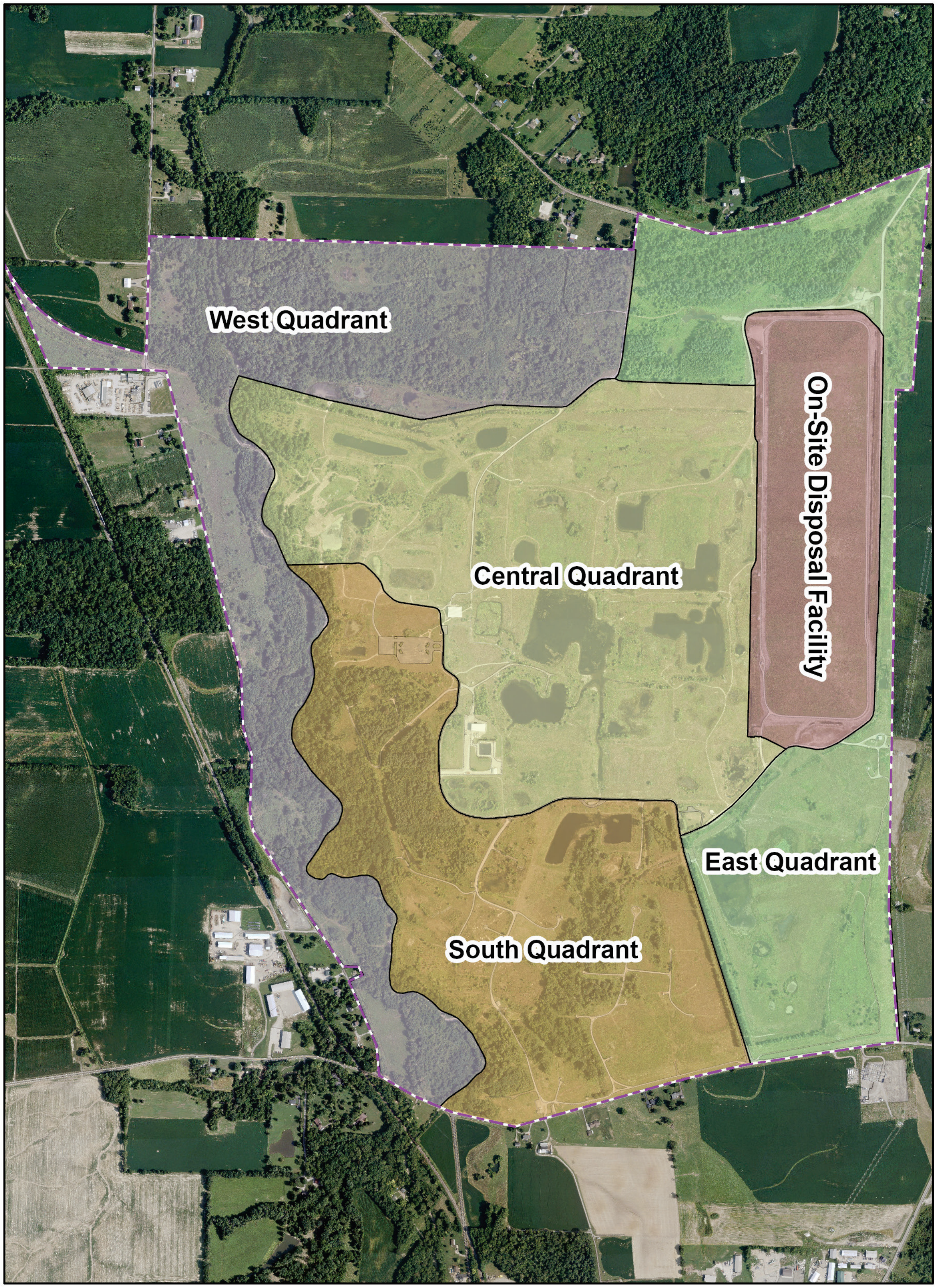

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Figure 9. Site Inspection Walkdown Quadrants

3.2 Fernald Preserve Inspections

Point-specific institutional controls and the OSDF are inspected quarterly; site walkdowns are conducted annually in the winter months. Vegetation establishment over the years has prevented optimal inspection coverage in many areas. Heavy vegetation hinders identification of inspection findings (e.g., unauthorized trails, erosion rills) and also creates safety hazards for the participants, especially in wooded areas. To ensure safe and effective inspections, the schedule was modified in 2015 to focus on walkdown completion during the dry, cooler months of November through April. Performing walkdowns during months when less vegetation is present optimizes visibility of site conditions and allows access to more areas. Additional field walkdowns will occur following prescribed burns; these post prescribed burn walkdowns were initiated in 2017. Vegetation is completely removed following a burn, so inspection findings such as erosion rills and debris are readily visible. Point-specific institutional control inspections continue on a quarterly basis throughout the year.

The field walkdown process is accomplished by dividing the site into quadrants (Figure 9) and organizing participants to ensure that all accessible portions of the inspection area are covered. Optimally, a “police line” is formed, with personnel spaced at regular intervals (e.g., 100 feet) and proceeding in unison. Access limitations (i.e., steep slopes, open water) require modification of the police line format in some locations.

Grating that was installed to prevent access to the 60-inch Main Drainage Corridor culvert is inspected as part of the quarterly point-specific institutional control inspection. This culvert, along with an adjacent 18-inch culvert that is completely buried, was left in place even though it has fixed radiological contamination. These culverts are located directly below the OSDF leachate conveyance system and the main effluent line running between the CAWWT and the Great Miami River. Because of their location, these culverts could not have been removed without potentially impacting ongoing CAWWT and OSDF operations. Instead, metal grating was installed to prevent access to the 60-inch culvert. Site inspections ensure that the 60-inch culvert grating is in place and is serviceable, and that the 18-inch culvert is not exposed through erosion or other ground disturbance. The fact sheet identifying clean buildings and structures for beneficial reuse under legacy management provides additional information regarding these culverts (DOE 2006a).

Prior to 2023, inspections were performed and documented on the Fernald Preserve Field Walkdown Inspection Form or the Fernald Preserve Institutional Control Inspection Form, as appropriate, to ensure that there is no digging or soil removal of any kind, including wind or water erosion, and that infrastructure designed and in place for protecting against human exposure to contaminants, such as fences and signs, are in good condition and functioning as intended. Beginning in 2023, inspection findings will be documented electronically. Information collected includes specific finding location, type of finding (i.e., biointrusion, debris, drainage, erosion, fencing, signage, structure, unauthorized use, vegetation or other) and a photograph of each finding.

Annual site inspection photographs have been taken across the site since 2007 to document the restoration following the extensive soil remediation which was completed in 2006. Additional photograph locations were added over the years as restoration projects were completed. The 2018 Site Environmental Report (DOE 2019b) was the first time these photographs were included as part of the Site Environmental Report. Prior to that, they were made available through the Geospatial Environmental Mapping System (GEMS), an internet-based interface that allows public access to monitoring and inspection data (https://gems.lm.doe.gov/#site=FER). The series of photographs show significant vegetation growth and development, and generally stable conditions across the site resulting in the photographs being less useful for documenting changing conditions at the site. DOE proposed eliminating these annual photographs of the site in the 2021 Site Environmental Report (DOE 2022a). Photographs will be taken of site features every 5 years in support of each CERCLA five-year reviews. The next set of site photographs to document site conditions will be taken in 2026. Photographs documenting the OSDF are discussed in Attachment B, "OSDF Post-Closure Care and Inspection Plan."

Findings for OSDF inspections, field walkdowns, point-specific institutional control inspections, and weekly trail inspections are generally mapped or identified in the field using pin flags (yellow flags are used for items of radiological concern). Global positioning systems (GPS) can be used to document the location of findings, especially during the growing season. Starting in calendar year 2022, a GPS will be used to document the location for all inspection debris that are above background radiological levels. Inspection findings are consolidated and logged into a maintenance action item list, where the resolution is tracked. The GPS will also be used to document radiological debris locations regardless of the mechanism by which the radiological debris is discovered. This information will be presented in the annual Site Environmental Report and the CERCLA Five-Year Review report.

The Environmental Covenant (State of Ohio 2008) requires that DOE submit to Ohio EPA on a quarterly basis a site inspection report verifying that the activity and use limitations remain in place and are being complied with. Through calendar year 2021, inspection reports were sent to the regulators on a quarterly basis, posted on the internet, and summarized in the annual Site Environmental Report. Beginning with calendar year 2022, a more streamlined reporting process was implemented. A report will continue to be submitted to the regulators on a quarterly basis; however, inspection finding details will be reported in the annual Site Environmental Report. If inspection findings indicate that activity and use limitations for the site are not in compliance, these findings will be discussed with the regulators during routine site meetings with timely notifications as necessary, and a more detailed report will be submitted for that quarter's inspection. Section 6.1 provides additional information regarding public access to inspection reports. Additional requirements concerning notifications of significant OSDF findings to the regulators are discussed in Attachment B, "OSDF Post-Closure Care and Inspection Plan."

The site inspections, how they are conducted, and elements of the inspections will continue to evolve and be refined as site conditions and activities change. The inspection process will be reviewed carefully each year, and revisions will be made as necessary. The process is detailed in the *Inspection Procedure for the Fernald Preserve* (DOE 2022b). More frequent inspections may be required under certain circumstances (e.g., a pattern of unauthorized activities or uses). A workforce is present onsite daily. It is part of the workforce's responsibilities to help ensure that prohibited activities are not taking place.

Additional inspections include the CAWWT, the groundwater restoration system, and the outfall line. Site personnel inspect the CAWWT and the groundwater restoration system daily. The inspection of the outfall line ensures that soil coverage is sufficient and that the pipeline is protected over the entire length of the outfall line. A proper check of the soil cover on the outfall line involves a field survey over the length where the thickness of soil is determined by comparing topographic elevation above the pipeline to the pipeline profile in the area affected by mining and farming operations. In addition to the topographical survey, any structures encroaching over the pipeline shall be surveyed, located, and identified. The survey will also identify the edge of any excavation within 75 feet north and south of the pipeline. A plan and profile drawing of the entire length of the pipeline developed from the field survey will be reviewed by an engineer who will do a field inspection. The field inspection will compare the survey information to the field conditions. The manholes will be inspected for any damage and to ensure accessibility. The field survey is completed annually in the fall, after the harvest. If soil cover over the pipeline is insufficient, DOE will notify the landowner and the regulators. DOE will then take the necessary corrective actions, in consultation with the landowner. Beginning in 2018, additional field walkdown inspections are conducted quarterly as part of the site inspection process, in order to evaluate whether conditions have changed.

The inspection of other uncertified areas (Figure 8) is also included in the site inspection process. This ensures that there is no digging or disturbance of the soils and no tampering with any signs that may be posted to define the areas.

3.3 Surface Water Discharge

Until the groundwater remedy is complete, and as long as surface water discharges to the Great Miami River, an NPDES permit or similar permit mechanism needs to be in place. Inspections, monitoring and reporting to maintain compliance with the permit requirements will be part of post-closure responsibilities at the Fernald Preserve. Once there is no longer any surface water discharge to the river, the permit for surface water discharge may be closed out. Prior to the completion of the remedy, if it is decided that monitoring a particular outfall location is no longer necessary, LM may request that Ohio EPA remove that particular location from the permit at that time. Ohio EPA issues and maintains the NPDES permit.

3.4 Groundwater Remedy and Monitoring

The institutional controls to prevent the use of groundwater in the off-property area where groundwater contamination is greater than the 30 ppb uranium final remediation level consist of the following:

- The DOE-funded public water system, which provides an alternate water supply for residents in the areas affected by groundwater contamination from the Fernald Preserve.
- The Hamilton County water well permitting process. Drinking water wells cannot be installed until a permit has been obtained from the Hamilton County Health Department. DOE will ensure that the Health Department is aware of the off-property areas where groundwater contamination is greater than 30 ppb uranium. DOE submitted a letter and map documenting the contaminated area to the Hamilton County Health Department and requested that no permits be issued in this area, given the contamination and the ongoing aquifer remediation (DOE 2006c). Additionally, the letter requests that DOE be notified of any proposed drilling activities in the vicinity of the plume. If DOE is made aware of any drilling activities in the area of the offsite plume, the regulators must be notified. As a result of additional discussions with Hamilton County Public Health in early 2015, the information was provided to the department in an electronic format.
- Daily well field operational inspections and routine groundwater sampling. Operational personnel make daily rounds of the South Plume well field and will be instructed to notify management of any unusual activity in the area (e.g., well drilling). Groundwater sampling personnel will also be in the area of the South Plume for routine groundwater monitoring and will be instructed to notify management of any unusual activities.

Aquifer restoration operations and maintenance activities are part of an ongoing remedial action governed by the OU5 ROD. The requirements for the operations and maintenance activities are outlined in the OMMP (Attachment A). The OMMP, as originally written, defines the operating philosophy for the extraction and re-injection treatment systems (re-injection is not being used at this time), the establishment of operational constraints and conditions for given systems, and the establishment of the process for reporting and instituting corrective measures to address exceedances in discharge limits. How to address exceptional operating conditions is also addressed.

Section 2.0 of the OMMP discusses the general commitments of the aquifer restoration and provides details regarding the aquifer cleanup levels, discharge limits, treatment capacity, treatment decisions, and extraction rates. Section 3.0 of the OMMP goes into more specific detail about the design of the groundwater remediation systems, well field designs, and pump details. Section 4.0 discusses the projected flow during remediation activities. Section 5.0 discusses the operations plan, Section 6.0 discusses operations and maintenance, and Section 7.0 discusses roles and responsibilities. Sections 6.0 and 7.0 provide information that pertains directly to institutional controls.

When DOE has certified the groundwater remedy complete (which is defined in the *Fernald Groundwater Certification Plan* [DOE 2006d]) and EPA has approved it, well field infrastructure will be decommissioned and disposed of. All needed soil excavation and certification associated with decontamination and demolition (D&D) of the CAWWT and the removal of well field infrastructure will be in accordance with SEP (DOE 1998b) requirements.

The CAWWT will undergo D&D once it has been documented to EPA and Ohio EPA that the facility is no longer needed to meet uranium discharge limits.

Post-remedy long-term groundwater monitoring will be conducted. Requirements are defined in the Fernald Groundwater Certification Plan and will be implemented through the IEMP (Attachment D). Post-remedy long-term groundwater monitoring will be evaluated as part of the CERCLA Five-Year Reviews.

3.5 On-Site Disposal Facility

Institutional controls are necessary for the OSDF and its buffer area to ensure the prevention of human and environmental exposure to residual contaminants. Further information about these controls is given below and is included in Table 4. Details regarding OSDF inspection and maintenance are included in the PCCIP (Attachment B). The OSDF was constructed to permanently contain impacted materials derived from the remediation of the OUs at the Fernald Preserve. All material placed in the OSDF was required to meet pre-established WAC. The WAC are presented in Table 2 of the PCCIP. Table 3 of the PCCIP provides a description of the types of material or material categories that were allowed in the OSDF. The design and construction of the OSDF is described in Section 3.0. Section 4.0 of the PCCIP discusses the institutional controls for the OSDF, which have been included and summarized in this IC Plan. Table 7 of the PCCIP shows institutional controls for the OSDF as they were identified in the OU2 and OU5 RODs.

Section 5.0 of the PCCIP discusses environmental monitoring activities that are necessary to continue during the post-closure care period, including groundwater monitoring, and the monitoring of other media (e.g., surface water, vegetation). Section 6.0 addresses routine inspections, which are important institutional controls. (Section 3.5.1 of this Institutional Control Plan addresses these inspections in detail.) Also addressed in the PCCIP are unscheduled inspections (Section 7.0), custodial monitoring and contingency repairs (Section 8.0), and emergency notifications (Section 10.0).

Table 4. Controls to Minimize Human and Environmental Exposure to Residual Contaminants at the On-Site Disposal Facility

Control	Reference	Requirement	Frequency	Scope
OSDF Inspection and Maintenance 1. Routine OSDF cap inspection	1. PCCIP	1. OAC 3745-66-18(A) and (C) 40 CFR 264.118(b)(2) 40 CFR 265.118(c)(2) OU5 ROD	1. Quarterly for the toe and specific institutional controls. Annually for the complete cap walkdown, in the fall (to coincide with mowing/burning and favorable weather conditions.)	1. Detect and record any change in the following: • General health, density, and variety of vegetation cover • Presence of deep-rooted woody species • Evidence of burrowing animals on the cover • Presence, depth, and extent of erosion or surface cracking, indicating possible cap deterioration • Visibly noticeable subsidence, either locally or over a large area—any sufficient to pond water • Presence and extent of any leachate seeps • Integrity of run-on and runoff control features • Integrity of benchmarks
2. Unscheduled OSDF cap inspection	2. PCCIP	2. OU5 ROD	2. As needed	2. Unscheduled inspections include Follow-Up and Contingency inspections. Follow-Up inspections quantify specific problems encountered during a routine inspection of the OSDF. Contingency inspections are initiated following an event that may threaten the integrity of the OSDF(e.g., after significant natural events). Regulators will be notified immediately of the need for a Contingency inspection following a significant natural event. Contingency inspections will be conducted and reported to regulators no more than 60 days after the unique event.
3. Routine OSDF cap custodial and preventive maintenance	3. PCCIP	3. OAC 3745-66-18(A) and (C) 40 CFR 264.118(b)(2) 40 CFR 265.118(c)(2) OU5 ROD OU2 ROD	3. As needed	3. Routine custodial and preventive maintenance consists of the following: • Upkeep of the vegetation cover via prescribed burning or mowing • Clearing of debris • Removal of woody vegetation • Prevention and repair of animal burrows • Minor erosion repair and reseeding

Table 4. Controls to Minimize Human and Environmental Exposure to Residual Contaminants at the On-Site Disposal Facility (continued)

Control	Reference	Requirement	Frequency	Scope
4. Routine OSDF site area inspection	4. PCCIP	4. OAC 3745-66-18(A) and (C) 40 CFR 264.118(b)(2) 40 CFR 265.118(c)(2) OU5 ROD OU2 ROD	4. Quarterly for the toe and specific institutional controls. For site walkdown, annually, in the fall (to coincide with mowing/burning and favorable weather conditions).	4. Inspect the adjacent area within approximately 0.25 mile of the OSDF buffer area. Describe evidence of land use changes. • Evaluate natural drainage courses in the immediate vicinity of the OSDF to determine whether there is a threat to the OSDF integrity. Walk approximately 1,000 feet of adjacent natural drainage courses, and note unusual or changed sediment deposits, large debris accumulations, manmade or natural constrictions, and recent or potential channel changes. • Evaluate and record the development of gullies. • Evaluate growth of vegetation in channels. • Determine the condition and required maintenance of on-property roads. • Inspect and record the area adjacent to the OSDF for erosion channels, accumulations of sediment, evidence of seepage, and signs of animal or human intrusion.
5. Unscheduled OSDF site area inspection	5. PCCIP	5. OU5 ROD OU2 ROD	5. As needed	5. Unscheduled inspections include Follow-Up and Contingency inspections. Follow-Up inspections quantify specific problems encountered during a routine inspection of the OSDF. Contingency inspections are initiated following an event that may threaten the integrity of the OSDF (e.g., after significant natural events). Contingency inspections will be conducted and reported to regulators no more than 60 days after the unique event.
6. Routine OSDF site area custodial and preventive maintenance	6. PCCIP	6. OAC 3745-66-18(A) and (C) 40 CFR 264.118(b)(2) 40 CFR 265.118(c)(2) OU5 ROD	6. As needed	6. Routine OSDF site area maintenance consists of the following: • Repair/replace fencing, gates, locks, and signs due to normal wear, severe weather conditions, or vandalism. • Mow/clear undesired woody vegetation; reshape, reseed, and repair banks; unplug culverts; and clean out run-on/runoff diversion channels.

Table 4. Controls to Minimize Human and Environmental Exposure to Residual Contaminants at the On-Site Disposal Facility (continued)

Control	Reference	Requirement	Frequency	Scope
Leak Detection/ Leachate Monitoring 1. OSDF leachate and environmental monitoring	1. GWLMP and IEMP	1. OAC 3745-27-6 OAC 3745-54-90 through 99 (applicable portions)[a] DOE 435.1	1. Varying frequencies depending on sampling stage (e.g., baseline)	1. • A routine monitoring program will be maintained for four zones within and beneath the OSDF. These zones include the LCS, the LDS, perched water within the glacial overburden, and the Great Miami Aquifer (GWLMP Section 3.2.1). Samples from the four zones are being collected and analyzed as specified in the GWLMP. • Environmental monitoring parameters and frequencies are identified in the GWLMP.
Leachate Management	GWLMP	OU5 ROD GWLMP	As needed	Leachate will continue to be treated.

[a] OAC 3745-54-90 through 99 are not applicable in entirety (refer to the OSDF GWLMP, Appendix A).

3.5.1 OSDF Inspection and Maintenance

DOE conducts inspections and maintenance on the OSDF cap and cover system. Inspections consist of an annual cap "walkover." Walkover inspections were conducted quarterly for 2 years following the completion of Cells 7 and 8. The frequency of inspections was to be reevaluated following the 2 years of quarterly monitoring. Beginning in spring 2009, walkover cap inspections of the entire OSDF cap were conducted semiannually, in the spring and fall. During the winter months, safely accessing the OSDF and scheduling of the inspection is difficult due to the frequency of inclement weather. During the summer months, vegetation on the majority of the cap is so dense that walking on the cap is difficult, and visibility of the ground surface is greatly reduced, limiting the quality of the actual inspection. These conditions were becoming more prevalent during the spring walkdown. So, beginning in 2012, the complete cap walkover was conducted annually in late fall or early winter, after warm-season grasses have gone dormant. Additional walkdowns of recently burned or mowed areas are also possible. Quarterly perimeter inspections include an evaluation of recent revegetation or other significant maintenance activities. Inspections also include a walkdown of the cap along the toe of the slope, as well as drainage features and institutional controls related to the OSDF (e.g., fencing, signs, locks). Custodial and preventive maintenance and unscheduled inspections will be conducted as needed. Table 4 provides current details on the required inspections and maintenance.

Routine inspections include monitoring the health of the vegetative cover, the presence of deep-rooted woody species, evidence of burrowing animals, the extent of surface erosion or cracking, subsidence (if any), the extent of any leachate seeps, the integrity of runoff controls, and the integrity of benchmarks. Inspections also include evaluating the condition of physical access controls (fences, gates, locks, and signs); observing adjacent properties for evidence of land-use changes; evaluating natural drainage courses in the immediate vicinity; and inspecting the general area for erosion, excess sediment, seepage, and signs of human or animal intrusion. If determined necessary or appropriate, the frequency of the routine inspections may be revised through the CERCLA Five-Year Reviews. More-frequent monitoring, due to changes in the cap or surrounding areas, is always a possibility; however, a decrease in frequency would require discussion, review, and approval at the time of the Five-Year Review. No significant changes to the inspection process were identified during the 2021 CERCLA five-year review (DOE 2021). Routine custodial maintenance includes the upkeep of the vegetative cover, general mowing, the clearing of debris and woody plants, and reseeding.

The monitoring and management of the OSDF vegetative cover will be carried out to optimize the establishment and continued growth of the native grass mix specified and seeded on the OSDF cap. Monitoring will consist of the collection of data to determine the percentage of native cover on the OSDF cap. Vegetation monitoring is conducted on a 3-year rotation. No changes to this approach were identified during the 2021 CERCLA five-year review (DOE 2021). Sample collection consists of establishing a grid on each cell cap and collecting data from random 1-meter quadrat locations within the grid. Data are collected once during each sampling event in late summer. Results are presented to regulators as part of the fall quarterly inspection report, no later than October 15 of the collection year.

Routine management of the OSDF cap includes prescribed burning or mowing and baling to manage the prairie and limit the establishment of woody vegetation and noxious weeds. Until 2016, mowing, raking, and baling was the only form of management used on the OSDF. Controlled burning of the vegetation on the cell cap is the preferred management tool to maximize the growth of prairie grass. It also eliminates the need to handle haybales. Working with the community and regulators, DOE moved forward with a prescribed burn on Cells 4, 5, and 6 in March 2016. The burn was successful, and DOE continued the 3-year management rotation using spring prescribed burns. Vegetation on Cells 7 and 8 was burned in March 2017, and vegetation on cells 1, 2 and 3 was burned in March 2018. In late 2018, DOE discussed with the regulators and then the Fernald Community Alliance changing the OSDF prescribed burn frequency and coverage to a two-year rotation and burning approximately half of the cap vegetation each year. In spring 2019, the southern half of the OSDF cap vegetation was burned and the northern half of the OSDF cap vegetation was planned to be burned in spring 2020. However, the response to the COVID-19 pandemic prevented prescribed burns in both 2020 and 2021. In 2022, DOE entered into an interagency agreement with the U.S. Forest Service to conduct all prescribed burns activities at the site; the agreement was finalized in July 2022.

Beginning in the spring of 2023, the entire OSDF cap will be burned on a 2-year rotation by the U.S. Forest Service. The increased burning frequency and larger area to be burned will improve efficiency of burning operations and ensure better management of invasive woody vegetation. If spring burns are not possible, the area may be mowed in the fall. Herbicide will also be used as needed to control invasive or nuisance plants that are identified on the cap. Decisions regarding management of the cell caps are made after percent-native-cover data are collected.

As stated, the goal is to optimize the establishment of native grasses on the OSDF cap. DOE and the regulatory agencies agree that the goal is not necessarily to establish a functioning prairie on the OSDF cap. Native grasses (e.g., big bluestem, little bluestem, switchgrass) are more drought-tolerant than cool-season grasses, and their complex root structures will provide additional stability. A pass/fail criterion will not be set for the performance of the native grasses on the OSDF cap. However, a goal of 50 percent native cover has been considered for restored prairies on the site and will be used as a goal for native grasses on the OSDF. If the concentration of native grasses remains at or above 50 percent, management and monitoring will continue as outlined above. If the concentration of native grasses falls below 50 percent, LM will work with the regulators to determine whether additional action is necessary. If so, DOE will develop an appropriate plan for increasing the concentration of native grasses. Steps taken may include, but are not limited to, selective reseeding, installing native grass plugs, increasing the use of selective herbicide, and increasing the frequency of controlled burns on the cap, or some combination of these. The requirement to maintain 90 percent cover at all times after seeding on the OSDF cap will remain unchanged to minimize cap erosion. The 90 percent cover requirement applies to all vegetation on the cap and is not specific to native grasses.

Unscheduled inspections will be conducted as needed if specific circumstances warrant. An example would include following up on the completion of a maintenance action or conducting a cap inspection after an unusually large storm. Based on the results and determinations made from the inspections, DOE will take appropriate actions to address any identified problems.

The maintenance and monitoring of the general support systems for the OSDF will include ensuring that physical access controls and restrictions are maintained, conducting routine inspections of the OSDF and surrounding area, performing routine maintenance activities, and monitoring the environment. Table 4 provides additional information on the required monitoring and maintenance.

The federal government will remain the property owner, and access to the OSDF and buffer area will continue to be restricted in perpetuity by means of fences, gates, locks, and warning signs (Figure 5). Only the federal government will authorize access, which will be limited to personnel conducting inspections, monitoring, custodial maintenance, corrective action, and escorted tours.

3.5.2 Leak Detection/Leachate Monitoring

Routine OSDF leak detection and leachate monitoring is currently governed by the GWLMP (Attachment C). Table 4 includes some of the details. Section 3.0 of the GWLMP provides the regulatory analysis and strategy for the OSDF monitoring. The regulatory drivers come from the applicable or relevant and appropriate requirements identified in the OU2, OU3, and OU5 RODs. Section 4.0 of the plan provides a significant amount of information on the OSDF leak detection monitoring program. The text includes the program elements, monitoring frequencies, selection of analytical parameters, and data evaluation. Section 5.0 is a discussion of the leachate management monitoring program. It covers the management approach and monitoring needs. Section 6.0 provides the reporting requirements and the notification and response actions for when flow in the leak detection system exceeds action levels, which could be an indication of a failure in the cap or liner and could pose a threat to human health or the environment. Table 3 of the GWLMP outlines these actions in detail.

3.5.3 Leachate Management

Also involved in the maintenance and monitoring of the OSDF system is the management of the leachate that enters the LCS. Additional information regarding leachate management is also found in Appendix D of the GWLMP. Leachate will be treated through the CAWWT until the CAWWT is no longer available. The quantity of leachate collected, treated, and discharged will be documented. A passive leachate treatment system is an option after the CAWWT is no longer available. Long-term treatment needs for the OSDF leachate during the period after the CAWWT is decommissioned will be evaluated prior to the shutdown and D&D of the CAWWT.

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4.0 Contingency Planning

Site inspections, monitoring activities, and maintenance activities are designed to identify problems before they develop into a need for corrective action. In the unlikely case that a natural event, vandalism, or other event threatens the integrity or operation of the OSDF or remainder of the site, corrective actions will be carried out to mitigate the problem. In addition, DOE will evaluate the factors that caused the problem and ensure that the possibility of reoccurrence is minimized or avoided.

To the extent that contingency actions can be anticipated or planned, they have been, and will continue to be, incorporated into the LMICP or attached support plans. Unanticipated contingency actions will be subject to CERCLA processes prior to implementation. Stakeholders, regulatory agencies, and the public will be notified of any unanticipated contingency actions under CERCLA that have to be implemented.

4.1 Unacceptable Disturbances or Use

If an unacceptable condition or disturbance occurs at the Fernald Preserve during legacy management, corrective actions will be employed, and appropriate notifications will occur. Unacceptable conditions regarding the disturbance or use of the Fernald Preserve may include unauthorized access to the site (e.g., off-road vehicles, hunters), attempts to use soil or water on the site in an inappropriate manner, attempts to access the OSDF, or damage to fencing, gates, or postings. Section 2.1.1 provides an extensive listing of those actions that are prohibited and apply to all unauthorized personnel. Unacceptable conditions related to exposure to residual contaminants could include damage or disruption to the OSDF or attempts to use groundwater still undergoing remediation.

Contingency inspections are unscheduled inspections ordered by DOE when it receives information indicating that site integrity has been or may be threatened. Events that could trigger contingency inspections include severe vandalism, intrusion by humans or livestock, severe rainstorms, or unusual events of nature such as tornadoes or earthquakes. If any unacceptable activities were found to be occurring onsite, LM would implement the appropriate corrective actions, both to repair damage, if required, and to prevent or reduce the chances of reoccurrence. Some of the possible corrective actions LM may consider are increasing the frequency of surveillances by site personnel, requesting patrols by local law enforcement personnel, adding surveillance cameras, evaluating and possibly revising current postings at the site, and prosecuting individuals caught engaging in prohibited, destructive, or disruptive behavior.

Events that have caused severe damage to the OSDF or that pose an immediate threat to human health and the environment will be immediately reported to EPA and Ohio EPA. Detailed information regarding OSDF Follow-Up and Contingency inspections, corrective actions, and reporting are contained in the PCCIP (Attachment B).

Minor maintenance actions such as seeding small areas, minor erosion repairs on the OSDF or other parts of the site, the replacement of postings and signs, minor fence and gate repairs, and minor maintenance of site infrastructure will not be subject to the notification process described above. The need for minor maintenance will be identified on routine inspection forms issued to EPA and Ohio EPA and will be subject to follow-up inspections as discussed above.

4.2 Suspected Contaminated Soil, Material, or Debris

Suspected contaminated soil, material, or debris is defined as items found by either Fernald Preserve workers or visitors to the Fernald Preserve that could pose an environmental or health hazard. The potential hazard may be radiological (e.g., contaminated metal, concrete, asphalt, tile), discolored soils, unidentified objects or containers, or suspect liquids exposed by erosion or excavation. Debris consists mostly of construction rubble (i.e., small chunks of broken building materials). Metal items from heavy equipment, such as bolts and plates, may be found, as well as pieces of graphite, which was used to construct molds during the production processes.

Upon discovery, the suspect soil, material, or debris will be marked with a pin flag, and Radiological Controls or Safety and Health personnel shall be notified. The radiological control technician will follow proper protocol addressed in the *Fernald Preserve Procedure for Suspect Material or Debris Discoveries* (DOE 2022c) for surveillance and disposition of the material or debris. GPS may be used to document the location of debris. Field personnel are briefed regarding the actions to take upon discovery of debris during inspections and construction activities. In addition, a public brochure is available that addresses the potential for debris discoveries.

For debris, DOE-approved limits for contamination from residual radioactive material will be used to determine the proper disposal method. For soils with evidence of contamination (i.e., removable contamination or removed debris with instrument readings above background), these areas will be marked for additional investigation. Debris that does not meet the unrestricted release criteria and soils that exceed the cleanup criteria will be transported to an offsite disposal facility for disposal in accordance with the terms of the Amended Consent Agreement and EPA's Off-Site Rule. If unexpected large-scale soil contamination is identified, the protocol in the SEP (DOE 1998b) will be followed, which is the same protocol that will be used for the uncertified areas described in Volume I, Section 2.4.4.

The disposal of any contaminated debris or soil will be handled on a case-by-case basis once adequate historical knowledge of the soil is compiled and any additional characterization is complete. Until then, temporary storage in covered stockpiles or appropriate containers (depending on volume) will be established, and a path forward through final disposition will be developed for review and approval by appropriate agencies as necessary.

Although not expected, any tagged Fernald property items suspected to be from Fernald that are found onsite or offsite are to be reported by calling either the contractor site lead at (513) 910-6107 during business hours or the 24-hour LM emergency number at (877) 695-5322.

4.3 Unexpected Cultural Resource Discoveries

Although excavation activities on the Fernald Preserve are expected to be limited, excavations may occur for ecological restoration, erosion repair, and the eventual removal of the CAWWT and associated aquifer restoration infrastructure. If unexpected cultural resources are identified within an excavation, the *Procedure for Unexpected Discovery of Cultural Resources at the Fernald Preserve* (DOE 2022d) will be followed. This procedure includes isolating the affected area until an on-call subcontractor can perform the necessary investigation. This response follows the same process used during remediation and restoration activities. DOE will continue to consult with the appropriate parties, such as the State of Ohio Historic Preservation Office, to determine an appropriate course of action.

4.4 Notification Process

Upon discovering any institutional control breaches that require corrective action, LM will notify EPA and Ohio EPA of the breaches and of DOE's plan for correcting them. Stakeholder notifications will be handled as deemed appropriate by DOE. LM will address any activity that is inconsistent with the institutional control objective or use restrictions as soon as practical, but in no case will the process begin later than 10 days after LM becomes aware of the violation.

DOE will notify EPA and Ohio EPA regarding how it has addressed or will address the breach within 10 days of the initial notification. A follow-up inspection will occur within 30 days of the completion of any corrective action. The results of follow-up inspections will be provided to EPA and Ohio EPA.

4.5 Coordination with Other Agencies

LM sent letters to the Hamilton County Sheriff's Department; the Butler County Sheriff's Department; and Ross, Crosby, and Morgan Township police and fire officials requesting that they notify LM if they observe any unauthorized human intrusion or unusual natural event.

LM sent a letter to the Ohio Earthquake Information Center, located at Alum Creek State Park in Delaware County, Ohio, requesting that they notify LM of any earthquake activity near the Fernald Preserve.

LM will monitor emergency weather notification system announcements and has requested notification from the National Weather Service (either Wilmington or Cincinnati) of severe weather alerts.

To notify LM of site concerns, the public may use the 24-hour security telephone numbers monitored at the DOE facility in Grand Junction, Colorado. The 24-hour security telephone numbers will be posted at site access points and other key locations on the site.

THE 24-HOUR EMERGENCY NUMBER

877-695-5322

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5.0 Natural Resources

As shown in Table 5, regulatory drivers for the management of natural resources and associated impact monitoring include six areas: endangered species protection; migratory bird protection; wetlands/floodplain regulations; cultural resource management; the CERCLA natural resource trusteeship process; and the National Environmental Policy Act (NEPA).

Table 5. Fernald Site Natural Resource Monitoring

Driver	Action
Endangered Species Act Ohio Endangered Species Regulations	This document describes management of existing habitat and follow-up surveys. Suitable habitat for threatened and endangered species is identified; surveys are conducted as-needed prior to implementation of field activities.
Migratory Bird Treaty Act Executive Order 13186	This document describes management activities to comply with the memorandum of understanding between DOE and U.S. Fish and Wildlife Service (DOE and USFWS 2013). Field activities are timed to avoid or minimize impacts to migratory birds. Restored areas are maintained to promote migratory bird habitat.
Clean Water Act Section 404 Clean Water Act Section 401 State Water Quality Certification	This document and Wetland Mitigation Monitoring Plan (DOE 2009) describe the monitoring of mitigation wetlands. The potential for dredge or fill of onsite wetlands is evaluated as part of project planning. Substantive permitting requirements are implemented if necessary. The WMMR (DOE 2012) documented completion of mitigation monitoring for site wetlands impacted by remedial activities.
National Historic Preservation Act Native American Graves Protection and Repatriation Act Archaeological Resources Protection Act	This document describes the monitoring of cultural resources. Surveys are conducted and reported as necessary prior to implementation of field activities. Consultation and reporting are conducted pursuant to the Programmatic Agreement between DOE and the Ohio Historic Preservation Office. Procedures are in place in the event of an unexpected discovery of cultural resources.
CERCLA Executive Order 12580 National Contingency Plan	Volume I of the LMICP describes the CERCLA Natural Resources Trusteeship process, which includes the Natural Resources Restoration Plan (NRRP). The Natural Resources Management Plan is included as Appendix A of Volume I.
NEPA	This document discusses the substantive requirements of NEPA for protecting sensitive environmental resources. Environmental impacts are evaluated as part of project-planning activities.

5.1 Protected Species

The federal laws and regulations listed below mandate that any action authorized, funded, or carried out by the DOE cannot jeopardize the continued existence of any threatened or endangered (i.e., listed) species or result in the destruction or adverse modification of the constituent elements essential to the conservation of a listed species within a defined critical habitat. Additional requirements may apply if it is determined that a proposed activity could adversely affect these species or their habitat. These laws and regulations include the Endangered

Species Act at Title 16 *United States Code* [USC] Section 1531 et seq. (16 USC 1531 et. seq.) and its associated regulations at Title 50 *Code of Federal Regulations* [CFR] Part 17 (50 CFR 17) and 50 CFR 402.

State law also protects endangered species by prohibiting the taking or destruction of any state-listed endangered species. These laws are found in Ohio Revised Code 1518 (ORC 1518) and ORC 1531, as well as in *Ohio Administrative Code* (OAC 1501).

There is the potential for other state-listed and federally listed threatened or endangered species to live in habitat ranges that encompass or occupy the Fernald Preserve. If activities at the Fernald Preserve could potentially impact Indiana bat habitat, active monitoring of those areas will be completed. Monitoring for several other listed species that may be present at the Fernald Preserve will take place if potential habitat would be impacted by site activities. Figure 10 identifies those potential habitats.

A number of endangered species surveys have been conducted at the Fernald Preserve. The formerly state-listed threatened Sloan's crayfish (*Orconectes sloanii*) and the federally endangered Indiana bat (*Myotis sodalis*) are the only threatened or endangered species observed at the site. As of 2022, Sloan's crayfish has been removed from Ohio's threatened and endangered species list. Monitoring was conducted as part of a re-introduction program for the formerly federally endangered American burying beetle (*Nicrophorus americanus*). The monitoring program was discontinued in 2021. The American burying beetle also has been downlisted to threatened.

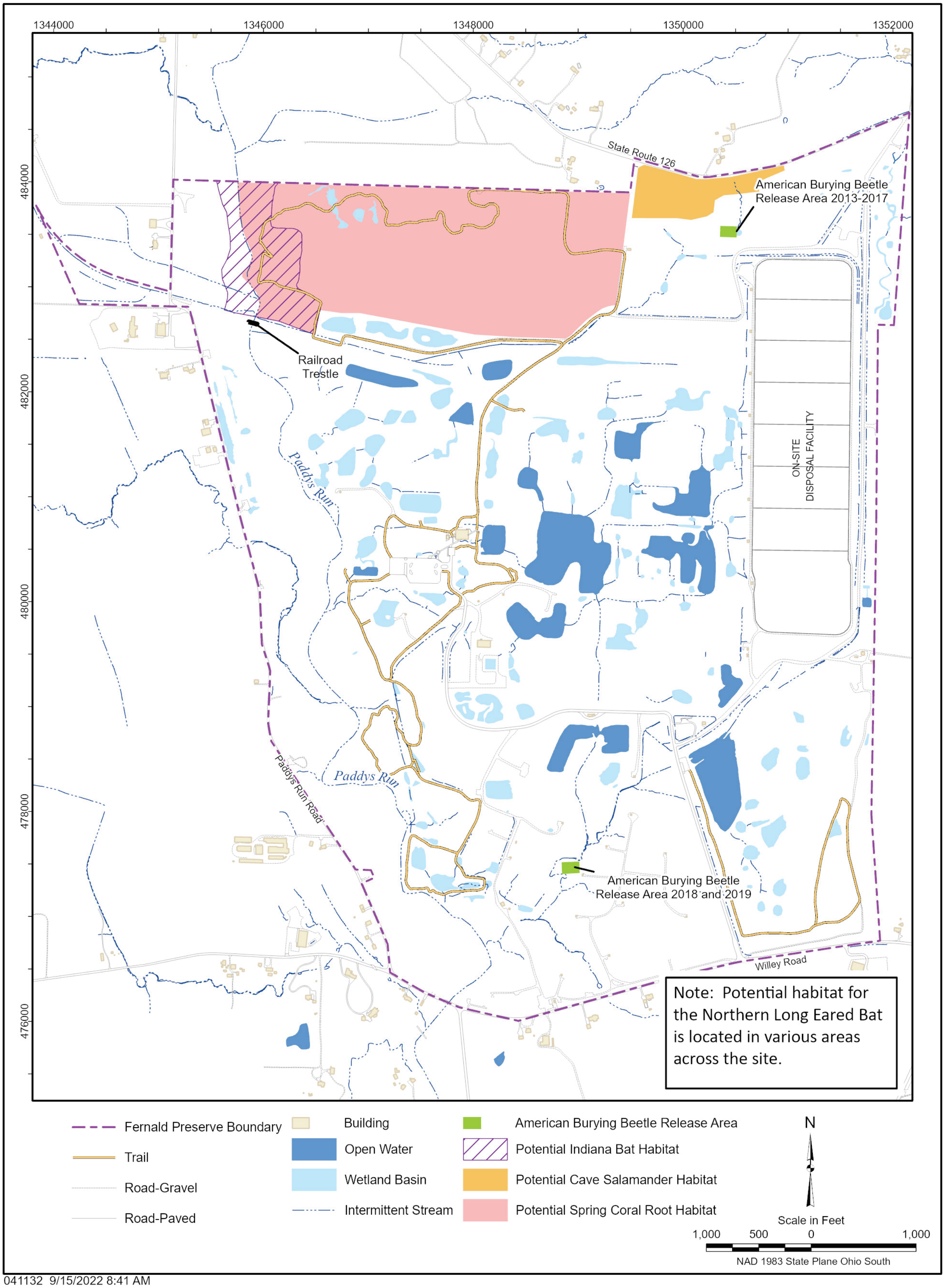

Figure 10. Potential Habitat of Threatened and Endangered Species

5.1.1 Indiana Bat and Northern Long-Eared Bat

Good to excellent summer habitat for the federally listed endangered Indiana bat (*Myotis sodalis*) has been identified north of the former rail trestle along Paddys Run. The habitat provides an extensive mature canopy from older trees and the presence of water throughout the year. In 1999, one adult female was captured along Paddys Run and released. Potential impacts to Indiana bat habitat would include tree removal and stream alteration in the northern on-property sections of Paddys Run. Because the bats use loose-bark trees and cavities in the trees for their maternal colonies, removal of trees would impact this species by eliminating its summer habitat.

The habitat of the Indiana bat was monitored on several occasions during remediation activities to identify any unanticipated impacts during remediation. Baseline surveys were conducted in 1994 and 1999. A follow-up survey was conducted in the summer of 2002 as a result of remediation activities north of the train trestle along Paddys Run. No Indiana bats were found during this survey.

DOE and the regulatory agencies agreed to keep the former rail trestle in place after a thorough review of the impacts that would result from its removal. The trestle was modified to promote use by bats.

The northern long-eared bat (*Myotis septentrionalis*) was listed by the U.S. Fish and Wildlife Service (USFWS) as federally threatened in 2015. This species shares summer breeding habitat with the Indiana bat. Suitable habitat exists within mature forest areas along the northern portions of the site and the Paddys Run corridor.

Monitoring methods for the Indiana bat and northern long-eared bat would consist of visual observations of bat activity and mist netting in areas suitable as bat flyways and where canopy occurs. Mist netting would occur between May 15 and August 15, because some bats begin to disperse for winter shelter in late August. Data recorded at each sampling site would include type of habitat, water depth and permanence, type of bottom, tree species and size, and presence of hollow trees or trees with loose bark in the vicinity.

In addition to mist nets, bat detectors (which indicate bat activity) would be used during all sampling to detect echolocation calls near the net. The number of calls on the detector would be recorded to indicate the effectiveness of the nets in relation to bat activity. Bat detectors can also be used to sample areas of marginal habitat to determine if netting should be attempted.

If removal of large trees is needed, or if disturbances to the trestle or any other portion of the Indiana bat or northern long-eared bat habitat area are required during the summer breeding season (i.e., April 1 to October 1), additional monitoring activities will be necessary. As necessary, USFWS will be consulted prior to implementation of field activities. In general, site personnel avoid the removal of mature trees across the site from April through September. Suitable roosting habitat for Indiana and long-eared bats includes forest patches with trees greater than or equal to 5 inches in diameter (USFWS 2022).

5.1.2 Spring Coral Root

The state-listed threatened spring coral root (*Corallorhiza wisteriana*) is a white-and-red orchid that blooms in April and May and grows in partially shaded areas of mesic deciduous woods, such as forested wetlands and wooded ravines. Although surveys conducted in 1994 and 1995 indicated that no individuals were found, suitable habitat exists in portions of the northern woodlot.

A floristic analysis for the northern woodlot and associated northern forested wetland was conducted in 1998. No spring coral root was observed during this survey. A field survey would take place during the bloom period if disturbance within suitable habitat is planned.

5.1.3 Cave Salamander

The state-listed endangered cave salamander (*Eurycea lucifuga*) is a slender, orange salamander with irregular black dots. It is found in caves, springs, small limestone streams, outcrops, and spring houses where groundwater is present. In Ohio, cave salamanders have only been documented in Hamilton, Butler, and Adams Counties. Suitable habitat within the Fernald Preserve is limited, but populations have been observed just north of the site. A survey conducted in 1993 did not reveal any individuals onsite.

5.1.4 American Burying Beetle

DOE entered into a Memorandum of Agreement with the USFWS and the Cincinnati Zoo (DOE 2017) to introduce the federally endangered American burying beetle into restored habitat at the Fernald Preserve. The American burying beetle is an orange and black carrion beetle that is known for burying carcasses up to 200 times their weight. The carcass is used as a host for eggs and larvae; adult beetles remain to care for the eggs and larvae. At the time the beetle was listed in 1989, only two known populations existed: Rhode Island and Oklahoma. USFWS has been reintroducing American burying beetles in Ohio since 1998. The Cincinnati Zoo bred the beetles and helped release captive pairs. In 2017, the parties signed a second agreement to continue releases at the Fernald Preserve through 2022 (Cincinnati Zoo 2021). From May 2013 through 2019, more than 650 beetle pairs have been released at the Fernald Preserve. Release sites are shown on Figure 10. Follow-up activities involved pre- and post-release monitoring. Pursuant to the Agreements, surveys are not required prior to ground-disturbing activities at the Fernald Preserve. DOE instead was to notify USFWS of large-scale disturbance activities (greater than 5 acres) and report any accidental injury or death of American burying beetles.

The first documented case of a beetle released at the site that survived through the winter occurred in spring 2019. In November 2020, the status of the American burying beetle was changed from endangered to threatened and in October 2021, the Cincinnati Zoo formally requested the termination of the Memorandum of Agreement to reallocate beetles to other release sites in the state. Zoo personnel completed 1 week of monitoring in spring of 2021 to support terminating the agreement. No American burying beetles were observed during this monitoring.

5.1.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act in 16 USC 703-712, prohibits the hunting, killing, capturing, possession, sale, transportation, and exportation of birds, feathers, eggs, and nests. Federal agencies are required to uphold responsibilities to protect migratory birds stated under Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. In accordance with these requirements, DOE and the USFWS have entered into a memorandum of understanding (DOE and USFWS 2013) because of the potential to negatively impact migratory bird species during land management practices. Within the memorandum of understanding, DOE recognizes that they are responsible for land management of regional ecosystems that actively promote wildlife and migratory bird habitat. Additionally, DOE agrees to collaborate with USFWS to enhance migratory bird habitat and increase conservation of migratory bird species. No specific monitoring activities are needed for compliance with the Migratory Bird Treaty Act. Activities at the Fernald Preserve are conducted to avoid or minimize adverse impacts to migratory birds. Personnel at the Fernald Preserve work to improve migratory bird habitat through restoration and conservation efforts. Site personnel are required to avoid impacting birds and nests and to report incidental damage as a result of field activities.

5.2 Wetlands and Floodplains

Executive Order 11990, *Protection of Wetlands*, and Executive Order 11988, *Floodplain Management*, which are implemented by 10 CFR 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements," specify the requirement for a Floodplain/Wetland Assessment in cases where DOE is responsible for providing federally undertaken, financed, or assisted construction and improvements that may impact floodplains or wetlands. This regulation further requires that DOE exercise leadership to minimize the destruction, loss, or degradation of wetlands; and preserve and enhance the natural and beneficial values of wetlands.

Pursuant to Section 404 of the Clean Water Act and 33 CFR 323.3, any activity that results in the discharge of dredged or fill material out of or into a wetland or water of the United States requires permit authorization by the U.S. Army Corps of Engineers. These permits can be in the form of either nationwide permits (33 CFR 330) or individual permits (33 CFR 323), depending on the nature of the activity.

Section 401 of the Clean Water Act and 33 CFR 325.2(b)(1)(ii) also require that a Section 401 State Water Quality Certification be obtained to authorize discharges of dredged and fill material under a Section 401 permit. In Ohio, the Section 401 State Water Quality Certification program is administered by Ohio EPA pursuant to OAC 3745:32.

Approximately 11.9 acres of on-property wetlands adjacent to the former production area were impacted as a result of contaminated soil excavation. The 26-acre northern forested wetland area and associated drainage characteristics were avoided and protected during remediation activities. A mitigation ratio of 1.5:1 (i.e., 1.5 acres of wetlands replaced for every 1 acre of wetland disturbed) was negotiated between DOE and the appropriate agencies (i.e., EPA, Ohio EPA, USFWS, and the Ohio Department of Natural Resources). As a result of this agreement, 17.8 acres of new wetlands were established to compensate for the impacts during remediation.

Compensatory mitigation for wetland impacts was specifically addressed in the NRRP (State of Ohio 2008). Since wetland habitat was a key component of sitewide restoration, many acres of wetlands were created across the site. The *Fernald Preserve Wetland Mitigation Monitoring Plan* (DOE 2009) was developed to ensure that compensatory mitigation was met using protocols established by Ohio EPA. A 3-year monitoring effort ensued, and results were presented in the WMMR (DOE 2012). The results showed that at least 31 acres of jurisdictional wetlands were established, thereby meeting the 17.8-acre compensatory requirement. DOE committed to continue wetland monitoring through the long-term restored area monitoring program, and wetland amphibian surveys and water elevation monitoring were added to the vegetation-focused functional monitoring program in 2012. These efforts continued through 2020. The Wetland Mitigation Monitoring Plan allowed for additional monitoring if site jurisdictional wetlands are impacted in the future. Note that the WMMR is referring to jurisdictional wetlands as defined by the U.S. Army Corp of Engineers in its *Wetland Delineation Manual* (USACE 1987). Many more acres of wetland community exist at the Fernald site, as described in Section 2.0.

5.3 Cultural Resource Management

Management of cultural resources, particularly archaeological sites, is mandated by the National Historic Preservation Act (16 USC §470), the Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.), and the Archaeological Resources Protection Act (16 USC §470aa–470ll). The associated regulations for the above laws are found in 36 CFR 800, 43 CFR 10, and 43 CFR 7, respectively. These laws and regulations ensure that archaeological resources on federal land are appropriately managed. Section 106 of the National Historic Preservation Act ensures that DOE considers the effect of its undertakings on properties eligible for listing on the National Register of Historic Places. The Native American Graves Protection and Repatriation Act and 43 CFR 10 require that the rightful control of Native American cultural items discovered on federal land be relinquished to the appropriate culturally affiliated tribe. Federal land is defined as “land that is owned or controlled by a federal agency.” Cultural items are defined in the Native American Graves Protection and Repatriation Act as “human remains, associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony.” The Archaeological Resources Protection Act and 43 CFR 7 ensure that competent individuals carry out archaeological excavations in a scientific manner.

DOE has implemented several policies to ensure compliance with cultural resources law and Native American consultation. The Department of Energy American Indian Tribal Government Interactions and Policy, DOE Order 144.1, communicates DOE’s responsibilities for interacting with American Indian Governments. Additionally, DOE Policy 141.1, *Department of Energy Management of Cultural Resources*, requires that DOE sites ensure cultural resource management is integrated into their missions and activities and to raise the level of awareness among DOE contractors regarding the importance of the DOE cultural resource responsibilities.

The Fernald Preserve implements these requirements through a Programmatic Agreement with the Ohio Historic Preservation Office (OHPO) that streamlines the National Historic Preservation Act Section 106 consultation process. Monitoring provisions are included as part of this agreement to ensure that appropriate management is implemented for any eligible properties at the Fernald Preserve. At the request of OHPO, the *Programmatic Agreement Among the U.S. Department of Energy Office of Legacy Management and the Ohio Historic Preservation Office Regarding Archaeological Investigations at the Fernald Preserve* (OHPO 2012) was updated in 2012. The required reporting frequency was changed from annual to “as needed.”

All field personnel must comply with the *Procedure for Unexpected Discovery of Cultural Resources at the Fernald Preserve* (DOE 2022d) if cultural resources are uncovered during ground-disturbing activities. Limited monitoring will occur in all areas that have been surveyed to identify any unexpected discoveries (Figure 11). More intensive field investigation will take place only in areas known to have a high potential for archaeological sites as determined by previous investigations. In most instances, discovery of artifacts in previously surveyed areas will require data recovery work. Disturbance of previously unsurveyed areas will require at least a Phase I investigation prior to soil disturbance. A summary of all cultural resource field activities is provided annually in the Site Environmental Report. Monitoring of cultural resource areas will continue during legacy management to ensure that the areas are not being disturbed (Figure 11).

5.4 National Environmental Policy Act

In addition to the regulatory drivers summarized above, aspects of natural resource management and monitoring are mandated through the incorporation of substantive NEPA requirements into remedial action planning. In June 1994, DOE issued a revised secretarial policy on NEPA compliance. This policy called for the integration of NEPA requirements into the CERCLA decision making process. Therefore, requirements for the protection of sensitive environmental resources, including threatened and endangered species and cultural resources, are to be considered throughout legacy management activities.

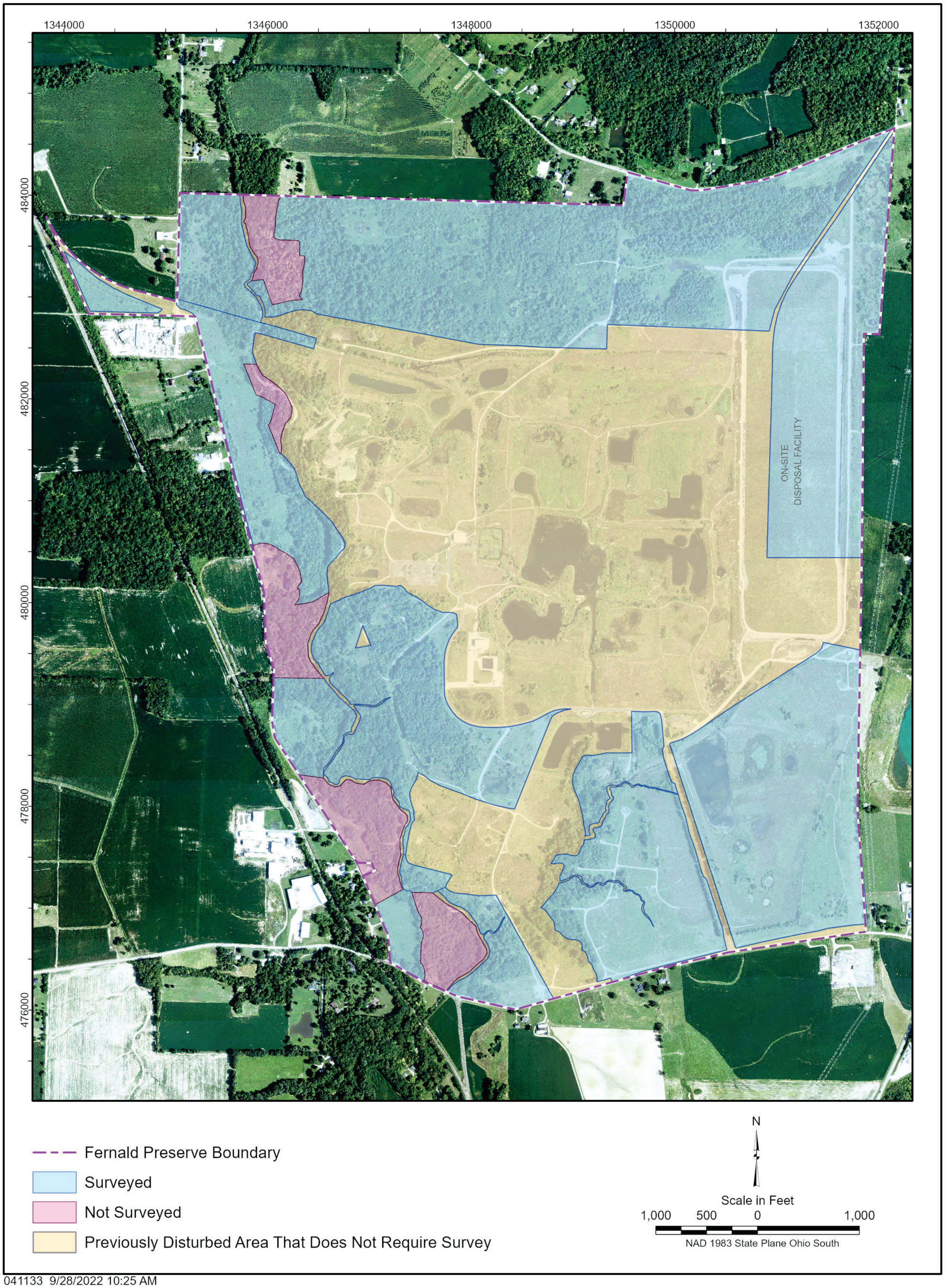

Figure 11. Cultural Resources Survey Areas

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6.0 Information Management and Public Involvement

6.1 Information Management

The long-term retention of records and dissemination of information is another critical aspect of legacy management. LM will manage records that are needed for legacy management purposes. Records will be dispositioned in accordance with DOE requirements at the National Archives and Records Administration or a Federal Records Center for their required retention period or destroyed once they have reached the end of their required retention. LM will retain copies of selected records documenting past remedial activities (e.g., CERCLA Administrative Record [AR]) for legacy management purposes. In addition, newly acquired CERCLA AR records will be available to stakeholders. LM will also manage any centralized system to provide stakeholders with access to information.

For institutional control purposes, LM will retain and manage copies of selected information or data documenting past remedial activities (e.g., soil certification) and the design and contents of the OSDF. In addition, newly acquired information or data related to remedy performance will be readily available to the regulatory agencies and the public. LM currently uses the Geospatial Environmental Mapping System (GEMS), a web-based application, to provide the agencies and the public with Internet access to electronic environmental groundwater, surface water and OSDF analytical data. Annual site and OSDF inspection photographs, historical environmental dosimeter, air particulate, and radon data are available upon request by contacting site personnel at (513) 648-3330.

6.1.1 Fernald Preserve Data and Information

Site inspection data will include information from inspections of the general site area, perimeter, access points, infrastructure, and signs and postings. The site inspection reports are available at https://lmpublicsearch.lm.doe.gov/SitePages/default.aspx?sitename=Fernald and will be included in the annual Site Environmental Report.

The IEMP (Attachment D) defines environmental monitoring requirements for the Fernald Preserve. Monitoring data will include all environmental monitoring data associated with the site, including groundwater remediation data and ecological restoration monitoring data.

6.1.2 OSDF Data and Information

OSDF inspection data will include information from inspections of the cap, infrastructure (e.g., LCS and LDS pipe networks), perimeter fencing, buffer area, and signs and postings. The OSDF inspection and LCS/LDS inspection will be documented. The OSDF inspection reports are available at https://lmpublicsearch.lm.doe.gov/SitePages/default.aspx?sitename=Fernald and will be included in the annual Site Environmental Report. Inspection data concerning the operation and maintenance of the LCS and LDS pipe network are also reported in the annual Site Environmental Report.

The GWLMP (Attachment C) specifies the frequencies and parameters being monitored in four horizons for each cell of the OSDF.

6.1.3 Reporting

The annual Site Environmental Report will continue to be submitted to EPA, Ohio EPA, and the community on June 1 of each year. It will provide information on institutional controls, monitoring, maintenance, site inspections, and corrective actions while continuing to document the technical approach and summarize the data for each environmental medium. It will also summarize CERCLA, Resource Conservation and Recovery Act (RCRA), and waste management activities. The report will include water quality and water accumulation rate data from the OSDF monitoring program. The summary report serves the needs of the regulatory agencies and other key stakeholders. The accompanying detailed appendixes of the Site Environmental Report are intended for a more technical audience. Additional continued reporting requirements under other regulatory programs will be addressed outside the annual Site Environmental Reports (e.g., NPDES monthly discharge reports).

Once it is determined that the institutional controls are functioning, the remedy is performing as intended, and the groundwater remediation is effective, the reporting frequency may be reevaluated. In the event of unacceptable conditions or disturbance, more frequent notification and reporting will be required as defined in Section 4.0.

Under CERCLA, a review of the remedy is required every 5 years at sites where the level of remaining contaminants limits site use. The CERCLA five-year reviews at the Fernald Preserve focus on the protectiveness of the remedies associated with each of the five OUs. Also included will be summaries of the inspections conducted for the OSDF, the CAWWT, the groundwater restoration system, and the outfall line to the Great Miami River. To facilitate the review, a report addressing the ongoing protectiveness of the remedies will be prepared and submitted to EPA and Ohio EPA. The institutional controls portion of the report will include the data collected from monitoring and sampling, summaries of the inspections conducted of the Fernald Preserve and OSDF site and cap during the 5-year period, and a discussion of the institutional controls' effectiveness. If it is determined that a particular control is not meeting its objectives, then required corrective actions will be included. The review may lead to revisions to the monitoring and reporting protocols. The most recent five-year review was approved in 2021. The next five-year review will begin in 2025 and will be finalized in 2026.

6.2 Public Involvement

The public played an important role in the remediation process at the Fernald Preserve, and the community remains involved in legacy management. DOE has written the CIP (Attachment E) to document how DOE will ensure the public's continued involvement in a variety of site-related decisions and activities, including post-closure monitoring. The CIP is a CERCLA-required document. Although the CIP contains all the requirements for public involvement under CERCLA, it also includes DOE's policy for public involvement, which extends beyond CERCLA requirements. Therefore, the CIP clearly identifies those elements that are not enforceable.

7.0 References

10 CFR 1022. “Compliance with Floodplain and Wetland Environmental Review Requirements,” *Code of Federal Regulations.*

33 CFR 323.3. “Discharges Requiring Permits,” *Code of Federal Regulations.*

33 CFR 325.2. “Processing of Applications,” *Code of Federal Regulations.*

33 CFR 330. “Nationwide Permit Program,” *Code of Federal Regulations.*

36 CFR 800. “Protection of Historic Properties,” *Code of Federal Regulations.*

40 CFR 300. U.S. Environmental Protection Agency, “National Oil and Hazardous Substances Pollution Contingency Plan,” *Code of Federal Regulations*.

43 CFR 7. “Protection of Archaeological Resources,” *Code of Federal Regulations.*

43 CFR 10. “Native American Grave Protection,” *Code of Federal Regulations.*

50 CFR 17. “Endangered and Threatened Wildlife and Plants,” *Code of Federal Regulations*.

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Appendix A

Records of Decision and Associated Documents

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Records of Decision and Associated Documents

Federal Facility Compliance Agreement	1986
Work Plan (identifies specific units of the site for RI/FS)	1988
Consent Agreement	1990
Amended Consent Agreement	1991
Record of Decision for Operable Unit 4	1994
Interim Record of Decision for Operable Unit 3	1994
Record of Decision for Operable Unit 1	1995
Record of Decision for Operable Unit 2	1995
Final Record of Decision for Operable Unit 3	1996
Record of Decision for Operable Unit 5	1996
Explanation of Significant Differences for Operable Unit 4 Silo 3	1998
Recommendation that treatment of Silo 3 material be evaluated and implemented separately from treatment of Silos 1 and 2 material	
Final Record of Decision Amendment for Operable Unit 4 Silos 1 and 2	2000
Explanation of Significant Differences for Operable Unit 5	2001
Resulted in change of FRL for uranium in groundwater from 20 ppb to 30 ppb	
Explanation of Significant Differences for Operable Unit 1	2002
Recommendation for processing other FEMP waste streams through the Operable Unit 1 remediation facilities and processes	
Final Record of Decision Amendment for Operable Unit 1	2003
Final Record of Decision Amendment for Operable Unit 4 Silo 3	2003
Final Explanation of Significant Differences for Operable Unit 4 Silos 1 and 2	2003
Final Explanation of Significant Differences for Operable Unit 4	2005
Final Fact Sheet for Operable Unit 3	2006
Operable Unit 1 Final Remedial Action Report	2006
Operable Unit 2 Final Remedial Action Report	2006
Operable Unit 3 Final Remedial Action Report	2007
Operable Unit 4 Final Remedial Action Report	2006
Operable Unit 5 Interim Remedial Action Report	2008
Preliminary Close Out Report (U.S. EPA Document)	2006

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Appendix B

Institutional Control Records as Stated in the Records of Decision

Operable Unit 2 Record of Decision (DOE 1995)

The selected remedy will include the following as institutional controls:

- Continued federal ownership of the OSDF site.
- OSDF access restrictions (fencing, gates, and warning signs) will be controlled by proper authorization and is anticipated to be limited to personnel for inspection, custodial maintenance, or corrective action.
- Restrictions on the use of property will be noted on the property deed before the property could be sold or transferred to another party.
- Groundwater monitoring following closure of the OSDF.

Operable Unit 5 Record of Decision (DOE 1996b)

Long-term maintenance will be provided as part of the selected remedy. The selected remedy includes the following key components for institutional controls and monitoring:

- Continuation of access controls at the Fernald Preserve, as necessary, during the conduct of remedial actions. Property ownership will be maintained by the federal government and will comprise the disposal facility and associated buffer areas.
- Maintenance of remaining portions of the Fernald Preserve (outside the disposal facility area) under federal ownership or control (e.g., deed restrictions) to the extent necessary to ensure the continued protection of human health commensurate with the cleanup levels established by the remedy. If portions of the Fernald Preserve are transferred or sold at any future time, restrictions will be included in the deed, as necessary, and proper notifications will be provided as required by CERCLA. EPA must approve of all institutional controls, including types of restrictions and enforcement mechanisms, if the property is transferred or sold.
- Maintenance of the on-property disposal facility, to ensure its long-term performance and the continued protection of human health and the environment.
- An environmental monitoring program conducted during and following remedy implementation to assess the short- and long-term effectiveness of remedial actions.
- Provision of an alternative water supply to domestic, agricultural, and industrial users relying upon groundwater from the area of the aquifer exhibiting concentrations of contaminants exceeding the final remediation levels. The alternative water supply will be provided until such time as the area of the aquifer impacting the user is certified to have attained the final remediation levels.

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Attachment A

Operations and Maintenance Master Plan for Aquifer Restoration and Wastewater Treatment

Contents

Figures

Tables

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Abbreviations

ARWWT	Aquifer Restoration and Wastewater Treatment
AWWT	Advanced Wastewater Treatment Facility
CAWWT	Converted Advanced Wastewater Treatment Facility
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FFCA	Federal Facilities Compliance Agreement
FRL	final remediation level
ft	foot/feet
gpm	gallons per minute
HMI	human-machine interface
IEMP	Integrated Environmental Monitoring Plan
lb/yr	pounds per year
LM	Office of Legacy Management
LMICP	Legacy Management and Institutional Controls Plan
LMS	Legacy Management Support
LTS	leachate transmission system
µg/L	micrograms per liter
NPDES	National Pollutant Discharge Elimination System
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan
OSDF	On-Site Disposal Facility
OU	Operable Unit
PLC	programmable logic controller
PLS	permanent lift station
ppb	parts per billion
RA	Remedial Action
ROD	Record of Decision
RW	recovery well

SSOD	storm sewer outfall ditch
SWRB	storm water retention basin
VFD	variable-frequency drive
WSA	Waste Storage Area

1.0 Introduction

This document is the Operations and Maintenance Master Plan (OMMP) for Aquifer Restoration and Wastewater Treatment (ARWWT) at the U.S. Department of Energy's (DOE's) Fernald Preserve. The OMMP is a formal remedial design deliverable, originally prepared to fulfill Task 2 of the *Remedial Design Work Plan for the Remedial Actions at OU5* (DOE 1996a). It was first issued in November 1997. The OMMP has undergone several revisions and became part of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) in January 2006.

1.1 Scope of ARWWT and Objectives of the OMMP

The scope of ARWWT includes the operation and maintenance of the site's groundwater and the On-Site Disposal Facility's (OSDF's) leachate management facilities.

The fundamental objectives of the OMMP are to guide and coordinate the extraction, collection, conveyance, treatment, and discharge of all groundwater and leachate during the post-closure period. Compliance with discharge limits includes a plan of the commitments, performance goals, operating schedule, treated water flow rates, direct discharge flow rates, and other operating priorities. This plan also provides the approach for the management of treatment residuals (e.g., backwash basin sediments, spent resins/filtration media) that are byproducts of the Fernald Preserve's wastewater treatment processes.

The OMMP serves as a comprehensive statement of management policy to ensure that planned modes of operation and maintenance for ARWWT are consistent with regulatory requirements and satisfy the Fernald Preserve's remedy performance commitments for groundwater restoration and wastewater treatment. The plan establishes the decision logic and priorities for the major flow and water treatment decisions needed to maintain compliance with the Fernald Preserve's National Pollutant Discharge Elimination System (NPDES) permit and Record of Decision (ROD)-based surface water discharge limits. The plan also provides the overall management philosophy and decision parameters to implement the day-to-day flow routing, critical-component maintenance, and treatment priority decisions. It is not intended to provide detailed, specific operating or maintenance procedures for ARWWT. The plan also serves to inform the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA) of the planned operational approaches and strategies that are intended to meet the regulatory agreements made during the Operable Unit 5 (OU5) remedial investigation/feasibility study (DOE 1995a, DOE 1995b) process and documented in the OU5 decision documents: the *Record of Decision for Remedial Actions at OU5* (DOE 1996b), the *Explanation of Significant Differences for Operable Unit 5* (DOE 2001b), and the *Remedial Design Fact Sheet for Operable Unit 5 Wastewater Treatment Updates* (DOE 2004).

The plan provides the basis for development of more-detailed internal operating procedure documents (e.g., standard operating procedures, preventive maintenance plans) that are required for execution of work at the Fernald Preserve. The existing detailed procedural documents that govern the performance of water-related operations and maintenance activities at the Fernald Preserve are expected to be updated (revised, combined, or eliminated) as required to conform to the general strategies, guidelines, and decision parameters defined in this plan.

1.2 Basis and Need

The need for the OMMP arose in the mid-1990s, as DOE and regulators realized that the various water and wastewater flows that originate from Fernald Site remediation activities were in direct competition with one another for treatment resources. The wastewater treatment capacities at the Fernald Site had to be prioritized so that (1) discharge limits could be maintained, (2) a range of flow conditions at various time intervals could be accommodated, and (3) the detrimental effects of exceptional operating circumstances could be effectively managed. The need for treatment (and the accompanying hierarchy of treatment priorities) has varied over the span of the site remedy as new projects came on line, other projects were completed, and aquifer restoration activities progressed.

During development of the OU5 ROD (DOE 1996b), it was recognized that the monthly average concentration discharge limit for total uranium (established at 20 parts per billion [ppb] in the OU5 ROD and revised to 30 ppb in the Explanation of Significant Differences [ESD] for Operable Unit 5 [DOE 2001b]) could probably be met under average operating conditions, but that maintaining the limit may not be achievable during periods of exceptional operating conditions. It was further recognized that the application of the discharge limit was not considered as a required component of the remedy to ensure protectiveness, but rather as an appropriate performance-based objective that appeared reasonably attainable through the application of an appropriate level of water treatment. It was recognized that the performance-based discharge limit must be able to accommodate exceptional operating conditions expected to occur over the duration of the remedy. Two exceptional operating conditions were actually cited in the OU5 ROD; it would permit relief allowances from the total uranium monthly average concentration discharge limit, when necessary, for (1) storm water bypasses during high-precipitation events and (2) periodic reductions in treatment plant operating capacity that are necessary to accommodate scheduled maintenance activities. Since storm water treatment is no longer required (other than a portion of the Converted Advanced Wastewater Treatment facility [CAWWT] footprint), storm water bypasses are no longer required.

At the time the ROD was signed, it was recognized that the OMMP would define the operating philosophy for (1) the extraction/re-injection and treatment systems, (2) the establishment of operational constraints and conditions for given systems, and (3) the establishment of the process for reporting and instituting corrective measures to address exceedances of discharge limits. The OMMP also contains detailed information about the manner in which exceptional operating conditions are to be accommodated and reported in the demonstration of discharge limit compliance.

The OMMP will be modified during the course of the remedy to accommodate changes to the treatment and well field systems or the retirement of individual restoration modules from service, once area-specific cleanup levels are achieved. The plan is intended to serve as a living guidance document to instruct operations staff in implementing required adjustments to the system over time and to ensure that the most recent instructions regarding treatment priorities and flow-routing decisions are available to system operators. Proper notifications for reporting maintenance shutdowns of the system, and the reporting and application of corrective measures to address exceedances of discharge limits, are also identified in the OMMP.

Prior to site closure in 2006, water treatment flows were primarily reduced to groundwater and leachate from the OSDF. Elimination of remediation wastewater, impacted storm water, and sanitary sewer wastewater provided an opportunity to reduce the size of the water treatment facility remaining to service the aquifer restoration and leachate treatment after site closure. Reducing the size of the treatment facility prior to site closure in 2006 reduced the amount of impacted materials that may need future offsite disposal.

Between October 2003 and March 2004, DOE conducted a series of meetings with public stakeholders, EPA, and the Fernald Citizens Advisory Board to identify a more cost-effective water treatment facility that would serve as a long-term replacement for the existing Advanced Wastewater Treatment (AWWT) facility. The interactions led to support for a plan to carve down the AWWT facility to permit the 1,800-gallons-per-minute (gpm) Phase III expansion system to remain as the long-term groundwater treatment facility. The 1,800-gpm CAWWT provided a 1,200-gpm capacity for groundwater and about 600 gpm of storm water capacity (including carbon treatment) to handle the last remaining storm water and remediation wastewater flows prior to site closure. Upon site closure in 2006, the need to treat storm water and wastewater flows ceased. Therefore, at site closure the CAWWT provided a dedicated long-term groundwater treatment capacity of up to 1,800 gpm.

In addition to the decrease in the size of the water treatment facility, operational approaches to the aquifer remedy were reevaluated and resulted in the elimination of well-based groundwater re-injection, since it was determined that this was not a cost-effective approach to aquifer restoration at Fernald. This OMMP reflects the aquifer restoration design provided in the *Waste Storage Area (Phase II) Design Report* (DOE 2005) and updated in the *Operational Design Adjustments-I WSA Phase I Groundwater Remediation Design, Fernald Preserve* (DOE 2014).

As predicted, each year the percentage of groundwater treatment needed to achieve uranium discharge limits decreased. As of the spring of 2011 the CAWWT was being operated on an as-needed basis. In 2011, DOE, EPA, and Ohio EPA agreed to proceed with reducing the treatment capacity from approximately 1,800 gpm down to 500–600 gpm. In 2012, the throughput treatment capacity of the CAWWT was safely reduced from 1,800 gpm down to 500–600 gpm by isolating trains 1 and 2 in place to serve as spare parts for treatment train 3.

Following the implementation of operational changes to the aquifer remediation system in 2014, a condition assessment of the CAWWT was conducted. The CAWWT condition assessment, issued in March 2015 (Whitman, Requardt & Associates, LLP 2015), concluded that many components of the CAWWT were past their design life and in need of replacement. Additionally, the treatment capacity of 500–600 gpm was significantly more than needed and groundwater modeling predictions based on the 2014 operational design predicted that this higher treatment capacity would not be needed in the future. Discussions were completed in the spring and summer of 2015 with regulators and stakeholders to help ensure a common understanding of the issues related to wastewater treatment at the site. DOE, EPA, Ohio EPA, and members of the community all reached agreement on replacing the 500 to 600 gpm system with a 50 gpm system that could be expanded in the future if deemed necessary.

Decontamination and demolition (D&D) of the 500 to 600 gpm system was completed at the end of 2016. Construction of the 50 gpm system began in September 2017 and was completed in April 2018. In 2019, the backwash basin, which is used to hold wastewater from the site before being treated, was refurbished to make it available until the end of groundwater remediation activities. Refurbishment efforts included the removal, shipping, and disposal of approximately 600 cubic yards of low-level radiological waste at a commercial disposal facility in western Texas.

1.3 Relationship to Other Documents

The OMMP functions in tandem with several other major ARWWT design documents and support plans, such as Attachment D, *Integrated Environmental Monitoring Plan* (IEMP); various aquifer restoration module design packages; the *Remedial Action* [RA] *Work Plan for Aquifer Restoration at Operable Unit 5* (DOE 1997a); and the *Fernald Groundwater Certification Plan* (DOE 2006).

The environmental monitoring and reporting activities conducted in support of aquifer restoration performance decisions are specified in the IEMP. Information obtained through the IEMP will be used to (1) appraise groundwater restoration progress, (2) assess the need for changing groundwater extraction flow rates, and (3) assess the durations of groundwater extraction activities over the life of the remedy.

The initial design flow rates, planned installation sequence, detailed design basis, and overall restoration strategy for the aquifer restoration modules that constitute the groundwater remedy were developed in the *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration* (DOE 1997b). The overall restoration strategy has been modified as a result of information gained from the ongoing remedy performance/operations monitoring and pre-design monitoring conducted in support of the Waste Storage Area (WSA) (Phases I and II) Modules and the South Field Extraction System (Phase II) Module.

The Remedial Action (RA) Work Plan (submitted to EPA and Ohio EPA as Task 10 of the OU5 Remedial Design Work Plan) conveyed the enforceable RA construction schedule for the initial restoration modules brought online in 1998 (the Re-injection Demonstration Module, the South Field Extraction System Module, and the South Plume Optimization Module). It also contained the planning-level RA construction schedule for the remaining modules to be brought online in later years. With the completion and startup of the Waste Storage Area Phase I Module in 2002 and the South Field Phase II Module in 2003, all the schedules specified in the RA Work Plan have been met.

The *Fernald Groundwater Certification Plan* (DOE 2006) defines a programmatic strategy for certifying the completion of the aquifer remedy. The Certification Plan establishes the processes that will be used to achieve groundwater restoration and conduct certification. The preferred outcome is to certify that the OU5 ROD groundwater remediation goals have been achieved using the pump-and-treat remediation system that is currently operating at the site. The plan also covers other potential contingencies and exit scenarios. Any change to the operation of the aquifer remedy system needed to achieve certification will be controlled through the OMMP.

The OMMP has functioned in tandem with several other remedial design or design support plans prepared by other project organizations outside ARWWT. All the other site remediation projects have been completed; therefore, there is no longer a need to interface with other projects, as only a small flow of leachate from the OSDF and groundwater remains to be treated.

1.4 Plan Organization

The plan is generally organized around the wastewater streams. The sections and their contents are as follows:

Section 1.0 Introduction: Presents an overview of the plan, its objectives, its relationship to other documents, and its organization.

Section 2.0 Summary of Regulatory Drivers and Commitments: Discusses the applicable or relevant and appropriate requirements compliance crosswalk and provides a summary of the other commitments and guidelines that the OU5 ROD has activated for ARWWT.

Section 3.0 Descriptions of Major ARWWT Components: Identifies the major collection, conveyance, and treatment components that constitute the Fernald Preserve's system for managing groundwater and leachate, the treatment capacities that are available, and a schedule of major ARWWT activities throughout the aquifer restoration process.

Section 4.0 Projected Flows: Provides an estimate of flow generation rates and durations for groundwater and leachate.

Section 5.0 Operations Plan: Establishes the operations philosophy, treatment priorities and hierarchy, treatment operational decisions, well field operational objectives and decisions, maintenance priorities, controlling documentation, and the management and flow of operations information to successfully operate the groundwater and leachate transmission systems to achieve regulatory requirements and commitments.

Section 6.0 Operations Performance Monitoring and Maintenance: Addresses the general methods, guidelines, and practices used in managing equipment operation and maintenance; discusses some of the dedicated organizational resources and management systems that will help to ensure that ROD requirements are met; describes the key parameters used to monitor the performance of the groundwater and wastewater facilities; and describes the principal features and maintenance needs of the overall operation.

Section 7.0 Organizational Roles, Responsibilities, and Communications: Presents the organizational roles and responsibilities with respect to implementation of this OMMP; also presents the communications protocol for coordinating with EPA and Ohio EPA.

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2.0 Summary of Regulatory Drivers and Commitments

Regulatory drivers and commitments, as they pertain to the successful operation of the treatment system and associated groundwater extraction systems, involve source water treatment requirements and the specific effluent limits that need to be met. (Other regulatory requirements, legal agreements, and agency commitments apply to the site as a whole, and those may apply to the treatment process. However, these general Fernald Preserve drivers and commitments are not discussed further in this section.)

2.1 Discharge Limits

The required effluent limits for this discharge are governed by the OU5 ROD for the uranium component of the discharge and by the NPDES permit (Permit No. 1IO00004*KD) for the non-uranium parameters. This permit became effective on June 1, 2022, and expires on May 31, 2027. Requirements from the new permit are incorporated into the LMICP.

Up until 2011, the discharges from the Fernald Preserve to the Great Miami River were primarily associated with the groundwater remedy involving the treated effluent (primarily groundwater) from the CAWWT and extracted groundwater that is discharged without treatment. Small volumes of other wastewater sources (Section 2.2) were blended into the treatment stream as needed. The combined effluent from the CAWWT was discharged to the Great Miami River through the Parshall Flume Building, which is the final monitoring point before effluent reaches the Great Miami River.

Since 2011, groundwater has not needed to be routinely treated to meet discharge limits, resulting in rightsizing the treatment system to a 50 gpm system. With no need to routinely treat groundwater and a smaller 50 gpm system, treatment mainly addresses the other wastewater sources (Section 2.2). The other wastewater streams are first sent to the backwash basin. Wastewater from the backwash basin is mixed with groundwater and is routed to the 50 gpm system. The ratio of water from the backwash basin to groundwater is variable depending on the concentration of suspended sediments in the basin and concentration of anions in the water.

2.1.1 OU5 ROD

The OU5 ROD states that treatment will be applied to all discharges to the Great Miami River, to the extent necessary, to limit the total mass of uranium discharged through the Fernald Preserve outfall to the Great Miami River to no more than 600 pounds per year (lb/yr). This mass-based discharge limit became effective upon the issuance of the OU5 ROD (DOE 1996b). Additionally, the necessary treatment will be applied to limit the concentration of total uranium in the blended effluent to the Great Miami River to no greater than 30 ppb. The 30 ppb discharge limit for uranium is based on a monthly flow-weighted average concentration. This limit became effective December 1, 2001, based on the *Explanation of Significant Differences for Operable Unit 5* (DOE 2001b), which replaced the original 20 ppb standard that applied to the Fernald site beginning January 1, 1998.

The OU5 ROD stipulates specific circumstances that necessitate relief from the concentration limit. Relief can be requested for maintenance activities. EPA approval must be obtained in advance by notification of these planned maintenance periods. The notification must be accompanied by a request for the uranium concentrations in the discharge not to be considered in the monthly averaging performed to demonstrate compliance with the 30 ppb total uranium discharge limit. Uranium contained in these bypass events will only be counted in the annually discharged mass, not in the monthly average concentration calculations.

2.1.2 NPDES Permit

Under the Clean Water Act, as amended, the Fernald Preserve is governed by 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, specifies discharge and sample locations, sampling and reporting schedules, and discharge limits. The Fernald Preserve submits monthly reports on NPDES activities to Ohio EPA. The Fernald Preserve's current NPDES permit, No. 1IO00004*KD, became effective on June 1, 2022, and expires on May 31, 2027. Requirements from this permit are incorporated into the LMICP.

2.2 Source Water Treatment Requirements

Three sources of wastewater have specific management requirements: groundwater, OSDF leachate, and storm water.

2.2.1 Groundwater

Since 2011, the aquifer remedy has been able to achieve uranium discharge limits (i.e., average monthly concentration of less than 30 micrograms per liter [µg/L] and 600 pounds annually) established in the OU5 ROD (DOE 1996b) without routine groundwater treatment.

2.2.2 Storm Water

With the exception of stormwater that falls on the concrete pad at the CAWWT, it is not expected that any storm water will require treatment, since soil remediation and certification has been completed. Storm water that falls on the CAWWT concrete tank pad is collected in a sump, pumped to the backwash basin, and sent to treatment.

2.2.3 OSDF Leachate

Ohio Administrative Code (OAC) 3745-27-19, "Operational Criteria for a Sanitary Landfill Facility," requires the treatment of leachate. Leachate from the OSDF is a minimal flow. Leachate will be treated through the CAWWT prior to discharge to the Great Miami River until the CAWWT is no longer needed. Leachate is pumped to the CAWWT backwash basin first and then for treatment through the 50 gpm treatment system. Prior to the cessation of CAWWT operations, DOE will have proposed and negotiated the future management of leachate with EPA and Ohio EPA.

3.0 Descriptions of Major ARWWT Components

This section describes the major operating system components required to accomplish aquifer remedy commitments and goals. The site conveyance and treatment system components for managing the major wastewater streams are identified, as are treatment capacities. This section also describes key linkages between the components. Figure 1 depicts the facilities as well as groundwater wells on a projected view of the site. Figure 2 provides a timeline of major activities that have occurred and those that are projected to occur throughout the aquifer restoration process.

3.1 Groundwater Component

Remediation of the Great Miami Aquifer is divided into area-specific groundwater restoration modules. These modules were specified in the following documents:

- Remedial Design/Remedial Action work plans for OU5
- *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration* (DOE 1997b)
- *Design for the 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)
- *Waste Storage Area (Phase II) Design Report* (DOE 2005)

During 2003, new information became available (refer to the *Comprehensive Groundwater Strategy Report* [Fluor Fernald Inc. 2003]) that allowed for more refined groundwater modeling predictions of when aquifer restoration would be completed. The updated modeling predictions and groundwater remedy performance monitoring data both indicated that the aquifer restoration time frame would likely be extended beyond the dates previously predicted. The updated modeling also indicated that the use of groundwater re-injection via wells did not significantly reduce the time required to remediate the aquifer.

In 2005, EPA approved the *Fernald Groundwater Certification Plan* (DOE 2006), a programmatic strategy for certifying the completion of the aquifer remedy. The Certification Plan established the processes that will be used to achieve groundwater restoration and conduct certification of the aquifer remedy. The Certification Plan relies on the IEMP and the OMMP for implementation of that process.

In 2014, the ongoing pump-and-treat groundwater remediation was optimized as presented in the *Operational Design Adjustments-1, WSA Phase-II Groundwater Remediation Design, Fernald Preserve* (DOE 2014). The changes were implemented because model-predicted cleanup times were extended when updated uranium analytical data were input into the model. Operational changes were made in an attempt to speed up the cleanup of some areas of the aquifer (DOE 2014). The new cleanup times are reflected in Figure 2. As shown in Figure 2, pump-and-treat activities are predicted to be necessary until 2045. Note that the groundwater remedy is concentration-based and will continue until the cleanup goals specified in the OU5 ROD are achieved.

In 2022, additional groundwater modeling was conducted to address the South Plume (DOE 2022). The modeling concluded that the six existing South Plume extraction wells could be replaced with two new extraction wells that would be better positioned for capture and remediation of the remaining South Plume. DOE is moving forward with the replacing the six existing South Plume Extraction Wells with two new replacement wells. RW-1, RW-2, and RW-3 will be operated at rates not to exceed 200 gpm until they can no longer maintain 100 gpm to provide additional flushing of the South Plume.

3.1.1 Current Groundwater Restoration Modules

Three groundwater restoration modules are currently in operation:

- South Plume
- South Field (Phases I and II)
- Waste Storage Area (Phases I and II)

Figure 3 shows the approximate area of each of these modules and associated wells. Subsections 3.1.1.1–3.1.1.3 provide descriptions of each of the modules.

3.1.1.1 South Plume Module

Five extraction wells were installed in 1993 at the leading edge of the off-property South Plume, as part of the South Plume removal action, to gain an early start on groundwater restoration. The South Plume removal action well system began pumping in August 1993. The primary intent of the original five-well system was to prevent further off-property migration of contamination within the groundwater plume. It was determined that one of the wells (RW-5) was not providing any additional benefit and was turned off in 1993. The other four wells have been operating since 1993. Two additional extraction wells came online in August 1998 for the active restoration of the central portion of the off-property plume. These two new wells, known as the South Plume Optimization Module, have now been incorporated into the South Plume Module for remedy performance tracking and reporting. Figure 3 shows the locations of the wells, and Table 1 provides the operating status of the South Plume Module.

As of 2021, the South Plume wells have been operating for over 28 years. Well RW-4 can no longer yield sufficient water to maintain the design set point of 200 gpm. To maintain the water level above the pump intake, during 2018 the pumping rate for the well was lowered several times. A concrete plug installed in 2011 in the bottom of the well to address a hole in the screen limits pump placement. The pump can no longer be lowered to maintain the water level above the pump intake. A modeling assessment was conducted to determine if model predicted cleanup times or capture of the remaining uranium plume would be impacted if well RW-4 was turned off. The model indicated that there would be no impact to model predicted cleanup times or capture of the remaining plume if the well was turned off in 2018 and the rest of the well field remained operating at design pumping rates. Modeling results were discussed with EPA and Ohio EPA in July 2018 during the quarterly regulator meeting. Consensus agreement was reached that the pumping rate in well RW-4 could be lowered to 100 gpm and that the well will continue to be operated until failure. Continued operation of well RW-4 at a 100 gpm set point is a conservative approach that provides for modeling uncertainties associated with pumping remedies. Well RW-4 was turned off permanently on June 6, 2022.

In 2021, it was observed that the pitless adaptor of well RW-3 was corroding. The corroded pitless adapter was allowing water to cascade back down the well inefficiently. This is believed to be in response to the long-term use of liquid acid descaler to clean the recovery wells. Liquid acid descaler is a blend of glycolic and hydrochloric acids. Uranium results indicate that as of 2021, the leading edge of the South Plume is north of recovery wells RW-1 through RW-4. Modeling was conducted in early 2022 to determine the continued importance of recovery wells RW-1 through RW-4 to maintain capture of the 30 µg/L uranium plume footprint identified in 2021.

Preliminary modeling results indicate that the best course of action would be to replace extraction wells RW-6 and RW-7 with wells situated in new locations. The model predicts that these two new wells operating by themselves would effectively capture the remaining uranium plume in the area. DOE is currently moving forward in this direction. Once implemented the importance of RW-1 through RW-4 for plume capture will be eliminated.

On July 25, 2022, well RW-6 developed an underground leak. Given that DOE is moving forward with a replacement well, RW-6 was permanently turned off on July 24, 2022.

3.1.1.2 South Field Module

The South Field Module was installed in two phases. South Field Extraction System Phase I Module includes 10 extraction wells. In 1996, as part of an EPA-approved early-start initiative, the 10 extraction wells were installed on Fernald Site property near the south field/storm sewer outfall ditch (SSOD). These wells are removing groundwater contamination in an on-property area of the southern uranium plume.

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Figure 1. ARWWT Facilities Locations Map

Aquifer Restoration	Year	Year	Wastewater Treatment
		1952	Sewage Treatment Plant (STP)
		1986	Bio-surge Lagoon/High Nitrate Tank (BSL/HNT)
		1988	Storm Water Retention Basin (SWRB)
		1992	Interim Advanced Wastewater Treatment (IAWWT) Facility
South Plume Extraction Wells	1993		
		1994	South Plume Interim Treatment (SPIT) Facility
		1995	Advanced Wastewater Treatment Facility (AWWT) Phases I/II
		1996	Slurry Dewatering Facility (SDF)
Injection Demonstration Module, South Plume Optimization Module, South Field Extraction Module (Phase I)	1998	1998	AWWT Resin Regeneration System, New STP Operational, AWWT Expansion
		1999	Bio-surge Lagoon (BSL) Pump and Piping Modifications/Sludge Removal System
Waste Storage Area Module (Phase I)	2002		
South Field Extraction Module (Phase II)	2003		
Shut Down Well-based Re-injection	2004	2004	Shut Down AWWT Expansion for Conversion to CAWWT – 9/04
		2005	Reroute of Leachate and Waste Storage Area Storm Water to SWRB – 3/05 BSL is Shut Down for decommissioning and demolition (D&D) and Excavation – 3/05 Begin Full-Scale Operation of CAWWT – 3/05 Shut Down SDF and Sewage Treatment Plant for D&D and Excavation – 3/05 Shut Down AWWT Phases I & II for Selective D&D and Excavation – 3-4/05 Shut Down SPIT/IAWWT for D&D and Excavation – 7/05 Reroute Waste Storage Area Storm Water to CAWWT – 10/05 Shut Down West SWRB for D&D and Excavation – 10/05
Waste Storage Area Module (Phase II) Pilot Plant Replacement Well Storm Sewer Outfall Ditch Infiltration	2006	2006	Shut Down East SWRB for D&D and Excavation – 2/06 Reroute of OSDF Leachate/Storm Water Directly to CAWWT – 2/06 CAWWT Backwash Basin Operational – 2/06 OSDF Capped Sufficiently Such that OSDF Storm Water Can Be Routed to Free Release – 2006
		----	Transfer of Site from the DOE Office of Environmental Management (EM) to the DOE Office of Legacy Management (LM).
		2011	Limited Groundwater Treatment to Meet Discharge Limits
		2012	Throughput Capacity of CAWWT Safely Reduced from 1,800 gpm Down to Approximately 500–600 gpm
		2015	CAWWT Conditions Assessment and Decision to Replace System
		2016	Completed Initial D&D of Eight of Ten CAWWT Treatment Vessels
		2018	Completed Construction and Startup of New 50 gpm CAWWT Treatment System
		2019	Completed replacement of CAWWT Backwash Basin
South Plume and Southern Portion of the South Field Module – Stop Pump-and-Treat Operations[a]	2025		
South Plume Module – Certified Clean[b]	2028		
Northern Portion of South Field Module – Stop Pump-and-Treat Operations[a] South Field Module Certified Clean[b]	2038 2041		
South Field Module – Remove Infrastructure South Plume Module – Remove Infrastructure	2042		
Waste Storage Area – Stop Pump-and-Treat Operations[a]	2046		
Waste Storage Area Certified Clean[b]	2048		
Waste Storage Area – Remove Infrastructure	2049		
Long-Term Monitoring Ends	2054		

[a] Stop pump-and-treat operations' dates are based on modeling predictions reported in *2022 Groundwater Modeling Report, Fernald Reserve, Ohio, Site, Revision 1 (DOE 2022)*, dates may need to be adjusted in the future to reflect actual start dates in the field for the new design. The groundwater remedy is concentration-based and will continue until OU5 ROD-specified cleanup goals are achieved.
[b] Certified clean dates assume best case (3.25 years).

Figure 2. Aquifer Restoration and Wastewater Treatment Timeline

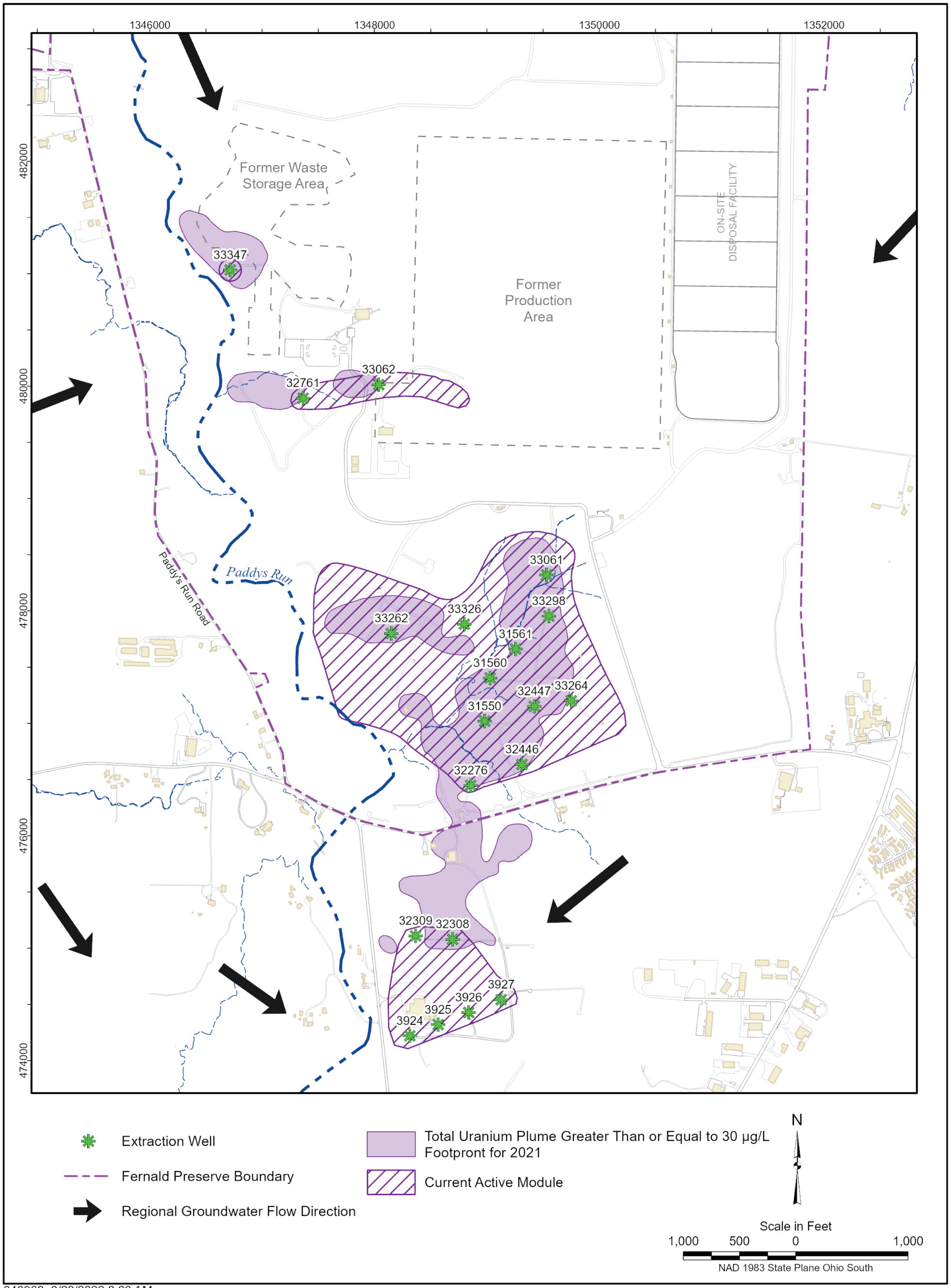

Figure 3. Extraction Wells for the Groundwater Remedy

Table 1. Well Field Operating Status

Module	Operations Identification	Database Identification	Date of Initial Operation	Current Status	Notes
South Plume	RW-1	3924	08/27/93	Active	
South Plume	RW-2	3925	08/27/93	Active	
South Plume	RW-3	3926	08/27/93	Active	
South Plume	RW-4	3927	08/27/93	Inactive	Turned off 6/6/2022
South Plume	RW-5	3928	08/27/93	Inactive	Turned off 9/11/94, not needed
South Plume	RW-6	32308	08/09/98	Inactive	Turned off 7/25/2022
South Plume	RW-7	32309	08/09/98	Active	
South Plume	RW-6A	33616			Well to be installed in 2023
South Plume	RW-7A	33617			Well to be installed in 2023
South Field	EW-13	31565	07/13/98	Inactive	Turned off 5/22/01
South Field	EW-14	31564	07/13/98	Inactive	Turned off 12/19/01
South Field	EW-15	31566	07/13/98	Inactive	Turned off 8/7/98, replaced by EW-15A
South Field	EW-15A	33262	07/26/03	Active	
South Field	EW-16	31563	07/13/98	Inactive	Turned off 12/19/02, converted to IW-16
South Field	EW-17	31567	07/13/98	Inactive	Turned off 9/6/05, replaced by EW-17A
South Field	EW-17A	33326	09/13/05	Active	
South Field	EW-18	31550	07/13/98	Active	
South Field	EW-19	31560	07/13/98	Active	
South Field	EW-20	31561	07/13/98	Active	
South Field	EW-21	31562	07/13/98	Inactive	Turned off 3/13/03, replaced by EW-21A
South Field	EW-21A	33298	07/29/03	Active	
South Field	EW-22	32276	07/13/98	Active	
South Field	EW-23	32447	02/02/00	Active	
South Field	EW-24	32446	02/02/00	Active	
South Field	EW-25	33061	05/07/02	Active	
South Field	EW-30	33264	07/25/03	Active	
South Field	EW-31	33265	07/25/03	Inactive	Turned off 4/14/14
South Field	EW-32	33266	07/25/03	Inactive	Turned off 4/14/14
Waste Storage Area	EW-26	32761	05/08/02	Active	
Waste Storage Area	EW-27	33062	05/08/02	Active	
Waste Storage Area	EW-28	33063	05/08/02	Inactive	Turned off 7/01/05, plugged and abandoned
Waste Storage Area	EW-28a	33334	06/29/06	Inactive	Turned off 4/14/14
Waste Storage Area	EW-33	33330		Inactive	Never installed, location moved
Waste Storage Area	EW-33A	33347	10/05/06	Active	
Re-injection	IW-8	22107	09/02/98	Inactive	Turned off 12/31/01
Re-injection	IW-8A	33253	11/07/02	Inactive	Turned off 9/25/04
Re-injection	IW-9	22108	09/02/98	Inactive	Turned off 3/01/02
Re-injection	IW-9A	33254	11/07/02	Inactive	Turned off 9/25/04
Re-injection	IW-10	22109	09/02/98	Inactive	Turned off 9/25/04
Re-injection	IW-10A	33255	05/22/03	Inactive	Turned off 9/25/04
Re-injection	IW-11	22240	09/02/98	Inactive	Turned off 9/25/04
Re-injection	IW-12	22111	09/02/98	Inactive	Turned off 9/25/04
Re-injection	IW-16	31563	07/27/03	Inactive	Turned off 9/25/04
Re-injection	IW-29	33263	07/27/03	Inactive	Turned off 9/25/04
Re-injection	Inj. Pond		07/27/03	Inactive	Turned off 9/25/04

Since the installation of the 10 original extraction wells of the South Field Extraction Phase I Module, and prior to 2014, three new extraction wells were added to the module, three of the original wells were shut down, and one of the original wells was converted to a re-injection well. The three extraction wells that were shut down are all located in the upgradient area of the plume where total uranium concentrations in the Great Miami Aquifer are now below the final remediation level (FRL). An additional consideration in removing two of these three wells was to accommodate soil remedial activities near the wells.

The three new wells added to the South Field Phase I Module were installed at locations where total uranium concentrations were considerably above the groundwater FRL, in the eastern, downgradient portion of the South Field plume. Two of the three new wells were installed in late 1999 and began pumping in February 2000. The third well was installed in 2001 and became operational in 2002.

Phase II components of the South Field became operational in 2003. The components included:

- Four additional extraction wells, one in the southern waste unit area and three along the eastern edge of the on-property portion of the southern uranium plume.
- One additional re-injection well in the southern waste unit area. All re-injection wells have been removed from service.
- A converted extraction well, which was converted into a re-injection well. All re-injection wells have been removed from service.
- An injection pond, which was located in the western portion of the Southern Waste Units Excavations. The injection pond was removed from service along with all re-injection wells.

Operational changes were implemented in the South Field in 2014 in an effort to accelerate the predicted cleanup of the southern half of the South Field. Two extraction wells in the South Field were turned off and the pumping budget was reallocated to other areas of the South Field where the uranium concentration remained above the cleanup FRL.

Table 1 provides the operational status of the currently configured South Field Extraction System Module (Phase I and Phase II components) with 2014 operational changes.

3.1.1.3 Waste Storage Area Module

The Waste Storage Area Module was designed and installed in two phases. The Waste Storage Area Extraction System targets contaminants in the Great Miami Aquifer underlying the former Waste Storage Area (OU1 and OU4). Figure 3 shows the geographical location of the area. The *Design for the Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001a) defines the Phase I design. Phase I addresses the plume of contamination defined in the vicinity of the Pilot Plant Drainage Ditch. The *Waste Storage Area (Phase II) Design Report* (DOE 2005) defines the Phase II design. Phase II addresses the plume of contamination defined in the vicinity of the former Waste Pit Area.

Phase I of the Waste Storage Area Module consists of one 12-inch diameter well and two 16-inch-diameter extraction wells complete with submersible pumps with variable-frequency drives (VFDs), well houses, electrical power, instrumentation and controls, fiber optic communications, and dual discharge headers (one for treatment and one for direct discharge).

Operation of this phase of the module began on May 8, 2002. The easternmost well in the Phase I design (extraction well [EW] 33063 or EW-28) was taken out of service, then plugged and abandoned in July 2004 to make way for soil remediation activities. The well was replaced in 2005 and was brought online in 2006 prior to the site's transition from the DOE Office of Environmental Management (EM) to the DOE Office of Legacy Management (LM).

The *Design for the Remediation of the Great Miami Aquifer in the Waste Storage Area and Plant 6 Areas* (DOE 2001a) concluded that uranium concentrations in the Great Miami Aquifer beneath Plant 6 had naturally attenuated to concentrations below 20 ppb. While the data indicated that no extraction wells and infrastructure were needed for the former Plant 6 Area, monitoring of the area will continue until aquifer restoration certification is completed and approved by EPA and Ohio EPA.

Phase II of the Waste Storage Area Module consists of one 16-inch-diameter well with a submersible pump, a VFD, a well house, electrical power, instrumentation and controls, fiber optic communications, and a dual-discharge header.

Operational changes were implemented in the Waste Storage Area Module in 2014 (DOE 2014) in an area where the uranium concentration was below the FRL. One extraction well in the Waste Storage Area was turned off, and the pumping budget was reallocated to areas of the south field where the uranium concentration remained above the cleanup FRL.

3.1.2 Groundwater Collection and Conveyance

An extensive system of collection and conveyance piping was installed for the remediation of the Great Miami Aquifer. These piping systems were specified in the various module-specific design documents. Figure 4 provides an overview of the current wellfield piping.

As described in Section 2.2.1, the piping network that conveys on-property extracted groundwater from the individual extraction wells has double headers, one connected to the main line to treatment and the other to the main discharge line as shown in Figure 4. The double headers allow for treatment/bypass decisions to be made on an individual-well basis for the on-property wells.

This design feature is not applicable to the off-property South Plume Module, which was largely in place prior to the design of the on-property piping network. Since individual well bypass/treatment lines are not available on the South Plume wells, treatment/bypass decisions for the six wells in this system are made on the basis of uranium concentration in the combined flow from all of the wells. Routing decisions for these wells need to be made on a modular basis, as indicated in Figure 4.

Since groundwater treatment is no longer routinely needed to meet discharge limits and the treatment system has a 50 gpm capacity, very little groundwater is routed to treatment. Groundwater is blended with water from the backwash basin to facilitate the treatment of water from the backwash basin.

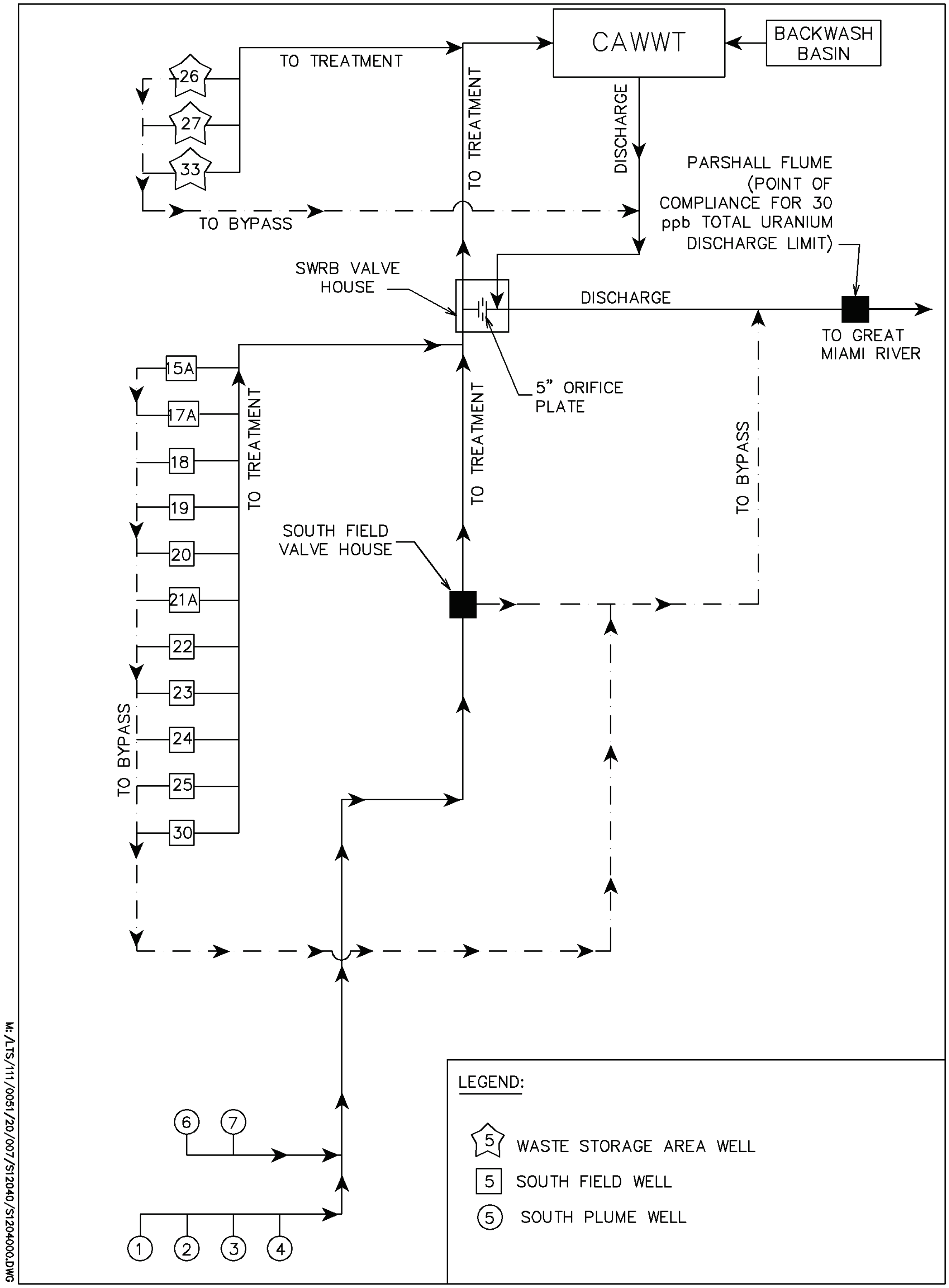

Figure 4. Current Groundwater Remediation/Treatment Schematic

3.1.3 Great Miami Aquifer Remedy Performance Monitoring

Section 3.0 of the IEMP provides for the routine remedy performance monitoring of the Great Miami Aquifer. Details of how the remedy performance data are being evaluated and the associated decision-making process are located in Section 3.7 of the IEMP. Figure 5 illustrates the groundwater certification process for the aquifer remedy. As illustrated in Figure 5 remedy performance monitoring is being conducted to assess the efficiency of mass removal and to gauge performance in meeting remediation objectives. If it is determined that aquifer restoration program expectations (as identified in the IEMP) are not being met, the design and operation of the aquifer restoration system will be evaluated to determine if a change needs to be implemented. A change to the operation of the aquifer restoration system would be implemented by a modification to this OMMP. A groundwater monitoring change, if found to be necessary, would be implemented through the IEMP review and approval process. If additional characterization data are needed (e.g., to determine the nature of a newly detected FRL exceedance), a modification to the IEMP would be implemented, or a new sampling plan would be prepared, depending on the anticipated size of the activity.

If a new extraction well is put into operation, additional monitoring wells may be installed to help monitor the performance of the new wells. New extraction wells are also monitored for uranium concentration on a frequent basis just after startup. The sitewide groundwater data collected via the IEMP are used to assess the performance of the sitewide groundwater remedy. Any data, derived from additional monitoring wells and/or new extraction well uranium monitoring, would be integrated with the IEMP groundwater monitoring such that area-wide interpretations could be made. Changes to the scope of the routine monitoring identified in the IEMP may be necessary based on the results of sampling conducted in the new monitoring and extraction wells. These changes would be accommodated as necessary through the prescribed IEMP review process.

Details of the annual reporting of groundwater remedy performance are also provided in the IEMP, Section 3.7. The reporting subsection provides the specific information to be reported in the comprehensive Site Environmental Report.

3.2 Other Site Wastewater Sources

Because treatment for groundwater on a routine basis is no longer needed to meet discharge limits, other site wastewater sources comprise the main portion of the water being sent to the 50 gpm system. Other wastewater sources include leachate from the OSDF, small amounts of wastewater from the extraction well rehabilitation, wastewater from the CAWWT laboratory, investigation-derived water from sampling, and a small amount of storm water from portions of the CAWWT footprint that will be collected and treated as necessary.

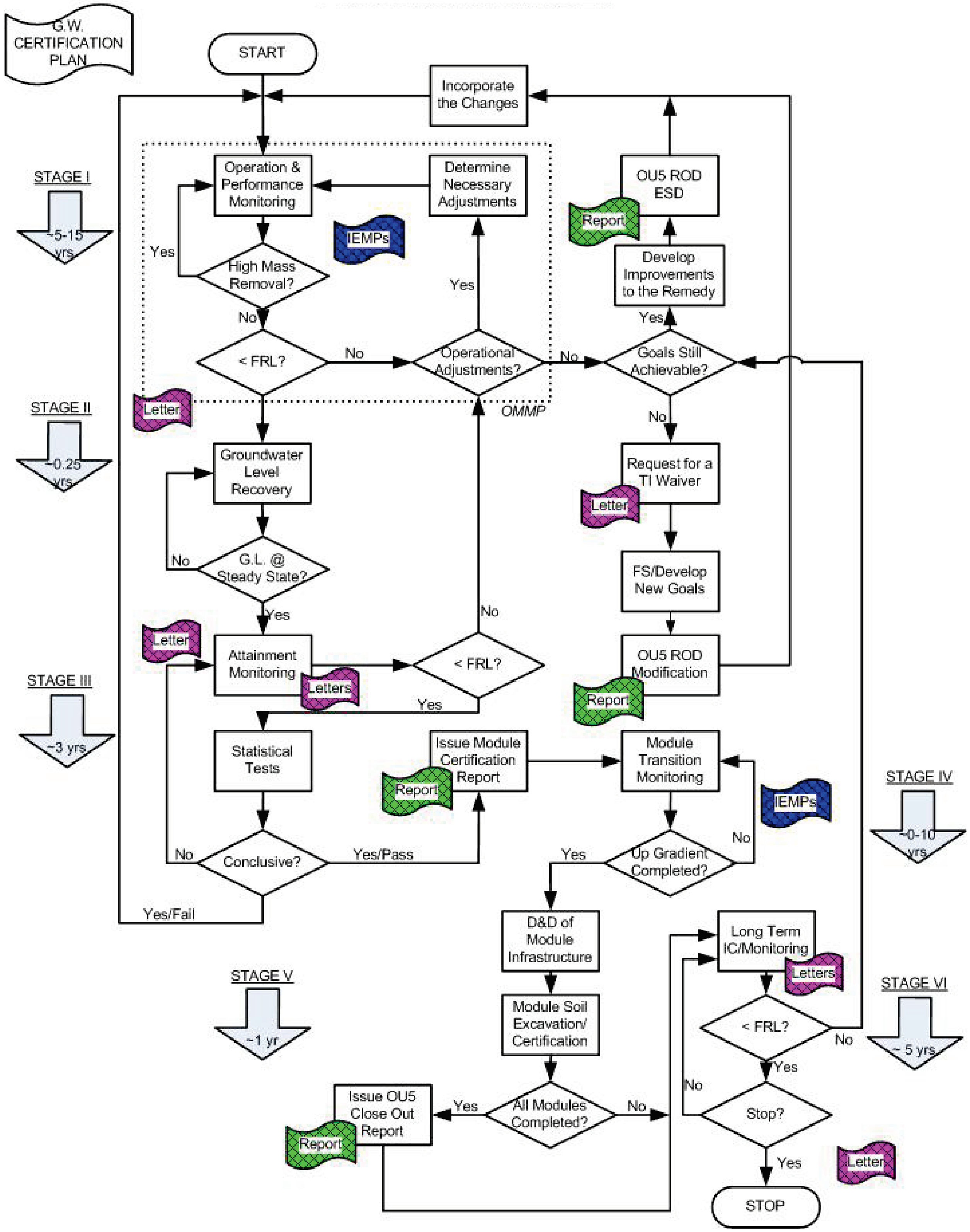

Figure 5. Groundwater Certification Process and Stages

3.3 Treatment System

As noted in Section 1.0, with site closure in 2006, several water treatment flows were eliminated (remediation and sanitary wastewater) or greatly reduced (storm water runoff) from the scope of the treatment operation. The elimination or reduction of these flow streams provided an opportunity to reduce the size of the water treatment facility that remained to service the aquifer restoration after site closure. The various facility shutdown dates are provided in Figure 2.

As noted in Section 1.0, the AWWT expansion system was "converted" to the long-term groundwater treatment facility called the CAWWT. The CAWWT provides a dedicated long-term groundwater treatment capacity for the Fernald Preserve. The original capacity of the CAWWT was up to 1,800 gpm.

As predicted, each year the percentage of groundwater treatment needed to achieve uranium discharge limits decreased. As of the spring of 2011, the CAWWT was being operated intermittently on an as-needed basis. In 2011, DOE, EPA, and Ohio EPA agreed to proceed with reducing the treatment capacity from approximately 1,800 gpm down to 500–600 gpm. In 2012, the throughput treatment capacity of the CAWWT was safely reduced from 1,800 gpm down to 500–600 gpm by isolating trains 1 and 2 in place to serve as spare parts for treatment train 3.

Following the implementation of operational changes to the aquifer remediation system in 2014, a condition assessment of the CAWWT was conducted. The CAWWT condition assessment, issued in March 2015 (Whitman, Requardt & Associates, LLP 2015), concluded that many components of the CAWWT were past their design life and in need of replacement. Additionally, the treatment capacity of 500 to 600 gpm was significantly more than needed and groundwater modeling predictions based on the new operational design predict that this higher treatment capacity would not be needed in the future. Discussions were completed in the spring and summer of 2015 with regulators and stakeholders to help ensure a common understanding of the issues related to wastewater treatment at the site. DOE, EPA, Ohio EPA, and the community all reached agreement on replacing the 500 to 600 gpm system with a new 50 gpm system within the footprint of the existing system that could be expanded in the future, if deemed necessary.

D&D of the 500 to 600 gpm system was completed in 2016. In April 2018, the 50 gpm system became operational. The 50 gpm system consists of multimedia filters and ion-exchange vessels that can be operated one at a time or in parallel. The system is used to treat water stored in the backwash basin. Water from the backwash basin is mixed with groundwater and sent to the 50 gpm treatment system. Water is blended to reduce potential plugging of the treatment system from suspended solids in the basin and to dilute the seasonally high anion concentrations in the water from the backwash basin. The anion concentrations in the backwash basin are higher in the summer when wastewater resulting from the summer well rehabilitation is discharged to the backwash basin. High anion concentrations cause reduced treatment efficiency by stripping uranium from the ion-exchange treatment resin. This small flow rate (50 gpm) of treated effluent is combined with untreated groundwater and discharged to the Great Miami River. The CAWWT process flow diagram is provided in Figure 6.

Figure 7 shows the percent treated and average monthly uranium discharge concentrations versus time from January 2004 through December 2021. As shown in Figure 7, the aquifer remedy achieves the uranium discharge limits (i.e., average monthly concentration of less than 30 µg/L, and 600 pounds annually) established in the OU5 ROD, without routine groundwater treatment.

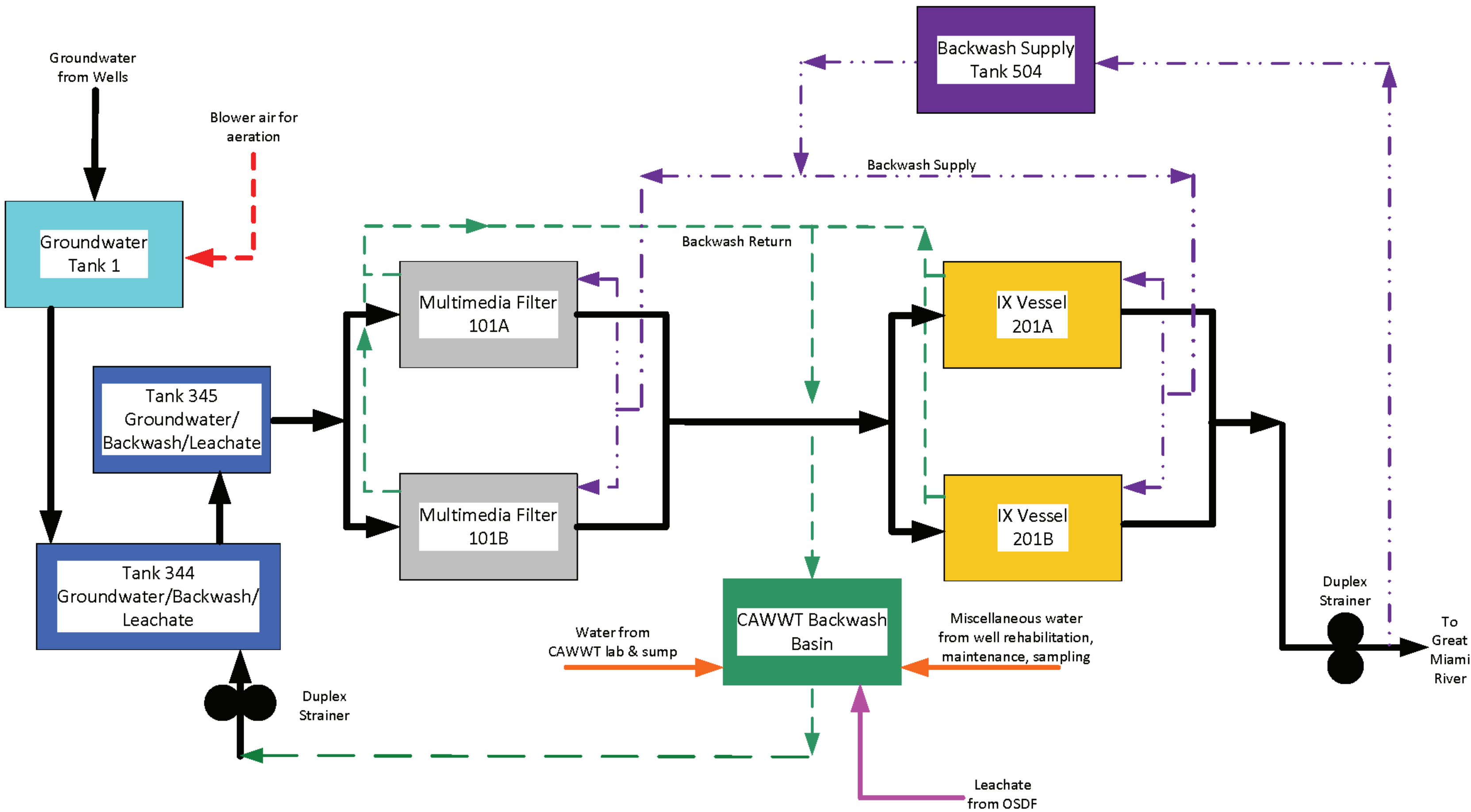

Figure 6. CAWWT Process Flow Diagram

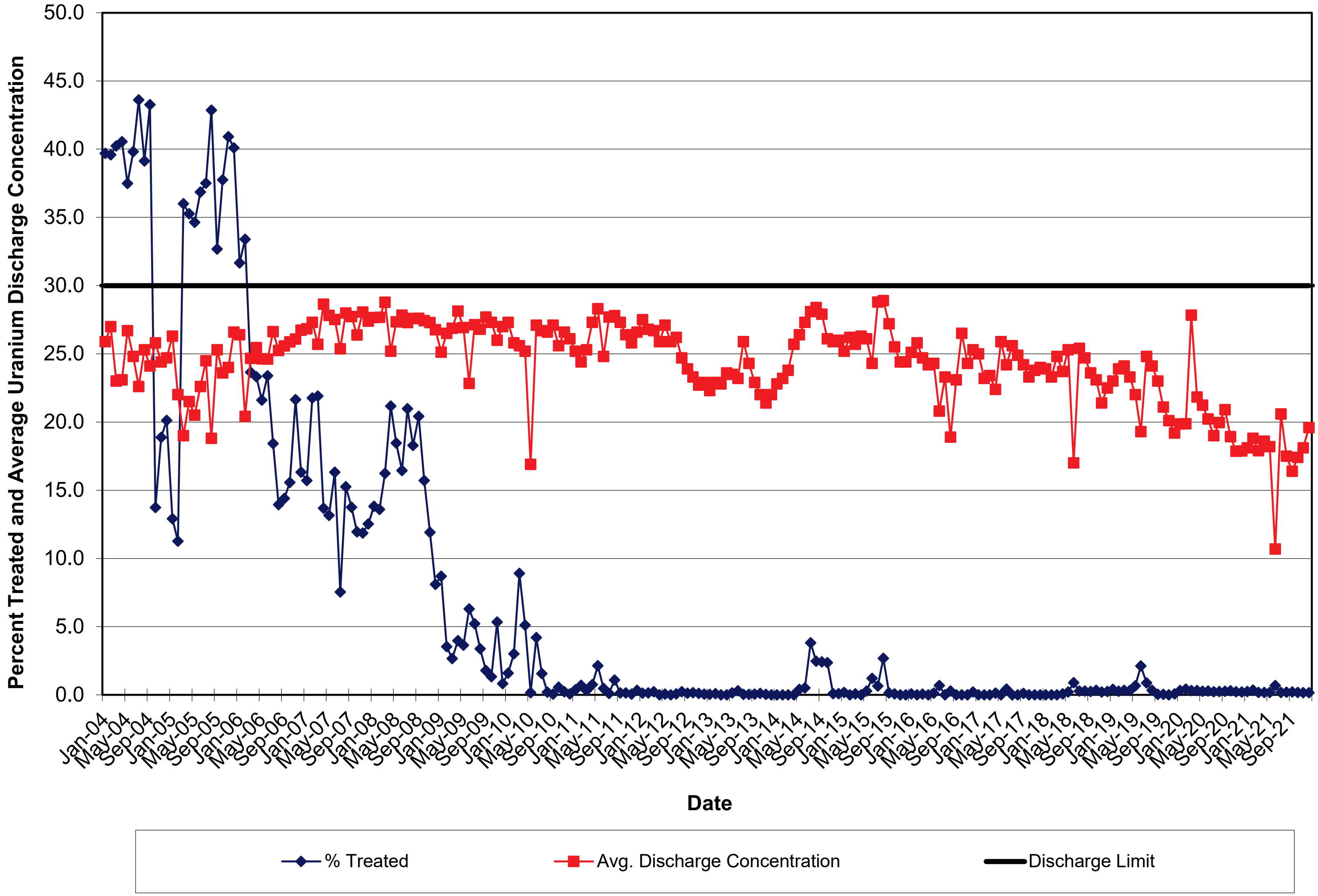

Figure 7. Percent Treated and Average Monthly Uranium Discharge Concentration versus Time (January 2004 through December 2021)

3.4 Ancillary Facilities

A number of facilities support the operation of aquifer restoration and the treatment system. These facilities include groundwater flow routing facilities, wastewater collection and transfer facilities, and discharge monitoring facilities.

3.4.1 Great Miami Aquifer

No specific headworks exist for groundwater. However, because this flow can be adjusted by regulating the extraction wells, the aquifer itself serves as the headworks for groundwater.

3.4.2 CAWWT Backwash Basin

The CAWWT includes a backwash basin. This basin is an aboveground, lined basin measuring 100 feet (ft) × 100 ft × 6 ft deep. It was installed December 2005 through January 2006 and became operational the week of January 30, 2006. The basin was designed to contain the last remaining impacted storm water prior to site closure and to serve as the facility to contain backwash water from the CAWWT multimedia filters and ion-exchange vessels for the duration of CAWWT operations, as well as leachate from the OSDF. The basin has an approximate working capacity of up to 400,000 gallons to allow for a minimum of 6 inches of freeboard at all times. The basin contains a baffle to separate the influent from the effluent and allow any solids backwashed from the filters and ion-exchange vessels to settle prior to discharge back into the CAWWT treatment system.

In 2019, the backwash basin 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. The backwash basin liner and support walls were replaced.

3.4.3 Storm Water Retention Basin Valve House

The storm water retention basin (SWRB) Valve House contains pipes that direct groundwater flow to the CAWWT for treatment. This facility also serves as the point of convergence for the effluent from the treatment system prior to discharge through the Fernald Preserve outfall pipeline. Changing the 500 to 600 gpm treatment system to a 50 gpm system required replacing the large pressure-regulating valve in the SWRB Valve House with a 5-inch orifice plate (Figure 4). The small orifice plate is necessary at a 50 gpm flow rate to place backpressure on the groundwater pipe and force flow to CAWWT for treatment. The orifice plate is a necessary piece of the system that allows for control of water flow to CAWWT for treatment.

3.4.4 South Field Valve House

As part of the South Field Extraction System Phase I construction, a new South Field Valve House was constructed, upstream of the SWRB Valve House. The primary purpose of this valve house is to receive the combined South Plume Recovery System groundwater. It directs all or portions of the combined flow toward treatment or toward untreated discharge prior to its being combined with other groundwater flows.

3.4.5 Parshall Flume

Downstream of the SWRB Valve House, the combined flows pass through the Parshall Flume and an associated outfall monitoring station for Fernald Preserve discharge flow measurement and monitoring.

3.4.6 OSDF Leachate Transmission System Permanent Lift Station

Leachate from the OSDF drains by gravity to the valve houses located on the west side of each cell. From the valve houses, the leachate is routed to the leachate transmission system (LTS) permanent lift station (PLS). When sufficient leachate collects in the PLS, it is pumped to the backwash basin at the CAWWT for treatment.

3.5 Current Performance

The performance of the ARWWT systems measured against the overriding goal of meeting OU5 ROD discharge standards relative to uranium as well as NPDES effluent limits has been satisfactory. The uranium mass loading limit of 600 lb/yr has been met every year since the requirement became effective in January 1998. As depicted in Figure 8, the monthly average concentration has been met every month since January 1998 with the exception of 5 months. The Fernald Preserve has been in compliance with NPDES effluent limits well in excess of 99 percent of the time since January 1995, the date the AWWT Phases I and II were placed into service.

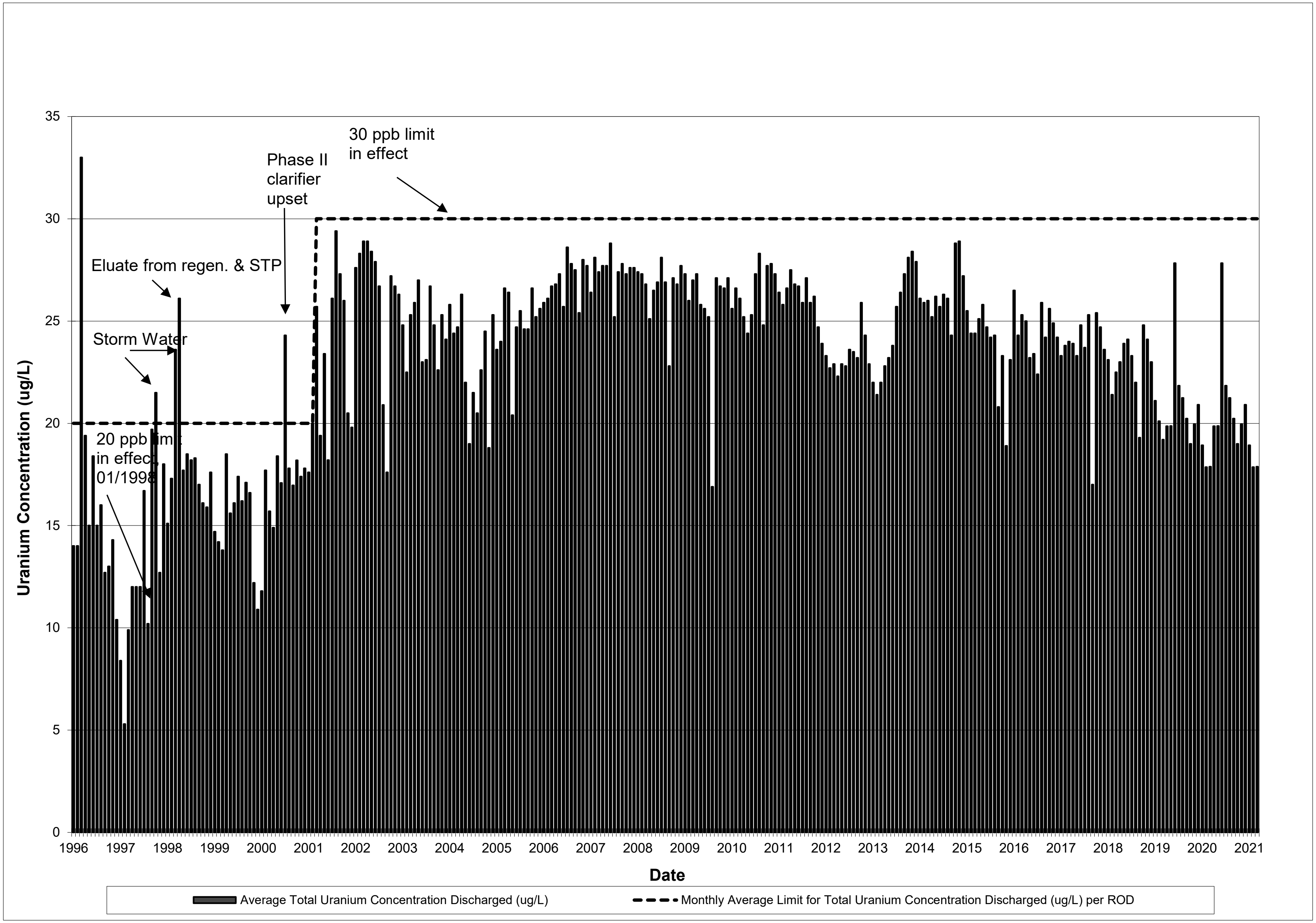

Figure 8. Monthly Average Uranium Concentration in the Effluent to the Great Miami River (through December 2021)

3.6 Current and Planned Discharge Monitoring

Currently, discharge monitoring is completed under two sampling programs. Conventional pollutants are monitored under the NPDES permit. Monitoring for uranium occurs under the OU5 ROD and the *Federal Facilities Compliance Agreement* (FFCA) (EPA 1986). These two programs have been incorporated into the IEMP sampling program as described in Section 4 of the IEMP. These monitoring programs are described briefly in the Subsections 3.6.1 and 3.6.2.

In the 2017 Site Environmental Report (DOE 2018), justification to eliminate radium-228 monitoring at PF4001was provided in Appendix B, Section B.1.5. The proposed elimination was based on the fact that the surface water FRL of 47 pCi/L had never been exceeded at the location since radium-228 monitoring began in 1997.

3.6.1 NPDES Monitoring

Four locations are monitored under the current NPDES permit. Two of the locations relate to permitted Fernald Preserve wastewater/storm water discharge outfalls to State of Ohio waters (biowetlands overflow and Parshall Flume), and two relate to upstream and downstream monitoring (relative to the Fernald Preserve outfall line) of the Great Miami River. The permit (Ohio EPA Permit No. 1IO00004*KD) is administered by Ohio EPA and granted to DOE at the Fernald Preserve. The effluent pollutant limitations, monitoring requirements, and reporting requirements are specified in the permit for each of the five monitored locations. The current NPDES permit became effective on June 1, 2022, and expires on May 31, 2027.

3.6.2 Uranium Monitoring

The Fernald Preserve conducts a surface water sampling and analytical program for liquid effluent and uncontrolled storm water runoff from the site. Details of this program are provided in Section 4.0 of the IEMP.

The daily total uranium analysis of the site effluent to the Great Miami River is used to track compliance with OU5 ROD established limits. The Fernald Preserve is obligated to limit the total mass of uranium discharged through the outfall line to the Great Miami River to 600 lb/yr while not exceeding a monthly average of 30 ppb.

This daily effluent uranium analysis is also used to demonstrate compliance with the monthly average uranium concentration of 30 ppb uranium in the site discharge to the river. The original requirement for compliance with a monthly average concentration became effective on January 1, 1998, as established in the OU5 ROD. The OU5 ROD established this concentration at 20 ppb uranium, which was the compliance standard from January 1998 through November 2001. The monthly average concentration limit changed from 20 ppb to 30 ppb beginning December 1, 2001, as a result of EPA approval of the *Explanation of Significant Differences* [ESD] *for Operable Unit 5* in November 2001 (DOE 2001b). This OU5 ESD changed the total uranium groundwater FRL from 20 ppb to 30 ppb and established the new monthly average concentration discharge standard. The 600 lb/yr limit was unaffected by this ESD and remains in effect.

The monthly average uranium concentration is calculated by multiplying each daily flow by the uranium concentration of the flow-weighted composite sample for that day. The sum of the values obtained by multiplying the flow times by the concentration is then divided by the sum of the flows for the month. The result is a flow-weighted average monthly uranium concentration. The daily flow-weighted concentrations are then multiplied by 8.35 lb/gallon to obtain the daily pounds of uranium discharged. The sum of the daily masses for the year is used to compare against the 600 lb/yr limit.

If the monthly average uranium concentration exceeds the 30 ppb limit, the exceedance will be reported to the agencies, and a course of action will be determined. Depending on the reason for the exceedances, corrective actions would be taken.

If corrective measures are deemed necessary, the situation will be outlined to EPA and Ohio EPA to reach consensus regarding what action (if any) is required.

3.6.3 IEMP Surface Water and Treated Effluent Monitoring Program

Significant portions of the current and past programs (NPDES and FFCA) have been incorporated into the IEMP. Section 4.0 of the IEMP describes these two programs in more detail and also how these two programs have been integrated into the IEMP surface water and treated effluent sampling program. Section 4.0 of the IEMP also provides the regulatory drivers and actions for additional monitoring. This additional monitoring is performed as a supplement to monitor surface water and treated effluent for potential site impacts to various receptors during aquifer remediation. In addition to identifying the sampling program requirements, the IEMP provides a comprehensive data evaluation and associated decision-making and reporting strategy for surface water and treated effluent.

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4.0 Projected Flows

This section addresses the latest understanding of flows for groundwater and OSDF leachate.

4.1 Groundwater

Extracted groundwater is the primary wastewater flow. Groundwater extraction rates can be controlled. Groundwater flows are defined such that discharge limits at the Parshall Flume, and capture of the 30 µg/L uranium plume, are achieved. The objective is to pump as aggressively as possible without exceeding discharge limits. The individual groundwater remediation modules that currently constitute the aquifer remedy are presented in Section 3.1. Figure 3 depicts the locations of current operating extraction wells. Table 2 provides the target extraction rate schedule for each of the wells currently operating. The combined modeled target pumping rate is approximately 4,975 gpm.

Throughout the duration of groundwater remediation, the pumping rates may be modified within system design and operational constraints, as necessary. These rate modifications will be made to maintain, to the degree possible, the aquifer restoration objectives outlined in the remedy design. An operational rate of 10 percent over the modeled pumping rates is being targeted to provide for anticipated and unanticipated downtime.

For pulse pumping operations, the selected rate and duration of pumping will assure that capture of the 30 µg/L uranium plume is maintained and that 24-hour volumes planned for removal under the current model design are achieved. For example, a 110 gpm well pumping for 24 hours a day will remove 158,400 gallons in 24 hours. Selection of a pulse pumping rate and time will also be based on removing a minimum of 158,400 gallons in a 24-hour time period. Pulse pumping operation instructions will be issued and documented through the use of standard operating procedures.

4.2 OSDF Leachate

In 2006, the year the OSDF was completed, 7.6 million gallons of leachate were collected. In 2021, 105,874 gallons of leachate were collected, a reduction of over 98%. This flow stream is expected to continue to decline since the facility was completely capped in late 2006. The leachate collects in the PLS sump and from there is pumped to the CAWWT backwash basin for treatment.

4.3 Other Flows

Other flows include wastewater from extraction well rehabilitation, wastewater from the CAWWT laboratory, investigation-derived waste water from sampling, and a small amount of storm water from portions of the CAWWT footprint. In 2021, these other flows amounted to approximately 700,00 gallons.

Table 2. 2022 Modeling Target Extraction Rate Schedule

System ID	Location	Operations ID	Database ID	Target Extraction Rates to South Plume Complete[a,b] (gpm)	Target Extraction Rates to South Field Complete[a] (gpm)	Target Extraction Rates To Waste Storage Area Complete[a] (gpm)
I	Waste Pits	EW-26	32761	300	500	500
I	Waste Pits	EW-27	33062	200	300	300
I	Waste Pits	EW-33A	33347	300	300	300
	System Totals	**Pumped**		**800**	**1,100**	**1,100**
II	South Field	EW-15A	33262	300	400	0
II	South Field	EW-17	31567	175	175	0
II	South Field	EW-18	31550	100	100	0
II	South Field	EW-19	31560	100	300	0
II	South Field	EW-20	31561	200	400	0
II	South Field	EW-21A	33298	300	400	0
II	South Field	EW-22	32276	300	300	0
II	South Field	EW-23	32447	500	500	0
II	South Field	EW-24	32446	400	400	0
II	South Field	EW-25	33061	100	300	0
II	South Field	EW-30	33264	400	400	0
	System Totals	**Pumped**		**2,875**	**2,875**	**0**
IV	South Plume	RW-1	3924	≤ 200[c]	0	0
IV	South Plume	RW-2	3925	≤ 200[c]	0	0
IV	South Plume	RW-3	3926	≤ 200[c]	0	0
IV	South Plume	RW-6	32308/ 33616	RW-6 0[d] RW-6A 300	0	0
IV	South Plume	RW-7	32309/ 33617	RW-7 200[e] RW-7A 300	0	0
	System Totals	**Pumped**		**800/600[f]**	**0**	**0**
	Total Extraction			**4,475/4,275[f]**	**3,975**	**1,100**

[a] 2022 modeling replaces RW-6 and RW-7 with two new wells (RW-6A and RW-7A), and demonstrates that RW-1, RW-2, and RW-3 are no longer needed for cleanup and capture of the South Plume.

[b] In 2022, the pumping rate at RW-4 and RW-6 went to zero when they were permanently turned off.

[c] 2022 modeling results demonstrate that RW-1, RW-2, and RW-3 are no longer needed to capture or remediate the uranium plume if replacement wells RW-6A and RW-7A are operating as designed. Wells RW-1, RW-2, and RW-3 will be operated at a pumping rate not to exceed 200 gpm until the wells fail. Their pumping rate will not be counted toward system operation pumping goals. Treatment of these wells with LAD is no longer viable due to the damage that the liquid acid descaler causes to the pitless adaptors. They will continue to operate to provide additional flushing in the South Plume. If the pumping rate of any of these three wells falls below 100 gpm, it will be turned off.

[d] Well RW-6 was turned off permanently on July 25, 2022. Under the 2022 Design, it will be replaced with RW-6A (33616) and operated at 300 gpm.

[e] The pumping rate at RW-7 was reduced from 300 gpm to 200 gpm in 2022 due to maintenance problems. Under the 2022 design, RW-7 it will be replaced with RW-7A (33617). RW-7A will be operated at 300 gpm.

[f] System Totals and Total Extraction numbers do not include RW-1, RW-2, and RW-3. Totals also reflect the shift in pumping rates when replacement wells for RW-6 and RW-7 become operational.

5.0 Operations Plan

This section contains the operations philosophy, treatment priorities, hierarchy of decisions, management and flow of operations information, and management of treatment residuals necessary to successfully operate the groundwater extraction and treatment systems to achieve regulatory requirements and commitments.

5.1 Wastewater Treatment Operations Philosophy

The primary goals of wastewater treatment operations and maintenance are to meet effluent discharge requirements and provide for leachate treatment. Until 2011, treatment capacity was needed to treat groundwater to meet system pumping rates, but since 2011, routine groundwater treatment to meet discharge limits has not been required. In 2018, to address current and ongoing treatment needs, which mostly center around other wastewater sources (Section 4.0), a new 50 gpm treatment system became operational.

Other regulatory discharge requirements, such as NPDES, must also be met. Sampling under the NPDES permit and the IEMP is performed to verify that requirements and effluent limits for discharges to the Great Miami River are met. Influent streams to treatment and effluent streams from treatment as well as other process control sampling around specific unit operations (e.g., ion exchangers) are conducted for uranium and other appropriate constituents as necessary to provide information needed to document compliance.

5.2 CAWWT Operation

As discussed in Section 3.3, a 50 gpm treatment system began operating in April 2018. The effluent from this system and bypassed (untreated) groundwater combine in the site discharge line to form the Fernald Preserve's regulated discharge to the Great Miami River.

Since 2011, groundwater has not needed to be routinely treated in order to meet discharge limits, resulting in rightsizing the treatment system to a 50 gpm system. With no need to routinely treat groundwater, and a smaller 50 gpm system, treatment mainly addresses the other wastewater sources (e.g., backwash from the treatment system, water from the CAWWT sump, water from well rehabilitations, and OSDF leachate).

These other wastewater sources are first sent to the backwash basin. Wastewater from the backwash basin is mixed with groundwater and sent to the 50 gpm system. Blending with groundwater occurs to dilute anion concentrations in the water from the backwash basin. High anion concentrations have been shown to reduce the life of the resin and even strip uranium off the ion-exchange treatment resin. The 50 gpm system effluent is combined with untreated groundwater and discharged through the Parshall Flume.

Water from the CAWWT backwash basin is pumped to the CAWWT at a flow rate adequate to ensure that the basin level does not exceed 5.5 ft so that a minimum of 6 inches of freeboard is maintained at all times.

Operators are onsite 365 days per year. The operators are responsible for ensuring that treatment and monitoring equipment is operated, maintained, and repaired so that the necessary treatment throughput is achieved. Operations and maintenance are performed in accordance with all appropriate standard operating procedures, standards, and specifications. Additionally, process engineering support personnel are on call to provide assistance in problem solving.

5.3 Groundwater Treatment

The CAWWT provides up to 50 gpm treatment capacity for wastewater from the backwash basin blended with groundwater. Most groundwater, therefore, is directed to the bypass header and does not go to treatment. The set points at which the wells are pumped are typically set to approximately 10 percent more than the groundwater remedy target set point to account for downtime.

5.3.1 Groundwater Treatment Prioritization versus Bypassing

The need for groundwater treatment prioritization was eliminated once discharge limits could be met without routine treatment. Historically, when groundwater needed to be routinely treated to meet discharge limits, groundwater well discharges were prioritized in order of uranium concentration; the highest uranium concentration wells were routed to treatment until the treatment capacity necessary to meet the site's uranium discharge limit was utilized. Remaining well discharges were bypassed around treatment to the Parshall Flume. As shown schematically in Figure 4, treatment/bypass decisions for the Southfield and Waste Storage Area extraction wells were made on a well-by-well basis.

With installation of the 50 gpm treatment system in April 2018, a 5-inch orifice plate was installed in the SWRB Valve House to increase the backpressure on all the wells being fed through the treatment header. This results in most groundwater flow bypassing treatment. A very small volume of groundwater (less than 50 gpm) is routed to treatment. Operating the system in this manner reduces the energy consumed by the well motors (by reducing back pressure on the pumps) and extends the operating life of the well pumps.

5.4 Well Field Operational Objectives

Several objectives must be considered when well field operational decisions are made. These objectives are listed in Table 3 along with the anticipated actions required to achieve each objective. Decisions that affect well field operations are communicated to EPA and Ohio EPA in the IEMP reports. Changes in groundwater restoration well pumping set points are transmitted to shift supervisors by the Site Operations Manager, after consultation with the Aquifer Restoration Lead.

In addition to the objectives listed in Table 3, the well field is shutdown each year for approximately one month to allow water levels in the aquifer to rebound. The shutdown is planned to take place in the late spring and early summer to correspond with seasonal water level highs in the aquifer. The objective of the shutdown is to allow water levels to reach uranium sorbed to aquifer sediments in the unsaturated portion of the aquifer beneath former source areas. Uranium contamination bound to aquifer sediments in the unsaturated portion of the Great Miami Aquifer has been identified under some former source areas at the site. Uranium bound to unsaturated aquifer sediments will remain bound unless water levels rise and saturate the sediments, allowing the uranium to dissolve into the groundwater.

Table 3. Well Field Operational Objectives

Objectives	Actions Required
Operate individual wells within constraints imposed by system design and equipment. Key constraints include: • Pumping equipment is limited to a range of flows that will dictate the flexibility of extraction rates for individual wells. • Hydraulic capacity of the piping limits extraction rates. • Average entrance velocity of water moving into the screen should not exceed 0.1 ft per second.	Operate well pumps and motors according to manufacturer recommendations. Operate extraction well systems within design constraints.
Perform necessary equipment and well maintenance in accordance with established schedules.	According to OMMP, Section 6.0.
Maintain compliance with the discharge limits of 30 µg/L monthly average uranium concentration and 600 lb/yr for the combined site water discharged to the Great Miami River.	Monitor discharge concentrations. Modify well set points as necessary to maintain compliance with discharge limits. Evaluate well set points. Use flow-weighted average-concentration calculations to predict how changes to set points will affect discharge concentrations. Compare predictions with actual measurements to evaluate if and how predictions can be improved. Maintain well set points to the degree possible.
Minimize impact to the Paddys Run Road Site plume.	Pumping from well 3924 (RW-1) should not exceed 300 gpm. Pumping from well 3925 (RW-2) should not exceed 300 gpm (if well 3924 is pumping) and 400 gpm (if well 3924 is not pumping). Pumping from well 3926 (RW-3) should not exceed 500 gpm if either well 3924 or well 3925 is not pumping. If the actual capture zone differs significantly from that defined via previous modeling, it may be determined that the pumping rates noted above require modification to maintain this objective. Required modifications will be made based on additional modeling projections and verified based on field data.
Maintain capture of the 30 µg/L uranium plume off-property.	The following pumping rates for each South Plume well provides for the capture (within system constraints) of the uranium plume off property: Well 33616 at 300 gpm Well 33617 at 300 gpm If the actual capture zone differs significantly from that defined via previous modeling, it may be determined that the pumping rates noted above require modification to maintain this objective. Required modifications will be made based on additional modeling projections and verified based on field data.

Table 3. Well Field Operational Objectives (continued)

Objectives	Actions Required
Maintain hydraulic capture of the remaining portions of the 30 µg/L uranium plume (within areas of active modules).	Establish pumping rates based on model predictions of required pumping rates to maintain a desired area of capture. Determine the actual area of capture created when the wells are operating at the modeled rates based on groundwater elevation contour maps derived from field measurements. Adjust pumping rates within system design and operational constraints, if warranted, when the actual area of capture is not consistent with the modeled area of capture. This will be done in an effort to establish an area of capture consistent with the desired area of capture, as modeled.
Minimize duration of cleanup time for off-property portion of the 30 µg/L uranium plume.	Give priority as follows: (1) off-property wells have priority over on-property wells for maintaining operation at the design set points. (2) South Field Wells EW-18, EW-22, EW-23, EW-24, and EW-30 have priority over other on-property wells for maintaining operation at the design set points. Maximize pumping rates within the following constraints and considerations: system design and equipment, hydraulic capacity of the piping, regulatory limits, interaction with other modules, and remedy performance.
Minimize duration of cleanup time for on-property portions of the uranium plume.	Maximize pumping rates within the following constraints and considerations: system design and equipment, hydraulic capacity of the piping, regulatory limits, interaction with other modules.
Minimize migration of on-property portion of the plume to off-property areas.	Balance pumping from the South Field Extraction System Module and South Plume Module such that the stagnation zone is at or south of Willey Road.
Minimize drawdown in off-property areas.	Do not exceed 110 percent of the set points defined in Table 2, with the exception of “Minimizing the impact to the Paddys Run Road Site Plume” Objective.

Water levels will be measured at key locations (by hand and downhole transducer/data logger) before, during, and after the shutdown to record the resulting water level change. The uranium concentration in the pumped groundwater immediately after the wells are restarted will be compared to pre-shutdown concentrations to determine the amount of concentration rebound that occurred. Shutdown times are subject to change.

The well field downtime period will also be used to conduct well field and water treatment system maintenance.

Groundwater modeling conducted in 2022 (DOE 2022) demonstrates that given the position of the leading edge of the South Plume in 2021, the South Plume extraction wells can be non-operational for approximately 3 years before water moving from the leading edge of the plume is outside capture created by the planned operation of two new replacement wells. Operation of the two new replacement wells (RW-6A and RW-7A) before the end of the three-year time period will maintain capture of the water moving from the leading edge of the plume during the down time period. It should be noted that this time estimate only considers the movement of groundwater. Retardation of uranium in the aquifer will result in slower movement of the plume than the water.

5.5 Operational Maintenance Priorities

Maintaining the treatment facilities online includes ensuring that all equipment is operating properly, that adequate personnel are assigned to operate the treatment systems safely, and that the site effluent requirements at the Parshall Flume are met. Following is a list of operational maintenance priorities in their order of importance:

1. Keep the Parshall Flume discharge point and sampling system operating. If the discharge monitoring system were to become nonoperational, discharge monitoring samples of effluent to the river from the Fernald Preserve would have to be collected manually or the CAWWT treatment system and all extraction wells would be shut down until the sampling system is operational. The sampling system must be operational so that accurate reports of uranium and NPDES contaminant levels can be made.
2. Pumping of off-property wells has priority over on-property wells.
3. South Field wells EW-18, EW-22, EW-23, EW-24, and EW-30 have priority over other on-property wells for maintaining operation of design set points.
4. Keep all extraction wells operating at the design set points.

Section 6.0 provides more-specific details of managing equipment operation and maintenance.

5.6 Operations Controlling Documents

Operations at the wastewater treatment facilities are controlled directly by standard operating procedures.

Section 6.1.2 provides a more extensive discussion of standard operating procedures. Standard operating procedures implement the requirements of this plan. The OMMP is not intended to replace standard operating procedures.

5.7 Management and Flow of Operations Information

Water samples are taken from the in service ion-exchange vessel on a regular basis to ensure that uranium is still being removed by the resin. Project personnel review the results of sample analysis as necessary to evaluate system performance and determine if either of the treatment system ion-exchange vessels needs to be removed from service for resin replacement.

The project issues monthly operations reports that summarize flow rates and flow totals as well as uranium concentrations from the CAWWT and the wells. Information on required well pumping rates is communicated from the Site Operations Manager to the operations personnel as specified in the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021).

5.8 Management of Treatment Residuals

Treatment residuals consist of exhausted ion-exchange resin, used filter media from the multimedia filters, and sediment in the backwash basin. These materials will ultimately be disposed of offsite at a licensed disposal facility. They will be transported using a subcontractor qualified to transport radioactive materials. Unused tanks at the CAWWT may be used for interim storage of spent resin and filter media until the CAWWT is decommissioned. Sediments in the backwash basin may be removed and disposed prior to decommissioning CAWWT if they are adversely impacting system operation.

6.0 Operations Performance Monitoring and Maintenance

This section describes the general methods, guidelines, and practices used in managing equipment operation and maintenance and presents planned maintenance and monitoring requirements for the groundwater restoration wells to support successful long-term operation of the groundwater restoration system.

Managing equipment operation and maintenance in the context of this document includes not only routine control panel monitoring and repair work, but also the preventive, predictive, and proactive actions used to maximize equipment operating efficiency and capacities. This section presents some of the management systems that will help to ensure that the OU5 ROD requirements continue to be met, describes the key parameters used to monitor performance of the groundwater and wastewater facilities, and describes the principal features and maintenance needs of the overall operation.

The treatment system and restoration well system performance parameters and maintenance requirements have unique differences. The treatment system is designed and built with redundant features and equipment to reduce potential downtime (e.g., installed spare pumps). Those features are not economically practical for the well systems. The equipment in the treatment systems has more easily discernible indicators of equipment condition and is more easily accessed for monitoring by operating personnel walk-through than the underground well system. The methods used to measure the equipment condition and the specific measurable goals for the two systems also are different.

The activities described in this section also provide the basis for routine maintenance of the system and for monitoring the system performance to determine if more extensive maintenance activities are required. Regularly scheduled maintenance minimizes system downtime. Continuous operation of the well system, within practical limitations, is required to maintain groundwater restoration objectives at the Fernald Preserve.

This plan describes monitoring and maintenance activities and their frequencies, based on current projections. The need for and frequency of these activities may change based on future experience gained through the operation, maintenance, and monitoring of the extraction wells that are currently operating. Parameter monitoring frequency may change as well. This plan will be revised as necessary during the life of the groundwater restoration process.

6.1 Management Systems

6.1.1 Maintenance and Support

A qualified subcontractor under the direction of Legacy Management Support (LMS) personnel will provide maintenance for the well field. Preventive maintenance will be performed on the schedule recommended by the equipment manufacturer.

The technical staff at the Fernald Preserve directly supports facility operation and maintenance. The technical staff members work together to resolve issues and improve operations. They also provide troubleshooting and technical assistance to the operations personnel.

The facilities consist of standard high-capacity filter-packed water wells and conventional water and wastewater treatment unit processes that are typical for the industry. The equipment is expected to continue to have good reliability and has well-documented maintenance guidelines. Routine maintenance practices, as documented by the original equipment manufacturer's maintenance manuals, have been used to provide the basis for maintenance procedures and practices. Maintenance feedback and component manufacturer suggestions have been used to develop a spare parts list and stock inventories of the most frequently used parts. The availability of spare parts will assist in minimizing downtimes associated with all maintenance activities.

6.1.2 Operations

Operating personnel play an important role in maximizing equipment operating efficiency and capacity. One significant duty of the facility operating personnel is to identify and report existing and potential future equipment problems. Operating personnel perform routine scheduled checks, inspections, and walk-throughs of the facilities and systems. Operating personnel maintain a shift logbook that documents activities and specific actions taken during each shift. The logbooks are kept as a historical record of operational activities. Logbooks and roundsheets are periodically reviewed as additional assurance that the systems are being operated effectively.

6.1.2.1 Process Control

Facilities are staffed by operating personnel daily. The operating personnel at CAWWT monitor the process using a computerized control system located in the control room. The control system receives input from process meters (e.g., tank level and process flow meters) and from devices that indicate equipment status (e.g., valve position limit switches and motor VFD). The control system outputs control signals to regulate the process (e.g., control valve positioning and motor speed control). The control system uses desktop-style computer equipment (monitors, keyboards, and pointing devices) to provide a graphic human-machine interface (HMI) for the process monitoring and control. The control system HMI includes various process graphics screens that depict portions of the treatment system in piping and instrumentation diagram format and provide real-time process measurements and information. The control system has process alert and alarm management and a historical database of all operating personnel input and process alert/alarms. The operating personnel at CAWWT also access process and equipment information by making "walking rounds" of all equipment in the process.

6.1.2.2 Standard Operating Procedures

Each operation is performed in accordance with approved standard operating procedures that are developed by the technical staff with the assistance of operations personnel. The standard operating procedures are reviewed periodically and revised as necessary for the safe and consistent operation of treatment processes.

Standard operating procedures provide step-by-step instructions for performing wastewater treatment operations activities. They also contain safety and health precautions that employees must follow while performing the steps in the procedure. The procedures are written from the perspective of the operating personnel who will be performing the steps.

Standard operating procedures also contain instructions as to when management must be notified of nonroutine operating conditions or events and to whom in management these conditions must be reported. Standard operating procedures include such activities as:

- Calibration of water quality meters.
- IEMP surface water sampling.
- NPDES sampling.
- Daily operations at the Parshall Flume.
- Enhanced permanent LTS operation.
- CAWWT system operations.
- Monitoring recovery and extraction wells.
- Measuring soluble uranium by kinetic phosphorescence analyzer.

6.1.2.3 Training

A training and qualification program is in place to ensure that all operating personnel involved in treating wastewater are qualified and competent for their positions. The goal of the training and qualification program is to prepare personnel for the operations team and to continually improve the team's knowledge and capabilities.

6.2 Restoration Well Performance Monitoring and Maintenance

This section describes the key performance monitoring and maintenance guidelines for the groundwater restoration well systems. To complete the aquifer restoration within the model-predicted time frames, a high level of on-stream time at the modeled pumping rates is needed for each well. Actual target pumping rates are set at around 110 percent of the modeled target pumping rates to provide for downtime. Some well downtime is expected and can be accommodated. However, lengthy outages can adversely impact model predictions. A well maintenance program is being implemented to address this issue. More frequent component preventive maintenance checks along with periodic formal performance testing and well and pump cleaning were identified and included as major program elements to improve well operating efficiency.

6.2.1 Well Descriptions

This section provides a general description of the extraction wells that constitute the active groundwater restoration modules. The active modules are the South Plume, South Field, and the Waste Storage Area.

6.2.1.1 South Plume Extraction Wells

The South Plume Module includes six wells that are used to pump groundwater from the off-property portion of the Great Miami Aquifer plume to the Fernald Preserve's South

Field Valve House. In the valve house, piping is provided that allows flow from the following South Plume wells to be routed either to treatment or to the Great Miami River:

Extraction Well ID	Common Well ID	Formal Site Well ID
EW-1	RW-1	3924
EW-2	RW-2	3925
EW-3	RW-3	3926
EW-6/6A	RW-6/6A	32308/33616
EW-7/7A	RW-7/7A	32309/33617

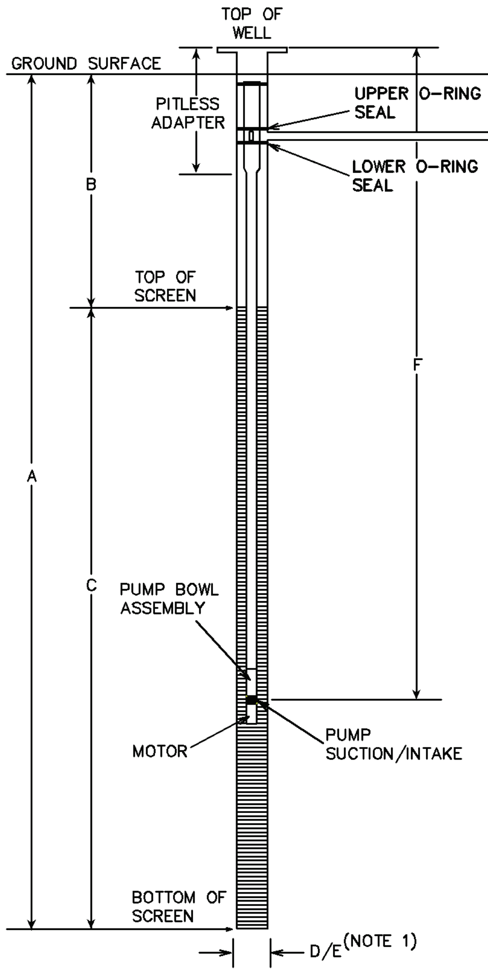
Each of the South Plume extraction wells contains a submersible pump/motor assembly and has a pitless-type adapter near the ground surface that transitions the vertical pump discharge piping to the underground force main. The underground force main from wells RW-1, RW-2, and RW-3 passes through individual underground valve pits. These valve pits contain several components of the individual well's control system. Wells RW-6 and RW-7 do not use underground valve pits to contain any control system components. All control components for these two wells are located in the South Plume Valve House.

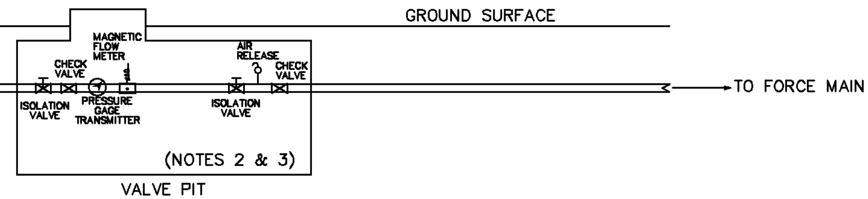
The flow control system for one of the six South Plume wells is controlled by a flow-control loop consisting of a magnetic flow meter, programmable logic controller (PLC), and a VFD.

Each South Plume extraction well is equipped with isolation valves, check valves, an air release, and a pressure-indicating transmitter. The pressure-indicating transmitters are tied to process interlocks that will shut the pumps down if high or low pressures are maintained for extended periods, indicating a closed valve or catastrophic system leak, respectively. This interlock is intended to protect the pump/motor assemblies from damage due to closed discharge valves or to shut down the pumps if no system backpressure is sensed. Critical control components are protected by lightning/surge arresters to help prevent damage to the control system during electrical storms.

Routine water level monitoring within the well is performed during regularly scheduled performance monitoring or more frequently if required.

Installation details of the South Plume extraction wells are shown in Figure 9. This figure will be updated when RW-6A and RW-7A are installed.





EXTRACTION WELL NUMBER	A WELL DEPTH BELOW GRADE (MEASURED)	B TOP OF SCREEN DEPTH BELOW GRADE	C SCREEN LENGTH	D SCREEN/ CASING DIAMETER	E (NOTE 1) INTERNAL SCREEN DIAMETER	F PUMP SUCTION DEPTH (BTOW)	SLOT SIZE	SURFACE ELEVATION	TOP OF WELL ELEVATION
EW–1	55'	15'	40'	12"	10"PS	33'	0.075	531.9	533.5
EW–2	65'	25'	40'	12"	12"TS	42'	0.075	540.3	542.0
EW–3	109'	69'	40'	12"	10"PS	87'	0.075	585.0	586.7
EW–4	105.5'	74'	31.5'	16"	N/A	92'	0.050	589.0	591.8
EW–6	(107')	84.6'	25'	12"	N/A	82'	0.035	581.4	581.7
EW–7	(112')	74.5'	30'	12"	N/A	82'	0.035	581.1	581.4

NOTES:

1: DIMENSION 'E' REPRESENTS THE NOMINAL SIZE OF THE SCREEN TELESCOPED INSIDE OF THE ORIGINAL SCREEN. PS = PIPE SIZE: TS = TELESCOPE SIZE

2: PLC's ARE LOCATED IN THE SOUTH PLUME VALVE HOUSE

3: EXTRACTION WELLS EW–6 AND EW–7 FLOW CONTROL VALVE, FLOW METER, PRESSURE INDICATORS AND STARTER PANELS ARE LOCATED IN SOUTH PLUME VALVE HOUSE

NOT TO SCALE

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FIGURE 6–1. SOUTH PLUME MODULE, EXTRACTION WELL INSTALLATION DETAILS

Figure 9. South Plume Module Extraction Well Installation Details

6.2.1.2 South Field and Waste Storage Area Extraction Wells

The South Field and Waste Storage Area Modules include 11 and 3 wells, respectively, which are used to pump groundwater from the Great Miami Aquifer to the Fernald Preserve water treatment facilities or to the Great Miami River if treatment is not required to achieve uranium discharge limits. These wells are as follows:

Extraction Well ID	Common Well ID	Formal Site Well ID
EW-15A[a]	EW-15A	33262
EW-17A[a]	EW-17A	31567
EW-18[a]	EW-18	31550
EW-19[a]	EW-19	31560
EW-20[a]	EW-20	31561
EW-21A[a]	EW-21A	31562
EW-22[a]	EW-22	32276
EW-23[a]	EW-23	32447
EW-24[a]	EW-24	32446
EW-25[a]	EW-25	33061
EW-30[a]	EW-30	33264
EW-26[b]	EW-26	32761
EW-27[b]	EW-27	33062
EW-33A[b]	EW-33A	33347

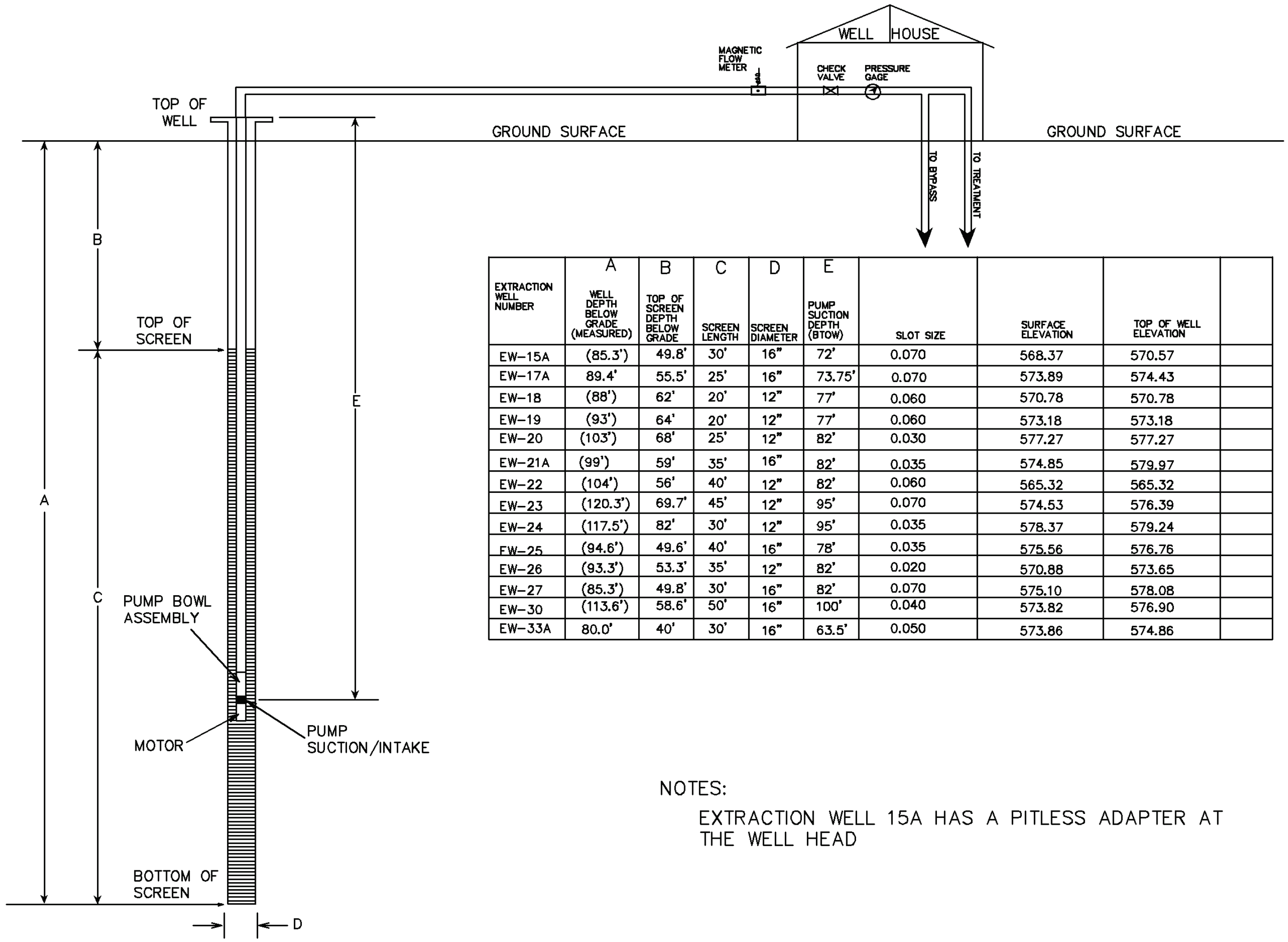
[a] Extraction well is in the South Field Module.
[b] Extraction well is in the Waste Storage Area Module.

Each of the 11 South Field and 3 Waste Storage Area extraction wells is of similar design with the exception of the well depth, screen length, and screen slot size. Each contains a submersible pump/motor assembly. Groundwater is pumped from the below-grade pump to the wellhead at the ground surface via the vertical discharge piping. At the wellhead, this piping is routed horizontally through a magnetic flow meter and into the individual well houses. All of the individual well control components are located at these well houses.

The flow control system for each of the 14 extraction wells is identical; flow is controlled by a flow-control loop consisting of a magnetic flow meter, a PLC, and a VFD. The desired flow rate set point for each extraction well is entered into the PLC at the individual well houses. This value is compared continuously to the actual flow rate measured by the magnetic flow meter. When required, the PLC adjusts the pump motor speed via the VFD to maintain the desired flow. Pump "Start" and "Stop" can be controlled by the PLC and can also be controlled at the VFD.

In addition, each extraction well is equipped with isolation valves, check valves, an air release, and a pressure-indicating transmitter. Routine water level monitoring within the well is performed during regularly scheduled performance monitoring and more frequently if required.

Installation details of the South Field extraction wells and Waste Storage Area wells are shown in Figure 10.



EXTRACTION WELL NUMBER	A WELL DEPTH BELOW GRADE (MEASURED)	B TOP OF SCREEN DEPTH BELOW GRADE	C SCREEN LENGTH	D SCREEN DIAMETER	E PUMP SUCTION DEPTH (BTOW)	SLOT SIZE	SURFACE ELEVATION	TOP OF WELL ELEVATION	
EW-15A	(85.3')	49.8'	30'	16"	72'	0.070	568.37	570.57	
EW-17A	89.4'	55.5'	25'	16"	73.75'	0.070	573.89	574.43	
EW-18	(88')	62'	20'	12"	77'	0.060	570.78	570.78	
EW-19	(93')	64'	20'	12"	77'	0.060	573.18	573.18	
EW-20	(103')	68'	25'	12"	82'	0.030	577.27	577.27	
EW-21A	(99')	59'	35'	16"	82'	0.035	574.85	579.97	
EW-22	(104')	56'	40'	12"	82'	0.060	565.32	565.32	
EW-23	(120.3')	69.7'	45'	12"	95'	0.070	574.53	576.39	
EW-24	(117.5')	82'	30'	12"	95'	0.035	578.37	579.24	
EW-25	(94.6')	49.6'	40'	16"	78'	0.035	575.56	576.76	
EW-26	(93.3')	53.3'	35'	12"	82'	0.020	570.88	573.65	
EW-27	(85.3')	49.8'	30'	16"	82'	0.070	575.10	578.08	
EW-30	(113.6')	58.6'	50'	16"	100'	0.040	573.82	576.90	
EW-33A	80.0'	40'	30'	16"	63.5'	0.050	573.86	574.86	

NOTES:

EXTRACTION WELL 15A HAS A PITLESS ADAPTER AT THE WELL HEAD

'O SCALE

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Figure 10. South Field Module and Waste Storage Area Extraction Well Installation Details

6.2.2 Factors Affecting System Operation

The original five extraction wells of the South Plume groundwater restoration module began operating in August 1993 as part of the OU5 South Plume Removal Action. In the intervening time, valuable operational experience and knowledge was gained that is being used to optimize long-term operation of extraction wells sitewide. This experience has resulted in identification of factors affecting operation life and efficiency, some of which were unknown at the start of pumping operations. These factors have either already been addressed or are incorporated into planned maintenance.

To better understand the factors affecting large-scale groundwater pumping operations, Moody's of Dayton, a water well maintenance and installation contractor, was consulted. Moody's has served the water well industry throughout the Great Miami Aquifer for more than 30 years and has extensive experience maintaining large-capacity wells for a number of major water supply systems. Frequencies for routine maintenance and monitoring activities were selected using recommendations from their evaluation of the South Plume extraction well system and their experience working with systems of similar magnitude in the regional aquifer. Well maintenance protocol was further refined in 2008 and 2014 based on additional consultation with Smith-Comeskey Groundwater Science LLC.

Several factors affect the performance of the extraction wells. In addition, a number of other specific requirements of the Fernald Preserve's system complicate these factors. All of these factors and requirements were considered in developing this plan. First, all the Fernald Preserve's extraction wells are placed in and are extracting water from the uppermost portions of the Great Miami Aquifer. This complicates both pump/motor cooling and iron fouling of the extraction well screen. Normal water well practice would place the screened section of the well deeply in the aquifer, and the pump/motor assembly would be placed above the screen in a submerged section of blank casing. Since the extraction wells are intended to intercept a plume of contamination located near the top of the aquifer, the screened sections begin near the normal water level. In order to provide the required submergence of the motor assembly, this assembly must be placed within the screened section. The high flow rates required for plume capture combined with the targeted removal of the contamination plume have led to difficulties ensuring that the flow of water passing the motor is adequate for cooling.

Placement of the pump/motor assembly within a screen that is located near the aquifer water table also complicates the impacts of iron-fouling. Moody's and Groundwater Science have confirmed that iron fouling is prevalent throughout the regional aquifer and that the configuration of the Fernald Preserve installation enhances the problem. These conditions and the fact that this region of the Great Miami Aquifer contains some of the highest concentrations of iron and iron-fouling bacteria have resulted in fouling of the well screens and other downstream equipment.

Continuous operation of the extraction wells also exacerbates the factors noted above. Normal water well industry practice does not require pumping wells to operate continuously. Typical water supply well systems pump between 6 and 10 hours per day and have spare wells that can be rotated in and out as demand requires (especially when maintenance is required). The Fernald Preserve's extraction well system, however, runs continuously and has no spare wells to compensate for wells taken out of service for maintenance. In fact, when a well is shut down for an extended period to perform maintenance, the remaining wells may need to increase their flow to continue the planned capture of the plume.

6.2.3 Maintenance and Operational Monitoring

Several routine activities are performed to optimize performance of the extraction wells in the South Plume, South Field, and Waste Storage Area groundwater restoration modules. The following maintenance and operational monitoring activities are described in this section:

- Routine system maintenance, which includes maintenance actions related to valves, instrumentation, and controls associated with each extraction well
- Operational monitoring, which includes quarterly monitoring of extraction well capacity as well as pump and motor assembly performance
- Well and pump cleaning

Table 4 lists planned outages for the South Plume, South Field, and Waste Storage Area wells. Routine well and screen maintenance (i.e., superchlorination) is no longer an activity of the OMMP. External technical advice, coupled with lessons learned by operating extraction wells at the Fernald Preserve, indicate that the superchlorination procedure is not effective and in fact may exacerbate well and pump fouling.

Table 4. Planned Outages

Item	Description	Frequency	Duration per Event
1	Performance Testing	Quarterly	4 hours per well
2	Pressure Transmitter Operational Check	Annually	2 hours per well
3	Magnetic Flow Meter Operational Check[a]	Semiannually	2 hours per well
4	Check Valve Inspect/Clean	Semiannually	4 hours per well
5	Rehabilitation	Variable	3 weeks
6	Well/Pump Cleaning	Variable	1–2 days

[a] Flow meter operational check may occur as a post-maintenance test using a portable flow meter.

6.2.3.1 Maintenance of the Pumps, Piping, and Controls

These maintenance activities are directed primarily at the valves, instrumentation, and controls associated with each extraction well. In addition to formal preventive maintenance activities, several routine system checks are performed by operations personnel, between scheduled preventive maintenance activities, to ensure that equipment is functioning properly.

The following is a list of preventive maintenance and operational checks that are routinely performed:

<u>Flow Meters: Operational Check Semiannually</u>

Operational checking of the flow meter is estimated to require an outage of 2 hours per extraction well in the South Plume and 2 hours for each on-property extraction well.

Check Valves: Inspect and Clean Seat Semiannually

All wells have a single in-line check valve that is removed, inspected, and cleaned. This maintenance activity is estimated to require each well to be shut down for approximately 4 hours.

Pressure-Indicating Transmitters: Annual Operational Checks

Each extraction well has a pressure-indicating transmitter that is used in performance testing to determine the pump's discharge head (pressure). Accurate pressure sensing in the full range of pumping pressures is required for accurate testing. No well shutdown is required.

Performance Testing

The main system performance indicators for the South Plume and South Field extraction well modules are gathered and summarized in performance tests conducted quarterly. These tests monitor the specific capacity of each recovery/extraction well and the pump/motor assembly performance. The test results are used to determine the need for well and pump cleaning, well redevelopment, or pump/motor rebuilding. The information helps minimize unscheduled, unplanned emergency maintenance and shortens the duration of well outages. Several of the parameters measured may be monitored more frequently to develop additional system data for trending purposes.

Parameters to Be Monitored

Extraction well operating parameters that are required to be routinely monitored include the following:

- Water level—static and pumping
- Flow
- Discharge pressure
- Motor amperage draw

Water Level Monitoring

Water level, both static and pumping, can vary significantly in a short time period and therefore needs to be measured routinely. The drawdown from static water level to the pumping water level is used to calculate a specific capacity for the well and is a direct indication of the degree of fouling of the well screen and the adjacent formation. The installation depth of the extraction well pump/motor assemblies has been established, based upon an anticipated worst-case drawdown of 10 ft below the seasonal low static water levels. Historical data were reviewed to determine seasonal lows. While each setting has some added submergence to be conservative, pumping levels are monitored routinely to ensure that adequate pump/motor submergence is maintained and to prevent severe component damage.

If the pumping water level measured during the quarterly performance testing approaches the top of the pump's bowl assembly, rehabilitation efforts may be necessary. Rehabilitation efforts include cleaning of the well using dual swab and airlift pumping to remove debris. After cleaning, the well will be acid-treated to break down encrustation on the well screen and within the local formation. These processes may, if necessary, be repeated several times to ensure that the well has been rehabilitated to its optimal condition.

Flow Monitoring

The ability of an extraction well pump and motor to sustain the desired flow is a key indicator of the health of the flow meter, controls, VFD, well, and pump/motor assembly. Testing to determine the ability of a pump and motor assembly to perform as expected will be completed quarterly. Additionally, individual extraction well flow is monitored continuously by the flow controller for each well. The actual flow verses the controller set point is checked by operations personnel at least once per day. Any significant deviation from the flow set point is investigated, and required maintenance actions are determined and carried out.

Discharge Pressure Monitoring

Pump discharge pressure, coupled with flow, is monitored quarterly to assess the pump/motor assemblies' performance against the manufacturer's published performance specifications.

Amperage

As with flow and pressure, amperage is a good indicator of how the pump/motor assembly is performing. During performance testing, motor amperage draw is measured on each of the three phases of the electrical supply. Amperage draw is compared to the motor manufacturer's published specifications. Amperage should be below the manufacturer's full-load amperage and should be approximately equal across the phases of the motor. An imbalance of greater than 20 percent across the phases indicates a motor or electrical supply situation that triggers more extensive diagnosis. Additional diagnostics and repairs are not within the scope of this plan.

6.3 Treatment Facilities Performance Monitoring and Maintenance

This section describes the key performance monitoring parameters and maintenance needs for the wastewater treatment systems and their ancillary facilities. Based on past performance, meeting the Fernald Preserve effluent discharge uranium limit of 30 ppb on a monthly average basis is routinely achievable.

6.3.1 Treatment Facilities Performance Monitoring

The CAWWT uses strong base-anion exchange as the final unit process for uranium removal. The strong base-anion exchange resins have a strong affinity for the uranyl carbonates in the Fernald Preserve's wastewater. The technology is reliable; however, treatment to the effluent levels required at the Fernald Preserve (i.e., less than 30 ppb) is not widely practiced in wastewater systems.

Measurable parameters for the CAWWT system are the total volume of water treated, the influent and effluent uranium concentrations and mass, and the total mass of uranium removed by treatment. The Fernald Preserve total effluent flow rate is metered. Flow-weighted composite samples of the effluent are analyzed daily for total uranium. Those two parameters are used to measure compliance with the OU5 ROD requirements for uranium discharge in the Fernald

Preserve's effluent. The sample results and treatment flow rates are reported, tracked, and used to determine the need for troubleshooting, process adjustments, and corrective actions. All of the routine uranium analytical work is conducted in a laboratory located within the CAWWT.

6.3.2 Treatment Facilities Maintenance Practices

Because the treatment systems have spare equipment installed along with bypass piping and valving, most of the routine preventive maintenance and repair work in the systems can be accomplished without a unit shutdown. For planned maintenance shutdowns, advance EPA approval will be obtained if relief allowances are requested. Some breakdowns will lead to system shutdowns. Loss of utilities or a failure in the CAWWT's computerized control system would result in a system shutdown. All treatment systems will fail safely on loss of a utility or a major component and are not complicated to restart.

6.4 Regulatory Issues

Current extraction well rehabilitation screen- and pump-cleaning efforts require the use of a blend of glycolic and hydrochloric acids (e.g., Cotey Chemicals Liquid Acid Descaler). The hydrochloric acid is used to break down flow-limiting mineral encrustation on the well screen/pump, and the glycolic acid removes fouling caused by bacterial growth. The spent hydrochloric-glycolic acid blend is purged from the well by pumping to a portable tank. The tank is emptied into the CAWWT backwash basin for subsequent treatment at the CAWWT before being discharged to the Great Miami River via the Parshall Flume.

The use of these acids in well rehabilitation and well and pump cleaning to date has been monitored closely. Ohio EPA has been notified and has approved of the intended chemical additions and subsequent discharges. After the addition of these chemicals, the water pumped initially from the extraction well is turbid, contains iron residual and dissolved scale, and has a low pH.

Placement of this wastewater stream in the CAWWT backwash basin is adequate to prevent turbidity and low pH from exceeding NPDES outfall limits.

In late 2021 and early 2022, following approval from Ohio EPA and EPA, DOE completed a small-scale test to use peracetic acid in place of liquid acid descaler. Preliminary results indicate that the use of peracetic acid over the continued use of liquid acid descaler would not be beneficial and the test was discontinued.

7.0 Organizational Roles, Responsibilities, and Communications

This section presents the organizational roles and responsibilities with respect to implementation of this OMMP. Also presented are information needs and communications protocol for coordination with other Fernald Preserve project organizations, and interaction with EPA and Ohio EPA.

7.1 Organization Roles and Responsibilities

7.1.1 DOE Office of Legacy Management

DOE is responsible for providing direction and oversight of all activities at the Fernald Preserve.

7.1.2 LMS Operating Contractor

The LMS Operating Contractor is responsible for all engineering, design, and construction activities for the OMMP, which include:

- Engineering functional requirements, design basis, and detailed design drawings and documents.
- Engineering support during construction.
- Start-up plans, system operability test procedures, and test supervision.
- Standard start-up review plans and coordinating resolution of operational issues.
- Technical support of well field and water treatment operations.
- Coordination of project-specific activities associated with procurement and management of construction contractors.

The LMS Operating Contractor is also responsible for all aquifer restoration planning and defining groundwater monitoring/reporting activities within the project, which include:

- Developing and maintaining the aquifer restoration strategy.
- Defining groundwater remedy performance monitoring requirements.
- Completing groundwater data evaluation and reporting.
- Providing technical input on well operation and maintenance.
- Providing technical input to operations regarding compliance with discharge limits.
- Providing technical input to design and construction of site groundwater extraction systems.
- Preparing required Comprehensive Environmental Response, Compensation, and Liability Act documentation (e.g., RA Work Plan, aquifer remedy design documents, the IEMP groundwater section, and various other required reports).

Site Operations personnel are responsible for all operations and maintenance activities within the project, which include:

- Operation of groundwater extraction well systems.
- Operation of all site wastewater conveyance and treatment systems and their ancillary facilities.
- Estimating, planning, and executing corrective and preventive maintenance.
- Training and qualification of operators and supervisors.
- Developing, reviewing, and revising standard operating procedures.
- Sampling of process streams for compliance with operational parameters and established regulatory limits.

Site Environmental Monitoring/Data Management and Reporting personnel are responsible for:

- Collection of groundwater monitoring samples and aquifer water level data.
- Coordination of sample analysis, data management, and preparation of the annual Site Environmental Report.
- Analysis of wastewater treatment operations process control samples.

Site Environmental Compliance personnel are responsible for:

- Fulfilling site NPDES reporting requirements.
- Analysis of state and federal regulations to identify project-specific regulatory requirements.

The site Safety and Health team, in conjunction with Safety and Health personnel, are responsible for the following Safety and Health activities within the project:

- Development and revision of Safety and Health project matrices for operations, maintenance, and construction.
- Radiological monitoring of activities.
- Industrial health monitoring of activities.
- Oversight of construction and operations safety programs.
- Safety design reviews and technical input.

Individual project team members are responsible for the safe execution of the work assigned to them and have the right to stop work if unsafe conditions are observed.

The project controls and finance personnel, in conjunction with Fernald project management, are responsible for:

- Project cost and schedule baseline development and maintenance.
- Cost performance and variance reporting.
- Estimate at completion funding analysis and reporting.

- Change proposal and cost-savings coordination.
- Project quality assurance oversight.

7.2 Regulatory Agency Interaction

As noted in Sections 1.0 and 3.0, Attachment D (the IEMP) provides for the collection and reporting of groundwater remedy performance (Section 3.0 of Attachment D) and treated effluent (Section 4.0 of Attachment D) information that supports operational decisions regarding groundwater restoration and water treatment. The current plan is that well field and treatment operational summaries are included in the annual Site Environmental Report. In addition, the NPDES reporting will continue as outlined in Section 4.0 of Attachment D. Meetings and conference calls will continue as necessary.

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Attachment B

On-Site Disposal Facility
Post-Closure Care and Inspection Plan

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Contents

Figures

Tables

Abbreviations

ARARs	applicable or relevant and appropriate requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facility Compliance Agreement
ft	foot/feet
GEMS	Geospatial Environmental Mapping System
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
IC Plan	Institutional Controls Plan
IEMP	Integrated Environmental Monitoring Plan
LCS	leachate collection system
LDS	leak detection system
LM	Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
mg/kg	milligrams per kilogram
mm	millimeters
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU	operable unit
PCCIP	Post-Closure Care and Inspection Plan
pCi/g	picocuries per gram
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
WAC	waste acceptance criteria

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1.0 Introduction

This On-Site Disposal Facility (OSDF) Post-Closure Care and Inspection Plan (PCCIP) covers the long-term care of the Fernald Preserve's OSDF and its associated buffer area. This plan has been developed to address reasonably expected circumstances that may arise during the post-closure care period, or legacy management, of the Fernald Preserve. Other relevant key concepts addressed by this PCCIP are ownership, access controls and restrictions, deed and use restrictions, environmental monitoring, inspections (scheduled, unscheduled, and contingency), custodial maintenance, contingency repair, corrective actions, emergency notification and reporting, and public involvement. The PCCIP became part of the Comprehensive Legacy Management and Institutional Controls Plan (LMICP) in January 2006.

1.1 Plan Scope and Duration

This PCCIP establishes the inspection, monitoring, and maintenance activities necessary to ensure the continued proper performance of the OSDF. The facilities and structures covered by this PCCIP include the following:

- Security system (e.g., fences, gates, warning signs).
- Permanently surveyed benchmarks, corner monuments, and cap survey anchors.
- OSDF run-on/runoff controls.
- OSDF final cover (referred to as the "cap").

As specified in the Records of Decision (RODs) and in accordance with appropriate regulations, the initially established duration of the post-closure care period is 30 years, subject to potential future modification. The applicable regulations are the Ohio solid waste rules (*Ohio Administrative Code* [OAC] 3745-27-14[A]) in lieu of federal solid waste regulation (Title 40 *Code of Federal Regulations* [CFR] § 258.61[a]), and Ohio hazardous waste rules OAC 3745-66-17 and 3745-68-10 in lieu of federal hazardous waste regulations 40 CFR §§265.117(a)(1) and 264.117(a)(1), respectively. Care and maintenance of the OSDF will continue in perpetuity.

1.2 Plan Organization

The plan is organized as follows:

- The remainder of Section 1.0 presents a description of the parties responsible for this plan and the support plans that are to be used in conjunction with this plan.
- Section 2.0 addresses the requirements pertinent to this plan.
- Section 3.0 addresses final site conditions at closure of the OSDF.
- Section 4.0 addresses institutional controls and points of contact.
- Section 5.0 addresses environmental monitoring.
- Section 6.0 addresses routine scheduled inspections.
- Section 7.0 addresses unscheduled inspections.

- Section 8.0 addresses custodial maintenance and contingency repair.
- Section 9.0 addresses corrective actions.
- Section 10.0 addresses emergency notification and reporting.
- Section 11.0 addresses public involvement.
- Section 12.0 presents references.

1.3 Responsible Parties

The governing document for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions at the Fernald Preserve is the Amended Consent Agreement between the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) Region 5, signed in September 1991. Responsibility for implementation of the PCCIP lies with DOE as the lead agency responsible for CERCLA activities at the Fernald Preserve and with EPA as the oversight agency. The DOE Office of Legacy Management (LM) has the ultimate authority for ensuring that the post-closure care of the OSDF meets all the goals, standards, specifications, and requirements of this PCCIP.

1.4 Related Plans

Several other support plans have been prepared for the OSDF remedial action project and should be used in conjunction with this plan, or referred to for information on how contaminated materials were placed into the OSDF. The other plans containing information relevant to this plan are listed below with a brief statement of the relationship to this plan. These plans are accessible either electronically or in hard copy.

- *Permitting Plan and Substantive Requirements for the On-Site Disposal Facility* (DOE 1998): Identifies the administrative and substantive requirements for the National Pollutant Discharge Elimination System permit, and the substantive requirements for all of the operable units' (OUs') onsite disposal needs for the Wetlands Nationwide Permit, the Ohio Solid Waste Permit to Install, and the Resource Conservation and Recovery Act (RCRA) permit; additionally, discusses how the requirements relate to the OSDF, presents the plan for compliance with the requirements, and discusses additional applicable or relevant and appropriate requirements (ARARs) that are not related to the issuance of a specific permit.
- *Construction Quality Assurance Plan; On-Site Disposal Facility* (Geosyntec 2001a): Contains procedures used to evaluate soils and other features of the OSDF liner and final cover system.
- *Final Design Criteria Package; On-Site Disposal Facility* (Geosyntec 1997): Provides the design of the OSDF and includes the *Final Remedial Design Work Plan*, which presents the design approach for the OSDF.
- *Impacted Materials Placement Plan; On-Site Disposal Facility* (Geosyntec 2005): Outlines waste acceptance criteria (WAC) for the OSDF and contains procedures used to place the contaminated materials into the OSDF.

- *Surface Water Management and Erosion Control Plan; On-Site Disposal Facility* (Geosyntec 2001b): Provides details of permanent erosion and sediment controls and surface water controls for the OSDF, including maintenance requirements for channels and sediment controls.
- Groundwater/Leak Detection and Leachate Monitoring Plan (Attachment C to the LMICP): Provides details on the leak detection monitoring program for the OSDF, addresses monitoring within the OSDF in the leachate collection system (LCS) and leak detection system (LDS), and the underlying groundwater in the till immediately underneath the OSDF and the groundwater in the Great Miami Aquifer.
- *Systems Plan; Collection and Management of Leachate for the On-Site Disposal Facility* (DOE 2001): Describes the inspection, monitoring, and maintenance activities that will be undertaken at the Fernald Preserve to collect and manage leachate collected from the OSDF.
- Integrated Environmental Monitoring Plan (IEMP) (Attachment D to the LMICP): Defines the environmental monitoring and reporting requirements, including post-closure requirements.
- *Work Plan for Removal and In-Place Abandonment of the OSDF Cell 1 Final Cover Monitoring System* (Geosyntec 2006): Explains the process used to remove and abandon in place the Cell 1 final cover monitoring system.

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2.0 Pertinent Requirements

2.1 Overview

Regulatory and other requirements pertinent to this plan primarily take the form of ARARs and to-be-considered criteria as determined by the ROD for each of the various Fernald Preserve OUs, functional requirements, and general design criteria. These are addressed in the following subsections.

2.2 Pertinent Requirements

ARARs and to-be-considered criteria that should be addressed by this plan are provided in Table 1 as obtained from the *Final Record of Decision for Remedial Actions at Operable Unit 2* (DOE 1995a), the *Final Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996a), and the *Operable Unit 3 Record of Decision for Final Remedial Action* (DOE 1996b), as identified by an *X* in the appropriate column. Additional regulatory requirements that are appropriate guidance for development or maintenance of this plan have been identified and are indicated by an *X* in the *Permitting Plan and Substantive Requirements for the On-Site Disposal Facility* (DOE 1998) column but no *X* in the previous columns.

Table 1. ARARs and To-Be-Considered Criteria

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
PLANS						
1	Ohio Municipal Solid Waste Rules—Sanitary Landfill Facility Permit to Install Application OAC 3745-27-06(C)(7)	• Prepare a post-closure plan as detailed in OAC 3745-27-11(B).	X	X	X	X
		• Prepare a leachate monitoring plan to ensure compliance with OAC 3745-27-19(M)(4).	X	X	X	X
		• Prepare a leachate contingency plan as required by OAC 3745-27-19(K)(6).	X	X	X	X
		• Prepare a groundwater detection monitoring plan as required by OAC 3745-27-10 and, if applicable, a groundwater quality assessment plan and/or corrective measures plan required by OAC 3745-27-10.	X	X	X	X
2	Ohio Municipal Solid Waste Rules—Final Closure of Sanitary Landfill Facility OAC 3745-27-11(B)	The owner shall prepare a post-closure plan which shall contain: • The name and location of the facility and unit(s) included in the plan. • A description of the post-closure activities. • The name, address, and telephone number of the person or office to contact regarding the unit(s) of the facility during the post-closure care period. The Ohio Environmental Protection Agency (Ohio EPA) shall be notified of any changes.			X	X

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
3	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Plan: Amendment of Plan OAC 3745-66-18(A) and (C)	The owner of a hazardous waste disposal unit shall have a written post-closure plan, which shall identify the activities that will be carried on after closure of each unit and the frequency of those activities, and include at least: • A description of the planned monitoring activities and frequencies at which they will be performed. • A description of the planned maintenance activities and frequencies at which they will be performed, to ensure (a) the integrity of the cap and final cover or other containment systems, and (b) the function of the monitoring equipment. • The name, address, and telephone number of the person or office to contact about the hazardous waste disposal unit or facility during the post-closure period.				X
CLOSURE AND POST-CLOSURE OBJECTIVES						
4	Ohio Municipal Solid Waste Rules—Final Closure of a Sanitary Landfill Facility OAC 3745-27-11(H)	At final closure of a landfill facility: • All land surfaces shall be graded to prevent ponding of water where solid waste has been placed. Drainage facilities shall be provided to direct surface water from the landfill facility. • A groundwater monitoring system shall be designed and installed in accordance with OAC 3745-27-10, if a system is not already in place.	X	X		X
5	Ohio Municipal Solid Waste Rules—Final Closure of a Sanitary Landfill Facility OAC 3745-66-11(O)	Closure of the sanitary landfill facility must be completed in a manner that minimizes post-closure formation and release of leachate to surface water to the extent necessary to protect human health and the environment.	X	X		X
6	Ohio Hazardous Waste Interim Standards Rules—Closure Performance Standard OAC 3745-66-11	The owner shall close his facility in a manner that: • Minimizes the need for further maintenance. • Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the groundwater, or surface waters, or to the atmosphere. • Complies with closure requirements.		X	X	X

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
7	Ohio Hazardous Waste Landfill Rules—Closure and Post-closure OAC 3745-68-10(A) (in lieu of 40 CFR § 265.310[a])	At final closure of the landfill, the owner or operator must cover the landfill with a final cover designed and constructed to: • Provide long-term minimization of migration of liquids through the closed landfill. • Function with minimum maintenance. • Promote drainage and minimize erosion or abrasion of the cover. • Accommodate settling and subsidence so that the cover's integrity is maintained. • Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present.		X	X	X
8	Ohio Municipal Solid Waste Rules—Operational Criteria for a Sanitary Landfill Facility OAC 3745-27-19-(J)(1) and (4)	Surface water shall be diverted from areas where solid waste has been deposited. The facility shall be designed, constructed, maintained, and provided with surface water control structures, as necessary, to control run-on and runoff of surface water to ensure minimal infiltration of water through the cover material and cap system, and minimal erosion of the cover material and cap system. If ponding or erosion occurs on areas of the landfill facility where solid waste had been deposited, action will be taken to correct the conditions causing the ponding or erosion.	X	X	X	X
9	Ohio Municipal solid Waste Rules—Operational Criteria for a Sanitary Landfill Facility OAC 3745-27-19(E)(26)	The integrity of the engineered components of the landfill facility shall be maintained and any damage to, or failure of, the components shall be repaired.	X	X	X	X
DURATION OF POST-CLOSURE CARE PERIOD						
10	Ohio Municipal Solid Waste Rules—Post-Closure Care of Sanitary Landfill Facilities OAC 3745-27-14(A) (in lieu of RCRA Subtitle D)	Following completion of final closure activities in accordance with OAC 3745-27-11, post-closure care activities shall be conducted at the sanitary landfill facility for a minimum of 30 years.	X	X	X	X
11	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Care and Use of Property OAC 3745-66-17(A) (in lieu of 40 CFR §265.117[a][1])	Post-closure care must begin after completion of the unit and continue for 30 years after that date, unless shortened or extended by the Ohio Director of Environmental Protection in accordance with OAC 3745-66-18(G) (40 CFR §265.117[a][2]). Note: Identified in OU5 ROD as applicable only to existing Hazardous Waste Management Units (HWMUs).			X	

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
12	Ohio Municipal Solid Waste Rules— Post-Closure Care of Sanitary Landfill Facilities OAC 3745-27-14(A)(1) and (2) (in lieu of RCRA Subtitle D)	Post-closure care activities for all sanitary landfill facilities shall include, but are not limited to: • Continuing operation and maintenance of the leachate management system, surface water management system, and the groundwater monitoring system. • Maintaining the integrity and effectiveness of the cap system, including making repairs to the cap system as necessary to correct the effects of erosion and preventing run-on and runoff from eroding or otherwise damaging the cap system.	X	X	X	X
13	Ohio Hazardous Waste Interim Standards Rules— Post-Closure Care and Use of Property OAC 3745-66-17(A)(1) (in lieu of 40 CFR §265.117[a][1])	Post-closure care must consist of at least the following: • Monitoring and reporting. • Maintenance and monitoring of waste containment systems. Note: Identified in OU5 ROD as applicable only to existing HWMUs.			X	
14	Ohio Hazardous Waste Landfill Rules—Closure and Post-Closure OAC 3745-68-10(B) (in lieu of 40 CFR §265.310[b])	After final closure, the owner or operator must comply with post-closure requirements, including maintenance and monitoring throughout the post-closure care period. The owner or operator must: • Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events. • Continue to operate the leachate collection and removal system until leachate is no longer detected. • Maintain and monitor the LDS. • Maintain and monitor the groundwater monitoring system. • Prevent run-on and runoff from eroding or otherwise damaging the final cover. • Protect and maintain surveyed benchmarks.		X	X	X
15	Ohio Hazardous Waste Landfill Rules—Closure and Post-Closure OAC 3745-68-10(D) (in lieu of 40 CFR§ 265.310[b])	During the post-closure period, the owner of a hazardous waste landfill must: • Maintain the function and integrity (integrity and effectiveness) of the final cover. • Maintain and monitor the leachate collection, removal, and treatment system to prevent excess accumulation of leachate in the system. • Protect and maintain surveyed benchmarks.		X	X	X

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
MODIFICATIONS TO POST-CLOSURE CARE PLAN OR PERIOD						
16	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Plan; Amendment of Plan OAC 3745-66-18(D)	The owner may amend the post-closure plan any time during the active life of the facility or during the post-closure period.				X
17	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Plan; Amendment of Plan OAC 3745-66-18(G)	The post-closure plan and length of the post-closure care period may be modified any time prior to the end of the post-closure care period. A modification of the post-closure plan may include, where appropriate, the temporary suspension rather than permanent deletion of one or more post-closure care requirements. At the end of specified period of suspension, the Ohio Director of Environmental Protection would then determine whether the requirements should be permanently discontinued or reinstated to prevent threats to human health and the environment.				X
PROPERTY USE RESTRICTIONS						
18	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Care and Use of Property OAC 3745-66-17(C) (in lieu of 40 CFR §265.117[c])	Post-closure use of property on or in which hazardous wastes remain after partial or final closure must never be allowed to disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the facility's monitoring systems, unless the Ohio Director of Environmental Protection approves otherwise. Note: Identified in OU5 ROD as applicable only to existing HWMUs. Note: If clean closure is performed, then post-closure care is not required.			X	
19	Ohio Hazardous Waste Landfill Rules—Closure and Post-Closure OAC 3745-68-10(D)(5)	During the post-closure period, the owner of a hazardous waste landfill must restrict access to the landfill as appropriate for its post-closure use.		X	X	X
20	Ohio Municipal Solid Waste Rules—Final Closure of a Sanitary Landfill Facility OAC 3745-27-11-(H)(5)	The owner shall file—with the board of health having jurisdiction, with the county recorder of the county in which the facility is located, and with the Ohio Director of Environmental Protection—a plat of the unit(s) of the sanitary landfill facility and information describing the acreage, exact location, depth, volume, and nature of the solid waste deposited in the unit(s) of the sanitary landfill facility.		X		X

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
21	Ohio Hazardous Waste Interim Standards Rules—Survey Plat OAC 3745-66-16	The owner shall submit—to the local zoning authority, or the authority with jurisdiction over local land use, and to the Ohio Director of Environmental Protection—a survey plat, prepared and certified by a professional land surveyor, indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat must contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the hazardous waste disposal unit in accordance with OAC 3745-66-17(C).		X		X
22	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Notices OAC 3745-66-19(A)	The owner shall submit—to the local zoning authority, or the authority with jurisdiction over local land use, and to the Ohio Director of Environmental Protection—a record of the type, location, and quantity of hazardous wastes disposed of within each cell or disposal unit of the facility.				X
		DEED NOTATION				
23	Ohio Municipal Solid Waste Rules—Final Closure of a Sanitary Landfill Facility OAC 3745-27-11(H)(5)	The owner shall record a notation on the deed to the sanitary landfill facility property, or on some other instrument which is normally examined during title search, that will notify in perpetuity any potential purchaser of the property that: • The land has been used as a sanitary landfill facility. • Includes information describing acreage, exact location, depth, volume, and nature of solid waste deposited in the sanitary landfill facility.	X	X		X
24	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Notices OAC 3745-66-19(B)	The owner shall record, in accordance with state law, a notation or the deed of the facility property, or on some other instrument which is normally examined during title search, that will notify in perpetuity the potential purchasers of the property that: • The land has been used to manage hazardous wastes. • Its use is restricted under the *Ohio Administrative Code* closure and post-closure rules. • The survey plat and record of the type, location, and quantity of hazardous wastes disposed of within each cell or hazardous waste unit of the facility as required by OAC 3745-66-16 and 3745-66-19(A) have been filed with the local zoning authority or the authority with jurisdiction over local land use and with the Ohio Director of Environmental Protection.				X

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
25	Ohio Hazardous Waste Interim Standards Rules—Post-Closure Notices OAC 3745-66-19(C)	If the owner or any subsequent owner of the land upon which a hazardous waste disposal unit was located wishes to remove hazardous wastes and hazardous waste residues in satisfaction of the criteria in OAC 3745-66-17(C), the owner may request that the Ohio Director of Environmental Protection approve either or the following: • The removal of the notation on the deed to the facility property or other instrument normally examined during title search. • The addition of a notation to the deed or instrument indicating the removal of the hazardous waste.				X
OTHER DOE CRITERIA						
26	Disposal Site Closure/Post-Closure DOE Order 5820.2A, Chapter III (3)(j)—This order has been replaced with DOE Order 435.1 Chg 2.	• During post-closure, residual radioactivity levels for surface soil shall comply with existing DOE decommissioning guidelines. • Inactive disposal facilities, disposal sites, and disposal units shall be managed in conformance with RCRA, CERCLA, and the Superfund Amendments and Reauthorization Act of 1986, as amended. • Corrective measures shall be applied to new disposal sites or individual disposal units if conditions occur or are forecasted that could jeopardize attainment of the performance objectives (of the unit). • Termination of monitoring and maintenance activity at closed facilities or sites shall be based on an analysis of site performance at the end of the institutional control period.	X	X	X	

Table 1. ARARs and To-Be-Considered Criteria (continued)

#	Title	Requirements	OU2 ROD	OU3 ROD	OU5 ROD	OSDF Permitting Plan
27	Environmental Monitoring DOE Order 5820.2A, Chapter III(3)(k)—This order has been replaced with DOE Order 435.1 Chg 1.	I.1.E.(7) Environmental Monitoring. Radioactive waste management facilities, operations, and activities shall meet the environmental monitoring requirements of DOE Order 5400.1, *General Environmental Protection Program*; and DOE Order 458.1, *Radiation Protection of the Public and the Environment*. IV.R.(3)(a) The site-specific performance assessment and composite analysis shall be used to determine the media, locations, radionuclides, and other substances to be monitored. IV.R.(3) Disposal Facilities. • (C) The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives in this chapter.	X	X	X	

2.3 Functional Requirements

The *Final Design Criteria Package; On-Site Disposal Facility* (Geosyntec 1997) contains a variety of functional requirements that have been established for the OSDF. The functional requirements pertinent to this plan are to:

- Protect the OSDF from damage caused by precipitation and storm water run-on and runoff.
- Route run-on and runoff to designated diversion channel locations for appropriate management.
- Discharge surface water to existing watercourses in accordance with applicable regulatory and DOE requirements.

The surface water management system should be maintained such that it will continue to perform in a manner that meets the project requirements for long-term conditions (i.e., after site physical completion). The system should prevent storm water run-on to the OSDF and uncontrolled storm water runoff from the OSDF. Features of the long-term surface water management system were constructed to require minimal monitoring and maintenance. The system was integrated, to the extent possible, with existing topography, features, and facilities.

2.4 General Design Criteria

The OSDF Design Criteria Package also identifies a number of general design criteria for the OSDF. The general design criteria pertinent to this plan are:

- Long-term erosion and sediment control features for the OSDF were designed for the 2,000-year, 24-hour storm event (design criterion for assumption of a DOE Performance Category 2 facility).
- Long-term run-on/runoff control structures for the OSDF were designed to limit interruption and damage (i.e., washout) of the OSDF in the 2,000-year, 24-hour storm event (design criterion for assumption of a DOE Performance Category 2 facility); run-on should be controlled and diverted away from and around the OSDF using swales, channels, or diversion berms.

2.5 Other Requirements

In addition to the requirements contained in the OSDF Design Criteria Package, the following requirements have been incorporated into this plan:

- Disturbed areas should be stabilized (i.e., vegetated) after the area has been reconstructed to final grade.
- General practices for inspection and maintenance of erosion and sediment control features should be as recommended by the Ohio Department of Natural Resources Division of Soil and Water Conservation document *Rainwater and Land Development: Ohio's Standards for Storm Water Management, Land Development, and Urban Stream Protection* (ODNR 2006 or its most current revision).

Other criteria relevant to this plan consist of those industry standard practices that have proven effective at other waste disposal facilities. Inspection and monitoring requirements from the manufacturers and suppliers of material and equipment installed at the OSDF are also criteria relevant to this plan.

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3.0 Final Site Conditions

3.1 Site History

In July 1986, DOE and EPA signed a Federal Facilities Compliance Agreement (FFCA), addressing impacts to the environment associated with the federally operated site known as the Feed Materials Production Center. DOE agreed to conduct the FFCA investigation as a remedial investigation/feasibility study in accordance with guidelines of CERCLA. In November 1989, the Fernald Site was included on the EPA National Priorities List. The FFCA was later amended by the June 1990 Consent Agreement between DOE and EPA, which was further modified by amendment in September 1991.

In accordance with the September 1991 Amended Consent Agreement, EPA approved and signed the OU2 ROD on June 8, 1995; the OU5 ROD on January 31, 1996; and similarly, the OU3 ROD for Final Remedial Action on September 24, 1996. The design of the OSDF, as currently developed, is presented in the *Final Design Criteria Package; On-Site Disposal Facility* (Geosyntec 1997). The Final Design Criteria Package includes the *Final Remedial Design Work Plan for Remedial Actions at Operable Unit 2* (DOE 1995b), which presents the design approach for the OSDF and which was submitted to EPA in August 1995 and subsequently approved in November 1995. The Ohio Environmental Protection Agency (Ohio EPA), which actively participated throughout the CERCLA response process, also concurred with the documentation and decisions to date.

The OSDF was constructed to permanently contain impacted materials derived from the remediation of the OUs at the Fernald Site. All material placed in the OSDF was required to meet OSDF WAC. The OU2 ROD established radiological WAC of 346 picocuries per gram (pCi/g) of uranium-238 or 1,030 milligrams per kilogram (mg/kg) total uranium for all soil and soil-like impacted material destined for the OSDF. Similarly, the OU5 ROD established additional radiological and chemical WAC for OU5 soils destined for the OSDF. The OU3 ROD established radiological WAC for debris materials destined for the OSDF of 105 total grams technetium-99. These radiological/chemical WAC have been compiled and are presented in Table 2. The impacted materials sent to the OSDF from OU3 may also have included small material contributions from OUs 1 and 4. Any material from OUs 1 and 4 destined for the OSDF met the OU3 WAC. In addition to the radiological/chemical WAC discussed above, the *Impacted Materials Placement Plan*; *On-Site Disposal Facility* (Geosyntec 2005) presents physical WAC for the OSDF.

The volume of the impacted material that was destined for disposal in the OSDF was originally estimated at 2.9 million cubic yards (2.2 million cubic meters) bank/unbulked. Approximately 80 percent of this volume was expected to consist of impacted soil, and the remainder would be building demolition rubble, fly ash, lime sludge, municipal solid waste, and small quantities of miscellaneous other materials. After soil and soil-like material, debris from demolition of buildings in the former production area was expected to constitute the largest volume of impacted material for OSDF disposal. The OU3 ROD indicates that impacted debris could be assigned to one of ten material categories. Only material from seven of these categories was disposed of in the OSDF. The seven material categories of impacted debris allowed for disposal in the OSDF are presented in Table 3, which also gives descriptions of the materials making up the categories.

Table 2. On-Site Disposal Facility Waste Acceptance Criteria

#	Constituent of Concern	Soil[a]		Debris[b]
		OU2	OU5[d]	OU3
	Radionuclides:			
1	Neptunium-237		3.12×10^{9} pCi/g	105 g
2	Strontium-90		5.67×10^{10} pCi/g	
3	Technetium-99		29.1 pCi/g	
4	Uranium-238	346 pCi/g		
	Total Uranium	1,030 mg/kg	1,030 mg/kg	
	Inorganics:			
5	Boron		1.04×10^{3} mg/kg	
6	Mercury[c]		5.66×10^{4} mg/kg	
	Organics:			
7	Bromodichloromethane		9.03×10^{-1} mg/kg	
8	Carbazole		7.27×10^{4} mg/kg	
9	Alpha-chlordane		2.89 mg/kg	
10	Bis (2-chlorisopropyl) ether		2.44×10^{-2} mg/kg	
11	Chloroethane		3.92×10^{5} mg/kg	
12	1,1-Dichloroethene[c]		11.4 mg/kg	
13	1,2-Dichloroethene[c]		11.4 mg/kg	
14	4-Nitroaniline		4.42×10^{-2} mg/kg	
15	Tetrachloroethene[c]		128 mg/kg	
16	Toxaphene[c]		1.06×10^{5} mg/kg	
17	Trichloroethene[c]		128 mg/kg	
18	Vinyl chloride[c]		1.51 mg/kg	

[a] Maximum concentration.
[b] Maximum total mass.
[c] RCRA-based constituent of concern.
[d] Constituents that have established maximums that serve as WACs; other compounds that will not exceed designated Great Miami Aquifer action levels within 1,000-year performance period, regardless of starting concentration in the OSDF, are not listed.

Sources: OU2 ROD (DOE 1995a), OU3 ROD (DOE 1996b), OU5 ROD (DOE 1996a).

Table 3. OU3 Material Categories and Descriptions

Category A **Accessible Metals**	**Category B** **Inaccessible Metals**	**Category D** **Painted Light Gauge Metals**	**Category E** **Concrete**	**Category G** **Non-regulated Asbestos-Containing Material**	**Category H** **Regulated Asbestos-Containing Material**	**Category I** **Miscellaneous Materials**
Structural and miscellaneous steel	• Doors • Conduit/wire/ cable tray • Electrical wiring and fixtures • Electrical transformers • Miscellaneous electrical items • Heating, ventilation, and air conditioning equipment • Material handling equipment • Process equipment • Miscellaneous equipment • Piping	• Ductwork • Lead flashing • Louvers • Metal wall and roof panels	• Asphalt • Slabs • Columns • Beams • Foundations • Walls • Masonry • Clay piping	• Ceiling demolition • Feeder cable • Fire brick • Floor tile • Transite wall and roof panels	• Ductwork insulation • Piping insulation • Personal protective equipment • Copper scrap metal pile	• Polyvinyl chloride (PVC) conduit • Basin liners • Fabric • Drywall • Building insulation • Miscellaneous debris • Personal protective equipment • PVC piping • Roofing build-up • Process trailers • Non-process trailers • Windows • Wood

Source: Table 4–2, OU3 Material Categories/Description, OU3 ROD (DOE 1996b).
Note: Only those seven material categories allowed for onsite disposal according to the OU3 ROD are presented.

3.2 Location and Description of the OSDF Area

A pre-design investigation was performed to define the most suitable location for the OSDF within an identified area at the Fernald Site, based on the OU2 and OU5 Remedial Investigation/Feasibility Study. The results of that investigation are presented in the *Pre-design Investigation and Site Selection Report for the On-Site Disposal Facility* (DOE 1995c). The report, its objectives, and its results are summarized below.

The identified best area is located on the east side of the Fernald Site property and measures approximately 2,000 feet (ft) east to west by 5,300 ft north to south. This location was considered the best location for an OSDF because it has the greatest thickness of gray clay, which provides a protective layer over the underlying Great Miami Aquifer. Fate and transport modeling and risk assessments in the OU2 and OU5 feasibility studies have shown that a disposal facility in this area, based on a feasible facility design and a 12-foot thick gray clay layer, would be protective of human health and the environment. The identified best area is bounded on the north, east, and south using the Ohio EPA siting requirements (buffer from property line and water supply wells). The western boundary incorporates areas with greater than 12 ft of gray clay, with the exception of the northern portion of the west boundary line, which was determined based on identification of sand lenses within the gray clay.

Planning meetings between DOE, EPA, and Ohio EPA resulted in a pre-design investigation that had three objectives (identified in Table 4). Results of the pre-design investigation served as the basis for selecting the location within the identified best area for siting the OSDF. The selected location, measuring 800 ft east to west by 4,300 ft north to south, provided suitable space for the estimated 2.5 million cubic yards of impacted materials and met applicable Ohio EPA siting requirements. The gray clay thickness is greater than the minimum 12-foot thickness established in the OU2 ROD (DOE 1995a) for protection of the Great Miami Aquifer; the gray clay is actually greater than 15 ft thick within the selected location, and approximately 75 percent of the selected location has a 20- to 50-foot thickness of gray clay. The investigation identified minimal amounts of interbedded granular material, none of which would offer a rapid migration pathway through the gray clay.

3.3 OSDF As-Built

The design approach for the OSDF is presented in the *Final Remedial Design Work Plan for Remedial Actions at Operable Unit 2* (DOE 1995b). The design approach of the OSDF, as currently developed, is presented in the *Final Design Criteria Package; On-Site Disposal Facility* (Geosyntec 1997). The design of the OSDF includes a liner system, impacted material placement, final cover system, leachate management system, surface water management system, and other ancillary features.

As-built conditions of the completed OSDF are documented with a set of as-built record drawings and photographs. These drawings are incorporated into the LM GIS database. This information provides baseline conditions for comparison to future conditions during the post-closure period. These drawings can be used to document changes in the physical site conditions of the OSDF over time and to develop a corrective action plan, if required. The drawings are accessible at the site, either electronically or in hard copy.

Table 4. Pre-Design Investigation Objectives and Field Components

#	Objective	Field Components
1	Identify the most suitable hydrogeology within the identified best area	Verification of the gray clay thickness Identification of interbedded granular material
2	Verify protection of human health and the environment	Verification of existing vertical and horizontal uranium contamination Actual uranium solubility Uranium retardation Lateral and vertical gradients Background concentrations of uranium in water in the vadose zone
3	Develop field information for the design of the OSDF	Location and extent of interbedded granular material Obtain geotechnical information in the footprint of the OSDF

The final OSDF site map was compiled from a final topographic map of the Fernald Site. The final topographical survey was conducted in accordance with the standards of the *Manual of Photogrammetry* (ASPRS 1980). The following specifications were used in developing the map, in accordance with the appropriate regulations (Ohio solid waste rules OAC 3745-27-06[B][2] and 3745-27-11[H][5][a], and Ohio hazardous waste general new facility rule OAC 3745-54-18 and hazardous waste interim status facility rule OAC 3745-66-16):

- A scale of 1 inch = 200 ft (1 millimeter [mm] = 2.4 m).
- A contour interval of 5 ft (1.5 m).
- A coverage area of the OSDF site and a distance of 1,000 ft.
- North arrow displayed.

In addition to existing topography, the maps will define the following:

- Property lines of the land owned by DOE.
- Limits of impacted material placement.
- Outline of the toe and crest of the OSDF.
- The individual phases/cells of the OSDF.
- OSDF site property boundaries, fences, gates, and access roads.
- Location and extent of permanent storm water run-on and runoff control features.
- Vegetation, streams, lakes, springs, and other surface waters.
- Survey control stations/benchmarks.
- Permanent site surveillance features (e.g., monuments, markers, signs).
- Wetlands (if any) within the limits of impacted material placement and within 200 ft of the limits of impacted material placement.

- Limits of a regulatory floodplain (i.e., 100-year floodplain as depicted on a federal insurance administration flood map, according to OAC 3745-27-01 and 3745-54-18[B]).
- Site coordinate system.
- Existing residences, land uses, zoning classifications, property ownership, political subdivisions, and communities.
- Underground utilities (sewers, water lines, electric cables), field tiles, French drains, pipelines.
- Location (if any) within 200 ft of the limits of impacted material placement of any fault that has had displacement in Holocene time (OAC 3745-54-18[A]).
- All public and private water supply wells within 2,000 ft of the limits of impacted material placement (using a scale insert if necessary), and the current status of each, including depth, use, and where applicable, abandonment date, based on publicly available information.

  Note: DOE plans to update information on water supply wells only during the CERCLA Five-Year Reviews.

These as-built drawings were submitted to EPA and Ohio EPA. The map will be revised as part of the CERCLA five-year review, if necessary. When the OSDF map is updated, the revised map will include the year of revision, the revision number, and the type of the activity or event that triggered the need for the revision. No revision was identified during the 2021 CERCLA five-year review. Aerial surveys of the site will be conducted via light detection and ranging (lidar) or equivalent technology shortly after the prescribed burn of the vegetated cell cap. Lidar surveys are planned to occur every 4 to 6 years, following an OSDF cap burn. Prescribed burns of the OSDF are scheduled to take place every other year. Implementation of both prescribed burns and lidar surveys is dependent on weather. These aerial surveys will allow for comparison of topography over time to detect changes in the OSDF cap that may not be observable during field walkdowns. Data from these aerial surveys will be used to supplement the field walkdowns.

All drawings, disposal facility site maps, and photographs will be archived. DOE is responsible for maintaining and archiving these maps, drawings, and photographs as part of the OSDF permanent record.

3.4 OSDF Baseline Photographs

A photographic record of the final conditions after closure of the final cell of the OSDF is included and maintained in the OSDF permanent site file. This record consists of a series of aerial and ground photographs that provide a baseline visual record of final site construction and final site conditions to complement the as-built drawings. In particular, this set of aerial photographs provides a permanent record of site conditions, enabling future inspectors to monitor changes in site conditions (e.g., erosion patterns, vegetation changes, land use) over time. The need for new aerial photographs will be evaluated at the CERCLA five-year reviews. Specifications for historical aerial photography are available from the 2006 LMICP (DOE 2006). DOE will consider use of new technology as it becomes available. The objective is to obtain information that can be compared to the baseline information. No new aerial photographs were specified during the 2021 CERCLA five-year review. An updated aerial photograph was taken in 2021.

3.5 OSDF Inspection Photographs

Photographs are taken annually and during the quarterly site inspections to document conditions at the OSDF and its surrounding permanent features. These photographs provide a continuous record for monitoring changing conditions over time. The photographs can be compared with the baseline photographs to monitor site integrity.

Each photograph is recorded individually in a site-inspection photo log. An appropriate description of the feature photographed will be entered into the log. If possible, a photograph will include a reference point such as a survey monument, boundary monument, site marker, or monitoring well.

For specific areas where a photograph is used to monitor change over time, the photo location and the azimuth should be recorded, and all subsequent photographs should be taken from the same orientation to provide an accurate picture of changing conditions. If vegetation obstructs the photograph, vegetation will be cleared, or an elevated position will be used to maintain a clear viewshed.

Through 2022, quarterly OSDF inspection photographs were included in inspection reports. Beginning in 2023, the quarterly OSDF photographs will be presented only in the Site Environmental Report unless a finding is considered significant.

Prior to 2019, annual OSDF inspection photographs were posted on Geospatial Environmental Mapping System (GEMS), a Web-based application used to manage and provide agencies and the public with Internet access to electronic data (https://www.energy.gov/lm/fernald-preserve-ohio-site). Beginning in 2019, annual OSDF inspection photographs are included in the annual Site Environmental Report. All annual OSDF inspection photographs, as well as all corresponding photo log forms, will also be maintained in the permanent OSDF file.

Quarterly inspection photographs typically include cell cap side slopes and associated drainages. Photographs used for inspection follow-up are taken as needed. Additional OSDF features are documented with annual photographs. Table 5 summarizes the type and frequency of photo-documentation.

Table 5. OSDF Inspection Photograph Frequency and Reporting Mechanisms

Photograph	Frequency	Reporting Mechanism
Survey monuments and other permanent features.	Annually	Site Environmental Report
Inner and outer drainages.	Annually	Site Environmental Report
Fences, gates, warning signs, access roads, perimeter roads, paths, toe, and drainages.	Annually	Site Environmental Report
The OSDF (top, sides, buffer area, and surrounding area). Panoramic sequences of photographs from selected vantage points may be used for this purpose.	Annually	Site Environmental Report
Any evidence of erosion (e.g., gullies, rivulets, rills) that the inspector considers significant and documents in the inspection notes.	As needed	OSDF Quarterly Inspection Reports

Table 5. OSDF Inspection Photograph Frequency and Reporting Mechanisms (continued)

Photograph	Frequency	Reporting Mechanism
Any evidence of burrowing animals.	As needed	OSDF Quarterly Inspection Reports
Any off-OSDF features that may affect the OSDF in the future and that the inspector considers significant and documents in the inspection notes.	As needed	OSDF Quarterly Inspection Reports
General vegetation (OSDF side slope), presence of woody vegetation and invasive plant species.	Annually	Site Environmental Report
General vegetation (OSDF top slope and buffer area), presence of woody vegetation and invasive plant species.	Annually	Site Environmental Report
Any evidence of ponded water.	As needed	OSDF Quarterly Inspection Reports
Erosion protection material (riprap).	As needed	OSDF Quarterly Inspection Reports
Evidence of leachate seeps.	As needed	OSDF Quarterly Inspection Reports
Damaged monitoring wells.	As needed	OSDF Quarterly Inspection Reports

Features that are designated with an "As needed" frequency will be photographed only if specific follow-up inspection is required. In addition to the above, any new or potential problem areas identified during an inspection will be documented with photographs. Photographs can also be taken to record developing trends and to allow inspectors to make reasonable decisions concerning additional inspections, custodial maintenance or repairs, or corrective action.

4.0 Institutional Controls and Points of Contact

4.1 Introduction

This section discusses the institutional controls that will be in place for the OSDF and its buffer area during the post-closure care period (legacy management). The Institutional Controls Plan (IC Plan) (Volume II of the LMICP) is the enforceable governing document for institutional controls for the Fernald Preserve, and this PCCIP provides supporting details for the OSDF. Table 6 presents a compilation of the institutional controls for the OSDF and its buffer area, as identified in the OU2 and OU5 RODs. Environmental monitoring (Item 5), inclusive of groundwater monitoring (Item 4), is discussed in Section 5.0 of this PCCIP. This PCCIP, in general, addresses the maintenance program (Item 6). The remainder of Section 4.0 discusses the remaining items (1, 2, and 3).

Table 6. Institutional Controls as Key Components in the RODs

Item	Component	OU2 ROD	OU5 ROD
Institutional Controls			
		The selected remedy will include the following as institutional controls:	"Institutional controls, such as."[5a]
1	Ownership	"continued federal ownership of the [OSDF] site" [2a]	"property ownership will be maintained by the federal government of the area comprising the [on-site] disposal facility and associated buffer areas"[5b]
2	Access Controls/ Restrictions	"access restrictions (fencing)"[2a]	"access controls"[5a]
3	Deed Notations/ Use Restrictions	"restrictions on the use of property will be noted on the property deed before the property could be sold or transferred to another party" [2c]	"deed restrictions"[5a] ; "if portions of the Fernald property [outside the disposal facility area] are transferred or sold at any future time, restrictions will be provided in the deed, and proper notifications will be provided as required"[5b]
4	Groundwater Monitoring Program	"groundwater monitoring"[2a] . . . "following closure of the on-site disposal facility"[2b]	See entry 5 below, but not identified as an institutional control
Other Key Components of the Selected Remedy			
5	Environmental Monitoring Program	See entry 4 above	"long-term environmental monitoring program"[5a]
6	Maintenance Program	"maintenance of the on-site disposal facility"[2b]	"maintenance program to ensure the continued protectiveness of the remedy"[5a]

[2a]Declaration, Description of the Selected Remedy, p. D-2, OU2 ROD (DOE 1995a).
[2b]Decision Summary, Section 9.1 Key Components, p. 9-2, OU2 ROD (DOE 1995a).
[2c]Responsiveness Summary, Section 3.0 Summary of Issues and Responses, Issue 7 C Future Use/Ownership, p. RS-3-33, OU2 ROD (DOE 1995a).
[5a]Declaration Statement, Description of the Selected Remedy, p. D-ii, OU5 ROD (DOE 1996a).
[5b]Decision Summary, Section 9.1 Key Components, p. 9-18, OU5 ROD (DOE 1996a).

4.2 Points of Contact

Points of contact by either the name or position title, address, and telephone number of the person or office to contact about the OSDF during the post-closure care period are provided in Table 7, in accordance with appropriate regulations (Ohio solid waste rule OAC 3745-27-11[B][3] in lieu of federal solid waste regulation 40 CFR §258.61[c][2], and Ohio hazardous waste rules OAC 3745-66-18[C][3] and 3745-68-10 in lieu of federal hazardous waste regulations 40 CFR §§265.118[c][3] and 264.118[b][3], respectively). Table 7 presents the onsite points of contact and an emergency contact number that is accessible 24 hours a day. These points of contact will serve to ensure that access to the facility will be possible for appropriate authorized personnel after closure and in the case of an emergency. An updated copy of this plan will be maintained at each of the locations identified in Table 7.

Table 7. Points of Contact

	Title of Contact	Telephone	Mailing Address
1	LM, Fernald Preserve	(513) 648-3333	7400 Willey Road Hamilton, Ohio 45013
2	Site Contractor	(513) 910-6107	7400 Willey Road Hamilton, Ohio 45013
3	LM 24-hour number	(877) 695-5322	N/A

Due to the duration of the post-closure period, DOE anticipates that the points of contact are likely to change over time. DOE will notify the regulatory agencies of any changes to the points of contact via modification to this PCCIP.

4.3 Ownership

As presented in item 1 of Table 6, property ownership of the area comprising the OSDF and its associated buffer areas will be maintained by the federal government (e.g., DOE or a successor federal agency).

4.4 Access Controls/Restrictions and Security Measures

Access to the OSDF will be restricted by means of fences, gates, and warning signs. Access to those areas within the fencing will be controlled by DOE authorization and will be limited to personnel for inspection, custodial maintenance, corrective actions, or other DOE-authorized activity. The fences, gates, and warning signs are covered by the inspection and custodial maintenance components of the post-closure care program implemented under this PCCIP (refer to Sections 7.0 and 8.0) and the IC Plan (Volume II of the LMICP).

To provide additional security, the warning sign (Figure 1) is placed on the access gates to the OSDF.

Figure 1. OSDF Gate Sign

In addition to the entrance signs, weather-resistant signs are mounted on the chain-link fence surrounding the OSDF at approximately equal spacing (Figure 2). Signs are also posted on the chain-link fence with the international symbol indicating the presence of radioactive material.

Figure 2. OSDF Fence Sign

The effectiveness of site security measures (e.g., fence condition, locked gate) will be monitored through routine scheduled site inspections (refer to Section 6.0).

4.5 Deed Notations and Use Restrictions

If management of the OSDF is transferred from DOE to another federal entity, real estate restrictions will be included in the deed, and proper notifications will be provided as required by the appropriate rules and regulations. Specific details and the exact language appropriate to the specific parcels of property will need to be developed and inserted at the time the deed notice is recorded. In 2009, an Environmental Covenant was recorded with Hamilton and Butler Counties that documents the activity and use limitations for the property. The Environmental Covenant also requires the owner to submit a quarterly inspection report that verifies activity and use limitations are in compliance with the requirements.

In such an event, signed certification that the notation in the deed has been recorded will be submitted to the EPA regional administrator and the Ohio Director of Environmental Protection in accordance with appropriate regulations (Ohio solid waste rule OAC 3745-27-11[H][5] in lieu of federal solid waste regulation 40 CFR §258.60[I], and Ohio hazardous waste rules OAC 3745-66-19[A] and [B], and 3745-68-10[B] in lieu of federal hazardous waste regulations 40 CFR §§265.119[b][1] and 264.119[b][1]), accompanied by a copy of the document in which the notation has been placed.

5.0 Environmental Monitoring

5.1 Introduction

The primary element of environmental monitoring associated with the OSDF post-closure care period is groundwater monitoring. This section describes the focus and scope of the plans for the groundwater monitoring that is continuing for the OSDF.

5.2 Groundwater Monitoring

Groundwater monitoring for the OSDF is currently presented in the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP) (Attachment C to the LMICP). The focus of that plan is the leak detection monitoring program for the OSDF, addressing monitoring both within the OSDF (in the LCS and LDS) and the underlying groundwater (in the till layer immediately underneath the OSDF and the groundwater in the Great Miami Aquifer). Although the temporal coverage of that plan began in part prior to the placement of impacted material/remediation waste into the OSDF, its coverage continues during the legacy management of the site. The GWLMP will be revised over time to address monitoring needs; DOE will complete any revisions in consultation with EPA and Ohio EPA.

If a leak is detected from the OSDF, DOE will consult with EPA and Ohio EPA in accordance with the requirements established in the GWLMP for notifications and response actions.

5.3 Monitoring of Other Media

All environmental monitoring is covered by both the GWLMP and the IEMP. Monitoring under the IEMP indicates the additional media to be monitored (e.g., surface water) and includes sampling frequencies and constituents to be analyzed.

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6.0 Routine Scheduled Inspections

6.1 Introduction

This section establishes inspection techniques and frequency as required by the appropriate regulations (Ohio hazardous waste rules OAC 3745-66-18[A] and [C] in lieu of federal hazardous waste regulations 40 CFR §§264.118[b][2] and 265.118[c][2]). Components covered by these inspections are:

- Security system (e.g., fences, gates, locks, warning signs).
- Final cover system.
- Run-on and runoff control systems.
- Surveyed benchmarks—at least three third-order benchmarks on separate sides of the OSDF within easy access to the limits of waste/impacted materials placement (Ohio solid waste rule OAC 3745-27-08[C][7][a]–[c], and Ohio hazardous waste rule OAC 3745-68-10[D][4] in lieu of federal hazardous waste regulation 40 CFR §265.310[b][6]).

6.2 Routine Facility Inspections

Discussed in this section are those background details and preliminary considerations necessary to conduct routine scheduled inspections, including the inspection team, frequency and timing of inspections, and inspection aids. Also discussed are the procedures for routine scheduled inspections.

6.2.1 Preliminary Considerations

6.2.1.1 Frequency and Timing of Inspections

Routine scheduled inspections were conducted quarterly at the OSDF until the closure of the Fernald Closure Project. The objective of these inspections was to establish and record physical modifications to the OSDF through many seasonal cycles and to provide a basis for decisions regarding future inspections. Inspections consist of a cap "walkover" as well as an evaluation of fencing, drainages, roads, etc. Walkover inspections were conducted quarterly for 2 years following completion of cells 7 and 8. After the 2-year period, the frequency was to be reevaluated. Since October 2008, 2 years after completion of the OSDF, the OSDF cap inspections were conducted semiannually, in spring and fall. During the winter months, safely accessing the OSDF and scheduling of the inspection is difficult due to frequent inclement weather. During the summer months, vegetation on the majority of the cap is so dense that walking on the cap is difficult, and visibility of the ground surface is greatly reduced, limiting the quality of the actual inspection. These conditions have become more prevalent during the spring walkdown. So, beginning in 2012, the complete cap walkover is conducted annually in late fall or early winter, after warm-season grasses have gone dormant. Additional walkdowns of recently burned or mowed areas will also be scheduled. Post-burn walkdowns have shown to be an optimal time for viewing inspection findings, such as erosion rills, animal burrows and woody vegetation. Inspection of the institutional controls related to the OSDF (fencing, signs, locks, etc.) is conducted quarterly as part of the point-specific institutional control inspections. Areas of recent revegetation and repair activities are also inspected quarterly. Inspection of buffer areas and drainage features are inspected annually during the site inspection walkdown process. The frequency would also be reevaluated through the CERCLA Five-Year Review process. No significant changes to the inspection frequency were identified during the 2021 CERCLA five-year review.

Should the inspectors find that weather conditions at the site are not conducive to making a complete and thorough inspection, they will use the opportunity to observe and record changes to the cover, diversion channels, and other facility features. The remainder of the inspection tasks will then be rescheduled to a more favorable day.

6.2.1.2 Inspection Team

The inspection team for routine scheduled inspections will consist of a chief inspector and one or more assistants. The minimum number on a team is two; more can be assigned depending on the conditions expected at the facility at the time of inspection. If only two inspectors are assigned, one will be a geotechnical or civil engineer, and the second will be an ecologist. Prior to each inspection, DOE or its contractor will determine the size of the inspection team. EPA, Ohio EPA, and the Ohio Department of Health will be notified of the scheduled dates and times of these routine inspections so they may send representatives to accompany the inspection team.

Quarterly OSDF inspections shall be led by site personnel that are familiar with inspection requirements, maintenance, and management of the cap. For annual cap walkovers, the team includes an inspector with a degree in civil engineering or soil mechanics, and at least 5 years of experience (or an equivalent amount of experience and education) in projects involving the planning and implementation of earthen structure designs. Where possible, the chief inspector will have made at least one site inspection as an assistant inspector. Other members of the inspection team will have degrees and experience complementing the engineer, as appropriate, for the expected facility conditions. Team members will have a minimum of 3 years' experience (or an equivalent amount of experience and education) in their field. Prior to each inspection, DOE or its contractor will designate the inspection team.

6.2.1.3 Familiarization with Site Characteristics

The site inspection team will become familiar with the OSDF facility by reviewing this PCCIP and the most recent inspection report.

6.2.1.4 Preparations for Conducting OSDF Inspections

After facility familiarization, the inspection team must make preparations to conduct the field inspection. This requires the inspection team to:

- Obtaining approval to enter adjacent property (if required).
- Assembling the equipment needed to conduct the inspection. Equipment may include such items as maps, inspection forms, cameras, binoculars, tape measure, GPS unit, optical ranging devices, Brunton compass or equivalent, photo scale stick, erasable board, markers and wire flags.

6.2.2 Conduct of OSDF Inspection

The primary objective of the routine scheduled OSDF inspection is to identify potential problems at an early stage prior to the need for significant maintenance or repairs. The inspection team will be guided by a knowledge and understanding of the processes that could adversely change the disposal facility. A fundamental part of the inspection will be the detection of change, and particularly the progressive change, over a number of years due to slow processes. The inspection will include the following:

- Security of fences, gates, and locks, as well as the condition of applicable warning signs.
- General health and density of the vegetation cover.
- Presence of any deep-rooted, woody species.
- Evidence of burrowing by animals on the cover.
- Presence, depth, and extent of erosion or surface cracking, indicating possible cap deterioration.
- Visibly noticeable subsidence, either localized or over a large area, especially that will allow for the ponding of water.
- Presence and extent of any leachate seeps.
- Integrity of run-on and runoff control features.
- Integrity of benchmarks.
- Integrity of monitoring wells.

Any findings observed during the inspections will be recorded on the forms contained in Appendix D of Volume II. Section 6.2.3 below describes the details of the OSDF field inspection process.

6.2.3 OSDF Inspection Field Procedures

6.2.3.1 Adjacent Offsite Features

A reconnaissance of the adjacent area within approximately 0.25 mile of the Fernald Preserve property line will be conducted as part of OSDF and site inspections. Any evidence of a change in land use will be described. In general, any increase of human activity in the vicinity increases the probability of either inadvertent or purposeful intrusion into the facility.

Evaluation will be made of whether the drainage courses in the immediate vicinity of the OSDF pose any threat to the continued integrity of the OSDF. An observation from a prominent topographic feature will be made first, looking for indications of high water levels, areas of active erosion and sedimentation, and potential changes in channel position.

Reaches of adjacent drainages are inspected during annual site walkdowns. Notes will be made of unusual or changed sediment deposits, large debris accumulations, manmade or natural constrictions, and recent or potential channel changes. Any such features will be documented with photographs, which will include recognizable landmarks and known objects for scale.

Similarly, any gullies, or locations that appear to be favorable to the development of gullies, will be examined. The portion of the head of the gully will be the most important observation, but the shape of the cross section will give an indication of the degree of the activity, and any interruption in the longitudinal profile may suggest rejuvenation or the presence of a local base level.

6.2.3.2 Monuments

Each survey monument and cell boundary marker will be examined for evidence of disturbance. If any have been disturbed, a recommendation for their re-establishment and possible protective action will be made.

A walking traverse of the fence will be made to inspect the condition of fencing, gates, locks, and signs. Evidence of deterioration, damage, or vandalism will be noted. Any breaks in the OSDF perimeter fence, or conditions which might lead to a break, will be described. Signs will be evaluated for legibility, proper location, and information. If human intrusion is indicated, an effort will be made to determine whether it was inadvertent or purposeful, and whether it poses any threat to the integrity of the OSDF. Missing, badly damaged, or defaced signs will be replaced in a timely manner.

6.2.3.3 Crest and Slopes

The crest of the OSDF is an obvious vantage point from which to examine the facility and surrounding area. Observations, with the aid of binoculars if necessary, will be made in all directions from the crest of any features which are anomalous or unexpected, and which may require further inspection. These will be recorded on the inspection form. Examples of such features that might be observed include changes in soil color, distressed vegetation patterns, trails, and patterns of erosion.

When conducting a walkover of a cell cap, the following process is used. Transects, at approximately 50-yard intervals, will be walked along the crest and side slopes. A search will be made for evidence of differential settling, subsidence, and cracks, if any. The patterns of cracks and evidence of subsidence will be described in an overlay and photographed. The depth and width of the cracks will be measured; notes will be made of any points at which the cracks extend below the outer erosion barrier.

Erosion of the crest is not expected to be a problem because of the low slopes. However, differential settling or sliding along the slopes may cause flow concentrations that may disturb that protection, and thus irregularities will be examined for early evidence of erosion. Evidence of wind erosion, including the presence of ripple marks, partially exhumed vegetation, the presence of pedestal rocks, or obvious lag gravels, will be noted. The OSDF was vegetated as part of the closure activities; therefore, careful examination will be made to determine areas of distressed or sparse vegetation, or the presence of deep-rooted, woody species.

Changes to the OSDF are most likely to occur in the lower portions of the slopes. Therefore, an examination at the toe of the slope will be a key part of the inspection. A traverse at the toe of the slope will be made during each inspection.

Settlement or sliding, although highly unlikely, will be apparent by the presence of bulges and depressions, cracks, and scarps. If any such features are observed, the extent of the area affected, whether the area is stable or likely to continue moving, and the nature of the movement that is occurring (settlement, planar, or rotational sliding) will be determined. Evidence of related erosion will be noted. Photographs showing detail and area perspective will be taken of any such features observed.

General health of grass cover and signs of stressed or dead grass will be noted. Grass density and coverage will be inspected. Any areas with sparse vegetation or no vegetation will be mapped and described. The presence of any woody vegetation or noxious/invasive plants will be noted.

During these inspections, the slopes will be examined for evidence of animal intrusion, burrowing, changes in vegetation, and human activity. Regularly used trails (human or animal) can concentrate runoff and encourage erosion; any such trails observed will be mapped and described. Any signs of small animal trails or burrows will be noted, and an effort will be made to tentatively identify the species. If animal burrows have been observed during previous inspections, the burrow sites will be examined for indications of current activity.

Erosion of vegetated slopes will first be apparent by the development of rills and rivulets, which extend only part way up the slope. If they are present, their spacing, length, depth, and width will be measured and noted. Particular attention will be placed on evidence of integration of the drainage and development of a master channel. Such a development can, in a short time, evolve into a gully.

Evidence of removal of the cover, extensive vandalism to signs and monuments, or the presence of well-established trails will be described in detail.

6.2.3.4 Periphery

The area adjacent to the OSDF will be examined during site walkdowns and the traverse at the toe of the slope. Features to be looked for and described, if present, include erosion channels, accumulations of sediment, evidence of seepage, and signs of animal or human intrusion.

6.2.3.5 Diversion Channels

Each diversion channel will be walked its entire on-property length to determine whether the channels have been functioning, and can be expected to continue as designed. The channels and side slopes will be examined for evidence of erosion or sedimentation, slides or incipient erosion channels, debris, or growing vegetation. The side slopes of the diversion channels also will be examined for evidence of piping or burrowing by animals, which could lead to sloughing of material into the channel.

For portions of the channel that have riprap (or a concrete spillway), the soil or rock material adjacent to the structure will be examined carefully for evidence of unstable conditions such as piping or destructive currents. The riprap (or concrete) will be examined for evidence of deterioration caused by weathering or erosion. At those portions of the channel slopes that are rock, plant colonization will be slow to develop but will gradually occur. The inspection procedure is expected to record this gradual colonization by noting the extent of vegetation, its location, and its cover density.

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7.0 Unscheduled Inspections

7.1 Introduction

An unscheduled inspection may be triggered by reports or information that the OSDF facility integrity has been or may be compromised. The two types of unscheduled inspections anticipated (follow-up inspections and contingency inspections) are discussed in the following subsections.

7.2 Follow-up Inspections

Follow-up inspections investigate and quantify specific problems encountered during a routine scheduled inspection, special study, or other DOE or other regulatory agency activity. They determine whether processes currently active at or near the facility threaten facility security or stability, and they evaluate the need for custodial maintenance, repairs, or corrective action. They will also be conducted to evaluate the effectiveness of corrective measures and contingency repairs that have been implemented. Some of the situations that may require a follow-up inspection include:

- Unforeseen subsidence of the OSDF slopes or its foundation.
- Gullying that has cut through or is threatening to cut through the outer cover.
- Slides on the slopes of the OSDF.
- Seepage.
- Change in the position of an adjacent stream channel.
- Indications of rapid headward cutting of a nearby gully.
- Cracks that extend deeply (greater than 6 inches) into the slopes.
- Presence of animal burrows on the OSDF or in its diversion channels.
- Invasion of trees or shrubs onto the vegetation cover of the OSDF.
- Removal of some of the material from the OSDF cover.
- Corrective measures or contingency repair has been implemented.

Follow-up inspections will be made by technical specialists in a discipline appropriate to the problem that has been recognized. That is, if erosion is a problem, the inspectors will be individuals knowledgeable in evaluating erosion, such as a soils scientist or geomorphologist; if settlement or sliding is the problem, a geotechnical engineer; if changes in an adjacent stream, a hydrologist; if plant invasion, a botanist; and the like.

The follow-up inspection begins with a facility visit to determine the need for definitive tests or studies. Additional visits may be scheduled if more data are needed to draw conclusions and recommend corrective action. If repair or corrective action is warranted, DOE will notify EPA, Ohio EPA, appropriate local officials, and other appropriate local stakeholders.

7.2.1 Objectives and Procedures

These investigations include all additional investigations or studies necessary to evaluate the continued effectiveness of the OSDF for containment of the encapsulated materials. The procedures used will be those required in the judgment of DOE and will depend upon the nature and severity of the problem. Representative and appropriate responses for several possible problems are listed in Table 8.

Table 8. Possible Problem Situations and Responses

Situation	Representative Response
Gullying on slopes	Measurement or mapping not done as part of routine scheduled inspection will be done. The primary objective is to determine the factors that led to the initiation of the gully. This might involve evaluation of the erosion barrier design parameters or facility drainage, and the role of sheet erosion, rill formation, slides, or burrows. The product will be a recommendation for maintenance and preventive measures, if required.
Headward gully erosion	Procedures to determine the rate of headcutting will be established and implemented. A line of reference stakes (capped rebar) upstream from the gully head is a simple and effective method of measuring change in the position of the gully; comparison of periodic aerial photographs might also be useful. An understanding of why dissection is occurring and any limiting conditions will be sought. The product will be a recommendation for maintenance and preventive measures, if required.
Invasive vegetation	Species identification and abundance will be determined if large trees or shrubs invade the vegetation cover of the OSDF. Large trees and shrubs are not permitted on the OSDF and will be removed if present.
Creep	The occurrence of creep can be determined by setting rows of stakes parallel to contours on the side slopes, which will gradually tilt downslope if creep is occurring. The rate of creep can best be determined by marking a number of rock fragments on the slopes, and accurately determining their location in relation to additionally emplaced survey monuments over a number of years.
Landslides	Upon evidence of a slide or debris flow, an additional investigation will be made. The area and volume affected, the type of movement, and causal factors will be determined. Drilling, hand augering, or excavation might be necessary. The product will be a recommendation for what remedial and preventive maintenance are required.

7.2.2 Schedule and Reporting

Once a routine scheduled inspection has identified a concern, DOE will notify EPA and Ohio EPA and begin a follow-up inspection by submitting a preliminary assessment of the concern and a plan for follow-up inspection. Upon review by EPA and Ohio EPA, DOE will implement the inspection plan. Once the follow-up inspection is completed, DOE will recommend maintenance or other appropriate action to be performed, as needed.

7.3 Contingency Inspections

Contingency inspections are unscheduled situation-unique inspections ordered by DOE when it receives information indicating that facility integrity has been or may be threatened. Events that could trigger contingency inspections include severe vandalism, intrusion by humans or livestock, severe rainstorms, or unusual events of nature such as tornadoes or earthquakes. Events that have caused severe damage to the OSDF or that pose an immediate threat to human health and the environment will be immediately reported to EPA and Ohio EPA.

A preliminary inspection/assessment report of each contingency inspection triggered by such an unusual event will be submitted to EPA and Ohio EPA within 60 days of the initial report that damage or disruption has occurred at the OSDF facility. At a minimum, this report will include:

- Problem/event description.
- Preliminary assessment of the custodial maintenance or repair or corrective action required.
- Conclusions and recommendations.
- Assessment data, including field and inspection data and photographs.
- Names and qualifications of the field inspectors.

A copy of the report and all other data and documentation from such a contingency inspection will be maintained in the permanent OSDF file and will be submitted to EPA and Ohio EPA.

After EPA and Ohio EPA have reviewed the preliminary inspection/assessment report, DOE will submit a corrective action plan (for those events requiring corrective action) for EPA review and approval in accordance with a schedule to be determined on a case-by-case basis by consultation between DOE, EPA, and Ohio EPA. Based on the findings of these reports, DOE will implement the corrective action.

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8.0 Custodial Maintenance and Contingency Repair

8.1 Introduction

This section explains the procedures to be used by DOE to determine when maintenance or contingency repairs are needed at the OSDF. In general, the decision to conduct maintenance or contingency repair will be based on the results of follow-up inspections or contingency inspections (refer to Section 7.0 for both), which assess problems on the OSDF.

This section will establish maintenance activities and their frequency, fulfilling the requirements to do so established in the appropriate regulations (Ohio hazardous waste rules OAC 3745-66-18[A] and [C] in lieu of federal hazardous waste regulations 40 CFR §§265.118[c][2] and 264.118[b][2]). The following subsections address custodial maintenance of the security system (e.g., fencing, gates, signage) and the impacted materials containment system.

8.1.1 Security System

Custodial maintenance of the security system may require the repair and replacement of sections of fences, gates, locks, and signs due to normal wear, severe weather conditions, or vandalism.

8.1.2 Impacted Materials Containment System

Custodial maintenance of the impacted materials containment system will require:

- Maintaining the integrity and effectiveness of the final cover, including making repairs to the cap/cover as necessary to correct the effects of settling, dead vegetation, subsidence, erosion, leachate outbreaks, or other events (Ohio solid waste rule OAC 3745-27-14[A], and Ohio hazardous waste landfill rule OAC 3745-68-10 in lieu of federal hazardous waste regulation 40 CFR §265.310).
- Mowing or prescribed burn to maintain native grass cover.
- Seeding and mulching repaired areas or areas that are lacking required vegetation cover.
- Maintaining surface water run-on and runoff drainage features to prevent erosion of, or other damage to, the final cover (Ohio solid waste rule OAC 3745-27-14[A], and Ohio hazardous waste landfill rule OAC 3745-68-10 in lieu of federal hazardous waste regulation 40 CFR 265.310).
- Controlling burrowing animals.

8.2 Conditions Requiring Maintenance or Repair Actions

Inspection reports and monitoring results will be reviewed, and facility conditions will be compared from inspection to inspection so that trends of changing conditions can be determined. Identifiable trends will provide a means for predicting when maintenance or repairs will be needed. DOE, in conjunction with EPA and Ohio EPA, will decide whether to initiate custodial maintenance or contingency repair. After the decision to initiate maintenance or a contingency repair, a statement of work will be prepared for the work to be performed. The maintenance or repair action required to correct a problem will depend on the nature of the problem. Although the details of maintenance or repair actions that may be needed throughout the post-closure care period cannot be reliably predicted in advance, examples of conditions that may require custodial maintenance or that may trigger contingency repairs are outlined in Table 9, along with the appropriate actions.

When compared with contingency repairs, custodial maintenance is expected to be generally less costly, smaller in scale, and more frequent in occurrence. In contrast, contingency repairs are very unlikely to be needed; however, repair costs may be more substantial due to the size of the workforce and the technical skills required for repairs.

Table 9. Examples of Conditions That May Require Custodial Maintenance or Contingency Repair

Condition	Appropriate Actions
Custodial Maintenance	
1. Damage due to normal wear, severe weather conditions, or vandalism to survey control monuments.	• Reestablish survey control monuments.
2. Growth of woody species such as deep-rooted shrubs or trees on the cover.	• Apply herbicide and/or remove deep-rooted shrubs or trees from the cover. • Backfill root hole with soil, compact to reestablish grade, and reestablish the regular vegetative cover via seeding. • Maintain the prairie cap using prescribed burn or mowing.
3. Development of animal burrows on the cover or in the diversion channels.	• Control or eradication of burrowing animals. • Backfill burrow hole with soil, compact to reestablish grade, and reestablish the regular vegetative cover via seeding. • If the problem becomes extensive, the services of a professional exterminator will be retained.
Contingency Repair	
4. Development of rills or gullies deeper than 6 inches with near-vertical walls and no vegetative cover.	• Fill in gullies or rills with soil, compact to reestablish grade, and reestablish the regular vegetative cover via seeding and mulching.[a,b]
5. Surface rupture where the dimensions of the cracks are larger than 1 inch wide by 10 ft long by 1 ft deep, which would indicate severe shrinkage of cover materials or differential settlement.	• Reconstruction of slope segments where slumping, mass wasting, liquefaction, or other severe events have occurred. • Root cause analysis, evaluate corrective actions and preventive measures, and implement recommended actions.[a,b]
6. Instability of the slopes to the point where mass wasting or liquefaction has occurred due to earthquakes, differential settlement, or other causes.	• Reconstruction of slope segments where slumping, mass wasting, liquefaction, or other severe events have occurred. • Root cause analysis, evaluate corrective actions and preventive measures, and implement recommended actions.[a,b]
7. Encroachment of stream channels or gullies into the disposal facility or its buffer area.	• Reconstruction of cover or other features.[a] • Root cause analysis, evaluate corrective actions and preventive measures, and implement recommended actions.[a,b]
8. Flood damage to the facility in the form of new channels, or debris deposits.	• Reconstruction of cover or other features.[a] • Root cause analysis, evaluate corrective and preventive measures/actions, and implement recommended actions.[a,b]

Table 9. Examples of Conditions That May Require Custodial Maintenance or Contingency Repair (continued)

Condition	Appropriate Actions
9. Human intrusion has resulted in removal of cover materials.	• Reconstruction of cover or other features.[a] • Root cause analysis, evaluate corrective actions and preventive measures, and implement recommended actions.[a,b]

[a] This might involve general regrading in the area to modify drainage and/or the use of temporary drainage structures and controls to reduce runoff velocities until vegetation has been reestablished.
[b] Severe or repetitive occurrences might best be addressed through a corrective action (refer to Section 9.0).

8.3 Maintenance and Repair

The following subsections discuss custodial maintenance for the security system, the cap and final cover, and the run-on and runoff drainage features.

8.3.1 Security System

The security system established for the OSDF includes fencing, gates, locks, and warning signs. The routine custodial maintenance and repairing of the security systems include conducting visual inspections and repairing or replacing affected components. Possible problems include deterioration, erosion, or frost heave of fence post anchors resulting in fence damage. Normal wear, deterioration, and vandalism are also possible on fencing, gates, locks, and signs. Table 10 presents the inspection and maintenance activities for these features.

Table 10. Site Security System Inspection and Maintenance Activities[a]

Component	Inspection Frequency	Condition	Remedy	Maintenance
Fence	Quarterly	• Damaged fence fabric or posts • Under-fence erosion	• Repair or replace as necessary • Repair erosion or extend fence as necessary	• Repair or replace as necessary • Provide erosion and sedimentation control
Gates	Quarterly	• Tampering or damage to locks	• Repair or replace as necessary	• Install proper locks
Warning signs	Quarterly	• Damaged or missing warning signs	• Repair or replace as necessary	• Install or re-attach warning signs to fence or gates

[a] Site security system shall be inspected after the occurrence of major earthquakes (refer to Section 10.3).

8.3.2 Cap and Final Cover System

The routine custodial and preventive maintenance of the cap and final cover includes the visual inspection of benchmark integrity, the upkeep of the vegetation cover, general mowing, the clearing of debris, the removal of woody weeds and seedlings, and reseeding. These activities will be performed as needed as identified during the routine inspections (refer to Section 6.0).

Table 9 presents the custodial maintenance for these features. When excessive localized depression is indicated by persistent water ponding, repairs will be performed.

Routine management of the OSDF cap includes prescribed burning or mowing and baling to manage the prairie grassland and limit the establishment of woody vegetation and noxious weeds. Until 2016, mowing, raking, and baling were the only forms of management used on the OSDF. Controlled burning of the vegetation on the cell cap is the preferred management tool to maximize the growth of prairie grass. It also eliminates the need to handle hay bales. Working with the community and regulators, DOE moved forward with prescribed burns on Cells 4, 5, and 6 in March 2016. The burn was successful, and DOE continued the 3-year management rotation using spring prescribed burns. Vegetation on Cells 7 and 8 was burned in March 2017, and vegetation on Cells 1, 2, and 3 was burned in March 2018. In late 2018, DOE discussed with the regulators and then the Fernald Community Alliance changing the OSDF prescribed burn frequency and coverage to a two-year rotation and burning approximately half of the OSDF each year. Beginning in spring 2019, the southern half of the OSDF cap vegetation was planned to be burned and the northern half of the OSDF cap vegetation is planned to be burned in spring 2020. Mowed fire breaks near the center of the OSDF cap were planned to be varied each year to ensure that they are burned every other year. The increased burning frequency and larger area to be burned improve efficiency of burning operations and ensure better management of invasive woody vegetation. If spring burns are not possible, the area was planned to be mowed in the fall. In the spring of 2019, the southern half of the OSDF was burned as planned; however, due to the response to the COVID-19 pandemic, prescribed burns were canceled in the spring of 2020. No prescribed burns occurred in 2021. In 2022, DOE entered into an interagency agreement with the U.S. Forest Service to conduct all prescribed burn activities at the site. This agreement was finalized in August 2022. The entire OSDF cap will be burned on a 2-year rotation by the U.S. Forest Service beginning in the spring of 2023. If burning is not accomplished, mowing and bailing may be considered, but is not the preferred method to manage the OSDF vegetation.

Woody reproduction that develops on the OSDF final cover system shall be eliminated by hand, mechanically, chemically, or by fire. Many woody species maintain their root systems when cut and will rapidly resprout. The root system continues to grow through repeated cuttings and can become extensive. For this reason, chemical herbicides (spraying of individual trees and shrubs) or fire shall be preferred for woody species control, as eradication of the whole plant including the root system is a primary goal. A combination of mechanical and chemical treatment where cut stumps are treated with herbicide to prevent resprouting may also be considered. DOE will evaluate the most effective method for managing woody species vegetation on the OSDF based on available equipment, expertise, and cost.

Inspection/investigation, corrective maintenance, or contingency repair of the cover may be required for one of the following reasons:

- Formation of localized depressions caused by subsidence of the emplaced impacted materials.
- Progressive deterioration of the cover caused by erosion.
- Destruction of a portion of the cover by some gross physical event.

Settlement is not expected to be a significant problem, as the OSDF contains little putrescible waste. In the case of localized depressions, it will likely be necessary to strip existing topsoil in the affected area and stockpile it in an adjacent area. General soil would then be used to fill the settled area to restore uniform grades in order to promote proper drainage. Topsoil would then be replaced. Where this phenomenon occurs in the upper cover, simple regrading and filling of the depression with compacted fill will likely be satisfactory. All affected areas will be reseeded and mulched immediately upon completion of repairs.

The following are typical steps to repair excessive settlement:

[1] When maintenance is required, the amount of soil needed should be estimated, and arrangements for stockpiling or delivery should be made in advance to minimize the amount of time the repair area is disturbed.

[2] Install temporary silt control and surface water controls.

[3] Remove and stockpile topsoil and vegetative soil layers. Segregate as necessary.

[4] Vegetative soil material can be added to the existing vegetative soil layer portion of the cover, or the existing vegetative soil material can be excavated, and appropriate fill placed to bring the area to acceptable grades.

[5] Document vegetative soil layer placement and compaction in accordance with the original construction quality assurance program (Geosyntec 2001a).

[6] Replace vegetative and topsoil layers, and revegetate. Care should be taken during final grading to ensure that the area is tracked perpendicular to the slope to minimize channeling by surface water.

Progressive deterioration of the cover caused by erosion will likely be addressed by reconstruction of the cover in that area and by improvement of the erosion problem. This may involve some general regrading in the area to modify drainage and the use of temporary drainage structures and controls to reduce runoff velocities until vegetation has been reestablished.

8.3.3 Run-on and Runoff Drainage Features

Diversion and drainage channels surrounding the OSDF collect runoff and divert run-on. The OSDF design allows for vegetation establishment within drainages; however, the channels may require clearing and, from time to time, reshaping to control the runoff. If necessary, vegetation growth in and around diversion channels would be maintained by periodic mowing and clearing. Large plants may be removed to prevent sediment buildup and damage caused by roots. Reseeding and mulching will be performed as needed in bare areas to prevent excessive erosion.

During the routine inspections (refer to Section 6.0), the drainage channels will be examined for erosion. Any problems identified by inspections will be repaired to conform as closely as possible to the original construction specifications and drawings. To the extent possible, appropriate measures will be taken to prevent problems from reoccurring.

Maintenance of the diversion channel system might be needed in areas of excessive sediment buildup, sloughing of banks, or plugging of culverts due to sediment and vegetation buildup. The grade control structures—rocks placed at an inlet, outlet, or along the length of a drainage channel—might also require maintenance for sediment and vegetation buildup. Appropriate actions will be taken to address these situations, including cleaning out and re-contouring channels, repairing banks, and unplugging culverts. Table 11 presents the inspection and custodial maintenance schedule for these features.

Table 11. Drainage Channel System Inspection and Maintenance Activities[a]

Component	Inspection Frequency	Condition	Remedy	Maintenance
Drainage channels	Quarterly	• Free-flowing • Clogging by sediment or debris • Scouring, other evidence or erosion, or other damage	• None—desired condition • Remove accumulated debris or sediment • Repair damage	• None—desired condition • Remove accumulated debris or sediment • Maintain as-built or undertake corrective action
Grade control structures	Quarterly	• Free-flowing • Clogging by sediment or debris • Scouring, undermining, other evidence of erosion, or other damage	• None—desired condition • Remove accumulated debris or sediment • Repair damage	• None—desired condition • Remove accumulated debris or sediment • Remove emergent vegetation • Maintain as-built or undertake corrective action
Culverts	Quarterly	• Free-flowing • Clogging by sediment or debris • Other damage	• None—desired condition • Remove accumulated debris or sediment • Repair damage	• None—desired condition • Remove accumulated debris or sediment • Maintain as-built or undertake corrective action

[a] Drainage system shall be inspected after the occurrence of major earthquakes (refer to Section 10.3).

9.0 Post-Closure Corrective Actions

9.1 Introduction

Previous sections of this plan address maintenance or repair activities for the OSDF, which are directed at routine or custodial problems. This section discusses at the conceptual level, the steps necessary to evaluate and correct situations of more significant concern. Those steps include:

- Preliminary assessment of the situation.
- Development of a technical approach and work plan.
- Identification of alternatives.
- Evaluation of alternatives.
- Identification of the preferred alternative.
- Public involvement.
- Selection of the corrective action/response action alternative.
- Implementation of the selected alternative.

9.2 Future Corrective Actions and Response Actions

The following points are important to keep in mind, based upon legislation and regulations in effect at the time of formulation of this plan:

- The Fernald Preserve has been listed on the National Priorities List.
- Response actions under CERCLA have been and are being conducted at the Fernald Preserve to remediate the threats (or potential threats) to human health and the environment from past releases and potential releases at the site.
- Regardless of whether the Fernald Preserve is deleted from the National Priorities List in the future, any future corrective actions/response actions would be conducted as a response action under CERCLA, either as a removal action or a remedial action as appropriate to the situation.

The inspection and maintenance activities identified throughout this plan will be the mechanism to identify, and address as appropriate, situations needing maintenance or repair activities of a custodial or routine nature. DOE will consult with EPA and Ohio EPA whenever it identifies a situation believed worthy of more significant attention.

When there is a situation that requires significant attention, the first focus will be identification of the perceived problem ("problem statement"). This should include, as possible based upon existing information, a preliminary assessment of the nature of the problem and its threats to human health and the environment. This step is intended to be a remedial or removal site evaluation, as those terms are currently used in the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300). The intended outcome of this first step is an assessment of the seriousness of the situation and a determination of the time-criticalness of response action. From this, the appropriate course of CERCLA response action (removal action or remedial action) will be decided.

Regardless of removal or remedial course of action, the next step would be development of a technical approach, including identification of objectives, activities to fulfill those objectives, and associated time frames. The embodying document would vary depending on the course of CERCLA response action identified as appropriate:

1. If a time-critical removal action is necessary, then a removal action work plan will be required.
2. If a non-time-critical removal action is necessary, then an engineering evaluation/cost analysis will be required.
3. If a remedial action is necessary, then a work plan for a focused feasibility study will be required.

For numbers 2 and 3, above, the process will include the following:

- Identification of alternatives
- Evaluation of alternatives
- Identification of the preferred alternative
- Public involvement
- Selection of the corrective action/response action alternative
- Implementation of the selected alternative

10.0 Emergency Notification and Reporting

10.1 Introduction

The OSDF was designed to comply with EPA and Ohio EPA standards with minimum maintenance and oversight during the post-closure care period. However, unforeseen events could create problems that could affect the disposal facility's ability to remain in compliance with these standards. Therefore, DOE has requested notification from local, state, and federal agencies of discoveries or reports of any purposeful intrusion or damage at the site, as well as the occurrence of earthquakes, tornadoes, or floods in the area of the OSDF. Such notification would trigger a contingency inspection, as discussed in Section 7.3.

10.2 Agency Agreements

LM issued letters to the Hamilton County sheriff's department, the Butler County sheriff's department, and the Ross, Crosby, and Morgan Township police and fire officials, requesting that they notify LM if they observe any unauthorized human intrusion or unusual natural event.

LM issued a letter to the Ohio Earthquake Information Center, located at Alum Creek State Park in Delaware County, Ohio, requesting that they notify LM in the event of an earthquake in the vicinity of the Fernald Preserve.

LM will monitor emergency weather notification system announcements and has requested notification from the National Weather Service (either Wilmington or Cincinnati) of severe weather alerts.

To notify LM of site concerns, the public may use the 24-hour security telephone number monitored at the DOE facility in Grand Junction, Colorado. The 24-hour security telephone number is posted at site access points and other key locations on the site.

THE 24-HOUR EMERGENCY NUMBER

877-695-5322

10.3 Unusual Occurrences, Earthquakes, and Meteorological Events

As the major portion of the OSDF is within Hamilton County, DOE has requested that the Hamilton County sheriff's department notify DOE of any unusual occurrences in the area of the OSDF that may affect surface or subsurface stability, as well as any reports of vandalism or unauthorized entry. DOE has also requested the same from the Butler County sheriff's department.

Because the Fernald Preserve and the OSDF are not in an active seismic zone and are not situated on or constructed of lithified earth materials, the probability of occurrence of seismic events that could damage the OSDF is slim. If they do occur, seismic events that could potentially damage the OSDF would manifest themselves in numerous ways in the area, the most apparent of which are:

- Rupture of potable water supply lines.
- Rupture of natural gas supply lines.
- Rupture of natural gas transmission lines.

As stated in Section 10.2 above, LM has issued a letter to the Ohio Earthquake Information Center requesting notification in the event of an earthquake in the vicinity of the site. In addition, LM issued letters to and requested acknowledgement from the Hamilton County sheriff's department, the Butler County sheriff's department, and both Ross and Crosby Township police and fire officials to notify LM in the event of unauthorized human intrusion or unusual natural events. All of the above-mentioned agencies have been asked to contact LM should an event occur that might affect the control of known contaminants or the condition of the OSDF.
LM will also monitor the National Weather Service emergency weather notification system announcements (e.g., flash-flood or tornado warnings) for both Hamilton and Butler Counties.

11.0 Community Relations

The public played an important role in the remediation process at the Fernald Preserve, and the stakeholders remain involved in legacy management. DOE holds regularly scheduled meetings with various groups and the general public to share information on the current site status and progress. The public and other key stakeholders will remain fully involved in the legacy management of the site, and DOE will continue to conduct public meetings as long as the public continues to show an active interest. Additional information on the history of the public's involvement is included in Section 5.2 of the IC Plan (Volume II of the LMICP) and in the Community Involvement Plan (Attachment E to the LMICP).

Another process involving the public is the CERCLA five-year review. The CERCLA five-year reviews will focus on the protectiveness of the remedies associated with each of the five OUs. Following the review, a report will be submitted to EPA. The public will also be able to review these reports and provide feedback. In addition, the data and documentation used for the report will be accessible, either electronically or in hard copy. The most recent CERCLA five-year review was completed in 2021. The next five-year review will begin in 2025 and will be finalized in 2026.

Reporting to the public and stakeholders will occur on a regular basis. These requirements are further defined in Section 4.4 of the Legacy Management Plan (Volume I of the LMICP), in Section 5.1.3 of the IC Plan (Volume II of the LMICP), and in the Community Involvement Plan (Attachment E to the LMICP).

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12.0 References

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40 CFR 300. U.S. Environmental Protection Agency, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*.

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Attachment C

Groundwater/Leak Detection and Leachate Monitoring Plan

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Contents

Figures

Tables

Appendixes

Abbreviations

ANOVA	analysis of variance
ARARs	applicable or relevant and appropriate requirements
CAWWT	converted advanced wastewater treatment facility
CFR	*Code of Federal Regulations*
cm/s	centimeters per second
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FRL	final remediation level
ft	foot/feet
GMA	Great Miami Aquifer
gpad	gallons per acre per day
gpm	gallons per minute
GWLMP	*Groundwater/Leak Detection and Leachate Monitoring Plan*
HDPE	high-density polyethylene
HTW	horizontal till well
IEMP	Integrated Environmental Monitoring Plan
K_d	distribution coefficient
K_l	leaching coefficient
K_v	vertical hydraulic conductivity
LCS	leachate collection system
LDS	leak detection system
LTS	leachate transmission system
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliters
NPDES	National Pollutant Discharge Elimination System
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU	operable unit
PCBs	polychlorinated biphenyls
PLS	permanent lift station

ppb	parts per billion
RA	remedial action
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
SWIFT	Sandia Waste Isolation Flow and Transport
TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halogens
UMTRCA	Uranium Mill Tailings Radiation Control Act
VAM3D	Variably Saturated Analysis Model in 3 Dimensions
WAC	waste acceptance criteria

1.0 Introduction

This document presents the Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP) for the On-Site Disposal Facility (OSDF) at the U.S. Department of Energy's (DOE's) Fernald Preserve. The GWLMP is a support plan for the OSDF, and it is required by the *Remedial Action* (RA) *Work Plan for the On-Site Disposal Facility* (DOE 1996a). Revision 0 of the GWLMP was issued in August 1997 (DOE 1997), Revision 1 was issued in April 2005 (DOE 2005), and draft final Revision 2 was issued in January 2006 (DOE 2006). The GWLMP is integrated into the *Comprehensive Legacy Management and Institutional Controls Plan.*

The DOE Office of Legacy Management is responsible for OSDF monitoring, maintenance, and reporting. The GWLMP will be revised, as necessary, to reflect approved updates to monitoring and reporting requirements and will continue to be used through the post-closure period.

The GWLMP was developed to meet the regulatory requirements for the first tier of a three-tiered monitoring strategy required for engineered disposal facilities (i.e., [1] detection, [2] assessment, and [3] corrective action monitoring strategy). Consistent with this three-tiered requirement, follow-up groundwater quality assessment and corrective action monitoring plans will be developed and implemented as necessary.

The monitoring program comprises two primary components: (1) a leak detection component, which provides information to verify the ongoing performance and integrity of the OSDF and its impact on groundwater, and (2) a leachate monitoring component, which satisfies regulatory requirements for leachate collection and management. Two groundwater zones are monitored beneath the OSDF: the Great Miami Aquifer (GMA) (a water table found at depths ranging from 40 to 90 feet [ft] below ground surface near the OSDF) and the perched groundwater in the glacial till overlying the GMA.

The OSDF is an engineered disposal cell. As such, it is unlikely that a leak would occur without a corresponding action leakage rate, but significant changes in either water quality and/or flow rates will be investigated. Table 1 provides a summary of key monitoring parameters. Beginning in 2017, DOE reduced the monthly monitoring frequency of the leachate collection system (LCS) and leak detection system (LDS) containment pipes from monthly to quarterly.

Table 1. Facility Performance Key Monitoring Parameters

Parameter Type	Parameter Description	Basis	Monitoring Frequency	Action Level[a]	Action Level Units[a]	Regulatory Status[b]
Flow Volume[d]	LDS[c] Flow Volume	Each Cell	Daily	2	gpad[d]	Approved
	LCS[e] Flow Volume	Each Cell	Daily	NA	NA	Approved
	LCS Containment Pipe Monitoring	Each Cell	Quarterly	2,270	mL[f]	Approved
	LDS Containment Pipe Monitoring	Each Cell	Quarterly	2,650	mL	Approved
	Redundant Leachate Collection System Containment Pipe Monitoring	Each Cell	Quarterly	2,650	mL	Approved
	LTS[g] in each Valve House (PS-1 through 7)	Each Cell	Quarterly	5,300	mL	Approved
	LTS at Port V1007 (PS-9)		Quarterly	18,900	mL	Approved
	LTS at Port V1006 (PS-10)		Quarterly	370	mL	Approved

Table 1. Facility Performance Key Monitoring Parameters (continued)

Parameter Type	Parameter Description	Basis	Monitoring Frequency	Action Level[a]	Action Level Units[a]	Regulatory Status[b]
Water Quality	GMA aqueous sample analysis for parameters listed in Table 1 of Appendix B.	Each Cell	Semiannual	NA	NA	Approved
	LCS, LDS, and HTW[h] aqueous sample analysis for parameters listed in Table 2 of Appendix B.	Each Cell	Semiannual	NA	NA	Approved

[a] NA = not applicable.
[b] Regulatory status (regarding description, basis, frequency, and action level) as of the time the plan was submitted for EPA/Ohio EPA review (e.g., "proposed" or "approved").
[c] LDS = leak detection system.
[d] gpad = gallons per acre per day.
[e] LCS = leachate collection system.
[f] mL = milliliters.
[g] LTS = leachate transmission system.
[h] HTW = horizontal till well.

1.1 Overview of the OSDF

The OSDF is located along the northeast portion of the Fernald Preserve and, as required by the Operable Unit (OU) 2, OU3, and OU5 Records of Decision (RODs), is situated over the “best available geology” at the Fernald Preserve to take maximum advantage of the protective hydrogeologic features of the glacial till above the GMA. The footprint of the actual disposal facility is approximately 75 acres. A perimeter security fence surrounds the OSDF and defines a footprint that occupies approximately 98 acres of the 1,050-acre Fernald Preserve. The 98-acre fenced area is dedicated to disposal and will remain under federal ownership and federal administrative control.

The OSDF provides onsite disposal capacity for approximately 2.95 million cubic yards of contaminated soil and debris generated by the Fernald Preserve’s environmental restoration and building decontamination and demolition activities. The OSDF has a maximum height of approximately 65 ft. The facility was constructed in phases, with eight individual cells. Cells are approximately 700 ft by 400 ft, or 280,000 square feet (ft^2) (6.4 acres). The dimensions of Cell 8 are larger than those of the other cells (approximately 9.3 acres). Each cell was constructed with a leachate collection system (LCS) that collected infiltrating rainwater and storm water runoff during waste placement and prevented it from entering the underlying environment. Other engineered features include a multilayer composite liner system, a leak detection system (LDS) positioned beneath the primary liner, and a multilayer composite cover placed over each cell following the completion of waste-placement activities.

Figure 1 shows an east-west cross section of the general design of each of the eight disposal cells in the facility. The LCS and LDS layers are designed to convey any leachate/fluid that enters the system through pipes (i.e., the LCS pipes and LDS pipes) to the west side of each cell to a liner-penetration box. The liner-penetration box is the point where the LCS and LDS pipes penetrate the liner system and therefore represents the lowest elevation of each cell and the most likely point for a leak to occur. From the liner-penetration box, the LCS and LDS pipes drain to valve houses where the leachate and LDS fluid are collected in tanks, flow rates and volumes are monitored, and samples are collected. Fluid that collects in the LCS and LDS collection tanks located in each cell’s valve house is pumped to the gravity drain portion of the leachate transmission system (LTS) line, which drains all valve houses to the permanent lift station (PLS). The leachate collected in the PLS is periodically pumped to the Converted Advanced Wastewater Treatment facility (CAWWT) backwash basin or directly to CAWWT feed tanks. The Enhanced Permanent Leachate Transmission System consists of the valve houses and the equipment contained within them as well as the gravity drain portion of the leachate transmission line that runs from the valve house at Cell 1 to the PLS. Figure 2 depicts a cross section of the liner system.

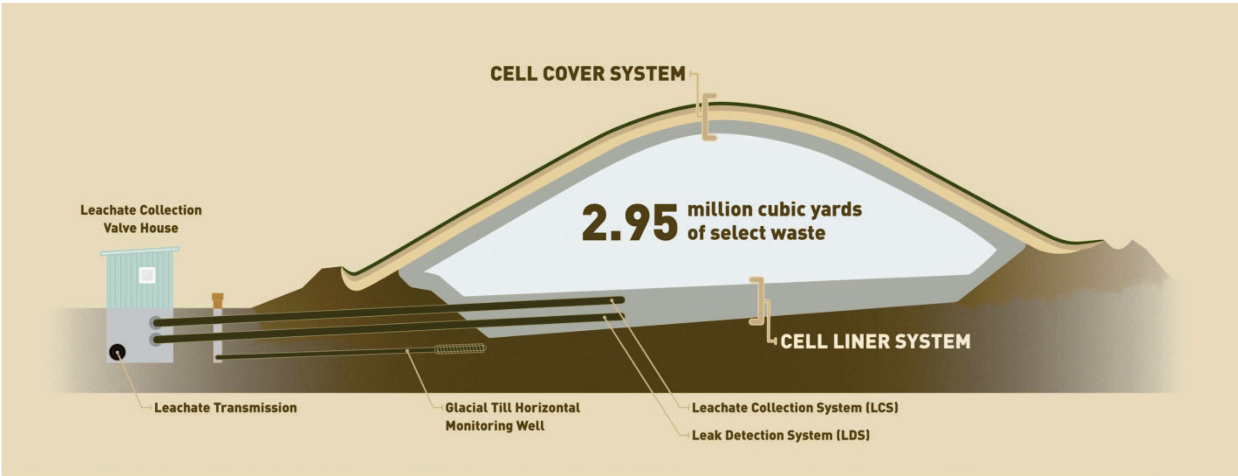

Figure 1. OSDF Cross Section

During the development of this plan, the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (Ohio EPA) identified the need to monitor the potential for leachate leakage from the OSDF at its first point of entry into the natural hydrogeologic environment (rather than relying on GMA groundwater monitoring alone). This led to the decision to install horizontal monitoring wells in the glacial till directly beneath the liner-penetration boxes of the LCS and LDS layers in each cell. Figure 1 shows the general placement of the horizontal wells in relation to the LCS, LDS, and where they penetrate the liner system. The subsurface area beneath the liner-penetration boxes provides the best opportunity to monitor for an initial leak into the subsurface environment, should such a leak occur.

As a result of the low transmissive properties of the glacial till and the discontinuous nature of the perched groundwater system in the till, it is not always possible to collect groundwater samples routinely from the horizontal wells. In view of this limitation, DOE, EPA, and Ohio EPA concurred that the placement of the horizontal wells beneath the liner-penetration boxes represents the most feasible site-specific approach to monitor for first entry leakage from the facility to the environment, and this approach provides adequate and appropriate early warning detection capabilities for this site-specific setting.

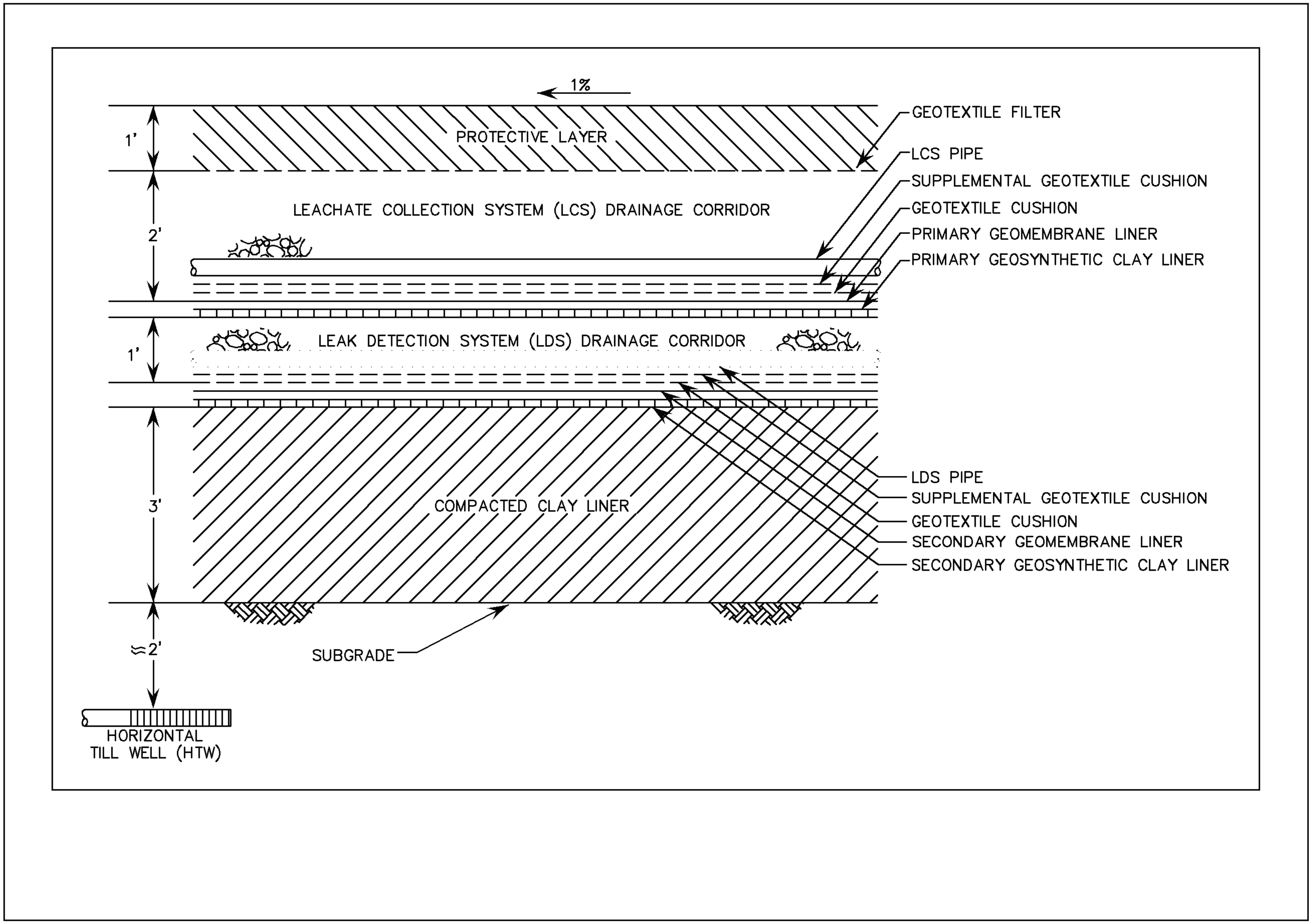

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Figure 2. OSDF Liner System with Horizontal Till Well at the Drainage Corridor

The OSDF performance period is divided into three operating time frames: (1) initial period, (2) intermediate period, and (3) final period. The initial period is defined as beginning with cell closure in 2006 to the end of the 30-year post-closure monitoring period (2006 to 2036). The intermediate period will begin in 2036 and continue for a minimum of 200 years (2236). It is expected that during the intermediate period, the geomembrane components of the liner system and final cover system will remain functional. The LCS and the LDS, as well as the cover system, will be maintained as necessary. The final period will occur between 200 and 1,000 years after final closure of the facility in 2006. During the final period, natural components of the liner and final cover will be functional. It is anticipated that in the future, the high-density polyethylene (HDPE) geomembrane and other geosynthetic components of the liner and cover systems will begin to degrade and progressively lose functionality.

An important design specification for the OSDF is the action leakage rate. The action leakage rate is the maximum design flow rate that the LDS can remove without the fluid head on the bottom liner exceeding 1 ft (Title 40 *Code of Federal Regulations* Part 264.302 [40 CFR 264.302]). Stated another way, it is the flow rate that corresponds to a hydraulic head within the facility capable of producing a leak through the compacted clay layer that is present at the base of the facility. The OSDF has an action leakage rate of 200 gallons per acre per day (gpad) (DOE 1997).

DOE will not wait until the action leakage rate of 200 gpad is reached to investigate the possibility of a leak from the facility. A phased response approach is defined that is triggered by two additional lower administrative action levels; a low-flow response leakage rate (2 gpad) and an initial response leakage rate (20 gpad) and are also defined. Notifications and response actions for all three leakage rates are presented in Section 6.2.

1.2 Program Overview

The GWLMP was developed by reviewing the pertinent regulatory requirements for detection monitoring and translating those requirements into site-specific monitoring elements (e.g., designation of monitoring zones, monitoring locations, sampling frequency, and establishment of analytical parameters).

Monitoring for a leak from the OSDF using water-quality data alone is challenging because:

- The low-permeability clay beneath the facility does not readily transmit water.
- Near the OSDF, contaminant concentrations exceed background levels in surface and subsurface soil, in perched groundwater in the glacial till, and in the GMA.
- Post-construction geochemistry and constituent concentrations in water beneath the OSDF have not reached steady-state conditions, and these fluctuations complicate data interpretations.
- There is evidence that at least one of the horizontal till wells (HTWs) is in hydraulic communication with a surface water drainage ditch on the west side of the OSDF.

The GWLMP considers current hydrogeologic and contaminant conditions in the glacial till and GMA beneath the facility. Preexisting contamination in the perched groundwater system and the GMA, the variable nature of the geology and hydrogeology of the clay-rich glacial deposits, and the influence of aquifer restoration activities in the GMA add complexity to the development of a groundwater monitoring program. Contaminated portions of the GMA were undergoing restoration during the same time period that the OSDF was actively accepting waste for disposal, after the facility was capped, and during post-closure. The aquifer restoration is a pump-and-treat operation. The closest pumping wells are approximately 2,000 ft upgradient of the OSDF footprint.

Available site-specific information generated from more than 15 years of detailed site characterization efforts, including geology and hydrogeology, results of detailed contaminant fate and transport modeling, OSDF construction activities, and monitoring results from the OSDF program and Attachment D (Integrated Environmental Monitoring Plan [IEMP]) were used to develop the monitoring strategy and to determine monitoring locations.

The GWLMP focuses on the monitoring needs associated with detection monitoring during post-closure. Future amendments to the plan will be prepared to address program modifications, if changes to the monitoring program are necessary. An in-depth review of program needs is also envisioned at the completion of GMA restoration activities.

A brief description of the monitoring program is as follows:

- Flow volumes in the LDS are tracked against the low-flow response leakage rate of 2 gpad. Flow in the LDS reaching a flow rate of 2 gpad indicates that hydraulic conditions are 1/100 of the level needed to achieve the hydraulic head within the OSDF required to produce a possible leak from the OSDF. If LDS flow measurements indicate a rate of 2 gpad, DOE will notify EPA and Ohio EPA and begin more frequent water quality monitoring. Additional notification and response actions for higher levels of flow are provided in Section 6.2.
- Water quality in the LCS, LDS, HTW, and GMA wells of each cell is routinely monitored. Control charts are prepared for those constituents in the HTW and GMA wells that pass statistical screening for the preparation of control charts. Plots of concentration versus time are prepared for constituents in the HTW and GMA wells that do not pass statistical screening for the preparation of control charts. Bivariate plots for uranium-sodium are prepared for each cell. Other appropriate multi-parameter multivariate plots may be prepared if necessary to show independence of sampled horizons.

It should be noted that it is unlikely that a leak would occur if flow in the LDS is below the design action leakage rate of 200 gpad. The phased approach presented in this plan to respond to increases in LDS flow rates is considered very conservative.

The OSDF groundwater monitoring plan has been implemented as a project-specific plan (refer to Appendix B), with the results presented for EPA and Ohio EPA review as part of the comprehensive IEMP reporting process (i.e., annual Site Environmental Reports). The IEMP provides a consolidated reporting mechanism for all of the environmental regulatory compliance monitoring activities, including the data and findings from the OSDF groundwater monitoring plan. Incorporating the OSDF data into the IEMP maintains the commitment to an effective remediation-focused environmental surveillance monitoring program. Once the environmental remediation requirements have been completed and the site is successfully removed from the Superfund National Priorities List, the monitoring activity for the OSDF (which will be the last remaining facility in place at the site) will continue in accordance with applicable regulatory monitoring and reporting requirements.

1.3 Plan Organization

The remainder of this plan is organized as follows:

- Section 2.0 presents a summary of the geology and hydrogeology in the immediate area of the OSDF.
- Section 3.0 presents a regulatory analysis and strategy for OSDF monitoring.
- Section 4.0 presents the OSDF leak detection monitoring program.
- Section 5.0 presents the OSDF leachate management monitoring program.
- Section 6.0 presents reporting requirements and notifications.
- Section 7.0 provides a list of references.

The appendixes that support this plan are:

- Appendix A—OSDF Applicable or Relevant and Appropriate Requirements and Other Regulatory Requirements.
- Appendix B—Project-Specific Plan for the On-Site Disposal Facility Monitoring Program.
- Appendix C—Fernald Preserve Data Quality Objectives, Monitoring Program for the On-Site Disposal Facility.
- Appendix D—Leachate Management System for the On-Site Disposal Facility.
- Appendix E—Selection Process for Site-Specific Leak Detection Indicator Parameters.

1.4 Related Plans

Several other remedial action (RA) plans have been prepared for the OSDF or for the Fernald Preserve as a whole, containing information relevant to this plan. They are listed below along with a brief statement of their relationship to this plan:

- *Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility* and addendum (DOE 1995a and DOE 1996b): Describe field activities used to assess potential sites for the OSDF, and present the information collected during addendum activities to the *Project-Specific Plan for Installation of the On-Site Disposal Facility Great Miami Aquifer Monitoring Wells* (DOE 2001a).
- OSDF Systems Plan (DOE 2001b): Describes the inspection and maintenance of the LCS and LDS.
- *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021a) and the *Converted Advanced Wastewater Treatment Facility Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021b): Describe the operational procedures for management, inspection, and conveyance of leachate and fluid from the LCS and LDS.
- OSDF Design Packages (Geosyntec 1996a, Geosyntec 1996b, Geosyntec 1997, DOE 2004a) and construction drawing packages: Provide the overall approved design for each cell of the OSDF.

- Post-Closure Care and Inspection Plan (Attachment B): Summarizes the inspection and maintenance activities (e.g., cap and runoff controls) to ensure continued proper performance of the OSDF, and also summarizes at the conceptual level corrective actions/response actions.
- *Borrow Area Management and Restoration Plan, On-Site Disposal Facility* (Geosyntec 2001a): Describes management of borrow soils used to construct the OSDF, and describes the planning for end state after soils have been excavated.
- *Surface Water Management and Erosion Control Plan, On-Site Disposal Facility* (Geosyntec 2001b): Describes soil erosion control to minimize sediment loss.
- *Construction Quality Assurance Plan, On-Site Disposal Facility* (Geosyntec 2002): Describes quality assurance methods and testing to certify the construction of the OSDF.
- *Impacted Materials Placement Plan, On-Site Disposal Facility* (Geosyntec 2005): Describes the categories of material, prohibited items, and placement methods for impacted material placement in the cells.
- *Waste Acceptance Criteria Attainment Plan for the On-Site Disposal Facility* (DOE 1998a): Defines the OSDF requirements for materials generated by the Fernald Site's environmental restoration, and decontamination and demolition efforts.
- *Project-Specific Plan for Installation of the On-Site Disposal Facility Great Miami Aquifer Monitoring Wells* (DOE 2001a): Describes the installation of GMA wells.
- *Technical Memorandum for the On-Site Disposal Facility Cells 1, 2, and 3 Baseline Groundwater Conditions* (DOE 2002): Describes baseline conditions for Cells 1, 2, and 3.
- IEMP (Attachment D).
- Additionally, annual Site Environmental Reports include OSDF reporting requirement updates.

2.0 OSDF Area Geology and Hydrogeology

2.1 Introduction

The OU2, OU3, and OU5 RODs contain requirements that led to the OSDF being located in an area of the Fernald Preserve that takes maximum advantage of available geologic and hydrogeologic conditions to further reduce the potential for contaminant migration from the facility. To identify the preferred OSDF location, a detailed pre-design geotechnical and hydrogeologic investigation was conducted as a supplement to the sitewide characterization efforts described in *Remedial Investigation Report for Operable Unit 5* (DOE 1995b). The detailed findings of the pre-design investigation are documented in the *Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility* (DOE 1995a). As documented in the site selection report, a final location along the eastern margin of the Fernald Preserve was selected to satisfy the RODs and other regulatory-based siting requirements.

The following sections summarize the principal geologic, hydrogeologic, and subsurface contaminant conditions in the OSDF area that have a direct bearing on the development of the leak detection and groundwater monitoring strategy for the facility. For more-detailed information, refer to the *Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility* (DOE 1995a) and *Remedial Investigation Report for Operable Unit 5* (DOE 1995b).

2.2 OSDF Area Geology

The perimeter security fence that surrounds the OSDF defines a 98- acre footprint in the northeastern corner of the Fernald Preserve. The facility is oriented in a north-south direction with dimensions of approximately 3,600 ft by 1,000 ft. The east edge of the facility (i.e., the toe of the cap system) is set back from the eastern property line by approximately 100 ft. The subsurface conditions in the immediate area of the OSDF were characterized through the following field and laboratory activities:

Test borings	Fifty-four borings were drilled in the immediate vicinity of the OSDF to obtain geotechnical soil samples and characterize underlying geology.
Monitoring wells	Fifty-one groundwater monitoring wells were installed in the general vicinity of the OSDF from which water level data, preexisting groundwater contaminant concentration data, and lithology data have been obtained.
Geotechnical tests	Key geotechnical tests (i.e., Atterberg limits, water content measurements, and permeability tests) were performed on subsurface geologic samples, including 116 sieve analyses to determine grain size.

Lysimeter installation	Eight lysimeters were installed in the OSDF site area to determine the nature and concentration of uranium in the vadose zone of the glacial till and the unsaturated GMA.
Slug tests	Twenty-four slug tests were performed to assess the hydraulic characteristics of the perched groundwater system.
Water level monitoring	Water levels obtained from the perched groundwater and the GMA wells were used to determine hydraulic gradients and flow directions.
Soil analyses	Soil samples collected during the remedial investigation (RI) and the Pre-Design Investigation were characterized for mineralogy and analyzed for uranium and other constituents of concern to determine preexisting contaminant levels in the soil beneath the OSDF.
Groundwater flowmeter study	Twenty-two flowmeter readings were obtained in the perched groundwater in the OSDF site area.
Distribution coefficient (K_d) study	A K_d study was performed to determine how uranium partitions between groundwater and soil in the OSDF site area.
Cone penetrometer tests	Eighty-eight cone penetrometer tests were conducted in the OSDF site area to aid in making subsurface lithologic interpretations.

The information obtained through these activities, coupled with the sitewide interpretations gained through the OU5 RI, formed the basis for the interpretations of subsurface conditions in the vicinity of the OSDF site.

In general, the OSDF is situated on glacial till underlain by sand and gravel deposits that comprise the GMA, which is designated as a sole-source aquifer under the Safe Drinking Water Act. The GMA is a high-yield aquifer (i.e., wells completed in some areas of the aquifer yield greater than 500 gallons per minute (gpm), and it supplies a significant amount of potable and industrial water to Butler and Hamilton Counties.

The glacial till ranges in thickness from approximately 20 to 60 ft in the immediate vicinity of the OSDF and is composed of about equal portions of carbonate (calcite and dolomite) and silicate (quartz, feldspar, and clay minerals) grains. Based on the results of 116 sieve and hydrometer analyses, the glacial till can be characterized as dense, heterogeneous, sandy, lean clay, with occasional discontinuous interbedded sand and gravel lenses. The glacial till can be further divided into an upper brown clay layer and a lower gray clay layer. This division is made on color and physical properties because the mineralogy is similar in both layers. The brown clay layer is more weathered (i.e., it exhibits iron oxidation and contains a greater abundance of desiccation fractures compared with the underlying gray clay layer) and has a higher incidence of interbedded sand and gravel lenses. In the eastern portions of the Fernald Preserve, the gray clay ranges in thickness from approximately 15 to 42 ft, and the brown clay ranges from approximately 8 to 15 ft. As indicated by the OU5 RI, the gray clay is the most uniform and least permeable and, therefore, the most protective geologic layer found above the GMA across the site.

As a follow-up to the OU5 RI, one of the primary objectives of the *Pre-Design Investigation and Site Selection Report for the On-Site Disposal Facility* (DOE 1995a) was to identify the location where the thickest, most laterally persistent gray clay layer is present that contains the least amount of interbedded coarse granular material, and that allows regulatory-based siting requirements (such as the property line and other geographic setbacks) to be met. The selected location for the OSDF has a minimum thickness of gray till of approximately 15 ft and an average thickness of approximately 30 ft. The percentage of interbedded sands and gravels in the gray till in this area is approximately 4 percent.

Beneath the glacial till layer, the sand and gravel deposits of the GMA are approximately 175 ft thick. For RI characterization and monitoring purposes, the GMA has been divided into three hydrologic zones: the uppermost zone, represented by the Fernald Preserve's Type 2 monitoring wells; the middle zone, represented by the Type 3 monitoring wells; and the lowermost zone, represented by the Type 4 monitoring wells. The sand and gravel deposits that constitute the aquifer are regionally extensive and occupy a land area of more than 970,000 acres.

Shale and limestone bedrock underlies the GMA deposits at a depth of approximately 200 ft beneath the OSDF. Regional studies by the Geological Survey of Ohio indicate the shale and limestone bedrock is approximately 330 ft thick in the Fernald Preserve area (Fenneman 1916).

2.3 Hydrogeologic Conditions

The Fernald Preserve has two distinct bodies of groundwater that have been extensively characterized through the remedial investigation/feasibility study (RI/FS) process and the Pre-Design Investigation: the GMA and the perched groundwater within the overlying glacial till. The discontinuous sand and sand and gravel lenses within the glacial till can provide water to a pumping well because the deposits are more permeable than the surrounding clay-rich glacial till. The entire section of glacial till is believed to be saturated or nearly saturated with groundwater. An unsaturated sand and gravel zone approximately 20 ft to 30 ft thick separates the base of the glacial till from the regional water table in the GMA. Depending on local weather patterns and rainfall, the water table in the GMA fluctuates approximately 6 ft annually within the unsaturated zone below the glacial till in the area of the OSDF.

The GMA is a classic example of an unconfined buried valley aquifer. The depth to water in the aquifer near the OSDF ranges from 40 to 90 ft below ground surface. The direction of groundwater flow beneath the OSDF is being temporarily influenced by the pump-and-treat remedy. Five years of water level measurements prior to operating the pump-and-treat system (1988 through 1993) indicate that groundwater flowed from the west to the east beneath the OSDF (refer to OU5 RI Report, Figure 3-50). The pump-and-treat system that is currently operating pulls groundwater in the area of the OSDF to the southwest. It will not be possible to establish a long term upgradient-downgradient monitoring relationship beneath the OSDF until the pump-and-treat remedy ends. The current early estimate for the completion of the pump and treat portion of the groundwater remedy is 2035. Groundwater velocity in the area of the OSDF is approximately 451 ft per year, based on an average hydraulic gradient of approximately

0.0008 (refer to OU5 RI, page 3–61); an average hydraulic conductivity of approximately 463 ft per day (average of three pumping tests); and an effective porosity of 30 percent. Geochemical processes influencing uranium distribution (i.e., rainfall/soil chemistry, leaching of uranium solids, oxidation-reduction reactions, adsorption and ion-exchange reactions, and uranium mineral solubility in perched groundwater) are presented in Section F.3.1.3.0 of Appendix F.3 of the *Remedial Investigation Report for Operable Unit 5* (DOE 1995b). Ranges for site-specific geochemical parameters are presented in Table F.3.1.5-1. As shown in Table F.3.1.5-1, the groundwater model was initially calibrated with a K_d of 1.8, which corresponds to a retardation factor of 12. At a retardation factor of 12, uranium moves approximately 1/12 as fast as the groundwater, or approximately 37.6 ft per year. Studies conducted by Sandia National Laboratories on uranium-contaminated sediment collected from the vadose zone indicate that the K_d ranges from 2.8 to 8.7 (SNL 2003, SNL 2004). The higher K_d values reported for the Sandia study reflect natural variability in the aquifer and stronger bonding of the adsorbed uranium as it ages on the mineral surface, which results in a higher retardation factor and indicates slower migration times. Uranyl carbonate is the dominant phase in both perched groundwater and the GMA near the Fernald Preserve.

Perched groundwater is present above the unsaturated zone of the GMA within the glacial till. Overall, the till exhibits 90 to 100 percent saturation (close to field capacity) and has the general properties of an aquitard. When the till reaches field capacity, it has the capability to release groundwater downward under a unit vertical hydraulic gradient into the underlying unsaturated zone of the GMA. Eventually, this downward-moving groundwater will enter the saturated portion of the GMA as recharge. Depths to perched groundwater in the till are generally 6 ft or less in the eastern portion of the Fernald Preserve in the area of the OSDF.

Although the till is generally saturated, there are no identified suitably thick or laterally continuous coarse-grained zones beneath the OSDF that can facilitate implementation of a comprehensive, interlinked (i.e., upgradient and downgradient monitoring points) perched groundwater monitoring system. The amount of saturation in the till is expected to be reduced even further over time since the cap and underlying liners of the OSDF are in place; they are serving as local hydraulic barriers to further reduce the volume of infiltrating moisture within the OSDF footprint.

Slug test data from 24 perched groundwater wells (Type 1 monitoring wells) indicate that the average horizontal hydraulic conductivity for wells screened across the brown and gray clay layer interface is 6.30×10^{-6} centimeters per second (cm/s). The gray clay layer beneath the brown clay is the least permeable layer above the GMA. Laboratory hydraulic conductivities conducted on samples collected from this layer indicate measured values ranging from 9.53×10^{-9} cm/s to 5.83×10^{-8} cm/s. Other laboratory and field measurements indicate the till has an effective porosity of 4 to 10 percent, and a representative bulk density of 1.85 grams per cubic centimeter. The discontinuous nature of the perched water in the glacial till does not facilitate the measurement of a continuous water table gradient in the OSDF site area.

Model calibration studies conducted during the OU5 RI/FS indicate average vertical groundwater flow rates through the glacial till (including the gray clay layer) to be approximately 6 inches per year. The time it takes a contaminant to move through the glacial till and break through into the GMA is controlled by the thickness of gray clay present in the till, the groundwater infiltration rate through the gray clay, and the retardation properties of the gray clay. In the OSDF area, modeled breakthrough travel times for uranium (the Fernald

Preserve's predominant contaminant) range from approximately 210 years (to have a 20-micrograms-per-liter concentration in the aquifer) to 260 years (to have 1 percent of the source concentration). These breakthrough times were calculated using a retardation factor of 165 for the gray clay, not considering movement through the brown clay, not including any retardation in the unsaturated GMA sand and gravel, and using a representative K_v value of 7.23E-07 cm/s for the gray clay (refer to Appendix F of the *Remedial Investigation Report for Operable Unit 5* [DOE 1995b]). The K_v for the gray clay was determined from modeling presented in the *Glacial Overburden/Upper Great Miami Aquifer System Report* (DOE 1994) and from slug test results from the gray clay.

The modeled breakthrough travel time for 1 percent of a technetium source, the Fernald Preserve's most mobile contaminant, is approximately 3.6 years. This breakthrough time was calculated using a retardation factor of 2.29 for the gray clay (refer to OU5 RI report, Appendix F [DOE 1995b]), not considering movement through the brown clay, and not including any retardation in the unsaturated GMA sand and gravel. This modeling strategy was used in the OU5 Feasibility Study (DOE 1995d) to calculate waste acceptance criteria (WAC) for the OSDF.

The extensive presence of low-permeability, lean sandy clay throughout the till matrix and the discontinuous nature of the coarser-grained lenses are the dominant factors controlling the rate at which fluids can migrate through the more permeable portions of till, either vertically or laterally.

Unlike conditions in the GMA, the upgradient and downgradient directions of perched groundwater flow are difficult to assign at the local scale. Groundwater flowmeter readings from 22 wells taken during the Pre-Design Investigation indicate that the horizontal flow directions vary abruptly from well to well, with no discernable consistent patterns. Consequently, horizontal flow regimes are interpreted to be very localized (perhaps tens to hundreds of feet in length) and, because the interbedded coarse-grained lenses are discontinuous, are not laterally persistent. Collectively, the water levels obtained during the OU5 RI indicate that if an area gradient were present, it would range from 0.008 to 0.015.

Model calibration studies conducted during the OU5 RI/FS indicate that vertical flow tends to dominate in the glacial till because of several factors: (1) the steep vertical hydraulic gradients across the till—which are at or near unity—compared to the small localized lateral hydraulic gradients, which collectively indicate a gradient that is much less than unity (0.008 to 0.015); (2) the laterally discontinuous nature of the coarse-grained lenses in the till; and (3) the shorter overall flowpath distance in the vertical dimension for the Fernald Preserve (60 ft compared to hundreds or thousands of feet in the horizontal) before a potential discharge point for the glacial till groundwater is reached.

It can be generally interpreted from this information that if a leachate leak were able to exit through the OSDF liner system, it would be expected to migrate vertically toward the GMA (although some localized "stair step" lateral motion may also be expected to take place en route). The exact pathway that a hypothetical leachate leak from the facility would take is difficult to determine, but it is clear that an effective monitoring program needs to consider both the most likely point of entry of the leak into the subsurface environment beneath the facility (i.e., above the HTW) and the ultimate arrival of the leak at the GMA.

2.4 Existing Contamination

In the immediate vicinity of the OSDF, contaminant concentrations are present above background levels in surface and subsurface soil, the perched groundwater in the glacial till, and GMA. The nature and extent of contamination in these media were documented in the OU5 RI report (DOE 1995b). Additional characterization of the perched groundwater in the glacial till in the OSDF footprint has been documented in the OSDF Pre-Design Report (DOE 1995a). Final remediation levels (FRLs) for soil were established in the OU5 ROD (DOE 1996c), and residual contamination at concentrations below the soil FRLs interferes with the interpretation of water-quality data.

Surface and subsurface soil within the OSDF footprint was contaminated above the soil FRLs, but certification reports (DOE 1998b; 1999; 2001d; 2004b) show that contaminant concentrations are now below FRLs. As an example, the background value of uranium is 4.56 milligrams per kilogram (mg/kg) (DOE 2001c), the FRL is 82 mg/kg (DOE 1996c), and the mean values for the 17 certification units that correspond to the locations of the HTWs range from 5.96 to 57.2 mg/kg (Table 2).

Table 2. Mean Uranium Value[a] for Certification Units at or near the HTWs, Expected Groundwater Uranium Concentrations Based on the Reported Range for Uranium Leach Coefficients (K_l) in Low-Leachability Soil[b], Maximum HTW Concentration[c], and Measured Perched-water Concentration prior to OSDF Construction[d]

Certification Unit	Uranium (mg/kg)	Cell	Uranium (mg/L)			
			K_l = 185	K_l = 2700	HTW-max	Pre-const
P19	38.1	1	0.206	0.014	0.012	0.020
P18	38.9	1, 2, & 3	0.210	0.014	0.029	0.010
P18-11	18.6	3	0.101	0.007	0.029	0.003
P17-33	11.7	3 & 4	0.063	0.004	0.029	0.013
P17-31	25	4	0.135	0.009	0.008	0.013
A1P2-S2SP-01	24.3	5	0.131	0.009	0.021	0.005
A1P2-S2SP-02	32.5	5	0.176	0.012	0.021	0.005
A1P2-S2SB-04	10.9	6	0.059	0.004	0.024	0.007
A1P2-S2NI-02	21.5	6	0.116	0.008	0.024	0.007
A1P2-S2SB-02	6.64	6	0.036	0.002	0.024	0.007
A1P2-S2NI-07	8.64	6 & 7	0.047	0.003	0.024	0.007
A1P2-S2SB-01	5.96	7	0.032	0.002	0.004	0.021
A1P2-S2SP-04	17.7	7	0.096	0.007	0.004	0.021
A1P2-S2NI-08	57.2	7 & 8	0.309	0.021	0.006	0.021
A1P4-C1	28.8	8	0.156	0.011	0.006	0.019
A1P4-C2	14.7	8	0.079	0.005	0.006	0.019
A1P4-C3	16.6	8	0.090	0.006	0.006	0.019

[a] Data obtained from certification reports (DOE 1998b; 1999; 2001d; 2004b).
[b] Leach coefficients obtained from Table 2.2 of the OU5 K_l study (DOE 1995c).
[c] HTW maximum concentrations taken from 2007 Site Environmental Report (DOE 2008a).
[d] Perched groundwater results taken from OSDF pre-construction study (DOE 1995a).
mg/L = milligrams per liter

DOE has been monitoring the concentration trend of refined baseline constituents in the HTWs, and some of these trends have been increasing. Given that residual contamination below the FRLs is present in the area of the HTWs, and installation of the facility changed recharge/infiltration conditions in the area, it is expected that contaminant concentrations in perched groundwater would change. The OU5 leaching coefficients for contaminated soil (DOE 1995c) can be used to calculate the range of expected groundwater uranium concentrations in below-FRL soil (Table 1), and uranium values in the HTWs (DOE 2008b) fall near or below the lower level of this range. The maximum measured concentration for perched groundwater (0.021 milligram per liter [mg/L]) prior to OSDF construction (DOE 1995b) is slightly lower than the measured maximum HTW value (Cell 3, 0.029 mg/L). However, this is expected, as the soil was disturbed during construction, and particle surfaces exposed to the atmosphere during construction may leach more readily than less-reactive surfaces in undisturbed soil. Based on the K_l value of 185 in Table 2, the uranium concentration in the Cell 3 HTW could reach a maximum value near 0.2 mg/L without uranium contribution from the OSDF.

Pre-OSDF GMA contamination near the OSDF footprint was present in the Plant 6 area, which is approximately 300 ft west of the OSDF. During the RI, a uranium plume was detected in this area. Direct-push sampling conducted in 2000 and 2001, in support of the *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001e), indicated that the uranium plume in the Plant 6 area was no longer present. It is believed that the uranium plume dissipated to concentrations below the FRL as a result of the shutdown of plant operations in the late 1980s and the pumping of highly contaminated perched water as part of the Perched Water Removal Action #1 in the early 1990s. Because a total uranium plume with concentrations above the groundwater FRL was no longer present in the Plant 6 area at the time of the design, a restoration module for the Plant 6 area became unnecessary and was no longer planned.

Deep excavation work in the Plant 6 area was completed in 2004. As a follow-up to the excavation work, direct-push groundwater sampling was conducted in 2004 in the area to determine if any post-excavation groundwater FRL exceedances for uranium or technetium-99 were present in the GMA. The results of the direct-push groundwater sampling showed no uranium or technetium-99 FRL exceedances.

Since the decision not to install extraction wells in the Plant 6 Area was approved in 2001, uranium FRL exceedances have been measured at one well in the area, monitoring well 2389. The uranium FRL exceedances at well 2389 will continue to be monitored as part of the IEMP. Although a thin layer of contamination appears to be present in the upper 1 ft or so of the aquifer at monitoring well 2389, the contaminant mass is not sufficient to warrant installation of a groundwater recovery well. It is expected that the concentration of uranium at well 2389 will dissipate over time. The data will continue to be tracked as part of the IEMP sampling activities.

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3.0 Regulatory Analysis and Strategy

The OSDF groundwater/leak detection and leachate monitoring plan is designed to comply with all regulatory requirements associated with groundwater detection monitoring and leachate monitoring for disposal facilities. The sources of these regulatory requirements are the applicable or relevant and appropriate requirements (ARARs) listed in the RODs for OU2, OU3, and OU5. This section summarizes the regulatory requirements by describing each ARAR and presents the regulatory strategy for compliance with the ARARs.

As indicated in Section 1.1, there is institutional knowledge regarding the various complexities associated with the regulatory strategy for the OSDF leak detection and data evaluation processes. This information should be considered during future post-closure evaluations.

3.1 Regulatory Analysis Process and Results

The analysis of the regulatory drivers for groundwater monitoring for the OSDF was conducted by examining the suite of ARARs in the Fernald Preserve's approved OU RODs to identify a subset of specific groundwater monitoring requirements for the OSDF. Three RODs (OU2, OU3, and OU5) include requirements related to onsite disposal. The RODs for these three OUs were reviewed, and the ARARs relevant to the OSDF were identified. The results of this review are provided in Appendix A and are summarized below.

The following regulations were identified as being ARARs for the OSDF groundwater monitoring program:

- Ohio Solid Waste Disposal Facility Groundwater Monitoring Rules, *Ohio Administrative Code* (OAC) 3745-27-10, which specify groundwater monitoring program requirements for sanitary landfills (although the OSDF is not a sanitary landfill). These regulations describe a three-tiered program for detection, assessment, and corrective measures monitoring.
- Resource Conservation and Recovery Act (RCRA)/Ohio Hazardous Waste Groundwater Monitoring Requirements for Regulated Units, 40 CFR 264.90–99 (OAC 3745-54-90–99), which specify groundwater monitoring program requirements for surface impoundments, landfills, and land treatment units that manage hazardous wastes. Similar to the Ohio Solid Waste regulations, these regulations describe a three-tiered program of detection, compliance, and corrective action monitoring. Because the Ohio regulations mirror or are more stringent than the federal regulations, the Ohio regulations are the controlling requirements and are cited in this document.
- Uranium Mill Tailings Radiation Control Act (UMTRCA) regulations codified at 40 CFR 192 Subpart D, which specify standards for uranium byproduct materials in piles or impoundments. This regulation requires conformance with the RCRA groundwater monitoring performance standard in 40 CFR 264.92. Compliance with RCRA/Ohio Hazardous Waste regulations for groundwater monitoring will fulfill the substantive requirements for groundwater monitoring in the UMTRCA regulations.
- DOE Manual 435.1-1, *Radioactive Waste Management Manual*, which requires low-level radioactive waste disposal facilities to perform environmental monitoring for all media, including groundwater. Complying with RCRA/Ohio Hazardous Waste and Ohio Solid Waste regulations for groundwater monitoring along with incorporating pertinent radiological parameters will fulfill the requirement for groundwater monitoring in this directive.

The following drivers necessitated an overall leak detection strategy:

- Ohio Municipal Solid Waste Rules, OAC 3745-27-06(C)(9a) and OAC 3745-27-10, which require that facilities prepare a groundwater monitoring plan that incorporates leachate monitoring and management to ensure compliance with OAC 3745-27-19(M)(4) and OAC 3745-27-19(M)(5).
- Ohio Municipal Solid Waste Rules—Operational Criteria for a Sanitary Landfill Facility, OAC 3745-27-19(M)(4) and (5), which require submittal of an annual operational report including:
  - A summary of the quantity of leachate collected for treatment and disposal on a monthly basis during the year, location of leachate treatment and/or disposal, and verification that the leachate management system is operating in accordance with the rule.
  - Results of analytical testing of an annual grab sample of leachate from the leachate management system.

3.2 OSDF Monitoring Regulatory Compliance Strategy

Of the ARARs presented above, the Ohio Solid Waste and the Ohio Hazardous Waste regulations are the most prescriptive and, therefore, warrant further discussion on how compliance with these two regulatory requirements will be met. The leak detection monitoring requirements of these two sets of regulations are similar, and they dictate the development of detection monitoring plans capable of determining the facility's impact on the quality of water in the uppermost aquifer and any significant zones of saturation above the uppermost aquifer underlying the landfill.

Typically a detection monitoring program consists of the installation of upgradient and downgradient monitoring wells, routine sampling of the wells, and analysis for a prescribed list of parameters, followed by a comparison of water quality upgradient of the landfill to water quality downgradient of the landfill. The detection of a statistically significant difference in downgradient water quality suggests that a release from the landfill may have occurred.

As discussed in Section 2.0, low permeability in the glacial till and preexisting contamination within the glacial till and the GMA add complexity to the development of a groundwater detection monitoring program consistent with the standard approach of the Solid and Hazardous Waste regulations. Both sets of regulations accommodate such complexities by allowing alternate monitoring programs, which provide flexibility with respect to well placement, statistical evaluation of water quality, facility-specific analyte lists, and sampling frequency. The OSDF groundwater/leak detection monitoring program has required the use of an alternate monitoring program, in accordance with the criteria in the Ohio Solid and Hazardous Waste regulations. Compliance with the criteria is discussed below in Section 3.2.1.
The regulatory requirements for the leachate monitoring program are provided by the Ohio Solid Waste regulations. The compliance strategy for the leachate monitoring program is discussed below in Section 3.2.2.

3.2.1 Leak Detection Monitoring Compliance Strategy

The leak detection monitoring program for the OSDF includes routine sampling and analysis of water drawn from four zones within and beneath the disposal facility: the LCS, the LDS (within the facility), perched water in the glacial till (beneath the facility), and the GMA (beneath the facility). This monitoring approach takes the unique hydrogeologic and preexisting contaminant situation at the site into consideration. However, this approach differs from a typical leak detection monitoring program in several ways and requires a compliance strategy to ensure that the program meets or exceeds the substantive requirements of the Ohio Solid and Hazardous Waste regulations. Below is a detailed discussion of compliance with several elements of the program, including alternate well placement, statistical analysis, monitoring frequency, and parameter selection. The implementation of the OSDF groundwater/leak detection program is presented in Section 4.0 and Appendix B.

3.2.1.1 Alternate Well Placement

The Ohio Solid Waste regulations require that a groundwater monitoring system consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from both the uppermost aquifer and any overlying significant zones of saturation (OAC 3745-27-10[B][1]). Groundwater samples are obtained through wells installed in the glacial till and the GMA.

The regulations also state that the wells must represent the quality of groundwater passing directly downgradient of the limits of solid waste placement (OAC 3745-27-10[B][1][b]). In lieu of installing vertical glacial till monitoring wells along the perimeter of the OSDF, horizontal wells were installed beneath the OSDF and screened beneath the liner-penetration box of the LDS for each disposal cell where the greatest potential for leakage exists. Horizontal wells are preferred to vertical wells due to restrictions on well installation within 200 ft of waste placement so as to avoid interference with the disposal facility cap, and the absence of significant lateral flow within the till. As discussed in Section 2.0, the time required for contaminants to migrate laterally in the till toward wells located 200 ft from the limits of waste placement greatly exceeds the vertical travel time through the glacial till; therefore, the aquifer would be impacted by contaminants long before vertical wells in the glacial overburden located outside the restricted area could detect the release. Although the existence of the OSDF may result in dewatering of the glacial till such that samples cannot be regularly obtained, horizontal wells installed beneath the liner of the OSDF represent the highest potential for detecting releases to the till. Such an alternate placement for the till wells is allowed in the Ohio Solid Waste regulations.

The performance criteria in OAC 3745-27-10(B)(4) require that the number, spacing, and depth of the wells must be based on site-specific hydrogeologic information and must be capable of detecting a release from the facility to the groundwater at the closest practical location to the limits of solid-waste placement. The placement of till wells beneath the facility, as opposed to along its perimeter, meets or exceeds the requirement to be located adjacent to waste placement.

3.2.1.2 Alternate Statistical Analysis

A statistical analysis is required in both the Ohio Solid and Hazardous Waste regulations (OAC 3745-27-10[C][6] and OAC 3745-54-97[H]). The statistical analysis methods listed in the regulations are parametric analysis of variance (ANOVA), an ANOVA based on ranks, a tolerance or prediction interval procedure, a control chart approach, or another statistical test method. The control chart approach (combined Shewhart CUSUM [cumulative sum] control charts) is being used, as it has been determined the most viable approach; however, problems with control charts exist. The method of evaluation for the OSDF groundwater/leak detection monitoring data is an intra-well trend analysis prior to the establishment of background (baseline) conditions in the perched water and GMA beneath the OSDF. Statistically significant evidence of an upward trend in some constituents negates the use of control charts for those constituents. Control charts are produced for those constituents in the HTW and GMA wells that are stable. Concentrations of the unstable constituents in the HTW and GMA wells are being monitored and trended over time. As constituent trends become stable, control charts will be prepared.

Although vertical monitoring wells are installed in the GMA upgradient and downgradient of the OSDF, an intra-well comparison is more appropriate than an upgradient versus downgradient comparison until aquifer restoration is complete. The direction of groundwater flow beneath the OSDF is being temporarily influenced by the pump-and-treat remedy. Five years of water level measurements prior to operating the pump-and-treat system (1988 through 1993) indicate that groundwater flowed from the west to the east beneath the OSDF (refer to OU5 RI report, Figure 3-50). The pump-and-treat system that is currently operating pulls groundwater in the area of the OSDF to the southwest. It will not be possible to establish a long term upgradient-downgradient monitoring relationship beneath the OSDF until the pump-and-treat remedy ends. The current early estimate for the completion of the remedy is 2035. Transient flow conditions within the aquifer, as well as the existence and expected fluctuation of contaminant concentrations at levels below the FRLs, discourage the use of a statistical comparison of upgradient and downgradient water quality as a reliable indicator of a release from the OSDF.

To date, establishing baseline conditions with statistical analyses has proven to be difficult due to a lack of steady state conditions. Steady-state conditions, which are a requirement of control charting, have not been reached for all constituents.

Recognizing that lack of steady state concentration conditions complicate the data evaluation process in the perched system and GMA, DOE conducted a common-ion study. The study was a comprehensive geochemical and statistical evaluation of the concentrations of 50 aqueous ions in fluid samples from the LCS, LDS, and HTWs of each cell (DOE 2008b). The study concluded that:

- Only a limited number of ions can serve as indicator ions because few ions have concentrations in the source horizon that exceeded their concentration in the target horizon by at least a factor of four.
- Many of the indicator ions in the target horizons show concentration trends or serial correlation, which precludes the use of control charts because steady-state conditions have not been established in the fluid-solid system.
- Fluid volume is the key monitoring parameter to indicate the potential for leachate migration, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

3.2.1.3 Alternate Parameter Lists

The process used to define an alternate parameter list, described in detail in Appendix E, used the extensive RI database and fate and transport modeling to evaluate potential indicator parameters. RIs have been completed for all Fernald Preserve source terms and contaminated environmental media. The RIs included extensive sampling and analysis to characterize wastes and quantify environmental contamination so that health protective remedies, such as the construction of the OSDF, could be selected.

Extensive databases were also used to develop WAC, which consist of concentration and mass-based limitations on the waste entering the OSDF. The WACs for the OSDF were developed with consideration of the types, quantities, and concentration of wastes that would be placed into the OSDF; the leachability, mobility, persistence, and stability of the waste constituents in the environment; and the toxicity of the waste constituents. Of 93 constituents that were evaluated for waste acceptance, 18 were identified as having a relatively higher potential to impact the aquifer within the 1,000-year specified performance period. Maximum allowable concentration limits were established for wastes containing these constituents. These 18 constituents were chosen as the initial site-specific leak detection monitoring parameters (initial baseline constituents).

The factors used to establish WAC for the OSDF are similar to the consideration criteria for developing an alternate parameter list specified in the Ohio Solid and Hazardous Waste regulations (OAC 3745-27-10[D][2] and [3]; OAC 3745-54-93[B]; OAC 3745-54-98[A]); and Ohio EPA policy and guidance (Ohio EPA 1995, 1996, 1997) for a hazardous waste landfill. The process is to identify waste constituents that are expected to be derived from wastes placed in the OSDF. The methodology for developing an OSDF-specific leak detection monitoring parameter list used the WAC methodology and the Ohio Solid and Hazardous Waste regulatory criteria to identify waste constituents that are expected to be derived from wastes placed in the OSDF. This effort was not completely successful, as waste materials are nearly identical in composition to material outside of the OSDF.

Additionally, review of OSDF monitoring data for the 18 constituents that were chosen for the initial site-specific leak detection monitoring parameters indicated that the majority of the constituents were not detected. As a result, DOE, Ohio EPA, and EPA agreed that the list of constituents monitored could be refined to those that were detected more than 25 percent of the time.

Twelve rounds of sampling for the initial site-specific leak detection monitoring parameters were completed at all eight cells in 2007. At the completion of the 12 rounds of sampling, five constituents/parameters were identified as having been detected at least 25 percent of the time. These five constituents/parameters (boron, sulfate, uranium, total organic carbon [TOC], and total organic halogens [TOX]) make up the refined baseline for each cell.

In 2002 there were relatively high concentrations of sulfate in the Cells 4 and 5 LCS water prior to waste placement, indicating a sulfate source (possibly gypsum) in the gravel composing the LCS layer. Due to sulfate's high mobility and the presence of an ongoing source in the LDS/LCS layers, it was added to the leak detection sampling program in 2003. This is discussed further in Appendix E.

In summary, baseline monitoring has progressed in two steps:

- Initial baseline monitoring—based on 12 rounds of samples for the 18 initial site-specific leak detection monitoring parameters.
- Refined baseline monitoring—based on initial baseline parameters that are detected 25 percent or more of the time.

Establishing baseline water chemistry in the perched groundwater and GMA horizon under each cell is complicated by the construction process used to install the HTWs and the existence of past groundwater contamination in the till and GMA zones. The installation of the HTWs involved excavation of a trench, placement of a porous filter media composed of sand, and then backfill with the porous media and till material. During this installation, the subsurface chemical properties of the till were altered by the contact of the excavated till material with the atmosphere (oxygen-rich environment). Contact of the subsurface till with the atmosphere may have impacted (1) the oxidation state of metals on the surface of grains and in the pore water and (2) microbial species that mediate oxidation-reduction reactions in the subsurface. Additionally, historical contamination in perched groundwater and GMA horizons surrounding the cell may be migrating and diffusing into the HTW and GMA monitoring wells.

As discussed in the preceding section, to address some of these uncertainties, DOE conducted a common-ion study. Results of the study were presented in *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b). The report identified four additional constituents—iron, manganese, sodium, and lithium—that are potentially beneficial leak detection monitoring parameters for the OSDF. Beginning in 2009 these four additional constituents were monitored quarterly in all horizons (LCS, LDS, HTW, and the GMA). The common-ion report also identified a few constituents in the HTW that passed the statistical screening requirements for control charting.

In addition to sampling for the approved initial baseline constituents, refined baseline constituents, and the selected common-ion constituents, DOE continued to sample the LCS once a year for the full list of Appendix I (OAC 3745-27-10) and polychlorinated biphenyl (PCB) constituents. A statistical screening process was developed to evaluate the results of the continued sampling with the objective of determining if any constituent not already on the alternate parameter list might also be a useful monitoring constituent. The screening process was initially presented in the *Fernald Preserve 2007 Site Environmental Report* (DOE 2008a), and was conducted once a data set of eight samples was available for a cell. The screening process has been conducted for all eight Cells, and the results have been reported as follows:

- Cells 1, 2, and 3 reported in the *Fernald Preserve 2007 Site Environmental Report* (DOE 2008a).
- Cells 4 and 5 reported in the *Fernald Preserve 2009 Site Environmental Report* (DOE 2010).
- Cell 6 reported in the *Fernald Preserve 2010 Site Environmental Report* (DOE 2011).
- Cells 7 and 8 reported in the *Fernald Preserve 2011 Site Environmental Report* (DOE 2012).

Upon completion of the parameter selection statistical process, annual sampling in the LCS continued for an agreed-to modified Appendix I parameter list.

The assessment process was based on showing statistically that the average LCS concentration was greater than either the pre-design or background average concentration. A constituent with a greater average LCS concentration than either pre-design or background was added to the monitoring list for deeper horizons. The resulting monitoring list contained 24 parameters which were sampled for in all horizons, except the HTW.

Monitoring List

Parameter	Source for Selection
Uranium	Refined Baseline
Boron	Refined Baseline
TOC	Refined Baseline
TOX	Refined Baseline
Sulfate	Refined Baseline
Iron	Common-Ion Report[a]
Lithium	Common-Ion Report
Manganese	Common-Ion Report
Sodium	Common-Ion Report
Arsenic	Screened in 2007
Cobalt	Screened in 2007
Nickel	Screened in 2007
Selenium	Screened in 2007
Total dissolved solids (TDS)	Screened in 2007
Zinc	Screened in 2007
Alkalinity	Screened in 2009
Barium	Screened in 2009
Calcium	Screened in 2009
Chloride	Screened in 2009
Copper	Screened in 2009
Magnesium	Screened in 2009
Nitrate/nitrite	Screened in 2009
Potassium	Screened in 2009
Chromium	Screened in 2011

Notes:
Technetium-99 is also sampled in Cell 8 only.
[a] *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

Ohio EPA proposed reducing the list of parameters being sampled in the HTW to just uranium, arsenic, and tritium (beginning in the second quarter of 2011). Sampling for tritium in all horizons was agreed to for a year. Tritium was added to the list of constituents because it was hoped that it might serve as a useful monitoring parameter. Tritium was used in exit signs, which may be in the OSDF with other building materials. Tritium has a relatively short half-life (approximately 12 years) but is fairly mobile and if present could be a good potential leak indicator parameter. One year of tritium sampling results showed that tritium was not a good monitoring parameter for the OSDF. Therefore, tritium is no longer sampled for in any of the monitoring horizons. In addition to sampling the HTWs for uranium and arsenic, DOE also sampled for sodium and sulfate in order to prepare bivariate plots. Bivariate plots are useful in illustrating that the chemical signatures of the different monitoring horizons (LCS, LDS, HTW) are separate and distinct.

As a final step to conclude the parameter selection process, DOE obtained the services of a recognized expert in the field of statistics to conduct an independent assessment of the parameter selection process that was used (MacStat Consulting Inc. 2014). Results of the independent assessment were presented to DOE, EPA, and Ohio EPA on April 15, 2015, at the Fernald site.

The monitoring program was assessed to reduce the potential for false positive or false negative conclusions concerning the interpretation of the data sets. The independent assessment concluded that only 12 of the 24 constituents being monitored provided any value. The 12 parameters identified for elimination either added no value to the monitoring effort or increased the potential for a false positive or negative conclusion based on the statistics being applied to evaluate the data sets. Listed below are the 12 monitoring constituents identified in the assessment as being useful monitoring constituents:

Useful Monitoring Constituents

Total uranium
Boron
TOX
Sulfate
Lithium
Selenium
TDS
Calcium
Magnesium
Nitrate + nitrite as nitrogen
Potassium
Technetium-99

On July 22, 2015, Ohio EPA participated in an onsite tour of an OSDF valve house to review the logistics involved in the collection of a water sample from an LDS. Upon inspection of the valve house, Ohio EPA made the following observations:

- Water is not being constantly replenished through the LDS collection tank, and the sample being bailed from the tank is representative of these stagnant conditions.
- A sample degassing potential is present because the low flow prolongs contact of a water sample with the atmosphere.
- Reduction-oxidation (redox) sensitive metals in the water could oxidize from the prolonged contact of the water with the atmosphere. Iron precipitates were observed in the interior of the collection tanks.
- Carbon dioxide could degas from the sample and affect the representativeness of other parameters (e.g., calcium and magnesium). A white precipitate, presumably calcite, was observed on the floor and lower walls of the collection tank.
- Ammonia in the sample could oxidize.

The observations noted above could at times bias analytical results high for certain constituents and other times bias results low for certain constituents. If the LDS dries up completely, no sample can be collected, and no leachate quality determination can be made.

Because of the low flows and the exposure of the sample to the atmosphere, it is uncertain whether an LDS sample periodically 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 be the best approach for complying with Ohio Solid Waste regulations (OAC 3745-27-19(M)(5)) for the OSDF. Monitoring leachate accumulation rates from the LDS (and comparing them to the action leakage rate and the initial response leakage rate) is a much better approach.

Given the low flows in the LDS, an additional geochemical assessment concerning the continued use of bivariate plots was conducted (DOE 2016). The concern was that the low-flow conditions could be impacting the water samples for the constituents being used to prepare the bivariate plots (i.e., uranium, sulfate, and sodium). The assessment concluded that continued use of bivariate plots was recommended.

Based on the final statistical and geochemical assessments discussed above, the following monitoring program was implemented January 1, 2017.

- Sample the LCS, LDS, and HTW semiannually for uranium, sodium, sulfate, and boron, and continue to use bivariate plots to illustrate chemical differences between the sampling horizons.
- Sample the GMA wells semiannually for the following 13 parameters: total uranium, boron, TOX, sulfate, lithium, selenium, TDS, calcium, magnesium, nitrate + nitrite as nitrogen, potassium, technetium-99, and sodium. These are the 12 parameters recommended in (Geochemical Consultants 2016) and sodium. Prepare control charts for the 13 parameters if control chart assumptions are met (i.e., defined distribution, no concentration trend, and no serial correlation) or prepare concentration trend plots if control chart assumptions are not met.

Sampling lists are provided in Appendix B, in Tables 1 and 2 as follows:

- Table 1: Semiannual GMA Monitoring List Requirements for Cells 1 Through 8
- Table 2: Semiannual LCS, LDS, and HTW Monitoring List Requirements for Cells 1 Through 8

3.2.1.4 Alternate Sampling Frequency

The Ohio Solid Waste regulations require that, for detection monitoring, at least four independent samples from each well will be taken during the first 180 days after implementation of the groundwater detection monitoring program and at least eight independent samples in the first year to determine the background (i.e., baseline) water quality (OAC 3745-27-10[D][5][a][ii][a]). The requirement to collect eight independent samples is only applicable to wells installed after August 15, 2003, the date that the code became effective. The Ohio Hazardous Waste regulations do not specify a frequency for determining a background data set. The Ohio Hazardous Waste regulations do require a performance standard for establishing background; OAC 3745-54-97(G) states that the number and kinds of samples taken to establish background be appropriate for the statistical test employed.

Experience and technical knowledge gained from cell monitoring indicated that it was necessary to collect initial baseline samples quarterly. Sampling frequencies were based on the following: HTWs and GMA wells were sampled bimonthly after waste placement until 12 samples were collected for statistical evaluation. These frequencies were selected to develop an appropriate statistical procedure, to address OSDF construction schedules, and to compensate for the varying temporal conditions and seasonal fluctuations. After sufficient samples were collected for statistical analysis, samples were collected quarterly from the HTWs and GMA. The Ohio Solid Waste regulations allow for a semiannual sampling frequency for detection monitoring after the first year but also allow for the proposal of an alternate sampling program (OAC 3745-27-10[D][5][a][ii][b] and [b][ii][b], and 3745-27-10[D][6]). The frequency of sampling was reduced from a quarterly frequency to a semiannual frequency beginning in January 2014.

3.2.2 Leachate Monitoring Compliance Strategy

The Solid Waste regulations (OAC 3745-27-19[M][5]) require collection and analysis of leachate annually for Appendix I constituents and PCBs listed in OAC 3745-27-10. Ohio Solid Waste regulations OAC 3745-27-10(D)(2) and (3) allow for the selection of an alternate list of constituents to monitor in lieu of some or all of the constituents listed in Appendix I of OAC 3745-27-10. As described in Section 3.2.1.3 and Appendix E, an alternate parameter list has been approved for the OSDF.

Although not specified in the OU RODs as an ARAR, the federal RCRA (Hazardous Waste) regulations include specific requirements in 40 CFR 264.303 for monitoring the volume of liquid collected from a disposal facility's LDS. Regulation 40 CFR 264.302 includes provisions for determining an action leakage rate that, if exceeded, would prompt specific response and notification actions. An action leakage rate of 200 gpad, an initial response leakage rate of 20 gpad, and a low-flow response leakage rate of 2 gpad are defined for the OSDF. The response and notification process for an exceedance of a leakage rate (40 CFR 264.304) is provided in Section 6.2.

The leachate monitoring strategy, as part of the groundwater monitoring plan and required by OAC 3745-27-06(C)(7), must include provisions for obtaining the monthly volume of leachate collected for subsequent treatment, provide the method of leachate treatment and/or disposal, and include verification that the leachate management system is operating properly (OAC 3745-27-19[M][4]). Monitoring to verify that the leachate management system is operating properly is identified in the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021a) and the *Converted Advanced Wastewater Treatment Facility Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021b) and in Appendix D of this document.

The monthly volume of leachate collected from the LCS for treatment and subsequent discharge will be obtained based on the program in 40 CFR 264.303(c) to determine the flow rates from the LCS. In 2018, LDS flow rates and volumes had diminished such that no LDS automatic tank pump outs occurred in any cell. Beginning in 2019, the volume of water collected from treatment from the LDS was obtained based on pump outs of the LDS. 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. Water collected in the 5-gallon container is monitored to determine if the low flow response leakage rate of 2 gpad is reached.

Monitoring the flow rates will provide data for determining the volume of leachate collected in the LCS and water collected in the LDS and will also provide data pertinent to the leak detection monitoring program. The flow rates are part of the leak detection monitoring program and are discussed further in Section 4.0. A separate leachate management monitoring strategy is provided as Section 5.0 to provide information on the method of leachate treatment and disposal, including analysis of parameters useful for leachate treatment.

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4.0 Leak Detection Monitoring Program

This section presents the technical approach for leak detection monitoring at the OSDF, in light of the regulatory requirements for leak detection monitoring summarized in Section 3.0. This section includes a summary of the objectives of the program, a description of the major program elements, the selection process for analytical parameters (i.e., site-specific leak detection indicator parameters), and the strategy for evaluating the data to determine whether a leak has occurred. The subsections are as follows:

- Section 4.1: Introduction.
- Section 4.2: Monitoring Objectives.
- Section 4.3: Leak Detection Monitoring Program Elements.
- Section 4.4: Sample Collection.
- Section 4.5: Leak Detection Data Evaluation Process.

Additionally, Appendixes B and C provide the Project-Specific Plan and Data Quality Objectives for the OSDF Monitoring Program for each cell, with details on specific monitoring lists and frequencies. Appendix E describes the selection process for site-specific leak detection indicator parameters. Section 5.0 describes leachate management activities. Section 6.2 provides a summary of the notifications and potential follow-up response actions that accompany the monitoring program.

4.1 Introduction

As discussed in Section 1.0, the OSDF leak detection monitoring program constitutes the first tier of a three-tiered detection, assessment, and corrective action monitoring strategy that is required for engineered disposal facilities. Consistent with this three-tiered approach, follow-up assessment and corrective action monitoring plans will be developed and implemented as necessary if it is deemed appropriate. Conversely, if the detection monitoring successfully demonstrates that leachate leaks have not occurred, then the monitoring program will remain in the first-tier "detection mode" indefinitely. The follow-up assessment and/or corrective action monitoring plans, if found to be necessary, would be prepared as new, independent plans that would supersede this first-tier detection program.

In leak detection assessments, water quality data will be evaluated in context with preexisting contamination data and LDS flow data. The leak detection monitoring program monitors two horizons inside of each cell: the LCS and the LDS. A perched groundwater monitoring well is located and monitored beneath the secondary facility liner and 3-foot thick compacted clay layer, directly below the LDS and LCS liner-penetration boxes of each cell (Figure 3). A GMA groundwater monitoring well is situated on the east and west of each cell at depths ranging from 40 to 90 ft beneath the OSDF. The data collected from the four components are evaluated comparatively over time.

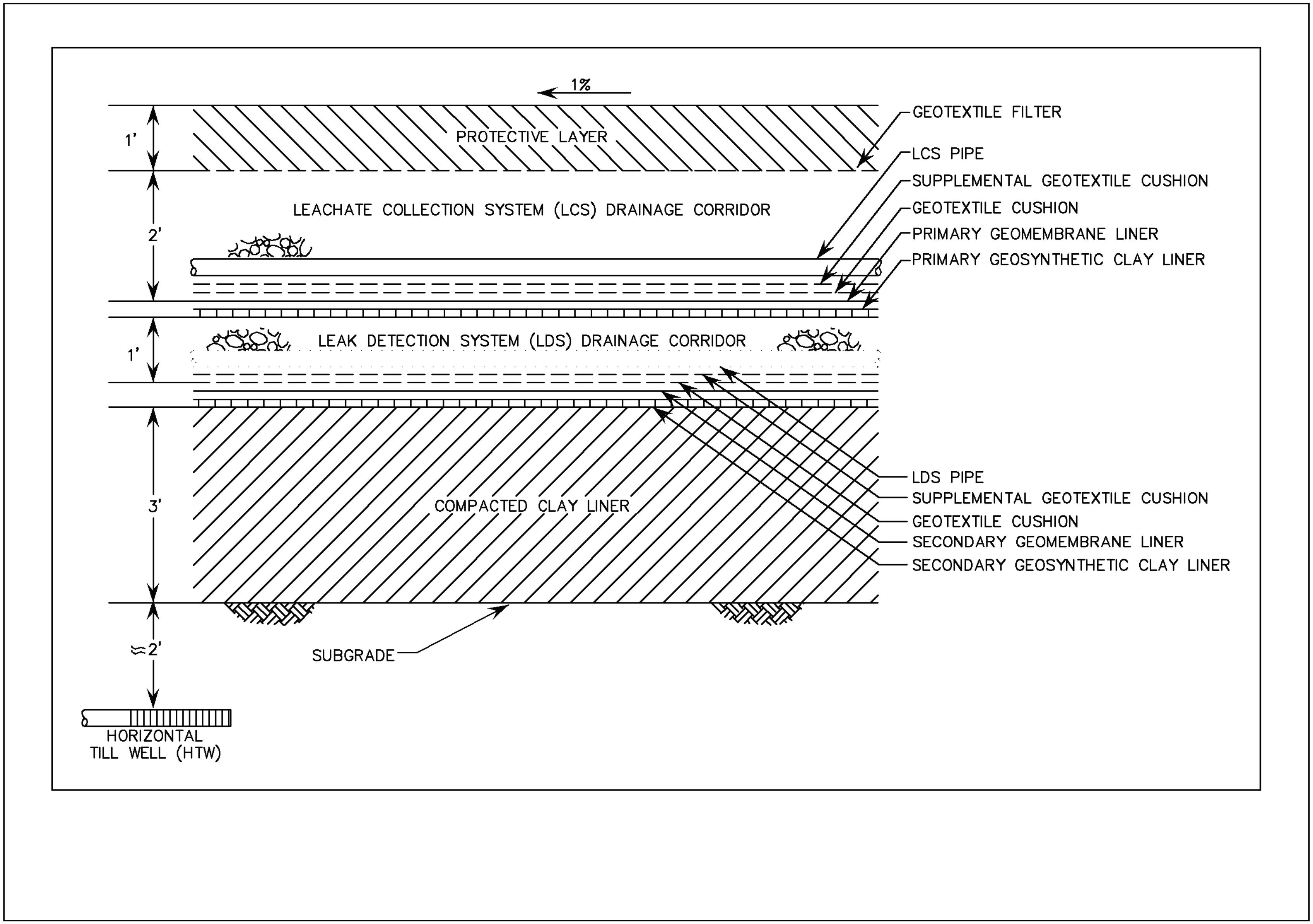

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Figure 3. OSDF Liner System with HTW at the Drainage Corridor

The GMA is the prime resource of concern that could potentially be affected by the OSDF in the unlikely event that a leachate leak occurred. Therefore, the aquifer is monitored for water quality at the immediate boundary of the OSDF. However, as discussed in Section 2.0, contaminant travel times to the aquifer through the glacial till beneath the OSDF are of such length that reliance on GMA monitoring alone would be insufficient to provide effective early warning of a leak from the facility. Therefore, perched groundwater monitoring wells are installed directly below the liner-penetration box of each cell.

Additionally, as indicated in Sections 1.1 and 3.0, there is institutional knowledge regarding the various complexities associated with the regulatory strategy for the OSDF leak detection and data evaluation processes. This information has been considered in the monitoring strategy.

4.2 Monitoring Objectives

The fundamental objective of the leak detection monitoring program is to provide the leachate flow and water quality data needed to determine if a leak may be occurring from the OSDF. Recognition of this fundamental objective allows the Fernald Preserve to move confidently into the next regulatory-based tiers of the program—assessment and corrective action monitoring—if required. This fundamental objective is the primary driver for all of the key site-specific elements (i.e., monitoring locations, frequencies, analytical parameters, and follow-up response actions) of the program.

In addition to this fundamental objective, several other objectives have been considered in the site-specific design of the leak detection program:

- The program should have the ability to distinguish an OSDF leak from the above-background preexisting levels of contamination that are found in the subsurface.
- All monitoring wells must be installed at locations and with construction methods that do not interfere with or compromise the integrity of the cap and liner system of the OSDF.
- The program needs to satisfy the site-specific regulatory requirements for leak detection monitoring summarized in Section 3.0.

The leak detection monitoring approach described below meets the intent of providing early detection of a release from the OSDF within the hydrogeologic regime at the Fernald Preserve, and is tailored to accommodate the additional program design objectives summarized above.

4.3 Leak Detection Monitoring Program Elements

4.3.1 Overview

The leak detection monitoring program involves (1) tracking the quantity of liquid produced within the LCS and LDS over time to determine if enough hydraulic head is present in the facility to drive leachate through a liner breach, and (2) water quality monitoring of the leachate, the perched groundwater, and groundwater in the GMA. The success of the leak detection monitoring strategy for the OSDF is dependent upon understanding how a leak might occur from the facility, and understanding that preexisting contaminant concentrations in the perched groundwater and GMA complicate water quality data interpretations.

The approved design for the OSDF is presented in detail in the initial OSDF Design Package and subsequent approved follow-up design and construction drawing packages. The OSDF is a double-lined landfill consisting of eight individual cells that were constructed in phases. A primary liner is located beneath the LCS drainage corridor and a secondary liner is located beneath the LDS drainage corridor. Both liners contain the following components in descending order: a supplemental geotextile cushion, geotextile cushion, geomembrane liner and a geosynthetic clay liner. As shown in Figure 3, a vertical profile of the OSDF consists of the following layers (top to bottom): a soil cushion layer underlain with geotextile fabric, an LCS drainage corridor underlain by a primary liner, and the LDS drainage corridor underlain by the secondary liner. Beneath the secondary liner is a 3-foot thick layer of compacted clay.

Both the LCS and LDS drainage corridors drain to the west within each cell. The base of each cell liner is sloped toward the center line of the cell, and the center line of the base is sloped toward the west. At the western edge of each cell liner, any liquid within the LCS and LDS is collected in pipes that pass through the liner-penetration box and flow to the respective cell's valve house. As identified previously, the liner-penetration box represents the area with the greatest leak potential for each cell and is considered the primary location where a leak would first enter the environment if a leak were to occur.

Each cell is also constructed with an engineered composite cover. The cover system consists of the following layers (top to bottom): a vegetation cover layer, a topsoil layer, a granular filter layer, a bio-intrusion barrier, a geotextile filter, a cover drainage layer, the primary composite cap (geotextile cushion, HDPE geomembrane, geosynthetic clay liner, and compacted clay), and an underlying contouring layer. The cover system was completed in 2006. Since the cover system has been in place, leachate production has diminished over time as a result of the moisture infiltration barrier properties of the cover system.

A construction quality assurance/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/quality control during 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 from the facility.

The performance of each cell is monitored individually; each cell has its own engineered LCS and LDS drainage layers, perched groundwater monitoring component, and upgradient and downgradient GMA monitoring wells.

As described earlier, a secondary liner is present at the base of each cell beneath the LDS. In order for leachate to migrate from the OSDF, a defect or tear (breach) would need to exist in the secondary liner and enough hydraulic head would be needed to drive the leachate through the breach. Without adequate hydraulic head to drive leachate through a liner breach, leachate would follow the pathway of least resistance, which would be across the top of the liner through gravel in the LDS drainage corridor. The gravel has a much higher hydraulic conductivity relative to the underlying compacted clay in the liner, or the gray clay that is present beneath the facility.

For a leak to occur and be detected in an HTW (the first monitoring point beneath the facility), a liner breach needs to exist, and enough hydraulic head needs to be present in the facility to drive leachate through the breach. The action leakage rate is the monitoring criterion used to assess the presence of hydraulic head in the cell of the facility. The action leakage rate is the maximum design flow rate that the LDS can remove without the fluid head on the bottom liner of the facility exceeding 1 ft (40 CFR 264.302). Stated in another way, it is the flow rate that corresponds to a hydraulic head within the facility capable of driving fluid through a liner breach, if the breach occurs at the penetration box. The OSDF has an action leakage rate of 200 gpad (DOE 1997).

Flow is monitored in the LDS of each cell and reported annually in the Site Environmental Report. To be conservative, DOE will not wait until the action leakage rate of 200 gpad is reached to investigate the possibility of a leak from the facility. A phased response approach is defined that is triggered by two additional lower administrative action levels; a low-flow response leakage rate (2 gpad) and an initial response leakage rate (20 gpad) are also defined. Notifications and response actions for all three leakage rates are presented in Section 6.2.

4.3.2 Monitoring the Engineered Layers within the OSDF

Water quality samples were collected from individual LCS and LDS drainage layers within each cell during waste placement and after cell closure as described below and in Section 5.0. In addition to water quality monitoring, the quantity of leachate and fluid flowing through the LCS and LDS layers is recorded and reported.

4.3.2.1 Leachate Collection System

The LCS drainage layer collects infiltrating water and keeps it from entering the environment. Since each cell was capped, the volume of leachate draining through the LCS of each cell has decreased. At some time in the future, decreased flow may limit the available sample volume and subsequently the number of parameters that can be analyzed.

The LCS drains to the west through an exit point in the liner to the LTS on the west side of the OSDF. From there, the leachate collected is periodically pumped to the CAWWT backwash basin or directly to CAWWT feed tanks. Both flow (quantity/volume) and water quality information are collected from the LCS drainage layer according to Section 4.4 and Appendix B.

4.3.2.2 Leak Detection System

By design, the primary composite liner located underneath the LCS drainage layer should not leak. By design, leachate that accumulates in the LCS drainage layer above the primary liner is drained by gravity out of the cells to further reduce the potential for leakage by minimizing the level of fluid buildup in the primary liner. Notwithstanding this design, a second fluid collection layer, the LDS drainage layer, is positioned beneath the primary composite liner to provide a means to track the integrity and performance of the primary liner. If fluids collect within the LDS layer, by design the fluids gravity-drain to the west, out of the cells, where they are routed for treatment.

Similar to the LCS, fluid volumes in the LDS have decreased since the cells were capped. Decreased flow now limits the available sample volume and, as discussed in Section 3.2.1.3, impacts the chemistry of the samples. Below the LDS drainage layer is a secondary composite liner that comprises an HDPE geomembrane, geosynthetic clay liner, and a 3-foot thick layer of compacted clay. This secondary liner serves as the lowermost hydraulic barrier in the liner system and inhibits fluids from entering the environment before they are collected and removed through the LDS drainage corridor.

Like the LCS drainage corridor, both flow (quantity/volume) and water quality information are collected from the LDS drainage layer according to Section 4.4 and Appendix B.

4.3.3 Monitoring Perched Groundwater Beneath the Facility

The perched groundwater monitoring component of the program is designed to monitor for the presence of leachate leakage from the OSDF at its first point of entry into the Fernald Preserve's natural hydrogeologic environment. As discussed in Section 1.0, a horizontally oriented glacial till monitoring well (i.e., HTW), positioned directly beneath the location of the LCS and LDS liner-penetration box in each cell, represents the most feasible site-specific approach to monitor for first entry leakage from the OSDF into the Fernald Preserve's environment.

The HTWs were installed as part of the subgrade construction activities for each cell of the OSDF. They were installed prior to waste placement, therefore eliminating final positioning uncertainties that would be associated with post-construction horizontal drilling techniques. The vertical portion of each of the monitoring wells is located along the western side of the OSDF, while the sample collection interval is positioned beneath the bottom of the secondary composite liner in alignment with the location of the LCS and LDS liner-penetration box.

In the vicinity of the OSDF, the clay-rich till deposits, consisting of carbonate and silicate grains, do not consistently yield fluid to a well. The amount of saturation in the till is further reduced by the barrier properties of the composite cover and liner system of the OSDF, which operate to significantly reduce local infiltration beneath the facility. These conditions make it difficult to obtain sufficient sample volume from the till wells to perform detailed water quality analyses. If sufficient sample volume cannot be obtained to perform the full list of required analyses, analyses will be prioritized as warranted.

Water quality information is collected from the HTWs according to Section 4.4 and Appendix B.

4.3.4 Monitoring the GMA

The subsections below describe the GMA component of the program, including a discussion of the influence of aquifer restoration activities on the program, the siting of the monitoring wells, and the use of the groundwater models (i.e., Variably Saturated Analysis Model in 3 Dimensions [VAM3D] and Sandia Waste Isolation Flow and Transport [SWIFT]) to evaluate the adequacy of the planned well locations.

4.3.4.1 Siting of the GMA Monitoring Wells

The GMA monitoring wells are located immediately adjacent to the OSDF, just outside the footprint of the final composite cap configuration, so as not to interfere with the integrity of the facility. Each cell has its own set of monitoring wells to assist with the evaluation of conditions associated with that cell. As each new cell was brought on line, its associated monitoring wells were installed before (or concurrently with) the construction of the cell liners so that the wells were available for the initiation of baseline sampling prior to waste placement. Thus, well installations have followed the north-to-south progression of OSDF cell construction. The OSDF is bordered by a network of 18 GMA monitoring wells that provide upgradient and downgradient monitoring points for each cell (Figure 4). All monitoring wells were constructed in accordance with the *Sitewide CERCLA Quality Assurance Project Plan* (DOE 2003) for Type 2 GMA wells.

The overall objective of the GMA component of the leak detection monitoring program is to provide long-term surveillance. Therefore, the current and future (post-remediation) aquifer flow conditions were used to select the 18 monitoring locations. As discussed in the next subsection, groundwater flow and particle tracking using both the VAM3D and the SWIFT groundwater modeling computer codes were used to help select the final monitoring locations identified in this plan.

4.3.4.2 VAM3D Flow Model and SWIFT Transport Model Evaluation of Well Locations

The VAM3D and SWIFT groundwater modeling codes were used to evaluate the adequacy of the density and locations of the monitoring wells planned for the GMA. The modeling effort examined the fate of a hypothetical release from each cell to the aquifer at a point directly beneath the liner-penetration box of the LCS and LDS. The modeling predicted the most likely flow path and plume configuration for particles released from the liner-penetration box area over time. The modeling was conducted for post-aquifer-remediation conditions (when groundwater flow directions would be from west to east). The original modeling was performed using the SWIFT computer code and has been updated subsequently using the VAM3D computer code. (**Note:** Modeling was performed on the assumption that there would be nine cells.)

Particle flow path modeling was conducted using the VAM3D flow model output from two model runs representing seasonal wet and dry conditions within the aquifer. Fifteen particles were seeded in a 125-foot radius around each of nine model nodes located nearest the nine cell liner-penetration box locations. These particles were tracked for a 20-year period with no retardation. The velocity flow field data from the post-aquifer-remediation scenario shows the advective particle path results (Figure 5). The particle tracks are generally from west to east beneath the OSDF. As indicated in the figure, the tracks deviate slightly in the north-south direction with seasonal water level fluctuations in the aquifer. Downgradient monitoring wells were located in the area traced out by the modeled flowpaths for each OSDF cell in order to be in the most likely position to detect a leak based on anticipated groundwater flow. These flow model results are similar to the flow model results obtained previously with the SWIFT groundwater model, which was used prior to converting to the VAM3D modeling code. Monitoring wells for Cells 1 through 3 were placed based on the results from the SWIFT groundwater flow model, and monitoring wells from Cells 4 through 8 were placed based on the results from the VAM3D flow model (DOE 2000).

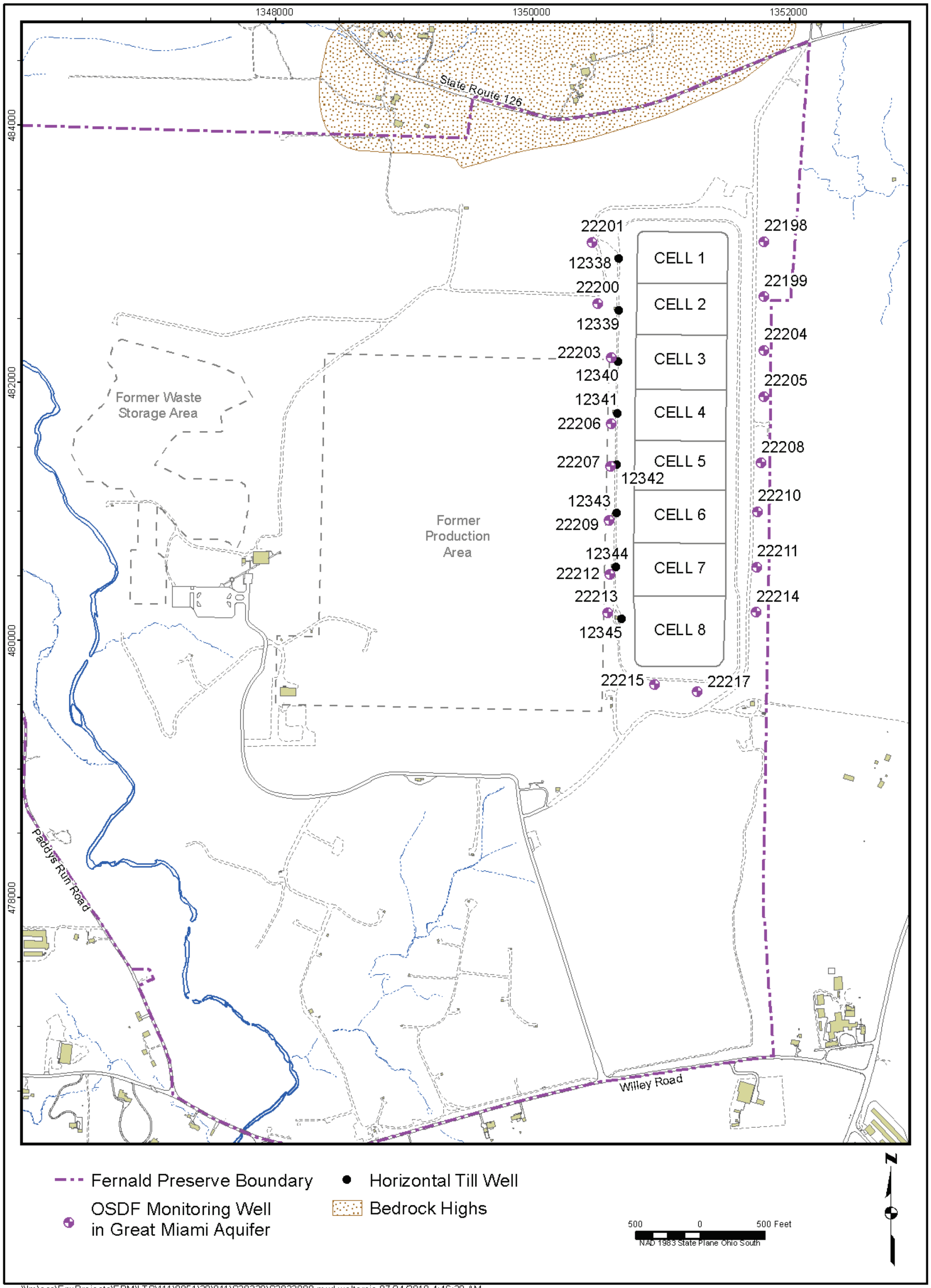

Figure 4. OSDF Well Locations

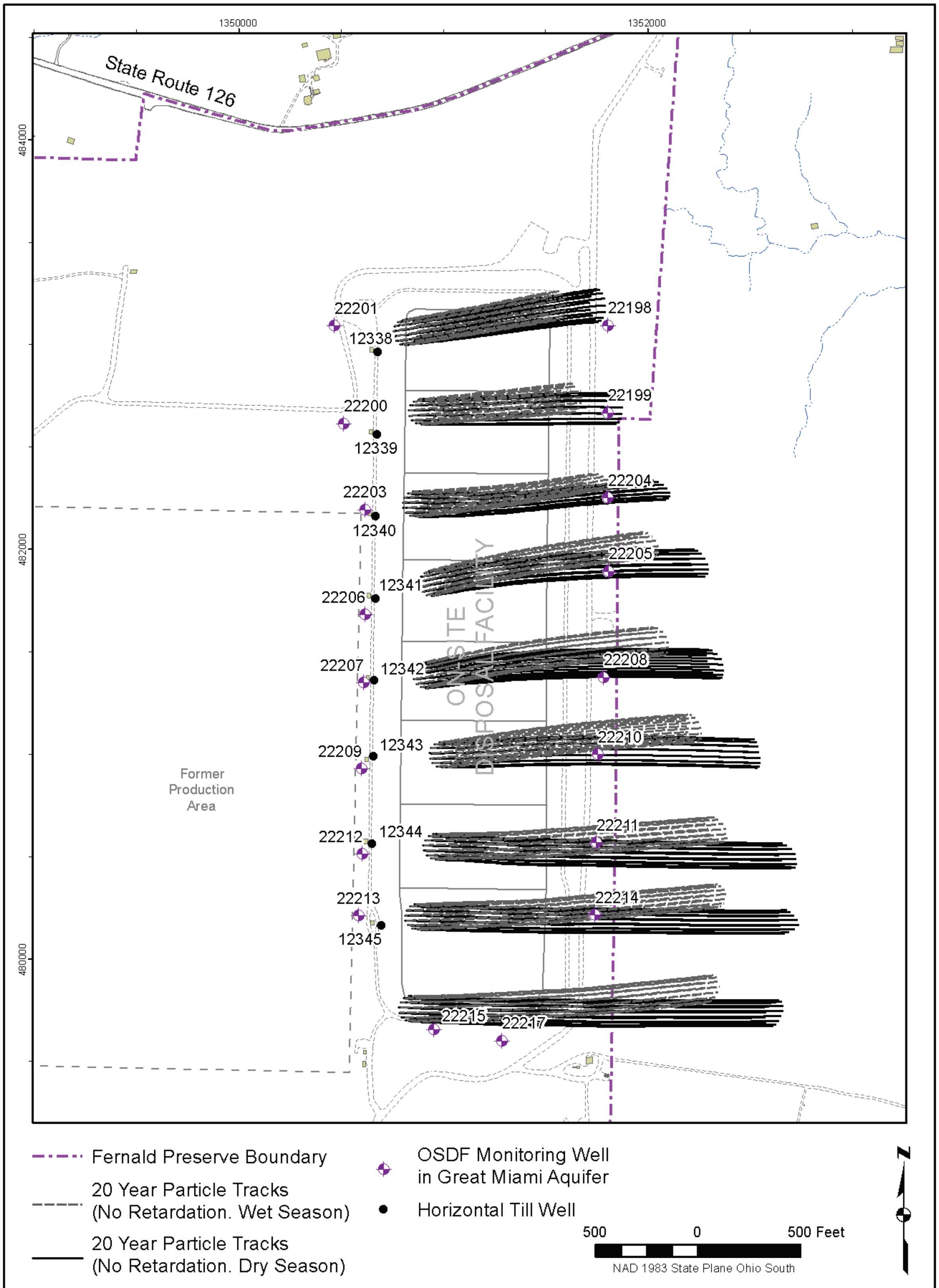

Figure 5. Post-Remediation Scenario

An earlier SWIFT model transport simulation was performed for Revision 0 of this plan to determine if the density of the downgradient GMA monitoring well network is adequate to detect the smallest contaminant plume resulting from a leak in the OSDF that would be of concern. Those SWIFT model results are included here for completeness. The SWIFT model was used to simulate a leak from the cell liner-penetration box beneath Cell 3 under natural flow gradients with no onsite pumping. Model simulations for both uranium and technetium-99 were performed. Constant loading from the cell was simulated throughout the model run such that a plume of minimum areal extent (i.e., a plume with maximum concentration equal to the FRL) was maintained in the aquifer. Hypothetical plumes of 20 parts per billion uranium and 94 picocuries per liter technetium-99 were maintained. The plumes were loaded from two hypothetical locations. One location was approximated to be beneath the cell liner-penetration box at the western edge of Cell 3 to represent the most likely leakage point from the cell. The other location was farther east, to provide a more conservative scenario where the plume would have less time to expand before the leading edge would reach the downgradient monitoring well network.

The modeling results for uranium at model year 55 (2051) and for technetium-99 at model year 30 (2026) are shown in Figure 6 and Figure 7, respectively. (**Note:** Modeling was performed on the assumption that there would be nine cells.) The durations were determined from the modeling, and they represent the period of time under constant loading for the respective plumes to disperse to the width of the spacing distance between monitoring wells (approximately equal to the OSDF cell width). Modeling results indicate that the density of downgradient GMA monitoring wells is sufficient to detect this minimal plume given the lateral expansion and the plume width under this minimal constant loading.

The width of each plume from horizontal dispersion is approximately the width of an OSDF cell, indicating that one downgradient GMA monitoring well per cell is sufficient to ensure that a GMA contaminant plume would be detected. Therefore, the configuration of GMA wells (Figure 4) is sufficient both in terms of well density and location for the OSDF leak detection monitoring program.

4.4 Sample Collection

The following subsections discuss the sample collection for the four components of the leak detection program: the LCS and the LDS drainage layers (flow and water quality), the HTWs in the glacial till (water quality), and the monitoring wells in the GMA (water quality).

4.4.1 HTW and GMA Monitoring

Sampling both the perched groundwater and the GMA groundwater during the same time frame is desired in order to enhance the comparability of the data; however, the overriding requirement is that the individual monitoring point has sufficient fluid to collect samples for a complete suite of analyses.

Prior to sample collection, the volume in the monitoring point is estimated to determine whether sufficient volume is present for the full suite of analytical parameters (refer to Appendix B for a discussion on setting priorities for low sample volume).

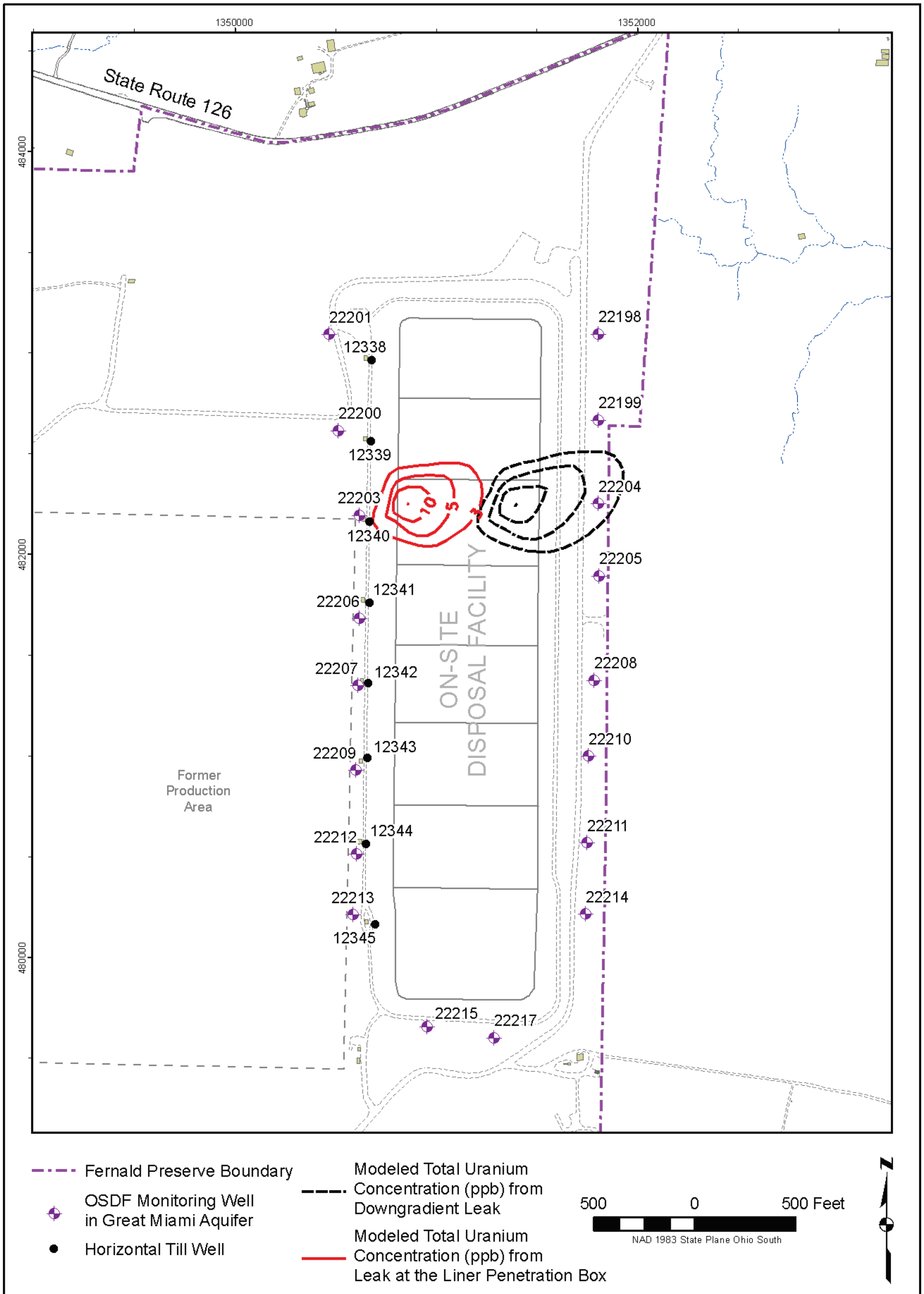

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Figure 6. SWIFT Modeling with Uranium Loading—55 Years

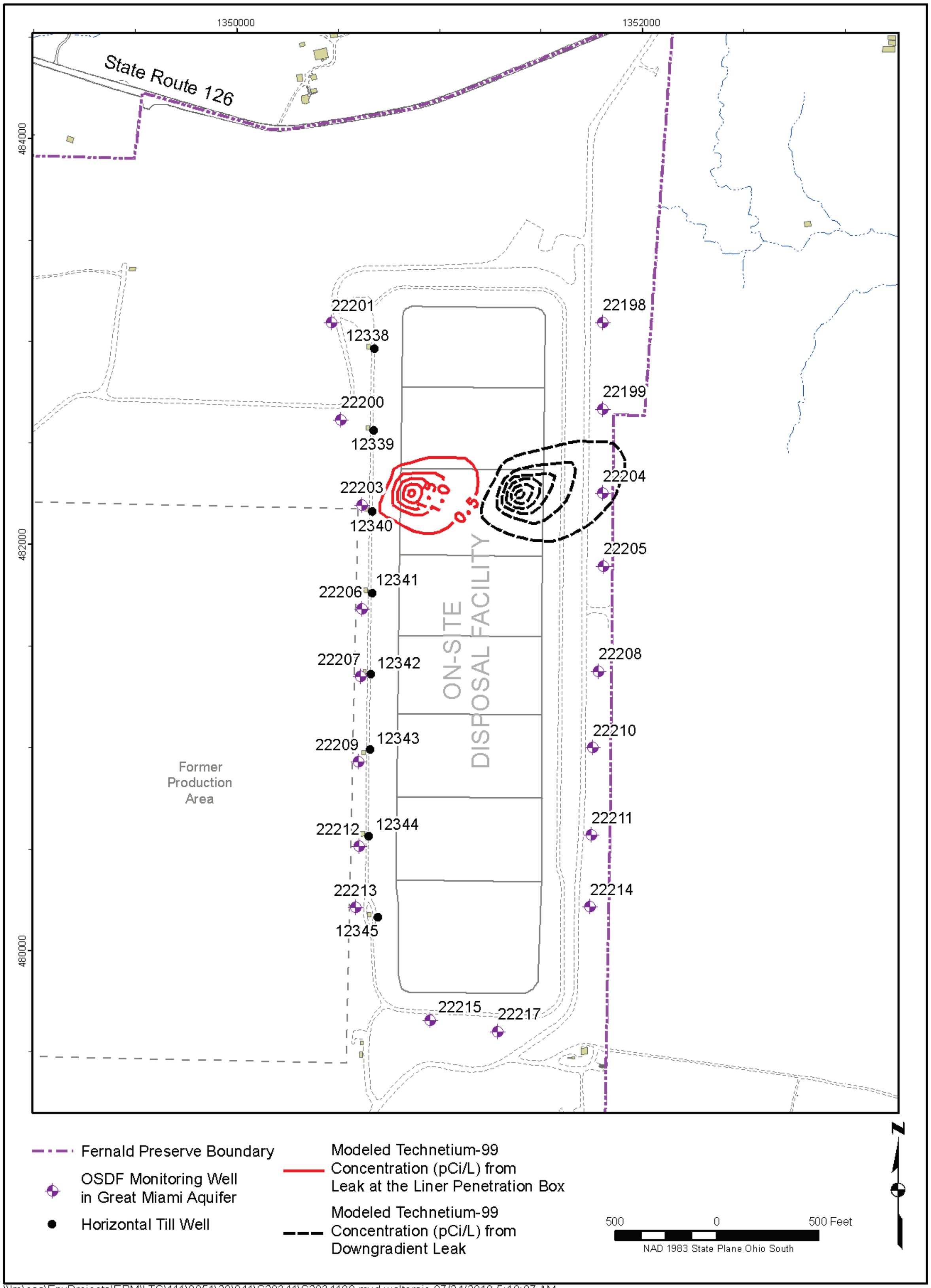

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Figure 7. SWIFT Modeling with Technetium-99 Loading—30 Years

4.4.1.1 Baseline Conditions in the Perched Groundwater and GMA

As discussed in Section 2.4, both the perched groundwater system and the GMA near the OSDF contain uranium and other Fernald Preserve–related constituents at levels above background. Monitoring data reported over the years indicate that many of the background constituent concentrations do not exhibit steady state conditions. The lack of steady state conditions complicates efforts to establish a concentration baseline. The lack of steady state conditions also complicates a determination that, on the basis of water quality data alone, a change in water quality in either the perched groundwater or GMA groundwater is due to a potential leak from the OSDF. In leak detection assessments, water quality data will be evaluated in context with preexisting contamination data and LDS flow data.

DOE's common-ion report (discussed in Section 3.2.1.2) established that several of the ions in the HTW and GMA were stable enough that a control chart could be prepared, although others remained unstable. Control charts are prepared for those constituents that meet the statistical requirements for control charting. Unstable constituent concentrations trends in the HTW and GMA are evaluated by plotting the concentration trends over time.

4.4.2 LCS/LDS Monitoring

4.4.2.1 Flow Monitoring in the LCS and LDS

Leachate collected by the LCS from each cell flows by gravity to tanks located in the valve houses where the fluid volume is measured. Flow in the LDS can be attributed to several sources (i.e., top liner leakage, construction water and compression water, consolidation water, and groundwater infiltration). If fluid is present in the LDS, it also flows by gravity to tanks located in the valve houses where its volume is measured. Fluid from the tanks is then pumped into the Enhanced Permanent Leachate Transmission System line, where it flows by gravity to the PLS then is pumped to the CAWWT for treatment.

Tank levels in each of the valve houses are monitored continuously, and valve houses are checked daily. Continuous monitoring takes place through the Human-Machine Interface system located in the CAWWT building. Continuous monitoring of LCS/LDS flow volumes is above and beyond what is required by the OAC and CFR. Prior to 2017, leachate pumps in the LCS/LDS tanks were set to automatically pump before the tanks are full. The set point for pump activation was approximately 80 percent of the tank capacity.

Flow monitoring has changed over the years. Through 2018, the high point alarm in the LDS tanks was set at approximately 40 gallons to provide an early alert that water levels in the tank were increasing. If the high water level alarm was reached, the flow rate into the tank would be estimated to determine if the low-flow response leakage rate of 2 gpad has been reached. Beginning in 2019, the volume of leachate had diminished such that no LDS automatic tank pump outs occurred in any cell. 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 should be large enough to collect all LDS flow. Water collected in the 5-gallon container will be sampled twice per year. Water collected in the 5-gallon container is monitored to determine if the low flow response leakage rate of 2 gpad is reached

The volume of leachate pumped from each LCS tank is recorded. to provide an indication of changes in system performance. LDS flow rates are estimated by tracking the volume of water removed from the 5-gallon container. Flow data are available to EPA and Ohio EPA are reported annually in the Site Environmental Report.

The LDS flow rate is monitored to ensure that the maximum design leakage rate is not exceeded. If the flow rate in the LDS exceeds the 200 gpad action leakage rate, DOE initiates notifications and response actions according to 40 CFR 264.304(b) and 40 CFR 264.304(c). Section 6.0 describes the required notifications and response actions.

4.4.2.2 Water Quality Monitoring in the LCS and LDS

With concurrence by the EPA and Ohio EPA, annual LCS sampling in Cells 1–8 for regulatory default Appendix I and PCB parameters (listed in OAC 3745-27-10) was discontinued at the end of 2016.

The LCS and LDS of Cells 1–8 are sampled semiannually for the alternate constituents listed in Table 2 of Appendix B.

Details concerning the selection and approval of an alternate monitoring parameter list (beginning with initial baseline) for the OSDF are provided in Appendix E. Details concerning the selection of the common ion constituents can be found in the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b). Details concerning the screening of additional Appendix I (of OAC 3745-27-10) and PCB parameters can be found in the 2007, 2009, 2010, and 2011 Site Environmental Reports. Details concerning the discontinuance of annual Appendix I sampling in the LCS and the selection of the current list of monitoring constituents can be found in the *Fernald Preserve 2015 Site Environmental Report* (DOE 2016). Appendix B provides a project-specific sampling plan that describes the current sampling program for each disposal cell.

Prior to sample collection, the LCS and LDS volumes are estimated in order to determine whether sufficient volume is present for the full suite of analyses (refer to the discussion in Appendix B for the setting of priorities). Although it is desirable that samples be collected from the LCS and LDS during the same time interval to enhance the comparability of the data, the overriding requirement is that the system has enough leachate/fluid volume for analysis of the full list of constituents.

An alternate list of monitoring parameters was approved for the OSDF because many of the constituents on the regulatory default list (OAC 3745-27-10) are not reasonably expected to be in or derived from the waste contained or deposited in the OSDF. Also, the chemical constituents listed in Appendix I (of OAC 3745-27-10) are typical contaminants found in sanitary landfills, and radionuclides are not included. Radionuclides are primary constituents of concern for the OSDF and need to be included in the monitoring program.

A statistical analysis screening process was developed to evaluate the results of the Appendix I and PCB monitoring in the LCS. This statistical screening process was initially presented in the *Fernald Preserve 2007 Site Environmental Report* (DOE 2008a). Results of the application of this process have been presented in the 2007, 2009, 2010, and 2011 Site Environmental Reports for Cells 1–3, Cells 4 and 5, Cell 6, and Cells 7 and 8, respectively. The assessment process shows whether the average LCS concentration was greater than either the average pre-design or background concentration. If it was determined statistically that the average LCS concentration of an Appendix I or PCB constituent was greater than either the average pre-design or background concentration, then the constituent was selected for monitoring in deeper monitoring horizons on a quarterly frequency. Results for Cells 1 through 8 have identified 24 constituents.

As a final step to conclude the parameter statistical screening process, DOE obtained the services of a recognized expert in the field of statistics to conduct an independent assessment of the screening process that was used (MacStat Consulting Inc. 2014). Results of the independent assessment were presented to the DOE, EPA, and Ohio EPA on April 15, 2015, at the Fernald site. The results indicated that only 12 of the 24 constituents provided value for the monitoring program in determining if a potential leak could be occurring.

4.5 Leak Detection Data Evaluation Process

Ohio Solid and Hazardous Waste regulations require that water quality be monitored for the purpose of determining if a leak is occurring from a disposal facility. Monitoring for a leak from the OSDF using only water quality data is challenging in that (1) the low-permeability clay beneath the facility does not readily transmit water, and (2) the presence of preexisting or background contamination and post-construction water quality changes (at below FRL levels) beneath the OSDF are still taking place, and these changes complicate the data interpretation process.

DOE has developed a strategy to meet the regulatory requirements, given the unique challenges presented by soil conditions beneath the OSDF. To evaluate the potential that a cell may be leaking, DOE will first review and compare flow rates from the LDS to the design action leakage rate to determine if sufficient hydraulic head is present in the cell to drive leachate through a liner breach. The key to a plausible potential leak determination is the presence of adequate hydraulic head (i.e., action leakage rate is present) coupled with observed water-quality changes within and beneath the facility. In leak detection assessments, water quality data will be evaluated in context with preexisting contamination data and LDS flow data. Significant changes in either water quality and/or flow rates will be investigated.

Three water quality data interpretation techniques will be used to assess changing water quality conditions in HTW and GMA wells and to compare conditions in the HTW and GMA wells to conditions inside the facility in the LCS and LDS. Concentrations will be trended over time for constituents that have not reached steady-state conditions. Control charts will be prepared for constituents that are stable. Bivariate plots will be prepared for each cell to illustrate how the water quality signature of the LCS, LDS, and HTW of a cell compare.

Ohio EPA proposed reducing the list of parameters being sampled in the HTW to just uranium, arsenic and tritium (beginning in the second quarter of 2010). Sampling for tritium in all horizons was agreed to for a year. Tritium was added to the list of constituents because it was hoped that it might serve as a useful monitoring parameter. Tritium was used in exit signs, which may be in the OSDF with other building materials. Tritium has a relatively short half-life (approximately 12 years) but is fairly mobile and if present could be a good potential leak indicator parameter. One year of tritium sampling results though showed that tritium was not a good monitoring parameter for the OSDF. Therefore, tritium is no longer sampled for in any of the monitoring horizons. In addition to sampling the HTWs for uranium and arsenic, DOE also samples for sodium and sulfate in order to prepare bivariate plots. Bivariate plots are useful in illustrating that the chemical signatures of the different monitoring horizons (LCS, LDS, HTW) are separate and distinct.

5.0 Leachate Management Monitoring Program

With closure of the OSDF in 2006, leachate management and monitoring has transitioned from a program that addressed an operating facility actively receiving waste to a monitoring program that now addresses a closed facility no longer receiving waste. The transition has resulted in changing from sampling the LCS in Cells 1–8 for the full list of default regulatory parameters (Appendix I of OAC 3745-27-10 and PCBs) to sampling for uranium, sodium, sulfate, and boron in the LCS, LDS, and HTW and 13 constituents in the GMA wells (total uranium, boron, TOX, sulfate, lithium, selenium, TDS, calcium, magnesium, nitrate + nitrite as nitrogen, potassium, technetium-99, and sodium).

Ohio Solid Waste Disposal regulations for an operating facility require an overall leak detection strategy to comply with the leachate management, monitoring, and reporting requirements in OAC 3745-27-19(M)(4) and OAC 3745-27-19(M)(5). To fulfill these requirements during the active life of the facility, the leachate management monitoring strategy needed to provide:

- A means to track the quantity of leachate collected for treatment and discharge, reported at least monthly.
- A means to verify that the engineering components of the leachate management system will operate in accordance with OAC 3745-27-19, "Operational Criteria for a Sanitary Landfill Facility."
- A description of the site-specific leachate treatment and discharge elements to ensure that leachate collected from the facility is properly managed.
- Collection and analysis of an annual leachate grab sample for Appendix I and PCB parameters according to OAC 3745-27-10 and OAC 3745-27-19.

The first item of the strategy above is fulfilled by the flow monitoring component of the leak detection monitoring strategy. Flow measurements are taken at the frequency identified in Section 4.4.2.1. The second item of the strategy above is fulfilled by the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021a) and the *Converted Advanced Wastewater Treatment Facility Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021b) and Appendix D of this plan. The description in Section 5.1 fulfills the third item. The fourth item is fulfilled by sampling Cells 1–8 for an alternate parameter monitoring list.

5.1 Leachate Treatment and Discharge Management

Leachate is treated in the CAWWT and discharged at the National Pollutant Discharge Elimination System (NPDES)–permitted outfall to the Great Miami River. The following is a description of the management approach for leachate treatment, along with a description of the treatment system and the leachate monitoring needs to ensure proper operation of the treatment facility and compliance with the NPDES permit.

Leachate is collected from both the LCS and LDS layers of each cell of the OSDF whenever such fluids are present. Fluid that collects in the LCS and LDS collection tanks located in each cell's valve house is pumped to the gravity drain portion of the LTS line, which drains all valve houses to the PLS. The leachate collected in the PLS is periodically pumped to the CAWWT backwash basin or directly to CAWWT feed tanks.

Upon site closure in 2006, the CAWWT was a 1,800-gpm facility divided into a 1,200-gpm treatment train dedicated to groundwater and a 600-gpm treatment train formerly used for the treatment of storm water and remediation wastewater, including leachate. Since site storm water no longer required treatment, the CAWWT 600-gpm treatment train treated primarily groundwater but also treated leachate and water from the backwash basin.

As predicted, each year the percentage of groundwater treatment needed to achieve uranium discharge limits decreased. As of the spring of 2011, the CAWWT was being operated on an as-needed basis. In 2011, DOE, EPA, and Ohio EPA agreed to proceed with reducing the treatment capacity from approximately 1,800 gpm down to 500–600 gpm. In 2012, the throughput treatment capacity of the CAWWT was safely reduced from 1,800 gpm down to 500–600 gpm by isolating trains 1 and 2 in place to serve as spare parts for treatment train 3.

In July 2014, operational changes were made to the ongoing pump-and-treat remediation (DOE 2014). Prior to these changes, groundwater was being treated on an as-needed basis to meet required discharge limits. In 2014, three extraction wells located in areas of the aquifer where uranium concentrations were low were no longer providing a benefit, so the wells were turned off. Pumping was increased in areas of the plume where uranium concentrations were higher. The changes resulted in an increase in the mass of uranium being removed from the aquifer. This increase resulted in the temporary need to treat more groundwater utilizing more of the existing approved groundwater treatment capacity (i.e., 600 gpm) to meet the required discharge limits from July 2014 to mid-November 2014. Another temporary need arose in August 2015, when well field maintenance activities required shutdown of some low uranium concentration wells. Since this last 2015 exception, groundwater treatment has resumed on an as needed basis, with very little treatment being required.

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 from the Fernald Community Alliance in August 2015. The project was initiated in 2016 and completed in 2018.

All discharges from the CAWWT are through the NPDES Outfall PF 4001. OAC 3745-27-19, “Operational Criteria for a Sanitary Landfill Facility,” requires treatment of leachate. Leachate is a minimal flow and will likely have no bearing on operational decisions. It is required, however, that leachate be treated through the CAWWT prior to discharge to the Great Miami River until the CAWWT is no longer needed.

6.0 Reporting

6.1 Routine Reporting

Annual Site Environmental Reports will serve as the formal reporting mechanism for OSDF monitoring activities. Presenting data in one report facilitates a qualitative assessment of the impact of the OSDF on the aquifer, as well as the operational characteristics of OSDF caps and liners. Additionally, monitoring data will be made available electronically through the Geospatial Environmental Mapping System. Flow data are available to EPA and Ohio EPA upon request by contacting the site (513) 648-3334.

Reporting will include:

- LCS volumes.
- LDS accumulation rates and volumes.
- Apparent liner efficiencies.
- HTW water yields.
- LCS, LDS, HTW, and GMA water quality results.

Water quality data will be evaluated to:

- Identify the parameters in the HTW and GMA that meet control-charting requirements and prepare control charts for them.
- Identify the parameters in the HTW and GMA that are not stable and prepare time versus concentration plots for them.
- Prepare bivariate plots for each cell.

6.2 Notifications and Response Actions

DOE has established two OSDF administrative action levels for leakage rates. The first is the low-flow response leakage rate of 2 gpad, which is 1% of the established OSDF action leakage rate of 200 gpad. If the flow rate into any LDS tank exceeds 2 gpad for a week or more, DOE will notify EPA of the increase and the LCS and LDS monitoring frequency for the specific cell will be increased to monthly as long as the flow rate in the LDS remains above 2 gpad. Leachate will be analyzed to determine concentrations of the indicator constituents. Should the flow rate decrease below 2 gpad and remain below 2 gpad for a month, then the monitoring frequency will adjust back to semiannual. All monitoring data collected during the subsequent increased monitoring frequency period will be submitted to EPA and Ohio EPA for review on a monthly basis or as it becomes available.

The second OSDF administrative action level is 20 gpad, which is 10 percent of the established OSDF action leakage rate of 200 gpad. If the flow rate in any LDS tank exceeds 20 gpad for a week or more, DOE will notify EPA of the increase and the LCS and LDS monitoring frequency for the specific cell will be increased to weekly as long as the high flow rate in the LDS remains above 20 gpad. Leachate will be analyzed to determine concentrations of the indicator constituents. Should the flow rate decrease below 20 gpad and remain below 20 gpad for a month, then the monitoring frequency will be adjusted back to monthly. All the monitoring data collected during the subsequent increased monitoring frequency period will be forwarded to EPA and Ohio EPA for review weekly or as it becomes available.

If the flow rate into any LDS tank exceeds 10 percent of the action leakage rate continuously in every weekly monitoring event for more than 3 months, an engineering evaluation of the integrity of the specific cell will be initiated. The cell cap and toe will be inspected for any potential problems. The perched groundwater levels in the surrounding area will also be evaluated. Any significant findings that indicate potential sources of liquid will be reported. Appropriate maintenance actions will be identified and implemented to address any identified problems following consultation with EPA and Ohio EPA.

If the flow rate into any LDS tank exceeds the action leakage rate of 200 gpad, the actions presented in Table 3 will be implemented. In following the steps required in Table 3, both flow volumes and concentration levels of indicator constituents in the leachate collected in the LDS will be evaluated on a cell-by-cell basis together with all the other monitoring data collected from the LCS, till monitoring wells, and GMA monitoring wells. Historical monitoring data and weather information will be compared with the current conditions to narrow the time frame of potential changes in the system performance.

Table 3. Notification and Response Actions

Step	Time Frame	Action
1.	Within 7 days of the determination of an exceedance into any LDS at the action leakage rate of 200 gpad.	Notify both of the following in writing: • EPA Region 5 Regional Administrator 77 West Jackson Boulevard, Chicago, Illinois 60604-3590 • Director, Ohio Environmental Protection Agency 50 West Town Street, Suite 700, Columbus, Ohio 43215
2.	Within 14 days of the determination of an exceedance into any LDS at the action leakage rate of 200 gpad.	Submit to both of the individuals identified in Step 1 a written preliminary assessment as to the: • Amount of liquids. • Likely sources of liquids. • Possible location, size, and cause of any leaks. • Short-term actions taken and planned.
3.	As practicable to meet Step 7.	Determine to the extent practicable the location, size, and cause of any leak.
4.	As practicable to meet Step 7.	Determine any other short- or long-term actions to take to stop or mitigate the leaks.
5.	As practicable to meet Step 7.	In order to conduct Steps 3 through 5: • Assess the source of liquids, and amounts of liquids by source; and • In order to identify the source of liquids and the possible location of any leaks, and the hazard and mobility of the liquid, conduct a fingerprint, hazardous constituent, or other analyses of the liquids in the LDS; and • Assess the seriousness of any leaks in terms of potential for escaping into the environment. OR • Document why such assessments are not needed.

Table 3. Notification and Response Actions (continued)

Step	Time Frame	Action
6.	Within 30 days of the notification given in Step 1.	Submit to both of the individuals identified in Step 1 a written report of the: • Results of the analyses and determinations made under Steps 3 through 6 (to the extent completed). • Results of action taken. • Actions ongoing (i.e., analyses and determinations under Steps 3 through 6 not yet completed) or planned (refer to Section 9.0 of the OSDF Post-Closure Care and Inspection Plan).
7.	Monthly thereafter, as long as the flow rate in the LDS exceeds the action leakage rate.	Submit to both of the individuals identified in Step 1 a written report summarizing the: • Results of actions taken. • Actions planned.

Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart NC-Landfills, Response Actions, 40 CFR 264.304(b) and 265.303(b).

Preliminary field inspections of the cell caps, toes, run-on/runoff control channel, valve houses, and lift station will be conducted as soon as possible to meet the Step 7 schedule and to identify any visible signs of potential problems or sources of liquids. Pending field conditions, some mowing or snow removal may be required in order to conduct these inspections sufficiently. All necessary efforts will be made to allow sufficient visual inspections. EPA and Ohio EPA will be notified prior to these inspections. Checklists similar to those prepared for the routine quarterly inspections will be submitted as a part of the written report specified in Step 7 to document these inspections.

The Engineer on Record for the OSDF (or other engineering consultants who specialize in landfill design and are acceptable to EPA and Ohio EPA) will be requested to assist with the data evaluation, field inspections, and preparation of the report.

Preventive maintenance or any necessary repairs of selected OSDF caps or toes will be conducted based on results of routine visual inspections, engineering evaluation triggered by exceeding 10 percent of the action leakage rate continuously for 3 months, or the Table 3 process. If it is determined that both the cap and primary liner have failed following any of the inspections and/or engineering evaluations, then a more intensive OSDF response action will also be required. A response action might include initiating cap repair, investigating whether contamination has breached the compacted clay liner of the secondary composite liner system that lies beneath the LDS, increasing monitoring, or a combination of these actions.

Potential leakage through the clay liner below the secondary liner will be assessed by using the HTW installed beneath the liner-penetration box area and secondary liner (along with the LCS and LDS flow volumes and water quality data). If it is determined that a leak has adversely impacted groundwater (till or GMA), then a groundwater quality assessment monitoring program will be developed and initiated to determine the nature, rate, and extent of contaminant migration. Groundwater monitoring might also be increased to determine if leakage from the OSDF has entered the GMA, although given the distances involved it would be unlikely that leakage from the OSDF would be able to migrate to the GMA in the short time interval between leak detection and response.

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7.0 References

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Appendix A

On-Site Disposal Facility Applicable or Relevant and Appropriate Requirements and Other Regulatory Requirements

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Abbreviations

ANOVA	analysis of variance
ARARs	applicable or relevant and appropriate requirements
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
LDS	leak detection system
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
RA	remedial action

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Applicable or relevant and appropriate requirements (ARARs) and to-be-considered criteria—for the On-Site Disposal Facility (OSDF) groundwater detection monitoring, the OSDF leachate monitoring, and the OSDF response action—that should be addressed by this plan are provided in Table 1, as obtained from the *Final Record of Decision for Remedial Actions at Operable Unit 2* (DOE 1995e), the *Operable Unit 3 Record of Decision for Final Remedial Action* (DOE 1996d), the *Record of Decision for Remedial Actions at Operable Unit 5* (DOE 1996c), or the *Permitting Plan and Substantive Requirements for the On-Site Disposal Facility* (DOE 1996e). Additional regulatory requirements that are appropriate guidance for formulation of this plan have also been identified and included.

Table 1. OSDF Groundwater/Leak Detection and Leachate Monitoring Plan Compliance Strategy ARARs and Other Regulatory Requirements

Citation	Requirement
PLANS	
Ohio Municipal Solid Waste Rules–Sanitary Landfill Facility Permit to Install Application OAC 3745-27-06(C)(9)(a)	• Prepare a "groundwater detection monitoring plan" as required by OAC 3745-27-10, and if applicable a "groundwater quality assessment plan" and/or "corrective measures plan" required by OAC 3745-27-10.
	• Prepare a "leachate monitoring plan" to ensure compliance with OAC 3745-27-19(M)(4) and (5).
GROUNDWATER/LEAK DETECTION MONITORING	
Ohio Municipal Solid Waste Rules–Groundwater Monitoring Program for a Sanitary Landfill Facility OAC 3745-27-10(A)	(1) The owner or operator of a sanitary landfill facility shall implement a "groundwater monitoring program" capable of determining the quality of groundwater occurring within the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system underlying the landfill facility, with the following elements: (a) A "groundwater detection monitoring program" which includes: (i) a "groundwater detection monitoring plan" in accordance with OAC 3745-27-10(B) through (D); (ii) a monitoring system in accordance with OAC 3745-27-10(B); (iii) sampling and analysis procedures, including an appropriate statistical method, in accordance with OAC 3745-27-10(C); and (iv) detection monitoring procedures, including monitoring frequency and a parameter list, in accordance with OAC 3745-27-10(D). (2) Schedule for implementation of detection monitoring. (4) For purposes of this rule, the groundwater monitoring program is implemented upon commencement of sampling of groundwater wells.
Ohio Municipal Solid Waste Rules–Groundwater Monitoring System OAC 3745-27-10(B)	(1) The "groundwater detection monitoring program" shall consist of sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from both the uppermost aquifer system and any significant zones of saturation that exist above the uppermost aquifer system that: (a) represent the quality of the background groundwater that has not been affected by past or present operations; and (b) represent the quality of the groundwater passing directly downgradient of the limits of solid waste placement. (4) The number, spacing, and depth of groundwater monitoring wells shall be: (a) based on site-specific hydrogeologic information; and (b) capable of detecting a release from the facility to the groundwater at the closest practicable location to the limits of waste placement.
Ohio Municipal Solid Waste Rules–Groundwater Sampling, Analysis, and Statistical Methods OAC 3745-27-10(C)	(1) The "groundwater monitoring program" shall include consistent sampling and analysis procedures and statistical methods that are protective of human health and the environment and that are designed to ensure monitoring results that provide an accurate presentation of groundwater quality at the background and downgradient well. (a) Sampling and analysis procedures employed must be documented in a written plan. (b) The statistical method selected by the owner or operator must be in accordance with OAC 3745-27-10(C)(6)&(7). (6) After completing collection of the background data, the owner or operator shall specify one of the following statistical methods to be used in evaluating groundwater quality; the statistical method chosen must be conducted separately for each of the parameters required to be statistically evaluated: (a) a parametric analysis of variance (ANOVA); or (b) an ANOVA based on ranks; or (c) a tolerance or prediction interval procedure; or (d) a control chart approach; or (e) another statistical method.

Table 1. OSDF Groundwater/Leak Detection and Leachate Monitoring Plan Compliance Strategy ARARs and Other Regulatory Requirements (continued)

GROUNDWATER/LEAK DETECTION MONITORING (cont.)	
	(7) Performance standards for statistical methods. (a) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of chemical parameters or leachate and leachate-derived constituents. If shown to be inappropriate, then the data should be transformed or a distribution free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed. (e) The statistical method shall account for data below the limit of detection with one or more statistical procedures that ensure protection of human health and the environment. Any practical quantitation limit used in the statistical method shall be the lowest concentration level that can be reliably achieved within the specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility. (f) If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data. (9) The number of samples collected to establish groundwater quality data shall be consistent with the appropriate statistical procedures.
Ohio Municipal Solid Waste Rules–Groundwater Detection Monitoring Program OAC 3745-27-10(D)	(2) Alternate monitoring parameter list. The owner or operator of a sanitary landfill facility may propose to delete any of the Appendix I parameters of this rule. The alternative monitoring parameter list may be approved if the removed parameters are not reasonably expected to be in or derived from the waste contained or deposited in the landfill facility. The following factors should be considered: (a) which of the parameters in Appendix I shall be deleted; (b) types, quantities, and concentrations of constituents in wastes managed at the landfill facility; (c) the concentrations of Appendix I constituents in the leachate from the relevant unit(s) of the landfill facility; (d) any other relevant information. (3) Alternate inorganic parameter list. The owner or operator of a sanitary landfill facility may propose that an alternative list of inorganic indicator parameters to be used in lieu of some or all of the inorganic parameters listed in Appendix I of this rule. The alternative inorganic indicator parameters may be approved if the alternative list will provide a reliable indication of inorganic releases from the facility to the groundwater. The following factors should be considered: (a) the types, quantities, and concentrations of constituents in wastes managed at the facility; (b) the mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the facility; (c) the detectability of the indicator parameters, waste constituents, and their reaction products in the groundwater; and (d) the concentrations or values and coefficients of variation of monitoring parameters or constituents in the background groundwater quality. (5) Monitoring parameters, frequency, location. The owner or operator shall monitor the groundwater monitoring well system (a) and (b) during the active life of the facility (including final closure and the post-closure care period), (ii) at least semiannually by collecting: (*a*) during the initial one hundred and eighty days after implementing the groundwater detection monitoring program (the first semiannual sampling event), a minimum of four independent samples from each monitoring well. Collect and analyze a minimum of eight independent samples during the first year of sampling. *(b)* After the first year during subsequent semiannual sampling events, at least one sample for each monitoring well. (iii) beginning with receiving the results from the first monitoring event under (D)(5)(a)(ii)(b) of this rule and semiannually thereafter, by statistically analyzing the results. (6) Alternative sampling and statistical analysis frequency. The owner or operator of a sanitary landfill facility may propose an alternative frequency for groundwater sampling and/or statistical analysis. The alternative frequency may be approved provided it is not less than annual. The following factors should be considered: (a) lithology of the aquifer system and all stratigraphic units above the uppermost aquifer system; (b) hydraulic conductivity of the uppermost aquifer system and all stratigraphic units above the uppermost aquifer system; (c) groundwater flow rates for the uppermost aquifer system and all zones of saturation above the uppermost aquifer system; (d) minimum distance between the upgradient edge of the limits of waste placement of the landfill facility and the downgradient monitoring well system; and (e) resource value of the uppermost aquifer system. NOTE: Table B-3 on page B.3-25 of the *Record of Decision for Operable Unit 5* states, “an alternate list of monitoring parameters will be required.”

Table 1. OSDF Groundwater/Leak Detection and Leachate Monitoring Plan Compliance Strategy ARARs and Other Regulatory Requirements (continued)

GROUNDWATER/LEAK DETECTION MONITORING (Cont.)	
Ohio Hazardous Waste General Facility Standard–New Facilities Rules–Required Programs OAC 3745-54-91; 40 CFR 264.91	Owners or operators subject to the groundwater protection rules must conduct a monitoring and response program as follows: (1) whenever hazardous constituents from a regulated unit are detected at the compliance point, the owner or operator must institute a compliance monitoring program. "Detected" is defined as statistically significant evidence of contamination. (2) whenever the groundwater protection standard is exceeded, the owner or operator must institute a corrective action program. "Exceeded" is defined as statistically significant evidence of increased contamination. (3) whenever hazardous constituents from a regulated unit exceed concentration limits in groundwater between the compliance point and the downgradient facility property boundary, the owner or operator must institute a corrective action program. (4) in all other cases, the owner or operator must institute a detection monitoring program.
Ohio Hazardous Waste General Facility Standards–New Facilities Rules–Groundwater Protection Standard OAC 3745-54-92; 40 CFR 264.92	The owner or operator must comply with conditions specified in the facility permit that are designed to ensure that hazardous constituents detected in the groundwater from a regulated unit do not exceed the specified concentration limits (specified in the permit) in the uppermost aquifer underlying the waste management area beyond the point of compliance. The groundwater protection standard will be established when hazardous constituents have been detected in the groundwater.
Ohio Hazardous Waste General Facility Standards–New Facilities Rules–Hazardous Constituents OAC 3745-54-93; 40 CFR 264.93	(A) The permit will specify the hazardous constituents to which the groundwater protection standard applies. Hazardous constituents are those that have been detected in the groundwater in the uppermost aquifer underlying a regulated unit and that are reasonably expected to be in or derived from waste contained in a regulated unit, unless excluded under paragraph B of this rule. (B) A constituent will be excluded from the list of hazardous constituents specified in the facility permit if it is found that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. The following will be considered: (1) Potential adverse effects on groundwater quality, considering: (a) the physical and chemical characteristics of the waste in the regulated unit, included its potential for migration; (b) the hydrogeological characteristics of the facility and surrounding land; (c) the quantity of groundwater and the direction of groundwater flow; (d) the proximity and withdrawal rates of groundwater users; (e) the current and future use of groundwater in the area; (f) the existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality; (g) the potential for health risks caused by human exposure to waste constituents; (h) the potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; (i) the persistence and permanence of the potential adverse effects.
Ohio Hazardous Waste General Facility Standards–New Facilities Rules–General Groundwater Monitoring Requirements OAC 3745 54 97; 40 CFR 264.97	(G) In detection monitoring or where appropriate in compliance monitoring, data on each constituent specified in the permit [or in the monitoring plan] is to be collected from background wells and wells at compliance point(s). The number and kinds of samples collected to establish background shall be appropriate for the form of statistical test employed. The sample size should be as large as necessary to ensure with reasonable confidence that a contaminant release to the groundwater from a facility will be detected. The owner or operator will determine an appropriate sampling procedure and interval for each constituent. (H) The owner or operator is to specify one of the following statistical methods to be used in evaluating groundwater monitoring data for each constituent to be specified. Use of any of the following statistical methods must be protective of human health and the environment: (1) a parametric ANOVA; (2) an ANOVA based on ranks; (3) a tolerance or prediction interval procedure; (4) a control chart approach; or (5) another statistical method.

Table 1. OSDF Groundwater/Leak Detection and Leachate Monitoring Plan Compliance Strategy ARARs and Other Regulatory Requirements (continued)

GROUNDWATER/LEAK DETECTION MONITORING (Cont.)	
Ohio Hazardous Waste General Facility Standards–New Facilities Rules–Detection Monitoring Program OAC 3745-54-98; 40 CFR 264.98	(A) The owner or operator must monitor for indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogens), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous constituents in groundwater. The director (of the Ohio Environmental Protection Agency [Ohio EPA]) will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors: (1) types, quantities, and concentrations of constituents to be managed at the regulated unit; (2) mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the waste management area; (3) detectability of the indicator parameters, waste constituents, and their reaction products in the groundwater; and (4) concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the groundwater background. (D) The permit will specify the frequencies for collecting samples and conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or hazardous constituent specified in the permit. (F) The owner or operator must determine whether there is statistically significant evidence of contamination for any chemical parameter or hazardous constituent specified in the permit at the frequency specified in the permit.
Federal Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings: Subpart D–Standards for Management of Uranium Byproduct Material Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended 40 CFR 192.30 through 34	Uranium byproduct materials shall be managed to conform to the groundwater protection standard in 40 CFR 264.92, which includes detection monitoring. Alternate concentration limits for uranium can be established, as described in 40 CFR 264.95 and 264.94(b).
Environmental Monitoring DOE M 435.1-1	I.1.E.(7) Environmental Monitoring. Radioactive waste management facilities, operations, and activities shall meet the environmental monitoring requirements of DOE Order 5400.1, General Environmental Protection Program; and DOE Order 5400.5, Radiation Protection of the Public and the Environment. IV.R.(3)(a) The site-specific performance assessment and composite analysis shall be used to determine the media, locations, radionuclides, and other substances to be monitored. IV.R.(3) Disposal Facilities. (C) The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives in this Chapter.
LEACHATE MANAGEMENT AND MONITORING	
Ohio Municipal Solid Waste Rules–Operational Criteria for a Sanitary Landfill Facility OAC 3745-27-19(M)(4)&(5)	The owner annually shall report: • a summary of the quantity of leachate collected for treatment and disposal on a monthly basis during the year; location of leachate treatment and/or disposal; and verification that the leachate management system is operating in accordance with this rule; • results of analytical testing of an annual grab sample of leachate.
OTHER REQUIREMENTS	
Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart N–Landfills, Monitoring and Inspection 40 CFR 264.302	Action Leakage Rate: (a) The action leakage rate is the maximum design flow rate that the leak detection system (LDS) can remove without the fluid head on the bottom liner exceeding 1 ft. The action leakage rate must include an adequate safety margin to allow for uncertainties in the design (e.g., slope, hydraulic conductivity, thickness of drainage material), construction, operation, and location of the LDS, waste and leachate characteristics, likelihood and amounts of other sources of liquids in the LDS, and proposed response actions (e.g., the action leakage rate must consider decreases in the flow capacity of the system over time resulting from siltation and clogging, rib layover and creep of synthetic components of the system overburden pressures, etc.). (b) To determine if the action leakage rate has been exceeded, the owner or operator must convert the weekly or monthly flow rate from the monitoring data obtained under 40 CFR 264.303(c), to an average daily flow rate (gallons per acre per day) for each sump (i.e., liner-penetration box). Unless the U.S. Environmental Protection Agency (EPA) approves a different calculation, the average daily flow rate for each sump must be calculated weekly during the active life and closure period, and monthly during the post-closure care period when monthly monitoring is required under 40 CFR 264.303(c).

Table 1. OSDF Groundwater/Leak Detection and Leachate Monitoring Plan Compliance Strategy ARARs and Other Regulatory Requirements (continued)

OTHER REQUIREMENTS (Cont.)	
Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart N–Landfills, Monitoring and Inspection 40 CFR 264.303(c)	An owner or operator required to have a LDS must record the amount of liquids removed from each LDS sump as follows: (1) During the active life and closure period, at least once each week. (2) After the final cover is installed, in accordance with the following graded approach: • at least monthly; or • if the liquid level in the sump stays below the pump operating level for two consecutive months, at least quarterly; or • if the liquid level in the sump stays below the pump operating level for two consecutive quarters, at least semiannually; but • if at any time during the post-closure care period the pump operating level is exceeded at units on quarterly or semiannual recording schedules, the owner or operator must return to monthly recording of amounts of liquids removed from each sump until the liquid level again stays below the pump operating level for two consecutive months. NOTE: There are no requirements in Ohio hazardous waste or Ohio solid waste rules regarding LDS flow monitoring.
Federal Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart N–Landfills, Response Actions 40 CFR 264.304	(a) The owner or operator of landfill units subject to 264.301(c) or (d) must have an approved response action plan before receipt of waste. The response action plan must set forth the action to be taken if the "action leakage rate" has been exceeded [in any LDS sump]. (b) At a minimum, the response action plan [see entry 2 above] must describe the following actions to be taken: (1) Notify the Regional Administrator in writing of the exceedance within 7 days of the determination; (2) Submit a preliminary written assessment to the Regional Administrator within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned; (3) Determine to the extent practicable the location, size, and cause of any leak; (4) Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed; (5) Determine any other short-term or longer-term actions to be taken to mitigate or stop any leaks; and (6) Within 30 days of the notification that the action leakage rate has been exceeded, submit to the Regional Administrator the results of the analysis specified in (3), (4), and (5) [above], the results of action taken, and actions planned. Monthly thereafter, as long as the flow rate in the LDS exceeds the action leakage rate, the owner or operator must submit to the Regional Administrator a report summarizing the results of any RAs taken and actions planned. (c) To make the leak and/or RA determinations in paragraphs (b)(3), (4) and (5) [above], the owner or operator must: • Asses the source of liquids, and amount of liquids by source; • Conduct a fingerprint, hazardous constituent, or other analyses of the liquids in the LDS to identify the source of liquids and possible location of any leaks, and the hazard and mobility of the liquid; and • Assess the seriousness of any leaks in terms of potential for escape to the environment; or • Document why such assessments are not needed.

Appendix B

Project-Specific Plan for the On-Site Disposal Facility Monitoring Program

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Contents

Figure

Tables

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Abbreviations

ASL	analytical support level
CAWWT	Converted Advanced Wastewater Treatment facility
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FPQAPP	*Fernald Preserve Quality Assurance Project Plan*
GMA	Great Miami Aquifer
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
LMS	Legacy Management Support
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility

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1.0 Introduction

1.1 Purpose

The purpose of this plan is to provide detailed information for samplers to collect data to support the analytical and reporting requirements described in the On-Site Disposal Facility (OSDF) Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP). The GWLMP divides the OSDF monitoring program into two primary elements: (1) a leak detection component, which will provide information to verify the OSDF's ongoing performance, its integrity, and its impact on groundwater; and (2) a leachate monitoring component, which will satisfy requirements for leachate collection and management. This plan discusses requirements for sampling the groundwater monitoring system (i.e., horizontal till wells [HTWs] and Great Miami Aquifer [GMA] wells), leachate collection system (LCS), and leak detection system (LDS). All sampling and analysis activities will be consistent with the data quality objective provided in Appendix C of the GWLMP.

1.2 Scope

The leak detection monitoring strategy recognizes the various operating phases of the OSDF, including periods before, during, and after waste placement. The facility is currently in the post-closure phase. Each cell has been constructed with an LCS to collect infiltrating rainwater and an LDS to provide early detection of leakage within the individual cells. Additionally, groundwater within the glacial till is monitored using a series of HTWs constructed beneath each cell, and the GMA is monitored by conventional monitoring wells located upgradient and downgradient of each OSDF cell. Monitoring locations for the eight cells are identified in Figure 1.

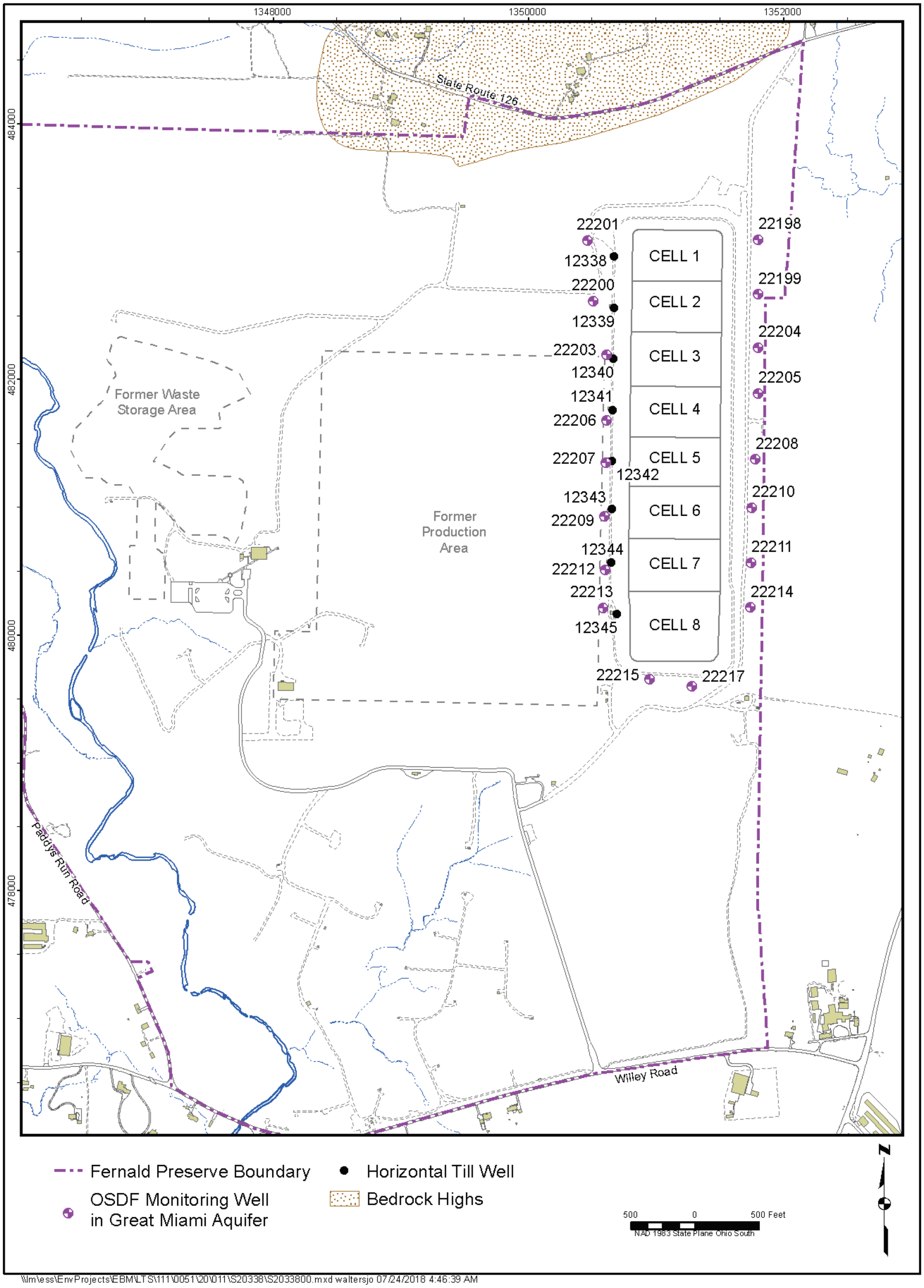

Figure 1. OSDF Well Locations

2.0 Sampling Program

As noted in Section 3.0 of the GWLMP, the Ohio Solid Waste regulations require that, for detection monitoring, at least four independent samples from each well will be taken during the first 180 days after implementation of the groundwater detection monitoring program and at least eight independent samples in the first year to determine the background (baseline) water quality (*Ohio Administrative Code* 3745-27-10[D][5][a][ii][a]). The requirement to collect eight independent samples is only applicable to those wells installed after August 15, 2003, because that is the date that the code became effective. The HTWs and GMA wells were sampled bimonthly after waste placement until 12 samples were collected. This frequency was selected to address OSDF construction schedules while the OSDF was under construction, to develop an appropriate statistical procedure, and to compensate for varying temporal conditions and seasonal fluctuations. After a sufficient number of samples were collected for statistical analysis, samples were collected quarterly from the HTWs and the GMA through 2013. Beginning in January 2014, sampling frequency was reduced from quarterly to semiannual.

Specific monitoring requirements for each cell are provided in Section 2.1, and the specific analytical parameters are listed in Table 1 and Table 2. Analytical methods have been chosen to achieve the lowest detection limits possible for the constituents of concern in the OSDF. A summary of sampling requirements for each OSDF cell is presented in Table 3.

2.1 Sampling at All Cells

Sampling will be as follows:

- Semiannual samples will be collected from the GMA wells of Cells 1–8 for the parameters listed in Table 1.
- Semiannual samples will be collected from all LCS, LDS, and HTWs for the parameters listed in Table 2.

Table 1. Semiannual GMA Monitoring List Requirements for Cells 1 Through 8

Parameter	RDL[a]	Method	Priority[b]	ASL	Holding Time	Preservation	Standard Volume	Minimum Volume	Container
Radionuclides	(pCi/L)								
Technetium-99	15	Liquid Scintillation[c]	2	D	6 months	HNO_3 to pH<2	1 L	500 mL	Plastic or Glass
Inorganics:	(mg/L)								
Boron	0.010	SW-846[d]	1	D	6 months	HNO_3 to pH<2	1 L	600 mL	Plastic or Glass
Calcium	5.00								
Lithium	0.002								
Magnesium	5.00								
Potassium	5.00								
Selenium	0.005								
Sodium	5.00								
Uranium	0.0002								
General Chemistry:	(mg/L)								
Total Organic Halogens (TOX)	0.025	9020B[d]	3	D	28 days	Cool to 4 °C, H_2SO_4 to pH<2	500 mL	20 mL	Amber Glass Bottle with Teflon-lined cap[e]
Nitrate/Nitrite	0.05	353.1[f], 353.2[f], 4500D[g], 4500E[g]	4	D	28 days	Cool to 4 °C, H_2SO_4 to pH<2	100 mL	20 mL	Plastic or Glass
Sulfate	0.5	375.2[f] 300.0[f], 4500E[g]	6	D	28 days	Cool to 4 °C	250 mL	100 mL	Plastic
Total Dissolved Solids (TDS)	10	160.1[f], 2540C[g]	5	D	7 days	Cool to 4 °C	500 mL	250 mL	Plastic or Glass

Notes: Field parameters are performed at each sampling location prior to sample collection and include dissolved oxygen, ORP, pH, specific conductance, temperature, and Turbidity at analytical support level (ASL) A, Priority 1.

[a] RDL = Required Detection Limit (pCi/L = picocuries per liter; mg/L = milligrams per liter).

[b] If sufficient volume is not available for collection of a full suite at standard volume, then the minimum volume and priority will be used to maximize the number of analytical groups collected. The prioritization is based upon uranium being the most important parameter. After that, the prioritization is based upon sample volatilization.

[c] Radiological analyses do not have standard methods; however, the performance-based analytical specifications for these parameters are provided in the FP QAPP. (Liquid Scint. = Liquid Scintillation)

[d] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1998).

[e] Minimal headspace – as close to zero as possible.

[f] *Methods for Chemical Analysis of Water and Wastes* (EPA 1983).

[g] *Standard Methods for Analysis of Water and Wastewater*, 23rd edition (APHA 2017).

Table 2. Semiannual LCS, LDS, and HTW Monitoring List Requirements for Cells 1 Through 8

Parameter	RDL[a]	Method	Priority[b]	ASL	Holding Time	Preservation	Standard Volume	Minimum Volume	Container
Inorganics:	(mg/L)								
Boron	0.010	SW-846[c]	1	D	6 months	HNO_3 to pH<2	1 L	600 mL	Plastic or Glass
Sodium	5.00								
Uranium	0.0002								
General Chem.:	(mg/L)								
Sulfate	0.5	375.2[d], 300.0[d], 4500E[e]	2	D	28 days	Cool to 4 °C	250 mL	100 mL	Plastic

Notes: Field parameters are performed at each sampling location prior to sample collection and include dissolved oxygen, ORP, pH, specific conductance, temperature, and Turbidity at analytical support level (ASL) A, Priority 1.

[a] RDL = Required Detection Limit (mg/L = milligrams per liter).

[b] If sufficient volume is not available for collection of a full suite at standard volume, then the minimum volume and priority will be used to maximize the number of analytical groups collected. The prioritization is based upon uranium being the most important parameter. After that, the prioritization is based upon sample volatilization.

[c] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1998).

[d] *Methods for Chemical Analysis of Water and Wastes* (EPA 1983).

[e] *Standard Methods for Analysis of Water and Wastewater*, 23rd edition (APHA 2017).

Table 3. Summary of Sampling Requirements for the OSDF

Cell(s)	Monitoring Horizons[a]	Semiannually
1 through 8	GMA	Table 1
	LCS, LDS, HTW	Table 2

[a] LCS = leachate collection system
LDS = leak detection system
HTW = horizontal till well
GMA = Great Miami Aquifer

2.2 Additional Sampling Requirements

All horizons for a particular cell will be sampled during the same time frame to enhance the comparability of the data. If insufficient volume is available for collection of the entire analytical suite, the sample sets shall be collected in accordance with the priorities listed in Table 1 and Table 2. Samples will be collected from the HTWs, GMA wells, LCS, and LDS in accordance with the *Fernald Preserve Quality Assurance Project Plan* (FPQAPP) (DOE 2014) and the *Fernald Preserve and Mound, Ohio, Sites Environmental Monitoring Procedures* (DOE 2021).

2.3 LCS and LDS Sample Collection

The LCS is located on the southern side of the valve house, and the LDS is located on the northern end of the valve house. Samples from the LCS and LDS shall be collected by entering the valve houses located on the western side of each cell.

Prior to 2023, samples were collected directly from the sample ports on the bottom of the LCS and LDS as the lines enter the eastern side of the valve house. No purging of the line was required prior to sample collection. If the discharge line was dry or did not yield enough water for the entire sample suite, the sample was collected from the LCS and LDS tanks located within the valve house. The samples from the tanks were collected using a dedicated Teflon bailer. If the sample was collected from the LCS or LDS tank, the tank was pumped down to a low level after the sample is collected to help ensure the next quarterly sample is representative.

In 2021, the LDS tanks in 5 of the 8 cells (Cells 1, 2, 3, 5, and 7) were dry. The estimated maximum accumulation rate measured for the remaining three cells that had flow in the LDS in 2021 (Cells 4, 6, and 8) were minimal. The LDS tanks hold approximately 300 gallons of water, making them oversized for current LDS flow conditions. In the 2018 Site Environmental Report (DOE 2018), 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. The thought was that the smaller container would better facilitate future sampling events and LDS flow measurement capabilities. Given that the LDS systems continue to dry up, DOE decided not to install the sampling ports.

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 being contained within the valve house. The leaks are the result of galvanic corrosion between two different types of metal components of the piping system. Beginning in late 2022, DOE began replacing the metal piping inside the valve houses that connects the leachate lines to the 300-gallon collection tanks with plastic piping before the metal components further deteriorate. This presented the opportunity to also replace the sampling ports on these lines, as previously discussed above. DOE reviewed these modifications with the U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) and began making the approved modifications to the valve house piping and added five-gallon containers with sampling ports in late 2022.

With these modifications, beginning in 2023, LCS and LDS samples will be collected using the sampling ports on the five-gallon containers. The LCS five-gallon containers will require opening of a valve at sample collection to allow flow into the container; LCS samples will be collected from the sampling port on the container. Following sample collection, the valve will be closed, and the liquid will be diverted to the tanks. Because most of the LDS locations are dry or very low flow, the valves to the five-gallon containers will remain open so that any water is collected in the five-gallon container. Following sample collection, the liquid remaining in the LCS and LDS containers will be drained into the leachate system.

2.4 HTW Sample Collection

The glacial till is monitored under each cell using horizontal wells installed during construction of each cell. Prior to sample collection, each HTW shall be purged of three well volumes or purged to dry, whichever occurs first. Sample collection from the horizontal well shall be accomplished using a Teflon bailer.

2.5 Great Miami Aquifer Sample Collection

Each cell is monitored by two GMA wells, located east and west of each individual cell. Two additional GMA wells are located on the south side of Cell 8. These wells are sampled using dedicated sampling equipment.

Filtering of groundwater samples at monitoring wells may take place on a case-by-case basis if deemed appropriate. If filtering is conducted, the reasons for filtering will be presented to U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (Ohio EPA) annually through the Site Environmental Report. Ohio EPA will be notified as soon as possible via email (laura.hafer@epa.ohio.gov or designee).

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3.0 Additional Sampling Program Requirements

3.1 Quality Assurance Requirements

Quality assurance requirements are consistent with those identified in the FPQAPP. Self-assessment and independent assessments of work processes and operations will be conducted to ensure quality of performance. Self-assessments will evaluate sampling procedures and paperwork associated with the sampling effort. Independent assessments will be performed by a Quality Assurance representative by conducting surveillances. Surveillances will be performed at least once per year at any time during the project and will consist of monitoring/observing ongoing project activity and work areas to verify conformance to specified requirements.

3.2 Changes to the Project-Specific Plan

Changes to this plan will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the medium-specific plan must have written approval by the project team leader or designee, Quality Assurance representative, and the field manager prior to implementation. If a Variance/Field Change Notice is required, it will be completed in accordance with the FPQAPP. The Variance/Field Change Notice form shall be issued as a controlled distribution to team members and will be included in the field data package to become part of the project record. During revisions to the Legacy Management and Institutional Controls Plan and GWLMP, Variance/Field Change Notices will be incorporated to update the plan.

If a change represents a significant change to the scope of the plan, approval would be requested through discussions with EPA and Ohio EPA. A Variance that documents the change and the justification for the change will be approved by the EPA and Ohio EPA.

3.3 Quality Control Samples

Quality control sample analyses are required as part of the GWLMP for the OSDF. A minimum of one set of field quality control samples is required for each sampling round. A “sampling round” refers to collection of samples from one or more locations for a specific project during a specified time period for a similar purpose. Duplicate and rinsate samples will be collected at a rate of one per sampling round or one per 20 samples, whichever is more frequent. Trip blanks will be collected one per day per team when samples are collected for volatile organic analysis. A rinsate sample will not be required for those locations with dedicated sample collection equipment. One matrix spike/matrix spike duplicate will be analyzed at a frequency of one per sampling event or one per 20 samples, whichever is more frequent. Quality control samples will be analyzed for the same analytes as the normal samples.

3.4 Equipment Decontamination

All nondedicated sampling equipment shall be decontaminated according to the FPQAPP prior to sample collection at each sample location. Sampling equipment shall also be decontaminated upon completion of sampling activities, unless equipment has been dedicated to the sample location.

3.5 Disposal of Wastes

During sampling activities, waste will be generated in various forms; disposal of all waste will be in accordance with site requirements and procedures. The various forms of waste expected to be encountered during this program are contact waste, purge water, and decontamination wastewater.

Contact waste will be minimized by limiting contact with the sample media and by using disposable materials whenever possible. Contact waste shall be placed into plastic garbage bags and disposed of in a dumpster onsite. If contact waste is determined to be radiologically contaminated, the assigned radiological control technician/engineer shall survey, contain, label, and dispose of the waste according to radiological control requirements.

All decontamination wastewater and purge water will be containerized and disposed of through the Converted Advanced Wastewater Treatment facility (CAWWT) for treatment. The point of entry into the CAWWT will be either the CAWWT backwash basin or the OSDF permanent lift station.

3.6 Safety and Health

Safety and health requirements for the Fernald Preserve are established in accordance with Title 10 *Code of Federal Regulations* Part 851, "Worker Safety and Health Program." This program establishes worker safety and health regulations to govern Legacy Management Support (LMS) contractor activities at U.S. Department of Energy (DOE) sites and establishes the framework for a worker protection program that will reduce or prevent occupational injuries, illness, and accidental losses by requiring DOE contractors to provide their employees with safe and healthful workplaces. These requirements are further defined in LMS contractor procedures, Fernald Preserve standard operating procedures, and job safety analyses.

3.7 Data Management

Information collected as a part of this monitoring program will be managed according to the guidelines below to ensure availability of documentation for verification and reference and to ensure regulatory compliance.

Field documentation, as required by the FPQAPP for this sampling program (e.g., Chain of Custody forms), will be carefully maintained in the field. To ensure that appropriate documentation was completed during field activities and that documentation was completed correctly, required documentation shall be verified by Environmental Monitoring personnel. One hundred percent of the analytical data shall be validated in accordance to the Analytical Support Level (ASL) specified in Tables 1 through 3. Information is stored in the environmental database, and the original field documentation packages shall be stored in in a long-term archive environment. According to regulatory guidance, these records must be maintained for a minimum of 75 years.

4.0 References

APHA (American Public Health Association), 2017. *Standard Methods for Analysis of Water and Wastewater*, 23rd Edition.

DOE (U.S. Department of Energy), 2014. *Fernald Preserve Quality Assurance Project Plan*, LMS/FER/S04774, Office of Legacy Management.

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EPA (U.S. Environmental Protection Agency), 1983. *Methods for Chemical Analysis of Water and Wastes*, EPA600/4-79-020, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March.

EPA (U.S. Environmental Protection Agency), 1998. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd edition, Office of Solid Waste, Washington, DC, April.

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Appendix C

Fernald Preserve Data Quality Objectives Monitoring Program for the On-Site Disposal Facility

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Contents

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Abbreviations

ASL	Analytical Support Level
BTX	benzene, toluene, and xylenes
CEC	cation exchange capacity
CFR	*Code of Federal Regulations*
COD	chemical oxygen demand
DQO	data quality objective
FP EMP	*Fernald Preserve Environmental Monitoring Procedures*
FPQAPP	*Fernald Preserve Quality Assurance Project Plan*
FS	feasibility study
GMA	Great Miami Aquifer
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
IEMP	Integrated Environmental Monitoring Plan
LCS	leachate collection system
LDS	leak detection system
OAC	*Ohio Administrative Code*
ORP	oxidation-reduction potential
OSDF	On-Site Disposal Facility
PCB	polychlorinated biphenyl
PSP	*Project-Specific Plan for the On-Site Disposal Facility Monitoring Program*
QC	quality control
RA	remedial action
RD	remedial design
RI	remedial investigation
R_vA	removal action
SVOC	semivolatile organic compound
SWIFT	Sandia Waste Isolation Flow and Transport
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halogens
TPH	total petroleum hydrocarbons

TSD	treatment, storage, and disposal
VAM3D	Variably Saturated Analysis Model in 3 Dimensions
VOC	volatile organic compound

1.0 Statement of Problem

<u>Problem Statement:</u> Analytical data, obtained from a multi-component monitoring system, is necessary to support the leak detection element of the On-Site Disposal Facility (OSDF) monitoring strategy.

Construction of the OSDF for long-term storage and containment of low-level radioactive waste was completed in phases with eight individual cells. Each cell is monitored individually for leak detection and possible environmental impact.

A major concern regarding the storage of waste at the Fernald Preserve is the prevention of any additional environmental impact to the Great Miami Aquifer (GMA). To address this concern, site-specific monitoring requirements that integrate state and federal regulatory requirements were developed to provide a comprehensive program for monitoring the ongoing performance and integrity of the OSDF.

In consideration of unique hydrogeologic conditions and preexisting contamination onsite a baseline data set (*Ohio Administrative Code* [OAC] 3745-27-10[D][5][a][ii][a], OAC 3745-27-10[A][2][b], and OAC 3745-54-97[G]) was established. In addition, an alternate sampling program (OAC 3745-27-10[D][5][a][ii][b] and [b][ii][b]; 3745-27-10[D][6]) was initiated to address site-specific complexities and provide an effective monitoring program for the OSDF that meets and exceeds federal and state regulations for treatment, storage, and disposal (TSD) facilities.

The OSDF monitoring program strategy uses OSDF system design in combination with a monitoring well network to provide data for a collective assessment of OSDF performance. Each OSDF cell is constructed with a leachate collection system (LCS) and a leak detection system (LDS); these systems are separate and contain sample collection points within the valve house. The LCS is designed to collect infiltrating rainwater (and storm water runoff during waste placement) and prevent it from entering the underlying environment; the leachate drainage layer drains to the west through an exit point in the liner to a leachate transmission system located on the west side of the OSDF and routed for treatment. The LDS is a drainage layer positioned beneath the primary composite liner; any collected fluids from that layer drain to the west where they are removed and routed for treatment as in the LCS. Flow monitoring of the LCS and LDS will be conducted on a scheduled basis. Monitoring the flow and sampling the LCS and LDS liquids will provide an assessment of migratory dynamics within each cell and determine primary liner performance.

The monitoring well network consists of two separate systems. A horizontal till well (HTW) is placed in the subsurface beneath the LCS and LDS liner-penetration box within each cell. Each liner-penetration box represents the lowest elevational area of each cell, by definition the most likely location for a potential leak to migrate. GMA monitoring wells are placed at the immediate boundaries of each cell, at upgradient and downgradient locations, to monitor the water quality of the aquifer and verify presence or absence of environmental impact.

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2.0 Identify the Decision

Flow and analytical data provided by a monitoring program will provide the information necessary for management of the OSDF. Information derived from flow volume assessment and sample analyses will constitute the first tier of a three-tier strategy: detection, assessment, and corrective action; if it is determined from detection monitoring that a leachate leak from the OSDF has occurred, additional groundwater quality assessment studies will be initiated, and corrective action monitoring plans will be developed and implemented as necessary. If the detection monitoring continues to successfully demonstrate that the OSDF is performing as designed, then the monitoring program will remain in the first-tier detection mode, and a follow-up groundwater quality assessment or corrective action monitoring plans will not be necessary.

The OSDF monitoring strategy includes the establishment of baseline conditions in the hydrogeological environment beneath each cell prior to waste placement. Both perched groundwater and the GMA contain uranium and other Fernald Preserve–related constituents at levels above background near the OSDF; therefore, it is necessary to establish preexisting conditions (constituent concentration levels and variability) for applicable OSDF monitoring parameters.

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3.0 Inputs That Affect the Decision

An extensive characterization of wastes to quantify environmental contamination in the area of the Fernald Preserve provided the information to develop the waste acceptance criteria for waste entering the OSDF. The leachability, mobility, persistence, toxicity, and stability of identified waste constituents were evaluated, and of 93 constituents, less than 20 constituents were identified as having the potential to impact the aquifer within a 1,000-year performance period. These site-specific leak detection indicator parameters chosen as monitoring parameters will be supplemented with additional water chemistry indicator parameters.

Additionally, waste TSD facilities must analyze collected leachate annually to fulfill a reporting requirement according to Ohio Solid Waste regulation OAC 3745-27-19(M)(5). Through 2008, OSDF monitoring was complying by collecting a grab sample yearly and performing analysis for the parameters listed in Appendix I of OAC 3745-27-10 and polychlorinated biphenyls (PCBs). Waste is no longer being placed in the OSDF, so an alternate sampling constituent list has been approved for the OSDF, a common-ion study was completed, and additional Appendix I parameters were identified for Cells 1 through 8 and sampled for through December of 2016. Annual sampling in the LCS for additional Appendix I parameters was discontinued in January of 2017.

Monitoring of the liquid flow within the LCS and LDS drainage layers will be performed to provide a trend analysis that can be used as an indicator of containment system performance; changes in the trend of flow will initiate follow-up inspection and corrective action measures as necessary. A graded approach, patterned after federal hazardous waste landfill regulations in Title 40 *Code of Federal Regulations* (CFR) Part 264.303(c)(2) and Ohio solid waste rule OAC 3745-27-19(M)(4), will be used to provide a quantitative monitoring control for drainage within the OSDF.

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4.0 Define the Boundaries of the Study

Subsurface conditions in the immediate area of the OSDF consist of a glacial till underlain by sand and gravel deposits that constitute the GMA. The GMA is a high-yield aquifer and a designated sole-source aquifer under the Safe Drinking Water Act. It supplies a significant amount of potable water for private and industrial use in Butler and Hamilton Counties, Ohio; therefore, a leakage of contaminants from the OSDF could affect water quality for a large population.

Typically, a detection monitoring program consists of upgradient and downgradient monitoring wells with routine sampling for a prescribed list of parameters. Consequently, detection of a statistically significant difference in downgradient water quality indicates that a release from a facility may have occurred. However, at the Fernald Preserve, low permeability and preexisting contamination within the overburden, and implementation of a sitewide groundwater remedial action (RA) for the subsurface, add complexity to the development of a groundwater detection monitoring program that is consistent with the standard approach in solid and hazardous waste regulations. To accommodate such complexities, federal and state regulations allow alternative monitoring strategies, which provide flexibility with respect to well placement, statistical evaluation of data, parameter lists, and sampling frequency. The OSDF monitoring program incorporates an appropriate alternative monitoring strategy to ensure integrity and provide effective early warning of a leak from the facility. The program includes alternate well placement, statistical analysis, parameter lists, and sampling frequencies.

An OSDF leak would migrate vertically downward toward the GMA; therefore, a horizontally positioned well placed within the glacial till shall have its screened interval beneath the LCS and LDS liner-penetration box of each cell as a site-specific approach to monitor a first-entry leakage from the OSDF. The GMA wells are installed immediately adjacent to the OSDF, just outside the boundary of the final composite cap. Each cell is monitored with a set of GMA monitoring wells, placed upgradient and downgradient of each cell. A network of GMA monitoring wells borders the OSDF and provides upgradient and downgradient monitoring points for the entire facility.

The parameters are limited to those indicated as having a potential to migrate from the OSDF and impact the GMA. The concentration levels of concern are those required to determine fluctuations in GMA concentrations and provide a sensitivity great enough to indicate potential impacts.

Sampling frequencies for the OSDF monitoring program meet federal and state requirements. The additional data will be used to develop an appropriate statistical procedure and to compensate for the varying temporal conditions in the groundwater flow direction and chemistry due to seasonal fluctuations.

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5.0 Decision Rule

Both water quality and leachate flow rates will be evaluated to determine the potential that a leak from a cell might be occurring. The U.S. Department of Energy will first review and compare flow rates from the LDS to the design action leakage rate to determine if sufficient hydraulic head is present in a cell to drive leachate through a liner breach. The key to a plausible potential-leak determination is the presence of an adequate hydraulic head (i.e., action leakage rate is present) coupled with observed water quality changes in the LDS and HTW. The water quality of the monitored horizon will also be used to assess for potential leakage. Unless an upward concentration trend in an HTW or GMA well is accompanied by a corresponding action leakage flow rate in the LDS, the upward concentration trend will not be attributed to a potential leak from the OSDF.

Three water quality data interpretation techniques will be used to assess changing water quality conditions in HTW and GMA wells and compare conditions in the HTW and GMA wells to conditions inside the facility in the LCS and LDS. Concentrations will be trended over time for those constituents that have not reached steady-state conditions. Control charts will be prepared for those constituents that are stable. Bivariate plots will be prepared for each cell to illustrate how the water quality signature of the LCS, LDS, and HTW of a cell compare.

Data collected from the OSDF monitoring program will also be used to supplement the compilation of data for the Integrated Environmental Monitoring Plan (IEMP) reports (Attachment D). Groundwater data for those OSDF leak detection constituents that are also common to the IEMP groundwater remedy performance constituents will be used in the IEMP data interpretations as the data become available. Groundwater data collected for the unique OSDF leak detection constituents that are not being monitored by the IEMP groundwater monitoring program will be used only for the establishment of the OSDF baseline and subsequent leak detection monitoring. To provide an integrated approach to reporting OSDF monitoring data, the annual Site Environmental Report will serve as the mechanism by which LCS and LDS volumes and concentrations will be reported, along with groundwater monitoring results, trending results, and interpretation of the data. Presenting data in one report will facilitate a qualitative assessment of the impact of the OSDF on the aquifer, as well as the operational characteristics of OSDF caps and liners.

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6.0 Limits on Uncertainty

The sensitivity and precision must be sufficient to define the GMA concentrations of the parameters of concern such that fluctuations will be observable, and effects impacting the final remediation levels are observed. A false-positive error would indicate either that certain parameters are present when in fact they are not, or that baseline parameters are present at higher concentrations than are actually present in the GMA. This type of error would give a false indication that a leak may exist. A false-negative error would indicate that certain parameters are not present when in fact they are. This may lead to a mistaken indication that a leak is not occurring. It is necessary to define the concentrations of the parameters of concern such that fluctuations in concentration and effects impacting the GMA will be observable.

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7.0 Optimize Design

An aquifer simulation model (i.e., Sandia Waste Isolation Flow and Transport [SWIFT] and, more recently, Variably Saturated Analysis Model in 3 Dimensions [VAM3D]) was used to select monitoring well locations, typically one upgradient and one downgradient of each cell. These wells are used in the detection monitoring program, as well as for baseline establishment.

Standard statistical modeling studies indicate that data from a minimum of four independent sampling events are necessary to establish baseline values; however, for an improved comparative statistical analysis, more sampling events were chosen to ensure sufficient available data for baseline establishment for each GMA monitoring well location.

To ensure consistency of method and an auditable sampling process, each sample will be collected according to the following:

- *Fernald Preserve and Mound, Ohio, Sites Environmental Monitoring Procedures* (DOE 2016).
- *Fernald Preserve Quality Assurance Project Plan* (FPQAPP) (DOE 2014).
- *Project-Specific Plan for the On-Site Disposal Facility Monitoring Program* (PSP) (Attachment C, Appendix B).

Laboratory quality control (QC) requirements will be as specified in the FPQAPP and PSP. One hundred percent of the data will undergo field and laboratory validation.

All chemical sample analyses will be performed at Analytical Support Level (ASL) D, except field water quality analyses, which will always be performed at ASL A. Radiological constituents will be analyzed at ASL D.

All samples require field QC and will include trip blanks as specified in the FPQAPP. Duplicates will be collected for each sampling round (a "sampling round" is defined as one round of sample collection from various locations occurring within a short period of time [i.e., several days]). Equipment rinsate blanks will be collected when dedicated equipment is not available. One laboratory QC sample set shall be collected per each release of samples. Laboratory QC will include a method blank and a matrix spike for each analysis, as well as all other QC required according to the method and FPQAPP.

If a well does not recharge sufficiently to allow collection of specified volumes for all analytes, or the LCS/LDS systems do not contain sufficient volume for a full suite of samples, parameters will be collected in the order of priority stated in the PSP. Sampling parameter requirements and frequencies are defined in the PSP and meet applicable federal and state requirements.

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8.0 Data Quality Objectives

Baseline Establishment for GMA Groundwater Monitoring of the OSDF

1a. Task/Description. Baseline Establishment for GMA Groundwater Monitoring of the OSDF. This sampling program will determine a baseline characterization of the GMA in the immediate vicinity of the OSDF.

1b. Project Phase. Put an *X* in the appropriate box:

RI ☐ FS ☐ RD ☐ RA ☐ R_VA ☐ Other ☒ Specify: Post-Closure______

1c. DQO No.: GW-024____ DQO Reference No.: not applicable

---

2. Media Characterization. Put an *X* in the appropriate box:

Air ☐ Biological ☐ Groundwater ☒ Sediment ☐ Soil ☐

Waste ☐ Wastewater ☐ Surface water ☐ Other ☐ Specify: Leachate_____________

---

3. Data Use with ASLs A−E. Put an *X* in the appropriate ASL boxes beside each applicable data use:

Site Characterization
A ☐ B ☐ C ☐ D ☐ E ☐

Risk Assessment
A ☐ B ☐ C ☐ D ☐ E ☐

Evaluation of Alternatives
A ☐ B ☐ C ☐ D ☐ E ☐

Engineering Design
A ☐ B ☐ C ☐ D ☐ E ☐

Monitoring during remediation activities
A ☐ B ☐ C ☐ D ☐ E ☐

Other (specify):_Post-Closure________
A ☒ B ☐ C ☐ D ☒ E ☐

4a. Drivers. OSDF GWLMP, the OAC for the containment of solid and hazardous waste, and the CFR TSD Facility Standards.

4b. Objective. To provide information by which verification of the ongoing performance and integrity of the OSDF and its impact on groundwater can be evaluated.

5. Site Information (description). The OSDF will consist of eight individual cells, and each cell will be monitored on an individual basis. The monitoring system developed to detect any potential leaks originating from the cells consists of four components: an LDS, an LCS, a till monitoring system, and a Great Miami Aquifer monitoring system. This DQO addresses post-closure OSDF leak detection monitoring.

---

6. Data Types with Appropriate ASL. Put an *X* in the appropriate boxes for required analyses:

A.	pH	☒	B.	Uranium	☐	C.	BTX ☐
	Temperature	☒		Full Radiologic	☐		TPH ☐
	Specific Conductance	☒		Metals	☒*		Oil/Grease ☐
	Dissolved Oxygen	☒		Cyanide	☐		
	Turbidity	☒		Silica	☐		
D.	Cations	☐	E.	VOC	☐	F.	Other (specify):
	Anions	☐		SVOC	☐		TDS, Sulfate,
	TOC	☐		Pesticides	☐		Nitrate/Nitrite,
	TCLP	☐		PCB	☐		ORP,
	CEC	☐		TOX	☒		
	COD	☐					

*See specific parameters listed in PSP.

7a. Sampling Methods. Put an *X* in the appropriate box:

Biased ☐ Composite ☐ Environmental ☐ Grab ☒ Grid ☐

Intrusive ☐ Non-Intrusive ☐ Phased ☐ Source ☐

Other (specify): ______ DQO Number: DQO #GW-024

7b. Sample Work Plan Reference. List the samples required and reference the work plan or sampling plan guiding the sampling activity, as appropriate. Baseline/background samples and routine monitoring samples: PSP for onsite disposal monitoring program.

7c. Sample Collection Reference. Provide a specific reference to the FPQAPP section and subsection guiding sampling collection procedures. A PSP will detail sampling methodology; unless otherwise indicated in the PSP, sampling will follow requirements outlined in the FPQAPP and FP EMP.

Sample Collection Reference: FPQAPP and FP EMP.

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8. Quality Control Samples. Put an *X* in the appropriate box:

Field Quality Control Samples

Trip Blanks	☒	Container Blanks	☐
Field Blanks	☐	Duplicate Samples	☒
Equipment Rinsate Samples	☒	Split Samples	☐
Preservative Blanks	☐	Performance Evaluation Samples	☐

Other (specify): none required

Laboratory Quality Control Samples

Method Blank	☒	Matrix Duplicate/Replicate	☒
Matrix Spike	☒	Surrogate Spikes	☐

Other (specify) none required

---

9. Other. Provide any other germane information that may impact the data quality or gathering of this particular objective, task, or data use.

9.0 References

DOE (U.S. Department of Energy), 2014. *Fernald Preserve Quality Assurance Project Plan,* LMS/FER/S04774, Office of Legacy Management.

DOE (U.S. Department of Energy), 2021. *Fernald Preserve and Mound, Ohio, Sites Environmental Monitoring Procedures,* LMS/FER/MND/S05277, Office of Legacy Management.

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Appendix D

Leachate Management System for the On-Site Disposal Facility

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Contents

Figure

Tables

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Abbreviations

CAWWT	Converted Advanced Wastewater Treatment Facility
CFR	*Code of Federal Regulations*
cm	centimeters
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EPLTS	enhanced permanent leachate transmission system
ft	foot/feet
HDPE	high-density polyethylene
HMI	human-machine interface
LCS	leachate collection system
LDS	leak detection system
LTS	leachate transmission system
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
PLS	permanent lift station
PS	pipe segment
RLCS	redundant leachate collection system

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1.0 Overview

The double liner system of each On-Site Disposal Facility (OSDF) cell contains a leachate collection system (LCS) and a leak detection system (LDS). These systems are designed to convey any leachate/fluid that enters the system through pipes (i.e., the LCS pipes and LDS pipes) to valve houses located outside each cell. After closure of the OSDF, fluids that enter the LCS have infiltrated through the emplaced impacted material. Fluid that collects in the LCS and LDS collection tanks located in the valve house for each cell will be pumped to the enhanced permanent leachate transmission system (EPLTS). The EPLTS conveys leachate from each of the valve houses, via gravity flow, to a permanent lift station (PLS). The location of the LCS, LDS, and EPLTS pipes and gravity lines are shown in the as-built construction drawings.

The *Systems Plan, On-site Disposal Facility* (DOE 2000), and *Systems Plan, Collection and Management of Leachate for the On-site Disposal Facility* procedure (DOE 2001a) provide specifics on activities during post-closure monitoring. Note that operational procedures are included in the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2015) and the *Converted Advanced Wastewater Treatment Facility Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021a). Equipment will be maintained, operated, and serviced according to manufacturer instructions and Section 4 of the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021b).

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2.0 Basic System Operation

What follows is a description of the basic operation of the OSDF leachate management system.

- The LCS and LDS pipes from the liner system to the valve houses for each cell consist of double-wall, high-density polyethylene (HDPE) pipes (i.e., inner carrier pipes and outer containment pipes). Each pipe drains by gravity from below the OSDF cell and terminates in a valve house for each cell.
- The LDS line in each valve house allows for direct discharge of flow from the LDS carrier pipe into a collection tank located inside the valve house. The lined valve house foundation wall serves as a secondary containment structure for the collection tank. The valve house has provisions to monitor liquid in the collection tank. The tank is equipped with a level-sensing element and a pump to discharge the contents of the tank. The tank level is monitored by the Converted Advanced Wastewater Treatment Facility (CAWWT) human-machine interface (HMI), and the tank is pumped automatically when the level reaches 80 percent. The discharge pipe from the tank pump is connected to the EPLTS gravity line. The LDS containment pipe has a monitoring port and a fixed end seal within the valve house to verify the absence of fluid in the annular space between the carrier pipe and containment pipe.
- Each LDS line has a cleanout within the valve house for maintaining the LDS carrier pipe.
- The LCS allows direct discharge of flow from the LCS carrier pipe into the EPLTS gravity line that passes through each valve house. LCS flow has diminished to the point that flow from all eight cells is currently directed through the collection tanks in each valve house. The tank level is monitored by the CAWWT HMI, and the tank is pumped automatically when the level reaches 80 percent. The LCS carrier pipe in each valve house also has a sampling port for obtaining leachate samples. Each valve house has an inlet for a redundant LCS (RLCS) carrier pipe. The redundant carrier pipe has a valve (secured in a closed position) and a monitoring port (for periodically confirming the absence of leachate in the pipe). The redundant carrier pipe valve is configured so that it can be opened to allow flow to the LCS tanks and then to the EPLTS gravity line in the event of a failure due to clogging of the primary LCS carrier pipe. Both the primary and RLCS containment pipes have monitoring ports and fixed end seals within the LCS to verify the absence of leachate in the annular space between the carrier pipe and the containment pipe.
- Each valve house is equipped with liquid-level alarms, consisting of a submersible liquid-level sensor (located in a small sump in the corner of each valve house) and alarm light. The liquid-level sensor is calibrated so that the alarm is activated when the fluid level in the valve house sump reaches approximately 11 inches.
- The EPLTS gravity line consists of a double-wall HDPE pipe with a 6-inch (15.2-centimeter [cm])-diameter inner carrier pipe, and a 10-inch (25-cm)-diameter outer containment pipe.
- The EPLTS gravity line is equipped with a vent at its northern end. The purpose of the vent is to prevent pressure buildup in the systems. The EPLTS gravity line has cleanouts in each valve house that provide access to the EPLTS line in both directions for maintenance.
- The PLS has secondary containment designed so that it can be monitored for the presence of leakage.

- The PLS was designed to be capable of storing the anticipated quantity of leachate generated during a 1-week period using design assumptions simulating final closure of the OSDF.
- Prior to the discharge of fluid into the PLS, the fluid passes through a motor-operated inflow valve located in the control valve house just upstream of the PLS. This valve closes automatically in the event of a power failure, or if fluid levels in the lift station rise above the high-level alarm set point (or any level that would cause an electrical short or damage to equipment in the lift station). In the event of a power failure or high-level alarm, the motor-operated valve for the leachate transmission system (LTS) will close automatically. Therefore, this valve can be closed if needed until appropriate maintenance activities can be implemented.
- The PLS is equipped with a pumping system to transfer liquids in the lift station to the CAWWT for treatment.

2.1 LDS and LCS

The LDS and LCS of each OSDF cell shall be operated in conformance with the requirements of Section 4.0 of the *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021b).

The valve on the RLCS carrier pipe shall be maintained closed at all times, unless it is determined that the LCS pipe is clogged.

In order to allow discharge to the EPLTS gravity line, the valve on the LCS carrier pipe shall be maintained open at all times during the post-closure period of the OSDF, except for those periods when the valve needs to be closed for system maintenance and repair, or in the event of an operational emergency.

The LCS valve houses are designed as a closed system; leachate should not accumulate in these valve houses. The sumps in the valve houses will be pumped as needed when water in the sump reaches the alarm level.

3.0 Inspection and Maintenance Activities

The *Wastewater Treatment Outside Systems Procedure for the Fernald Preserve, Fernald, Ohio* (DOE 2021b) provides the current details associated with inspection and maintenance activities for the leachate management system. The following subsection and Table 1 provide guidelines for the activities to continue during the post-closure period.

3.1 LCS and LDS

The LCS and LDS shall be inspected and maintained according to the schedule and activity requirements outlined in Table 1, or until leachate is no longer generated and an alternative activity schedule has been approved.

According to appropriate regulations—*Ohio Administrative Code* (OAC) 3745-27-19(k)(3)—the routine inspection of the pipe network shall be annual until final closure to ensure that clogging has not occurred. Clogging could occur from deposition of sediments or from biological growth inside the pipe. Since the facility closed in 2006, the annual inspection requirement is no longer applicable. The U.S. Department of Energy (DOE) inspected the pipe network in 2015. When inspections occur, this pipe network shall be inspected between the valve house and the first 100 feet (ft) of the subdrain pipe inside the cell (at a minimum). 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 2015 inspection indicated that no cleaning was necessary based on the absence or minimal presence of both gravel and scale, the inspection frequency was decreased to once every 10 years. The next inspection will be in 2025.

Access to the network pipes for inspection shall be through cleanouts located in each cell's valve house. Inspections shall be performed using a video camera or any other appropriate inspection equipment. The inspection equipment shall have the ability to monitor its location (e.g., distance counter), be sized to fit within the LCS and LDS inner carrier pipes indicated on construction drawings, and be capable of being pushed the length to be inspected.

If an inspection indicates that a pipe in the pipe network is obstructed, the pipe shall be flushed by pumping water from a water truck through a hose inserted in the pipe cleanout. If flushing does not remove the obstruction, other methods shall be used to clean the pipe. These other methods may include blowing the obstruction out with air; vacuuming; jet rodding; or inserting a snake, fish tape, or other suitable device. If air or water pressure is used, the working pressure inside the pipe shall not exceed the rated pressure for the pipe.

Table 1. Post-Closure OSDF Leachate Management System Inspection and Maintenance Activities

Component	Inspection Frequency	Conditions to Check	Remedy (and/or Actions)
Routine inspection and maintenance of LDS	Various	• Check general condition of valve house for each cell annually. • Inspect the primary containment vessel for leakage quarterly. • Check for fluid in LDS containment pipe monthly.	• Check level transmitter operations (e.g., operating temperature range, accuracy), electrical connections, and alarm light. • Check for source of leak; if source identified, then take appropriate corrective measures (e.g., spot-seal vessel, replace vessel). • Keep monitoring port drained; if above the action level specified in the *Leachate Management Contingency Plan for the On-Site Disposal Facility* (DOE 2001b), perform video inspection of pipe and attempt to identify source of leakage; develop plan to mitigate effects.
Routine inspection and maintenance of LCS	Various	• Check general condition of valve house for each cell annually. • Check for leachate in LCS containment pipe monthly.	• Check level transmitter operations (e.g., operating temperature range, accuracy), electrical connections, and radio transmission. • Keep monitoring port drained; if above the action level specified in the *Leachate Management Contingency Plan for the On-Site Disposal Facility* (DOE 2001b), perform video inspection of pipe and attempt to identify source of leakage; develop plan to mitigate effects.
Routine inspection and maintenance of pipe networks	Once every 10 years with the next inspection in 2025. Note: Monitoring is anticipated to remain in effect until it is demonstrated that leachate no longer poses a threat to human health or the environment. Temporary suspension of leachate requirements may also be considered.	• Check condition of shutoff valve. • Check for leachate in LCS containment pipe monthly. Video inspect for: • Cracking/crushing of pipe. • Clogging of pipe.	• Check valve operability; correct any deficiencies. • Drain pipe into EPLTS gravity line. • Flush clogged pipe with water or mechanically clean. • Insert small-diameter pipe in crushed pipe, if possible. • Replace cracked/crushed pipe if cracked/crushed portion is outside of the cell. • Use RLCS.

Table 1. Post-Closure OSDF Leachate Management System Inspection and Maintenance Activities (continued)

Component	Inspection Frequency	Conditions to Check	Remedy (and/or Actions)
OSDF cell valve houses	Annually	• Confirm that all required signage is visible. • Check general structural condition of valve house components. • Check for odors, bacterial growth (containment vessel).	• Repair or replace as necessary. • Check for structural integrity; if problems are found, take appropriate measures (e.g., spot-seal vessel, replace vessel) and implement permanent solution. • Clean tanks when needed with Alconox or equivalent.
EPLTS gravity line	Various	• Check for fluid in EPLTS gravity line containment pipe monthly. • Inspect pipe for clogging or crushing once every 5 years if needed.	• Keep containment pipe drained; if above the action level specified in the *Leachate Management Contingency Plan for the On-Site Disposal Facility* (DOE 2001b), perform video inspection of pipe and attempt to identify source of leakage; if leakage is minor, continue to operate; if leakage is significant, evaluate repair options. • Flush clogged pipe with water, or mechanically clean; repair as necessary.
LCS and LDS tank-level transmitters	Once every 6 months	• Operational check of transmitter.	• Clean or replace as necessary.
Valve house sump alarms	Quarterly	• Verify that the alarm switch is operational. • Verify that the alarm signal is sent to and acknowledged at the alarm panel in the valve house.	• Repair or replace switch and/or panel relay as necessary.

The specific pipe maintenance procedures (other than flushing) to be used to remove a pipe obstruction will be selected by DOE on a case-by-case basis.

If an LCS or LDS pipe obstruction cannot be dislodged, or in the very unlikely event that a pipe has undergone partial or total cracking, the following procedures will be considered:

- For the LCS, activate the RLCS pipe.
- For the LCS or LDS, insert a new small-diameter pipe within the obstructed/collapsed pipe or replace the broken piece, as necessary.
- For the LCS or LDS pipe, if the obstruction or collapse is outside of the disposal facility containment systems, replace the pipe.
- All equipment inserted into the LCS or LDS line for inspection and/or maintenance shall be decontaminated prior to its removal from the OSDF.

In addition to the aforementioned requirements, all mechanical and electrical equipment shall be tested, operated, maintained, and serviced according to the manufacturer's instructions and site procedures.

3.2 EPLTS Inspection and Maintenance Activities

The EPLTS shall be inspected and maintained in accordance with the schedule and activity requirements outlined in Table 1, or until leachate is no longer generated and an alternative activity schedule has been approved.

The LTS, valves, connections, sampling ports, monitoring ports, pumps, and other components shall be routinely inspected and maintained to provide for proper OSDF operation. All mechanical and electrical equipment shall be tested, operated, maintained, and serviced according to the manufacturers' instructions and site procedures.

In addition, the inspection and maintenance activities for the EPLTS shall include the following:

- Confirm that appropriate warning signs are visible (e.g., for confined space).
- Check instruments and valves (e.g., note any sticking or jammed devices, corrosion, leaks, and misalignments).
- Verify instrument systems status (e.g., operation of automatic level switch in the lift station).
- Check for the presence of fluids in all secondary containment systems.
- Confirm pump operation.

4.0 Leachate Management

Treatment of fluids collected from the LCS and LDS will be through the CAWWT as long as it is operating. Long-term treatment of the fluids collected from the LCS and LDS will be evaluated prior to discontinuation of operations of the CAWWT. In accordance with Ohio solid waste rule OAC 3745-27-19(K)(5), some of those alternatives are expected to consist of the following:

- Onsite pretreatment of collected fluids with offsite disposal.
- Offsite treatment and disposal of collected fluids.
- Various options that may exist for the offsite portion of either of these alternatives.

Offsite treatment and/or disposal would likely require collection of leachate in the sump or another accumulation tank while awaiting periodic removal. Any modification involving such accumulation in a tank would require an estimate of the quantity of leachate per time period, in order to specify the frequency of removal and how it will be disposed of or treated.

The processes presented above are expected to remain in effect until leachate is no longer detected (refer to federal hazardous waste regulation in Title 40 *Code of Federal Regulations* [CFR] Part 264.310[b][2]), or until it is demonstrated that leachate no longer poses a threat to human health or the environment. If leachate volumes decrease below anticipated levels and the leachate toxicity decreases, DOE may choose to petition the director of the Ohio Environmental Protection Agency (Ohio EPA) to modify or temporarily suspend some of the leachate management requirements. OAC 3745-66-18(G) gives the director of Ohio EPA authority to extend or reduce the post-closure care period based on cause. Eventually the leachate management system will be placed into its final, long-term configuration with the valve houses and contents being removed and replaced with straight lengths of pipes connecting the LDS and LCS to the EPLTS line. The decision regarding when the long-term configuration can be implemented will be made with concurrence of the U.S. Environmental Protection Agency (EPA) and Ohio EPA. This decision will be based on criteria developed in consultation with EPA and Ohio EPA. The criteria will include factors such as asymptotic leachate flows, a past history of no problems with plugging of the LCS or LDS lines, no recent activity to repair or revegetate the cap, and the absence of similar conditions that would argue for maintaining the ability to inspect and repair the LCS and LDS lines.

Information associated with leachate monitoring will be reported through the annual Site Environmental Reports as identified in the front sections of the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan (Attachment C of the Legacy Management and Institutional Controls Plan).

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5.0 Leachate Contingency Plan

By the summer of 2006, the flows from the OSDF LCS and LDS had decreased significantly due to the filling and capping of cells. The previous *Leachate Management Contingency Plan for the On-Site Disposal Facility* (DOE 2001b) was written in January 2001 for failure of the LDS, LCS, or EPLTS lines. The plan contained detailed operating modes for each line failure, including failure of the line downstream of the PLS that required using a tanker to transport water from the PLS to the treatment system. A review of the plan indicated that most of the actions detailed in the plan are no longer applicable. For a failure of the EPLTS or the line downstream of the PLS, the preferred option is to close the valves from the LDS and LCS for each cell, allow the water to accumulate in the cells, and repair the line as necessary.

To determine if this option was feasible, calculations were performed for each cell to determine how much water could be allowed to accumulate in each cell without exceeding 1 ft of head on the primary liner (DOE 1997). Information from Geosyntec indicated that the 1-foot level would be reached in each cell when 8,623 gallons had accumulated (Geosyntec 2006). Daily flow from the cells in 2015 was compared to that volume to determine the number of days required for each cell to accumulate 8,623 gallons. Table 2 shows the data used to determine the number of days.

Table 2. Determination of the Number of Days Required to Reach the 1 ft Level (8,623 Gallons)

Tank	Total Volume Pumped in 2015 (gallons)	Average Gallons Pumped per Day in 2015	Days to Accumulate 8,623 Gallons
LCS 1	16,338	44.8	193
LCS 2	18,196	49.9	173
LCS 3	20,149	55.2	156
LCS 4	17,003	46.6	185
LCS 5	16,959	46.5	186
LCS 6	14,391	39.4	219
LCS 7	12,419	34.0	253
LCS 8	14,923	40.9	211

Since the minimum number of days required to reach the accumulation limit was determined to be 156, transporting leachate water by tanker to the treatment system in the event of a line failure is unnecessary. If any of the lines in the leachate system fail, the valves from the affected cell's LDS and LCS will be closed, and water will be allowed to accumulate in the cells while repairs are performed. The new contingency leachate plan for the EPLTS or the line downstream of the PLS is to develop a repair plan and repair the line(s) before any of the affected cells accumulate 8,623 gallons. If repairs are anticipated to take longer than the time it would take to accumulate 1 ft of head on the primary liner, leachate would be transferred to the CAWWT via a rental tanker truck or other portable tank.

Monitoring of the LDS, LCS, RLCS, and LTS containment pipes will continue as specified in Table 1. Refer to Figure 1 for a schematic of the Leachate Management System.

The action levels listed in Table 3 were derived from the *Leachate Management Contingency Plan for the On-Site Disposal Facility* (DOE 2001b) and apply on a weekly basis. As the period between monitoring events is extended, the weekly action levels will be multiplied by the number of weeks between monitoring events to yield the applicable periodic action levels.

Table 3. Action Levels for Containment Pipe Monitoring

	LDS	LCS	RLCS	LTS in Each Valve House (PS-1 through PS-7)	LTS at Port V1007 (PS-9)	LTS at Port V1006 (PS-10)
Weekly Maximum (milliliters)	2,270	2,650	2,650	5,300	18,900	370

If the water collected from any monitoring port exceeds the action level for the period, the port will be checked again in 1 week. If the amount of water collected again exceeds the action level, an investigation of the pipe segment (PS) in question will be performed and corrective actions taken as needed. Note that PS-8 on Figure 1 is no longer monitored because the interim LTS is no longer used as a contingency pipeline.

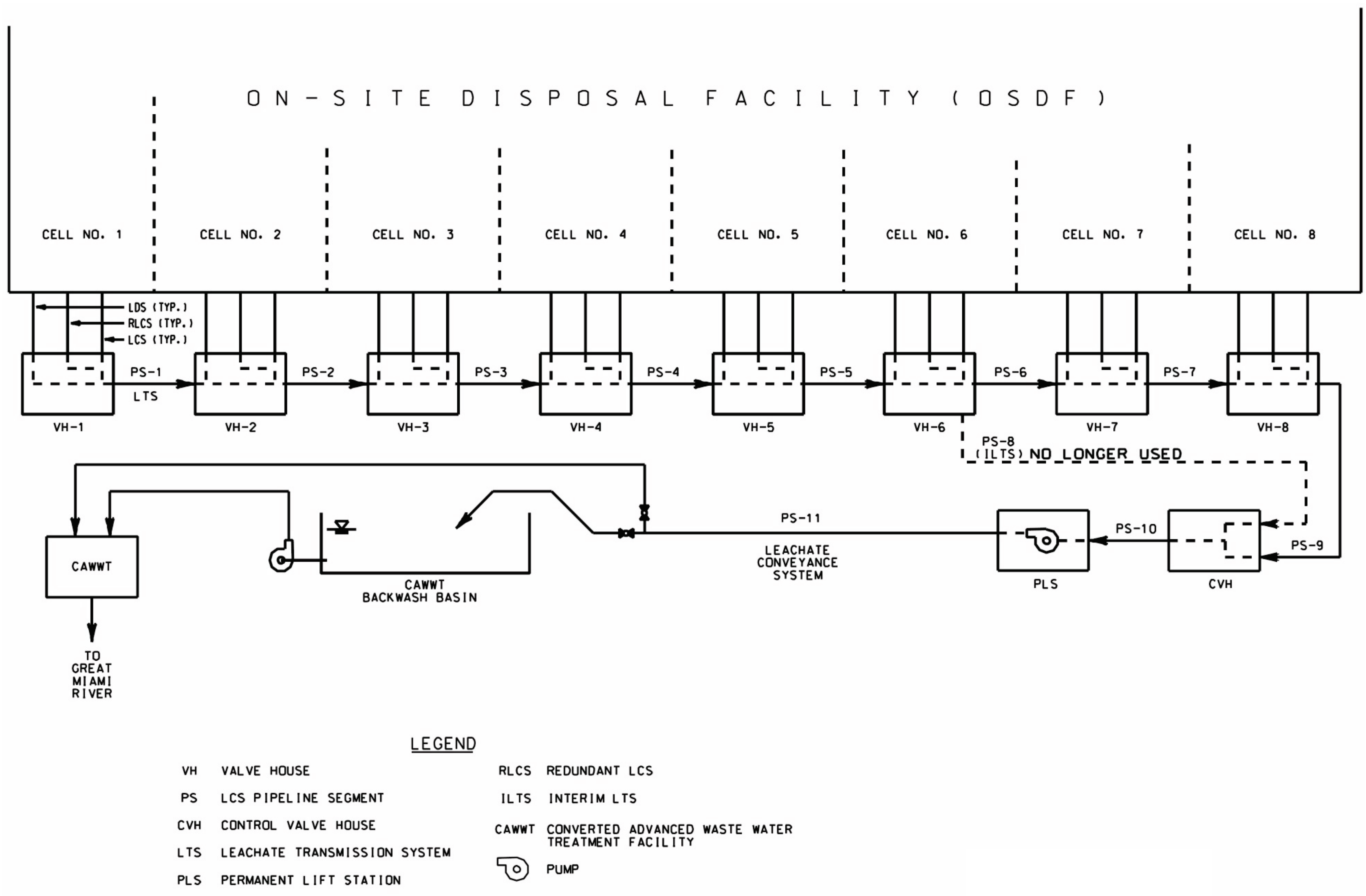

Figure 1. Leachate Management System

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Appendix E

Selection Process for Site-Specific Leak Detection Indicator Parameters

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Contents

Figures

Tables

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Abbreviations

COC	constituent of concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FS	feasibility study
GMA	Great Miami Aquifer
HTW	horizontal till well
LCS	leachate collection system
LDS	leak detection system
mg/kg	milligrams per kilogram
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
OU	Operable Unit
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
TDS	total dissolved solids
TOC	total organic carbon
TOX	total organic halogens
WAC	waste acceptance criteria

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1.0 Introduction

A successful leak detection monitoring program must focus on the best indicators of potential releases, as opposed to analyzing for every possible constituent that may be present in a disposal facility (which would add unnecessary complexity to the data analysis process). This section presents the criteria and process used to identify the site-specific indicator parameters for the On-Site Disposal Facility (OSDF) groundwater leak detection monitoring program.

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2.0 Guidelines for Site-Specific Monitoring Parameter Selection

At the Fernald Preserve, residual soil contamination may impact the aquifer at concentrations below the groundwater final remediation levels but statistically elevated above current background conditions. All of the inorganic constituents and all but nine organic constituents included in the regulatory default monitoring parameters list (i.e., Appendix I of *Ohio Administrative Code* [OAC] 3745-27-10) have been detected in perched groundwater samples collected at various locations under the Fernald Preserve. Such preexisting contamination in the environment beneath the site, along with aquifer remediation activities, add complexity to the development of a successful leak detection parameter list capable of indicating the presence of a leak from the OSDF. Therefore, a tailored leak detection parameter list has been developed that provides adequate leak detection and is in compliance with the standard requirements of the Ohio Solid Waste Rules and the Ohio Hazardous Waste Rules. As discussed in Section 3.0 of the Groundwater/Leak Detection and Leachate Monitoring Plan (Attachment C), both sets of rules allow the use of an alternate monitoring parameter list based on site-specific conditions.

Ohio Solid Waste regulations OAC 3745-27-10(D)(2) and (3) allow six considerations in proposing an alternate monitoring parameter list in lieu of some or all of the parameters listed in Appendix I of OAC 3745-27-10. Also, the Ohio Hazardous Waste regulations for new facilities, OAC 3745-54-98(A), recognize four considerations in formulating the facility-specific monitoring parameter list. Table 1 summarizes the important considerations and approval criteria related to monitoring parameter selection under the Ohio Solid Waste and Ohio Hazardous Waste regulations.

The chemical constituents listed in Appendix I of OAC 3745-27-10 are typical contaminants found in sanitary landfills. Appendix I does not include any radionuclides, which are the primary constituents of concern (COCs) at the Fernald Preserve. Therefore, any site-specific constituents that are not included in Appendix I of OAC 3745-27-10, but that are good indicators of potential leaks from the OSDF, also need to be evaluated in the parameter selection process. However, the general considerations summarized in Table 1 can apply to any constituent when selecting the leak detection indicator parameters.

Table 1. Regulatory Criteria for Alternate Parameter List

Ohio Solid Waste Regulation	Ohio Hazardous Waste Regulation
Requirements:	
• For all parameters, the removed parameters are not reasonably expected to be in or derived from the waste contained or deposited in the landfill facility (OAC 3745-27-10 [D][2]); and	—
• For inorganic parameters, the approved alternative monitoring parameter list will provide a reliable indication of inorganic releases from the landfill facility to the groundwater (OAC 3745-27-10 [D][3]).	Indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogen), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous constituents in groundwater (OAC 3745-54-98 [A])
Considerations:	
Types, quantities, and concentrations of constituents to be managed at the facility (OAC 3745-27-10 [D][2][b] and [D][3][a]);	Types, quantities, and concentrations of constituents to be managed at the regulated unit; (OAC 3745-54-98 [A][1])
• Mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the facility (OAC 3745-27-10 [D][3][b]);	Mobility, stability, and persistence of the waste constituents or their reaction products in the unsaturated zone beneath the waste management area (OAC 3745-54-98 [A][2])
• Concentrations in the leachate from the relevant unit(s) of the facility (OAC 3745-27-10 [D][2][c]);	—
• Detectability of the parameters, waste constituents, and their reaction products in the groundwater (OAC 3745-27-10 [D][3][c]);	Detectability of the indicator parameters, waste constituents, and their reaction products in the groundwater; (OAC 3745-54-98 [A][3]); and
• Concentrations or values and coefficients of variation of monitoring parameters or constituents in the background [baseline] groundwater quality (OAC 3745-27-10 [D][3][d]); and	Concentrations or values and coefficients of variation of monitoring parameters or constituents in the background (baseline) groundwater quality [OAC 3745-54-98 (A)(4)].
• Any other relevant information (OAC 3745-27-10 [D][2][d]).	–

Parameter selection focuses on establishing baseline conditions for the individual cells of the OSDF. Parameters selected for the baseline sampling and analysis approach of the OSDF groundwater monitoring program were selected using site-specific contamination data generated for the previous Operable Unit (OU) 5 Remedial Investigation (RI) Report (DOE 1995a) and the OU 5 Feasibility Study (FS) Report (DOE 1995b) in accordance with the regulatory considerations presented above.

The remainder of this section presents the site-specific monitoring parameters. These lists correspond to an alternate monitoring program parameters list as defined in the regulations. These indicator parameters will provide sufficient and reliable indication of potential releases from the OSDF.

3.0 Initial Leak Detection Monitoring Parameter List

An alternate leak detection monitoring parameters list should include both primary parameters and supplemental indicator parameters. As suggested by the regulatory considerations summarized in Table 1, primary parameters should consist of selected site-specific chemical constituents that are expected to be of significant amounts in the monitored facility, and that are persistent, mobile, and differentiable from existing background conditions when released. The supplemental indicator parameters may include general groundwater quality parameters, which will have rapid and detectable changes in response to variations in chemical compositions in groundwater under the monitored facility, potentially as a result of a leak.

The Initial Leak Detection Monitoring Parameter list consisted of 14 primary parameters and four supplemental indicator parameters (i.e., initial baseline monitoring). Samples collected in all four monitoring horizons of each cell were sampled for these 18 parameters. Twelve rounds of sampling were completed at each cell. Following is the rationale that was used for the selection of the primary and supplemental indicator parameters.

3.1 Primary Parameters

In general, organic constituents are more mobile but less persistent than most inorganic constituents and radionuclides. Because inorganic constituents and most radionuclides are present in natural soil, if the OSDF were constructed in a pristine site, organic constituents may be the preferred primary monitoring parameters for early leak detection purposes. However, because all three types of constituents have been detected in the media (i.e., perched groundwater and the Great Miami Aquifer [GMA]), and because a monitoring parameter must be differentiable from background conditions in case of a release, a good leak detection monitoring parameter must also be present in significant abundance or at relatively high source strengths in the OSDF.

Constituent-specific quantity, persistence, and mobility data were considered during the development of the waste acceptance criteria (WAC) for the OSDF. Therefore, information from the OSDF WAC development process was first reviewed to select the primary parameters for leak detection monitoring purposes. The WAC for the OSDF were developed for 42 constituents during the OU5 FS (DOE 1995b); 41 of the WAC are included in the final OU5 Record of Decision (DOE 1996). (As discussed later, one compound—magnesium—was eliminated following completion of the FS.) As discussed in this section, 18 of the 41 WAC are numerical limits and 23 are non-numerical limits that were established to satisfy regulatory screening criteria for constituents regulated under the Resource Conservation and Recovery Act (RCRA).

The maximum acceptable leachate concentrations for constituents that will be present in the OSDF were determined by contaminant fate and transport modeling. The constituent-specific leaching potential, solubility, mobility, and benefits of the engineering controls in the OSDF were considered in the modeling process. These maximum acceptable leachate concentrations were converted into solid-phase WAC at the end of the process. These solid-phase WAC represent the maximum concentrations for soil and debris that can be disposed of in the OSDF.

To assist in selecting the primary parameters, the actual soil concentrations for each of the 18 COCs for which numerical WAC were developed were also reviewed to provide a clear perspective regarding which COCs may approach their corresponding WAC concentrations and, therefore, are more likely to be detectable when released from the OSDF.

During the OU5 FS (DOE 1995b), two categories of COCs were evaluated in the WAC development process. The first category includes all site-specific groundwater pathway COCs that were identified in the OU5 RI (DOE1995a). As a result of the process, 12 numerical WAC were developed for the groundwater pathway COCs. The second category includes those Fernald Preserve constituents that need to be managed and accounted for under RCRA regulations. Six additional numerical WAC were developed for the RCRA-regulated constituents, bringing the total numerical WAC for the OSDF to 18. The following subsections summarize the WAC development process for these two categories of constituents, as derived from the sitewide WAC development process described in the OU5 FS (DOE 1995b). Figure 1 summarizes the process in a flowchart.

3.1.1 Groundwater Pathway COCs

Initially, only the WAC for groundwater pathway COCs were developed. WAC were determined necessary for 15 groundwater pathway COCs selected from Table F.2–2 of Appendix F of the OU5 FS (DOE 1995b). Among all the detected soil and groundwater constituents at the Fernald Preserve, these 15 COCs have potential to reach and impact the GMA through the glacial till within 1,000 years under natural conditions (i.e., if they are not disposed of in the OSDF). Table F.2–2 of Appendix F of the OU5 FS also lists all the other constituents screened for potential cross-media impacts. Overall, 53 organics, 25 inorganics, and 15 radionuclides were evaluated in the groundwater COC selection process, including all the RCRA constituents that have been detected in soil and groundwater at the Fernald Preserve.

After consideration of the engineering controls provided by the OSDF in the modeling procedures, 12 of the original 15 groundwater pathway COCs were found to require numerical WAC. In a determination of which materials can be disposed of in the OSDF, compliance with the 12 numerical WAC will be required for the long-term protection of the GMA. Table 2 lists the 15 COCs considered and the WAC that were developed. The technical approach of fate and transport modeling conducted to develop the COC-specific WAC has been summarized in Section F.5 in the OU5 FS.

Upon further review of the initial WAC development process contained in the OU5 FS, the U.S. Environmental Protection Agency (EPA), the Ohio Environmental Protection Agency (Ohio EPA), and the U.S. Department of Energy (DOE) concurred that magnesium does not present a significant threat to human health. Therefore, magnesium was eliminated from further consideration, and a WAC for magnesium was not presented in Table 9–6 of the OU5 Record of Decision (DOE 1996).

The numerical WAC for the 12 groundwater pathway COCs were the main controlling factors for the disposal of contaminated soil in the OSDF. The 12 groundwater pathway COCs, which have numerical WAC, have significantly higher mobility and persistence and, therefore, should be considered prime candidates when selecting the indicator parameters for the detection monitoring program for the OSDF.

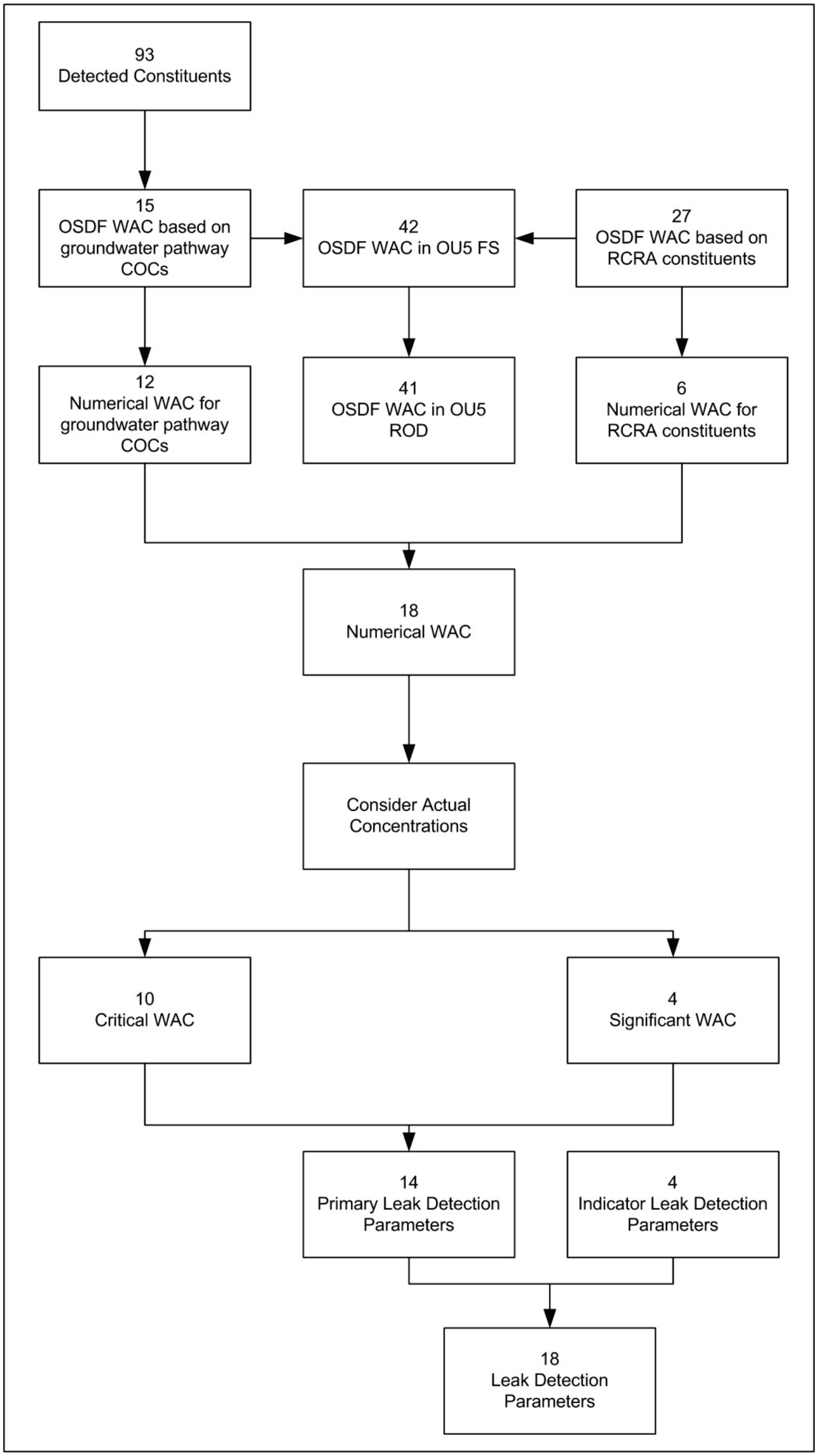

Figure 1. Groundwater/Leak Detection Parameter Selection Process

Table 2. WAC for Groundwater Pathway COCs

COC[a]	WAC
Radionuclides (pCi/g):	
Neptunium-237	3.12×10^{9}
Strontium-90	5.67×10^{10}
Technetium-99	2.91×10^{1}
Total Uranium (mg/kg)	1.03×10^{3}
Organics (mg/kg):	
alpha-Chlordane	2.89×10^{0}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}
Bromodichloromethane	9.03×10^{-1}
Carbazole	7.27×10^{4}
1,2-Dichloroethane	*
4-Nitroaniline	4.42×10^{-2}
Vinyl Chloride[b]	1.51×10^{0}
Inorganics (mg/kg):	
Boron	1.04×10^{3}
Chromium VI[b]	*
Magnesium	*
Mercury[b]	5.66×10^{4}

[a] pCi/g = picocuries per gram;
mg/kg = milligrams per kilogram.
[b] RCRA constituent.
* Denotes constituents that will not exceed designated GMA action level within 1,000-year performance period, regardless of starting concentration in the disposal facility.

The numerical WAC for the 12 groundwater pathway COCs in Table 2 only define the maximum allowable soil concentrations that can be safely disposed of in the OSDF; they do not indicate what level of soil concentrations will actually be encountered during soil remediation. In order to frame the relative significance of these 12 WAC, the maximum soil concentrations for the 12 constituents that are expected in the OSDF following soil placement are provided in Table 3.

As shown in Table 3, the expected maximum soil concentrations in the OSDF reveal that only 5 of the 12 groundwater pathway COCs with numerical WAC (technetium-99, total uranium, vinyl chloride, bis(2-chloroisopropyl) ether, and 4-nitroaniline) are expected to approach their respective WAC concentrations. The other seven COCs will have maximum soil concentrations in the OSDF that are much less than the corresponding WAC. This information regarding overall abundance is also an important consideration for selecting indicator parameters for the leak detection monitoring program.

Table 3. Expected Maximum COC Concentrations in the OSDF

COC	Maximum Concentration[a]	WAC	MAX/WAC
Radionuclides (pCi/g except uranium):			
Neptunium-237	2.63×10^{0}	3.12×10^{9}	8.43×10^{-10}
Strontium-90	6.49×10^{0}	5.67×10^{10}	1.14×10^{-10}
Technetium-99	2.91×10^{1}	2.91×10^{1}	1.00×10^{0}
Total Uranium (mg/kg)	1.03×10^{3}	1.03×10^{3}	1.00×10^{0}
Organics (mg/kg):			
alpha-Chlordane	5.10×10^{-3}	2.89×10^{0}	1.76×10^{-3}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}	2.44×10^{-2}	1.00×10^{0}
Bromodichloromethane	7.00×10^{-3}	9.03×10^{-1}	7.75×10^{-3}
Carbazole	2.50×10^{-1}	7.27×10^{4}	3.44×10^{-6}
4-Nitroaniline	4.42×10^{-2}	4.42×10^{-2}	1.00×10^{0}
Vinyl Chloride[b]	1.51×10^{0}	1.51×10^{0}	1.00×10^{0}
Inorganics (mg/kg):			
Boron	1.43×10^{1}	1.04×10^{3}	1.38×10^{-2}
Mercury	1.30×10^{0}	5.66×10^{4}	2.30×10^{-4}

[a] Lower value between the WAC and the maximum soil concentration presented in Table F.3.4–3 of OU5 RI (DOE 1995a).
[b] Also consider tetrachloroethene and trichloroethene in soil.

3.1.2 RCRA Constituents

After the WAC for the groundwater pathway COCs were developed, WAC for 27 additional RCRA-regulated constituents (termed the RCRA COCs) were evaluated. The development of WAC for these specific constituents was considered necessary from a regulatory standpoint to address a requirement that the RCRA COCs not be eliminated in any COC screening step during the RI/FS process. The intention was to demonstrate compliance with RCRA regulations by providing a mechanism for keeping track of the fate of materials contaminated with RCRA constituents during the remediation.

Most of the RCRA COCs are not groundwater pathway COCs; thus, the calculated WAC for the majority of these constituents are relatively high (i.e., essentially pure product concentration). Only six of the additional constituents were determined to need a numerical WAC. The details of the RCRA constituent WAC development process are provided in Attachment F.5.I of the OU5 FS (DOE 1995b). Table 4 summarizes the results.

Table 4. WAC for Additional RCRA Constituents

RCRA Constituents	Detected and Previously Screened	WAC	OAC 3745-27-10 Appendix I
Organics (mg/kg):			
Acetone	Yes	*	Yes
Benzene	Yes	*	Yes
Carbon tetrachloride	Yes	*	Yes
Chloroethane	No	3.92×10^5	Yes
Chloroform	Yes	*	Yes
Chloromethane	No	*	Yes
1,1-Dichloroethane	Yes	*	Yes
1,1-Dichloroethene	Yes	1.14×10^1	Yes
1,2-Dichloroethene	No	1.14×10^1	Yes
Endrin	No	*	No
Ethylbenzene	Yes	*	Yes
Heptachlor	No	*	No
Heptachlor epoxide	No	*	No
Hexachlorobutadiene	No	*	No
Methoxychlor	No	*	No
Methylene chloride	Yes	*	Yes
Methyl ethyl ketone	Yes	*	Yes
Methyl isobutyl ketone	No	*	Yes
Tetrachloroethene	Yes	1.28×10^2	Yes
1,1,1-Trichloroethane	Yes	*	Yes
Trichloroethene	Yes	1.28×10^2	Yes
Toluene	Yes	*	Yes
Toxaphene	No	1.06×10^5	No
Xylenes	Yes	*	Yes
Inorganics (mg/kg):			
Barium	Yes	*	Yes
Lead	Yes	*	Yes
Silver	Yes	*	Yes

*Denotes constituents that will not exceed designated GMA action level within 1,000-year performance period, regardless of starting concentration in the disposal facility.

The six additional numerical WAC in Table 4 are actually not expected to affect any disposal decisions for contaminated waste, soil, and debris from OU2, OU3, and OU5. As shown in Table 4, the WAC for chloroethane and toxaphene are close to pure product concentration (i.e., 1.00×10^6 milligrams per kilogram [mg/kg]). The WAC for tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene are higher than the highest detected soil concentrations, which were used in the previous screening process summarized in Table F.2–2 of the OU5 FS (DOE 1995b). The maximum detected soil concentrations presented in Table F.3.4–3 of the OU5 RI (DOE 1995a) for tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene are 1.6×10^{0}, 8.90×10^{1}, 3.90×10^{-2}, and 3.4×10^{-1} mg/kg, respectively.

In general, the 15 groundwater pathway COCs listed in Table 2 already include all the constituents detected in soil and groundwater at the Fernald Preserve that may have potential to impact the GMA and, therefore, are more likely to be detectable in the monitoring system in case of a leak from the OSDF.

3.1.3 Selected Primary Parameters

Based on information presented in Table 2 through Table 4, 14 constituents are considered to be the initial primary parameters list for OSDF leak detection monitoring purposes. Table 5 summarizes these constituents and the rationale for their selection. Table 5 also indicates whether each of the 14 constituents is listed in OAC 3745-27-10 Appendix I as a regulatory default parameter.

Table 5. Proposed Primary Parameters List

Constituents of Concern	Rationale	Appendix I
Radionuclides (pCi/g):		
Technetium-99	likely detectable when released	No
Total uranium (mg/kg)	likely detectable when released	No
Organics (mg/kg):		
alpha-Chlordane	likely detectable when released	No
Bis(2-chloroisopropyl)ether	likely detectable when released	No
Bromodichloromethane	likely detectable when released	Yes
Carbazole	likely detectable when released	No
1,1-Dichloroethene	significant RCRA constituent	Yes
1,2-Dichloroethene	significant RCRA constituent	Yes
4-Nitroaniline	likely detectable when released	No
Tetrachloroethene	significant RCRA constituent	Yes
Trichloroethene	significant RCRA constituent	Yes
Vinyl Chloride	likely detectable when released and significant RCRA constituent	Yes
Inorganics (mg/kg):		
Boron	likely detectable when released	No
Mercury	likely detectable when released and significant RCRA constituent	No

Four of the 18 constituents that have numerical WAC listed in Table 2 or Table 4 (chloroethane, toxaphene, neptunium-237, and strontium-90) were not selected because of their expected actual maximum concentrations in the OSDF and their comparatively high WAC values that indicate less likely potential impacts and detectability in case of a leak from the OSDF. However, four RCRA constituents that are not groundwater pathway COCs (tetrachloroethene, trichloroethene, 1,1-dichloroethene, and 1,2-dichloroethene) were selected because their expected maximum soil concentrations are reasonably close to the WAC.

The 14 constituents identified in Table 5 that were selected as the primary leak detection monitoring parameters have a potential to enter the environment in measurable quantities and are likely to be more differentiable from background conditions. These 14 constituents will provide a reliable indication of potential releases from the OSDF to the groundwater. A possible exception may be boron, because it is present in the crushed carbonate stone used for the leachate collection system (LCS), leak detection system (LDS), and cap drainage layers.

3.2 Supplemental Indicator Parameters

In addition to the primary parameters discussed in the preceding subsection, four general groundwater contamination indicator parameters were also proposed to supplement the selected chemical constituents in the initial leak detection monitoring parameters list. These supplemental indicator parameters consist of the following:

- pH
- Specific Conductance
- Total Organic Halogens (TOX)
- Total Organic Carbon (TOC)

These general groundwater contamination indicator parameters are typically used to aid in the detection of releases from disposal facilities. However, given that the largest volume of material placed in the cell is contaminated glacial till (made up of approximately 50 percent carbonate grains by volume), the pH of leachate will not be appreciably different from the pH of perched water or groundwater in the GMA. Therefore, the remaining three supplemental indicator parameters provide an added means to detect contaminant migration and will be useful as indicators for general groundwater quality degradation.

Although the initial indicator parameters should provide indications of potential releases throughout the operational life of the OSDF, efficiency of the parameters list may still be improved based on the collected data obtained over the course of the program. Any proposed modifications based on the accumulated database will involve EPA and Ohio EPA review and approval before adoption.

4.0 Parameter Lists

The sections above identify the process that was used for selecting parameters for initial baseline sampling and analysis (i.e., site-specific leak detection indicator parameters, which are the proposed primary parameters in Table 5, and the supplemental indicator parameters listed in Section 3.2 of this appendix).

Twelve rounds of sampling for the initial site-specific leak detection monitoring parameters were completed at all eight cells in 2007. At the completion of the 12 rounds of sampling, five parameters were identified as having been detected at least 25 percent of the time. These five parameters (boron, sulfate, uranium, TOC, and TOX) make up the refined baseline for each cell.

In 2002 there were relatively high concentrations of sulfate in the Cells 4 and 5 LCS water prior to waste placement, indicating a sulfate source (possibly gypsum) in the gravel composing the LCS layer. Due to sulfate's high mobility and the presence of an ongoing source in the LDS/LCS layers, it was added to the leak detection sampling program in 2003.

Establishing baseline water chemistry in the perched groundwater and GMA horizon under each cell is complicated by the construction process used to install the horizontal till wells (HTWs) and the presence of past groundwater contamination in the till and GMA zones. The installation of the HTWs involved excavation of a trench, placement of a porous filter media composed of sand, and then backfill with the porous media and till material. During this installation, the subsurface chemical properties of the till were altered by the contact of the excavated till material with the atmosphere (oxygen-rich environment). Contact of the subsurface till with the atmosphere may have impacted (1) the oxidation state of metals on the surface of grains and in the pore water and (2) microbial species that mediate oxidation-reduction reactions in the subsurface. Additionally, historical contamination in perched groundwater and GMA horizons surrounding the cell may be migrating and diffusing into the horizontal and GMA monitoring wells.

To address some of these uncertainties, DOE conducted a common-ion study. Results of the study were presented in a report titled *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008a). The report identified four additional constituents (iron, manganese, sodium, and lithium) as potentially beneficial monitoring parameters. These four additional constituents are monitored in the LCS, LDS, and GMA wells of each cell.

In addition to sampling for the approved initial baseline constituents, refined baseline constituents, and the selected common-ion constituents, DOE continued to sample the LCS once a year for the full list of Appendix I (OAC 3745-27-10) and polychlorinated biphenyl (PCB) constituents. A statistical screening process was developed (Figures 2 and 3) to evaluate the results of the continued sampling with the objective of determining if any constituent not already on the alternate parameter list might also be a useful monitoring constituent. The screening process was initially presented in the 2007 Site Environmental Report, and was conducted once a data set of eight samples was available for a cell. The screening process has been conducted for all eight cells, and the results have been reported as follows:

- Cells 1, 2, and 3 reported in the *Fernald Preserve 2007 Site Environmental Report* (DOE 2008b).
- Cells 4 and 5 reported in the *Fernald Preserve 2009 Site Environmental Report* (DOE 2010).

- Cell 6 reported in the *Fernald Preserve 2010 Site Environmental Report* (DOE 2011).
- Cells 7 and 8 reported in the *Fernald Preserve 2011 Site Environmental Report* (DOE 2012).

The assessment process was based on showing statistically that the average LCS concentration was greater than either the pre-design or background average concentration. A constituent with a greater average LCS concentration than either pre-design or background was added to the monitoring list for deeper horizons. The resulting monitoring list contained 24 parameters to be sampled for in all horizons, except the HTW. Beginning in January 2014, sampling frequency was reduced from quarterly to a semiannual sampling frequency.

Monitoring List

Parameter	Source for Selection
Uranium	Refined Baseline
Boron	Refined Baseline
TOC	Refined Baseline
TOX	Refined Baseline
Sulfate	Refined Baseline
Iron	Common Ion Report[a]
Lithium	Common Ion Report[a]
Manganese	Common Ion Report[a]
Sodium	Common Ion Report[a]
Arsenic	Screened in 2007
Cobalt	Screened in 2007
Nickel	Screened in 2007
Selenium	Screened in 2007
TDS[b]	Screened in 2007
Zinc	Screened in 2007
Alkalinity	Screened in 2009
Barium	Screened in 2009
Calcium	Screened in 2009
Chloride	Screened in 2009
Copper	Screened in 2009
Magnesium	Screened in 2009
Nitrate/nitrite	Screened in 2009
Potassium	Screened in 2009
Chromium	Screened in 2011

Notes: Technetium-99 is also sampled in Cell 8 only.
[a] *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008a).
[b] TDS = total dissolved solids.

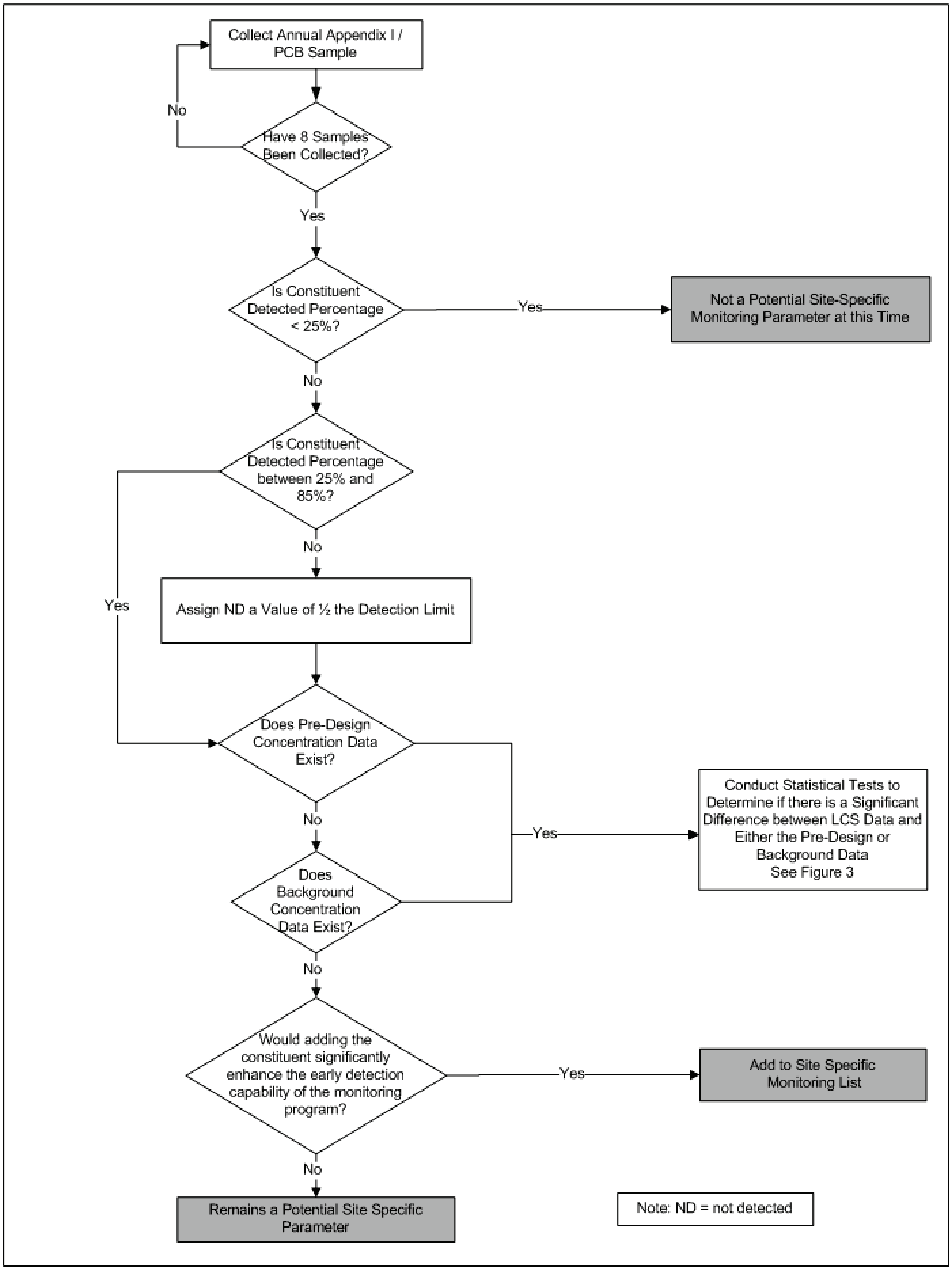

Figure 2. OSDF Site-Specific Leachate Monitoring Parameter Selection Approach

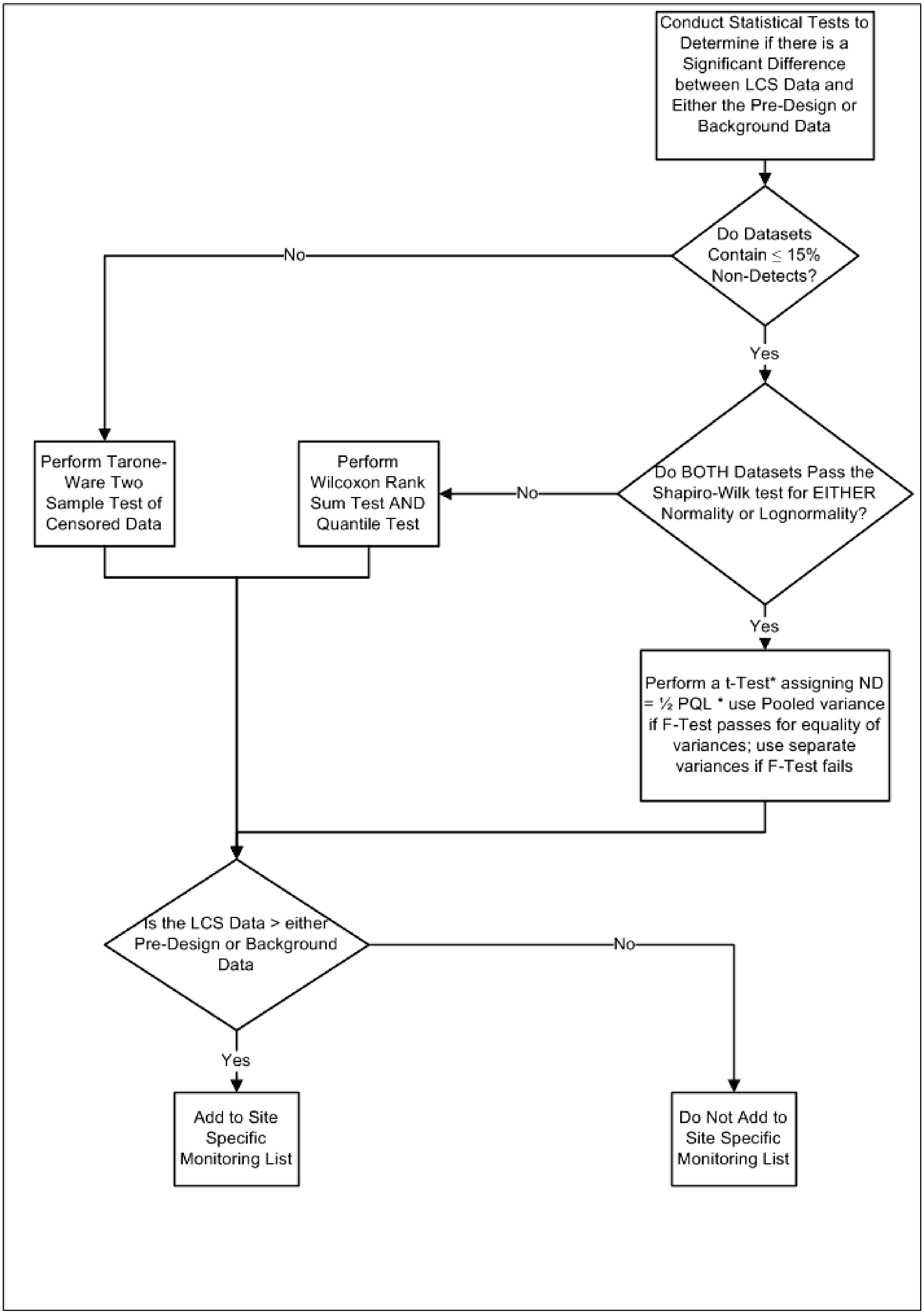

Figure 3. OSDF Site-Specific Leachate Monitoring Parameter Selection Statistical Testing Approach

Even though all eight cells had gone through the parameter selection statistical screening process, annual sampling in the LCS for an agreed to modified Appendix I parameter list continued through December of 2016.

Ohio EPA proposed reducing the list of parameters being sampled in the HTW to just uranium, arsenic, and tritium (beginning in the second quarter of 2011). Sampling for tritium in all horizons was agreed to for a year. Tritium was added to the list of constituents because it was hoped that it might serve as a useful monitoring parameter. Tritium was used in exit signs, which may be in the OSDF with other building materials. Tritium has a relatively short half-life (approximately 12 years) but is fairly mobile and, if present, could be a good potential leak indicator parameter. One year of tritium sampling results indicated that tritium was not a good monitoring parameter for the OSDF. Therefore, tritium is no longer sampled for in any of the monitoring horizons. In addition to sampling the HTWs for uranium and arsenic, DOE also samples for sodium and sulfate in order to prepare bivariate plots. Bivariate plots are useful in illustrating that the chemical signatures of the different monitoring horizons (LCS, LDS, HTW) are separate and distinct.

As a final step to conclude the parameter selection process, DOE obtained the services of a recognized expert in the field of statistics to conduct an independent assessment of the parameter selection process that was used (MacStat Consulting Ltd. 2014). Results of the independent assessment were presented to DOE, EPA, and Ohio EPA on April 15, 2015, at the Fernald site.

The monitoring program was assessed to reduce the potential for false positive or false negative conclusions concerning the interpretation of the data sets. The independent assessment concluded that only 12 of the 24 constituents being monitored provided any value. The 12 parameters identified for elimination either added no value to the monitoring effort or increased the potential for a false positive or negative conclusion based on the statistics being applied to evaluate the data sets. Listed below are the 12 monitoring constituents identified in the assessment as being useful monitoring constituents:

Useful Monitoring Constituents

Total uranium
Boron
TOX
Sulfate
Lithium
Selenium
Total dissolved solids
Calcium
Magnesium
Nitrate + nitrite as nitrogen
Potassium
Technetium-99

On July 22, 2015, Ohio EPA participated in an onsite tour of an OSDF valve house to review the logistics involved in the collection of a water sample from an LDS. Upon inspection of the valve house, Ohio EPA made the following observations:

- Water is not being constantly replenished through the LDS collection tank, and the sample being bailed from the tank is representative of these stagnant conditions.
- A sample degassing potential is present because the low flow prolongs contact of a water sample with the atmosphere.
- Reduction-oxidation (redox) sensitive metals in the water could oxidize from the prolonged contact of the water with the atmosphere. Iron precipitates were observed in the interior of the collection tanks.
- Carbon dioxide could degas from the sample and affect the representativeness of other parameters (e.g., calcium and magnesium). A white precipitate, presumably calcite, was observed on the floor and lower walls of the collection tank.
- Ammonia in the sample could oxidize.

The observations noted above could at times bias analytical results high for certain constituents and other times bias results low for certain constituents. If the LDS dries up completely, no sample can be collected, and no leachate quality determination can be made.

Because of the low flows and the exposure of the sample to the atmosphere, it is uncertain if an LDS sample periodically 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 be the best approach for complying with Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) for the OSDF. As stated in the current *Groundwater/Leak Detection and Leak Detection Monitoring Plan*, monitoring leachate accumulation rates from the LDS (against the Action Leakage Rate and Initial Response Leakage Rate) is a much better approach.

Given the low flows in the LDS, an additional geochemical assessment concerning the continued use of bivariate plots was conducted (Geochemical Consultants 2016). The concern was that the low flow conditions could be impacting the water samples for the constituents being used to prepare the bivariate plots (i.e., uranium, sulfate, and sodium). The assessment concluded that continued use of bivariate plots was recommended.

Based on the final statistical and geochemical assessments discussed above, the following monitoring program will be implemented beginning January 1, 2017.

- Sample the LCS, LDS, and HTW semiannually for uranium, sodium, sulfate, and boron, and continue to use bivariate plots to illustrate chemical differences between the sampling horizons.
- Sample the GMA wells semiannually for the following 13 parameters: total uranium, boron, TOX, sulfate, lithium, selenium, total dissolved solids (TDS), calcium, magnesium, nitrate + nitrite as nitrogen, potassium, technetium-99, and sodium. These are the 12 parameters recommended in (Geochemical Consultants 2016) and sodium. Prepare control charts for the 13 parameters if control chart assumptions are met (i.e., defined distribution, no concentration trend, and no serial correlation) or prepare concentration trend plots if control chart assumptions are not met.

5.0 References

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Attachment D

Integrated Environmental Monitoring Plan

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Contents

Figures

Tables

Abbreviations

ARARs	applicable or relevant and appropriate requirements
ASL	analytical support level
CAWWT	Converted Advanced Wastewater Treatment Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CMT	continuous multichannel tubing
COC	contaminant of concern
DOE	U.S. Department of Energy
DOECAP	U.S. Department of Energy Consolidated Audit Program
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facility Compliance Agreement
FPQAPP	Fernald Preserve Quality Assurance Project Plan
FRL	final remediation level
GEMS	Geospatial Environmental Mapping System
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
IEMP	Integrated Environmental Monitoring Plan
LM	Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
µg/L	micrograms per liter
µm	micrometers
mrem/yr	millirem per year
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
Ohio EPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan for Aquifer Restoration and Wastewater Treatment
OSDF	On-Site Disposal Facility
OU	operable unit
PRRS	Paddys Run Road Site
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SER	Site Environmental Report

1.0 Introduction

The Integrated Environmental Monitoring Plan (IEMP) is the mechanism to assess the continued protectiveness of the remedial actions and comply with applicable U.S. Department of Energy (DOE) orders and environmental regulations. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted during remedy implementation and, ultimately, following the cessation of remedial operations. The IEMP will delineate the Fernald Preserve's responsibilities for sitewide monitoring of surface water over the life of the remedy and ensure that final remediation levels (FRLs) are achieved at project completion. The IEMP will also serve as the primary vehicle for determining (to the satisfaction of the U.S. Environmental Protection Agency [EPA] and Ohio Environmental Protection Agency [Ohio EPA]) that remedial action objectives for the Great Miami Aquifer are being attained.

1.1 Background

The DOE Office of Legacy Management (LM) Fernald Preserve completed its remedial investigation/feasibility study obligations, and the final Records of Decision (RODs) for all five Fernald Preserve operable units (OUs) are in place. In 1997, in recognition of the increased focus on remedy implementation, DOE developed an integrated environmental monitoring strategy tailored to these cleanup actions. Between 1997 and 2006, the site's focus was on the safe and efficient execution of site remediation, including facility decontamination and dismantling, the design and construction of waste processing and disposal facilities, waste excavation and shipping, and the continuation of groundwater remediation.

Near the end of 2006, Declaration of Physical Completion (i.e., closure) was achieved. The On-Site Disposal Facility (OSDF) was closed, the final cap was installed, and all site cleanup activities were completed, with the exception of the ongoing remediation of the Great Miami Aquifer. Even though the site met the closure criteria, the integrated environmental monitoring strategy will continue to ensure that environmental monitoring and reporting for all site media, including remedy performance monitoring, is a coordinated effort.

The basis for the current understanding of environmental conditions at the Fernald Preserve is the extensive site environmental data that have been collected. The data were collected over a 10-year period through the remedial investigation process required under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, combined with routine environmental monitoring data collected through the IEMP. Analysis of the remedial investigation data resulted in the selection of a final remedy for the Fernald Preserve's environmental media, with the issuance of the *Record of Decision for Remedial Actions at Operable Unit 5* (OU5 ROD) (DOE 1996b) in January of 1996. OU5 includes all environmental media, contaminant transport pathways, and environmental receptors (soil, groundwater, surface water, sediment, air, and biota) at and around the Fernald Preserve that have been affected by past uranium production operations. The remedy for OU5 defines final sitewide cleanup levels and establishes the general areal extent of on- and off-property actions necessary to mitigate the environmental effects of site production activities.

The IEMP is a formal remedial design deliverable required to fulfill Task 9 of the *Remedial Design Work Plan for Remedial Actions at Operable Unit 5* (DOE 1996c) and is an enforceable portion of the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP). The revision to the IEMP provides an update to the original IEMP (approved in August of 1997) as required by the Remedial Design Work Plan (DOE 2008b).

1.2 Program Objectives and Scope

As post-closure and continued cleanup activities are conducted, the need for accurate, accessible, and manageable environmental monitoring information continues to be essential. The IEMP has been formulated to meet this need and will serve several comprehensive functions for the site by:

- Maintaining the commitment to a remediation-focused environmental surveillance monitoring program that is consistent with DOE Order 458.1 Admin Chg 3, *Radiation Protection of the Public and the Environment,* and that continues to address stakeholder concerns. The order is listed as "to be considered" criteria in the OU5 ROD and is, therefore, a key driver for the scope of the monitoring program.
- Fulfilling additional sitewide monitoring and reporting requirements activated by the CERCLA applicable or relevant and appropriate requirements (ARARs) for the OU5 ROD, including determining when environmental restoration activities are complete and cleanup standards have been achieved.
- Providing the mechanism for assessing the performance of the Great Miami Aquifer groundwater remedy, including determining when restoration activities are complete.
- Providing a reporting mechanism for many environmental regulatory compliance-monitoring activities. These may include OSDF groundwater monitoring, Federal Facility Compliance Agreement (FFCA) requirements, and elements of the National Pollutant Discharge Elimination System (NPDES) discharge reporting.
- Providing a reporting interface for project-specific monitoring (i.e., OSDF), which is conducted under a separate attachment to the LMICP (Attachment C, "Groundwater/Leak Detection and Leachate Monitoring Plan").

Under the IEMP, data showing the environmental conditions at the Fernald Preserve are collected, maintained, and evaluated. Performance monitoring results associated with the Fernald Preserve are also evaluated and compared against established thresholds. DOE fulfills its obligation to document environmental monitoring information under the umbrella of the annual Site Environmental Report (SER).

The boundary conditions defined in the IEMP are as follows:

- The administrative boundary lies between remedial actions for groundwater south of the Fernald Preserve and those potential remedial actions associated with the Paddys Run Road Site (PRRS) plume. This boundary is shown in the *Feasibility Study Report for Operable Unit 5* (DOE 1995a) and the *Final Operable Unit 5 Proposed Plan* (DOE 1995c).
- The programmatic boundary refers to the differentiation between the scope and responsibility associated with the design, implementation, and documentation. OSDF monitoring activities are designated as project-specific monitoring. The designation is based on an evaluation of the pertinent regulatory drivers and DOE requirements that have monitoring implications.

The IEMP monitoring programs measure the collective environmental impacts resulting from continued Fernald Preserve cleanup and monitoring activities.

1.3 Plan Organization

The IEMP is composed of six sections and one appendix. The remaining sections and their contents are as follows:

- Section 2.0—Fernald Preserve Post-Closure Strategy: Provides an overview of the post-closure monitoring strategy and a description of the post-closure organization.
- Section 3.0—Groundwater Monitoring Program: Provides a description of the monitoring activities necessary to track the progress of the restoration of the Great Miami Aquifer; discusses the groundwater monitoring activities necessary to maintain compliance with Resource Conservation and Recovery Act (RCRA) requirements as specified in the Ohio EPA Director's Findings and Orders dated September 2000; and provides a description of the integration with the groundwater monitoring for the OSDF.
- Section 4.0—Surface Water and Treated Effluent Monitoring Program: Provides a description of the routine sitewide surface water monitoring required to maintain compliance with surface water and treated effluent discharge requirements.
- Section 5.0—Dose Assessment Program: Provides a historical summary of the external radiation monitoring and dose calculations required to maintain compliance with DOE Order 458.1.
- Section 6.0—Program Reporting: Provides a detailed accounting of the reporting elements included within the IEMP reporting framework.

The IEMP is organized according to the principal environmental media and contaminant migration pathways routinely examined under the program. For each of the media constituting the program, evaluations of the regulatory drivers and pertinent DOE requirements that govern environmental monitoring were conducted. The details and results of this evaluation are presented in Sections 3.0 and 4.0. Prior to 2023, the Natural Resource Monitoring Plan was included as Appendix A of the IEMP. Beginning in 2023, this information is provided in Volume I as Appendix A and in Volume II.

1.3.1 Plan Implementation

A multidiscipline organization has been established to effectively implement and manage planning, sample collection and analysis, and data management activities directed in each medium-specific section. The key positions and associated responsibilities required for successful implementation are as follows:

- The environmental team leader will have full responsibility and authority for the implementation of the medium-specific plan in compliance with all regulatory specifications and sitewide programmatic requirements. Integration and coordination of all medium-specific plan activities defined in this IEMP with other project groups is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.

- Safety and health are the responsibility of all individuals working on this project scope. Qualified Safety and Health personnel shall participate on the project team to assist in preparing and obtaining all applicable permits. In addition, safety specialists shall periodically review and update the specific safety and health documents and operating procedures, conduct pertinent safety briefings, and assist in evaluating and resolving all safety concerns.
- Quality Assurance personnel will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the *Fernald Preserve Quality Assurance Project Plan* (DOE 2014a) (FPQAPP) or other referenced standard and assist in evaluating and resolving all quality-related concerns.
- Environmental Compliance shall participate on the project team to assist in preparing and obtaining all applicable environmental permits. In addition, Environmental Compliance shall periodically review and update the specific environment compliance documents and operating procedures, and assist in evaluating and resolving all environmental concerns.

1.3.2 Plan Change Control

Changes to the medium-specific plan will be at the discretion of the project team leader. Prior to implementation of field changes, the project team leader or designee shall be informed of the proposed changes and circumstances substantiating the changes. Any changes to the medium-specific plan must have written approval by the project team leader or designee, Quality Assurance representative, Environmental Compliance representative, and the field manager prior to implementation. If a variance is required, it will be completed in accordance with the FPQAPP. The variance form shall be issued as controlled distribution to team members and will be included in the field data package to become part of the project record. During revisions to the IEMP, variances will be incorporated in the medium-specific sections.

If a change significantly affects the scope of the plan, approval would be requested through EPA and Ohio EPA. Afterward, a variance that documents the change and the justification for the change will be provided to EPA and Ohio EPA.

1.3.3 Safety and Health Considerations

The Fernald Preserve's Safety and Health personnel are responsible for the development and implementation of safety and health requirements for all medium-specific plans. Hazards (physical, radiological, chemical, and biological) typically encountered by personnel when performing the specified fieldwork will be addressed during team briefings. All involved personnel will receive adequate training in the safety and health requirements prior to implementation of the fieldwork required by this medium-specific plan. Safety and health requirements have been incorporated into *Fernald Preserve and Mound, Ohio, Sites Environmental Monitoring Procedures* (DOE 2021a) and job safety analyses.

1.3.4 Data Management

Specific requirements for field and laboratory data documentation and validation are established to meet the IEMP data reporting and quality objectives and comply with the FPQAPP.

Data documentation and validation requirements for data collected for the IEMP fall into two categories, depending upon whether the data are field- or laboratory-generated. Field documentation review will consist of verifying medium-specific plan compliance and appropriate documentation of field activities. Laboratory data validation will consist of verifying that data generated are in compliance with medium-specific, plan-specified analytical support levels (ASLs).

Four ASLs (ASL A through ASL D) are defined for use at the Fernald Preserve. For groundwater, sediment, and surface water, field data documentation will be at ASL A, and laboratory data documentation will be at ASL D, except for NPDES constituents carbonaceous biochemical oxygen demand, total hardness, total phosphorus, total dissolved solids, and total suspended solids, which will be ASL C. Laboratory data validation will consist of verifying that data generated are in compliance with specified ASL D. ASL D provides quantitative data with some quality assurance/quality control checks.

Data will be entered into a controlled database using a verification method to ensure accuracy. The data will be managed in the project file in accordance with LM record-keeping requirements and DOE orders.

1.3.5 Quality Assurance

Assessments of work processes shall be conducted to verify quality of performance and may include audits, surveillances, inspections, tests, data verification, field validation, and peer reviews. Assessments shall include performance-based evaluation of compliance with technical and procedural requirements and corrective action effectiveness necessary to prevent defects in data quality. Assessments may be conducted at any point in the life of the project. Assessment documentation shall verify that work was conducted in accordance with IEMP and FPQAPP requirements.

Recommended annual quality assurance assessments or surveillances shall be performed on tasks specified in the medium-specific plan. These assessments may be in the form of independent assessments or self-assessments, with at least one independent assessment conducted annually. Independent assessments are the responsibility of Quality Assurance personnel. The project team leader and Quality Assurance personnel will coordinate assessment activities and comply with the FPQAPP. The project or Quality Assurance personnel shall have "stop work" authority if significant adverse effects to quality conditions are identified or work conditions are unsafe.

1.4 Role of the IEMP in Remedial Action Decision Making

The IEMP is the mechanism to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted during remedy implementation and, ultimately, following the cessation of remedial operations. The IEMP will delineate the Fernald Preserve's responsibilities for sitewide monitoring of surface water over the life of the remedy and ensure that FRLs are achieved at project completion. The IEMP will also serve as the primary vehicle for determining (with concurrence from EPA and Ohio EPA) that remedial action objectives for the Great Miami Aquifer are being attained.

Subject matter experts are responsible for the ongoing review of media-specific monitoring data and the identification of any related environmental compliance issues. If the potential for an unacceptable future situation is identified, then options for addressing the problem will be identified. The options will be assessed with respect to their implications, and the results of the evaluations will be communicated as necessary to the Fernald Preserve's stakeholders, EPA, and Ohio EPA.

The medium-specific sections of this plan (Sections 3.0 through 4.0) identify monitoring requirements and ARARs for each environmental medium with the applicable compliance locations. Additionally, the medium-specific sections define the criteria to be used to identify trends in the data that could indicate an imminent unacceptable situation. Each of the medium-specific sections specifies the frequency of the data evaluations to satisfy the Fernald Preserve's overall planning and decision-making requirements. DOE will evaluate the data accordingly and will report the results according to the approach summarized below.

Each medium section of this IEMP presents medium-specific reporting components, and Section 5.0 summarizes the overall reporting strategy for the IEMP. The annual SERs will be furnished to EPA and Ohio EPA in accordance with the provisions summarized in Section 5.0. The SERs will also be available for review by the Fernald Preserve's stakeholders at the Fernald Preserve Visitors Center and to selected stakeholders via mail.

2.0 Fernald Preserve Post-Closure Strategy

This section presents a description of the Fernald Preserve's post-closure strategy and organizational structure associated with post-closure activities, which includes the continuing OU5 (i.e., environmental media) remediation and monitoring efforts. The post-closure organizational structure is less complex than previous Fernald organizations. Adequate staff will remain at the site to continue to meet regulatory and OU5 commitments.

The Fernald Preserve's post-closure strategy reflects the completion of the majority of CERCLA activities at the site. There have been extensive site characterization activities to determine the nature and extent of contamination, baseline risk assessments, and detailed evaluation and screening of remedial alternatives leading to a final remedy selection as documented in the ROD for each OU. The majority of all OU remediation activities were completed in 2006. The remaining OU with continuing remediation efforts is OU5. Table 1 provides a summary of the OU5 remedy overview.

Active remediation of the Great Miami Aquifer will continue during the post-closure period. Additionally, surface water surveillance monitoring (including NPDES monitoring) and natural resources restoration activities continue.

In 2006, the contaminant sources at the Fernald Preserve were removed. Soil and on-property sediments were certified, with the exception of those areas indicated in Figure 1. Great Miami Aquifer restoration activities continue after closure as do surveillance monitoring for surface water. Natural resource restoration activities also continue after closure. Monitoring associated with the IEMP is mainly associated with these activities. Figure 2 shows the current site configuration.

Table 1. OU5 Remedy Overview

OU	Description	Remedy Overview
OU5	Environmental Media • Groundwater • Surface water and sediments (on-property sediment cleanup completed) • Soil not included in the definitions of OU1 through OU4 (cleanup completed with the exception of those areas identified in Figure 1) • Flora and fauna	ROD Approved: January 1996 An Explanation of Significant Differences document 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. Continued 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. Continued site restoration maintenance, institutional controls, and post-remediation maintenance. Completion of excavation of contaminated soil and sediment to meet FRLs. Excavation of contaminated soil containing perched water that presents an unacceptable threat, through contaminant migration, to the underlying aquifer. Completion of onsite disposal of contaminated soil and sediment that met the OSDF waste acceptance criteria. Soil and sediment that exceeded the waste acceptance criteria for the OSDF were treated, when possible, to meet the OSDF waste acceptance criteria or were disposed of at an offsite facility.

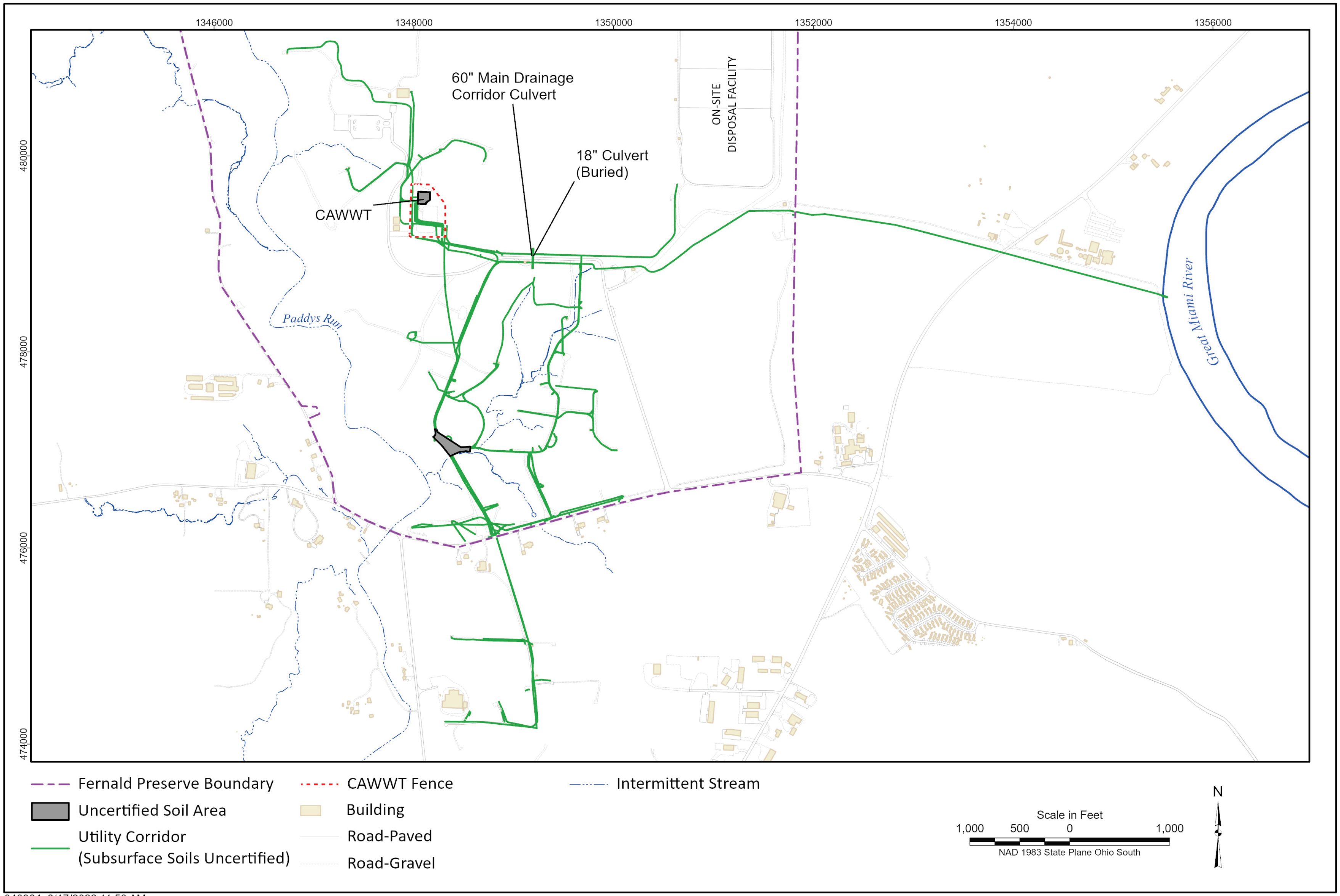

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Figure 1. Uncertified Areas and Subgrade Utility Corridors

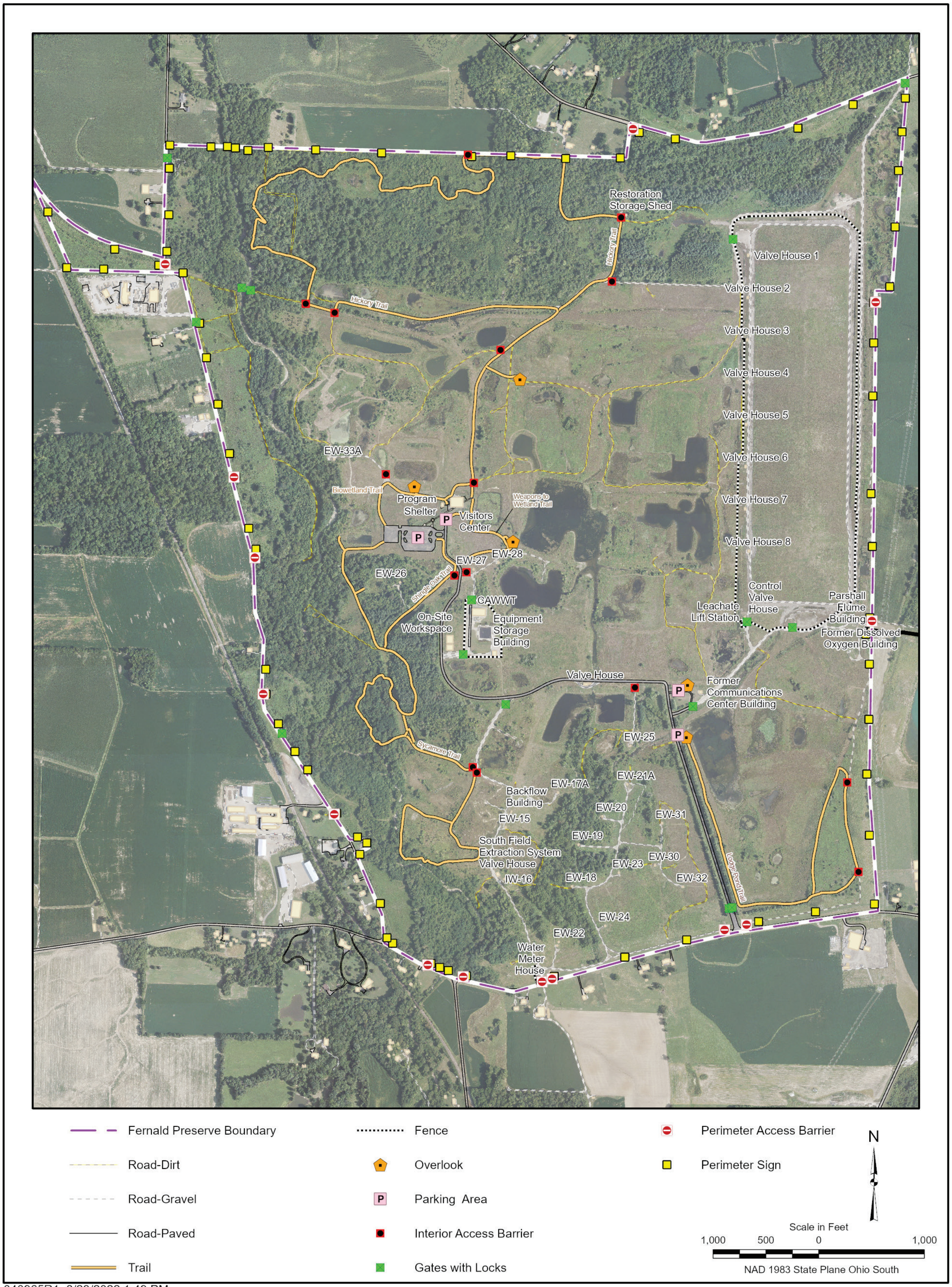

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Figure 2. Fernald Preserve Site Configuration

3.0 Groundwater Monitoring Program

Section 3.0 presents the monitoring strategy for tracking the progress of the restoration of the Great Miami Aquifer and satisfying the site-specific commitments related to groundwater monitoring. A medium-specific plan for conducting all groundwater monitoring activities is provided. Program expectations are outlined in Section 3.4, and the program design is presented in Section 3.5.

3.1 Integration Objectives for Groundwater

The IEMP serves to integrate several former compliance-based groundwater monitoring or protection programs under a single reporting structure to facilitate regulatory agency review of the progress of the OU5 groundwater remedy, including:

- Ohio EPA Director's Findings and Orders (Ohio EPA 2000) for property boundary groundwater monitoring to satisfy RCRA facility groundwater monitoring requirements.
- Private well sampling.
- Groundwater protection management program plan.

The IEMP also serves to integrate requirements of the *Fernald Groundwater Certification Plan* (DOE 2006), which defines a programmatic strategy for certifying the completion of the aquifer remedy.

Remediation of the Great Miami Aquifer is being conducted using pump-and-treat technology, and it is progressing toward certification through a six-stage process:

Stage I: Pump-and-Treat Operations
Stage II: Post–Pump-and-Treat Operations/Hydraulic Equilibrium State
Stage III: Certification/Attainment Monitoring
Stage IV: Declaration and Transition Monitoring
Stage V: Demobilization
Stage VI: Long-Term Monitoring

The groundwater sampling specified in the IEMP tracks the performance of the aquifer remedy. The IEMP is the controlling document for groundwater remedy performance monitoring and is currently focused on groundwater monitoring to support Stage I (Pump-and-Treat Operations). Groundwater monitoring requirements for Stages II through VI of the groundwater certification process will be defined in future revisions of the IEMP. The following is a brief description of the certification stages listed above.

Stage I—Pump-and-Treat Operations

The aquifer remedy is currently in Stage I. The principal contaminant of concern is uranium. Groundwater is being pumped from contaminated portions of the aquifer and treated for uranium as needed.

Remediation of the aquifer (operations and monitoring) is organized around three groundwater restoration modules:

- The South Plume Module
- The South Field (Phases I and II) Module
- The Waste Storage Area (Phases I and II) Module

Figure 3 identifies the locations of these modules.

Pump-and-treat operations will continue for each groundwater module until FRLs in the aquifer have been achieved or until the mass removal efficiency of the extraction system has decreased such that it is apparent that groundwater FRLs will not be achieved.

The controlling document for the operation of the pump-and-treat system is the "Operations and Maintenance Master Plan for Aquifer Restoration and Wastewater Treatment" (OMMP) (Attachment A). Ultimately, the IEMP will be used to document the approach to determine when the various modules complete pump-and-treat operations. Monitoring requirements needed to support later stages of the certification strategy will be incorporated into future revisions of the IEMP when deemed appropriate.

Stage II—Post–Pump-and-Treat Operations/Hydraulic Equilibrium State

Stage II monitoring will begin on a module-specific basis when pump-and-treat operations have stopped. The objective will be to document that the aquifer has readjusted to steady-state nonpumping conditions prior to proceeding to Stage III (Certification/Attainment Monitoring). During Stage II, groundwater levels will be routinely measured to document that steady-state water level conditions have been achieved. Concentrations of groundwater FRL constituents will also be routinely measured. If uranium concentrations rebound to levels above the groundwater FRL during the steady-state assessment, then pumping operations would resume. If uranium concentrations remain below the groundwater FRL during the steady-state assessment and do not appear to be trending up toward the groundwater FRL, then the certification process will proceed to Stage III (Certification/Attainment Monitoring). Stage II monitoring is estimated to take approximately 3 months.

Stage III—Certification/Attainment Monitoring

Certification/attainment monitoring will also be module specific. Data collected during Stage III will be used to document that remediation goals have been met and that the goals will continue to be maintained in the future. Statistical tests will be used to predict the long-term ability to stay below FRLs.

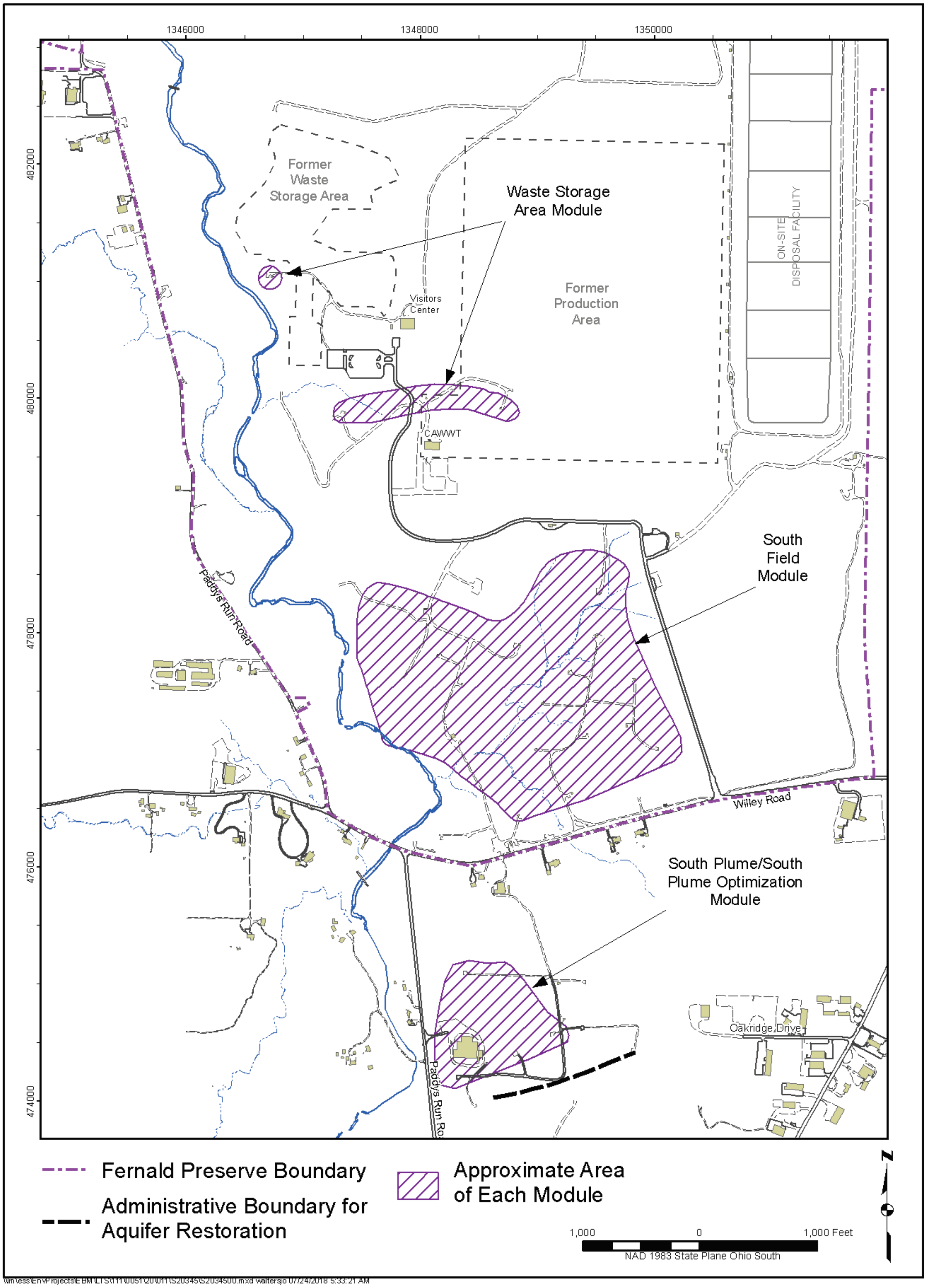

Figure 3. Location of Aquifer Restoration Modules

Stage IV—Declaration and Transition Monitoring

Because certification is being approached on a module-specific basis, efforts need to be taken to ensure that upgradient plumes do not migrate into and re-contaminate downgradient areas where remediation goals have been achieved. A few monitoring wells will be positioned at the upgradient edge of the clean areas and will be monitored to document that the upgradient plume is not impacting the clean area. It is estimated that Stage IV monitoring could be conducted for as long as 13 years, essentially the time when the groundwater model predicts that cleanup goals will be achieved in the South Plume Module versus the Waste Storage Area Module.

Stage V—Demobilization

Stage V identifies that all structures, trailers, liners, pipes (except the outfall line), and utilities dedicated for aquifer restoration and wastewater treatment will need to be properly decontaminated and dismantled in order to be protective of the environment. With the exception of the water treatment facility, the decontamination and dismantling of infrastructure will not take place until the entire aquifer has been certified clean. This will provide the means to reinitiate pumping in any area of the aquifer that may require additional pumping prior to achieving final certification.

Stage VI—Long-Term Monitoring

Long-term monitoring will be conducted in former source areas after the last groundwater module is certified clean. If the water table rises to an elevation that exceeds what was previously recorded for a former source area, then groundwater monitoring beneath the former source area will be initiated to determine if any new sources have dissolved into the groundwater.

3.2 Summary of Regulatory Drivers, DOE Requirements, and Other Fernald Preserve–Specific Agreements

This section presents a summary evaluation of the regulatory-based requirements and policies governing the monitoring of the Great Miami Aquifer. The intent of the section is to identify the pertinent regulatory drivers, including ARARs and to-be-considered requirements, for the scope and design of the Great Miami Aquifer groundwater monitoring system. These requirements are used to confirm that the program design satisfies the regulatory obligations for monitoring that have been activated by the OU5 ROD and to achieve the intentions of other pertinent criteria, such as DOE orders and the Fernald Preserve's existing agreements that have a bearing on the scope of groundwater monitoring.

3.2.1 Approach

The analysis of the regulatory drivers and requirements for groundwater monitoring was conducted by examining the suite of ARARs and to-be-considered requirements in the five approved CERCLA OU RODs to identify the subset with specific groundwater monitoring requirements. The Fernald Preserve's existing compliance agreements issued outside the CERCLA process were also reviewed.

3.2.2 Results

The following regulatory drivers, compliance agreements, and DOE requirements govern the monitoring scope and reporting requirements for remedy performance monitoring and general surveillance of the protectiveness of the Great Miami Aquifer groundwater remedy.

- The CERCLA ROD for remedial actions at OU5 requires the extraction and treatment of Great Miami Aquifer groundwater above FRLs until the full, beneficial use potential of the aquifer is achieved, including use as a drinking water source. The FRLs are established by considering chemical-specific ARARs, hazard indices, and background and detection limits for each contaminant. Many Great Miami Aquifer FRLs are based on established or proposed Safe Drinking Water Act maximum contaminant levels, which are ARARs for groundwater remediation. For Fernald Preserve-related contaminants that do not have an established maximum contaminant level under the Safe Drinking Water Act, a concentration equivalent to an incremental lifetime cancer risk of 10^{-5} for carcinogens or a hazard quotient of 1 for noncarcinogens was used as the FRL, unless background concentrations or detection limits are such that health-based limits could not be attained. In these cases the background or detection limit became the FRL. The FRLs will be tracked throughout all affected areas of the aquifer and will be the basis for determining when the Great Miami Aquifer restoration objectives have been met. By definition, the OU5 ROD incorporates the requirements of the Fernald Preserve's existing CERCLA South Plume Removal Action, which was the regulatory driver for the former *South Plume Groundwater Recovery System Design, Monitoring, and Evaluation Program Plan* (DOE 1993).
- According to the *CERCLA Remedial Design Work Plan* (DOE 1996a) for remedial actions at OU5, monitoring will be conducted following the completion of cleanup as required to assess the continued protectiveness of the remedial actions. The IEMP will specify the type and frequency of environmental monitoring activities to be conducted during remedy implementation and, ultimately, following the cessation of remedial operations. The IEMP will delineate the Fernald Preserve's responsibilities for sitewide monitoring over the life of the remedy and ensure that FRLs are achieved at project completion. The IEMP will also serve as the primary vehicle for determining to EPA and Ohio EPA's satisfaction that remedial action objectives for the Great Miami Aquifer have been attained.
- The September 10, 1993, Ohio EPA Director's Final Findings and Orders required groundwater monitoring at the Fernald Preserve's property boundary to satisfy RCRA facility groundwater monitoring requirements (Ohio EPA 1993). The 1993 Final Findings and Orders were superseded by the September 7, 2000, Director's Final Findings and Orders (Ohio EPA 2000). The September 7, 2000, order 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.
- DOE Order 450.1A, *Environmental Protection Program*, established the requirement for a groundwater protection management program plan for DOE facilities. The required informational elements of the plan are fulfilled by the *Remedial Investigation Report for Operable Unit 5* (DOE 1995e) and the *Feasibility Study Report for Operable Unit 5* (DOE 1995a). The groundwater monitoring program requirement was being fulfilled by the IEMP. DOE Order 450.1A was replaced by DOE Order 458.1, *Radiation Protection of the Public and the Environment.*

- DOE Order 458.1, Admin Chg 4. *Radiation Protection of the Public and the Environment,* establishes radiological dose limits and guidelines for the protection of the public and environment. Demonstration of compliance with these limits and guidelines for radiological dose is based on calculations that make use of information obtained from the Fernald Preserve's monitoring and surveillance program. This program is based on guidance in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991). The Fernald Preserve's private well sampling program for the Great Miami Aquifer (which was previously in the *Fernald Site Environmental Monitoring Plan* [DOE 1995b]) is conducted to satisfy the intention of this DOE order with respect to groundwater. While most private well water users in the affected area are now provided with a public water supply, a limited private well sampling activity will be maintained to supplement the groundwater monitoring network provided by monitoring wells. Because a public water supply is now available, a dose assessment is no longer required.
- The 1986 Federal Facilities Compliance Agreement requires that the Fernald Preserve maintain a sampling program for daily flow and uranium concentration of discharges to the Great Miami River and report the results quarterly to the EPA, Ohio EPA, and 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 in early 1996 with modifications documented in IEMP revisions. For groundwater, this agreement is specifically related to the South Plume well field to quantify the amount of uranium removed and total volume of groundwater extracted.

The groundwater monitoring plan provided in this IEMP has been developed with full consideration of the regulatory drivers described above. Each of these drivers, and the associated monitoring conducted to comply with these drivers, is listed in Table 2. Sections 3.7 and 5.0 outline the current and long-range plan for complying with the reporting requirements contained in the IEMP drivers.

Table 2. Fernald Preserve Groundwater Monitoring Regulatory Drivers and Responsibilities

	Driver	Action
IEMP	CERCLA ROD for OU5	The IEMP describes routine monitoring to ensure remedy performance and to evaluate impacts of remediation activities to the Great Miami Aquifer. The IEMP will be modified toward completion of the remedial action to include a sampling plan to certify achievement of the FRLs.
	Ohio EPA Director's Final Findings and Orders; RCRA/Hazardous Waste Facility Groundwater Monitoring	The IEMP describes routine monitoring at wells located at the property boundary to ensure remedy performance and to evaluate impacts of remediation activities to the Great Miami Aquifer.
	DOE Manual 435.1, which refers to DOE Order 5400.5 DOE Order 5400.5 has been replaced by DOE Order 458.1	The IEMP describes routine monitoring to ensure remedy performance of the Great Miami Aquifer.
	Federal Facilities Compliance Agreement, Radiological Monitoring	The IEMP describes the routine sampling and reporting of well field performance in terms of the total volume extracted and the amount of uranium removed.

3.3 Groundwater Monitoring Administrative Boundaries

As described in the remedial investigation report for OU5 (refer to Section 4.8.2), the PRRS consists of two facilities: Potash Corporation (formerly Albright and Wilson Americas Inc.) and Nease Chemical Company Inc. (Nease). Potash Corporation occupies the northern portion of the site and manufactures phosphate compounds. Nease manufactures aromatic sulfonated compounds and occupies the southern portion of the site.

The PRRS Remedial Investigation Report released in September 1992 documented releases to the Great Miami Aquifer of inorganic constituents, volatile organic compounds, and semivolatile organic compounds. The *Proposed Plan for OU5* (DOE 1995d) acknowledged that DOE's role and involvement, if any, in Ohio EPA's ongoing assessment and cleanup of the PRRS plume would be defined separately as part of the PRRS response obligations and in accordance with the PRRS project schedule. Groundwater monitoring will continue south of the Administrative Boundary until certification of the off-property South Plume is complete. This monitoring will assess the nature of the greater than or equal to 30 micrograms per liter (µg/L)-total uranium plume south of the Administrative Boundary and the impact that pumping of the South Plume extraction wells has on the PRRS plume.

3.4 Program Expectations and Design Considerations

3.4.1 Program Expectations

The IEMP groundwater monitoring program is designed to provide a comprehensive monitoring network that will track remedial well-field operations and assess aquifer conditions. The expectations of the monitoring program are to:

- Provide groundwater data to assess the capture and restoration of the greater than or equal to 30-µg/L total uranium plume.
- Provide groundwater data to assess the capture and restoration of non-uranium FRL constituents.
- Provide groundwater data to assess groundwater quality at the downgradient Fernald Preserve property boundary and offsite at the leading edge of the 30-µg/L total uranium plume.
- Provide groundwater data that are sufficient to assess how reasonable model predictions are over the long term.
- Provide groundwater data to assess the impact that the aquifer restoration is having on the PRRS plume.
- Continue to address concerns of the community regarding the progress of the aquifer restoration.

3.4.2 Design Considerations

3.4.2.1 Background

The Great Miami Aquifer is contaminated with uranium and other constituents from historical operations at the Fernald Site. An evaluation of the nature and extent of contamination in the Great Miami Aquifer can be found in the *Remedial Investigation Report for Operable Unit 5*. Uranium is the principal constituent of concern (COC).

Figure 4 shows the maximum total uranium plume map (30 µg/L uranium or higher) as of the second half of 2021. These maps represent a compilation of several different monitoring depths within the aquifer, and they illustrate the maximum lateral extent interpretation of the plume at all depths. The top of the plume is usually situated at the water table. In some regions of the aquifer, however, the top of the plume is situated below the water table. More detailed presentations of the geometry of the uranium plume can be found in Appendix G of the *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)* (DOE 1997a); the *Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2000); the *Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module* (DOE 2002b), the *Waste Storage Area (Phase II) Design Report* (DOE 2005b), and *Operational Design Adjustments-1 WSA Phase-II Groundwater Remediation Design Fernald Preserve* (DOE 2014b).

The primary sources of contamination that contributed to the present geometry of the uranium plume include (1) the former waste pits that were present in the waste storage area, (2) the former inactive fly ash pile that was present in the South Field area, (3) former production activities, and (4) the previously uncontrolled surface water runoff from the former production area that had direct access to the aquifer through a former drainage originating near the former Plant 1 pad and flowing west through the former waste storage area and the Pilot Plant drainage ditch.

A groundwater remediation strategy that relies on pump-and-treat technology is being used to conduct a concentration-based cleanup of the Great Miami Aquifer. The restoration strategy focuses primarily on the removal of uranium, but it has also been designed to limit the further expansion of the plume, remove targeted contaminants to concentrations below designated FRLs, and prevent undesirable drawdown impacts beyond the Fernald Preserve.

The OU5 ROD establishes that "areas of the Great Miami Aquifer exceeding FRLs will be restored through extraction methods." The aquifer's "target certification footprint" is a term used to define those areas of the aquifer targeted for remediation.

The target certification footprint is conservatively defined as the areas contained within a composite of all previous 20-µg/L maximum uranium plume interpretations through 2000, and 30-µg/L maximum uranium plume interpretations subsequent to 2000, located north of the Administrative Boundary for aquifer restoration. The target certification footprint of the aquifer (updated through 2021) is shown in Figure 5. If warranted, the interpretation will be updated each year in the SER as new data are collected.

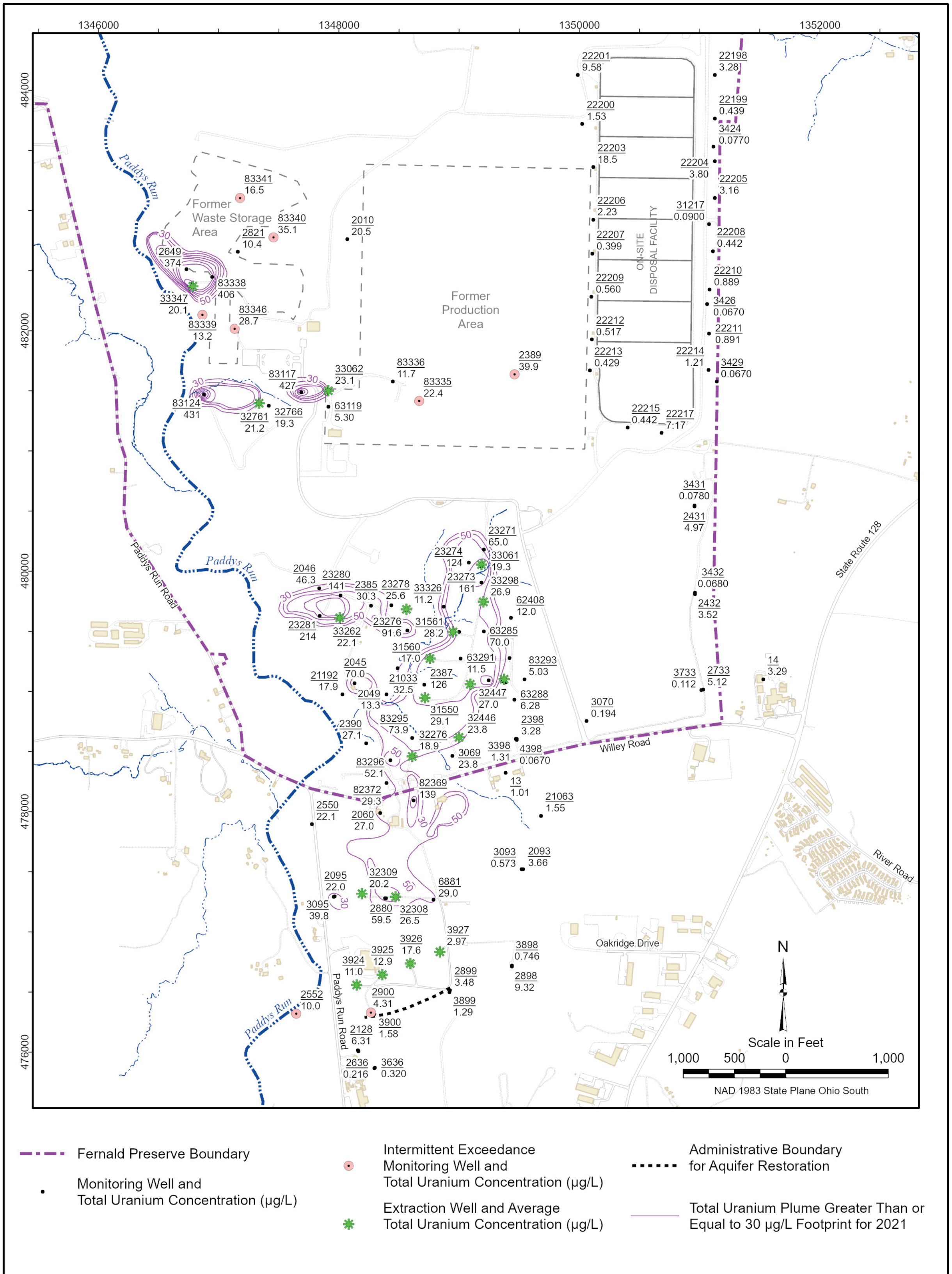

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Figure 4. Monitoring Well Data and Maximum Total Uranium Plume Through the Second Half of 2021

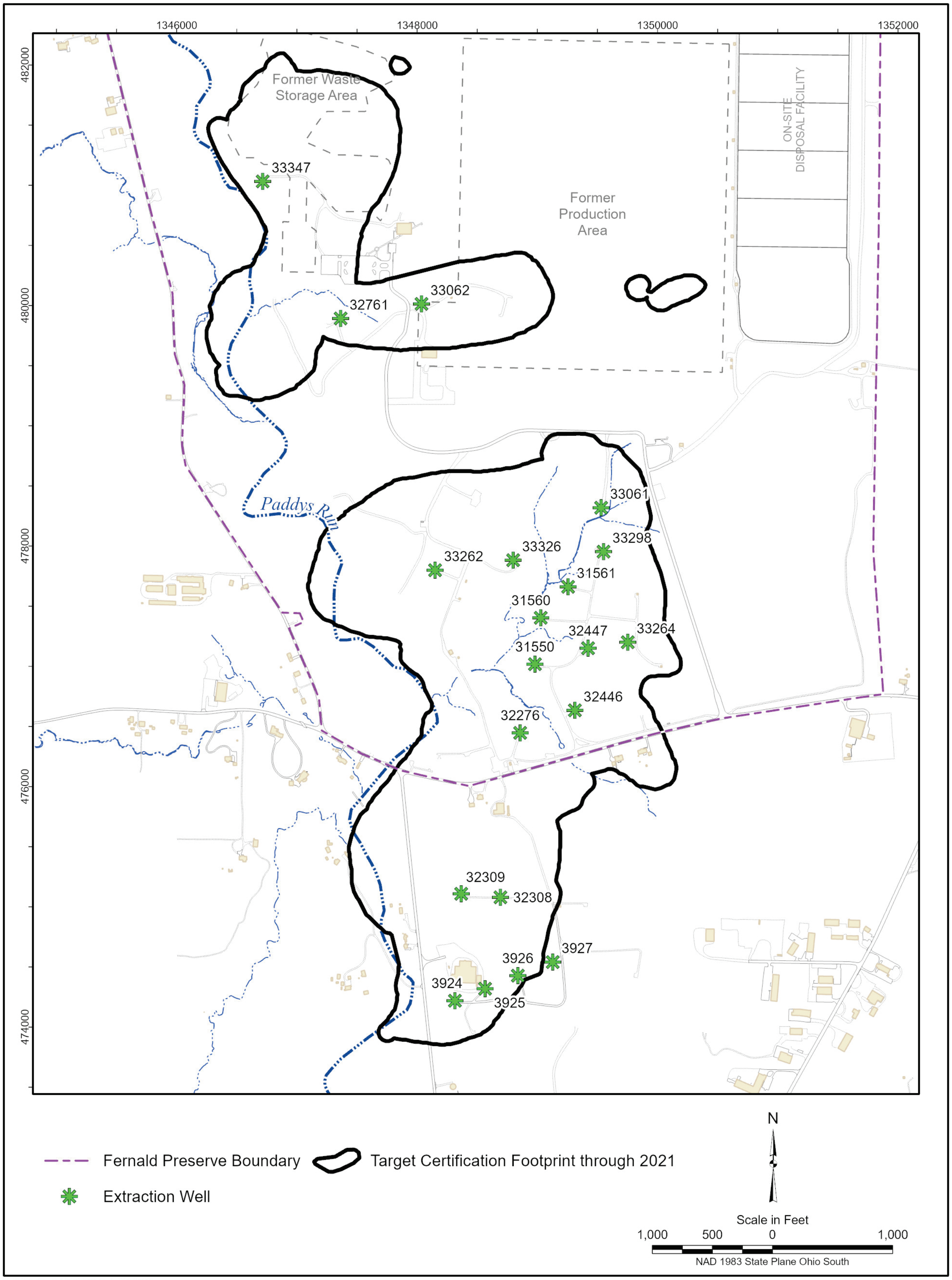

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Figure 5. Extraction Well Locations

Pumping groundwater from the aquifer prior to the start of the actual groundwater remediation began in August 1993 with the startup of five extraction wells in the South Plume. The wells were installed and operated as part of a removal action to prevent further southern migration of the uranium plume while the remedial investigation of the plume was being completed and a remediation system was being designed.

The design of the aquifer remediation system has evolved via the issuance of several different design documents:

- *Feasibility Study Report for Operable Unit 5* (DOE 1995a).
- *Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1)* (DOE 1997a).
- *Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2000).
- *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001).
- *Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module* (DOE 2002b).
- *Waste Storage Area (Phase II) Design Report* (DOE 2005b) and the *Addendum to the Waste Storage Area (Phase II) Design Report* (DOE 2005a).
- *Operational Design Adjustments-1 WSA Phase-II Groundwater Remediation Design Fernald Preserve* (DOE 2014b).

Summaries of how the aquifer remediation system has evolved can be found in previous years' IEMPs.

In 2014, the ongoing pump-and-treat remedy was optimized. Three extraction wells (EW-28A in the waste storage area, and EW-31 and EW-32 in the South Field) were turned off because they were no longer providing a benefit to the ongoing pump-and-treat operation. The pumping budget freed up by turning off these three wells was reallocated to other wells in the South Plume and southern South Field Areas in order to accelerate cleanup of those areas.

3.4.2.2 The Modular Approach to Aquifer Restoration

Restoration of the Great Miami Aquifer is being accomplished by operating 20 extraction wells in three area-specific groundwater restoration modules (South Plume Module, South Field Module, and Waste Storage Area Module) and a centralized water treatment facility (Figure 3). Figure 5 shows the locations of the extraction wells that these modules comprise.

<u>South Plume Module</u>
Six extraction wells (3924, 3925, 3926, 3927, 32308, and 32309).

<u>South Field Module</u>
Eleven extraction wells (31550, 31560, 31561, 32276, 32446, 32447, 33061, 33262, 33264, 33298, and 33326).

Waste Storage Area Module
Three extraction wells (32761, 33062, and 33347).
For monitoring purposes, the aquifer is divided into five zones referred to as "aquifer zones" (see Figure 6). These aquifer zones are used to evaluate the predicted performance (both individually and collectively) at the aquifer restoration modules. Aquifer Zones 1, 2, and 4 contain aquifer remediation modules. Aquifer Zone 0 (the fifth zone) is the area outside the other four aquifer zones.

The locations of the extraction wells that constitute the restoration modules are as follows:

- The South Plume Module is located in Aquifer Zone 4.
- The South Field Module (Phases I and II) is located in Aquifer Zone 2.
- The Waste Storage Area Module (Phases I and II) is located in Aquifer Zone 1.

Reverse particle-path modeling predicts a hydraulic capture zone that is larger than the actual dimension of the 30-µg/L total uranium plume. The time-of-travel remediation footprint presented in this plan (see Figure 6) reflects the operational changes implemented in 2014 (DOE 2014b). This design remediation footprint was constructed using reverse, nonretarded, particle-path interpretations from the Variability Saturated Analysis Model in 3 Dimensions (VAM3D) Groundwater Model. The limits of most of the particle tracks are truncated because the particles reached the edge of the groundwater model domain. The particle paths were modeled for 8-year travel times to correspond to predicted cleanup of the South Plume and southern South Field areas.

3.4.2.3 Well Selection Criteria

Geologic and hydrogeologic properties, predicted and actual groundwater flow, and contaminant distribution within the Great Miami Aquifer (before and during remediation) serve as input to the design and modification of the IEMP groundwater monitoring network. Field measurements and computer simulations were conducted to support initial design efforts.

All available information is reviewed to select appropriate monitoring well locations. The monitoring well locations for the IEMP are selected according to the following:

- Monitor within the projected capture zone of the groundwater restoration operation unless an operational concern (e.g., the proximity of the South Plume extraction wells to the PRRS plume) requires a monitoring location to be outside of the capture zone. **Note:** Pumping rates may change to optimize the operation through time; therefore, the capture zone may also change.
- Use existing monitoring wells in the remediation footprint of the aquifer and avoid installing new monitoring wells unless determined necessary based on operational knowledge, which will be used to help select new locations.
- Provide adequate areal coverage across each remediation module area.
- Include monitoring wells that are needed to meet site-specific monitoring commitments.
- Select monitoring well locations that will provide data needed to determine how reasonable model predictions are over the long term.

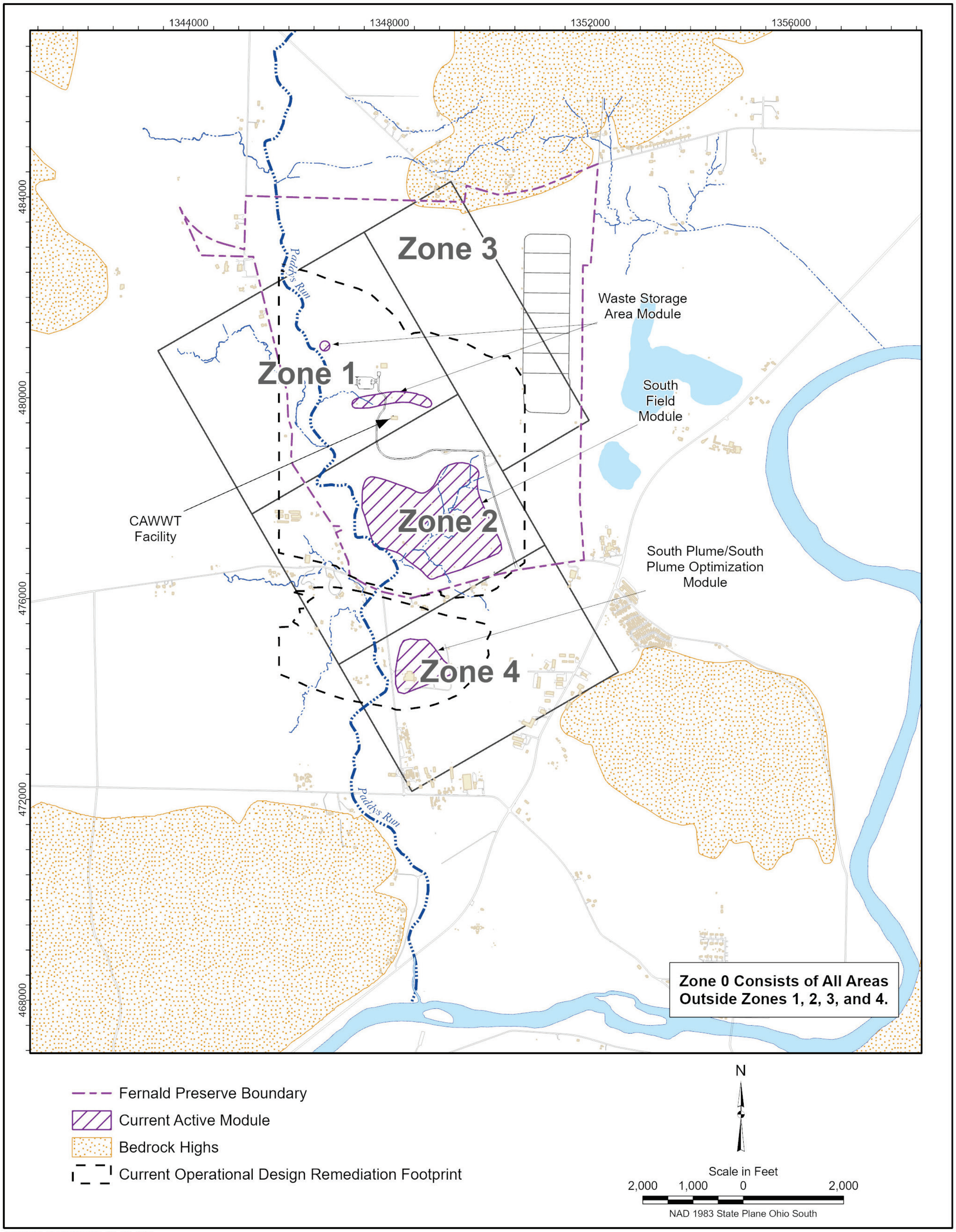

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Figure 6. Groundwater Aquifer Zones and Design Remediation Footprint

- Select monitoring well locations in consideration of landowner concerns. In the off-property portion of the South Plume, landowner access concerns have, and will continue to have, a bearing on the location and number of monitoring wells in that area. Generally, location of monitoring wells is limited to peripheral areas along the edges of the farm fields. This monitoring well limitation is being addressed through supplemental use of direct-push sampling that can be conducted during the times of the year when the fields are not being used for crops.

As of January 1, 2023, 91 wells at the Fernald Preserve are being sampled as identified in the following subsections.

3.4.2.4 Constituent Selection Criteria

The groundwater sampling constituent selection criteria are based on evaluation of the groundwater data that have been collected since the inception of the IEMP. Rationale and information concerning constituent selection have been presented in previous versions or the IEMP. Following is an overview.

Restoration of the aquifer will be verified against FRLs. The FRLs for the aquifer have been established in the OU5 ROD for 50 COCs. Groundwater monitoring focuses on these 50 FRL constituents to assess the progress of the aquifer remedy.

A short list of constituents has been established for monitoring purposes and is based on where and whether constituents have had FRL exceedances in the aquifer since the inception of the IEMP. Constituents on the short list are monitored semiannually. Monitoring of constituents not on the short list will be addressed during Stage III (Certification/Attainment Monitoring), as necessary.

Table 3 summarizes groundwater sampling results since the inception of the IEMP program and contains the following information:

- Column 1 lists the 50 constituents for which FRLs were established in the OU5 ROD.
- Column 2 lists the FRL for each of the constituents.
- Column 3 identifies the basis for each FRL constituent (i.e., risk, ARAR, background, or detection limit) as defined in the OU5 Feasibility Study Report.
- Column 4 documents the number of samples that have been analyzed for each constituent since the start of IEMP sampling.
- Column 5 notes the number of samples that have had a concentration greater than the FRL for each constituent.
- Column 6 notes the percent of the samples for each constituent that have had a concentration greater than the FRL.
- Column 7 identifies the zones where FRL exceedances have been observed and the number of wells in each zone that had exceedances.
- Column 8 shows the above-FRL concentration range for each constituent that had FRL exceedances.

Table 3. Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (August 1997 through 2021)

(1) Constituent	(2) Groundwater FRL[a]	(3) Basis for FRL[b]	(4) No. of Samples[c]	(5) No. of Samples >FRL[c,d]	(6) Percent of Samples >FRL	(7) Zones with FRL Exceedances (No. of Wells with exceedances in each aquifer zone)[c,d,e]	(8) Range above FRL[c,d,e]
Uranium, Total	30 µg/L	A	9962	2536	25.5	1(21) 2(43) 3(3) 4(17)	30.1 J/2660 –
Zinc	0.021 mg/L	B	2388	106	4.44	0(12) 1(5) 2(14) 3(6) 4(4)	0.0212 NV/13.6 –
Manganese	0.90 mg/L	B	3222	209	6.49	0(7) 1(14) 2(10) 3(5) 4(5)	0.913 J/105 J
Nickel	0.10 mg/L	A	3044	24	0.79	0(1) 1(3) 2(7) 3(1) 4(1)[f]	0.101 –/1.54 –
Technetium-99	94 pCi/L	R*	2278	155	6.80	1(5)	94.5 –/1660 –
Nitrate[g]	11 mg/L	B	2772	227	8.19	1(8) 2(1)[h]	11.2 –/331 NV
Lead	0.015 mg/L	A	2093	20	0.96	0(3) 1(2) 2(4) 3(2)	0.0154 –/0.349 –
Arsenic	0.050 mg/L	A	2615	16	0.61	0(1) 1(1) 2(1) 4(4)	0.051 –/0.194 –
Molybdenum	0.10 mg/L	A	1457	44	3.02	1(1)	0.178 –/1.26 –
Boron	0.33 mg/L	R	2584	15	0.58	2(2)	0.331 –/1.16 –
Antimony	0.0060 mg/L	A	2194	36	1.64	0(15) 1(1) 2(6)4(2)	0.00601 –/0.0334 –
Trichloroethene	0.0050 mg/L	A	1589	45	2.83	0(1)[i] 1(3) 4(1)[i]	0.00524 J/0.120 –
Carbon disulfide	0.0055 mg/L	A	1180	6	0.51	0(1)[i] 1(3) 2(1)[i]	0.006 –/0.014 –
Fluoride	4 mg/L	A	2272	4	0.18	0(2) 1(1) 3(1)	5.3 –/12.3 –
Vanadium	0.038 mg/L	R	959	1	0.10	0(1)	0.0664 J[j]
1,1-Dichloroethane	0.28 mg/L	A	86	0	0	NA	NA
1,1-Dichloroethene	0.0070 mg/L	A	586	0	0	NA	NA
1,2-Dichloroethane	0.0050 mg/L	A	704	0	0	NA	NA
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin	0.000010 mg/L	D	19	0	0	NA	NA
4-Methylphenol	0.029 mg/L	R	86	0	0	NA	NA
4-Nitrophenol	0.32 mg/L	R	86	0	0	NA	NA
alpha-Chlordane	0.0020 mg/L	A	792	0	0	NA	NA
Aroclor-1254	0.00020 mg/L	D	86	0	0	NA	NA
Barium	2.0 mg/L	A	342	0	0	NA	NA
Benzene	0.0050 mg/L	A	1221	0	0	NA	NA
Beryllium	0.0040 mg/L	A	877	0	0	NA	NA
Bis(2-chloroisopropyl) ether	0.0050 mg/L	D	480	0	0	NA	NA
Bis(2-ethylhexyl) phthalate	0.0060 mg/L	A	86	0[kj]	0	NA[k]	NA
Bromodichloromethane	0.10 mg/L	A	792	0	0	NA	NA
Bromomethane	0.0021 mg/L	R	86	0	0	NA	NA
Cadmium	0.014 mg/L	B	994	0	0	NA	NA
Carbazole	0.011 mg/L	R	459	0	0	NA	NA

Table 3. Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (August 1997 through 2021) (continued)

(1) Constituents	(2) Groundwater FRL[a]	(3) Basis for FRL[b]	(4) No. of Samples[c]	(5) No. of Samples >FRL[c,d]	(6) Percent of Samples >FRL	(7) Zones with FRL Exceedances (No. of Wells with exceedances in each aquifer zone)[c,d,e]	(8) Range above FRL[c,d,e]
Chloroethane	0.0010 mg/L	D	86	0	0	NA	NA
Chloroform	0.10 mg/L	A	86	0	0	NA	NA
Chromium VI	0.022 mg/L	R	16	0	0	NA	NA
Cobalt	0.17 mg/L	R	1082	0	0	NA	NA
Copper	1.3 mg/L	A	234	0	0	NA	NA
Mercury	0.0020 mg/L	A	2133	0[l]	0	NA	NA
Methylene chloride	0.0050 mg/L	A	84	0	0	NA	NA
Neptunium-237	1.0 pCi/L	R*	1606	0	0	NA	NA
Octachlorodibenzo-*p*-dioxin	1.0E-7 mg/L	D	19	0	0	NA	NA
Radium-226	20 pCi/L	A	194	0	0	NA	NA
Radium-228	20 pCi/L	A	86	0	0	NA	NA
Selenium	0.050 mg/L	A	1181	0	0	NA	NA
Silver	0.050 mg/L	A	1112	0	0	NA	NA
Strontium-90	8.0 pCi/L	A	1394	0	0	NA	NA
Thorium-228	4.0 pCi/L	R*	992	0	0	NA	NA
Thorium-230	15 pCi/L	R*	86	0	0	NA	NA
Thorium-232	1.2 pCi/L	R*	902	0	0	NA	NA
Vinyl chloride	0.0020 mg/L	A	792	0	0	NA	NA

[a] From OU5 ROD, Table 9–4.
[b] From OU5 Feasibility Study, Table 2–16.
A = ARAR-based
B = Based on 95th percentile background concentrations
D = Based on lowest achievable detection limit
R = Risk-Based Preliminary Remediation Goal (PRG)
R* = Risk-Based Preliminary Remediation Level includes the radionuclide risk-based PRG plus its 95th percentile background concentration
[c] Based on filtered and unfiltered samples from the August 1997 through 2021 (IEMP groundwater data).
[d] Sample results having a -, J, or NV qualifier were used:
– = result is confident as reported
J = result is quantitatively estimated
NV = result is not validated
[e] NA = not applicable
[f] The result from the September 30, 2015, sampling event is not considered representative of aquifer conditions for monitoring well 2625 (Zone 4): the water in the well was highly turbid and the well was almost dry with insufficient water for all of the constituents. The well was resampled and analyzed on January 28, 2016, The nickel result from January 28, 2016, was not an FRL exceedance and would not be included if the January 28, 2016, results replaced the September 30, 2015, results.
[g] Nitrate/nitrite results are evaluated with respect to the nitrate FRL.
[h] Since the IEMP inception, there has been only one nitrate/nitrite exceedance at well 2017 (in 1998).
[i] Since the IEMP inception, there has been one isolated exceedance at two locations.
[j] Since the IEMP inception, there has been only one vanadium exceedance at well 2426 (in 1998).
[k] Of the 86 samples analyzed for bis(2-ethylhexyl)phthalate, a common laboratory contaminant, five had results above the FRL. The above-FRL results are all considered suspect due to laboratory analysis issues, laboratory blank and field blank contamination, or field duplicate results being nondetected. The five exceedances are as follows: 0.014J mg/L, well 2398 and 0.010J mg/L, well 3390 in Aquifer Zone 2; 0.016J mg/L, well 2109 in Aquifer Zone 3; and 0.008J mg/L, well 2125 and 0.13J mg/L, well 3095 in Aquifer Zone 4.
[l] The mercury exceedance is suspect, due to negative matrix spike/matrix spike duplicate (MS/MSD) recoveries. In fact, the MS/MSD (i.e., spiked samples) results were both much less than the original sample result.

As shown in Table 3, 35 of the 50 groundwater FRL constituents have not had an FRL exceedance. Excluding uranium, the groundwater FRL constituents that did have recorded exceedances were from a limited number of wells. The spatial distribution of these wells indicates that many of the non-uranium FRL exceedances are not associated with a plume.

Groundwater monitoring focuses on the short list of 15 groundwater FRL constituents. The following monitoring will be conducted:

1. Uranium, which is the primary COC and has the greatest number of wells with exceedances, will be monitored semiannually.
2. Constituents that have FRL exceedances in multiple zones (i.e., antimony, arsenic, fluoride, lead, manganese, nickel, and zinc) will be monitored as follows:
   - At a minimum, all constituents will be monitored at downgradient wells, including existing property boundary/OSDF wells along the eastern perimeter of the site and those wells along the eastern/southern boundary of the South Plume. The area identified as Property/Plume Boundary on Figure 7 shows the configuration of this monitoring network, which lies in Zones 0, 2, 3, and 4, and for the most part outside of the restoration footprint. Monitoring at these locations will document that above-FRL contaminants are not migrating beyond the expected capture zone.

     Note: Carbon disulfide and nitrate/nitrite are considered to have legitimate exceedances in only one zone (Zone 1) and are discussed below (refer to item 3).
   - In addition to being monitored in Zones 0, 2, 3, and 4, constituents that have exceedances in multiple zones were evaluated with respect to Zone 1 to determine if monitoring is conducted to address consistent/recent exceedances in this area. Monitoring will be addressed in this zone, in addition to the monitoring at the Property/Plume Boundary, to ensure that the constituents exhibiting consistent/recent exceedances are being monitored near potential sources. Manganese in Zone 1 appears to have consistent/recent exceedances. Therefore, it will be monitored in this zone at wells that have exceedances. In addition to manganese, nickel had an exceedance in 2002. Nickel will also be monitored in Zone 1. Refer to the area identified as Former Waste Storage Area on Figure 7 for the locations to be monitored in Zone 1.
3. Constituents that have FRL exceedances in only one zone will be monitored solely in that zone. The monitoring will consist of the following: carbon disulfide, molybdenum, nitrate/nitrite, technetium-99, and trichloroethene in Zone 1 (Waste Storage area), and boron in Zone 2 (South Field). Specific monitoring locations will be based on the wells that have exceedances.

   Nitrate/nitrite has exceedances primarily in Zone 1. One well (2017), which is located in Zone 2, had a one-time exceedance in 1998.
4. Vanadium has had a one-time exceedance in 1998 during quarterly sampling at one well (2426). This constituent will be monitored less than semiannually due to the lack of exceedances. Monitoring for this constituent is addressed in Section A.3.2. Vanadium will be addressed during Stage III (Certification/Attainment Monitoring).

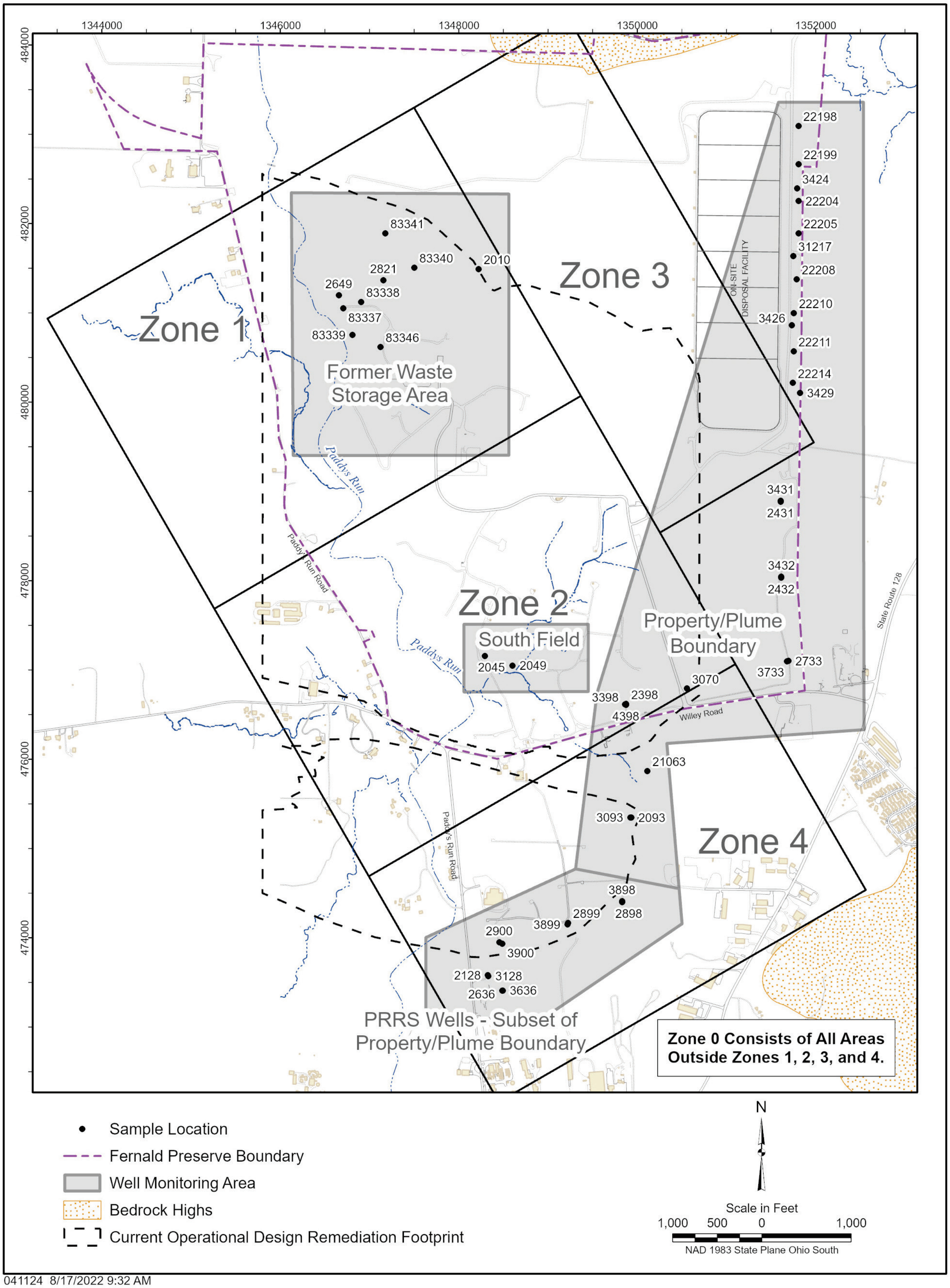

Figure 7. Locations for Property/Plume Boundary, South Field, and Waste Storage Area Monitoring

Based on the above four criteria, 13 non-uranium groundwater FRL constituents are on the short list and are monitored annually, at a minimum (Table 4).

Table 4. IEMP Constituents with FRL Exceedances, Location of Exceedances, and Revised Monitoring Program

Parameter	Aquifer Zones with Exceedances	Monitoring Program
Antimony	Multiple Zones	Property/Plume Boundary
Arsenic	Multiple Zones	Property/Plume Boundary
Boron	Aquifer Zone 2 (South Field)	South Field
Carbon disulfide	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Fluoride	Multiple Zones	Property/Plume Boundary
Lead	Multiple Zones	Property/Plume Boundary
Manganese	Multiple Zones[a]	Property/Plume Boundary, Waste Storage Area
Molybdenum	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Nickel	Multiple Zones	Property/Plume Boundary, Waste Storage Area
Nitrate/Nitrite	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Technetium-99	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Trichloroethene	Aquifer Zone 1 (Waste Storage Area)	Waste Storage Area
Zinc	Multiple Zones	Property/Plume Boundary

[a] Manganese has consistent/recent exceedances in Zone 1; therefore, this constituent will be monitored in the Waste Storage Area and along the Property/Plume Boundary.

3.5 Design of the IEMP Groundwater Monitoring Program

Monitoring focuses on IEMP data and specifically calls for annual or semiannual monitoring of groundwater FRL constituents with exceedances. A list of IEMP groundwater monitoring wells is provided in Table 5. Table 6 provides a list of the monitoring requirements.

The monitoring strategy and technical approach will be revised as necessary in subsequent revisions to the IEMP to encompass operational changes over the life of the remedy. A startup monitoring, project-specific plan, or variance to an existing plan will be developed to supplement the IEMP each time a new extraction well begins to operate for the first time.

<u>Annual Well Field Shutdown</u>
A 1- to 4-week shutdown of all extraction wells (with the exception of the four leading-edge South Plume recovery wells) will be conducted each year in late spring/early summer when water levels in the aquifer are seasonally high. Shutting down the extraction wells during this time period will allow water levels in the aquifer to rise as high as possible, resulting in the saturation of as much of the aquifer sediments as possible. The well field shutdown period will also be utilized to conduct well field and water treatment system maintenance.

Uranium concentrations will be measured at six monitoring wells (2045, 2046, 23274, 83124, 83294, and 83337) to support the shutdown activity. First-half of the year total uranium measurements will serve as pre-shutdown concentrations for the six wells. The six wells will be sampled just prior to restarting the extraction wells. Type 8 wells will be sampled in both Channel 1 and Channel 2.

Table 5. List of IEMP Groundwater Monitoring Wells

		Property/Plume Boundary Monitoring				South Field
Number[a]	Total Uranium Monitoring	Monitor FRL Exceedances	Monitor OSDF Constituents[b]	Monitor PRRS Constituents[c]	Waste Storage Area Monitoring: FRL Exceedances	South Field Monitoring: FRL Exceedances
1	2010				2010	
2	2045					2045
3	2046					
4	2049					2049
5	2060 (12)					
6	2093	2093				
7	2095					
8	2128	2128		2128		
9	2385					
10	2386					
11	2387					
12	2389					
13	2390					
14	2397					
15	2398	2398				
16	2431	2431				
17	2432	2432				
18	2550					
19	2552					
20	2636	2636		2636		
21	2649				2649	
22	2733	2733				
23	2821				2821	
24	2880					
25	2898	2898		2898		
26	2899	2899		2899		
27	2900	2900		2900		
28	3069					
29	3070	3070				
30	3093	3093				
31	3095					
32	3128	3128		3128		
33	3398	3398				
34	3424	3424				
35	3426	3426				
36	3429	3429				
37	3431	3431				
38	3432	3432				
39	3636	3636		3636		
40	3733	3733				
41	3898	3898		3898		
42	3899	3899		3899		
43	3900	3900		3900		
44	4398	4398				

Table 5. List of IEMP Groundwater Monitoring Wells (continued)

Number[a]	Total Uranium Monitoring	Property/Plume Boundary Monitoring			Waste Storage Area Monitoring: FRL Exceedances	South Field Monitoring: FRL Exceedances
		Monitor FRL Exceedances	Monitor OSDF Constituents[b]	Monitor PRRS Constituents[c]		
45	6880					
46	6881					
47	21033					
48	21063	21063				
49	21192					
50	22198	22198	22198			
51	22199	22199	22199			
52	22204	22204	22204			
53	22205	22205	22205			
54	22208	22208	22208			
55	22210	22210	22210			
56	22211	22211	22211			
57	22214	22214	22214			
58	23271					
59	23273					
60	23274					
61	23275					
62	23276					
63	23278					
64	23280					
65	23281					
66	31217	31217				
67	32766					
68	62408					
69	62433					
70	63119					
71	63285					
72	63287					
73	63288					
74	63291					
75	82433					
76	83117					
77	83124					
78	83293					
79	83294					
80	83295					
81	83296					
82	83335					
83	83336					
84	83337				83337[d]	
85	83338				83338[d]	
86	83339				83339[d]	
87	83340				83340[d]	
88	83341				83341[d]	
89	83346				83346[d]	

Table 5. List of IEMP Groundwater Monitoring Wells (continued)

		Property/Plume Boundary Monitoring				
Number[a]	Total Uranium Monitoring	Monitor FRL Exceedances	Monitor OSDF Constituents[b]	Monitor PRRS Constituents[c]	Waste Storage Area Monitoring: FRL Exceedances	South Field Monitoring: FRL Exceedances
90	82369					
91	82372					

[a] The number in column 1 is used to identify the number of wells in the program. The individual monitoring well identification numbers are provided in columns 2–7 as appropriate.
[b] List of total uranium monitoring wells and Property/Plume Boundary monitoring wells that overlap with OSDF monitoring wells.
[c] List of total uranium monitoring wells and Property/Plume Boundary monitoring wells that overlap with PRRS monitoring wells.
[d] Volatile organic compounds are not sampled in Type 8 wells.

Table 6. IEMP Monitoring Requirements

1. Total Uranium[a]

2. Waste Storage Area[a]

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
Nitrate/Nitrite	Manganese Molybdenum Nickel	Technetium-99 Total Uranium[c]	Carbon Disulfide Trichloroethene

3. South Field[a]

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
NA[d]	Boron	Total Uranium[c]	NA[d]

4. Property/Plume Boundary for FRL Exceedances[b]

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
Fluoride	Antimony Arsenic Lead Manganese Nickel Zinc	Total Uranium[c]	NA[d]

5. Property/Plume Boundary for PRRS[b]

(These wells are also monitored for Property/Plume Boundary for FRL exceedances constituents)

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
Phosphorous	Arsenic[e] Potassium Sodium	NA[d]	Benzene Ethylbenzene Isopropylbenzene Toluene Total Xylenes

[a] Monitoring will be conducted semiannually.
[b] Monitoring will be conducted annually.
[c] Total uranium is monitored as part of the sitewide uranium monitoring.
[d] NA = not applicable.
[e] Arsenic is also monitored with respect to FRL exceedances as part of the Property/Plume Boundary.

The extraction wells will be sampled just prior to shutdown, and once a week during the shutdown. Wells will be operated for approximately 10 minutes prior to the collection of a groundwater sample. The extraction wells will be sampled daily for up to 4 days following restart of the extraction wells.

During the annual shutdowns, water level measurements will be recorded at selected locations using downhole pressure transducers. Selected locations will be identified in the annual SER along with the collected data.

3.6 Medium-Specific Plan for Groundwater Monitoring

This section serves as the medium-specific plan for implementation of the sampling, analysis, and data-management activities associated with the sitewide groundwater remedy performance monitoring program. The program expectations and design presented in Section 3.4 were used as the framework for developing the monitoring approach presented in this section. The activities described in this medium-specific plan have been designed to provide groundwater data of sufficient quality to meet the program expectations as defined in Section 3.4.1. All sampling procedures and analytical protocols described or referenced in this IEMP are consistent with the requirements of the FPQAPP as the primary document that describes procedures and protocols for monitoring the Fernald Preserve.

Subsequent sections of this medium-specific plan define the following:

- Project organization and associated responsibilities
- Sampling program
- Change control
- Safety and health
- Data management
- Project quality assurance

3.6.1 Groundwater Sampling Program

The information derived from the groundwater monitoring program should produce a clear understanding of groundwater quality in the Great Miami Aquifer. The groundwater sampling process will be controlled so that collected samples are representative of groundwater quality. All procedures for monitoring well development, sample collection, and shipment will be performed in accordance with the FPQAPP.

3.6.1.1 Total Uranium Monitoring

Ninety-three monitoring wells will be sampled at least annually for total uranium. Forty-six of these wells will be sampled for additional constituents as described in Sections 3.6.1.2 through 3.6.1.4. A list of the wells to be sampled for only total uranium is provided in Table 7. Figure 8 identifies all wells sampled for total uranium. The wells extend across all aquifer zones and provide monitoring coverage in all restoration module areas. Figure 8 shows the locations of the monitoring wells.

Table 7. List of Groundwater Wells to Be Sampled for Total Uranium Only

2046	21033	63288
2060 (12)	21192	63291
2095	23271	82369
2385	23273	82372
2386	23274	82433
2387	23275	83117
2389	23276	83124
2390	23278	83293
2397	23280	83294
2550	23281	83295
2552	32766	83296
2880	62408	83335
3069	62433	83336
3095	63119	
6880	63285	
6881	63287	

Note:
The channel completed in the plume interval with the highest measured uranium concentration will be sampled every 6 months. The other channels will be sampled once a year to document any changes in the plume concentration profile.

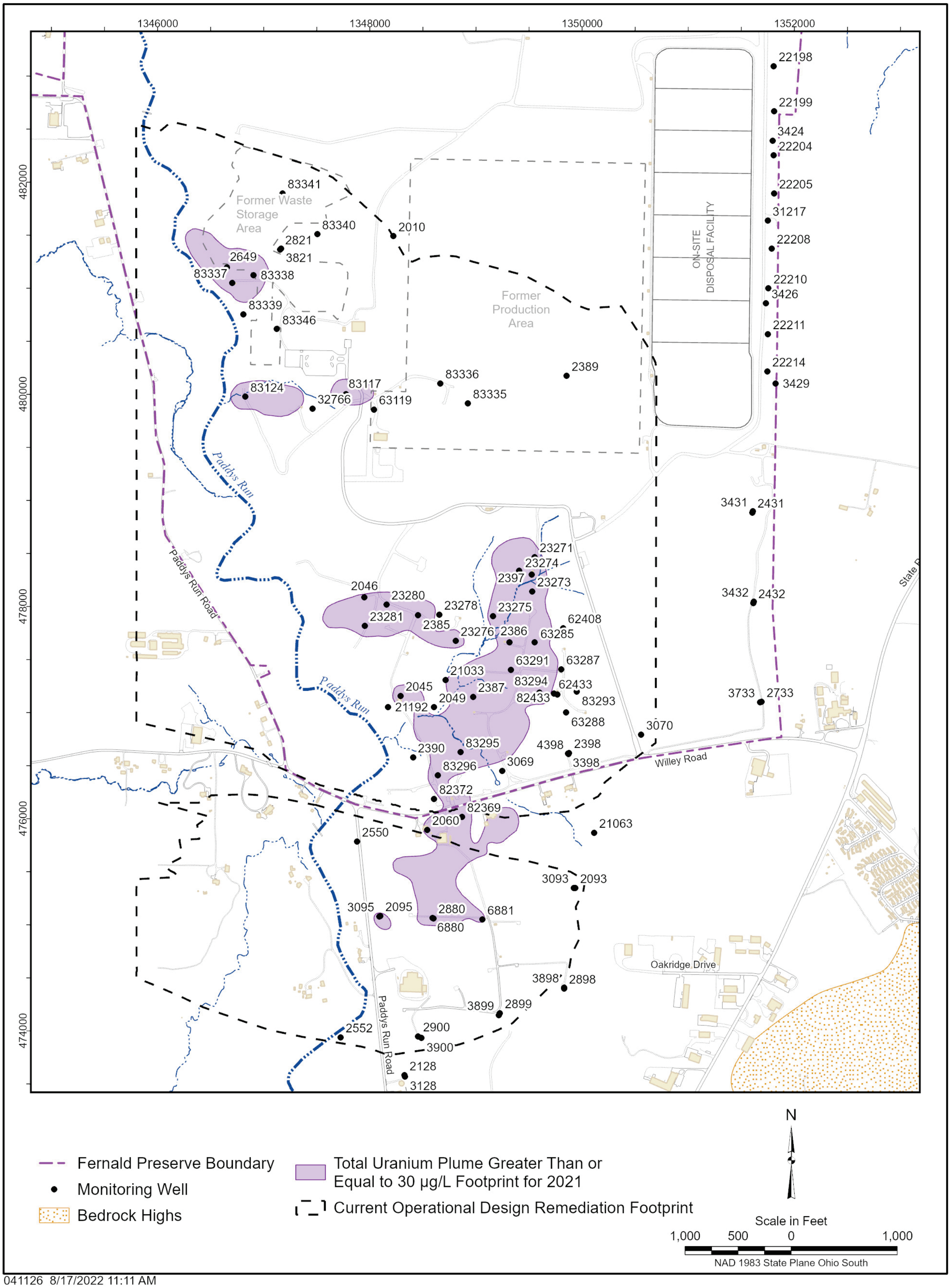

Figure 8. Locations for Total Uranium Monitoring

This total uranium sampling activity will address the following remediation sampling needs:

- The need to interpret changes to the total uranium plume over time due to remediation activities.
- The need to interpret the extent of capture in relation to the total uranium plume.
- The need to interpret the effectiveness of the aquifer remedy in maintaining a hydraulic barrier that limits further southern migration of the total uranium plume, and the need to document the area of uranium contamination (at or above 30 µg/L) south of the Administrative Boundary.
- Continued tracking of uranium concentrations at one off-property private monitoring wells.

Up to 27 locations will also be sampled each year for total uranium using a direct-push sampling tool. Direct-push sampling will provide vertical profile concentration data. The vertical profile data will be used to supplement the fixed monitoring well data in order to produce more robust plume interpretations. Exact locations for the direct-push sampling will be selected each year and identified in the SER. The selection process is based on monitoring well data, modeling needs, and data-interpretation needs.

Until January 1, 2023, three private wells (2060 [12], 13, and 14) were being sampled for total uranium. The private homeowner sampling program 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). It should be noted that well 2060 was the private well where off-property contamination was initially reported in 1981. 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).

Monitoring well 13 had been below the uranium FRL since 2002 and monitoring well 14 had been below the FRL since this well was first sampled in 1988. These wells are located off-site and are outside of the uranium plume boundary identified in Section 3.0 and have been below the FRL for over 20 years. For these reasons, DOE proposed in the 2021 Site Environmental Report (DOE 2022) to eliminate monitoring in two of the private wells which are outside the current plume (13 and 14) and to continue monitoring in well 2060. Beginning January 1, 2023, the only private well to be monitored will be 2060.

3.6.1.2 South Field Monitoring

The South Field area is located in Aquifer Zone 2 (refer to Figure 6). Eleven extraction wells (South Field [Phases I and II] Module) are operating in the South Field.

In addition to the monitoring wells being sampled in the South Field for total uranium only (refer to Section 3.6.1.1), two monitoring wells (2045 and 2049) will be sampled semiannually for boron as well as total uranium. The rationale for the selection of these wells and this additional constituent is presented in Section 3.4. Figure 7 shows the locations of these two wells. Following is the monitoring table:

South Field Monitoring Project Table
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
NA	Boron	Total Uranium	NA

Up until 2011, direct-push sampling was conducted annually at five locations (12368, 12369, 12370, 12372, and 12373) along and south of Willey Road. These five locations were included in the 27 locations sampled yearly using direct-push technology. Figure 9 shows these five locations. This annual direct-push sampling was used to help track remediation progress. At each direct-push location, a groundwater sample was collected at 10-foot intervals beneath the water table and analyzed for only uranium until it can be verified that the entire thickness of the 30-µg/L total uranium plume has been sampled.

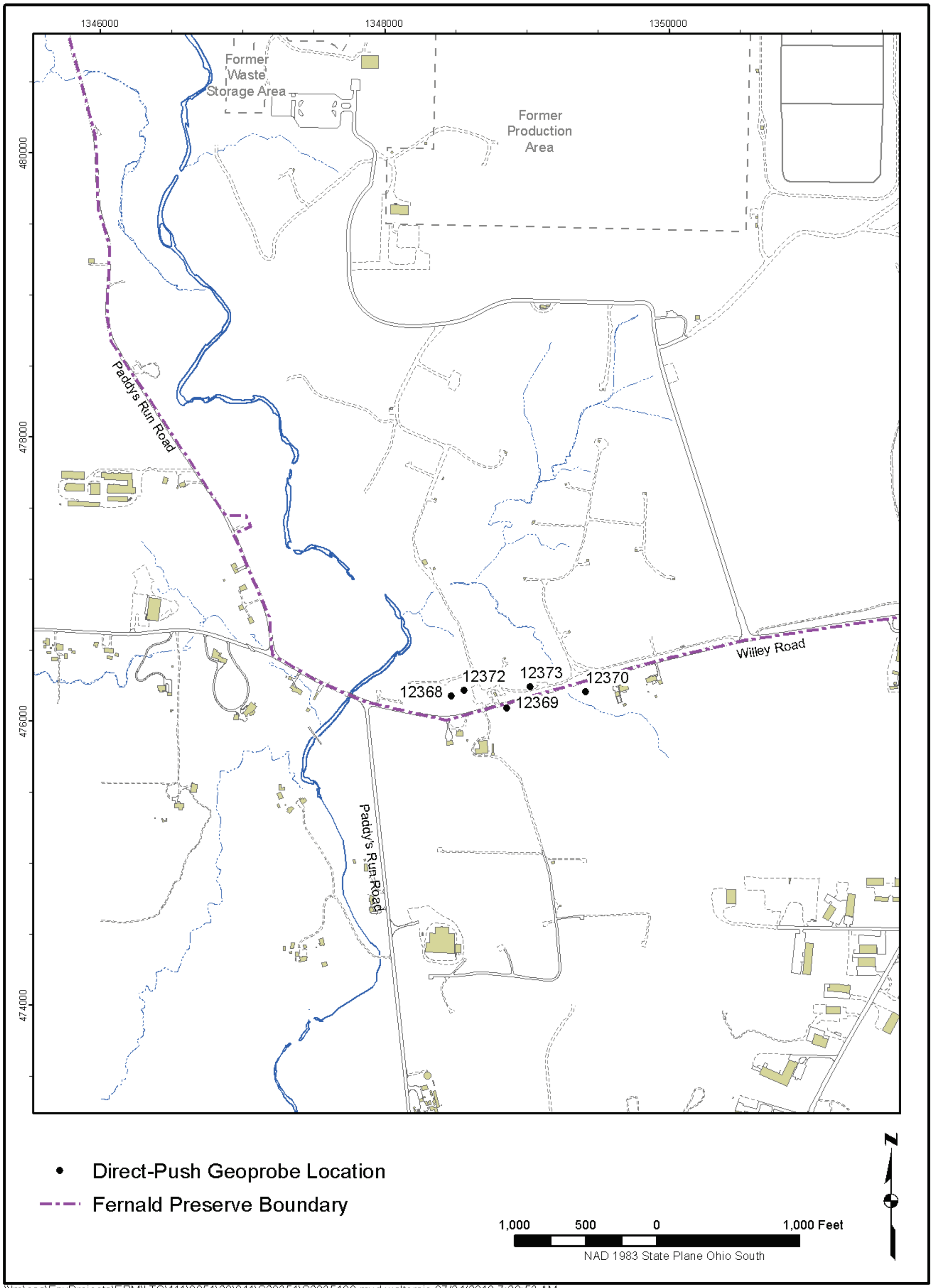

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Figure 9. Former Direct Push Sampling Locations

Annual sampling of these locations was creating a problem in the field, in that it was becoming hard to find a location free of grout from multiple previous sampling efforts. Over the years, the plume has decreased so that currently only two locations remain within the greater than or equal 30 µg/L uranium plume (Locations 12372 and 12369). DOE installed multi-level monitoring wells at these two locations (82369 and 82372). The other locations that are no longer in the greater than or equal to 30 µg/L uranium plume (locations 12373, 12368, and 12370) will not be sampled again until the South Plume certification stage of the groundwater remedy, unless it is deemed necessary to do so.

3.6.1.3 Waste Storage Area Monitoring

The Waste Storage area is located in Aquifer Zone 1 (refer to Figure 6). Three extraction wells (32761, 33062, and 33347) are operating in the Waste Storage area. Figure 5 shows the locations of these three wells.

In addition to the monitoring wells being sampled in the Waste Storage area for total uranium only (refer to Section 3.6.1.1), the 9 wells listed below will be sampled semiannually (refer to Figure 7 for the locations of these 9 wells).

Monitoring Wells to Be Monitored Semiannually
In the Waste Storage Area

2010	2649	2821	83337	83338
83339	83340	83341	83346	

The three Type 2 and Type 3 wells will be sampled semiannually for the constituents listed in the table below. The rationale for the selection of these wells and these constituents is presented in Section 3.4. The six Type 8 wells will also be sampled for the constituents listed in the table below, with the exception of the organics. Type 8 wells will not be used to sample for organics. The six Type 8 wells listed above for the Waste Storage area are three-channel continuous multichannel tubing (CMT) wells. All three channels will be sampled semiannually.

Waste Storage Area Monitoring Project Table
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
Nitrate/Nitrite	Manganese Molybdenum Nickel	Technetium-99 Total Uranium	Carbon Disulfide Trichloroethene

As explained in Section 3.6.1.7, filtering of groundwater samples at monitoring wells may take place on a case-by-case basis if deemed appropriate.

> Note: *Filtering of groundwater samples using a 0.45-micrometer (µm) filter was deemed appropriate for monitoring well 2010 because the well had shown evidence of being biofouled in the past. A discussion of the biofouling problem at monitoring well 2010 is presented in the* Addendum to the Waste Storage

Area (Phase II) Design Report *(DOE 2005a). The pump was replaced in monitoring well 2010 in 2009, and the turbidity of the well decreased dramatically. With the new pump, filtering of the samples is no longer required.*

Locations may also be sampled in the Waste Storage area, using a direct-push sampling tool. Direct-push sampling will provide vertical profile concentration data. The vertical profile data will be used to supplement the fixed monitoring well data to produce more robust plume interpretations. Direct-push locations in the Waste Storage area will be sampled for the Waste Storage area monitoring semiannual constituents listed on the previous page, excluding the organic constituents. Location numbers and collected data will be provided in each annual SER.

A direct-push sample will be collected prior to any filtering and will be analyzed for nitrate/nitrite. The remainder of the samples (manganese, molybdenum, nickel, total uranium, and technetium-99) will, at a minimum, be filtered through a 5-µm filter.

If the turbidity of the 5-µm filter direct-push sample is below 5 nephelometric turbidity units (NTUs), the remaining five constituents will be sampled. If the turbidity of the 5-µm filtered direct-push sample is above 5 NTUs, the sample will be further filtered through a 0.45-µm filter. Both the 5-µm and the 0.45-µm filtered sample will be analyzed for total uranium, and the four remaining constituents will be analyzed from the 0.45-µm filtered sample only.

3.6.1.4 Property/Plume Boundary Monitoring

The focus of the Property/Plume Boundary Groundwater Monitoring project 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.

Monitoring will be conducted along the property boundary and downgradient uranium plume boundary for FRL exceedances; the influence (or lack of influence) that pumping is having on the PRRS plume will be documented. Monitoring will also reduce redundancy with OSDF monitoring prescribed in the Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP).

<u>Property/Plume Boundary Monitoring for FRL Exceedances</u>
Twenty-five monitoring wells along the eastern property boundary and the leading edge of the offsite total uranium plume will be sampled annually (refer to the table that follows). Figure 7 shows the locations of the wells.

The 25 monitoring wells will be sampled annually for the constituents listed below. All of these constituents have had FRL exceedances. The rationale for the selection of these constituents and the monitoring schedule are presented in Section 3.4.

Eight of the 25 monitoring wells (22204, 22205, 22208, 22198, 22211, 22214, 22210, and 22199) are also sampled for OSDF constituents listed in the GWLMP.

Property/Plume Boundary Monitoring Wells
to be Monitored for FRL Exceedances Only

2093	3426	22204
2398	3429	22205
2431	3431	22208
2432	3432	22211
2733	3733	22214
3070	4398	22210
3093	21063	31217
3398	22198	
3424	22199	

Property Plume Boundary Monitoring Table
for FRL Exceedances, Annual Sampling Frequency

General Chemistry	Inorganic	Radionuclides and Uranium	Organic
Fluoride	Antimony Arsenic Lead Manganese Nickel Zinc	Total Uranium	NA

Property/Plume Boundary Monitoring for Paddys Run Road Site Constituents
Groundwater is being pumped from the aquifer immediately north of the PRRS (extraction wells 3924, 3925, 3926, and 3927); it remains important to document the influence (or lack of influence) that the pumping has on the PRRS plume. Groundwater samples will be collected annually from 10 monitoring wells (refer to Figure 7).

The 10 wells are:

2128	2899	3898
2636	2900	3899
2898	3128	3900
	3636	

These 10 wells will be analyzed for PRRS constituents as well as for IEMP FRL exceedance constituents. The PRRS constituents listed below are the constituents to be monitored:

Property Plume Boundary Monitoring Table for
FRL Exceedances and Paddys Run Road Site Constituents
Annual Sampling Frequency

General Chemistry	Inorganic	Uranium	Organic
Fluoride	Antimony	Total Uranium	Benzene
Phosphorous	Arsenic		Ethylbenzene
	Lead		Isopropylbenzene
	Manganese		Toluene
	Nickel		Total Xylenes
	Potassium		
	Sodium		
	Zinc		

If pumping rates of wells in the South Plume Module are increased above rates established in 1998 (maximum pumping rates listed in Table 3 of the OMMP under the objective of minimizing the impact to the PRRS plume), then arsenic sampling will be conducted weekly in monitoring wells 2128 and 2900 and in extraction wells 3924 and 3925. The arsenic sampling will be used to determine if the increased pumping rates have adversely impacted the PRRS plume. The weekly sampling will be done for a minimum of 3 weeks after a pumping rate increase; if no changes in arsenic concentration trends are observed, the increased arsenic sampling will be discontinued. Figure 7 identifies the locations of these monitoring wells.

3.6.1.5 Monitoring Non-Uranium Groundwater FRL Constituents without IEMP FRL Exceedances

Monitoring for non-uranium groundwater FRL constituents that have not had an FRL exceedance since the inception of the IEMP will be addressed during Stage III (Certification/Attainment Monitoring), as necessary.

3.6.1.6 Routine Water Level Monitoring

The water table in the Great Miami Aquifer and its response to seasonal fluctuations has been well characterized in the Remedial Investigation Report for OU5. Water level data have been routinely collected at the Fernald Preserve since 1988. Water level data are used to evaluate seasonal variations and interpret groundwater flow directions. This is accomplished by preparing hydrographs and maps of the water table in the Great Miami Aquifer. Water levels will be monitored across the site to assess the effects of extraction operations on the water table and flow conditions within the Great Miami Aquifer.

The Great Miami Aquifer is an unconfined aquifer and responds rapidly to recharge events. Data collected at the Fernald Preserve and reported in the OU5 Remedial Investigation Report (DOE 1995e) document that no strong vertical gradients exist in the area of the Fernald Preserve. Water level monitoring will rely mostly on data from Type 2 wells, which will be supplemented as necessary with data from Type 3, Type 6, and Type 8 wells. Type 8 wells will have water level measurements taken in the top and bottom channels. If the top channel is dry, a measurement will be collected from the next deeper channel that is not dry.

One hundred seventy-two monitoring wells are available for measurement, as shown in Figure 10 and listed in Table 8. In the second quarter of each year, water levels at all wells will be measured; for the other three quarters, 99 of 172 wells will be measured. The 99 wells are identified with bold font and shading in Table 8. Groundwater elevation monitoring locations were selected to provide areal coverage across the Fernald Preserve with an increasing density of wells in areas surrounding active aquifer restoration wells. Groundwater elevations will be measured quarterly to provide data for construction of water table elevation maps. These maps will be used to interpret the location of flow divides, capture zones, and stagnation zones created by the operation of remediation wells. Additional monitoring wells and more frequent measurement intervals may be used if sensitive capture zones or stagnation zones are identified, or if unpredicted fluctuations in contaminant concentrations are observed.

3.6.1.7 Sampling Procedures

Sample analysis will be performed either onsite or at offsite contract laboratories, depending on specific analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing have been audited to ensure that Department of Energy Consolidated Audit Program (DOECAP) or equivalent process requirements have been met as specified in the FPQAPP. These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

All monitoring wells will be purged and sampled using the requirements specified in the FPQAPP, which have been incorporated into the *Fernald Preserve and Mound, Ohio, Sites Environmental Monitoring Procedures* (DOE 2021a).

Table 9 summarizes the field sampling information by analytical constituent groups and includes the ASL, holding times, preservatives, container requirements, and analytical methods. Groundwater samples collected at monitoring wells are not routinely filtered.

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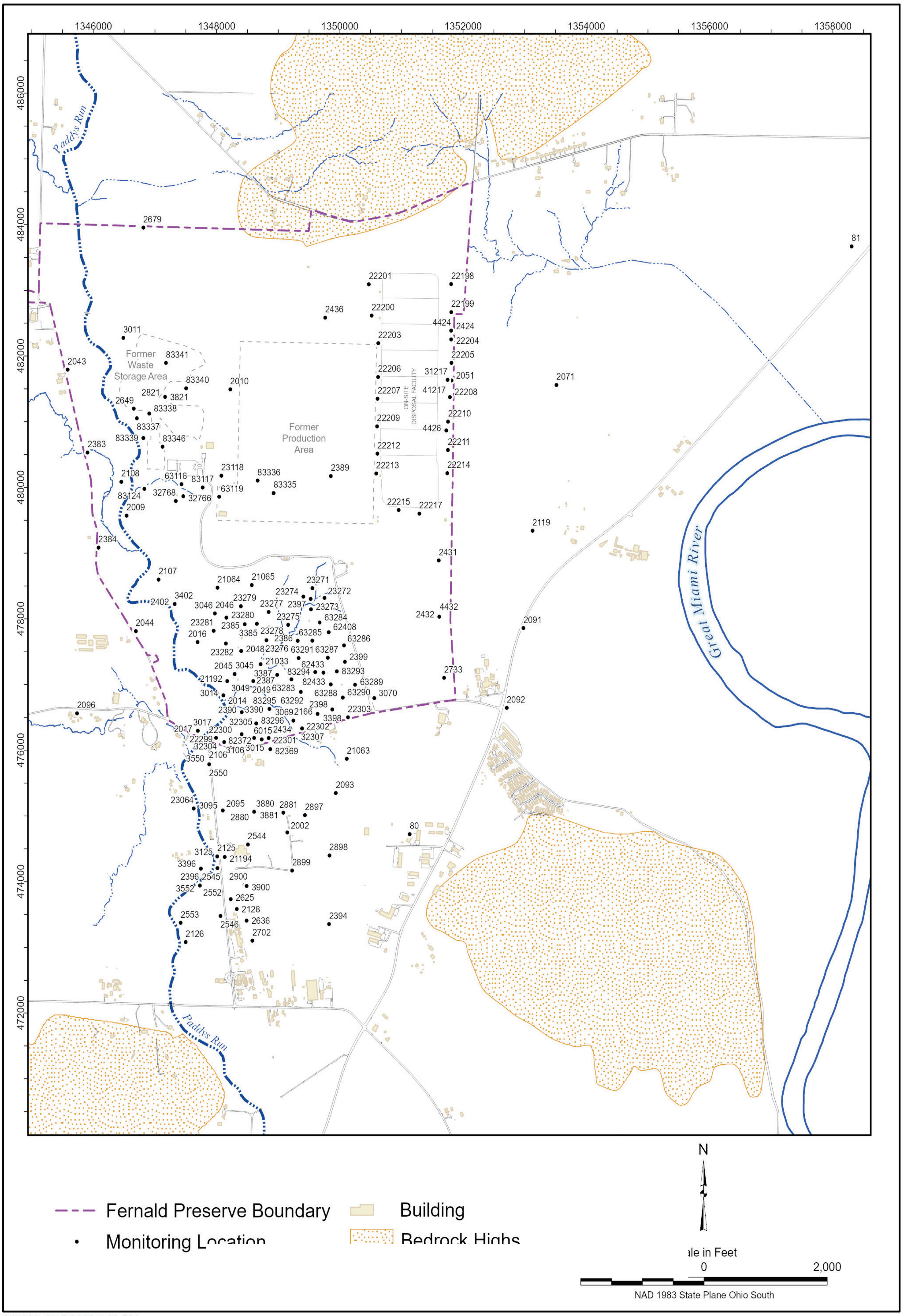

Figure 10. Location of Groundwater Elevation Monitoring Wells

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Table 8. List of Groundwater Elevation Monitoring Wells[a]

80	**2389**	**3045**	22204	32307
81	**2390**	3046	22205	**32766**
2002	**2394**	3049	22206	**32768**
2009	2396	3069	**22207**	41217
2010	2397	**3070**	**22208**	62408
2014	2398	3095	22209	**62433**
2016	2399	3106	22210	**63116**
2017	**2402**	3125	22211	**63119**
2043	2424	3385	22212	63283
2044	**2431**	3387	**22213**	**63284**
2045	**2432**	3390	**22214**	63285
2046	2434	3396	22215	**63286**
2048	**2436**	3398	22217	63287
2049	**2545**	3402	22299	63288
2051	**2546**	3550	22300	63289
2071	**2550**	3552	22301	63290
2091	**2552**	**3880**	**22302**	**63291**
2092	**2553**	**3881**	**22303**	**63292**
2093	**2636**	3900	**23064**	**82369**[b]
2095	**2649**	4424	**23118**	**82372**[b]
2096	**2679**	4426	**23271**	82433[b]
2106	**2702**	4432	23272	**83117**[b]
2107	**2733**	**6015**	23273	**83124**[b]
2108	**2821**	21033	23274	**83293**[b]
2119	2880	**21063**	**23275**	83294[b]
2125	2881	**21064**	23276	**83295**[b]
2126	**2897**	**21065**	23277	83296[b]
2128	**2898**	**21192**	23278	**83335**[b]
2166	**2899**	21194	**23279**	**83336**[b]
2383	**2900**	22198	23280	**83337**[b]
2384	**3011**	22199	**23281**	**83338**[b]
2385	**3014**	22200	**23282**	**83339**[b]
2386	3015	**22201**	31217	**83340**[b]
2387	3017	22203	**32304**	**83341**[b]
			32305	**83346**[b]

[a] Bold font and shading identifies the subset of 99 wells measured the first, third, and fourth quarters of each year.
[b] Multichannel wells will have water level measurements taken in the top and bottom channels. If the top channel is dry, a measurement will be collected from the next deeper channel that is not dry.

Table 9. Analytical Requirements for the Groundwater Monitoring Program

Constituent	Analytical Method	Sample Type	ASL	Holding Time[a]	Preservative[a]	Container[a,b]
General Chemistry:						
Fluoride	300.0[c], 340.2[c], 4500C[d], or 9056[e]	Grab	D	28 days	None	Plastic
Nitrate/Nitrite	353.1[c], 353.2[c], or 4500D,E,H[e]	Grab	D	28 days	Cool to 4 °C, H_2S0_4 to pH <2	Plastic or glass
Phosphorus	365.(all)[c] or 4500E[d]	Grab	D	28 days	Cool to 4 °C, H_2S0_4 to pH <2	Plastic or glass
Inorganics:						
Metals	6020[e], 7000A[e], or 6010B[e]	Grab	D	6 months	HNO_3 to pH <2	Plastic or glass
Radionuclides and Uranium:						
Technetium-99	DOE-EML HASL 300[f]	Grab	D	6 months or 5 × half-life, whichever is less	HNO_3 to pH <2	Plastic or glass
Total Uranium	6020[e]	Grab	D	6 months	HNO_3 to pH <2	Plastic or glass
Volatile Organics[h]:	8260B[e]	Grab	D	NA[i]	Cool to 4 °C	NA[i]
		Grab	D	14 days	Cool to 4 °C H_2SO_4, HCl, or solid $NaHSO_4$ to pH <2	Glass vial with Teflon-lined septum cap
Field Parameters[g]:	FPQAPP[h]	Grab	A	NA[i]	NA[i]	NA[i]

Note: The analytical site-specific contract identifies the specific method.

[a] Appropriate preservative, holding time, and container will be used for the corresponding method.
[b] Container size is left to the discretion of the individual laboratory.
[c] *Methods for Chemical Analysis of Water and Wastes* (EPA 1983).
[d] *Standard Methods for the Examination of Water and Wastewater* (APHA 1989).
[e] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1998).
[f] *Procedures Manual of the Environmental Measurements Laboratory* (DOE 1997c).
[g] Field parameters are dissolved oxygen, pH, oxidation-reduction potential, specific conductance, temperature, and turbidity.
[h] The FPQAPP provides field analytical methods.
[i] NA = not applicable.

Not filtering groundwater samples collected at monitoring wells is a conservative (and EPA-recommended) approach to determining the true mobility of metals and uranium in groundwater. Filtering of groundwater samples at monitoring wells may take place on a case-by-case basis if deemed appropriate.

If filtering is conducted, the reasons for filtering will be provided to EPA and Ohio EPA as soon as possible and will be documented annually in the SER.

Due to the temporary nature of direct-push sampling locations and the smaller amount of development that takes place compared to a monitoring well, direct-push samples are often turbid. Therefore, direct-push groundwater samples are routinely filtered through a 5-µm filter. Past experience has shown that measured uranium concentrations in direct-push samples are consistently similar regardless of whether the sample was filtered using a 5-µm filter or a 0.45-µm filter. Therefore, direct-push samples for uranium analysis are routinely filtered through a 5-µm filter only. Exceptions to this filtering procedure include the collection of Waste Storage area parameters as discussed in Section 3.6.1.3.

3.6.1.8 Quality Control Sampling Requirements

Field quality control samples will be collected to assess the accuracy and precision of field and laboratory methods as outlined in the FPQAPP. These samples will be collected and analyzed to evaluate the possibility that some controllable practice, such as equipment decontamination, sampling technique, or analytical method, may be responsible for introducing bias in the analytical results. The following types of quality control samples will be collected: sampling equipment rinsate blanks, trip blanks, and duplicate samples. Each quality control sample is preserved using the same method as groundwater samples.

The quality control sample frequencies will be tracked to ensure that proper frequency requirements are met as follows:

- Trip blanks will be prepared for each sampling team on each day of sampling when organic compounds are included in the respective analytical program. They will be prepared before the sampling containers enter the field and will be taken into the field and handled along with the collected samples. Trip blanks will not be opened in the field.
- Equipment rinsate blanks will be collected for every 20 groundwater samples that are collected using reusable sampling equipment. If a specific sampling activity consists of less than 20 groundwater samples, then a rinsate sample will still be required. Rinsate blanks are not required when dedicated well equipment or disposable sampling equipment is used.
- Field duplicates will be collected for every 20 or fewer groundwater samples if the specific sampling program consists of fewer than 20 samples. For direct-push sampling locations, one duplicate will be collected at a chosen depth per location.

The groundwater samples associated with each quality control sample also will be tracked to ensure traceability if contaminants are detected in the quality control samples.

3.6.1.9 Decontamination

In general, decontamination of equipment is minimized by limited use of reusable equipment during sample collection. However, if decontamination is required, then sampling equipment will be cleaned between sample locations. The decontamination requirements are identified in the FPQAPP.

3.6.1.10 Waste Disposition

Wastes that will be generated during sampling activities are purge water, decontamination solutions, and contact wastes. The following subsections provide the disposal method for each type of waste generated.

Purge Water and Decontamination Solutions: All decontamination wastewater and purge water will be containerized and disposed of through the Converted Advanced Wastewater Treatment Facility (CAWWT) for treatment. The point of entry into the CAWWT will be either the CAWWT backwash basin or the OSDF permanent lift station.

Contact Wastes: Contact wastes, such as personal protective equipment, paper towels, and other solid waste is typically not contaminated with radiological constituents and is placed in plastic bags and disposed of through the normal sanitary waste stream.

3.6.1.11 Monitoring Well Maintenance

Monitoring wells at the Fernald Preserve will be maintained to keep them in a condition that is protective of the subsurface environment and to ensure that representative groundwater samples can be obtained. Two types of activities are recognized: well maintenance inspections and well evaluations.

Well Maintenance Inspections

Routine inspections of Great Miami Aquifer groundwater monitoring wells will be conducted during sampling or collection of water levels (at a minimum of once a year if the well is not being routinely sampled) to determine if the well is protective of the environment based on the inspection criteria below. All assessment and maintenance activities will be recorded on applicable field data forms. The inspections include, but are not limited to, the following:

- Ensuring that the well identification number is painted or welded on the top of the lid.
- Inspecting the ground surrounding the well for depressions and channels that allow surface water to collect and flow toward the wellhead.
- Ensuring visibility and accessibility to the well.
- Inspecting locking lids and padlocks to check for rust and ease of operation.
- Inspecting the exposed (protective) well casing to ensure that it is free of cracks and signs of corrosion; it is reasonably plumb with the ground surface; it is painted bright orange; and the well casing has no sharp edges.
- Removing and inspecting the well cap to ensure that it is free of debris, fits securely, and the vent hole is clear.

- Inspecting concrete surface seals for settling and cracking.
- Inspecting the exterior guards for visibility and damage, and repainting if necessary.

In addition to the inspection items noted above, monitoring wells that are not being routinely monitored for water quality will undergo a downhole camera survey every 5 years (at a minimum) to inspect the integrity of the casing and screen. Camera surveys were completed in 2017 and 2018. The next camera surveys will occur in 2022. Results of the survey will be presented in the annual Site Environmental Report.

Well Evaluation
A monitoring well evaluation will be initiated if there is an indication that the monitoring well may no longer be yielding a representative groundwater sample. A monitoring well may no longer be yielding a representative groundwater sample for several reasons. The well's integrity may be compromised, as determined through the well maintenance inspections discussed above. The downhole integrity of the monitoring well may be compromised, as evidenced through an increase in the turbidity of the collected sample or the amount of sediment measured in the bottom of the well. The bioaccumulation of metals around the well screen may be occurring as evidenced by the cloudiness or coloration of the collected water sample or the odor of the collected sample. If a problem is suspected, then the following work may be performed to evaluate the cause:

- Review existing well installation documentation.
- Review well history and historical water quality data to identify whether it produces consistently clear or turbid samples.
- Review groundwater sampling field records.
- Conduct a downhole camera survey to inspect the integrity of the screen and casing.

At least once a year, an assessment will be made of wells that are sampled as to whether the well is yielding a representative sample. This assessment includes, but is not limited to, the following:

- Determining how much sediment has entered the well screen and accumulated in the well, and review historical depth records. This will be done by measuring the depths of wells that do not have dedicated packers.
- Determining if any foreign material is present in the well (e.g., bentonite grout).
- Determining if the groundwater color has changed over time (e.g., due to iron bacteria).
- Evaluating turbidity within the sample.
- Noting if an odor that could be associated with biofouling (i.e., rotten-egg or fish odor) is present.

Well Maintenance Corrective Actions
Corrective actions to address problems identified in the well maintenance inspections will be conducted as soon as feasible. Corrective maintenance to address excessive turbidity will include removal of sediment from the well through redevelopment of the well.

It is possible that minerals can precipitate on well screens or that metals can bioaccumulate around well screens. If it is determined that minerals have precipitated in the well or on the well screen, or that metals have bioaccumulated around the well screen, and the representativeness of the groundwater sample is being impacted, then the limited use of chemicals (e.g., chlorine, hydrochloric acid) to remove the mineral build-up or alleviate the biofouling may be considered. CMT wells could probably not be rehabilitated due to the small diameters of the sampling channels. Chemicals have a very limited application in the rehabilitation of monitoring wells because the chemicals can cause changes such that the well will no longer yield a representative sample (EPA 1991). Changes resulting from the use of chemicals could last for a short time or could be permanent. Therefore, if chemical rehabilitation is attempted, it will only be attempted as a last resort. Water quality parameters (such as Eh [oxidation-reduction potential], pH, temperature, and conductivity) will be measured prior to the application of the chemicals and following the use of the chemicals. These measurements will serve as values for comparison of water quality before and after well maintenance.

If a groundwater monitoring well has been damaged in such a way that it is no longer protective of the subsurface environment and it cannot be repaired, then the well will be plugged and abandoned. If it is determined that the well is not yielding a representative groundwater sample, and rehabilitation efforts are not effective in correcting the condition, then the well will be considered for plugging and abandonment. If the well is still protective of the subsurface environment, then it might be used for the collection of water level data even though it does not yield representative groundwater samples. Wells designated for plugging and abandonment may be sampled one last time for a subset of water quality parameters listed in Table 6.

The exact parameter list selected for the sampling will be based on the location of the well. CMT wells being plugged and abandoned may have each available channel sampled for total uranium (or any groundwater FRL constituent) prior to being plugged and abandoned, as deemed appropriate. A replacement monitoring well will only be installed if the monitoring well that was plugged and abandoned was being actively monitored for either water quality or water levels. Any preliminary decision not to replace a monitoring well will be discussed with the EPA and Ohio EPA prior to finalizing the decision.

3.7 IEMP Groundwater Monitoring Data Evaluation and Reporting

This section provides the methods to be used in analyzing the data generated by the IEMP groundwater sampling program. It summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated groundwater data, including specific information to be reported in the annual SER, is also provided.

3.7.1 Data Evaluation

Data resulting from the IEMP groundwater program will be evaluated to meet the program expectations identified in Section 3.4.1. Data evaluation will look at both the operational efficiency and the operational effectiveness of the groundwater remediation system (EPA 1992). Operational efficiency refers to implementing the most efficient remedy possible. The objectives are to minimize downtimes, conduct stable operations, meet planned performance goals, and operate a cost-effective system. Operational efficiency will be assessed by tracking the following:

- Pumping rates for individual wells and modules.

- Gallons of water pumped.
- Extraction well total hours of operation during the year.
- The volume of treated water.
- Planned versus actual gallons of water pumped.

Operational effectiveness refers to the evaluation of the degree of contamination cleanup achieved. Operational effectiveness will be assessed by tracking the following:

- Planned versus actual pounds of uranium removed from the Great Miami Aquifer.
- Pounds of uranium removed per million gallons of water pumped (uranium removal index).
- Running cumulative pounds of uranium removed from the Great Miami Aquifer versus predicted running cumulative pounds of uranium removed from the Great Miami Aquifer.
- Total uranium concentration data collected from extraction wells.
- Total uranium concentration data collected from monitoring wells.
- Water level data collected from monitoring wells.
- Interpretations of capture zones.
- Regression curves of uranium concentration data at extraction wells.

Most of the data will be tabulated, presented in graphs, or presented in maps and evaluated in the following manner:

- Concentration versus time plots for specific constituents.
- Tables identifying wells with constituents above FRL concentrations.
- Mann-Kendall trend analyses for specific constituents.
- Concentration contour maps.

Large quantities of data will be collected and evaluated each year. In order to evaluate the sampling results, the data collected for the IEMP will be presented and evaluated using the formats above. The findings of data evaluations will be shared with project personnel. EPA and Ohio EPA have indicated that this is a successful method of evaluating and presenting the data. Groundwater monitoring program data will be evaluated to:

- Assess progress in capturing and restoring the area containing the greater than or equal to 30-µg/L total uranium plume.
- Assess progress in capturing and restoring the areas affected by non-uranium FRL exceedances.
- Assess water quality at the downgradient Fernald Preserve property boundary.
- Assess model predictions.
- Assess the impact that the aquifer restoration is having on the PRRS plume.
- Meet other monitoring commitments.
- Address community concerns.

The aquifer restoration system is designed to reduce the concentration of uranium and non-uranium FRL constituents in the aquifer to concentrations that are at or below their FRLs. Because uranium is the principal COC, the aquifer restoration system has been designed to capture the 30-µg/L total uranium plume, with the understanding that the system may need to be modified in the future to capture and remediate non-uranium FRL constituents.

Extraction wells have been positioned within each restoration module to capture the uranium plume. Operational decisions and pumping changes will focus on the capture of the uranium plume. Operational changes to meet non-uranium FRLs are considered to be a secondary objective. However, evaluation of the need for an operational change to address non-uranium FRL constituents will be ongoing throughout the aquifer remediation period and is expected to gain in importance as the achievement of the uranium objective approaches.

Following is a discussion of how each of the groundwater program expectations is intended to be met through evaluation of IEMP groundwater data.

<u>Capturing and Restoring the Area Containing the greater than or equal to 30-µg/L Total Uranium Plume</u>
Capture and restoration of the area containing the greater than or equal to 30-µg/L total uranium plume will be evaluated using groundwater elevation data and the most current maximum total uranium plume interpretation. Groundwater elevation maps with capture zone and flow divide interpretations will be prepared to evaluate the extent of capture.

Remediation of the greater than or equal to 30-µg/L total uranium plume will be assessed by monitoring total uranium concentrations over time. The greater than or equal to 30-µg/L maximum total uranium plume will be mapped and compared to previous maps to determine how the plume has changed in response to remediation. Direct-push sampling data will be used throughout the remedy to supplement fixed monitoring well location data by providing vertical profile concentration data.

If a new total uranium FRL exceedance is detected in the aquifer, then an attempt will be made to determine the cause of the exceedance. Considerations will include:

- Movement of known total uranium contamination in response to pumping or natural migration.
- Previously undetected uranium contamination that has now moved into a monitoring zone as a result of pumping or natural migration.

When a new extraction well begins operating, water levels will be collected more frequently until conditions have stabilized. Once conditions have stabilized, monitoring will fall back to the regular IEMP monitoring schedule. Individual startup plans will provide specifics on the frequency of water level and water quality data collection during the startup time period.

<u>Capturing and Restoring the Areas Affected by Non-uranium FRL Exceedances</u>
The OU5 ROD identifies 49 FRL constituents, other than total uranium, that also need to be tracked as part of the aquifer restoration. These 49 constituents are collectively referred to as the non-uranium FRL constituents. During the aquifer restoration, groundwater monitoring will take

place for the non-uranium FRL constituents. Constituents that have been detected in the aquifer above their respective FRLs will be monitored semiannually.

Non-uranium FRL constituent concentration trends in the Great Miami Aquifer will be assessed through trend analysis when sufficient data have been obtained. The Mann-Kendall statistical test for trend will be used to facilitate the trending interpretation. Concentration versus time plots may be used to illustrate how the concentrations are trending.

If a new non-uranium FRL exceedance is detected in the aquifer, then an attempt will be made to determine the cause of the exceedance. Considerations will include:

- Movement of known contamination in response to pumping or natural migration.
- Previously undetected contamination that has now moved into a monitoring zone as a result of pumping or natural migration.

Any FRL exceedance detected at a property boundary/plume boundary well location will be evaluated using the same data evaluation protocol that was approved for the *Restoration Area Verification and Sampling Program, Project Specific Plan* (DOE 1997d) to determine if additional action is required. The constituent concentration data over time will be graphed. If two or more sampling events following an FRL exceedance indicate that the concentrations are below the FRL, then the location will not be considered for remediation or further monitoring beyond what is already prescribed by the IEMP. If sampling following the initial FRL exceedance indicates that the exceedance was not just a one-time occurrence, and the exceedance is judged to be the result of Fernald Preserve activities (either historical or current), then action will be taken to address the exceedance.

Meeting Other Monitoring Commitments

Other groundwater monitoring commitments that need to be addressed are private well sampling, property boundary monitoring, and fulfillment of DOE Order 458.1 requirements to maintain an environmental monitoring program for groundwater.

Total uranium data collected at private wells will be graphed to illustrate changes and will be used in the preparation of total uranium contour maps. Data collected from the Fernald Preserve property/plume boundary monitoring system will be compared to FRLs. This will facilitate the detection and monitoring of FRL exceedances and will determine if interim actions are warranted, in addition to implementing the sitewide aquifer restoration.

Groundwater Modeling

Groundwater uranium concentration data and water level data obtained through the life of the remedy will be compared against model-predicted concentrations and water levels to evaluate how reasonable the predictions are over the long term. Individual well residuals (model-predicted concentration versus actual measured concentrations) will be determined without running the model. Monitoring wells in the remediation footprint of the aquifer will be included in the residuals exercise. Assessments will be conducted every 5 years. Results of the first assessment were provided in the 2007 Site Environmental Report (DOE 2008a). Results of the second assessment were provided in the *Fernald Preserve 2010 Site Environmental Report* (DOE 2011). A brief summary of background information on the groundwater model can be found in previous versions of the IEMP.

Operational changes to the Waste Storage area Phase-II design were implemented in 2014. Following the same protocol described above, assessments of the new operational performance began in 2015 for the extraction wells. Assessments for the monitoring wells began with data collected in 2016.

Assess the Impact that the Aquifer Restoration Has on the Paddys Run Road Site Plume

As has been done since 1997, concentration data collected for key PRRS constituents will be evaluated using trend analysis. Water level maps will be produced to determine where capture is occurring due to pumping in the South Plume Module.

Adequately Address Community Concerns

The IEMP fulfills the informational needs of the Fernald community by preparing groundwater environmental results in the annual SER. DOE makes these reports available to the public. Comments received over the life of the IEMP program regarding the IEMP groundwater program will be considered for future revisions to the IEMP.

Groundwater Certification Process and Stages

A Groundwater Certification Plan has been prepared for the groundwater remedy. The objective of the Certification Plan is to document the process that will be followed to certify that aquifer remedy objectives have been met. As explained below, pump-and-treat operations are currently in progress at the Fernald Preserve. The IEMP is the controlling document for remedy performance monitoring during the pump-and-treat operational period. The IEMP will continue to be the controlling document for all groundwater monitoring needed to support the certification process following completion of pump-and-treat operations.

Figure 11 illustrates the groundwater certification process. Six stages have been identified for the certification process:

- Stage I: Pump-and-Treat Operations
- Stage II: Post Pump-and-Treat Operations/Hydraulic Equilibrium State
- Stage III: Certification/Attainment Monitoring
- Stage IV: Declaration and Transition Monitoring
- Stage V: Demobilization
- Stage VI: Long-Term Monitoring

Remedy performance monitoring is currently supporting pump-and-treat operations. As illustrated in Figure 11, remedy performance monitoring is conducted to assess the efficiency of mass removal and to gauge performance in meeting FRL objectives. If it is determined that high mass removal is not being maintained, or FRL goals are not being achieved, then the need for operational adjustment will be evaluated and implemented if deemed appropriate. A change to the operation of the aquifer restoration system would be implemented through the OMMP. A groundwater monitoring change, if found to be necessary, would be implemented through the IEMP. If additional characterization data are needed beyond the current scope of the IEMP, then a separate sampling plan will be prepared. Additional sampling activities may use other sampling techniques, such as a direct-push sampling tool, which has been successfully used at the Fernald Preserve to obtain groundwater samples without the use of a permanent monitoring well.

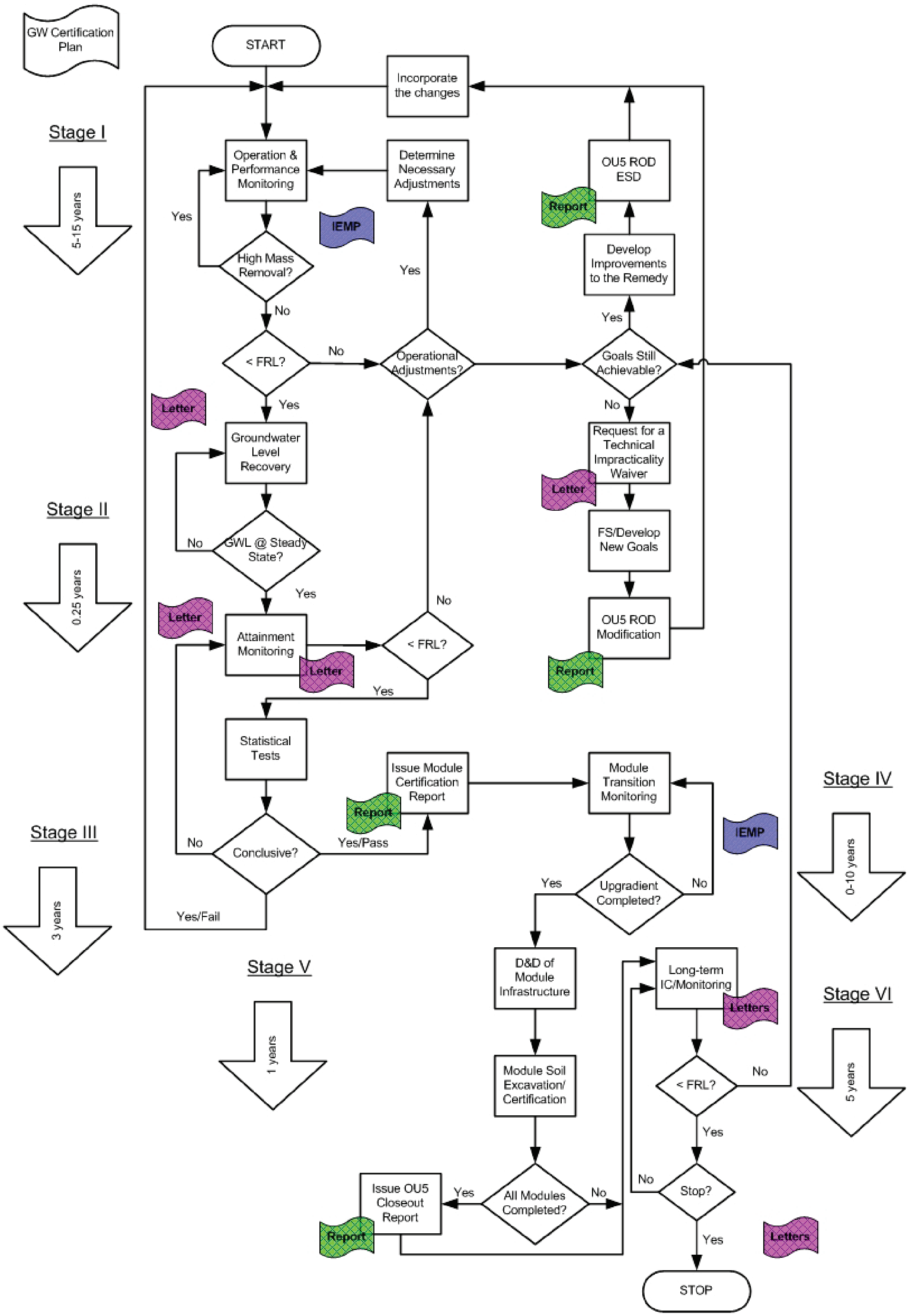

Figure 11. Groundwater Certification Process and Stages

The IEMP will be used to document the approach for determining when various modules can be removed from service and groundwater monitoring can focus on subsequent stages of the groundwater certification process.

3.7.2 Reporting

The IEMP groundwater program data will be reported in the annual SER and posted on the LM website at https://www.energy.gov/lm/fernald-preserve-ohio-site. Data on the website will be in the format of searchable data sets and downloadable data files. Additional information on IEMP data reporting is provided in Section 6.0.

The annual SER will be issued each June for the previous calendar year. This comprehensive report discusses a year of IEMP data previously reported on the LM website. The report includes the following:

Operational Assessment

- The set-point pumping rates for each extraction well during the year.
- The uranium removal rate of individual extraction wells.
- Extraction well total hours of operation during the year.
- The volume of treated groundwater.
- Extraction well operating time expressed as a percentage of total available operating time.
- The volume of water pumped from each extraction well during the year.
- Planned versus actual gallons of water pumped.
- The net water balance.
- Total pounds of uranium removed from the aquifer during the year.
- Total pounds of uranium removed from the aquifer since the start of remediation.
- Planned versus actual pounds of uranium removed from the Great Miami Aquifer.
- Running cumulative pounds of uranium removed from the Great Miami aquifer versus predicted running cumulative pounds of uranium removed from the Great Miami Aquifer.
- Total uranium concentration data collected from extraction wells.
- Total uranium concentration data collected from monitoring wells.
- Water level data collected from monitoring wells.
- The maximum, minimum, and average uranium concentration sent to treatment during the last year.
- The monthly average uranium concentration in water discharged to the Great Miami River during the year.
- Pumping rate figures for each extraction well.
- Regression curves of uranium concentration data at extraction wells.

Aquifer Conditions

- The area of capture during the year.
- A description of the geometry of the total uranium plume during the year.
- The effect that pumping had on the PRRS plume during the year.
- The status of non-uranium FRL exceedances, including any newly detected FRL exceedances.
- Identification of any new areas of FRL exceedances.
- A comparison of groundwater restoration performance with respect to model predictions established in the *Operational Design Adjustments-1 WSA Phase-II Groundwater Remediation Design Fernald Preserve* (DOE 2014b).
- Any changes that may have been made to the operation or design.

Data That Support the OSDF Groundwater/Leak Detection and Leachate Monitoring Plan

- Status information pertaining to the OSDF wells.
- Leachate volumes and concentrations from the leachate collection system and from the leak detection system for the OSDF.
- Results of semiannual groundwater sampling.

In addition, the annual SER will include trend analysis of the data collected from the OSDF and a summary of monitoring well maintenance actions.

The annual review cycle provides the mechanism for identifying and initiating any groundwater program modifications (e.g., changes in constituents, locations, or frequencies) that are necessary to align the IEMP with the current activities. Any program modifications that may be warranted prior to the annual review would be communicated to EPA and Ohio EPA.

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4.0 Surface Water and Treated Effluent Monitoring Program

Section 4.0 discusses the monitoring strategy for assessing sitewide surface water and treated effluent. The strategy includes compliance-based monitoring and reporting obligations, a medium-specific plan, sampling design, and data evaluation.

4.1 Integration Objectives for Surface Water and Treated Effluent

The IEMP is the designated mechanism for conducting the sitewide surface water and treated effluent surveillance and compliance monitoring. In this role, the IEMP serves to integrate several compliance-based monitoring and reporting programs currently in existence for the Fernald Preserve:

- The discharge monitoring and reporting program related to the site's NPDES permit.
- The radiological monitoring of and reporting for the treated effluent mandated by the OU5 ROD.
- The IEMP Characterization Program, which combines portions of the former Environmental Monitoring Program that has been ongoing at the Fernald Preserve since the 1950s and was updated in Revision 0 of the IEMP (DOE 1997b), to accommodate surface water monitoring during the post-closure period.

4.2 Analysis of Regulatory Drivers, DOE Requirements, and Other Fernald Preserve Site-Specific Agreements

This section presents a summary evaluation of the regulatory drivers governing the monitoring of the Fernald Preserve's point-source and non-point-source discharges to Paddys Run and the Great Miami River. The intent of this section is to identify the pertinent regulatory requirements for the scope and design of the surface water and treated effluent monitoring program. These requirements will be used to confirm that the program satisfies the regulatory obligations for monitoring that have been activated by the RODs and will achieve the intentions of other pertinent criteria, such as DOE orders and the Fernald Preserve's existing agreements and permits, as appropriate, that have a bearing on the scope of surface water and treated effluent monitoring.

4.2.1 Approach

The analysis of the regulatory drivers and requirements for surface water and treated effluent monitoring was conducted by examining the ARARs and CERCLA RODs to identify subsets with specific environmental monitoring requirements. The Fernald Preserve's existing compliance agreements issued outside the CERCLA process were also reviewed.

4.2.2 Results

The surface water and treated effluent monitoring program described in this IEMP has been developed with full consideration of the regulatory drivers and requirements. Table 10 lists each of these IEMP drivers and the associated actions conducted to comply with them. A brief summary of regulatory drivers and requirements has been provided in previous IEMPs.

Sections 4.5 and 5.0 provide the Fernald Preserve's current and long-range plan for complying with the reporting requirements invoked by these drivers.

Table 10. Fernald Preserve Surface Water and Treated Effluent Monitoring Program Regulatory Drivers and Actions

	Driver	Action
IEMP	DOE Order 458.1, Admin Chg 4, *Radiation Protection of the Public and the Environment*	The IEMP includes a description for routine sampling of Paddys Run and onsite drainage ditches for radiological constituents.
	CERCLA Remedial Design Work Plan (DOE 1996a)	The IEMP describes treated effluent and surveillance monitoring.
	OU5 ROD	The IEMP will be modified toward completion of the remedial action to include surface water sampling to certify FRL achievement. The IEMP includes monitoring for performance-based uranium discharge limits.
	OU5 Feasibility Study/OU5 ROD	The IEMP will be modified toward completion of the remedial actions to include sediment sampling to verify FRL achievement.
	NPDES Permit	The IEMP describes routine sampling of permit-designated treated effluent discharges and storm water drainage points for NPDES permit constituents.
	Federal Facilities Compliance Agreement Radiological Monitoring	The IEMP describes the routine sampling at the Parshall Flume (PF 4001) for radiological constituents[a].

[a] Radium-228 was eliminated from PF 4001 monitoring requirements beginning in 2019 as described in Section B.1.5 of the 2017 SER (DOE 2018).

Note: Soil and sediment at the Fernald Preserve have been certified, with the exception of those areas identified in Figure 1 and Figure 2. Therefore, it is not expected that FRL exceedances will occur in association with uncontrolled runoff.

4.3 Program Expectations and Design Considerations

4.3.1 Program Expectations

The expectations for the surface water and treated effluent monitoring program are to:

- Provide an ongoing assessment of the potential for cross-medium impacts from surface water to the underlying Great Miami Aquifer at locations near the point where the protective glacial overburden has been breached by site drainages.
- Document whether the sporadic exceedances of FRLs in various site drainages (noted in IEMP reports) continue to occur at key onsite locations, at the property boundary on Paddys Run, and in the Great Miami River outside the mixing zone, and determine if monitoring can be reduced based on surface water data results.
- Provide an assessment of impacts to surface water due to uncontrolled runoff.
- Provide additional data at background locations on Paddys Run and the Great Miami River to refine the ability to distinguish site impacts from background.
- Continue to fulfill monitoring and reporting requirements associated with the site NPDES permit.

- Continue to fulfill monitoring and reporting requirements associated with the FFCA and OU5 ROD.
- Continue to address the concerns of the community regarding the magnitude of the Fernald Preserve's discharges to surface water (i.e., to Paddys Run and the Great Miami River).

The following section provides the design considerations required to fulfill these expectations.

4.3.2 Design Considerations

This section provides the IEMP surface water and treated effluent monitoring program design considerations. The nonradiological discharge monitoring and reporting related to the NPDES permit has been incorporated into the IEMP. The radiological discharge monitoring related to the FFCA and OU5 ROD has been incorporated into the IEMP.

4.3.2.1 Constituents of Concern

A comprehensive list of surface water COCs is presented in Table 11. The following is a description of information provided in Table 11.

- Column 1, Constituent: This column represents the constituents for which an FRL was established in the OU5 ROD.
- Column 2, FRL (Final Remediation Level): This column represents the human/health protective remediation levels for surface water that were established in the OU5 ROD.
- Column 3, FRL Basis: This column is the basis for establishment of the FRL as defined in the OU5 Feasibility Study.
- Column 4, Background Values in Surface Water: This column represents updated 95th percentile background values for Paddys Run and the Great Miami River based on data collected for the IEMP through 2011 (Revised). In addition, the original 95th percentile background values are provided from the *Remedial Investigation Report for Operable Unit 5* (DOE 1995e). The IEMP provides this information for purposes of comparison.

The parameters and locations for monitoring are indicated in Table 12.

Table 11. Surface Water Selection Criteria Summary

Constituent	FRL[a]	FRL Basis[a]	95th Percentile Background Level in Surface Water[b,c]			
			Paddys Run		Great Miami River	
			Original	Revised	Original	Revised
General Chemistry (mg/L)						
Fluoride	2.0	A	0.22	0.091	0.9	0.504
Nitrate/Nitrite	2400	R	1.7	4.90	6.6	7.87
Inorganics (mg/L)						
Antimony	0.19	A	ND	0.0012	ND	0.00175
Arsenic	0.049	R	ND	0.00616	0.0036	0.0139
Barium	100	R	0.053	0.0545	0.1	0.100
Beryllium	0.0012	A	ND	0.0003	ND	0.0009
Cadmium	0.0098	B	ND	0.00074	0.01	0.000221
Chromium (VI)[d]	0.010	D	ND	0.00890	ND	0.00842
Copper	0.012	A	ND	0.00575	0.012	0.00910
Cyanide	0.012	A	ND	0.00367	0.005	0.00412
Lead	0.010	B	ND	0.00568	0.010	0.00840
Manganese	1.5	R	0.035	0.238	0.08	0.117
Mercury	0.00020	D	ND	0.000104	ND	0.000075
Molybdenum	1.5	R	ND	0.00328	0.02	0.00902
Nickel	0.17	A	ND	0.00792	0.023	0.0105
Selenium	0.0050	A	ND	0.00254	ND	0.00293
Silver	0.0050	D	ND	0.000656	ND	0.000348
Vanadium	3.1	R	ND	0.0188	ND	0.00671
Zinc	0.11	A	ND	0.0292	0.045	0.0428

Table 11. Surface Water Selection Criteria Summary (continued)

Constituent	FRL[a]	FRL Basis[a]	95th Percentile Background Level in Surface Water[b,c]			
			Paddys Run		Great Miami River	
			Original	Revised	Original	Revised
Radionuclides (pCi/L) and Uranium						
Cesium-137	10	R	3.1	4.74	ND	3.16
Neptunium-237	210	R	–	0.054	ND	0.083
Lead-210	11	R	–	2.97	–	2.45
Plutonium-238	210	R	ND	ND	ND	0.038
Plutonium-239/240	200	R	0.09	0.093	ND	0.01
Radium-226	38	R	0.35	0.808	0.41	0.791
Radium-228	47	R	2.1	1.73	2.2	3.79
Strontium-90	41	R	0.96	0.712	ND	1.14
Technetium-99	150	R	ND	4.64	ND	7.64
Thorium-228	830	R	ND	0.238	0.62	0.185
Thorium-230	3500	R	ND	0.539	0.36	0.605
Thorium-232	270	R	ND	0.213	ND	0.144
Uranium, Total **(µg/L)**	530	R	1.0	1.31	1.0	2.03
Pesticide/PCBs (µg/L)						
Alpha-Chlordane	0.31	R	–	ND	–	0.003
Aroclor-1254	0.20	D	–	ND	–	ND
Aroclor-1260	0.20	D	–	ND	–	ND
Dieldrin	0.020	D	–	ND	–	0.0095
Semivolatiles (µg/L)						
Benzo(a)anthracene	1.0	D	–	ND	–	ND
Benzo(a)pyrene	1.0	D	–	ND	–	ND
Bis(2-chloroisopropyl)ether	280	R	–	ND	–	ND
Bis(2-ethylhexyl)phthalate	8.4	A	–	2	–	2.5
Dibenzo(a,h)anthracene	1.0	D	–	ND	–	1.9
3,3’-Dichlorobenzidine	7.7	R	–	ND	–	ND

Table 11. Surface Water Selection Criteria Summary (continued)

Constituent	FRL[a]	FRL Basis[a]	95th Percentile Background Level in Surface Water[b,c]			
			Paddys Run		Great Miami River	
			Original	Revised	Original	Revised
Semivolatiles (µg/L) (Cont.)						
Di-n-butylphthalate	6000	R	–	5.09	–	5.5
Di-n-octylphthalate	5.0	D	–	1.75	–	ND
p-Methylphenol	2200	R	–	ND	–	0.6
4-Nitrophenol	7,400,000	R	–	ND	–	ND
Volatiles (µg/L)						
Benzene	280	R	–	ND	–	0.35
Bromodichloromethane	240	R	–	ND	–	ND
Bromomethane	1300	R	–	ND	–	ND
Chloroform	79	A	–	0.782	–	0.3
1,1-Dichloroethene	15	R	–	ND	–	ND
Methylene chloride	430	A	–	1	–	ND
Tetrachloroethene	45	R	–	0.367	–	ND
1,1,1-Tricholoroethane	1.0	D	–	ND	–	ND
1,1,2-Tricholoroethane	230	R	–	ND	–	ND
Other Constituents						
Ammonia	–	–	–	0.14	–	0.496
Carbon disulfide	–	–	–	ND	–	0.35
Cobalt	–	–	–	-	–	0.00287
Trichloroethene	–	–	–	0.2	–	ND

[a] Derived from OU5 ROD, Table 9–5.
A = ARAR values
B = background concentrations
D = analytical detection limit
R = human health risk
[b] ND = not detected.
– = not applicable/not available
[c] For small data sets (less than or equal to seven samples), the maximum detected concentration is used as the 95th percentile.
[d] FRL based on chromium (VI); however, the analytical results are for total chromium.

Table 12. Summary of Surface Water and Treated Effluent Sampling Requirements by Location

Location	Constituent[a]	IEMP Characterization Requirements (reason for selection)[b,c]	NPDES Requirements[c]
SWR-01 (SWR-4801 for NPDES only) (Great Miami River Background)	**General Chemistry:**		
	Ammonia	–	Quarterly
	Nitrate/Nitrite	–	Quarterly
	Total Kjeldahl Nitrogen	–	Quarterly
	Total Phosphorous as P	–	Quarterly
SWP-03 (Paddys Run at Downstream Property Boundary)	**Radionuclides and Uranium:**		–
	Uranium, Total	Annually (PC)	–
PF 4001 (Parshall Flume—Treated Effluent)	**General Chemistry:**		
	Carbonaceous biochemical oxygen demand	–	2/Week
	Nitrate/nitrite	–	Quarterly
	Oil and grease	–	2/Week
	Total dissolved solids	–	Monthly
	Total Kjeldahl Nitrogen		Quarterly
	Total phosphorus as P	–	Monthly
	Total suspended solids	–	Daily
	Inorganics:		
	Mercury (low level)	–	Quarterly
	Radionuclides and Uranium:		
	Uranium, Total	Semiannually (PC)	Daily[d]
	Other:		
	Flow rate	–	Daily
STRM 4005 (Drainage to Paddys Run)	**Radionuclides and Uranium:**		
	Uranium, Total	Semiannually (PC)	–
4007 (Biowetland Emergency Overflow to Paddys Run)	Flow rate	–	Daily during overflow
SWD-04[e]	**Radionuclides and Uranium:**		
	Uranium, Total	Semiannually (PC)	–
SWD-05[e]	**Radionuclides and Uranium:**		
	Thorium-228	Annually(C)	–
	Thorium-232	Annually (C)	–
	Uranium, Total	Semiannually (PC)	–
SWD-08	**Radionuclides and Uranium:**		
	Thorium-232	Annually (C)	
	Uranium, Total	Semiannually (PC)	
SWD-09	**Radionuclides and Uranium:**		
	Uranium, Total	Semiannually (PC)	–
SWR-4902 (Downstream of Fernald Preserve Effluent)	**General Chemistry:**		
	Total Hardness	–	Quarterly
	Ammonia	–	Quarterly
	Nitrate/Nitrite	–	Quarterly
	Total Kjeldahl Nitrogen	–	Quarterly
	Total Phoshorous as P		Quarterly

[a] Field parameter readings, taken at each location, include temperature, specific conductance, pH, and dissolved oxygen.
[b] C = DOE response to Ohio EPA comment, 2008 LMICP, M = based on modeling; PC = primary COC;
[c] "–'' indicates the constituent is not included in the sample program.
[d] This constituent is sampled under the OU5 ROD.
[e] Locations are based on sampling from Residual Risk Assessment Analysis (DOE 2007) and lack of glacial overburden.

4.3.2.2 Surface Water Cross-Medium Impact

To assess the cross-medium impact that contaminated surface water has on the underlying Great Miami Aquifer, the following design considerations are necessary:

- Samples should be collected at points near where the glacial overburden has been breached by site drainages (Figure 12). At these locations (i.e., SWD-04, SWD-05, and SWD-08) a direct pathway exists for surface water and associated contaminants to reach the underlying sand and gravel Great Miami Aquifer.
- During remediation and restoration efforts, new wetlands and ponds were created within the site perimeter. Some of these water bodies have little or no underlying glacial overburden. Therefore, five additional surface water locations (SWD-04, SWD-05, SWD-06, and SWD-08) were selected to assess the possible impacts of surface water infiltrating into the aquifer. Sampling at these locations will occur semiannually for uranium to evaluate potential impacts. Data will be evaluated annually to determine the need for further sampling. Location SWD-05 was selected specifically to monitor any impact on the underlying groundwater from surface water where elevated uranium concentrations have been discovered. This area is a small watershed draining south to this location where surface water then dissipates via infiltration or evaporation. It appears from a study conducted in March 2007 that the soil leachability characteristics in this area differ from those of the surrounding area. A maintenance activity was implemented in the summer of 2007 to remove a limited amount of soil from the area. To monitor how the area has responded to this maintenance activity, another location (SWD-09) upgradient of SWD-05 is also being monitored.
- Constituents analyzed should represent those area-specific COCs identified in the OU5 Feasibility Study and subsequent fate and transport modeling as having the potential for cross-medium impact to groundwater via the surface water pathway.

4.3.2.3 Sporadic Exceedances of FRLs

Sample locations should be (1) on-property locations downstream of historical FRL exceedances, (2) at the point where Paddys Run flows off the Fernald Preserve property, and (3) at the Parshall Flume (PF 4001), where treated effluent is discharged from the Fernald Preserve to the Great Miami River. (Refer to Figure 13 for IEMP surface water and treated effluent sample locations).

To determine the concentration of the treated effluent constituents outside the mixing zone in the Great Miami River, a conservative calculation using the 10-year, low-flow conditions is necessary and requires that flow conditions at the Hamilton Dam gauge be periodically reviewed.

To assist in the development of the scope and focus of the IEMP surface water and treated effluent program, a review of the IEMP monitoring data is conducted periodically. The recommended parameters and locations for monitoring are indicated in Table 12 (i.e., IEMP Characterization). To provide surveillance monitoring for FRL exceedances, samples will be collected and analyzed for those constituents and associated monitoring frequencies identified in Table 12.

Constituents are monitored at SWP-03 because it is the last location that surface water is monitored on Paddys Run prior to leaving the site, and all area-specific constituents are monitored at this location in order to be conservative. Previous years' IEMPs provided maps detailing surface water locations with historical FRL exceedances, including those exceedances at background locations.

4.3.2.4 Impacts to Surface Water Due to Storm Water Runoff

With remediation completed, there are no areas where storm water runoff is controlled, with the exception of the footprint of the CAWWT tanks located on a controlled pad. However, IEMP surface water monitoring will continue at points of storm water runoff entry into receiving waters or within main site drainage ditches (in addition to ambient monitoring for background quantification purposes). Figure 14 shows a comparison of average total uranium concentrations at Paddys Run at sample location SWP-03. Important distinctions regarding uranium in storm water runoff from the site to Paddys Run, based on the data in Figure 14, include:

- Average concentrations have been far below the human health protective surface water FRL of 530 µg/L each year since 1981, including 9 years that the site was in production.
- Annual average monthly concentrations have been consistently below the human health protective groundwater FRL of 30 µg/L each year since 1986.
- Temporary controls are used during construction activities to minimize increased sedimentation into receiving streams. The Ohio Department of Natural Resources Rainwater and Land Development Standards (ODNR 2006) identify the best management practices to be used for construction projects.

4.3.2.5 Background Evaluation

Because the remedial investigation/feasibility study background data set for Paddys Run and the Great Miami River surface water was limited by the number of samples and temporal variability represented by the samples, monitoring for surface water background has been performed from the initiation of the IEMP through 2004 for all 55 surface water FRL constituents identified in Table 11. Although there are only 17 area-specific surface water constituents (i.e., constituents identified as being FRL concerns and monitored under the IEMP characterization program), the extensive list of 55 constituents was monitored at background to establish a robust data set. The more extensive list was monitored at background so that if soil sampling indicated the need to expand the list of 17 area-specific surface water constituents, there would be corresponding background data.

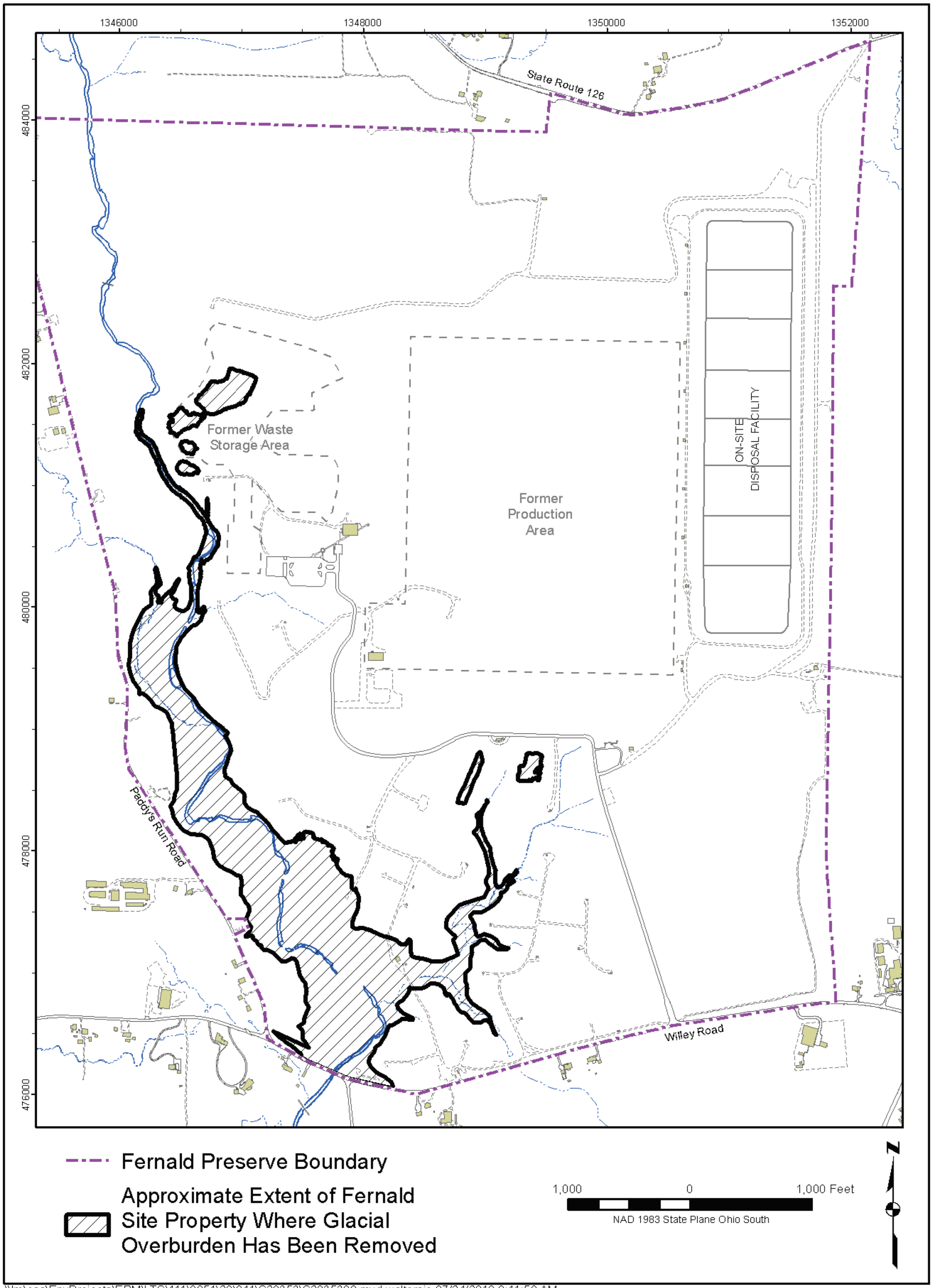

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Figure 12. Area Where Glacial Overburden Has Been Removed

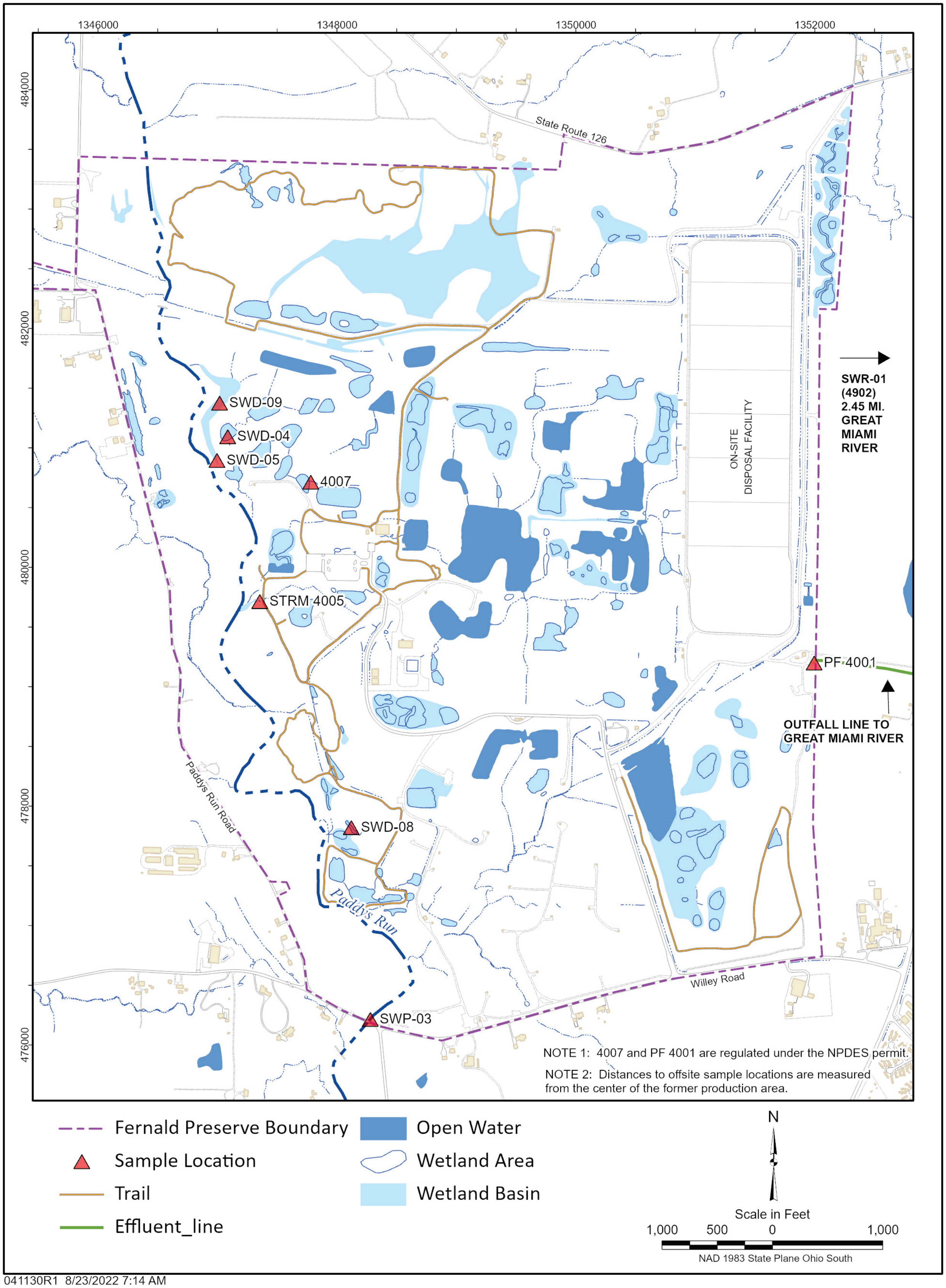

Figure 13. IEMP Surface Water, NPDES, and Treated Effluent Sample Locations

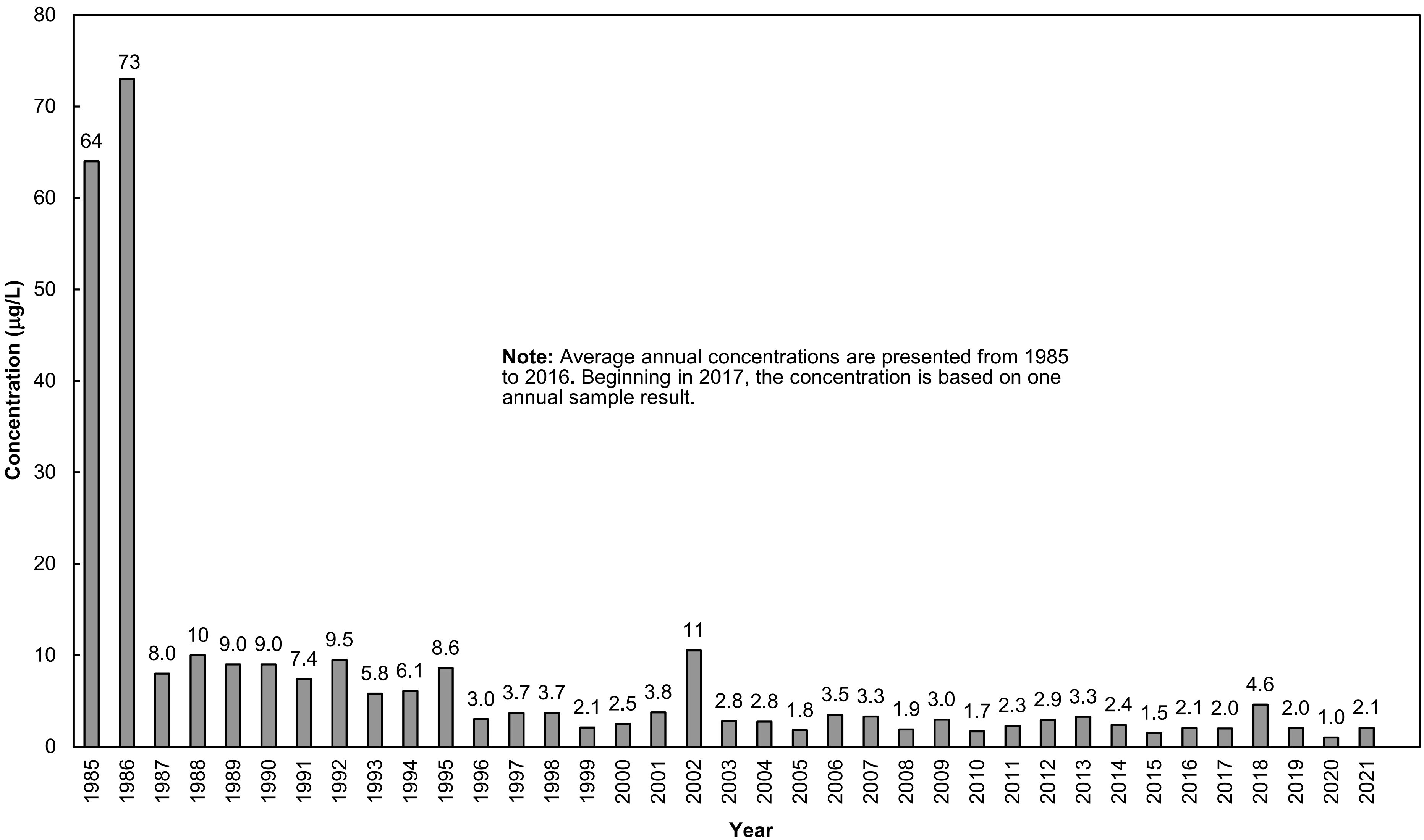

Figure 14. Comparison of Average Total Uranium Concentrations in Paddys Run at Willey Road Sample Location SWP-03

Because soil sampling did not indicate a need to add constituents to the list of 17 area-specific surface water constituents, and an abundance of background data are available, the list of surface water constituents monitored at the background locations was reduced to coincide with the 17 area-specific constituents monitored for surface water FRLs beginning in 2005. In 2008, the list was reduced from 17 to 10 based on monitoring data results and agencies' approvals.

In 2012, the background values were recalculated using data from August 1997 through 2011. The revised values are provided in Table 11. Background locations were only sampled for uranium and applicable NPDES requirements as specified in Section 4.3.2.6 in 2014 through 2016. In 2016, surface water sampling was discontinued at background location SWP-01 and uranium will no longer be sampled at location SWR-01.

4.3.2.6 Fulfill NPDES Requirements

As noted in Section 4.2.2, treated effluent and storm water discharges from the Fernald Preserve are regulated under the State-administered NPDES program. Ohio EPA Permit 1IO00004*ID took effect on March 1, 2015, and expires on February 29, 2020. A modification to the permit was submitted in the fall of 2018 to change the frequency of pH measurements at the Parshall Flume (PF 4001) from continuous to once per week. The change became effective of December 1, 2018. Figure 13 identifies the NPDES permit sample locations.

4.3.2.7 Fulfill Federal Facilities Compliance Agreement and OU5 ROD Requirements

The design considerations provided in Section 4.3.2 are sufficient to meet or exceed the current FFCA sampling and reporting requirements as summarized in Section 4.2.2. The sampling requirements include sampling at the PF 4001 and the South Plume extraction wells. In addition to these sampling requirements, an estimate of the amount of uranium reaching Paddys Run via uncontrolled storm water runoff is calculated. Section 3.2.2 discusses sampling of the South Plume extraction wells. As discussed in Section 5.0, monitoring data required by the FFCA have been incorporated into the comprehensive IEMP reporting structure.

4.3.2.8 Address Concerns of the Community

The monitoring described in Section 4.3.2.4 will be sufficient to address the concerns of the community. These concerns focus on limiting the amount of Fernald Preserve-related contamination entering Paddys Run and the Great Miami River. This monitoring will provide a comprehensive monitoring program in bodies of water near public access areas, in Paddys Run at the site boundary, and in the treated effluent destined for the Great Miami River.

In 2009, total uranium sampling at four locations was added where the public could access the surface water as trails were constructed. Sampling at these four locations continued through 2022. As stated in the Fifth CERCLA Five Year Review Report (DOE 2021b) and the 2021 Site Environmental Report (DOE 2022), based on a review of the over 10 years of data collected at these locations, it is appropriate to discontinue monitoring. With approval from the regulators, these changes are being implemented in 2023.

4.4 Medium-Specific Plan for Surface Water and Treated Effluent Sampling

This section serves as the medium-specific plan for implementation of the sampling, analytical, and data management activities associated with the IEMP surface water and treated effluent sampling program. The activities described in this medium-specific plan were designed to provide data of sufficient quality to meet the program expectations as stated in Section 4.3.1. The program expectations, along with the design considerations presented in Section 4.3.2, were used as the framework for developing the monitoring approach presented in this plan. All sampling procedures and analytical protocols described or referenced in this IEMP are consistent with the requirements of the FPQAPP.

4.4.1 Sampling

To fulfill the requirements of the integrated surface water and treated effluent monitoring program, surface water and treated effluent samples shall be collected from locations shown in Figure 13.

Sample analysis will be performed either onsite or at offsite contract laboratories, depending on analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing have been audited to ensure that DOECAP or equivalent process requirements have been met as specified in FPQAPP. These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

4.4.1.1 Sampling Procedures

Surface water and treated effluent will be sampled using the requirements specified in the FPQAPP, which have been incorporated into the *Fernald Preserve and Mound, Ohio, Sites Environmental Monitoring Procedures* (DOE2021a).

Table 13 and Table 14 identify the sample preservative, volume, and container requirements for each constituent.

<u>Surface Water Sampling</u>
Surface water samples will be collected from locations identified in Figure 13. Sampling personnel will ensure that access to the sample locations will not result in the inadvertent introduction of foreign materials into the water sample. Additional precautions will be taken to avoid the introduction of floating organic material such as leaves or twigs during sample collection. Samples will be collected without disturbing bottom sediment. Sample technicians shall approach sample locations from downstream of the location; if sample locations are accessed by way of a bridge, samples shall be collected on the upstream side of the bridge.

Table 13. Surface Water Analytical Requirements for Constituents at Sample Locations STRM4005, SWD-04, SWD-05, SWD-08, SWD-09, and SWP-03

Constituent[a]	Analytical Method	ASL	Holding Time	Preservative	Container
Radionuclides and Uranium:					
Thorium-228	EML HASL 300[b]	D	6 months	HNO_3 to pH <2	Plastic or glass
Thorium-232	EML HASL 300[b]				
Uranium, Total	6020[c] or 200.8[d]				
Field Parameters[e]:	FPQAPP[f]	A	Not applicable	Not applicable	Not applicable

Notes:
The analytical site-specific contract identifies the specific method.
[a] Sample locations are analyzed for a subset of these constituents (summarized in Table 12).
[b] *Procedures Manual of the Environmental Measurements Laboratory* (DOE 1997c).
[c] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1998).
[d] *Methods for the Determination of Metals in Environmental Samples* (EPA 1994).
[e] Field parameters are temperature, specific conductance, pH, and dissolved oxygen.
[f] The FPQAPP provides field methods.

Table 14. Surface Water and Treated Effluent Analytical Requirements for Constituents at Sample Locations PF 4001, SWR-4801, SWR-4902

Constituent[a]	**Analytical Method**[b]	**Sample Type**[c]	**ASL**[b]	**Holding Time**[b]	**Preservative**[b]	**Container**[b]
General Chemistry:						
Ammonia	350[d]	Grab	D	28 days	Cool 4 °C, H_2SO_4 to pH <2	Plastic or glass
Carbonaceous biochemical oxygen demand	5210B[e]	Composite	C	48 hours	Cool 4 °C	Plastic or glass
Nitrate/nitrite	353.1[d], 353.2[d], 353.3[d], 4500D[e], or 4500E[e]	Composite/Grab[j]	D	28 days	Cool 4 °C, H_2SO_4 to pH <2	Plastic or glass
Oil and grease	1664A[f] or 5520B[e]	Grab	D	28 days	Cool 4 °C, H_2SO_4 to pH <2	Glass
Total dissolved solids	160.1[f] or 2540C[e]	Grab	C	7 days	Cool 4 °C	Plastic or glass
Total hardness	130.2[d] or 2340C[e]	Grab	C	28 days	Cool 4 °C, H_2SO_4 to pH <2	Plastic
Total Kjeldahl nitrogen	351.2[d]	Composite/Grab[j]	D	28 days	Cool 4 °C, H_2SO_4 to pH <2	Plastic or glass
Total phosphorus	365.1[d], 365.2[d], 365.3[d], or 4500B[e]	Composite/Grab[j]	C	28 days	Cool 4 °C, H_2SO_4 to pH <2	Plastic
Total suspended solids	160.2[d] or 2540D[e]	Composite	C	7 days	Cool 4 °C	Plastic or glass
Inorganics:						
Mercury (low level)	1631[d]	Grab	D	14 days	None	Amber glass
Radionuclides and Uranium:						
Uranium, Total	200.8[g], 6020[h], or D5174-91[i]	Composite	D		HNO_3 to pH <2	Plastic or glass
Other:						
Flow rate	NA	24 hour total	NA	NA	NA	NA
Field Parameters[k]	FPQAPP[l]	Grab	A	NA	NA	NA

Notes: The analytical site-specific contract identifies the specific method.
[a] This represents a comprehensive list of constituents taken from the indicated list of surface water and treated effluent monitoring locations. Each location will be analyzed for a subset of these constituents (summarized in Table 12).
[b] NA = not applicable.
[c] For composite samples at PF 4001, a flow-weighted composite sample collected over a 24-hour period;
[d] *Methods for Chemical Analysis of Water and Wastes* (EPA 1983).
[e] *Standard Methods for the Examination of Water and Wastewater* (APHA 1989).
[f] Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM; Non-Polar material) by Extraction and Gravimetry.
[g] *Methods for the Determination of Metals in Environmental Samples* (EPA 1994).
[h] *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1998).
[i] American Society for Testing and Materials (ASTM).
[j] These analytes are grab sample at SWR-4801 and SWR-4902 and a composite sample at PF4001.
[k] Field parameters include dissolved oxygen, pH, specific conductance, and temperature.
[l] The FPQAPP provide field analytical methods.

Treated Effluent Composite Sampling
Treated effluent composite samples will be collected by means of flow-proportional samplers at the Parshall Flume. After every 24 hours of operation, the collected liquid is removed from the automatic sampler to provide a daily flow-weighted sample of the treated effluent. A portion of each daily sample is analyzed to determine the estimate of total uranium discharged to the Great Miami River for the day. The Parshall Flume (PF 4001) will be analyzed for the constituents listed in Table 12.

4.4.1.2 Quality Control Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the FPQAPP. These samples will be collected and analyzed to evaluate the possibility that some controllable practice, such as sampling technique, may be responsible for introducing bias into the project's analytical results. Quality control samples will be collected as follows:

- One field duplicate sample shall be collected each semiannual sampling event at a randomly selected surface water sample location.

For low-level mercury, all field sampling equipment will be sent to the offsite laboratory for decontamination. The offsite laboratory shall document certification of cleanliness via equipment rinsate blank analysis. In addition, trip blanks and field blanks will be supplied by the offsite laboratory and shall accompany the samples from collection to receipt at the laboratory.

4.4.1.3 Decontamination

In general, decontamination of equipment is minimized because reusable equipment is not used during sample collection. However, if decontamination is required, then it will be performed between sample locations to prevent the introduction of contaminants or cross contamination into the sampling process. The decontamination requirements are identified in the FPQAPP. Sampling bailers used in sampling for mercury at NPDES permit locations will be decontaminated at a contract laboratory.

4.4.1.4 Waste Disposition

Contact waste that is generated by the field technicians during field sampling activities is collected, maintained, and disposed of as necessary.

4.5 IEMP Surface Water and Treated Effluent Monitoring Data Evaluation and Reporting

This section describes the methods for analyzing data generated by the IEMP surface water and treated effluent monitoring program and summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated surface water and treated effluent data, including specific information to be reported in the annual SER, is also provided.

4.5.1 Data Evaluation

Data resulting from the IEMP surface water and treated effluent program will be evaluated to meet the program expectations identified in Section 4.3.1. Based on these expectations, the following questions will be answered through the surface water and treated effluent data evaluation process, as indicated:

- Are surface water contaminant concentrations such that cross-medium impacts to the underlying aquifer could be expected?

  Data from sample locations near areas where the glacial overburden is breached by site drainages will be compared to surface water and groundwater FRLs to assess potential impacts to the Great Miami Aquifer. Basic statistics, such as the minimum, maximum, and mean, will be generated annually. The data generated from individual sampling events will be trended by sample location over time via graphical and, if necessary, statistical methods when sufficient data become available. If concentration trends above historical ranges or above FRLs are observed, actions shown in Figure 15 will be implemented.

  Any potential adverse cross-medium impacts will be factored into the site groundwater remedy. Decision-making process described in Figure 15 can be implemented as necessary.

- Do the sporadic exceedances of FRLs continue to occur? Are concentrations decreasing or increasing?

  Data evaluation will consist of direct comparison of data to FRLs. It is likely that the list of constituents monitored with respect to FRLs can be reduced (i.e., IEMP Characterization Monitoring).

- Has storm water runoff caused an undue adverse impact to the surface water or treated effluent?

  Trend analyses of data will be used to identify trends that may require further investigation of activities occurring within the drainage basin (or basins).

- Are the requirements of the NPDES permit being fulfilled?

  Data collected to fulfill the site NPDES permit requirements will be evaluated for compliance with the NPDES permit provisions. This evaluation will serve to identify whether immediate reporting of noncompliance to Ohio EPA is necessary and to determine the appropriate corrective actions to address the noncompliance.

- Are the FFCA and OU5 ROD reporting requirements being fulfilled?

  Radiological discharges to the Great Miami River and Paddys Run are regulated by the FFCA and OU5 ROD. Reporting requirements have been incorporated into the IEMP reporting structure and include a cumulative summary of pounds of total uranium discharged and the monthly average total uranium concentration discharged to the Great Miami River.

- Are community concerns being met through the surface water and treated effluent IEMP program?

  The IEMP fulfills the needs of the Fernald Preserve community by presenting surface water and treated effluent environmental results in the annual SER. The specific community concern of the magnitude of Fernald Preserve discharges to Paddys Run and the Great Miami River is addressed in the annual SER in the surface water and treated effluent section.

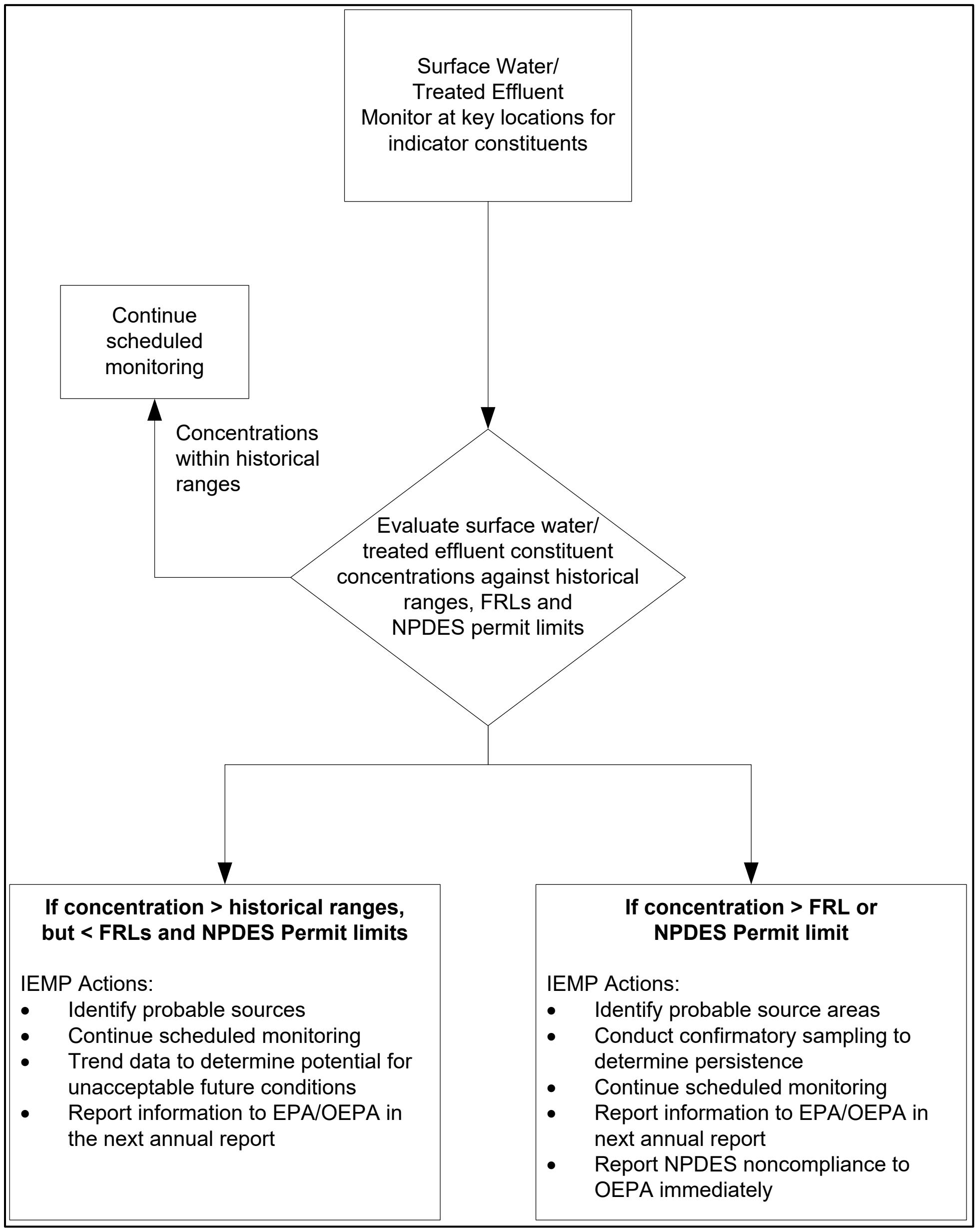

Figure 15. IEMP Surface Water Data Evaluation and Associated Actions

4.5.2 Reporting

The IEMP surface water, treated effluent, and FFCA data will be reported in the annual SER and on the LM website at https://www.energy.gov/lm/fernald-preserve-ohio-site.

Data on the LM website will be in the format of searchable data sets and downloadable data files. Additional information on IEMP data reporting is provided in Section 5.0.

The annual SER will be issued each June. This comprehensive report will discuss a year of IEMP data previously reported on the LM website. The annual SER will include the following:

- An annual summary of data from the IEMP surface water and treated effluent monitoring program.
- Constituent concentrations for each sample location.
- Statistical analysis summary for constituents, as warranted by data evaluation.
- Status of FFCA and OU5 ROD Great Miami River effluent limits, to be presented graphically showing status of compliance with the 30-µg/L and 600-pound total uranium limits.
- Status of regulatory compliance with provisions of the NPDES permit.
- Actions taken to mitigate unacceptable surface water conditions revealed by the IEMP surface water sampling program.
- Observed trends and results of the data comparison to FRLs.

Because the IEMP is a living document, a structured schedule of annual reviews and 5-year revisions has been instituted. The annual review cycle provides the mechanism for identifying and initiating any surface water and treated effluent program modifications (i.e., changes in constituents, locations, or frequencies) that are necessary. Any program modifications that may be warranted prior to the annual review will be communicated to EPA and Ohio EPA.

5.0 Dose Assessment Program

Section 5.0 discusses the reasons for eliminating the air particulate, direct radiation monitoring and the reporting requirement for the annual sitewide radiological dose assessment to meet the intentions of DOE Order 458.1. The sources associated with air monitoring requirements were removed in 2006; however, limited monitoring occurred through 2009, as identified in previous IEMP revisions, to ensure that all air monitoring requirements were met and levels were acceptable from a closure standpoint. Air particulate monitoring ceased at the beginning of 2010. Direct radiation monitoring ceased at the end of 2016. The final annual sitewide radiological dose assessments to meet DOE Order 458.1 was presented in the 2016 SER (DOE 2017).

5.1 Background, Regulatory Drivers, and Requirements

Past assessments were prepared to confirm that radiological doses to the public from routine operations and emissions comply with the dose limits set by EPA and DOE regulations and orders. With the completion of remedial activities in October 2006, operational sources for the emission of particulates to the air pathway no longer exist. Two years of post-remediation (soil remediation was completed in 2006) air monitoring have shown that the air inhalation dose at the Fernald Preserve boundary is orders of magnitude lower than the National Emissions Standards for Hazardous Air Pollutants (NESHAP) limit of 10 millirem per year (mrem/yr) (the value was 0.034 mrem/yr in 2009; see Appendix D of 2009 SER). Additionally, the measured post-remediation values are well below 1 mrem/yr, which is the NESHAP threshold for the monitoring requirement. That is, NESHAP monitoring is no longer required because the dose is less than 1 mrem/yr. NESHAP monitoring was discontinued at the end of 2009. As DOE Order 458.1 follows NESHAP requirements for air inhalation, there is no significant dose to the public from the air inhalation pathway when the values are less than 1 mrem/yr; therefore, air monitoring data are no longer a component of the annual dose assessments. Through calendar year 2016, dose assessments for DOE Order 458.1 used the annual direct radiation measurements and annual surface water results for radionuclides to calculate the total dose to the public. The final dose assessment for DOE Order 458.1 was presented in the 2016 SER (DOE 2017).

5.2 Analysis of Regulatory Drivers, DOE Policies, and Other Fernald Preserve Site-Specific Agreements

This section identifies the pertinent regulatory requirements, including ARARs and to-be-considered requirements, for the scope and design of the former dose assessment program. These requirements were used to confirm that the program satisfied the regulatory obligations for monitoring (activated by the RODs) and achieved the intentions of other pertinent criteria (such as DOE orders and the Fernald Preserve existing agreements) that had a bearing on the scope of dose assessment.

5.2.1 Approach

The analysis of additional regulatory drivers and policies for dose assessments was conducted by identifying the suite of ARARs and to-be-considered requirements in the approved CERCLA RODs and legal agreements that contain specific dose assessment requirements. This subset was further divided to identify requirements with sitewide implications (i.e., those within the scope of the IEMP [DOE 1997b]).

5.2.2 Air Requirements

The air monitoring program described in previous IEMPs was developed with full consideration of the regulatory drivers and policies. Table 15 lists the air-monitoring drivers, the previous monitoring conducted to comply with them, and results for the path forward. The results indicated that 3 years of post-remediation monitoring for air particulates and 10 years of post-remediation dosimeter monitoring have provided sufficient data to discontinue future monitoring of the air pathway.

5.2.3 Dose Requirements

A sitewide radiological dose assessment was required to demonstrate compliance with DOE Order 458.1. The dose assessment described here and in Appendix C of previous IEMPs was developed with full consideration of the regulatory drivers and policies, as discussed in previous IEMPs.

The exposure to all radiation sources, as a consequence of routine activities at a DOE site, shall not cause an effective dose equivalent of greater than 100 mrem/yr to any member of the public.

The annual effective dose equivalent was a weighted summation of doses to various organs of the body, which is incorporated in the derived concentration guidelines used to assess dose from the air and surface water pathways. For the Fernald Preserve, it was defined as the sum of external-radiation exposure plus the dose derived from the surface water pathway. These pathways are the only potential exposures to the public that could exceed 1 percent (1 mrem) of the 100-mrem/yr limit. The collective population dose attributed to direct radiation at the Fernald Preserve has been very low relative to background dose values for several years and DOE discontinued the direct radiation monitoring program at the end of 2016. Dose reporting will no longer occur; the final dose calculation was presented in the 2016 SER (DOE 2017).

DOE Order 458.1 states that the absorbed dose to native aquatic organisms shall not exceed 1 radiation absorbed dose (rad) per day from exposure to the radioactive material in liquid wastes discharged to natural waterways. DOE issued a technical standard entitled *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002a) and supporting software (RAD-BCG) for use in the evaluation and reporting of biota dose limits. A biota dose assessment divides the radionuclide concentration in surface water by a biota concentration guide and sums the biota concentration guide for all radionuclides. If the resulting sum is less than 1.0, compliance with the biota dose limit is achieved. Since 1999, the sum has been below 0.06, and in 2007 (the first year after closure) the sum dropped to 0.009 (DOE 2008a). The final aquatic dose calculation was 0.011 and has been far below the compliance threshold for many years (DOE 2017). The final dose calculations were presented in the 2016 SER.

Table 15. Air Monitoring Regulatory Drivers, Required Actions, and Results

IEMP		
DRIVER	**REQUIRED ACTION**	**RESULTS**
DOE Order 458.1; Title 10 *Code of Federal Regulations* Section 834 (10 CFR 834), *Radiation Protection of the Public and the Environment*	• Establishes radiological dose limits and guidelines for the protection of the public and environment. Under this requirement, the exposure to members of the public associated with activities from DOE facilities from all pathways must not exceed, in 1 year, an effective dose equivalent of 100 mrem. • For radiological dose due to airborne emissions only, the DOE order requires compliance with the 40 CFR 61 Subpart H limit of an effective dose equivalent of 10 mrem/year to a member of the public. Demonstration of compliance with this standard is to be based on an air monitoring approach. • The DOE order also provides guidelines for radionuclide concentrations in air (known as Derived Concentration Guides). • Provides reasonable assurance that releases of radon-222 to the atmosphere will not: (1) exceed an average release rate of 20 picocuries per square meter per second or (2) increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half picocurie per liter.	• The final year of soil remediation at the Fernald Preserve was 2006. By the end of October 2006, all major sources of airborne contamination were removed from the site or placed in the OSDF. In recognition of the removal of emissions sources from the site, the number of air monitoring stations was decreased from 17 to 11 in April 2006 (DOE 2006c) and from 11 to 6 in November of 2006 (DOE 2006d). Monitoring data collected from 2006 through 2009 indicated that no additional air particulate monitoring is required for airborne contamination. Environmental dosimeter monitoring was eliminated at the end of 2016. • In 2009, the maximally exposed individual, standing at the eastern boundary monitor with the highest above-background reading, could receive a dose of 9 mrem. The contributions to the estimated dose are 0.034 mrem from air inhalation and 9 mrem from direct radiation. This dose is 9 percent of the adopted DOE limit, which is 100 mrem/yr above background (exclusive of radon), as established by the International Commission on Radiological Protection. Therefore, with EPA concurrence, the air particulate monitoring was discontinued in 2010.
DOE Order 458.1; Title 10 *Code of Federal Regulations* Section 834 (10 CFR 834), *Radiation Protection of the Public and the Environment* (continued)		• In 2008, the annual average concentration of radon-222 in air was 0.15 picocurie per liter (pCi/L) above background. This is less than 30 percent of the 0.5 pCi/L DOE limit. Therefore, with EPA concurrence, the radon monitoring was discontinued in 2009. • Monitoring data collected from 2006 through 2009 have demonstrated that the Fernald Preserve no longer has the potential to expose members of the public to an effective dose equivalent of 100 mrem/yr, and radon-222 released to the atmosphere anywhere outside the on-site disposal facility is less than 0.5 pCi/L above background.

Table 15. Air Monitoring Regulatory Drivers, Required Actions, and Results (continued)

IEMP		
DRIVER	**REQUIRED ACTION**	**RESULTS**
Federal Facility Agreement Control and Abatement of Radon-222 Emissions	• Ensures that DOE takes all necessary actions to control and abate radon-222 emissions at the Fernald Preserve. • Previous IEMPs included radon monitoring.	Waste material generated from uranium extraction processes performed decades ago contained radium-226, which produces radon. This waste material is no longer a source for radon at the site because the last of this material was shipped offsite in 2006. Present radon sources at the Fernald Preserve are limited to residual radium-226 concentrations in the soil (near-background levels) and waste material disposed of in the OSDF. Waste materials in the OSDF are covered with a polyethylene liner and several feet of stone and soil, which provides an effective radon barrier. Two years of continued monitoring demonstrated that no additional monitoring is required for radon. Radon monitoring was discontinued in 2009, as noted above.
DOE Order 435.1, *Radioactive Waste Management*	• RODs are filed. • Be in compliance with DOE Order 458.1, *Radiation Protection of the Public and the Environment*. • Requires low-level radioactive waste disposal facilities to perform environmental monitoring. • Previous IEMPs boundary monitoring included air monitoring at locations adjacent to the OSDF.	Waste materials in the OSDF are covered with a polyethylene liner and several feet of stone and soil, which provides an effective radon barrier. Three years of continued monitoring following closure of the OSDF in 2006 showed that no additional air monitoring is required.
CERCLA Remedial Design Work Plan (DOE 1996a)	Monitoring will be conducted as required following the completion of cleanup to assess the continued protectiveness of the remedial actions.	Three years of continued monitoring after closure have shown the protectiveness of the remedial actions, and thus no additional monitoring is required.

6.0 Program Reporting

6.1 Introduction

This section summarizes how the reporting discussions in Sections 3.0 through 4.0 are integrated and provides an overview of the entire environmental data reporting strategy.

6.2 IEMP Monitoring Summary

The IEMP monitoring scope for groundwater, surface water, and dose has been described in detail in Sections 3.0 through 5.0. The summary that follows is intended to provide the basis for each medium's monitoring program. Evaluation of each program will form the basis for any IEMP program modifications in the future.

Groundwater: The groundwater monitoring program for the Great Miami Aquifer provides for monitoring water quality and water levels in monitoring wells distributed over the aquifer restoration area, along the Fernald Preserve's downgradient property boundary, and at a few private well locations. These wells provide a monitoring network to track the progress of the aquifer restoration and to monitor groundwater quality in the area of the OSDF. The analytical requirements for this monitoring program are based on the FRLs documented in the ROD for Remedial Actions at OU5.

Surface Water: The surface water and treated effluent monitoring program is designed to assess the impacts on surface water. The nonradiological discharge monitoring and reporting related to the NPDES permit have been incorporated into the IEMP.

The IEMP will be reviewed and revised each September. Revisions will identify any program modifications and any changes to existing regulatory agreements or requirements applicable to sitewide monitoring.

In addition to the IEMP-sponsored review and revision obligations, an independent review and assessment mechanism exists through the Cost Recovery Grant reached between Ohio EPA and DOE. The Cost Recovery Grant provides a way for Ohio EPA to conduct an independent review of DOE environmental monitoring programs. Ohio EPA's role, as defined in the Cost Recovery Grant, is to independently verify the adequacy and effectiveness of DOE's environmental monitoring programs through program review and independent data collection. Any environmental data collected independently by Ohio EPA are provided to DOE. Modifications to the scope or focus of the IEMP as a result of Ohio EPA's activities will be incorporated as necessary via the annual LMICP review process.

6.3 Reporting

As stated in Section 1.0, a primary objective of the IEMP is to successfully integrate the numerous routine environmental reporting requirements under a single comprehensive framework. The IEMP centralizes, streamlines, and focuses sitewide environmental monitoring and associated reporting under a single controlling document.

The IEMP reporting frequency will be annual with a continued emphasis on timely data reporting in the form of electronic files (i.e., the LM website). The annual SER will continue to be submitted by June 1 to provide a comprehensive evaluation of IEMP data for both the regulatory agencies and the public, and electronic data will be made available to the regulatory agencies as soon as data have been reviewed.

6.3.1 LM Website

The LM website (ttps://www.energy.gov/lm/fernald-preserve-ohio-site) allows the regulatory agencies and members of the public to access Fernald Preserve data in a timely manner. The data are available after analysis and entry into an environmental database. The OSDF Leachate Collection System and Leak Detection System volumes and groundwater operational data are available upon request by contacting (513) 648-3334. Groundwater and surface water data are available through user-defined queries that use the Geospatial Environmental Mapping System (GEMS). GEMS is an internet-based application that provides the ability to query LM environmental data. Once the user is on the GEMS website, the environmental data can be queried by selecting Environmental Reports from the menu. A tutorial is available under Help, which is also on the menu. The use of the LM website for reporting IEMP data provides the agencies with access to IEMP data sooner than through the annual reports. In addition to the environmental media addressed in the IEMP, water quality and water accumulation rate data from the OSDF are included on the LM website.

6.3.2 Annual Site Environmental Reports

The annual SER will continue to be submitted to EPA and Ohio EPA on June 1 of each year. It will continue to document the technical monitoring approach and to summarize the data for each environmental medium. The report will also include water quality and water accumulation rate data from the OSDF monitoring program. The summary report serves the needs of both the regulatory agencies and the public. The accompanying detailed appendixes are a compilation of the information reported on the LM website and are intended for a more technical audience, including the regulatory agencies.

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Attachment E

Community Involvement Plan

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Contents

Figure

Table

Appendix

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Abbreviations

AR	Administrative Record
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
FCAB	Fernald Citizens Advisory Board
FFCA	Federal Facilities Compliance Agreement
FRESH	Fernald Residents for Environmental Safety and Health
LM	Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
LSO	Local Stakeholder Organization
LTS&M	long-term surveillance and maintenance
NPL	National Priorities List
Ohio EPA	Ohio Environmental Protection Agency
OU	operable unit
SARA	Superfund Amendments and Reauthorization Act of 1986

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1.0 Introduction

The Fernald Preserve, located northwest of Cincinnati, Ohio, is currently managed by the U.S. Department of Energy (DOE) Office of Legacy Management (LM). DOE established LM in December 2003 to manage the nation's legacy waste that remained at the conclusion of the nuclear weapons program after World War II and the Cold War. The mission of LM is to manage legacy land, structures, and facilities in a way that is protective of human health and the environment.

Since the early 1990s, DOE has made it a priority to gather community opinion as part of its decision-making process. Involvement by stakeholders who possess local knowledge and diverse areas of expertise was instrumental to the success of the Fernald cleanup project. Stakeholders were involved in site cleanup activities, have assisted in addressing technical and management challenges, and have guided the decision-making process. The Fernald cleanup, including plans for long-term management of the site, benefited from early dialogue among state and federal regulators, stakeholder organizations, elected officials, and members of the general public. Long-term site management goals included informing future generations and new residents about the site, ensuring the effectiveness of institutional controls, and maintaining community support for the site remedy. LM established a Visitors Center and will cooperate to the extent possible in helping the community make this a viable entity. The Visitors Center was completed in August 2008.

This Community Involvement Plan is a follow-on document to existing public affairs plans for the site and public involvement efforts described in the Federal Facilities Compliance Agreement (FFCA). All public affairs activities, including this Community Involvement Plan, continue to follow U.S. Environmental Protection Agency (EPA) and DOE guidance on public participation and comply with public participation requirements in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. This Community Involvement Plan documents how DOE will ensure that the public has appropriate opportunities for involvement in site monitoring and maintenance.

This Community Involvement Plan outlines the methods of communication and addresses plans for public involvement. The plan will be updated as appropriate to address post-closure public involvement activities. Updates will be made as needed, but no more frequent than annually. Significant changes in public participation activities, changes in land reuse plans, and remedy failures are examples of scenarios under which updates would be considered. DOE will collaborate with stakeholder organizations in effect at that time to update the plan. Notification of any changes to the Comprehensive Legacy Management and Institutional Controls Plan (LMICP) or the Community Involvement Plan will be through the annual meeting and the Fernald Preserve web page (https://www.energy.gov/lm/fernald-preserve-ohio-site).

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2.0 Site Description and Background

In 1951, construction of the uranium processing plant began on a 1,050-acre parcel of land near Cincinnati, Ohio. During the Cold War, the Fernald plant, originally named the Feed Materials Production Center, produced 500 million pounds of high-purity uranium metal products for the nation's weapons production program. The products were shipped to other DOE sites within the nuclear weapons complex. Some sites used the products as fuel for nuclear reactors to produce plutonium.

In the late 1980s, when Fernald shut down because of declining demand for Fernald's product and increasing environmental concerns, 31 million net pounds of nuclear product, 2.5 billion pounds of waste, and 2.5 million cubic yards of contaminated soil and debris remained onsite. The mission of producing uranium metal ceased, and the focus shifted to environmental restoration and waste management.

To manage the cleanup more effectively, DOE organized the entire site into five study areas called operable units (OUs). Each OU had similar physical characteristics, waste inventories, regulatory requirements, and anticipated remedial action technologies. The OUs were as follows:

- OU1 included six waste pits, a Burn Pit, and Clearwell.
- OU2 included a solid waste landfill, lime sludge ponds, inactive fly ash pile, active fly ash pile, and the South Field area.
- OU3 included all processing facilities located in a 136-acre area.
- OU4 included K-65 Silos 1 and 2, which contained radium-bearing radioactive wastes dating back to the 1940s; Silo 3, which contained dried uranium-bearing wastes; and Silo 4, which was always empty.
- OU5 encompassed the environmental media on the Fernald property and surrounding areas that were impacted by the facility. Environmental media included the groundwater, surface water, soils, sediments, vegetation, and wildlife throughout the Fernald facility and surrounding areas. OU5 also included the South Plume, an area of off-property groundwater contamination.

Cleanup of OU1 through OU4 was a requirement for site closure. Aquifer restoration in OU5 will continue under LM.

In 1996, Fernald completed a 10-year environmental investigation to determine contamination levels and develop cleanup plans. The significant investigation resulted in Records of Decision, or final cleanup plans, for the five OUs. After completing the engineering designs, DOE organized the site's cleanup program into seven major projects to integrate fieldwork and improve safety and efficiency. Those project areas included:

- Aquifer Restoration.
- Building Demolition.
- Soil and Disposal Facility.
- Silos 1 and 2.
- Silo 3.

- Waste Pits.
- Waste Management/Nuclear Material Disposition.

The final mission of the Fernald Closure Project was to clean up the site in compliance with Fernald's approved Records of Decision. In 1999, DOE issued the Final Land Use Environmental Assessment (DOE 1999) that addressed recommendations and feedback received from the public. Final land use involved transformation of the Fernald site into an undeveloped park with an emphasis on wildlife. To ensure appropriate future use, the site will remain under federal ownership in perpetuity.

From 1996 to 2006, the Fernald site underwent extensive remediation pursuant to CERCLA. Remedial activities and subsequent ecological restoration have converted the site from an industrial production facility to an undeveloped park, encompassing wetlands, prairies, and forest. Upon completion of large-scale soil remediation and waste disposition in the fall of 2006, the site was successfully transitioned to LM.

LM is responsible for long term monitoring and maintenance of the Fernald site, as well as continued implementation of groundwater remediation. As originally envisioned by the community, DOE opened the site to the public in August 2008, with a series of trails and a Visitors Center. The site was renamed the Fernald Preserve.

3.0 Regulatory Framework

In response to growing concern about health and environmental risks posed by hazardous waste sites, Congress established CERCLA in 1980 (Title 42 *United States Code* Section 9601 et seq.) and SARA in 1986 (Public Law 99-499). EPA administers CERCLA in cooperation with individual states and tribal governments. The National Priorities List (NPL) is a list of top-priority hazardous waste sites that are eligible for extensive, long-term cleanup under CERCLA. EPA placed Fernald on the NPL in November 1989 as the Feed Materials Production Center. All cleanup activities at Fernald must satisfy the requirements of CERCLA, as amended by SARA, and Subpart E of the National Oil and Hazardous Substances Pollution Contingency Plan, found in Title 40 *Code of Federal Regulations* Part 300.400, “Hazardous Substance Response.”

In July 1986, DOE and EPA signed the FFCA, which established a procedural framework and schedule for developing appropriate response actions and facilitated cooperation and exchange of information. The FFCA initiated the Remedial Investigation/Feasibility Study, a comprehensive environmental investigation conducted in and around Fernald to identify the nature and extent of contamination and to determine the best cleanup solutions.

DOE and the Ohio Environmental Protection Agency (Ohio EPA) signed a Consent Decree in November 2008 that settled a natural resource damage claim under Section 107 of CERCLA, which was originally filed by Ohio EPA in 1986. As part of this process, DOE and Ohio EPA signed an Environmental Covenant that established activity and use limitations that are detailed in Volume II of the LMICP.

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4.0 Community Profile

The Fernald Preserve is located in southwest Ohio, approximately 18 miles northwest of Cincinnati, and straddles the boundary between Butler and Hamilton counties (Figure 1). The site is located near the unincorporated communities of Ross (northeast), Shandon (northwest), Fernald (south), New Baltimore (southeast), and New Haven (southwest). The site encompasses portions of Crosby, Ross, and Morgan townships.

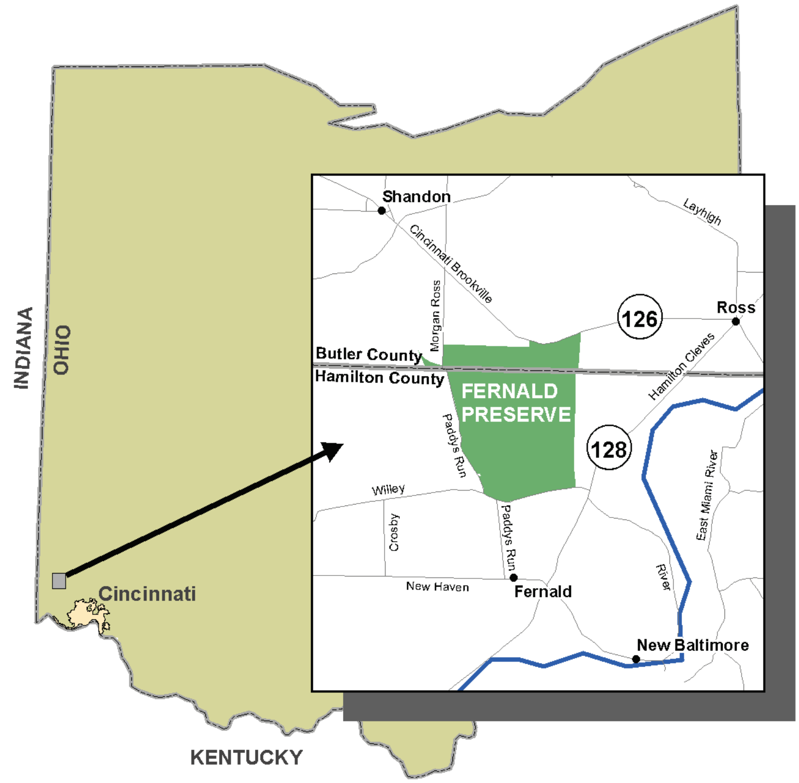

Figure 1. Fernald Preserve Location Map

Hamilton County is in the southwest corner of Ohio and covers an area of 406 square miles. The county is the economic nucleus of the 13-county Cincinnati metropolitan area. As of July 1, 2021, the estimated population of Hamilton County was 826,139, which is a slight increase since 2017. Butler County is directly north of Hamilton County and covers an area of 467 square miles. Although Butler County contains more wide-open spaces and is less densely populated, the county is showing a growth trend. In 2021, the population estimate was 390,234.

Most of the Fernald Preserve lies within Crosby Township, which has a population of 6,030, which is a significant increase since 2017. Ross Township has a population of 8,751, and Morgan Township has a population of 5,345.

The Great Miami River is located to the east of the Fernald Preserve. Land use in the area consists primarily of residential, agricultural, and gravel-excavation operations. Some land near the Fernald Preserve is dedicated to housing developments, light industry, and parks. Local history also includes settlement of the area by Native Americans. DOE agreed to make land available for the reinternment of Native American remains with the following understandings:

- The land remains under federal ownership.
- DOE will not take responsibility for, or manage, the reinternment process. Maintenance and monitoring will not be funded or implemented by DOE.
- The remains must be culturally affiliated with a modern day tribe. The National Park Service had no objections to the reinternment process as long as the "repatriation associated with the reburials comply with the Native American Graves Protection and Repatriation Act as applicable."
- Records must be maintained for all repatriated items reinterred under this process. DOE is not responsible for these records.

Thus far, several federally recognized tribes have been contacted regarding this offer of land for reinternment purposes. To date, only one response has been received from a modern-day tribe with repatriated remains under the Native American Graves Protection and Repatriation Act. The Miami Tribe of Oklahoma has informed DOE that they are not interested in use of the site. DOE has received no other responses from modern-day tribes and is no longer pursuing the effort. The proposal may be reconsidered in the future if other modern day tribes with repatriated remains come forward.

4.1 History of Community Involvement

During most of the production era, little thought was given to public participation or community involvement. When public concerns about contamination problems peaked in the 1980s, site management was unprepared to handle these concerns. There were no public forums to discuss concerns and issues, and there were no site contacts for people to call if they had questions. In 1985, the first public relations professional was hired at Fernald. During the first few years, the new Public Affairs department focused primarily on establishing contacts with the community and creating public information channels so people could learn about the site operations. DOE opened several reading rooms to make site documents available to the public, and site management started holding community meetings to begin a dialogue with interested members of the public.

Within a few years, a new strategy for public participation was developed, exceeding the textbook style found in the regulations. In November 1993, Fernald adopted its public involvement program. The basic precepts of this program were:

- People have a fundamental desire to participate in decisions that affect their lives.
- Many people working together can often find better solutions to difficult problems.
- Fernald management is responsible for including public involvement in decision making.

With the new emphasis on public involvement, the public became more aware of the scope of the site's contamination, and changes began to occur. The public insisted on a greater role in cleanup decisions, and project managers began to realize that the public could help them find answers to difficult questions, such as, "How clean is clean?" Several citizen groups formed to provide avenues for citizen participation in the two-way communication path that was established and stakeholders became instrumental in the cleanup progress at Fernald.

Several groups followed the remediation and cleanup process, including the Fernald Citizens Advisory Board (FCAB), Fernald Residents for Environmental Safety and Health (FRESH), and the Fernald Community Alliance (formerly known as Fernald Living History Inc.). The FCAB was established to formulate cleanup policy and to help guide the cleanup activities at the site. Representatives that included local residents, governments, businesses, universities, and labor organizations constituted the advisory board membership. In 1995, the FCAB issued recommendations to DOE on remedial action priorities, cleanup levels, waste disposition alternatives, and future uses for the Fernald Preserve property. The FCAB was actively involved in the final remediation and restoration activities for the Fernald Preserve, with monthly full-board meetings and meetings of the FCAB Stewardship Committee. DOE worked closely with the FCAB until September 2006, when the FCAB held its final meeting.

FRESH was formed by local residents in 1984 and has played an important role in providing community input on the characterization and remediation of the Fernald Preserve. The group held its final public meeting in November 2006, after 22 years of environmental activism.

The FCAB co-sponsored (along with FRESH, the Community Reuse Organization, and the Fernald Living History Project) four "Future of Fernald" workshops. The workshops were open to the public and gave the community input on the final public-use decisions as described in the *Master Plan for Public Use of the Fernald Environmental Management Project* (DOE 2002). The later workshops led to the recommendation of a multi-use education facility at the site.

The Fernald Envoy Program was initiated to promote one-on-one communication between Fernald personnel and representatives of local community groups interested in Fernald-related cleanup activities, issues, and progress. Approximately 30 Fernald employees served as messengers to local neighbors, business leaders, educators, environmental groups, regulatory agencies, and elected officials. Fernald envoys built close relationships with community groups interested in Fernald-related activities and supplied them with detailed information. They also listened to ideas, suggestions, concerns, and questions from people and then provided feedback to those making decisions about Fernald cleanup activities.

Fernald also established support programs for both charitable causes and education. Created in 1996, the Fernald Community Involvement Team was a volunteer task force composed of employees, their family members, and friends who were active in social service projects within the local community. In addition, Fernald sponsored educational programs for local students and teachers by establishing strong partnerships with area schools.

Now that site activities have shifted to the long-term surveillance and maintenance phase, so too has the community involvement focus shifted. Community awareness of the remaining contamination is vital to the continued protection of human health and the environment at the Fernald Preserve. Ensuring community awareness of the site's history and maintaining environmental controls will require outreach to new residents and future generations. DOE remains committed to its public involvement program.

Today, one citizen group, the Fernald Community Alliance, formerly known as Fernald Living History Inc., remains dedicated to ensuring that the history of Fernald is available for future generations. The group meets regularly and is looking to expand its member base.

The Visitors Center is open to the public and has computers for accessing electronic copies of the Fernald CERCLA Administrative Record (AR). The CERCLA AR documents for Fernald were scanned into industry-standard searchable Adobe Acrobat PDF files for viewing over the Internet. The AR documents are available to the public on the LM website under CERCLA Collections (https://www.energy.gov/lm/administrative-record-ar). Documents are searchable by document number, document date, or document title. Additionally, key document indexes were created for each operable unit and posted on the website. The CERCLA AR will be updated as new documents are created.

DOE consulted with appropriate stakeholders, including site labor unions, retirees, former employees, the Crosby Township Historical Society, and Fernald Living History Inc. to create a Cold War Commemorative Brick Garden located on the Fernald property. This memorial was dismantled and moved to a location near the Fernald Preserve Visitors Center in 2008.

4.2 Interested Community Members and Local, City, and State Elected Officials

DOE recognizes that stakeholders may be any affected or interested party, including, but not limited to:

- Local elected officials.
- Fernald Citizens Advisory Board (FCAB).
- Fernald Residents for Environmental Safety and Health (FRESH).
- Fernald Community Alliance.
- Fernald Community Health Effects Committee.
- Current and retired Fernald contractor employees.
- Citizens of Hamilton and Butler Counties.
- State and local government agencies, including Ohio EPA.
- Elected State of Ohio officials.
- Federal agencies, including EPA.
- Congressional delegations for Ohio and part of Indiana.
- Local media.
- Local elementary and secondary schools.
- Local colleges and universities.
- Environmental organizations.
- Business owners.

- Service organizations.
- Other interested individuals.

The FCAB was originally established in August 1993 as the Fernald Citizens Task Force. In 1997, the task force changed its name to the Fernald Citizens Advisory Board to coincide with citizen advisory boards at other DOE sites. The FCAB was a DOE site-specific advisory board chartered by the Federal Advisory Committee Act to advise DOE on activities pertaining to the remediation and future use of the Fernald Preserve. The board consisted of members of the public, including local residents, labor representatives, local government, academia, business representatives, and ex-officio members from DOE, EPA, Ohio EPA, and the Agency for Toxic Substances and Disease Registry. The FCAB was disbanded in September 2006.

FRESH is an environmental activist group that was formed in 1984 to monitor Fernald activities. The stated purposes of the organization were to ensure that the Fernald site was cleaned up, to communicate and educate the surrounding communities about the site, and to advocate responsible environmental restoration and human safety and health. FRESH was a member of the Alliance for Nuclear Accountability (formerly known as the Military Production Network) and the Ohio Environmental Council and Environmental Community Organization. The group's motto was "Making a Difference Since 1984." FRESH held its last public meeting related to Fernald activities in November 2006.

Fernald Living History Inc. is dedicated to ensuring that knowledge of the history of Fernald, its importance to the Cold War effort, the facilities that existed at the site, and its cultural significance is available for future generations. This organization has played an important role in establishing institutional controls as a means of protecting the cleanup remedy at Fernald. The group changed its name to the Fernald Community Alliance to reflect a change in mission and emphasis.

The organizations described above have played integral roles in the cleanup and legacy management planning of Fernald. The Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (PL 108-375) includes language that specifies the development of local stakeholder organizations (LSOs) at three closure sites, including Fernald. The purpose of the LSOs is to provide a formal mechanism for local communities to continue to be involved in DOE's decision-making process as it relates to the sites' post-closure care. LM met with stakeholder groups representing each of these three closure sites to gather input on the potential LSO membership and transition to LSOs. Public meetings to discuss the formation of a Fernald LSO were held on August 31, 2005; November 16, 2005; and February 8, 2006. Local stakeholders decided to defer formation of an LSO. Public meetings to discuss the formation of a Fernald LSO were held on August 31, 2005; November 16, 2005; and February 8, 2006. Local stakeholders decided to defer formation of an LSO.

4.3 Roles and Responsibilities

DOE's Office of Environmental Management (EM) was responsible for completing cleanup and closure of Fernald. This cleanup and closure included the decontamination and decommissioning of 255 former production plants, support structures, and associated components; the shipment of all radioactive waste offsite; remediation of five OUs; removal of waste from three silos;

extraction and treatment of contaminated groundwater; transfer of excess government property to state and local agencies; and preparation of the property for long-term management by LM.

LM is responsible for the long-term care of legacy liabilities at former nuclear weapons production sites, following completion of the EM cleanup effort. The primary goals are to:

- Protect human health and the environment through effective and efficient long-term surveillance and maintenance.
- Manage legacy land assets, emphasizing safety, reuse, and disposition.
- Maintain the remedy, including the continuing groundwater remediation.
- Mitigate community impacts resulting from the cleanup of legacy waste and changing DOE missions.
- Administer post-closure benefits for former contractor employees.
- Manage site records.

Following the cleanup and closure of Fernald, as an EM site, responsibility for maintaining the CERCLA remedies transferred to LM. LM is responsible for compliance with the legacy management requirements and protocols that are documented in the site-specific LMICP. At other DOE sites, the LMICP is known as the Long-Term Surveillance and Maintenance (LTS&M) Plan. Fernald's post-closure LTS&M requirements fall into three categories: operation and maintenance of the remedy, legacy management in restored areas, and public involvement.

Legacy management activities related to the maintenance of the remedy include monitoring and maintaining the On-Site Disposal Facility, ensuring that site access and use restrictions are enforced, continuing the active groundwater remediation, and managing records. Maintaining institutional controls, safeguards that effectively protect human health and the environment, is a fundamental component of LTS&M at Fernald and includes ensuring that no residential, agricultural, hunting, swimming, camping, fishing, or other prohibited activities occur on the property. In addition, appropriate wildlife management techniques and processes may also be necessary.

Legacy management in restored areas includes ensuring that natural and cultural resources are protected in accordance with applicable laws and regulations. Wetlands and threatened and endangered species are examples of natural resources that are monitored.

Legacy management activities related to public involvement include continued communication with the public regarding the continuing groundwater remediation, legacy management activities, and the future of the Fernald Preserve. Emphasis is also be placed on education of the public regarding the site's former production activities, the site's remediation, and land use restrictions. Education includes displays and programs at the Visitors Center and outreach programs at local community events, schools and organizations.

5.0 Public Participation Activities

Public participation is an important part of the CERCLA process. As a testament to that fact, the Community Involvement Plan is included in Volume II, the enforceable portion of the LMICP. DOE will offer opportunities for public involvement beyond those required by regulations. Public participation activities are conducted in support of the DOE goal of actively informing the public about the Fernald Preserve and to provide opportunities for open, ongoing, two-way communication between DOE and the public.

DOE has been conducting public participation activities to meet citizen expectations for involvement in the decision-making process for areas not specified by statutes and regulations. In such cases, DOE has successfully used the consultation process by inviting the general public, special interest groups, and the local government to participate early in the decision-making process and the prioritization of Fernald activities. The consultation process supplements the public involvement activities required by law. By engaging the community early in decision-making processes, DOE is better able to integrate community values into its decisions and build trust among stakeholders. In 2019, a site Master Plan (DOE 2019) was developed to guide future decisions regarding land use, public amenities and interpretive services. Public input was sought in 2018 via an online survey and several workshops.

The following are general descriptions of post-closure public participation activities LM has planned. As remediation activities at the site decreased after closure of the site in 2006, DOE anticipated a corresponding reduction in topics that warrant communication to stakeholders. Table 1 shows the planned public participation activities.

5.1 Ongoing Decisions and Public Involvement

The Visitors Center opened to the public on August 20, 2008, and the community was allowed unescorted access to the Fernald Preserve at this time. The design phase for the Visitors Center was completed in 2007 and included community involvement from the beginning. In 2006, a faculty and student team from the University of Cincinnati (College of Design, Architecture, Art, and Planning, Center for Design Research and Innovation) conducted a series of meetings with the community to produce a conceptual design for the reuse of an existing warehouse on the Fernald property. The plan included opportunities in landscape, sustainability, graphics, exhibits, branding, and delivering documentation of ideas suitable for transfer to a commercial architect–builder team for implementation. Updates on public use are provided through LM community meetings, Fernald Community Alliance meetings, and email distributions.

Input on future legacy management planning decisions will occur through formal document reviews and the annual community meeting. Currently, DOE holds briefings for interested stakeholders. DOE expects to continue these updates using a similar forum/format throughout legacy management. Notification of the annual community meeting and document reviews (i.e., the LMICP and CERCLA Five-Year Review) will be made through the stakeholder mailing list. In 2019, a site master plan was developed to help guide future decisions regarding land use, public amenities, and interpretive services. Public input was sought in 2018 via an online survey and several workshops. This information was combined with demographic research regarding local, regional, and national trends in land use and public planning to forecast how the Fernald Preserve can continue to serve as a community asset for years to come. The 2019 master plan is an update to *The Master Plan for Public Use of the Fernald Environmental Management Project* (DOE 2002).

Another process involving the public is the CERCLA five-year review. The five-year reviews are performed pursuant to CERCLA Section 121, "The National Contingency Plan" (see Title 40 *Code of Federal Regulations* Section 300 [40 CFR 300]), and the *Comprehensive Five-Year Review Guidance* (EPA 2001). These regulations state that a public comment and review period will be provided so that interested persons may submit comments. The public is notified of each CERCLA five-year review prior to the start of the review through the stakeholder mailing list and at the annual community meeting. The CERCLA Five-Year Review Report is available for public comment at the Visitors Center and on the Fernald Preserve webpage (https://www.energy.gov/lm/fernald-preserve-ohio-site). Input from the public regarding the legacy management of the site and the ongoing groundwater remediation will always be considered, just as it was during the remediation of the site.

5.2 Public Meetings and Other Activities

LM provides briefings, workshops, and presentations on site activities in a variety of public forums.

5.2.1 Annual Community Meetings

LM held public meetings quarterly for the first year after closure and has since held meetings at least annually thereafter to address post-closure issues of importance to stakeholders. This meeting provides information about LTS&M activities being conducted at the site and will present the results of annual Site Environmental Report which includes site inspections. Notification of the annual community meeting will be made through the stakeholder mailing list.

5.2.2 Briefings for Local, State, and Federal Elected Officials

LM will brief elected officials as needed to discuss new data trends or the evaluation of post-Record of Decision changes. There have been no briefings required since closure of the site.

Table 1. Matrix of Public Participation Activities

Activity	Post-closure
Meetings	
Public Meetings	• Quarterly public meetings for the first year following closure and annually thereafter. Notification of the public meeting will be made through the stakeholder mailing list. • Address post-closure issues, including LTS&M activities and annual Site Environmental Report results.
Briefings for Elected Officials	• Conduct briefings, if required.
Meetings With Citizens Groups	• LM will meet with stakeholders. • Local stakeholders decided to defer formation of an LSO.
Administrative Record	• Maintain an internet accessible electronic copy of the AR. • Maintain a public resource room that allows computer access to electronic copies of AR documents.
Onsite Education Facility	• The Visitors Center is located onsite. • The educational and information function serves as an institutional control. • The Cold War Commemorative Brick Garden is located onsite.
Internet Website	• LM will maintain a webpage for the Fernald Preserve and will include CERCLA documents prepared after closure. • Administrative Record will be available electronically through the Internet.
Site Tours, Programs, and Outreach Presentations	• LM will conduct site tours as requested and is located at https://www.energy.gov/lm/fernald-preserve-visitors-center
Documents for Public Review and Comment	• CERCLA requirements will be followed for public comment. • The public shall be notified prior to the start each CERCLA five-year review to provide an opportunity for public comment. The public shall also be notified following the completion of the Five-Year Review Report. • Stakeholders will be consulted on review of pertinent nonregulatory documents. • Post-closure changes required to significant cleanup documents will be discussed with stakeholders.
News Releases	• LM will continue to issue news releases, as needed.
Publications	• LM will prepare fact sheets and brochures, as needed. Fact sheets and brochures will be available at the Visitors Center and will be posted on the website.
Emergency Contacts	• In case of an emergency, dial 911. • Established contacts will be notified in emergency situations. • Signs with the site manager or a toll-free number will be posted around the site. • The contractor site manager number is (513) 910-6107. The 24-hour emergency number is (877) 695-5322.
Mailing Lists	• LM is responsible for maintaining Fernald Preserve contacts.

5.2.3 Meetings with Citizens Groups

LM will meet with stakeholder groups to discuss topics of interest and concern. A currently active stakeholder group, the Fernald Community Alliance, meets with LM at the site six times per year and encourages area stakeholders to attend.

5.3 Visitors Center

The Visitors Center is an onsite education facility and contains exhibits and documents about the history and remediation of the Fernald site, including information on site restrictions, ongoing maintenance and monitoring, and residual risk data. The Visitors Center provides educational services, meeting accommodations, and storage for historical information and photographs. A primary goal of the Visitors Center is to fulfill an informational and educational function within the surrounding community. The information made available at the Visitors Center serves as an institutional control for the site. Meeting space is available for use by the public. Policies for use and an application process are established in the *Meeting Space and Program Request Policy, Fernald Preserve, Ohio, Site* (DOE 2022).

In response to the COVID-19 pandemic in early 2020, all in-person interpretive services including Visitors Center access, were discontinued, and virtual activities were provided. The site's trails closed briefly for 2 months, then re-opened, providing outdoor wildlife watching and hiking opportunities for the duration of the pandemic. All interpretive services including Visitor Center access and in-person programs resumed in April 2022.

LM will continue to work with interested stakeholders who desire to preserve and tell the story of Fernald. The Visitors Center serves as an onsite education facility for schools and community groups. LM will support community efforts to develop and provide historical preservation programs.

5.4 Trails and Public Amenities

The Fernald Preserve is open to the public from 7:00 a.m. to dusk every day. A series of trails provides access to ecologically restored areas of the site. Several overlooks and an observation blind provide additional opportunities for viewing wildlife. A number of interpretive signs have been installed along site trails and overlooks. These signs provide information to the public regarding the history of the Fernald Preserve and wildlife that can be observed onsite.

5.5 Public Access to Information

The Visitors Center houses computing facilities for access and acquisition to electronic copies of the CERCLA AR. The CERCLA AR documents for Fernald were scanned into industry-standard searchable PDF files for viewing over the Internet. The AR documents are available to the public on the LM website under CERCLA Collections (https://www.energy.gov/lm/administrative-record-ar). The documents are searchable by document number, document date, document title, and by searching the text of the document. Additionally, key document indexes were created and posted for each operable unit. The Fernald Preserve staff can be contacted at (513) 648-3106 for assistance in searching for a document in the CERCLA AR. The CERCLA AR will be updated as new documents are created.

5.6 Interpretive Services

Interpretive services provide an important forum to help the community understand post-closure site conditions and the controls in place to protect human health and the environment. Official visits, tours, or customized programs are scheduled in response to specific requests. Access to the On-Site Disposal Facility is limited to pre-scheduled groups escorted by authorized personnel. LM will continue to offer stakeholder and media tours as requested. The *Meeting Space and Program Request Policy, Fernald Preserve, Ohio, Site* (DOE 2022). establishes a standard process for requesting site interpretive services.

5.7 Documents for Public Review and Comment

LM will provide opportunities for stakeholders to review and comment on post-closure documents as required by CERCLA regulations, including five-rear review reports. For documents not specified by statutes and regulations, LM will consult with stakeholders to address citizen expectations for involvement in public reviews and comments. LM anticipates the number of CERCLA post-closure documents developed to be minimal.

The LMICP explains how LM will fulfill its LTS&M obligations at the site. The public has been provided an opportunity to comment on the LMICP and will continue to have the opportunity to comment on revisions to the plan. Changes required to significant site documents will be discussed with stakeholders. Notification of public document reviews will be made through the stakeholder mailing list.

5.8 Public Announcements

LM will issue information announcing public meetings regarding LM documents or significant post-closure activities.

5.9 Publications

LM will prepare fact sheets, brochures, and other information as needed to describe site activities. These documents will be provided to stakeholders in the Visitors Center and will be posted on the LM website.

5.10 Public Outreach Presentations

LM will continue with public outreach presentations on Fernald as requested.

5.11 Emergency Contacts

In the event of an emergency, LM will notify established points of contact, regulators, local elected officials, and community officials. Congressional offices will be informed promptly if an emergency situation arises. The 911 service will be used to request emergency assistance on or near the site. Signs with a local number for the site manager or a toll-free number for citizens to register concerns about the site will be posted at visible locations around the site. The public may use either of these numbers to notify LM of site concerns. The 24-hour security telephone numbers will be posted at site access points and other key locations on the site. The contractor site manager number is (513) 910-6107. The toll free 24-hour emergency number is (877) 695-5322.

5.12 Mailing Lists

LM maintains a contact database of stakeholders associated with any legacy management site. LM is responsible for maintaining the list of Fernald stakeholders after closure. The public can request to be added to this mailing list via fernald@lm.doe.gov or by contacting (513) 648-3330.

6.0 References

42 USC 9601 et seq. “Comprehensive Environmental Response, Compensation, and Liability Act of 1980,” as amended, *United States Code*.

DOE (U.S. Department of Energy), 1999. *Environmental Assessment for Proposed Final Land Use at the Fernald Environmental Management Project,* Revision 1, Fernald Environmental Management Project, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2002. *Master Plan for Public Use of the Fernald Environmental Management Project*, 20900-PL-0002, Fernald Environmental Management Project, Fernald Area Office, Cincinnati, Ohio, June.

DOE (U.S. Department of Energy), 2019. *Fernald Preserve, Ohio, Site Master Plan,* LMS/FER/S19953, April.

DOE (U.S. Department of Energy), 2022. *Meeting Space and Program Request Policy, Fernald Preserve, Ohio, Site,* LMS/FER/S05063, Office of Legacy Management.

PL 99-499. “Superfund Amendments and Reauthorization Act of 1986,” Public Law.

PL 108-375. “Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005,” Public Law.

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Appendix A

Contact List

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<table>
<tr><th colspan="2">Site Contact Information</th></tr>
<tr><td colspan="2">Legacy Management 24-Hour Monitored Security Telephone Number
(877) 695-5322 or (513) 910-6107

Administrative Record Assistance
(https://www.energy.gov/lm/administrative-record-ar)
(513) 648-3106</td></tr>
<tr><th colspan="2">U.S. Department of Energy (DOE)</th></tr>
<tr><th colspan="2">DOE Office of Legacy Management</th></tr>
<tr><td>Carmelo Melendez
U.S. Department of Energy LM-1
1000 Independence Ave., S.W.
Washington, D.C. 20585
Email: carmelo.melendez@lm.doe.gov</td><td>Brian Zimmerman
Office of Legacy Management
Fernald Preserve Manager
U.S. Department of Energy
7400 Willey Road
Hamilton, OH 45013
(513) 648-3340
Email: brian.zimmerman@lm.doe.gov</td></tr>
<tr><th>U.S. Environmental Protection Agency</th><th>Ohio Environmental Protection Agency</th></tr>
<tr><td>Syed Quadri
Remedial Project Manager
U.S. Environmental Protection Agency, Region 5
Remedial Response Section #7
77 W. Jackson Blvd, Mail Code SR-6J
Chicago, IL 60604-3507
(312) 886-5736
Email: quadri.syed@epa.gov</td><td>Laura Hafer
Fernald Project Coordinator
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, OH 45402-2911
(937) 285-6455
Email: laura.hafer@epa.ohio.gov
Website: https://epa.ohio.gov</td></tr>
<tr><th colspan="2">Federal Elected Officials</th></tr>
<tr><th colspan="2">Ohio</th></tr>
<tr><td>The Honorable Sherrod Brown, Senator
United States Senate
503 Hart Senate Office Building
Washington, D.C. 20510-3505
(202) 224-2315
Email: Contact via Web Form:
https://www.brown.senate.gov/contact/</td><td>The Honorable J.D. Vance, Senator
United States Senate
B40C Dirksen Senate Office Building
Washington, D.C. 20510-3506
(202) 224-3353
Email: Contact via Web Form:
https://www.vance.senate.gov/</td></tr>
<tr><td>The Honorable Greg Landsman, Representative
U.S. House of Representatives, District 1
1432 Longworth House Office Building
Washington, D.C. 20515-3501
(202) 225-2216
Email: Contact via Web Form:
https://landsman.house.gov/contact/</td><td>The Honorable Warren Davidson, Representative
U.S. House of Representatives
2113 Rayburn HOB
Washington, D.C. 20515
(202) 225-6205
Email: Contact via Web Form:
https://davidson.house.gov/contact/email</td></tr>
</table>

State Elected Officials	
State of Ohio	
The Honorable Mike DeWine, Governor of Ohio Riffe Center, 30th Floor 77 S. High Street Columbus, OH 43215-6117 (614) 466-3555 Email: Contact via Web Form: https://www.governor.ohio.gov/Contact/ContacttheGovernor.aspx	The Honorable Jon Husted, Lt. Governor of Ohio Riffe Center, 30th Floor 77 S. High Street Columbus, OH 43215-6117 (614) 466-3555 Email: Contact via Web Form: https://www.governor.ohio.gov/Contact/ContacttheGovernor.aspx
The Honorable Louis W. Blessing, Senator Ohio Senate – District 8 Senate Building 1 Capitol Square, Ground Floor Columbus, OH 43215-4275 (614) 466-8068 Email: Contact via Web Form: https://www.ohiosenate.gov/members/louis-w-blessing-iii/contact	The Honorable George Lang, Senator Ohio Senate – District 4 Senate Building 1 Capitol Square, Ground Floor Columbus, OH 43215 (614) 466-8072 Email: Contact via Web Form: https://www.ohiosenate.gov/senators/lang/contact
The Honorable Cindy Abrams, Representatives Ohio House of Representatives – District 29 77 S. High Street, 13th Floor Columbus, OH 43215 (614) 466-9091 Email: Contact via Web Form: https://www.ohiohouse.gov/cindy-abrams/contact	The Honorable Warren Davidson, Congressman Ohio House of Representatives – District 8 Washington, D.C Office 2113 Rayburn HOB Washington, DC 20515 (202) 225-6205 Email: Contact via Web Form: https://davidson.house.gov/contact
State of Indiana	
The Honorable Eric Holcomb Governor of Indiana 200 West Washington Street, Room 206 Indianapolis, IN 46204-4567 (317) 232-4567 Email: Contact via Web Form: https://www.in.gov/gov/ask-eric	

County and Local Elected Officials	
Ms. Alicia Reese, Commissioner Hamilton County, Administration Building 138 East Court Street, Room 603 Cincinnati, OH 45202 (513) 946-4401 Email: alicia.reese@hamilton-co.org	Ms. Denise Driehaus, Commissioner Hamilton County Administration Building 138 East Court Street, Room 603 Cincinnati, OH 45202 (513) 946-4406 Email: denise.driehaus@hamilton-co.org
Ms. Stephanie Summerow Dumas, Commissioner Hamilton County Administration Building 138 East Court Street, Room 603 Cincinnati, OH 45202 (513) 946-4400 Email: stephanie.dumas@hamilton-co.org	Mr. Timothy C. Rogers, Commissioner Butler County, Government Services Center 315 High St., 6th floor Hamilton, OH 45011 (513) 887-3247 Email: rogerst@butlercountyohio.org
Ms. Cindy Carpenter, Commissioner Butler County Government Services Center 315 High St., 6th floor Hamilton, OH 45011 (513) 887-3247 Email: carpenterc@butlercountyohio.org	Mr. Donald L. Dixon, Commissioner Butler County Government Services Center 315 High St., 6th floor Hamilton, OH 45011 (513) 887-3247 Email: dixond@butlercountyohio.org
Mr. Dennis Heyob Crosby Township 8910 Willey Road Harrison, OH 45030 (513) 317-2861 Email: dheyob@crosbytwp.org	Mr. Thomas Bruckner Morgan Township 3141 Chapel Road, Box 1 Okeana, OH 45053 (513) 706-1785 Email: tbruckner@morgantownship.org
Mr. Dennis Conrad, Jr. Reily Township 6061 Reily Millville Road Oxford, OH 45056 (513) 757-4113 No email address available	Ms. Jennifer Patterson, J.D. Ross Township 4055 Hamilton Cleves Road Fairfield, OH 45014 (513) 863-2337, Extension 110 Email: jpatterson@rosstwp.org

Health Departments	
Hamilton County Public Health 250 William Howard Taft, 2nd Floor Cincinnati, OH 45219 (513) 946-7800	Butler County Health Department 301 South 3rd Street Hamilton, OH 45011 (513) 863-1770
Mr. Stephen Helmer Ohio Department of Health Bureau of Environmental Health and Radiation Protection 246 North High St. Columbus, OH 43215 (614) 644-2727 Email: BRadiation@odh.ohio.gov or Stephen.helmer@odh.ohio.gov	
Environmental/Interest Groups	
Fernald Community Alliance Graham Mitchell President PO Box 156 Ross, Ohio 45061 (513) 777-0212 Email: grahamitchell@gmail.com http://fernaldcommunityalliance.org/	