Attachment D

Integrated Environmental Monitoring Plan

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Appendix

Appendix A Natural Resource Monitoring Plan

Acronyms and Abbreviations

ALARA	As Low as Reasonably Achievable
ARARs	Applicable or Relevant and Appropriate Requirements
ASL	Analytical Support Level
BAT	Best Available Technology
BCG	Biota Concentration Guide
BTV	Benchmark Toxicity Value
CAWWT	Converted Advanced Wastewater Treatment Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIP	Community Involvement Plan
CFR	*Code of Federal Regulations*
CMT	Continuous Multi-Channel Tubing
COC	Contaminant of Concern
DCF	Dose Conversion Factor
DCG	Derived Concentration Guideline
DFM	Data Fusion Modeling
DOE	U.S. Department of Energy
LM	U.S. Department of Energy Office of Legacy Management
DOECAP	U.S. Department of Energy Consolidated Audit Program
EMP	Fernald Site Environmental Monitoring Program
EPA	United States Environmental Protection Agency
FCAB	Fernald Citizens Advisory Board
FEMP	Fernald Environmental Management Project
FFA	Federal Facility Agreement
FFCA	Federal Facility Compliance Agreement
FMPC	Feed Material Production Center
FRESH	Fernald Residents for Environmental Safety and Health
FRL	Final Remediation Level(s)
GEMS	Geospatial Environmental Mapping System
gpm	gallons per minute
GPMPP	Groundwater Protection Management Program Plan
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
IC Plan	Institutional Controls Plan
IEMP	Integrated Environmental Monitoring Plan
LDS	Leak Detection System
LM QAPP	Legacy Management CERCLA Sites Quality Assurance Project Plan
LMICP	Comprehensive Legacy Management and Institutional Controls Plan
MCL	Maximum Contaminant Level
MDC	Minimum Detectable Concentration
mrem	millirem
m^3/min	cubic meters per minute
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards Hazardous Air Pollution
NPDES	National Pollutant Discharge Elimination System

Acronyms and Abbreviations (continued)

NTU	Nephelometric Turbidity Units
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Project
OSDF	On-Site Disposal Facility
OU	Operable Unit
pCi/kg	picocuries per kilogram
pCi/L	picocuries per liter
pCi/m^3	picocuries per cubic meter
PCCIP	Post-Closure Care and Inspection Plan
PDF	Portable Document File
ppb	parts per billion
PRG	Preliminary Remediation Goal
PRRS	Paddys Run Road Site
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SER	Site Environmental Report
SSOD	Storm Sewer Outfall Ditch
SWIFT	Sandia Waste Isolation Flow and Transport
TLD	Thermoluminescent Dosimeter
μg/L	micrograms per liter
VAM3D	Variability Saturated Analysis Model in 3 Dimensions

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 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 as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for site-wide monitoring of surface water and sediment over the life of the remedy and ensure that final remediation levels (FRL) 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 [OEPA]) that remedial action objectives for the Great Miami Aquifer are being attained.

As noted in the executive summary, the IEMP has been integrated into the *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP). The IEMP is no longer a stand-alone document with its own review and revision cycle. It will be reviewed and, if necessary, revised each September.

1.1 Background

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) Fernald Preserve completed its remedial investigation/feasibility study (RI/FS) 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 9 years of subsequent 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 1996a) 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 site-wide 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 1996b) and is an enforceable portion of the 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 and DOE Order 450.1A* (DOE 2008a).

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 Orders 450.1A and 5400.5 (DOE 1993) and that continues to address stakeholder concerns. Both orders are listed as "to be considered" criteria in the OU5 ROD and are, therefore, key drivers for the scope of the monitoring program.
- Fulfilling additional site-wide 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) 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, "On-Site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan [GWLMP]").

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 IEMP reports.

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 1995b).

- 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 policies 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 seven sections and one appendix. The remaining sections and their contents are as follows:

- Section 2.0—Post-Closure Strategy and Organization: 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 and discusses the groundwater monitoring activities necessary to maintain compliance with Resource Conservation and Recovery Act (RCRA) requirements as specified in the OEPA Director's Findings and Orders dated September 2000; and a description of the integration with the groundwater monitoring for the OSDF.
- Section 4.0—Surface Water, Treated Effluent, and Sediment Monitoring Program: Provides a description of the routine site-wide surface water monitoring to be performed during post-closure to maintain compliance with surface water and treated effluent discharge requirements. Additionally, this section provides a description of the sediment monitoring activities to independently verify the overall effectiveness of the sediment controls.
- Section 5.0—Air Monitoring and Dose Assessment Program: Provides a description of the site-wide air monitoring, external-radiation monitoring, and dose calculations to be performed during post-closure to maintain compliance with DOE Order 5400.5.
- Section 6.0—Program Reporting: Provides a detailed accounting of the reporting elements included within the IEMP reporting framework.
- Appendix A – Natural Resource Monitoring Plan: Provides the regulatory requirements and strategy for the monitoring of ecological impacts to wetlands, threatened and endangered species, and terrestrial and aquatic habitats.

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 policies that govern environmental monitoring were conducted. The details and results of this evaluation are presented in Sections 3.0 through 5.0.

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 site-wide programmatic requirements. Integration and coordination of all medium-specific plan activities defined herein with other project groups is also a key responsibility. All changes to project activities must be approved by the project team leader or designee.
- Health and safety are the responsibility of all individuals working on this project scope. Qualified health and safety 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 health and safety documents and operating procedures, conduct pertinent safety briefings, and assist in evaluating and resolving all safety concerns. All activities will be conducted according to the *Fernald Preserve Safety Plan* (DOE 2006c).
- Quality assurance personnel will participate on the project team, as necessary, to review project procedures and activities ensuring consistency with the requirements of the *Legacy Management CERCLA Sites Quality Assurance Project Plan* (DOE 2006b) (LM QAPP) or other referenced standard and assist in evaluating and resolving all quality-related 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, and the field manager prior to implementation. If a variance is required, it will be completed in accordance with the LM QAPP. 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.

In the event a change significantly affects the scope of the plan, approval would be requested through monthly conference calls with EPA and OEPA. Afterward, a variance that documents the change and the justification for the change will be provided to EPA and OEPA.

1.3.3 Health and Safety Considerations

The Fernald Preserve's health and safety personnel are responsible for the development and implementation of health and safety 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 to the health and safety requirements prior to implementation of the fieldwork required by this medium-specific plan. Health and safety requirements are addressed in the *Fernald Project Health and Safety Plan* (DOE 2006g) 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 LM QAPP and the *Legacy Management Standard Practice for Validation of Laboratory Data* (DOE 2008).

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 data validation 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 ASLs.

There are four analytical levels (ASL A through ASL D) defined for use at the Fernald Preserve. For groundwater, sediment, surface water, and air, field data documentation will be at ASL A and laboratory data documentation will be at ASL D. 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 double key or verification method to ensure accuracy. The hard-copy 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 to 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 LM QAPP requirements.

Recommended semiannual 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 LM QAPP. 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 as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for site-wide monitoring of surface water and sediment 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 U.S. Environmental Protection Agency's [EPA's] and OEPA's satisfaction) that remedial action objectives for the Great Miami Aquifer are being attained. Additionally, the IEMP will define site-wide remedial monitoring requirements for air.

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 OEPA.

The medium-specific sections of this plan (Sections 3.0 through 5.0) 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 6.0 summarizes the overall reporting strategy for the IEMP. LM information is available on the LM website (http://www.lm.doe.gov/). The Fernald data will be made available to the regulatory agencies on an ongoing basis in the form of electronic data files through this site at the following link: http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm.

The annual site environmental reports will be furnished to EPA and OEPA in accordance with the provisions summarized in Section 6.0. The annual site environmental reports will also be available for review by the Fernald Preserve's stakeholders at the Visitors Center and the Public Environmental Information Center and to select stakeholders via mail.

2.0 Fernald Preserve Post-Closure Strategy and Organization

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.

2.1 Post-Closure Strategy

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. In 2008, the remaining OU with continuing remediation efforts is OU5. Table 2–1 provides a summary of the OU5 remedy overview.

During post-closure, active remediation of the Great Miami Aquifer will continue. Additionally, surface water surveillance monitoring (including NPDES monitoring), sediment surveillance monitoring, and natural resources restoration activities will also continue. The sources associated with air monitoring requirements were removed in 2006; however, monitoring for air particulate will occur through 2009 to ensure that all requirements are met and levels are acceptable from a closure standpoint.

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 have shown that no additional monitoring is required for radon. With agency approval of the LMICP, radon monitoring will cease with this revision of the LMICP.

2.2 Post-Closure Organization

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.

2.3 Post-Closure Status

In 2006, the contaminant sources that were at the Fernald Preserve were removed. Soil and on-property sediments were certified, with the exception of those areas indicated in Figure 2–1 and Figure 2–2. Great Miami Aquifer restoration activities continue post-closure as do surveillance monitoring for surface water and sediment. Natural resource restoration activities also continue post-closure. Monitoring associated with the IEMP is mainly associated with these activities. Figure 2–3 shows the post-closure site configuration.

Table 2–1. 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 Figures 2–1 and 2–2) • 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 μg/L 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, 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 on-site 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 off-site facility.

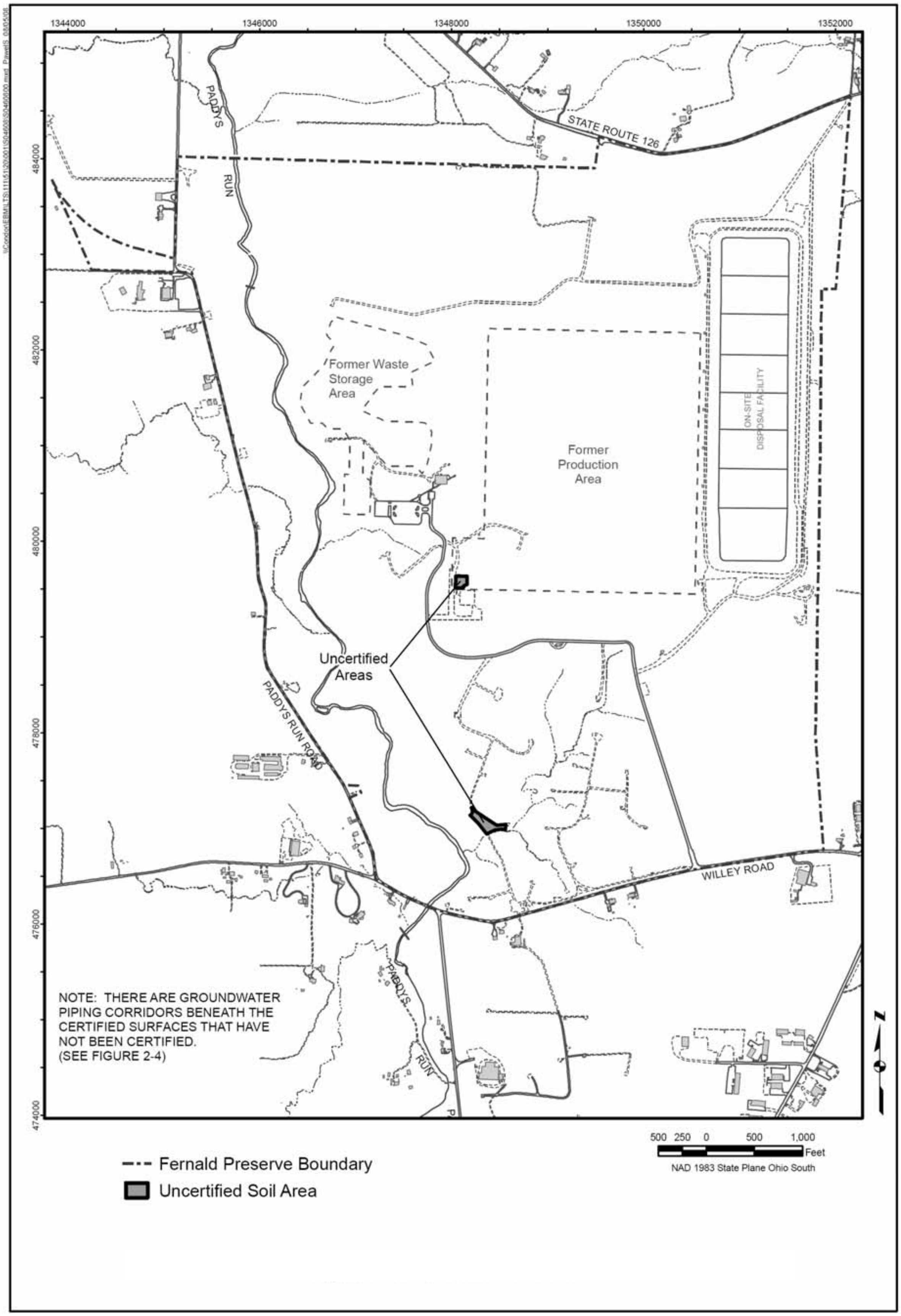

Figure 2–1. Uncertified Areas

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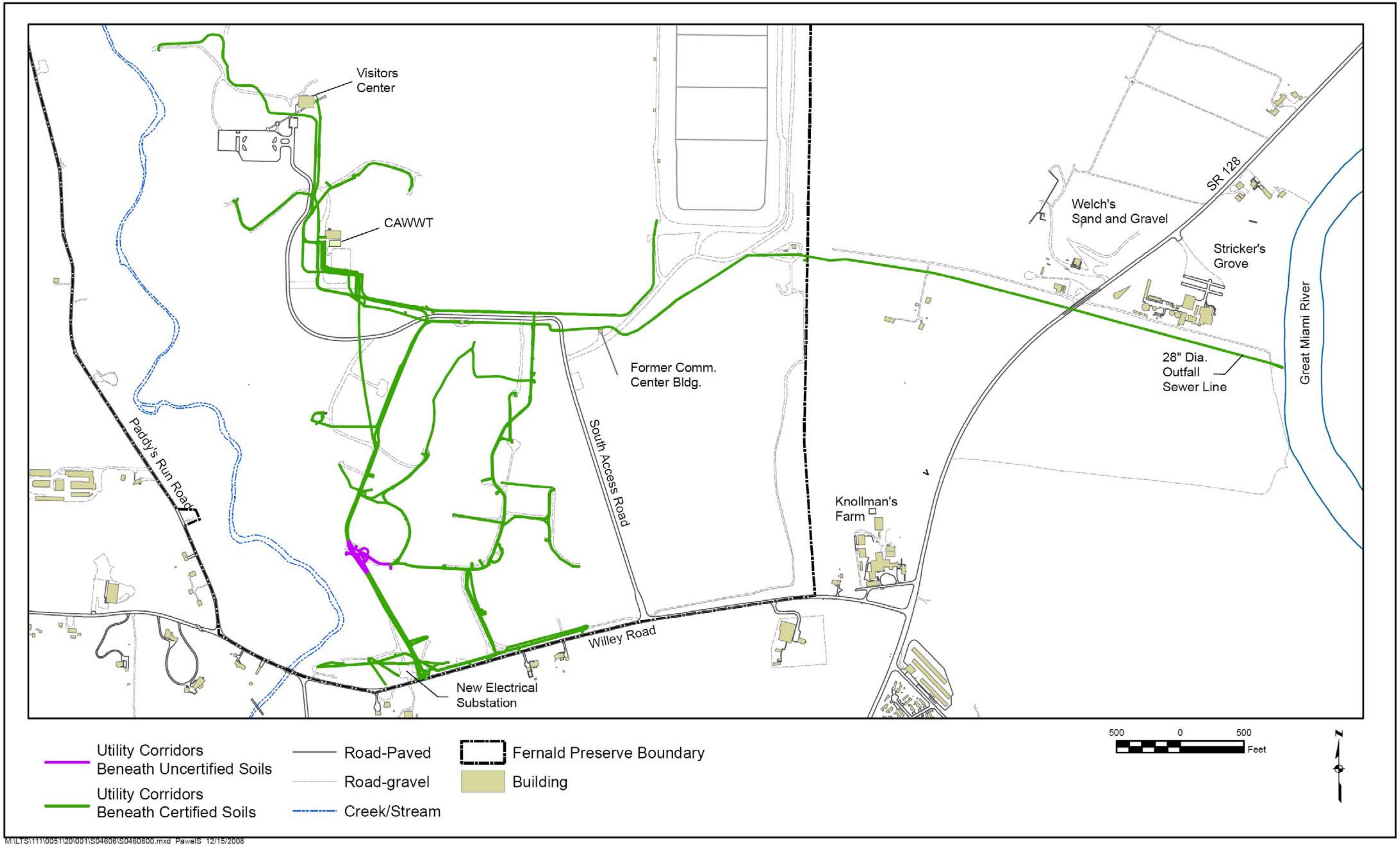

Figure 2–2. Uncertified Subgrade Utility Corridors

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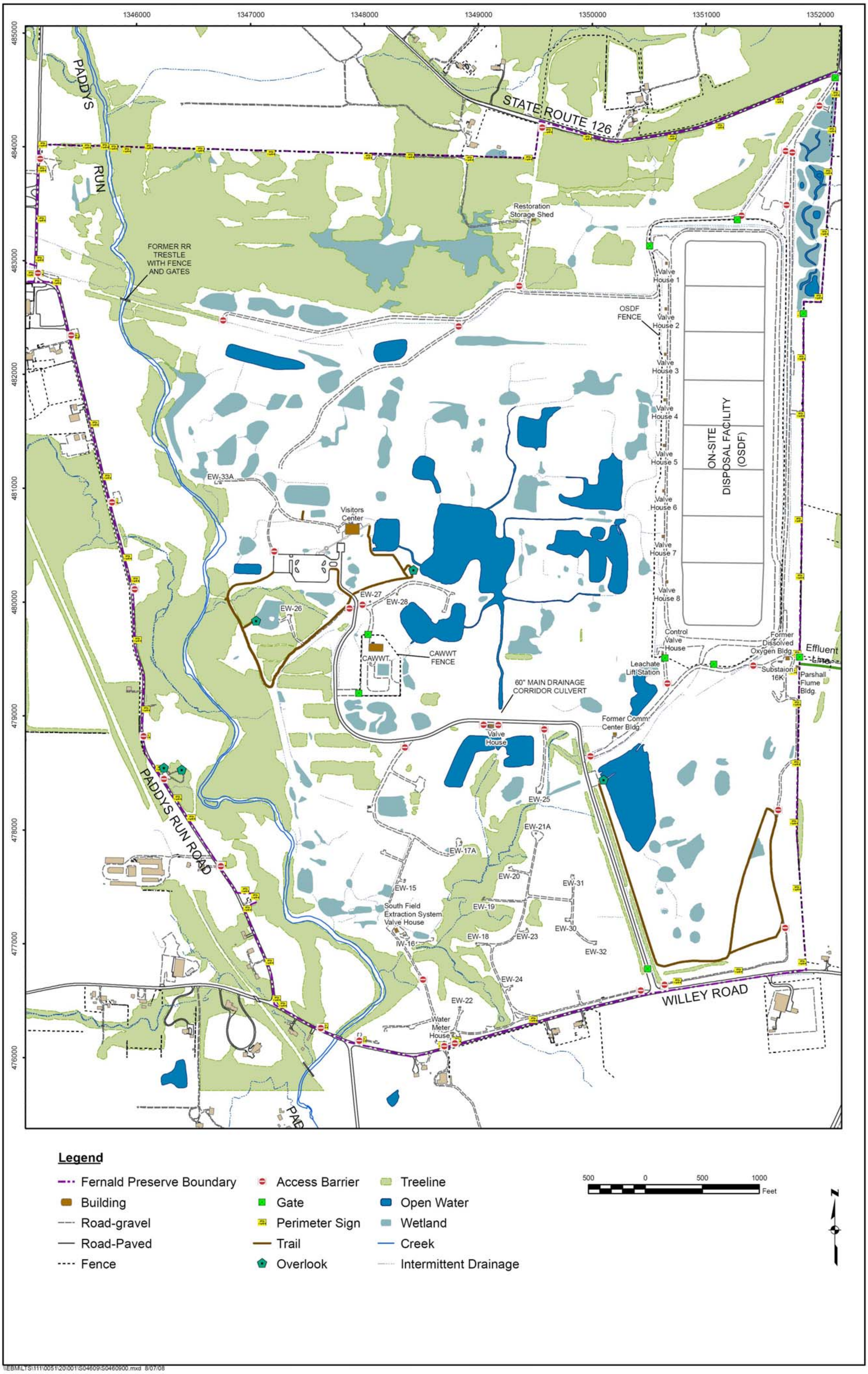

Figure 2–3. Fernald Preserve Site Configuration

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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 *Fernald Groundwater Certification Plan* (DOE 2006a) 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 Great Miami Aquifer groundwater restoration remedy. The IEMP is the controlling document for groundwater remedy performance monitoring and is currently focused on groundwater monitoring needed 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 stages listed above.

<u>Stage I – Pump-and-Treat Operations</u>

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.

Remediation of the aquifer is organized around three groundwater restoration modules:

1. The South Plume Module
2. The South Field Module
3. The Waste Storage Area Module

Figure 3–1 identifies the locations of these aquifer restoration modules.

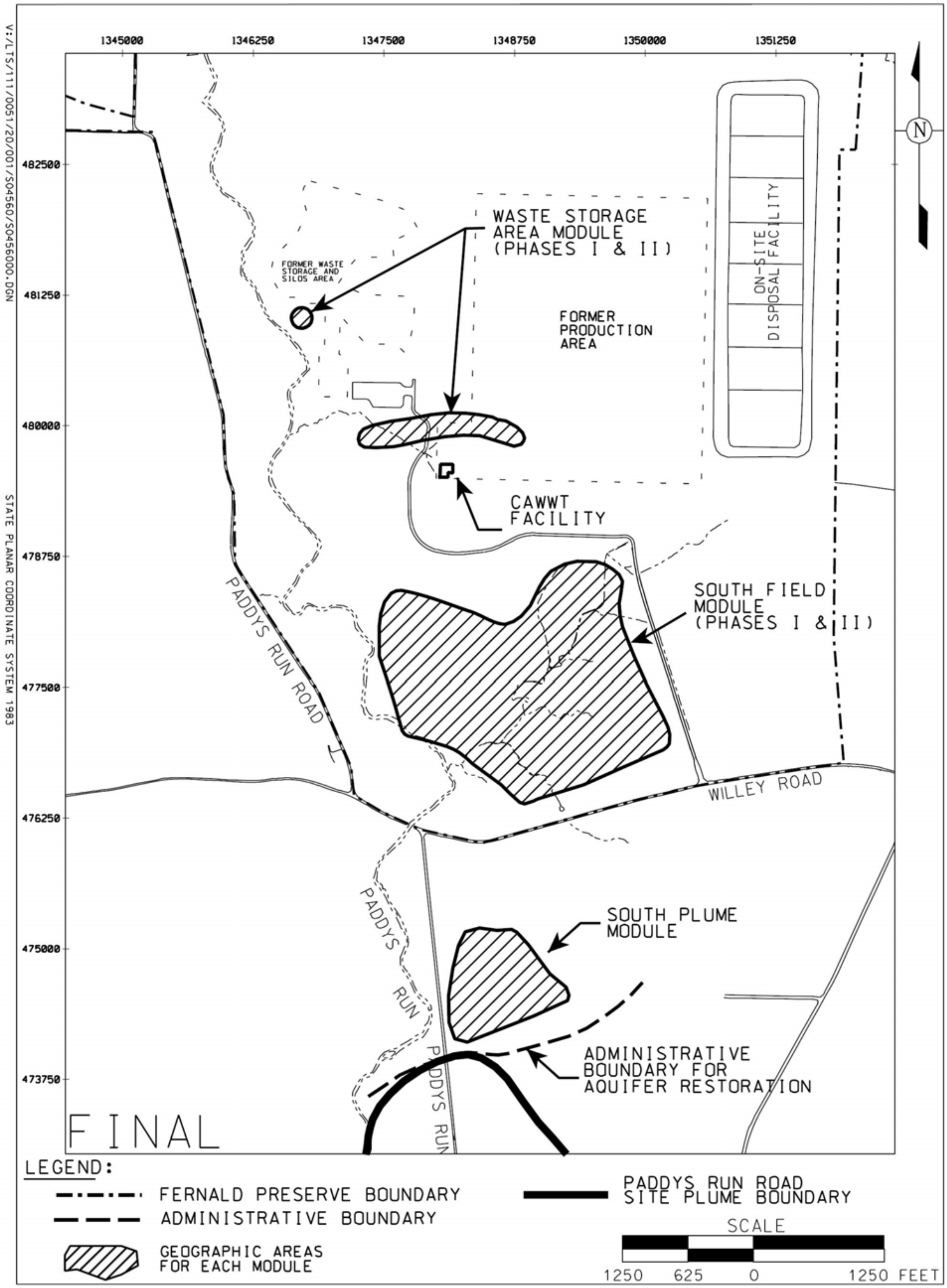

Figure 3–1. Location of Aquifer Restoration Modules

Pump-and-treat operations will continue for each groundwater module until FRL concentrations in the aquifer have been achieved or until the mass removal efficiency of the extraction system has decreased such that it is apparent groundwater FRL concentration limits in the aquifer 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.

The design of the groundwater monitoring program was developed in recognition of:

- Operation of the South Field (Phases I and II) Module.
- Operation of the South Plume Module.
- Operation of the Waste Storage Area (Phases I and II) Module.

Along with this performance-based responsibility, the IEMP serves to integrate several former compliance-based groundwater monitoring or protection programs:

- OEPA Director's Findings and Orders (OEPA 2000) for property boundary groundwater monitoring to satisfy RCRA facility groundwater monitoring requirements.
- Private well sampling.
- Groundwater protection management program plan.

As discussed in Section 3.7, these activities were brought together under a single reporting structure to facilitate regulatory agency review of the progress of the OU5 groundwater remedy.

<u>Stage II—Post Pump-and-Treat Operations/Hydraulic Equilibrium State</u>

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 non-pumping conditions prior to proceeding to Stage III (Attainment Monitoring). During Stage II, groundwater levels will be routinely measured to document that steady-state water level conditions have been achieved. Groundwater FRL constituent concentrations 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). It is anticipated that Stage II monitoring will take approximately 3 months.

<u>Stage III—Certification/Attainment Monitoring</u>

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 FRL constituent concentrations.

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 anticipated that Stage IV monitoring could be conducted for as long as 10 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 Policies, 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 policies 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 policies were found to 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 (MCLs), which are ARARs for groundwater remediation. For Fernald Preserve related contaminants that do not have an established MCL 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 non-carcinogens 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 1993a]).
- Per the *CERCLA Remedial Design Work Plan* (DOE 1996c) 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 as appropriate. The IEMP will delineate the Fernald Preserve's responsibilities for site-wide 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 OEPA's satisfaction that remedial action objectives for the Great Miami Aquifer have been attained.
- The September 10, 1993, OEPA Director's Findings and Orders required groundwater monitoring at the Fernald Preserve's property boundary to satisfy RCRA facility groundwater monitoring requirements (OEPA 1993), and have been superseded by Director's Final Findings and Orders, issued September 7, 2000. The September 7, 2000, Director's Final Findings and Orders specify that the site's groundwater monitoring activities will be implemented in accordance with the IEMP. The revised language allows modification of the groundwater monitoring program as necessary via the IEMP revision process without issuance of a new order.
- DOE Order 450.1A, *Environmental Protection Program*, establishes the requirement for a groundwater protection management program plan (GPMPP) for DOE facilities. The required informational elements of a GPMPP are fulfilled by the *Remedial Investigation Report for Operable Unit 5* (DOE 1995c) and the *Feasibility Study Report for Operable Unit 5* (DOE 1995b). The groundwater monitoring program requirement is being fulfilled by the IEMP. This also satisfies DOE Manual 435.1 (DOE 2001a), which refers to DOE Order 5400.5.

- DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993b), 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 (that was previously in the *Fernald Site Environmental Monitoring Plan* [DOE 1995d]) 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. A dose assessment is no longer required due to the availability of a public water supply.
- 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, OEPA, 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 OEPA 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 3–1. Sections 3.7 and 6.0 outline the current and long-range plan for complying with the reporting requirements contained in the IEMP drivers.

Table 3–1. 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.
	OEPA 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 Order 450.1A, *Environmental Protection Program*. Also satisfies DOE M 435.1 which refers to DOE Order 5400.5	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 the South Plume well field in terms of the total volume extracted and the amount of uranium removed.

3.3 Groundwater Monitoring Administrative Boundaries

Administrative Boundary between the IEMP and Paddys Run Road Site Contaminant Plumes
As described in the remedial investigation report for OU5 (refer to Section 4.8.2), the PRRS consists of two facilities: PCS Purified Phosphates (formerly Albright and Wilson Americas Inc.) and Ruetgers-Nease Chemical Company Inc. PCS Purified Phosphates occupies the northern portion of the site and manufactures phosphate compounds. Rutgers-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 inorganics, volatile organic compounds, and semi-volatile organic compounds. The *Proposed Plan for OU5* (DOE 1995e) acknowledged that DOE's role and involvement, if any, in OEPA's ongoing assessment and cleanup of the PRRS plume would be separately defined 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 30-microgram-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 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 off site 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 fulfill DOE Order 450.1A requirements to maintain an environmental monitoring plan for groundwater.
- 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 the Fernald Preserve. 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 3–2 shows the maximum total uranium plume map (30 µg/L uranium or higher) as of the second half of 2007. These maps represent a compilation of several different monitoring depths within the aquifer, and they illustrate the maximum lateral extent of the plume at all depths. The majority of the top of the plume is 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 2000a); the *Design for Remediation of the Great Miami Aquifer, South Field (Phase II) Module* (DOE 2002b), and the *Waste Storage Area (Phase II) Design Report* (DOE 2005b).

The primary sources of contamination at the Fernald Preserve 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 flyash 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 farther 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 2007) is shown in Figure 3–3. The interpretation will be updated each year in the Site Environmental Report (SER) as new data are collected.

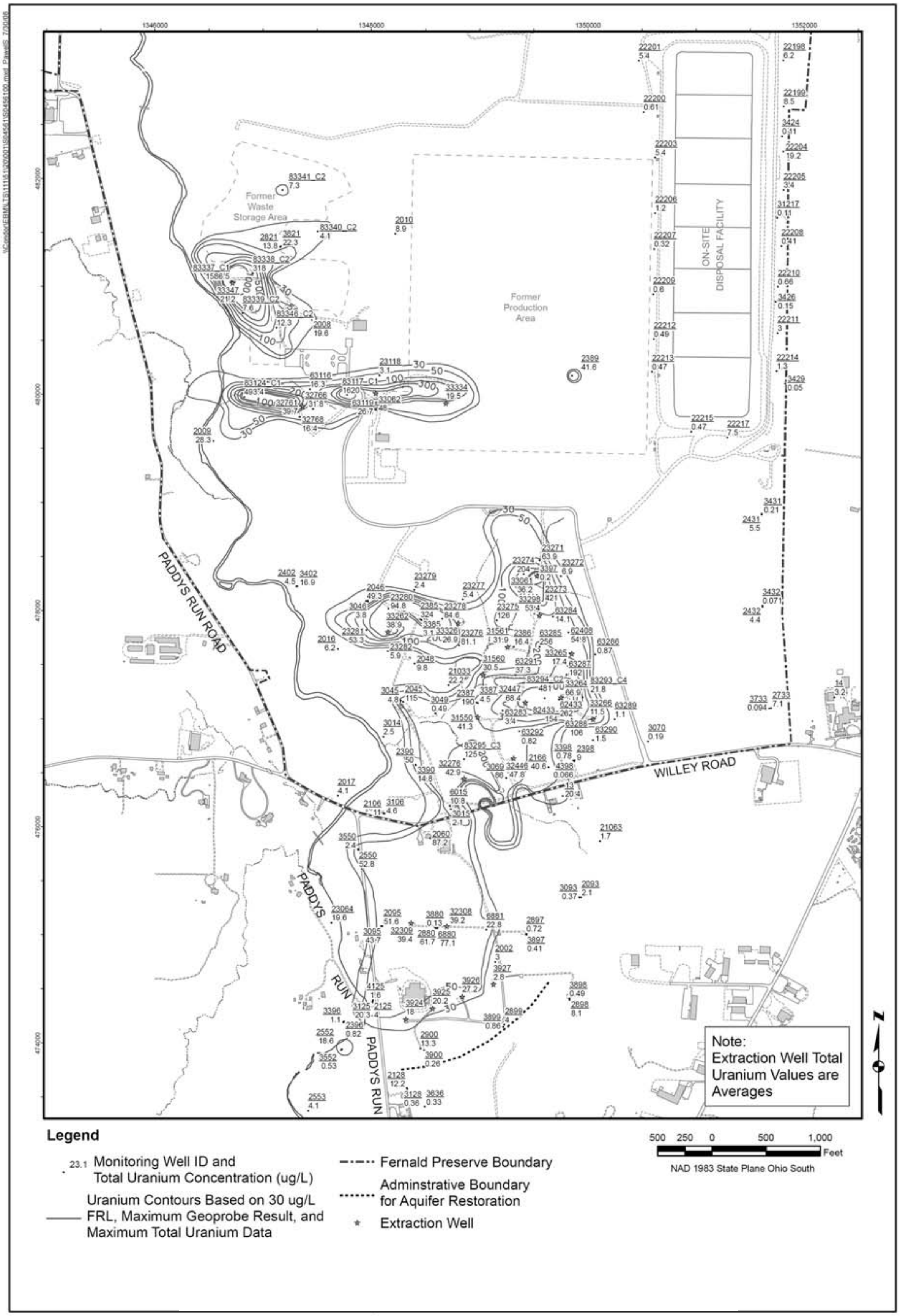

Figure 3–2. Monitoring Well Data and Maximum Total Uranium Plume Through the Second Half of 2007

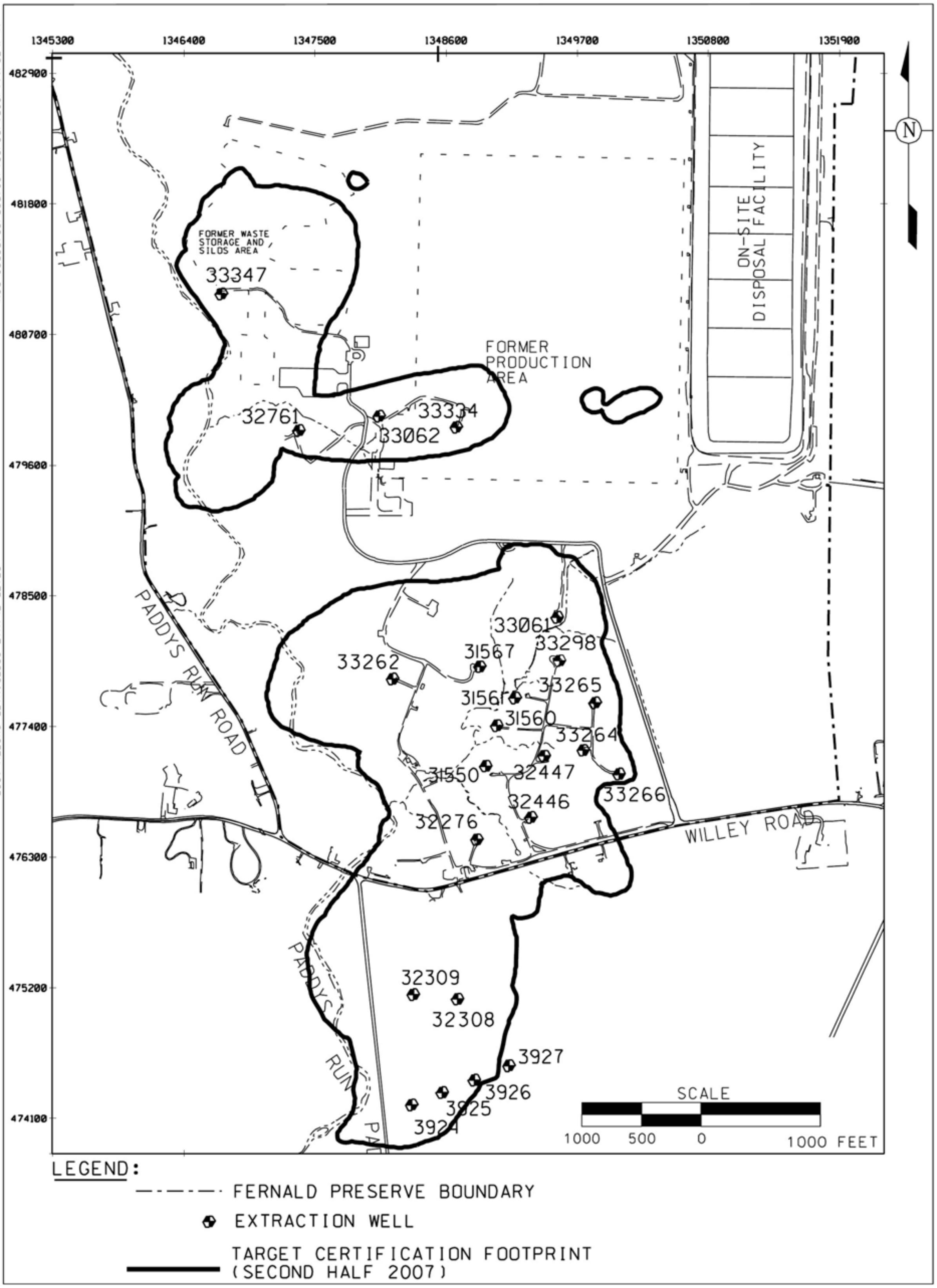

Figure 3–3. Extraction Well Locations

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 the farther 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 2000a).
- *Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas* (DOE 2001b).
- *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* (2005c).

Summaries of how the aquifer remediation system has evolved through the issuance of each of these design documents can be found in previous years' IEMPs.

A test was conducted in 2005 to gauge seasonal flow of water in the storm sewer outfall ditch (SSOD) and to determine if recharge to the Great Miami Aquifer through the SSOD at a rate of 500 gallons per minute (gpm) was feasible (DOE 2005d). As reported in the *Groundwater Remedy Evaluation and Field Verification Plan* (DOE 2004), infiltration through the SSOD at a rate of 500 gpm was predicted to decrease the cleanup time by 1 year. The study concluded, though, that the operation would not be cost effective. Subsequent discussions with EPA and OEPA in 2006 led to an agreement to proceed with a scaled-down version of the operation. Clean groundwater is being pumped into the SSOD to supplement natural storm water runoff in an attempt to accelerate remediation of the South Plume. Three existing wells on the east side of the site are being utilized to deliver as much clean groundwater as is needed to maintain a flow of approximately 500 gpm into the SSOD. This supplemental pumping will continue until the existing wells, pumps, or motors are no longer serviceable. At that time, the operation will be suspended, pending a determination that the remedy is benefiting from the operation.

3.4.2.2 The Modular Approach to Aquifer Restoration

Restoration of the Great Miami Aquifer is being accomplished by operating 23 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 3–1). Figure 3–3 shows the location of the extraction wells that comprise these modules.

South Plume Module
Six extraction wells (3924, 3925, 3926, 3927, 32308, and 32309).

South Field Module
Thirteen extraction wells (31550, 31560, 31561, 32276, 32446, 32447, 33061, 33262, 33264, 33265, 33266, 33298, and 33326).

Waste Storage Area Module
Four extraction wells (32761, 33062, 33334, and 33347).

For monitoring purposes, the aquifer is divided into five zones referred to as “aquifer zones” (see Figure 3–4). 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 comprising 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 3–4) is based on the Waste Storage Area (Phase II) design (2007 through 2023). This design remediation footprint was constructed using reverse, non-retarded, particle-path interpretations from the VAM3D Groundwater Model. The limits of most of the particle tracks are truncated because the particles reached the edge of the Zoom groundwater model domain.

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 close 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.

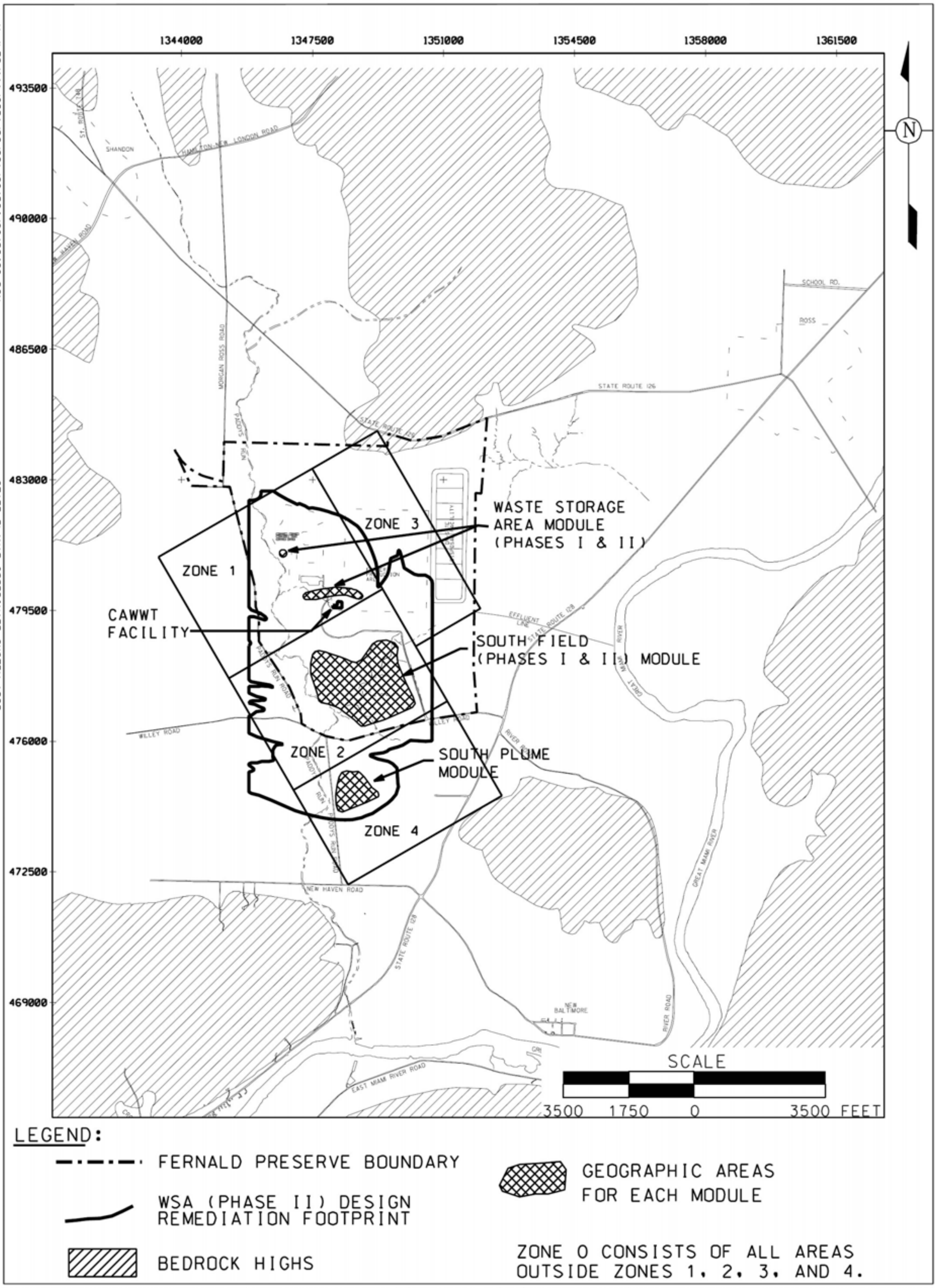

Figure 3–4. Groundwater Aquifer Zones and Design Remediation Footprint

- 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.
- 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.

Approximately 140 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 those constituents not on the short list will be addressed during Stage III (Certification/Attainment Monitoring), as necessary.

Table 3–2 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 respective FRL concentration 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.

Table 3–2. Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (from August 1997 through 2007)

(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	4986	1286	25.79%	1(19) 2(38) 3(3) 4(16)	30.13 J/1620 J
Zinc	0.021 mg/L	B	1337	82	6.13%	0(10) 1(5) 2(14) 3(5) 4(2)	0.0212 NV/13.6 -
Manganese	0.90 mg/L	B	1585	110	6.94%	0(6) 1(11) 2(10) 3(5) 4(4)	0.916 -/105 J
Nickel	0.10 mg/L	A	1407	20	1.42%	0(1) 1(1) 2(7) 3(1)	0.101 -/1.54 -
Technetium-99	94 pCi/L	R*	1587	45	2.84%	1(5)	101.08 -/1352.266 J
Nitrate[f]	11 mg/L	B	1959	51	2.60%	1(8) 2(1)[g]	11.4 -/331 NV
Lead	0.015 mg/L	A	1346	13	0.97%	0(2) 1(2) 2(4) 3(2)	0.0157 -/0.201 -
Arsenic	0.050 mg/L	A	1564	14	0.90%	0(1) 1(1) 2(1) 4(4)	0.051 -/0.125 -
Molybdenum	0.10 mg/L	A	871	14	1.61%	1(1)	0.207 -/0.69 -
Boron	0.33 mg/L	R	2142	15	0.70%	2(2)	0.331 -/1.16 -
Antimony	0.0060 mg/L	A	1347	19	1.41%	0(9) 1(1) 2(6)4(2)	0.00601 -/0.0196 J
Trichloroethene	0.0050 mg/L	A	1418	16	1.13%	0(1) 1(3) 4(1)	0.0207 -/0.120 -
Carbon disulfide	0.0055 mg/L	A	1029	6	0.58%	0(1)[h] 1(3) 2(1)[h]	0.006 -/0.014 -
Fluoride	4 mg/L	A	1567	4	0.26%	0(2) 1(1) 3(1)	5.3 -/12.3 -
Vanadium	0.038 mg/L	R	951	1	0.11%	0(1)	0.0664 J[i]
1,1-Dichloroethane	0.28 mg/L	A	86	0	0%	NA	NA
1,1-Dichloroethene	0.0070 mg/L	A	584	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	791	0	0%	NA	NA
Aroclor-1254	0.00020 mg/L	D	86	0	0%	NA	NA
Barium	2.0 mg/L	A	194	0	0%	NA	NA
Benzene	0.0050 mg/L	A	967	0	0%	NA	NA
Beryllium	0.0040 mg/L	A	877	0	0%	NA	NA
bis(2-Chloroisopropyl) ether	0.0050 mg/L	D	478	0	0%	NA	NA
bis(2-Ethylhexyl)phthalate	0.0060 mg/L	A	86	0[j]	0%	NA[j]	NA
Bromodichloromethane	0.10 mg/L	A	790	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

Table 3–2 (continued). Groundwater FRL Exceedances Based on Samples and Locations Since IEMP Inception (from August 1997 through 2007)

(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]
Carbazole	0.011 mg/L	R	459	0	0%	NA	NA
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	878	0	0%	NA	NA
Copper	1.3 mg/L	A	86	0	0%	NA	NA
Mercury	0.0020 mg/L	A	2131	0[k]	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	991	0	0%	NA	NA
Silver	0.050 mg/L	A	856	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	790	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 2006 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]Nitrate/nitrite results are evaluated with respect to the nitrate FRL.
[g]Since the IEMP inception, there has been only one nitrate/nitrite exceedance at Well 2017 (in 1998) (refer to Figure A–12).
[h]Since the IEMP inception, there has been one isolated exceedance for carbon disulfide at two locations (refer to Figure A–5).
[i]Since the IEMP inception, there has been only one vanadium exceedance at Well 2426 (in 1998) (refer to Figure A–16).
[j]Of the 86 samples analyzed for bis(2-Ethylhexyl)phthalate, a common laboratory containment, five had results above the FRL. The FRL results above are all considered suspect due to laboratory analysis issues, laboratory blank and field blank contamination, or field duplicate results being non-detected. 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.
[k]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 extremely below the original sample result.

- 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.

As shown in Table 3–2, 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 semiannually 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 3–5 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 Historic Waste Storage Area on Figure 3–5 for the locations to be monitored in Zone 1.

3. Constituents that have FRL exceedances in only one zone will be monitored semiannually 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.

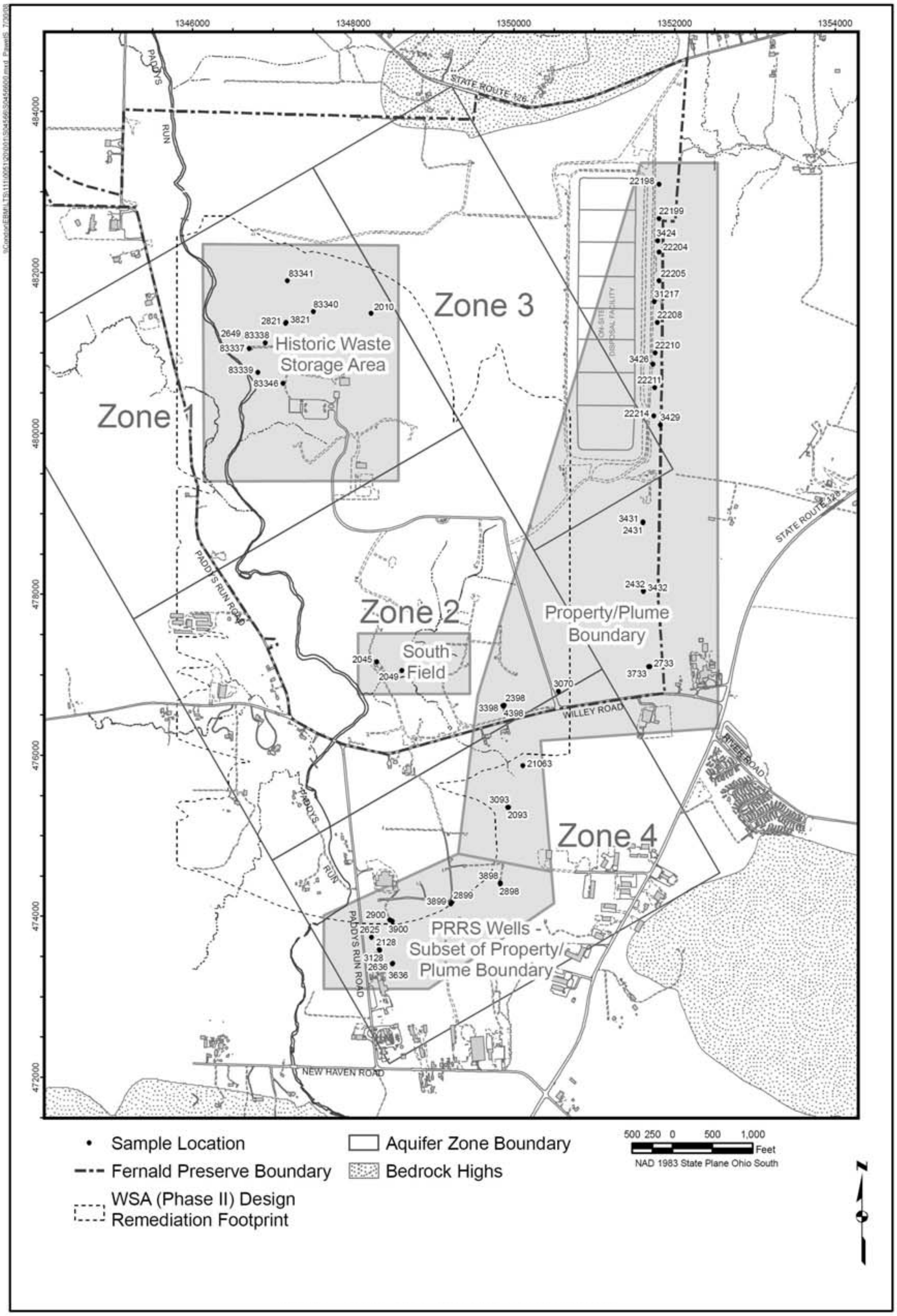

Figure 3–5. Locations for Semiannual Monitoring for Property/Plume Boundary, South Field, and Waste Storage Area

Note: Carbon disulfide has exceedances primarily in Zone 1. The two wells that have exceedances outside Zone 1 were Property Boundary Wells 2432 and 3069. These wells were sampled quarterly and exceedances were slightly above the FRL (6 µg/L with respect to the 5.5 µg/L FRL). For Well 2432, there have been no additional exceedances since the occurrence during first quarter 1999. With regard to the one exceedance for Well 3069 that occurred during fourth quarter 2001, a duplicate result during the sampling event was below the FRL. No additional exceedances for carbon disulfide have occurred at Well 3069 since 2001.

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 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).

Based on the above four criteria, 13 non-uranium groundwater FRL constituents are on the short list and are monitored semiannually (Table 3–3).

3.5 Design of the IEMP Groundwater Monitoring Program

Monitoring focuses on IEMP data and specifically calls for semiannual monitoring of groundwater FRL constituents with exceedances. A list of IEMP groundwater monitoring wells is provided in Table 3–4. Table 3–5 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 2-week shutdown of all extraction wells (with the exception of the 4 leading edge South Plume Recovery Wells) will be conducted each year when water levels in the aquifer are seasonally high. Water levels in the aquifer are seasonally at their highest in late spring/early summer. 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 wellfield 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 2008 total uranium measurements will serve as pre-shutdown concentrations for the six wells. The six wells will be sampled just prior to re-starting the extraction wells in early May. Type 8 wells will be sampled in both Channel 1 and Channel 2.

Table 3–3. 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]There are consistent/recent exceedances of manganese in Zone 1; therefore, this constituent will be monitored in the waste storage area and along the Property/Plume Boundary.

Table 3–4. List of IEMP Groundwater Monitoring Wells[a]

		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**
1	13					
2	14					
3	2002					
4	2008					
5	2009					
6	2010				2010	
7	2014					
8	2016					
9	2017					
10	2045					2045
11	2046					
12	2048					
13	2049					2049
14	2060 (12)					
15	2093	2093				
16	2095					
17	2106					
18	2125					
19	2128	2128		2128		
20	2166					
21	2385					
22	2386					

Table 3–4 (continued). List of IEMP Groundwater Monitoring Wells

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]		
23	2387					
24	2389					
25	2390					
26	2396					
27	2397					
28	2398	2398				
29	2402					
30	2431	2431				
31	2432	2432				
32	2550					
33	2552					
34	2553					
35	2625	2625		2625		
36	2636	2636		2636		
37	2649				2649	
38	2733	2733				
39	2821				2821	
401	2880					
41	2897					
42	2898	2898		2898		
43	2899	2899		2899		
44	2900	2900		2900		
45	3014					
46	3015					
47	3045					
48	3046					
49	3049					
50	3069					
51	3070	3070				
52	3093	3093				
53	3095					
54	3106					
55	3125					
56	3128	3128		3128		
57	3385					
58	3387					
59	3390					
60	3396					
61	3397					
62	3398	3398				
63	3402					
64	3424	3424				
65	3426	3426				
66	3429	3429				
67	3431	3431				
689	3432	3432				
69	3550					

Table 3–4 (continued). List of IEMP Groundwater Monitoring Wells

		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
70	3552					
71	3636	3636		3636		
72	3733	3733				
73	3821				3821	
74	3880					
75	3897					
76	3898	3898		3898		
77	3899	3899		3899		
789	3900	3900		3900		
79	4125					
80	4398	4398				
81	6015					
82	6880					
83	6881					
84	21033					
85	21063	21063				
86	21192					
87	22198	22198	22198			
88	22199	22199	22199			
89	22204	22204	22204			
90	22205	22205	22205			
91	22208	22208	22208			
92	22210	22210	22210			
93	22211	22211	22211			
94	22214	22214	22214			
95	23064					
96	23118					
97	23271					
98	23272					
99	23273					
100	23274					
101	23275					
102	23276					
103	23277					
104	23278					
105	23279					
106	23280					
107	23281					
108	23282					
109	31217	31217				
110	32766					
111	32768					
112	62408					
113	62433					
114	63116					
115	63119					
116	63283					

Table 3–4 (continued). List of IEMP Groundwater Monitoring Wells

		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**
117	63284					
118	63285					
1190	63286					
120	63287					
121	63288					
122	63289					
123	63290					
124	63291					
125	63292					
126	82433					
127	83117					
128	83124					
129	83293					
130	83294					
131	83295					
132	83296					
133	83335					
134	83336					
135	83337				83337[d]	
136	83338				83338[d]	
137	83339				83339[d]	
138	83340				83340[d]	
139	83341				83341[d]	
140	83346				83346[d]	

[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 organics are not sampled in Type 8 wells.

Table 3–5. IEMP Monitoring Requirements[a]

1. Total Uranium

2. Waste Storage Area

General Chemistry	Inorganic	Radionuclide	Organic
Nitrate/Nitrite	Manganese Molybdenum Nickel	Technetium-99 Total Uranium[b]	Carbon Disulfide Trichloroethene

3. South Field

General Chemistry	Inorganic	Radionuclide	Organic
NA[c]	Boron	Total Uranium[b]	NA[c]

4. Property/Plume Boundary For FRL Exceedances

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony Arsenic Lead Manganese Nickel Zinc	Total Uranium[b]	NA[c]

5. Property/Plume Boundary For PRRS
(These wells are also monitored for Property/Plume Boundary for FRL Exceedances constituents)

General Chemistry	Inorganic	Radionuclide	Organic
Phosphorous	Arsenic[d] Potassium Sodium	NA[c]	Benzene Ethyl benzene Isopropyl benzene Toluene Total xylene

[a]Monitoring will be conducted semiannually.
[b]Total uranium is monitored as part of the site-wide uranium monitoring.
[c]NA = not applicable
[d]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 approximately 4 days following re-start of the extraction wells.

During the annual shutdowns, water level measurements will be recorded at select locations using down-hole pressure transducers. The transducers will be set to record a water level every hour, on the top of each hour. 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 site-wide 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 herein are consistent with the requirements of the LM QAPP, which references the *Site-Wide CERCLA Quality Assurance Project Plan* (SCQ) (DOE 2003) 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
- Health and safety
- 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 LM QAPP.

3.6.1.1 Total Uranium Monitoring Project

Approximately 140 monitoring wells will be sampled semiannually for total uranium. Approximately 50 of these wells will be sampled for additional constituents as described in Sections 3.6.2.2 through 3.6.2.4. A list of the wells to be sampled for only total uranium is provided in Table 3–6 and shown in Figure 3–6. The wells extend across all aquifer zones and provide monitoring coverage in all restoration module areas. Figure 3–6 shows the locations of the monitoring wells.

Table 3–6. List of Groundwater Wells to Be Sampled for Total Uranium Only

13	3046	23278
14	3049	23279
2002	3069	23280
2008	3095	23281
2009	3106	23282
2014	3125	32766
2016	3385	32768
2017	3387	62408
2046	3390	62433
2048	3396	63116
2060 (12)	3397	63119
2095	3402	63283
2106	3550	63284
2125	3552	63285
2166	3880	63286
2385	3897	63287
2386	4125	63288
2387	6015	63289
2389	6880	63290
2390	6881	63291
2396	21033	63292
2397	21192	82433
2402	23064	83117
2550	23118	83124
2552	23271	83293
2553	23272	83294
2880	23273	83295
2897	23274	83296
3014	23275	83335
3015	23276	83336
3045	23277	

Note: Six of the seven available channels in a Type 8 well (also known as a continuous multi-channel tubing [CMT] well) are available for water quality sampling. The seventh channel is used only for water level measurements. The channel completed in the plume interval with the highest measured uranium concentration will be sampled every 6 months. The other five channels will be sampled once a year to document any changes in the plume concentration profile.

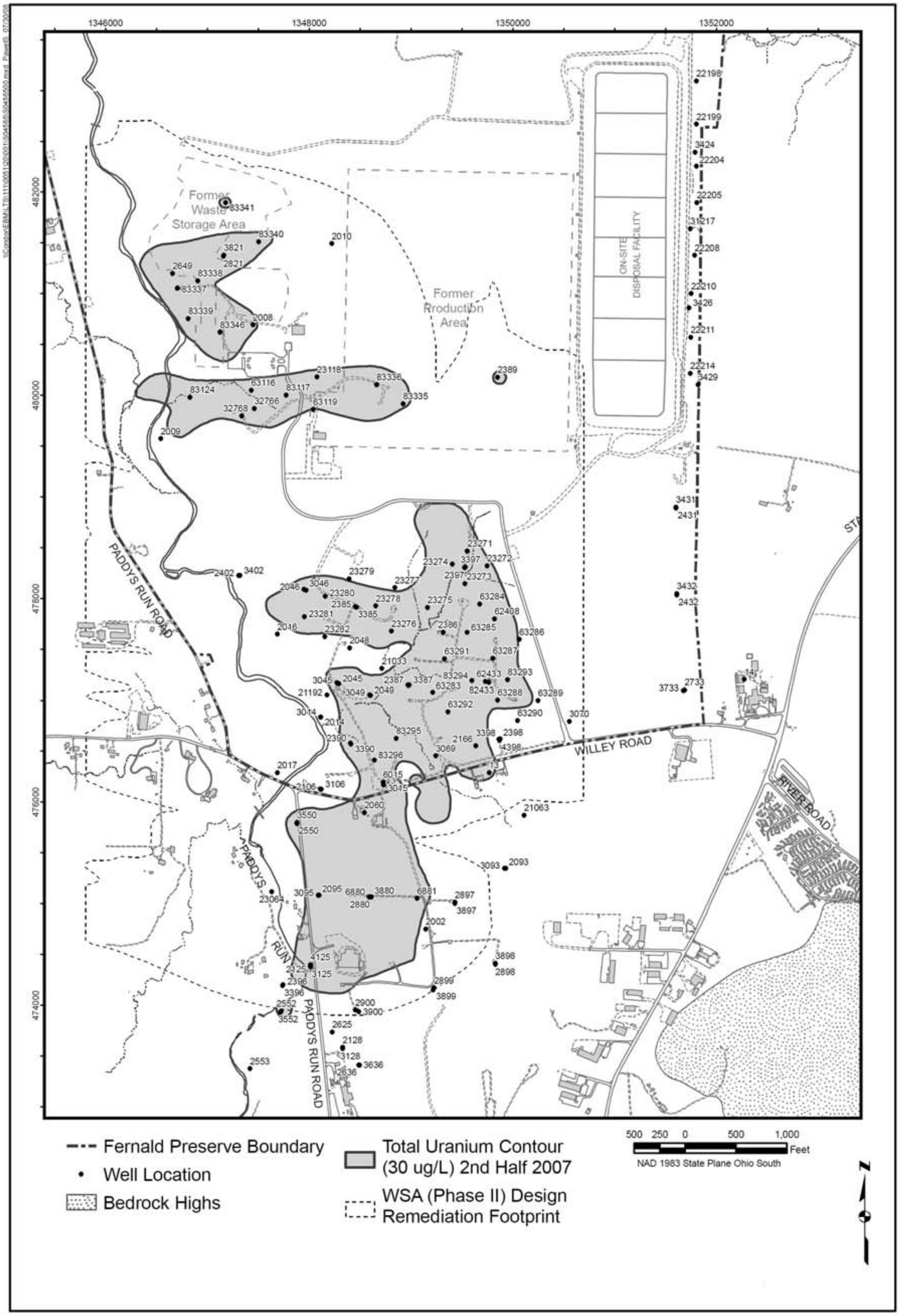

Figure 3–6. Locations for Semiannual Total Uranium Monitoring Only

This semiannual 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 the further southern migration of the total uranium plume and to document the area of uranium contamination (above 30 µg/L) south of the Administrative Boundary.
- Continued tracking of uranium concentrations at three 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.

Three private wells (12, 13, and 14) will also be sampled for total uranium. Figure 3–6 shows the location of these three wells (Private Well 12 is also identified as Monitoring Well 2060). Continuing to add to the historical database at these three private-well locations is beneficial for facilitating discussions with area stakeholders on the progress of the aquifer restoration. The three locations are situated immediately downgradient of the Fernald Preserve property boundary.

3.6.1.2 South Field Monitoring Project

The South Field area is located in Aquifer Zone 2 (refer to Figure 3–4). Thirteen 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 3.6.2.1), 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 3–5 shows the locations of these two wells. Following is the monitoring table:

South Field Monitoring Project Table
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
NA	Boron	Total Uranium	NA

Direct-push sampling will be conducted annually at five locations (12368, 12369, 12370, 12372, and 12373) along and south of Willey Road. These 5 locations are included in the 27 locations sampled yearly using direct-push technology. Figure 3–7 shows these locations. This annual direct-push sampling will be used to help track remediation progress. At each direct-push location, a groundwater sample will be 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.

3.6.1.3 Waste Storage Area Monitoring Project

The waste storage area is located in Aquifer Zone 1 (refer to Figure 3–4). Four extraction wells (32761, 33062, 33347, and 33334) are operating in the waste storage area. Figure 3–3 shows the locations of these four wells.

In addition to the monitoring wells being sampled in the waste storage area for total uranium only (refer to Section 3.6.2.1), the 10 wells listed below will be sampled semiannually (refer to Figure 3–5 for the locations of these 10 wells).

Monitoring Wells to Be Monitored Semiannually In the Waste Storage Area

2010	2649	2821	3821	83337
83338	83339	83340	83341	83346

The four 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 CMT wells. All three channels will be sampled semiannually.

As explained in Section 3.6.2.7, filtering of groundwater samples at monitoring wells may take place on a case-by-case basis if deemed appropriate. Filtering of groundwater samples using a 0.45-micron filter is deemed appropriate for Monitoring Well 2010 because the well has 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 2005c). An unfiltered sample will be collected for general chemical, organic constituents, and total uranium. A second sample will be collected after filtering with a 0.45-micron filter and analyzed for metals and radiological constituents, including total uranium.

Locations may also be sampled in the waste storage area, utilizing 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. Direct-push locations in the waste storage area will be sampled for the waste storage area monitoring semiannual constituents listed below, excluding the organic constituents. Location numbers and collected data will be provided in each annual SER.

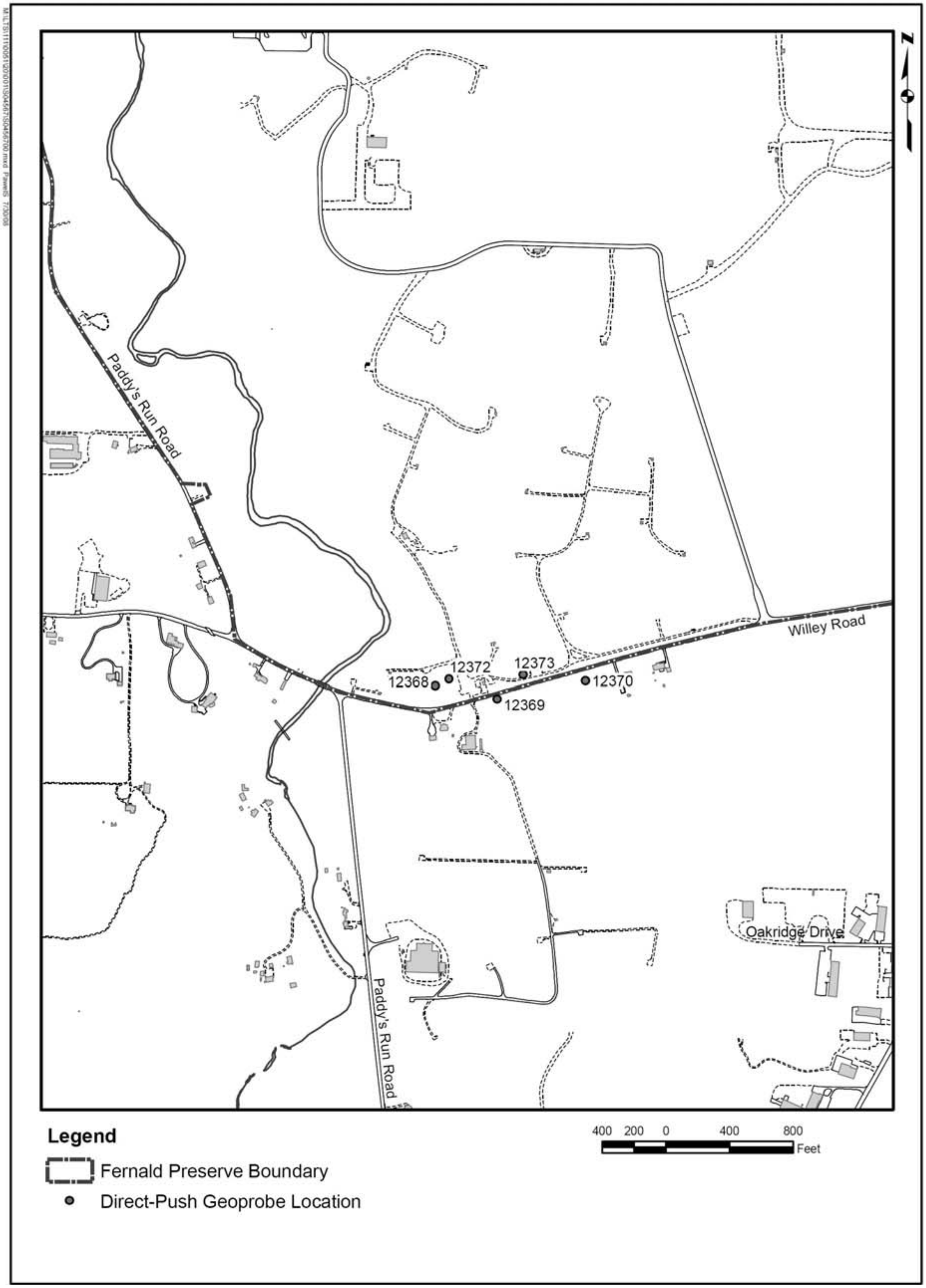

Figure 3–7. Direct Push Sampling Locations

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-micron filter.

If the turbidity of the 5-micron filter direct-push sample is below 5-NTUs, the remaining five constituents will be sampled. If the turbidity of the 5-micron filtered direct-push sample is above 5-NTUs, the sample will be further filtered through a 0.45-micron filter. Both the 5-micron and the 0.45-micron filtered sample will be analyzed for total uranium and the four remaining constituents will be analyzed from the 0.45-micron filtered sample only.

Waste Storage Area Monitoring Project Table
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
Nitrate/Nitrite	Manganese Molybdenum Nickel	Technetium-99 Total Uranium	Carbon Disulfide Trichloroethene

3.6.1.4 Property/Plume Boundary Monitoring Project

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 GWLMP.

Property/Plume Boundary Monitoring for FRL Exceedances

Twenty-five monitoring wells along the eastern property boundary and the leading edge of the off-site total uranium plume will be sampled semiannually (refer to the table that follows). Figure 3–5 is a map showing the locations of the wells.

The 25 monitoring wells will be sampled semiannually 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 Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	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 (of lack of influence) that the pumping has on the PRRS plume. Groundwater samples will be collected semiannually from 11 monitoring wells (refer to Figure 3–5).

The 11 wells are:

2128	2899	3898
2625	2900	3899
2636	3128	3900
2898	3636	

These 11 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
Semiannual Sampling Frequency

General Chemistry	Inorganic	Radionuclide	Organic
Fluoride	Antimony	Total Uranium	Benzene
Phosphorous	Arsenic		Ethyl benzene
	Lead		Isopropyl benzene
	Manganese		Toluene
	Nickel		Total Xylene
	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 5–1 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, 2625, 2636, 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 3–5 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 Project

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 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.

Approximately 180 monitoring wells were selected for water level monitoring; they are shown in Figure 3–8 and listed below. 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 in these wells 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 on-site or at off-site 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 LM QAPP. 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 LM QAPP, which have been incorporated into the following standard operating procedures used for conducting groundwater sampling:

- Liquids Sample Collection
- Field Quality Control Sample Collection
- Environmental Sample Shipment
- Water Quality Meter Calibration, Operation, and Maintenance

Table 3–7 summarizes the field sampling information by analytical constituent groups and includes the analytical support level (ASL), holding time, preservative, container requirement, and analytical method. Routine filtration of groundwater samples collected at monitoring wells will not occur.

Not filtering groundwater samples collected at monitoring wells is a conservative (and an 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 the EPA and OEPA as soon as possible through a conference call update and annually in the annual SER.

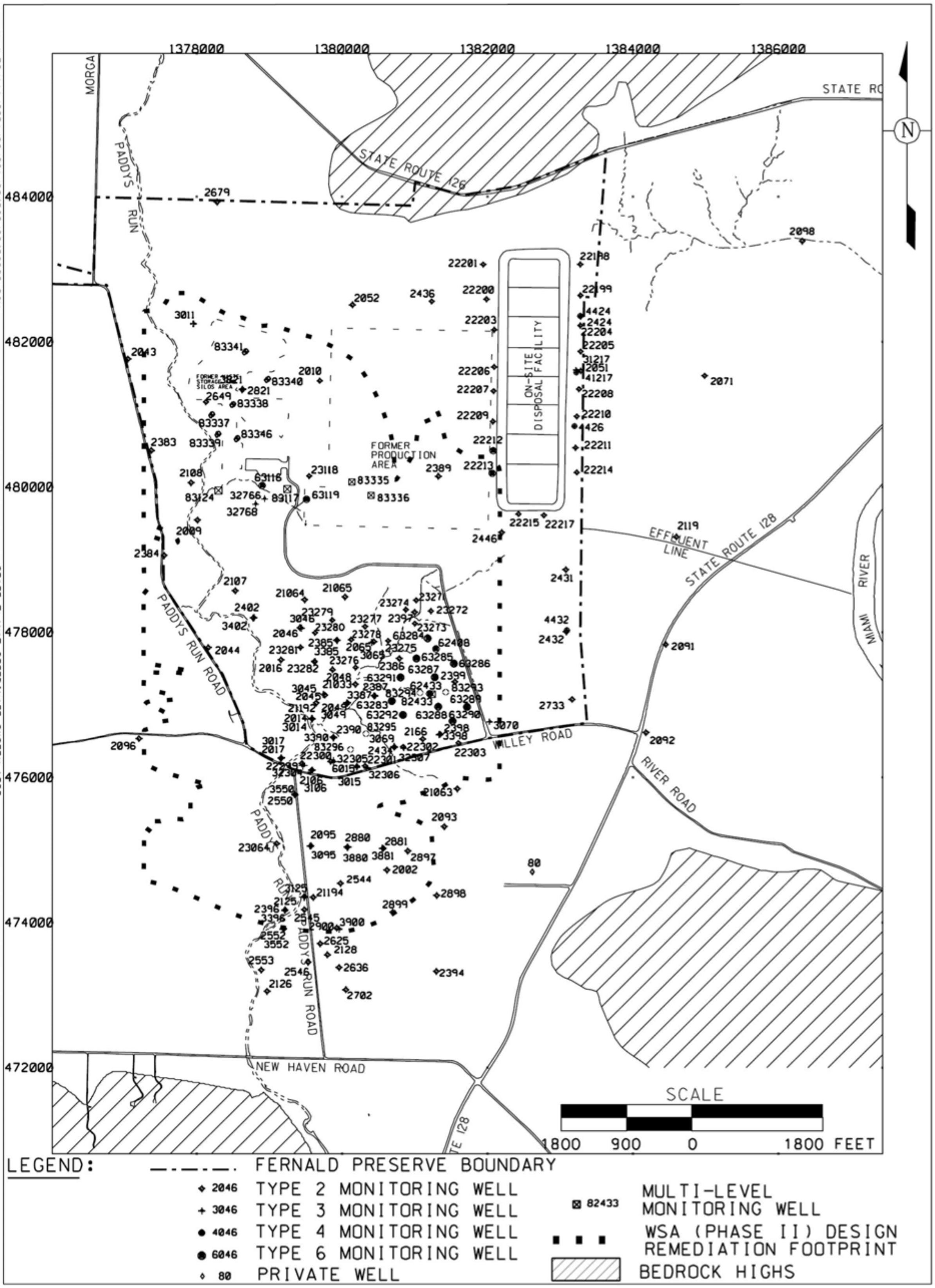

Figure 3–8. Groundwater Elevation Monitoring Wells

Table 3–7. Analytical Requirements for the Groundwater Monitoring Program

Constituent	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:						
	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		6 months	HNO_3 to pH <2	Plastic or glass
Field Parameters[h]:	8260B[e]	Grab	D	NA[j]	Cool to 4°C	NA[j]
		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]:	LM QAPP[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 1997b).
[g]Field parameters include dissolved oxygen, pH, specific conductance, temperature, and turbidity.
[h]The LM QAPP provides field analytical methods.
[i]NA = not applicable.

List of Groundwater Elevation Monitoring Wells

80	2389	3017	22203	32306
2002	2390	3045	22204	32307
2009	2394	3046	22205	32766
2010	2396	3049	22206	32768
2014	2397	3065	22207	41217
2016	2398	3069	22208	62408
2017	2399	3070	22209	62433
2043	2402	3095	22210	63116
2044	2424	3106	22211	63119
2045	2431	3125	22212	63283
2046	2432	3385	22213	63284
2048	2434	3387	22214	63285
2049	2436	3390	22215	63286
2051	2446	3396	22217	63287
2052	2544	3398	22299	63288
2065	2545	3402	22300	63289
2071	2546	3550	22301	63290
2091	2550	3552	22302	63291
2092	2552	3821	22303	63292
2093	2553	3880	23064	82433
2095	2625	3881	23118	83117
2096	2636	3900	23271	83124
2098	2649	4424	23272	83293
2106	2679	4426	23273	83294
2107	2702	4432	23274	83295
2108	2733	6015	23275	83296
2119	2821	21033	23276	83335
2125	2880	21063	23277	83336
2126	2881	21064	23278	83337
2128	2897	21065	23279	83338
2166	2898	21192	23280	83339
2383	2899	21194	23281	83340
2384	2900	22198	23282	83341
2385	3011	22199	31217	83346
2386	3014	22200	32304	
2387	3015	22201	32305	

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-micron filter. Past experience has shown that measured uranium concentrations in direct-push samples are consistently similar regardless of whether or not the sample was filtered using a 5-micron filter or a 0.45-micron filter. Therefore, direct-push samples for uranium analysis are routinely filtered through a 5-micron filter only. Exceptions to this filtering procedure include the collection of Waste Storage Area parameters as discussed in Section 3.6.2.3.

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 LM QAPP. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as 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 rinsates, trip blanks, and duplicate samples. Each quality control sample is preserved using the same method for 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 entering 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 rinsates 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. Rinsates are not required when dedicated well equipment or disposable sampling equipment is used.
- Field duplicates will be collected for every 20 groundwater samples (or a fraction thereof) if the specific sampling program consists of fewer than 20 samples.

The groundwater samples associated with each quality control sample also will be tracked to ensure traceability in the event that contaminants are detected in the quality control samples.

3.6.1.9 Decontamination

In general, decontamination of equipment is minimized due to limited use of reusable equipment during sample collection. However, if decontamination is required, then equipment will be cleaned between sample locations. The decontamination is identified in the LM QAPP.

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 disposition methodology for each type of waste generated.

Purge Water and Decontamination Solutions: All decontamination wastewater and purge water will be containerized and disposed through the Converted Advanced Wastewater Treatment Facility (CAWWT) for treatment. The point of entry into the CAWWT will either be via 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 non-radiological contaminated and is placed in plastic bags and disposed through the normal sanitary waste stream.

3.6.1.11 Monitoring Well Maintenance

Monitoring wells at the Fernald Preserve will be maintained in order 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; the drain hole is clear; it is free of debris; 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; and if equipped with a ground-flush cap, ensuring that it is water-tight to prevent surface water from entering the well.
- Inspecting concrete surface seals for settling and cracking.
- Periodically inspecting the exterior guards for visibility and damage and repaint, if necessary.

Well Evaluation

A monitoring well evaluation will be initiated if there is an indication that the monitoring well may no longer by 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 monitoring well. The bioaccumulation of metals around the monitoring well 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 or not 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 those 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.

<u>Well Maintenance Corrective Actions</u>

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 the removal of sediment from the well through the 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. It should be noted that CMT wells could probably not be rehabilitated due to the small diameters of the sampling channels. It is understood that 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 [redox 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 3–5.

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 OEPA 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.
- Regression curves of uranium concentration data at groundwater monitoring wells every 5 years. Regression curves of uranium concentration data at groundwater monitoring wells will be prepared every 5 years because only two data points a year will be added to the database used to generate the curves.

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 results of the sampling, 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 OEPA have identified 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 >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 FRL. 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 FRL concentrations 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 aquifer remediation 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 are intended to be met through evaluation of IEMP groundwater data.

<u>Capturing and Restoring the Area Containing the >30-µg/L Total Uranium Plume</u>
Capture and restoration of the area containing the >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 30-µg/L total uranium plume will be assessed by monitoring total uranium concentrations over time. The 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 FRL will be monitored semiannually.

Non-uranium FRL 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. Concentrations 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 Sampling Program, Project-Specific Plan* (DOE 1997c) in order 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 above and 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.

<u>Meeting Other Monitoring Commitments</u>
Other groundwater monitoring commitments that need to be addressed are private well sampling, property boundary monitoring, and fulfillment of DOE Order 450.1A 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 site-wide aquifer restoration. Lastly, this groundwater monitoring program presented in the IEMP, along with the groundwater data reporting in IEMP annual integrated SERs, fulfills DOE Order 231.1 requirements.

<u>Groundwater Modeling</u>
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. A mean residual calculation for each monitoring event will also be determined. Monitoring wells in the remediation footprint of the aquifer will be included in the residual exercise. Results of the first assessment were provided in the 2005 SER. A brief summary of background information on the groundwater model can be found in previous versions of the IEMP.

<u>Assess the Impact that the Aquifer Restoration Has on the Paddys Run Road Site Plume</u>
As was 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.

<u>Adequately Address Community Concerns</u>
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.

<u>Groundwater Certification Process and Stages</u>
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 the

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 3–9 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 3–9, 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.

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.

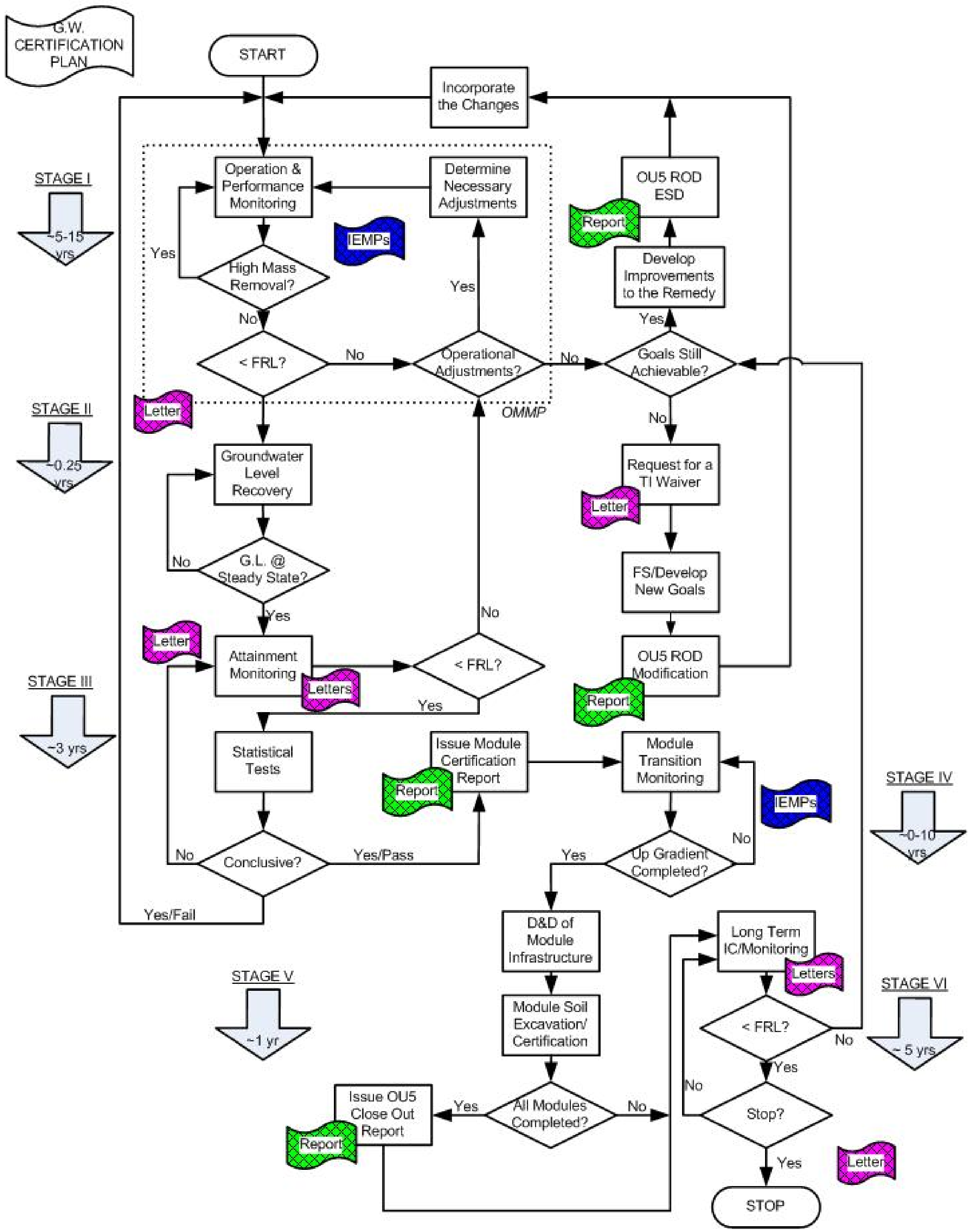

Figure 3–9. Groundwater Certification Process and Stages

3.7.2 Reporting

The IEMP groundwater program data will be reported in the annual SER and on the LM website at http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm. Data on the website will be in the format of searchable data sets and/or 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 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 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.
- Regression curves of uranium concentration data at groundwater monitoring wells (every 5 years).

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 restoration had (i.e., pumping) 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 *Baseline Remedial Strategy Report* (DOE 1997a).
- 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 along with baseline data summaries.
- Leachate volumes and concentrations from the leachate collection system and from the leak detection system for the OSDF.
- Results of quarterly groundwater sampling initiated after waste is placed in a cell of the OSDF.

In addition, the annual SER will include trend analysis of the data collected from the OSDF.

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 OEPA.

4.0 Surface Water, Treated Effluent, and Sediment Monitoring Program

Section 4.0 discusses the monitoring strategy for assessing site-wide surface water, treated effluent, and sediment. 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, Treated Effluent, and Sediment

The IEMP is the designated mechanism for conducting the site-wide surface water, treated effluent, and sediment 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 (EMP) that has been ongoing at the Fernald Preserve since the 1950s and was updated in Revision 0 of the IEMP (DOE 1997d), to accommodate surface water monitoring during post-closure.
- The radiological monitoring of and reporting for off-property sediment mandated by the OU5 ROD.

4.2 Analysis of Regulatory Drivers, DOE Policies, 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 and non-point source discharges to Paddys Run and the Great Miami River, and also includes post-closure sediment monitoring. The intent of this section is to identify the pertinent regulatory requirements for the scope and design of the surface water, treated effluent, and sediment 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, treated effluent, and sediment monitoring.

4.2.1 Approach

The analysis of the regulatory drivers and policies for surface water, treated effluent, and sediment 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, treated effluent, and sediment monitoring program described in this IEMP has been developed with full consideration of the regulatory drivers and policies. Table 4–1 lists each of these IEMP drivers and the associated actions conducted to comply with them. A brief summary of regulatory drivers and policies has been provided in previous IEMPs. Sections 4.5 and 6.0 provide the Fernald Preserve's current and long-range plan for complying with the reporting requirements invoked by these drivers.

Table 4–1. Fernald Preserve Surface Water, Treated Effluent, and Sediment Monitoring Program Regulatory Drivers and Actions

	Driver	Action
IEMP	DOE Order 450.1A, environmental monitoring plan for all media	The IEMP describes treated effluent and surveillance monitoring as required by DOE Order 450.1A.
	DOE Order 5400.5, *Radiation Protection of Public and Environment*	The IEMP includes a description for routine sampling of Paddys Run and on-site drainage ditches for radiological constituents.
	CERCLA Remedial Design Work Plan (DOE 1996c)	The IEMP specifies describes treated effluent and surveillance monitoring as required by DOE Order 450.1A.
	OU5 ROD	The IEMP will be modified toward completion of the remedial action to include surface water sampling to certify FRL achievement. 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.

Note: Soil and sediment at the Fernald Preserve have been certified, with the exception of those areas identified in Figures 2–1 and 2–2. 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 on-site 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 fulfill DOE Order 450.1A requirements to maintain an environmental monitoring plan for surface water.
- 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 expectations for the sediment monitoring program are to:

- Continue monitoring sediment in the Great Miami River to confirm that the river is not being impacted by Fernald Preserve effluent discharges.
- Confirm that remediation of sediment in the Great Miami River is unnecessary and fulfill the OU5 Feasibility Study conclusion/recommendation.

The following section provides the design considerations required to fulfill these expectations.

4.3.2 Design Considerations

This section provides the IEMP surface water, treated effluent, and sediment monitoring program design considerations. The non-radiological 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 listing of surface water COCs is presented in Table 4–2. The following is a description of information provided in Table 4–2.

- Column 1, Constituent: This column represents the constituents for which an FRL was established in the OU5 ROD.
- Column 2, Final Remediation Levels: 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 background values for Paddys Run and the Great Miami River based on data collected for the IEMP through 2006. The IEMP provides this information for purposes of comparison.

Sediment samples will be collected from the two locations on the Great Miami River: one downstream from the outfall line and one background location, and analyzed for uranium as identified in Table 4–2. Samples will be collected in 2009 and then will be collected every 5 years thereafter. The sediment FRL for uranium is 210 mg/kg.

Table 4–2. 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	0.00075	0.01	0.00375
Chromium (VI)[d]	0.010	D	ND	0.00943	ND	0.00991
Copper	0.012	A	ND	0.00652	0.012	0.0141
Cyanide	0.012	A	ND	0.00367	0.005	0.00412
Lead	0.010	B	ND	0.00568	0.010	0.00958
Manganese	1.5	R	0.035	0.229	0.08	0.113
Mercury	0.00020	D	ND	0.000126	ND	0.000175
Molybdenum	1.5	R	ND	0.00328	0.02	0.00902
Nickel	0.17	A	ND	0.00792	0.023	0.0116
Selenium	0.0050	A	ND	0.00254	ND	0.00293
Silver	0.0050	D	ND	0.000706	ND	0.000348
Vanadium	3.1	R	ND	0.0188	ND	0.00671
Zinc	0.11	A	ND	0.0361	0.045	0.0463

Table 4–2 (continued). 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
Radionuclides (pCi/L)						
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	0.844	0.41	0.728
Radium-228	47	R	2.1	1.98	2.2	3.85
Strontium-90	41	R	0.96	1.09	ND	1.14
Technetium-99	150	R	ND	4.65	ND	7.65
Thorium-228	830	R	ND	0.238	0.62	0.234
Thorium-230	3500	R	ND	0.543	0.36	0.789
Thorium-232	270	R	ND	0.213	ND	0.231
Uranium, Total **(µg/L)**	530	R	1.0	1.29	1.0	2.13
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
Semi-Volatiles (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 4–2 (continued). 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
Semi-Volatiles (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	-	0.176
Carbon disulfide	-	-	-	ND	-	0.35
Cobalt	-	-	-	-	-	0.00799
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 = non-detected result
- = 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.

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 those points near where the glacial overburden has been breached by site drainages (Figure 4–1). At these locations (i.e., STRM 4005, SWP-02, SWD-02, SWD-03, SWD-04, SWD-05, SWD-07, 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 (i.e., SWD-04, SWD-05, SWD-06, SWD-07, 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 for 2 years to evaluate potential impacts. Data will be evaluated to determine the need for further sampling following the initial 2-year period. 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 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 located (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 4–2 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 requiring 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, treated effluent, and sediment program, a review of the IEMP monitoring data is conducted periodically. The last such review was based on data collected under the IEMP program from August 1997 through December 2007. The recommended parameters and locations for monitoring are indicated in Table 4–3 (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 4–3.

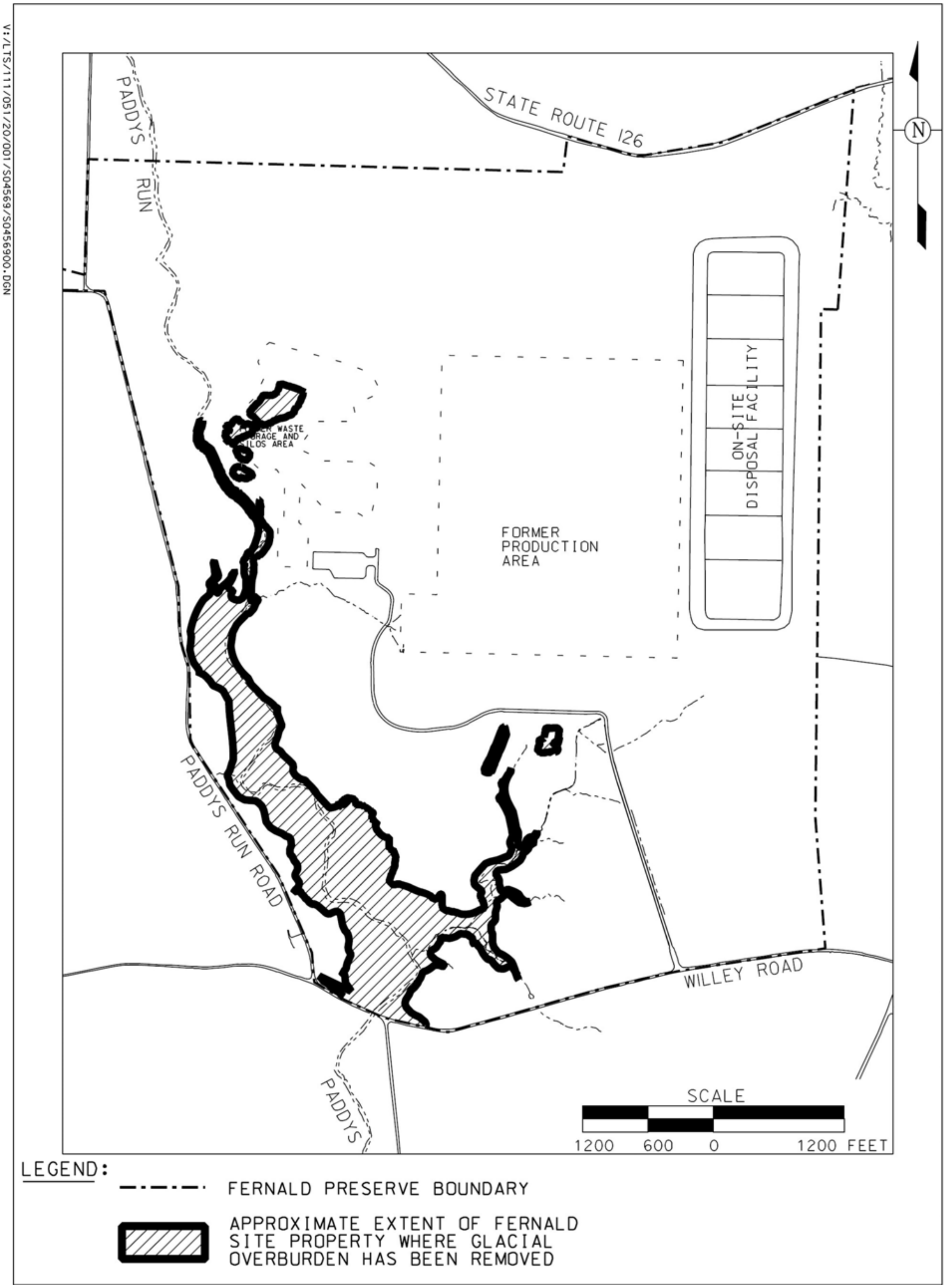

Figure 4–1. Area where Glacial Overburden Has Been Removed

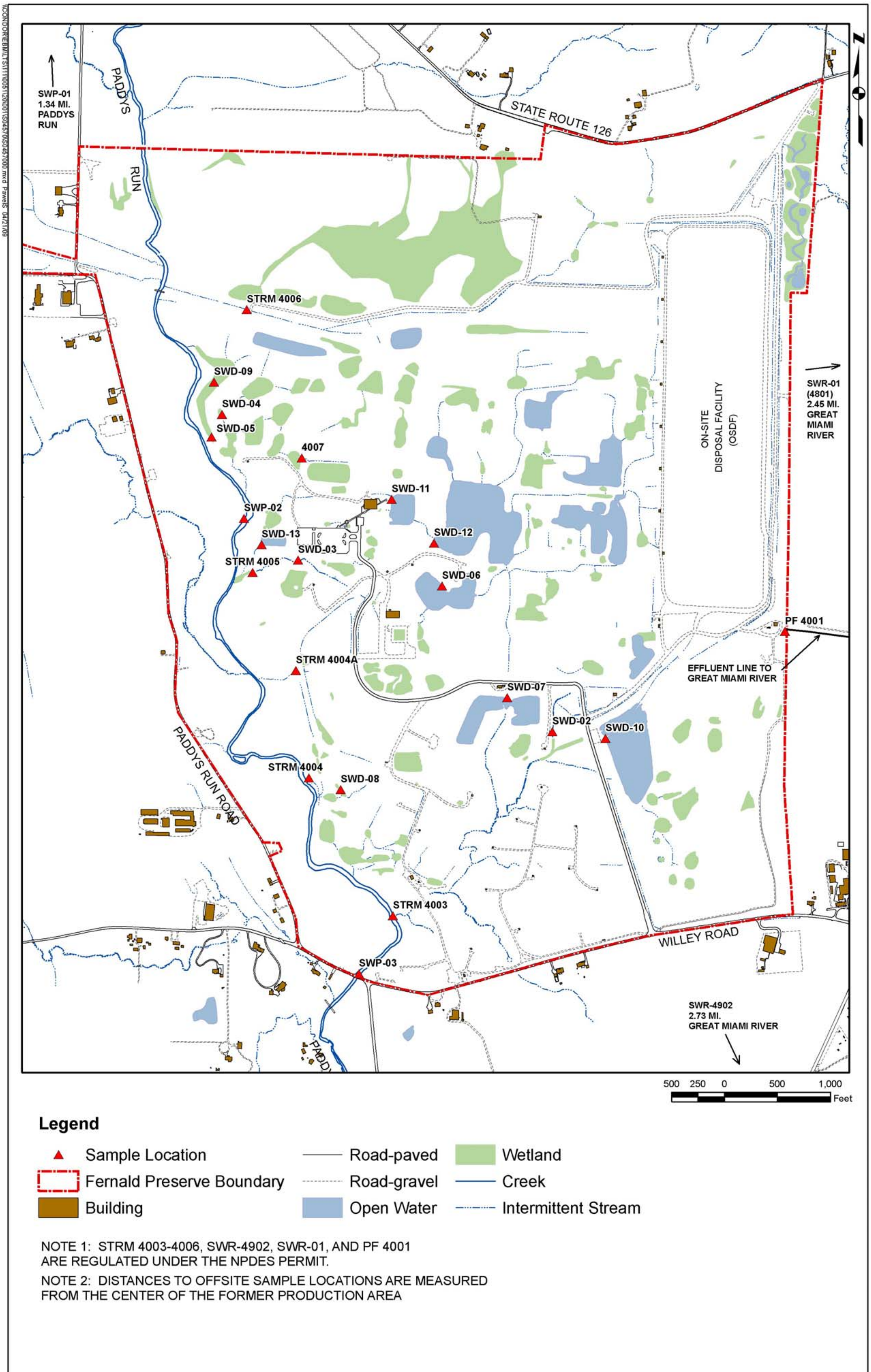

Figure 4–2. IEMP Surface Water, NPDES, and Treated Effluent Sample Locations

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Table 4–3. Summary of Surface Water, Treated Effluent, and Sediment Sampling Requirements by Location

Location	Constituent[a]	IEMP Characterization Requirements (reason for selection)[b,c]	NPDES Requirements[c] (Jan – Mar)	NPDES Requirements[c] (Apr – Dec)
SWR-01 (SWR-4801) (Great Miami River Background)	**General Chemistry:**			
	Ammonia	-	Quarterly	-
	Total hardness	-	Quarterly	Quarterly
	Inorganics:			
	Beryllium	Semiannually (B)	-	-
	Cadmium	Semiannually (B)	Quarterly	-
	Chromium, Total	Semiannually (B)	Quarterly	-
	Cobalt	-	Quarterly	-
	Copper	Semiannually (B)	Quarterly	-
	Cyanide, Total	Semiannually (B)	-	-
	Lead	-	Quarterly	-
	Manganese	Semiannually (B)	Quarterly	Quarterly
	Mercury (low level)	-	Quarterly	-
	Mercury	Semiannually (B)	-	Quarterly
	Nickel	-	Quarterly	-
	Silver	Semiannually (B)	Quarterly	-
	Zinc	Semiannually (B)	Quarterly	-
	Radionuclides:			
	Uranium, Total	Semiannually(B)	-	-
SWP-01 (Paddys Run Background)	**Inorganics:**			
	Beryllium	Semiannually (B)	-	-
	Cadmium	Semiannually (B)	-	-
	Chromium, Total	Semiannually (B)	-	-
	Copper	Semiannually (B)	-	-
	Cyanide, Total	Semiannually (B)	-	-
	Manganese	Semiannually (B)	-	-
	Mercury	Semiannually (B)	-	-
	Silver	Semiannually (B)	-	-
	Zinc	Semiannually (B)	-	-
	Radionuclides:			
	Uranium, Total	Semiannually (B)	-	-
SWP-02 (Paddys Run)	**Radionuclides:**			
	Radium-226	Annual	-	-
	Radium-228	Annual	-	-
	Technetium-99	Annual	-	-
	Thorium-228	Annual	-	-
	Thorium-230	Annual	-	-
	Thorium-232	Annual	-	-
	Uranium, Total	Semiannually (PC)	-	-
SWP-03 (Paddys Run at Downstream Property Boundary) continued on next page	**Inorganics:**			
	Beryllium	Semiannually (S)	-	-
	Cadmium	Semiannually (S)	-	-
	Chromium, Total	Semiannually (S)	-	-
	Copper	Semiannually (S)	-	-
	Cyanide	Semiannually (M)	-	-
	Manganese	Semiannually (S)	-	-
	Mercury	Semiannually (M)	-	-
	Silver	Semiannually (M)	-	-
	Zinc	Semiannually (M)	-	-

Table 4–3 (continued). 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] (Jan – Mar)	NPDES Requirements[c] (Apr – Dec)
SWP-03 continued	**Radionuclides:**			
	Radium-226	Annual	-	-
	Radium-228	Annual	-	-
	Technetium-99	Annual	-	-
	Thorium-228	Annual	-	-
	Thorium-230	Annual	-	-
	Thorium-232	Annual	-	-
	Uranium, Total	Semiannually (PC)	-	-
SWD-02 (Storm Sewer Outfall Ditch)	**Radionuclides:**			
	Uranium, Total	Semiannually (PC)	-	-
SWD-03 (Waste Storage Area)	**Radionuclides:**			
	Radium-226	Annually	-	-
	Radium-228	Annually	-	-
	Technetium-99	Annually	-	-
	Thorium-228	Annually	-	-
	Thorium-230	Annually	-	-
	Thorium-232	Annually	-	-
	Uranium, Total	Semiannually (PC)	-	-
PF 4001 (Parshall Flume - Treated Effluent) continued on next page	**General Chemistry:**			
	Ammonia	-	3/Week[d]	-
	Carbonaceous biochemical oxygen demand	-	2/Week	2/Week
	Fluoride	-	Monthly	Monthly
	Nitrate/Nitrite	-	Monthly	Monthly
	Oil and grease	-	2/Week	2/Week
	Total dissolved solids	-	Monthly	Monthly
	Total phosphorus - P	-	-	Weekly
	Total residual chlorine	-	2/Week[e]	-
	Total suspended solids	-	Daily	Daily
	Inorganics:			
	Antimony	-	Monthly	-
	Arsenic	-	Monthly	-
	Barium	-	3/Week	-
	Beryllium	-	Monthly	-
	Boron	-	Monthly	-
	Cadmium	-	3/Week	-
	Chromium, Total	-	3/Week	-
	Cobalt	-	2/Week	-
	Copper	-	3/Week	-
	Cyanide, Free	-	Monthly	Monthly
	Lead	-	3/Week	-
	Manganese	-	2/Week	2/Week
	Mercury (low level)	-	Monthly	Monthly
	Molybdenum	-	3/Week	-
	Nickel	-	3/Week	-
	Selenium	-	3/Week	-
	Silver	-	3/Week	-
	Zinc	-	3/Week	-
	Radionuclides:			
	Radium-226	Semiannually (M)	-	-
	Radium-228	Semiannually	-	-
	Technetium-99	Semiannually (M)	-	-
	Uranium, Total	Semiannually(PC)	Daily[f]	Daily[f]

Table 4–3 (continued). Summary of Surface Water, Treated Effluent, and Sampling Requirements by Location

Location	Constituent[a]	IEMP Characterization Requirements (reason for selection)[b,c]	NPDES Requirements[c] (Jan – Mar)	NPDES Requirements[c] (Apr – Dec)
PF 4001 continued	**Semi-Volatiles:**			
	Bis (2-ethylhexyl) phthalate	-	Quarterly	Quarterly
	Volatiles:			
	Chloroform	-	Quarterly	-
	1,1-Dichloroethane	-	Quarterly	-
	Trichloroethene	-	Quarterly	-
	Other:			
	Flow Rate	-	Daily	Daily
STRM 4003 (Drainage to Paddys Run)	**General Chemistry:**			
	Total suspended solids	-	Semiannually	Semiannually
	Inorganics:			
	Copper	-	Semiannually	-
	Mercury (low level)	-	Semiannually	Semiannually
	Radionuclides:			
	Uranium, Total	Semiannually (PC)	-	-
	Other:			
	Fecal coliform	-	Semiannually	-
	Flow Rate	-	Semiannually	Semiannually
STRM 4004[g] (Drainage to Paddys Run)	**General Chemistry:**			
	Total suspended solids	-	Semiannually	-
	Inorganics:			
	Copper	-	Semiannually	-
	Lead	-	Semiannually	-
	Mercury (low level)	-	Semiannually	-
	Silver	-	Semiannually	-
	Radionuclides:			
	Uranium, Total	Semiannually (PC)	-	-
	Other:			
	Fecal coliform	-	Semiannually	-
	Flow Rate	-	Semiannually	-
STRM 4005 (Drainage to Paddys Run)	**General Chemistry:**			
	Total suspended solids	-	Semiannually	-
	Inorganics:			
	Lead	-	Semiannually	-
	Mercury (low level)	-	Semiannually	-
	Radionuclides:			
	Uranium, Total	Semiannually (PC)	-	-
	Other:			
	Fecal coliform	-	Semiannually	-
	Flow Rate	-	Semiannually	-
STRM 4006 (Drainage to Paddys Run)	**General Chemistry:**			
	Total suspended solids	-	Semiannually	-
	Inorganics:			
	Copper	-	Semiannually	-
	Lead	-	Semiannually	-
	Mercury (low level)	-	Semiannually	-
	Silver	-	Semiannually	-
	Radionuclides:			
	Uranium, Total	Semiannually (PC)	-	-
	Other:			
	Fecal coliform	-	Semiannually	-
	Flow Rate	-	Semiannually	-

Table 4–3 (continued). 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] (Jan – Mar)	NPDES Requirements[c] (Apr – Dec)
4007 (Biowetland Emergency Overflow to Paddys Run)	Flow Rate	-	-	Daily during overflow
SWD-04[h], SWD-05[h], SWD-06[h], SWD-07[h], SWD-08[h]	**Radionuclides:**			
	Radium-226	Annually	-	-
	Radium-228	Annually	-	-
	Technetium-99	Annually	-	-
	Thorium-228	Annually	-	-
	Thorium-230	Annually	-	-
	Thorium-232	Annually	-	-
	Uranium, Total	Semiannually	-	-
SWD-09	**Radionuclides:**			
	Uranium, Total	Semiannually	-	-
SWD-10, SWD-11, SWD-12, SWD-13	**Radionuclides:**			
	Uranium, Total	Annually	-	-
SWR-4902 (Downstream of Fernald Preserve Effluent)	**General Chemistry:**			
	Ammonia	-	Quarterly	-
	Total Hardness	-	Quarterly	Quarterly
	Inorganics			
	Cadmium	-	Quarterly	-
	Chromium	-	Quarterly	-
	Cobalt	-	Quarterly	-
	Copper	-	Quarterly	-
	Lead	-	Quarterly	-
	Manganese	-	Quarterly	Quarterly
	Mercury (low level)	-	Quarterly	-
	Mercury	-	-	Quarterly
	Nickel	-	Quarterly	-
	Silver	-	Quarterly	-
	Zinc	-	Quarterly	-
G4 (Great Miami River-downstream sediment)	Uranium	Annually	-	-
G2 (Great Miami River-sediment background)	Uranium	Annually	-	-

[a]Field parameter readings, taken at each location, include temperature, specific conductance, pH, and dissolved oxygen.
[b]B = background evaluation; M = based on modeling; PC = primary COC; S = sporadic exceedances of FRLs; WP = Waste Pits Excavation Monitoring
[c] "-" indicates the constituent is not included in the sample program.
[d]Sampled twice a week in winter (November 1 through April 30) and three times a week in summer (May 1 through October 31).
[e]Constituent not sampled from November through April.
[f]This constituent is sampled under the OU5 ROD.
[g]New location STRM 4004A has been identified as an alternative sample location for STRM 4004. STRM 4004A will be sampled for the constituents if no flow is observed at STRM 4004 or is otherwise not accessible.
[h]Sampling will be conducted for 2 years to determine if sampling should continue. Locations are based on sampling from Residual Risk Assessment Analysis and lack of glacial overburden.

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 non-radiological area specific constituents and uranium are monitored at this location in order to be conservative. Appendix B in 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 4–3 shows the 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 4–3, include:

- Average concentrations have been far below the human/health protective surface water FRL concentration (530 µg/L) in each year since 1981. (This includes 9 years while the site was in production.)
- Annual average monthly concentrations have been consistently below the human/health protective groundwater FRL (30 µg/L) in each year since 1986.

4.3.2.5 Ongoing Background Evaluation

Because the RI/FS 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 4–2. 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 in order 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.

Since soil sampling did not indicate a need to add constituents to the list of 17 area-specific surface water constituents and due to the abundance of background data, 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 2007, the background values were recalculated using data from August 1997 through 2006. The revised values are provided in Table 4–2. Refer to Table 4–3 for background monitoring requirements; refer to Figure 4–2 for background surface water sample locations.

4.3.2.6 Fulfill National Pollutant Discharge Elimination System 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. OEPA Permit 1IO00004*GD was issued on June 1, 2003; became effective on July 1, 2003; and expired on June 30, 2008. A new permit application was filed in December 2007. The site continued to discharge under the OEPA Permit 1IO00004*GD until a new permit is issued by OEPA. The new permit (OEPA 1IO00004*HD) took effect on April 1, 2009, and will remain in effect until March 31, 2014. Figure 4–2 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 Parshall Flume (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 6.0, monitoring data required by the FFCA have been incorporated into the comprehensive IEMP reporting structure.

4.3.2.8 Fulfill DOE Order 450.1A Requirements

The design considerations provided in Section 4.3.2, are sufficient to meet or exceed the requirements of DOE Order 450.1A as summarized in Section 4.2.2.

4.3.2.9 Address Concerns of the Community

In addition to the monitoring derived from Section 4.3.2.4, four new surface water sampling locations (SWD-10, SWD-11, SWD-12, and SWD-13) have been indentified for annual total uranium analysis. This sampling 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, and to demonstrate to the public that there is no need for apprehension with the on-site water bodies relative to contamination. 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.

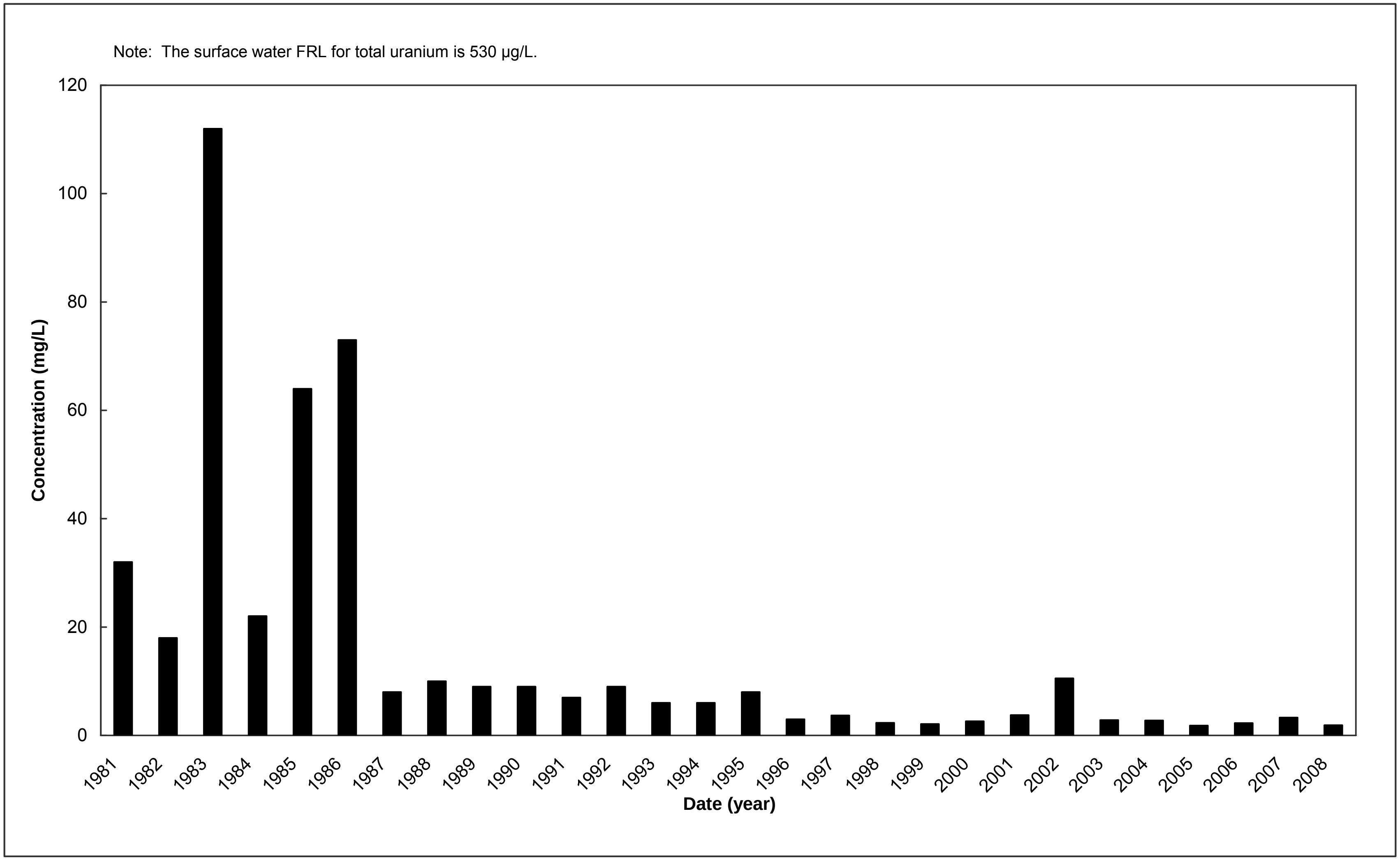

Figure 4–3. Comparison of Average Total Uranium Concentrations in Paddys Run at Willey Road Sample Location SWP-03

4.4 Medium-Specific Plan for Surface Water, Treated Effluent, and Sediment 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, treated effluent, and sediment 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 herein are consistent with the requirements of the LM QAPP.

4.4.1 Sampling

To fulfill the requirements of the integrated surface water, treated effluent, and sediment monitoring program, surface water and treated effluent samples shall be collected from locations shown in Figure 4–2 and sediment samples shall be collected from locations shown in Figure 4–4.

Sample analysis will be performed either on site or at off-site 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 DOECAP or equivalent process requirements have been met as specified in LM QAPP. These criteria include meeting the requirements for performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

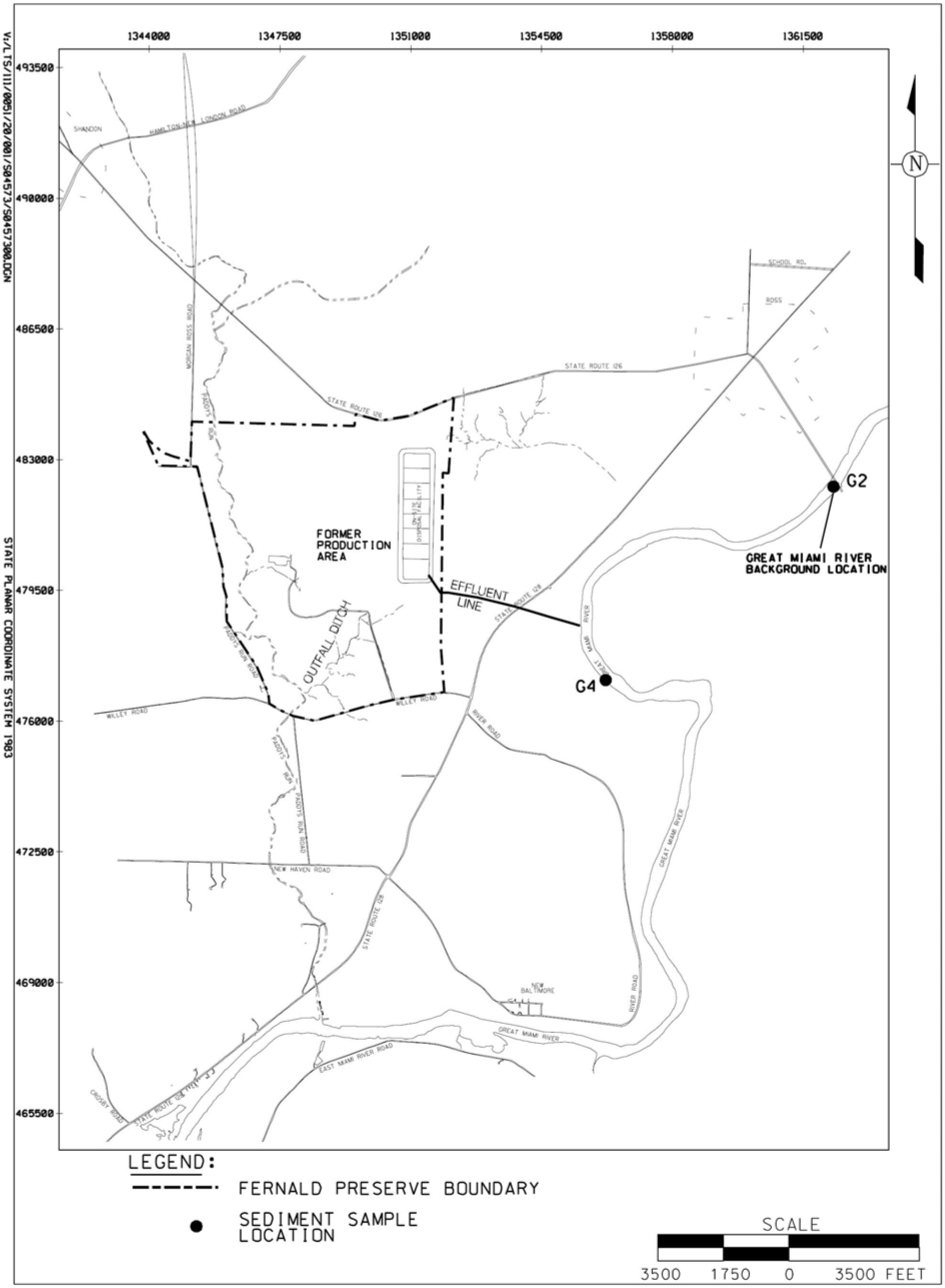

Figure 4–4. Sediment Sample Locations

4.4.1.1 Sampling Procedures

Surface water, treated effluent, and sediment will be sampled using the requirements specified in the LM QAPP, which have been incorporated into the following standard operating procedures used for conducting surface water sampling:

- Liquids Sample Collection
- Solid Sample Collection
- Treated Effluent Sample Collection
- Field Quality Control Sample Collection
- Environmental Sample Shipment
- Water Quality Meter Calibration, Operation, and Maintenance

Tables 4–4 and 4–5 identify the sample preservative, volume, and container requirements for each constituent.

Surface Water Sampling
Surface water samples will be collected from locations identified in Figure 4–2. A qualitative assessment of flow conditions (i.e., base flow, storm flow, or between storm and base flow) will be documented at the time of sample collection at each of these locations. 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.

Treated Effluent Sampling
Treated effluent 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 4–3.

Table 4–4. Surface Water Analytical Requirements for Constituents at Sample Locations[a] SWD-02, SWD-03, SWD-04, SWD-05, SWD-06, SWD-07, SWD-08, SWD-09, SWD-10, SWD-11, SWD-12, SWD-13, SWP-01, SWP-02, SWP-03, and SWR-01

Constituent	Analytical Method	ASL	Holding Time	Preservative	Container
Inorganics:					
Beryllium Cadmium Chromium, Total Copper Manganese Silver Zinc	7000A[b], 3500[c], 6020[b], 6010B[b] or 200.2,7,8[d]	D	6 months	HNO_3 to pH <2	Plastic or glass
Mercury	7470A[b]	D	28 days	HNO_3 to pH <2	Plastic or glass
Cyanide, Total	9010B[b], 9012[b], 335.2[d], or 335.3[d]	D	14 days	Cool 4°C, NaOH to pH >12	Plastic or glass
Radionuclides and Uranium:					
Radium-226 Radium-228 Technetium-99 Thorium-228	EML HASL 300[e]	D	6 months	HNO_3 to pH <2	Plastic or glass
Thorium-230 Thorium-232 Uranium, Total	6020[b]				
Field Parameters[f]:	LM QAPP[g]	A	NA[h]	NA[h]	NA[h]

Note: The analytical site-specific contract identifies the specific method.

[a]Sample locations are analyzed for a subset of these constituents (summarized in Table 4–3).
[b]Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
[c]Standard Methods for the Examination of Water and Wastewater
[d]Methods for Chemical Analysis of Water and Wastes
[e]Procedures Manual of the Environmental Measurements Laboratory .
[f]Field parameters include temperature, specific conductance, pH, and dissolved oxygen.
[g]The LM QAPP provides field methods.
[h]NA = not applicable

Table 4–5. Surface Water, Treated Effluent, and Sediment Analytical Requirements for Constituents at Sample Locations PF 4001, STRM 4003, STRM 4004, STRM 4005, STRM 4006, SWR-4801, SWR-4902, G2, and G4

Constituent[a]	Analytical Method	Sample Type	ASL	Holding Time	Preservative	Container
General Chemistry:						
Ammonia	350.1[d], 350.3[d], 4500C[e], or 4500F[e]	Composite or Grab[f]	D	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic or glass
Carbonaceous biochemical oxygen demand	5210B[e]	Composite	D	48 hours	Cool 4°C	Plastic or glass
Chlorine, residual	4500[e]	Grab	D	Analyze immediately	None	Plastic or glass
Fluoride	300.0[d], 340.2[d], 4500C[e]	Composite	D	28 days	None	Plastic or glass
Nitrate/Nitrite	353.1[d], 353.2[d], 353.3[d], 4500D[e], or 4500E[e]	Composite	D	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic or glass
Oil and grease	1664A[g] or 5520B[e]	Grab	D	28 days	Cool 4°C, H_2SO_4 to pH <2	Glass
Total dissolved solids	160.1[d] or 2540C[e]	Grab	D	7 days	Cool 4°C	Plastic or glass
Total hardness	2340C[e]	Grab	D	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic
Total phosphorus	365.1[d], 365.2[d], 365.3[d], or 4500B[e]	Composite	D	28 days	Cool 4°C, H_2SO_4 to pH <2	Plastic
Total suspended solids	160.2[d] or 2540D[e]	Composite	D	7 days	Cool 4°C	Plastic or glass
Inorganics:						
Antimony	6020[h], 7000A[h], 3500[e], 6010B[h], 200.8[i], 220.2[d], or 272.2[d]	Composite or Grab[f]	D	6 months	HNO_3 to pH <2	Plastic or glass
Arsenic						
Barium						
Beryllium						
Boron						
Cadmium						
Chromium, Total						
Cobalt						
Copper						
Lead						
Manganese						
Molybdenum						
Nickel						
Selenium						
Silver						
Zinc						
Mercury	7470A[h]	Grab	D	28 days	HNO_3 to pH <2	Plastic or glass
Mercury (low level)	1631[d]	Grab	D	14 days	None	Amber glass
Cyanide, Free	335.1[d] or 4500-G[e]	Grab	D	14 days	Cool 4°C, NaOH to pH >12	Plastic or glass

Table 4–5 (continued). Surface Water, Treated Effluent, and Sediment Analytical Requirements for Constituents at Sample Locations PF 4001, STRM 4003, STRM 4004, STRM 4005, STRM 4006, SWR-4801, SWR-4902, G2, and G4

Constituent[a]	Analytical Method	Sample Type[c]	ASL	Holding Time	Preservative	Container
Radionuclides:						
Radium-226	EML HASL 300[j]	Grab	D	6 months	HNO_3 to pH <2	Plastic or glass
Radium-228						
Technetium-99						
Thorium-228						
Thorium-230						
Thorium-232						
Uranium, Total	6020[h], D5174-91[k]	Composite[l]	D		HNO_3 to pH <2	Plastic or glass
Uranium, Total[q]	6020[h]	Grab[p]	D	6 months	None	500 ml Plastic or glass
Semi-Volatiles:						
Bis(2-ethylhexyl)phthalate	625[m]	Grab	D	**7** days to extraction 40 days from extraction to analysis	Cool 4°C	Glass (amber with Teflon-lined cap)
Volatiles:						
Trichloroethene	624[m]	Grab	D	14 days	H_2SO_4 pH <2 Cool 4°C	Glass (with Teflon-lined septum cap)
Chloroform						
1,1-Dichloroethane						
Other:						
Fecal coliform	9222D[e]	Grab	D	6 hours	Cool 4°C	Plastic or glass (sterile)
Flow rate	NA	24 hour total	NA[b]	NA[b]	NA[b]	NA[b]
Field Parameters[n]	LM QAPP[o]	Grab	A	NA[b]	NA[b]	NA[b]

Note: 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 4–3).
[b]NA = not applicable
[c]For composite samples at PF 4001, a flow-weighted composite sample collected over a 24-hour period; for STRM 4003, STRM 4004, STRM 4005, and STRM 4006, composite samples shall be comprised of four samples collected at intervals of at least 30 minutes but not more than 2 hours.
[d]Methods for Chemical Analysis of Water and Wastes
[e]Standard Methods for the Examination of Water and Wastewater
[f]Grab samples are collected at locations SWR-4801 and SWR-4902 for this constituent.
[g]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.
[h]Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
[i]Methods for the Determination of Metals in Environmental Samples
[j]Procedures Manual of the Environmental Measurements Laboratory.
[k]American Society for Testing and Materials (ASTM)
[l]Total uranium is a grab sample at STRM 4003, STRM 4004, STRM 4005, and STRM 4006 and a composite sample at all other locations.
[m]40 CFR 136, Appendix A
[n]Field parameters include dissolved oxygen, pH, specific conductance, and temperature.
[o]The LM QAPP provide field analytical methods.
[p] Grab sample for sediment is collected at location G4 for this constituent.
[q]Covers sediment only.

Sediment Sampling
Sampling is typically performed in summer or fall in order to take advantage of the abundance of fresh sediment deposited during flood conditions that commonly occur after winter and spring seasons. Only recently deposited surface sediment shall be collected, typically from deposition locations such as areas with a slow flow rate (e.g., obstructions in the stream bed that allow sediment to be deposited).

The exact locations of the sediment sample points are approximate and may change based on where stream flow has deposited sufficient material for sampling. Samples shall be collected from the top 2 inches and consist of fine-grained material. Any non-sediment materials shall be discarded from the sample, any free water drained from the non-sediment material, and the sediment material placed in the sample container.

4.4.1.2 Quality Control Sampling Requirements

Quality control samples will be taken according to the frequency recommended in the LM QAPP. These samples will be collected and analyzed in order to evaluate the possibility that some controllable practice, such as sampling technique, may be responsible for introducing bias in the project's analytical results. Quality control samples will be collected as follows:

- One field duplicate sample shall be collected each quarter at a randomly selected surface water sample location.
- One field duplicate will be collected from the G4 sediment location in the Great Miami River.
- Trip blanks will be prepared and placed in coolers containing samples for volatile organic compound analysis and shall accompany the samples from collection to receipt at the laboratory.

For low-level mercury, all field sampling equipment will be sent to the off-site laboratory for decontamination and certification of cleanliness via rinsate analysis (equipment blank analysis) before reuse. In addition, trip blanks and field blanks will be supplied by the off-site 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 is identified in the LM QAPP. 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 are collected, maintained, and dispositioned, as necessary.

4.5 IEMP Surface Water, Treated Effluent, and Sediment Monitoring Data Evaluation and Reporting

This section provides the methods for analyzing the data generated by the IEMP surface water, treated effluent, and sediment monitoring program. This section summarizes the data evaluation process and actions associated with various monitoring results. The planned reporting structure for IEMP-generated surface water, treated effluent, and sediment 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, treated effluent, and sediment 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, treated effluent, and sediment 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 yearly. 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.

- Should trends above the historical ranges or above FRLs be observed, actions shown in Figure 4–6 will be implemented.

  The personnel responsible for the restoration of the Great Miami Aquifer will be informed so that any potential adverse cross-medium impacts can be factored into the site groundwater remedy. Decision-making process described in Figure 4–5 can be implemented as necessary.

- Do the sporadic exceedances of FRLs continue to occur, decrease, or increase?

  Data evaluation will consist of direct comparison of data to FRLs. It is anticipated that it will be possible to reduce the list of constituents monitored with respect to FRLS (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 if immediate reporting of noncompliance’s to OEPA 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 for these 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.

- Have changes in the residual contaminant concentrations occurred in sediments found in the Great Miami River as a result of runoff and treated effluent from the site?

  Data evaluation will consist of comparison to historical data, background levels, and FRLs. This evaluation will identify long-tern trends of targeted radiological constituents in sediment to determine if the potential exists for an FRL exceedance in the future.

- Should the sediment program be refined in scope?

  Data evaluation to determine if the IEMP sediment program should be revised will be based on the comparison to historic ranges and the sediment FRLs. Data evaluation to address any remaining expectations identified in Section 4.3.1 is encompassed in the data evaluation techniques described above.

- Are the program and reporting requirements of DOE Order 450.1A being met?

  DOE Order 450.1A requires that DOE implement and report on an environmental protection program for the Fernald Preserve. The surface water and treated effluent monitoring program is one component of the site-wide IEMP monitoring program. This IEMP and the annual SER fulfill the requirements of this DOE Order.

- Are community concerns being met through the surface water, treated effluent, and sediment IEMP program?

  The IEMP fulfills the needs of the Fernald community by preparing surface water and treated effluent environmental results in the annual SER. DOE makes these reports available to the public at the Public Environmental Information Center.
  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.

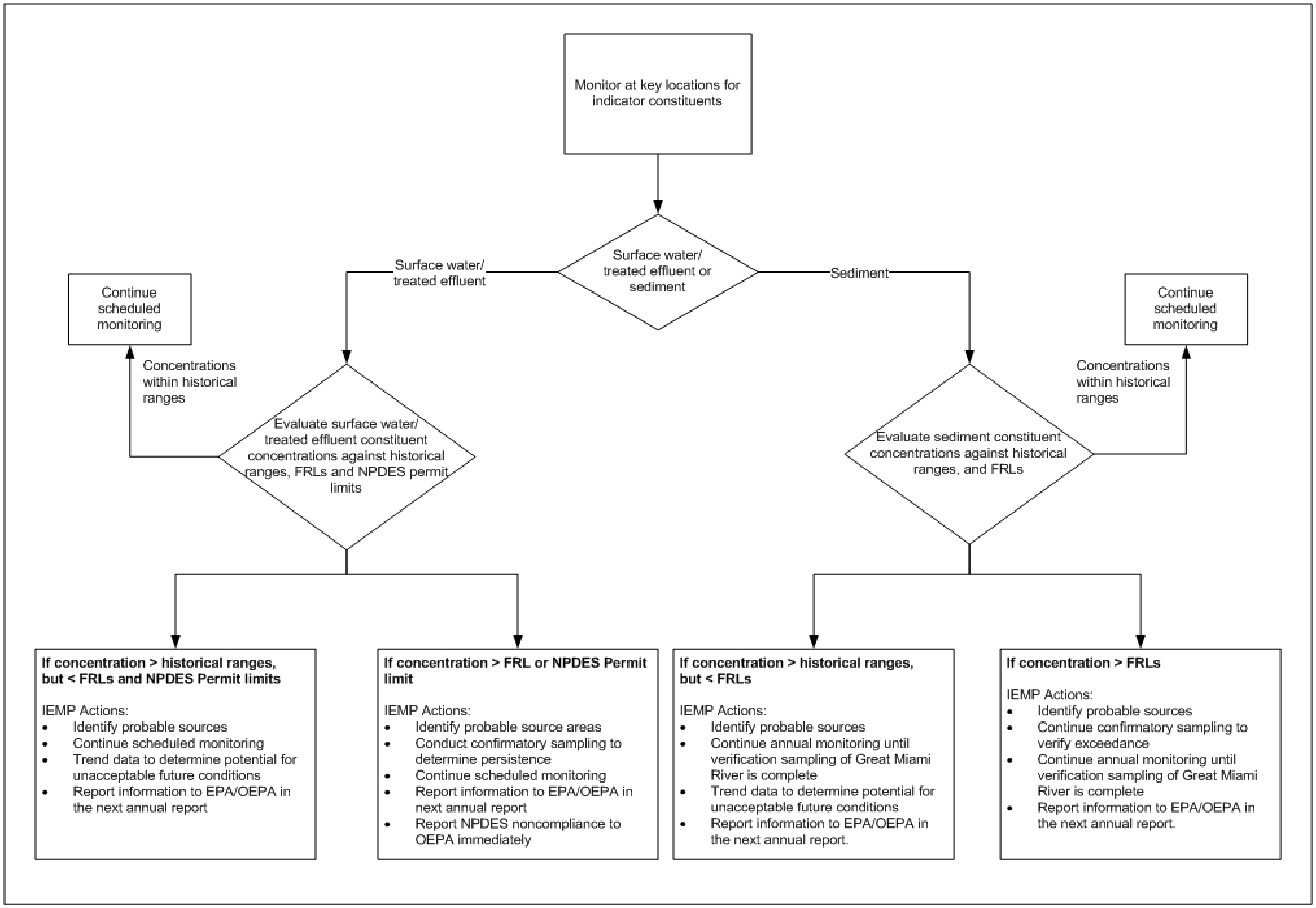

Figure 4–5. IEMP Surface Water and Sediment Data Evaluation and Associated Actions

4.5.2 Reporting

The IEMP surface water, treated effluent, sediment, and quarterly FFCA data will be reported in the annual SER and on the LM website at http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm.

Data on the LM website will be in the format of searchable data sets and/or downloadable data files. Additional information on IEMP data reporting is provided in Section 6.0.

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, treated effluent, and sediment 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 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, treated effluent, and sediment 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 would be communicated to EPA and OEPA.

5.0 Air Monitoring and Dose Assessment Program

The IEMP air monitoring and dose assessment program (the Program, hereinafter) for 2009 is consistent with previous IEMP revisions, with the exception of eliminating radon monitoring, discontinuing the dose assessment for native aquatic organisms, and adding the surface-water pathway to the annual dose assessment. Primary objectives include monitoring radionuclide concentrations in air particulate and surface water, measuring direct radiation levels, assessing the annual effective radiation dose to a human receptor, and demonstrating compliance with requirements in NESHAP (40 CFR 61, Subpart H), DOE Order 5400.5, and DOE Order 450.1A.

All significant radon sources were removed from the Fernald Preserve in 2006. Limited monitoring continued for two additional years (through 2008, as identified in previous IEMP versions) to ensure that all radon monitoring requirements were met and levels were acceptable from a closure standpoint. The Sitewide Environmental Report for 2007 and 2008 documents that radon levels for the site and background monitors are similar. Therefore, with agency approval, radon monitoring will cease with this revision of the LMCIP.

As the Fernald Preserve is now open to the public, there is the potential for a member of the public to illegally wade in the site ponds and accidentally ingest surface water. To account for this inadvertent exposure, the annual dose assessment will calculate the dose from ingested surface water using measured radionuclide concentrations for surface water, DOE derived concentration guidelines for drinking water (DOE 1993), and the receptor consumption volumes presented in the Interim Residual Risk Assessment (DOE 2007).

5.1 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 Program. The implementation of these requirements ensures that the Program satisfies the regulatory obligations for monitoring and dose assessment (activated by the RODs) and achieves the intentions of other pertinent criteria (such as DOE Orders and the Fernald Preserve existing agreements).

5.1.1 Approach

An analysis of regulatory drivers and policies was conducted to identify the suite of ARARs and to-be-considered requirements in the CERCLA RODs and legal agreements that contain air monitoring and dose assessment language that is applicable to the Program. This subset was further divided to identify site-specific requirements that fall under the scope of the IEMP (DOE 1997d). Reporting requirements for the IEMP, as dictated by the applicable regulatory drivers, are presented in Section 6.0.

5.1.2 Monitoring and Dose Requirements

Table 5–1 lists the regulatory drivers, the monitoring that is conducted to comply with them, and results for the path forward. For radon monitoring requirements under DOE Order 5400.5 and proposed 10 CFR 834, the results indicate that 2 years of post-remediation monitoring for radon have provided sufficient data to discontinue radon monitoring. However, NESHAP and DOE Order 5400.5 monitoring requirements must continue for air particulate and direct radiation to

Table 5–1. Air Monitoring Regulatory Drivers, Required Actions, and Results

IEMP		
Driver	**Required Action**	**Results**
• DOE Order 450.1A, Environmental Protection Program Environmental Monitoring Plan for all media	• Requires DOE facilities that use, generate, release, or manage significant pollutants or hazardous materials to develop and implement an environmental monitoring plan • The previous IEMPs described effluent and surveillance monitoring as required by DOE Order 450.1A.	• 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 2006d) and from 11 to 6 in November of 2006 (DOE2006e).
• DOE Order 5400.5, Proposed 10 CFR 834 Radiation Protection of the Public and 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.	• In 2008, the maximally exposed individual, standing at the eastern boundary monitor with the highest above background reading, could receive a dose of 6.0 mrem. The contributions to the estimated dose are 0.002 mrem from air inhalation and 6.0 mrem from direct radiation. This dose is 6 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.

Table 5–1 (continued). Air Monitoring Regulatory Drivers, Required Actions, and Results

IEMP		
Driver	**Required Action**	**Results**
• DOE Order 5400.5, Proposed 10 CFR 834 Radiation Protection of the Public and Environment (continued)	• The DOE Order also provides guidelines for radionuclide concentrations in air (known as Derived Concentration Guides) and • Provides radon concentration limits for interim storage of sources during remediation. • Previous IEMPs described on-site and off-site monitoring for radon and other radionuclides, and monitoring to determine annual dose from the air pathway.	• 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 2006d) and from 11 to 6 in November of 2006 (DOE2006e). • 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 have shown no additional monitoring is required for radon.
• NESHAP, 40 CFR 61, Subpart H, Emission Standards for Radionuclides (excluding radon)	• Requires emission measurements at point sources with a potential to discharge radionuclides into the air in quantities that could cause an effective dose equivalent in excess of 1 percent of the standard (10 mrem/year). • Provides an assessment of the annual dose to the public from the air pathway.	• The largest historical source at the site was the waste materials stored in the silos. This and all other significant airborne contamination and direct radiation sources were removed from the site or placed in the on-site disposal facility in 2006. Present emissions are restricted to wind erosion of soil particles that contain residual contaminants at concentrations below the OU5 ROD final remediation levels.

Table 5–1 (continued). Air Monitoring Regulatory Drivers, Required Actions, and Results

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. With agency approval, radon monitoring will cease with this revision of the LMCIP.	• Waste material generated from uranium extraction processes performed decades ago contained radium-226, which produces radon. This waste material no longer serves as a source for radon at the site because the last of this material was shipped off site 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 have shown no additional monitoring is required for radon.
• DOE Order 435.1, Radioactive Waste Management	• RODs are filed with HQs • Be in compliance with DOE 5400.5 Radiation Protection of the Public and Environment. • Requires low-level radioactive waste disposal facilities to perform environmental monitoring. • Provide boundary monitoring downwind from 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 have shown no additional radon monitoring is required. Monitoring for air particulate will continue.
• CERCLA Remedial Design Work Plan (DOE 1996c)	• Monitoring will be conducted as required following the completion of cleanup to assess the continued protectiveness of the remedial actions.	• Two years of continued radon monitoring have shown the protectiveness of the remedial actions and thus no additional radon monitoring is required. Monitoring for air particulate will continue.

assess the radiation dose to a human receptor from residual contamination in soil at the Fernald Preserve. Additionally, radionuclide levels in the ponds will be monitored to ensure that visitors who trespass into the ponds and receive an internal dose from incidental ingestion of surface water do not exceed the annual dose limit established in DOE Order 5400.5. The radiological dose assessment is required to demonstrate compliance with NESHAP and DOE Order 5400.5 (DOE 1993).

An evaluation of the ARARs that consider protection of human health and the environment (Table 5–1) indicates that the NESHAP 10-mrem/year above-background dose limit for air emissions from point sources (excluding radon) is the most stringent emission limit, and it will be used to ensure compliance with annual dose limits. DOE Order 5400.5 requires that radiation exposure to members of the public from ingestion of a DOE drinking-water source must not exceed 4 mrem/yr, and the dose from all pathways must not exceed an effective dose equivalent of 100-mrem/year above background. The applicable pathways for the human dose assessment are direct radiation, inhalation of air particulate and incidental ingestion of surface water. Table 5–2 lists the site-wide dose tracking and annual assessment tasks.

Table 5–2. Sitewide Monitoring and Annual Dose Assessment Tasks

IEMP	Tasks
Evaluate planned activities and conditions at the beginning of the year	Annual Sitewide Planning
Conduct direct-radiation monitoring at background, trail and site boundary locations; conduct monitoring for air particulate at boundary and background locations; collect surface-water samples	Routine Site Monitoring
Directly compare routine monitoring results to annual dose benchmarks; report and evaluate any exceedance	Preventive Tracking/Feedback
Based on monitoring data, calculate annual dose for a receptor at monitoring locations.	NESHAP and DOE 5400.5 Compliance Demonstration
Prepare summaries and the annual dose assessment report	Reporting

Exposure to direct radiation (gamma, x-ray and beta) is assessed quarterly using optically stimulated luminescence (OSL) dosimeters placed along the site trails and boundary (Figure 5.1). Previous monitoring for direct radiation was performed using thermoluminescent dosimeters (TLDs), which had a nominal energy response of 0.03 to 1.25 million electron volts (MeV). OSL dosimeters have a wider energy-response range (0.005 to 20 MeV). DOE Order 5400.5 is not prescriptive on the monitoring devices that must be used to assess the direct radiation dose, but analytical integrity must be maintained and the yearly dose to members of the public, from all pathways, must be less than 100 mrem above background.

For the air pathway, public exposure to radioactive particulate (excluding radon and its daughters) released to the atmosphere from activities at a DOE site shall not result in an effective dose equivalent greater than 10 mrem/yr (NESHAP requirement) above background. Compliance will be demonstrated using monitoring data obtained from the six AMS locations on Figure 5–1. Because radium-226 waste products were removed from the site, there is no significant source for radon-222, and doses caused by radon-222 and its decay products are no longer included in the air assessment.

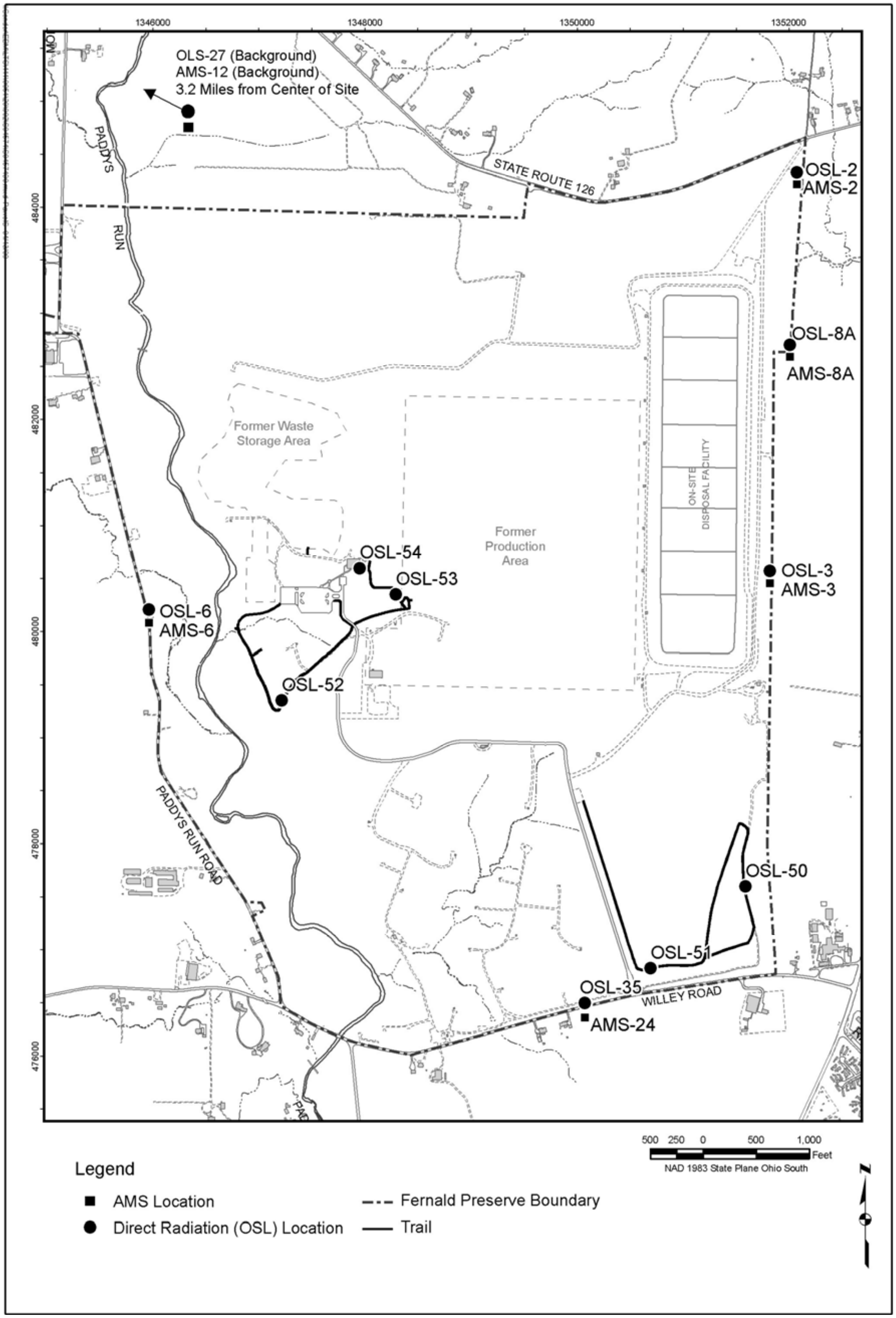

Figure 5–1. Location of Air Monitoring Stations and OSL Devices

Public exposure due to the ingestion of a DOE drinking water source shall not result in an effective dose equivalent greater than 4 mrem/yr. Although there is no DOE drinking water source at the Fernald Preserve, an on-site visitor may illegally wade in the ponds and incidentally ingest the surface water. This scenario will be treated as a member of the public ingesting a DOE drinking water supply.

DOE Order 5400.5 states that the absorbed dose to native aquatic organisms from exposure to the radioactive material in liquid wastes discharged to natural waterways shall not exceed 1 rad per day. DOE has 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 radionulcide concentration in surface water by a biota concentration guide (BCG) and sums the BCGs 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 and 2008 (the first and second years of post-closure) the sum dropped to 0.009 (DOE 2008b) and 0.010 (DOE 2009). Therefore, it is reasonable to assume that post-closure discharges in future years will not exceed the 0.06 sum observed during active remediation, and dose calculations for aquatic organisms will be discontinued in 2009.

5.2 Program Expectations and Design Considerations

5.2.1 Program Expectations

The 2009 activities for the Program are:

- Measure public exposure to direct radiation (gamma ray, x-ray and beta) with OSL devices placed along the site trails and boundary.
- Monitor the air pathway to demonstrate that the inhaled dose from radionuclide levels in particulate results in an annual effective dose to any member of the public of less than 10 mrem/yr (NESHAP, 40 CFR 61 Subpart H) above background.
- Analyze surface-water samples to demonstrate that dose due to incidental ingestion of pond water is less than 4 mrem/yr above background, per DOE Order 5400.5.
- Doses from the air, surface-water and direct-radiation pathways will be used to show that the annual dose from all pathways is less than 100 mrem/yr above background (DOE Order 5400.5), and that dose to the public is as low as is reasonably achievable (ALARA).
- Provide a program that promotes the continued confidence of the public and is responsive to concerns raised by stakeholders.

5.2.2 Design Considerations

The Program is comprised of three monitoring components:

- Evaluate internal dose from radionuclide concentrations in suspended particulate that is inhaled via the air pathway.
- Evaluate internal dose from radionuclide concentrations in pond water that is incidentally ingested via the surface-water pathway.
- Measure direct radiation (gamma, x-ray and beta) to assess external dose.

Each component of the Program is designed to address a unique aspect of the annual dose assessment requirements in NESHAP and DOE Order 5400.5. The following sections provide a detailed discussion on the distinct sampling methodologies and analytical procedures used to obtain the data needed to demonstrate compliance with the requirements.

5.2.2.1 Air Pathway

The air-monitoring activities for 2009 are:

- Operate six air-monitoring stations to obtain data on particulate mass and radionuclide concentrations (Figure 5–1).
- Use the data to demonstrate compliance with the requirement in NESHAP (40 CFR 61 Subpart H) that states no member of the public will receive an annual effective dose equivalent greater than 10 mrem above background.

To meet these expectations during 2009, the Program will operate and maintain six high-volume air monitoring stations (Figure 5-1). Five air monitoring stations will be along the site boundary, with three of the five stations located in the prevailing downwind direction (refer to wind rose diagram, Figure 5–2). In addition, there is one background monitor (AMS-12) located approximately 3 miles northwest of the site boundary.

The sampling and analysis plan for air-particulate samples is designed to meet the following two criteria:

- Provide routine analysis that supports a quarterly evaluation of potential dose to the public.
- Account for the site-specific radionuclide contaminants that contribute to dose.

Based on these criteria, the sampling and analysis frequency for the air-particulate component consists of the following:

- Monthly Uranium and Total Particulate Samples

  Filters will be exchanged monthly at all air monitoring stations and will be analyzed for total uranium and total particulate. Monthly frequency is acceptable because the only source for contaminants is soil that has been certified to meet the final remediation limits of the OU5 ROD.

- Quarterly Composite Sampling

  A portion of each monthly sample will be used to form a quarterly composite sample for each station. The quarterly composite samples will be analyzed at an off-site laboratory for uranium-238, uranium-235/236, uranium-234, thorium-232, thorium-230, thorium-228, and radium-226. The selected isotopes represent nuclides that were stored, handled and/or processed during the remediation effort. Results from the quarterly composite samples will be used to track compliance against the NESHAP and DOE Order 5400.5 requirements.

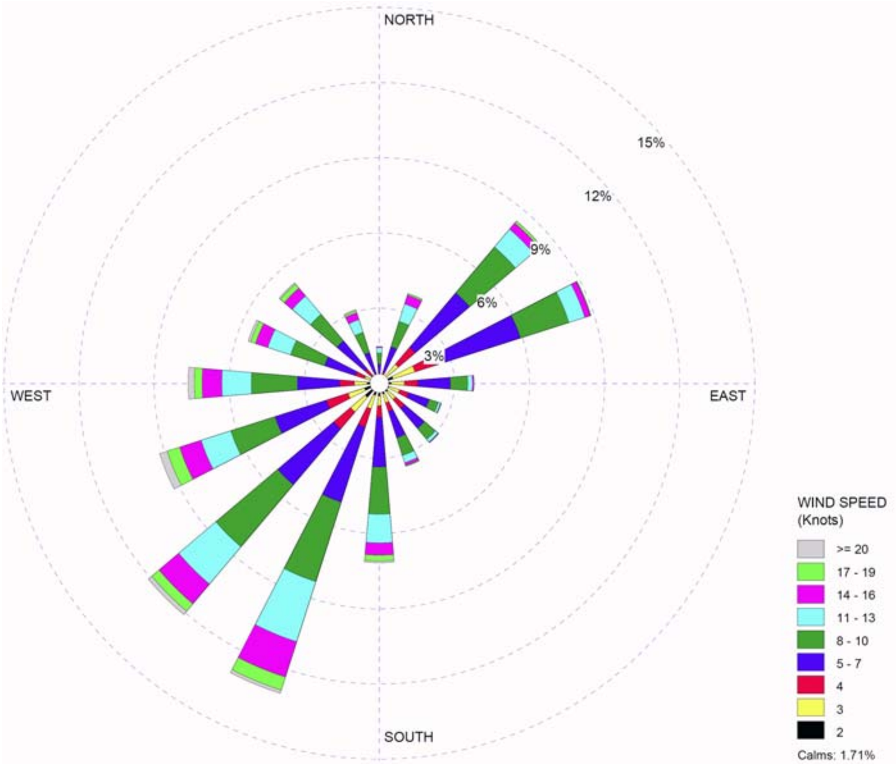

Figure 5–2. Fernald Site 2002–2006 Wind Rose, 197-ft (60-m) Height

Table 5–3 presents a summary of the sampling and analytical information.

Table 5–3. Sampling and Analytical Summary for Air Particulate Samples

Constituent	Sample Matrix	Sample Frequency	ASL	Container
Total Uranium	Air	Monthly	D	20 cm × 25 cm polypropylene 0.3-µm filter
Total Particulate	Air	Monthly	A	20 cm × 25 cm polypropylene 0.3 µm filter
Uranium-234 Uranium-235/236 Uranium-238 Thorium-228 Thorium-230 Thorium-232 Radium-226	Air	Quarterly composite	D	NA[a]

[a]NA = not applicable

5.2.2.2 Surface-Water Pathway

Monitoring activities and sample locations for surface water are discussed in Section 4.4. The incidental ingestion of surface water will be evaluated using the derived concentration guidelines (DCGs) for drinking water, as established in DOE Order 5400.5. Concentration data from surface-water samples and the DCGs will be used to assess compliance with the following DOE limit:

- No person shall receive an effective dose equivalent in excess of 4 mrem/yr above background from the consumption of drinking water.

The receptor is defined in Section 5.5.2 and the volume of ingested surface water will be set to 0.6 L/yr, which agrees with the intake listed in the Interim Residual Risk Assessment for the Fernald Closure Project (DOE 2007).

5.2.2.3 Direct Radiation

The direct-radiation component of the monitoring program is designed to assess the external environmental dose from gamma ray, x-ray and beta radiation. This is accomplished using 11 OSL devices: six are collocated with the air-particulate monitors and five are placed along the hiking trails (Figure 5–1). Three OSL devices are placed approximately one meter above the ground at each location to assess the precision of the data. The OSL devices are processed quarterly at a DOE–approved laboratory.

The OSL devices deployed in 2009 replace the TLDs used in previous years. OSL dosimeters have a superior energy-response range (0.005 to 20 MeV), relative to TLDs (0.03 to 1.25 MeV), and the stored energy can be measured many times (without losing the exposure record) because the radiation dose is measured using a light emitting diode, rather than the thermal annealing process used to read TLDs. Thermal annealing erases the exposure record held in the TLD.

The monitoring plan meets the following criteria:

- Provide quarterly analysis to evaluate direct radiation levels.
- Account for the annual dose from direct radiation to support the annual dose assessment required by DOE Order 5400.5.

Table 5–4 summarizes the sampling and analysis plan for the direct radiation monitoring program.

Table 5–4. Analytical Summary for Direct Radiation

Analyte	Sample Matrix	Sample Frequency	ASL	Detection Level
Gamma and Beta Radiation	OSL	Quarterly	B	5 mrem

5.2.2.4 Meteorological Monitoring

Meteorological monitoring is no longer performed at the Fernald Preserve. Data on wind speed and direction, obtained from the former Fernald station over the 2001 to 2006 time period, are combined with meteorological data on temperature and precipitation, obtained annually from the Butler County airport, to assess the influence of atmospheric conditions on the transport and dispersion of particulate suspended in the air pathway.

5.3 Plan for Implementation of the Monitoring Program

Implementation of the sampling, analytical, and data-management activities associated with monitoring internal and external exposure pathways are described herein to demonstrate that environmental data of sufficient quality are collected to meet the intended data use. All sampling procedures and analytical protocols described or referenced in this plan are consistent with the requirements of the LM QAPP.

5.3.1 Sampling Program

Sample analysis will be performed at off-site contract laboratories. Laboratories will be selected based on specific analyses required, laboratory capacity, turnaround time, and performance of the laboratory. The laboratories used for analytical testing will meet DOECAP requirements, as specified in LM QAPP. These criteria include performance evaluation samples, pre-acceptance audits, performance audits, and an internal quality assurance program.

5.3.1.1 Sampling Procedures

Sampling procedures associated with the Program will be performed in accordance with the LM QAPP, and these procedures have been incorporated into the standard operating procedure *Fernald Preserve Environmental Monitoring Procedures Manual* (DOE 2008c).

Air Particulate

Table 5–3 summarizes the sampling frequency and isotopes of interest for the particulate samples. Sample collection is accomplished by using high-volume air monitors that continuously collect samples of airborne particulate (Table 5–5). Changes in flow rate are accounted for by the automatic flow controller in the monitor and are documented on a flow chart recorder that continuously records flow data.

Table 5–5. Technical Specifications for Particulate Monitors

Monitor Type	Flow Rate	Filter Type	Gauge/Meters	Indicator
High-volume continuous	45 cfm	Multi-ply polypropylene	Hours Flow Rate Set Point	Low Flow Warning Light

Per DOE guidance and industry practice, air monitoring equipment must meet the following criteria:

- Environmental air samplers shall be mounted in locked, all-weather stations with the sampler discharge positioned to prevent the recirculation of air.
- The air sampling system shall have a flow-rate meter, and the total air flow or total running time should be indicated.
- The air sampling rate should not vary by more than 10 percent of the monitor set point of 45 cfm for the collection of a given sample.
- Linear flow rate across air particulate filters should be maintained between 20 and 50 meters per minute (m/min).
- Air sampling systems shall be flow-calibrated, tested, and routinely inspected according to written procedures. Flow calibration shall be at least as often as recommended by the manufacturer.

All units placed in the field have a field tracking log that indicates when calibrations were last completed and the date of the next scheduled calibration. Boundary monitors are checked daily to ensure continuous operation.

Direct Radiation

Table 5–4 provides a sample and analytical summary for the external-radiation monitoring program. Environmental monitoring of direct radiation must meet the following criteria, per DOE guidance:

- Environmental dosimeters shall be mounted at 1 meter above ground.
- The frequency of exchange should be based on predicted exposure rates from site operations.
- The exposure rate should be long enough (typically one calendar quarter) to produce a readily detectable dose.
- Calibration, readout, storage, and exposure periods used should be consistent with the recommendations of the American National Standard Institute.

All dosimeters placed in the field have a field-tracking log that indicates deployment and collection dates.

5.3.1.2 Quality Control Sampling Requirements

Air Particulate

One blank sample is submitted with each set of monthly samples, and these blanks are used to form the quarterly composite blank. The monthly blank is analyzed for total uranium, and the quarterly blank is evaluated for isotopes listed in Table 5–3. The laboratory also analyzes method blanks, matrix spikes, and laboratory control samples as required by the LM QAPP for the corresponding ASL and analytical method.

Direct Radiation

Three dosimeters will be placed at each location to evaluate precision in the external-radiation measurement. The dosimeters will be collected and analyzed each quarter. Measurements recorded for the three dosimeters at each location must agree within 15 percent or the results will be considered suspect and invalid.

5.3.1.3 Decontamination

Sampling equipment is not needed to recover the air filters and dosimeters. For the surface-water samples, decontamination of sampling equipment will be performed between sample locations to prevent the introduction of contaminants or cross contamination into the sampling process. Additional details are identified in the LM QAPP.

5.3.1.4 Waste Disposition

Contact wastes that are generated by the field technicians during sampling activities are collected and managed in accordance with site requirements.

5.4 Data Evaluation and Reporting

This section discusses the data evaluation process and actions associated with the monitoring systems and the reporting requirements that must be met to comply with NESHAP, DOE Orders, and the Federal Facility Agreement.

5.4.1 Data Evaluation

Data produced from the Program monitoring activities will be evaluated to ensure consistency with the expectations identified in Section 5.2.1. Based on these expectations, the following questions will be answered:

- Do the results of quarterly composite radionuclide concentrations indicate the potential to exceed the 10 mrem/yr above-background dose limit of NESHAP Subpart H?

  The quarterly composite results will be compared to the NESHAP Appendix E, Table 2 values. If this comparison indicates that the annual limit may be exceeded, sampling and analytical protocols will be evaluated to identify the problem. If needed, modifications to the Program will be proposed to mitigate future problems.

- Do results for radionuclide concentrations in surface water indicate the potential to exceed the 4 mrem/yr above-background dose limit for drinking water (DOE Order 5400.5)?
  The data from surface-water samples is used to assess the drinking-water dose to a member of the public who illegally wades in a pond and accidentally ingests the water. If annual results indicate that the dose limit may be exceeded, site conditions and analytical protocols will be evaluated to identify the problem. If needed, modifications to the Program will be proposed to mitigate future problems.

- Do quarterly direct radiation levels indicate the potential to exceed the all pathway dose limit (100 mrem/yr above background) of DOE Order 5400.5?

  The data generated from individual dosimeter locations will be compared to historic data to assess the validity of the results. If quarterly results are inconsistent with historic data, site conditions and analytical protocols will be evaluated to identify the problem. If needed, modifications to the Program will be proposed to mitigate future problems.

- Are the program and reporting requirements of DOE Order 450.1A being met?

  DOE Order 450.1A requires that DOE implement and report on an environmental protection program for the Fernald Preserve. Monitoring for air particulate, surface water and external radiation are components of the site-wide IEMP monitoring program. This IEMP and the annual SER fulfill the requirements of this DOE Order.

- Are the program goals in line with ALARA?

  External radiation is the largest component of the annual dose (greater than 90 percent), and monitoring provides a quarterly assessment of this exposure to ensure the dose to a member of the public remains ALARA.

- Are community concerns being met through the present monitoring program?

  The IEMP fulfills the needs of the Fernald community by presenting monitoring results in the annual SER.

5.4.2 Reporting

The Program will meet the reporting requirements for the NESHAP Subpart H and the FFA compliance, as follows:

- The NESHAP Subpart H report has been incorporated into the annual site environmental report.
- The quarterly FFA reporting is being fulfilled via the LM website.

The annual SER is issued each June for the previous year and contains the following, as well as additional, information:

- An annual summary of data from the IEMP monitoring program.
- Constituent concentrations for each sample location.
- Statistical analysis summary for each constituent, as warranted by data evaluation.
- A summary of the annual dose assessment and the status of regulatory compliance with NESHAP Subpart H and DOE Orders.
- Information that indicates achievement of ARAR goals.

Program data posted on the LM website is in the form of searchable data sets and/or downloadable data files. This site will be updated routinely after data are reported, validated and released for posting.

A complete discussion of reporting information is provided in Section 6.0.

5.5 Dose Assessment

This section presents the general technical approach for performing the annual dose assessment, including a description of exposure pathways, potential receptors for these pathways, sampling frequency, radionuclides evaluated in the dose assessment, and the dose calculation procedure.

5.5.1 Exposure Pathways

According to past dose assessments at the Fernald Preserve, human receptors are exposed through two primary pathways: the air pathway, which includes inhalation and ingestion of soil particulate suspended by the wind; and the external radiation pathway. The radioactive source for the external radiation is also the soil, which contains radionuclide concentrations below the final remediation levels established in the OU5 ROD. Additionally, because the site is now open to the public and unescorted hiking is permitted on designated trails, a surface-water exposure pathway is present. Although wading and swimming are prohibited in the site ponds, incidental ingestion of surface water is a viable exposure pathway for visitors that do not follow the rules.

5.5.2 Potential Receptor

A hypothetical receptor that represents the maximally exposed individual (MEI) is used for the annual dose assessment. The MEI is an off-property resident that is assumed to spend 24 hours a day, 365 days a year living at the fence line and visiting the site. Under this worse-case exposure scenario, the MEI inhales fugitive dust and receives external radiation from the site soil while living next to or visiting the site and consumes surface water when illegally wading or swimming in the site ponds. The inhalation and external radiation dose received by the MEI corresponds to the maximum measured values obtained from the air monitoring and dosimeter stations along the site boundary. Dose from the incidental ingestion of surface water is calculated using the highest radionuclide concentrations reported for pond samples.

5.5.3 Routine Surveillance of Pathways

Residual radionuclide levels in soil serve as the exposure source for the air and external radiation pathways, while radionuclide concentrations in ponds serve as the source for the surface-water pathway. These pathways are monitored throughout the year to collect the data needed for the annual dose assessment.

Radionuclide concentrations in air particulate obtained from fence-line samples (Figure 5–2) will be used to assess the NESHAP 10 mrem/yr above-background limit. Samples will be collected monthly and analyzed for uranium and particulate mass. A quarterly composite will be created from the monthly samples and this composite will be analyzed for the isotopes in Table 5–3. The location that corresponds to the highest radionuclide concentrations will be selected to perform the NESHAP analysis. This result will also be used to assess the all pathway dose, which must be less than 100 mrem/yr above background (DOE Order 5400.5).

External radiation is monitored via dosimeters placed at the fence line, the visitor museum, and along hiking trails (Figure 5–1). Dosimeters are collected and analyzed quarterly (Table 5–5). The station that corresponds to the highest direct-radiation measurement will be selected to perform the all pathway dose, which must be less than 100 mrem/yr above background (DOE Order 5400.5).

Samples collected from ponds and wetlands (Figure 4–2) will be used to assess the internal dose to a visitor that illegally wades in the pond and incidentally ingests surface water. Samples are collected annually for radionuclides (semi-annually for uranium) from two ponds and three wetland locations (Table 4–3). The sample with the highest radionuclide concentrations will be selected to evaluate DOE Order 5400.5, which requires that the dose due to ingestion of water be less than 4 mrem/yr above background. This result will also be used to assess the all pathway dose, which must be less than 100 mrem/yr above background (DOE Order 5400.5).

5.6 Analytes and Analytical Results

The list of radionuclides contributing to the annual dose must reflect past site contaminants, and laboratory quality assurance/quality control (QA/QC) must be sufficient to maintain program integrity and confidence in the assessment of the 100 mrem/yr above-background dose limit. Therefore, contract laboratories that perform work for the Fernald Preserve must meet the QA/QC requirements of the LM QAPP.

5.6.1 Parent and Daughter Nuclides

Uranium-238, thorium-232, and uranium-235 are parent nuclides in the uranium, thorium, and actinide decay chains, respectively (Table 5–6). These isotopes, along with thorium-230 and thorium-228, are measured and reported by the laboratory. Although most uranium and thorium processed at the former Fernald Feed Materials Production Center did not contain daughter nuclides, decades of post-production time have passed and some daughters have achieved secular equilibrium with the parent nuclide. Therefore, decay-chain daughters with a half-life less than six years that are not reported by the laboratory (thorium-234, protactinium-234, radium-228, actinium-228, radium-224, and thorium-231) are assumed to be present at an activity equal to that of the parent, and this activity will be used in the dose assessment. Exceptions to this rule are daughters below radon-220 and radon-222. These daughters are excluded from the calculation because radon diffuses out of the soil and the present radon levels are similar to background levels.

5.6.2 Analytical Results

Laboratory data validation will consist of verifying that, at a minimum, 10 percent of the data are in compliance with the criteria associated with ASL E for the quarterly samples used for the NESHAP analysis and 10 percent with ASL B for the samples used to assess external radiation and surface-water dose. The analysis of environmental samples may result in reported contaminant concentrations that are at or below the minimum detectable concentration (MDC). Contaminant concentrations that are at or below the MDC are statistically indistinguishable from concentrations found in a blank sample, and results below the MDC will be set to zero for the dose assessment. Detectable contaminant concentrations will be converted to net concentrations by subtracting the blank concentration (if detected) and background concentration from the measured result prior to performing the dose assessment. All laboratory QA/QC measures and MDCs must meet the requirements established in the LM QAPP.

Table 5–6. Uranium, Thorium, and Actinide Decay Chains

Uranium	Half-Life	Thorium	Half-Life	Actinide	Half-Life
Uranium-238 [a]	4.5 x 10^9 years	Thorium-232 [a]	1.4 x 10^{10} years	Uranium-235 [a]	7.1 x 10^8 years
Thorium-234[b]	24 days	Radium-228[b]	5.7 years	Thorium-231[b]	25.64 hours
Protactinium-234[b]	1.2 minutes &				
(2 isomeric states)	6.7 hours	Actinium-228[b]	6.13 hours	Protactinium-231	3.25 x 10^4 years
Uranium-234 [a]	2.5 x 10^5 years	Thorium-228 [a]	1.9 years	Actinium-227	21.6 years
Thorium-230 [a]	8.0 x 10^4 years	Radium-224[b]	3.64 days	Thorium-227	18.2 days
Radium-226 [a]	1622 years	Radon-220	55 seconds	Francium-223	22 minutes
Radon-222	3.8 days	Polonium-216	0.16 second	Radium-223	11.4 days
Polonium-218	3.05 minutes	Lead-212	10.6 hours	Radon-219	4.0 seconds
Lead-214	26.8 minutes	Bismuth-212	60.5 minutes	Polonium-215	1.77 x 10^{-3} seconds
Bismuth-214	19.7 minutes	Polonium-212	3.04 x 10^{-7} seconds	Lead-211	36.1 minutes
Polonium-214	1.6 x 10^{-4} sec.	Lead-208	Stable	Bismuth-211	2.16 minutes
Thallium-210	1.3 minutes			Thallium-207	4.79 minutes
Lead-210	22 years			Lead-207	Stable
Bismuth-210	5 days				
Polonium-210	138 days				
Lead-206	Stable				

[a] Analytical measurement
[b]Activity assumed to be equal to parent nuclide
Remaining nuclides are omitted from dose calculation

5.7 All-Pathway Dose Calculations

This section describes the calculations for compliance with the 100-mrem/yr below-background dose limit in DOE Order 5400.5 (DOE 1993). Estimates of annual dose are based on the background-corrected concentration of a contaminant in each environmental medium.

The general form of the dose assessment equation is:

$$D = C_{\mathbf{i,m}} * I_{\mathbf{m}} * DCF_{\mathbf{i}}$$

where:

D = Dose (mrem/year)

$C_{i,m}$ = Blank and background-corrected concentration of radionuclide "i" in medium "m" (pCi/kg or pCi/L)

I_m = Intake (ingestion) rate for medium (kg/year or L/year)

DCF_i = Dose conversion factor for radionuclide "i" (mrem/pCi)

The detailed calculation of dose from various environmental media follows the LM SAP (DOE 2006b) and the discussion in this section. External-radiation, air-inhalation, and surface-water doses will be calculated separately and then combined into the DOE all-pathway annual dose. Additionally, air-inhalation and surface-water doses must meet annual dose limits that are specific for the air (NESHAP Subpart H) and drinking-water (DOE Order 5400.5) pathways.

Quarterly dosimeter results are reported as mrem per quarter, and the 4 quarters will be added together to obtain the yearly dose for external radiation. This dose is added to the air and surface-water doses to obtain the all-pathway dose.

The air dose will be calculated with the particulate samples from the monitoring location that yields the highest radionuclide concentrations. NESHAP Subpart H, Appendix E values will be used to calculate the dose for each nuclide. Nuclides identified in Table 5–6 will be summed to obtain the total air dose, and this sum will be compared to the 10 mrem/yr limit to assess compliance. The NESHAP air dose result is added to the direct-radiation and surface-water doses to evaluate the DOE Order 5400.5 all-pathway dose.

DOE Order 5400.5 states that DOE sources of drinking water must maintain EPA drinking water standards, and radionuclide concentrations must be low enough to ensure that an internal dose is less than 4 mrem/yr above background. Although the 4 mrem/yr standard applies to drinking water, it will be used to assess the dose to an on-site visitor that illegally enters the ponds and incidentally ingests the surface water. Surface-water samples will be screened to obtain the sample with the highest radionuclide values, and the volume of surface water ingested will be set to the value used for the Fernald Preserve visitor in the *Interim Residual Risk Assessment for the Fernald Closure Project* (DOE 2007), which is 0.6 liters per year.

The derived concentration guidelines (DCGs) for water (Chapter III of DOE Order 5400.5) are based on an internal exposure of 100 mrem/yr and a person consuming drinking water at a rate of 730 liters per year. Therefore, the DCGs must be adjusted to account for the 4 mrem/yr limit and much lower intake (0.6 L) attributed to incidental ingestion of surface water (adjusted DCG = original DCG * 4/100 * 730/0.6). The dose from each isotope in Table 4–4 will be summed to obtain the total surface-water dose, and this sum will be compared to the 4 mrem/yr criterion to evaluate compliance with the Order. The surface-water dose is added to the air and direct-radiation doses to evaluate the all-pathway dose.

6.0 Program Reporting

6.1 Introduction

This section summarizes how the reporting discussions in Sections 3.0 through 5.0 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, sediment, and air, and dose has been described in detail in Sections 3.0 through 6.0. 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 site'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 non-radiological discharge monitoring and reporting related to the NPDES Permit have been incorporated into the IEMP.

Sediment: The IEMP sediment sampling program determines whether substantial changes to current residual contaminant conditions occur in the sediment along the Great Miami River. Sediment sampling will continue at the Great Miami River sample points for uranium to verify that no adverse impacts have occurred to sediment.

Air/Dose: The air monitoring program consists of three distinct sampling elements: airborne particulate monitoring stations, radon monitoring locations, and direct radiation monitoring locations. Each element has five monitoring locations at the Fernald Preserve boundary, and one off-site background location.

The surface water and air monitoring program provide data that is used to report the annual sitewide radiological dose assessment to meet the intentions of U.S. Department of Energy (DOE) Order 5400.5: Program Review and Revision.

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 site-wide 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 OEPA and DOE. The Cost Recovery Grant provides a way for OEPA to conduct an independent review of

DOE environmental monitoring programs. OEPA'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 independently collected by OEPA is provided to DOE. Modifications to the scope or focus of the IEMP, as a result of OEPA'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 site-wide 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.

<u>LM Website</u>
The LM website (http://www.lm.doe.gov/land/sites/oh/fernald/fernald.htm) allows the regulatory agencies and members of the public to access to Fernald Preserve data in a timely manner. The data are available after analysis and entry into the SEEPro environmental database. The TLD, OSDF Leachate Collection System and LDS volumes, and sediment data are provided in downloadable files. Groundwater and surface water data are available through user-defined queries through the Geospatial Environmental Mapping System (GEMS). GEMS is a web-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.

Based on the objective of the dose assessment described in Section 5.0, there will be two interfacing and reporting mechanisms in which the dose assessment results will be presented. The two reporting mechanisms are regulatory interfaces and annual reporting.

<u>Annual Site Environmental Reports</u>
As previously stated, annual SER will continue to be submitted to EPA and OEPA 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 appendices compile the information reported on the LM website and are intended for a more technical audience including the regulatory agencies.

Table 6–1, IEMP Reporting Schedule for 2009, identifies the media that are being reported under the IEMP and the associated reporting schedule.

Table 6–1. IEMP Reporting Schedule for 2009

	2009											
	First Quarter			Second Quarter			Third Quarter			Fourth Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GROUNDWATER/OSDF[a]	*	*	*	*	*	* ●	*	*	*	*	*	*
SURFACE WATER[b]	*	*	*	*	*	* ●	*	*	*	*	*	*
NPDES PERMIT COMPLIANCE	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
SEDIMENT						●					*	
Dose						●						

*= LM website Data Reporting
●=Annual Reporting
♦=Monthly Reporting

[a]Encompasses aquifer restoration operational assessment, aquifer conditions, and OSDF groundwater monitoring.
[b]Encompasses NPDES and IEMP characterization monitoring.

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40 CFR 61. Environmental Protection Agency, Title 40, "Protection of Environment," Part 61, "National Emission Standards for Hazardous Air Pollutants," *U.S. Code of Federal Regulations.*

40 CFR 192.32. Environmental Protection Agency, Title 40, "Protection of Environment, Part 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," Subpart 32, "Standards," *U.S. Code of Federal Regulations.*

40 CFR 264. Environmental Protection Agency, Title 40, "Protection of Environment," Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, Releases from Solid Waste Management Units," *U.S. Code of Federal Regulations.*

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Appendix A

Natural Resource Monitoring Plan

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Acronyms and Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	U.S. *Code of Federal Regulations*
DOE	U.S. Department of Energy
DOE-LM	DOE Office of Legacy Management
DOE-EM	DOE Office of Environmental Management
EPA	U.S. Environmental Protection Agency
IEMP	Integrated Environmental Monitoring Plan
NEPA	National Environmental Policy Act
NRMP	Natural Resource Monitoring Plan
NRRDP	Natural Resource Restoration Design Plans
OEPA	Ohio Environmental Protection Agency
U.S.C.	United States Code

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1.0 Introduction and Objectives

The purpose of the Natural Resource Monitoring Plan (NRMP) is to outline a comprehensive plan for monitoring natural resources at the Fernald Preserve. Monitoring requirements related to natural resources include the following: (1) monitoring the status of several priority natural resource areas to maintain compliance with applicable regulations; (2) monitoring of completed restoration projects as specified in Natural Resource Restoration Design Plans (NRRDP); and (3) monitoring impacts to natural resources from site activities. The results of this monitoring will be used to inform the U.S. Environmental Protection Agency (EPA), Ohio Environmental Protection Agency (OEPA), and the Fernald Natural Resource Trustees of the status of natural resources at the Fernald Preserve. Monitoring results will be reported in the annual site environmental reports.

2.0 Analysis of Regulatory Drivers

As shown in Table A–1, regulatory drivers for the management of natural resources and associated impact monitoring include six areas: endangered species protection; wetlands/floodplain regulations; cultural resource management; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) natural resource trusteeship process; the National Environmental Policy Act (NEPA); and the NRRDPs.

2.1 Threatened and Endangered Species

The federal laws and regulations listed below mandate that any action authorized, funded, or carried out by the U.S. Department of Energy (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 (16 United States Code [U.S.C.] §1531, et seq.) and its associated regulations (50 *Code of Federal Regulations* [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 and §1531, as well as in Ohio Administrative Code §1501.

2.2 Wetlands/Floodplains

Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Protection of Floodplains), which are implemented by DOE Regulation 10 CFR 1022, “Compliance with Floodplain/Wetlands 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.

Table A−1. Fernald Site Natural Resource Monitoring

DRIVER	ACTION
Endangered Species Act Ohio Endangered Species Regulations	The IEMP describes management of existing habitat and follow-up surveys.
Clean Water Act — Section 404	The IEMP describes the monitoring of mitigated wetlands.
National Historic Preservation Act Native American Graves Protection and Repatriation Act Archaeological Resources Protection Act	The IEMP describes the monitoring of cultural resources.
CERCLA Executive Order 12580 National Contingency Plan	The IEMP describes the CERCLA Natural Resources Trusteeship process.
NEPA	The IEMP discusses the substantive requirements of NEPA for protecting sensitive environmental resources.
Project-specific NRRDPs	The IEMP discusses restored area monitoring.

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 Army Corps of Engineers. These permits can be in the form of either nationwide permits (33 CFR Part 330) or individual permits (33 CFR Part 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 OEPA pursuant to Chapter 3745-32 of the Ohio Administrative Code.

2.3 Cultural Resource Management

Management of cultural resources, particularly archeological sites, is mandated by the National Historic Preservation Act (16 United States Code [U.S.C.] §470), the Native American Graves Protection and Repatriation Act (25 U.S.C. 3001, et seq.), and the Archeological Resources Protection Act (16 U.S.C. §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 archeological resources on federal land are appropriately managed. Section 106 of the National Historic Preservation Act ensures that DOE takes into consideration 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 as “human remains, associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony.” The Archeological Resources Protection Act and 43 CFR 7 ensure that competent individuals carry out archeological excavations in a scientific manner.

DOE signed a Programmatic Agreement with the Advisory Council on Historic Preservation and the Ohio Historic Preservation Office that streamlines the National Historic Preservation Act, Section 106 consultation process. Monitoring provisions will be included as part of this agreement to ensure that appropriate management is implemented for any eligible properties at the Fernald Preserve.

2.4 The CERCLA Natural Resource Trusteeship Process

CERCLA, Executive Order 12580, and the National Contingency Plan collectively require certain federal and state officials to act on behalf of the public as trustees for natural resources. Natural Resource Trustees for the Fernald Preserve are the Secretary of DOE; the Secretary of the U.S. Department of the Interior; and officials of the OEPA, appointed by the governor of Ohio.

The role of the Natural Resource Trustees is to act as guardians for public natural resources at or near the Fernald Preserve. The trustees are responsible for determining if natural resources have been injured as a result of a release of a hazardous substance or oil spill from the site, and if so, how to restore, replace, or acquire the equivalent natural resources to compensate for the injury. As the responsible party, DOE is potentially liable for costs related to natural resource injury.

The Fernald Natural Resource Trustees began meeting in June 1994 to evaluate and determine the feasibility of integrating the trustees' concerns with site remediation activities. The trustees identified their desire to resolve DOE's liability by integrating restoration activities with the Fernald Site's remediation.

The Fernald Natural Resource Trustees chose to focus on a restoration-based approach to resolve DOE's liability for natural resource impacts. To accomplish this, the trustees signed a Memorandum of Understanding that established implementation of a Natural Resource Restoration Plan (NRRP) as the primary means of settlement for an existing natural resource damage claim by OEPA against DOE. The NRRP set forth a conceptual design for a series of ecological restoration projects that encompasses approximately 904 acres of the Fernald Site. Detailed designs were generated through NRRDPs written for each restoration project. Results of NRMP monitoring were taken into consideration during the design of these area-specific restoration projects. NRRDPs have project-specific monitoring requirements to determine the success of the restoration project. As stated in Section D.1, this monitoring will be summarized in the site environmental reports. Detailed results of restoration monitoring will be provided annually in the appendix to the site environmental report.

2.5 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.

2.6 Natural Resource Restoration Design Plans

NRRDPs were written for each ecological restoration project completed on site. The design documents were submitted to EPA and the Fernald Natural Resource Trustees prior to the commencement of restoration activities in a given area. In addition to describing the restoration activities, they also outline the monitoring requirements for each project area once restoration activities were completed. Following is a list of the NRRDPs that are associated with the areas that require monitoring following closure of the site (i.e., physical completion was declared on October 29, 2006).

- Wetland Mitigation Project (Phase II) NRRDP (Area 6, Phase I).
- Borrow Area NRRDP Wetland Mitigation (Phase III).
- Area 8, Phase III NRRDP (Paddys Run West).
- Paddys Run East NRRDP.
- Silos NRRDP.
- Former Production Area NRRDP.
- Waste Pits Area and Paddys Run NRRDP.

3.0 Program Expectations and Design Considerations

The expectations of the monitoring and reporting as outlined in the NRMP are as follows:

- Provide a mechanism to monitor the status of the Fernald Site's natural resources to remain in compliance with applicable laws and regulations.
- Monitor restored areas to ensure requirements of the NRRDPs are being met and restored areas continue to develop and function as designed.

The results of the monitoring outlined in this NRMP will be compiled and reported to EPA and OEPA. Results will be reviewed to ensure that ecologically restored areas are performing as designed. In the event that results indicate that a restored area is not functioning as intended, decisions will need to be made by the DOE Office of Legacy Management (DOE-LM) in consultation with EPA, OEPA, and Natural Resource Trustees regarding appropriate corrective actions.

4.0 Natural Resource Monitoring Plan

Monitoring was implemented during remediation activities to identify impacts to natural resources at the Fernald Site with particular emphasis placed on meeting regulatory requirements for NEPA, threatened and endangered species, wetlands/floodplains, and cultural resources. To accommodate natural resource monitoring, priority natural resource areas have been established across the Fernald Preserve (Figure A–1). Fernald Site personnel conducted all natural resource monitoring during remediation, with oversight from the DOE Office of Environmental Management (DOE-EM). Monitoring has and will continue during legacy management (post-closure), but will be carried out under DOE-LM.

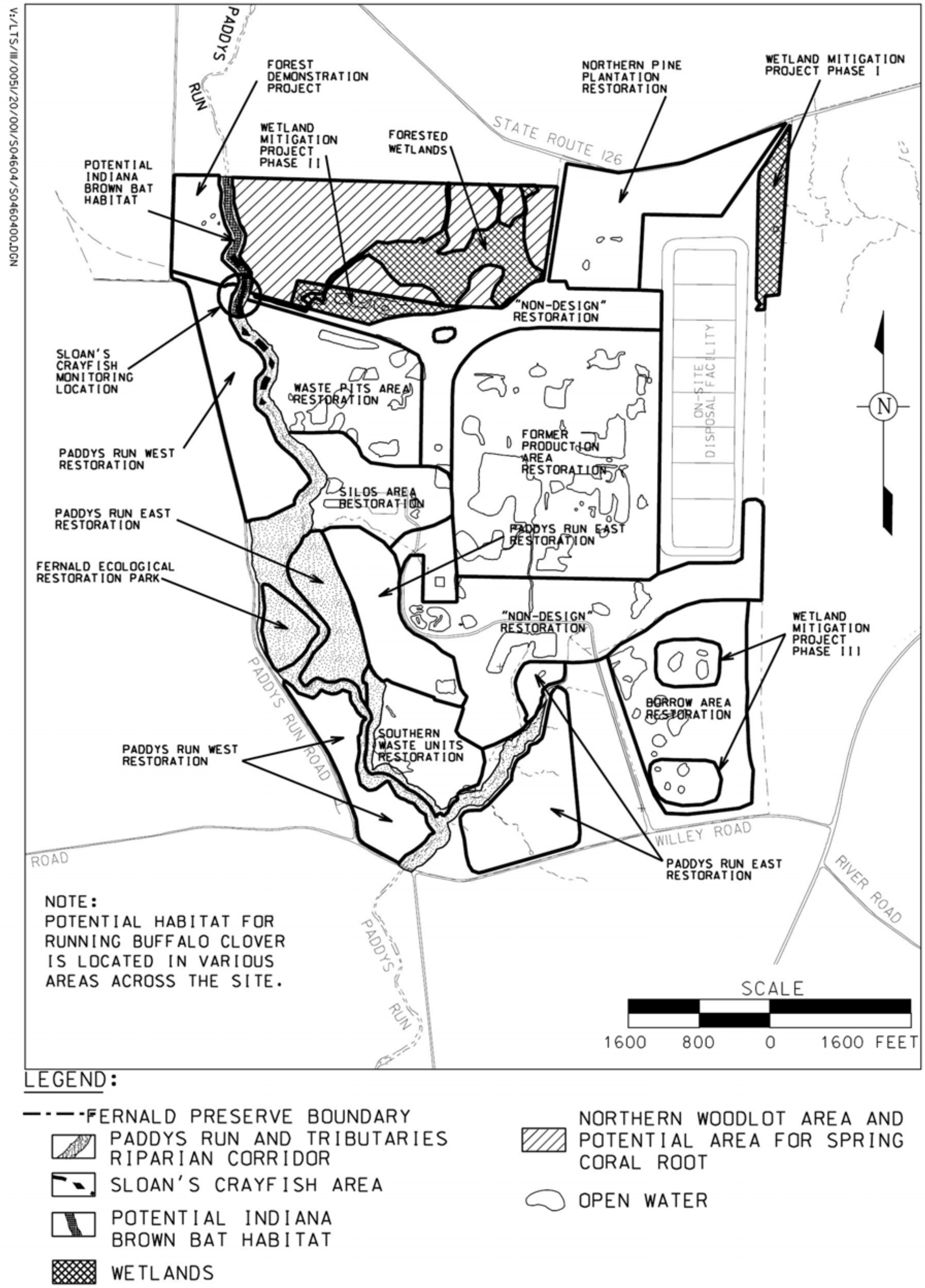

Figure A–1. Priority Natural Resource Areas

Outside expertise may be used in limited circumstances depending on the type of monitoring to be conducted. A description of the monitoring strategies to be implemented at the Fernald Preserve is provided below.

4.1 Threatened and Endangered Species

The state-listed threatened Sloan's crayfish (*Orconectes sloanii*) and the federally endangered Indiana brown bat (*Myotis sodalis*) are the only threatened or endangered species to have a known population at the Fernald Preserve. However, there is the potential for other state-listed and federally listed threatened and endangered species to have habitat ranges that encompass and/or occupy the Fernald Preserve. Monitoring will continue to track the status of the Indiana brown bat populations and their habitat. If activities take place at the Fernald Preserve that could potentially impact the Sloan's crayfish habitat, active monitoring of those areas will resume. 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.

4.1.1 Sloan's Crayfish

The state-listed threatened Sloan's crayfish is a small crayfish found in the streams of southwest Ohio and southeast Indiana. It prefers streams with constant (though not necessarily fast) current flowing over rocky bottoms. A large, well-established population of Sloan's crayfish is found at the Fernald Site in the northern reaches of Paddys Run. In dry periods, the crayfish retreat to the deeper pools that remain, primarily upstream of the former rail trestle, located approximately at the boundary between Hamilton and Butler counties. A significant population of Sloan's crayfish also resides in an off-property section of Paddys Run at New Haven Road.

This species resides with one other competing species of crayfish (*Orconectes rusticus*) that is generally considered more aggressive. In addition, the Sloan's crayfish is sensitive to siltation in streams.

Impacts on Sloan's crayfish are similar to those on other aquatic organisms in Paddys Run. Impacts of concern would include excavation and alteration of the streambed along with increased siltation and runoff into Paddys Run. With the majority of onsite soil disturbance now complete, habitat impacts are not expected. A survey of Sloan's crayfish was conducted in 2008 to assess the post-closure status of the onsite population. If the potential for impacts does return, a Sloan's crayfish management plan will be put in place. This plan would detail monitoring and contingency plans to mitigate impacts.

4.1.2 Indiana Brown Bat

Good to excellent summer habitat for the federally listed endangered Indiana brown 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 brown bat habitat would include tree removal and/or stream alteration in the northern on-property sections of Paddys Run. Because the bats use loose-bark trees for their maternal colonies, removal of trees would impact this species by eliminating its summer habitat.

The habitat of the Indiana brown bat was monitored during remediation activities to identify any unanticipated impacts during remediation. 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 brown bats were found during this survey.

DOE and the 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. Additional monitoring will be conducted in 2008 to determine the extent of bat use.

Monitoring methods for the Indiana brown bat would consist of visual observations of that activity and mist netting in areas suitable as bat flyways and where canopy occurs. Mistnetting 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 mistnets, 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.

One such sampling event took place in the summer of 2007. While several species of bats were collected, no Indiana brown bats were captured. Visual monitoring for bat activity was conducted through 2008.

4.1.3 Running Buffalo Clover

Surveys conducted in 1994 of the federally listed endangered running buffalo clover (*Trifolium stoloniferum*) found no individuals of this species at the Fernald Site. However, because running buffalo clover is found nearby in the Miami Whitewater Forest, the potential exists for this species to establish at the Fernald Site. The running buffalo clover prefers habitat with well-drained soil, filtered sunlight, limited competition from other plants, and periodic disturbance. This plant is a perennial that forms long stolons, rooting at the nodes. The plant is also characterized by erect flowering stems, typically 3 to 6 inches tall, with two leaves near the summit topped by a round flower head. In the event surveys are necessary, they would be conducted between May and June, which is the optimal time frame for blooms. An appropriate number of transects would be walked in suspect areas to identify the running buffalo clover. If populations are discovered, then best management practices will be used to minimize impending impacts, if any.

4.1.4 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 no individuals were present, 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. This analysis showed that no spring coral root was present in the northern woodlot.

4.2 Wetlands/Floodplains

Approximately 11.87 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 one acre of wetland disturbed) was negotiated between DOE and the appropriate agencies (i.e., EPA, OEPA, U.S. Fish and Wildlife Service, and Ohio Department of Natural Resources). As a result of this agreement, 17.8 acres of new wetlands had to be established to compensate for the impacts during remediation.

Wetland mitigation was initiated at the Fernald Site in 1999. Approximately 6 acres of wetlands were constructed within a 12-acre ecological restoration project along the North Access Road. Monitoring requirements for this wetland area have been completed. Two other wetland mitigation projects have been completed: Area 6, Phase I; and the Borrow Area. Monitoring for these two project areas will continue during legacy management under DOE-LM. More detailed monitoring requirements are discussed in the NRRDP for each project.

4.3 Cultural Resource Management

All field personnel must comply with the procedure, Unexpected Discovery of Cultural Resources, if cultural resources are uncovered during ground disturbing activities. In the event that ground-disturbing activities must occur during legacy management, limited monitoring will occur in all areas that have been surveyed to identify any unexpected discoveries of human remains (Figure A–2). More intensive field monitoring 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 human remains in previously surveyed areas will require data recovery work. Disturbance of previously unsurveyed areas will require at least a Phase I investigation. An annual summary of all cultural resource field activities is provided separately from the IEMP under the Programmatic Agreement for Archeological Activities at the Fernald Site. Monitoring of cultural resource areas will continue during legacy management to ensure that the areas are not being disturbed, as is described in the Institutional Controls Plan.

4.4 Restored Area Monitoring

Restored area monitoring is required following the completion of natural resource restoration work. Monitoring of restored areas involved two phases, implementation phase and functional phase monitoring. However, only implementation phase monitoring is currently ongoing at the site.

Implementation phase monitoring is conducted to ensure that restoration projects are completed pursuant to their NRRDP and to determine vegetation survival and herbaceous cover. There must be 80 percent survival of all planted vegetation in any given restored area, determined by mortality counts. There must be 90 percent cover for any seeded area, with 50 percent being native species.

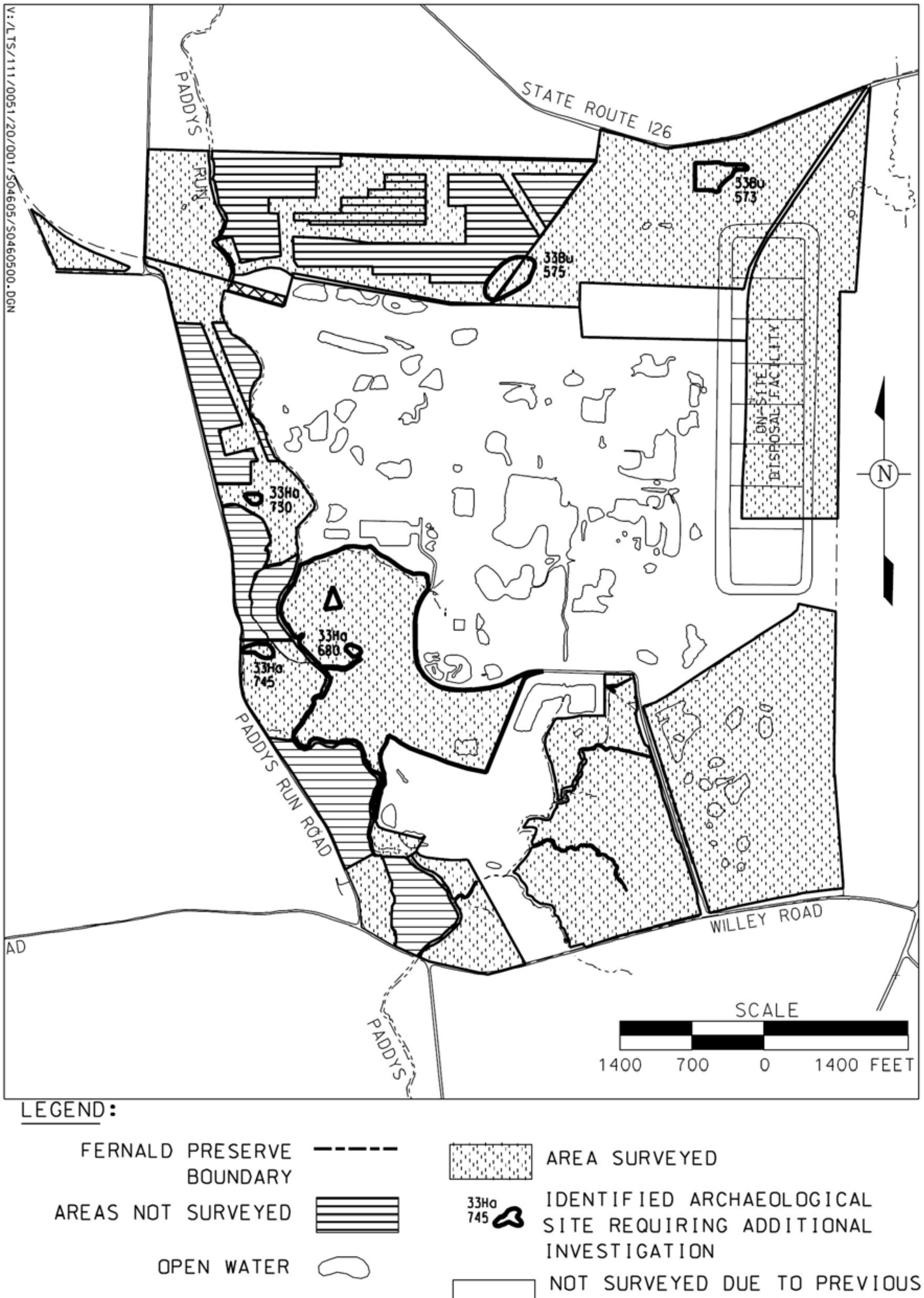

Figure A–2. Cultural Resource Survey Areas

Functional phase monitoring was conducted to evaluate the progress of a restored community against pre-restoration baseline conditions and an ideal reference site. Woody and herbaceous vegetation were evaluated for species richness, density, and frequency. Size of woody vegetation was also recorded. Currently, no further functional monitoring is scheduled for any restored area. The last round of functional monitoring was conducted in the fall of 2005.

4.4.1 Implementation Phase Monitoring

To determine vegetation survival, mortality counts are conducted at the end of the first growing season. Each container grown tree and shrub will be inspected and assigned one of four categories: alive, resprout, vitality, or dead. Trees and shrubs will be considered “alive” when their main stem and/or greater than 50 percent of the lateral stems are viable. “Resprout” trees and shrubs will have a dead main stem, with one or more new shoots growing from the stem or the root mass. Plants will be categorized as “vitality” when less than 50 percent of its lateral branches are alive. “Dead” trees will have no signs of life at all.

For seeded areas within a restoration project, the Natural Resource Trustees agreed to a 90 percent cover survival rate for cover crops (necessary for slope stabilization and erosion control) and 50 percent survival rate for native species at the end of the implementation monitoring period as a goal.

All seeded areas are evaluated within each restoration project. Depending on the size of the restoration project, seeded areas may be grouped into habitat-specific sub-areas. For each distinct area, at least three one-meter square quadrats are randomly distributed and surveyed. Field personnel will estimate the total cover and list all species present within each quadrat. The data collected will be used to determine total cover, percent native species composition, and relative frequency of native species, as described below.

For total cover, the quadrat-specific cover estimates will be averaged. Percent native species composition will be calculated by dividing the total number of species surveyed into the total number of native species present. The relative frequency of native species will be determined as follows. First, DOE will record the number of times each species appears in a quadrat. To obtain the frequency, the number of times a species appears in a quadrat will be divided by the total number of quadrats surveyed. Next, the frequencies of all native species will be summed and divided by the total of all frequencies within a given area.

By collecting the information described above, DOE will evaluate implementation phase success of seeded areas based on two criteria. First, 90 percent cover must be met by the end of the first growing season. Second, the goal of 50 percent native species composition or relative frequency must be obtained by the end of the implementation monitoring period. These criteria address both erosion control and native community establishment, which are the two primary goals of seeding in restored areas.

Implementation phase monitoring for all restoration projects was completed in 2007. However, additional monitoring may be required in future years in order to ensure adequate herbaceous cover and vegetation survival.

4.4.2 Implementation Monitoring for Mitigation Wetlands

Area 6, Phase I, and the Borrow Area were the only wetland mitigation projects that required implementation monitoring in 2008. The requirements for the wetland areas were typically for 3 years following completion, instead of just one as with the other restoration areas. The monitoring requirements were also more extensive. The monitoring included water level measurements, water quality sampling, soil sampling, and wetland plant (herbaceous cover) surveys. Implementation monitoring for mitigation wetlands was carried out under DOE-LM, and the requirements are spelled out in the NRRDP for the project. Monitoring of Area 6, Phase I was originally to be completed in 2007. However, given the extremely dry summer in 2007, DOE determined that it was necessary to suspend the final year of monitoring until 2008.

4.4.3 Functional Monitoring

Currently, negotiations are still ongoing for the Natural Resource Damage Settlement. The negotiations include functional monitoring requirements. At this time, no further functional monitoring is scheduled for any restoration area. However, the outcome of the settlement may require that functional monitoring be resumed. In that case, details of the functional monitoring methodology and the areas that require functional monitoring would be included in the next revision of the Comprehensive Legacy Management and Institutional Controls Plan and this IEMP. If functional monitoring of restored areas is resumed at the Fernald Preserve, the monitoring activities would be carried out under DOE-LM.

4.5 Natural Resource Data Evaluation and Reporting

The results of natural resource monitoring will be integrated with the annual reporting, a commitment in the IEMP. Annual site environmental reports will provide appropriate updates on unexpected impacts to natural resources and the results of specific natural resource monitoring that have been implemented (e.g., monitoring of crayfish, cultural resources, etc.). A summary of the findings will be provided in the site environmental report. A detailed discussion and evaluation of the available data will be presented in the appendix to the site environmental report. Significant findings as a result of natural resource monitoring will be communicated to EPA and OEPA as needed.

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