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Revision 13.0

Fernald Preserve, Fernald, Ohio

Comprehensive Legacy Management and Institutional Controls Plan

Volumes I and II

January 2023

U.S. DEPARTMENT OF ENERGY | Legacy Management

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Volumes I and II

Fernald Preserve
Fernald, Ohio

January 2023

Revision 13
Final

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Volume I

Legacy Management Plan

January 2023

U.S. Department of Energy

Revision 13
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Abbreviations

AEC	U.S. Atomic Energy Commission
AR	Administrative Record
CAWWT	Converted Advanced Wastewater Treatment facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
FFCA	Federal Facilities Compliance Agreement
FMPC	Feed Materials Production Center
FRL	final remediation level
ft	foot/feet
LCS	leachate collection system
LDS	leak detection system
LM	Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
LMS	Legacy Management Support
NRRP	Natural Resource Restoration Plan
Ohio EPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan
OSDF	On-Site Disposal Facility
OU	operable unit
PCCIP	Post-Closure Care and Inspection Plan
ppb	parts per billion
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SEP	Sitewide Excavation Plan
UNH	uranyl nitrate hexahydrate
WAC	waste acceptance criteria
WCS	Waste Control Specialists, LLC

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Executive Summary

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

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

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

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

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

The future LMICP schedule will be as follows:

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

1.0 Introduction

Legacy management is required at the Fernald Preserve to ensure that the remedial actions implemented at the site continue to be effective and protective of human health and the environment following site closure. This *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) outlines the U.S. Department of Energy's (DOE's) approach to, and documents the requirements for, the long-term care of the Fernald Preserve. The LMICP serves the same function as the Long-Term Surveillance and Maintenance Plan used at other DOE sites. It is DOE's intent to continue to review and refine the LMICP, with the involvement of the local community and the regulators, to ensure that legacy management activities meet stakeholder and regulatory requirements. All revisions will be subject to regulatory agency review and will be made available to the community. Revisions can always be made as needed if the results of the site inspections, the On-Site Disposal Facility (OSDF) inspections, or monitoring require them. The term "legacy management" is used throughout this LMICP and is intended to encompass all activities defined as such in DOE policy and guidance. Legacy management activities were formerly referred to as "stewardship" activities, a term that this LMICP uses interchangeably.

The DOE Office of Legacy Management (LM) is responsible for ensuring that DOE's post-closure responsibilities are met and for providing DOE programs for long-term surveillance and maintenance, records management, workforce restructuring and benefits continuity, property management, land-use planning, and community assistance. Additional information regarding LM can be found at https://www.energy.gov.

DOE policy and guidance clearly identify protectiveness of the remedies carried out at the Fernald Preserve (e.g., groundwater, OSDF, institutional controls) as the top priority for legacy management. Specifically, the OSDF requires regular monitoring and maintenance to ensure its integrity and performance. The restored areas of the site also require monitoring to ensure that applicable laws and regulations are followed. DOE policy and funding priorities regarding legacy management emphasize supporting the remedies as described in the Fernald Preserve's records of decision (RODs).

1.1 Purpose and Organization of the LMICP

The LMICP provides an overview of the defined end-state maintenance and monitoring requirements as well as the contingencies that are in place to address any changes made to the end state.

The LMICP has been developed as a two-volume set. Volume I is the Legacy Management Plan, which outlines DOE's approach to legacy management, including such issues as community involvement, records management, and funding. Volume II, the Institutional Controls Plan, outlines the specific surveillance and maintenance requirements for the Fernald Preserve.

Five support plans are included in Volume II of the LMICP as attachments:

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

These support plans outline the operational requirements associated with the ongoing groundwater remedy (Attachment A); the surveillance and maintenance requirements for the OSDF (Attachment B); surveillance and maintenance for the leachate and groundwater associated with the OSDF (Attachment C); the environmental monitoring requirements necessary to ensure the completion and effectiveness of the remedies (Attachment D); and the methods DOE will use to maintain communication with the public and involve the public in legacy management activities at the Fernald Preserve (Attachment E).

DOE is required to conduct legacy management activities at facilities that have completed site remediation (refer to Section 1.2). The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Title 42 *United States Code* Section 9601 et seq.) requires that institutional controls be part of selected remedies where land-use restrictions are placed on the property. The Fernald Preserve remedies include use restriction, waste disposal (the OSDF), and continuing groundwater extraction and treatment. DOE has followed U.S. Environmental Protection Agency (EPA) guidance on institutional controls (refer to Section 1.2). Existing laws, regulations, policies, and directives provide broad requirements for DOE to conduct legacy management activities. These activities include monitoring, reporting, record keeping, and long-term surveillance and maintenance for various facilities and media, including engineered waste disposal units, surface water, and groundwater.

The PCCIP (Attachment B) includes detailed information about the OSDF, and the OMMP (Attachment A) includes detailed information about the monitoring and maintenance of the Converted Advanced Wastewater Treatment facility (CAWWT), groundwater restoration systems, and the outfall line. Legacy management activities covered in the PCCIP and OMMP also include ensuring that restrictions on access to and use of the Fernald Preserve are enforced (for example, through records management and education). Surveillance and maintenance in restored areas focuses on protecting natural and cultural resources in accordance with applicable laws and regulations. Legacy management activities related to public involvement include maintaining communication with the public and providing the public with information about the site's former production activities, its historical remediation, site restoration, continuing groundwater remediation, land-use restrictions, public use and the future of the Fernald Preserve. Displays and programs at the Visitors Center (former Silos Warehouse) and outreach programs at local schools and organizations will help LM meet this objective.

This Legacy Management Plan describes planned legacy management activities at the Fernald Preserve as well as issues related to stewardship and is organized into the following sections:

Section 1.0 (Introduction): Provides an introduction to this plan and discusses the purpose and necessity of legacy management at DOE facilities.

Section 2.0 (Site Background): Provides the history of the Fernald Preserve, beginning with the site's construction in the 1950s, and presents a discussion of production activities, remediation, and site conditions at the time of closure in 2006.

Section 3.0 (Scope of Legacy Management at the Fernald Preserve): Discusses the scope of legacy management at the Fernald Preserve, including the management of site property, legacy management of the OSDF, and surveillance and maintenance of restored areas.

Section 4.0 (Oversight of Legacy Management at the Fernald Preserve): Describes the breakdown of responsibilities for legacy management activities at the Fernald Preserve, including LM, contractors, regulators, the CERCLA five-year review, and reporting requirements.

Section 5.0 (Records Management): Describes the importance of records management and preservation and how they apply to legacy management. This section also describes various avenues for records management during legacy management.

Section 6.0 (Funding): Discusses the funding needed to implement and sustain a legacy management program at the Fernald Preserve.

The LMICP, a revised document or approved variances to the document, will be finalized by January each year to correspond with calendar-year monitoring and reporting. Comments from EPA, the Ohio Environmental Protection Agency (Ohio EPA), and the community will be addressed between October and January.

The future LMICP schedule will be as follows:

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

Pertinent information associated with the CERCLA five-year reviews is included in the LMICP revisions as appropriate. The first CERCLA five-year review was in 2001 and occurs every 5 years thereafter. The latest CERCLA Five-Year Review Report was approved in 2021. The next CERCLA Five-Year Review Report will be completed in 2026.

1.2 Purpose of Legacy Management

DOE orders and policies applicable to legacy management are located at https://www.directives.doe.gov/. Below are other documents and reports that address legacy management issues across the DOE complex and help to better define the activities that may be required for legacy management purposes.

- *From Cleanup to Stewardship* (DOE 1999) addresses the nature of long-term stewardship at DOE sites, anticipated long-term stewardship at DOE sites, and planning for long-term stewardship.
- *Institutional Controls in RCRA and CERCLA Response Actions at Department of Energy Facilities* (DOE 2000a) provides DOE environmental restoration project managers with the information on institutional controls that they need to make environmental restoration remedy decisions under the Resource Conservation and Recovery Act (RCRA) and CERCLA.
- *Memorandum: Long-Term Stewardship Guiding Principles* (DOE 2000b) identifies broad concepts pertaining to stewardship and elements that Ohio stakeholders identified as critical to the success of stewardship planning.
- *A Report to Congress on Long-Term Stewardship* (DOE 2001a), required by the fiscal year 2000 National Defense Authorization Act, represents the most comprehensive compilation of DOE's expected long-term stewardship obligations to date, and it provides summary information for site-specific, long-term stewardship scopes, costs, and schedules. The report provides a snapshot of DOE's understanding of stewardship activities and highlights areas where significant uncertainties still remain.
- *Long-Term Stewardship Study* (DOE 2001c) describes and analyzes several significant national or crosscutting issues associated with long-term stewardship and, where possible, options for addressing these issues. The principal purposes are to promote the exchange of information and to provide information on the decision-making processes at the national level and at individual sites.
- *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups* (EPA 2000) provides an overview of the types of institutional controls that are commonly available, including their relative strengths and weaknesses. It also provides a discussion of the key factors to consider when evaluating and selecting institutional controls in CERCLA and RCRA corrective-action cleanups.
- *Institutional Controls: A Guide to Planning Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites* (EPA 2012) provides information and recommendations for planning, implementing, maintaining, and enforcing institutional controls for CERCLA site cleanups.

- *Managing Data for Long-Term Stewardship* (ICF 1998) represents a preliminary assessment of how successfully information about the hazards that remain at DOE sites will be preserved and made accessible for the duration of long-term stewardship.

DOE defines stewardship as "all activities required to protect human health and the environment from hazards remaining after remediation is completed" (DOE 1999). Three categories, or levels, of stewardship are recognized: "active," "passive," and "no stewardship required." Active stewardship is defined as "the direct performance of continuous or periodic custodial activities such as controlling access to the site; preventing releases from a site; performing maintenance operations; or monitoring performance parameters." Passive stewardship is defined as "the long-term responsibility to convey information warning about the hazards at a site or limiting access to, or use of, a site through physical or legal mechanisms." No stewardship is required "where cleanup has been completed to levels that will allow for unrestricted or residential future use" (DOE 1999). The Fernald Preserve will have a combination of active and passive measures during the legacy management of the site. This plan describes both active and passive measures, ranging from regular monitoring and maintenance to land use restrictions and postings.

The implementation of the LM Environmental Management System (EMS) ensures that sound stewardship practices protective of the air, land, water, and other natural and cultural resources potentially affected by operations are employed throughout the project. EMS is a systematic process for reducing the environmental impacts that result from LM and contractor work activities, products, and services and for directing work to occur in a manner that protects workers, the public, and the environment. The process adheres to Plan-Do-Check-Act principles, mandates environmental compliance, and integrates green initiatives into all phases of work, including scoping, planning, construction, subcontracts, and operations. Proposed site maintenance activities will be assessed for opportunities to improve environmental performance and sustainable environmental practices. Some areas for consideration include reusing and recycling products or wastes, using environmentally preferable products (i.e., products with recycled content, such as office furniture, concrete, asphalt; products with reduced toxicity; and energy-efficient products), using alternative fuels, using renewable energy, and making environmental habitat improvements.

The fundamental components of the long-term care of the Fernald Preserve include input from the regulators and the public, and public access to site information. Public involvement and access to information during legacy management are emphasized in all DOE policy and guidance, and this Legacy Management Plan is intended to clearly outline DOE's commitment to those aspects of legacy management. Federal policies, executive orders, and Department of Energy Secretary memorandums will continually be reviewed to determine their applicability to the site. LM will not implement any policies that are not in compliance with existing site requirements.

1.3 Approach to Legacy Management at the Fernald Preserve

At the Fernald Preserve, completing remediation to levels acceptable for unrestricted use was not feasible. As a result, legacy management is necessary to ensure that all remedial efforts continue to be effective and protective of human health and the environment. The OSDF was constructed to contain waste materials that will remain on the Fernald Preserve. This facility must be monitored and maintained to ensure its integrity and the public's safety.

1.3.1 Inspections According to Institutional Control Plan Requirements

Required inspections include inspections of the OSDF cap, the leachate collection system (LCS) and the leak detection system (LDS), the CAWWT, extraction wells and associated piping, the outfall line, signs, fencing, trails, overlooks, and restored areas of the site. Inspections can be scheduled or unscheduled as needed. These inspections are further defined in the Institutional Control Plan.

1.3.2 Increase Monitoring as Needed

LM has the option of increasing monitoring at any time, as needed. However, any proposed decrease in the frequency of monitoring activities included in the Institutional Control Plan will require EPA approval.

1.3.3 DOE Management of the Legacy Management Program

The LM mission includes (1) providing sustained human and environmental protection through the mitigation of residual risks and (2) protecting natural and cultural resources at DOE facilities. LM provides overall departmental policy, direction, and program guidance on matters affecting legacy management.

2.0 Site Background

2.1 Site Description

2.1.1 Fernald Preserve Description

The Fernald Preserve is on a 1,050-acre tract of land, approximately 18 miles northwest of Cincinnati, Ohio, and near the unincorporated communities of Ross, Fernald, Shandon, New Haven, and New Baltimore (Figure 1). The former production area occupies approximately 136 acres in the center of the site. The former waste pit area and the former silos area were located adjacent to the western edge of the production area. Paddys Run, an intermittent stream, flows from north to south along the Fernald Preserve's western boundary and empties into the Great Miami River approximately 1.5 miles south of the site. The Fernald Preserve lies on a terrace that slopes gently between vegetated bedrock outcrops to the north, southeast, and southwest. Soil beneath the site is glacial overburden, consisting primarily of clay and silt with minor amounts of sand and gravel, that overlies the Great Miami Aquifer. Paddys Run and the Storm Sewer Outfall Ditch, which empties into Paddys Run, have eroded the glacial overburden, exposing the sand and gravel that make up the Great Miami Aquifer.

2.1.2 Fernald Preserve and Surrounding Area

In the vicinity of the Fernald Preserve are the communities of Shandon (northwest), Ross (northeast), New Baltimore (southeast), Fernald (south), and New Haven (southwest) (Figure 1). Land use in the area consists primarily of residential use, farming, and gravel excavation operations. Some land in the vicinity of the Fernald Preserve is dedicated to housing development, light industry, and parkland. The Great Miami River is located to the east, and, like Paddys Run and the Storm Sewer Outfall Ditch, it has eroded significant portions of the glacial overburden, exposing the sand and gravel of the Great Miami Aquifer.

2.2 Site History

2.2.1 Feed Materials Production Center

The Feed Materials Production Center (FMPC) was the original name given to what is now the Fernald Preserve. The U.S. Atomic Energy Commission (AEC) constructed the FMPC in the early 1950s for the purpose of producing high-purity uranium metal from ores and process residues for use at other government facilities involved in the production of nuclear weapons for the nation's defense.

A variety of materials were used throughout the production process, including ore concentrates and recycled materials that were dissolved in nitric acid to produce a uranyl nitrate hexahydrate (UNH) feed solution. The UNH was then concentrated and thermally denitrated to uranium trioxide (UO_3), or orange oxide. The orange oxide was either shipped to the gaseous diffusion plant in Paducah, Kentucky, or converted to uranium tetrafluoride (UF_4), also known as green salt. The green salt was blended with magnesium-metal granules and placed in a closed reduction pot to produce a mass of uranium metal called a derby. Some derbies were shipped to other facilities, but the remainder were melted and poured into preheated graphite molds to form ingots.

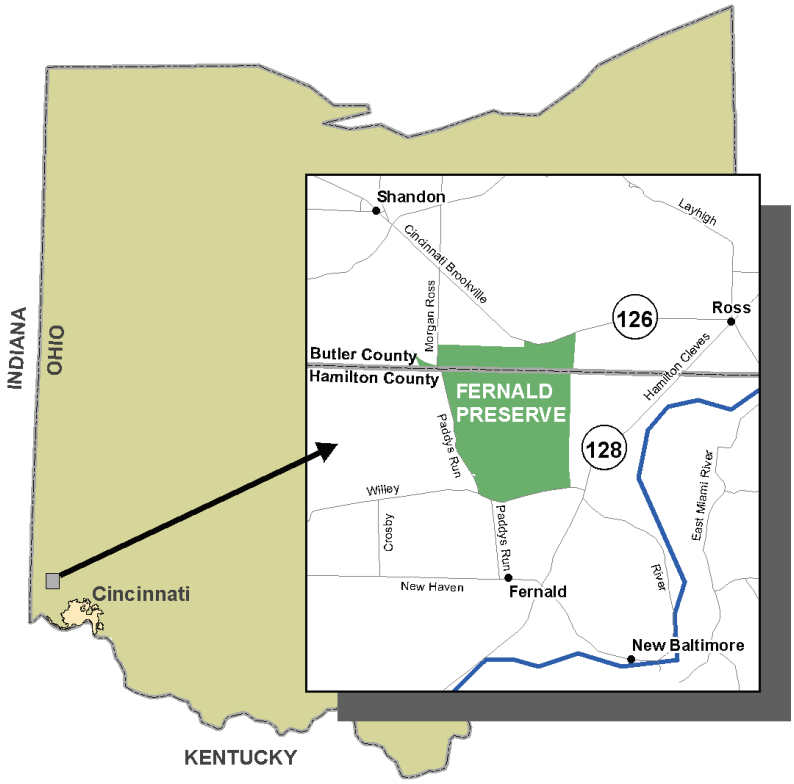

Figure 1. Fernald Site and Vicinity

Some ingots were rolled or extruded to form billets. Small amounts of thorium were also produced at the site from 1954 to 1975. The site then served as a thorium repository for DOE. Two reports that explain in greater detail the role of the Fernald Preserve within the DOE complex and the processes that took place at the Fernald Preserve are *Historical Documentation of the Fernald Site and Its Role Within the U.S. Department of Energy Weapons Complex* (DOE 1998a) and *Historical Documentation of Facilities and Structures at the Fernald Site* (DOE 1998b).

High-purity uranium metal was produced at the site from 1952 through 1989. During that time, more than 500 million pounds of uranium metal products were shipped from Fernald to other sites. During these production operations, uranium was released into the environment, resulting in the contamination of soil, surface water, sediment, and groundwater on and around the site.

2.2.2 Change in Site Mission from Production to Remediation

In July 1986, DOE and EPA signed a Federal Facilities Compliance Agreement (FFCA), addressing impacts to the environment that were associated with the site. DOE agreed to conduct the FFCA investigation as a remedial investigation/feasibility study (RI/FS) in accordance with CERCLA guidelines. In 1989, production ceased at the FMPC due to a decrease in the demand for the feed materials and an increase in environmental restoration efforts. The site was subsequently included on the EPA National Priorities List. In 1991, the site was renamed the

Fernald Environmental Management Project, and it was officially closed as a production facility. DOE's management of the site switched from the Defense Programs division to the Environmental Restoration and Waste Management division. The National Lead Company of Ohio operated the site during most of the production years under contracts with AEC and DOE. The Westinghouse Environmental Management Company became the site's prime contractor in 1986. In 1992, after the conversion of the site's mission to environmental cleanup, DOE awarded an Environmental Restoration Management Contract to the Fernald Environmental Restoration Management Corporation, which later became known as Fluor Fernald, Inc. DOE awarded a new contract to Fluor Fernald, Inc. in November 2000 to complete the facility's remediation. In 2003, DOE changed the site name to the Fernald Closure Project. The sitewide remediation effort was conducted pursuant to CERCLA. Waste management was conducted according to RCRA.

2.2.3 Conditions at Declaration of Physical Completion

The Declaration of Physical Completion occurred on October 29, 2006. Contaminated soils detected above final remediation levels (FRLs) were excavated and appropriately disposed. Remaining soils were certified to meet FRLs (with the exception of certain areas associated with utility corridors and groundwater infrastructure discussed in Section 2.4.4); all excavated areas were graded and restored; the OSDF was closed, capped, and covered; all required groundwater infrastructure was installed, operational, and secured.

2.3 Remediation Process

2.3.1 Summary of Remediation Efforts

CERCLA is the primary driver for the environmental remediation of the Fernald Preserve. The site was divided into five operable units (OUs) as follows:

- OU1—Waste Pits Area
- OU2—Other Waste Units
- OU3—Production Area
- OU4—Silos 1 through 4
- OU5—Environmental Media

An RI/FS was conducted for each of the five OUs listed above. Based on the results of the RI/FS, RODs outlining the selected remedy for each OU were issued. A summary of the remedies follows.

The remedy for OU1 included removing all material from the waste pits, stabilizing the material by drying it, and shipping it offsite for disposal. This process was completed in summer 2005.

The remedy for OU2 included removing material from the various units, disposing of material that met the onsite waste acceptance criteria (WAC) in the OSDF, and shipping all other material offsite for disposal. DOE and regulators, in consultation with the local community, developed the WAC to strictly control the type of waste disposed of onsite.

The OU3 remedy included decontaminating and decommissioning all contaminated structures and buildings, recycling waste materials if possible, disposing of material that met the onsite WAC in the OSDF, and shipping all other material offsite for disposal.

The OU4 remedy included removing and treating all material from the silos, dismantling the silos, and shipping the waste materials and silo debris offsite for disposal. Silos 1, 2, and 3 contained waste material; Silo 4 was empty.

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

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

OU5 includes all environmental media, such as soil, sediment, surface water, groundwater, and vegetation. The Site-wide Excavation Plan (SEP) (DOE 1998c) describes the remediation of soils. First, material exceeding the WAC for the OSDF was disposed of by one of the following methods: (1) transporting material to an offsite disposal facility for treatment and disposal, (2) treating material onsite and transporting it to an offsite disposal facility, or (3) treating material onsite and disposing of it in the OSDF. Details and exceptions for the methods listed above are outlined in the SEP.

Soils and sediments with contaminants in concentrations that exceeded FRLs, which are defined in the SEP but were below the OSDF WAC, were excavated and placed in the OSDF. Several subgrade utility corridors that are being used to support the continuing groundwater remediation were not certified at closure, but they will be certified following the completion of remediation and discontinuation of their use (see Section 2.4.4).

The OU5 ROD (DOE 1996) describes the approved remediation method of pump-and-treat for groundwater. The OU5 ROD also committed to continual evaluation of remediation technologies to allow for the improvement of the remedy with new technologies. As a result, an enhanced groundwater remedy, which could reduce groundwater remediation by 10 years, was suggested and subsequently approved. The enhanced remedy included additional extraction wells.

The primary constituent of concern for groundwater is uranium. Other constituents have been identified and will be removed during remediation of the uranium. The OU5 ROD provides a complete list of all of the constituents identified in groundwater. The FRL for uranium in

groundwater is 30 parts per billion (ppb). In the original ROD, the FRL for uranium in groundwater was 20 ppb. After EPA changed the drinking water standard, and after EPA and Ohio EPA approved of the *Explanation of Significant Differences for Operable Unit 5* (DOE 2001b), the FRL was raised to 30 ppb. DOE and regulators based the target cleanup levels for groundwater on the use of the aquifer as a potable water supply and incorporated Safe Drinking Water Act standards (or proposed standards) for all constituents for which these standards were available.

Ecological restoration followed remediation and was the final step in completing the site's cleanup. The goal for ecological restoration of the Fernald Preserve was to enhance, restore, and construct (as feasible, given post-excavation landforms and soils) the early stages of vegetation communities native to pre-settlement southwestern Ohio.

Figure 2 illustrates the ecological restoration of the Fernald Preserve. The restoration involved four major components:

- Expanding and enhancing the riparian corridor along Paddys Run.
- Expanding and enhancing the wooded areas in the northern portion of the Fernald Preserve.
- Restoring a contiguous prairie in the central and eastern portions of the Fernald Preserve (including the OSDF).
- Creating open water areas and wetlands throughout the site as topography and hydrology allow.

2.3.2 Completion of Site Remediation

In January 2003, the site's name was changed to the Fernald Closure Project. DOE's closure contract with Fluor Fernald Inc. outlined the scope of remediation activities required for closure. The process of legacy management or long-term stewardship began immediately following DOE's Determination of Reasonableness, or acceptance, of Fluor Fernald Inc.'s Declaration of Physical Completion (the point commonly referred to as "closure"). The Declaration of Physical Completion occurred on the day that remediation of the site (with the exception of groundwater) as outlined in Fluor Fernald Inc.'s Comprehensive Exit Transition Plan was completed. LM assumed legacy management responsibilities for the site on October 29, 2006.

2.4 Site Conditions

Sections 2.4.1 through 2.4.5 provide an overview of conditions of the OSDF, restored areas, groundwater remediation, uncertified areas, and existing infrastructure and facilities.

2.4.1 OSDF

A predesign investigation determined that the most suitable location for the OSDF was on the eastern side of the Fernald Preserve (Figure 2). Details of the investigation are in the *Pre-design Investigation and Site Selection Report for the On-site Disposal Facility* (DOE 1995a). This location was considered the best because of the thickness of the gray clay layer that overlies the Great Miami Aquifer.

Construction of the OSDF began with Cell 1 in December 1997 and ended with the completion of the permanent cap for Cell 8 in late 2006. The OSDF consists of eight individual cells covered by a continuous permanent cap. The final dimensions are approximately 950 feet (ft) east to west and 3,600 ft north to south, with a maximum height of 65 ft. The footprint of the actual disposal facility is approximately 75 acres. A perimeter fence surrounds the disposal facility. The OSDF, including the fenced area, covers approximately 98 acres. Institutional controls are described in greater detail in Volume II of this plan (the Institutional Control Plan), and additional details are included in the PCCIP (Attachment B), OU2 ROD (DOE 1995b), and OU5 ROD (DOE 1996). Approximately 2.96 million cubic yards of impacted materials were placed in the facility. The PCCIP (Attachment B) provides a summary of the materials permitted to be placed in the OSDF. The design approach for the OSDF is described in both the OU2 ROD (DOE 1995b) and the *Final Design Calculation Package; On-site Disposal Facility* (Geosyntec 1997). The design includes a liner system, impacted-materials placement, a final cover system, a leachate management system, a surface water management system, and other ancillary features.

2.4.2 Restored Areas

At site closure in 2006, approximately 900 acres of the Fernald Preserve had been ecologically restored. Restored areas are those parts of the site that have been graded following remedial excavation, amended, planted, or enhanced to create the early stages of ecosystems comparable to native pre-settlement southwestern Ohio. The specific habitats restored included upland forest, riparian forest, tallgrass prairie and savanna, and wetlands and open water (Figure 2). In addition, previously existing habitats such as the pine plantations were enhanced.

The following are brief summaries of the habitat restorations at site closure. Details of the actual projects and further information on the restored areas are described in the Natural Resource Restoration Plan (NRRP), which is Appendix B of the *Consent Decree Resolving Ohio's Natural Resource Damage Claim Against DOE* (State of Ohio 2008).

Upland Forest: Upland forest areas existed in a northern portion, in a southern portion, and on the western perimeter of the site. Restoration activities expanded these forested areas. The *Site-wide Characterization Report* (DOE 1993) describes the Fernald Preserve as existing in a transition zone between the Oak–Hickory and Beech–Maple sections of the Eastern Deciduous Forest province. That is, a mosaic of both Oak–Hickory and Beech–Maple forest types can be found in southwestern Ohio. Forest communities at the Fernald Preserve would gradually move toward one of these forest types, depending on site-specific factors such as topography and hydrology. Therefore, the restoration of upland forests at the Fernald Preserve focused on the establishment of this Beech–Maple/Oak–Hickory transition zone. The trees and shrubs used are native to southwestern Ohio and are listed in the NRRP, Table 3-1.

Riparian Forest: Riparian corridors existed along Paddys Run and the Storm Sewer Outfall Ditch. Restoration activities were conducted to expand these corridors through revegetation. The selected species of trees were those that can withstand periodic inundation, and they are listed in the NRRP. The Paddys Run floodplain was expanded as part of the long-term management plan for Paddys Run.

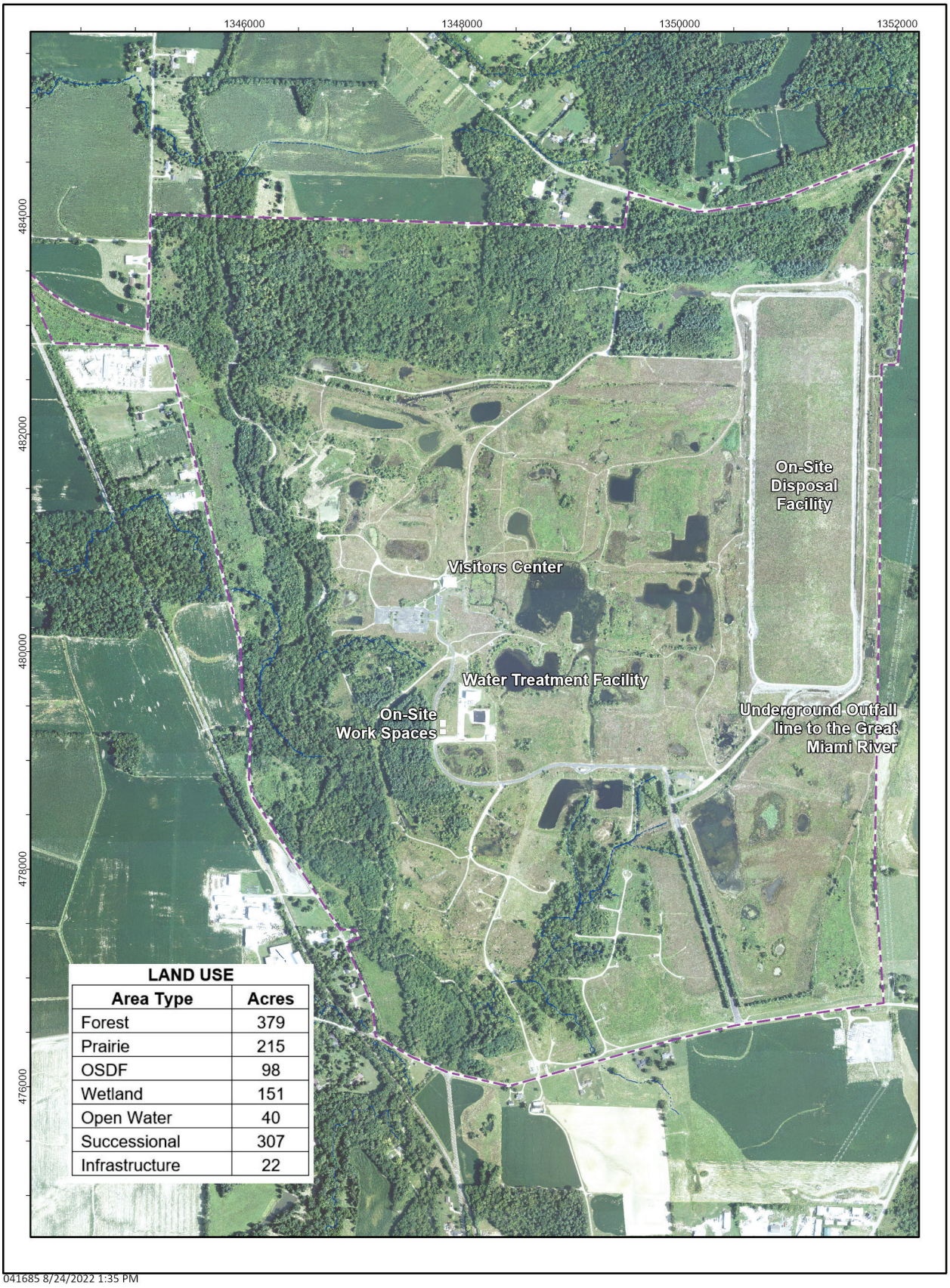

Figure 2. Fernald Preserve Land Use

Tallgrass Prairie and Savanna: The former waste pit, former production area, OSDF, Lodge Pond, and South Field areas were restored as a contiguous prairie. Some prairies and savannas were established along the western perimeter of the site, but the concentration was primarily in formerly disturbed areas. Prairie restoration involved amending soil, if necessary, and seeding grasses and forbs (wildflowers). All seeded grasses and forbs were native to the area. Savannas were established by planting a sparse mix of trees and shrubs, and seeding the area with native grasses.

While not considered a part of the restored prairies onsite, the OSDF, located adjacent to both the former production area and the borrow area, was seeded with native prairie grasses and forbs to provide vegetative cover. Native vegetation is used because of its ecological benefits, drought tolerance, and ability to provide soil stability.

Wetlands and Open Water: Wetlands and open water areas were established throughout the site where topography permitted. The Former Production Area has open water areas as a result of deep excavations, and wetlands are established throughout the site. DOE is responsible for providing 17.8 acres of mitigated wetlands under Section 404 of the Clean Water Act. In addition to mitigating wetlands, upland and riparian forest revegetation in various areas was designed to restore forest areas. Details and drivers for wetland mitigation are described in the NRRP. As a condition of the natural resource damage settlement with the State of Ohio, an enhanced wetland mitigation monitoring program was undertaken from 2009 to 2011. Results are presented in the *Fernald Preserve, Ohio, Wetland Mitigation Monitoring Report* (DOE 2012a). As of 2012, approximately 31.3 acres of jurisdictional wetlands had been created at the site.

2.4.3 Groundwater

Groundwater remediation and monitoring will continue until the FRL of 30 ppb for uranium has been achieved. Groundwater monitoring will be required following the completion of remediation to ensure continued protectiveness of the remedy and to support the CERCLA Five-Year Reviews. The OMMP is included as Attachment A to the LMICP and describes the groundwater extraction system (e.g., well fields, treatment facility) used to complete the remedy. Additional information is included in the Institutional Control Plan. Long-term monitoring of groundwater will be required around the OSDF. The exact approach to groundwater monitoring has been continually refined, with input from the local community and regulators.

2.4.4 Uncertified Areas

Soils have yet to be certified beneath two facilities onsite: the CAWWT and the South Field Valve House (Figure 3). There are also subgrade utility corridors that were not certified at closure (Figure 3). These facilities and utilities primarily support the ongoing groundwater remedy.

The 60-inch Main Drainage Corridor culvert and an adjacent 18-inch culvert were left in place even though fixed contamination remains within the culverts. Both culverts are located directly below the OSDF leachate conveyance system and the main effluent line running between the CAWWT and the Great Miami River. Because of their locations, these culverts could not be removed without potentially impacting ongoing CAWWT and OSDF operations. The 18-inch

culvert is completely buried, and grating was installed on the ends of the 60-inch culvert to prevent access.

The subgrade utility corridors will be certified following the completion of groundwater remediation, when these systems are no longer needed and are removed. Soils within the footprints of the CAWWT and South Field Valve House will be certified when these facilities are no longer needed, are removed from service, and are decommissioned and dismantled. Because the groundwater remediation end date is uncertain, no firm schedule for soil certification in the corridors can be established at this time.

The existing paved roadways themselves cannot be certified; however, the soil beneath them is certified.

2.4.5 Existing Infrastructure and Facilities

A few facilities remain onsite. These include the CAWWT and supporting infrastructure; extraction wells, associated piping, and utilities; the outfall line to the Great Miami River; the restoration storage shed; the former Communications Building; the former Dissolved Oxygen Building; and the Visitors Center. A trailer complex and garage complex, on-site workspaces, were constructed in 2022 adjacent to the CAWWT to provide office space for field personnel and replace the sample preparation area that had previously been located just offsite.

DOE refurbished the former Silos Warehouse for use as an onsite Visitors Center, which was completed in summer 2008. The Visitors Center contains information and context on the remediation of the Fernald Preserve, including information on site restrictions, ongoing maintenance and monitoring, and residual risk. It also provides historical information and photographs, a meeting place, and other educational resources. A primary goal of the Visitors Center is to fulfill an informational and educational function within the surrounding community. The information made available at the center also serves as an institutional control.

Several public amenities have been added to the site since opening to the public in 2008, including a program shelter located adjacent to the Visitors Center, a 7-mile trail system, several observation decks, a wetland boardwalk, and a wildlife observation blind.

The Visitors Center is maintained and operated under the direction of LM. DOE will periodically evaluate the use of the public amenities, the Visitors Center, and the programming provided there. DOE will obtain community input on decisions regarding any significant changes to the ongoing operation of the Visitors Center and to the other public-access areas.

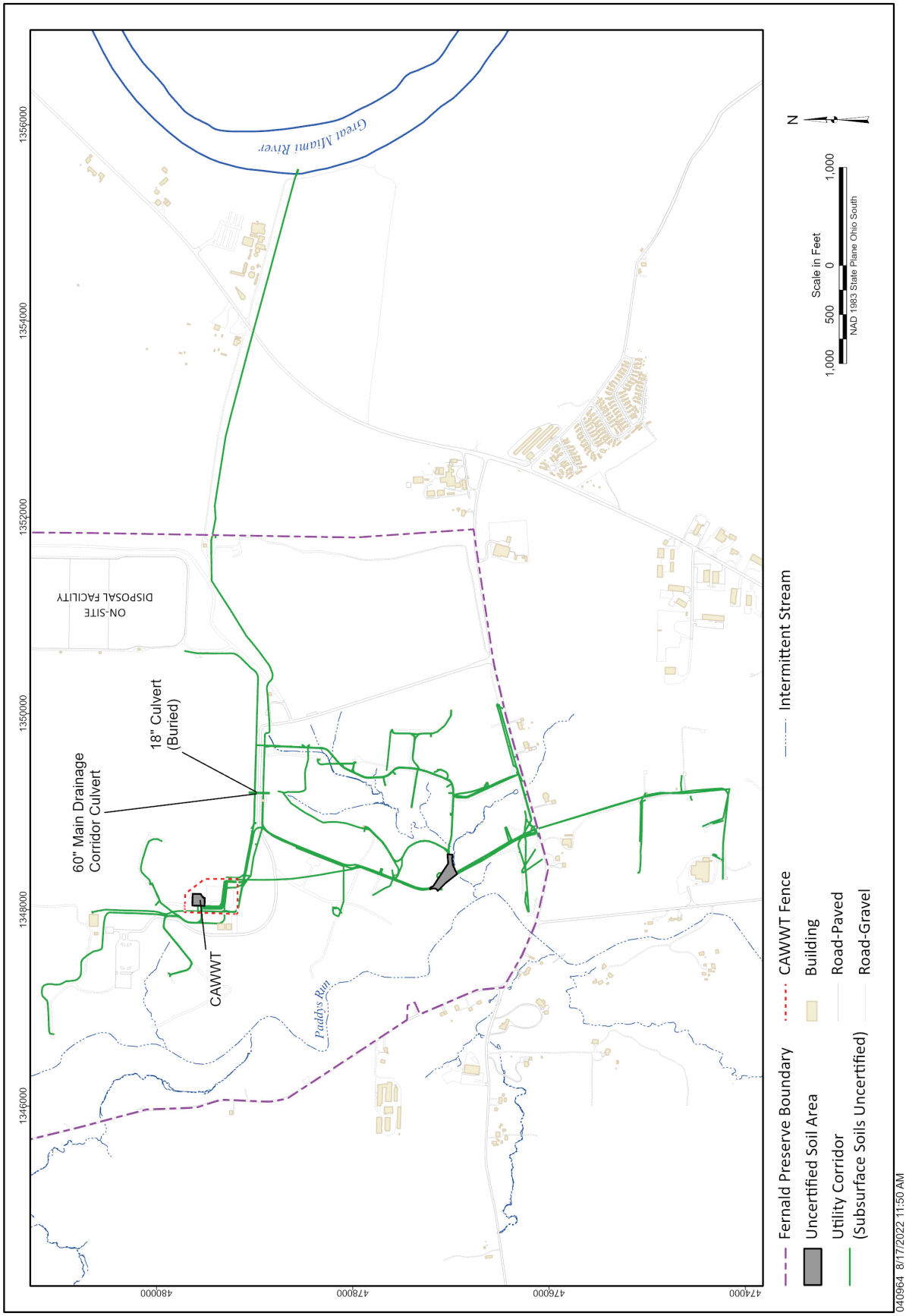

Figure 3. Uncertified Areas and Subgrade Utility Corridors

3.0 Scope of Legacy Management at the Fernald Preserve

Post-closure requirements include maintaining the remedies and ensuring the protectiveness of human health and the environment. Other post-closure activities include monitoring and maintaining the Fernald Preserve property, facilities, and structures that remain. Post-closure requirements at the Fernald Preserve are the responsibility of LM. Within LM, the Office of Site Operations (LM-20) is responsible for ongoing surveillance and maintenance at the Fernald Preserve and the continuation of the groundwater remedy.

The commitments in the RODs relevant to legacy management include the following:

- DOE will achieve the FRLs for all contamination attributed to the Fernald Preserve. Sitewide cleanup levels for soil are documented in the OU2 ROD (DOE 1995b) and in the OU5 ROD (DOE 1996) based on a recreational use and undeveloped park scenario. The FRLs do not allow unrestricted use of the Fernald Preserve, and institutional controls are required.
- According to the OU2 and OU5 RODs, the Fernald Preserve will remain under federal ownership. Therefore, any final land-use alternative and legacy management planning must include DOE's commitment to continued federal ownership.
- Commitments for other environmental monitoring will be carried out as long as appropriate, according to the existing RODs.

Maintaining institutional controls at the Fernald Preserve is a fundamental component of legacy management and includes ensuring that no residential or agricultural uses and only limited recreational uses occur on the property. Activities such as swimming, hunting, fishing, and camping are prohibited. Additional information regarding prohibited activities is included in the Institutional Control Plan, Section 2.1. The intent of this Legacy Management Plan is to provide an overview of institutional controls required for the Fernald Preserve to support legacy management. The separate Institutional Control Plan is required for the Fernald Preserve according to DOE's commitment to EPA in the OU5 ROD (DOE 1996). DOE and EPA guidance were used to identify planned institutional controls at the Fernald Preserve. The Institutional Control Plan will continue to be reviewed annually, as necessary, based on changing site conditions and input from the community and regulators. Section 4.4 of this Legacy Management Plan discusses the Five-Year Review process and how it relates to legacy management, including institutional controls.

The scope of legacy management activities at the Fernald Preserve can be divided into three categories: (1) the operation and maintenance of the remedies, (2) surveillance and maintenance in restored areas, and (3) public involvement. Legacy management activities related to the maintenance of the remedies include monitoring and maintaining the OSDF, the CAWWT and supporting infrastructure, the extraction wells and associated piping, and the outfall line to the Great Miami River. Also included is the decontamination and dismantling of the aquifer remediation infrastructure (CAWWT, well system, etc.). The OMMP includes the details of the monitoring and maintenance of the CAWWT, groundwater restoration systems, and the outfall line. Legacy management activities also include ensuring that remedy-driven restrictions on access to and use of the Fernald Preserve are enforced, that aquifer remediation is continued, and that information is properly managed.

Legacy management in restored areas includes ensuring that natural and cultural resources are protected in accordance with applicable laws and regulations. Any amenities supporting access to and use of the Fernald Preserve will be kept in a safe configuration. The cleanup levels established for the Fernald Preserve ensured that the site was remediated to a level consistent with recreational use.

DOE and Ohio EPA signed a Consent Decree in November 2008 that settled a long-standing natural resource damage claim under Section 107 of CERCLA. As a result, the Fernald Natural Resource Trustees (DOE, Ohio EPA, and the U.S. Department of Interior) finalized the NRRP, which is Appendix B of the *Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008). The NRRP specifies an enhanced monitoring program for ecologically restored areas at the site. Monitoring activities include a comprehensive wetland mitigation monitoring program and resumption of ecosystem-based functional monitoring. In addition, the Natural Resource Trustees conducted field walkdowns of all restored areas in 2009, and developed a path forward for several repair and enhancement projects. The Natural Resource Monitoring Plan, which is included as part of the Integrated Environmental Monitoring Plan (Attachment D of the LMICP Volume II), describes the Natural Resource Trusteeship process at the Fernald Preserve and the monitoring activities that have been agreed to by the Trustees.

The NRRP also called for a maintenance program for ecological restored areas at the Fernald site. Maintenance activities were detailed in the RAMP (DOE 2012b). This document described how restored areas at the site would be managed to ensure that the goals above are met. The NRRP stipulated a review of the RAMP following 10 years of implementation. The Trustees conducted this review in 2020, which resulted in development of the Natural Resources Management Plan (DOE 2020). The Natural Resources Management Plan, which was implemented in 2021, includes a plan for both maintenance and evaluation of ecologically restored areas. The Natural Resources Management Plan is included as Appendix A.

In addition to the monitoring, maintenance and repair activities discussed above, several on-property ecological restoration projects have been undertaken by the Trustees. A vernal pool and forest restoration project was constructed in 2012, and approximately 4 acres of mesic tall grass prairie were seeded. Additionally, a wetland swale was constructed to enhance wetland habitat within the footprint of the former Silos Area. In 2015, agricultural drain tiles were collapsed to expand wetland communities on the western portion of the site. Additional wetland creation and revegetation efforts were undertaken across the northern forested portion of the site in 2016. Restoration projects and associated monitoring activities are described in annual Site Environmental Reports.

The potential reburial of Native American remains is another initiative that has been considered at the Fernald Preserve since 1999. DOE agreed to make land available for the reinterment of Native American remains with the following understandings:

- The land remains under federal ownership.
- DOE will not take responsibility for, or manage, the reinterment process. DOE will neither fund nor implement maintenance and monitoring.

- The remains must be culturally affiliated with a modern-day tribe. The National Park Service had no objections to the reinterment process as long as the "repatriations associated with the reburials comply with the Native American Graves Protection and Repatriation Act as applicable."
- Records must be maintained for all repatriated items reinterred under this process. DOE is not responsible for these records.

Several federally recognized tribes were contacted regarding this offer of land for reinterment purposes. To date, DOE has received only one response from a modern-day tribe with repatriated remains under the Native American Graves Protection and Repatriation Act. The Miami Tribe of Oklahoma has informed DOE that they are not interested in using the site. DOE has received no other responses from modern-day tribes and is no longer pursuing the effort. The proposal may be reconsidered in the future if other modern-day tribes with repatriated remains come forward.

Legacy management activities related to public involvement include ongoing communication with the public regarding continuing groundwater remediation, legacy management activities, ecological restoration, public use, and the future of the Fernald Preserve. Emphasis will also be placed on educating the public about the site's former production activities, its remediation, and its land-use restrictions. Displays and programs at the Visitors Center and outreach programs at local schools and organizations will help LM meet this objective.

In 2019, a site master plan was developed to help guide decisions regarding future use of the site, including land use, public amenities, and interpretive services. Public input was sought in 2018 via an online survey and two community workshops. This information was combined with demographic research regarding local, regional, and national trends in land use and public planning to forecast how the Fernald Preserve can continue to serve as a community asset for years to come. The 2019 Fernald Preserve Master Plan was an update to the *Master Plan for Public Use of the Fernald Environmental Management Project* (DOE 2002), which was published in 2002 and helped define the community vision for final land use of the site.

3.1 Legacy Management of the OSDF

The OU2 ROD (DOE 1995b) states that the Fernald Preserve will remain under federal ownership. DOE has committed to the goal of ensuring legacy management activities of the OSDF in perpetuity. The PCCIP (Attachment B) for the OSDF outlines the routine legacy management activities for the initial 30 years. The activities include routine inspections and ongoing monitoring of the LCS, the LDS, and groundwater in the vicinity of the OSDF. DOE will conduct a CERCLA review every 5 years and will issue a report summarizing the results of the review to the appropriate regulatory agencies. Periodic monitoring and maintenance of the LCS and the vegetative cap of the OSDF will be necessary, as will the occasional maintenance of signs, fencing, and the buffer zone around the OSDF. The inspections and monitoring are discussed in greater detail in the Institutional Control Plan.

The extent of legacy management activities will continue to be defined on the basis of regulatory requirements, community and regulatory input, and agreements between DOE, EPA, and Ohio EPA. More information about the maintenance and monitoring requirements for the LCS, the capping and cover system, and the support systems for the OSDF are included in the Institutional Control Plan and supporting documents.

3.2 Surveillance and Maintenance of Restored Areas

According to the OU5 ROD (DOE 1996), DOE will protect the existing natural resources at the Fernald Preserve. The monitoring and maintenance of restored areas focus on ensuring that natural resources are protected in accordance with appropriate laws and regulations, such as the Clean Water Act and the Endangered Species Act. Wetlands and threatened or endangered species are examples of natural resources that are monitored. Maintenance of ecologically restored areas is further detailed as part of the NRRP (State of Ohio 2008). The NRRP requires long-term maintenance of restored areas in order to ensure that restoration goals are met.

Restored areas will be inspected to ensure that protected natural resources are maintained in accordance with applicable laws and regulations. The physical disturbance of restored areas will not be permitted unless it is authorized by LM (and, if necessary, in consultation with EPA). Soil and vegetation will not be removed from the Fernald Preserve unless LM, with EPA and Ohio EPA concurrence, authorizes their removal.

Existing cultural resource areas, including the reinterment area that resulted from the public water supply project, are a part of the undeveloped park and require inspections to ensure their preservation, and to determine if natural forces, vandalism, or looting are affecting the resources. Corrective actions will be implemented if there is evidence that natural forces or human activities threaten the integrity of a site.

4.0 Oversight of Legacy Management at the Fernald Preserve

4.1 Office of Legacy Management Responsibilities

LM is responsible for the oversight of the Fernald Preserve during legacy management and will ensure that all legacy management activities are conducted as required. LM makes the decisions regarding changes in surveillance, maintenance, engineering, access, public use, and other issues. LM also manages any contractors hired to perform work required for legacy management purposes and ensures that the contractors have the skills necessary to perform the work. Additionally, LM is responsible for communicating with regulators and the public regarding the legacy management of the Fernald Preserve.

4.2 Role of the Site Contractor and Use of Subcontracts

A site contractor, or contractors, will support LM under the Legacy Management Support (LMS) contract, will work closely with and communicate regularly with LM, and will be the physical presence at the site. LMS contractor personnel will be responsible for operating the groundwater remediation systems; conducting inspections, monitoring, and sampling; collecting all data; developing the reports; and making those reports available to the public. Maintenance activities for the OSDF and ecologically restored areas are the LMS contractor responsibility as well. The LMS contractor will notify LM in the event of an emergency and will take action to prevent damage to the site.

Subcontractor services may be used to conduct a variety of operation and maintenance tasks, such as minor repairs to fencing, gates, signs, or components of the groundwater infrastructure. Repairs that require earthwork, erosion control, seeding, mowing, clearing, herbicide application, or repair or maintenance to pumps and piping may also be completed by subcontractors.

The LMS contractor will procure goods and services according to DOE-approved procurement policies and procedures. These procedures use the best commercial practices and are in compliance with the requirements and intent of the *Federal Acquisition Regulation* policies and DOE acquisition regulations. The terms and conditions in subcontracts incorporate the required flow-down clauses from the prime contract.

As technical leads identify site requirements, contractor staff will develop a scope of work and initiate a solicitation package. The package will generally include statements of work, safety and health requirements, estimated costs, and required approvals. The written contracts will also include the appropriate restrictions and prohibited activities for the work to be performed onsite. In cases where similar existing subcontracts were issued, the existing work scope may be used as a framework for a new subcontract. New subcontracts may be developed through a competitive bid process or through the negotiation of a sole-source procurement. The type of procurement will be determined by analyzing the nature of the work scope, the critical nature of the services, and the importance of historical information known only by the previous contractor. Although LM intends to maximize the use of new subcontracts for most services, there may be a need to request the assignment of an existing subcontract in unique circumstances to ensure continuation of a service.

4.3 Role of Regulators

LM is required to implement the requirements outlined in the Institutional Control Plan subject to enforcement by EPA. While both Ohio EPA and EPA have a role in enforcing institutional controls, those institutional controls identified through the CERCLA process are primarily enforceable under the consent agreement with EPA and the institutional controls identified with the Ohio Consent Decree (State of Ohio 2008) are primarily enforceable by Ohio EPA.

The need for institutional controls is described in the OU2 and OU5 RODs (Appendix B); and in the Environmental Covenant, which is Appendix D of the *Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008). The OU5 ROD states: "One element of the selected remedy that will be used to ensure protectiveness is institutional controls, including continued access controls at the site during the remediation period, alternative water supplies to affected residential and industrial wells, continued federal ownership of the disposal facility and necessary buffer zones, and deed restrictions to preclude residential and agricultural uses of the remaining regions of the Fernald Environmental Management Project (FEMP) property." These requirements are further defined in the environmental covenant where it states: "...the Property shall not be used for any residential or agricultural purposes, and shall only be used in a manner consistent with the Natural Resource Restoration Plan, Fernald Preserve..." and "...the groundwater underlying all or any portion of the Property shall not be withdrawn or used as a drinking water supply." The intent of the Institutional Control Plan is to describe the institutional controls, both physical and administrative, used at the Fernald Preserve.

The regulators will ensure that DOE is performing the required legacy management operations, surveillance, and maintenance activities at the Fernald Preserve, as agreed upon by DOE and EPA, in consultation with Ohio EPA, in the LMICP. Both EPA and Ohio EPA will be provided with all reporting on the legacy management activities at the Fernald Preserve. Both EPA and Ohio EPA will be notified of any institutional control breaches as outlined in Section 4.0 of the Institutional Control Plan. Both EPA and Ohio EPA will be involved in overseeing the legacy management activities at the Fernald Preserve.

4.4 CERCLA Five-Year Reviews

Under CERCLA, if use of a site is limited because a certain level of contamination remains, a review of the remedy at that site is required every 5 years. CERCLA five-year reviews at the Fernald Preserve will focus on the protectiveness of the remedies associated with each of the five OUs. Summaries of the inspections conducted for the OSDF, the CAWWT, the groundwater restoration system, and the outfall line to the Great Miami River will also be included. To facilitate the review, a report addressing the ongoing protectiveness of the remedies will be prepared and submitted to EPA and Ohio EPA. The report will include the data collected from monitoring and sampling; summaries of inspections of the Fernald Preserve, the OSDF site, and the OSDF cap conducted during the 5-year period; and a discussion of the effectiveness of the CERCLA institutional controls. If it is determined that a particular control is not meeting its objectives, then required corrective actions will be included. The review may lead to revisions to the monitoring and reporting protocols. The most recent CERCLA Five-Year Review Report was approved in 2021 (DOE 2021). Therefore, the next review will be completed in September 2026.

4.5 Reporting Requirements

The annual Site Environmental Report will be submitted to EPA and Ohio EPA and distributed to key stakeholders on June 1 of each year. It will provide information on institutional controls, monitoring, maintenance, site inspections, and corrective actions while continuing to document the technical approach and summarizing the data for each environmental medium, along with summarizing CERCLA, RCRA, and waste management activities. 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 other key stakeholders. The detailed appendixes accompanying the Site Environmental Report are intended for a more technical audience, including the regulatory agencies. Additionally, other reporting, such as the National Pollutant Discharge Elimination System monthly discharge reports, will continue as required under other regulatory programs and will be addressed outside the annual Site Environmental Reports.

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5.0 Records Management

The long-term retention of records and dissemination of information is another critical aspect of legacy management. LM will manage records that are needed for legacy management purposes. Records will be dispositioned in accordance with DOE requirements at the National Archives and Records Administration or a Federal Records Center for their required retention period. Records that have reached the end of the scheduled retention period will be reviewed and approved by management for final destruction or rescheduled for additional retention. Within 60 days of EPA's approval of this LMICP, the LM website will be updated to include the most recent version of the Fernald Preserve LMICP.

5.1 Types of Data Required for Legacy Management

Data considered critical for legacy management purposes have been divided into four categories: historical data, RI/FS process and results, remediation data, and post-closure data. Table 1 presents the types of information that fall into each category.

In fall 2002, DOE personnel began working with stakeholder groups to identify critical records in the four categories and ensure that the appropriate types of information and records were being retained to support legacy management. The ongoing interface with stakeholders will allow DOE to retain the appropriate information to support future legacy management needs. DOE maintains these records in accordance with the 1991 Consent Agreement as Amended Under CERCLA (EPA 1991) and National Archives and Records Administration requirements.

5.2 Legacy Management Records Custodian

LM assumed custodianship of the Fernald records when the site transitioned from DOE's Office of Environmental Management to LM in fiscal year 2007. Site records fall under the DOE retention schedules and will remain in DOE custody for the required, pre-established retention period.

5.3 Records Storage Location

Fernald records are currently stored at two locations: the National Archives, Great Lakes Region, in Chicago, Illinois, and the Department of Energy Office of Legacy Management Business Center located at Morgantown, West Virginia. Their respective websites are https://www.archives.gov/frc/chicago/ and https://energy.gov/lm/services/records-management.

Table 1. Types of Data Needed to Support Legacy Management Activities

Data Category	Summary of Information Required
Historical Data	• Real estate records • Information pertaining to the acquisition of property • Process documents and reports (summary level) • Cultural resource records • Photographs (significant for legacy management purposes)
RI/FS Process and Results	• Risk assessments • Public comments • RI/FS reports for each OU • RODs for each OU • ROD amendment documents
Remediation Data	**For Soil:** • Design and excavation plans • Documentation of the certification process for each area/phase • Certification reports[a] **For Groundwater:** • Pump-and-treat system design documents • Groundwater monitoring data • Groundwater extraction data • Design and monitoring data for the CAWWT **For Environmental Monitoring:** • Integrated Environmental Monitoring Plan reports[a] • Regular updates[a] **For Buildings and Structures:** • Plans for decommissioning and dismantling buildings and structures **For the OSDF:** • Design, construction, material placement, and closure documentation • Leak detection/leachate monitoring data[a] • Cover/cap monitoring data **For Restoration:** • Design plans • Implementation documentation • Completion reports • Monitoring data[a] **General:** • Remedial Design/Remedial Action Reports • Aerial photographs taken during remediation processes
Post-Closure Data	• Decision documents on land use • Documents on public-use decisions • All monitoring and maintenance data for the OSDF[a] • All monitoring and maintenance data for the restored areas[a] • All institutional control data • Drawings of remaining facilities (including the OSDF)[a]
[a] Will require retention of electronic data.	

5.4 Public Access Requirements

Stewards and stakeholders, whether located in the surrounding communities or in remote locations, will require easy access to copies of the Fernald Preserve CERCLA Administrative Record (AR). The Visitors Center houses computing facilities for acquisition and access to electronic copies of the CERCLA AR. The CERCLA AR documents for the Fernald Preserve were scanned into industry-standard searchable PDF files for viewing over the Internet. The AR documents are available to the public on the LM website under CERCLA Collection (https://www.energy.gov/lm/administrative-record-ar). Documents are searchable by document number, document date, and document title, and by searching the text of the document. Additionally, key document indexes were created and posted on the LM website for each operable unit. The Fernald Preserve staff can be contacted by phone at (513) 648-3106 for assistance in searching for a document in the CERCLA AR. The CERCLA AR will be updated as new documents are created.

Fernald Preserve environmental data are available to the public through LM's Geospatial Environmental Mapping System (https://gems.lm.doe.gov/#site=FER). Examples of the electronic data include environmental sampling and monitoring data, OSDF monitoring data, and annual site inspection photographs.

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6.0 Funding

Currently, legacy management activities at the various DOE facilities are funded through the annual appropriations process. Funding for sites in the long-term surveillance and maintenance program is maintained in a separate line item in the LM budget. For the time being, this process for funding legacy management will continue; however, DOE will continue to investigate other funding and management options.

It is anticipated that LM funds will be available for monitoring and maintaining the OSDF, managing leachate, remediating the aquifer, and ensuring that applicable laws and regulations are adhered to in restored areas. DOE will keep the public informed of its plans to fund legacy management activities as new information becomes available.

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Appendix A

Natural Resource Management Plan

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Contents

Figures

Tables

Abbreviations

CC	coefficient of conservatism
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
FQAI	Floristic Quality Assessment Index
LM	Office of Legacy Management
LMICP	*Comprehensive Legacy Management and Institutional Controls Plan*
NRD	Natural Resources Damage
NRMP	Natural Resource Management Plan
NRRP	Natural Resource Restoration Plan
NRT	Natural Resource Trustee
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility

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1.0 Introduction

The Fernald Preserve, Ohio, Site is on 1,050 acres approximately 18 miles northwest of Cincinnati, Ohio. The U.S. Department of Energy (DOE) uranium processing facility that once operated on the site was shut down in 1991. Since then, the site has undergone extensive remediation pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Remedial activities and subsequent ecological restoration have converted the site from an industrial production facility to a publicly accessible, undeveloped park that encompasses wetlands, prairies, and forest. Figure 1 shows the current configuration of the Fernald Preserve. This Natural Resource Management Plan (NRMP) describes management and evaluation of the ecologically restored portions of the site. Restored area maintenance and monitoring are key components of DOE's long-term surveillance and maintenance plans at the Fernald Preserve.

The *Fernald Preserve, Ohio, Site Master Plan* (DOE 2019) was published as an update to earlier planning that helped define final land use of the site. The Fernald Preserve Master Plan evaluated current conditions and future trends to see how best the site can continue to serve as a community asset. The effort focused on three areas: public amenities, interpretive services, and ecosystem management. Public input was sought via online surveys and workshops. Results showed that the community was interested in continued natural resource management of the site and additional opportunities through public access and education. LM will consider the findings of the Fernald Preserve Master Plan when planning and implementing natural resource management activities. Funds permitting, it is possible that additional hiking trails and wildlife viewing amenities may be added to the site.

Natural resource management activities at the Fernald Preserve fit within an LM-wide natural resource management program. DOE has established sustainability goals for LM, including beneficial reuse of LM land assets. Management of restored areas at Fernald are considered conservation reuse and contribute to LM-wide progress tracking. Additionally, DOE participates in a federal program to promote pollinator species. Many of the management activities at the Fernald Preserve are considered best management practices for pollinators. These activities are tracked and reported as well. Additional details regarding the LM environmental policy framework are provided in the *Natural Resources Management Plan for Legacy Management Sites* (DOE 2020a).

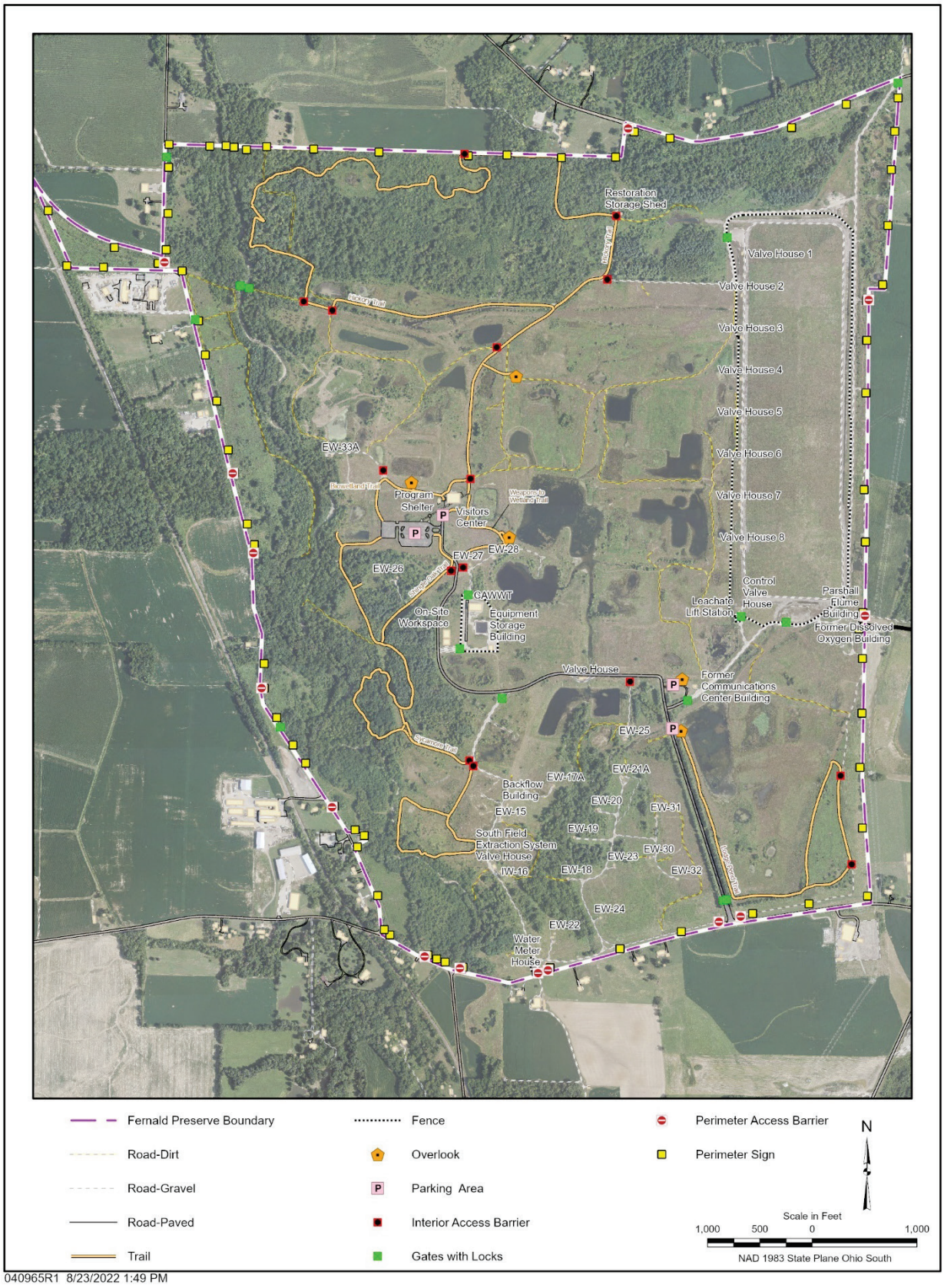

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Figure 1. Fernald Preserve Current Land Use

1.1 Purpose

The purpose of the NRMP is to ensure that ecologically restored communities at the Fernald Preserve are managed consistent with DOE policies and plans. Legacy Management activities across LM include responsible land stewardship for undeveloped areas. This includes fulfillment of the following LM Goals:

- Goal 1: Protect human health and the environment
- Goal 4: Sustainably manage and optimize the use of land and asset
- Goal 5: Sustain management excellence
- Goal 6: Engage the public, governments, and interested parties

The LM Natural Resources Management Plan (DOE 2020a) provides a thorough overview of drivers for natural resource management. Further detail is provided with respect to LM Goals, the LM Environmental Management System (EMS), which establishes LM environmental policies, and the regulatory framework for LM sites. The Fernald Preserve NRMP is intended to provide site-specific plans that are a subset of the LM NRMP.

The Fernald NRMP also ensures that the site is maintained in a manner consistent with the Fernald Natural Resource Restoration Plan (NRRP). The NRRP established a conceptual restoration plan for the site that resulted in a series of area-specific restoration projects that were undertaken following soil remediation. From 1999 to 2006, 13 ecological restoration projects were completed as outlined in the NRRP. Additional areas were restored to connect project areas together. Several other areas were restored after transition to LM. These combined efforts transitioned the site into a network of integrated forest, prairie, and wetland communities (Figure 2). The NRRP was finalized as part of the 2008 Natural Resources Damages (NRD) settlement and is included as an attachment to the *Consent Decree Resolving Ohio's Natural Resource Damage Claim Against DOE* (State of Ohio 2008).

The NRD settlement resulted in the establishment of the Environmental Covenant, which is a CERCLA institutional control. The Environmental Covenant prohibits the use of groundwater as a source of drinking water, sets the activity and use limitations for the site, requires an inspection process to ensure the limitations are maintained, and requires that the site is maintained in a manner consistent with the NRRP. The NRMP fulfills these requirements by establishing site-specific management and evaluation plans for the site.

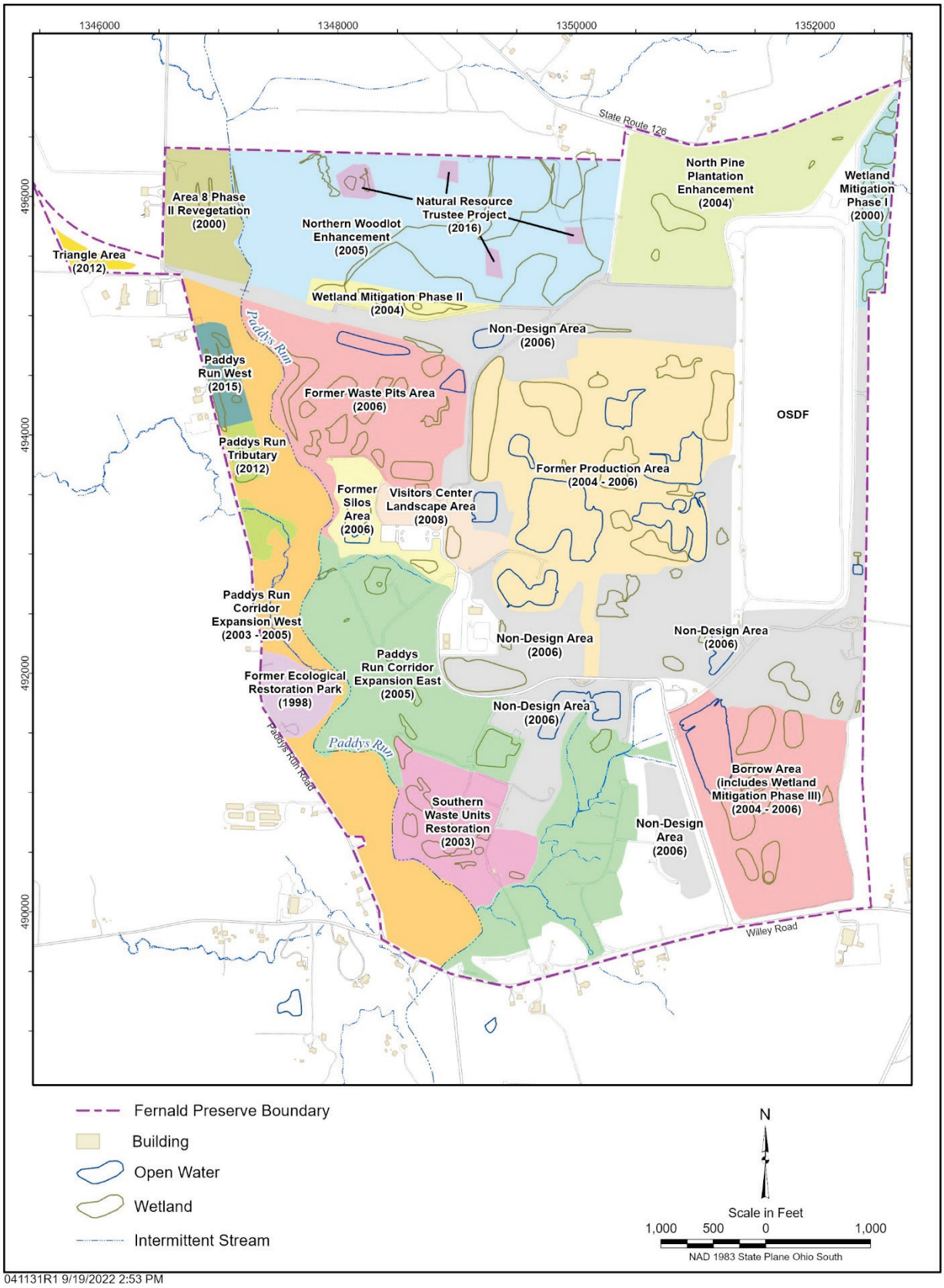

Figure 2. Fernald Preserve Ecological Restoration Projects with Project Completion Dates

1.2 Scope

The scope of the Fernald NRMP applies to all ecologically restored and undeveloped areas within the Fernald site property. Groundskeeping and maintenance of public amenities is also included. Vegetation management associated with site facilities and remedy infrastructure is outside the scope of this document.

The NRMP addresses both land management and evaluation. By including an evaluation component to the NRMP, DOE can improve the effectiveness and efficiency of natural resource management at the Fernald site. Further detail is provided below.

1.2.1 Natural Resource Management

The scope of this plan is limited to monitoring and maintenance of ecologically restored areas and undeveloped portions of the site. For example, this NRMP does not address the site inspection process, debris removal, repairs to signage, fencing, etc. Because portions of the Fernald Preserve are accessible by the public, maintenance and repair of public amenities, landscaping around the Fernald Preserve Visitors Center, and groundskeeping along the site access corridor are required to ensure safe and enjoyable use of the site. The NRMP addresses these amenities, because they are the primary interface between the public and the undeveloped park that serves as a community asset.

1.2.2 Monitoring and Evaluation

Ecological monitoring is an important component of ecosystem management. It is used to assess whether management goals and objectives are being met and helps land managers adjust strategies and tactics through the concept of adaptive management. The NRMP does not include project-specific monitoring activities that are required to ensure environmental compliance obligations are met. These requirements are contained in Volume II, the Institutional Control Plan of the LMICP.

Monitoring is used in part to determine the appropriate course of action with respect to maintenance. This process of adaptive management is defined in the NRRP as “a continuing process of planning, monitoring, and adjusting with the objective of improving the project implementation and outcomes.” Adaptive management allows flexibility in making decisions regarding needed maintenance and management of restored areas. Therefore, this NRMP includes processes for monitoring and evaluation.

A 74-acre vegetated cap covers the On-Site Disposal Facility (OSDF); this feature is maintained as a mesic tallgrass prairie. Management of this cap is described in the OSDF Post-Closure Care and Inspection Plan, Attachment B of the LMICP. While the goal of OSDF vegetation management is to ensure a functioning cap rather than a prairie ecosystem, management is very similar to the restoration prairies established in remediated portions of the site.

2.0 Site Description

The 1,050-acre Fernald Preserve is near the unincorporated communities of Ross, Fernald, Shandon, New Haven, and New Baltimore. Land use in the surrounding area is mostly agricultural and residential. Some light industry occurs west and south of the site. Sand and gravel mining operations are located east of the site. Commercial use is primarily along local transportation routes (State Routes 128, 126, and 27). The Fernald Preserve Master Plan (DOE 2019) provides a detailed community analysis that includes land use and demographics.

The former production area occupied approximately 136 acres in the center of the site. The former waste storage area and the former silos area were adjacent to the western edge of the production area. Current public use amenities, including the Fernald Preserve Visitors Center, have been established through beneficial reuse of clean infrastructure that was used in support of these remediation areas.

2.1 Fernald Preserve Geography and Geology

The site lies on a terrace that slopes gently between vegetated bedrock outcroppings to the north, southeast, and southwest. The site is located within the Great Miami River Valley near the transition of the Interior Plateau and Eastern Corn Belt Plains ecoregions. These ecoregions are subsections of the Eastern Deciduous Forest. The ecoregions both share a strong beech forest component, and the Interior Plateau is also characterized by oak-hickory forests (Woods et al. 1998). Dominant species in these forests include American beech (*Fagus grandifolia*), maples (*Acer saccharum, Acer rubrum*), oaks (*Quercus* species), hickories (*Carya* species). Ashes (*Fraxinus* species), elm (*Ulmus* species), and tulip poplar (*Liriodendron tulipifera*) are also present. The *Site-Wide Characterization Report, Fernald Environmental Management Project, Fernald, Ohio, Remedial Investigation and Feasibility Study* (DOE 1993) described regional forested communities as a mosaic of oak-hickory and beech-maple forests. The best representation of these forest types can be found in the forested corridors along Paddys Run and the Storm Sewer Outfall Ditch (Figure 1).

Regional ecology has been greatly altered by past agricultural and land management practices. Large portions of forests have been cleared and converted into agricultural land or pasture. These changes led to a fragmented landscape with a patchwork of cleared land, old fields, and second growth woodlands, with very little mature forest remaining. At the Fernald Preserve, additional changes took place with the planting of several areas of pine plantations in the northern and southern portions of the property. Facemire et al. (1990) recognized the pine plantations as a distinct habitat, along with introduced grasslands, deciduous woodlands, riparian woodlands, and old fields. Additional wet forest habitat was recognized as part of sitewide wetland delineation efforts in the 1990s. Approximately 26 acres of forested wetland community was delineated in the northern portion of the site (Ebasco 1993). Green ash (*Fraxinus pennsylvanicum*) is the dominant canopy species in this area. Infestation of emerald ash borer has greatly altered this area in recent years, with the loss of many ash trees.

Regional geology is influenced by repeated periods of glaciation. The site is on a layer of glacial overburden, consisting primarily of clay and silt with minor amounts of sand and gravel, that overlies the Great Miami Aquifer. Paddys Run and the Storm Sewer Outfall Ditch, which

empties into Paddys Run, have eroded the glacial overburden, exposing the sand and gravel that make up the Great Miami Aquifer. Three major soil series exist in the Fernald Preserve region. These are the Russel-Xenia-Wynn, Fincastle-Xenia-Wynn, and Fox-Genesee. The soils are generally light in color, acidic, and well drained. Within the boundaries of the Fernald Preserve, the Butler and Hamilton County soil surveys mapped a total of 15 soil types, or series. The descriptions of these soil types can be found in the *Site-Wide Characterization Report, Fernald Environmental Management Project, Fernald, Ohio, Remedial Investigation and Feasibility Study* (DOE 1993).

During remediation of the site, many cubic acres of topsoil were removed, particularly in the former production area, former waste pits area, and former borrow area (now known as the Lodge Pond Area) in the southeast corner of the site. Excavation of the building foundations, waste pits, and soils in other areas left primarily heavy clay subsoil with no organic matter. Approximately 265 acres of land were disturbed across the site. Various soil amendments (topsoil, compost, mulch, wood chips) were added to provide organic matter to aid in rebuilding the soil and enhance revegetation efforts. Organic material was either incorporated into the soil with mechanical rakes or spread across the surface of an area.

Paddys Run is the primary surface water drainage feature onsite. It is a third-order stream that flows from north to south along the Fernald Preserve's western boundary and empties into the Great Miami River approximately 1.5 miles south of the site. Several man-made and natural drainages drain across the site mostly west and south toward Paddys Run. The stream flows year-round in the northernmost portions of the site but is intermittent throughout most of its run along the Fernald Preserve due to erosion of the glacial overburden as described earlier. The creek is typically dry by midsummer and does not maintain surface flow until wetter conditions in the fall. The streambank is very steep in some areas of the site, with several areas of eroding cutbank present. Channel erosion was exacerbated by several instances of on-property channelization in the 50's and 60's. This led to additional erosion and loss of floodplain. The creek channel is primarily wooded through most of its length at the Fernald Preserve. The Fernald property resides mostly within the 19-square-meter Paddys Run watershed (Figure 3).

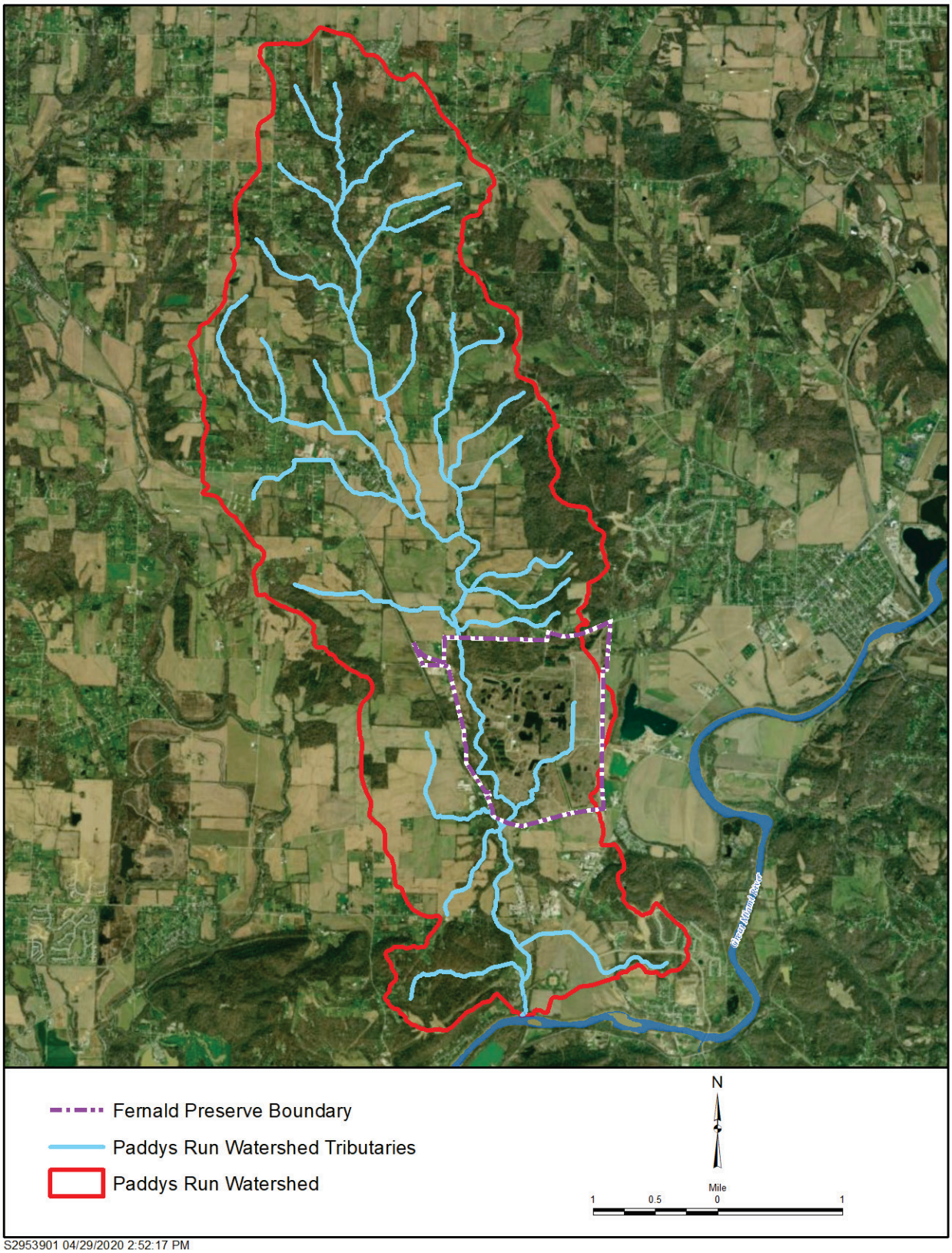

Figure 3. Paddys Run Watershed

As stated earlier, sitewide ecological restoration has converted much of the site from an industrial facility into a series of restored forest, prairie, and wetland communities. Current land use across the site includes the following:

- 379 acres of forest
- 215 acres of prairies
- 151 acres of wetlands
- 40 acres of open water
- 307 acres of successional areas

In addition to the acreage above, approximately 22 acres of land are designated as infrastructure and 98 acres are designated for the OSDF. The OSDF is capped with a 78-acre mesic prairie, so in many ways this feature contributes to the grassland habitat at the site.

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2.2 Fernald Preserve Current Land Use

Upon completion of large-scale soil remediation and waste disposition in fall 2006, the site was successfully transitioned to LM. The site opened to the public in August 2008, with access to a series of trails and a staffed Fernald Preserve Visitors Center. The current scope of activities at the site includes ongoing groundwater remediation, environmental monitoring, inspection and maintenance of CERCLA institutional controls and public amenities, management of ecologically restored areas, and operation of the Visitors Center and provision of interpretive services.

2.3 Natural Resource Management Areas

As stated earlier, large-scale restoration took place from 1999 to 2006. Since initial establishment, many of the area-specific restoration efforts have transitioned from stand-alone construction projects to integrated plant communities. The Fernald NRMP recognizes this transition and is organized to manage the site accordingly. Figure 4 shows the community types that have developed at the Fernald Preserve. Further discussion regarding these resource management areas is provided below.

2.3.1 Prairie Areas

Prairies are found in the central portion of the site, adjacent to the OSDF (Figure 4). Most of this area is within the footprint of the former production area, which was heavily impacted by remediation activities. The NRRP considered that prairie grasses and forbs were best suited to revegetate remediated areas, since these areas were compacted and left devoid of topsoil (State of Ohio 2008). While large expanses of grasslands would naturally occur farther west of the site, prairie grasslands have been documented as native communities in southwest Ohio. In addition, an important design consideration for the OSDF is to prevent establishment of woody vegetation on the cap. Maintaining grasslands adjacent to the OSDF helps to maintain this requirement.

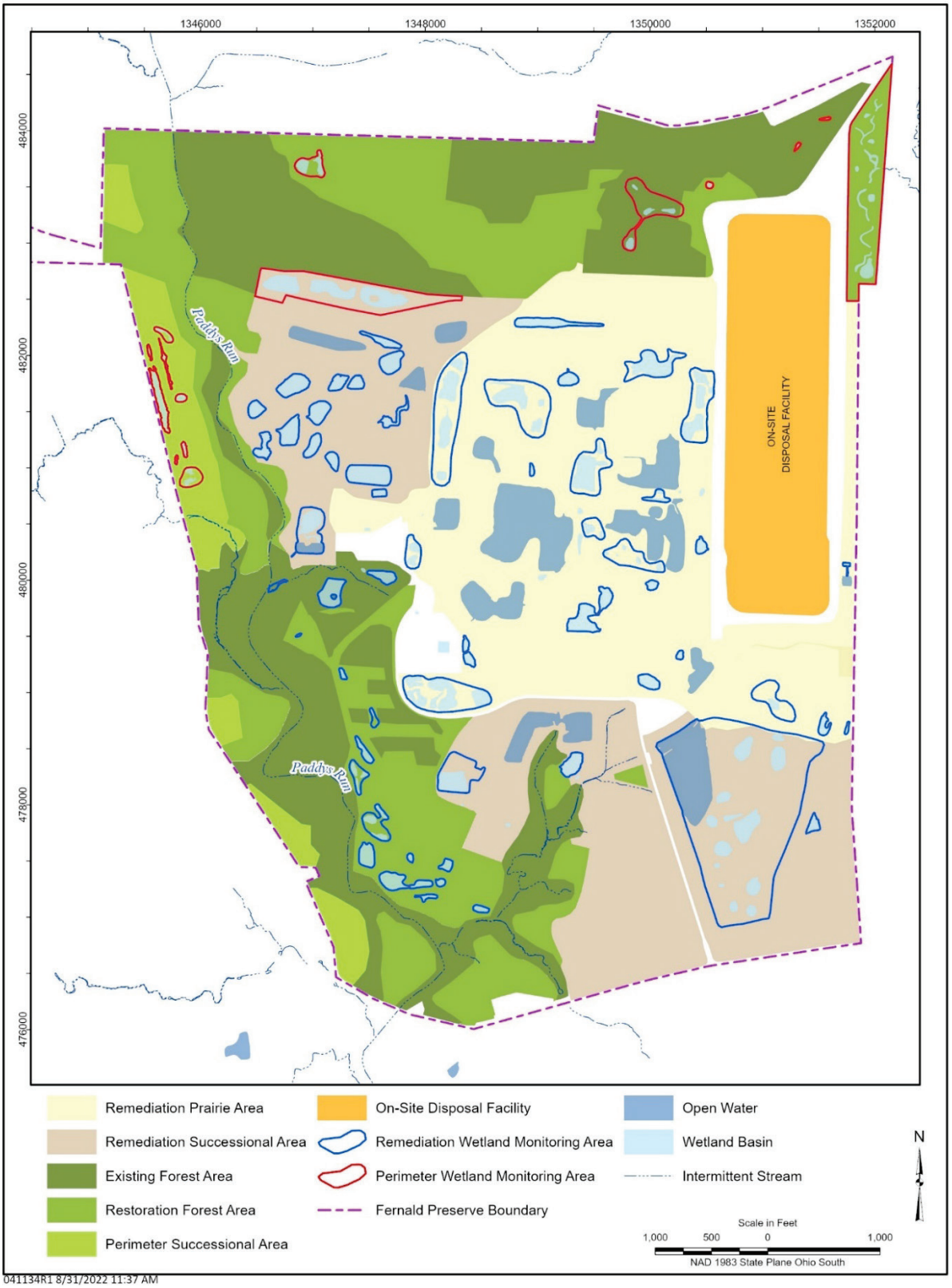

Figure 4. Fernald Preserve Natural Resource Management Areas

2.3.2 Successional Areas

Areas designated as successional areas consist primarily of old fields, grasslands not adjacent to the OSDF, and early successional forest areas where woody vegetation is becoming reestablished (Figure 4). Old fields and grasslands have shrubs and trees that are naturally becoming established across the area, by windblown and wildlife-spread seed, creating a multilayered mosaic on the landscape. Successional establishment of deciduous forest is what would typically take place in southwest Ohio (Spurr and Barnes 1973). Successional areas make possible a multilayered wildlife habitat that increases wildlife and vegetative diversity. The use of these natural succession processes is a key concept in sitewide restoration. Section 2.1.1 of the NRRP (State of Ohio 2008) states that "the intent of this restoration plan is to use the natural dynamics of ecological systems to the extent possible." This NRMP recognizes this intent by establishing specific management actions to facilitate succession.

2.3.3 Forest Areas

Forest areas onsite consist of both existing communities that were present before remediation and restored areas that expand and connect the existing forested areas (Figure 4). Currently, forest communities are concentrated along the northern portion of the site, and riparian corridors exist to the west and south. Planted expansion forests (restored areas) are growing up to fill in open areas between forests. Deer exclosure fencing or individual tree protection cages are instrumental to the success of these plantings. Successional areas are expected to convert to forest communities over time, thereby expanding forest to cover most of the site. Eventually, expansive reforested areas would be reminiscent of the conditions at the Fernald site before early settlers began to clear the land for agricultural purposes. As discussed in Section 2.1, southwest Ohio lies within the footprint of the Eastern Deciduous Forest.

2.3.4 Wetlands, Streams, and Open Water

The NRRP documents that wetland communities are native to southwest Ohio (DOE 2008). In addition, a key component of restoration design in the NRRP was to use post-remediation topography when possible. As a result, several wetland and open water areas have been created at the site (Figure 4). The high clay content in the glacial overburden resulted in the development of wetlands that are primarily fed by surface water. Groundwater-fed wetlands are limited.

2.3.5 Mowed Areas

Mowed areas are portions of the site that are maintained as part of the site groundskeeping activities or at the request of adjacent landowners. Firebreaks, access paths, and vegetation near site infrastructure are also mowed regularly. Additional information is provided in Section 4.2.6.

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3.0 Revegetation Activities

While large-scale revegetation is no longer anticipated, some project-specific planting and seeding may be required. Revegetation activities could be undertaken to restore habitat affected by extreme weather, wildlife damage, invasive plant and insect infestation, and construction-related ground disturbance. Vegetative replacement of woody, herbaceous, and grass cover is an essential component of long-term ecological restoration.

3.1 Planting Activities

Revegetation activities are categorized as planting or seeding. Project-specific planting plans for the Fernald Preserve will include detailed cover types for specific areas of the site to reflect the soil and moisture regimes present and meet long-term goals. Revegetation efforts will support establishment of the community types described in Section 2.3.

3.2 Woody Vegetation

There are two possible scenarios for planting woody vegetation: replacement of individual plants and large-scale planting. When individual trees or shrubs die within an area, an attempt will be made to replant with the same species. If the species is unavailable, a similar type of plant that exhibits the same function, form, and habitat type will be installed.

Large-scale planting efforts would be designed to enhance or expand existing restoration efforts. Again, the intent of the original planting efforts as detailed in project-specific plans will be replicated unless site conditions do not warrant additional planting within an area. If DOE determines that additional planting is needed to expand or enhance an area, a planting template will be developed that is suitable to the intent of the restoration and specific site conditions (e.g., slope, hydrology, soil type). Historically, a planting density of 165 canopy and understory trees per acre and 92 shrubs per acre was used in project-specific designs. These densities were augmented with bareroot seedling installation at approximately 400 stems per acre. Future planting efforts will consider this base design and adapt as needed to account for existing vegetation and site conditions. Additional considerations specific to successional areas and forest diversity are provided below.

Woody and herbaceous vegetation native to southwestern Ohio will be procured. Woody vegetation will be balled and burlap or container grown. Placement of plants is randomized across the planting patch, with provisions for certain species based on specific habitat requirements. Native herbaceous vegetation would be established via plugs or seeding. Site procedures and project specific planting and seeding specifications will be developed as needed.

Planted vegetation will be protected from deer and other nuisance animals to ensure survival. Section 4.5.2 provides details about installation of exclosure fencing.

3.2.1 Successional Areas

Successional areas can benefit from grouped plantings of native trees and shrubs to establish thickets. This process would provide wildlife cover and establish dense stands of native

vegetation that is resilient against invasive species. The master planting list in Appendix A identifies appropriate species for thicket establishment.

3.2.2 Forest Diversity

As forest communities mature, DOE may consider targeted understory and forest gap plantings that are intended to increase diversity. A review of assigned coefficient of conservatism (CC) values would assist in the planning process for these types of plantings. A targeted diversity approach might also be appropriate when disease-resistant varieties of keystone species are commercially available (e.g., American chestnut hybrids). Decisions regarding specific planting activities focused on increasing diversity will be made on a case-by-case basis. The Master Planting List in Appendix A will be used as a guide for species selection.

3.3 Herbaceous Vegetation

Planted herbaceous vegetation is established through potted plugs. These can be used in any type of habitat, but they are typically installed in wetland communities. Reestablishment of herbaceous plugs may be required within restored areas for a variety of reasons, including poor germination due to soil conditions, drought, and impacts from nuisance animals. Plant species will be selected based on the available species that are native to southwest Ohio for the type of community being revegetated (e.g., mesic, wetland, xeric). Plants will be placed generally on 2-foot centers, for an approximate density of 11,000 plants per acre. As with woody vegetation, this planting density is consistent with previous site restoration design plans.

3.4 Seeding

Seeding is conducted via seed drill, broadcast, or hydro-mulch. Specific methods will be determined based on access, time of year, species seeded, and project-specific objectives. Seed mixes provide species that are prevalent for the three soil types at the Fernald Preserve (mesic, wetland, xeric). Project-specific seeding plans may be revised as a result of species availability.

4.0 Natural Resource Management Activities

As stated in the NRRP, maintenance is necessary to ensure successful establishment of restoration areas. This section describes the actions taken to effectively manage restored and undeveloped areas at the Fernald Preserve.

4.1 Management Area Focus

Management activities at the Fernald Preserve will be conducted to provide consistent application across the Natural Resource Management Areas described in Section 2.3. For forest and successional areas, fieldwork will primarily focus on facilitating ecological succession to establish native forest communities. In prairie areas, periodic disturbance will be used to sustain grasslands. The management activities discussed below will be tailored to fit these fundamental focus areas. For example, large-scale mowing is an appropriate means of invasive species control in prairie areas, but it would not be the preferred approach in successional areas, since this may hinder establishment of woody vegetation. Area-specific management decisions will reflect these considerations.

4.2 Vegetation Management

Vegetation management is the primary approach for natural resource management at the Fernald Preserve. Activities take place throughout the year and consist primarily of some form of disturbance that promotes native vegetation and discourages nonnative or invasive species. A variety of practices are described below, including the use of herbicides, prescribed burns, mowing, and other forms of physical removal.

4.2.1 Target Invasive Species

Most vegetation management efforts at the Fernald Preserve involve controlling invasive species, which impact the forest, wetland, and grassland communities at the site. In addition, the State of Ohio regulates invasive plants and noxious weeds that can impact agricultural activities. Table 1 lists target species that are managed at the Fernald Preserve. Additional species may be identified through ecological monitoring and site inspection. Plants are identified as invasive through a variety of means, including state and federal noxious weed lists, conservation organizations, and published literature. The Ohio Invasive Plant Council is a good resource for obtaining information regarding identification and treatment of invasive species.

Various methods are used, depending on the species and its location on the Fernald Preserve, to aid in species control or elimination. Control methods can be broken down into two main categories: disturbance measures and removal. Disturbance measures include mowing, burning, and grazing. Removal can include the use of chemicals or herbicides; physical removal by hand pulling herbaceous vegetation or using equipment to pull or cut woody vegetation; and other methods, such as flooding or smothering vegetation. The primary methods used to control invasive species onsite are mowing and burning (disturbance) and the use of herbicides and physical extraction (removal). In most cases, combinations of these methods are used, providing even better control. For example, a combination of methods used would be first cutting down a honeysuckle shrub (physical removal) and then applying herbicide to the stump (chemical) or

first mowing a field (disturbance) and then spot-spraying approximately 2 weeks later with a broadleaf herbicide (chemical) for thistle or teasel control. Table 1 lists the primary control methods for species of concern at the Fernald Preserve. Further detail on the various methods used to aid in the control of invasive species and noxious weeds is included in the following sections.

Table 1 Target Species at the Fernald Preserve

Scientific Name	Common Name	Plant Type	Habitat	Control Methods[a]	Time Frame	Comments
Ailanthus altissima	Tree of heaven	Tree	Open woods	Physical, chemical	Summer–early fall	***State-listed invasive species*** A combination of cutting woody vegetation followed by herbicide application to the cut stump is effective method.
Alliaria petiolata	Garlic mustard	Biennial	Open woods, wood edge	Physical, chemical	Early spring or early fall	***State-listed invasive species*** Hand pulling before seed production is easily accomplished and is very effective, though labor intensive. Herbicide application is effective, but care must be taken to not harm surrounding vegetation with herbicide.
Carduus nutans	Musk thistle	Biennial	Field, open woods	Chemical, disturbance	Early spring–early fall	***State-listed noxious species*** Herbicide application is an effective control method. Repeated disturbance by mowing will deter seeding. For large patches, a combination of disturbance by mowing or burning followed by herbicide application is also effective.
Cirsium arvense	Canada thistle	Perennial	Field, open woods	Chemical, disturbance	Early spring–early fall	***State-listed noxious species*** Herbicide application is an effective control method. Repeated disturbance by mowing will deter seeding. For large patches, a combination of disturbance by mowing or burning followed by herbicide application is also effective.
Cirsium vulgare	Bull thistle	Biennial	Field, open woods	Chemical, disturbance	Early spring–early fall	Herbicide application is an effective control method. Repeated disturbance by mowing will deter seeding. For large patches, a combination of disturbance by mowing or burning followed by herbicide application is also effective.
Dipsacus fullonum and *Dipsacus laciniatus*	Common teasel Cutleaf teasel	Biennial	Field, wood edge, open woods	Chemical, disturbance	Early spring–summer	***State-listed invasive species*** Herbicide application is an effective control method. Repeated disturbance by mowing will deter seeding. For large patches, a combination of disturbance by mowing or burning followed by herbicide application is also effective.
Lespedeza cuneata	Chinese bushclover	Perennial	Field, wood edge	Chemical	Spring–early fall	Herbicide application has been the only method of control used at the Fernald Preserve.

Table 1. Target Species at the Fernald Preserve (continued)

Scientific Name	Common Name	Plant Type	Habitat	Control Methods[a]	Time Frame	Comments
Lonicera maackii	Amur honeysuckle	Shrub	Woodland, wood edge	Chemical, physical	Early spring or late fall	***State-listed invasive species*** Herbicide application (foliar) in the fall, after most other species are dormant, has proved a very effective control method. A combination of cutting the shrubs and applying herbicide to the cut stumps is an effective control method. A combination of cutting the shrubs in the fall and applying herbicide to the resprouting vegetation in the spring is effective but is not preferred: care must be taken to not harm surrounding vegetation in the spring. Digging up or pulling the shrubs, including the roots, is also effective.
Lythrum salicaria	Purple loosestrife	Perennial	Field (wet)	Chemical	Spring	***State-listed noxious and invasive species*** Herbicide application has been the only method of control used at the Fernald Preserve.
Microstegium vimineum	Japanese stiltgrass	Annual	Open woods	Disturbance, physical, chemical	Summer	***State-listed invasive species*** Repeated disturbance by mowing before flowering will deter seeding. Hand pulling before seed production is effective, though labor intensive. Herbicide application is effective when using a nonselective herbicide, but care must be taken to not harm surrounding vegetation.
Phalaris arundinacea	Reed canary grass	Perennial	Wet areas	Disturbance, chemical, other	Spring	Reed canary grass is extremely difficult to control and usually requires a combination of methods. Herbicide application is effective when using a nonselective herbicide, but it will usually require repeated applications. The herbicide used must be suitable for use in aquatic environments. Care must be taken to not harm surrounding vegetation. Disturbance by burning or mowing followed by herbicide application is an alternative. Smothering patches is also suggested to reduce spread of the vegetation. However, this method will also impact desirable vegetation in the area and may require the use of herbicide for resprouting vegetation.

Table 1. Target Species at the Fernald Preserve (continued)

Scientific Name	Common Name	Plant Type	Habitat	Control Methods[a]	Time Frame	Comments
Phragmites australis	Common reed	Perennial	Wet areas	Chemical, disturbance	Spring–summer	***State-listed invasive species*** Herbicide application is effective when using a nonselective herbicide, but it will usually require repeated applications. Common reed also gets very tall, and herbicide application can be difficult. The herbicide used must be suitable for use in aquatic environments. Care must be taken to not harm surrounding vegetation. A combination of disturbance by cutting or mowing, before seed head development, followed by herbicide application is also effective. Repeated cutting and herbicide applications may be necessary.
Pyrus calleryana	Callery pear	Tree	Field, wood edge, open woods	Physical, chemical	Early spring–summer	***State-listed invasive species*** A combination of cutting the woody vegetation followed by herbicide application to the cut stump is an effective method.
Ranunculus ficaria	Lesser celandine	Perennial	Along drainages	Chemical	Early spring	***State-listed invasive species*** Herbicide application is effective when using a nonselective herbicide and is most effective when applied before flower development. The herbicide used must be suitable for use in aquatic environments. Care must be taken to not harm the surrounding vegetation.
Rosa multiflora	Multiflora rose	Shrub	Field, open woods	Chemical, physical	Spring–fall	***State-listed invasive species*** Herbicide application (foliar) is effective. A combination of cutting the shrub and applying herbicide to the cut stalks is also effective.
Schoenoplectus mucronatus	Ricefield bulrush	Perennial	Wet areas	Physical, chemical	Spring–early summer	Hand pulling is easily accomplished and effective, though labor intensive. Herbicide application is effective when using a nonselective herbicide. Care must be taken to not harm surrounding vegetation.
Sorghum halepense	Johnsongrass	Perennial	Field	Chemical	Spring–summer	***State-listed noxious species*** Herbicide application is effective when using a nonselective herbicide. Care must be taken to not harm surrounding vegetation.

[a] For most species, it is important to apply control methods before seeds develop. If seed is produced before control methods are applied (e.g., spraying with herbicide), removing seed heads by hand before employing control methods will help prevent widespread reproduction.

4.2.2 Use of Herbicides

Herbicide use is a common method of invasive species and noxious weed control, but its use requires careful consideration. While these chemicals are effective, the type of herbicide used may have adverse effects on native species or on the immediate surroundings of the unwanted plant. For example, a broadleaf herbicide may be suitable to eliminate thistle but will also impact numerous desirable native forbs that come into contact with the chemical. For another example, not all chemicals can be used in or around water. Common reed grows in a wet environment; therefore, an herbicide used for its elimination must be safe for aquatic use.

The use of chemical application as a means of controlling invasive species and noxious weeds is closely monitored and controlled at the Fernald Preserve. Site personnel applying herbicide are required to be licensed by the Ohio Department of Agriculture.

4.2.3 Physical Removal

Physical removal of invasive species and noxious weeds includes methods to physically remove the plant, including manually pulling herbaceous vegetation and cutting down or uprooting woody vegetation by hand or mechanical means (using equipment). Physical removal is typically coupled with herbicide application to better ensure elimination of the undesirable vegetation.

Physically pulling out vegetation, either by hand (e.g., for herbaceous vegetation such as garlic mustard) or with equipment (e.g., for woody vegetation such as honeysuckle), is an effective means of control as long as all plant roots are removed. Roots of some plants left in the ground (e.g., Canada thistle or common reed) can resprout. Physical removal of vegetation can be quite labor intensive and therefore is usually not the preferred method of control.

Woody vegetation can be manually cut back to ground level. This will certainly deter growth of the tree or shrub, but often it will eventually resprout. To prevent resprout, herbicide is usually applied to the cut stump.

4.2.4 Grazing or Browsing

Grazing or browsing are newer methods being used across the nation for invasive species and noxious weed control. For areas that are heavily inundated with unwanted vegetation and need to be cleared, allowing goats or sheep to graze may prove to be an effective method for clearing an area. The animals will consume the vegetation, leaving a cleared area that can then be restored or managed more easily using the other methods discussed above. DOE is investigating use of grazing and browsing at other DOE sites. Any use at the Fernald site would need to comply with all regulatory requirements and institutional controls. DOE would evaluate future use on a case-by-case basis.

4.2.5 Prescribed Burn

A primary method of prairie and grassland maintenance used at the Fernald Preserve is prescribed burning. Prescribed burns provide numerous benefits for restored prairie areas. Many undesirable or invasive species are killed by the fire (based on when the burn is conducted). The fire burns over and reduces the level of thatch within a patch, as heavy thatch layers will shade

out the native plants. The burn eliminates the shading out of plants by opening the plants to full sunlight. The ash left after the burn allows the nutrients from the plant material to be rapidly returned to the soil, increasing soil nutrient levels. The darkened soil also warms the soils earlier in the year and allows the vegetation to break dormancy quicker in the spring, resulting in a longer growing season. In addition, invasive species and noxious weeds not destroyed by the fire are often the first plants to rebound. These plants are then usually easily identified and can be spot-sprayed to kill them without injury to desirable plants, which are a little slower to resprout.

Beginning in 2022, prescribed burns at the Fernald Preserve are conducted by the U.S. Forest Service via an interagency agreement established with DOE.

4.2.5.1 Prairie Areas

Established prairies have been burned onsite since 2009. Burn planning sought to establish a 3-year rotation for prairie areas. From 2009 to 2014, burn plans were developed for use across the site, and decisions regarding which areas to burn were based on wind direction, fuel load, and access. This sometimes resulted in only a few, if any, areas being burned in a given year. A revised approach was implemented in 2015 following discussion with the Fernald Preserve Natural Resource Trustee (NRTs) and stakeholders. The Fernald Preserve was divided into management areas, and a more formal 3-year rotation was established. From 2015 through 2019, 341 acres were burned at the site (compared to a total of 82 acres that were burned from 2009 to 2014).

For the prairie areas designated in this NRMP, a rotational burn program will continue. Burn frequencies and areas will be integrated with OSDF prescribed burn plans as described below. Burn areas are broken down into manageable burn units based on ecological conditions, size, natural boundaries, and accessibility.

4.2.5.2 On-Site Disposal Facility

The cover on the OSDF cap was established using a prairie seed mix chosen to provide drought resistance and ease of maintenance. Since vegetation is now fully established, maintenance primarily addresses the encroachment of invasive plants. Additionally, the OSDF design specifications require that all woody vegetation be kept from the cap to protect the cell liner. Woody species seeds are constantly being dropped on the cap of the OSDF by natural causes such as weather or by birds as they fly over the cap while foraging for food, are nesting and/or are seeking shelter. The seeds in the bird droppings lead to the establishment of new woody species on the cap. DOE initiated a prescribed burn program for the OSDF in 2016. Burns are conducted each spring, as conditions allow. This minimizes the chance for erosion to develop on the cap. Prescribed burns on the OSDF are essential for control of invasive and undesirable species and the health of the prairie stands. Additionally, burning prevents the generation of hay bales that result from mowing, raking, and baling. Additional information is provided in Volume II, Institutional Control Plan and Attachment B, OSDF PCCIP.

4.2.5.3 Other Applications

The use of prescribed burns at the Fernald Preserve has been limited to dormant prairies. However, it is a recognized management tool for a variety of applications. For example,

prescribed burn can be used to control invasive plant species and open forest understory. In addition, dense patches of specific invasive species may be targeted, with fire used alone or in combination with other techniques. The U.S. Department of Agriculture publishes species-specific guidelines for management and control of invasive species through the "Fire Effects Information System (FEIS)" website (https://www.feis-crs.org/feis/). Use of fire for other management tools at the Fernald Preserve will be evaluated on a case-by-case basis.

4.2.5.4 Prescribed Burn Frequency and Timing

Field personnel must ensure that wildlife populations have refuge from the temporary but unavoidable disturbances resulting from prescribed burns. Land managers typically do not burn an entire prairie community at once. Portions of the project area are left alone to keep wildlife habitat in place. To accomplish this at the Fernald Preserve, DOE has established a goal of burning not more than one-third of prairie habitat onsite each burn season. By considering the OSDF and prairie areas as one contiguous community type, approximately 300 acres will be managed as grassland at the Fernald Preserve. As discussed above, OSDF prescribed burns will be conducted every other year, starting in 2023. For prairie areas, burn activities will focus on years when the OSDF is not scheduled to be burned. Field personnel will prioritize burn areas following inspection and monitoring results. Approximately 100 acres will be planned for burn every other year, opposite OSDF burn years. Burns will be planned for the fall; any that were not completed will be attempted again in the spring. Other burn applications discussed in Section 4.2.5.3 will be scheduled on a case-by-case basis.

4.2.6 Mowing Activities

Mowing is done at the Fernald Preserve using a variety of equipment, depending on the frequency and purpose for the mowing, the vegetation being cut and the height of vegetation. The types of vegetation include turf grass, prairie grasses, and former pastures. Fire breaks, access paths, and designated public hiking trails will also be regularly maintained to ensure safe access to undeveloped portions of the site.

4.2.6.1 Groundskeeping Areas

Mowing is the primary method of maintaining the turf grass areas of the Fernald Preserve. The areas around the Visitors Center, along the main corridor road, and along the south boundary of the preserve (along Willey Road) are mowed regularly to keep the grasses healthy and an aesthetically pleasing height. Riding mowers, push mowers, and trimmers are used to cut and scatter grasses in the landscape.

Some of the former pastures onsite (the South Field and the field east of the Lodge Pond Trail) are mowed once or twice a year. This mowing is for aesthetics and to help control the spread of noxious weeds (primarily thistle species). Mowing is typically conducted in spring to minimize impacts on nesting birds. If needed, a second mow is conducted in late summer across pasture areas. If possible, mowing should be completed before May 15 or after July 15. Figure 4 shows the turfgrass and former pasture areas at the Fernald Preserve.

Mowing would usually be done using a tractor pulling a bush-hog attachment and cut grass would be allowed to stay on the ground. The South Field area contains a swale that generally flows to the northwest, fed by a culvert under Willey Road along the southern boundary of the

site. Drainage was historically facilitated in this area with subsurface clay tiles, which have been collapsing in recent years. Several sinkholes have developed, so the drain lines are marked and mowing within the drainage swale was discontinued beginning in 2020.

4.2.6.2 Prairie Areas

Mowing is used in prairie areas to help vegetation establish in the first couple of years following seeding. Native grasses and forbs are generally slower growing than weeds and the original cover crops that were necessary to ensure soil stability and reduce wind or water erosion of recently disturbed areas. Cover crops and weeds are mowed using a bush-hog attachment before they go to seed to prevent them from overshadowing the young native grasses. The native grasses and forbs are not hurt by the mowing; eventually they will outcompete the weeds. Once established, the preferred management of the prairie areas is prescribed burning. However, when a prescribed burn cannot be conducted as planned, the area is mowed and baled to remove high levels of thatch that can smother native grasses and forbs. Hay bales must remain onsite, consistent with the prohibition of agricultural use along with other activity and use limitations for the site as described in the Environmental Covenant, Appendix B of the Consent Decree between the State of Ohio and DOE (State of Ohio 2008). Storage and reuse need to be considered when deciding whether to bale a prairie area.

4.2.6.3 Successional Areas

Mowing within successional areas will be limited in scope and used selectively. Mowing suppresses establishment of woody vegetation and is counterproductive to area-specific goals. However, mowing may be appropriate for control of invasive species. Field personnel will evaluate the need for mowing on a case-by-case basis. If it is determined that mowing is needed, equipment will be used that permits precise application and minimal ground disturbance. For example, a front-mounted mower deck on a low ground pressure track loader is more appropriate than a rear-mounted brush hog pulled by a tractor.

4.3 Water Management

Wetland restoration designs often relied on the use of water control devices to manipulate water levels. These features helped to raise water levels to facilitate wetland vegetation and soils establishment. As project areas matured, wetland habitat reached an equilibrium, and water level control was not typically needed. Control devices actually became more of a liability in some instances. For example, concrete headwalls exacerbated erosion, and gate control devices became clogged by beaver activity. In 2017, repair work in the Wetland Mitigation Phase I area involved removal of several concrete headwalls. Extensive erosion repairs were also needed in 2018 at the Wetland Mitigation Phase II area after beavers clogged a water level control structure.

While large-scale wetland establishment is no longer needed, manipulation of water levels can be helpful to control invasive vegetation and wildlife. Elevations may be temporarily raised to flood an area and inundate undesired plants. Likewise, ponds may be drained to prevent the establishment of nonnative fish (e.g., green sunfish) that overrun native amphibians. Field personnel will evaluate the need for raising or lowering water levels on a case-by-case basis. Implementation will be conducted through temporary damming or the use of pumps to draw down water levels.

4.4 Erosion Control

Erosion control and slope stabilization are sometimes necessary to maintain the integrity of restored areas. Areas of concern are identified during weekly trail inspections, quarterly site inspections, and other field walkdowns. Future erosion repair will be addressed on a case-by-case basis. Factors to consider when determining whether to implement erosion repair include impacts to water quality, safety of employees and visitors, maintenance of CERCLA remedies, and habitat. DOE may determine that an eroded area should be left alone because of the habitat loss that would result if construction was undertaken. Likewise, an erosion rill that presents a safety hazard to the public would be prioritized for repair.

Engineering designs will be developed as necessary. Ecological restoration personnel will be involved with design and implementation of erosion repairs. The use of bioengineering principles for erosion control is preferred and will be incorporated into designs when applicable. The primary source of guidance and specifications for erosion repair activities is the Ohio Department of Natural Resources (ODNR) publication *Rainwater and Land Development: Ohio's Standards for Storm Water Management, Land Development, and Urban Stream Protection* (ODNR 2006). Project-specific design drawings and specifications will incorporate the planting and seeding mixes.

4.5 Nuisance Animal Control

The ecosystems created at the Fernald Preserve provide habitat that is favorable for wildlife. As stated in Section 1.1, wildlife promotion was an original goal of the NRRP. While wildlife is desired at the Fernald Preserve, some animals, native and nonnative alike, can do more harm than good if not controlled. The population of wildlife onsite has increased each year as ecosystems have matured, but wildlife increases can lead to higher pressure on vegetation that can damage or prevent the establishment of mature plants. Damage can be from feeding on vegetation, cutting or scraping vegetation, burrowing into site structures, or flooding site access or public areas. Therefore, some means of control is often necessary for proper natural resource management.

4.5.1 Goose and Swan Prevention and Mitigation

During the early ecological restoration years, the Canada goose population at the Fernald Preserve was excessive. The geese interfered with wetland restoration by pulling plant plugs out of the wetlands and eating the new growth in seeded areas. Goose droppings were unsightly and could also create slipping hazards on paved areas. Hazing, using trained dogs, was employed from 2007 through 2014 to help reduce the Canada goose population on the Fernald Preserve site. During that time, restored areas gradually became established with tall grasses and forbs, making a large portion of the site unfavorable to the geese. With the expansion of restored areas (wetlands, prairies, and forests), the populations of natural predators of geese (e.g., coyote, fox, bobcat, snapping turtles, and mink) also increased. After several years, a balance was established between the Canada goose and predator populations. With the decrease in favorable grazing and habitable areas and the balance between predator and prey, little human interference is necessary today to help with population reduction.

When necessary, egg addling and nest removal are conducted at Fernald Preserve to help control the Canada goose population. These State of Ohio-approved, effective practices for maintaining or reducing goose populations are allowed under a goose damage permit issued by ODNR. The permit comes with specific instructions describing how to perform these activities appropriately and safely. These tactics are used only if a nest location could present potential harm to visitors or staff or if the nest is located where a natural predator cannot reach it. Under no circumstance is harm done to adult geese. Compliance with the permit also requires that ODNR receive a report of how many nests were destroyed and how many nests had eggs that were addled. Nests are typically removed only when they are in a location that could result in harm to the public or site personnel.

More recently, the Fernald Preserve has been the home of nesting mute swans. The State of Ohio has a program in place to eliminate the mute swan from the state. Again, with permission from ODNR, swan egg addling is permitted at the Fernald Preserve to deter the population growth of this invasive species.

4.5.2 Deer Exclosure Fencing

Newly planted grasses, forbs, saplings, seedlings, and shrubs are often foraged or scraped by deer. Deer can prevent planted and seeded areas from becoming established when they are allowed unrestricted access to the new vegetation. Therefore, newly planted tree and shrub areas are fenced to protect them from browsing and scrapes. A 4-foot to 5-foot welded wire fence can be placed around individual trees and shrubs and secured with staples to the ground. This fencing can deter deer from scraping their antlers on the tree trunk or browsing on the shrubs. Larger plantings are protected by installation of a deer exclosure fence around the perimeter of the planting area; this type of barrier is made by attaching 9-foot and 10-foot polyethylene fencing material to metal fence poles. A rodent guard (fencing made of polyethylene-covered metal mesh) is installed along the bottom of the fence to deter smaller mammals, such as rabbits and groundhogs, from chewing or pushing through the fence. One or two access locations are installed in the fencing to allow monitoring and maintenance of the planted areas.

Use of deer exclosure fencing for forest restoration at the Fernald Preserve has proved to accelerate tree establishment and canopy cover development. Additional fencing may be installed in successional areas to facilitate volunteer tree and shrub establishment. For older fenced areas, assessments are conducted to determine when fencing can be removed. Field personnel will decide on fence removal through evaluation of monitoring data and inspection results. Removed fencing can sometimes be reused.

4.5.3 Ground-Burrowing Mammal Mitigation

Several ground-burrowing mammals live at the Fernald Preserve. Some (e.g., meadow voles) are small; others (e.g., groundhog and muskrat) are large. They all burrow into the ground to build a den to be safe from predators. On most of the site, these burrows are recognized as part of the habitat; however, they also can be a physical hazard (e.g., a hole on a pond bank) and damaging to Fernald Preserve infrastructure. Physical barriers and deterrents are usually sufficient to keep burrowing animals away from infrastructure.

Ground-burrowing animals must be controlled on the OSDF cap. Burrows are identified during OSDF inspections and addressed as needed. The *OSDF Post-Closure Care and Inspection Plan*, Attachment B, provides additional details about OSDF cap inspection, maintenance, and repair.

Groundhogs are the primary concern on the OSDF cap; they can dig a hole up to 3 feet deep to the biointrusion layer of the cap. Groundhogs must be live trapped and removed from the area to prevent them from coming back to their den. The den is then collapsed and filled with dirt to maintain the integrity of the OSDF cap.

Live trapping small mammals is an occasional practice. For lethal trapping of some animals, permits must be obtained from ODNR, and trapping permits are only valid during the specified trapping season. In addition, permitted personnel may be used to remove nuisance animals if necessary. Consultation with ODNR and local wildlife officer takes place as needed.

4.5.4 Beaver Dam Prevention and Mitigation

The Fernald Preserve has seen a dramatic increase in beaver activity over the past several years. Dams and lodges can be found in water bodies across the site. LM site practice is to permit beaver activity onsite unless site infrastructure or public safety is compromised. This has led to the need for mitigation and repair of roads and drainages in several areas. It is also proving detrimental to forest restoration goals. For example, beavers have moved from clearing willows and cottonwoods, which rapidly resprout, to clearing hardwood oaks, hickories, and poplars in some areas.

Researchers from Miami University are modeling beaver population dynamics in southwest Ohio and have indicated that Fernald Preserve is an ideal location for beavers because of its fragmented patchwork of open water near forest edge and pioneer wetland trees (i.e., willows and cottonwoods). It is suspected that, while beavers would normally be kept in check through predation, their onsite population continues to grow because there are so many water features that provide refuge from predators. It is anticipated that long-term maintenance activities will be required to address ongoing beaver impacts.

The long-term approach includes expansion of woodland habitat within forest and successional management areas. As successional areas mature, fragmented communities will converge, and edge habitat will be reduced. In the near term, site personnel will be proactive in preventing and removing beaver dams that may result in an impact to site infrastructure or high-quality habitats. Beaver deterrence measures will be implemented pursuant to USFWS guidance (Pollock et al. 2017). Exclosure fencing will also be used to protect trees and shrubs, as discussed above.

4.5.5 Culling

If the population of an animal species at Fernald Preserve becomes so large that current means of control to protect the vegetation or site infrastructure are ineffective, or if the animals become a safety issue by interfering with public-use amenities or with members of the public, further actions may be necessary. Decreasing the population of such species via a controlled hunt or use of a sniper is an option, but only if it is deemed absolutely necessary by the Fernald Preserve NRTs and other stakeholders. DOE will work with ODNR to plan such events to ensure that

control measures are safe and effective, that all applicable laws and regulations are followed, and that all necessary reporting is completed.

4.6 Trails, Signs, Displays, and Overlooks (Public-Use Amenities)

Maintenance and repair of public amenities will be addressed as needed. Repairs are identified through weekly trail inspections and the quarterly site inspection process described in the LMICP. Public safety is the highest priority at the Fernald Preserve. Trails and public amenities may need to be closed until repairs are made. Trails may also be closed when trail surfaces or weather conditions are unsafe.

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5.0 Monitoring and Evaluation

As stated above, monitoring and evaluation are important components of ecosystem management. Ecological restoration monitoring from 2009 to 2020 was a key component of ensuring long-term success of restoration efforts across the site. Now that restored communities are more established, a revised evaluation process is needed to ensure proper maintenance from a land stewardship perspective.

The ecological monitoring program described in this section continues the use of vegetation data to assess communities through generation of floristic inventories. This will allow a tie-in to previous data collection efforts through comparison of percent nativity and mean CC. Additional detail is provided below.

5.1 Natural Resource Monitoring Areas

The Fernald Preserve has been divided into monitoring areas that combine similar types of restored communities across the site (Figure 5). Additional detail regarding each community is provided below.

5.1.1 Wetland Communities

Wetland communities are divided into two types: remediation wetland areas and perimeter wetland areas (Figure 5). Remediation area wetlands generally align with portions of the site where extensive ground disturbance took place. They are characterized by having no topsoil or nearby established vegetation in place before establishment. These wetlands often resulted from the excavation footprint following remediation and were once the location of building foundations and settling basins for runoff control. Perimeter area wetlands are mostly in areas where little or no remediation took place. Topsoil was usually still in place at the time of construction. Some areas underwent removal of surface soil during remediation. However, these impacts were mitigated by the presence of intact forest communities nearby. As Figure 5 shows, all of the perimeter wetlands are within or adjacent to forest areas.

The wetland project areas are further combined into specific project areas. Table 2 lists the monitoring areas and former monitoring subareas that are included within each of these wetland types and project areas. The identification of project areas and former monitoring subareas allow a review of data collected from previous years. While most of the former monitoring subareas are wetland communities, adjacent upland communities were included in several project areas.

5.1.2 Prairie Communities

Prairie communities are within the central remediation footprint of the former production area west and south of the OSDF (Figure 5). These areas will continue to be managed as grassland communities to prevent woody vegetation within the OSDF buffer area. Table 3 lists the monitoring areas and former monitoring subareas that constitute the prairie community type.

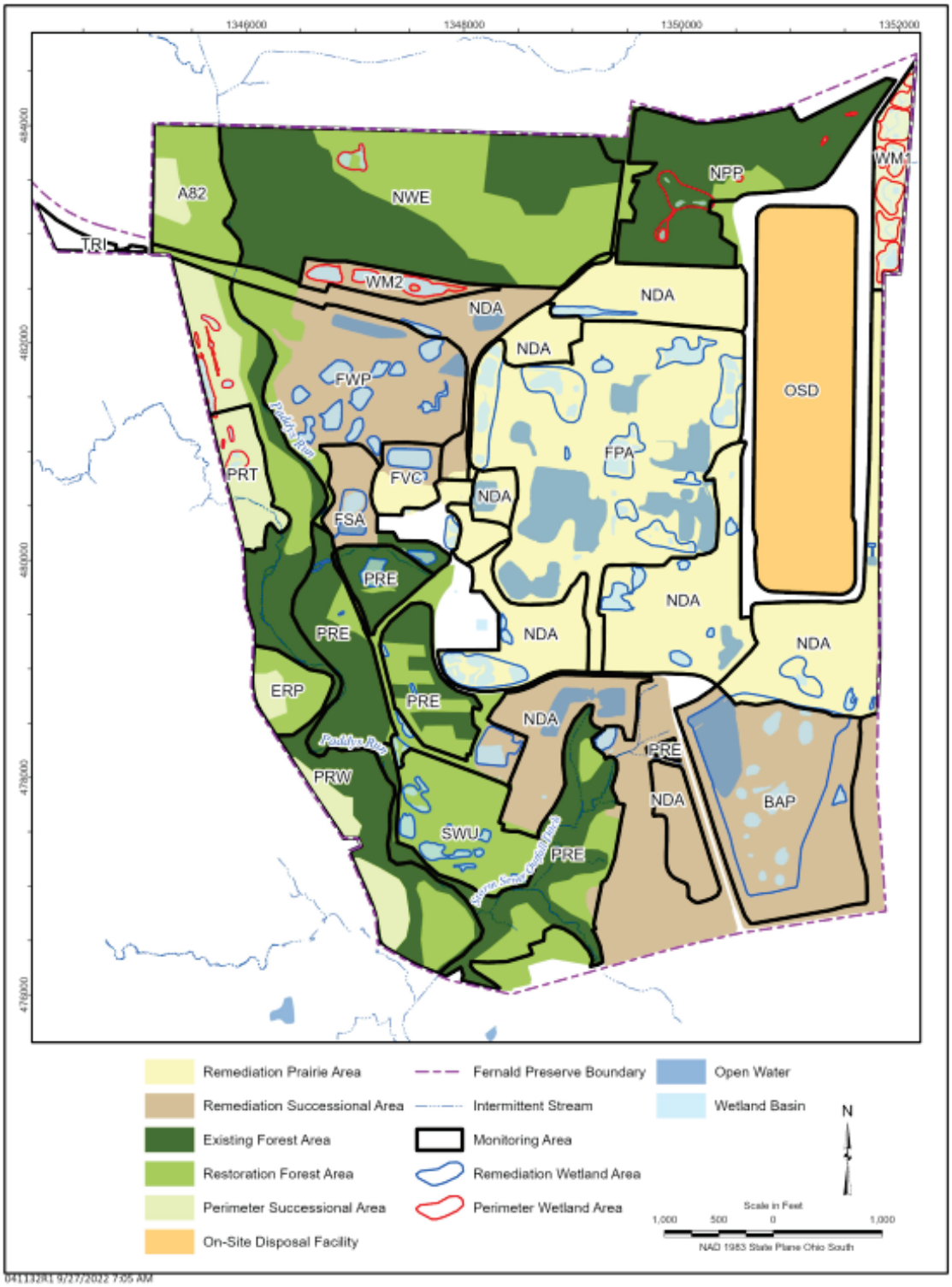

Figure 5. Natural Resource Monitoring Areas

Table 2. Wetland Community Monitoring Areas

Community Type	Monitoring Area	Former Monitoring Subarea
Remediation Wetland Area	Borrow Area	BAPBA1
		BAPBA2
		BAWW2
		BAWW3
		BAWW4
		BAWW7
		BAWW9
	Former Production Area	FPAW2
		FPAW4
		FPAW5
		FPAW7
		FPAW9
		PREW6
	Former Silos Area	FSAW1
Perimeter Wetland Area	North Pines Plantation	NPPW4
		NPPW5
	Northern Woodlot Enhancement	NWEW1
	Paddys Run West	PRTW1
		PRWW1
		PRWW2
	Wetland Mitigation Phase I	WM1PR1
		WM1W1
		WM1W2
		WM1W3
		WM1W4
		WM1W5
		WM1W6
		WM1W7
	Wetland Mitigation Phase II	WM2PR1
		WM2W1
		WM2W2
		WM2W3

5.1.3 Successional Communities

Successional areas are in both remediated and non-remediated portions of the site (Figure 5). These areas include project areas originally seeded as grassland communities that will be managed to facilitate ecological succession and conversion to forest over time. As with the wetland community type described above, successional areas are divided into remediation areas and perimeter areas. Table 4 lists the monitoring areas and former monitoring subareas that make up each of these community types.

5.1.4 Forest Communities

Forest communities are grouped into two categories: restoration forest areas and existing forest areas (Figure 5). A different kind of grouping was needed since most forest restoration efforts were in non-remediated areas. The designation of restoration and existing community types permits newly established forest planting areas to be evaluated in comparison with woodland communities that were in place before the onset of environmental restoration. Table 5 lists the monitoring areas and former monitoring subareas for each of these community types.

5.2 Floristic Inventories

As stated earlier, LM will use floristic inventories to evaluate the restoration community types. Floristic inventories will result in a comprehensive species list for a given area. This information can then be used to calculate percent nativity and average CC and thus allow evaluation over time, including comparison to past vegetation survey results. Further detail is provided below.

5.2.1 Data Collection

Species richness data have been collected across restored areas since initial restoration in the early 2000s. Results since restart of functional monitoring in 2009, after settlement of the natural resource damage claim in 2008, are included in a Microsoft Access database. For each of the community types described in Section 5.1, a flora checklist has been developed. These worksheets list all species recorded within a community type since 2009. These checklists are formatted to allow rapid data collection by field personnel. The intent is to establish a floristic inventory within a community type for a given year. Personnel can conduct field walkdowns throughout the season to take advantage of bloom periods and growth habit.

Table 3. Prairie Community Monitoring Areas

Monitoring Area	Former Monitoring Subarea
Former Production Area	FPAA3A
	FPAA3B
	FPAA4A
	FPAA4B
	FPAA6A
	FPAA6B
	FPAMDC
	FPAMDCS
Visitor Center	FVCPR1
Non-Design Area	NDAA14
	NDAA6E
	NDAARA
	NDACWT
	NDAEPL
	NDALSP
	NDASP7

Table 4. Succession Community Monitoring Areas

Community Type	Monitoring Area	Monitoring Subarea
Remediation Successional Area	Borrow Area	BAPPR1
		BAPBAW
	Former Silos Area	FSAPR1
	Former Waste Pit Area	FWPPR1
		FWPPR2
		FWPPR3
	Non-Design Area	NDAARAW
		NDAFPP
		NDARP
		NDASP7W
		NDASRB
Perimeter Successional Area	Area 8, Phase II Revegetation	A82PR1
	Former Ecological Restoration Park	ERPPR1
	Paddys Run Tributary	PRTRF1
		PRTRF2
	Paddys Run West	PRWPR1
		PRWPR2
		PRWPR3

Table 5. Forest Community Monitoring Areas

Community Type	Monitoring Area	Former Monitoring Subarea
Restoration Forest Area	Area 8, Phase II Revegetation	A82RF1
		A82RF2
	Former Ecological Restoration Park	ERPRF1
	Former Waste Pits	FWPRF1
	North Pine Plantation	NPPBR1
		NPPRF1
	Northern Woodlot Enhancements	NWERF2
		NWESF2
	Paddys Run East	PRERF1
		PRERF2
	Paddys Run West	PRWRF1
		PRWRF2
	Southern Waste Unit	SWUPR1
		SWURF1
		SWURF2
Existing Forest Area	Former Silos Area	FSAPR2
	North Pine Plantation	NPPPP1
		NPPSF1
	Northern Woodlot Enhancement	NWEFO1
		NWERF1
		NWESF1
	Paddys Run East	PREFO1
		PREFO2
		PRESF1
	Paddys Run West	PRWFO1
		PRWFO2
		PRWFO3

Several walkdowns will be conducted throughout the season. It is anticipated that a large number of common and widespread species will be quickly identified and recorded on the flora checklist during a general walkdown of the area. Less common and unique species can be sought out within particular project areas. Experience of site personnel will be helpful in locating these species.

Floristic inventories will be developed for each community type on a 3-year rotation. The year natural resource monitoring was initiated for community type inventories is provided in Table 6.

Table 6. Natural Resource Monitoring Area Schedule

Year	Community Type
2021	Remediation Wetland Area
	Perimeter Wetland Area
2022	Prairie Area
	Remediation Successional Area
2023	Perimeter Successional Area
	Remediation Forest Area
	Existing Forest Area

5.2.2 Data Analysis

A list of species will be created from the season-long walkdowns of community type areas. This species richness information will be used to calculate percent nativity, Floristic Quality Assessment Index (FQAI), and mean CC. While FQAI will be calculated, it would not be as helpful for comparison to previous functional monitoring efforts because the size of the surveyed area can influence the FQAI score. Mean CC is a more appropriate index for comparison. Spyreas (2016) has shown that mean CC values are useful for comparison when there is variety in plot size and sampling intensity, as well as species misidentification. Mean CC is reported annually in the Site Environmental Reports.

5.3 Site Inspections

The site inspection process will be used to supplement the development of floristic inventories. Inspection participants note areas where nonnative or invasive vegetation is present, both woody and herbaceous. This information is helpful when prioritizing fieldwork and making adaptive management decisions for restored areas onsite.

5.4 Adaptive Management

As discussed earlier, ecological monitoring helps prioritize restored area management. Adaptive management allows flexibility in making decisions about needed maintenance and management of restored areas. Restored areas are dynamic in nature and set standards may not always apply. Changes can occur gradually over many decades or rapidly in response to an acute event or occurrence. Examples include impacts to wetlands due to beaver activity and loss of forest canopy due to infestation by emerald ash borer beetles. Ecological monitoring and site inspections will help identify these changes and allow field personnel at the Fernald Preserve to adjust management activities to optimize ecosystem development through natural succession processes.

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6.0 Reporting

A comprehensive review of natural resource management activities is included in annual Site Environmental Reports. This is the primary means of summarizing monitoring and maintenance activities.

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