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Office of Legacy Management

February 19, 2010

Mr. Raymond Plieness, Program Manager
U.S. Department of Energy
Office of Legacy Management
2597 B ¾ Road
Grand Junction, CO 81503

Mr. Thomas Schneider, Project Manager
Ohio Environmental Protection Agency
Southwest District Office
401 East Fifth Street
Dayton, Ohio 45402-2911

Mr. David Devault
United States Fish and Wildlife Services
Regional Office – Federal Building
Fort Snelling, Minnesota 55111

Dear Mr. Plieness, Mr. Schneider, and Mr. Devault:

Subject: **Transmittal of the Restored Area Maintenance Plan**

This letter transmits the Fernald Preserve Restored Area Maintenance Plan (RAMP) and responses to Ohio Environmental Protection Agency (OEPA) and United States Fish and Wildlife Services (FWS) comments (References 1 and 2) on the RAMP to the Natural Resource Trustees. The RAMP has been revised as a result of the comments. Updates to the document are highlighted within the text (i.e., track changes), which is included as an enclosure to this transmittal letter. A copy of the final RAMP without track changes is also attached.

If you have any questions regarding this matter, please call me at (513) 648-3148.

Sincerely,

Jane Powell

Jane Powell
Fernald Preserve Site Manager
DOE-LM-20.1

Enclosure

cc w/enclosure:
Project File (Thru W. Sumner)
Administrative Records (Thru W. Sumner)

cc w/o enclosures:
F. Johnston, Stoller
J. Homer, Stoller
T. Pauling, DOE-LM

LMS/FER/S05080-0.0

Fernald Preserve
Restored Area Maintenance Plan

February 2010

U.S. DEPARTMENT OF ENERGY | Office of Legacy Management

Response to United States Fish and Wildlife Service's Comments on the March 2009 Fernald Preserve Restored Area Maintenance Plan

1. Comment: The tree planting activities include the use of native plants and indicate the three that need to be replaced will attempt to be replaced with the same species. Due to the confirmed presence of the Emerald Ash Borer in both Hamilton and Butler Counties, ash trees that need to be replaced should not be replanted with ash, another species should be substituted.

Response: Agree

Action: Revise text in Table 3-1 to caution future use.

2. Comment: While most of the maintenance will require additional plantings it can also be expected that occasionally a tree may need to be removed. There is a record of an Indiana bat at the site. Summer habitat requirements for this species are not well defined but the following are considered important:

(1) dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas;
(2) live trees (such as shagbark hickory and oaks) which have exfoliating bark;
(3) stream corridors, riparian areas, and upland woodlot which provide forage sites.

Therefore, we recommend that any trees within a forested area exhibiting any of the characteristics, listed above, as well as surrounding trees be saved. If the tree must be removed they should only be cut between September 30 and April 1. Removal of trees during winter will also limit impacts to migratory bird species.

Response: Agree. Protection of Indiana bat habitat is addressed in the Natural Resource Monitoring Plan, which is found as an attachment to the Fernald Preserve Legacy Management and Institutional Controls Plan.

Action: None

3. Comment: On page 18 under 4.6 Grassland Maintenance the plan indicates that mowing will be limited to the spring to limit impacts to nesting birds. We recommend that mowing be completed before April 1 or after July 15 to avoid seasons when ground-nesting birds are breeding.

Response: Agree. Note that spring mowing after April 1 may be necessary due to wet field conditions in early spring.

Action: Add text to clarify desired mowing timeframes.

Response to Ohio EPA's Comments on the March 2009 Fernald Preserve Restored Area Maintenance Plan

1. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Executive Summary Pg #: v
Comment: The second sentence of the second paragraph needs to be corrected to add that the communities are located in Hamilton *and* Butler counties. The sentence should read: "The site is located near the unincorporated communities of Ross, Fernald, Shandon, and New Haven in Hamilton and Butler counties."

Response: Agree.

Action: The text will be updated to include Butler County.

2. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Executive Summary Pg #: v
Comment: Third paragraph, the consent decree was signed by the State of Ohio not the Ohio EPA, please revise.

Response: Agree.

Action: The text will be revised to the State of Ohio.

3. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Executive Summary Pg #: v
Comment: The last sentence of the fourth paragraph has the phrase, "...maintenance of grassland areas including prairies and pastures," Ohio EPA recommends replacing pastures with "old fields" since no active grazing is occurring.

Response: Agree.

Action: Pastures will be replaced with old fields in the text of the document.

4. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 1.2 Pg #: 1
Comment: Replace "OEPA" with "State of Ohio" when discussing signing of the consent decree.

Response: Agree.

Action: The text will be revised to the State of Ohio.

5. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 1.2 Pg #: 2
Comment: Areas of the site, besides the 11 area noted, are considered "non-design" areas. The Restored Area Maintenance Plan needs to include the site as a whole.

Response: Agree.

Action: Text will be added to describe non-design restoration areas.

6. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 1.2 Pg #: 2
Comment: To be consistent with the NRRP, revise the last sentence to state, "..in effect for a period of ten years after its approval, after which the NRTs..."

Response: Agree.

Action: The sentence will be updated to include "after its approval."

7. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Figure 1-1 Pg #: 3
Comment: Why are areas in the southern portion of the site not considered within the non-design areas? These areas are covered by the NRRP and should be addressed by this maintenance plan.

Response: The Non-Design areas on Figure 1-1 designate the location of projects that were constructed using the general restoration design criteria developed during closure of the site. No "active" ecological restoration took place in the southern portion of the site, so they were not included in either a Natural Resource Restoration Design Plan or designated as a "Non Design Area." These areas are addressed by the Restored Area Maintenance Plan as described in the last paragraph of Section 1.2, as well as Section 1.4 (see comment 8 below).

Action: None.

8. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 1.4 Pg #: 5
Comment: This plan not only applies to all restored areas of the site, but future areas that may be restored per NRT resolution. Additionally, the plan should apply non-restored areas such as old pasture, etc.

Response: Agree.

Action: Revise text to clarify that all undeveloped portions of the site are subject to restored area maintenance.

9. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 3.0 Pg #: 7
Comment: Before replanting takes place an evaluation of the area should be conducted to ensure that the original ecological plan is appropriate for the area. For example a wetland area fails because it is too dry, should be considered for a different ecological use such as prairie or riparian. NRTs should be consulted for these types of changes.

Response: Agree. Section 2.3 discusses the role of Adaptive Management in the implementation of maintenance activities.

Action: Revise Section 2.3 to clarify evaluation of restoration goals.

10. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.1 Pg #: 13
Comment: The section should include a frequency or goal for the invasive species control. Either some set rotation schedule to ensure all areas are sweeped of invasives on a given frequency or a criteria for implementing controls such as percent cover or maximum individual area. Invasive species are one of the most significant threats to the success of the Fernald restoration efforts necessitating a focused, objective driven approach to control.

Response: The Restored Area Maintenance Plan is intended to provide the "how" of restored area maintenance. A general schedule of activities is provided in Section 5.0, but it is not intended to establish specific goals for field activities. Specific goals, objectives and other commitments relating to restored area maintenance should be agreed to by the NRTs and documented via resolution.

Action: None.

11. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.1 Pg #: 14
Comment: The last sentence of the last paragraph should be changed from, "All herbicide applications are conducted by licensed personnel." to, "All herbicide applications are conducted by *appropriately* licensed *and trained* personnel." Simply being licensed to apply herbicides doesn't ensure the applicator will recognize and avoid native vegetation.

Response: Agree.

Action: The text will be updated to "appropriately licensed and trained personnel."

12. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.2 Pg #: 14
Comment: The section should include specific objectives to be met by water management. For example a delineation of those water bodies intended to be fishless should be listed and efforts made to dewater those areas if fish become established in them. Dewatering can also be an effective tool for aquatic invasive species control. If the intent is to manage water bodies for waterfowl through level control, the document should discuss which basins will be managed as such and provide specifics on when drawdown or filling would occur. Specific O & M sections could be created for each waterbody/grouping detailing the water management strategy /goal for each.

Response: See response to Comment 10 above.

Action: None.

13. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.2 Pg #: 14
Comment: The 3rd sentence in the first paragraph should read, "Flooding areas is an effective tool for ~~maintaining~~ *controlling* invasive species infestation."

Response: Agree

Action: The text will be revised from "maintaining" to "controlling."

14. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.3 Pg #: 14
Comment: Some specific factors should be considered when determining the appropriateness of an erosion repair. At a minimum these factors should be evaluated, impact of the erosion on: 1) water quality, 2) safety, 3) remedy protection and 4) habitat destruction.

Response: Agree

Action: Add text in Section 4.3 to clarify the factors that determine the need for erosion repair.

15. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.4 Pg #: 15
Comment: Maps indicating the location, type, and success for each wildlife amenity should be provided to the NRTs to help measure the ecological benefits provided by the site.

Response: A map of wildlife amenities will be provided to the NRTs separately from the Restored Area Maintenance Plan.

Action: Provide wildlife amenity map to the NRTs.

16. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.6.1 Pg #: 18
Comment: As discussed in the during the NRT walk down and subsequent summary, the mowing of the areas along the southern portion of the site should be incrementally reduced in order to expand the adjacent prairie and old field habitats. Annually reducing the mowed area by ~50" feet swath, herbicide, followed by seed drilling would expand the habitat and reduce maintenance costs over the long term without making a dramatic change in the aesthetics of the southern boundary.

Response: See Response to Comment No. 10 above.

Action: None required

17. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: 4.6.2 Pg #: 21
Comment: Since the Wildland Fire Management Plan was not officially sent to the trustees it would be helpful to include it as appendices to this document. Additionally, since fire is such an important maintenance tool for the habitats at Fernald an annual prioritized list of proposed burn areas should be provided to the trustees. Prescribed burns should be considered for both the spring and fall burning seasons at least until the backlog of needed burns has been eliminated.

Response: See Response to Comment No. 10 above.

Action: None required

18. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Table 5-1 Pg #: 22
Comment: July and August would seem to be bad times for herbaceous plug planting unless supplemental watering is used. The notes should require supplemental watering if plugging that late in the summer.

Response: Agree

Action: Add text regarding supplemental watering in the Notes column of Table 5-1.

19. Commenting Organization: Ohio EPA Commentor: OFFO
Section #: Tables 02930-1A and -1B Pg #: B-9 & B-10
Comment: Since most future seeding will be reseeding or over seeding an area and not broad scale seeding of remediation areas, it would seem appropriate to reduce the cover crop rate to reduce competition with the target species. The cover crop is important for erosion control, but in most future applications the goal will be species diversity rather than erosion control.

Response: Agree

Action: Add a note to seed mix tables that specifies reduction in cover crop for overseeding activities.

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Fernald Preserve

Restored Area Maintenance Plan

February 2010

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Contents

Abbreviations iii
Executive Summary v
1.0 Introduction 1–1
1.1 Purpose 1–1
1.2 Background for Plan Development 1–1
1.3 Site Description 1–2
1.3.1 Fernald Preserve Geography and Geology 1–2
1.3.2 Fernald Preserve Current Land Use 1–2
1.4 Scope 1–4
2.0 Restored Area Operations 2–1
2.1 NRRP Goals 2–1
2.2 Comprehensive Legacy Management and Institutional Controls Plan Inspections 2–1
2.3 Ecological Monitoring and Adaptive Management 2–2
3.0 Replanting Activities 3–1
3.1 Woody Vegetation 3–1
3.2 Herbaceous Vegetation 3–1
4.0 Restored Area Maintenance Activities 4–1
4.1 Invasive Species and Noxious Weed Control 4–1
4.2 Water Management 4–3
4.3 Erosion Control 4–3
4.4 Wildlife Amenities 4–3
4.5 Nuisance Animal Control 4–4
4.5.1 Physical Barriers 4–4
4.5.2 Trapping 4–4
4.5.3 Scare Tactics and Hazing 4–5
4.5.4 Culling 4–5
4.6 Grassland Maintenance 4–5
4.6.1 Mowing 4–6
4.6.2 Prescribed Burning 4–6
4.7 Trails, Signs, Displays, and Overlooks (Public Use Amenities) 4–6
5.0 Schedule 5–1
6.0 Reporting 6–1
7.0 References 7–1

Figures

Figure 1–1. Fernald Preserve Ecological Restoration Projects 1–5
Figure 1–2. Fernald Preserve Current Land Use 1–6
Figure 4–1. Fernald Preserve Mowing Map 4–7

Tables

Table 3–1. Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve 3–3
Table 4–1. Control Methods for Species of Concern 4–2
Table 5–1. Scheduling of Maintenance Activities 5–2

Appendixes

Appendix A Planting Specifications
Appendix B Seeding Specifications

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
LMICP	*Comprehensive Legacy Management and Institutional Control Plan*
NRRP	Natural Resource Restoration Plan
NRT	Natural Resource Trustee
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
WFMP	Wildland Fire Management Plan

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Executive Summary

The Fernald Preserve Restored Area Maintenance Plan describes how the U.S. Department of Energy (DOE) will maintain the ecologically restored areas at the Fernald Preserve to ensure their success. Maintenance of restored areas is aimed at facilitating progress of the restored areas to achieving the restoration goals and maintaining the function of onsite restored ecological communities.

The Fernald Preserve is situated on a 1,050-acre tract of land, approximately 18 miles northwest of Cincinnati, Ohio. The site is located near the unincorporated communities of Ross, Fernald, Shandon, and New Haven in Hamilton and Butler Countiesy. It is a former uranium-processing facility that 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 an undeveloped park, encompassing wetlands, prairies, and forest. When the large-scale soil remediation and waste disposition was completed in the fall of 2006, the site was successfully transitioned to the DOE Office of Legacy Management. The Fernald Closure Project was then renamed the Fernald Preserve.

This plan is stipulated through the Fernald Preserve Natural Resource Restoration Plan (NRRP), which is Appendix B of the *Partial Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008), and which was finalized as part of the Consent Decree that settled a long-standing natural resource damage claim under Section 107 of CERCLA. The Consent Decree was signed in the fall of 2008 by DOE and the State of Ohio Environmental Protection Agency (OEPA). The NRRP calls for the Fernald Natural Resource Trustees (DOE, OEPA, and the U.S. Department of Interior) to develop a plan for maintenance of ecologically restored areas.

This *Restored Area Maintenance Plan* addresses all activities associated with meeting the goals of the NRRP and project-specific restoration design plans, as well as DOE's legacy management responsibilities for the Fernald Preserve. Specific tasks include vegetation establishment via planting and seeding, control of invasive species, management of water levels in wetlands and open water areas, steps to address erosion control issues, management of nuisance animals, maintenance of grassland areas including prairies and old fieldspastures, and upkeep of public use amenities, such as trails and overlooks.

The plan provides a general schedule for implementation of maintenance activities and also outlines the process for reporting to National Resource Trustees and other stakeholders. Planting and seeding specifications are included as appendixes to this plan.

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1.0 Introduction

Ecological restoration was part of the remedy of the Fernald Preserve. It is also a requirement of the settlement of the Natural Resources Damages claim filed by the State of Ohio against the U.S. Department of Energy (DOE). Restored area maintenance is required at the Fernald Preserve to ensure that restoration efforts continue to be successful, resulting in properly functioning ecosystems, and to ensure that natural resources are protected in accordance with appropriate laws and regulations, such as the Clean Water Act and the Endangered Species Act.

1.1 Purpose

This Restored Area Maintenance Plan describes how the restored areas at the Fernald Preserve will be maintained to ensure their success. Long-term maintenance is aimed at facilitating progress of restored areas to achieving the restoration goals and maintaining the function of the ecosystems. Accomplishing this task will require that all components of the various ecosystems are managed to ensure successful establishment. The components of the ecosystems include vegetation, water, soil, and wildlife. If any or all of the components of these ecosystems do not progress as necessary, then the ecosystem as a whole is subject to lesser success. How these components will be maintained and addressed is described in detail in Section 4.0 of this plan.

1.2 Background for Plan Development

The Fernald Natural Resource Trustees (NRTs) consist of DOE, the Ohio Environmental Protection Agency (OEPA), and the U.S. Department of the Interior (DOI). They have been meeting since 1994 to oversee planning, design, implementation, monitoring, and maintenance of ecological restoration projects at the Fernald Preserve. In November 2008, DOE and ~~OEPA~~the State of Ohio signed a Consent Decree that settles a long-standing natural resource damage claim under Section 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This Consent Decree stipulates that maintenance activities are required, as they are critical to the success of the restoration efforts at the Fernald Preserve.

Goal and objectives of the NRTs are stipulated in a Natural Resource Restoration Plan (NRRP), which is Appendix B of the *Partial Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008) for the Fernald site. The NRRP serves as the conceptual ecological restoration plan for the site. It outlines the approach for site restoration through a series of projects that were integrated into the CERCLA remediation process. The NRRP was first drafted in 1998, but was not finalized until fall 2008, upon signing the Consent Decree.

The NRRP describes the conceptual restoration for 11 projects across the site. These projects are shown on Figure 1–1 and include the following:

- Wetland Mitigation – Phase I
- Area 8, Phase II Revegetation
- Southern Waste Units Restoration
- Northern Pine Plantation Enhancement (includes Northern Woodlot Enhancement)
- Wetland Mitigation – Phase II

- Paddys Run Corridor Expansion East
- Paddys Run Corridor Expansion West
- Borrow Area Restoration (includes the Aesthetic Barrier along Willey Road and the OSDF perimeter buffer)
- Silos Area
- Former Production Area
- Waste Pit Area (includes Paddys Run Stream Restoration)

For each of these projects, one or more Natural Resource Restoration Design Plans (NRRDP) was developed. The NRRDPs provided detailed designs for construction, as well as project-specific monitoring and maintenance requirements. Several "Non-Design" restoration areas were also constructed using general restoration design criteria rather than specific plans. DOE moved forward with the development and implementation of these ecological restoration projects as part of site closure. Projects were sequenced following remediation and certification of portions of the site. Restoration construction took place form 1999 to 2006. Once all projects were completed, over 900 acres of the 1,050-acre site were ecologically restored.

With all ecological restoration projects now completed, the Fernald Preserve has transitioned to the current land use as described in Section 1.3.2 below. The site must be managed as a whole rather than as a series of stand-alone projects. The final NRRP addresses this issue by requiring that a maintenance plan be written (this plan) that will function as a guide for the maintenance activities necessary at the Fernald Preserve. The maintenance plan will be in effect for a period of 10 years after its approval, after which time the NRTs will evaluate the need for continued maintenance.

1.3 Site Description

1.3.1 Fernald Preserve Geography and Geology

The Fernald Preserve is situated on 1,050 acres, approximately 18 miles northwest of Cincinnati, Ohio. It is located near the unincorporated communities of Ross, Fernald, Shandon, New Haven, and New Baltimore. The former production area occupied approximately 136 acres in the center of the 1,050 acres. The former waste pit area and the former silos area were located adjacent to the western edge of the production area. Paddys Run 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 outcroppings to the north, southeast, and southwest. The site is situated 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.

1.3.2 Fernald Preserve Current Land Use

As stated above, over 900 acres of the Fernald Preserve were ecologically restored. Areas were graded where needed following remedial excavation activities, amended, planted, or enhanced to

create the early stages of ecosystems comparable to native pre-settlement southwestern Ohio. The specific habitats restored include upland forest; riparian forest; tall-grass prairie and savanna; and wetlands and open water. Previously existing habitats, such as the pine plantations, were altered in ways that would enhance those areas to promote wildlife use. Current land use is shown on Figure 1–2.

Following are brief summaries of the habitat restorations. Details of the actual projects and further information on the restored areas are described in the NRRP, project specific NRRDPs, and project completion reports.

Upland Forest: Upland forest areas existed in a northern portion, in a southern portion, and on the western perimeter of the site. Restoration activities were conducted to expand 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 Oak–Hickory/Beech–Maple transition zone.

Riparian Forest: Riparian corridors existed along Paddys Run and the Storm Sewer Outfall Ditch. Restoration activities were conducted to expand these corridors through re-vegetation. 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.

Tall-grass Prairie and Savanna: The waste pit, production, On-Site Disposal Facility (OSDF), and borrow (east 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 on site, the OSDF, located adjacent to both the former production area and the borrow area, was seeded with native prairie grasses to provide a vegetative cover. The native grasses are being used because of their 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 was responsible for providing approximately 17.8 acres of mitigated wetlands under Section 404 of the Clean Water Act. In addition to mitigation wetlands, several other ecological restoration projects include wetland components. A 26-acre wet forest/wet meadow complex was also preserved on site.

1.4 Scope

This Restored Area Maintenance Plan applies to all restored or undeveloped areas of the site. It describes the types of maintenance activities that are required, provides the schedule for those activities, and describes the circumstances under which maintenance might be required. These maintenance activities are necessary to help ensure the successful establishment of the various ecosystems created during ecological restoration of the Fernald Preserve.

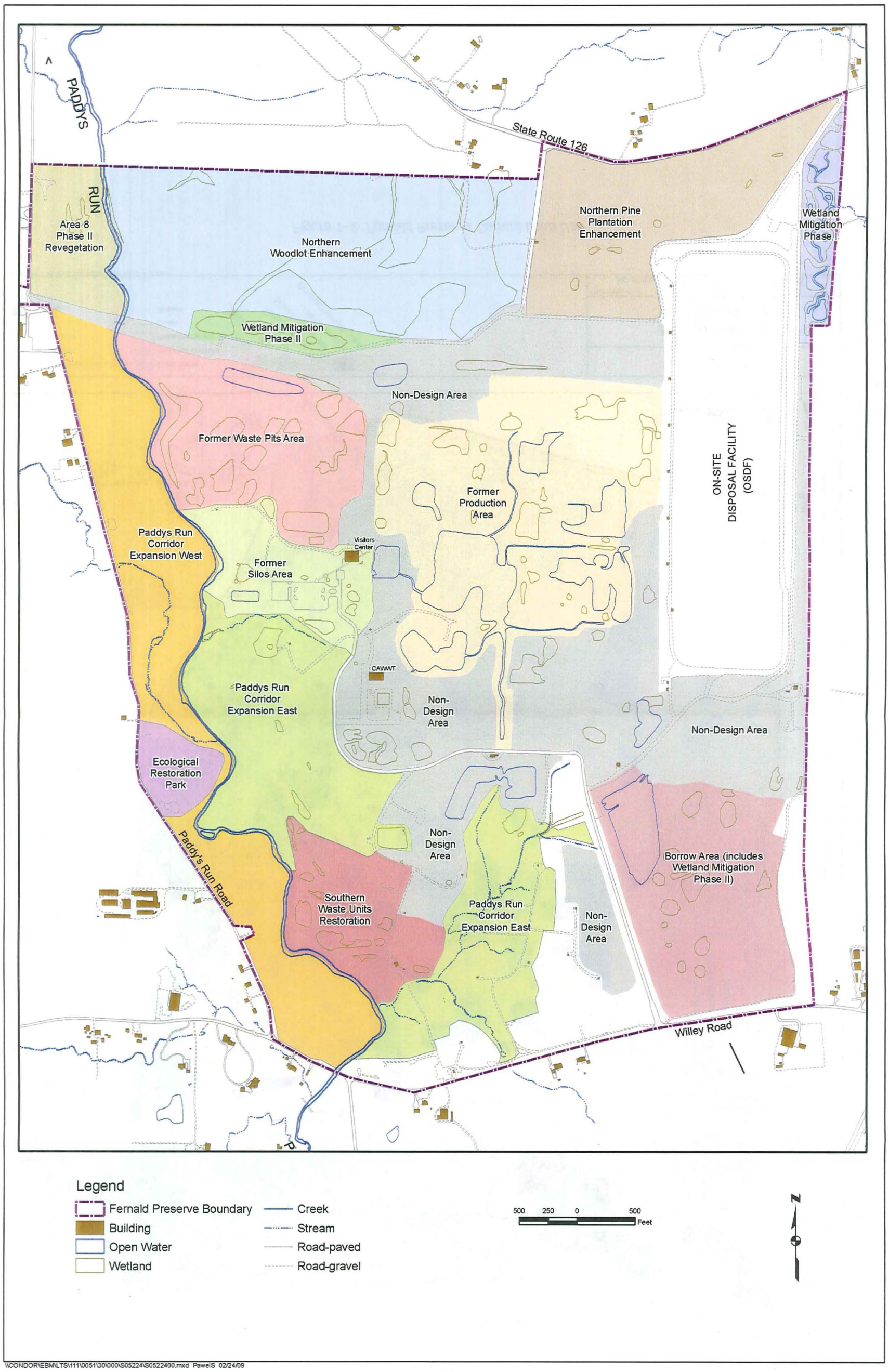

Figure 1–1. Fernald Preserve Ecological Restoration Projects

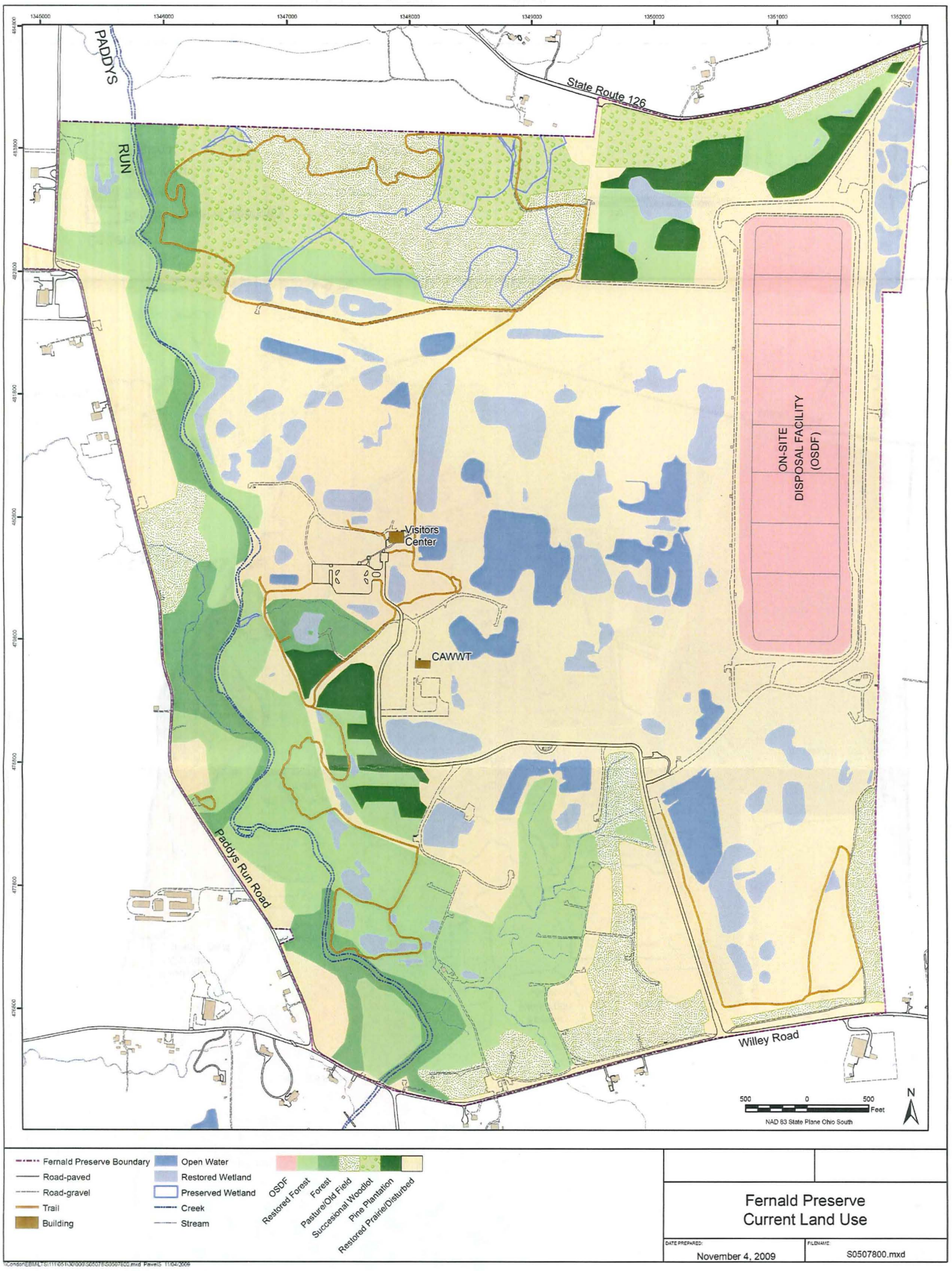

Figure 1–2. Fernald Preserve Current Land Use

2.0 Restored Area Operations

2.1 NRRP Goals

The goal of the NRRP is to resolve past, present, and future natural resource impacts at the Fernald Preserve while meeting regulatory commitments and addressing stakeholder concerns. The NRRP was developed with input from the NRTs and the stakeholders. The specific administrative goals that guided the development of the NRRP are as follows:

- Establish a restoration plan that is satisfactory to the NRTs;
- Ensure the Fernald Preserve is transitioned to the selected final land use for the site and considers the interests of stakeholders to the degree possible and will accommodate future public use as determined appropriate;
- Ensure that restoration of the Fernald Preserve is conducted in a manner that is consistent with the established risk levels and decisions reached in various operable unit records of decision; and
- Establish a restoration plan that is fully integrated with the remedial design and remedial action processes at the site.

2.2 Comprehensive Legacy Management and Institutional Controls Plan Inspections

The *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2009a) states that the Fernald Preserve property will be inspected annually. The site was divided into four areas. One area is inspected each quarter, resulting in a complete inspection of the entire property during the course of the year. Part of the purpose of these inspections is to ensure that the desired results from restoration efforts are being achieved (seeded areas are becoming established, wetlands are holding water, etc.). In addition the presence and impact of nuisance and invasive species, both flora and fauna alike, are assessed.

While not intended to become a functioning prairie ecosystem, the OSDF cap is inspected quarterly. The OSDF cap is inspected to ensure that it is in good condition and functioning properly (no subsidence, no standing water, no erosion, or other breeches). The inspection also includes ensuring the proper establishment of the grasses, primarily for erosion control purposes. The OSDF cap was seeded with native prairie grasses and forbs.

To ensure continued safe use by the public, weekly inspections of the trails and overlooks are conducted at the Fernald Preserve. Additional detail on these inspections is included in Section 4.7.

Findings from all of the inspections mentioned above are recorded into a database. A determination on appropriate repair or required maintenance is made and the finding is corrected. Some examples of corrective actions are: re-seeding, re-planting, herbicide application, and deer ex-closure fence repair. Once the repair or correction has been made, the resolution is documented in the database as well. This Maintenance and Repair Action Items List is included as part of the quarterly site and OSDF inspection reports that are submitted to the regulators.

2.3 Ecological Monitoring and Adaptive Management

Requirements for ecological monitoring are explained in detail in the NRRP. Two phases of monitoring, implementation and functional, have been conducted at the Fernald Preserve since restoration activities began. Monitoring is used in part to determine the appropriate course of action with respect to maintenance. This process, termed '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." This process allows flexibility in making decisions regarding needed maintenance and management of restored areas. Restored areas are very dynamic in nature and set standards or rules may not always apply to all situations in the field. The goal of restored area inspections, monitoring, and the use of adaptive management will be to optimize the progress of restored areas towards functional success and eventual trending towards a mature ecosystem through the natural succession process.

The maintenance activities discussed below provide general guidance. New approaches and specific maintenance activities may result from the adaptive management concept. Likewise, restoration areas require periodic evaluation to assess future maintenance actions. Original goals and objectives for a particular area may be revised based on monitoring results and field observations.

3.0 Replanting Activities

Replanting activities may become necessary for numerous reasons, some of which include lack of germination, heavy foraging by wildlife, affects of extreme weather conditions, and future construction or ground disturbance activities. The NRRP provides general guidance regarding the siting of re-vegetation efforts and the selection of specific plants. Project-specific NRRDPs included detailed planting and seeding plans. This plan will serve as the planting and seeding plan for re-vegetation efforts with site maintenance activities.

3.1 Woody Vegetation

There are two scenarios where planting woody vegetation is conducted at the Fernald Preserve. The first scenario involves replacement of individual plants due to mortality. In this case, an attempt will be made to replant with the same species of plant. If the species is unavailable or unknown, then a similar type of plant will be installed pursuant to the guidelines in Table 3–1. This table lists the form, function, and acceptable habitat types for all trees and shrubs available for planting at the site.

The second scenario involves more large-scale planting efforts that are designed to replace, enhance or expand existing restoration efforts. Again, the intent of the original planting efforts as detailed in project-specific NRRDPs will be replicated, unless site conditions do not warrant additional planting within an area. If the NRTs decide 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). Table 3–1 will be used as a guide for design of planting templates.

Conventional planting plans in NRRDPs will continue to be used for replanting activities. NRRDPs usually specified a planting density of 165 canopy and understory trees per acre and 92 shrubs per acre. These densities were usually augmented with bareroot seedling installation at approximately 400 stems per acre. Trees and shrubs are procured either as balled and burlap or container grown. Herbaceous plugs were typically planted on two-foot centers, for an approximate density of 11,000 plants per acre. Placement of plants is randomized across the "planting patch," with provisions for certain species based on specific habitat requirements as specified in Table 3–1. In general, planting activities would be undertaken pursuant to the specifications provided in Appendix A. Revisions to these planting specifications may be needed based on project-specific requirements. Also, vegetation will be protected from deer and other nuisance animals as discussed in Section 4.5.1 of this plan.

3.2 Herbaceous Vegetation

Herbaceous vegetation is established through the establishment of potted plugs or seed. Seeding is typically used for large-scale prairie and wetland establishment, as well as slope-stabilization and erosion control. Potted plugs are used primarily for wetland creation. Reseeding and/or reestablishment of herbaceous plugs may be required within restored areas for a variety of factors, including poor germination due to soil conditions, drought, and impacts from nuisance animals. As with woody vegetation, the NRTs may determine that additional seeding and plugging is desired in order to enhance or expand some areas.

Seeding is conducted via seed drill, broadcast or hydromulch. Specific methods will be determined based on access, time of year, species seeded and project-specific objectives. The seeding specifications in Appendix B detail the seeding process for the Fernald Preserve. The seed mixes listed in Appendix B are consistent with the list provided in Table 3–2 of the NRRP. Again, seeding specifications may be revised as a result of project-specific requirements.

Table 3–1. Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
Acer nigrum	black maple	canopy tree	cover	B	Similar to *Acer saccharum,* but likes slightly moister conditions.
Acer rubrum	red maple	canopy tree	cover	H R W	Tolerates a wide variety of conditions. Can pioneer disturbed sites
Acer saccharinum	silver maple	canopy tree	cover	R W	Fast growing. Pioneers disturbed banks following *Populus deltoides*
Acer saccharum	sugar maple	canopy tree	cover, mast	B H	Co-dominant in beech-maple forest
Aesculus glabra	ohio buckeye	understory tree	diversity	R W	Tolerates a wide variety of conditions. Avoided by deer
Aesculus octandra	yellow buckeye	understory tree	diversity	O	Generally found east of FEMP in unglaciated portions of Ohio
Alnus serrulata	brookside alder	shrub	cover	R W	Obligate wetland species
Amelanchier arborea	downy serviceberry	shrub	fruit, diversity	H R W	Found mostly east of FEMP. Associated with *Acer rubrum*
Amelanchier laevis	allegheny serviceberry	shrub	cover	O	Not common in Ohio. Abundant in southern Appalachian highlands
Amorpha fruticosa	false indigo-bush	shrub	cover	W	Fast growing. Avoided by deer. Facultative wetland species
Aronia melanocarpa	black chokeberry	shrub	aesthetics	O	Found in wet areas and dry ledges/slopes. Found mostly east of FEMP
Asimina triloba	paw paw	understory tree	fruit, diversity	B R	Forms clustered stands in forest understory. Tap root
Campsis radicans	trumpet creeper	vine	aesthetics	R E	Showy. Naturalized in Ohio
Carpinus caroliniana	hornbeam	understory tree	diversity, mast	B R	Very shade tolerant. Found in moist and mesophytic woods
Carya cordiformis	bitternut hickory	canopy tree	cover	B H R	Common *Carya* spp. at FEMP. Tap root
Carya laciniosa	shellbark hickory	canopy tree	cover, mast	R	Found in moist to wet sites and along streams
Carya ovata	shagbark hickory	canopy tree	cover, mast	H R W	Similar to *Carya laciniosa*, but found in drier areas as well
Castanea dentata	chestnut	canopy tree	diversity, mast	O	Rare due to chestnut blight. Historically found mostly east of FEMP
Ceanothus americanus	new jersey tea	shrub	diversity	H R W	Found mostly east of FEMP
Celastrus scandens	bittersweet	vine	diversity	R	Drought and flood tolerant
Celtis occidentalis	hackberry	canopy tree	diversity	R E	Common at FEMP in a variety of habitats
Cephalanthus occidentalis	buttonbush	shrub	cover	W	Emergent species that forms pure stands
Cercis canadensis	redbud	understory tree	aesthetics	H E	Showy edge species
Cornus alternafolia	alternate-leaved dogwood	understory tree	diversity, cover	B R	Found mostly east of FEMP
Cornus amomum	silky dogwood	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Cornus drumondii	roughleaf dogwood	shrub	cover	H E	Edge species

Table 3–1 (continued). Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
Cornus florida	flowering dogwood	understory tree	aesthetics	H	Showy shade tolerant species
Cornus racemosa	grey dogwood	shrub	cover	H	Seems to compete well with *Lonicera mackii*
Cornus stolonifera	red-osier dogwood	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Corylus americana	hazel nut	shrub	diversity	R W	Found in a variety of habitats. Can form large patches
Crataegus crus-galli	cockspur hawthorne	shrub	diversity	E	Thorny edge species
Crataegus mollis	downy hawthorne	understory tree	cover	B	Thorny
Crataegus phaenopyrum	Washington hawthorne	understory tree	diversity	E	Thorny
Decodon verticillatus	water willow	shrub	diversity	W	Emergent species
Diospyros virginiana	persimmon	understory tree	fruit	O	Edible fruit. Found mostly east of FEMP in unglaciated areas
Euonymus atropurpureus	eastern wahoo	understory tree	aesthetics	R	Showy
Fagus grandifolia	beech	canopy tree	cover, mast	B	Co-dominant in beech-maple forest
Fraxinus americana	white ash	canopy tree	cover	B H	Avoid future use due to emerald ash borer
Fraxinus nigra	black ash	canopy tree	cover, diversity	R W	Avoid future use due to emerald ash borer
Fraxinus pennsylvanicum	green ash	canopy tree	cover	R	Avoid future use due to emerald ash borer
Fraxinus quadrangulata	blue ash	canopy tree	cover, diversity	H	Avoid future use due to emerald ash borer
Gymnocladus dioica	kentucky coffeetree	canopy tree	diversity	H	Most common in southwestern portion of Ohio
Hamamelis virginiana	witch hazel	understory tree	cover	B	Found in a variety of habitats singularly or in groups
Hydrangea arborescens	wild hydrangea	shrub	aesthetics	O	Found in ravines and shaded bluffs
Hypericum spathulatum	shrubby st. john's wort	shrub	diversity	W	Showy species that can form large patches
Ilex verticallata	winterberry	shrub	aesthetics	W	Found mostly east of FEMP
Juglans cinerea	butternut	canopy tree	mast, diversity	O	Rare Ohio species
Juglans nigra	black walnut	canopy tree	mast, diversity	B R	Allelopathic. Can form pure stands
Juniperus virginiana	eastern red cedar	understory tree	cover	E	Only coniferous species native to FEMP
Lindera benzoin	spicebush	shrub	cover	B	Common shrub of beech-maple forest
Liquidambar styraciflua	sweetgum	canopy tree	diversity	O	Southern tree found mostly east and south of FEMP
Liriodendron tulipifera	tulip poplar	canopy tree	cover, aesthetics	B H	Tallest deciduous species in the eastern U.S.
Lonicera sempervirens	trumpet honeysuckle	vine	aesthetics	O	Southern species uncommon in Ohio
Morus rubra	red mulberry	understory tree	fruit	E	Fast growing. Shade tolerant
Nyssa sylvatica	black gum	canopy tree	diversity, aesthetics	H R	Found in a variety of habitats
Ostrya virginiana	hop-hornbeam	understory tree	diversity	B R W	Found in a variety of habitats
Parthenocissus quinquefolia	Virginia creeper	vine	diversity	H	Showy in autumn

Table 3–1 (continued). Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
Physocarpus opulifolius	ninebark	shrub	diversity	E	Plant in open areas
Platanus occidentalis	sycamore	canopy tree	cover	R E	Fast growing streamside spp. Can also pioneer old fields
Populus deltoides	cottonwood	canopy tree	cover	R E	Fast growing streamside spp. Can also pioneer old fields
Prunus americana	American plum	understory tree	diversity, fruit	E	Forms large patches
Prunus serotina	black cherry	canopy tree	fruit	B	Found in a variety of habitats. Largest *Prunus* spp. In Ohio
Prunus virginiana	choke cherry	shrub	cover	O	Found mostly north of FEMP
Quercus alba	white oak	canopy tree	cover, mast	H	Found in a variety of habitats
Quercus bicolor	swamp white oak	canopy tree	cover, mast	R W	Flood tolerant bottomland spp
Quercus coccinea	scarlet oak	canopy tree	cover, mast	H	Found mostly east of FEMP
Quercus inbricaria	shingle oak	canopy tree	diversity	H	Found in a variety of habitats
Quercus macrocarpa	bur oak	canopy tree	diversity, mast	R S	Burn resistant woody dominant of savanna habitat
Quercus muehlenbergii	chinquapin oak	canopy tree	diversity, mast	H	Most common in southwestern portion of Ohio
Quercus palustris	pin oak	canopy tree	cover	R W	Can form pure stands in bottomlands
Quercus prinus	chestnut oak	canopy tree	diversity	O	Found mostly east of FEMP in unglaciated areas
Quercus rubra	red oak	canopy tree	cover, mast	B H	Found in a variety of upland habitats
Quercus shumardii	shumard oak	canopy tree	diversity, mast	H	Southern tree found in southwest Ohio
Quercus velutina	black oak	canopy tree	cover, mast	H	Similar to *Quercus rubra*
Rhus aromatica	fragrant sumac	shrub	cover, aesthetics	H	Prefers dry, gravelly, rocky banks
Rhus glabra	smooth sumac	shrub	aesthetics	E	Showy species. Most abundant *Rhus* spp. In Ohio
Rhus typhina	staghorn sumac	shrub	aesthetics	E	Similar to *Rhus glabra*
Ribes americanum	black currant	shrub	diversity	O	Found mostly north of FEMP
Rosa caroliniana	carolina rose	shrub	aesthetics	E S	Prefers dry open areas
Rosa palustris	swamp rose	shrub	aesthetics	R W	Prefers wet areas and banks of slow-flowing stream
Rosa setigera	prairie rose	shrub	aesthetics	E S	Can form large stands
Rubus allegheniensis	blackberry	shrub	fruit	E	Thorny. Edible fruit
Rubus occidentalis	black raspberry	shrub	fruit	E	Thorny. Edible fruit
Salix amygdaloides	peach-leaf willow	understory tree	cover	R	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix discolor	pussy willow	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix eriocephala	heart-leaved willow	shrub	diversity	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix exigua	sandbar willow	understory tree	cover	R	Can reproduce by dormant live cuttings. Suitable for

Table 3–1 (continued). Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
					erosion control
Salix humila	prairie willow	shrub	cover	S	Can reproduce by dormant live cuttings.
Salix nigra	black willow	understory tree	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix sericea	silky willow	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Sambucus canadensis	elder	shrub	fruit	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Sassafras albidum	sassafras	understory tree	diversity	H E	Can form pure stands
Smilax rotundifolia	greenbriar	shrub	diversity	O	Thorny
Spiraea alba	meadow sweet	shrub	aesthetics	W	Found mostly north of FEMP
Spiraea tomentosa	steeple bush	shrub	aesthetics	O	Found mostly north and east of FEMP
Staphylea trifolia	bladdernut	shrub	diversity	B H R	Prefers shaded banks
Symphoricarpos orbiculatus	coral berry	shrub	diversity	E	Can form large patches in disturbed areas
Tilia americana	basswood	canopy tree	cover, aesthetics	B	Common in glaciated portion of Ohio
Ulmus americana	american elm	canopy tree	cover	O	Found in a variety of habitats. Impacted by dutch elm disease
Ulmus rubra	slippery elm	canopy tree	cover	H R	Found in a variety of habitats
Vaccinium corymbosum	highbush blueberry	shrub	fruit	O	Boreal relic found in wet areas within glaciated portion of Ohio
Viburnum acerifolium	mapleleaf viburnum	shrub	diversity	B	Associated with *Fagus grandifolia*
Viburnum dentatum	arrowwood	shrub	cover	O	Found mostly east of FEMP
Viburnum lentago	nannyberry	shrub	cover	O	Found mostly north of FEMP
Viburnum prunifolium	blackhaw viburnum	understory tree	cover	B H	Found in a variety of habitats singularly or in groups
Zanthozylum americanum	prickly ash	understory tree	diversity	E	Thorny. Can form large stands

Use Key:
B = beech-maple forest template
H = oak-hickory forest template
R = riparian template
W = wetland template
E = edge habitat template
S = savanna template
O = other species

4.0 Restored Area Maintenance Activities

In order to ensure the success of restoration efforts at the Fernald Preserve, maintenance of these areas is necessary. Pursuant to the NRRP, the types of maintenance activities that will be required include invasive species and noxious weed control, water management, erosion control, wildlife amenities maintenance, nuisance animal control, and maintenance of public use amenities. Specific maintenance requirements and methods are discussed in greater detail later in this section.

4.1 Invasive Species and Noxious Weed Control

A very important component of restoration of the site involves the removal or extirpation of invasive and aggressive species to the degree practicable. Without some control, invasive and aggressive species may impede or prevent the natural succession process by out-competing native plants and alter the intended course of maturation for restored areas. DOE is also required to manage state-listed noxious weeds pursuant to state regulations. Examples of the invasive species or noxious weeds at the Fernald Preserve include, but are not limited to various thistle species (*Cirsium arvense*, *Cirsium vulgare*, *Carduus nutans*), amur honeysuckle (*Lonicera maackii*), multiflora rose (*Rosa multiflora*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), Johnson grass (*Sorghum halepense*), tree of heaven (*Ailanthus altissima*), garlic mustard (*Alliaria petiolata*), and teasel (*Dipsacus fullonum*). At the Fernald Preserve, all state-listed noxious weeds will be treated as necessary.

Various methods are used, depending on the species and its location on the Fernald Preserve, to aid in the control and/or elimination of these species. Mowing, mechanical removal, and chemical applications (herbicides) are the primary methods used. In most cases, combinations of these methods are used, providing even better control. An example of a combination of methods used is first cutting down a honeysuckle shrub and then applying herbicide to the stump or to the re-sprouting vegetation. A second example is first mowing a field and then spot spray about 2 weeks later with a broad leaf herbicide for thistle control. Table 4–1 lists the primary control methods for species of concern at the Fernald Preserve.

Much care must be taken when applying herbicides. While very effective, the type of herbicide used may have adverse affects on native species or the immediate surroundings of the unwanted plant as well. For example, a broad leaf herbicide may be suitable for the elimination of thistle, but will also impact numerous forbs should the chemical come into contact with them. Another example is that 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 environments. The use of chemical application as a means of control of invasive and aggressive species is closely monitored at the Fernald Preserve. The plants being treated, the chemical being used, and the area in which the application occurred are documented. All herbicide applications are conducted under the supervision of appropriately licensed and trained personnel.

Table 4–1. Control Methods for Species of Concern

Species	Common Name	Control Alternatives	Habitat	Timeframe	Comments
Cirsium arvense	Canada thistle (perennial)	• Herbicide applications • Mechanical removal • Mowing	Open fields, sparsely wooded areas	Early spring – early fall	A combination of mowing/cutting followed by herbicide application is an effective method of Canada thistle control. Mechanical removal is least effective, as the roots typically break off in the ground, resulting in quick re-sprout in the immediate location.
Cirsium vulgare	Bull thistle (biannual)	• Herbicide applications • Mechanical removal • Mowing	Open fields, sparsely wooded areas	Early spring – early fall	
Carduus nutans	Musk thistle (biannual)	• Herbicide applications • Mechanical removal • Mowing	Open fields, sparsely wooded areas	Early spring – early fall	
Lonicera maackii	Amur honeysuckle (woody)	• Herbicide applications (foliar or stump) • Mechanical removal	Woodlands and forest edges	Early spring or late fall	Mechanical removal of the shrubs in the fall and applying herbicide to the re-sprouting vegetation in the spring has proven effective at the Fernald Preserve. A combination of cutting the shrub and applying herbicide to the stumps is another common practice. Fall foliar application in late fall (after other species are dormant) is also used.
Rosa multiflora	Multiflora rose (woody)	• Herbicide applications (foliar or stump) • Mechanical removal	Open fields and sparsely wooded areas	Summer – fall	A combination of cutting the shrub and applying herbicide to the stump, even when dormant, is recommended.
Phalaris arundinacea	Reed canary grass (perennial)	• Mowing • Burning • Herbicide applications	Wet areas	Spring	Reed canary grass is extremely difficult to control. Burning is the recommended method of removal. Mowing before seed development can also aid in controlling the spread of the grass. If herbicide is used, it must be suitable for use in aquatic environments.
Phragmites australis	Common reed (perennial)	• Herbicide applications	Wetlands	Spring – summer	Herbicide used must be suitable for use in aquatic environments. Hand removal of seed heads followed by hand application of herbicide is the primary means of control.
Sorghum halepense	Johnson grass (perennial)	• Herbicide applications		Spring – summer	
Ailanthus altissima	Tree of heaven (woody)	• Herbicide applications	Sparsely wooded areas		
Alliaria petiolata	Garlic mustard (biennial)	• Herbicide applications • Mechanical removal			
Dipsacus fullonum	Teasel (biennial)	• Herbicide applications	Open fields, edge of woods, sparsely wooded areas	Spring – summer	

NOTE: For most species, it is very important to apply control methods prior to the development of the seed. In the event that seed is produced prior to control methods being applied (e.g., spraying with herbicide), the seed heads should be removed by hand to aid in the prevention of widespread reproduction.

4.2 Water Management

Water management at the Fernald Preserve is required for wetlands and open water on site. In general, water levels are maintained to maximize vegetation establishment and promote wildlife use. Flooding areas is an effective tool for ~~maintaining~~controlling invasive species infestation. It also can provide open water for waterfowl during spring and fall migrations. Likewise, drawdown of basins during migration periods promotes mudflat habitats for shorebirds. Also, periodic drawdown of wetland basins discourages the establishment of fish, which in turn promotes amphibian habitat.

Some constructed wetlands include water control structures that allow for some manipulation of water levels. Water level control structures are located within the Phase I and II Wetland Mitigation Projects and the Southern Waste Units. Other areas can be manipulated with pumps if necessary.

4.3 Erosion Control

Erosion control and slope stabilization is required in order to maintain the integrity of restored areas. Areas of concern are identified via site inspection and other walk downs. Future erosion repair, if necessary, 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, remedy protection and habitat. NRTs may determine that an eroded area should be left alone because of the habitat loss that would result if a construction activity was undertaken. Likewise, an erosion rill that presents a safety hazard to the public would be prioritized for repair.

The use of bioengineering principles for erosion control is preferred. In cases where vegetation control will not be sufficient, the area will be evaluated by ecologists and engineers, a design for repairs will be prepared, and the appropriate repairs will be carried out. The primary source of guidance and specifications for erosion repair activities is from the Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Manual (ODNR 2006). This document can be accessed online at http://www.dnr.state.oh.us/tabid/9186/default.aspx#Manual. Additional specifications for installation of erosion matting are provided in Appendix B.

4.4 Wildlife Amenities

Various wildlife amenities were installed on site to aid in the habitation of restored areas. Examples of these amenities include bluebird boxes, wood duck boxes, woodpecker boxes, kestrel boxes, raptor platforms, bat boxes, fox dens, snake dens, and salamander habitat. In addition, brush piles were left where feasible to provide shelter for small mammals such as the eastern cottontail. These structures are periodically inspected, monitored, cleaned, and maintained to ensure their integrity and continued use.

Inspection of wildlife amenities is conducted as part of the LMICP Site inspection process. Monitoring to determine use is typically undertaken in the late fall, along with clean-out of any nesting material. Repair activities are usually required due to weathering and wear from use.

4.5 Nuisance Animal Control

While wildlife is desired at the Fernald Preserve, some animals, native and non-native alike can do more harm than good if not controlled. For example, newly planted saplings, seedlings, and shrubs are often scraped or foraged by deer. Newly germinating grasses attract geese. The wildlife can prevent planted and seeded areas from becoming established if permitted to forage heavily on these areas. Therefore, some means of control is often necessary if the restoration is to be successful.

4.5.1 Physical Barriers

The primary method of control used at the Fernald Preserve is using ex-closure fencing to prevent the animals from getting to the newly planted areas. A polyethylene fence may be installed around large planted areas to deter deer from entering the area. The fence is between 9 and 10 feet tall. One or two access locations are installed in the fencing to allow for monitoring and maintenance of the planted areas. A rodent guard, a smaller mesh fencing made of the same material, is installed along the bottom of the fence to deter smaller mammals such as rabbits and groundhogs from entering the area. For smaller areas, such as a small patch of shrubs or around individual trees, welded wire fencing 4 or 5 feet tall is used. This fencing deters deer from scraping their antlers on the tree trunks or browsing on the shrubs.

For open water areas and wetlands, monofilament line is used to create grids a couple of feet above the water surface. These grids are a deterrent for the geese, preventing them from landing on the water surface and potentially foraging on the seed and plugs planted along the waters' edge. The monofilament line is also used to create a barrier at the ground level to prevent geese from accessing the area around the water from the land surface.

Fencing material (wire mesh) is also used to deter beaver from using subsurface drain pipes as travel corridors. The wire mesh was installed at the outlet drain pipe for a pond that was inhabited by several beavers. Wire mesh fence of various sizes was overlapped to keep the openings small enough to prevent the beaver from passing through. Plastic rodent fence (the same used with the deer fence discussed above) was placed on the bottom of the pond below the wire mesh fence and the outlet opening to prevent the beaver from digging to get under the fence.

Physical barriers can also help deter muskrat from digging into dams and pond banks. The most common is to line the bank with riprap, making digging virtually impossible. However, this method is not the most aesthetically pleasing. Another method is to line the bank with fence material (e.g., chain link or wire mesh) to make digging very difficult. Due to the prevalence of existing vegetation, this technique will only be used in newly graded or completely denuded areas. Options for muskrat control are under review.

4.5.2 Trapping

When physical barriers and deterrents are not enough, then more proactive measures sometimes need to be taken. Removal of animals by various methods is also practiced at the Fernald Preserve. Live trapping small mammals and releasing them at another location on site is an occasional practice. In order to trap some animals, permits must be obtained from the ODNR. Trapping permits are only valid during the specified trapping season. In addition, permitted subcontract personnel may be used to remove nuisance animals if necessary.

4.5.3 Scare Tactics and Hazing

Scare tactics and hazing are used on Canada geese at the site. The Canada goose can do a great deal of damage to restored areas, if allowed. The geese will gather in large flocks and forage on newly germinating seeded areas, or will pull newly planted plugs right out of the ground. The scare tactics that are used consist of suspending large "scare eyes" in seeded areas. These are large, beach ball-like objects that have graphics on them that emulate a large predator's eye or gaping mouth. Using a metallic ribbon tied to a wooden stake or post has a similar effect. The metallic ribbon makes noise when the wind blows and reflects sunlight, making the geese uncomfortable. These props need to be moved around on a regular basis for this method to be successful.

A technique called 'hazing' is also used at the Fernald Preserve. Border collies trained to work with geese are used to scare the geese away, with no harm done to the geese. In basic terms, the dogs attempt to gather, or herd, the geese. The geese are threatened by the presence of the dogs and leave. Regular appearances by the dogs will cause the geese to eventually think an area is unsafe and they tend to then stay away on a more permanent basis.

A second goal of hazing is to attempt to prevent the geese from nesting. However, once geese have laid their eggs, they are very unlikely to leave their nest for anything more than a very short period of time. In addition, during the mating and egg-laying season, the adult geese molt, losing their flight feathers. This prevents them from flying any more than a very short distance. During this time, hazing is not going to be successful. Hazing activities are stopped until the adults and young have their flight feathers and can fly long distances, enabling them the leave the property.

4.5.4 Culling

In the event that the deer population at the Fernald Preserve becomes so large that current means of control to protect the vegetation are ineffective, or they become a safety issue, interfering with public use amenities or the with public themselves, further actions may be necessary. Decreasing the deer population by means of a controlled hunt or a sniper is an option, only if deemed absolutely necessary by the NRTs and other stakeholders. DOE will work with ODNR to set up such events, to ensure that all applicable laws and regulations are followed, and that all necessary reporting is completed.

The most proactive method used at the Fernald Preserve for controlling the Canada geese population is egg addling and nest removal. These are effective tools for reducing reproduction of Canada geese. A Goose Damage Permit is issued by ODNR, allowing the conduct of these activities. The permit comes with specific instructions describing how to carry out these activities appropriately and safely. Under no circumstance is harm done to the adult geese. Compliance with the permit also requires that a report of the number of nests destroyed and the number of eggs addled be provided to ONDR for their records.

4.6 Grassland Maintenance

The grasslands at the Fernald Preserve consist of pastures formerly use for grazing, old fields; turf grass lawns; and restored prairies and savannas. Maintenance of these areas is necessary for both aesthetic and restoration purposes.

4.6.1 Mowing

Mowing is the primary method of maintaining the grass areas at the Fernald Preserve. The areas around the Visitors Center, along the access road, and along the south boundary of the Preserve (along Willey Rd.) are mowed on a regular basis to keep the grasses short and aesthetically pleasing. Some of the pastures on site (the South Field and the field east of the Lodge Pond trail) are mowed and bailed once or twice a year. This mowing is for aesthetics and to help control the spread of invasive species (primarily thistle species). Mowing is typically conducted in the spring in order to minimize impacts to nesting birds. If needed, a second mow is conducted in late summer across pasture areas. If possible, mowing should be completed before April 1 or after July 15. Figure 4–1 shows the type and frequency of mowing at the Fernald Preserve.

Mowing is used in prairie and savanna areas in order to assist with establishment in the first couple years following seeding. Native grasses and forbs are generally slower growing than cover crops and weedy species. These plants are mowed before they go to seed. The native grasses and forbs are not affected by mowing because of their smaller size. This process allows the native grasses and forbs to eventually out-compete weedy growth. Once established, the preferred management of prairie areas at the Fernald Preserve is prescribed burning, as described below.

4.6.2 Prescribed Burning

A second method of grassland maintenance to be used at the Fernald Preserve is prescribed fire. The Fernald Preserve *Wildland Fire Management Plan* (WFMP) (DOE 2009b) establishes the process for conducting prescribed burns at the Fernald Preserve. Prescribed fire provides numerous benefits for restored prairie areas. In addition, invasive species and noxious weeds that are not destroyed by the fire are usually easily identified following a burn and can then be spot sprayed in order to kill them without injuring desirable plants, which are a little slower at rebounding.

Burning identified prairies and savannas every 3 to 5 years in conjunction with herbicide applications will control undesirable species and stimulate native species growth. Pursuant to the WFMP, the size of the burns will be controlled to fit inside established fire breaks. Natural features of the site may also be used as boundaries. Fire size will also be limited by the number of personnel available to conduct the burn.

4.7 Trails, Signs, Displays, and Overlooks (Public Use Amenities)

A weekly inspection is conducted of all of trails and overlooks at the Fernald Preserve. This includes inspection of the walking surface, signs, displays, overlooks, and parking areas. These inspections are conducted to ensure continued public safety during use of these amenities. Each week, items requiring attention are documented and entered into a database of maintenance items that need to be addressed. Examples of maintenance items include such things as standing water on the trails, rutting of trails, fallen trees along the trails, loose or fallen signs, loose boards on overlooks, etc. Once the items are addressed, completion of those items is documented as well.

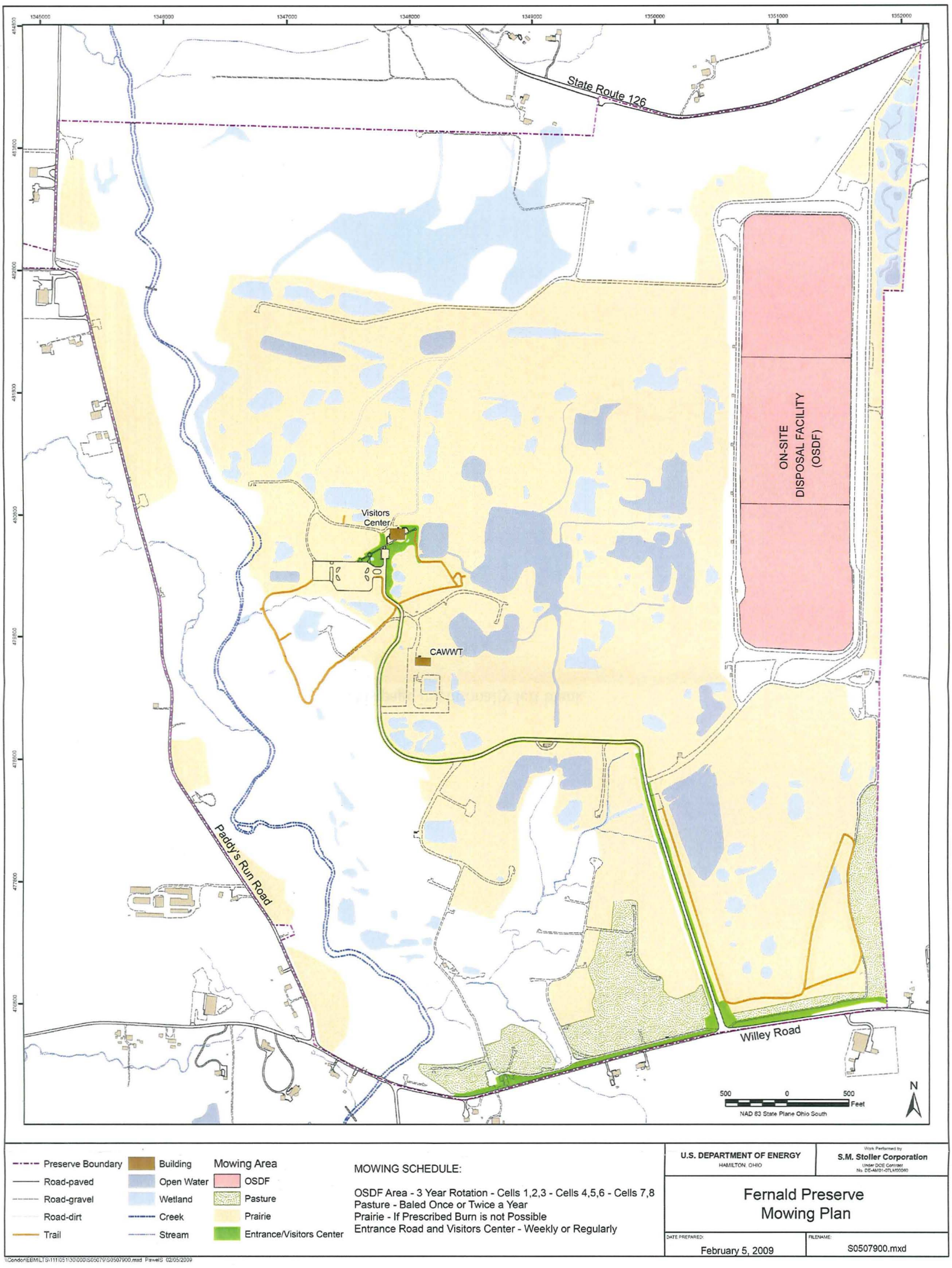

Figure 4–1. Fernald Preserve Mowing Map

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5.0 Schedule

The scheduling of maintenance activities can be difficult to predict. Often, unexpected conditions arise that call for immediate attention. However, a general schedule can be estimated based on the timing and frequency of activities discussed in Sections 3 and 4 above. Table 5–1 shows a typical monthly schedule of maintenance activities for a calendar year.

Table 5–1. Scheduling of Maintenance Activities

Activity	Section	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Notes
Woody vegetation replanting	3.1			X	X	X	X	X	X	X	X	X	X	Acceptable anytime during year except when ground is frozen.
Herbaceous plug planting	3.2				X	X	X	X	X					Must allow for root establishment prior to dormancy. Supplemental watering may be needed in summer months
Seeding	3.2			X	X	X	X			X	X	X		Allowable seeding dates are detailed in specification
Invasive species - herbicides	4.1				X	X	X		X	X	X			Target active growing, resprouting timeframes
Invasive species - removal	4.1	X	X	X	X	X	X	X	X	X	X	X	X	Honeysuckle removal in fall/winter, target other species prior to seed dispersal
Invasive species - mowing	4.1				X	X	X	X	X	X				Target mowing prior to flowering - includes spot trimming with weed whips
Water management - flooding	4.2					X	X	X	X	X	X	X	X	Control invasive and expand waterfowl habitat
Water management - drawdown	4.2						X	X	X	X	X	X		Discourage fish and expand mudflat habitat
Erosion control	4.3				X	X	X	X	X	X	X			Must insure adequate time for seed germination
Wildlife amenities - inspection	4.4			X			X			X			X	Coincides with quarterly site inspection process
Wildlife amenities - Monitoring and cleanout	4.4											X	X	End of season activity
Nuisance animals - barriers	4.5.1	X	X	X	X	X	X	X	X	X	X	X	X	Installation and repair as weather allows
Nuisance animals - trapping	4.5.2	X	X	X	X	X	X	X	X	X	X	X	X	Trapping as weather permits
Nuisance animals - hazing	4.5.3	X	X	X	X						X	X	X	Hazing with dogs stops during nesting season/molt
Nuisance animals - culling	4.5.4			X	X	X								Goose egg addling only
Grassland maintenance - mowing	4.6.1				X	X				X	X			Target prior to bird nesting season
Grassland maintenance - prescribed burning	4.6.2		X	X	X									Implementation dependent on parameters specified in site-specific prescribed burn plans
Public use amenities	4.7	X	X	X	X	X	X	X	X	X	X	X	X	Installation and repair as weather allows

6.0 Reporting

Reporting on maintenance activities will occur through the quarterly Fernald Preserve site inspection reports. An updated Maintenance Action Items List is included with those reports. Maintenance needs are recorded and tracked from identification through resolution in the database. A yearly summary of maintenance activities will be included in Annual Site Environmental reports. In addition, the NRTs will be regularly updated and consulted on maintenance activities during periodic meetings.

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7.0 References

DOE (U.S. Department of Energy), 1993. *Site Wide Characterization Report.*

State of Ohio, 2008. *Partial Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE*, State of Ohio v. United States Department of Energy, et al, Civil Action No. C 1-86-0217, Judge Spiegel.

DOE (U.S. Department of Energy), 2009a. *Comprehensive Legacy Management and Institutional Controls Plan*, Revision 3, Final, DOE, Fernald Area Office, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2009b. *Wildland Fire Management Plan*, Final, DOE, Fernald Area Office, Cincinnati, Ohio, February.

ODNR (Ohio Department of Natural Resources), 2006. *Rainwater and Land Development Manual*, Third Ed., ODNR, Division of Soil and Water Conservation, Columbus, Ohio, December.

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Appendix A

Planting Specifications

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SECTION 02940
PLANTING

PART 1 GENERAL

1.1 SCOPE

A. This Section includes the requirements for planting trees, shrubs, and herbaceous potted plants as shown on the Construction Drawings.

1.2 RELATED SECTIONS AND DOCUMENTS

A. Section 02930 – Seeding and Bioengineering Erosion Control

PART 2 PRODUCTS

2.1 MATERIALS

A. Container grown trees shall be a minimum of 6 feet in height, grown in "spin-out" containers and acquired from a local seed source if possible. Potting material shall be pre-inoculated with mycorrhizae.

B. Container-grown shrubs shall be a minimum of 1 foot in height, grown in "spin-out" containers and acquired from a local seed source if possible. Potting material shall be pre-inoculated with mycorrhizae.

C. Balled and burlapped trees and shrubs shall be a minimum of 1.5-inch caliper diameter, with a root ball that conforms to American Nursery and Landscape Association Standards. Trees and Shrubs shall be harvested from the same hardiness zone in which the Fernald Preserve is located.

D. Bareroot seedlings shall be pre-inoculated with ecto-mycorrhizae and shall not be exposed to the air any longer than possible prior to planting.

E. Herbaceous potted plants shall be grown in open bottom, minimum 2-inch square and 3-inch deep containers. Potting material shall be inoculated with ecto-mycorrhizae.

F. Fertilizer shall be slow-release tablet form, and not exceed an N-P-K mix of 22-5-10. Fertilizer shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.

G. Mulch shall be an aged hardwood mulch, free of clay, stone, foreign substances, and free of weeds.

H. Wooden stakes for staking trees as needed shall be nominal 2 inch square, approximately 18-inches in length.

2.2 EQUIPMENT

A. Equipment for performing work in this section shall be low ground pressure equipment that will not compact amended soils.

PART 3 EXECUTION

3.1 GENERAL

A. Planting locations will be flagged in the field by the Restoration Ecologist. The Restoration Ecologist is the Fluor Fernald contact responsible for identifying locations of all plant material installation, verifying acceptance of delivered plant material, and ensuring proper installation.

B. Unless otherwise approved by the Restoration Ecologist, all plant installation shall take place between October 1 and December 15 or February 15 and May 15.

C. The Restoration Ecologist may restrict planting activities based on field conditions (e.g., droughts, unseasonable freezes).

D. No plant installation may take place while the soil surface is frozen.

E. Plant material delivered to the project site that will not be planted within 24 hours shall have their containers completely covered with woodchip mulch and kept moist with periodic watering.

F. The Construction Manager will provide a source of water sufficient to support all field activities specified in this Section.

3.2 INSTALLATION OF BALLED AND BURLAPPED AND CONTAINER-GROWN TREES AND SHRUBS

A. Excavate planting pit to a depth such that the top of the ball, when planted, extends 1 to 2 inches above ground surface.

B. Excavate the planting pit so that it is twice as wide as the width of the root ball.

C. Scarify the sides of the planting pit using a shovel.

D. For container grown plants, remove the plant from the container by carefully inverting the plant and loosening the root ball from the container, cutting the container if necessary. Keep the root ball as intact as possible. Handle the plant by the root ball only. Do not pull the plant from the container by the trunk of the tree or shrub.

E. For balled and burlapped plants, loosen the burlap from around the root collar and fold it back. No portion of the burlap shall be left about ground upon backfilling.

F. Add a slow-release fertilizer tablet or packet (e.g., Osmocote, Agriform or similar) around the ball per manufacturers recommendations.

G. Set trees and shrubs such that the top of the ball extends 1 to 2 inches above the ground surface and that the trunk is vertical. Trunks shall have no appreciable lean, at the discretion of the Restoration Ecologist.

H. Backfill around the root ball with a mixture of the topsoil and subsoil removed from the pit. Gently tamp the backfill as it is placed into the pit.

I. Water the tree/shrub immediately after planting to saturate the upper 12 inches of soil.

J. Remove any tags, labels, strings or wires from the plant, unless otherwise directed by the Restoration Ecologist.

3.3 INSTALLATION OF BAREROOT PLANTS

A. Carry bareroot plants in a bucket of water (or moist sand or other moist medium) in the field to keep the roots from drying out. Bareroot plants shall not be stored in water for more than 6 hours at a time. Bareroot plants that require overnight storage shall have their root balls covered completely with moist hardwood mulch and kept moist with periodic watering.

B. Excavate the planting pit by hand using a dibble bar or spade. The pit shall be only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.

C. Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.

D. Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.

E. Firmly tamp backfill with the heel of the shoe when complete.

F. Remove any tags, labels, and strings from the plant, unless otherwise directed by the Restoration Ecologist.

3.4 INSTALLATION OF HERBACEOUS POTTED PLANTS

A. Place potted plant flats in standing water immediately upon delivery to the project site. Keep flats in water until installation.

B. Excavate the planting pit by hand using a dibble bar or spade. The pit shall be only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.

C. Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.

D. Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.

E. Firmly tamp backfill with the heel of the shoe when complete.

F. Remove any tags, labels, and strings from the plant, unless otherwise directed by the Restoration Ecologist.

3.5 PRUNING

A. Once trees and shrubs are planted, prune off any dead or damaged limbs.

B. All pruning shall involve removal of limbs back to a lateral branch or bud.

C. Perform additional pruning at the request of the Restoration Ecologist.

3.6 MULCHING

A. Apply a 4-inch layer of hardwood mulch over a circular area 4 feet in diameter surrounding balled and burlapped and container grown trees and shrubs. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.

B. Apply a 4-inch layer of hardwood mulch over a circular area 2 feet in diameter surrounding each bare root or potted plant. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.

C. Mulch shall be placed so as to not physically contact the plants.

3.7 WATERING

A. Water all planted material weekly for 6 weeks following installation, unless otherwise directed by the Restoration Ecologist. Watering shall be sufficient to saturate the entire root ball. This typically requires the slow release of approximately 10 gallons of water for each plant.

3.8 STAKING AND GUYING

A. Stake and guy trees only at the request of the Restoration Ecologist.

END OF SECTION

Appendix B

Seeding Specifications

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SECTION 02930
SEEDING AND BIOENGINEERING EROSION CONTROL

PART 1 GENERAL

1.1 SCOPE

A. This Section includes soil stabilization, which includes application of crusting agent, establishing vegetation by seeding and dormant live cuttings, and installing biodegradable erosion control materials. The work in this Section includes, but is not limited to; soil preparation, interim vegetation, permanent vegetation, application of fertilizer, application of mulches, application of crusting agent, and installation of erosion control materials.

1.2 RELATED SECTIONS AND PLANS

A. Section 02940 – Planting

1.3 REFERENCES

A. Latest version of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Standards (ODNR Rainwater and Land Development Standards).

B. "*Identification and Listing of Hazardous Waste,*" Title 40, Code of Federal Regulations (CFR), Part 261, Subpart E.C.

C. "*Federal Hazardous Material Transportation Law,*" U.S. Department of Transportation (U.S. DOT, 1994).

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish seed labeled in accordance with U.S. Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its date of expiration. Each variety of seed shall have a purity of not less than 90 percent by weight, a percentage of germination not less than 80 percent by weight, and a weed to seed content of not more than 0.75 percent by weight and contain no noxious weeds. Furnish seed mixtures having seed proportioned by weight in accordance with Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section. Areas requiring permanent seeding during the summer months (July 1 – September 1) shall be seeded with 30 lbs/acre of ReGreen or stabilize with a crusting agent as specified in this Section, unless otherwise directed by the Restoration Ecologist. Stabilization performed during the summer shall be followed by fall application of the appropriate permanent seed mix.

B. Permanent seed mixes shall be treated with fungal (mycorrhizae) inoculant and bacterial (rhizobium) inoculants. The specified legumes must be inoculated with the appropriate rhizobial strains.

C. Furnish mulch meeting the following requirements:

1. Mulch shall be straw or wood cellulose fibers; free of clay, stone, foreign substances, and free of weeds.

2. Straw should not contain sticks larger than ¼-inch diameter or other materials that may prevent matting down during application. Use straw that is free from mold and other objectionable material for placing with mulch blower equipment or other equipment as approved by the Construction Manager. Straw shall be generally 6 inches or more in length.

3. Straw shall be:

   a. Weed free straw from the Minnesota Crop Improvement Association certified weed free straw vendors;

   b. Straw that has been inspected and determined to be weed free by Central Ohio Seed Testing;

   c. Native prairie grass mulch; or

   d. Equivalent substitute as approved by the Construction Manager.

4. Mulch applied by hydrospraying shall be a bonded fiber matrix containing wood fibers held together with a hydrocolloid-based binder, which upon drying becomes insoluble and non-dispersible. The fibers shall be composed of 100 percent wood or wood by-products and shall be 100 percent biodegradable. Use a bonded fiber matrix containing a green dye that will provide for easy visual inspection for uniformity of slurry spread. The bonded fiber matrix, including dye, shall contain no growth or germination inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

Item	Specification Limit
Particle Length	0.4 inch (maximum)
Particle Thickness	0.047 inch (maximum)
PH	4.0 to 8.5
Ash Content	1.6 % (maximum)
Water Holding Capacity (based on fiber dry weight)	500 % (minimum)
Moisture Content	12 % ± 3 % (by weight)

D. Mulch binder agent shall be as approved by the Construction Manager and shall meet the following requirements:

1. The mulch binder shall be hydrocolloid base (guar gum) and shall not dissolve or disperse upon rewetting.

2. The mulch binder shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states.

3. The mulch binder shall have a flash point greater than 200°F. The mulch binder shall be neither a flammable nor combustible liquid per U.S. Department of Transportation definition (DOT 1994). The mulch binder must not be susceptible to significant deterioration from exposure to the elements, including sunlight.

4. The mulch binder shall be provided in concentrated solution and prepared so that it will not change in transportation or storage.

E. The crusting agent shall be as approved by the Construction Manager and shall meet the following criteria:

1. Pine sap emulsion comprised of a 100 percent organic emulsion produced from naturally occurring resins (pine sap); or a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik tacking agent (mulch binder); or an approved equal;

2. Not comprised of chloride, lignosulfonate, petroleum, or asphaltic-type emulsions;

3. Provide dust suppression and surface stability for exposed soils, both disturbed and undisturbed soils, and exposed coal fired ash (flyash);

4. Compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application;

5. Non-tracking (i.e., will not stick to boots or tires) once cured;

6. Not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states;

7. Have a flash point greater than 200°F;

8. Be neither a flammable nor combustible liquid per DOT definition; and

9. Not be susceptible to significant deterioration from exposure to the elements, including sunlight.

F. Woven coir erosion mat shall meet the following criteria:

1. Coconut fiber content: 100%

2. Weight: 22 ounces per square yard

3. Thickness: 0.3 inches

4. Open area: 38%

5. Tensile strength: 1,350 lb/ft by 626 lb/ft (length by width)

6. Elongation: 34% by 38% (length by width)

G. Coconut logs shall be constructed of 100% coconut fiber, 10-inch minimum diameter and 8-foot maximum length.

H. Wood stakes for fastening coir mats and logs shall be as follows:

1. Stakes for coir erosion mats shall be nominal 2-inch square, minimum 8 inches in length.

2. Stakes for coconut logs shall be nominal 2-inch square, minimum 35 inches in length.

I. Metal staples for fastening coir mats shall be 11-gauge wires formed into a staple shape with minimum dimensions of 6 inches by 1 inch by 6 inches.

J. Dormant live cuttings for bioengineering erosion control shall be as follows:

1. Length: 2.5-foot minimum, 4 foot maximum

2. Diameter: 0.5-inch minimum, 2 inch maximum

3. Acceptable species include: silky dogwood (*Cornus amonum*), gray *dogwood (Cornus racemosa*), red osier dogwood (*Cornus stolonifera*), cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*), pussy willow (*Salix discolor*), sandbar willow (*Salix exigua*), black willow (*Salix nigra*), silky willow (*Salix sericea*), elderberry (*Sambucus canadensis*), and arrow wood (*Viburnum dentatum*). Additional species may be used upon approval by the Restoration Ecologist.

K. Fertilizer:

1. Furnish commercial grade fertilizer, uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists.

2. Fertilizer shall be slow release complete fertilizer.

3. Fertilizer for application within the area shall be 34-0-10; other fertilizers may be approved by the Construction Manager or Restoration Ecologist. Fertilizers shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.

4. Fertilizer must have MSDS submitted in accordance with this Section.

5. Fertilizer shall be used for interim seeding only.

L. Construction water shall be obtained from the on-site water source as directed by the Construction Manager.

2.2 EQUIPMENT

A. Provide equipment of size and type to perform work specified in this Section.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver containerized materials in uniform packages bearing the name of the manufacturer, the net weight and a statement of content. Deliver containerized materials to the site in original, properly labeled, unopened, clean containers each showing the manufacturer's guaranteed analysis conforming to applicable regulations and standards.

B. Store materials in a dry area in a manner to prevent physical damage.

3.2 GENERAL

A. Stabilization of disturbed areas by vegetation or by use of a crusting agent shall be performed at completion of excavation and stockpiles or within 7 calendar days of knowing a disturbed area will be idle for more than 45 calendar days, whichever is sooner.

B. Crusting agents may be used as temporary measures prior to placement of interim vegetation after approval for the area by the Construction Manager.

C. Disturbed areas which are scheduled to be significantly disturbed after initial stabilization and/or need effective erosion control immediately, are to be stabilized with the interim seed mix rate specified in this Section. Disturbed areas, which are not scheduled to be significantly disturbed again, are to be stabilized with the permanent seed mix rate specified in this Section. Soil piles, which require effective erosion control immediately, are to be stabilized with the interim seed mix rate or a crusting agent as specified in this Section.

D. Stabilization of permanent slopes steeper than 3H:1V (horizontal to vertical) shall utilize coir matting as specified in Section 3.5 of this specification after application of seed mixture, unless otherwise specified by the Construction Manager or Restoration Ecologist.

E. Area(s) to be seeded shall be generally free of debris, rock, root material, and other objects that may impede soil preparation and seeding activities. Perform soil preparation by tilling/cultivating, to a depth of approximately 2 inches, to eliminate uneven areas and low spots. Maintain lines, levels, and contours.

F. Repeat cultivation in areas where equipment used for hauling and spreading has compacted the area(s) to be seeded.

3.3 APPLICATION OF SEED AND CRUSTING AGENT

A. The seeding season, for interim vegetation specified in this Section, is year round. However, if seeding is contemplated during the winter months of December through March, then field conditions should be assessed for ability to provide soil to seed contact. If field conditions do not support the ability to provide soil to seed contact then the area shall be stabilized with a crusting agent followed by seeding during conditions conducive to adequate soil to seed contact.

B. The seeding seasons for permanent seeding in wet and dry areas are Spring Season between March 1 and July 1 and Fall Season between September 1 and November 15.

C. Apply fertilizer, seed, and mulch to disturbed areas and areas excavated and graded under this Contract requiring seeding unless otherwise directed by the Construction Manager. Apply mulch within 24 hours of seeding; do not seed areas in excess of that which can be mulched within 24 hours. Winter application of seed and related materials are subject to adjustment as directed by the Construction Manager.

D. Apply seed using either the drilling, broadcasting, or hydroseeding method, as described below:

1. Seed drilling method:

a. This method shall be used for applying the permanent seed mix in accessible areas unless otherwise approved by the Construction Manager. The method may also be used for interim vegetation.

b. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches.

c. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.

d. Install seed with a seed drill to obtain a final planting depth of ¼ to ½ inch using the seed rates indicated in Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section. All seed drilling should be done perpendicular to the direction of surface-water flow.

2. Broadcast Seeding Method:

   a. This method may be used for interim vegetation, and can be performed with the use of mechanical "cyclone" seeders, by hand seeding or by any other method which scatters seed over the soil surface.

   b. This method may also be used for permanent seeding in areas that are not accessible with the seed drill (i.e., sloped areas) as approved by the Construction Manager.

   c. If Broadcast Method is used to apply permanent seed mix in sloped areas (3H:1V slope or steeper), seeding application rates in Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section shall be doubled.

   d. Prepare the area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.

   e. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.

   f. Install seed by broadcasting evenly over the entire site using the seed rates indicated in Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section.

   g. Rake the area after seeding.

   h. Mulch and disc-anchor using weed free mulch at a rate of 2.0 tons per acre. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. During June through September, increase straw mulch application rate to 3 air-dried tons per acre.

3. Hydroseeding Method:

   a. This method may be used for interim vegetation only. Hydroseeding shall be a two-step process. The seed shall be applied first, followed by a separate application of the mulch. This is to ensure soil to seed contact.

   b. The mixture tank shall be cleaned prior to use to ensure remnant seed is not introduced to the proposed seed mixture.

   c. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.

   d. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre. The fertilizer is to be mixed and applied with the mulch.

e. Install seed by hydroseeding evenly over the entire area using the seed rates indicated in Table 02930-2. Use a fan-type nozzle with approximately 500 gallons of water per acre to ensure even distribution.

f. Rake the area where accessible following seeding.

g. Apply sprayed mulch at a net dry weight of 2,000 pounds per acre minimum and 100 percent continuous coverage. Mix the mulch with water at a ratio of 50 pounds of mulch per 100 gallons of water.

E. Application of Crusting Agent:

1. Apply crusting agent in accordance with manufacturer's directions.

2. Unless otherwise specified by the manufacturer, dilute concentrated pinesap emulsion to ratio of 4 parts water to 1 part concentrate. Apply diluted pinesap emulsion at a rate of 2,500 gallons per acre.

3. Apply a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik mulch binder, using the hydroseeder, at the rate of 1,000 lbs/acre on flat surfaces; and 1,125 lbs/acre on slopes greater than 3H:1V. The mixture rate for each product shall be 20 lbs/acre on flat surfaces and 30 lbs/acre on greater than 3H:1V slopes for the hydraulic mulch; and 20 lbs/acre on flat surfaces and 30 lbs/acre on slopes greater than 3H:1V for the Hydro-Stik mulch binder.

3.4 BIOENGINEERING EROSION CONTROL

A. Following seeding, install coir matting and/or coir logs in areas indicated on the Construction Drawings, on slopes steeper than 3H:1V, or in any other areas prone to erosion, as identified by the Restoration Ecologist. Installation is as follows:

1. Coir matting: Stake coir matting on minimum 5-foot centers with wood stakes, angled upstream/upgradient. Use metal staples for added support, installing staples on minimum 5-foot centers between wood stakes and in additional areas so that the coir matting is in direct contact with the soil. The Restoration Ecologist shall direct the installation of additional stakes and/or staples as necessary. Overlap adjoining sections of coir matting 6 to 12 inches, with the upstream/upgradient matting laid on top. Sew adjoining sections of matting together with coir rope. Bury the upper edge of coir matting in a 6-inch trench.

2. Coir logs: Stake coir logs on 10-foot centers. Install 2 stakes opposite each other and tie the stakes together with coir rope. Sew adjoining coir logs together with coir rope.

B. Secure all coir materials at the end of the day in preparation for unexpected rain events.

C. Dormant live cuttings shall be installed as follows: Cut a point onto the bottom of the live cutting and drive into the soil on 4 foot centers using a dead blow hammer. Drive cuttings (minimum two-thirds, maximum four-fifths of their length) into soil angled slightly downstream/downgradient. Minimize damage to the cuttings when driving into the soil. If necessary, prepare a pilot hole by driving rebar into the soil and removing prior to inserting cuttings. Saw any damaged tops once the cuttings are installed. Dormant live cuttings may be installed into coir matting or other areas prone to erosion as directed by the Restoration Ecologist.

TABLE 02930–1A
SEED MIX IN DRY AREAS FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Grasses[1]	
Big Bluestem (*Andropogen gerardi*)	3.0
Little Bluestem (*Andropogen scoparius)*	2.0
Side-Oats Grama (*Bouteloua curtipendula*)	0.5
Canada Wild-Rye (*Elymus canadensis*)	10
Annual Rye (*Lolium multiflorum)*	25
Switch grass (*Panicum virgatum*)	0.5
Indian Grass (*Sorghastrum nutans*)	2
Wildflowers [2]:	
Butterflyweed (*Asclepias tuberosa*)	1.5
Smooth Aster (*Aster laevis*)	
Blue False Indigo (*Baptisia australis*)	
Partridge Pea (*Cassia fasciculata*)	
Rattlesnake Master (*Eryngium yuccifolium*)	
Ox-eye Sunflower (Heliopsis helianthoides)	
Round-headed Bush Clover (*Lespedeza capitata*)	
Bergamot (*Monarda fistulosa*)	
Purple Coneflower (*Echinacea purpurea*)	
Sweet Joe Pye-Weed (*Eupatorium purpureum*)	
Beardtongue (*Penstemon grandiflorus*)	
Yellow Coneflower (*Ratibida pinnata*)	
Black-Eyed Susan (*Rudbeckia hirta*)	
Stiff Goldenrod (*Solidago rigida*)	
Spiderwort (*Tradescantia ohioensis*)	
Hoary Vervain (*Verbena stricta*)	

[1] – Eliminate annual rye and reduce Canada wild rye seed rates to 5 lb/ac when overseeding existing prairie areas.

[2] – Wildflower mix to be apportioned according to species aggressiveness and seed counts as determined by the Restoration Ecologist. If certain species are not available, appropriate substitutions will be determined by the Restoration Ecologist.

TABLE 02930–1B
SEED MIX IN WET AREAS[1] FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Grasses and Other Graminoids [2]	
Big Bluestem (Andropogen gerardi)	3
Blue Joint Grass (Calamagrostis canadensis)	0.5
Porcupine Sedge (*Carex hystericina*)	1 ounce per acre (oz/ac)
Fox Sedge (*Carex stipata*)	1 ounce per acre (oz/ac)
Virginia Wild-Rye (*Elymus virginicus*)	10
Annual Rye (*Lolium multiflorum*)	25
Switch Grass (Panicum virgatum)	0.5
Dark Green Bulrush (*Scirpus atrovirens*)	1 ounce per acre (oz/ac)
Prairie Cordgrass (*Spartina pectinata*)	1
Wildflowers [3]:	1.5
Angelica (*Angelica atropurpurea*)	
Red Milkweed (*Asclepias incarnata*)	
New England Aster (*Aster novae-angliae*)	
Wild Senna (*Cassia hebecarpa*)	
Spotted Joe-Pye Weed (*Eupatorium maculatum)*	
Sweet Joe-Pye Weed (*Eupatorium purpureum*)	
Sawtooth Sunflower (*Helianthus grosserratus*)	
Cardinal Flower (*Lobelia cardinalis*)	
Great Blue Lobelia (*Lobelia siphilitica)*	
Yellow Coneflower (*Ratibida pinnata*)	
Blue Vervain (*Verbena hastata*)	

[1] – Seeding in drainage ditches or swales shall contain erosion mats as specified in Section 02270 after application of seed mixture.

[2] – Eliminate annual rye and reduce Virginia wild rye seed rates to 5 lb/ac when overseeding existing wet areas.

[3] – Wildflower mix to be apportioned according to species aggressiveness and seed counts as determined by the Restoration Ecologist. If certain species are not available, appropriate substitutions will be determined by the Restoration Ecologist.

TABLE 02930–2
SEED MIX FOR INTERIM VEGETATION

Species	Pounds Per Acre (lb/ac)
ReGreen	50
Canada Wild-Rye (Elymus canadensis)	20
Annual Rye (*Lolium multiflorum*)	20
Partridge Pea (*Cassia fasciculata*)	2 ounces
Black-Eyed Susan (*Rudbeckia hirta*)	2 ounces

[END]

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Fernald Preserve

Restored Area Maintenance Plan

February 2010

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Contents

Abbreviations iii
Executive Summary v
1.0 Introduction 1–1
1.1 Purpose 1–1
1.2 Background for Plan Development 1–1
1.3 Site Description 1–2
1.3.1 Fernald Preserve Geography and Geology 1–2
1.3.2 Fernald Preserve Current Land Use 1–2
1.4 Scope 1–4
2.0 Restored Area Operations 2–1
2.1 NRRP Goals 2–1
2.2 Comprehensive Legacy Management and Institutional Controls Plan Inspections 2–1
2.3 Ecological Monitoring and Adaptive Management 2–2
3.0 Replanting Activities 3–1
3.1 Woody Vegetation 3–1
3.2 Herbaceous Vegetation 3–1
4.0 Restored Area Maintenance Activities 4–1
4.1 Invasive Species and Noxious Weed Control 4–1
4.2 Water Management 4–3
4.3 Erosion Control 4–3
4.4 Wildlife Amenities 4–3
4.5 Nuisance Animal Control 4–4
4.5.1 Physical Barriers 4–4
4.5.2 Trapping 4–4
4.5.3 Scare Tactics and Hazing 4–5
4.5.4 Culling 4–5
4.6 Grassland Maintenance 4–5
4.6.1 Mowing 4–6
4.6.2 Prescribed Burning 4–6
4.7 Trails, Signs, Displays, and Overlooks (Public Use Amenities) 4–6
5.0 Schedule 5–1
6.0 Reporting 6–1
7.0 References 7–1

Figures

Figure 1–1. Fernald Preserve Ecological Restoration Projects 1–5
Figure 1–2. Fernald Preserve Current Land Use 1–6
Figure 4–1. Fernald Preserve Mowing Map 4–7

Tables

Table 3–1. Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve 3–3
Table 4–1. Control Methods for Species of Concern 4–2
Table 5–1. Scheduling of Maintenance Activities 5–2

Appendixes

Appendix A Planting Specifications
Appendix B Seeding Specifications

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
LMICP	*Comprehensive Legacy Management and Institutional Control Plan*
NRRP	Natural Resource Restoration Plan
NRT	Natural Resource Trustee
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OSDF	On-Site Disposal Facility
WFMP	Wildland Fire Management Plan

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Executive Summary

The Fernald Preserve Restored Area Maintenance Plan describes how the U.S. Department of Energy (DOE) will maintain the ecologically restored areas at the Fernald Preserve to ensure their success. Maintenance of restored areas is aimed at facilitating progress of the restored areas to achieving the restoration goals and maintaining the function of onsite restored ecological communities.

The Fernald Preserve is situated on a 1,050-acre tract of land, approximately 18 miles northwest of Cincinnati, Ohio. The site is located near the unincorporated communities of Ross, Fernald, Shandon, and New Haven in Hamilton and Butler Counties. It is a former uranium-processing facility that 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 an undeveloped park, encompassing wetlands, prairies, and forest. When the large-scale soil remediation and waste disposition was completed in the fall of 2006, the site was successfully transitioned to the DOE Office of Legacy Management. The Fernald Closure Project was then renamed the Fernald Preserve.

This plan is stipulated through the Fernald Preserve Natural Resource Restoration Plan (NRRP) which is Appendix B of the *Partial Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008), that settled a long-standing natural resource damage claim under Section 107 of CERCLA. The Consent Decree was signed in the fall of 2008 by DOE and the State of Ohio. The NRRP calls for the Fernald Natural Resource Trustees (DOE, OEPA, and the U.S. Department of Interior) to develop a plan for maintenance of ecologically restored areas.

This *Restored Area Maintenance Plan* addresses all activities associated with meeting the goals of the NRRP and project-specific restoration design plans, as well as DOE's legacy management responsibilities for the Fernald Preserve. Specific tasks include vegetation establishment via planting and seeding, control of invasive species, management of water levels in wetlands and open water areas, steps to address erosion control issues, management of nuisance animals, maintenance of grassland areas including prairies and old fields, and upkeep of public use amenities, such as trails and overlooks.

The plan provides a general schedule for implementation of maintenance activities and also outlines the process for reporting to National Resource Trustees and other stakeholders. Planting and seeding specifications are included as appendixes to this plan.

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1.0 Introduction

Ecological restoration was part of the remedy of the Fernald Preserve. It is also a requirement of the settlement of the Natural Resources Damages claim filed by the State of Ohio against the U.S. Department of Energy (DOE). Restored area maintenance is required at the Fernald Preserve to ensure that restoration efforts continue to be successful, resulting in properly functioning ecosystems, and to ensure that natural resources are protected in accordance with appropriate laws and regulations, such as the Clean Water Act and the Endangered Species Act.

1.1 Purpose

This Restored Area Maintenance Plan describes how the restored areas at the Fernald Preserve will be maintained to ensure their success. Long-term maintenance is aimed at facilitating progress of restored areas to achieving the restoration goals and maintaining the function of the ecosystems. Accomplishing this task will require that all components of the various ecosystems are managed to ensure successful establishment. The components of the ecosystems include vegetation, water, soil, and wildlife. If any or all of the components of these ecosystems do not progress as necessary, then the ecosystem as a whole is subject to lesser success. How these components will be maintained and addressed is described in detail in Section 4.0 of this plan.

1.2 Background for Plan Development

The Fernald Natural Resource Trustees (NRTs) consist of DOE, the Ohio Environmental Protection Agency (OEPA), and the U.S. Department of the Interior (DOI). They have been meeting since 1994 to oversee planning, design, implementation, monitoring, and maintenance of ecological restoration projects at the Fernald Preserve. In November 2008, DOE and the State of Ohio signed a Consent Decree that settles a long-standing natural resource damage claim under Section 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This Consent Decree stipulates that maintenance activities are required, as they are critical to the success of the restoration efforts at the Fernald Preserve.

Goal and objectives of the NRTs are stipulated in a Natural Resource Restoration Plan (NRRP), which is Appendix B of the *Partial Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE* (State of Ohio 2008) for the Fernald site. The NRRP serves as the conceptual ecological restoration plan for the site. It outlines the approach for site restoration through a series of projects that were integrated into the CERCLA remediation process. The NRRP was first drafted in 1998, but was not finalized until fall 2008, upon signing the Consent Decree.

The NRRP describes the conceptual restoration for 11 projects across the site. These projects are shown on Figure 1–1 and include the following:

- Wetland Mitigation – Phase I
- Area 8, Phase II Revegetation
- Southern Waste Units Restoration
- Northern Pine Plantation Enhancement (includes Northern Woodlot Enhancement)
- Wetland Mitigation – Phase II

- Paddys Run Corridor Expansion East
- Paddys Run Corridor Expansion West
- Borrow Area Restoration (includes the Aesthetic Barrier along Willey Road and the OSDF perimeter buffer)
- Silos Area
- Former Production Area
- Waste Pit Area (includes Paddys Run Stream Restoration)

For each of these projects, one or more Natural Resource Restoration Design Plans (NRRDP) was developed. The NRRDPs provided detailed designs for construction, as well as project-specific monitoring and maintenance requirements. Several "Non-Design" restoration areas were also constructed using general restoration design criteria rather than specific plans. DOE moved forward with the development and implementation of these ecological restoration projects as part of site closure. Projects were sequenced following remediation and certification of portions of the site. Restoration construction took place form 1999 to 2006. Once all projects were completed, over 900 acres of the 1,050-acre site were ecologically restored.

With all ecological restoration projects now completed, the Fernald Preserve has transitioned to the current land use as described in Section 1.3.2 below. The site must be managed as a whole rather than as a series of stand-alone projects. The final NRRP addresses this issue by requiring that a maintenance plan be written (this plan) that will function as a guide for the maintenance activities necessary at the Fernald Preserve. The maintenance plan will be in effect for a period of 10 years after its approval, after which time the NRTs will evaluate the need for continued maintenance.

1.3 Site Description

1.3.1 Fernald Preserve Geography and Geology

The Fernald Preserve is situated on 1,050 acres, approximately 18 miles northwest of Cincinnati, Ohio. It is located near the unincorporated communities of Ross, Fernald, Shandon, New Haven, and New Baltimore. The former production area occupied approximately 136 acres in the center of the 1,050 acres. The former waste pit area and the former silos area were located adjacent to the western edge of the production area. Paddys Run 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 outcroppings to the north, southeast, and southwest. The site is situated 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.

1.3.2 Fernald Preserve Current Land Use

As stated above, over 900 acres of the Fernald Preserve were ecologically restored. Areas were graded where needed following remedial excavation activities, amended, planted, or enhanced to

create the early stages of ecosystems comparable to native pre-settlement southwestern Ohio. The specific habitats restored include upland forest; riparian forest; tall-grass prairie and savanna; and wetlands and open water. Previously existing habitats, such as the pine plantations, were altered in ways that would enhance those areas to promote wildlife use. Current land use is shown on Figure 1–2.

Following are brief summaries of the habitat restorations. Details of the actual projects and further information on the restored areas are described in the NRRP, project specific NRRDPs, and project completion reports.

Upland Forest: Upland forest areas existed in a northern portion, in a southern portion, and on the western perimeter of the site. Restoration activities were conducted to expand 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 Oak–Hickory/Beech–Maple transition zone.

Riparian Forest: Riparian corridors existed along Paddys Run and the Storm Sewer Outfall Ditch. Restoration activities were conducted to expand these corridors through re-vegetation. 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.

Tall-grass Prairie and Savanna: The waste pit, production, On-Site Disposal Facility (OSDF), and borrow (east 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 on site, the OSDF, located adjacent to both the former production area and the borrow area, was seeded with native prairie grasses to provide a vegetative cover. The native grasses are being used because of their 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 was responsible for providing approximately 17.8 acres of mitigated wetlands under Section 404 of the Clean Water Act. In addition to mitigation wetlands, several other ecological restoration projects include wetland components. A 26-acre wet forest/wet meadow complex was also preserved on site.

1.4 Scope

This Restored Area Maintenance Plan applies to all restored or undeveloped areas of the site. It describes the types of maintenance activities that are required, provides the schedule for those activities, and describes the circumstances under which maintenance might be required. These maintenance activities are necessary to help ensure the successful establishment of the various ecosystems created during ecological restoration of the Fernald Preserve.

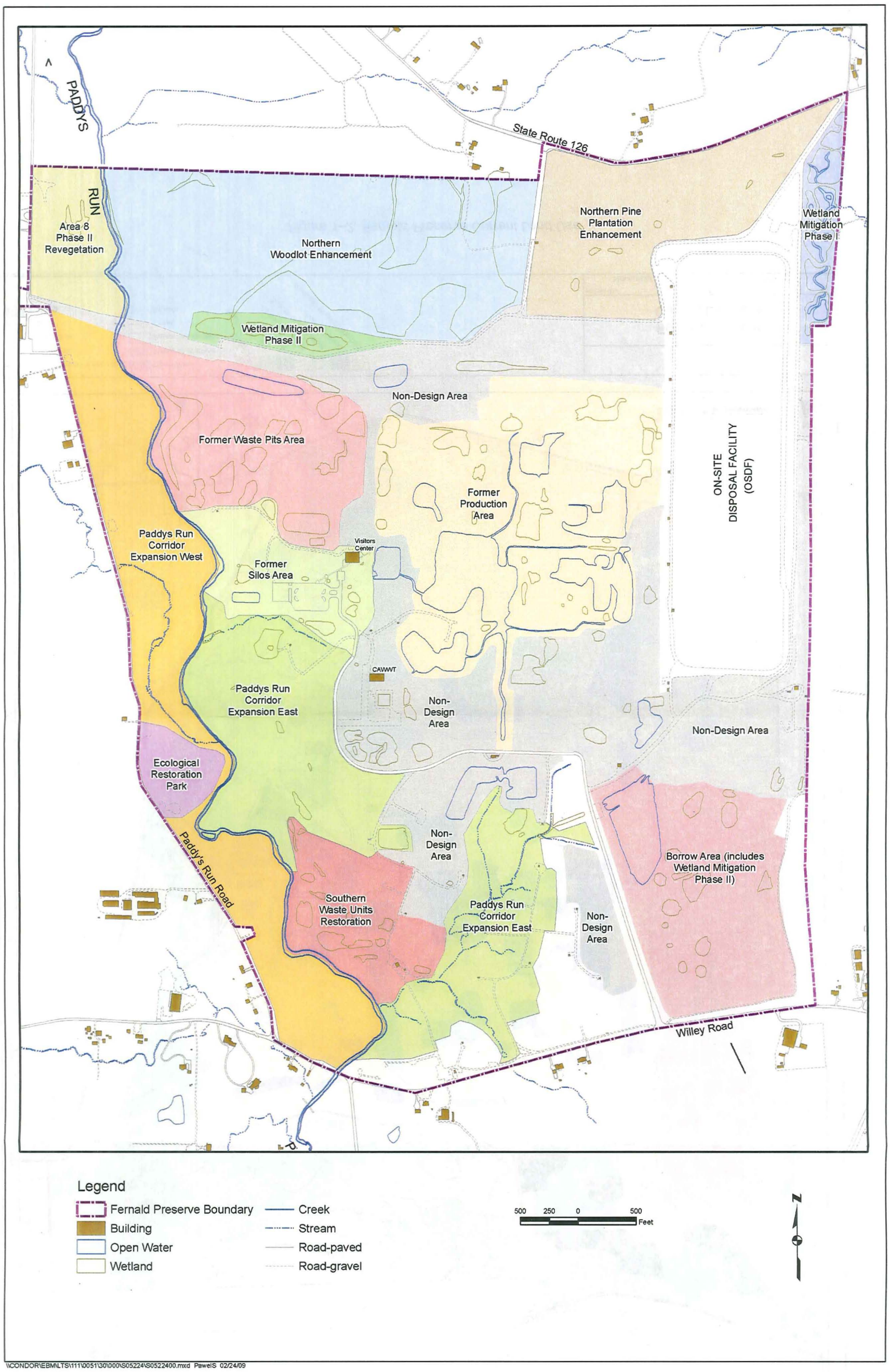

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Figure 1–1. Fernald Preserve Ecological Restoration Projects

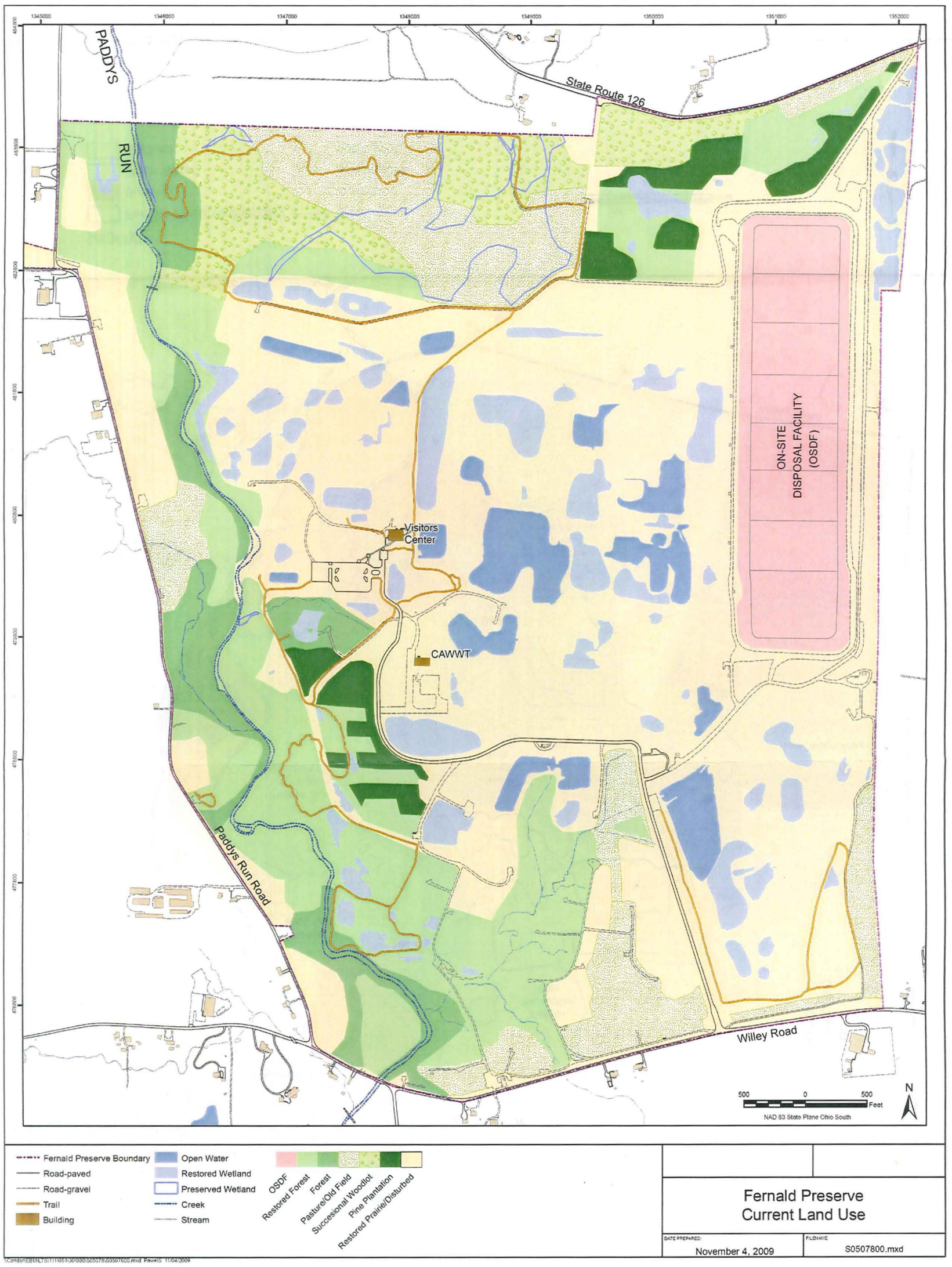

Figure 1–2. Fernald Preserve Current Land Use

2.0 Restored Area Operations

2.1 NRRP Goals

The goal of the NRRP is to resolve past, present, and future natural resource impacts at the Fernald Preserve while meeting regulatory commitments and addressing stakeholder concerns. The NRRP was developed with input from the NRTs and the stakeholders. The specific administrative goals that guided the development of the NRRP are as follows:

- Establish a restoration plan that is satisfactory to the NRTs;
- Ensure the Fernald Preserve is transitioned to the selected final land use for the site and considers the interests of stakeholders to the degree possible and will accommodate future public use as determined appropriate;
- Ensure that restoration of the Fernald Preserve is conducted in a manner that is consistent with the established risk levels and decisions reached in various operable unit records of decision; and
- Establish a restoration plan that is fully integrated with the remedial design and remedial action processes at the site.

2.2 Comprehensive Legacy Management and Institutional Controls Plan Inspections

The *Comprehensive Legacy Management and Institutional Controls Plan* (LMICP) (DOE 2009a) states that the Fernald Preserve property will be inspected annually. The site was divided into four areas. One area is inspected each quarter, resulting in a complete inspection of the entire property during the course of the year. Part of the purpose of these inspections is to ensure that the desired results from restoration efforts are being achieved (seeded areas are becoming established, wetlands are holding water, etc.). In addition the presence and impact of nuisance and invasive species, both flora and fauna alike, are assessed.

While not intended to become a functioning prairie ecosystem, the OSDF cap is inspected quarterly. The OSDF cap is inspected to ensure that it is in good condition and functioning properly (no subsidence, no standing water, no erosion, or other breeches). The inspection also includes ensuring the proper establishment of the grasses, primarily for erosion control purposes. The OSDF cap was seeded with native prairie grasses and forbs.

To ensure continued safe use by the public, weekly inspections of the trails and overlooks are conducted at the Fernald Preserve. Additional detail on these inspections is included in Section 4.7.

Findings from all of the inspections mentioned above are recorded into a database. A determination on appropriate repair or required maintenance is made and the finding is corrected. Some examples of corrective actions are: re-seeding, re-planting, herbicide application, and deer ex-closure fence repair. Once the repair or correction has been made, the resolution is documented in the database as well. This Maintenance and Repair Action Items List is included as part of the quarterly site and OSDF inspection reports that are submitted to the regulators.

2.3 Ecological Monitoring and Adaptive Management

Requirements for ecological monitoring are explained in detail in the NRRP. Two phases of monitoring, implementation and functional, have been conducted at the Fernald Preserve since restoration activities began. Monitoring is used in part to determine the appropriate course of action with respect to maintenance. This process, termed '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." This process allows flexibility in making decisions regarding needed maintenance and management of restored areas. Restored areas are very dynamic in nature and set standards or rules may not always apply to all situations in the field. The goal of restored area inspections, monitoring, and the use of adaptive management will be to optimize the progress of restored areas towards functional success and eventual trending towards a mature ecosystem through the natural succession process.

The maintenance activities discussed below provide general guidance. New approaches and specific maintenance activities may result from the adaptive management concept. Likewise, restoration areas require periodic evaluation to assess future maintenance actions. Original goals and objectives for a particular area may be revised based on monitoring results and field observations.

3.0 Replanting Activities

Replanting activities may become necessary for numerous reasons, some of which include lack of germination, heavy foraging by wildlife, affects of extreme weather conditions, and future construction or ground disturbance activities. The NRRP provides general guidance regarding the siting of re-vegetation efforts and the selection of specific plants. Project-specific NRRDPs included detailed planting and seeding plans. This plan will serve as the planting and seeding plan for re-vegetation efforts with site maintenance activities.

3.1 Woody Vegetation

There are two scenarios where planting woody vegetation is conducted at the Fernald Preserve. The first scenario involves replacement of individual plants due to mortality. In this case, an attempt will be made to replant with the same species of plant. If the species is unavailable or unknown, then a similar type of plant will be installed pursuant to the guidelines in Table 3–1. This table lists the form, function, and acceptable habitat types for all trees and shrubs available for planting at the site.

The second scenario involves more large-scale planting efforts that are designed to replace, enhance or expand existing restoration efforts. Again, the intent of the original planting efforts as detailed in project-specific NRRDPs will be replicated, unless site conditions do not warrant additional planting within an area. If the NRTs decide 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). Table 3–1 will be used as a guide for design of planting templates.

Conventional planting plans in NRRDPs will continue to be used for replanting activities. NRRDPs usually specified a planting density of 165 canopy and understory trees per acre and 92 shrubs per acre. These densities were usually augmented with bareroot seedling installation at approximately 400 stems per acre. Trees and shrubs are procured either as balled and burlap or container grown. Herbaceous plugs were typically planted on two-foot centers, for an approximate density of 11,000 plants per acre. Placement of plants is randomized across the "planting patch," with provisions for certain species based on specific habitat requirements as specified in Table 3–1. In general, planting activities would be undertaken pursuant to the specifications provided in Appendix A. Revisions to these planting specifications may be needed based on project-specific requirements. Also, vegetation will be protected from deer and other nuisance animals as discussed in Section 4.5.1 of this plan.

3.2 Herbaceous Vegetation

Herbaceous vegetation is established through the establishment of potted plugs or seed. Seeding is typically used for large-scale prairie and wetland establishment, as well as slope-stabilization and erosion control. Potted plugs are used primarily for wetland creation. Reseeding and/or reestablishment of herbaceous plugs may be required within restored areas for a variety of factors, including poor germination due to soil conditions, drought, and impacts from nuisance animals. As with woody vegetation, the NRTs may determine that additional seeding and plugging is desired in order to enhance or expand some areas.

Seeding is conducted via seed drill, broadcast or hydromulch. Specific methods will be determined based on access, time of year, species seeded and project-specific objectives. The seeding specifications in Appendix B detail the seeding process for the Fernald Preserve. The seed mixes listed in Appendix B are consistent with the list provided in Table 3–2 of the NRRP. Again, seeding specifications may be revised as a result of project-specific requirements.

Table 3–1. Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
Acer nigrum	black maple	canopy tree	cover	B	Similar to *Acer saccharum,* but likes slightly moister conditions.
Acer rubrum	red maple	canopy tree	cover	H R W	Tolerates a wide variety of conditions. Can pioneer disturbed sites
Acer saccharinum	silver maple	canopy tree	cover	R W	Fast growing. Pioneers disturbed banks following *Populus deltoides*
Acer saccharum	sugar maple	canopy tree	cover, mast	B H	Co-dominant in beech-maple forest
Aesculus glabra	ohio buckeye	understory tree	diversity	R W	Tolerates a wide variety of conditions. Avoided by deer
Aesculus octandra	yellow buckeye	understory tree	diversity	O	Generally found east of FEMP in unglaciated portions of Ohio
Alnus serrulata	brookside alder	shrub	cover	R W	Obligate wetland species
Amelanchier arborea	downy serviceberry	shrub	fruit, diversity	H R W	Found mostly east of FEMP. Associated with *Acer rubrum*
Amelanchier laevis	allegheny serviceberry	shrub	cover	O	Not common in Ohio. Abundant in southern Appalachian highlands
Amorpha fruticosa	false indigo-bush	shrub	cover	W	Fast growing. Avoided by deer. Facultative wetland species
Aronia melanocarpa	black chokeberry	shrub	aesthetics	O	Found in wet areas and dry ledges/slopes. Found mostly east of FEMP
Asimina triloba	paw paw	understory tree	fruit, diversity	B R	Forms clustered stands in forest understory. Tap root
Campsis radicans	trumpet creeper	vine	aesthetics	R E	Showy. Naturalized in Ohio
Carpinus caroliniana	hornbeam	understory tree	diversity, mast	B R	Very shade tolerant. Found in moist and mesophytic woods
Carya cordiformis	bitternut hickory	canopy tree	cover	B H R	Common *Carya* spp. at FEMP. Tap root
Carya laciniosa	shellbark hickory	canopy tree	cover, mast	R	Found in moist to wet sites and along streams
Carya ovata	shagbark hickory	canopy tree	cover, mast	H R W	Similar to *Carya laciniosa*, but found in drier areas as well
Castanea dentata	chestnut	canopy tree	diversity, mast	O	Rare due to chestnut blight. Historically found mostly east of FEMP
Ceanothus americanus	new jersey tea	shrub	diversity	H R W	Found mostly east of FEMP
Celastrus scandens	bittersweet	vine	diversity	R	Drought and flood tolerant
Celtis occidentalis	hackberry	canopy tree	diversity	R E	Common at FEMP in a variety of habitats
Cephalanthus occidentalis	buttonbush	shrub	cover	W	Emergent species that forms pure stands
Cercis canadensis	redbud	understory tree	aesthetics	H E	Showy edge species
Cornus alternafolia	alternate-leaved dogwood	understory tree	diversity, cover	B R	Found mostly east of FEMP
Cornus amomum	silky dogwood	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Cornus drumondii	roughleaf dogwood	shrub	cover	H E	Edge species

Table 3–1 (continued). Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
Cornus florida	flowering dogwood	understory tree	aesthetics	H	Showy shade tolerant species
Cornus racemosa	grey dogwood	shrub	cover	H	Seems to compete well with *Lonicera mackii*
Cornus stolonifera	red-osier dogwood	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Corylus americana	hazel nut	shrub	diversity	R W	Found in a variety of habitats. Can form large patches
Crataegus crus-galli	cockspur hawthorne	shrub	diversity	E	Thorny edge species
Crataegus mollis	downy hawthorne	understory tree	cover	B	Thorny
Crataegus phaenopyrum	Washington hawthorne	understory tree	diversity	E	Thorny
Decodon verticillatus	water willow	shrub	diversity	W	Emergent species
Diospyros virginiana	persimmon	understory tree	fruit	O	Edible fruit. Found mostly east of FEMP in unglaciated areas
Euonymus atropurpureus	eastern wahoo	understory tree	aesthetics	R	Showy
Fagus grandifolia	beech	canopy tree	cover, mast	B	Co-dominant in beech-maple forest
Fraxinus americana	white ash	canopy tree	cover	B H	Avoid future use due to emerald ash borer
Fraxinus nigra	black ash	canopy tree	cover, diversity	R W	Avoid future use due to emerald ash borer
Fraxinus pennsylvanicum	green ash	canopy tree	cover	R	Avoid future use due to emerald ash borer
Fraxinus quadrangulata	blue ash	canopy tree	cover, diversity	H	Avoid future use due to emerald ash borer
Gymnocladus dioica	kentucky coffeetree	canopy tree	diversity	H	Most common in southwestern portion of Ohio
Hamamelis virginiana	witch hazel	understory tree	cover	B	Found in a variety of habitats singularly or in groups
Hydrangea arborescens	wild hydrangea	shrub	aesthetics	O	Found in ravines and shaded bluffs
Hypericum spathulatum	shrubby st. john's wort	shrub	diversity	W	Showy species that can form large patches
Ilex verticallata	winterberry	shrub	aesthetics	W	Found mostly east of FEMP
Juglans cinerea	butternut	canopy tree	mast, diversity	O	Rare Ohio species
Juglans nigra	black walnut	canopy tree	mast, diversity	B R	Allelopathic. Can form pure stands
Juniperus virginiana	eastern red cedar	understory tree	cover	E	Only coniferous species native to FEMP
Lindera benzoin	spicebush	shrub	cover	B	Common shrub of beech-maple forest
Liquidambar styraciflua	sweetgum	canopy tree	diversity	O	Southern tree found mostly east and south of FEMP
Liriodendron tulipifera	tulip poplar	canopy tree	cover, aesthetics	B H	Tallest deciduous species in the eastern U.S.
Lonicera sempervirens	trumpet honeysuckle	vine	aesthetics	O	Southern species uncommon in Ohio
Morus rubra	red mulberry	understory tree	fruit	E	Fast growing. Shade tolerant
Nyssa sylvatica	black gum	canopy tree	diversity, aesthetics	H R	Found in a variety of habitats
Ostrya virginiana	hop-hornbeam	understory tree	diversity	B R W	Found in a variety of habitats
Parthenocissus quinquefolia	Virginia creeper	vine	diversity	H	Showy in autumn

Table 3–1 (continued). Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
Physocarpus opulifolius	ninebark	shrub	diversity	E	Plant in open areas
Platanus occidentalis	sycamore	canopy tree	cover	R E	Fast growing streamside spp. Can also pioneer old fields
Populus deltoides	cottonwood	canopy tree	cover	R E	Fast growing streamside spp. Can also pioneer old fields
Prunus americana	American plum	understory tree	diversity, fruit	E	Forms large patches
Prunus serotina	black cherry	canopy tree	fruit	B	Found in a variety of habitats. Largest *Prunus* spp. In Ohio
Prunus virginiana	choke cherry	shrub	cover	O	Found mostly north of FEMP
Quercus alba	white oak	canopy tree	cover, mast	H	Found in a variety of habitats
Quercus bicolor	swamp white oak	canopy tree	cover, mast	R W	Flood tolerant bottomland spp
Quercus coccinea	scarlet oak	canopy tree	cover, mast	H	Found mostly east of FEMP
Quercus inbricaria	shingle oak	canopy tree	diversity	H	Found in a variety of habitats
Quercus macrocarpa	bur oak	canopy tree	diversity, mast	R S	Burn resistant woody dominant of savanna habitat
Quercus muehlenbergii	chinquapin oak	canopy tree	diversity, mast	H	Most common in southwestern portion of Ohio
Quercus palustris	pin oak	canopy tree	cover	R W	Can form pure stands in bottomlands
Quercus prinus	chestnut oak	canopy tree	diversity	O	Found mostly east of FEMP in unglaciated areas
Quercus rubra	red oak	canopy tree	cover, mast	B H	Found in a variety of upland habitats
Quercus shumardii	shumard oak	canopy tree	diversity, mast	H	Southern tree found in southwest Ohio
Quercus velutina	black oak	canopy tree	cover, mast	H	Similar to *Quercus rubra*
Rhus aromatica	fragrant sumac	shrub	cover, aesthetics	H	Prefers dry, gravelly, rocky banks
Rhus glabra	smooth sumac	shrub	aesthetics	E	Showy species. Most abundant *Rhus* spp. In Ohio
Rhus typhina	staghorn sumac	shrub	aesthetics	E	Similar to *Rhus glabra*
Ribes americanum	black currant	shrub	diversity	O	Found mostly north of FEMP
Rosa caroliniana	carolina rose	shrub	aesthetics	E S	Prefers dry open areas
Rosa palustris	swamp rose	shrub	aesthetics	R W	Prefers wet areas and banks of slow-flowing stream
Rosa setigera	prairie rose	shrub	aesthetics	E S	Can form large stands
Rubus allegheniensis	blackberry	shrub	fruit	E	Thorny. Edible fruit
Rubus occidentalis	black raspberry	shrub	fruit	E	Thorny. Edible fruit
Salix amygdaloides	peach-leaf willow	understory tree	cover	R	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix discolor	pussy willow	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix eriocephala	heart-leaved willow	shrub	diversity	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix exigua	sandbar willow	understory tree	cover	R	Can reproduce by dormant live cuttings. Suitable for

Table 3–1 (continued). Master List of Trees and Shrubs Used in Natural Resource Restoration at the Fernald Preserve

Scientific Name	Common Name	Form	Function	Use	Comments
					erosion control
Salix humila	prairie willow	shrub	cover	S	Can reproduce by dormant live cuttings.
Salix nigra	black willow	understory tree	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Salix sericea	silky willow	shrub	cover	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Sambucus canadensis	elder	shrub	fruit	R W	Can reproduce by dormant live cuttings. Suitable for erosion control
Sassafras albidum	sassafras	understory tree	diversity	H E	Can form pure stands
Smilax rotundifolia	greenbriar	shrub	diversity	O	Thorny
Spiraea alba	meadow sweet	shrub	aesthetics	W	Found mostly north of FEMP
Spiraea tomentosa	steeple bush	shrub	aesthetics	O	Found mostly north and east of FEMP
Staphylea trifolia	bladdernut	shrub	diversity	B H R	Prefers shaded banks
Symphoricarpos orbiculatus	coral berry	shrub	diversity	E	Can form large patches in disturbed areas
Tilia americana	basswood	canopy tree	cover, aesthetics	B	Common in glaciated portion of Ohio
Ulmus americana	american elm	canopy tree	cover	O	Found in a variety of habitats. Impacted by dutch elm disease
Ulmus rubra	slippery elm	canopy tree	cover	H R	Found in a variety of habitats
Vaccinium corymbosum	highbush blueberry	shrub	fruit	O	Boreal relic found in wet areas within glaciated portion of Ohio
Viburnum acerifolium	mapleleaf viburnum	shrub	diversity	B	Associated with *Fagus grandifolia*
Viburnum dentatum	arrowwood	shrub	cover	O	Found mostly east of FEMP
Viburnum lentago	nannyberry	shrub	cover	O	Found mostly north of FEMP
Viburnum prunifolium	blackhaw viburnum	understory tree	cover	B H	Found in a variety of habitats singularly or in groups
Zanthozylum americanum	prickly ash	understory tree	diversity	E	Thorny. Can form large stands

Use Key:
B = beech-maple forest template
H = oak-hickory forest template
R = riparian template
W = wetland template
E = edge habitat template
S = savanna template
O = other species

4.0 Restored Area Maintenance Activities

In order to ensure the success of restoration efforts at the Fernald Preserve, maintenance of these areas is necessary. Pursuant to the NRRP, the types of maintenance activities that will be required include invasive species and noxious weed control, water management, erosion control, wildlife amenities maintenance, nuisance animal control, and maintenance of public use amenities. Specific maintenance requirements and methods are discussed in greater detail later in this section.

4.1 Invasive Species and Noxious Weed Control

A very important component of restoration of the site involves the removal or extirpation of invasive and aggressive species to the degree practicable. Without some control, invasive and aggressive species may impede or prevent the natural succession process by out-competing native plants and alter the intended course of maturation for restored areas. DOE is also required to manage state-listed noxious weeds pursuant to state regulations. Examples of the invasive species or noxious weeds at the Fernald Preserve include, but are not limited to various thistle species (*Cirsium arvense*, *Cirsium vulgare*, *Carduus nutans*), amur honeysuckle (*Lonicera maackii*), multiflora rose (*Rosa multiflora*), reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), Johnson grass (*Sorghum halepense*), tree of heaven (*Ailanthus altissima*), garlic mustard (*Alliaria petiolata*), and teasel (*Dipsacus fullonum*). At the Fernald Preserve, all state-listed noxious weeds will be treated as necessary.

Various methods are used, depending on the species and its location on the Fernald Preserve, to aid in the control and/or elimination of these species. Mowing, mechanical removal, and chemical applications (herbicides) are the primary methods used. In most cases, combinations of these methods are used, providing even better control. An example of a combination of methods used is first cutting down a honeysuckle shrub and then applying herbicide to the stump or to the re-sprouting vegetation. A second example is first mowing a field and then spot spray about 2 weeks later with a broad leaf herbicide for thistle control. Table 4–1 lists the primary control methods for species of concern at the Fernald Preserve.

Much care must be taken when applying herbicides. While very effective, the type of herbicide used may have adverse affects on native species or the immediate surroundings of the unwanted plant as well. For example, a broad leaf herbicide may be suitable for the elimination of thistle, but will also impact numerous forbs should the chemical come into contact with them. Another example is that 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 environments. The use of chemical application as a means of control of invasive and aggressive species is closely monitored at the Fernald Preserve. The plants being treated, the chemical being used, and the area in which the application occurred are documented. All herbicide applications are conducted under the supervision of appropriately licensed and trained personnel.

Table 4–1. Control Methods for Species of Concern

Species	Common Name	Control Alternatives	Habitat	Timeframe	Comments
Cirsium arvense	Canada thistle (perennial)	• Herbicide applications • Mechanical removal • Mowing	Open fields, sparsely wooded areas	Early spring – early fall	A combination of mowing/cutting followed by herbicide application is an effective method of Canada thistle control. Mechanical removal is least effective, as the roots typically break off in the ground, resulting in quick re-sprout in the immediate location.
Cirsium vulgare	Bull thistle (biannual)	• Herbicide applications • Mechanical removal • Mowing	Open fields, sparsely wooded areas	Early spring – early fall	
Carduus nutans	Musk thistle (biannual)	• Herbicide applications • Mechanical removal • Mowing	Open fields, sparsely wooded areas	Early spring – early fall	
Lonicera maackii	Amur honeysuckle (woody)	• Herbicide applications (foliar or stump) • Mechanical removal	Woodlands and forest edges	Early spring or late fall	Mechanical removal of the shrubs in the fall and applying herbicide to the re-sprouting vegetation in the spring has proven effective at the Fernald Preserve. A combination of cutting the shrub and applying herbicide to the stumps is another common practice. Fall foliar application in late fall (after other species are dormant) is also used.
Rosa multiflora	Multiflora rose (woody)	• Herbicide applications (foliar or stump) • Mechanical removal	Open fields and sparsely wooded areas	Summer – fall	A combination of cutting the shrub and applying herbicide to the stump, even when dormant, is recommended.
Phalaris arundinacea	Reed canary grass (perennial)	• Mowing • Burning • Herbicide applications	Wet areas	Spring	Reed canary grass is extremely difficult to control. Burning is the recommended method of removal. Mowing before seed development can also aid in controlling the spread of the grass. If herbicide is used, it must be suitable for use in aquatic environments.
Phragmites australis	Common reed (perennial)	• Herbicide applications	Wetlands	Spring – summer	Herbicide used must be suitable for use in aquatic environments. Hand removal of seed heads followed by hand application of herbicide is the primary means of control.
Sorghum halepense	Johnson grass (perennial)	• Herbicide applications		Spring – summer	
Ailanthus altissima	Tree of heaven (woody)	• Herbicide applications	Sparsely wooded areas		
Alliaria petiolata	Garlic mustard (biennial)	• Herbicide applications • Mechanical removal			
Dipsacus fullonum	Teasel (biennial)	• Herbicide applications	Open fields, edge of woods, sparsely wooded areas	Spring – summer	

NOTE: For most species, it is very important to apply control methods prior to the development of the seed. In the event that seed is produced prior to control methods being applied (e.g., spraying with herbicide), the seed heads should be removed by hand to aid in the prevention of widespread reproduction.

4.2 Water Management

Water management at the Fernald Preserve is required for wetlands and open water on site. In general, water levels are maintained to maximize vegetation establishment and promote wildlife use. Flooding areas is an effective tool for controlling invasive species infestation. It also can provide open water for waterfowl during spring and fall migrations. Likewise, drawdown of basins during migration periods promotes mudflat habitats for shorebirds. Also, periodic drawdown of wetland basins discourages the establishment of fish, which in turn promotes amphibian habitat.

Some constructed wetlands include water control structures that allow for some manipulation of water levels. Water level control structures are located within the Phase I and II Wetland Mitigation Projects and the Southern Waste Units. Other areas can be manipulated with pumps if necessary.

4.3 Erosion Control

Erosion control and slope stabilization is required in order to maintain the integrity of restored areas. Areas of concern are identified via site inspection and other walk downs. Future erosion repair, if necessary, 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, remedy protection and habitat. NRTs may determine that an eroded area should be left alone because of the habitat loss that would result if a construction activity was undertaken. Likewise, an erosion rill that presents a safety hazard to the public would be prioritized for repair.

The use of bioengineering principles for erosion control is preferred. In cases where vegetation control will not be sufficient, the area will be evaluated by ecologists and engineers, a design for repairs will be prepared, and the appropriate repairs will be carried out. The primary source of guidance and specifications for erosion repair activities is from the Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Manual (ODNR 2006). This document can be accessed online at http://www.dnr.state.oh.us/tabid/9186/default.aspx#Manual. Additional specifications for installation of erosion matting are provided in Appendix B.

4.4 Wildlife Amenities

Various wildlife amenities were installed on site to aid in the habitation of restored areas. Examples of these amenities include bluebird boxes, wood duck boxes, woodpecker boxes, kestrel boxes, raptor platforms, bat boxes, fox dens, snake dens, and salamander habitat. In addition, brush piles were left where feasible to provide shelter for small mammals such as the eastern cottontail. These structures are periodically inspected, monitored, cleaned, and maintained to ensure their integrity and continued use.

Inspection of wildlife amenities is conducted as part of the LMICP Site inspection process. Monitoring to determine use is typically undertaken in the late fall, along with clean-out of any nesting material. Repair activities are usually required due to weathering and wear from use.

4.5 Nuisance Animal Control

While wildlife is desired at the Fernald Preserve, some animals, native and non-native alike can do more harm than good if not controlled. For example, newly planted saplings, seedlings, and shrubs are often scraped or foraged by deer. Newly germinating grasses attract geese. The wildlife can prevent planted and seeded areas from becoming established if permitted to forage heavily on these areas. Therefore, some means of control is often necessary if the restoration is to be successful.

4.5.1 Physical Barriers

The primary method of control used at the Fernald Preserve is using ex-closure fencing to prevent the animals from getting to the newly planted areas. A polyethylene fence may be installed around large planted areas to deter deer from entering the area. The fence is between 9 and 10 feet tall. One or two access locations are installed in the fencing to allow for monitoring and maintenance of the planted areas. A rodent guard, a smaller mesh fencing made of the same material, is installed along the bottom of the fence to deter smaller mammals such as rabbits and groundhogs from entering the area. For smaller areas, such as a small patch of shrubs or around individual trees, welded wire fencing 4 or 5 feet tall is used. This fencing deters deer from scraping their antlers on the tree trunks or browsing on the shrubs.

For open water areas and wetlands, monofilament line is used to create grids a couple of feet above the water surface. These grids are a deterrent for the geese, preventing them from landing on the water surface and potentially foraging on the seed and plugs planted along the waters' edge. The monofilament line is also used to create a barrier at the ground level to prevent geese from accessing the area around the water from the land surface.

Fencing material (wire mesh) is also used to deter beaver from using subsurface drain pipes as travel corridors. The wire mesh was installed at the outlet drain pipe for a pond that was inhabited by several beavers. Wire mesh fence of various sizes was overlapped to keep the openings small enough to prevent the beaver from passing through. Plastic rodent fence (the same used with the deer fence discussed above) was placed on the bottom of the pond below the wire mesh fence and the outlet opening to prevent the beaver from digging to get under the fence.

Physical barriers can also help deter muskrat from digging into dams and pond banks. The most common is to line the bank with riprap, making digging virtually impossible. However, this method is not the most aesthetically pleasing. Another method is to line the bank with fence material (e.g., chain link or wire mesh) to make digging very difficult. Due to the prevalence of existing vegetation, this technique will only be used in newly graded or completely denuded areas. Options for muskrat control are under review.

4.5.2 Trapping

When physical barriers and deterrents are not enough, then more proactive measures sometimes need to be taken. Removal of animals by various methods is also practiced at the Fernald Preserve. Live trapping small mammals and releasing them at another location on site is an occasional practice. In order to trap some animals, permits must be obtained from the ODNR. Trapping permits are only valid during the specified trapping season. In addition, permitted subcontract personnel may be used to remove nuisance animals if necessary.

4.5.3 Scare Tactics and Hazing

Scare tactics and hazing are used on Canada geese at the site. The Canada goose can do a great deal of damage to restored areas, if allowed. The geese will gather in large flocks and forage on newly germinating seeded areas, or will pull newly planted plugs right out of the ground. The scare tactics that are used consist of suspending large "scare eyes" in seeded areas. These are large, beach ball-like objects that have graphics on them that emulate a large predator's eye or gaping mouth. Using a metallic ribbon tied to a wooden stake or post has a similar effect. The metallic ribbon makes noise when the wind blows and reflects sunlight, making the geese uncomfortable. These props need to be moved around on a regular basis for this method to be successful.

A technique called 'hazing' is also used at the Fernald Preserve. Border collies trained to work with geese are used to scare the geese away, with no harm done to the geese. In basic terms, the dogs attempt to gather, or herd, the geese. The geese are threatened by the presence of the dogs and leave. Regular appearances by the dogs will cause the geese to eventually think an area is unsafe and they tend to then stay away on a more permanent basis.

A second goal of hazing is to attempt to prevent the geese from nesting. However, once geese have laid their eggs, they are very unlikely to leave their nest for anything more than a very short period of time. In addition, during the mating and egg-laying season, the adult geese molt, losing their flight feathers. This prevents them from flying any more than a very short distance. During this time, hazing is not going to be successful. Hazing activities are stopped until the adults and young have their flight feathers and can fly long distances, enabling them the leave the property.

4.5.4 Culling

In the event that the deer population at the Fernald Preserve becomes so large that current means of control to protect the vegetation are ineffective, or they become a safety issue, interfering with public use amenities or the with public themselves, further actions may be necessary. Decreasing the deer population by means of a controlled hunt or a sniper is an option, only if deemed absolutely necessary by the NRTs and other stakeholders. DOE will work with ODNR to set up such events, to ensure that all applicable laws and regulations are followed, and that all necessary reporting is completed.

The most proactive method used at the Fernald Preserve for controlling the Canada geese population is egg addling and nest removal. These are effective tools for reducing reproduction of Canada geese. A Goose Damage Permit is issued by ODNR, allowing the conduct of these activities. The permit comes with specific instructions describing how to carry out these activities appropriately and safely. Under no circumstance is harm done to the adult geese. Compliance with the permit also requires that a report of the number of nests destroyed and the number of eggs addled be provided to ONDR for their records.

4.6 Grassland Maintenance

The grasslands at the Fernald Preserve consist of pastures formerly use for grazing, old fields; turf grass lawns; and restored prairies and savannas. Maintenance of these areas is necessary for both aesthetic and restoration purposes.

4.6.1 Mowing

Mowing is the primary method of maintaining the grass areas at the Fernald Preserve. The areas around the Visitors Center, along the access road, and along the south boundary of the Preserve (along Willey Rd.) are mowed on a regular basis to keep the grasses short and aesthetically pleasing. Some of the pastures on site (the South Field and the field east of the Lodge Pond trail) are mowed and bailed once or twice a year. This mowing is for aesthetics and to help control the spread of invasive species (primarily thistle species). Mowing is typically conducted in the spring in order to minimize impacts to nesting birds. If needed, a second mow is conducted in late summer across pasture areas. If possible, mowing should be completed before April 1 or after July 15. Figure 4–1 shows the type and frequency of mowing at the Fernald Preserve.

Mowing is used in prairie and savanna areas in order to assist with establishment in the first couple years following seeding. Native grasses and forbs are generally slower growing than cover crops and weedy species. These plants are mowed before they go to seed. The native grasses and forbs are not affected by mowing because of their smaller size. This process allows the native grasses and forbs to eventually out-compete weedy growth. Once established, the preferred management of prairie areas at the Fernald Preserve is prescribed burning, as described below.

4.6.2 Prescribed Burning

A second method of grassland maintenance to be used at the Fernald Preserve is prescribed fire. The Fernald Preserve *Wildland Fire Management Plan* (WFMP) (DOE 2009b) establishes the process for conducting prescribed burns at the Fernald Preserve. Prescribed fire provides numerous benefits for restored prairie areas. In addition, invasive species and noxious weeds that are not destroyed by the fire are usually easily identified following a burn and can then be spot sprayed in order to kill them without injuring desirable plants, which are a little slower at rebounding.

Burning identified prairies and savannas every 3 to 5 years in conjunction with herbicide applications will control undesirable species and stimulate native species growth. Pursuant to the WFMP, the size of the burns will be controlled to fit inside established fire breaks. Natural features of the site may also be used as boundaries. Fire size will also be limited by the number of personnel available to conduct the burn.

4.7 Trails, Signs, Displays, and Overlooks (Public Use Amenities)

A weekly inspection is conducted of all of trails and overlooks at the Fernald Preserve. This includes inspection of the walking surface, signs, displays, overlooks, and parking areas. These inspections are conducted to ensure continued public safety during use of these amenities. Each week, items requiring attention are documented and entered into a database of maintenance items that need to be addressed. Examples of maintenance items include such things as standing water on the trails, rutting of trails, fallen trees along the trails, loose or fallen signs, loose boards on overlooks, etc. Once the items are addressed, completion of those items is documented as well.

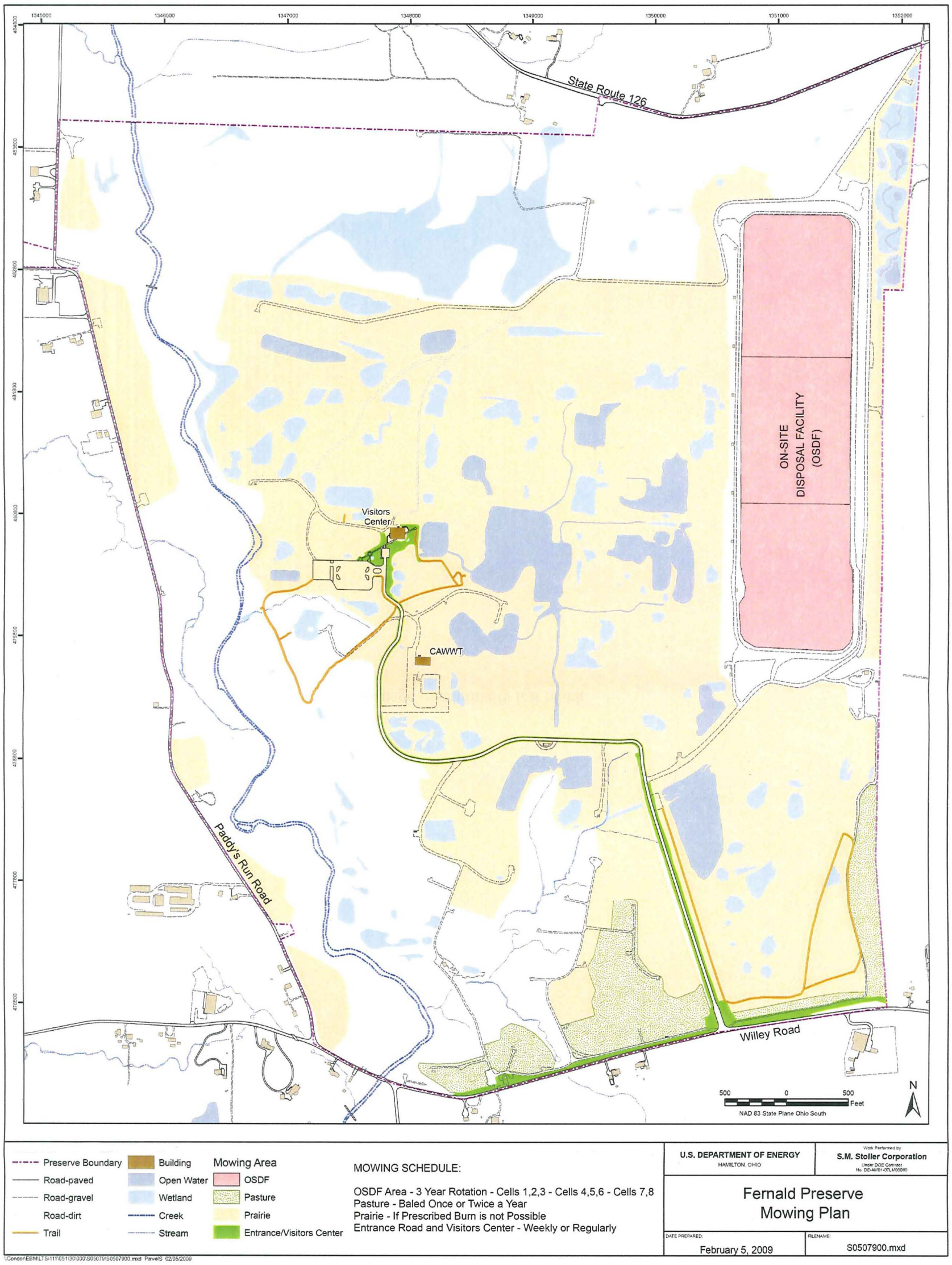

Figure 4–1. Fernald Preserve Mowing Map

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5.0 Schedule

The scheduling of maintenance activities can be difficult to predict. Often, unexpected conditions arise that call for immediate attention. However, a general schedule can be estimated based on the timing and frequency of activities discussed in Sections 3 and 4 above. Table 5–1 shows a typical monthly schedule of maintenance activities for a calendar year.

Table 5–1. Scheduling of Maintenance Activities

Activity	Section	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Notes
Woody vegetation replanting	3.1			X	X	X	X	X	X	X	X	X	X	Acceptable anytime during year except when ground is frozen.
Herbaceous plug planting	3.2				X	X	X	X	X					Must allow for root establishment prior to dormancy. Supplemental watering may be needed in summer months
Seeding	3.2			X	X	X	X			X	X	X		Allowable seeding dates are detailed in specification
Invasive species - herbicides	4.1				X	X	X		X	X	X			Target active growing, resprouting timeframes
Invasive species - removal	4.1	X	X	X	X	X	X	X	X	X	X	X	X	Honeysuckle removal in fall/winter, target other species prior to seed dispersal
Invasive species - mowing	4.1				X	X	X	X	X	X				Target mowing prior to flowering - includes spot trimming with weed whips
Water management - flooding	4.2					X	X	X	X	X	X	X	X	Control invasive and expand waterfowl habitat
Water management - drawdown	4.2						X	X	X	X	X	X		Discourage fish and expand mudflat habitat
Erosion control	4.3				X	X	X	X	X	X	X			Must insure adequate time for seed germination
Wildlife amenities - inspection	4.4			X			X			X			X	Coincides with quarterly site inspection process
Wildlife amenities - Monitoring and cleanout	4.4											X	X	End of season activity
Nuisance animals - barriers	4.5.1	X	X	X	X	X	X	X	X	X	X	X	X	Installation and repair as weather allows
Nuisance animals - trapping	4.5.2	X	X	X	X	X	X	X	X	X	X	X	X	Trapping as weather permits
Nuisance animals - hazing	4.5.3	X	X	X	X						X	X	X	Hazing with dogs stops during nesting season/molt
Nuisance animals - culling	4.5.4			X	X	X								Goose egg addling only
Grassland maintenance - mowing	4.6.1				X	X				X	X			Target prior to bird nesting season
Grassland maintenance - prescribed burning	4.6.2		X	X	X									Implementation dependent on parameters specified in site-specific prescribed burn plans
Public use amenities	4.7	X	X	X	X	X	X	X	X	X	X	X	X	Installation and repair as weather allows

6.0 Reporting

Reporting on maintenance activities will occur through the quarterly Fernald Preserve site inspection reports. An updated Maintenance Action Items List is included with those reports. Maintenance needs are recorded and tracked from identification through resolution in the database. A yearly summary of maintenance activities will be included in Annual Site Environmental reports. In addition, the NRTs will be regularly updated and consulted on maintenance activities during periodic meetings.

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7.0 References

DOE (U.S. Department of Energy), 1993. *Site Wide Characterization Report.*

State of Ohio, 2008. *Partial Consent Decree Resolving Ohio's Natural Resource Damage Claim against DOE*, State of Ohio v. United States Department of Energy, et al, Civil Action No. C 1-86-0217, Judge Spiegel.

DOE (U.S. Department of Energy), 2009a. *Comprehensive Legacy Management and Institutional Controls Plan*, Revision 3, Final, DOE, Fernald Area Office, Cincinnati, Ohio, January.

DOE (U.S. Department of Energy), 2009b. *Wildland Fire Management Plan*, Final, DOE, Fernald Area Office, Cincinnati, Ohio, February.

ODNR (Ohio Department of Natural Resources), 2006. *Rainwater and Land Development Manual*, Third Ed., ODNR, Division of Soil and Water Conservation, Columbus, Ohio, December.

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Appendix A

Planting Specifications

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SECTION 02940
PLANTING

PART 1 GENERAL

1.1 SCOPE

A. This Section includes the requirements for planting trees, shrubs, and herbaceous potted plants as shown on the Construction Drawings.

1.2 RELATED SECTIONS AND DOCUMENTS

A. Section 02930 – Seeding and Bioengineering Erosion Control

PART 2 PRODUCTS

2.1 MATERIALS

A. Container grown trees shall be a minimum of 6 feet in height, grown in "spin-out" containers and acquired from a local seed source if possible. Potting material shall be pre-inoculated with mycorrhizae.

B. Container-grown shrubs shall be a minimum of 1 foot in height, grown in "spin-out" containers and acquired from a local seed source if possible. Potting material shall be pre-inoculated with mycorrhizae.

C. Balled and burlapped trees and shrubs shall be a minimum of 1.5-inch caliper diameter, with a root ball that conforms to American Nursery and Landscape Association Standards. Trees and Shrubs shall be harvested from the same hardiness zone in which the Fernald Preserve is located.

D. Bareroot seedlings shall be pre-inoculated with ecto-mycorrhizae and shall not be exposed to the air any longer than possible prior to planting.

E. Herbaceous potted plants shall be grown in open bottom, minimum 2-inch square and 3-inch deep containers. Potting material shall be inoculated with ecto-mycorrhizae.

F. Fertilizer shall be slow-release tablet form, and not exceed an N-P-K mix of 22-5-10. Fertilizer shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.

G. Mulch shall be an aged hardwood mulch, free of clay, stone, foreign substances, and free of weeds.

H. Wooden stakes for staking trees as needed shall be nominal 2 inch square, approximately 18-inches in length.

2.2 EQUIPMENT

A. Equipment for performing work in this section shall be low ground pressure equipment that will not compact amended soils.

PART 3 EXECUTION

3.1 GENERAL

A. Planting locations will be flagged in the field by the Restoration Ecologist. The Restoration Ecologist is the Fluor Fernald contact responsible for identifying locations of all plant material installation, verifying acceptance of delivered plant material, and ensuring proper installation.

B. Unless otherwise approved by the Restoration Ecologist, all plant installation shall take place between October 1 and December 15 or February 15 and May 15.

C. The Restoration Ecologist may restrict planting activities based on field conditions (e.g., droughts, unseasonable freezes).

D. No plant installation may take place while the soil surface is frozen.

E. Plant material delivered to the project site that will not be planted within 24 hours shall have their containers completely covered with woodchip mulch and kept moist with periodic watering.

F. The Construction Manager will provide a source of water sufficient to support all field activities specified in this Section.

3.2 INSTALLATION OF BALLED AND BURLAPPED AND CONTAINER-GROWN TREES AND SHRUBS

A. Excavate planting pit to a depth such that the top of the ball, when planted, extends 1 to 2 inches above ground surface.

B. Excavate the planting pit so that it is twice as wide as the width of the root ball.

C. Scarify the sides of the planting pit using a shovel.

D. For container grown plants, remove the plant from the container by carefully inverting the plant and loosening the root ball from the container, cutting the container if necessary. Keep the root ball as intact as possible. Handle the plant by the root ball only. Do not pull the plant from the container by the trunk of the tree or shrub.

E. For balled and burlapped plants, loosen the burlap from around the root collar and fold it back. No portion of the burlap shall be left about ground upon backfilling.

F. Add a slow-release fertilizer tablet or packet (e.g., Osmocote, Agriform or similar) around the ball per manufacturers recommendations.

G. Set trees and shrubs such that the top of the ball extends 1 to 2 inches above the ground surface and that the trunk is vertical. Trunks shall have no appreciable lean, at the discretion of the Restoration Ecologist.

H. Backfill around the root ball with a mixture of the topsoil and subsoil removed from the pit. Gently tamp the backfill as it is placed into the pit.

I. Water the tree/shrub immediately after planting to saturate the upper 12 inches of soil.

J. Remove any tags, labels, strings or wires from the plant, unless otherwise directed by the Restoration Ecologist.

3.3 INSTALLATION OF BAREROOT PLANTS

A. Carry bareroot plants in a bucket of water (or moist sand or other moist medium) in the field to keep the roots from drying out. Bareroot plants shall not be stored in water for more than 6 hours at a time. Bareroot plants that require overnight storage shall have their root balls covered completely with moist hardwood mulch and kept moist with periodic watering.

B. Excavate the planting pit by hand using a dibble bar or spade. The pit shall be only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.

C. Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.

D. Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.

E. Firmly tamp backfill with the heel of the shoe when complete.

F. Remove any tags, labels, and strings from the plant, unless otherwise directed by the Restoration Ecologist.

3.4 INSTALLATION OF HERBACEOUS POTTED PLANTS

A. Place potted plant flats in standing water immediately upon delivery to the project site. Keep flats in water until installation.

B. Excavate the planting pit by hand using a dibble bar or spade. The pit shall be only broad enough to accommodate the roots when fully extended and only deep enough such that the uppermost roots will be just below ground surface.

C. Set the plant and spread the roots in a natural pattern such that the roots are fully extended without touching the sides of the planting pit and that the uppermost roots are just below ground surface.

D. Carefully work backfill (mix of topsoil and subsoil removed from the planting pit) through the fully spread root systems and water while backfilling.

E. Firmly tamp backfill with the heel of the shoe when complete.

F. Remove any tags, labels, and strings from the plant, unless otherwise directed by the Restoration Ecologist.

3.5 PRUNING

A. Once trees and shrubs are planted, prune off any dead or damaged limbs.

B. All pruning shall involve removal of limbs back to a lateral branch or bud.

C. Perform additional pruning at the request of the Restoration Ecologist.

3.6 MULCHING

A. Apply a 4-inch layer of hardwood mulch over a circular area 4 feet in diameter surrounding balled and burlapped and container grown trees and shrubs. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.

B. Apply a 4-inch layer of hardwood mulch over a circular area 2 feet in diameter surrounding each bare root or potted plant. At the discretion of the Restoration Ecologist, straw may be used as a substitute for hardwood mulch.

C. Mulch shall be placed so as to not physically contact the plants.

3.7 WATERING

A. Water all planted material weekly for 6 weeks following installation, unless otherwise directed by the Restoration Ecologist. Watering shall be sufficient to saturate the entire root ball. This typically requires the slow release of approximately 10 gallons of water for each plant.

3.8 STAKING AND GUYING

A. Stake and guy trees only at the request of the Restoration Ecologist.

END OF SECTION

Appendix B

Seeding Specifications

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SECTION 02930
SEEDING AND BIOENGINEERING EROSION CONTROL

PART 1 GENERAL

1.1 SCOPE

A. This Section includes soil stabilization, which includes application of crusting agent, establishing vegetation by seeding and dormant live cuttings, and installing biodegradable erosion control materials. The work in this Section includes, but is not limited to; soil preparation, interim vegetation, permanent vegetation, application of fertilizer, application of mulches, application of crusting agent, and installation of erosion control materials.

1.2 RELATED SECTIONS AND PLANS

A. Section 02940 – Planting

1.3 REFERENCES

A. Latest version of Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Standards (ODNR Rainwater and Land Development Standards).

B. "*Identification and Listing of Hazardous Waste,*" Title 40, Code of Federal Regulations (CFR), Part 261, Subpart E.C.

C. "*Federal Hazardous Material Transportation Law,*" U.S. Department of Transportation (U.S. DOT, 1994).

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish seed labeled in accordance with U.S. Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its date of expiration. Each variety of seed shall have a purity of not less than 90 percent by weight, a percentage of germination not less than 80 percent by weight, and a weed to seed content of not more than 0.75 percent by weight and contain no noxious weeds. Furnish seed mixtures having seed proportioned by weight in accordance with Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section. Areas requiring permanent seeding during the summer months (July 1 – September 1) shall be seeded with 30 lbs/acre of ReGreen or stabilize with a crusting agent as specified in this Section, unless otherwise directed by the Restoration Ecologist. Stabilization performed during the summer shall be followed by fall application of the appropriate permanent seed mix.

B. Permanent seed mixes shall be treated with fungal (mycorrhizae) inoculant and bacterial (rhizobium) inoculants. The specified legumes must be inoculated with the appropriate rhizobial strains.

C. Furnish mulch meeting the following requirements:

1. Mulch shall be straw or wood cellulose fibers; free of clay, stone, foreign substances, and free of weeds.

2. Straw should not contain sticks larger than ¼-inch diameter or other materials that may prevent matting down during application. Use straw that is free from mold and other objectionable material for placing with mulch blower equipment or other equipment as approved by the Construction Manager. Straw shall be generally 6 inches or more in length.

3. Straw shall be:

   a. Weed free straw from the Minnesota Crop Improvement Association certified weed free straw vendors;

   b. Straw that has been inspected and determined to be weed free by Central Ohio Seed Testing;

   c. Native prairie grass mulch; or

   d. Equivalent substitute as approved by the Construction Manager.

4. Mulch applied by hydrospraying shall be a bonded fiber matrix containing wood fibers held together with a hydrocolloid-based binder, which upon drying becomes insoluble and non-dispersible. The fibers shall be composed of 100 percent wood or wood by-products and shall be 100 percent biodegradable. Use a bonded fiber matrix containing a green dye that will provide for easy visual inspection for uniformity of slurry spread. The bonded fiber matrix, including dye, shall contain no growth or germination inhibiting properties. The wood cellulose fiber shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed on the ground, the material shall allow absorption and percolation of moisture. The wood cellulose fiber shall meet the following requirements:

Item	Specification Limit
Particle Length	0.4 inch (maximum)
Particle Thickness	0.047 inch (maximum)
PH	4.0 to 8.5
Ash Content	1.6 % (maximum)
Water Holding Capacity (based on fiber dry weight)	500 % (minimum)
Moisture Content	12 % ± 3 % (by weight)

D. Mulch binder agent shall be as approved by the Construction Manager and shall meet the following requirements:

1. The mulch binder shall be hydrocolloid base (guar gum) and shall not dissolve or disperse upon rewetting.

2. The mulch binder shall not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states.

3. The mulch binder shall have a flash point greater than 200°F. The mulch binder shall be neither a flammable nor combustible liquid per U.S. Department of Transportation definition (DOT 1994). The mulch binder must not be susceptible to significant deterioration from exposure to the elements, including sunlight.

4. The mulch binder shall be provided in concentrated solution and prepared so that it will not change in transportation or storage.

E. The crusting agent shall be as approved by the Construction Manager and shall meet the following criteria:

1. Pine sap emulsion comprised of a 100 percent organic emulsion produced from naturally occurring resins (pine sap); or a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik tacking agent (mulch binder); or an approved equal;

2. Not comprised of chloride, lignosulfonate, petroleum, or asphaltic-type emulsions;

3. Provide dust suppression and surface stability for exposed soils, both disturbed and undisturbed soils, and exposed coal fired ash (flyash);

4. Compatible with application via a hydro seeder, and must not require intense cleaning of equipment after application;

5. Non-tracking (i.e., will not stick to boots or tires) once cured;

6. Not have hazardous characteristics of ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR Part 261, Subpart C, for a hazardous waste in either its pre-applied or cured states;

7. Have a flash point greater than 200°F;

8. Be neither a flammable nor combustible liquid per DOT definition; and

9. Not be susceptible to significant deterioration from exposure to the elements, including sunlight.

F. Woven coir erosion mat shall meet the following criteria:

1. Coconut fiber content: 100%

2. Weight: 22 ounces per square yard

3. Thickness: 0.3 inches

4. Open area: 38%

5. Tensile strength: 1,350 lb/ft by 626 lb/ft (length by width)

6. Elongation: 34% by 38% (length by width)

G. Coconut logs shall be constructed of 100% coconut fiber, 10-inch minimum diameter and 8-foot maximum length.

H. Wood stakes for fastening coir mats and logs shall be as follows:

1. Stakes for coir erosion mats shall be nominal 2-inch square, minimum 8 inches in length.

2. Stakes for coconut logs shall be nominal 2-inch square, minimum 35 inches in length.

I. Metal staples for fastening coir mats shall be 11-gauge wires formed into a staple shape with minimum dimensions of 6 inches by 1 inch by 6 inches.

J. Dormant live cuttings for bioengineering erosion control shall be as follows:

1. Length: 2.5-foot minimum, 4 foot maximum

2. Diameter: 0.5-inch minimum, 2 inch maximum

3. Acceptable species include: silky dogwood (*Cornus amonum*), gray *dogwood (Cornus racemosa*), red osier dogwood (*Cornus stolonifera*), cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*), pussy willow (*Salix discolor*), sandbar willow (*Salix exigua*), black willow (*Salix nigra*), silky willow (*Salix sericea*), elderberry (*Sambucus canadensis*), and arrow wood (*Viburnum dentatum*). Additional species may be used upon approval by the Restoration Ecologist.

K. Fertilizer:

1. Furnish commercial grade fertilizer, uniform in composition that meets the requirements of all State and Federal regulations and standards of the Association of Agricultural Chemists.

2. Fertilizer shall be slow release complete fertilizer.

3. Fertilizer for application within the area shall be 34-0-10; other fertilizers may be approved by the Construction Manager or Restoration Ecologist. Fertilizers shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.

4. Fertilizer must have MSDS submitted in accordance with this Section.

5. Fertilizer shall be used for interim seeding only.

L. Construction water shall be obtained from the on-site water source as directed by the Construction Manager.

2.2 EQUIPMENT

A. Provide equipment of size and type to perform work specified in this Section.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Deliver containerized materials in uniform packages bearing the name of the manufacturer, the net weight and a statement of content. Deliver containerized materials to the site in original, properly labeled, unopened, clean containers each showing the manufacturer's guaranteed analysis conforming to applicable regulations and standards.

B. Store materials in a dry area in a manner to prevent physical damage.

3.2 GENERAL

A. Stabilization of disturbed areas by vegetation or by use of a crusting agent shall be performed at completion of excavation and stockpiles or within 7 calendar days of knowing a disturbed area will be idle for more than 45 calendar days, whichever is sooner.

B. Crusting agents may be used as temporary measures prior to placement of interim vegetation after approval for the area by the Construction Manager.

C. Disturbed areas which are scheduled to be significantly disturbed after initial stabilization and/or need effective erosion control immediately, are to be stabilized with the interim seed mix rate specified in this Section. Disturbed areas, which are not scheduled to be significantly disturbed again, are to be stabilized with the permanent seed mix rate specified in this Section. Soil piles, which require effective erosion control immediately, are to be stabilized with the interim seed mix rate or a crusting agent as specified in this Section.

D. Stabilization of permanent slopes steeper than 3H:1V (horizontal to vertical) shall utilize coir matting as specified in Section 3.5 of this specification after application of seed mixture, unless otherwise specified by the Construction Manager or Restoration Ecologist.

E. Area(s) to be seeded shall be generally free of debris, rock, root material, and other objects that may impede soil preparation and seeding activities. Perform soil preparation by tilling/cultivating, to a depth of approximately 2 inches, to eliminate uneven areas and low spots. Maintain lines, levels, and contours.

F. Repeat cultivation in areas where equipment used for hauling and spreading has compacted the area(s) to be seeded.

3.3 APPLICATION OF SEED AND CRUSTING AGENT

A. The seeding season, for interim vegetation specified in this Section, is year round. However, if seeding is contemplated during the winter months of December through March, then field conditions should be assessed for ability to provide soil to seed contact. If field conditions do not support the ability to provide soil to seed contact then the area shall be stabilized with a crusting agent followed by seeding during conditions conducive to adequate soil to seed contact.

B. The seeding seasons for permanent seeding in wet and dry areas are Spring Season between March 1 and July 1 and Fall Season between September 1 and November 15.

C. Apply fertilizer, seed, and mulch to disturbed areas and areas excavated and graded under this Contract requiring seeding unless otherwise directed by the Construction Manager. Apply mulch within 24 hours of seeding; do not seed areas in excess of that which can be mulched within 24 hours. Winter application of seed and related materials are subject to adjustment as directed by the Construction Manager.

D. Apply seed using either the drilling, broadcasting, or hydroseeding method, as described below:

1. Seed drilling method:

a. This method shall be used for applying the permanent seed mix in accessible areas unless otherwise approved by the Construction Manager. The method may also be used for interim vegetation.

b. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches.

c. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.

d. Install seed with a seed drill to obtain a final planting depth of ¼ to ½ inch using the seed rates indicated in Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section. All seed drilling should be done perpendicular to the direction of surface-water flow.

2. Broadcast Seeding Method:

   a. This method may be used for interim vegetation, and can be performed with the use of mechanical "cyclone" seeders, by hand seeding or by any other method which scatters seed over the soil surface.

   b. This method may also be used for permanent seeding in areas that are not accessible with the seed drill (i.e., sloped areas) as approved by the Construction Manager.

   c. If Broadcast Method is used to apply permanent seed mix in sloped areas (3H:1V slope or steeper), seeding application rates in Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section shall be doubled.

   d. Prepare the area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.

   e. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre at the time of preparing the seedbed for seeding.

   f. Install seed by broadcasting evenly over the entire site using the seed rates indicated in Table 02930-1A, Table 02930-1B, and Table 02930-2 of this Section.

   g. Rake the area after seeding.

   h. Mulch and disc-anchor using weed free mulch at a rate of 2.0 tons per acre. Spread straw mulch, either by hand or by blowing method, at the rate of 2 air-dried tons per acre. During June through September, increase straw mulch application rate to 3 air-dried tons per acre.

3. Hydroseeding Method:

   a. This method may be used for interim vegetation only. Hydroseeding shall be a two-step process. The seed shall be applied first, followed by a separate application of the mulch. This is to ensure soil to seed contact.

   b. The mixture tank shall be cleaned prior to use to ensure remnant seed is not introduced to the proposed seed mixture.

   c. Prepare area to be seeded by loosening the soil to a minimum depth of 3 inches. This is critical to allow seeds to filter into the soil to avoid washout from runoff.

   d. Apply commercial grade, slow release complete fertilizer, for interim vegetation only, at a rate of 150 lbs/acre. The fertilizer is to be mixed and applied with the mulch.

e. Install seed by hydroseeding evenly over the entire area using the seed rates indicated in Table 02930-2. Use a fan-type nozzle with approximately 500 gallons of water per acre to ensure even distribution.

f. Rake the area where accessible following seeding.

g. Apply sprayed mulch at a net dry weight of 2,000 pounds per acre minimum and 100 percent continuous coverage. Mix the mulch with water at a ratio of 50 pounds of mulch per 100 gallons of water.

E. Application of Crusting Agent:

1. Apply crusting agent in accordance with manufacturer's directions.

2. Unless otherwise specified by the manufacturer, dilute concentrated pinesap emulsion to ratio of 4 parts water to 1 part concentrate. Apply diluted pinesap emulsion at a rate of 2,500 gallons per acre.

3. Apply a mixture of Conwed Fiber's Enviroblend hydraulic mulch and Finn Corporation's A-500 Hydro-Stik mulch binder, using the hydroseeder, at the rate of 1,000 lbs/acre on flat surfaces; and 1,125 lbs/acre on slopes greater than 3H:1V. The mixture rate for each product shall be 20 lbs/acre on flat surfaces and 30 lbs/acre on greater than 3H:1V slopes for the hydraulic mulch; and 20 lbs/acre on flat surfaces and 30 lbs/acre on slopes greater than 3H:1V for the Hydro-Stik mulch binder.

3.4 BIOENGINEERING EROSION CONTROL

A. Following seeding, install coir matting and/or coir logs in areas indicated on the Construction Drawings, on slopes steeper than 3H:1V, or in any other areas prone to erosion, as identified by the Restoration Ecologist. Installation is as follows:

1. Coir matting: Stake coir matting on minimum 5-foot centers with wood stakes, angled upstream/upgradient. Use metal staples for added support, installing staples on minimum 5-foot centers between wood stakes and in additional areas so that the coir matting is in direct contact with the soil. The Restoration Ecologist shall direct the installation of additional stakes and/or staples as necessary. Overlap adjoining sections of coir matting 6 to 12 inches, with the upstream/upgradient matting laid on top. Sew adjoining sections of matting together with coir rope. Bury the upper edge of coir matting in a 6-inch trench.

2. Coir logs: Stake coir logs on 10-foot centers. Install 2 stakes opposite each other and tie the stakes together with coir rope. Sew adjoining coir logs together with coir rope.

B. Secure all coir materials at the end of the day in preparation for unexpected rain events.

C. Dormant live cuttings shall be installed as follows: Cut a point onto the bottom of the live cutting and drive into the soil on 4 foot centers using a dead blow hammer. Drive cuttings (minimum two-thirds, maximum four-fifths of their length) into soil angled slightly downstream/downgradient. Minimize damage to the cuttings when driving into the soil. If necessary, prepare a pilot hole by driving rebar into the soil and removing prior to inserting cuttings. Saw any damaged tops once the cuttings are installed. Dormant live cuttings may be installed into coir matting or other areas prone to erosion as directed by the Restoration Ecologist.

TABLE 02930–1A
SEED MIX IN DRY AREAS FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Grasses[1]	
Big Bluestem (*Andropogen gerardi*)	3.0
Little Bluestem (*Andropogen scoparius)*	2.0
Side-Oats Grama (*Bouteloua curtipendula*)	0.5
Canada Wild-Rye (*Elymus canadensis*)	10
Annual Rye (*Lolium multiflorum)*	25
Switch grass (*Panicum virgatum*)	0.5
Indian Grass (*Sorghastrum nutans*)	2
Wildflowers [2]:	
Butterflyweed (*Asclepias tuberosa*)	1.5
Smooth Aster (*Aster laevis*)	
Blue False Indigo (*Baptisia australis*)	
Partridge Pea (*Cassia fasciculata*)	
Rattlesnake Master (*Eryngium yuccifolium*)	
Ox-eye Sunflower (Heliopsis helianthoides)	
Round-headed Bush Clover (*Lespedeza capitata*)	
Bergamot (*Monarda fistulosa*)	
Purple Coneflower (*Echinacea purpurea*)	
Sweet Joe Pye-Weed (*Eupatorium purpureum*)	
Beardtongue (*Penstemon grandiflorus*)	
Yellow Coneflower (*Ratibida pinnata*)	
Black-Eyed Susan (*Rudbeckia hirta*)	
Stiff Goldenrod (*Solidago rigida*)	
Spiderwort (*Tradescantia ohioensis*)	
Hoary Vervain (*Verbena stricta*)	

[1] – Eliminate annual rye and reduce Canada wild rye seed rates to 5 lb/ac when overseeding existing prairie areas.

[2] – Wildflower mix to be apportioned according to species aggressiveness and seed counts as determined by the Restoration Ecologist. If certain species are not available, appropriate substitutions will be determined by the Restoration Ecologist.

7226

TABLE 02930–1B
SEED MIX IN WET AREAS[1] FOR PERMANENT VEGETATION

Species	Pounds Per Acre (lb/ac)
Grasses and Other Graminoids [2]	
Big Bluestem (Andropogen gerardi)	3
Blue Joint Grass (Calamagrostis canadensis)	0.5
Porcupine Sedge (*Carex hystericina*)	1 ounce per acre (oz/ac)
Fox Sedge (*Carex stipata*)	1 ounce per acre (oz/ac)
Virginia Wild-Rye (*Elymus virginicus*)	10
Annual Rye (*Lolium multiflorum*)	25
Switch Grass (Panicum virgatum)	0.5
Dark Green Bulrush (*Scirpus atrovirens*)	1 ounce per acre (oz/ac)
Prairie Cordgrass (*Spartina pectinata*)	1
Wildflowers [3]:	1.5
Angelica (*Angelica atropurpurea*)	
Red Milkweed (*Asclepias incarnata*)	
New England Aster (*Aster novae-angliae*)	
Wild Senna (*Cassia hebecarpa*)	
Spotted Joe-Pye Weed (*Eupatorium maculatum*)	
Sweet Joe-Pye Weed (*Eupatorium purpureum*)	
Sawtooth Sunflower (*Helianthus grosserratus*)	
Cardinal Flower (*Lobelia cardinalis*)	
Great Blue Lobelia (*Lobelia siphilitica*)	
Yellow Coneflower (*Ratibida pinnata*)	
Blue Vervain (*Verbena hastata*)	

[1] – Seeding in drainage ditches or swales shall contain erosion mats as specified in Section 02270 after application of seed mixture.

[2] – Eliminate annual rye and reduce Virginia wild rye seed rates to 5 lb/ac when overseeding existing wet areas.

[3] – Wildflower mix to be apportioned according to species aggressiveness and seed counts as determined by the Restoration Ecologist. If certain species are not available, appropriate substitutions will be determined by the Restoration Ecologist.

TABLE 02930–2
SEED MIX FOR INTERIM VEGETATION

Species	Pounds Per Acre (lb/ac)
ReGreen	50
Canada Wild-Rye (Elymus canadensis)	20
Annual Rye (*Lolium multiflorum*)	20
Partridge Pea (*Cassia fasciculata*)	2 ounces
Black-Eyed Susan (*Rudbeckia hirta*)	2 ounces

[END]