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BORROW AREA
NATURAL RESOURCE RESTORATION DESIGN PLAN
WETLAND MITIGATION PHASE III

FERNALD CLOSURE PROJECT
FERNALD, OHIO

SEPTEMBER 2004

U.S. DEPARTMENT OF ENERGY

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ACRONYM LIST

A1PII	Area 1, Phase II Certification Area
BA	Borrow Area
BAR	Borrow Area Restoration
DOE	United States Department of Energy
FCP	Fernald Closure Project
LM	Legacy Management
NRRDP	Natural Resource Restoration Design Plan
NRT	Natural Resource Trustees
ODNR	Ohio Department of Natural Resources
OSDF	On-Site Disposal Facility
PPDD	Pilot Plant Drainage Ditch
STP	Sewage Treatment Plant
USFWS	United States Fish and Wildlife Service

1.0 INTRODUCTION

This Natural Resource Restoration Design Plan (NRRDP) is for the Borrow Area Restoration (BAR) Project. The BAR Project will include the third wetland mitigation project at the Fernald Closure Project (FCP). The BAR Project is located in Area 1, Phase II (A1PII) and covers approximately 80 acres in the Southeastern portion of the Fernald Closure Project (FCP). Certification of A1PII was completed in 2000 (DOE 2000). Prior to certification, there was isolated excavation of impacted soil in the project area due to lead contamination in the Former Trap Range. The removal of impacted material was not required in the remainder of the restoration project. All ongoing borrow activities are being performed as clean work.

Borrow activities in the area are being performed to provide a soil source for the construction of the On-Site Disposal Facility (OSDF). The Borrow Area (BA) was divided into eight Subareas that would be processed individually (*reference Borrow Area Strategy Report*). The original topsoil and extensive amounts of clay are in the process of being removed from each subarea and used in the construction of the OSDF. The borrow operations will leave a series of depressions that are void of topsoil or organic materials.

Subareas 1 and 2 have had preliminary restoration work completed under "Grading Plan for the Accelerated Restoration of the On-Site Disposal Facility" (DOE 2002). Under this plan, Subareas 1 and 2 were graded and seeded consistent with restoration goals outlined in the Final Natural Resources Restoration Plan (NRRP) (DOE 2002). Areas that were not expected to be underwater on an ongoing basis were seeded with a wetland seed mix. Sloped areas on the perimeter of Subareas 1 and 2 were seeded with an upland mix.

1.1 PURPOSE OF RESTORATION PLAN

A Conceptual Restoration Plan was issued to the Natural Resource Trustees and Agencies in March 2004 (DOE 2004). The Conceptual Restoration Plan outlined the general overview of the restoration activities planned in the BA (Figure 1-1). The planned activities were based on Subarea breakdown used in the Borrow Area Strategy for the BA footprint and new BA perimeter patches. The Conceptual Design provided the Fernald Natural Resource Trustees (NRTs) and the Regulatory Agencies the opportunity to review and comment on DOE's restoration approach for the BAR Project. It was agreed that the conceptual plan would not be revised or reissued, rather that the input received would be used in the development of this Natural Resource Restoration Design Plan (NRRDP). Comments received on the Conceptual Restoration Plan have been factored into the development of this NRRDP.

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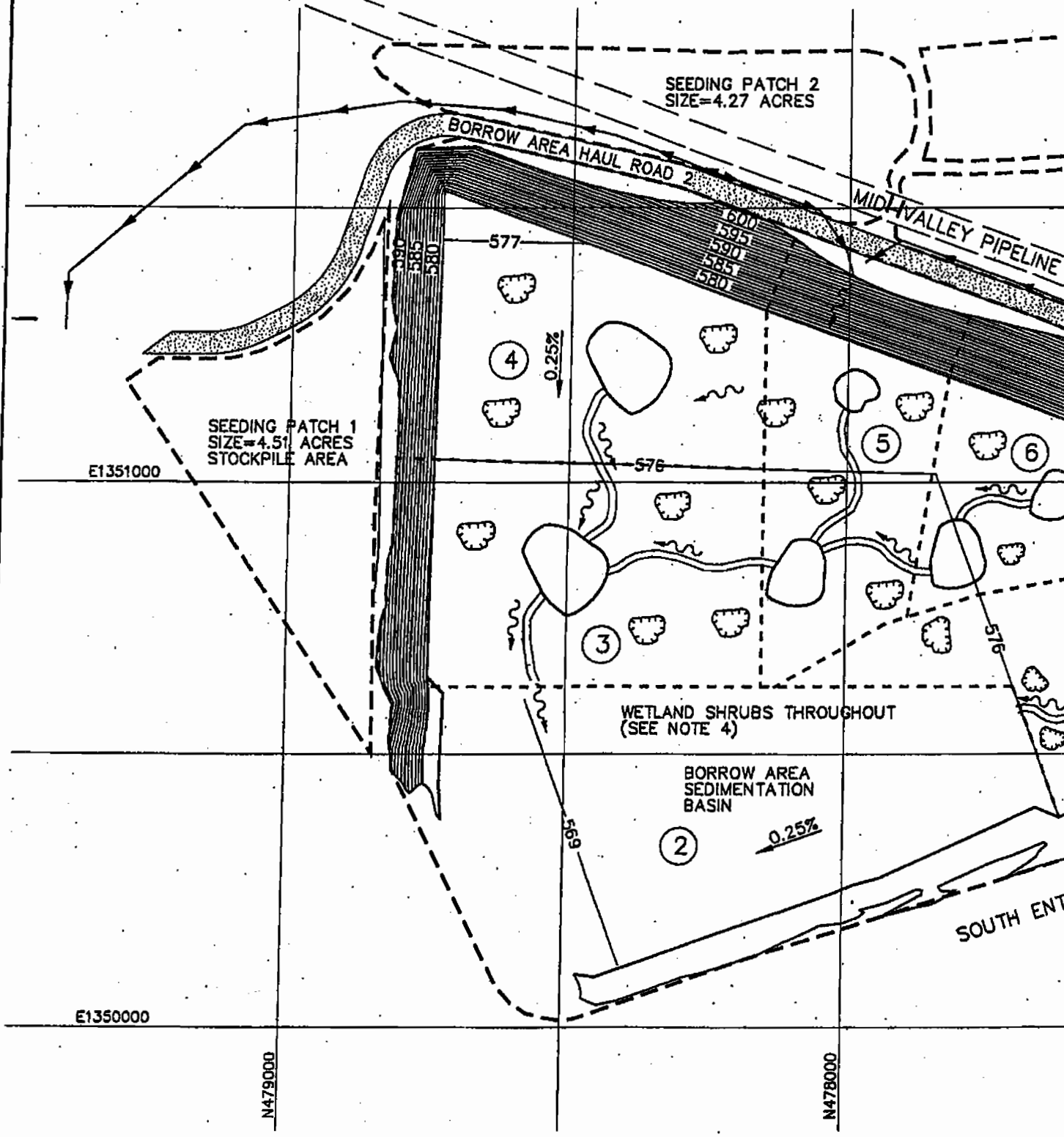
BORROW AREA RESTORATION
CONCEPTUAL RESTORATIO



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This NRRDP outlines the approach for the final restoration of the BA, once all borrow activities are complete. The NRRDP includes all details regarding planting and seeding in the BAR Project (e.g., specified seed mixes, planting patch pages). In addition, monitoring and maintenance requirements are outlined in the NRRDP. The NRRDP is being initially submitted as a draft document. Grading plans in this Draft NRRDP will not be certified for construction, but will provide the planned grading contours and outfall elevations for each subarea. Some details such as survey points and drawing notations are not included in this NRRDP. Once NRT and Environmental Protection Agency input is received on the Draft NRRDP, the grading plans will be certified for construction and submitted with the Final NRRDP for NRT and Agency review.

1.2 PROJECT GOALS AND OBJECTIVES

The goals and objectives of the BAR Project were outlined in the NRRP (DOE 2002) as follows:

- Restore the Borrow Area footprint to predominantly wet prairie and marsh;
- Restore Borrow Area perimeter areas to an upland prairie ecosystem with a surrounding buffer of upland trees and savanna;
- Establish open water in the northwest corner of the project; and
- Construct wetlands to fulfill regulatory wetland mitigation requirements.

Restoration of the Borrow Area will focus on the establishment of native vegetative communities: predominantly wet prairie, marsh, and an upland prairie ecosystem with a surrounding buffer of upland savannas (DOE 2002). Further planting of trees and shrubs will occur to enhance the existing Aesthetic Barrier on the southern perimeter of the BA along Willey Road. Three of the Borrow Area Subareas (3, 4, and 8) will be designed as the Wetland Mitigation Phase III Project and will create additional wetlands required under the June 1995 DOE mitigation agreement with the Ohio Environmental Protection Agency, the U.S. Fish and Wildlife Service, and Ohio Department of Natural Resources (DOE 2002). The new wetland acreage will serve as part of the compensation for wetland acreage lost during remedial activities in other portions of the FCP. A total of 11.87 acres of wetlands have been impacted during remediation requiring the creation of 17.8 acres of new wetlands.

1.3 SITE DESCRIPTION

The BAR Project (Figure 1-2) covers approximately 80 acres in the Southeastern portion of the Fernald Closure Project (FCP). Generally, the BAR Project covers a portion of the A1PII Certification Area.

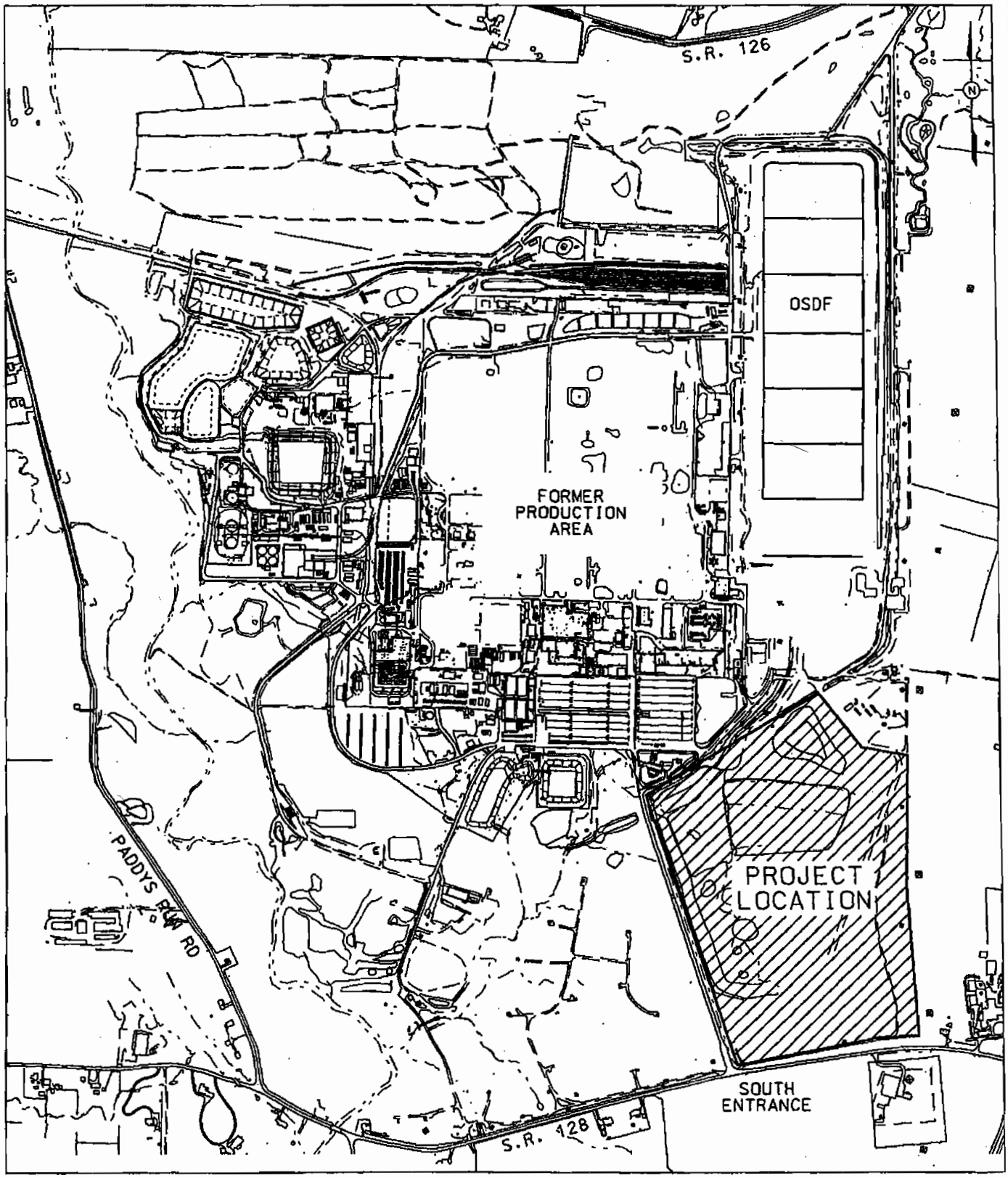

FIGURE 1-2

BORROW AREA RESTORATION PROJECT LOCATION

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Certification of A1PII was completed in 2000 (DOE 2000). The BAR Project area is bounded on the south and east by the FCP property boundaries; in the west by the FCP South Access Road; on the north by three inter-connected roads: the North Entrance Road (from the South Entrance Road to the Emergency Access Road), the east-west portion of the Emergency Access Road, and the northern portion of the Borrow Area Haul Road. The former Sewage Treatment Plant (STP) footprint, the existing trailer complex and associated parking area to the south of the STP footprint, and the existing gravel construction laydown area are not included in the scope of the BAR Project. The restoration of these areas will be addressed in the OSDF Perimeter Restoration Project.

The BA Footprint consists of exposed subgrade clay soils that extend from high cut banks around the perimeter to standing water in northwest corner of area. The topsoil and much of the brown clays have been removed. The gray clay layer is exposed. Some of the gray clays will be removed for fill in the OSDF construction. Current ground slope is from the south to the north and from the east to the west. The area has been subdivided into Subareas to aid in soil removal tracking. Subareas 1 and 2 have been partially restored. The area was graded to form an island, vernal pools, ponds, and swales for the creation of wetland acreage. The areas have been seeded with wet prairie mix consisting of wetland grasses, sedges, rushes, and wildflowers. Subareas 3 through 7 are at varying stages of borrow activities. Subarea 8 has been scraped and is ready for removals of borrow material.

The remaining areas of the BAR Project perimeter consists of old pasture fields and an aesthetic barrier along the southern edge of BA footprint. The old fields are the areas referred to in Figure 1-1 as Seeding Patches and a Savanna Patch. This area has not seen any construction activities except the installation of the Borrow Area Haul Road. The soils in the area are moderately well drained with a couple of pockets of somewhat poorly drained soils (Appendix A) along the Borrow Area Haul Road. Cattle grazed the areas until 1996. Access to the area is from the Borrow Area Haul Road and a gravel road that provided access to monitoring wells in the area, which are included in the restoration. Fields have been maintained through mowing with a bush-hog and through spraying with a pre-emergent herbicide to control invasive species. The Aesthetic Barrier was originally planted in 1998 to create a visual barrier along Willey Road. The Aesthetic Barrier consists of two rows of White Pines, Norway Spruces and hardwood saplings. The trees are aligned to help shelter the view of the BA footprint from Willey Road.

2.0 COMPONENTS OF RESTORATION

The Borrow Area Restoration Project Conceptual Restoration Plan (DOE 2003) provided a broad description of the activities considered for restoration of the BA. This section of the NRRDP will expand on the information provided in the Conceptual Restoration Plan and address comments to that plan. The activities necessary to implement ecological restoration will be broken down for each project Subarea and in the perimeter areas around the BA. Work in each Subarea will be initiated as those areas become available for restoration.

The restoration of the BAR footprint will include grading activities to create additional ponds and shallow pools to function as wetlands and vernal pools. The design for the ponds and pools will include extended shallow sloping shelves to support shorebird and amphibian populations (U.S. F&WS, 2002). Areas within wetlands and around the ponds and swales will be constructed with topographical variations to enhance water retention and provide micro-ecosystem variations within the areas. Revegetation of this portion of the BAR Project will be accomplished through the seeding of native grasses, the installation of wetland plugs, and the planting of shrub patches appropriate for the hydrological conditions. Figure 2-1 shows the planting plan for the BA excavation footprint.

The BAR perimeter has not been scraped of its vegetative cover or topsoil, and there will not be any grading required for the BAR perimeter. Restoration will consist of conversion of some pastures to native grasses and the planting of trees and shrubs to supplement current populations. Figure 2-2 shows the planting plan for the BA Perimeter.

2.1 SUBAREAS 1 AND 2

As stated above, Subareas 1 and 2 have been partially restored. The area has been graded to final elevations. A layer of topsoil was spread over the basin floor to amend the clay subsoils in areas that were above normal water levels. Topographical features in the Subareas include ponds, vernal pools, swales, an island, gentle sloping basin topography, and quickly rising cut slopes. The basin floor, with the exception of ponds and vernal pools, has been seeded with a wet prairie seed mix of native grasses, sedges, rushes, and forbs. Water levels have remained steady in the ponds and the pools did not dry up fully last summer; so there is no vegetative cover in the ponds or vernal pools. The cut slopes were seed drilled with an upland prairie mix and have minimal coverage. Additional germination and growth of native species is anticipated this growing season.

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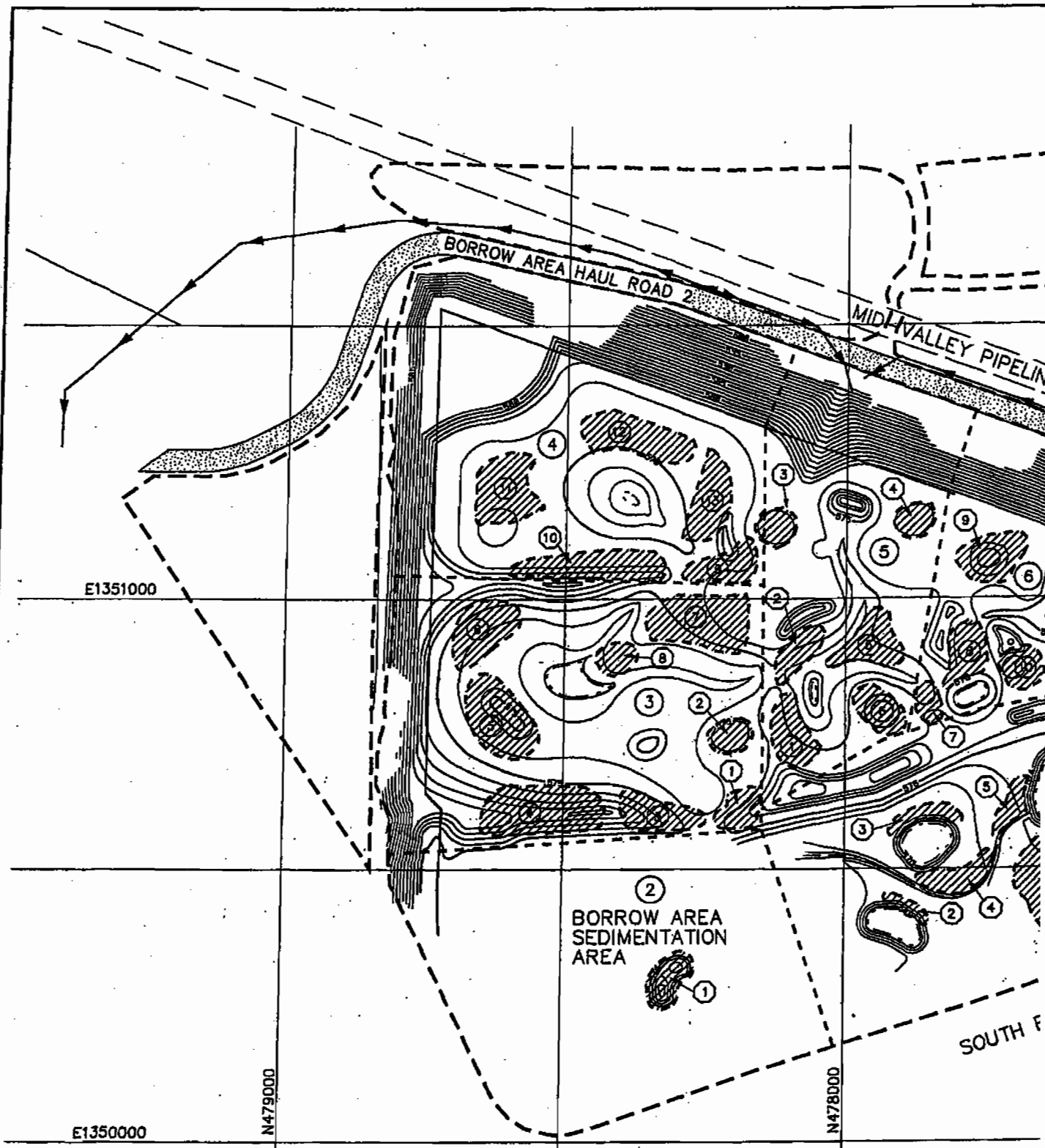

SUBAREA 1 AND 2 PATCHES

(1) 0.14 ACRES	(5) 0.08 ACRES	(9) 0.08 ACRES
(2) 0.05 ACRES	(6) 0.46 ACRES	(10) 0.23 ACRES
(3) 0.09 ACRES	(7) 0.10 ACRES	(11) 0.08 ACRES
(4) 0.12 ACRES	(8) 0.12 ACRES	

TOTAL = 1.55 ACRES

SUBAREA 3, 4, AND 8 PATCHES

(1) 0.11 ACRES	(5) 0.32 ACRES	(9) 0.16 ACRES	(13) 0.22 AC
(2) 0.10 ACRES	(6) 0.23 ACRES	(10) 0.28 ACRES	(14) 0.21 AC
(3) 0.18 ACRES	(7) 0.37 ACRES	(11) 0.27 ACRES	(15) 0.23 AC
(4) 0.41 ACRES	(8) 0.08 ACRES	(12) 0.28 ACRES	(16) 0.18 AC

TOTAL = 3.63 ACRES

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Restoration needs for Subareas 1 and 2 include: the installation of wetland plugs around edges of ponds and pools, placement of live willow stakes in potential high erosion areas, the creation of shrub patches, the placement of wood debris in pools for aquatic wildlife attractors, and the inoculation of ponds and pools with pond muck. Details of these activities are listed below.

Wetland plugs (Table 2-1) will be purchased for placement along the edge of each pond and pool in Subareas 1 and 2. Plugs will be planted to jumpstart vegetation development in ponds and pools. The mixture of plugs is the same as that used for placement in other on-site wetland projects. Sedge and rush plugs will be placed inside the high water mark, and wildflower plugs will be installed along the edge of the high water line. Plugs will be planted a minimum of 3 feet apart.

TABLE 2-1
SUBAREA 1 AND 2 - FORB, GRASS, RUSH, AND SEDGE PLUGS

Scientific Name	Common Name	Total Needed
Carex frankii	Frank's Sedge	98
Carex lurida	Bottlebrush Sedge	98
Carex vulpinoidea	Fox Sedge	98
Eupatorium maculatum	Spotted joe-pye weed	49
Juncus effuses	Soft Rush	98
Lobelia cardinalis	Cardinal Flower	49
Lobelia siphilitica	Great blue Lobelia	49
Scirpus altrovirens	Dark green Bulrush	98
Scirpus cyperinus	Woolgrass	98
Sparganium eurycarpum	Giant Bur-reed	98
	Total	882

Live willow stakes will be purchased for erosion control along boundary between Subareas 1 and 2 and the other Subareas. Flows from adjacent subareas have caused some washing of soils along the Subareas 1 and 2 perimeters. Until excavation is complete in subareas adjacent to 1 and 2, the willow stakes will provide some protection to area soils. The willow species (Table 2-2) are the same as those used on previous wetland projects. The willows will be installed three feet apart within flow areas or fashioned as live fascines in trenches across the flow area.

TABLE 2-2
SUBAREA 1 AND 2 – LIVE CUTTINGS

Scientific Name	Common Name	Total Needed
Cornus stolonifera	Red Osier Dogwood	20
Salix discolor	Pussy Willow	20
Salix eriocephala	Heart Leaved Willow	20
Salix nigrum	Black Willow	20
Salix sericea	Silky Willow	20
	Total	100

Eleven small shrub patches are planned for this area (Figure 2-1). The shrub patches are composed of various wet tolerant species (Table 2-3) that have done well on-site in the past. Placement will take into account the tolerance of the shrubs. Plants will be planted in tight groupings. Species that have been susceptible to browsing in the past will be fenced to protect them from predation. Patch pages providing the specific species to be installed in each patch are provided in Appendix B.

TABLE 2-3
SUBAREA 1 AND 2 - SHRUBS

SPECIES	COMMON NAME	Borrow Area Subareas 1 & 2
Alnus serrulata	Smooth Alder	28
Amorpha fruticosa	False Indigo Bush	24
Celastrus scandens	Bittersweet	4
Cephalanthus occidentalis	Buttonbush	46
Cornus amomum	Silky Dogwood	20
Corylus Americana	Hazelnut	26
Hypericum spathulatum	Shrubby St. John's Wort	20
Ilex verticallata	Winterberry	22
Rosa palustris	Swamp Rose	34
Rosa setigera	Prairie Rose	16
Salix discolor	Pussy Willow	50
Salix eriocephala	Heart-Leaf Willow	22
Salix sericea	Silky Willow	20
Sambucus Canadensis	Elderberry	8
Spirea alba	Meadowsweet	10
		350

Subareas 1 and 2 have extensive use by waterfowl during the spring and fall flyovers. Additionally, a number of ducks and geese stay on the ponds year round. To encourage the nesting of ducks within the area, duck boxes will be purchased and installed on two of the Subarea ponds. Locations for the boxes are identified on Wildlife Structure Plan (Figure 2-3). Duck boxes will be constructed in a manner consistent with past projects at the FCP. Boxes will be tall rectangular boxes with a sloping roof and a protective opening that will preclude predators and unwanted birds from utilizing the boxes. Construction should favor the nesting of wood ducks and mallards in the boxes. Boxes will be mounted on 4-in. X 4-in. (at a minimum) treated timber that is tall enough to maintain the box one foot above the high water mark. A typical design for the box is included in Appendix C.

The cavity dwelling songbirds expected to frequent the ponds of the area would benefit from the placement of nesting boxes around the area. These birds feed on insects that fly above the water of the ponds or pools. A total of three Bluebird and Tree Swallow boxes would be dispersed throughout Subareas 1 and 2 (Figure 2-3). The boxes would be placed in areas that are above normal high water levels and are along the outside edge of shrub patches. A typical design of the boxes is included in Appendix C.

A number of logs and branches from trees that were cut from the area prior to borrow activities have been staged on the eastern edge of Subareas 1 and 2. This wood debris will be separated and placed in the vernal pools (Figure 2-3) prior to planting the wetland plugs. The debris will be placed across the deepest portion of the pools, leaving open water space around the edge of pools. Debris will not displace all the water space in the pool, but will provide breeding and sunning areas within the area of the pool. Smaller debris or branches from the pile may be used to construct a small mammal den. The limbs would be placed on the ground to form an entry way and at least one dwelling cavity prior to the small brush being applied. Leaves or pine needles would then be placed on top in a small layer. Brush pile will be placed in areas that will remain above high water for most of the year (Figure 2-3).

In conjunction with debris placement, ponds and pools will be inoculated with organic rich muck from healthy wetlands at the FCP and from off-site locations in conjunction with the OEPA. Buckets of muck will be collected from the donor site and transported to the BAR Project Subareas 1and 2 for placement within its ponds and vernal pools. The muck should include aquatic plants, macro-invertebrates, mud, and water from the donor pond or wetland. Muck will be placed directly in each pond and/or pool along water's edge.

Placement of the muck in the ponds and pools will accelerate the development of healthy ponds and pools in the area by transferring elements of the healthy ponds to BA waterways.

2.2 SUBAREAS 3, 4, AND 8

These Subareas are grouped together because they will become available for restoration in 2004 and will support wetland mitigation at the FCP. The wetland areas in these Subareas will be designated as the Wetland Mitigation Phase III Project. They will provide additional wetlands required under the June 1995 DOE Mitigation Agreement with the Ohio Environmental Protection Agency, the U.S. Fish and Wildlife Service (USFWS), and Ohio Department of Natural Resources (ODNR). The proposed wetlands in these areas will be wide flats with a minimal berm to maintain approximately six inches of water across the area during the wet season. The water will flow across the areas as a sheet flow and cross the berm into lower areas in the same manner. Each Subarea flat will contain a deepwater pond with a shallow, gently sloping bottom in at least one direction to promote amphibian development and shorebird use of the pools. The flats will also contain occasional depressions that will hold water for a short time as water recedes during dry seasons and small rises or mounds that will act as islands during wet seasons.

Subareas 3, 4 and 8 are in differing states of excavation. Subareas 3 and 4 have had the brown clay excavated and the screened material is stored in the area for later placement in construction of the OSDF cells. The gray

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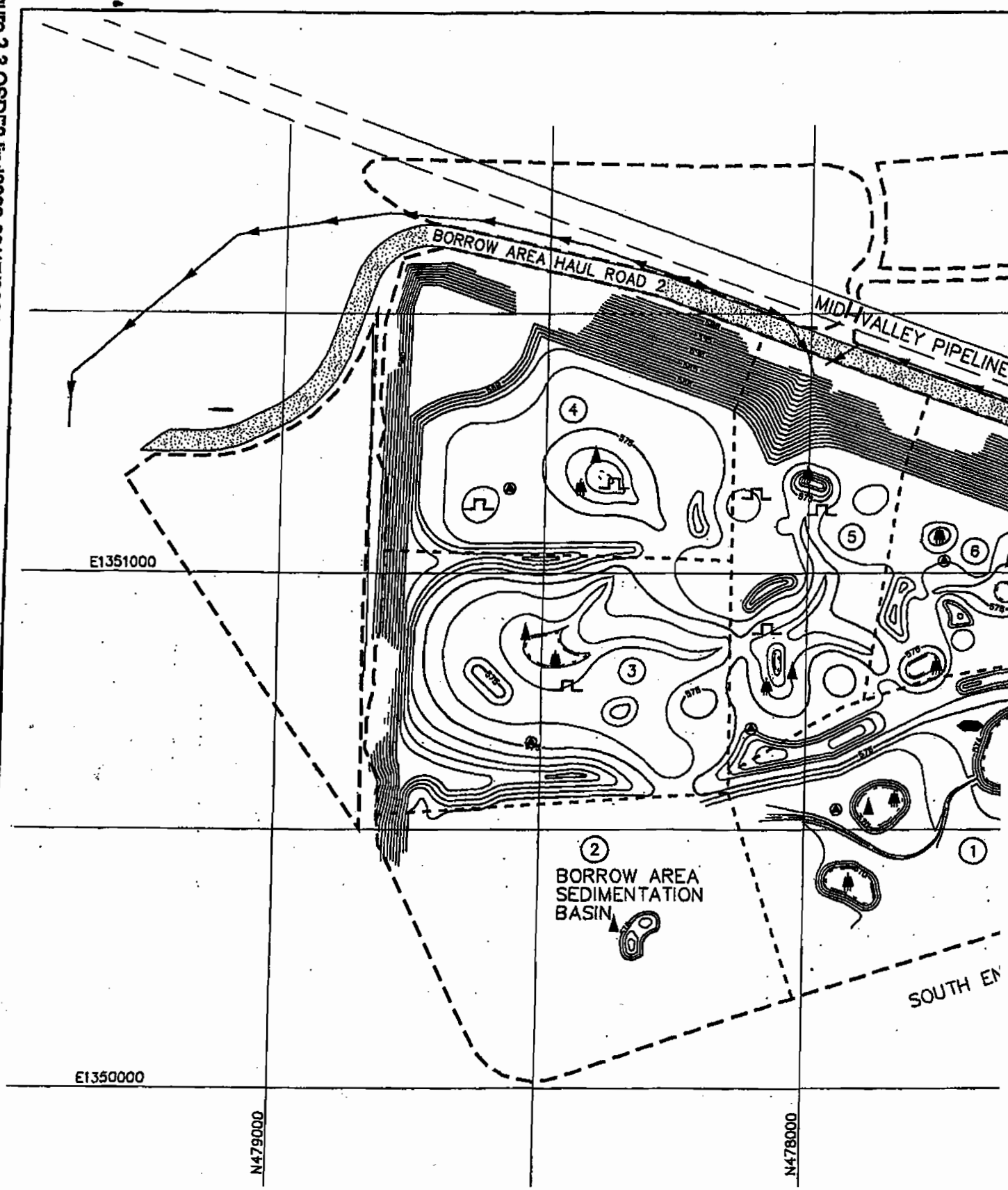

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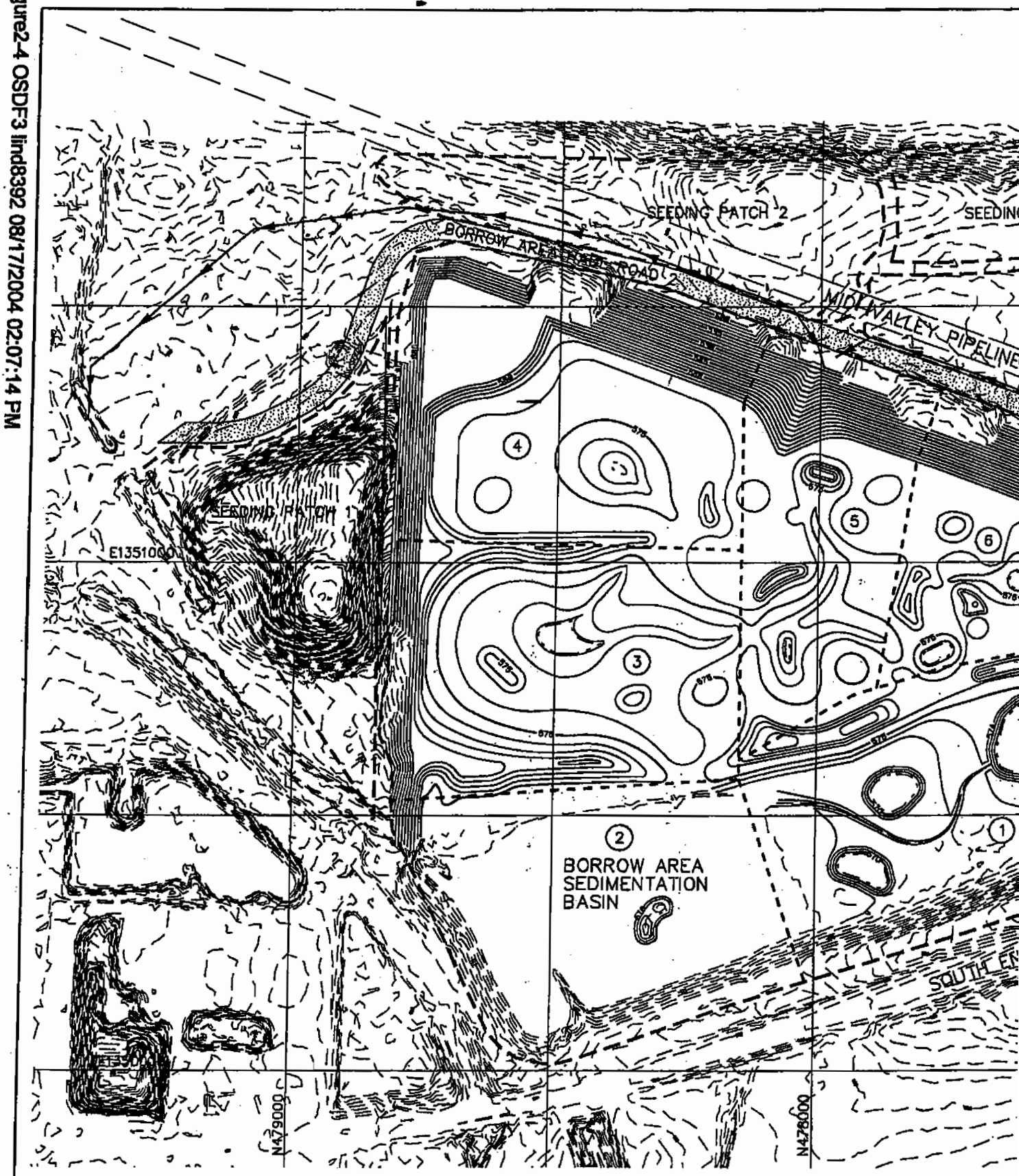

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clay within the area will be excavated to final grade after the piles of screened clay have been removed. This material will also be used in the cells of the OSDF. Restoration will begin once excavation of the area is complete. Final grading will be included in the excavation (see Grading Plan, Figure 2-4).

Restoration needs for Subareas 3, 4, and 8 will include: soil amendment, seeding of wetland and upland areas, installation of wetland plugs, placement of live willow stakes in potential high erosion areas, the creation of shrub patches, the construction of wildlife structures, and the inoculation of ponds and vernal pools with pond muck. Details of these activities are listed below.

The soils at final grade for restoration are heavy clay subsoil with little or no organic matter or humus. Soil amendment will be necessary for establishment of plant populations in each subarea. Soil amendment will consist of placement of a six-inch layer of topsoil on top of the clay. If topsoil is not available, compost will be purchased and spread across the top of the clay. Purchased compost will then be tilled into the clay to a depth of six inches to provide a layer of organic rich soil. All soils in each Subarea will be amended, including the bottom of pools or ponds.

Erosion control becomes the greatest need once grading and soil amendment are complete. Amended soils will be seeded in accordance with whether the soil will be in a wetland area (will the soil be submerged in water during wet season) or an upland area (will the soil be above high water mark during wet season). The flat areas of Subareas 3, 4, and 8 and shallow areas of ponds will be seeded with a wetland seed mix (Appendix D). Deepwater areas will not be seeded. The steep slopes on the edge of the BA will be seeded with an upland seed mix (Appendix D). These areas include the steep slopes on the east edge of Subarea 4; the north edge of Subareas 3 and 4; and the east, south, and west edge of Subarea 8. Seed mix will include inoculants for the grasses and forbs. Inoculants may be on the seed or applied with the seed during seeding.

Wetland plugs (Table 2-4) will be purchased for placement along the edge of each pond and pool and in shallow shelves of ponds. Plugs will be planted to jumpstart vegetation development in ponds and pools. The mixture of plugs is the same as that used for placement in other on-site wetland projects. Sedge and rush plugs will be placed inside the high water mark, and wildflower plugs will be installed along the edge of high water line. Plugs will be planted a minimum of 3 feet apart.

Live willow stakes will be purchased for use as erosion control along the bottom of berms and slopes where the potential for washing of soils exists. The willow species (Table 2-5) are the same as those

used on previous wetland projects. The willows will be installed three feet apart or in fascines within flow areas.

TABLE 2-4
SUBAREA 3, 4, AND 8 - FORB, GRASS, RUSH, AND SEDGE PLUGS

Scientific Name	Common Name	Total Needed
Carex frankii	Frank's Sedge	294
Carex lurida	Bottlebrush Sedge	294
Carex vulpinoidea	Fox Sedge	294
Eupatorium maculatum	Spotted joe-pye weed	172
Juncus effuses	Soft Rush	294
Lobelia cardinalis	Cardinal Flower	245
Lobelia siphilitica	Great blue Lobelia	245
Scirpus altrovirens	Dark green Bulrush	343
Scirpus cyperinus	Woolgrass	294
Sparganium eurycarpum	Giant Bur-reed	343
	Total	2818

TABLE 2-5
SUBAREA 3, 4, AND 8 - LIVE CUTTINGS

Scientific Name	Common Name	Total Needed
Cepahalanthus occidentalis	Buttonbush	40
Cornus stolonifera	Red Osier Dogwood	40
Salix discoler	Pussy Willow	40
Salix exigua	Sandbar Willow	40
Salix nigrum	Black Willow	100
Salix sericea	Silky Willow	40
	Total	300

TABLE 2-6
SUBAREA 3, 4, AND 8 SHRUBS

SPECIES	COMMON NAME	Total Number Of Plants
Alnus serrulata	Smooth Alder	24
Amorpha fruticosa	False Indigo Bush	16
Asimina triloba	Pawpaw	
Celastrus scandens	Bittersweet	2
Cephalanthus occidentalis	Buttonbush	122
Cornus amomum	Silky Dogwood	55
Corylus Americana	Hazelnut	22
Hypericum spathulatum	Shrubby St. John's Wort	25
Ilex verticallata	Winterberry	60
Rosa palustris	Swamp Rose	95
Rosa setigera	Prairie Rose	
Salix discolor	Pussy Willow	37
Salix erlocephala	Heart-Leaf Willow	11
Salix sericea	Silky Willow	11
Sambucus Canadensis	Elderberry	12
Spirea alba	Meadowsweet	8
		500

Sixteen small shrub patches are planned for this portion of the BAR Project (Figure 2-1). Patches, as with the Subarea 1 and 2 patches, are composed of various wet tolerant species (Table 2-6) that have done well at the FCP in the past. The shrubs will be planted in tight groupings to aid in protection actions to prevent browsing and rubbing by deer. Species that have been susceptible to browsing in the past will be fenced to protect them from predation. Patch pages providing the specific species to be installed in each patch are provided in Appendix B.

The waterfowl nesting capacity for the BAR Project will be expanded through the placement of a wood duck box in each of the Subareas. A total of three boxes will be installed. Locations for the boxes are identified on the Wildlife Structure Plan (Figure 2-3). As stated above the boxes will be constructed consistent with boxes used in past projects. The boxes will be mounted on 4-in. X 4-in. (at a minimum) treated timber approximately one to two feet above the high water mark. A typical design of the boxes is included in Appendix C.

An additional three bluebird boxes will be installed within the Subareas. Locations for the boxes are shown in Figure 2-3. The boxes will provide nesting sites for cavity dwelling songbirds that frequently feed around the ponds. The boxes will be placed in general proximity to the ponds. Boxes will be mounted on a post at the edge of a shrub patch above the normal high water mark. A typical box design is included in Appendix C.

A fox den is proposed for construction on the base of the eastern slope of Subarea 8 (Figure 2-3). The den will be constructed from rock taken from the BA during excavation. The rocks will be aligned in an excavation cut into the slope. Excavated soils will then be replaced over the stone den. Instructions for construction of typical den are included in Appendix C.

Additional rocks will be placed in deep water areas of ponds to provide habitat for rock salamanders and shelter for crayfish and other water creatures. Rocks will also be placed in some depressions to provide sunning areas. More habitat will be provided in the deepwater portion of the Subarea 4 pond by placing wood debris on the edge of the deepwater shelf (Figure 2-3). Debris will consist of logs and larger limbs from dead trees collected from Certified Areas of the FCP.

In conjunction with the installation of the wetland plugs, ponds and pools will be inoculated with organic rich muck from healthy wetlands at the FCP and from off-site locations in conjunction with the OEPA. Buckets of muck will be collected from the donor site and transported to the BAR Project Subareas 3, 4, and 8 for placement within its ponds and vernal pools. The muck should include aquatic plants, macro-invertebrates, mud, and water from the donor pond or wetland. Muck will be placed directly in each pond and/or pool along water's edge. Placement of the muck in the ponds and pools will accelerate the development of healthy ponds and pools by transferring elements of the healthy ponds to BA waterways.

2.3 SUBAREAS 5, 6, AND 7

As with the previous section, the remaining wetlands Subareas are grouped together. This grouping contains three proposed Subareas that provide a continuous flow wetland system. Each basin contains a wetland or pond that drains successively from the south into Subarea 3. The Subarea 7 wetland flows down into and through two ponds in Subarea 6. The ponds in Subarea 6 discharge into a swale that flows into a swale in Subarea 5 and then into a large pond in Subarea 5. This pond also receives flow from an additional pond located to the east in Subarea 5. The water from these ponds flows into the wetland in Subarea 3. The eastern edge of Subareas 5, 6, and 7 is the steep BA excavation slope. The general topography of the remaining land of the Subarea is a gradual slope from east to west of approximately 0.25%. This area includes some variations in the slope to include some depressions and small mounds that will provide for diversity in habitat. The depressions will hold water for a short time during dry season and the mounds will act as islands during wet seasons.

Subareas 5, 6, and 7 have had most of the brown clays excavated from the area. The gray clays will be removed as needed for use in the construction of the OSDF Cells. Additionally some screened soils may be stockpiled in this area until needed for the OSDF. Restoration will begin once excavation of the area is complete. Final grading will be included in the excavation (See Grading Plan, Figure 2-4).

Restoration needs for Subareas 5, 6, and 7 will include: soil amendment, seeding of wetland and upland soils, installation of wetland plugs, erosion control measures, the creation of shrub patches, the construction of wildlife structures, and the inoculation of ponds and vernal pools with pond muck. Details of these activities are listed below.

The soils at final grade, as stated for previous Subareas, are heavy clay subsoil with little or no organic matter or humus. Soil amendment will be necessary for establishment of plant populations in each Subarea. Amendment will consist of placement of a six-inch layer of topsoil on top of the clay. If topsoil is not available, compost will be purchased and spread across the top of the clay. The compost

will then be tilled into the clay to a depth of six inches to provide a layer of organic rich soil. All soils in each Subarea will be amended, including the bottom of pools and ponds.

Erosion control becomes the greatest need once grading and soil amendment are complete. Amended soils will be seeded according to whether the soil will be in a wetland areas (will the soil be submerged in water during wet season) or an upland area (will the soil be above high water mark during wet season). The flat areas of Subareas 5, 6, and 7 and shallow areas of ponds will be seeded with a wetland seed mix (Appendix D). Deepwater areas will not be seeded. The steep slopes on the edge of the BA will be seeded with an upland seed mix (Appendix D). These areas include the steep slopes on the east edge of the Subareas. Seed mix will include inoculants for the grasses and forbs. Inoculants may be on the seed or applied with the seed during seeding.

Wetland plugs (Table 2-7) will be purchased to jumpstart vegetation development in ponds and pools. Plugs will be planted along the edge of each pond and pool and in shallow shelves of ponds. Sedge and rush plugs will be placed in shallow water areas and wildflower plugs will be installed along the edge of the high water line. Plugs will be planted a minimum of 3 feet apart.

TABLE 2-7
SUBAREA 5, 6, AND 7 - FORB, GRASS, RUSH, AND SEDGE PLUGS

Scientific Name	Common Name	Total Needed
Carex frankii	Frank's Sedge	147
Carex lurida	Bottlebrush Sedge	147
Carex vulpinoidea	Fox Sedge	147
Eupatorium maculatum	Spotted joe-pye weed	75
Juncus effuses	Soft Rush	147
Lobelia cardinalis	Cardinal Flower	98
Lobelia siphilitica	Great blue Lobelia	98
Scirpus altrovirens	Dark green Bulrush	147
Scirpus cyperinus	Woolgrass	147
Sparganium eurycarpum	Giant Bur-reed	147
	Total	1300

TABLE 2-8
SUBAREA 5, 6, AND 7 - LIVE CUTTINGS

Scientific Name	Common Name	Total Needed
Cephalanthus occidentalis	Buttonbush	60
Cornus amomum	Silky Dogwood	40
Cornus stolonifera	Red Osier Dogwood	40
Salix eriocephala	Heart Leaved Willow	40
Salix nigrum	Black Willow	80
Salix sericea	Silky Willow	40
	Total	300

Live willow stakes will be purchased for use as erosion control along the bottom of swales and at the base of slopes where the potential for washing of soils exists. The willow species (Table 2-8) are the same as those used on previous wetland projects. The willow stakes will be installed three feet apart or in fascines within flow areas.

Twelve small shrub patches are planned for this portion of the BAR Project (Figure 2-1). Patches are composed of various wet tolerant species (Table 2-9) that have done well at the FCP in the past. The shrubs are to be planted in tight groupings to aid in protection actions to control browsing and rubbing by deer. Species that have been susceptible to browsing in the past will be fenced to protect them from predation. Patch pages providing the specific species to be installed in each patch are provided in Appendix B.

Installation of additional wood duck boxes is planned to provide adequate nesting sites for cavity dwelling ducks. A total of three boxes will be installed. Locations for the boxes are identified on the Wildlife Structure Plan (Figure 2-3). As stated previously the boxes will be constructed consistent with boxes used for past projects. The boxes will be mounted on 4-inch X 4-inch (at a minimum) treated timber approximately two feet above the high water mark. A typical box design is included in Appendix C.

TABLE 2-9
SUBAREA 5, 6, AND 7 - SHRUBS

SHRUBS		
SPECIES	COMMON NAME	Total Number Of Plants
Alnus serrulata	Smooth Alder	33
Amorpha fruticosa	False Indigo Bush	27
Asimina triloba	Pawpaw	20
Celastrus scandens	Bittersweet	4
Cephalanthus occidentalis	Buttonbush	51
Cornus amomum	Silky Dogwood	23
Corylus americana	Hazelnut	31
Hypericum spathulatum	Shrubby St. John's Wort	23
Ilex verticallata	Winterberry	25
Rosa palustris	Swamp Rose	41
Rosa setigera	Prairie Rose	36
Salix discolor	Pussy Willow	58
Salix eriocephala	Heart-Leaf Willow	23
Salix sericea	Silky Willow	29
Sambucus canadensis	Elderberry	10
Spirea alba	Meadowsweet	17
		450

Three bluebird boxes are planned for installation (Figure 2-3). The boxes will provide nesting sites for cavity dwelling songbirds that frequently feed around ponds. Boxes will be placed in general proximity to the ponds. Boxes would be mounted on a treated post at the edge of a shrub patch above the normal high water mark. A typical box design is included in Appendix C.

Two small mammal dens are proposed for this area (Figure 2-3). The dens will be composed of limbs and small brush collected from certified areas of the FCP. The limbs will be placed on the ground to form an entry way and at least one dwelling cavity prior to the small brush being applied. Leaves or pine needles would then be placed on top in a small layer. Brush piles will be placed in areas that will not be normally flooded.

Habitat for amphibians and other water dwellers is needed for the pools and ponds of these Subareas. This need can be met by placing large rocks singularly or stacked in depressions, vernal pools, or ponds. Proposed locations for their placement is shown in the Wildlife Structure Drawing (Figure 2-2). More habitat can be provided in the deepwater portion of ponds by placing wood debris on the edge of the deepwater shelf (Figure 2-3). Debris will consist of logs and larger limbs from dead trees collected from Certified Areas of the FCP.

In conjunction with the installation of the wetland plugs, ponds and pools will be inoculated with organic rich muck from healthy wetlands at the FCP and from off-site locations. Buckets of muck will be collected from the donor site and transported to the BAR Project for placement within the ponds and vernal pools. The muck should include aquatic plants, macro-invertebrates, mud, and water from the donor pond or wetland. Muck will be placed directly into each pond and/or pool along the water's edge. Placement of the muck in the ponds and pools will accelerate the development of healthy ponds and pools by transferring elements of the healthy ponds to BA waterways.

2.4 PRAIRIE

Restoration of the areas around the perimeter of the BA excavation will require different activities from those within the excavation. There will be no grading required for these areas. The Borrow Area Haul Road will have to be removed once excavation and hauling are complete. The soil and rock that make up the road will be removed and the footprint returned to a cleared condition. The stratum within these areas contains a topsoil layer in place. The area also contains a vegetative cover of fescue and other pasture grasses. The rolling topography of the area allows for moderate drainage of water. The majority of this old pasture is planned for conversion to a native tall-grass prairie (Figure 2-2). The figure identifies these areas as Seeding Patches. These areas will be converted either within the spring or fall planting season to allow for seeding of the areas within the timeframe identified in Appendix D. The seeding areas located on the eastern edge of the BA excavation (Figure 2-2), contains land included in the Mid-Valley Pipeline Easement. Mid-Valley Pipeline will have to be notified of work within the pipeline easement boundary. To accomplish the transformation from an old pasture to a prairie, the following activities will be required: elimination of current pasture grasses, shallow tilling of soils, and seeding of native grasses. These restoration activities are discussed further below.

The pasture grasses are too thick to allow sufficient germination and development of stands of native grasses; therefore, the pasture grasses must be eradicated prior to seeding. The most cost effective method for eliminating the current grasses is to spray the area with a glyphosate mixture. Two applications of the mixture will be applied in the growing season prior to seeding. The area will be allowed to brown between applications and prior to application of seed to the area. If the ground is compacted or the area cannot be sprayed to allow for seeding within the allowed timeframe, then the area will be disked to prepare the ground for seeding. Disking will break up compacted soils and would expose soil for seed germination. Disking will be limited to the top six inches of the soil. The area will then be seeded using a seed drill. The seed mixture will be an upland seed mix of grasses and forbs as identified in Appendix D. Any areas that will not drain or drains slowly could be seeded with a wetland seed mix.

2.5 SAVANNA

To broaden the diversity of the BAR Project, a savanna is being proposed for the area. The savanna will consist of an upland native prairie interspersed with oaks. Located on the eastern edge of the BA excavation (Figure 2-2), the proposed area contains the land included in the Mid-Valley Pipeline Easement. Mid-Valley Pipeline will have to be notified of work within the pipeline easement boundary. No trees will be planted within the footprint of the easement. There will be no excavation required for this area. To accomplish the transformation from an old pasture to a savanna, the following activities will be required: elimination of current pasture grasses, tilling of soils, seeding of native grasses, and planting of trees. These restoration activities are discussed further below.

As with the development of the prairies above, the area would be converted from old pasture fields to tall grass prairie using the measures addressed above. Oak trees (Table 2-10) would then be interspersed throughout the area. Oaks would be planted in small groups of three or four on the southwest corner. As trees are planted to the north and to the east, the number planted in groups would diminish and plantings would be further apart.

TABLE 2-10
SAVANNA - SAPLINGS

SPECIES	COMMON NAME	Number Plants
Quercus alba	White Oak	3
Quercus bicolor	Swamp White Oak	9
Quercus macrocarpa	Bur Oak	88
	Total	100

2.6 AESTHETIC BARRIER ENHANCEMENT

The aesthetic barrier helps shield current borrow activities and also helps shield the proposed wetlands construction from Willey Road traffic. The barrier is composed currently of only saplings. As the trees grow, the shielding will decrease with the overstory development; there will be less low limbs as hardwood trees get taller. To continue to provide shielding in the future, additional plantings are proposed for the Aesthetic Barrier. The area of the barrier would be expanded (Figure 2-2) and additional trees (Table 2-11) would be planted within the expanded footprint. Shrubs (Table 2-12) would be interspersed between existing trees and within the expanded footprint. Seedlings (Table 2-13) would finally be planted throughout the barrier. The shrubs and younger trees will provide additional shielding needed at ground level. All woody plants would be installed in accordance with the requirements of Appendix E.

TABLE 2-11
AESTHETIC BARRIER – SAPLINGS

SPECIES	COMMON NAME	Number Plants
Acer rubrum	Red Maple	9
Acer saccharum	Sugar Maple	2
Aesculus glabra	Ohio Buckeye	2
Cercis Canadensis	Redbud	3
Cornus alternifolia	Alternate-leafed Dogwood	2
Cornus florida	Flowering Dogwood	3
Cornus racemosa	Grey Dogwood	3
Crataegus mollis	Downy Hawthorne	2
Fagus grandifolia	Beech	1
Fraxinus Americana	White Ash	2
Fraxinus pennsylvanicum	Green Ash	2
Gymnocladus dioica	Kentucky Coffetree	1
Juglans nigra	Black Walnut	3
Liriodendron tulipifera	Tulip Poplar	2
Prunus serotina	Black Cherry	1
Quercus alba	White Oak	4
Quercus bicolor	Swamp White Oak	3
Quercus macrocarpa	Bur Oak	9
Quercus palustris	Pin Oak	2
Quercus rubra	Northern Red Oak	8
Tilia Americana	Basswood	1
	Total	65

TABLE 2-12
AESTHETIC BARRIER - SHRUBS

SPECIES	COMMON NAME	Number Plants
Amelanchier arborea	Downy Serviceberry	30
Amorpha fruticosa	False Indigo Bush	15
Asimina triloba	Pawpaw	8
Campsis radicans	Trumpet Creeper	8
Carpinus caroliniana	American Hornbeam	12
Cornus racemosa	Gray Dogwood	5
Crateagus mollis	Downy Hawthorne	12
Hamamelis virginiana	Witch Hazel	28
Lindera benzoin	Spicebush	14
Physocarpus opulifolius	Ninebark	24
Rhus glabra	Smooth Sumac	8
Rhus typhina	Staghorn Sumac	5
Rubus occidentalis	Black Raspberry	12
Staphylea trifolia	Bladdernut	26
Symphoricarpos orbiculatus	Coralberry	24
	Total	230

TABLE 2-13
AESTHETIC BARRIER – SEEDLINGS

SPECIES	COMMON NAME	Number Plants
Acer saccharinum	Silver Maple	24
Acer saccharum	Sugar Maple	128
Carya cordiformis	Bitternut Hickory	14
Carya laciniosa	Shellbark Hickory	16
Carya ovata	Shagbark Hickory	16
Fagus grandifolia	Beach	72
Fraxinus americana	White Ash	29
Juglans nigra	Black Walnut	20
Liriodendron tulipifera	Tulip Poplar	14
Prunus serotina	Black Cherry	14
Quercus alba	White Oak	29
Quercus rubra	Red Oak	24
	Total	400

3.0 FIELD IMPLEMENTATION

This section describes the activities that will be undertaken to implement the ecological restoration components discussed above. There are four major phases of implementation: grading, site preparation, installation of vegetation, and wildlife structure installation. Fluor Fernald Building Trade personnel will perform the fieldwork. All activities will be undertaken in accordance with Module 1 and 2 of the Soils Excavation and On-Site Disposal Facility Construction Work Activities Traveler. This document describes the health and safety requirements for all restoration activities at the FCP. Field personnel will be briefed on the Traveler modules as well as this NRRDP prior to commencement of field activities. The project Construction Manager will provide direction for all grading and site preparation operations for the project. The Restoration Ecologist will provide technical direction and oversight of field personnel during vegetation and wildlife structure operations.

3.1 PROJECT SCHEDULE

The BAR Project area can be broken up into two general areas: BA Excavation Footprint and the BA Perimeter. Work in the excavation footprint is dependant upon the OSDF schedule for release of Subareas. When final grades have been reached and all required clay has been excavated, the Construction Manager will release the areas for restoration work. The tentative schedule, pending release, would allow for work to begin for Subareas 3, 4, and 8 in the Fall of 2004 and for Subareas 5, 6, and 7 in the Spring of 2005.

Subareas 1 and 2 were released previously for restoration. These areas are available for scheduling with the approval of this plan. Planting and installation of wildlife structures can begin in the first planting season following document approval. Work in perimeter areas with the exception of Seeding Patch 1 have been released for work and are available for restoration with the approval of this plan. Seeding Patch 1 will be released when soil piles have been removed and the area will no longer be required for laydown.

3.2 SITE PREPARATION

Site preparation involves all the activities necessary to prepare restoration areas for plant installation. Activities include the establishment of construction boundaries, access points, and staging areas; excavation of area to final grade; and soil amendment. Each of these items is discussed in more detail below.

3.2.1 CONSTRUCTION AREA BOUNDARIES AND ACCESS

Figure 3-1 shows the location of construction area boundaries, access points, and staging areas. The main access into the restoration area will be Borrow Area Haul Road. Construction will establish and maintain an entry route (Figure 2-1) from the Haul Road to the base of the excavation slope from which all Subareas can be reached. Entry surface would be composed of Geogrid material base. The honeycomb pattern of the Geogrid will be filled half way with gravel to provide a solid base and allow for quicker drainage. The remainder of the honeycomb void will be filled with clay. The surface will be supplemented with topsoil once restoration work within the excavation footprint is complete and seeded to tall grass prairie. This entry route will provide access to the area for current grading and planting operations, as well as, future monitoring and general access. Limited access can be accomplished from the South Access Road. A pull off is located on northern end of South Access Road, but the steep slope of the banks can limit use on wet days.

3.2.2 EQUIPMENT AND MATERIAL STAGING AREAS

Staging areas for material and equipment will be established in several locations. Seeding Patch 1 will contain a laydown area for mulch and planting stock. Additional satellite woodchip storage areas may be required for ease of distribution. The Restoration Ecologist will establish these satellite areas in the field. Planting stock will be staged adjacent to woodchip pile that will be established in the laydown area. In the fall of 2004, four separate restoration projects will be underway. A central plant staging area will be established in this area for the four restoration projects. Daily planting assignments for the various restoration projects will be distributed from this central staging area. Materials such as fencing and seed will be stored at Building 12G on the Old North Access Road. Tools and equipment will be staged at T-139.

3.2.3 GRADING

Final grading will be initiated after all borrow activities are complete. A Construction Manager will direct the removal of clay from the excavation footprint and ensure the soils are at final grade before releasing the areas for restoration. The area within Seeding Patch 1 will be released for restoration once the materials from the laydown have been removed and the soils are returned to grade. The Borrow Area Haul Road will be removed once the borrow excavation and removal have been completed. The road surface and aggregate base will be pulled out and the original grade re-established. There will be no grading required in the rest of the BA perimeter; these areas are already at grade.

3.2.4 SOIL AMENDMENT

A Construction Manager will direct soil amendment activities. There are two possible amendments for the soils in the excavation footprint of the BAR Project. The first possible amendment is to spread a layer of topsoil over the entire surface of the excavation footprint. Topsoil may be taken from the topsoil pile in the area of Seeding Patch 1 and used in Subareas 3 - 8. The second possible amendment is to add compost to the soil. Compost may be used if topsoil is not available for the entire area. Compost may be purchased and delivered to the staging area. The compost may be spread over the area to be amended and tilled into the top six inches of clay. Tilling may be accomplished using a tiller or disk.

Soil amendment for the BA Perimeter will consist of spraying herbicide on the areas to be converted to tall grass prairie and Savanna. If weather conditions prevent the application of herbicide in a timely manner, then the soils can be prepared for seeding by disking the area with a tractor and disk to a depth of six inches until the grasses are cut up sufficiently to expose large areas of soil.

3.2.5 Herbicide Application

BA Perimeter areas being converted from pasture to prairie or savanna will be treated with herbicide to aid in the conversion. The areas will need two applications of glyphosate herbicide prior to seeding. The two applications should be made approximately 30 days apart. The last spraying should be applied approximately two weeks prior to seeding. A licensed contractor shall apply the glyphosate mixture at a rate consistent with manufacturer's specifications.

3.3 VEGETATION INSTALLATION

The establishment of native vegetation is a primary goal of the NRRDP. This will be accomplished in several ways. Native grasses and wildflowers will be established through seeding across prepared seedbeds and by installation of herbaceous plant plugs into wetland areas. Woody native plants will be installed as live cuttings in high flow areas and as container grown and bare root trees and shrubs in patches. Implementation of these methods is discussed in more detail below.

3.3.1 Seeding

All seeding will be conducted pursuant to the seeding specification (Appendix D). A Restoration Ecologist will direct the seeding operations, determining which type of seeds will be used in each area and the method of application. Seeding activities will be broken down into perimeter areas, excavation cut banks, and Subarea basin wetland seeding. These are discussed below.

As stated in Section 3.2.4 above, areas in the perimeter areas will be seeded following two applications of glyphosate herbicide. These areas will then be seeded with an upland mesic grass and forb mix, with the exception of several small wet areas within the seeding patches that will hold water for an extended period of time due to drainage constraints. A wet prairie mix will be seeded within these areas. Seeding of perimeter uplands will be completed with a seed drill pulled by a tractor when possible. Grasses and forbs will be mixed in the large box of the seed drill and mycorrhizae will be placed in the small box allowing seed and inoculant to be applied at the same time.

After each of the Subareas has been released for restoration and the soil amendment is complete, the banks of that Subarea will be seeded with the upland mesic grass and forb mix. Banks with a slope of 5 to 1 and less will be seeded with the seed drill in the same manner as described above. Banks with a slope of greater than 5 to 1 will be broadcast seeded. These banks will be broadcast seeded in accordance with the requirements listed in Appendix D.

After each of the Subareas has been released for restoration and the soil amendment is complete, the Restoration Ecologist will ensure the Subarea basin wetlands are seeded with the wet prairie mix as listed in Appendix D. Seeding will be performed with a seed drill pulled by a tractor when possible. Grasses and forbs will be mixed and placed in the large box of the seed drill as stated above with the upland mix. The mycorrhizae inoculant will be placed in the small box. When soil moisture conditions prohibit the use of the seed drill, seed will be broadcast using hand broadcasters. In the event of needing to hand broadcast, application of the grasses and forbs can be made jointly or separately. The mycorrhizae will be seeded with a separate seeder. Seed and mycorrhizae will be raked into the soil following dispersion and mulch spread over the area. Application and mulching will be accomplished in accordance with the requirements of Appendix D.

3.3.2 Herbaceous Plants

The use of herbaceous plants will be limited to shallow areas of vernal pools, ponds, and wetland features. The tables in Section 2 of this document list the species and quantities of plugs to be installed in each Subarea. The Restoration Ecologist will identify specific locations for placement of plant species. Plants will be delivered to the site in 2.375-inch square open-bottom pots. These plants must be staged by placing them in water immediately upon arrival at the FCP. Herbaceous plant installation will be conducted using a dibble bar or shovel. Plants will be carefully removed from their pot and placed into the planting hole, keeping the root mass and soil ball intact. The plant is then gently pressed into place by hand. Field personnel should make sure that no roots are exposed.

Donor herbaceous vegetation may be imported into the area wetland areas from other restoration projects at the FCP or from off-site donor wetlands. Field personnel will use a round point shovel to transplant root wads from established stands of desirable wetland species. The Restoration Ecologists will identify plants to be used and locations for planting. These established plants will rapidly spread via root sprouting, accelerating the establishment of native wetland vegetation. In addition, the soil, water, and organic matter that accompany the transplants serve to inoculate created wetlands with desirable mycorrhizae and macro-invertebrates.

3.3.3 Live Stakes

Live willow cutting species and quantities have been identified in Section 2 tables. The willow stakes will be installed by driving the cutting into the ground to a depth of one-half to two-thirds the length of the stake, or by securing fascines of live cuttings in a trench. Cuttings will be placed to secure the soil from erosion in areas that have the potential for increased water flow or for erosion. Installation of live willow cuttings shall be in accordance with the requirements of Appendix E. The Restoration Ecologist can designate alternate methods when soil conditions prohibit driving of stakes.

3.3.4 Woody Trees and Shrubs

Planting activities involve the establishment of trees and shrubs across the project area. All planting activities, with the exception of the Aesthetic Barrier, will be conducted pursuant to the densities documented in the NRRP (DOE 2002a) (160 trees/acre, 90 shrubs/acre, and 400 seedlings/acre). Densities for the Aesthetic Barrier are lower for the trees/acre and 230 shrubs/acre. Densities within wetland shrub patches will meet the 90shrubs/acre target. The shrubs will not be spread over the entire area but will be grouped in tight patch groupings for increased protection. The savanna will have less than the 160 trees/acre.

Woody plants will be installed in the same manner as other ecological restoration projects at the FCP. Each Subarea will be divided into smaller planting patches (Appendix B). Each planting patch will be laid out in the field and planting locations identified. The plants will be staged at a central location and tagged to identify patch location. Field personnel will place plants in the appropriate patches and install them pursuant to the planting specifications in Appendix E. This method will allow the Restoration Ecologist to strategically place species based on its habitat requirements, distribution patterns, exposure, topography, deer pressure, hydrology, soils, etc.

Bare-root seedlings will be grouped by patch. Field personnel will be instructed by the Restoration Ecologist to randomly distribute the seedlings within the patch area. Seedlings will also be installed pursuant to the specification in Appendix E.

All plant material will be procured from local sources, if possible. All trees shall be at least one-gallon container size, grown in "spin-out" containers to prevent root binding. Shrubs must also be grown in "spin-out" containers, and must be at least one foot tall. Seedlings may be container grown or bare root. Certain species may not be available locally, if at all. The Restoration Ecologist will determine the appropriate substitution for a plant. The function of the plant as listed in Table 3-1 will be used as a guide to determining substitutions.

4.0 MONITORING AND MAINTENANCE

4.1 MAINTENANCE ACTIVITIES

Maintenance is critical to the success of the BAR Project. Activities that will be required for the BAR Project may include watering, deer control, and invasive species control. These activities are discussed in more detail below.

4.1.1 Watering

Each plant will be watered at the time of installation. Watering will also be carried out as needed during the first six weeks following plant installation as required per Specification 2940 (Appendix E). Watering will also be carried out beyond the initial six-week period as directed by the Restoration Ecologist if drought conditions persist during the first growing season.

Water is not directly available for the project area. Water will be made accessible for watering operations via polyethylene tanks on trailers or water trucks. Watering will be carried out either directly via hose, tree gator and/or bucket, or remotely via water cannon. Watering may be carried out during the second growing season if significant drought conditions occur similar to the summer of 1999 and 2002.

For seeded areas, the planting window restrictions in the attached seeding specification help to ensure that sufficient soil moisture exists for germination and survival of seeds. Weather patterns will be a contributing factor in timing of seed application. Some watering may be needed the first season if drought conditions threaten the survival of germinated seed.

4.1.2 Deer Control

Installed trees and shrubs must be protected from deer browsing and rubbing in order for forest restoration efforts to be successful. Experience from past restoration projects at the FCP show that exclosure fencing is the most effective means of protection. The Restoration Ecologist will clump shrub plantings and some tree plantings in order to maximize the effectiveness of fencing. Field personnel will then install welded wire or deer exclusion fencing around plant material. In the event that fencing is not practical, the use of tree tubes and repellant sprays will be employed to protect trees and shrubs.

4.1.3 Invasive Species

The forest restoration concept developed in the NRRP depends on ecological succession as the primary component. Without adequate control, invasive and aggressive species may impede or prevent natural

succession and alter the intended course of maturation for restored areas. Therefore, field personnel will mechanically remove or apply glyphosate herbicide to thistle varieties, Typha spp., and Phragmites spp., present in the A1PII planting areas.

4.2 MONITORING

Both Implementation and Functional Monitoring will be conducted for the BAR Project. The portions of the BAR Project that are being constructed as a wetland mitigation project will have more intensive monitoring than the remaining subareas and project perimeter.

4.2.1 Wetland Mitigation Monitoring

For Subareas 3, 4, and 8 (i.e., wetland mitigation), implementation monitoring will include water level measurements, water quality measurements, wetland plant surveys and soil analyses for a three-year period. The DOE Office of Legacy Management, the Post-Closure site steward, will complete this monitoring after FCP cleanup has been completed. Monitoring will also be documented with photographs. Plant survival and herbaceous coverage will only be evaluated in the first year after project completion. To facilitate plant survival evaluations, all sapling trees and shrubs will be tagged with a unique number, which will be recorded on patch-specific data sheets. Mortality counts will be conducted at the end of the first growing season following completion of project area restoration. For Implementation Monitoring of seeded areas, herbaceous cover will be evaluated pursuant to the process and criteria set forth in the 2002 Consolidated Monitoring Report for Restored Areas (DOE 2003).

4.2.2 Implementation Monitoring for Balance of BAR Project

Implementation monitoring parameters for the BAR Project will consist of plant survival and herbaceous cover measurements. Mortality counts will be conducted at the end of the first growing season following completion of each phase of restoration. For implementation monitoring of seeded areas, herbaceous cover will be evaluated pursuant to the process and criteria set forth in the 2002 Consolidated Monitoring Report (DOE 2003).

4.2.3 Functional Monitoring

Functional Monitoring will also commence following restoration. In accordance with the current Functional Monitoring schedule, completed prairie areas will be evaluated in 2004 and completed forest areas will be evaluated in 2005. As with Implementation Monitoring methods, the methods, results, analyses, and reporting are conducted under the Annual Consolidated Monitoring Report for Restored Areas.

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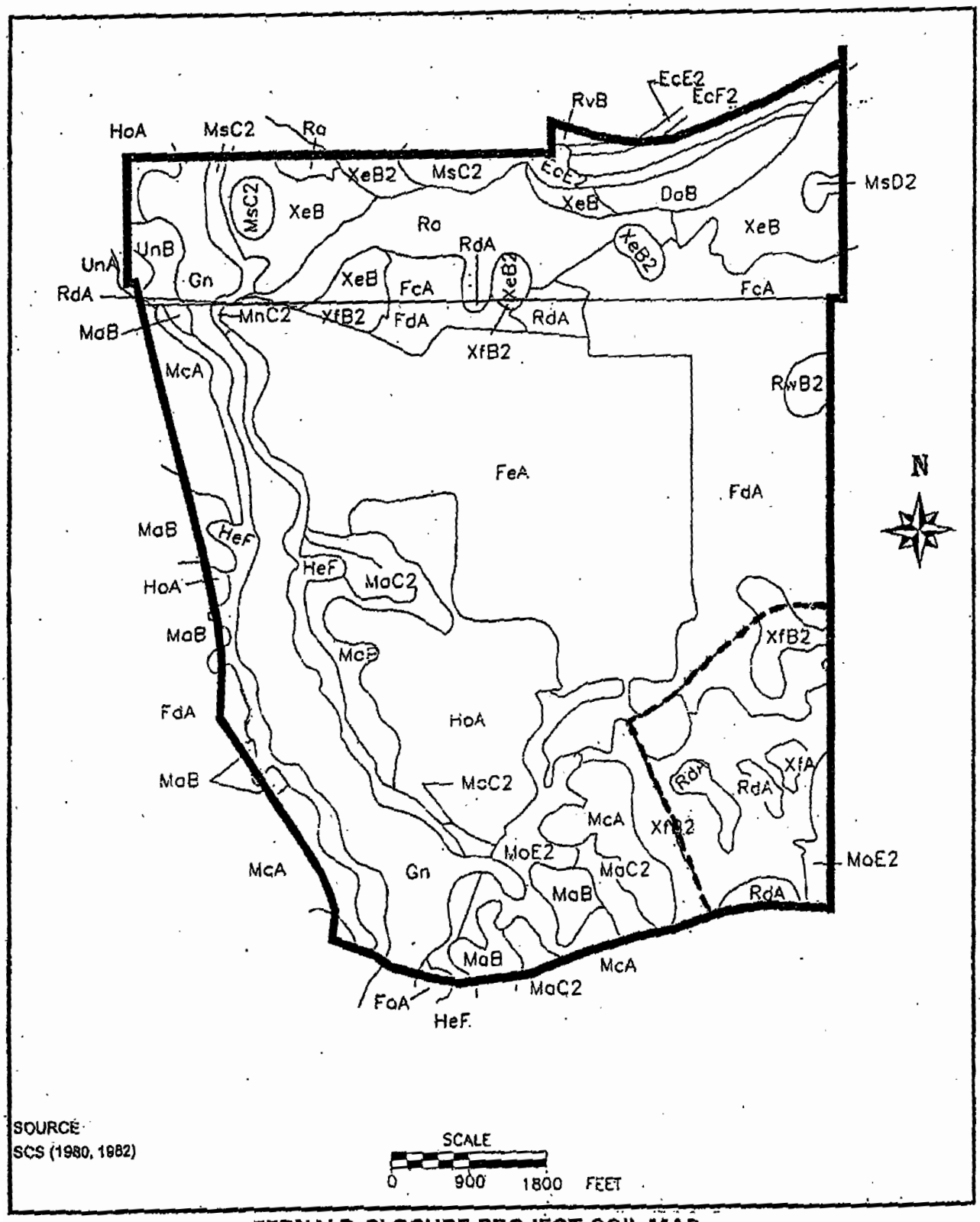
APPENDIX A

SCS SOILS DRAINAGE CLASSIFICATION

SCS SOILS DRAINAGE CLASSIFICATION
FERNALD CLOSURE PROJECT

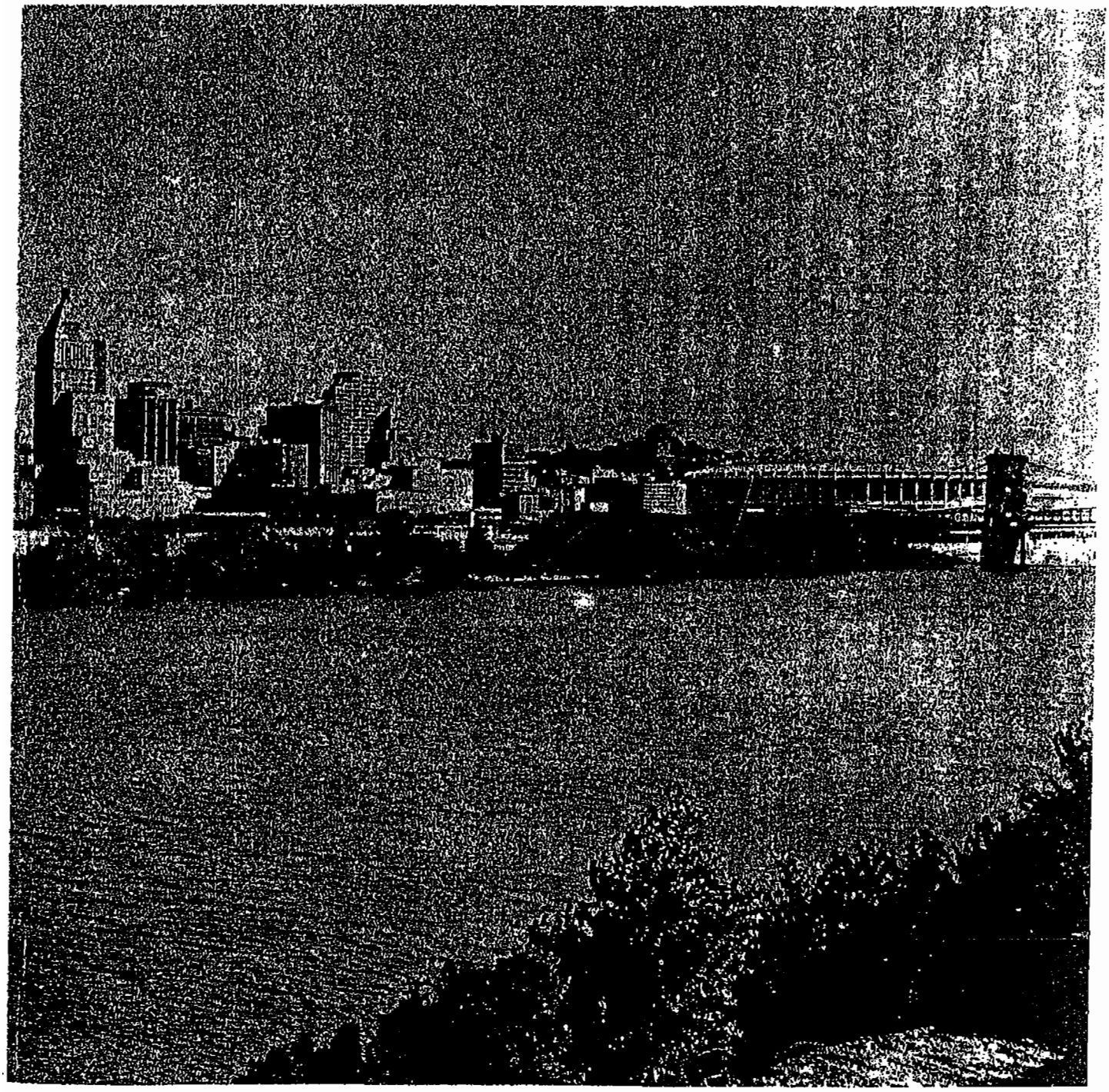
Symbol	Name	Slopes (%)	Drainage Classification
MoE2	Miamian-Hennepin silt loam	25-35, eroded	Well drained
RdA	Raub silt loam	0-2	Somewhat poorly drained
XfA	Xenia silt loam	0-2	Moderately well drained
XfB2	Xenia silt loam	2-6, eroded	Moderately well drained



FERNALD CLOSURE PROJECT SOIL MAP

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Ohio Department of Natural Resources
Division of Lands and Soil, and
Ohio Agricultural Research and Development Center

soil survey of Hamilton County Ohio



MoE2—Miamian-Hennepin silt loams, 25 to 35 percent slopes, eroded. These deep, steep, well drained soils are on dissected parts of glacial till plains of Wisconsinan age. Most areas of this complex are long and narrow and range from 10 to 60 acres in size. They are about 40 percent Miamian silt loam and 40 percent Hennepin silt loam. The Miamian soil is on the ridge crests and shoulder slopes and toe slopes, and the Hennepin soil is on back slopes, where erosion has been more active. Areas of the Miamian and Hennepin soils are so intricately mixed, or so small, that it is not practical to separate them at the scale used in mapping.

The Miamian soil typically has a surface layer of dark yellowish brown, friable silt loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part of the subsoil is dark yellowish brown, friable silty-clay loam; and the lower part is dark yellowish brown, firm clay loam. The substratum to a depth of about 60 inches is light olive brown, firm clay loam glacial till.

The Hennepin soil typically has a surface layer of very dark grayish brown, friable silt loam about 2 inches thick. The subsoil is yellowish brown, friable loam about 12 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, firm loam glacial till.

Included in mapping, and making up about 20 percent of most areas, are narrow strips of steeper soils and narrow areas of well drained Genesee and Lanier soils on flood plains.

Permeability is moderately slow in the Miamian soil and moderately slow or slow in the Hennepin soil. The available water capacity is moderate in both soils. Runoff is very rapid. The organic matter content is moderately low in both soils.

The soils in this complex are used mainly as woodland and pasture. They are unsuited to cultivated crops and are moderately well suited to pasture plants. Slopes are too steep for safe operation of modern farm machinery. Erosion is a severe hazard if adequate plant cover is not maintained. Grazing when the soils are wet causes surface compaction and excessive runoff and reduces yields. The trash-mulch seeding method reduces erosion during reseeding. Proper stocking, pasture rotation, and restricted grazing when the soils are wet help keep the pasture plants and the soils in good condition.

These soils are well suited to trees. The slope, however, severely limits the use of planting and harvesting equipment. Logging roads and skid trails should be constructed on the contour wherever possible. Plant competition can be reduced by spraying, cutting, or girdling.

These soils are poorly suited to building site development, sanitary facilities, and many recreation uses. Construction for recreation and urban uses is very difficult. Deep excavations are needed for these uses. Retaining walls are used in many areas. Erosion is a very severe hazard if vegetation is removed. Hiking paths and trails should be established across the slope, wherever possible, and permanent steps should be used where the paths go up and down the slope. Most areas are esthetically pleasing and are very beneficial as open space.

These soils are in capability subclass VIIe and woodland suitability subclass 1r.

RdA—Raub silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on Wisconsinan till plains. It is adjacent to depressions and shallow drainageways. Most areas are oblong or fan shaped and range from 3 to 20 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is brown, dark yellowish brown, and yellowish brown, mottled, firm silty clay loam and clay loam about 38 inches thick. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable clay loam. In some places the soil is wetter and has a thicker mantle of loess.

Included in mapping, and making up about 15 percent of most areas, are a few small areas of moderately well drained Dana soils. These soils are slightly higher on the landscape and are more sloping.

The seasonal high water table is between depths of 12 and 36 inches in winter and in spring and other extended wet periods. This soil has moderately slow permeability and high available water capacity. Runoff is slow. The soil has high organic matter content and good tilth. The subsoil is dominantly strongly acid to slightly acid; in some places it is neutral in the lower part.

This soil is mainly used as cropland. It is well suited to corn, soybeans, wheat, and hay and to pasture plants. It can be used for row crops year after year under optimum management. Drainage is the main management concern. This soil dries slowly in spring, and in areas not artificially drained, planting is delayed in most years. Surface and subsurface drains are used. Soil compaction is a problem if heavy machinery is used.

This soil is poorly suited to use as a site for buildings and to use as septic tank absorption fields, and it is moderately well suited to many recreation uses. Wetness and moderately slow permeability limit these uses. Curtain drains can lower the seasonal high water table in septic tank absorption fields. Alternating septic tank absorption fields can also help overcome the wetness and permeability limitations. Building sites should be landscaped so that surface water drains away from foundations. The use of this soil as a site for local roads and streets is limited by the low strength of the soil and by the hazard of frost action in the soil. Those limitations can be overcome by providing artificial drainage and by using a suitable base material.

This soil is in capability subclass IIw. It is not assigned to a woodland suitability subclass.

XfA—Xenia silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on the broad flats on the Wisconsinan till plains. Most areas are irregularly shaped and range from 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 37 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, mottled, friable silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 62 inches is light olive brown, mottled, friable loam glacial till. In a few areas the soil is better drained, and in some areas it is 40 to 72 inches deep to bedrock.

Included in mapping, and making up about 15 percent of most areas, are somewhat poorly drained Fincastle soils along waterways and in depressions and well drained Miamian soils on rises.

The seasonal high water table is between depths of 24 and 72 inches in spring and other extended wet periods. Permeability is moderately slow, available water capacity is high, and runoff is slow. This soil is highly corrosive to steel, and the potential for frost action is high.

This soil is used mainly as cropland and pasture. It is well suited to corn, soybeans, wheat, hay, and pasture plants. Row crops can be grown year after year if well managed. Regular addition of organic matter reduces surface crusting and increases soil fertility. Subsurface drains are needed in included wetter soils. Grazing when the soil is wet causes surface compaction, increases runoff, and reduces yields. Proper stocking, pasture rotation, and restricted grazing when the soil is wet help keep the pasture plants and the soil in good condition.

This soil is well suited to trees. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited to use as a site for buildings and recreation uses and poorly suited to use as septic tank absorption fields. Seasonal wetness and shrinking and swelling of the subsoil limit the use of this soil as a site for buildings. Draining surface water away from foundations and backfilling around foundations with soil material that has low shrink-swell potential help overcome these limitations. Drains at the base of footings and exterior basement wall coatings are used to help prevent wet basements. Seasonal wetness and moderately slow permeability limit the use of this soil as septic tank absorption fields. These limitations can be overcome by using curtain drains to lower the seasonal high water table and by using a larger absorption area than normal. The use of the soil as a site for local roads and streets is limited by the low strength of the soil and by the hazard of frost action in the soil. Those limitations can be overcome by providing suitable base material and artificial drainage.

This soil is in capability class I and woodland suitability subclass 1o.

XfB2—Xenia silt loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on the Wisconsinan till plains. Erosion has removed part of the original surface layer, and subsoil material has been tilled into the present surface layer. Most areas are irregular in shape and 5 to 100 acres in size.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 37 inches thick. The upper part of the subsoil is yellowish brown and dark yellowish brown, mottled, friable and firm silty clay loam; and the lower part is yellowish brown, mottled, firm clay loam. The substratum to a depth of about 62 inches is light olive brown, mottled, friable loam glacial till. In a few areas the soil is better drained and does not have gray mottles in the upper part of the subsoil. In some areas the loess mantle is thinner, and in a few areas the soil is 40 to 72 inches deep to bedrock.

Included in mapping, and making up about 10 percent of most areas, are small areas of somewhat poorly drained Fincastle soils along waterways and well drained Miamian soils on knolls.

The seasonal high water table is between depths of 24 and 72 inches in spring and other extended wet periods. Permeability is moderately slow, available water capacity is high, and runoff is medium. This soil is highly corrosive to steel. The potential for frost action is high.

This soil is used mainly as cropland and pasture. It is well suited to corn, soybeans, wheat, hay, and pasture plants. Erosion is a hazard if the soil is cultivated. Using minimum tillage and planting cover crops reduce erosion. Regular addition of organic matter reduces surface crusting and increases soil fertility.

The use of this soil as pasture is very effective in controlling erosion. Grazing when the soil is wet, however, causes surface compaction and excessive runoff and reduces yields. Proper stocking, pasture rotation, and restricted grazing when the soil is wet help keep the pasture plants and the soil in good condition.

This soil is well suited to trees. Plant competition can be reduced by spraying, mowing, or disking.

This soil is moderately well suited to use as a site for buildings and recreation uses and poorly suited to use as septic tank absorption fields. Seasonal wetness and shrinking and swelling of the subsoil limit the use of this soil as a site for buildings. Draining surface water away from foundations and backfilling around foundations with soil material that has low shrink-swell potential help overcome these limitations. Drains at the base of footings and exterior basement wall coatings are used to help prevent wet basements. Seasonal wetness and moderately slow permeability limit the use of this soil as septic tank absorption fields. Those limitations can be overcome by using curtain drains to lower the seasonal high water table and by using a larger absorption area than normal. The use of the soil as a site for local roads and streets is limited by the low strength of the soil and by the hazard of frost action in the soil. Those limitations can be overcome by providing suitable base material and artificial drainage.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

Hennepin series

The Hennepin series consists of deep, well drained soils on valley side slopes in dissected parts of glacial till plains. These soils formed in calcareous Wisconsinan glacial till. Permeability is moderately slow or slow. Slope ranges from 15 to 60 percent.

Hennepin soils are similar to Miamian soils and are commonly adjacent to Miamian and Russell soils. Miamian and Russell soils have an argillic horizon and a thicker solum. Russell soils also have a loess mantle.

Typical pedon of Hennepin silt loam, 35 to 60 percent slopes, in the city of Sharonville, Sycamore Township, about 600 feet east and 1,200 feet north of the center of sec. 24, R. 1, T. 4.

A1—0 to 2 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate medium granular structure; friable; many roots; 2 percent coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

B2—2 to 12 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure parting to moderate medium and coarse granular; friable; 6 percent coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

C—12 to 60 inches; dark yellowish brown (10YR 4/4) loam; massive; firm; 12 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness ranges from 5 to 20 inches.

The A1 horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4.

The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or light clay loam.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6.

Miamian series

The Miamian series consists of deep, well drained soils on Wisconsinan till plains. These soils formed in a thin layer of loess and the underlying glacial till. Permeability is moderately slow. Slope ranges from 8 to 35 percent.

Miamian soils are commonly adjacent to Hennepin and Russell soils and are similar to Eldean and Russell soils. Eldean soils have sand and gravel at a depth of 25 to 40 inches. They are in hummocky areas. Hennepin and Russell soils have less clay in the subsoil. They occupy positions similar to those of the Miamian soils.

Typical pedon of Miamian silt loam, 8 to 15 percent slopes, eroded, in the city of Sharonville, Sycamore Township, about 780 feet east and 825 feet north of the center of sec. 24, R. 1, T. 4.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

B21t—6 to 10 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine and medium subangular and angular blocky structure; friable; thin very patchy brown (10YR 4/3) clay films on vertical faces of peds; neutral; clear smooth boundary.

IIB22t—10 to 15 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular and angular blocky structure; firm; thin continuous brown (10YR 4/3) clay films on vertical faces of peds; about 5 percent coarse fragments; neutral; clear smooth boundary.

IIB23t—15 to 22 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thin continuous brown (10YR 4/3) clay films on vertical faces of peds; about 5 percent coarse fragments; many black (10YR 2/1) concretions and stains (iron and manganese oxides); neutral; clear smooth boundary.

IIB24t—22 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; weak coarse subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on vertical faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxides); about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

IIC—27 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; firm; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness ranges from 20 to 40 inches, and depth to carbonates ranges from 18 to 40 inches. Reaction ranges from medium acid to neutral in the A horizon, strongly acid to neutral in the upper part of the B horizon, and slightly acid to mildly alkaline in the lower part. Coarse fragment content below the loess mantle is 2 to 15 percent by volume.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is dominantly silt loam but is silty clay loam in some pedons. Some pedons have a B1 horizon.

The IIB2 horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or silty clay loam.

The IIC horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is light clay loam or loam glacial till.

Raub series

The Raub series consists of deep, somewhat poorly drained, moderately slowly permeable soils on till plains. These soils formed in a mantle of loess and in the underlying calcareous Wisconsinan glacial till. Slope is 0 to 2 percent.

Raub soils are commonly adjacent to Dana, Fincastle, and Xenia soils and are similar to Fincastle soils. Dana and Xenia soils are moderately well drained and do not have gray mottles as close to the surface as do Raub soils. Fincastle and Xenia soils do not have a mollic epipedon.

Typical pedon of Raub silt loam, 0 to 2 percent slopes, in the city of Forest Park, in Springfield Township, about 1,850 feet east and 200 feet south of the northwest corner of sec. 19, R. 2, T. 2.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A12—9 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, very dark grayish brown (10YR 3/2) dry; moderate medium granular structure; friable; many fine roots; neutral; clear smooth boundary.

B21t—13 to 18 inches; brown (10YR 4/3) silty clay loam; common fine faint dark grayish brown (10YR 4/2) and common fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; many fine roots; thin patchy dark grayish brown (10YR 4/2) clay films on faces of peds; slightly acid; clear smooth boundary.

B22t—18 to 30 inches; dark yellowish brown (10YR 4/4) silty clay loam; many medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine roots; thin continuous dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; clear smooth boundary.

IIB23t—30 to 38 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; common fine roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; medium acid; clear smooth boundary.

IIB3—38 to 51 inches; brown (10YR 5/3) clay loam; common medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin very patchy grayish brown (10YR 5/2) clay films on faces of peds; few coarse fragments; slightly acid; clear wavy boundary.

IIC—51 to 60 inches; yellowish brown (10YR 5/4) light clay loam; few medium distinct grayish brown (10YR 5/2) mottles; massive; friable; 3 percent coarse fragments; strong effervescence; moderately alkaline.

The loess mantle is 22 to 40 inches thick, and the solum is 40 to 60 inches thick. The mollic epipedon ranges from 10 to 18 inches in thickness.

The Ap and A12 horizons range from medium acid to neutral.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It commonly is slightly acid to strongly acid but ranges to neutral in the lower part.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is loam or clay loam.

Xenia series

The Xenia series consists of deep, moderately well drained, moderately slowly permeable soils on till plains. These soils formed in a mantle of loess and in the underlying calcareous Wisconsinan glacial till. Slope ranges from 0 to 6 percent.

Xenia soils are similar to Dana and Russell soils and are commonly adjacent to Dana, Fincastle, and Russell soils. Dana soils have a mollic epipedon. Fincastle soils are somewhat poorly drained and have more gray colors in the subsoil. Russell soils are well drained and do not have mottles in the upper part of the subsoil.

Typical pedon of Xenia silt loam, 2 to 6 percent slopes, eroded, in the city of Forest Park, in Springfield Township, about 500 feet west and 1,000 feet south of the northeast corner of sec. 25, R. 2, T. 2.

Ap—0 to 9 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

B21t—9 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint yellowish brown (10YR 5/6) and few fine faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; friable; thin patchy dark yellowish brown (10YR 3/4) clay films on vertical faces of peds; common small root channels with brown (10YR 4/3) linings; medium acid; clear wavy boundary.

B22t—17 to 26 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and common fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thin continuous brown (10YR 4/3) clay films on vertical and horizontal faces of peds; common very dark brown (10YR 2/2) concretions (iron and manganese oxides); medium acid; clear wavy boundary.

IIB23t—26 to 33 inches; yellowish brown (10YR 5/4) clay loam; common medium faint yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on vertical faces of peds; few very dark brown (10YR 2/2) concretions and stains (iron and manganese oxides); few coarse fragments; medium acid; clear wavy boundary.

IIB3t—33 to 46 inches; yellowish brown (10YR 5/4) clay loam; common medium faint yellowish brown (10YR 5/6) and common fine distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on vertical faces of peds; few coarse fragments; neutral on ped surfaces; slight effervescence within peds; mildly alkaline; clear irregular boundary.

IIC1—46 to 54 inches; light olive brown (2.5Y 5/4) loam; many medium distinct gray (10YR 5/1) and grayish brown (10YR 5/2) mottles; massive; friable; few coarse fragments; strong effervescence; moderately alkaline; diffuse irregular boundary.

IIC2—54 to 62 inches; light olive brown (2.5Y 5/4) loam; common medium distinct gray (10YR 5/1) and grayish brown (10YR 5/2) mottles; massive; friable; 5 percent coarse fragments; strong effervescence; moderately alkaline.

Solum thickness ranges from 36 to 54 inches. Depth to carbonates ranges from 30 to 40 inches. Thickness of the loess mantle ranges from 22 to 35 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 to 4.

The B2 horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4.

The IIB horizon has colors similar to those in the B2 horizon.

The C horizon is loam or light clay loam glacial till.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
EpA, EpB2, EpC2 Eldean	2o	Slight	Slight	Slight	Slight	Northern red oak	80	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, white oak.
						Black oak	80	
						White oak	80	
						Black walnut	---	
						Black cherry	---	
						Sugar maple	---	
						White ash	---	
						Yellow-poplar	---	
FdA Fincastle	3o	Slight	Slight	Slight	Slight	Northern red oak	75	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						White oak	75	
						Pin oak	85	
						Yellow-poplar	85	
						Sweetgum	80	
FoA, FoB2 Fox	2o	Slight	Slight	Slight	Slight	Northern red oak	80	Yellow-poplar, white ash, eastern white pine, red pine.
						White oak	---	
						Sugar maple	---	
Gn Genesee	1o	Slight	Slight	Slight	Slight	Yellow-poplar	100	Eastern white pine, black walnut, yellow-poplar.
HeF Hennepin	1r	Severe	Severe	Slight	Slight	Northern red oak	85	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine.
						White oak	---	
HoA Henshaw	2o	Slight	Slight	Slight	Slight	Pin oak	95	White ash, sweetgum, eastern cottonwood, yellow-poplar.
						Yellow-poplar	95	
						Sweetgum	95	
Hu Huntington	1o	Slight	Slight	Slight	Slight	Yellow-poplar	96	Yellow-poplar, black walnut, eastern white pine.
						Northern red oak	85	
Ju Jules	---	--------	--------	--------	--------	--------	---	Black walnut, American sycamore, eastern cottonwood, red maple, green ash, sweetgum, common hackberry.
Lg Lanier	2s	Slight	Slight	Slight	Slight	Northern red oak	80	Eastern white pine, red pine, green ash.
						Black oak	80	
						Red maple	---	
						Bur oak	---	
						Quaking aspen	---	
						Green ash	---	
						Slippery elm	---	
MaB, MaC2, MaD2, MaE2 Markland	2c	Slight	Slight	Severe	Severe	White oak	75	Eastern white pine, red pine, yellow-poplar, white ash.
						Northern red oak	78	
MoA, MoB Martinsville	1o	Slight	Slight	Slight	Slight	White oak	90	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
						Yellow-poplar	98	
						Sweetgum	76	

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
C2---------- iamian	1o	Slight	Slight	Slight	Slight	Northern red oak----	87	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, northern red oak, white oak.
						Black walnut--------	---	
						White oak----------	---	
						Yellow-poplar-------	---	
						Black cherry--------	---	
						Sugar maple---------	---	
						White ash----------	---	
D2*:								
iamian----------	1r	Moderate	Moderate	Slight	Slight	Northern red oak----	87	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, northern red oak, white oak.
						Black walnut--------	---	
						White oak----------	---	
						Yellow-poplar-------	---	
						Black cherry--------	---	
						Sugar maple---------	---	
						White ash----------	---	
ennepin----------	1r	Moderate	Moderate	Slight	Slight	Northern red oak----	86	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine.
						White oak----------	---	
E2*:								
iamian----------	1r	Moderate	Moderate	Slight	Slight	Northern red oak----	87	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, northern red oak, white oak.
						Black walnut--------	---	
						White oak----------	---	
						Yellow-poplar-------	---	
						Black cherry--------	---	
						Sugar maple---------	---	
						White ash----------	---	
ennepin----------	1r	Severe	Severe	Slight	Slight	Northern red oak----	86	Northern red oak, white oak, green ash, black walnut, eastern white pine, red pine.
						White oak----------	---	
32, PbC2--------- arke	1o	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.
						Yellow-poplar-------	98	
						Sweetgum----------	76	
), PbE---------- arke	1r	Moderate	Moderate	Slight	Slight	White oak----------	90	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.
						Yellow-poplar-------	98	
						Sweetgum----------	76	
---------- ite	1c	Slight	Slight	Severe	Severe	Northern red oak----	86	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
						Yellow-poplar-------	98	
						Virginia pine-------	---	
						White oak----------	---	
						Sweetgum----------	---	
), PfE---------- ite	1c	Moderate	Moderate	Severe	Severe	Northern red oak----	86	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
						Yellow-poplar-------	98	
						Virginia pine-------	---	
						White oak----------	---	
						Sweetgum----------	---	
---------- itton	2w	Slight	Severe	Moderate	Moderate	Pin oak----------	85	Eastern white pine, red maple, white ash, sweetgum.
						White oak----------	75	
						Sweetgum----------	80	
						Northern red oak----	75	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
PrA, PrB, PrC2 Princeton	1o	Slight	Slight	Slight	Slight	White oak Yellow-poplar Sweetgum	90 98 76	Eastern white pine, red pine, black walnut, yellow-poplar, white ash, black locust.
RdA Raub	---	--------	--------	--------	--------	--------	---	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
Rn Ross	1o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Sugar maple White oak Black walnut Black cherry White ash	86 96 85 --- --- --- ---	Eastern white pine, black walnut, white ash, yellow-poplar.
RpA, RpB2, RpC2 Rossmoyne	2d	Slight	Slight	Moderate	Moderate	Northern red oak White ash White oak Sugar maple Slippery elm American beech American sycamore	80 --- --- --- --- --- ---	Green ash, Virginia pine, yellow-poplar, red pine.
RwB2 Russell	1o	Slight	Slight	Slight	Slight	White oak Northern red oak Yellow-poplar Sweetgum	90 90 98 76	Eastern white pine, red pine, white ash, yellow-poplar, black walnut.
St Stonelick	2o	Slight	Slight	Slight	Slight	Northern red oak White oak Black walnut Black cherry Sugar maple White ash Yellow-poplar	80 --- --- --- --- --- ---	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, white oak.
SwB2, SwC2 Switzerland	1o	Slight	Slight	Slight	Slight	Northern red oak Yellow-poplar Virginia pine Shortleaf pine White oak Sweetgum	86 98 --- --- --- ---	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
SwD2 Switzerland	1r	Moderate	Moderate	Slight	Slight	Northern red oak Yellow-poplar Virginia pine Shortleaf pine White oak Sweetgum	86 98 --- --- --- ---	Eastern white pine, yellow-poplar, black walnut, white ash, red pine.
Wa Wakeland	2o	Slight	Slight	Slight	Slight	Pin oak Sweetgum Yellow-poplar Virginia pine	90 88 90 85	Eastern white pine, American sycamore, red maple, white ash.
WbA Warsaw Variant	---	--------	--------	--------	--------	--------	---	Eastern white pine, black walnut, yellow-poplar, white ash, red pine, white oak.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
A---------- ea	---	---	---	---	---	---	---	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.
A---------- hitaker	3o	Slight	Slight	Slight	Slight	White oak----------	70	Eastern white pine, white ash, red maple, yellow-poplar, American sycamore.
						Pin oak----------	85	
						Yellow-poplar--------	85	
						Sweetgum----------	80	
						Northern red oak----	75	
A, XfB2---------- nia	1o *	Slight	Slight	Slight	Slight	White oak----------	90	Eastern white pine, red pine, black walnut, yellow-poplar, white ash.
						Yellow-poplar--------	98	
						Sweetgum----------	76	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
EeC*:										
Urban land.										
EeD*:										
Eden	Very poor.	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Urban land.										
EpA Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
EpB2 Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
EpC2 Eldean	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
ErA*:										
Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
ErB*:										
Eldean	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
FdA Fincastle	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
FeA*:										
Fincastle	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Urban land.										
FoA, FoB2 Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
FpA*:										
Fox	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										
Gn Genesee	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Go*:										
Genesee	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Urban land.										
HeF Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
HoA Henshaw	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Hu Huntington	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Ju Jules	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Lg: Lanier	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
MaB: Markland	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MaC2: Markland	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MaD2, MaE2: Markland	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
McA, McB: Martinsville	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MnC2: Miamian	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
MoD2[a]:										
Miamian	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
MoE2[a]:										
Miamian	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hennepin	Very poor.	Poor	Good	Good	Fair	Very poor.	Very poor.	Poor	Good	Very poor.
MuC[a]:										
Miamian	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										
PbB2: Parke	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
PbC2: Parke	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
PbD: Parke	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
PbE: Parke	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
PcB[a]:										
Parke	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
PcC[a]:										
Parke	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
PfC---------- Pate	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
PfD---------- Pate	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
PfE---------- Pate	Good	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
PhD*:										
Pate----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Urban land.										
Pn---------- Patton	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Po*. Pits										
PrA, PrB---------- Princeton	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
PrC2---------- Princeton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RdA---------- Raub	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Rn---------- Ross	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RpA---------- Rossmoyne	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
RpB2---------- Rossmoyne	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RpC2---------- Rossmoyne	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
RtA*:										
Rossmoyne----------	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Urban land.										
RtB*:										
Rossmoyne----------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
RtC*:										
Rossmoyne----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										
RwB2---------- Russell	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
RxB*:										
Russell----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
UrB*:										
Urban land.										
Rossmoyne	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Ux*:										
Urban land.										
Stonelick	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
Wa Wakeland	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
WbA Warsaw Variant	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WeA Wea	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
WhA Whitaker	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
XfA, XfB2 Xenia	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
FpA*: Urban land.						
Gn: Genesee	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
Go*: Genesee	Moderate: seepage.	Moderate: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
Urban land.						
HeF: Hennepin	Severe: slope.	Severe: piping.	Severe: no water.	Droughty, percs slowly.	Slope, percs slowly.	Slope, droughty, percs slowly.
HoA: Henshaw	Slight	Severe: piping, wetness.	Severe: slow refill.	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
Hu: Huntington	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Flooding	Favorable	Favorable.
Ju: Jules	Moderate: seepage.	Severe: piping.	Severe: no water.	Erodes easily, flooding.	Erodes easily	Erodes easily.
Lg: Lanier	Severe: seepage.	Severe: seepage.	Severe: no water.	Droughty, soil blowing, flooding.	Too sandy, soil blowing.	Droughty.
MeB: Markland	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
MaC2, MaD2, MaE2: Markland	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
MgA: Martinsville	Moderate: seepage.	Severe: thin layer.	Severe: no water.	Favorable	Erodes easily	Erodes easily.
MgB: Martinsville	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Slope	Erodes easily	Erodes easily.
MnC2: Miamian	Severe: slope.	Severe: piping.	Severe: no water.	Rooting depth, slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
MoD2*, MoE2*: Miamian	Severe: slope.	Severe: piping.	Severe: no water.	Rooting depth, slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Hennepin	Severe: slope.	Severe: piping.	Severe: no water.	Droughty, percs slowly.	Slope, percs slowly.	Slope, droughty, percs slowly.
MuC*: Miamian	Severe: slope.	Severe: piping.	Severe: no water.	Rooting depth, slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Urban land.						
PbB2: Parke	Moderate: seepage, slope.	Slight	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
PbC2, PbD, PbE---- Parke	Severe: slope.	Slight---------	Severe: no water.	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
PoB*: Parke----------	Moderate: seepage, slope.	Slight---------	Severe: no water.	Slope, erodes easily.	Erodes easily	Erodes easily.
Urban land.						
PoC*: Parke----------	Severe: slope.	Slight---------	Severe: no water.	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Urban land.						
PrC---------- Pate	Severe: slope.	Moderate: hard to pack.	Severe: no water.	Droughty, percs slowly, slope.	Slope, large stones, erodes easily.	Slope, erodes easily, droughty.
PrD, PrE---------- Pate	Severe: slope, slippage.	Moderate: hard to pack.	Severe: no water.	Droughty, percs slowly, slope.	Slope, large stones, erodes easily.	Slope, erodes easily, droughty.
PhD*: Pate----------	Severe: slope, slippage.	Moderate: hard to pack.	Severe: no water.	Droughty, percs slowly, slope.	Slope, large stones, erodes easily.	Slope, erodes easily, droughty.
Urban land.						
Pn---------- Patton	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding---------	Ponding---------	Wetness.
Po*. Pits						
PrA---------- Princeton	Moderate: seepage.	Moderate: thin layer, piping.	Severe: no water.	Soil blowing---	Soil blowing---	Favorable.
PrB---------- Princeton	Moderate: seepage, slope.	Moderate: thin layer, piping.	Severe: no water.	Soil blowing, slope.	Soil blowing---	Favorable.
PrC2---------- Princeton	Severe: slope.	Moderate: thin layer, piping.	Severe: no water.	Soil blowing, slope.	Slope, soil blowing.	Slope.
RdA---------- Raub	Slight---------	Severe: wetness.	Severe: slow refill.	Wetness---------	Erodes easily, wetness.	Wetness, erodes easily.
Rn---------- Ross	Severe: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Favorable------	Favorable------	Favorable.
RpA---------- Rossmoyne	Moderate: seepage.	Moderate: piping, wetness.	Severe: no water.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
RpB2---------- Rossmoyne	Moderate: seepage, slope.	Moderate: piping, wetness.	Severe: no water.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
RpC2---------- Rossmoyne	Severe: slope.	Moderate: piping, wetness.	Severe: no water.	Wetness, percs slowly, rooting depth.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
Uh*: Urban land.						
Huntington	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Flooding	Favorable	Favorable.
UmB*: Urban land.						
Martinsville	Moderate: seepage, slope.	Severe: thin layer.	Severe: no water.	Slope	Erodes easily	Erodes easily.
UmC*: Urban land.						
Martinsville	Severe: slope.	Severe: thin layer.	Severe: no water.	Slope	Slope, erodes easily.	Slope, erodes easily.
Uo*: Urban land.						
Patton	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding	Ponding	Wetness.
UrB*: Urban land.						
Rossmoyne	Moderate: seepage, slope.	Moderate: piping, wetness.	Severe: no water.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
Ux*: Urban land.						
Stonelick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Droughty, flooding.	Too sandy, soil blowing.	Droughty.
Wa Wakeland	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
WbA Warsaw Variant	Severe: seepage.	Severe: seepage.	Severe: no water.	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
WeA Wea	Moderate: seepage.	Moderate: thin layer.	Severe: no water.	Favorable	Erodes easily	Erodes easily.
WhA Whitaker	Moderate: seepage.	Severe: wetness.	Moderate: slow refill, cutbanks cave.	Wetness	Erodes easily, wetness.	Wetness, erodes easily.
XfA Xenia	Moderate: seepage.	Moderate: thin layer, wetness.	Severe: slow refill.	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
XfB2 Xenia	Moderate: seepage, slope.	Moderate: thin layer, wetness.	Severe: slow refill.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

APPENDIX B

PATCH PAGES

PATCH PAGES

SUBAREA 1 AND 2

SHRUBS

SPECIES		COMMON NAME	Total Plants	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5	Patch 6	Patch 7	Patch 8	Patch 9	Patch 10	Patch 11
Alnus serrulata	rw	Smooth Alder	28		4	3			8		6	3	4	
Amorpha fruticosa	w	False Indigo Bush	24			6	4	6	3	2				3
Celastrus scandens	r	Bittersweet	4				4							
Cephalanthus occidentalis	w	Buttonbush	46		4	3		5			10	8	6	10
Cornus amomum	rw	Silky Dogwood	20			2			7		3		5	3
Corylus americana	rw	Hazelnut	26				6		7		3	3	7	
Hypericum spathulatum	w	Shrubby St. John's Wort	20			4			6	3			7	
Ilex verticillata	w	Winterberry	22			4			6	4			8	
Rosa palustris	rw	Swamp Rose	34				12	3	6		7		6	
Rosa setigera	rw	Prairie Rose	16						16					
Salix discolor	rw	Pussy Willow	50	16		5	3	6		6	5		5	4
Salix eriocephala	rw	Heart-Leaf Willow	22		6	5				4		5	2	
Salix sericea	rw	Silky Willow	20					6		8			3	3
Sambucus canadensis	rw	Elderberry	8	8										
Spirea alba	w	Meadowsweet	10				4		6					
			350	24	14	32	33	26	65	27	34	19	53	23

PATCH PAGES

SUBAREA 3, 4, AND 8

SHRUBS

SPECIES		COMMON NAME	Total Plants	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5	Patch 6	Patch 7	Patch 8	Patch 9	Patch 10	Patch 11	Patch 12	Patch 13	Patch 14	Patch 15	Patch 16
Alnus serrulata	rw	Smooth Alder	24		2	2	6		4	4		2	2	2					
Amorpha fruticosa	w	False Indigo Bush	16	2		1	2		2					2	2	2			3
Celastrus scandens	r	Bittersweet	2		2														
Cephalanthus occidentalis	w	Buttonbush	122		4	3	3	4	3	4	4	8	11	13	12	12	11	20	10
Cornus amomum	rw	Silky Dogwood	55		3	2	4	8		3		2	2	5	2	2	5	12	5
Corylus americana	rw	Hazelnut	22	3		2	5		2	3		1	3				1		2
Hypericum spathulatum	w	Shrubby St. John's Wort	25	3	2	4	3	3		2		2	2			1	3		
Ilex verticallata	w	Winterberry	60		4	5	6		6	8		5	9	8		6			3
Rosa palustris	rw	Swamp Rose	95	5	3				12	7				12	13	14	18	3	8
Salix discolor	rw	Pussy Willow	37			2	4	8		5	7	3	3		2	3			
Salix eriocephala	rw	Heart-Leaf Willow	11									5	6						
Salix sericea	rw	Silky Willow	11			5	2			4									
Sambucus canadensis	rw	Elderberry	12					8			4								
Spirea alba	w	Meadowsweet	8	2		2	2		2										
			500	15	20	28	37	31	31	40	15	28	38	42	31	40	38	35	31

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PATCH PAGES

SUBAREA 5, 6, AND 7

SHRUBS

SPECIES		COMMON NAME	Total Plants	Patch 1	Patch 2	Patch 3	Patch 4	Patch 5	Patch 6	Patch 7	Patch 8	Patch 9	Patch 10	Patch 11	Patch 12
Alnus serrulata	rw	Smooth Alder	33	4	3					10	8	5		3	
Amorpha fruticosa	w	False Indigo Bush	27	3	2			3	3	3	2	3	3	2	3
Asimina triloba	br	Pawpaw	20	3	3				4			8		2	
Celastrus scandens	r	Bittersweet	4											4	
Cephalanthus occidentalis	w	Buttonbush	51			8	9		8			7	8		11
Cornus amomum	rw	Silky Dogwood	23			4	5		4			3	4		3
Corylus americana	rw	Hazelnut	31	3	4			3		7	8		5	1	
Hypericum spathulatum	w	Shrubby St. John's Wort	23	4	3	4	5	3						1	3
Ilex verticallata	w	Winterberry	25	3	5			5			6			3	3
Rosa palustris	rw	Swamp Rose	41			4						3	10		24
Rosa setigera	rw	Prairie Rose	35						9					26	
Salix discolor	rw	Pussy Willow	58			10	11	7	5			11	8		6
Salix eriocephala	rw	Heart-Leaf Willow	23							8	9			3	3
Salix sericea	rw	Silky Willow	29	12	8			9							
Sambucus canadensis	rw	Elderberry	10					8						2	
Spirea alba	w	Meadowsweet	17								8				9
			450	32	28	30	30	38	33	28	41	40	38	47	65

PATCH PAGES

SAVANNA

SAVANNA SAPLINGS

SPECIES	COMMON NAME	Number Plants
Quercus alba	White Oak	3
Quercus bicolor	Swamp White Oak	9
Quercus macrocarpa	Bur Oak	88
		100

AESTHETIC BARRIER

SHRUBS

SPECIES	COMMON NAME	Number
Amelanchier arborea	Downy Serviceberry	30
Amorpha fruticosa	False Indigo Bush	15
Asimina triloba	Pawpaw	8
Campsis radicans	Trumpet Creeper	8
Carpinus caroliniana	American Hornbeam	12
Cornus racemosa	Gray Dogwood	5
Crataegus mollis	Downy Hawthorne	12
Hamamelis virginiana	Witch Hazel	28
Lindera benzoin	Spicebush	14
Physocarpus opulifolius	Ninebark	24
Rhus glabra	Smooth Sumac	8
Rhus typhina	Staghorn Sumac	5
Rubus occidentalis	Black Raspberry	12
Staphylea trifolia	Bladdernut	25
Symphoricarpos orbiculatus	Coralberry	24
		230

PATCH PAGES

AESTHETIC BARRIER

SAPLINGS

SPECIES	COMMON NAME	Number
Acer rubrum	Red Maple	9
Acer saccharum	Sugar Maple	3
Aesculus glabra	Ohio Buckeye	2
Cercis Canadensis	Redbud	3
Cornus alternifolia	Alternate-leafed Dogwood	2
Cornus florida	Flowering Dogwood	3
Cornus racemosa	Gray Dogwood	3
Crataegus mollis	Down Hawthorne	2
Fagus grandifolia	Beech	2
Fraxinus Americana	White Ash	2
Fraxinus pennsylvanicum	Green Ash	2
Gymnocladus dioica	Kentucky Coffetree	1
Juglans nigra	Black Walnut	3
Liriodendron tulipifera	Tulip Poplar	2
Prunus serotina	Black Cherry	1
Quercus alba	White Oak	4
Quercus bicolor	Swamp White Oak	3
Quercus macrocarpa	Bur Oak	11
Quercus muhlenbergii	Chinqapin Oak	1
Quercus palustris	Pin Oak	2
Quercus rubra	Northern Red Oak	10
Quercus shumardii	Shumard Oak	1
Quercus velutina	Black Oak	1
Tilia Americana	Basswood	1
		65

SEEDLINGS

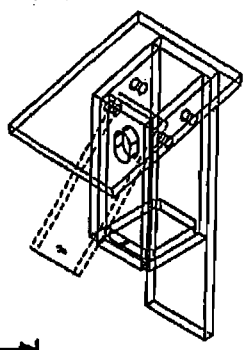
SPECIES	COMMON NAME	Number
Acer saccharinum	Silver Maple	24
Acer saccharum	Sugar Maple	128
Carya cordiformis	Bitternut Hickory	14
Carya laciniosa	Shellbark Hickory	16
Carya ovata	Shagbark Hickory	16
Fagus grandifolia	Beech	72
Fraxinus Americana	White Ash	29
Juglans nigra	Black Walnut	20
Liriodendron tulipifera	Tulip Poplar	14
Prunus serotina	Black Cherry	14
Quercus alba	White Oak	29
Quercus rubra	Red Oak	24
		400

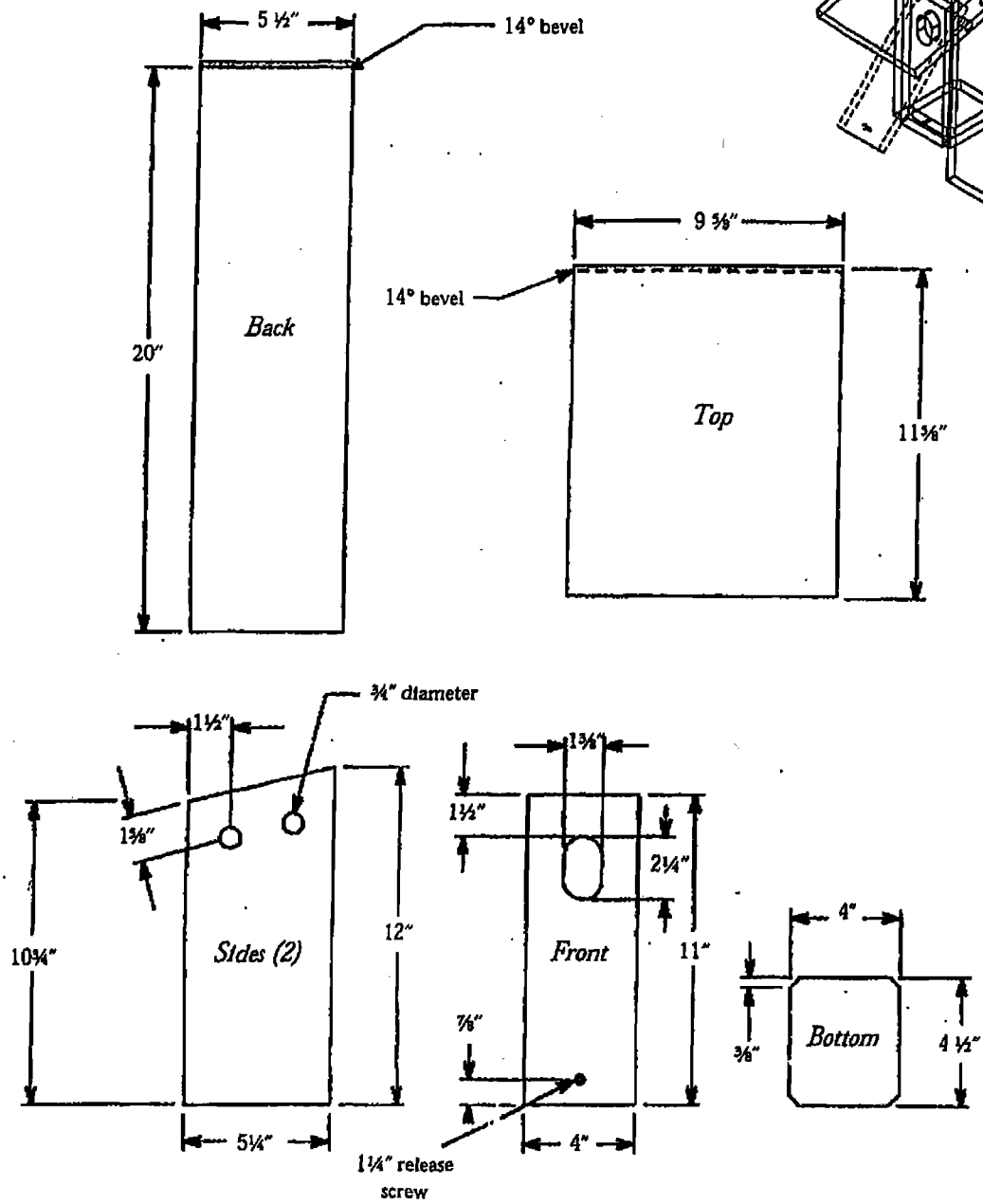
APPENDIX C

TYPICAL WILDLIFE STRUCTURE DESIGNS

A Nest-Box Plan for Cavity-Nesting Songbirds

(flycatchers, swallows, titmice, chickadees, nuthatches, wrens, and bluebirds)





All wood in the design is 3/4" actual thickness. The pictured entrance hole is recommended for bluebirds. To adapt the nest box for individual species, change the dimensions of the entrance hole. Visit <http://birds.cornell.edu/birdhouse> for guidelines on entrance hole sizes.

Printed with permission from the New York State Bluebird Society (Herm Bressler modified nest box)

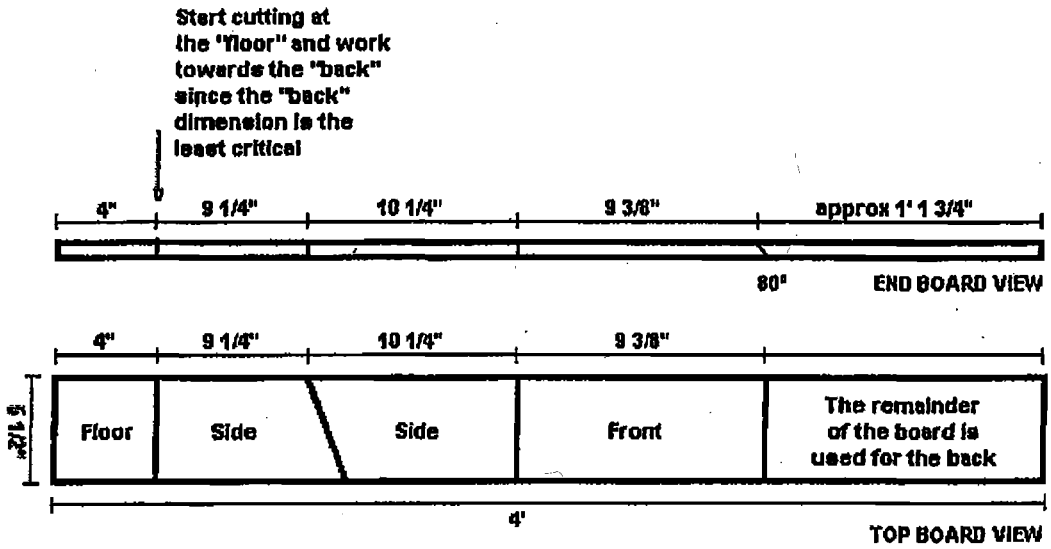
The North American Bluebird Society

Eastern/Western Bluebird Nest Box Plans -- Part 1

MATERIALS LIST

- **Standard Board 1" x 6" x 4' long**
- **Standard Board 1" x 10" x 10 1/2" long (for roof)**
- **1 3/4" galvanized nails or screws -- approx. 20**
- **1 3/4" galvanized screw or nail for pivot point -- 2**
- **Double-headed Nail for holding door closed -- 1**

BOARD DIAGRAM



Back | **Go to Construction Plans**

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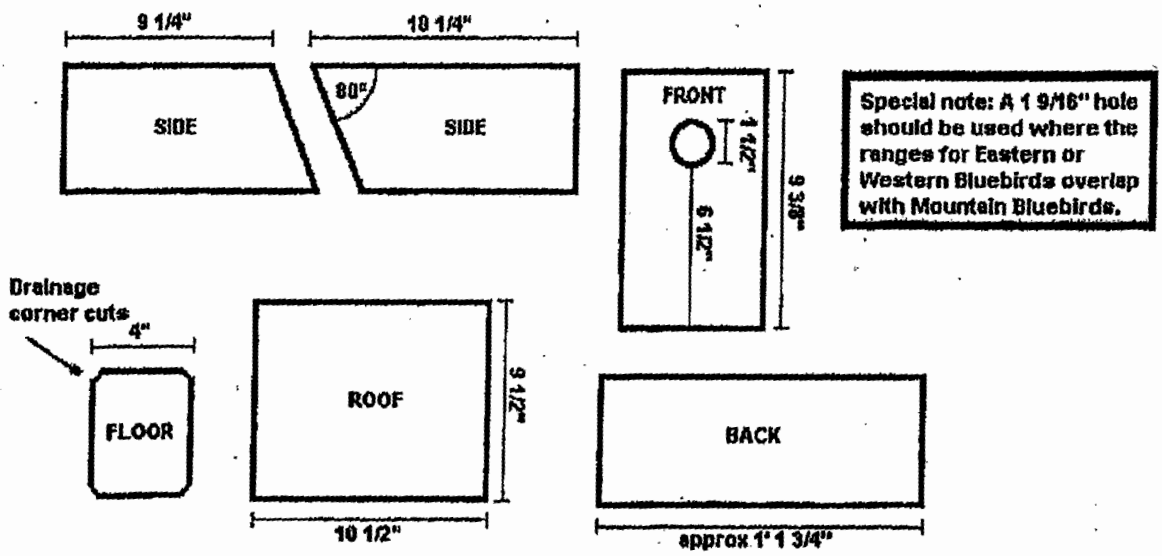
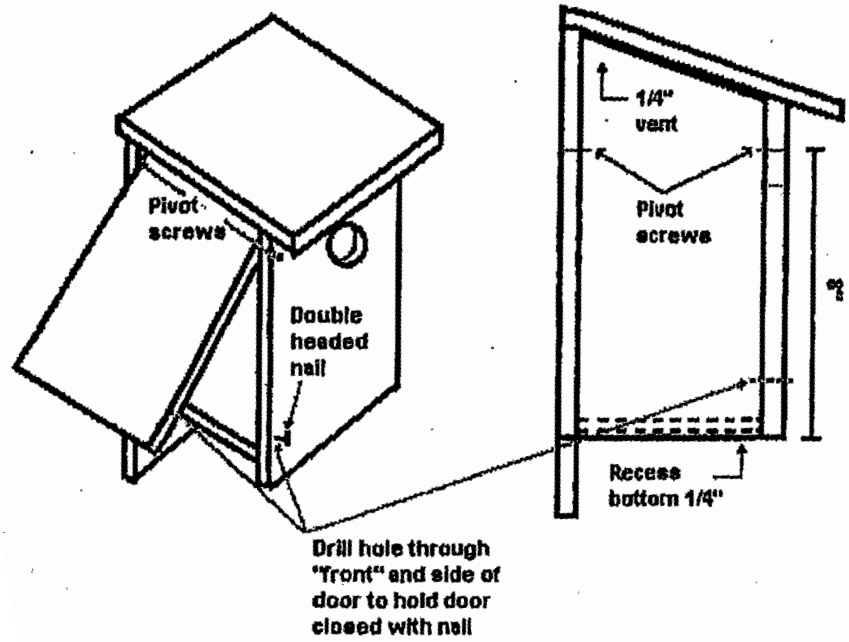
Eastern/Western Bluebird Nest Box Plans -- part 2

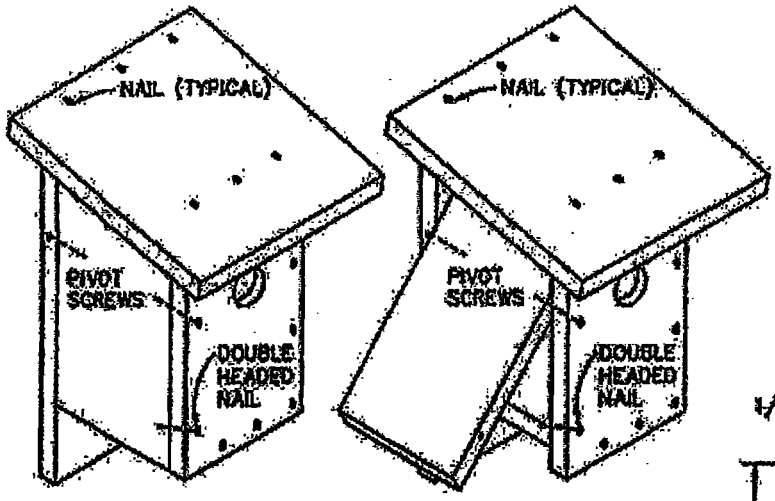
CONSTRUCTION PLAN

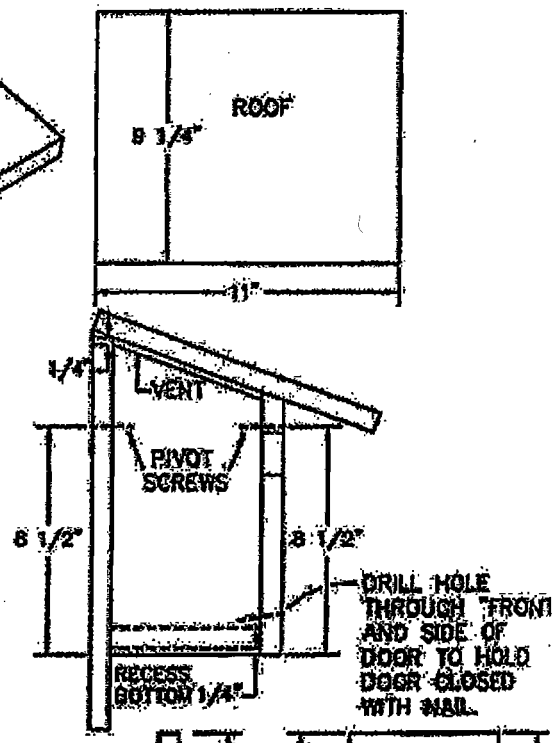




Go to Plans for Optional Oval Hole

MOUNTAIN BLUEBIRD NEST BOX (Western Bluebird also where ranges overlap.)

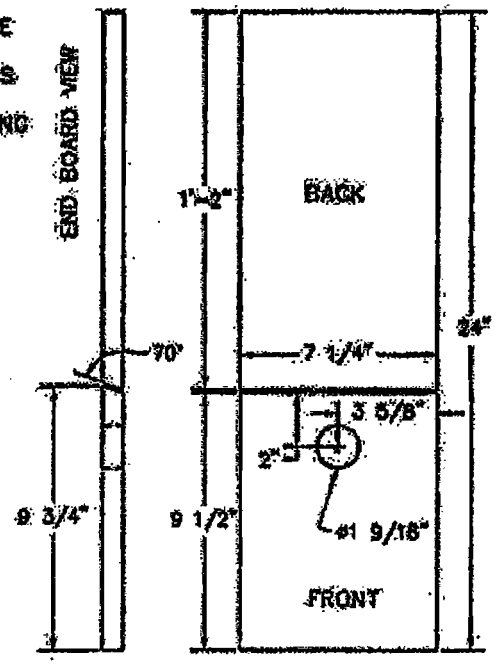


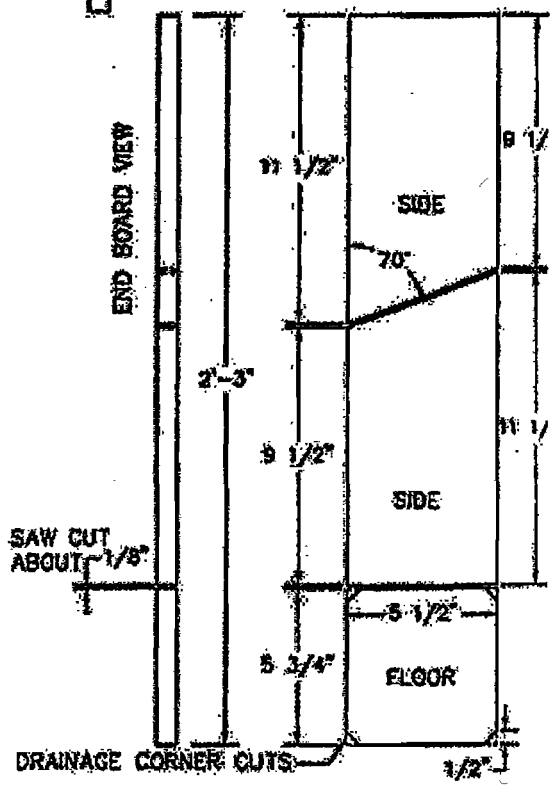


MATERIALS LIST

STANDARD 1" X 6" NOMINAL – 27" LONG
(ACTUAL SIZE 3/4" X 5 1/2")
STANDARD BOARD 1" X 8" NOMINAL – 24" LONG
(ACTUAL SIZE 3/4" X 7 1/4")
STANDARD BOARD 1" X 10" NOMINAL – 11" LONG
(ACTUAL SIZE 3/4" X 9 1/4")
HOLE CUTTER 1 9/16" DIAMETER
1 3/4" GALVANIZED NAILS – APPROX. 20
1 3/4" GALVANIZED SCREW FOR PIVOT POINT – 2
DOUBLE HEADED NAIL FOR HOLDING DOOR CLOSED – 1

BELOW ENTRANCE ON BOTH SIDES MAKE SCRATCHES INTO WOOD WITH NAIL FOR CLIMBING TRACTION.





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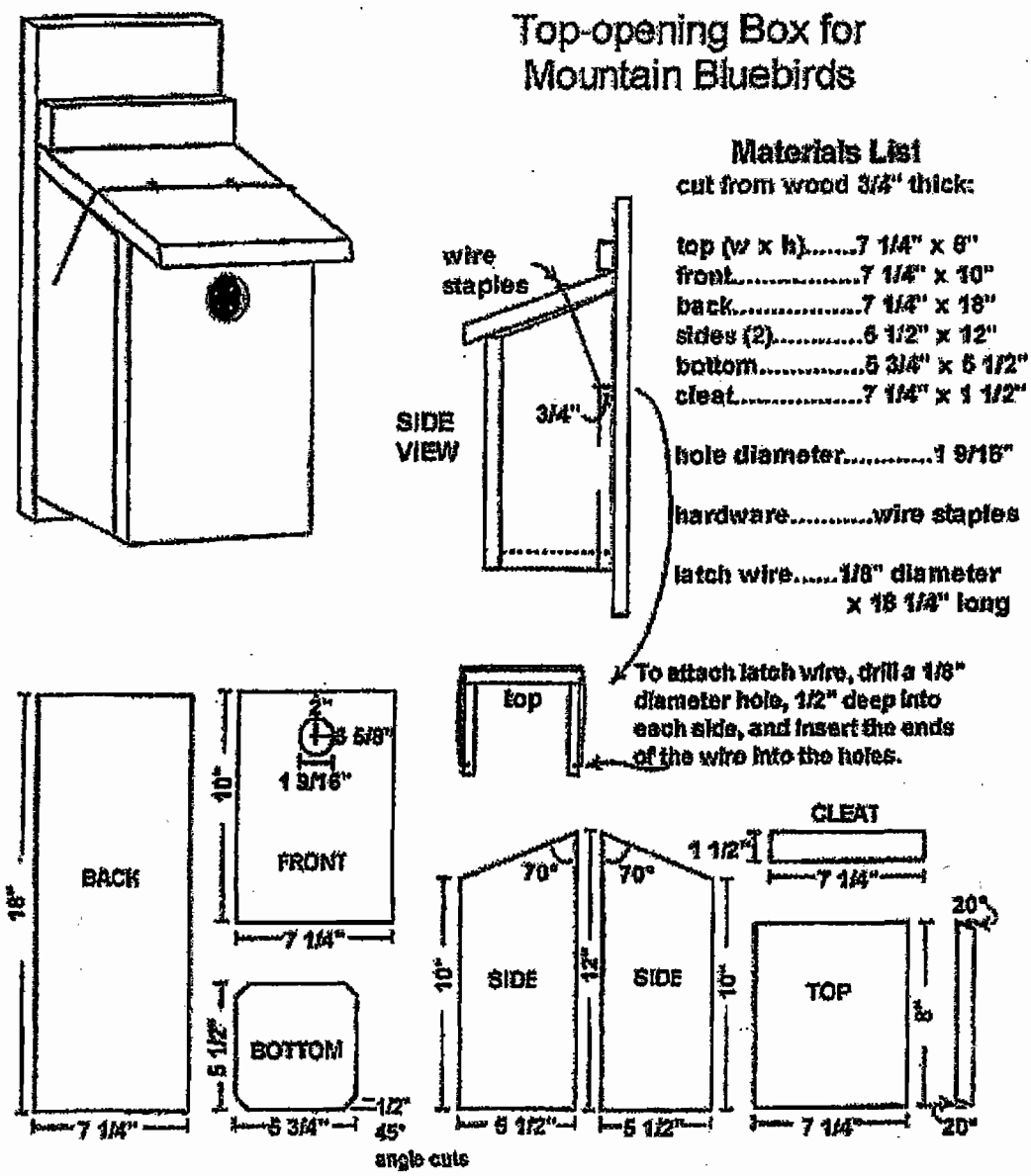

The dimensions of this box are generously sized to accommodate the larger nests of Mountain Bluebirds. To attach latch wire, drill a 1/8" diameter hole, 1/2" deep into each side. Insert the ends of the wire into these holes. Instead of using a latch wire, the top can be secured with a #8 x 1 1/2" wood screw.

These plans have been made available to NABS by: Mountain Bluebird Trails, P.O. Box 794, Ronan, MT.

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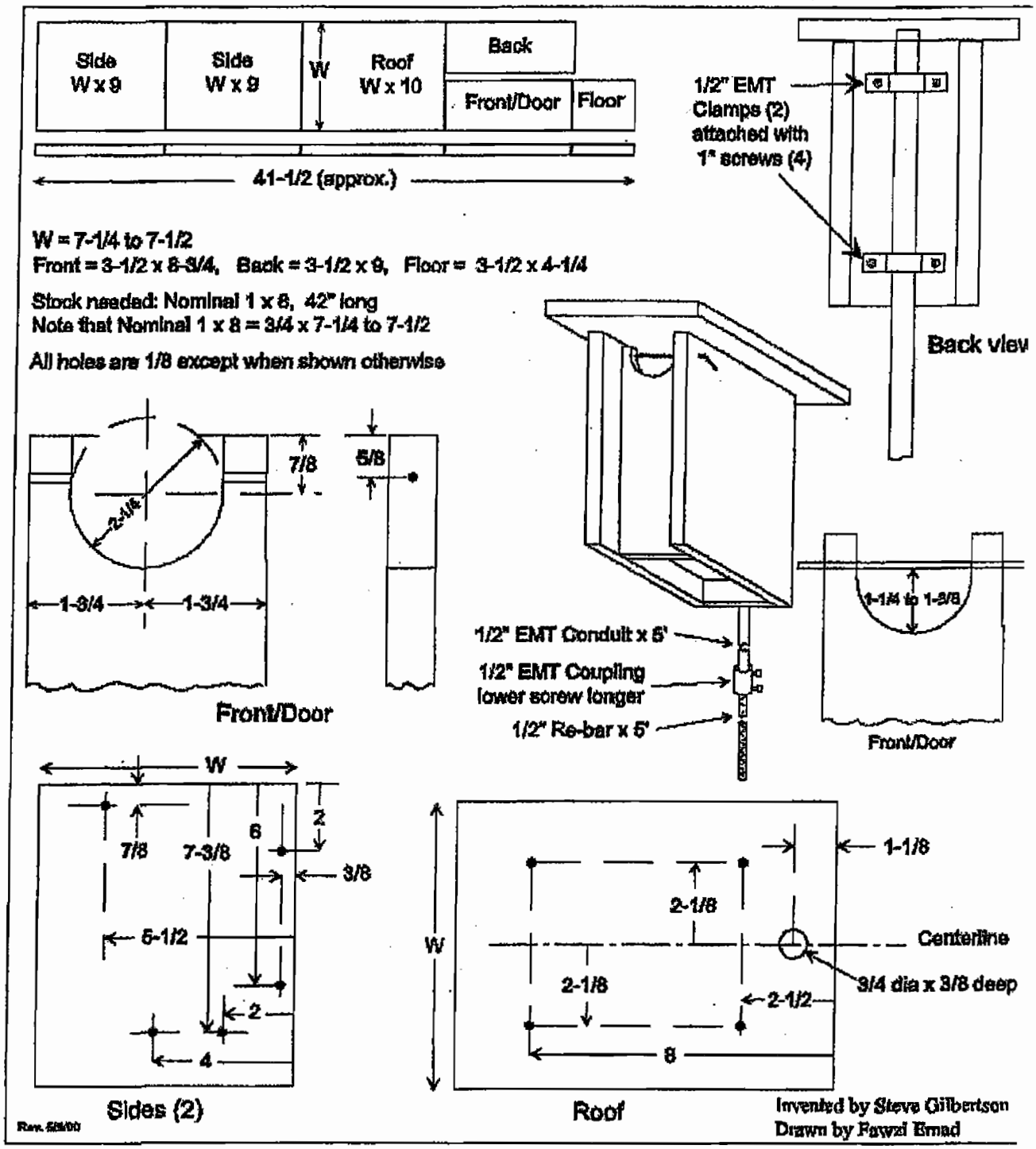
Gilwood Nest Box Plans



More Gilwood Box Information | Back

PETERSON BLUEBIRD HOUSE
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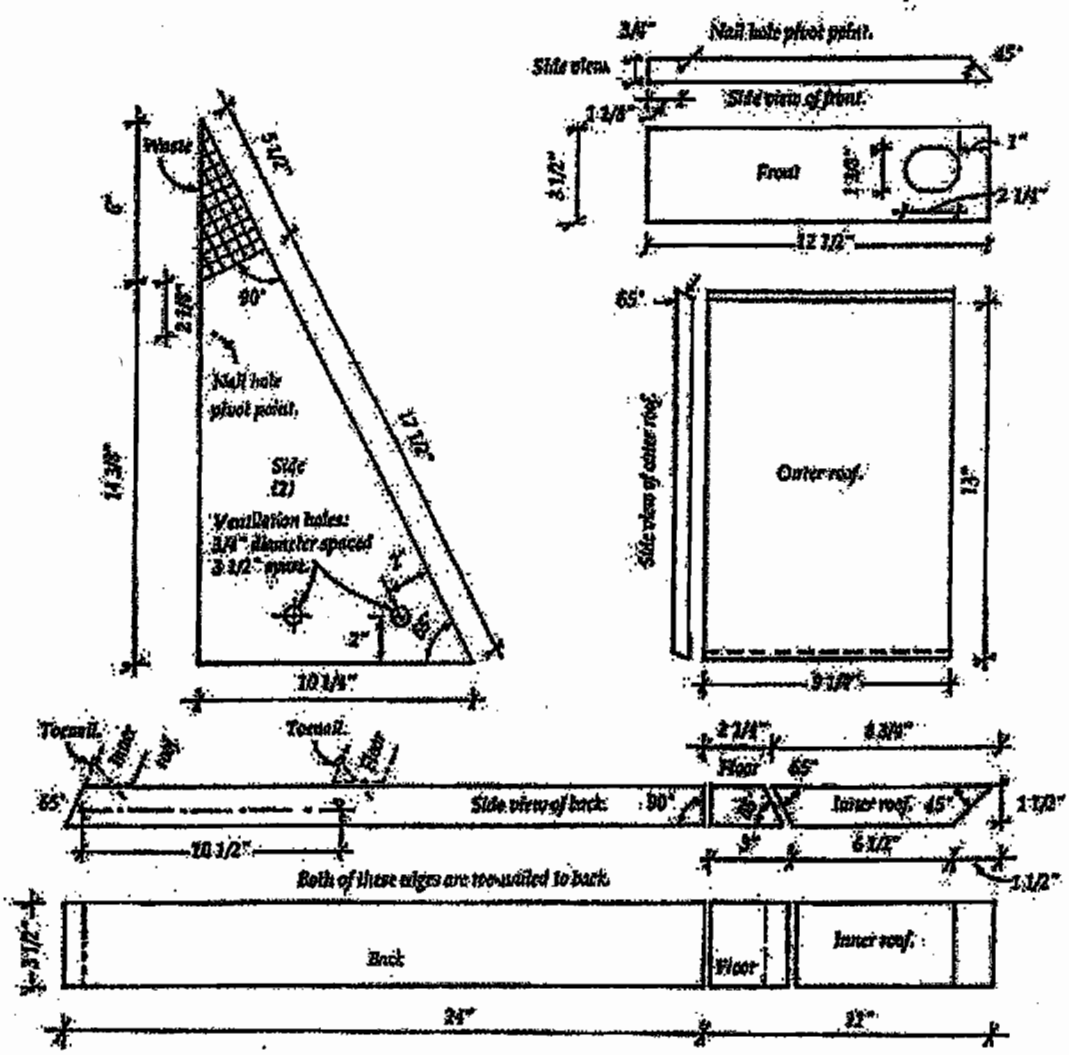
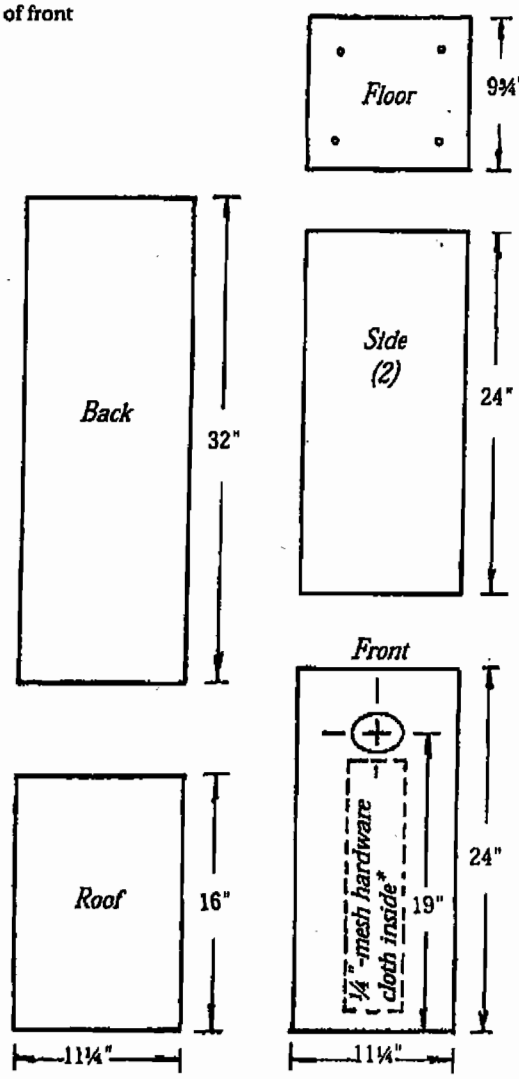


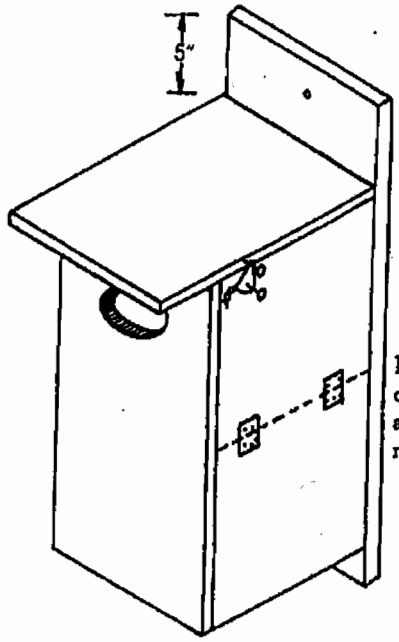
BACK

A Nest-Box Plan for Common and Hooded Mergansers, Wood Ducks, and American Kestrels

Entrance Holes

Common Merganser—minimum 5" diameter round
Wood Duck and Hooded Merganser—3"-high by 4"-wide oval
American Kestrel—3" diameter round, 4 1/2" down from top edge of front

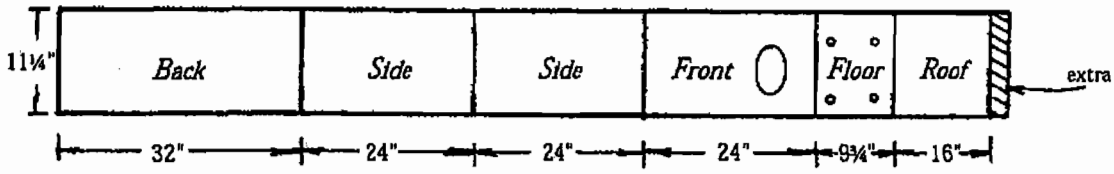




Place 3 to 4 inches of wood shavings in bottom of box.

*Ducklings need a "ladder" to provide toe-holds so they can climb out of nest box.

Lumber: One 1" × 12' × 12' 0'



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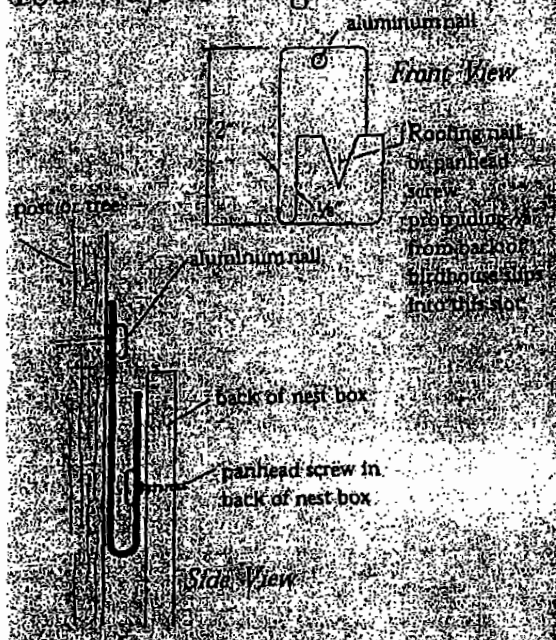
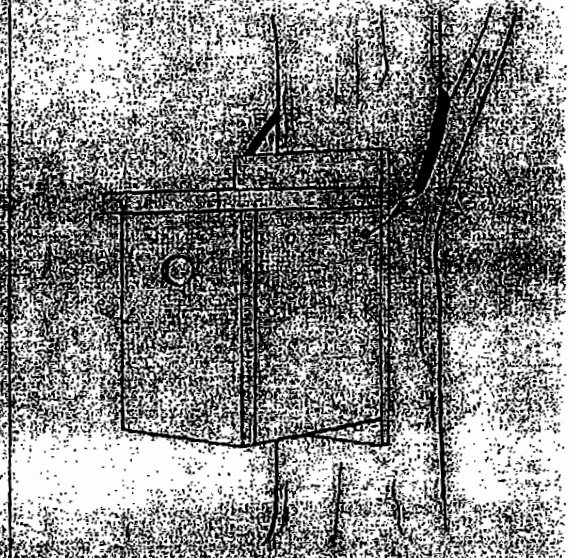
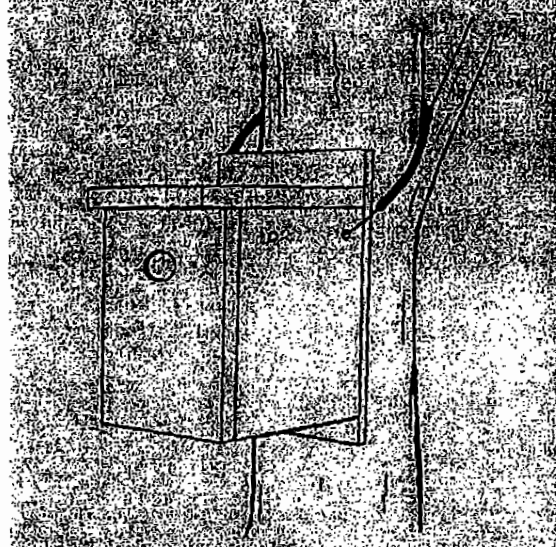
Four Ways to Hang Nest Boxes



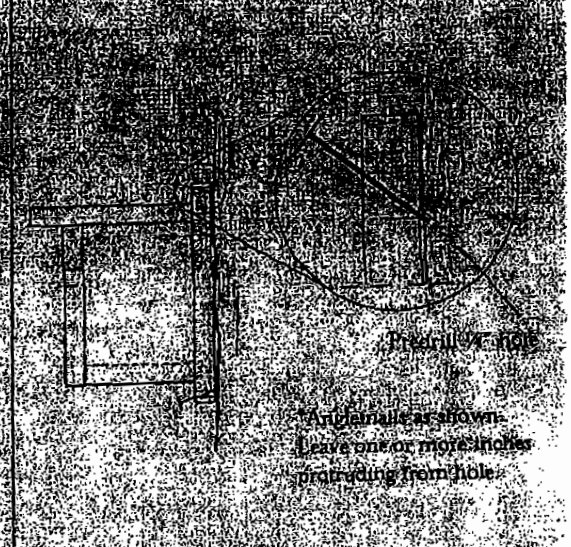
Metal clip—This clip, made from rust-proofed heavy gauge metal, allows easy removal of boxes from posts or trees. This makes for easier cleaning and Winter storage.



Bungee cord—After pulling galvanized wire through vent holes, attach bungee cords. Stretch cord around tree, over limb, as illustrated.



Wire through hose—Galvanized wire through vent holes; attach rubber-coated wire (or hose with wire run through it) and loosely drape over limb as illustrated.



Aluminum nails—Drill 1/4" holes into top and bottom of the back board of the box. Aluminum nails are driven in at an angle, as illustrated. As the tree grows the box is forced to slide along the flexing nail.

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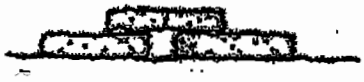
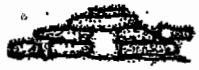
FOX DEN STRUCTURE

CROSS SECTIONS



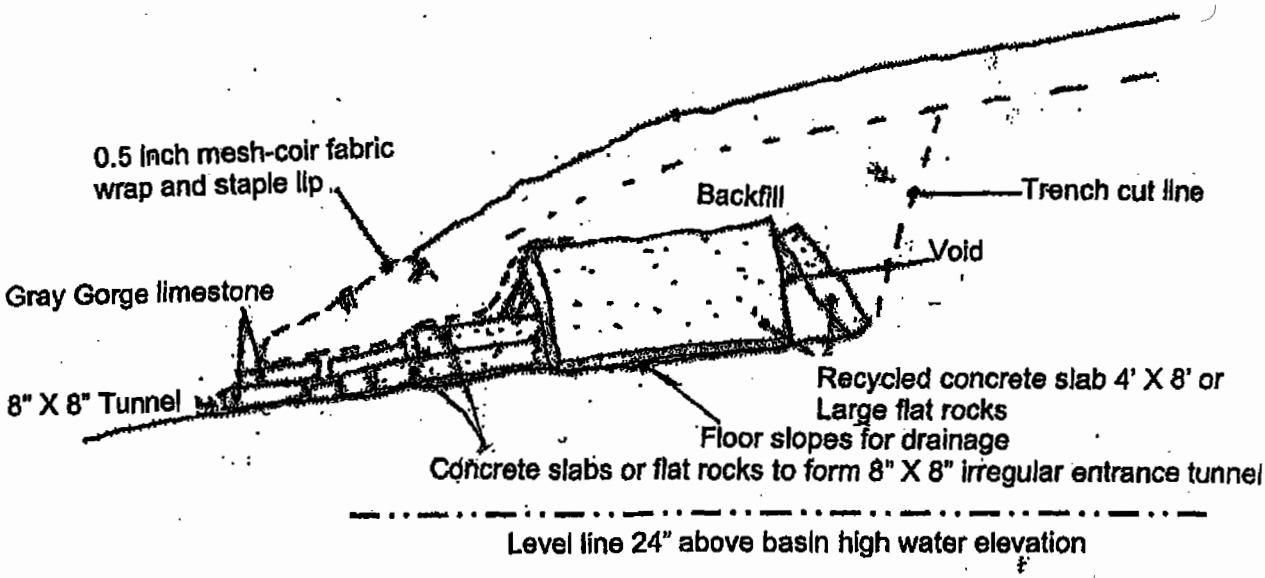
Tunnel structure



Visible entrance

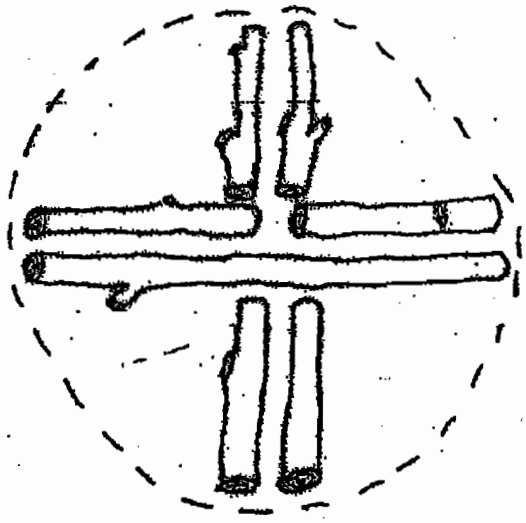
Den support structure

SIDE VIEW

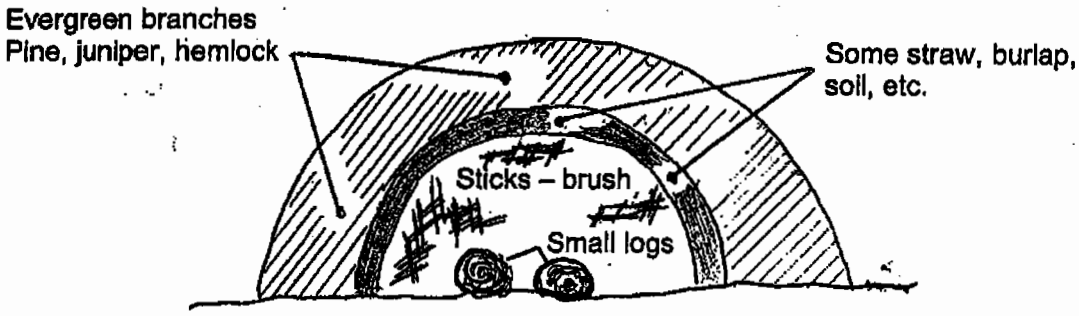


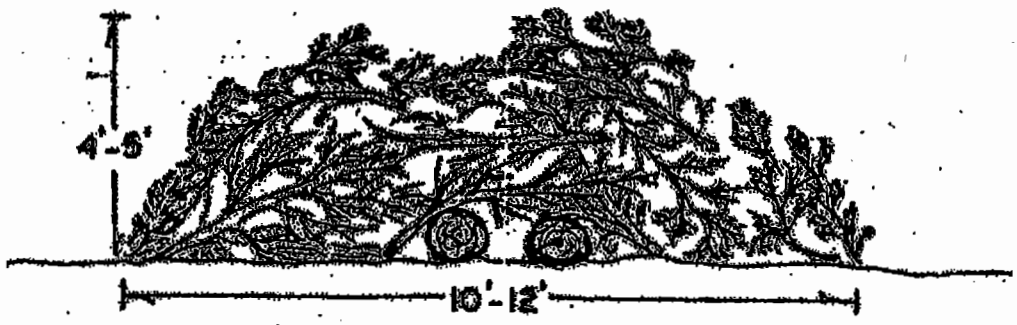
BRUSH PILE

PLAN VIEW



Log pattern





APPENDIX D

SEEDING AND BIOENGINEERING EROSION CONTROL SPECIFICATIONS

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

C. 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 20) 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 Construction Manager or 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.

C. 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.

D. 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.

E. 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 April 1 and July 1 and Fall Season between October 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:

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.

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 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.

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, s identified by the Construction Manager or 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.

3.5 MAINTENANCE

A. Maintain the vegetated areas in satisfactory condition until acceptance of the vegetation by the Construction Manager. Maintenance of the vegetated areas includes repairing eroded areas, revegetating when necessary, watering, and mowing (if applicable). A satisfactory condition of vegetated area is defined as follows:

1. an area shall have a predominant stand of the seeded vegetation;

2. within 3 weeks, germination must occur over 90 percent of the area with no single bare area greater than 3 square feet; and

3. within 3 months, 90 percent of the area must be covered with mature vegetation.

B. The above timeframes for germination and coverage requirements are to be delayed during the dormant season between November 1 and March 15 application of the seed. The performance criteria shall be measured at the beginning of the growing season (April 1) for seed applied during the previous dormant season.

C. Areas that fail to meet these requirements shall be repaired or reseeded as necessary to produce an acceptable stand of vegetation, as specified in this Section.

D. Construction Manager will perform the acceptance inspection and determine whether repair of vegetated areas or revegetation is required.

E. Maintain areas with a crusting agent to ensure proper erosion control. The crusting agent shall be reapplied to eroded and bare areas as necessary.

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

Species	Pounds Per Acre (lb/ac)
Grasses	
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 [1]:	1.5
Butterflyweed (*Asclepias tuberosa*)	
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] – 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	
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)
Canada Wild-Rye (Elymus canadensis)	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 [2]:	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) 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*)	
Black-Eyed Susan (*Rudbeckia hirta*)	

APPENDIX E

PLANTING SPECIFICATIONS

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

D. 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.

E. Fertilizer shall be slow-release tablet form, and not exceed a 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.

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

G. Compost shall be mature and stable, as determined by the U.S. Compost Council Seal of Testing Assurance program.

H. Wooden stakes for staking trees as needed shall be nominal 1 inch square, approximately 5 feet 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. Equipment shall not exceed 6.0 psi.

PART 3 EXECUTION

3.1 GENERAL

A. The Restoration Ecologist will flag planting locations in the field. 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 saturated or 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 CONTAINER-GROWN TREES AND SHRUBS (DETAIL A-1)

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 wider than the root ball by at least 9 inches on all sides.

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

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

F. 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.

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

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

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

3.3 INSTALLATION OF BAREROOT PLANTS (DETAIL A-2)

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 unless otherwise directed by the Restoration Ecologist.

B. Excavate the planting pit by hand using a dibble bar, spade, or auger. 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