# SOUTHERN WASTE UNITS ACCELERATED NATURAL RESOURCE RESTORATION DESIGN PLAN

## FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
## FERNALD, OHIO

FOR INFORMATION ONLY

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U.S. DEPARTMENT OF ENERGY
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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| A8PII | Area 8, Phase II |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| DOE | U.S. Department of Energy |
| DOT | U.S. Department of Transportation |
| FEMP | Fernald Environmental Management Project |
| NRRDP | Natural Resource Restoration Design Plan |
| NRRP | Natural Resource Restoration Plan |
| NRTs | Natural Resource Trustees |
| ODNR | Ohio Department of Natural Resources |
| SWU | Southern Waste Units |
| USDA | U.S. Department of Agriculture |

# 1.0 INTRODUCTION

The Southern Waste Units (SWU) is one of the first extensive soil remediation projects completed at the Fernald Environmental Management Project (FEMP). This project encompasses approximately 25 acres in the southwest corner of the FEMP property. The SWU consists of the former Active and Inactive Flyash Piles, the South Field, and the Carolina Area (Figure 1-1). This accelerated Natural Resource Restoration Design Plan (NRRDP) addresses ecological restoration of the SWU, pursuant to the conceptual design set forth in the FEMP Natural Resource Restoration Plan (NRRP, DOE 2002).

## 1.1 PROJECT OVERVIEW

The restoration objectives for the SWU is to expand the riparian corridor along Paddys Run, create several open water areas, and establish the early stages of an upland forest community within the project area (DOE 2002). Some areas within the SWU have been excavated to the extent that the sand and gravel of the Great Miami Aquifer is exposed. In these areas, establishing woody vegetation could prove difficult, so the seed mix will be modified for more sandy soil. Several deep basins will remain so that they may provide recharge to the aquifer.

## 1.2 CONCEPT OF ACCELERATED NRRDP

The schedule for design submittal and field implementation of the SWU ecological restoration project was recently accelerated to 2002, as part of an effort to complete site closure by 2006. To accomplish this, the design for ecological restoration of the SWU will be divided into two separate submittals; an accelerated NRRDP and a final NRRDP. This accelerated NRRDP will detail the vegetation material and planting layout requirements for the project. By providing this information early, the U.S. Department of Energy (DOE) can expedite procurement of vegetation in order to initiate field implementation in Spring 2002. Detail on the majority of planting activities will be reserved until the final NRRDP is submitted. The final NRRDP will also detail the process for maintenance, implementation monitoring requirements, herbivore control, access path construction, and wildlife amenities. The final NRRDP will be submitted by July 1, 2002.

## 1.3 COORDINATION WITH RESTORATION GRADING

Design detail for grading activities is outside the scope of the accelerated and final NRRDP. For the purposes of this design it is assumed that restoration grading has been completed prior to field implementation. A conceptual grading plan has been developed in conjunction with the FEMP Natural Resource Trustees (NRTs), and is presented as Figure 1-1. However, design details and field implementation are handled as part of interim restoration at the end of remediation instead of through ecological restoration. This approach is consistent with the path forward established for most projects at the FEMP. It should be noted that the conceptual grading plan (Figure 1-1) is subject to change, based on the extent of contamination encountered during excavation. Planting area layouts may need to be revised in the field due to changes in the restoration grade.

## 1.4 COORDINATION WITH AQUIFER RESTORATION

Several features of the SWU ecological restoration design have been developed to accommodate remediation of the Great Miami Aquifer being carried out by the Aquifer Restoration Project. First, several deep excavations will be left unlined and allowed to drain into the aquifer. These basins will act as infiltration sources, which will result in accelerated remediation of the aquifer. Second, a path will be constructed to allow access to groundwater monitoring wells that are located in the middle of the project area (Figure 1-1). This path will also be the primary means of access to the expanded floodplain area. Instead of gravel, DOE will install a geotextile cellular confinement system that will be filled with topsoil and seeded. Third, an extraction well will be installed within an upland portion of the project area. Planting activities will be adjusted to account for the planned extraction well. The planting layout (Figure 2-1) may need to be adjusted in the field to account for the extraction well footprint.

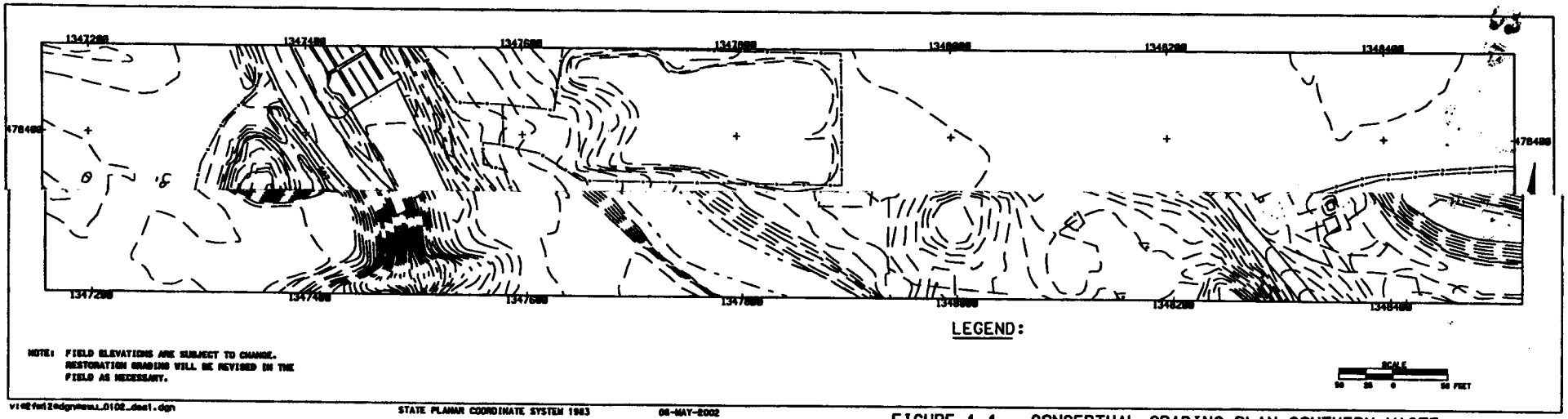


FIGURE 1-1. CONCEPTUAL GRADING PLAN SOUTHERN WASTE UNITS NATURAL RESOURCE RESTORATION DESIGN

# 2.0 DESIGN COMPONENTS AND GOALS

As stated above, this accelerated NRRDP will detail planting layout and vegetation material requirements only. However, in order to understand the rationale for the planting layout, a discussion on the overall design components and goals is required. Pursuant to the NRRP, the main objectives for the SWU ecological restoration include expansion of the Paddys Run riparian corridor, creation of several open water areas, and creation of the early stages of an upland forest. A secondary objective involves the expansion of floodplain along Paddys Run (DOE 2002). The planting layout on Figure 2-1 and the seeding plan on Figure 2-2 are based on the design components listed above. These components are discussed in more detail below.

## 2.1 FLOODPLAIN EXPANSION AND WETLAND CREATION

Approximately seven acres of the SWU project area will consist of expanded floodplain and created wetland habitat. The final grading was configured to take advantage of the deep excavations and sediment basins resulting from remedial activities. Once grading efforts are complete, a riprap wall will be removed from the east bank of Paddys Run. This opening will allow for inflow from Paddys Run about once a year. The system will also outflow downstream into Paddys Run near the Carolina Area (Figure 1-1). A water control structure will be installed at the outfall point, so that project water levels can be managed. As stated in Section 1.3, the restoration grading design is outside the scope of this accelerated NRRDP.

Most planting within the expanded floodplain will be conducted in the second phase of SWU restoration. This will allow DOE to observe the new hydrological regime for a season and adjust planting plans accordingly. However, some planting may occur in Spring 2002 in order to stabilize areas that should not be impacted by the altered hydrology.

## 2.2 SOIL AMENDMENT

Remediation activities removed topsoil across the SWU and compacted the remaining subsoil. Therefore, soil amendment will be conducted prior to planting. In some areas, only sand and gravel remain. These conditions require a revision to the goals and objectives established in the NRRP. Instead of attempting to amend the sandy areas and plant woody vegetation, they will be seeded with a sand prairie mix or left alone. The SWU will be amended with woodchips recovered from chipping in the

Northern Pine Plantation during Winter 2002 or compost from an off-site location. The woodchips will be transported to the SWU, stockpiled and allowed to compost for at least two weeks, then spread across the project area approximately 2 inches thick. The woodchips will then be tilled into the soil. For areas that will not be planted until the fall, woodchips may be composted for a longer period of time. Spring planting and seeding areas may be amended with compost imported from off site. Figure 2-2 shows the anticipated locations for application of soil amendments.

## 2.3 REVEGETATION

The majority of the SWU will be revegetated with trees and shrubs and seeded with native grasses and forbs. All plant material that will be used for ecological restoration of the SWU is native to southwest Ohio. Previous restoration designs have documented the appropriate plant communities to be restored at the FEMP (DOE 2000). The plant community templates developed for Area 8, Phase II (A8PII) were used as a starting point for development of the SWU templates. The A8PII forest templates include beech-maple, oak-hickory, and mesophytic. These original templates were adjusted to account for deer preferences, plant hardiness, and micro-habitat differences present in the SWU, as described below. Based on these adjustments, upland forest communities that will be established in the SWU include beech-maple forest, oak-hickory forest, and mesophytic forest. Seeded areas will include mesic prairie and xeric prairie. Wetland communities include riparian floodplain forest, emergent wetlands, sedge meadow, and wet prairie. Each of these communities is discussed in more detail below. The master plant lists are provided as Tables 2-1 and 2-2, and the master seed list is provided as Table 2-3.

### 2.3.1 Upland Forest Communities

Upland forest communities will encompass approximately 14 acres across the SWU (Table 2-4). Most of this acreage (approximately eight acres) will be planted with the beech-maple forest template. About three acres of well-drained south facing slopes will be planted with an oak-hickory forest template. About three acres of mesophytic template will be used to transition from the beech-maple/oak-hickory complex to riparian and wetland communities that are found in the expanded floodplain of Paddys Run. Each of these templates is discussed in more detail below.

#### 2.3.1.1 Beech-Maple Forest Template

As stated above, the beech-maple forest template will encompass approximately eight acres across the SWU (Table 2-4, Figure 2-1). Table 2-5 shows the beech-maple species list and planting quantities.

Most of the area consists of clay, sand, and silt subsoils that are adequately drained. Following the application of amendments, the soil should be amenable to planting. A few areas consist of poorly drained depressions that may be periodically inundated following precipitation. When applicable, planting patches will be revised to include more wet species. The A8PII beech-maple template was revised to include a higher diversity of wet shrubs and trees, in order to take advantage of these depressions. Also, the number of oak species was reduced, since patches of oak-hickory forest will be found among the beech-maple templates (Figure 2-1).

2.3.1.2 Oak-Hickory Forest Template

An oak-hickory forest template will be utilized on approximately three acres within the SWU (Table 2-4, Figure 2-1). This forest type is best suited to take advantage of the south-facing, well-drained slopes present in the project area. The species list and planting quantities for the oak-hickory forest template are presented in Table 2-6. In general, the oak-hickory template species prefer more well-drained conditions. However, oak-hickory forests still share a number of species with the beech-maple template. This is consistent with the view that oak-hickory forests represent a climate-driven transition from beech-maple forest across glaciated portions of Ohio (Vankat 1992). The A8PII oak-maple template was adjusted to account for these conditions. The density of maples was reduced, while the diversity and density of oaks was increased.

2.3.1.3 Mesophytic Forest Template

The mesophytic forest template will encompass approximately three acres across the project area (Table 2-4, Figure 2-1). This template will serve as a transition from the riparian floodplain communities to the upland communities in the SWU. The species list and planting quantities for the mesophytic forest template are presented in Table 2-7. This template is the most diverse of the three upland forest templates, with 38 species present. Unlike the beech-maple and oak-hickory communities, the mesophytic forest can not be characterized by a few dominant species. The A8PII mesophytic template was adjusted by reducing the density of basswood (*Tilia americana*). This species is a component of the mesophytic forest, and is included in the SWU template. However, the number of basswood was significantly reduced, in response to the heavy deer pressure they received in A8PII. Also, based on the location of the mesophytic templates in the SWU, additional edge species were included in the template.

2.3.2 Riparian Floodplain and Wetland Communities

Approximately 10 acres will be restored to a riparian floodplain and/or wetlands (Table 2-4, Figure 2-1). The restored systems will include riparian forest, emergent wetland, and sedge meadow. Each of these communities is discussed in more detail below.

2.3.2.1 Riparian Forest Template

The riparian forest template will be used on approximately three acres across the Paddys Run floodplain (Table 2-4, Figure 2-1). This template generally includes species that are tolerant of wet conditions and periodic flooding. The species list and planting quantities for the riparian forest template are provided on Table 2-8. This template includes some additional shrub species that will be planted into adjacent wetland habitat.

2.3.2.2 Emergent Wetland

It is anticipated that portions of the expanded floodplain area will retain water. The clay lining under Basin 1 was left in place when the synthetic liner was removed, thereby creating a depression to hold water. Several other locations will be graded to retain water. These areas will not be lined with clay, but should retain water due to the clay content of existing soil and continued siltation (Figure 2-1). In these areas, small amounts of donor wetland soils and bur reed (*Sparganium eurycarpum*) will be placed in standing water.

2.3.2.3 Sedge Meadow

The sedge meadow acts as a transition from open water and emergent communities to drier grass and forest communities. This system is dominated by sedges and rushes that can withstand periodic inundation. The sedge meadow community within the expanded floodplain area is limited to the edges of basins and depressions that will hold water. The list of species included in this community is provided in Table 2-9.

2.3.3 Seeding Areas

Since the majority of the SWU has been significantly disturbed and its existing vegetation removed, seeding is required across the entire project area. Three different native grass and forb seed mixes will be used to reestablish herbaceous cover across the SWU. The seed mixes, which include mesic prairie, xeric prairie, and wet prairie, are discussed in more detail below.

2.3.3.1 Mesic Prairie

Mesic prairie will cover approximately 11 acres across the SWU (Figure 2-2). This mix will be used to establish herbaceous cover in the beech-maple and oak-hickory forest templates. The use of native grasses and forbs in forest restoration provides several benefits, including soil stabilization, soil conditioning, and competition with aggressive non-native species. The species mix for the mesic prairie is shown on Table 2-3.

2.3.3.2 Xeric Prairie

Approximately three acres of the SWU are comprised of pure sand and gravel (Figure 2-2). These areas are very well drained, low in organic matter, and difficult to stabilize and establish woody vegetation. Therefore, no trees and shrubs will be planted, and a xeric grass and forb mix will be used to seed these areas. Some species are adapted to the sandy conditions present in portions of the SWU. This species list is provided on Table 2-3.

2.3.3.3 Wet Prairie

Approximately seven acres of the SWU will be seeded in wet prairie (Figure 2-2). The wet prairie mix consists of native grasses and forbs that prefer wet conditions and are tolerant of periodic inundation. As Figure 2-2 shows, wet prairie seeding will be primarily limited to the expanded floodplain along Paddys Run. A few depression areas within the beech-maple forest template may also be seeded with a wet prairie mix.

2.3.4 Bioengineering and Erosion Control

Approximately 0.25 acre within the expanded floodplain area will require bioengineering erosion control (Figure 2-2). This will involve seeding with the wet prairie seed mix, installing coir matting and bioengineering logs, and planting dormant live cuttings into matting material and slopes. Table 2-10 lists the species and quantities anticipated for the installation of dormant cuttings. DOE plans on retrieving some of the willow cuttings from on-site sources, so the species list and quantities are subject to change.

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# TABLE 2-1
# MASTER PLANT LIST

| Scientific Name | Common Name | Form | Template | | | | Placement | Quantity |
|---|---|---|---|---|---|---|---|---|
| *Acer nigrum* | black maple | canopy tree | B | | M | | | 134 |
| *Acer rubrum* | red maple | canopy tree | | H | | R | wet | 99 |
| *Acer saccharinum* | silver maple | canopy tree | B | | | R | wet | 34 |
| *Acer saccharum* | sugar maple | canopy tree | B | H | M | | | 314 |
| *Carya cordiformis* | bitternut hickory | canopy tree | B | H | M | R | | 60 |
| *Carya laciniosa* | shellbark hickory | canopy tree | B | | | R | wet | 77 |
| *Carya ovata* | shagbark hickory | canopy tree | | H | M | | | 101 |
| *Celtis occidentalis* | hackberry | canopy tree | B | H | M | R | edge | 44 |
| *Fagus grandifolia* | beech | canopy tree | B | | M | | | 492 |
| *Fraxinus americana* | white ash | canopy tree | B | H | M | | | 178 |
| *Fraxinus pennsylvanicum* | green ash | canopy tree | | | | R | | 81 |
| *Fraxinus quadrangulata* | blue ash | canopy tree | | H | M | | | 25 |
| *Gymnocladus dioica* | kentucky coffeetree | canopy tree | | H | M | | | 3 |
| *Juglans nigra* | black walnut | canopy tree | B | | M | R | | 139 |
| *Liquidambar styraciflua* | sweetgum | canopy tree | | | M | | | 4 |
| *Liriodendron tulipifera* | tulip poplar | canopy tree | B | H | M | | | 72 |
| *Platanus occidentalis* | sycamore | canopy tree | | | M | R | edge | 39 |
| *Populus deltoides* | cottonwood | canopy tree | | | | R | edge | 16 |
| *Prunus serotina* | black cherry | canopy tree | B | | M | | | 97 |
| *Quercus alba* | white oak | canopy tree | | H | M | | | 126 |
| *Quercus bicolor* | swamp white oak | canopy tree | | | | R | wet | 7 |
| *Quercus coccinea* | scarlet oak | canopy tree | | H | | | | 11 |
| *Quercus imbricaria* | shingle oak | canopy tree | | H | M | | | 5 |
| *Quercus muehlenbergii* | chinquapin oak | canopy tree | | H | M | | | 6 |
| *Quercus palustris* | pin oak | canopy tree | B | | | R | wet | 41 |
| *Quercus prinus* | chestnut oak | canopy tree | | H | | | | 65 |
| *Quercus rubra* | red oak | canopy tree | B | H | M | | | 83 |
| *Quercus shumardii* | shumard oak | canopy tree | | H | M | | | 22 |
| *Quercus velutina* | black oak | canopy tree | | H | | | | 11 |



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**TABLE 2-1**
**MASTER PLANT LIST**

| Scientific Name | Common Name | Form | Template | | | | Placement | Quantity |
|---|---|---|---|---|---|---|---|---|
| *Tilia americana* | basswood | canopy tree | B | | M | | | 132 |
| *Ulmus rubra* | slippery elm | canopy tree | | H | M | R | | 53 |
| *Aesculus glabra* | ohio buckeye | understory tree | | H | M | R | wet | 100 |
| *Asimina triloba* | paw paw | understory tree | B | | M | R | | 26 |
| *Carpinus caroliniana* | hornbeam | understory tree | B | | M | R | | 9 |
| *Cercis canadensis* | redbud | understory tree | | H | M | | edge | 8 |
| *Cornus alternifolia* | alternate leaf dogwood | understory tree | B | | | R | | 5 |
| *Cornus drumondii* | roughleaf dogwood | understory tree | | H | | | edge | 7 |
| *Cornus florida* | flowering dogwood | understory tree | | H | M | | | 10 |
| *Cornus racemosa* | grey dogwood | understory tree | | H | M | | | 51 |
| *Crataegus mollis* | downy hawthorne | understory tree | B | | M | | | 11 |
| *Ostrya virginiana* | hop-hornbeam | understory tree | B | | M | R | wet | 8 |
| *Ceanothus americanus* | new jersey tea | shrub | | H | | R | wet | 19 |
| *Corylus americana* | hazel nut | shrub | B | | | R | wet | 101 |
| *Euonymus atropurpureus* | eastern wahoo | shrub | B | | | R | | 8 |
| *Hamamelis virginiana* | witch hazel | shrub | B | | M | | | 121 |
| *Hypericum spathulatum* | shrubby st. john's wort | shrub | B | | | R | wet | 77 |
| *Ilex verticallata* | winterberry | shrub | | | | R | wet | 71 |
| *Lindera benzoin* | spicebush | shrub | B | | M | | | 124 |
| *Prunus americanus* | wild plum | shrub | | H | | | edge | 20 |
| *Physocarpus opulifolius* | ninebark | shrub | B | H | M | | edge | 98 |
| *Rhus aromatica* | fragrant sumac | shrub | | H | M | | edge | 62 |
| *Rhus glabra* | smooth sumac | shrub | B | H | | | edge | 52 |
| *Rosa caroliniana* | carolina rose | shrub | | H | M | | edge | 63 |
| *Rosa palustris* | swamp rose | shrub | B | | | R | wet | 63 |
| *Rubus occidentalis* | black raspberry | shrub | B | H | | | edge | 48 |
| *Salix humila* | prairie willow | shrub | B | H | | | edge | 66 |
| *Sambucus canadensis* | elder | shrub | B | | | R | wet | 56 |
| *Staphylea trifolia* | bladdernut | shrub | B | H | M | R | | 130 |

**TABLE 2-1**
**MASTER PLANT LIST**

| Scientific Name | Common Name | Form | Template | | | | Placement | Quantity |
|---|---|---|---|---|---|---|---|---|
| *Symphoricarpos orbiculatus* | coral berry | shrub | | H | M | | edge | 64 |
| *Viburnum acerifolium* | mapleleaf viburnum | shrub | B | | | | | 60 |
| *Viburnum prunifolium* | blackhaw viburnum | shrub | B | H | M | | | 114 |
| *Zanthozylum americanum* | prickly ash | shrub | B | H | M | R | edge | 128 |
| *Campsis radicans* | trumpet creeper | vine | | | | R | edge | 19 |

Template Key:
- B = beech-maple forest template
- H = oak-hickory forest template
- M = mesophytic template
- R = riparian template

| | |
|---|---|
| **Totals:** | 4,370 |
| trees | 2,806 |
| shrubs | 1,564 |



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**TABLE 2-2**
**SEEDLING PLANT LIST**

| Scientific Name | Common Name | Beech-Maple | Oak-Hickory | Mesophytic | Riparian | Placement | Totals |
|---|---|---|---|---|---|---|---|
| *Acer rubrum* | red maple | | 166 | | 176 | wet | 342 |
| *Acer saccharinum* | silver maple | 60 | | | 76 | wet | 136 |
| *Acer saccharum* | sugar maple | 431 | 179 | 154 | | | 764 |
| *Carya cordiformis* | bitternut hickory | 76 | 28 | 28 | 34 | | 166 |
| *Carya laciniosa* | shellbark hickory | 58 | | | 127 | wet | 185 |
| *Carya ovata* | shagbark hickory | | 168 | 161 | | | 329 |
| *Celtis occidentalis* | hackberry | 71 | 33 | 20 | 42 | edge | 166 |
| *Fagus grandifolia* | beech | 925 | | 259 | | | 1184 |
| *Fraxinus americana* | white ash | 324 | 180 | 155 | | | 659 |
| *Fraxinus pennsylvanicum* | green ash | | | | 52 | | 52 |
| *Juglans nigra* | black walnut | 194 | | 58 | 142 | | 394 |
| *Liriodendron tulipifera* | tulip poplar | 85 | 19 | 29 | | | 133 |
| *Prunus serotina* | black cherry | 246 | | 96 | | | 342 |
| *Quercus alba* | white oak | | 210 | 132 | | | 342 |
| *Quercus palustris* | pin oak | 38 | | | 98 | wet | 136 |
| *Quercus rubra* | red oak | 225 | 85 | 88 | | | 394 |
| *Tilia americana* | basswood | 494 | | 176 | | | 670 |
| *Aesculus glabra* | ohio buckeye | | 136 | 83 | 187 | wet | 406 |
| | **Totals:** | 2,018 | 805 | 710 | 467 | | 6,800 |



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# TABLE 2-3
# SEED MIXES

**Upland Mesic (11 Acres)**

**Grasses**

| Scientific Name | Common Name | CW | lb/acre | lb Req. |
|---|---|---|---|---|
| *Andropogon gerardi* | big bluestem | 1 | 3 | 33 |
| *Andropogon scoparius* | little bluestem | 4 | 2 | 22 |
| *Bouteloua curtipendula* | side-oats grama | 5 | 0.5 | 5.5 |
| *Elymus canadensis* | Canada wild-rye | 1 | 25 | 275 |
| *Lolium multiflorum* | annual rye | n/a | 5 | 55 |
| *Panicum virgatum* | switchgrass | -1 | 0.5 | 5.5 |
| *Sorghastrum nutans* | indian grass | 2 | 2 | 22 |
| | | **Total =** | **38** | **418** |

**Forbs**

| Scientific Name | Common Name | CW | oz/acre | oz Req. |
|---|---|---|---|---|
| *Asclepias tuberosa* | butterflyweed | 5 | 2 | 22 |
| *Aster laevis* | smooth aster | 5 | 0.25 | 2.75 |
| *Aster novae-anliae* | New England aster | -3 | 0.125 | 1.375 |
| *Astragalus canadensis* | Canada milkvetch | -1 | 0.375 | 4.125 |
| *Baptisia australis* | blue false indigo | 5 | 3.5 | 38.5 |
| *Baptisia leucantha* | white false indigo | 3 | 3.5 | 38.5 |
| *Cassia fasciculata* | partridge pea | 4 | 1.75 | 19.25 |
| *Echinacea pallida* | pale purple coneflower | 5 | 1.5 | 16.5 |
| *Echinacea purpurea* | purple coneflower | 5 | 1.5 | 16.5 |
| *Eryngium yuccafolium* | rattlesnake master | -1 | 0.75 | 8.25 |
| *Eupatorium purpureum* | sweet Joe pye-weed | 0 | 0.1875 | 2.0625 |
| *Heliopsis helianthoides* | Ox-eye sunflower | 5 | 1.25 | 13.75 |
| *Lespedea capitata* | round-headed bush clover | 3 | 0.5 | 5.5 |
| *Liatris pycnostachya* | prairie blazingstar | 1 | 1.75 | 12.25 |
| *Monarda fistulosa* | bergamot | 3 | 0.125 | 1.375 |
| *Penstemon grandiflorus* | beardtongue | 5 | 0.75 | 8.25 |
| *Petalostemum purpureum* | purple prairie clover | 5 | 0.25 | 2.75 |
| *Ratibida pinnata* | yellow coneflower | 5 | 0.375 | 4.125 |
| *Rudbeckia hirta* | black-eyed Susan | 3 | 0.125 | 1.375 |
| *Silphium perfoliatum* | cupplant | -2 | 3.75 | 41.25 |
| *Solidago rigida* | stiff goldenrod | 4 | 0.0625 | 0.6875 |
| *Tradescantia ohioensis* | spiderwort | 2 | 1 | 11 |
| *Verbena hastata* | blue vervain | -4 | 0.125 | 1.375 |
| *Verbena stricta* | hoary vervain | 5 | 0.25 | 2.75 |
| | | **Total =** | **25.75** | **276.25** |

# TABLE 2-3
# SEED MIXES

**Upland Xeric (3 acres)**

**Grasses**

| Scientific Name | Common Name | CW | lb/acre | lb Req. |
|---|---|---|---|---|
| *Andropogon gerardi* | big bluestem | 1 | 0.5 | 1.5 |
| *Andropogon scoparius* | little bluestem | 4 | 3 | 9 |
| *Bouteloua curtipendula* | side-oats grama | 5 | 5 | 15 |
| *Elymus canadensis* | Canada wild-rye | 1 | 25 | 75 |
| *Lolium multiflorum* | annual rye | n/a | 5 | 15 |
| *Panicum virgatum* | switchgrass | -1 | 0.5 | 1.5 |
| *Sorghastrum nutans* | indian grass | 2 | 0.5 | 1.5 |
| *Sporobulus heterolepis* | prairie dropseed | 4 | 1.5 | 4.5 |
| | | **Total =** | **41** | **123** |

**Forbs**

| Scientific Name | Common Name | CW | oz/acre | oz Req. |
|---|---|---|---|---|
| *Asclepias tuberosa* | butterflyweed | 5 | 3.25 | 9.75 |
| *Aster laevis* | smooth aster | 5 | 0.25 | 0.75 |
| *Baptisia australis* | blue false indigo | 5 | 4 | 12 |
| *Baptisia leucantha* | white false indigo | 3 | 4 | 12 |
| *Cassia fasciculata* | partridge pea | 4 | 1 | 3 |
| *Echinacea pallida* | pale purple coneflower | 5 | 2 | 6 |
| *Echinacea purpurea* | purple coneflower | 5 | 2 | 6 |
| *Heliopsis helianthoides* | Ox-eye sunflower | 5 | 1.75 | 5.25 |
| *Lespedea capitata* | round-headed bush clover | 3 | 1 | 3 |
| *Liatris pycnostachya* | prairie blazingstar | 1 | 1 | 7 |
| *Lupinis perennis* | lupine | 5 | 5 | 15 |
| *Monarda fistulosa* | bergamot | 3 | 0.25 | 0.75 |
| *Penstemon grandiflorus* | beardtongue | 5 | 1 | 3 |
| *Petalostemum purpureum* | purple prairie clover | 5 | 0.25 | 0.75 |
| *Ratibida pinnata* | yellow coneflower | 5 | 0.25 | 0.75 |
| *Rudbeckia hirta* | black-eyed Susan | 3 | 0.25 | 0.75 |
| *Solidago rigida* | stiff goldenrod | 4 | 0.25 | 0.75 |
| *Verbena stricta* | hoary vervain | 5 | 0.5 | 1.5 |
| | | **Total =** | **28** | **88** |

**TABLE 2-3**
**SEED MIXES**

**Wetland (7 acres)**
**Grasses**

| Scientific Name | Common Name | CW | lb/acre | lb Req. |
|---|---|---|---|---|
| *Andropogon gerardi* | big bluestem | 1 | 3 | 21 |
| *Calamagrostis canadensis* | blue joint grass | -5 | 0.5 | 4 |
| *Carex comosa* | bristly sedge | -5 | 1 (oz/ac) | 7 (oz) |
| *Carex hystericina* | porcupine sedge | -5 | 1 (oz/ac) | 7 (oz) |
| *Elymus canadensis* | Canada wild-rye | 1 | 25 | 175 |
| *Lolium multiflorum* | annual rye | n/a | 5 | 35 |
| *Panicum virgatum* | switchgrass | -1 | 0.5 | 4 |
| *Scirpus atrovirens* | dark green bulrush | -5 | 1 (oz/ac) | 7 (oz) |
| *Spartina pectinata* | prairie cordgrass | -4 | 1 | 7 |
| | | **Total =** | **35.188** | **246** |

**Forbs**

| Scientific Name | Common Name | CW | oz/acre | oz Req. |
|---|---|---|---|---|
| *Angelica atropurpurea* | angelica | -5 | 3 | 21 |
| *Asclepias incarnata* | swamp milkweed | -5 | 4.5 | 32 |
| *Aster novae-angliae* | New England aster | -3 | 0.5 | 4 |
| *Cassia hebecarpa* | wild senna | -3 | 7.5 | 53 |
| *Desmodium canadense* | Canada tick trefoil | 1 | 4.75 | 33 |
| *Eupatorium maculatum* | spotted Joe pye-weed | -5 | 0.5 | 4 |
| *Liatris spicata* | marsh blazingstar | 0 | 2 | 14 |
| *Lobelia siphilitica* | great blue lobelia | -4 | 0.125 | 1 |
| *Monarda fistulosa* | bergamot | 3 | 0.375 | 3 |
| *Pycanthemum virginianum* | mountain mint | -4 | 0.25 | 2 |
| *Rudbeckia hirta* | black-eyed Susan | 3 | 0.25 | 2 |
| *Verbena hastata* | blue vervain | -4 | 0.25 | 2 |
| | | **Total =** | **24** | **168** |

CW = Coefficient of Wetness

**TABLE 2-4**
**PLANT COMMUNITY ACREAGE ESTIMATES**

| Community | Acreage |
|---|---|
| ***Upland Communities*** | |
| Beech-maple | 8 |
| Oak-hickory | 3 |
| Mesophytic | 3 |
| Mesic prairie | 11 |
| Xeric prairie | 3 |
| ***Wetland Communities*** | |
| Riparian | 3 |
| Wet prairie | 7 |
| Wetland herbaceous | 1 |
| Erosion control | 1 |

**TABLE 2-5**
**BEECH-MAPLE FOREST TEMPLATE**

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Acer nigrum* | black maple | canopy tree | cover | | 114 |
| *Acer saccharinum* | silver maple | canopy tree | cover | wet | 7 |
| *Acer saccharum* | sugar maple | canopy tree | cover, mast | | 245 |
| *Carya cordiformis* | bitternut hickory | canopy tree | cover | | 19 |
| *Carya laciniosa* | shellbark hickory | canopy tree | cover, mast | wet | 13 |
| *Celtis occidentalis* | hackberry | canopy tree | diversity | edge | 14 |
| *Fagus grandifolia* | beech | canopy tree | cover, mast | | 434 |
| *Fraxinus americana* | white ash | canopy tree | cover | | 118 |
| *Juglans nigra* | black walnut | canopy tree | mast, diversity | | 66 |
| *Liriodendron tulipifera* | tulip poplar | canopy tree | cover, aesthetics | | 46 |
| *Prunus serotina* | black cherry | canopy tree | fruit | | 75 |
| *Quercus palustris* | pin oak | canopy tree | cover | wet | 8 |
| *Quercus rubra* | red oak | canopy tree | cover, mast | | 20 |
| *Tilia americana* | basswood | canopy tree | cover, aesthetics | | 89 |
| *Asimina triloba* | paw paw | understory tree | fruit, diversity | | 14 |
| *Carpinus caroliniana* | hornbeam | understory tree | diversity, mast | | 2 |
| *Cornus alternifolia* | alternate leaf dogwood | understory tree | diversity, aesthetics | | 2 |
| *Crataegus mollis* | downy hawthorne | understory tree | cover | | 7 |
| *Ostrya virginiana* | hop-hornbeam | understory tree | diversity | wet | 4 |
| *Corylus americana* | hazel nut | shrub | diversity | wet | 67 |
| *Euonymus atropurpureus* | eastern wahoo | shrub | aesthetics | | 3 |
| *Hamamelis virginiana* | witch hazel | shrub | cover | | 76 |
| *Hypericum spathulatum* | shrubby st. john's wort | shrub | diversity | wet | 36 |
| *Lindera benzoin* | spicebush | shrub | cover | | 95 |
| *Physocarpus opulifolius* | ninebark | shrub | diversity | edge | 44 |
| *Rhus glabra* | smooth sumac | shrub | aesthetics | edge | 33 |
| *Rosa palustris* | swamp rose | shrub | aesthetics | wet | 18 |
| *Rubus occidentalis* | black raspberry | shrub | fruit | edge | 33 |
| *Salix humila* | prairie willow | shrub | cover | edge | 35 |



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**TABLE 2-5**
**BEECH-MAPLE FOREST TEMPLATE**

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Sambucus canadensis* | elder | shrub | fruit | wet | 15 |
| *Staphylea trifolia* | bladdernut | shrub | diversity | | 67 |
| *Viburnum acerifolium* | mapleleaf viburnum | shrub | diversity | | 60 |
| *Viburnum prunifolium* | blackhaw viburnum | shrub | cover | | 74 |
| *Zanthozylum americanum* | prickly ash | shrub | diversity | edge | 58 |



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**TABLE 2-6**
**OAK-HICKORY FOREST TEMPLATE**

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Acer rubrum* | red maple | canopy tree | cover | wet | 48 |
| *Acer saccharum* | sugar maple | canopy tree | cover, mast | | 29 |
| *Carya cordiformis* | bitternut hickory | canopy tree | cover | | 16 |
| *Carya ovata* | shagbark hickory | canopy tree | cover, mast | | 53 |
| *Celtis occidentalis* | hackberry | canopy tree | diversity | edge | 12 |
| *Fraxinus americana* | white ash | canopy tree | cover | | 39 |
| *Fraxinus quadrangulata* | blue ash | canopy tree | cover, diversity | | 13 |
| *Gymnocladus dioica* | kentucky coffeetree | canopy tree | diversity | | 1 |
| *Liriodendron tulipifera* | tulip poplar | canopy tree | cover, aesthetics | | 10 |
| *Quercus alba* | white oak | canopy tree | cover, mast | | 83 |
| *Quercus coccinea* | scarlet oak | canopy tree | cover, mast | | 11 |
| *Quercus imbricaria* | shingle oak | canopy tree | diversity, mast | | 2 |
| *Quercus muehlenbergii* | chinquapin oak | canopy tree | diversity, mast | | 4 |
| *Quercus prinus* | chestnut oak | canopy tree | diversity | | 65 |
| *Quercus rubra* | red oak | canopy tree | cover, mast | | 50 |
| *Quercus shumardii* | shumard oak | canopy tree | diversity, mast | | 14 |
| *Quercus velutina* | black oak | canopy tree | cover, mast | | 11 |
| *Ulmus rubra* | slippery elm | canopy tree | cover | | 25 |
| *Aesculus glabra* | ohio buckeye | understory tree | diversity | wet | 40 |
| *Cercis canadensis* | redbud | understory tree | aesthetics | edge | 3 |
| *Cornus drumondii* | roughleaf dogwood | understory tree | cover | edge | 7 |
| *Cornus florida* | flowering dogwood | understory tree | aesthetics | | 6 |
| *Cornus racemosa* | grey dogwood | understory tree | cover | | 24 |
| *Ceanothus americanus* | new jersey tea | shrub | diversity | wet | 11 |
| *Physocarpus opulifolius* | ninebark | shrub | diversity | edge | 32 |
| *Prunus americana* | wild plum | shrub | fruit, diversity | edge | 20 |
| *Rhus aromatica* | fragrant sumac | shrub | cover, aesthetics | | 42 |
| *Rhus glabra* | smooth sumac | shrub | aesthetics | edge | 19 |
| *Rosa caroliniana* | carolina rose | shrub | aesthetics | edge | 36 |



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**TABLE 2-6**
**OAK-HICKORY FOREST TEMPLATE**

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Rubus occidentalis* | black raspberry | shrub | fruit | edge | 15 |
| *Salix humila* | prairie willow | shrub | cover | edge | 31 |
| *Staphylea trifolia* | bladdernut | shrub | diversity | | 13 |
| *Symphoricarpos orbiculatus* | coral berry | shrub | diversity | edge | 34 |
| *Viburnum prunifolium* | blackhaw viburnum | shrub | cover | | 24 |
| *Zanthozylum americanum* | prickly ash | shrub | diversity | edge | 35 |

# TABLE 2-7
# MESOPHYTIC FOREST TEMPLATE

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Acer nigrum* | black maple | canopy tree | cover | | 20 |
| *Acer saccharum* | sugar maple | canopy tree | cover, mast | | 40 |
| *Carya cordiformis* | bitternut hickory | canopy tree | cover | | 15 |
| *Carya ovata* | shagbark hickory | canopy tree | cover, mast | | 48 |
| *Celtis occidentalis* | hackberry | canopy tree | diversity | edge | 6 |
| *Fagus grandifolia* | beech | canopy tree | cover, mast | | 58 |
| *Fraxinus americana* | white ash | canopy tree | cover | | 21 |
| *Fraxinus quadrangulata* | blue ash | canopy tree | cover, diversity | | 12 |
| *Gymnocladus dioica* | kentucky coffeetree | canopy tree | diversity | | 2 |
| *Juglans nigra* | black walnut | canopy tree | mast, diversity | | 20 |
| *Liquidambar styraciflua* | sweetgum | canopy tree | diversity | | 4 |
| *Liriodendron tulipifera* | tulip poplar | canopy tree | cover, aesthetics | | 16 |
| *Platanus occidentalis* | sycamore | canopy tree | cover | edge | 4 |
| *Prunus serotina* | black cherry | canopy tree | fruit | | 22 |
| *Quercus alba* | white oak | canopy tree | cover, mast | | 43 |
| *Quercus imbricaria* | shingle oak | canopy tree | diversity, mast | | 3 |
| *Quercus muehlenbergii* | chinquapin oak | canopy tree | diversity, mast | | 2 |
| *Quercus rubra* | red oak | canopy tree | cover, mast | | 13 |
| *Quercus shumardii* | shumard oak | canopy tree | diversity, mast | | 8 |
| *Tilia americana* | basswood | canopy tree | cover, aesthetics | | 43 |
| *Ulmus rubra* | slippery elm | canopy tree | cover | | 6 |
| *Aesculus glabra* | ohio buckeye | understory tree | diversity | wet | 27 |
| *Asimina triloba* | paw paw | understory tree | fruit, diversity | | 6 |
| *Carpinus caroliniana* | hornbeam | understory tree | diversity, mast | | 4 |
| *Cercis canadensis* | redbud | understory tree | aesthetics | edge | 5 |
| *Cornus florida* | flowering dogwood | understory tree | aesthetics | | 4 |
| *Cornus racemosa* | grey dogwood | understory tree | cover | | 27 |
| *Crataegus mollis* | downy hawthorne | understory tree | cover | | 4 |
| *Ostrya virginiana* | hop-hornbeam | understory tree | diversity | wet | 2 |



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**TABLE 2-7**
**MESOPHYTIC FOREST TEMPLATE**

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Hamamelis virginiana* | witch hazel | shrub | cover | | 45 |
| *Lindera benzoin* | spicebush | shrub | cover | | 29 |
| *Physocarpus opulifolius* | ninebark | shrub | diversity | edge | 22 |
| *Rhus aromatica* | fragrant sumac | shrub | cover, aesthetics | | 20 |
| *Rosa caroliniana* | carolina rose | shrub | aesthetics | edge | 27 |
| *Staphylea trifolia* | bladdernut | shrub | diversity | | 41 |
| *Symphoricarpos orbiculatus* | coral berry | shrub | diversity | edge | 30 |
| *Viburnum prunifolium* | blackhaw viburnum | shrub | cover | | 16 |
| *Zanthozylum americanum* | prickly ash | shrub | diversity | edge | 24 |



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**TABLE 2-8**
**RIPARIAN FOREST TEMPLATE**

| Scientific Name | Common Name | Form | Function | Placement | Quantity |
|---|---|---|---|---|---|
| *Acer rubrum* | red maple | canopy tree | cover | wet | 51 |
| *Acer saccharinum* | silver maple | canopy tree | cover | wet | 27 |
| *Carya cordiformis* | bitternut hickory | canopy tree | cover | | 10 |
| *Carya laciniosa* | shellbark hickory | canopy tree | cover, mast | wet | 64 |
| *Celtis occidentalis* | hackberry | canopy tree | diversity | edge | 12 |
| *Fraxinus pennsylvanicum* | green ash | canopy tree | cover | | 81 |
| *Juglans nigra* | black walnut | canopy tree | mast, diversity | | 53 |
| *Platanus occidentalis* | sycamore | canopy tree | cover | edge | 35 |
| *Populus deltoides* | cottonwood | canopy tree | cover | edge | 16 |
| *Quercus bicolor* | swamp white oak | canopy tree | cover, mast | wet | 7 |
| *Quercus palustris* | pin oak | canopy tree | cover | wet | 33 |
| *Ulmus rubra* | slippery elm | canopy tree | cover | | 22 |
| *Aesculus glabra* | ohio buckeye | understory tree | diversity | wet | 33 |
| *Asimina triloba* | paw paw | understory tree | fruit, diversity | | 6 |
| *Carpinus caroliniana* | hornbeam | understory tree | diversity, mast | | 3 |
| *Cornus alternifolia* | alternate leaf dogwood | understory tree | diversity, aesthetics | | 3 |
| *Ostrya virginiana* | hop-hornbeam | understory tree | diversity | wet | 2 |
| *Ceanothus americanus* | new jersey tea | shrub | diversity | wet | 8 |
| *Corylus americana* | hazel nut | shrub | diversity | wet | 34 |
| *Euonymus atropurpureus* | eastern wahoo | shrub | aesthetics | | 5 |
| *Hypericum spathulatum* | shrubby st. john's wort | shrub | diversity | wet | 41 |
| *Ilex verticallata* | winterberry | shrub | aesthetics | wet | 71 |
| *Rosa palustris* | swamp rose | shrub | aesthetics | wet | 45 |
| *Sambucus canadensis* | elder | shrub | fruit | wet | 41 |
| *Staphylea trifolia* | bladdernut | shrub | diversity | | 9 |
| *Zanthozylum americanum* | prickly ash | shrub | diversity | edge | 11 |
| *Campsis radicans* | trumpet creeper | vine | aesthetics | edge | 19 |

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**TABLE 2-9**
**SEDGE MEADOW/MARSH PLANT LIST**

| Scientific Name | Common Name | % Composition | Quantity |
|---|---|---|---|
| *Carex lurida* | bottlebrush sedge | 5% | 225 |
| *Carex stricta* | tussock sedge | 15% | 675 |
| *Carex stipata* | awl-fruited sedge | 5% | 225 |
| *Carex vulpinoidea* | fox sedge | 10% | 450 |
| *Eupatorium maculatum* | spotted Joe pye weed | 5% | 225 |
| *Juncus effusus* | soft rush | 5% | 225 |
| *Lobelia cardinalis* | cardinal flower | 5% | 225 |
| *Lobelia siphilitica* | great blue lobelia | 5% | 225 |
| *Scirpus atrovirens* | dark green bulrush | 10% | 450 |
| *Scirpus cyperinus* | woolgrass | 10% | 450 |
| *Scirpus validus* | softstem bulrush | 15% | 675 |
| *Spartina pectinata* | prairie cordgrass | 10% | 450 |
| | **Totals =** | 100% | 4,500 |

**TABLE 2-10**
**BIOENGINEERING EROSION CONTROL DORMANT LIVE CUTTINGS**

| Scientific Name | Common Name | Quantity |
|---|---|---|
| *Cornus amonum* | silky dogwood | 145 |
| *Cornus stolonifera* | red-osier dogwood | 145 |
| *Salix amygdaloides* | peachleaf willow | 145 |
| *Salix discolor* | pussy willow | 145 |
| *Salix nigra* | black willow | 145 |
| *Salix sericea* | silky willow | 145 |
| *Sambucus canadensis* | elder | 145 |

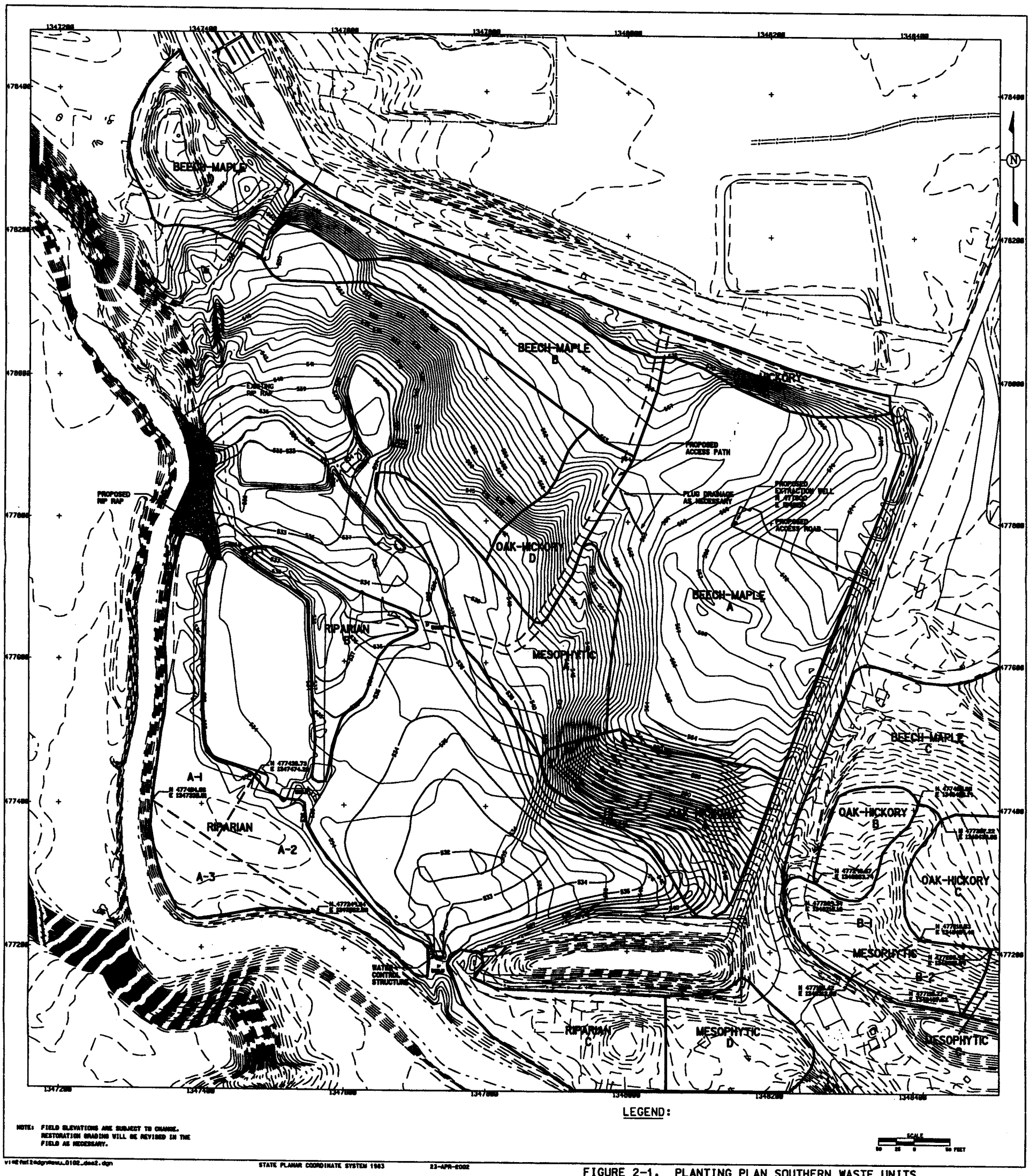



FIGURE 2-1. PLANTING PLAN SOUTHERN WASTE UNITS
NATURAL RESOURCE RESTORATION DESIGN

FIGURE 2-2. SOIL AMENDMENT, SEEDING, AND EROSION CONTROL PLAN SOUTHERN WASTE UNITS NATURAL RESOURCE RESTORATION DESIGN

# 3.0 FIELD IMPLEMENTATION

Field implementation of the SWU ecological restoration is described below, and in the planting and seeding specifications attached as Appendices A and B.

## 3.1 REVEGETATION

Revegetation involves the establishment of trees, shrubs, and herbaceous plants across the project area. All revegetation activities will be conducted pursuant to the densities agreed on by the NRTs, as documented in the NRRP. Densities for areas amenable to planting include 160 trees/acre, 90 shrubs/acre, and 400 seedlings/acre.

Since the majority of the SWU has been excavated and only compacted subsoils remain, it is crucial that plants are properly installed. All plant material used in the SWU must be inoculated with mycorrhizal fungi prior to or during installation.

Spring 2002 activities will involve woody plant installation and seeding. Herbaceous plant installation will mostly occur during the second phase of SWU restoration. However, the methods for planting are briefly described below.

### 3.1.1 Woody Plant Installation

Woody plants will be installed in the same manner as other ecological restoration projects at the FEMP. Habitat templates will be divided into smaller (i.e., 0.25-acre) planting patches. Each planting patch will be laid out in the field, and color-coded flags will be randomly distributed through the patch. Each flag will be labeled with a plant code that corresponds to a specific plant. The plants themselves will be staged at the project site and tagged with a corresponding plant code and colored patch code. Laborers would then simply match the plant/patch codes and install the plant pursuant to the planting specifications in Appendix A. This "random patch" method allows the restoration ecologist to strategically place specific species based on its habitat requirements. The "Placement" column on the template species lists in Tables 2-2 and 2-5 through 2-8 provides a general guide for placement of a species in a wet area or on the edge of a community. The restoration ecologist will also consider other factors, including distribution patterns, exposure, topography, deer pressure, hydrology, soils, etc.

Bare-root seedlings will not be individually "flagged and tagged." Instead, the restoration ecologist will group the seedlings by patch and instruct the laborers to randomly distribute the seedlings within the patch area. Seedlings will also be installed pursuant to the specifications in Appendix A.

### 3.1.2 Herbaceous Plant Installation

Most herbaceous plants will be delivered to the site in 2-inch square open-bottom pots. These plants must be staged by placing in water immediately upon arrival at the site. 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. Laborers should make sure that no roots are exposed. Most herbaceous plants will be installed in or near standing water.

### 3.1.3 Seeding

Seeding of all areas within the SWU will take place in 2002. Where possible, seeding will be conducted with the seed drill. However, most areas that need to be seeded will be revegetated with trees and shrubs, too sandy, too wet, or too steep for the seed drill to access. Therefore, the majority of seeding in the SWU will be broadcast by hand, pursuant to the specifications included in Appendix B.

## 3.2 BIOENGINEERING EROSION CONTROL

As stated above, bioengineering erosion control will be needed on approximately 0.25 acre within the SWU. All coir matting and coir logs shall be installed pursuant to the specifications provided in Appendix B. Live cuttings will be installed on 4-foot centers. The cuttings will be driven into the ground at least two-thirds of their length, angled downgradient. The restoration ecologist will determine the species-specific placement of the cuttings within each erosion control area.

## 3.3 PROCUREMENT OF PLANT MATERIALS

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 1 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 tree as listed in Tables 2-5 through 2-8 will be

used as a guide to determining substitutions. The NRTs will be notified of any substitutions as part of the consolidated monitoring program discussed in the NRRP.

### 3.3.1 Delivery and Staging

All plant material will be delivered to the SWU project area directly. A laydown area will be established adjacent to the mulch stockpile area, where plant material may be staged. Any plants that are stored for more than 24 hours at the staging area shall be healed in with woodchip mulch. Bare root seedlings shall be immediately removed from their packing materials and healed in or placed directly in water, in accordance with the vendor's directions. Live stakes will be installed as soon as possible upon receipt. Seed will be stored in a cool place until it can be applied to the project area.

## 3.4 SEQUENCING

The sequence of activities for Spring 2002 is provided below. The sequence of activities for Fall 2002 will be provided in the final NRRDP. In general, Spring 2002 activities include the installation of bioengineering control measures, planting a portion of the forest templates, and seeding the expanded floodplain. The SWU project area would then be maintained until Fall 2002. At that time, the remainder of all plant material will be installed, as well as all herbaceous wetland plant plugs. It should be noted that the sequence of activities is subject to change due to a variety of factors, including weather conditions, plant availability, etc.

The sequence of activities for Spring 2002 are as follows:

1. Complete remediation activities and restoration grade
2. Import woodchips/compost into spring planting and seeding areas
3. Stockpile Northern Pines woodchips for composting
4. Install bioengineering erosion control features
5. Plant oak-hickory forest template in Areas B and C
6. Plant mesophytic forest template in Areas B and C
7. Seed wet mix in expanded floodplain and wet areas
8. Install access paths.

# REFERENCES

U.S. Department of Energy, 2000, "Area 8, Phase II Natural Resource Restoration Design Plan," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio.

U.S. Department of Energy, 2002, "Natural Resource Restoration Plan," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio.

Vankat, J. L., 1992, The Natural Vegetation of North America, Krieger Publishing Company, Malabar, Florida.

# APPENDIX A

# 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 - Vegetation.

## 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 ectomycorrhizae 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, 3-inch deep containers. Potting material shall be inoculated with ectomycorrhizae.

E. Fertilizer shall be slow-release tablet form, and not exceed a N-P-K mix of 34-0-10. 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. Wooden stakes for staking trees as needed shall be nominal 2 inch square, approximately 18-inches in length.

### 2.2 EQUIPMENT

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

# PART 3 EXECUTION

## 3.1 GENERAL

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

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

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

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

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

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

## 3.2 INSTALLATION OF 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 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) 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 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 hardwood mulch.

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

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

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

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

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

## 3.4 INSTALLATION OF HERBACEOUS POTTED PLANTS

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

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

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

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

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

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

## 3.5 PRUNING

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

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

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

## 3.6 MULCHING

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

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

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

## 3.7 WATERING

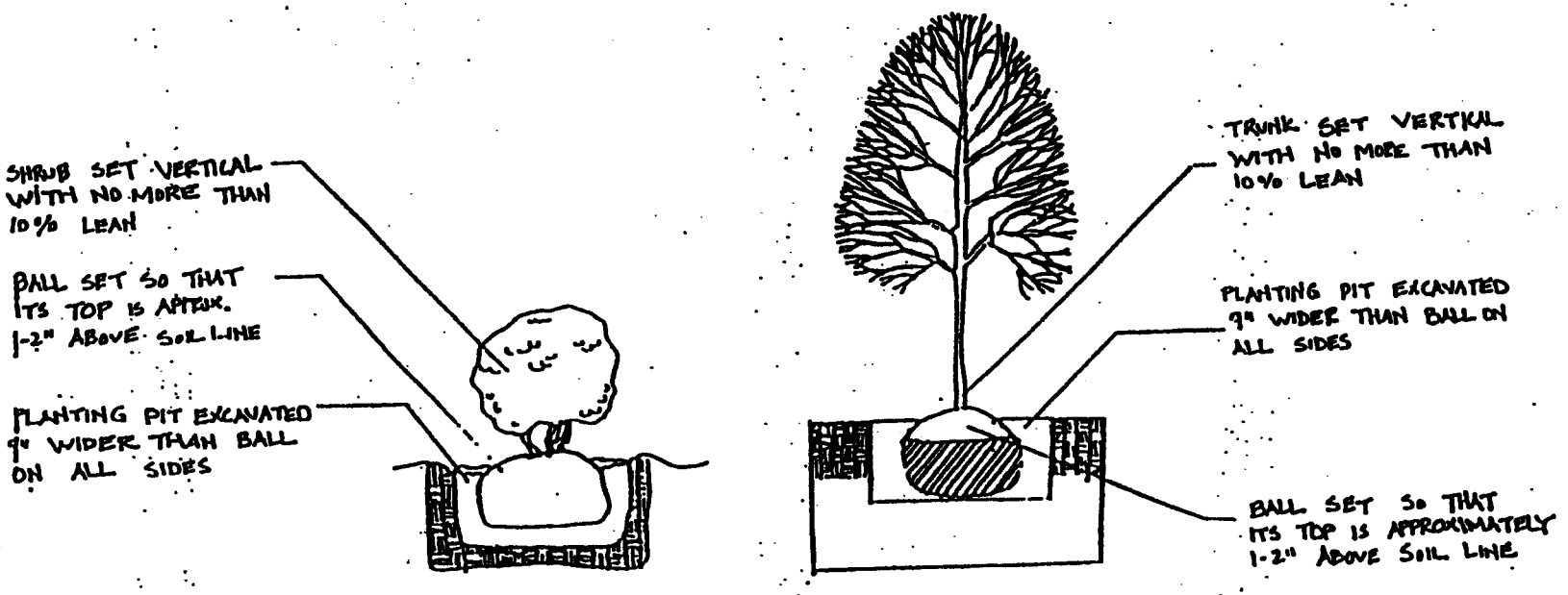
A. Water all planted material weekly for 6 weeks following installation, unless otherwise directed by the Restoration Ecologist. Watering shall be sufficient to saturate the entire root ball. This typically requires the slow release of approximately 10 gallons of water for each plant.

## 3.8 STAKING AND GUYING

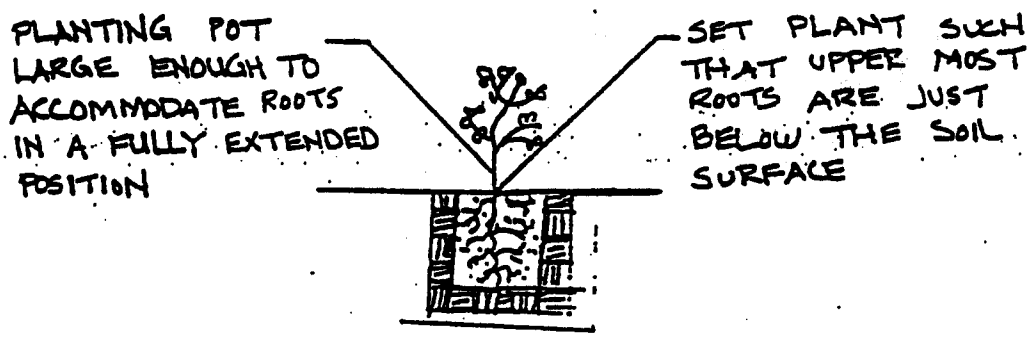
A. Stake and guy trees only at the request of the Restoration Ecologist.

END OF SECTION

## Detail A-1: Installation of Balled and Burlapped and Container-Grown Trees and Shrubs



**Detail A-2: Installation of Bareroot Plants**



# APPENDIX B

# 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

A. Section 02940 - Planting

### 1.3 REFERENCES

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

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

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

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Furnish seed labeled in accordance with U.S. Department of Agriculture (USDA) Rules and Regulations under the Federal Seed Act and applicable State seed laws. Furnish seed in sealed bags or containers bearing the date of expiration. Do not use seed after its date of expiration. Each variety of seed shall have a purity of not less than 90 percent by weight, a percentage of germination not less than 80 percent by weight, and a weed to seed content of not more than 0.75 percent by weight and contain no noxious weeds. Furnish seed mixtures having seed proportioned by weight in accordance with Table 2-3 of the Southern Waste Units Accelerated Natural Resource Restoration Design Plan (SWU NRRDP), 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 fiber, 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 [U.S. 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 (fly ash);

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, 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 wire 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. Two types of fertilizer mixes shall be used. Fertilizer for application within the SWU area shall be 34-0-10; other fertilizers may be approved by the Construction Manager for the former production area, but they must not contain phosphorous. Fertilizer for other areas shall be 22-5-10. Fertilizers shall contain not less than 1 percent added sulfur and not more than 8 percent added iron, or an approved equal.

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

5. Fertilizer shall be used for interim seeding only.

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

## 2.2 EQUIPMENT

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

# PART 3 EXECUTION

## 3.1 DELIVERY, STORAGE, AND HANDLING

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

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

## 3.2 GENERAL

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

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

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

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

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

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

## 3.3 APPLICATION OF SEED AND CRUSTING AGENT

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

B. The seeding seasons for permanent seeding in wet and dry areas are Spring Season between April 1 and July 1 and Fall Season between September 20 and November 30.

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

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

1. Seed drilling method:

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

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

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

d. Install seed with a seed drill to obtain a final planting depth of ¼ to ½ inch using the seed rates indicated in Table 2-3 of the SWU ANRRDP, and 02930-2 of this Section. All seed drilling should be done perpendicular to the direction of surface-water flow.

2. Broadcast Seeding Method:

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

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

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

g. Rake the area after seeding.

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

3. Hydroseeding Method:

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

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

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

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

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

   f. Rake the area where accessible following seeding.

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

E. Application of Crusting Agent:

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

   2. Unless otherwise specified by the manufacturer, dilute concentrated pine sap emulsion to ratio of 4 parts water to 1 part concentrate. Apply diluted pine sap 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. The acceptance inspection will be performed by the Construction Manager who will 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 02930-2**
**SEED MIX FOR INTERIM VEGETATION**

| Species | Pounds Per Acre (lb/ac) |
|---|---|
| ReGreen | 50 |
| Annual Rye Grass | 20 |
| Canada Wild Rye | 20 |

[END OF SECTION]