MINED LAND TECHNICAL REFORESTATION GUIDANCE & RECOMMENDATIONS (7/24/2001)

Introduction

For many years, the division has been actively involved in initiatives and proposals designed to promote the increased utilization of trees as a viable vegetative component in the reclamation of Ohio mined lands. Despite past efforts, the division believes acreage planted, as well as growth and productivity of trees planted on reclaimed land can be increased and improved. This is based on scientific literature and a review of reforestation recommendations published by other mining states. It is hoped application of these ideas will assist the mining industry in enhancing and encouraging successful reforestation efforts in the state of Ohio, so as to increase both the quantity and quality of reforestation on Ohio mines. Specifically, these recommendations can assist mine operators so that your bond release efforts will occur rapidly and successfully. Regulatory Procedure Directive (PD) 95-1 previously provided guidance on wildlife habitat reforestation. It remains in effect. This memorandum should be viewed as a supplement to PD 95-1.

Background

Development of good quality forest and wildlife habitat lands demand reclamation techniques and husbandry practices that encourage and enhance productive tree/shrub survivability and growth. Current reclamation practices present four prevalent problems, which inhibit proper reforestation (KY DSMRE RAM #124, 1997; Virginia DMME, 1996).

1) Excessive compaction of the rooting medium (soil or approved alternative resoiling materials).

2) Inappropriate rooting medium (some spoil material).

3) Excessive competition from the herbaceous ground cover species established to control erosion, especially Kentucky 31 fescue.

4) Alleopathic effect of some fescues on tree seedlings.

Independent research as well as that generated by mining and reclamation professionals responsible for meeting current standards, indicates that the following conditions are necessary to ensure proper tree growth and survival on mined lands:

1) Because trees have a high demand for water, the replaced rooting zone soil on areas which will support a land use of forest or wildlife habitat must be composed of soil materials with a high water holding capacity. Most tree species therefore,

require a thick uncompacted rooting zone of 4-6 feet of soil material with a soil texture that will hold high amounts of available water (KY RAM #124, 1997). Upland deciduous trees require greater than 0.10 inch of available water per inch of soil to be well suited for use as wildlife habitat (National Soil Survey Handbook, 1996). Available water holding capacity (AWC) is reduced proportionately to the percent by volume of coarse fragments (rock fragments), i.e., 15 percent coarse fragments reduce AWC by 15 percent. A minimum of 5 percent coarse fragments is needed before a reduction is calculated (National Soil Survey Handbook, 1996). Therefore, minimizing rock fragments will enhance the soil's ability to retain moisture for tree roots.

2) To attain best survival and productivity which will lead to quick bond release, it is recommended during the mining and reclamation process, that acid or toxic material be covered with four to six feet of acceptable rooting medium that will support trees. All highly alkaline materials with excessive soluble salt levels should also be buried in a similar fashion (source: reforestation guidance documents from Kentucky, Virginia and Indiana).

3) It is recommended herbaceous and woody species be selected which (a) provide long-term erosion control, (b) are compatible with one another, and (c) are suited to site-specific conditions. Less aggressive ground covers will facilitate tree seedling survival. Kentucky 31 fescue is strongly discouraged due to its alleopathic influences and aggressive growth characteristics (source: reforestation guidance documents from Kentucky, Virginia and Indiana).

Forestry Reclamation Practices

These reclamation practices are recommended when establishing a post-mining land use, which requires the planting and survival of tree and shrub woody species in Ohio.

1) Selection of a Growth Medium

All good reclamation begins with the best available growth medium. Soil quality is particularly critical on land to be reforested. In addition to the available topsoil, when available in sufficient quantities, at least four feet of the best available rooting medium within the permit area should be placed on the surface to accommodate the needs of deeply rooted trees. Rooting media with low to moderate levels of soluble salts (less than 8mmho/cm), an equilibrium pH of 5.0 to 7.0, low pyritic sulfur content and a texture conducive to proper drainage are preferred. Research in Virginia recommends that highly alkaline shale materials be avoided in the growth medium for trees (Burger and Torbert, 1992). However, for those sites where the best available material vary from the above recommendation, an equilibrium pH as low as 4.5 and as high as 8.0 can be successful, so long as species tolerant of those conditions are selected and utilized. Kost et al (1994) found better survival and growth when natural soils were used for rooting medium in Ohio. For optimum productivity and carbon fixing, rooting medium from the top 3-4 feet of the surface and containing the natural topsoil and subsoil is recommended. Alternative resoiling materials may be approved under the provisions provided in PD Technical 94-1 when there is a lack of soil or for use to supplement existing soils.

2) **Soil Replacement Techniques**

Minimizing soil compaction during application of the rooting medium and the final grading operation is extremely important. Once material with appropriate texture is selected, care must be taken to minimize heavy equipment traffic on the soil materials during and after replacement of the rooting zone. Scraper placement is strongly discouraged. Research indicates that the best available known technology for preventing compaction is to replace the soils with end dump trucks that do not drive upon the soil, followed by a final grading with low ground pressure bulldozers (Burger and Torbert, 1992) (Torbert et al, 1994) (Dunker et al, 1998). The operator is still responsible for assuring that AOC and backfill stability are achieved. As an alternative, deep soil ripping to a depth of 4 feet can be employed to reduce compaction after restoration of the root zone.

3) **Tree Compatible Ground Cover**

Reforestation requires a carefully planned balance between ground cover and tree requirements for light, water and space. Ground cover is recommended to include grasses and legume species that are slow growing, are tolerant of a pH of 4.5 to 8.0, and can be established in mine soils. Tree compatible ground covers are relatively sparse during the first year and become increasingly lush by the second and third years. This allows tree seedlings to emerge above the ground cover and enhances their survival. Kentucky-31 fescue, Sericea lespedeza, all vetches, clovers (except Ladino), alfalfa and other aggressive or invasive species should be avoided. For best results a herbaceous seed mixture for an area which is to be planted to trees and shrubs should have a balance or permanent grasses, legumes, temporary plants and small grains/ground cover species. A balanced seed mixture will allow for short-term and long-term erosion control and not inhibit tree growth or survival. Some suitable examples of good woodland ground cover species follow. For specific seed mixture recommendations, refer to PD 95-1 or consult the department or a forest professional.

Upland Species	Wet Species	Acid Tolerant Species
Orchard Grass	Virginia Wildrye	Redtop
Perennial Ryegrass	Redtop	Timothy
Red Creeping Fescue	Korean Lespedeza	Perennial Ryegrass
Redtop	Deertongue	Weeping Lovegrass(annual)
Ladino Clover	Alsike Clover	Birdsfoot Trefoil
Korean Lespedeza	Reed Canarygrass	Partridge Pea
Kobe Lespedeza		Deertongue
Appalow Lespedeza		Kobe Lespedeza
Partridge Pea		Appalow Lespedeza
Birdsfoot Trefoil		

Herbicide Application: Even when using compatible ground covers, herbicide application is necessary to reduce the ground cover in the planting strip or spot. This will eliminate competition while the tree is being established without compromising erosion control protection of the reclaimed area.

4) **Fertilizer Requirements**

Fertilizer requirements should be based on a current soil test. Make sure to inform the soil test laboratory that it will be making a recommendation for an area to be planted to trees. The fertilizer recommendation should have an adequate rate of phosphorus and potassium and a low rate of nitrogen. The lower rate of nitrogen reduces the height of the ground cover but not its density. By the third year, the inoculated legumes should be providing an adequate supply of nitrogen.

5) **Tree Species Selection**

Tree species, shrub species and nurse tree/shrub selections should be based on the approved post-mining land use and site-specific characteristics. If available, mycorrhizal inoculated seedlings can be helpful to enhance success on previously mined or acid soils. Considerable thought and planning should go into the species selection process. Whenever possible, the operator should consider the use of native species. The species established must be capable of satisfying the requirements of a particular post-mining land use whether it is forest land or wildlife habitat.

6) **Tree Planting**

Trees can be properly established by utilizing hydroseeding, mechanical planters, hand planting or a combination of these methods, depending upon the species established. Ideally, an experienced, reputable tree planter should be used. For additional guidance, refer to PD 95-1 issued on April 5, 1993, which includes methods for storage and handling of seedlings that will enhance chances for success. Some examples of recommended woodland planting species follow:

Upland Forest Species	Acid Tolerant Species	Wetland Species
Sweetgum White Ash Green Ash Red Oak White Oak Sawtooth Oak Bur Oak White Oak Chestnut Oak Black Cherry Shagbark Hickory Black Locust ◆ Sugar Maple Red Maple Silver Maple Tulip Poplar (Yellow Poplar)	Sweetgum White Ash Green Ash Sycamore Black Locust ◆ Bristly Locust Virginia Pine Pt* Pitch Pine Pt* Red Oak Pt* Chinkapin Oak Pt* Bur Oak Pt* Scarlet Oak Pt*	Bald Cypress Pin Oak Shumard Oak Swamp White Oak Buttonbush Green Ash Sycamore River Birch Boxelder Red Maple

- ◆ Black locust can serve as an early successional “nurse tree” species, but should be limited to 25% of the mixture to prevent over-dominance that will discourage growth of climax tree species and hinder species diversity.

* Pt = inoculated with the Pisolithus tinctorius mycorrhizal species

If you have any questions or comments about this memorandum, or need further information concerning the ongoing reforestation initiative, please contact this office.

Trees and Shrubs Available from the Ohio Division of Forestry

See the attached list. Species may vary a small amount from one year to the next.

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