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Office of Surface Mining Reclamation and Enforcement — U.S. Department of the Interior

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Development of a Modified Forest Reclamation Approach to Establish Coniferous Forest Plantations in the Pacific Northwest

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Project Description and Objectives

The overall objective of this project was to test a modified version of the forest reclamation approach (FRA) that has been successfully used in the Appalachian Region of the United States to accomplish reforestation following surface coal-mining operations. The hope was to reestablish Douglas-fir plantations, on reclaimed land in the Pacific Northwest, that would approach the productivity of the original forested lands.

Applicability to Mining and Reclamation

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) describes the postmining reclamation goals for mined land as twofold: "to protect society and the environment from the adverse effects of surface coal mining operations" and "to assure that surface coal mining operations are so conducted as to protect the environment." In the Appalachian Region, much of the land that went on to be mined was designated prior to mining as wildlife habitat or grazing or unmanaged forest land. However, following both mining and reclamation, little of this land was actively managed as such, instead persisting as habitat for aggressive and often invasive grasses or becoming low-value forest land. Whereas the postmining goals of assuring land stability and limiting erosion were often accomplished, compaction by excessive machinery operation and competition from grasses limited forest growth and restricted the economic value of the land, failing to return it to its original level of capability, clearly SMCRA's ultimate goal.

Photograph showing an AFR treatment plot at the Centralia mine before planting, in April 2010.

Photograph showing the same AFR treatment plot at the Centralia mine 1 year after planting, in July 2011.

As a consequence, in 2005, the Office of Surface Mining Reclamation and Enforcement advocated and began to enforce a new approach to postmining reclamation in the Appalachian States called the FRA of the Appalachian Regional Reforestation Initiative (ARRI).

Methodology

The original FRA has five basic steps: (1) create a suitable rooting medium for good tree growth that is no less than 4 feet deep and that comprises topsoil, weathered sandstone, or whatever else might be the best available growth material (***correct?***); (2) loosely grade the topsoil or topsoil substitute thus established to create a non-compacted growth medium; (3) plant this medium with ground covers that are compatible with growing

trees; (4) then plant two types of trees—nurse trees and commercial crop trees—; and (5), in the process, employ proper tree-planting techniques.

This project investigated modifications to the FRA that were intended to adapt it to western Washington's climate and coniferous ecosystem. In particular, the project examined three treatments: the modified FRA, the modified FRA with an amendment of bottom ash (FRA+Ash), and the standard reclamation approach used at the Centralia TransAlta mine near Centralia, Washington. In addition to examining current reclamation treatments, the project looked at past reclamation efforts using a chrono-sequential approach.

Highlights

Because the climate of western Washington continues to support highly-productive forests, and productive forestland surrounds the Centralia minesite, the Centralia mine area is a perfect test ground for the application of region-specific FRA techniques for restoring soil productivity. Clearly, the Appalachian Region differs from the Pacific Northwest in general, and the Centralia minesite in particular, in many ways that impact tree growth. The climate of Centralia, Washington, for instance, is maritime, with cool, rainy winters and warm, dry summers. By contrast, the regional climate of the FRA sites in the Appalachian Region vary, but are characterized by cool to cold winters and warm or hot summers with a more even distribution of precipitation. These climatic differences have major impacts on when and how forests can be established, as well as on how they grow.

In addition, succession in Appalachian *v*. Pacific Northwest forests also differs. Douglas-fir seedlings often establish strongly after disturbance and can dominate both early succession and a site's biomass for hundreds of years. The long life and vigor of Douglas-fir trees assures that most forests of the Pacific Northwest do not reach the climax forest stages that Appalachian forests often do before disturbance renews the cycle.

Results/Findings

The primary goal of this project was to test different reclamation practices to see if survival of Douglas-fir seedlings could be improved by using the FRA or FRA+Ash methods adapted for Pacific Northwest forests plantations.

Overall, survival after 2 years was best with the FRA+Ash treatment; however, both the FRA and FRA+Ash treatments afforded better survival than did the control reclamation plots. Elk damage, water-logged soils, competition from understory vegetation, and extremely dry soils late in the summer all appeared to reduce seedling survival. Containerized seedlings did not have a greater survival rate than did bare-root seedlings, despite each having a plug of fertile soil available for nutrient uptake, but their rates were consistently improved by the

Photograph showing a seedling planted on an FRA and Ash treatment plot at the Centralia mine.

FRA+Ash treatment. Bare-root seedlings grew more than did containerized seedlings in year 2.

By and large, all seedlings showed nutrient deficiencies, which may be owing to poor nutrient availability or to anaerobic soils. Soil properties did not vary consistently on the basis of treatment nor did they appear to improve with any particular treatment. On the other hand, properties did vary greatly within treatments which may have prevented observing any statistical differences among treatments. No treatment appeared to result in excessive erosion, but some erosion occurred with all treatments.

To access the final report: The final report "Development of a Modified Forest Reclamation Approach to Establish Coniferous Forest Plantations in the Pacific Northwest" is available to view at http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/AScompleted.shtm.

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