

REFORESTATION OF MINED LAND FOR PRODUCTIVE LAND USES AND ENVIRONMENTAL QUALITY

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PROGRESS REPORT (2005-2006)

The Forestry Reclamation Approach

In the Appalachian region, mined land reclaimed to grass quickly reverts to undesirable invasive species (autumn olive, serecia lespedeza) if not adequately managed as pasture land. Reforestation of mined land by coal operators, at the request of landowners, is becoming more common, because owners of reclaimed mined land see more economic opportunity associated with forest land reclamation. Our research shows that reforestation is just as dependable and no more expensive to establish than grassland. Virtually all native hardwoods can be established, and they grow rapidly when a Forestry Reclamation Approach (FRA) is used.

The Forestry Reclamation Approach requires five straightforward steps: (1) select the best soil or mine spoil for trees and apply about 4 feet for the final surface material; (2) grade it lightly or not at all to leave it loose and uncompacted; (3) employ a professional tree planter who guarantees his work; (4) have him plant a mix of commercially valuable native hardwoods (oaks, black cherry, sugar maple, ash, etc., at a rate of 600 trees/acre) along with a lesser amount of wildlife or nurse trees (dogwood, redbud, hawthorn, crabapple, etc. at a rate of 100 trees/acre); (5) after the trees are planted in winter, hydroseed a tree-compatible ground cover the following spring. More specific recommendations for the FRA can be found in the Virginia Cooperative Extension Bulletin 460-123 at <http://www.ext.vt.edu/pubs/mines/460-123/460-123.html>.

This Forestry Reclamation Approach, if done properly, should provide a mix of valuable native hardwoods that could be harvested in 60 to 80 years. The planted wildlife trees help create habitat for animals and birds, and the tree-compatible ground cover allows native herbs and woody species to volunteer and become established. In effect, natural succession of native plants and animals is accelerated while ensuring the presence of valuable tree species for landowners who care to maximize the economic return from their land. In addition to restoring a forest that will provide valuable wood products in the shortest time possible, the FRA will produce a forest that provides many other services such as wildlife habitat, watershed control, water quality, biodiversity, carbon sequestration, and aesthetic landscapes.

The foundation for the Forestry Reclamation Approach is our ongoing Powell River Project reforestation research program consisting of many forestry research sites in Virginia and adjacent states. The results from these research sites allow us to develop reforestation guidelines for reclaiming mined land. Because forestry is a long-term enterprise, we maintain and monitor our field sites over time. The older these research sites become, the more valuable they are, because they show how reclamation treatments will ultimately affect the success and value of the restored forest. As we collect data from these older sites, we adjust our guidelines and recommendations in ways that will improve reclamation for better long-term land uses.

Research Reports

An example of a long-term forestry project that we maintain on the Powell River Project demonstration area is a 3-acre sugar maple plantation. This trial is used to test the suitability of this valuable species for mined land, and, in particular, it will test if it can be planted and cultured in plantations for maple syrup production. Included in this report is a research paper detailing the performance of this plantation after 15 years. It shows that sugar maple grows quite well and it responds to the addition of fertilizer. In a few years the trees can be tapped and tested further.

Critical to the success of the FRA is Step 1, the selection of the best mine soil material for growing trees. We recently completed a study that tested the suitability of different mine soils for trees. The results show that sandy loam, uncompacted, fertile mine soils on northeast slopes are the most productive. A detailed research paper on the results of this study is included as part of this progress report.

Ongoing Research Activities

Our ongoing Powell River Project reforestation research program is dedicated to: (1) helping coal operators meet their reclamation requirements; (2) helping landowners maximize the value of their reclaimed mined land; and (3) helping mining communities meet their socio-economic needs. The following studies are being conducted to meet these goals:

1. Use of herbicides for weed control to improve native hardwood establishment.

- This PRP project is in its fourth growing season. The results after three years were published recently in the proceedings of the American Society for Mining and Reclamation.

Burger, J. A., D. O. Mitchem, C. E. Zipper, and R. Williams. 2005. Herbaceous ground cover control effects on native hardwoods planted on mined land. *In*: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd. Lexington, KY.

2. Hardwood establishment field trials:

- This is a large study with 10 three-acre sites located in three states. We completed tree, ground cover, and site measurements for eight continuous years. A preliminary analysis of this project was presented and published at the annual meeting of the American Society of Mining and Reclamation in Breckenridge, CO, in June, 2005:

Auch, W. T., J. A. Burger, and D. O. Mitchem. 2005. Hardwood stocking after five years on reclaimed mined land in the Central Appalachians. *In*: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd. Lexington, KY.

3. Response of reclaimed forests to silvicultural treatments:

- Our long-term white pine silvicultural treatments study located on the PRP was re-measured, analyzed, and reported in the proceedings of a meeting on mined land reforestation sponsored by the American Society for Mining and Reclamation.

Casselman, T.C. N., T. R. Fox, J. A. Burger, and A. T. Jones. First-year seedling response to three levels of silvicultural input on post-SMCRA reclaimed lands. In: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd. Lexington, KY.

4. *Restoring forests on mined land for wood products and carbon sequestration:*

- This study is largely funded by the Department of Energy. It is a multiple-investigator project that entails replicate study areas in Ohio, West Virginia, and Virginia. The productivity of several forest types across several different mine soils is being tested. Sites are being ameliorated with tillage, fertilization, and weed control (Casselman et al. 2005). The costs and benefits of different forest management scenarios are being compared. The economic and policy implications of forest management on mined land for products and carbon sequestration will be analyzed for the Appalachian region. Methods for classifying forest site quality have been developed (Jones et al. 2005).

Casselman, T.C. N., T. R. Fox, J. A. Burger, and A. T. Jones. First-year seedling response to three levels of silvicultural input on post-SMCRA reclaimed lands. In: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd. Lexington, KY.

Jones, A. T., J. M. Galbraith, and J. A. Burger. 2005. Development of a forest site quality classification model for mine soils in the Appalachian Coalfield Region. In: R. I. Barnhisel (ed.). Proc., 22nd Mtg., Amer. Soc. for Mining and Reclamation. June 18-24, 2005, Breckenridge, CO. ASMR, 3234 Montavesta Rd. Lexington, KY.

5. *Evaluation of topsoil substitutes for hardwood reforestation on mined land:*

- This greenhouse study was done with the help of Pritchard Mining Co. of West Virginia. The growth of three hardwood species planted in three different topsoil substitutes was compared with tree growth on native topsoil. The effect of inoculation on trees growing in each spoil type with 1 inch of topsoil was compared to tree growth on spoils receiving no inoculation. The results of this work were reported by Showalter (2005).

Showalter, J. M. 2005. Evaluation of topsoil substitutes for hardwood reforestation of mined land. Master of Science Thesis. Virginia Polytechnic Institute and State University.

6. *White oak response to different mine soil types:*

- We continue to monitor an 80-acre native hardwood planting on Rapoca Coal Company land. This cooperative effort between Rapoca, Virginia Tech, and the Virginia DMME serves as a model for the application of Powell River Project reforestation guidelines. We recently completed a study of white oak response to mine soil types on this field site. A detailed report is attached.

Showalter, J. M., J. A. Burger, C. E. Zipper, J. M. Galbraith, and P. F. Donovan. 2006. Influence of mine soil properties on white oak seedling growth: A proposed mine soil classification model. *Northern Journal of Applied Forestry*. In press.

7. Carbon sequestration by forests and soils on mined land:

- This project is funded largely by the Virginia Department of Mines, Minerals and Energy and the U.S. Department of Energy. The reforestation of mined land has the potential to sequester large amounts of atmospheric carbon, which is associated with the greenhouse effect and climate change. Much of the elevated level of CO₂ in the atmosphere is attributed to the burning of coal and other fossil fuels. This project will determine the benefits of reforesting mined land for sequestering carbon from the atmosphere. A presentation of this research was made at the World Soils Congress in July, 2006.

Amichev, B., and J. A. Burger. 2006. Forest soil carbon sequestration, measurement, and verification on reclaimed mined land in the Appalachian Coalfield. World Congress of Soil Science, July 9-15, 2006, Philadelphia, PA. (International group of Soil Scientists)

What Are the Benefits of This Reforestation Research?

The people of the Appalachian region will always depend on its forest resources for products and services. Worldwide demand for Appalachian timber will increase as the U.S. Forest Service reduces its harvest on national forests. Demand for forest products will create significant opportunities for the owners of Appalachian forest land. Timber harvesting and value-added products will help diversify the economy. Much of this forestry activity will occur on reclaimed mined land. Economic analyses have shown that the economic return on mined land reclaimed according to guidelines based on PRP research can be several times higher than land currently reclaimed to unmanaged land uses. While improving the value of mined land for the landowner, coal operators benefit through more timely and successful recovery of performance bonds, and local communities benefit from land reclamation that improves water quality, reduces flooding potential, is more aesthetically pleasing, and more valuable for a diversifying economy.