The Forestry Reclamation Approach: Guide to Successful Reforestation of Mined Lands

Mary Beth Adams, Editor

Cover Photos of Success Stories

These mined sites in West Virginia have been reclaimed to healthy forest with the Forestry Reclamation Approach. Top left: A backfilled outslope in Kanawha County, about 15 years after reclamation by planting minimal ground cover. Top right: A valley fill in Logan County, 12 years after reclamation. Bottom left: Mined site in Monongalia County, 10 years after reclamation by planting tree seedlings into heavy ground cover. Bottom right: Mined site in Nicholas County, about 10 years after reclamation by planting tree seedlings on good mine soil material. Note how much growth has occurred between the top whorl of branches and the second row of branches in the sapling at center. This is the type of growth that can be expected with eastern white pine on a suitable soil medium. Photos by J. Skousen, West Virginia University, used with permission.

U.S. Department of Agriculture
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Office of Surface Mining Reclamation and Enforcement

ABSTRACT

Appalachian forests are among the most productive and diverse in the world. The land underlying them is also rich in coal, and surface mines operated on more than 2.4 million acres in the region from 1977, when the federal Surface Mining Control and Reclamation Act was passed, through 2015. Many efforts to reclaim mined lands most often resulted in the establishment of grasses, shrubs, and nonnative plants. Research showed that forests could be returned to these mined lands, also restoring the potential for the land to provide forest ecosystem services and goods. Scientists and practitioners developed a set of science-based best management practices for mine reforestation called the Forestry Reclamation Approach (FRA). To help practitioners implement the 5 steps of the FRA and achieve other restoration goals (such as wildlife enhancement), 13 Forest Reclamation Advisories have been written since 2005 and others are underway. The 12 Advisories that are most directly relevant to the Appalachian region are being published here in a single volume for the first time.

These Advisories were originally posted on the Web site of the Appalachian Regional Reforestation Initiative (ARRI), an organization created in 2004 by the U.S. Department of the Interior's Office of Surface Mining Reclamation and Enforcement along with State mining regulatory authorities in the Appalachian region. Members of ARRI come from the coal mining industry, government agencies, and research institutions. The goal of this initiative is to promote forest reclamation and restoration on mine lands through planting of high-value hardwood trees, increasing those trees' survival rates and growth, and speeding the establishment of forest habitat through natural succession. To accomplish these goals, ARRI promotes and encourages use of the FRA by reclamation specialists. The Advisories are intended to serve as easy-to-understand guides to implementing the FRA; they provide specific recommendations as well as illustrations and photos to demonstrate tasks. The reformatted Advisories in this volume contain updated information and the latest additional resources to guide reclamation practitioners and other stakeholders in the reestablishment of healthy, productive forests in the Appalachian region.

This publication/database reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

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PREFACE

Christopher Barton, Carl Zipper, and James Burger

In 2004, the U.S. Department of the Interior's Office of Surface Mining Reclamation and Enforcement (OSMRE) along with State mining regulatory authorities from coal-producing areas in the Appalachian region created the Appalachian Regional Reforestation Initiative (ARRI) to promote forest reclamation and restoration on active and abandoned mine lands in the eastern United States. Since the passage of the federal Surface Mining Control and Reclamation Act (SMCRA) in 1977 (Public Law 95-87, 30 U.S.C. 1201 and following), through 2015, more than 2.4 million acres of land were mined for coal in the Appalachian region. Efforts to reforest these areas had historically resulted in high seedling mortality, slow growth, and poor production. In a region of the United States that is known for its beautiful mountainous forests, coal mining was dramatically changing the land cover. Where forest once prevailed, grass, shrubs, and nonnative plants were introduced—and began to dominate the landscape—after the mining was complete. The loss of the forest resource due to reclamation with grass and shrub species posed many environmental, ecological, and economic challenges to the region. Not only were soil, water, and air quality affected, but wildlife habitat and food webs were altered. Moreover, this large-scale and systematic land-use conversion compromised future economic opportunities involving timber and nontimber forest products.

Although grassland reclamation became the norm in the Appalachian region after the passage of SMCRA, research showed that forests could be returned to these postmining lands if proper reclamation practices specific for forest reclamation were followed. Several studies had documented that highly compacted soils with chemical characteristics unfavorable to forest trees, and intense competition from seeded herbaceous plants, were impeding the establishment of productive forest trees on surface mines in the Appalachian region. Other obstacles to reforestation of mined lands included poor selection of rooting media, planting of tree species that were not suited to site conditions, improper tree planting techniques, and competition from invasive plants that proliferate and thrive on mined areas.

Drawing on the recommendations generated by decades of surface mine reclamation research, reclamation scientists developed a set of best management practices for mine reforestation called the Forestry Reclamation Approach (FRA). The FRA is based on the research, knowledge, and experience of forest soil scientists, other scientists, and reclamation practitioners.

With the development of the FRA, OSMRE made a commitment to address reforestation shortcomings by regulatory authorities and the mining industry alike through the creation of ARRI. Simply, the goals of this initiative were to promote planting of high-value hardwood trees on surface mines, increase the survival rates and growth rates of those trees, and expedite the establishment of forest habitat through natural succession (the natural changes in plant community composition with time). These goals were to be accomplished by promoting and encouraging use of the FRA by reclamation practitioners, including the coal mining industry.

The organization of ARRI consists of two teams, the Core Team and the Science Team. The Core Team is made up of State mining agency and OSMRE personnel. It facilitates and coordinates the cooperative efforts of many groups: the coal industry; landowners; university researchers; watershed, environmental, and conservation groups; and State and federal government agencies that have an interest in creating productive forest land on reclaimed mined lands. The Core Team also addresses regulatory policies when such policies are found to be hindering effective application of the FRA. The Science Team consists of university, federal agency, and other scientists who are familiar with Appalachian mining and reclamation. The Science Team ensures that the methods ARRI promotes are based on proven science, conducts continued scientific research into forestry reclamation, and communicates effective and science-based reforestation practices to reclamation practitioners, including those who work with industry and agencies.

To this end, the ARRI Science Team prepared a series of Forest Reclamation Advisories that are intended to serve as guidance documents for FRA implementation. The content of the Advisories was based on proven scientific research and field application, but the Advisories were written with the intention of easy understanding by field practitioners. The Advisories provide specific recommendations as well as illustrations and photos to demonstrate how these tasks are implemented. A small group of Science Team members initiates preparation of each Advisory, sometimes at the request of the Core Team, but the full Science Team is involved with developing the Advisory. Each Advisory is reviewed by the full Science Team, and revisions continue until the Science Team members reach consensus that the Advisory is complete. At that point, the Core Team also reviews the Advisory, but with a focus on regulatory issues. If Core Team members think that a recommended practice is not consistent with State or regulatory policy, that issue is addressed with another revision. Once the full Science Team and Core Team agree that the Advisory is ready for publication, the Advisory is posted on the ARRI Web site, and shared with industry and agency practitioners to encourage more effective reforestation of mine sites.

To date, 13 Advisories have been written and are available at no cost on the ARRI Web site (http://arri.osmre.gov/) hosted by OSMRE. The first two Advisories provide specific information on ARRI and describe the FRA. The following seven Advisories (numbers 3 through 9) describe how to implement the five steps of the FRA. The next three Advisories (numbers 10 through 12) document how the FRA can be used for other restoration goals (wildlife enhancement; restoring mined lands that were reclaimed under SMCRA but not reforested, or "legacy mines"; return of the American chestnut). The 13th Advisory deals with mine land reclamation in the Midwest. Other Advisories are under development including planting mixes for forest reclamation outside the Appalachian region and planning for pollinators as a postmining land use.

Many in the coal industry within the Appalachian region have embraced the focused efforts by ARRI and its partners to promote the FRA, and significant changes in reclamation practices have resulted. From ARRI's inception in 2004 through 2015, about 95 million trees were planted on more than 140,000 acres of surface coal mines. ARRI continues to educate and train active mining industry and regulatory personnel about the FRA to promote effective reforestation of new surface mine disturbances. ARRI has also been instrumental in the reforestation of "legacy mines" and abandoned mined lands in the United States. Implementation of the reforestation guidelines for legacy mined land developed by ARRI scientists has resulted in the planting of these lands throughout the Appalachians.

The Forest Reclamation Advisories were instrumental in the success of ARRI and widespread application of the FRA. Both the ARRI Science and Core Teams expressed a desire to compile the Advisories in a single volume that could be distributed to interested parties. Not only would the development of this product be useful for that purpose, but putting it together would provide an opportunity to revisit each Advisory and update it with the most current information.

This volume contains 12 chapters, one for each of the Forest Reclamation Advisories that are directly relevant to the Appalachian region. These Advisories have been reformatted for this publication and are arranged by theme. Our hope is that this volume will continue to aid restoration efforts for one of the region's most valuable assets—the Appalachian forest—and will present ARRI reforestation methods to a wider audience.

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