Measuring FRA Success in Appalachia

2008 ARRI Conference
Mined Land Reforestation
Logan, WV
August 5-7, 2008

Patrick Angel and Jim Burger

Office of Surface Mining

Virginia Tech Forestry

Measuring success

- The ARRI organization
- ARRI outreach
- Overcoming barriers
- The number of permits/acres/trees planted
- Increase survival and growth
- Future reforestation success

How has the ARRI organization grown?

How has the ARRI organization grown?

- ARRI's Core Team – created December 2003
- Core co-team leaders:
  - Scott Eggerud, West Virginia
  - Paul Rothman, Kentucky
  - Mike Bower, OSM
- 24 representatives from 7 Appalachian coal states and OSM

How has the ARRI organization grown?

- **Kentucky**
  - Linda Keene, Paul Rothman, Gail Smith, Richard Wahrer
- **Maryland**
  - Mark Carney, Pete Hartman
- **Ohio**
  - Jeff Emmons, Mike Hiscar
- **OSM Appalachian Region**
  - Patrick Angel, Mike Bower, Jim Holliday, Molly Sager, Jim Taitt
- **Pennsylvania**
  - Doug Saylor, Dave Hamilton
- **Tennessee**
  - Vic Davis, Becky Hatmaker
- **Virginia**
  - Tim Brehm, Richard Davis, Ken Commer
- **West Virginia**
  - Brad Edwards, Scott Eggerud

How has the ARRI organization grown?

- ARRI's Science Team – created in 2005
- Science co-team leaders:
  - Dr. James Burger, Virginia Tech
  - Dr. Chris Barton, University of Kentucky
- 27 reforestation researchers and experts representing 13 universities and research institutions

How has the ARRI organization grown?

- Ohio State University
- Ohio University
- Pennsylvania State University
- Purdue University
- Southern Illinois University
- The American Chestnut Foundation
- University of Kentucky
- University of Maryland
- University of Tennessee
- Virginia Polytechnic Institute and State University
- West Virginia State University
- West Virginia University
- US Forest Service

How has the ARRI organization grown through partnerships?

The American Chestnut Foundation

Cerulean Warbler Technical Group

How has the ARRI organization grown?

ARRI's Statement of Mutual Intent

- Initial Signing Ceremony 12-15-04 at Stonewall Jackson Lake State Park, WV
- The 267 signatories collected to date represent 125 different organizations
  - 40 Government Agencies
  - 24 Environmental Groups
  - 39 Industry Organizations
  - 15 Academic Institutions
  - 7 Citizen Groups
  - Numerous landowners and individuals

Please sign the ARRI SMI

STATEMENT OF MUTUAL INTENT

for the

APPALACHIAN REGIONAL REFORESTATION INITIATIVE

The States of Appalachia including the Regulatory Authorities in Kentucky, Maryland, Ohio, Pennsylvania, Virginia, and West Virginia; the Office of Surface Mining, including the Tennessee Federal Program; and all other parties of this Statement of Mutual Intent desire to work together to promote and encourage planting more trees on active and abandoned coal mined lands. We will increase efforts, cooperate and partner among ourselves to plant economically viable trees, while using current Forestry Reclamation Approach (FRA) technology. This technology will increase survival rates and growth rates of crop trees, increase overall productivity, and promote natural invasion and succession of plant and animal communities.

FRA technology is a five-step reclamation process that has been proven by forestry research to increase tree survival and tree productivity. The five steps in the FRA are:

1. Create a suitable rooting medium for good tree growth that is no less than four feet deep and comprised of topsoil, weathered sandstone and/or the best available material.
2. Loosely grade the topsoil or topsoil substitutes established in step one to create a non-compacted growth medium.
3. Use ground covers that are compatible with growing trees.
4. Plant two types of trees; early succession species for wildlife and soil stability, and commercially valuable crop trees.
5. Use proper tree planting techniques.

Reforestation of coal mined land using the FRA will provide multiple environmental and economic benefits:

Environmental Benefits of Reforestation

- Increased diversity of plant succession
- Natural succession of native forest plants
- Reduced potential for establishment of invasive species

STATEMENT OF MUTUAL INTENT

APPALACHIAN REGIONAL REFORESTATION INITIATIVE

Signature

Date

Mr. ☐ *Ms.* ☐ *Mrs.* ☐ *Dr.* ☐ *Jr.* ☐ *Sr.* ☐

Print Name (First, Last)

Title

Company/Organization

Address, Line 1

Address, Line 2

City, State, Zip

Phone

Email (Join the ARRI Mailing List)

Spreading the FRA through...

- Arbor Day Events
- SMI Signing Ceremonies
- TV and Radio
- Newspaper Articles
- DVDs, Videos
- ARRI Website

  http://arri.osmre.gov

- Reclamation Advisories
- ARRI Newsletters
- Reforestation Award Ceremonies
- FRA Trainings
- Partnerships

Spreading the FRA through…

- Arbor Day Events
- SMI Signing Ceremonies

Spreading the FRA through…

- TV and Radio
- Newspaper Articles

The Courier News

WEDNESDAY

FRANCES HAMILTON OATES

Ignoring rain and mud, Heather Hedden of Clinton, right, and Vic Davis of the Appalachian Regional Reforestation Initiative plant a chestnut seed on Zeb Mountain.

Volunters plant trees they know will die in hopes of restoring chestnuts

BY FRANCES HAMILTON OATES
noctiasews@bellsouth.net

Under a spreading chestnut tree
the village smithy stands …
-Henry Wadsworth Longfellow (1807-1882)

When Longfellow drew his word-picture of "The Village Blacksmith," the chestnut tree image would have been visualized instantly by any Easterner from Maine to Georgia and west to the Ohio Valley.

Today, we just can't picture it. American chestnut trees virtually vanished in the early 1900s, all but a few sad sprouts wiped out by an Asian fungus that arrived in North America about the time Longfellow died.

Gone though the chestnuts are, however, they're so far from forgotten that when word got out about a chestnut-seed planting March 14 on Zeb Mountain, so many people volunteered to help that many were turned away.

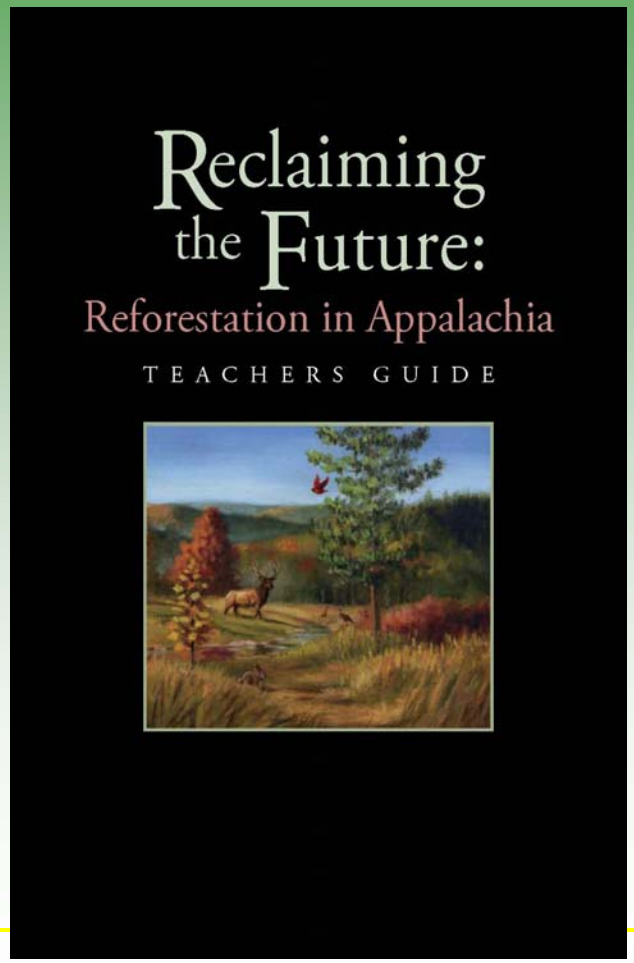
Luckily I got in my bid early. With about 60 others (including journalists from several other papers

• CHESTNUT to 7

Spreading the FRA through…

- ARRI Website

- DVDs, Videos



Spreading the FRA through…

- Reclamation Advisories
- ARRI Newsletters

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI)

FOREST RECLAMATION ADVISORY

Forest Reclamation Advisory No. 4 — July 2007

LOOSENING COMPACTED SOILS ON MINED SITES

R. Sweigard, J. Burger, D. Graves, C. Zipper, C. Barton, J. Skousen, P. Angel

Because successful surface-coal mining businesses must move earth materials efficiently, mining operations today use large and heavy equipment. Track dozers and haul trucks used for mining can weigh in excess of 100 tons each, while wheel loaders and loaded haul trucks often exceed 200 tons. It is becoming well known within the mining industry that successful reforestation of reclaimed sites requires loose and uncompacted surface materials, but some areas become compacted due to machinery operation, traffic, and storage that is necessary for the mining business to be successful.

Figure 1. Even when empty, haul trucks can weigh 50 - 100 tons or more; this weight exerts force where tires meet the land surface, causing severe compaction of mine soils. Loaders, dozers, and other heavy mining equipment also cause compaction that hinders tree growth when operated on surface soils.

Trees require deep, loose mine soils to survive and grow into healthy, productive forests. Such forests can support viable forest-products' businesses, protect the watershed, store carbon, and serve as wildlife habitat. This advisory describes procedures that can be used to loosen soils that have become compacted by mining equipment in order to restore land capability for forests.

Avoiding Soil Compaction

The best way to deal with compaction on mine sites is to avoid compacting the soil in the first place. Uncompacted conditions suitable for trees can be created using techniques that cost less than traditional smooth-surface "tracked in" reclamation. Loose dumping of surface materials, combined with the minimum grading necessary to shape the land, creates loose soils and rough surfaces, increases rainwater infiltration, and increases the survival and growth of trees. Throughout Appalachia, coal operators are finding these techniques to be a cost-effective successful method for establishing forests and achieving timely bond release when used with the Forestry Reclamation Approach (Burger and others 2005).

Coal operators can minimize equipment use on the final surface but there will often be areas that become compacted, generally the flatter areas and sites used for equipment storage. Many Appalachian and midwestern mine sites reclaimed under SMCRA have become compacted due to excessive equipment operation (Angel and others 2005). In order for such lands to support a forested postmining land use, soils must be loosened prior to reforestation.

What Can Be Done to Loosen Compacted Soil?

Ripping of the soil with a ripper blade or a deep plow attached to a dozer can alleviate most soil compaction effects on mine sites (Figure 2).

Figure 2. A dozer is ripping to loosen soils and produce soil conditions favorable to successful reforestation in a former roadway.

Subsurface ripping was first used for reclamation on prime farmlands disturbed by mining in the Midwest. In years following SMCRA's passage, rubber-tired equipment was often used to replace the subsoil and topsoil on prime farmland sites. Such practices compacted soils and created lands that could not produce the required crop yields.

APPALACHIAN REGIONAL REFORESTATION INITIATIVE

ARRI News

Hardwood Trees Reign in Virginia

By Richard Davis
Photo by Gavin Bledsoe

Torrential rains failed to dampen the enthusiasm for Virginia's 4th annual Arbor Day celebration on April 4, 2008. The Virginia Department of Mines, Minerals and Energy (DMME), the Office of Surface Mining Reclamation and Enforcement (OSM), and the Virginia Department of Forestry hosted the event for secondary school students from Dickenson County, Virginia. Other Arbor Day partners included The Nature Conservancy, The American Chestnut Foundation (TACF), and Take Pride in America.

DMME and its partners held the event at a previously mined site in Russell County, Virginia where The Nature Conservancy has accomplished a pilot carbon sequestration project. Although the surface mining was post Surface Mining Control and Reclamation Act of 1977 (SMCRA), the reclamation was typical of many pre-SMCRA sites with highly compacted soils, competitive ground cover, and numerous invasive shrubs. The Nature Conservancy had contracted to rework the site to make it compliant with the forestry reclamation approach, under the Appalachian Regional Reforestation Initiative. The work included shearing the existing woody vegetation, liming and fertilizing, ripping, and planting native hardwood species. *(Hardwood Trees continued on page 2)*

Virginia DMME personnel assist Dickenson County students plant native hardwoods for Arbor Day.

Pennsylvania Arbor Day Event Educates School Children

By Dave Hamilton
Photos by Tom Grote

The Office of Surface Mining Reclamation and Enforcement's Harrisburg, Pennsylvania Office, in collaboration with the Jennings Environmental Center, hosted an Arbor Day tree planting event near Slippery Rock, Pennsylvania, on April 25, 2008.

(Arbor Day continued on page 2)

Dave Hamilton, OSM, gives tree planting instructions to Pennsylvania school students.

Spreading the FRA through…

- Reforestation Award Ceremonies
- FRA Trainings

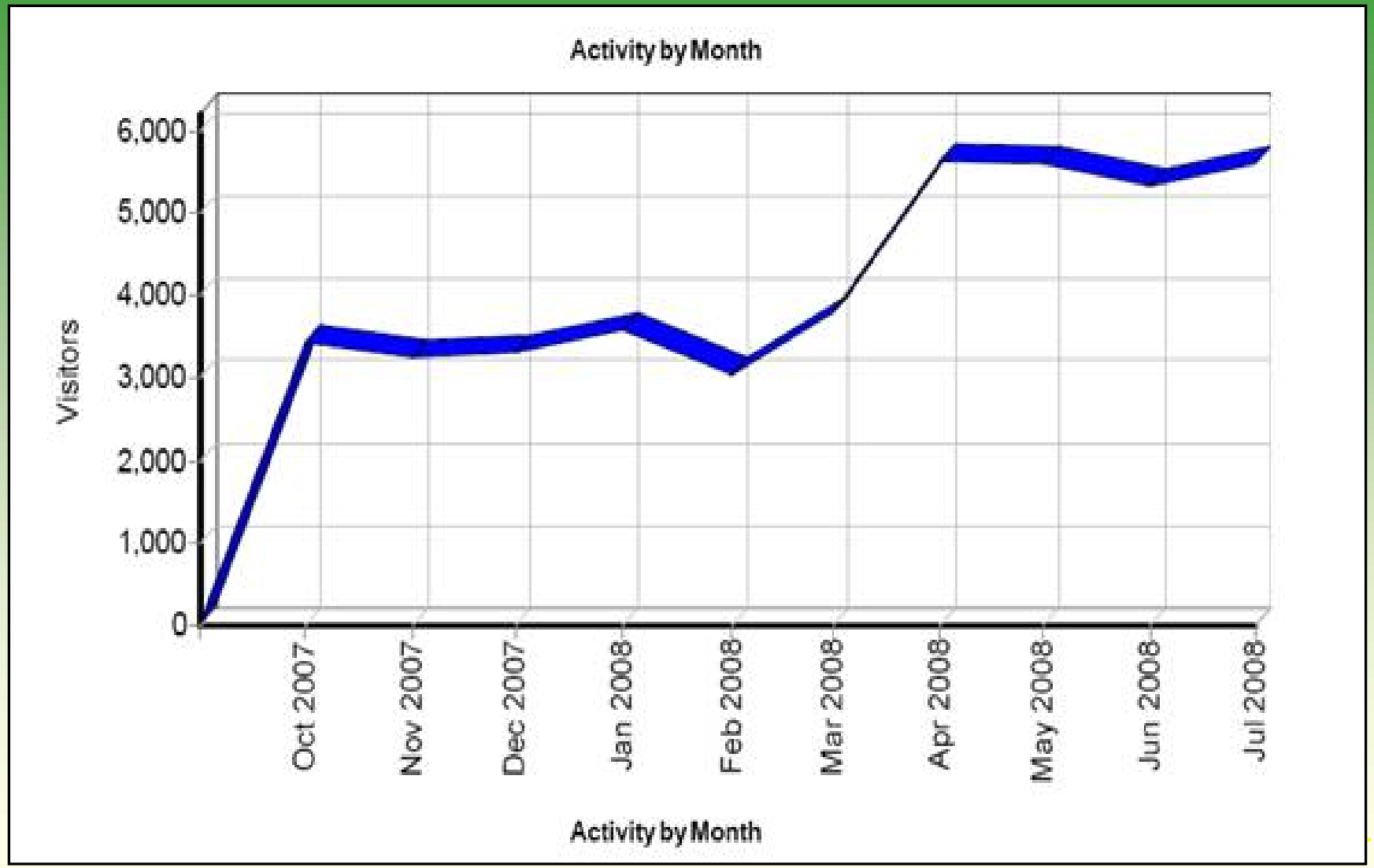
Spreading the FRA through…

- Partnerships

The American Chestnut Foundation

Cerulean Warbler Technical Group

How successful has ARRI outreach been?



How successful has ARRI outreach been?

- FRA TRAINING
  - State and OSM Inspectors
  - Consultants
  - Permit Reviewers
  - Industry
  - Small Landowners
  - Large Landowner Groups
  - Other Government Agencies
  - Conservation Groups
  - NTTP
  - Mined Land Reforestation Conferences

How successful has ARRI outreach been?

THE APPALACHIAN REGIONAL REFORESTATION INITIATIVE (ARRI)

FOREST RECLAMATION ADVISORY

Forest Reclamation Advisory No. 5 July 2007

MINE RECLAMATION PRACTICES TO ENHANCE FOREST DEVELOPMENT THROUGH NATURAL SUCCESSION

J. Groninger, J. Skousen, P. Angel, C. Barton, J. Burger, C. Zipper

Succession is a term used to describe natural changes in plant community composition over time. In the forested Appalachian region, disturbances from storms, fire, logging, or mining can disrupt or destroy established forests. Natural processes that lead to restoration of the forest vegetation after such a disturbance usually begin quickly and result in development of another forest. On former mine sites, the quality of that forest and the speed with which it develops depend upon the conditions created by the mining and reclamation process (see Photo 1).

Conventional surface mine reclamation as practiced from the late 1970's to the present commonly featured smooth grading of topsoil or topsoil substitute material followed by establishment of grasses and legumes that grow rapidly to form a thick groundcover. These compacted mine soils and competitive grasses hinder tree establishment and growth and delay the process of succession to forest cover.

In contrast, reclamation practices known as the Forestry Reclamation Approach (FRA) are intended to encourage succession in a manner that helps the mine operator satisfy regulatory requirements cost effectively and achieve prompt bond release (See Box 1).

This advisory describes the ways in which reclamation methods can encourage rapid succession and accelerate development of high quality postmining forests.

Photo 1. Succession and invasion of native species over 47 years formed a forest on this mine site in eastern Tennessee. This site was mined and reforested with various pine species and black locust in 1959 on un-compacted spoil with no planted ground cover. Succession has occurred over the years and the pine forest has been replaced with vegetation similar to the nearby native forest: yellow-poplar dominant in the overstory, red maple, sassafrass and northern red oak in the mid-story, and blueberries, ground pine, Virginia creeper and ferns in the understory (photo by Vic Davis)

1

4 more Advisories by the end of 2008:

No. 6 – Tree compatible ground covers

No. 7 – Selecting tree species

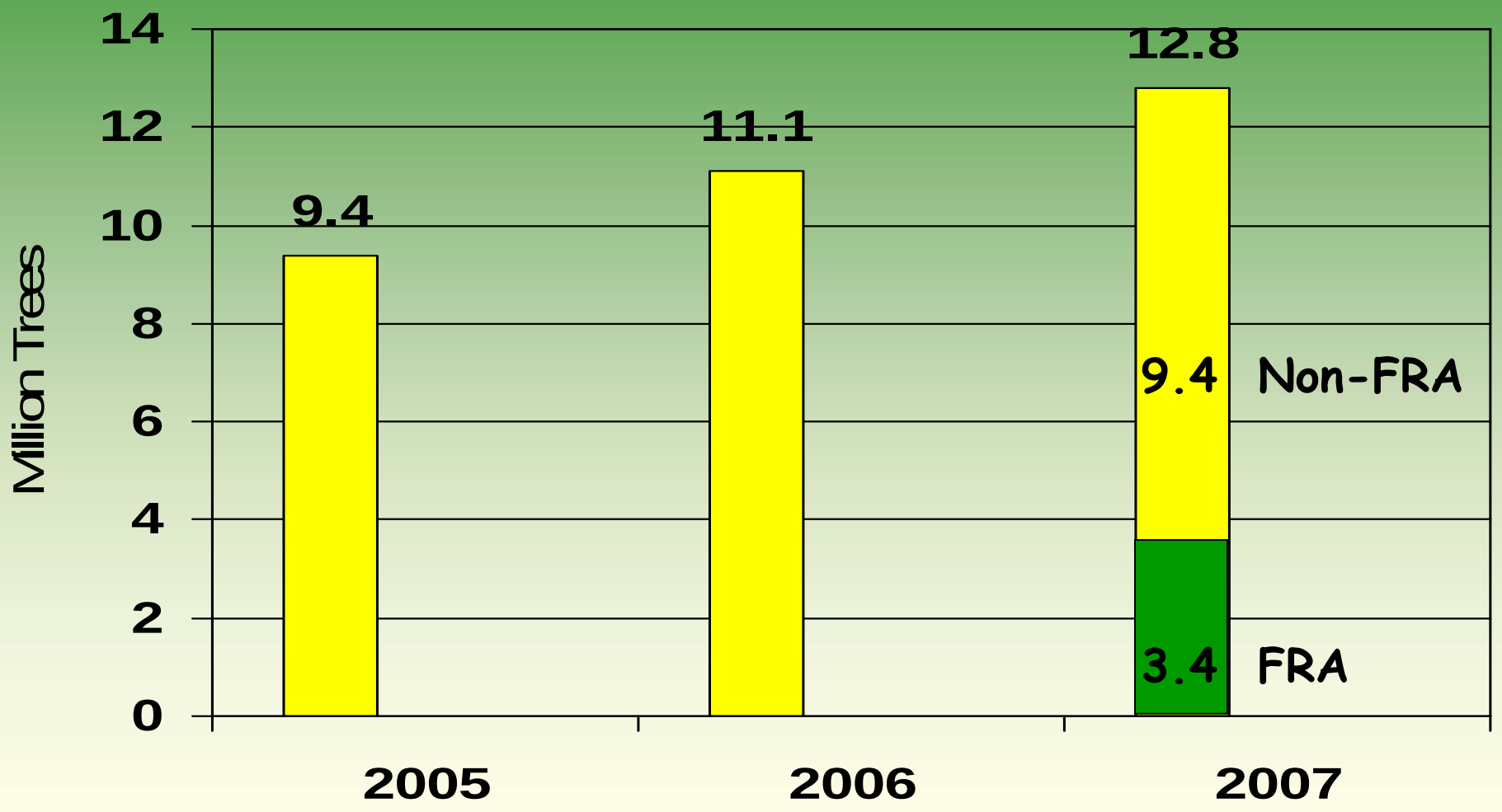
No. 8 – Tree planting procedures

No. 9 – Choosing a suitable growth medium

Is ARRI overcoming regulatory, technical, and cultural barriers?

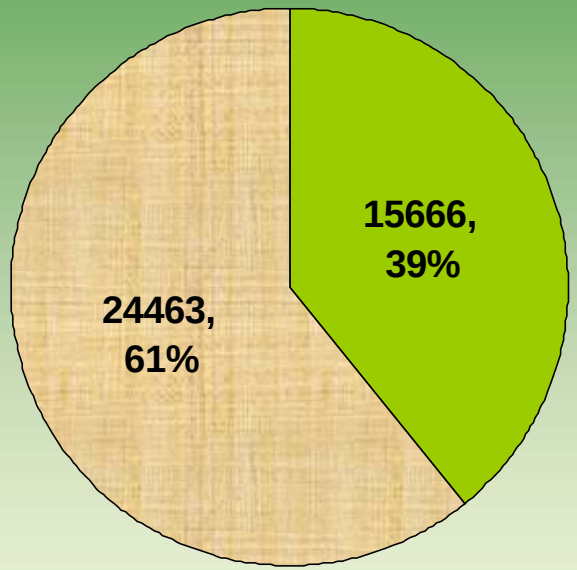
- **Regulatory**
  - **Tennessee and Virginia rule change**
- **Technical**
  - **$20 million Applied Science Projects**
  - **Operation Springboard**
- **Cultural**
  - **OSM's National Directive**

Number of trees planted in ARRI states in 2005, 2006, and 2007



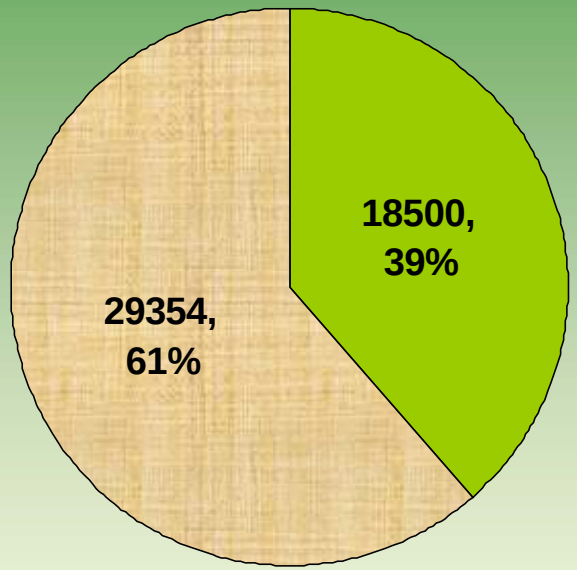
Land reclaimed in ARRI states in 2005, 06, and 07

2005



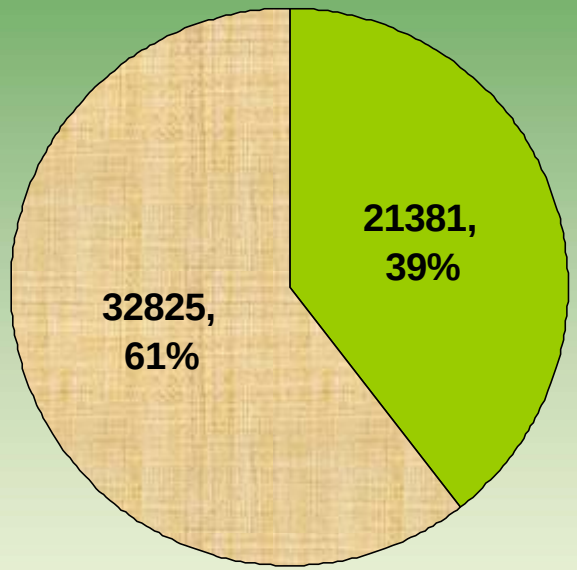
Total acres reclaimed = 40,129

2006



Total acres reclaimed = 47,854

2007



Total acres reclaimed = 54,206

Land reclaimed with trees

Land reclaimed without trees

To stop, turn, and reverse direction of a fully loaded supertanker traveling at 16 knots, the captain needs...

...at least 20 minutes
...5.5 miles to stop
...a turning circle of 2 miles

Has the number of permits/acres/trees planted increased?

CATERPILLAR
CAT 245B
85

CATERPILLAR
CAT
245B
85

CATERPILLAR
245B
CAT

Are we seeing an increase in survival and growth?

Third year (2007) percent survival by spoil type for all species at UK's Bent Mountain

	BROWN	GRAY	MIXED
Green ash	97 (a)	96 (a)	96 (a)
Red Oak	77 (ab)	80 (a)	73 (b)
White Oak	100 (a)	100 (a)	93 (b)
Yellow- poplar	70 (a)	72 (a)	65 (a)
All species	86 (a)	88 (a)	81 (b)

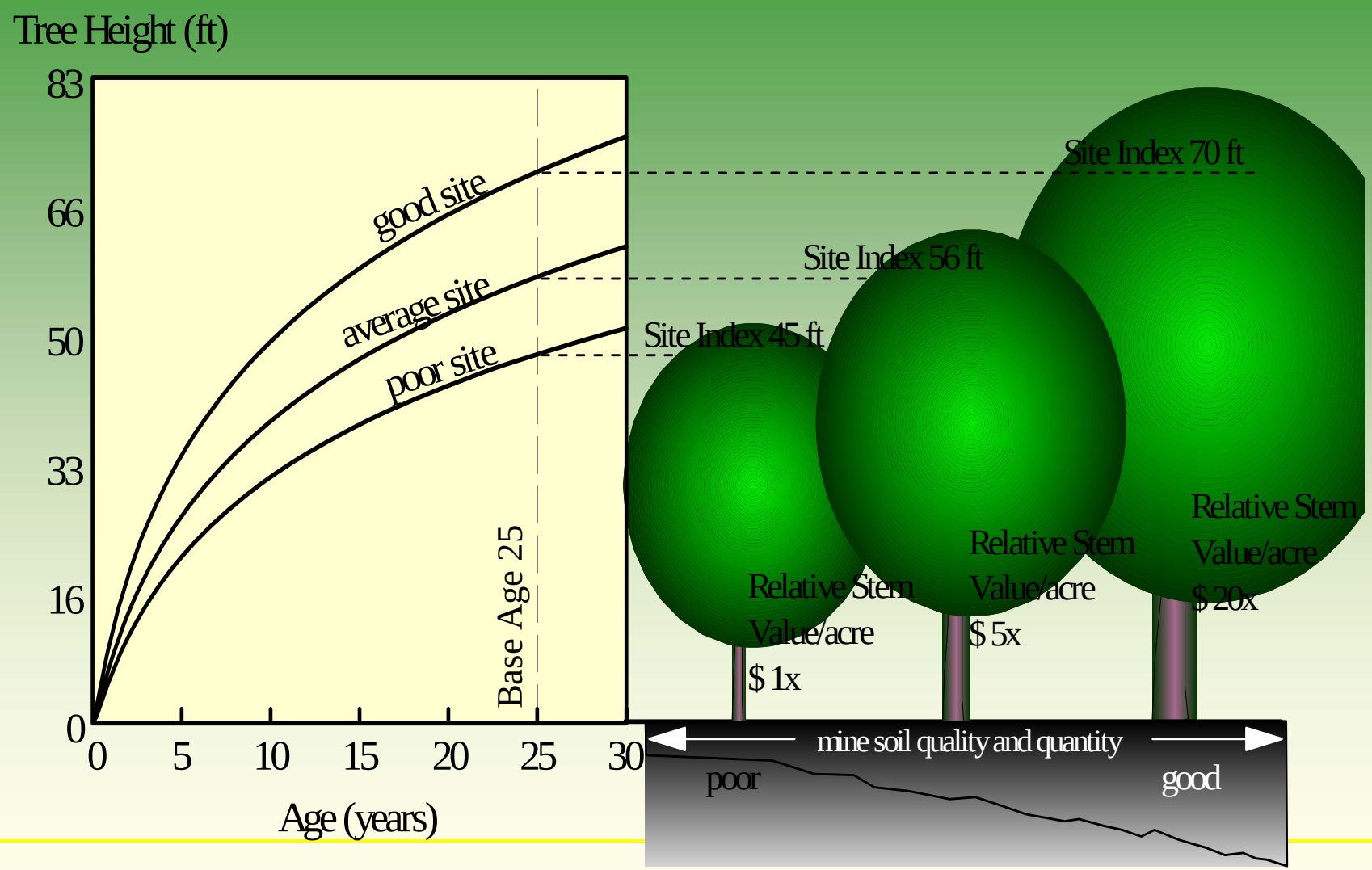
Comparisons are made between spoil types for each species. Spoil types with the same letter are not significantly different at $p = 0.05$ level.

Are we seeing an increase in survival and growth?

SITE INDEX –

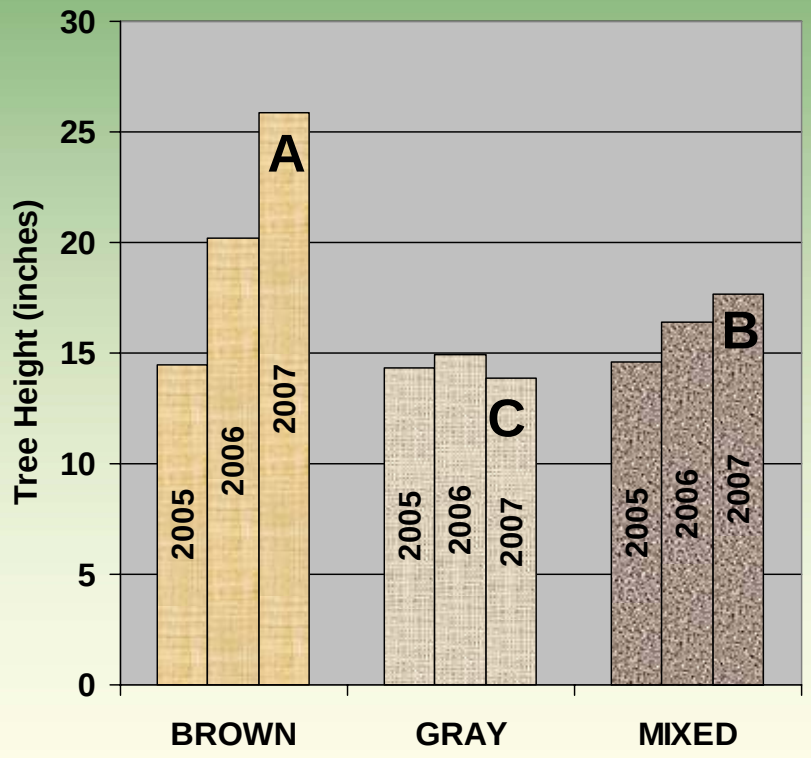
The total height to which the dominant trees
of a given species will grow
on a given site at some index age,
usually 25 or 50 years in the Southeast.

Are we seeing an increase in survival and growth?

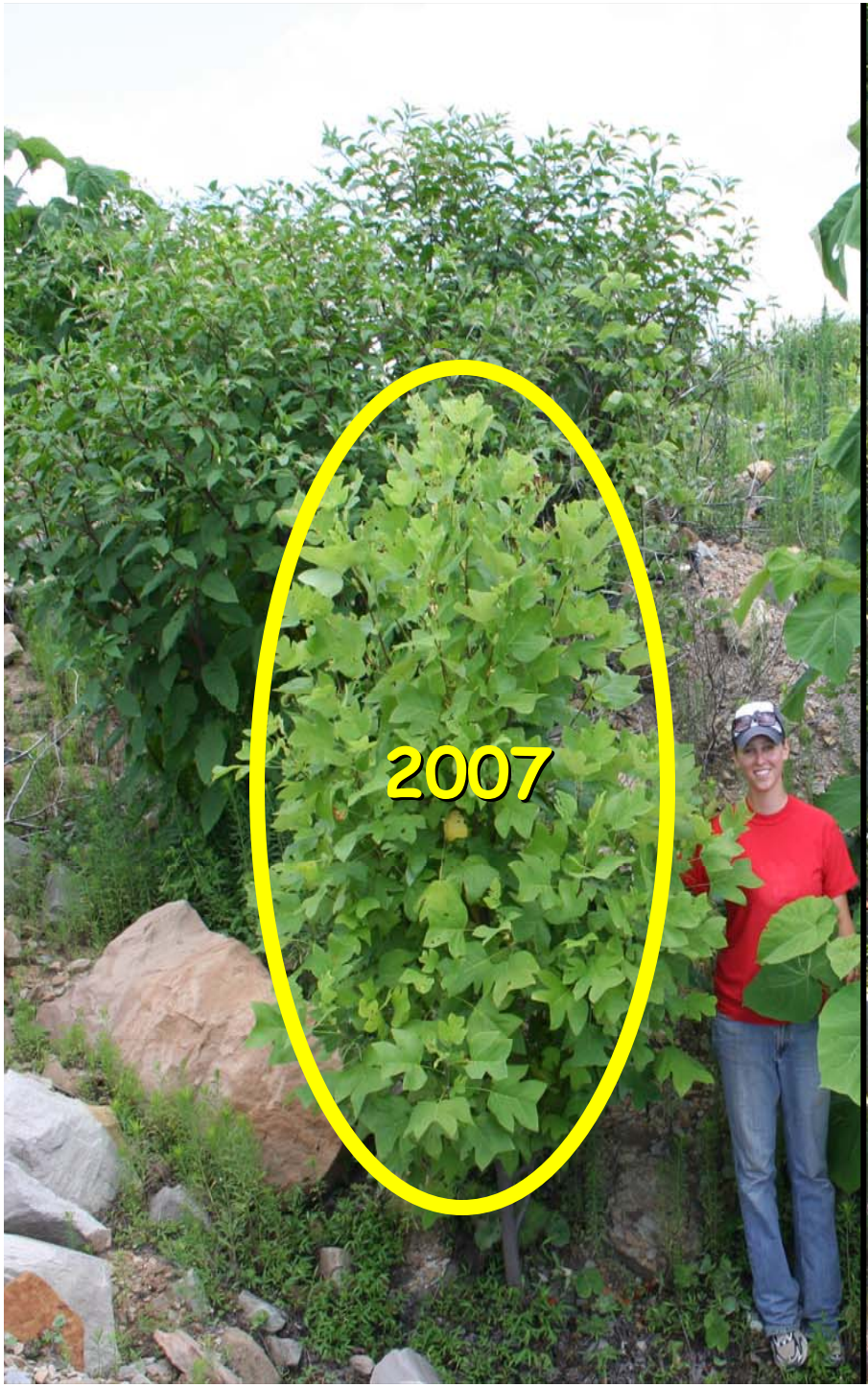


Are we seeing an increase in survival and growth?

Research Comparisons



White Pine Productivity Standard


2007

2008

Estimating a forest productivity index based on 7 physical and chemical mine soil properties:

Bulk Density (BD)

Coarse Fragments (CF)

Texture (TX)

Base Saturation (BS)

pH (pH)

Electrical Conductivity (EC)

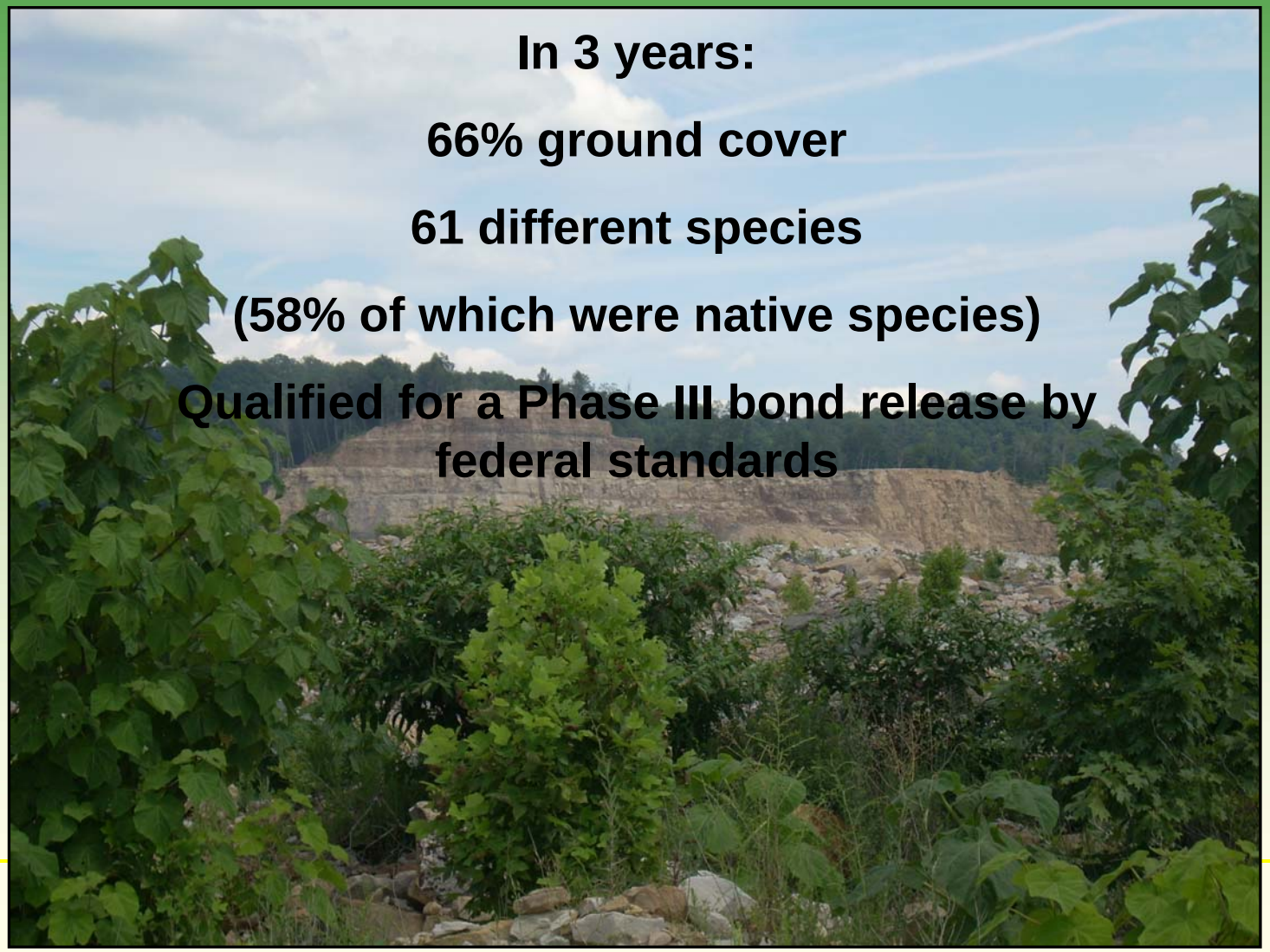
Phosphorus (P)

PI = (SBD + SCF + STX + SBS + SpH + SEC + SP) / 7

Sufficiency values, productivity index, and site index using VT's methodology

Spoil Type	S_{BD}	S_{CF}	S_{TX}	S_{BS}	S_{pH}	S_{EC}	S_{P}	PI	$SI50_{WO}$ (in feet)
BROWN	1.00	0.07	1.00	1.00	0.99	0.90	0.94	0.84	84
GRAY	1.00	0.12	0.78	1.00	0.34	0.93	0.58	0.68	35
MIXED	1.00	0.21	0.93	1.00	0.35	0.91	0.44	0.69	40

Are we expediting the establishment of forest habitat through natural succession?



In 3 years:

66% ground cover

61 different species

(58% of which were native species)

Qualified for a Phase III bond release by federal standards

Thanks to…

Selena Allen
Chris Barton
Karrie Bernhard
Mike Bower
Vic Davis
Mike Dunn
Brad Edwards
Chet Edwards
Scott Eggerud
Mike French
Don Graves
Becky Hatfield
Mike Hiscar
Jim Holliday
Linda Keene
Bob McKenzie
Molly Sager
Brian Smith
Jim Taitt
Brent Wahlquist
Vann Weaver
Carl Zipper
Appalachian Fuels
Powell River Project
University of Kentucky
Virginia Tech

Questions