Mined Land Reforestation Conference

August 7-8, 2007 **Abingdon, Virginia**

Advances in Scientific Knowledge and the Forestry Reclamation Approach

Jim Burger
Department of Forestry, Virginia Tech

VIRGINIA TECH FORESTRY

Powell River Project

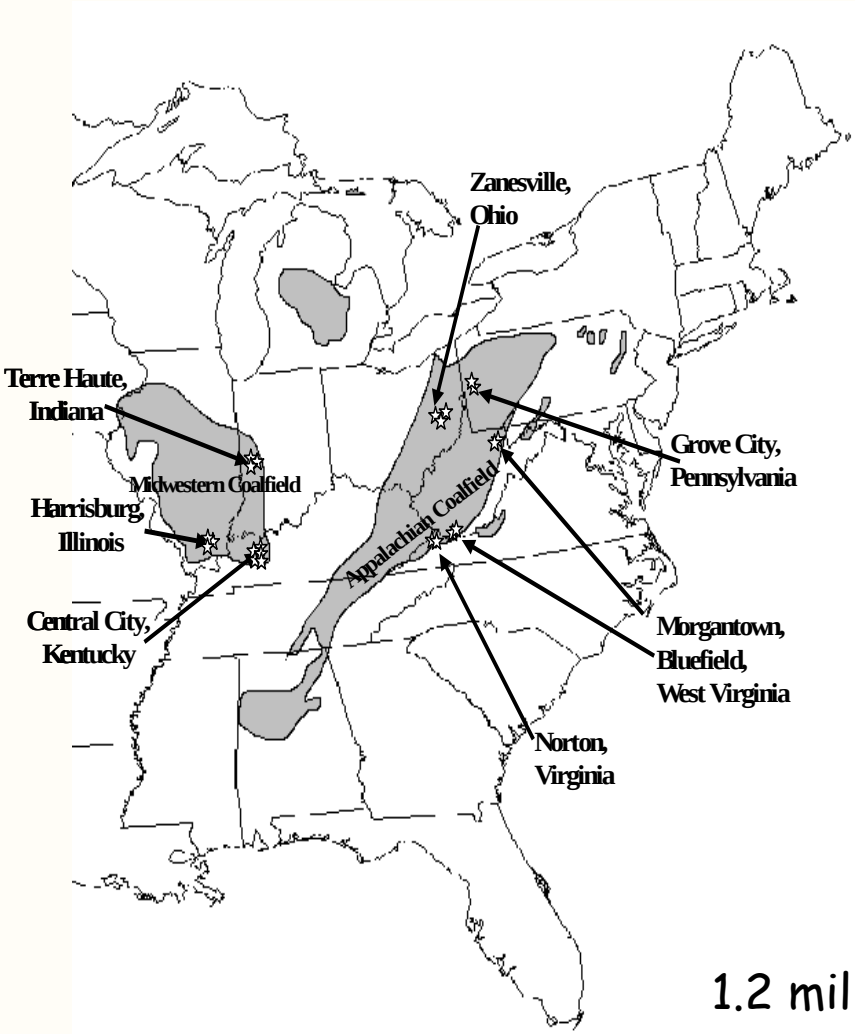
Purpose

- Present an overview of the Forestry Reclamation Approach (FRA) and how it is supported by research results.

Presentation Outline:

- Importance of forests in the Appalachian region of the U. S.
- History and evolution of the FRA
- Examples of research and practice that underpin the FRA
- Why the FRA and the ARRI is important

Midwestern and Appalachian Coalfield Regions



1.2 million acres disturbed by mining in the East

West Virginia Forestry Statistics

American Forest and Paper Asso. (2002) (http://www.afandpa.org/)

- 79% forested
- 9 million individual woodlot owners
- 271 manufacturing facilities
- Wood products is 3rd in manufacturing after metals and chemicals
- Annual payroll $430 Million
- Value of industry shipments: $1.8 Billion

Forest Products and Services

- Products
  - Wood, fiber and paper
- Ecosystem Services
  - Water quality
  - Flood control
  - Erosion control
  - Biodiversity
  - Wildlife habitat
  - Carbon sequestration

Photo: Richard Calmes

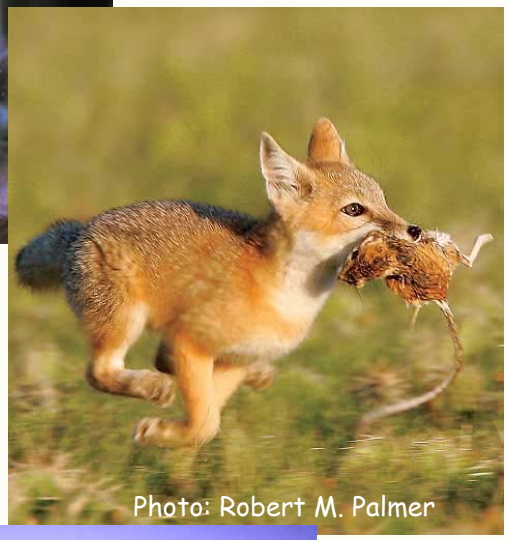


Photo: Robert M. Palmer

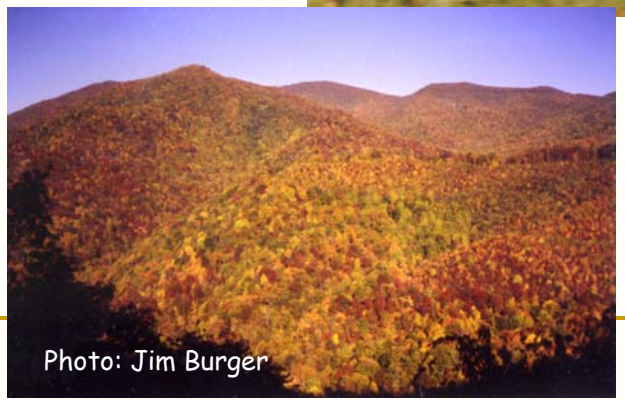
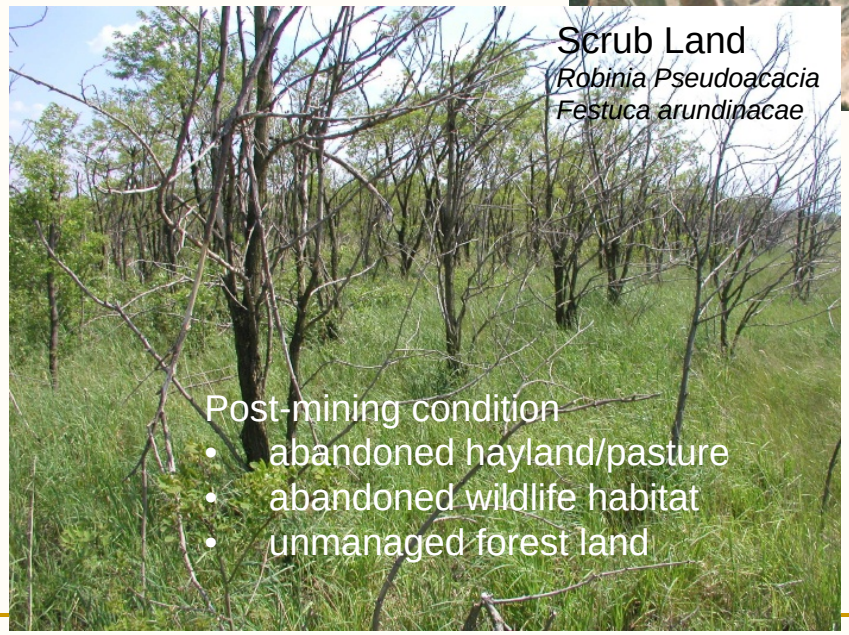


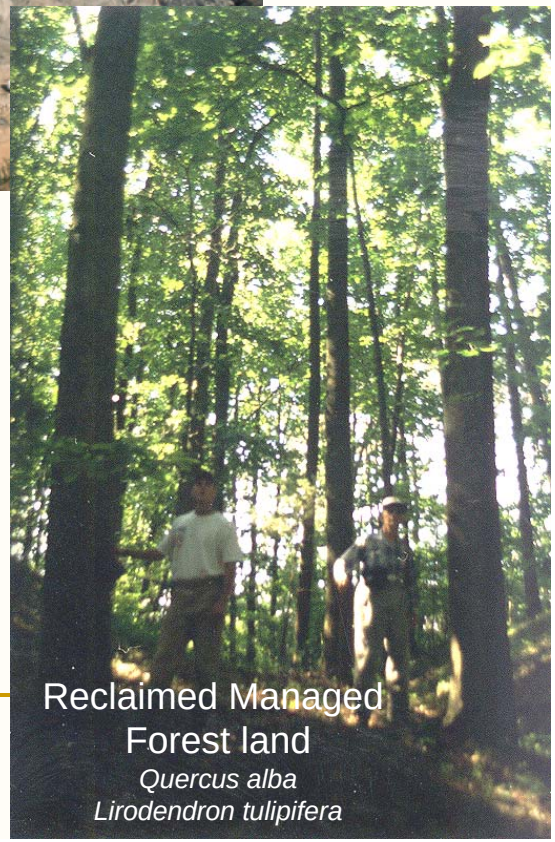
Photo: Jim Burger

Land Use Change in the Midwestern and Appalachian Coalfields

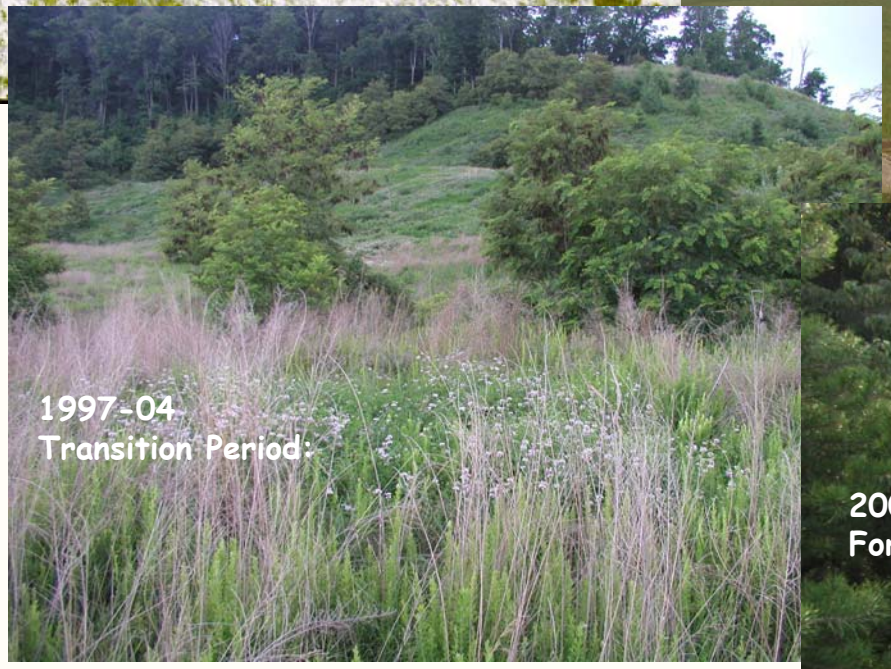


Our Reclamation Legacy

Which will it be
←----?----→



Sixty-year History of Mined land Reforestation in the Appalachian and Midwestern Coalfields: 1947-2007



Sixty-year History of Mined land Reforestation in the Appalachian and Midwestern Coalfields: 1947-2007

1947-76
Pre-SMCRA: Tree planting
- Loose spoils
- Little or no competing cover
- Tree selection for variable spoils
- Tree planting & handling
- Very productive forests in many cases

1977-96
Grassland Reclamation approach:

1997-04
Transition Period:

2004-07
Forestland Reclamation Approach:

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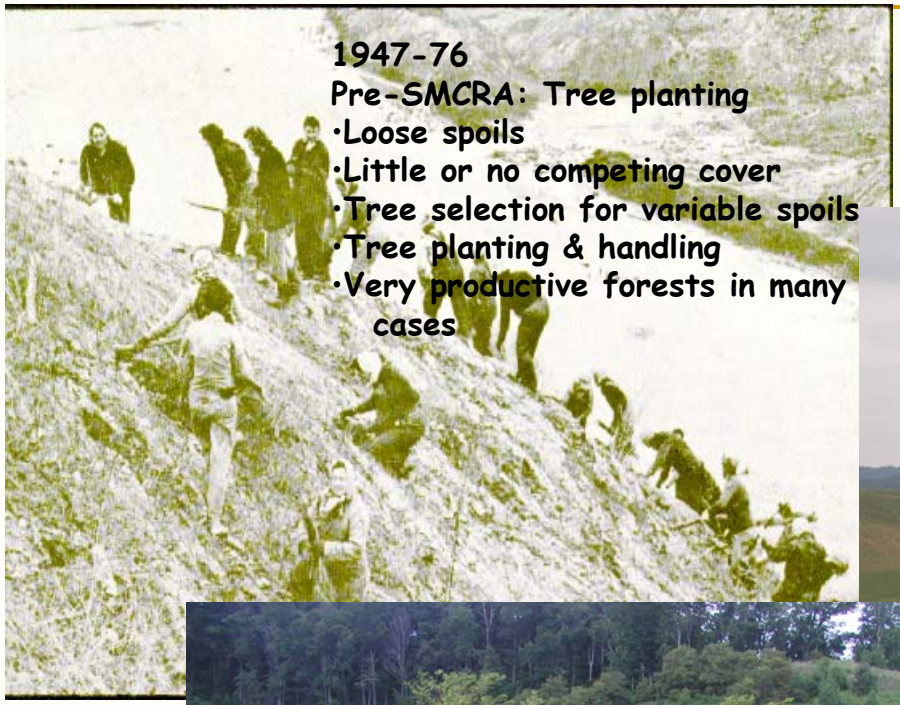

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- Few trees planted
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- Heavily graded, compacted mine soils
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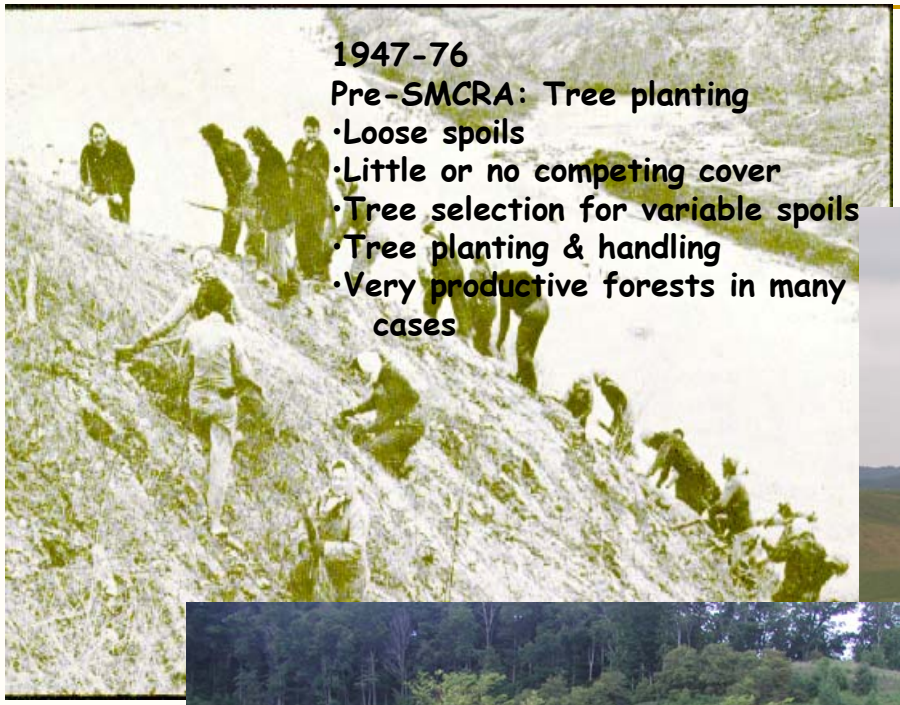

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- Wildlife habitat & unmanaged forest land primary land uses
- Mine soils still compacted
- Competitive agricultural grasses/legumes
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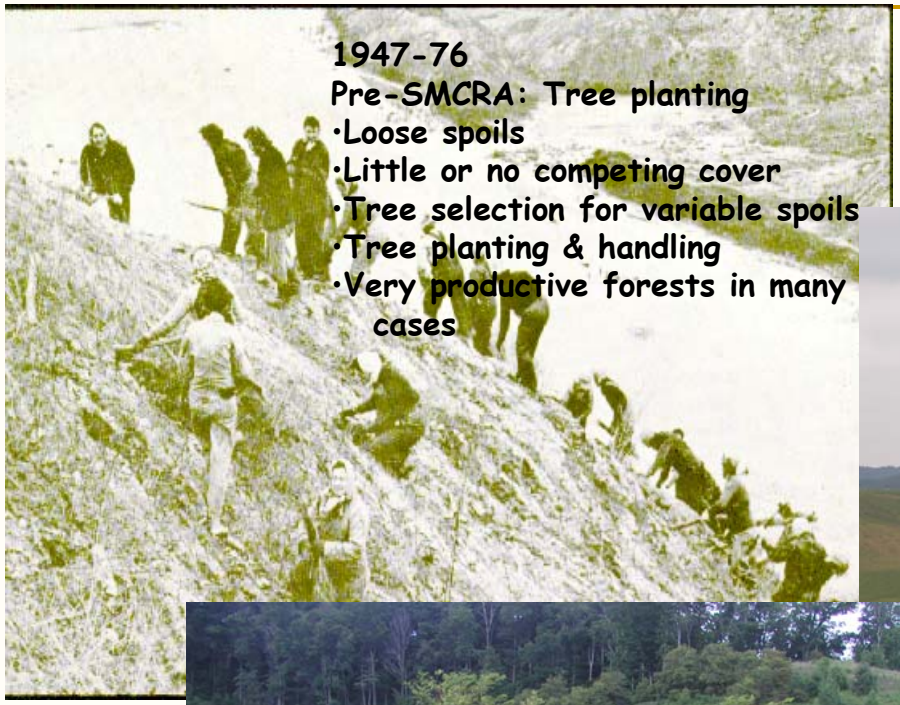

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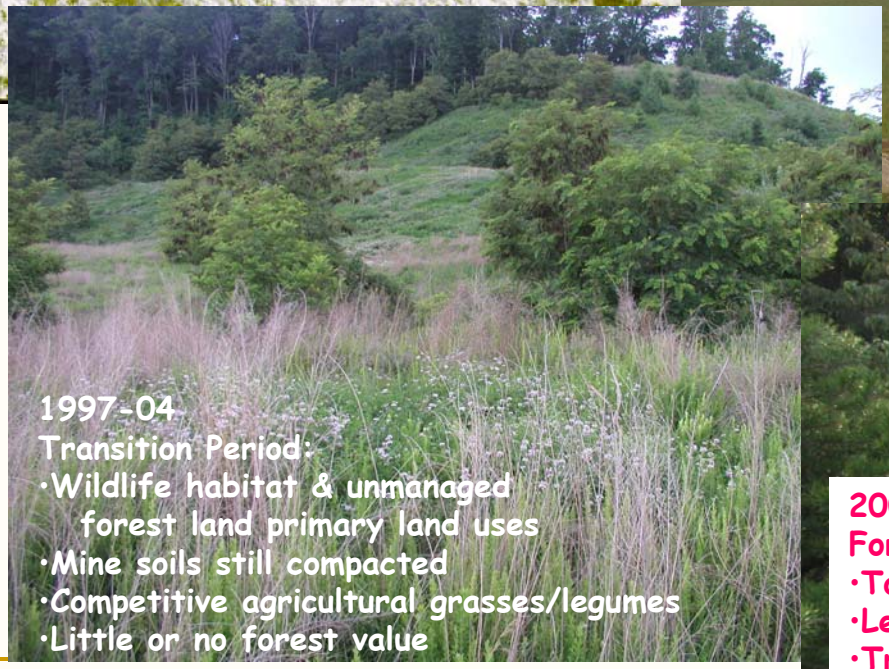

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- Wildlife habitat & unmanaged forest land primary land uses
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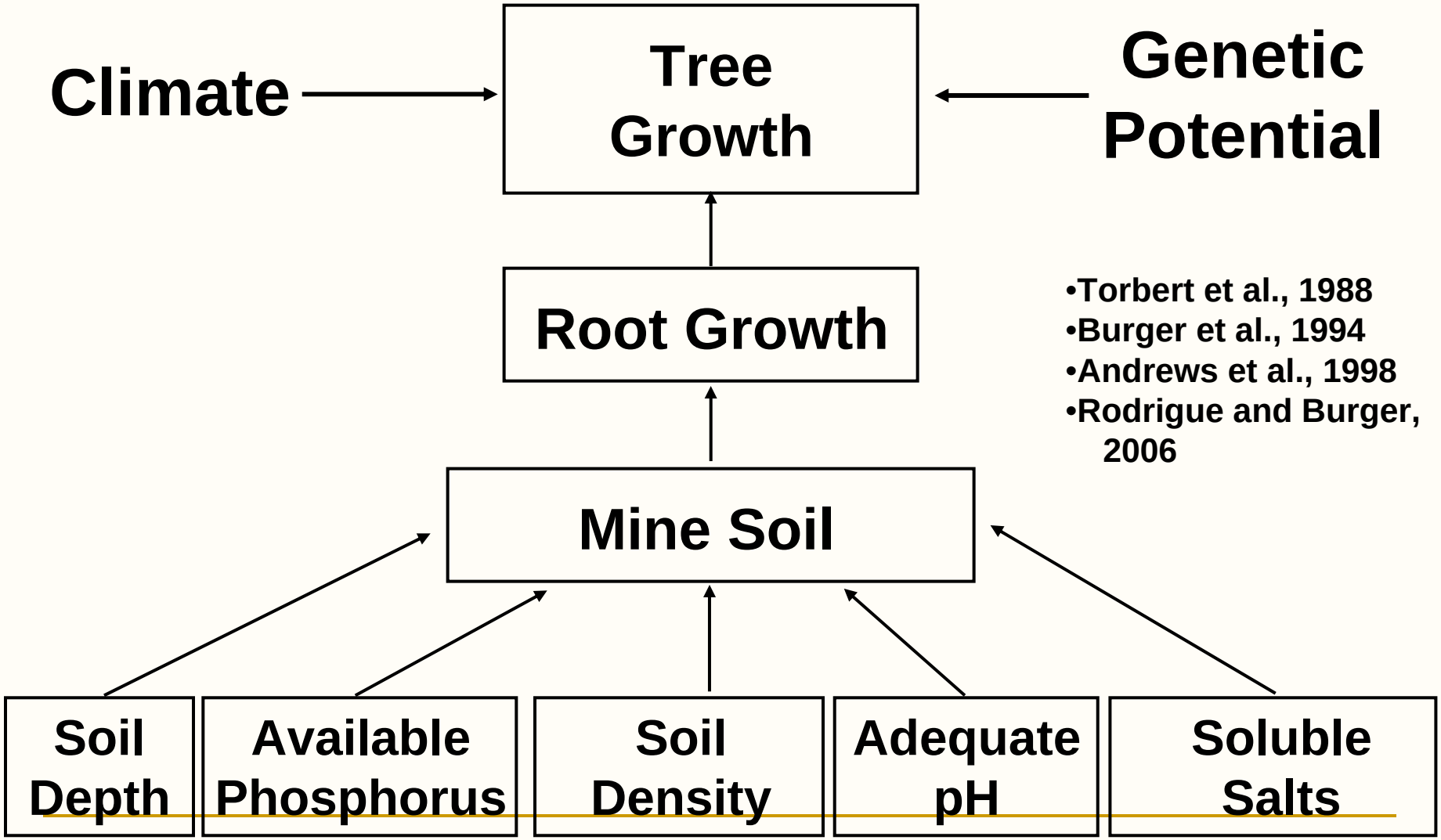
2004-07
Forestland Reclamation Approach:
- Top soil substitutes for trees
- Less grading, loose spoils
- Tree-compatible ground cover
- Valuable native tree mix
- Good Planting techniques

ARRI Forestland Reclamation Approach ("Best Practices")

1. Select and use specific top soil substitutes for trees
2. Reduce grading, leave spoils loose and uncompacted
3. Use a tree-compatible ground cover and reduce herbaceous cover as much as possible
4. Use a valuable native tree mix consisting of crop and wildlife species
5. Hire reputable tree planters who use good techniques

Step 1. Select a topsoil substitute for trees and place it 4-ft thick on surface.

Mine Soil Quality Model



- Torbert et al., 1988
- Burger et al., 1994
- Andrews et al., 1998
- Rodrigue and Burger, 2006

Influence of mine site quality on commercial forest value

Post-SMCRA Mined Land

Average for Appalachian Region

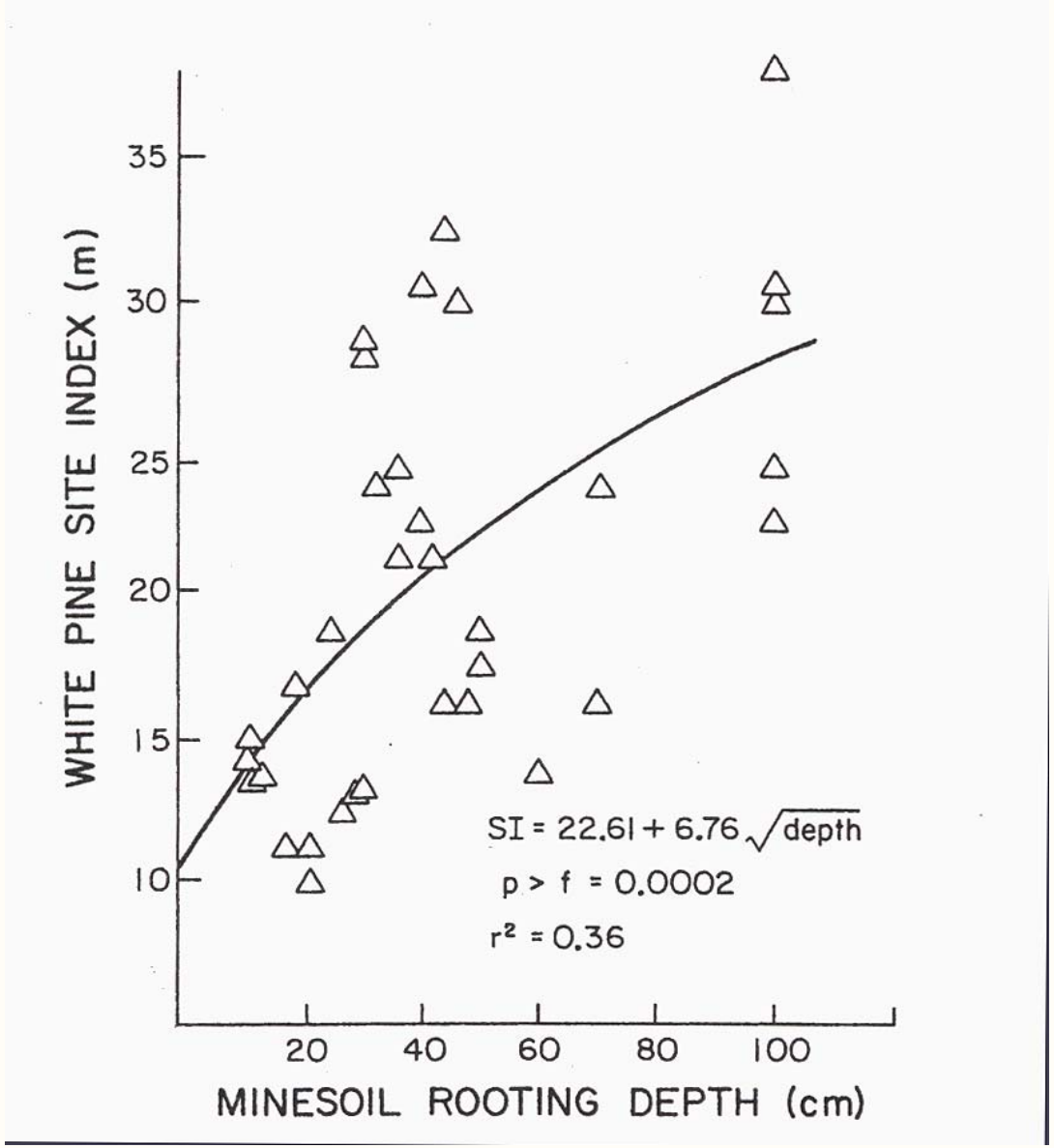
Mine Soil Quality	Very Poor	Poor	Fair	Good	Very Good
Site Quality Class	V	IV	III	II	I
Oak Site Index (ft_{50})	45	55	65	75	85
Potential Species	Black locust, Autumn olive	Chestnut oak, Scarlet oak	White oak, White ash	N. Red oak, Yellow poplar	Black cherry, Sugar maple
Potential Commercial Uses	None	Fire-wood OSB chips	R R Ties Small saw-timber	Large saw-timber	Large saw-timber Veneer
% Return on Investment (Probert, 1999)	-2	1	2	4	8

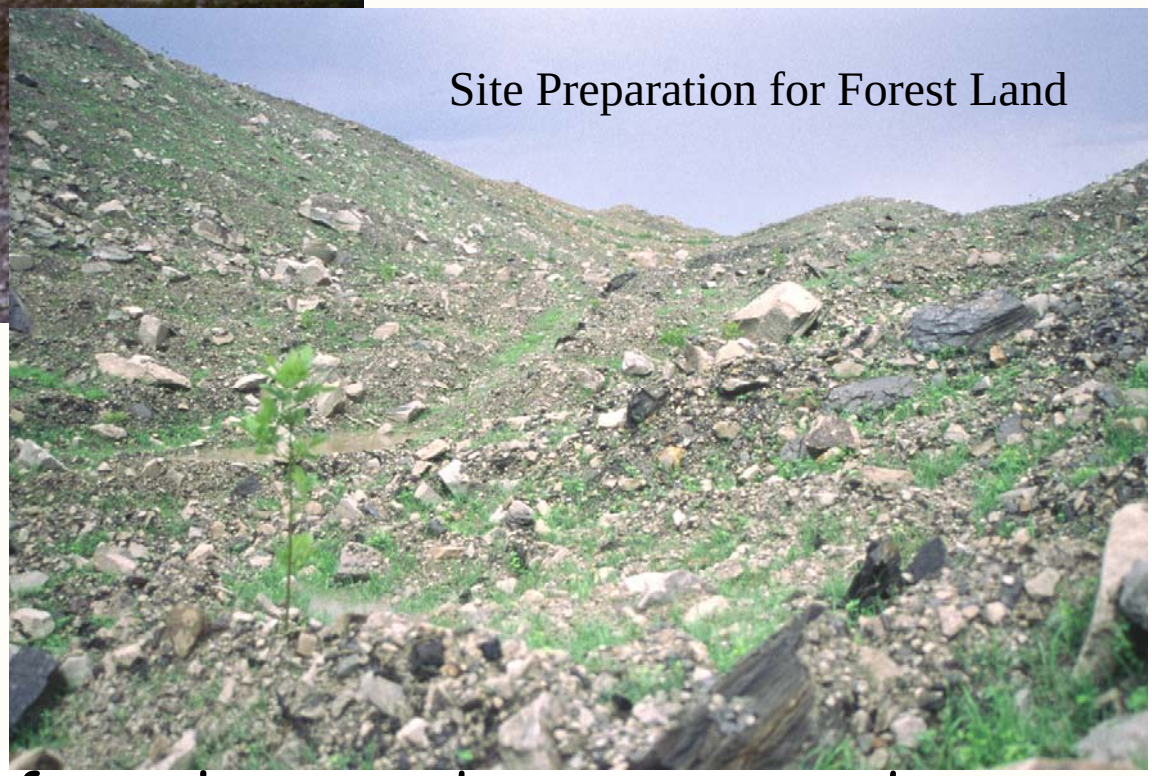
Mine Soil Depth Wedge Study

Torbert and Burger, 1992

White pine site index (age 50) as a function of rooting depth

(Torbert et al. 1988 Jour. Environ. Qual.)

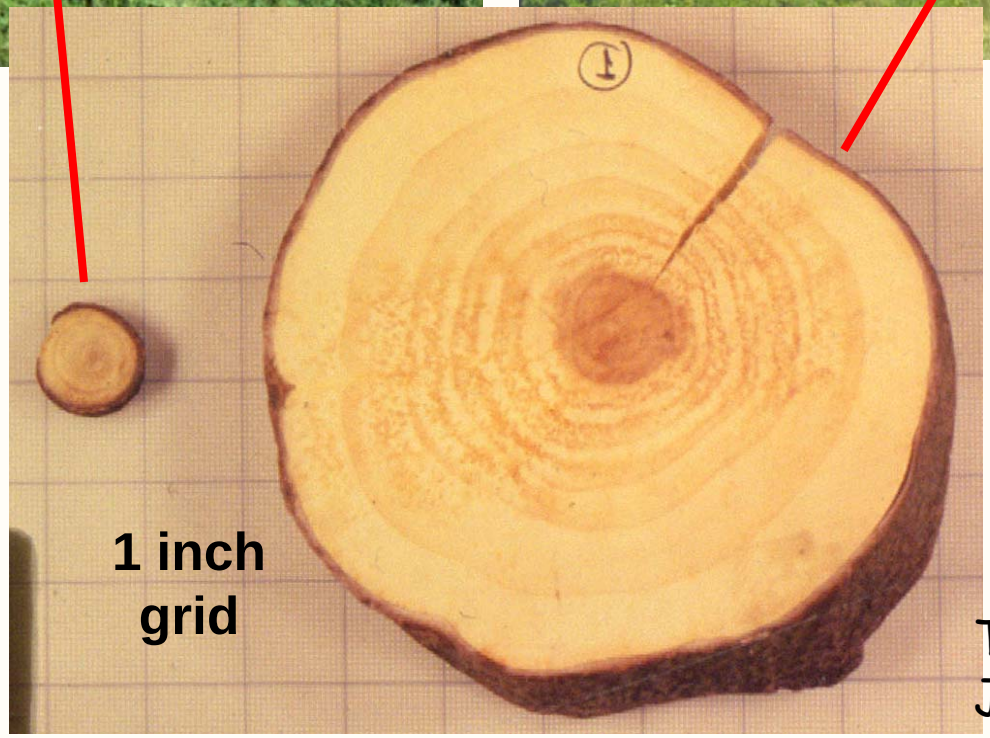




Step 2. Leave surfaces loose and un-compacted.

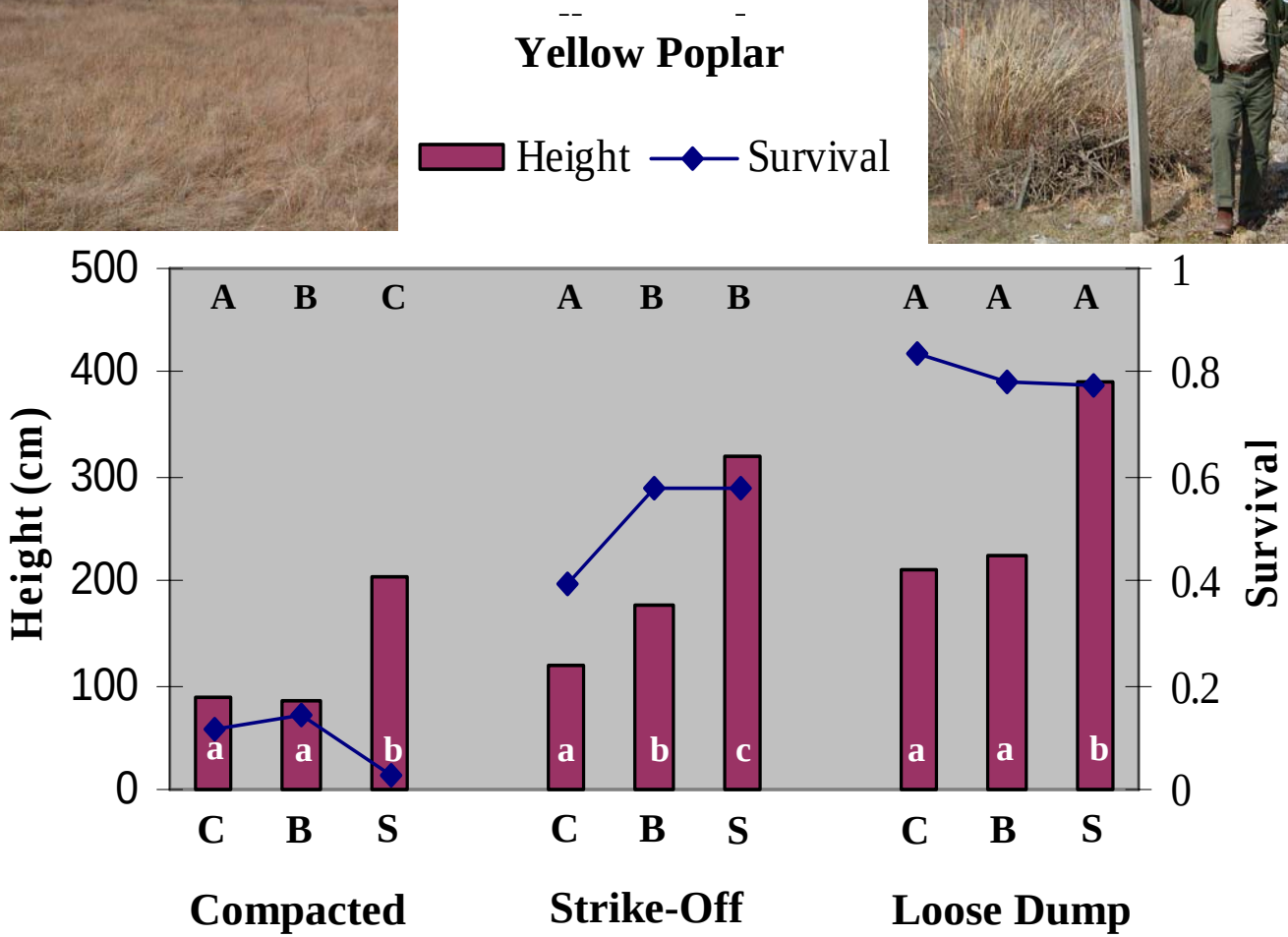
8-yr-old white pine; site class V

8-yr-old white pine; site class I



Torbert et al., 1988,
J. Environ. Qual.

University of Kentucky Starfire Project



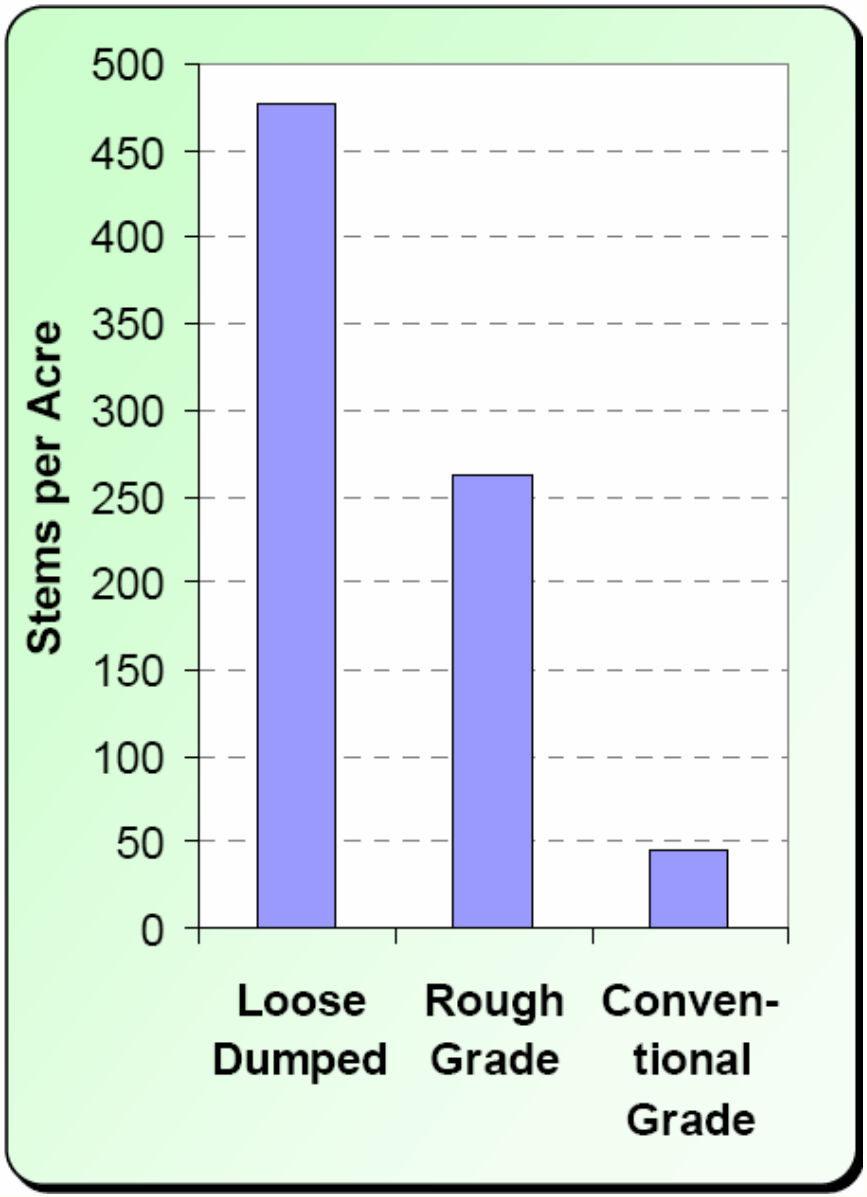
Angel et al., 2006

Grading effect on Natural Seeding of forest species

Naturally seeded forest species after 8 years in loose dumped, rough graded, and conventionally graded areas of a Perry County, Kentucky, surface mine.

After 8 years, the woody canopy occupied more than half the area. In contrast, canopy cover was only 5% percent in the "Conventional Grade" areas of the mine site.

(Groninger et al., 2007; Data from Cook, 2007).



Another Influential Study: At Martiki Coal, Eastern KY

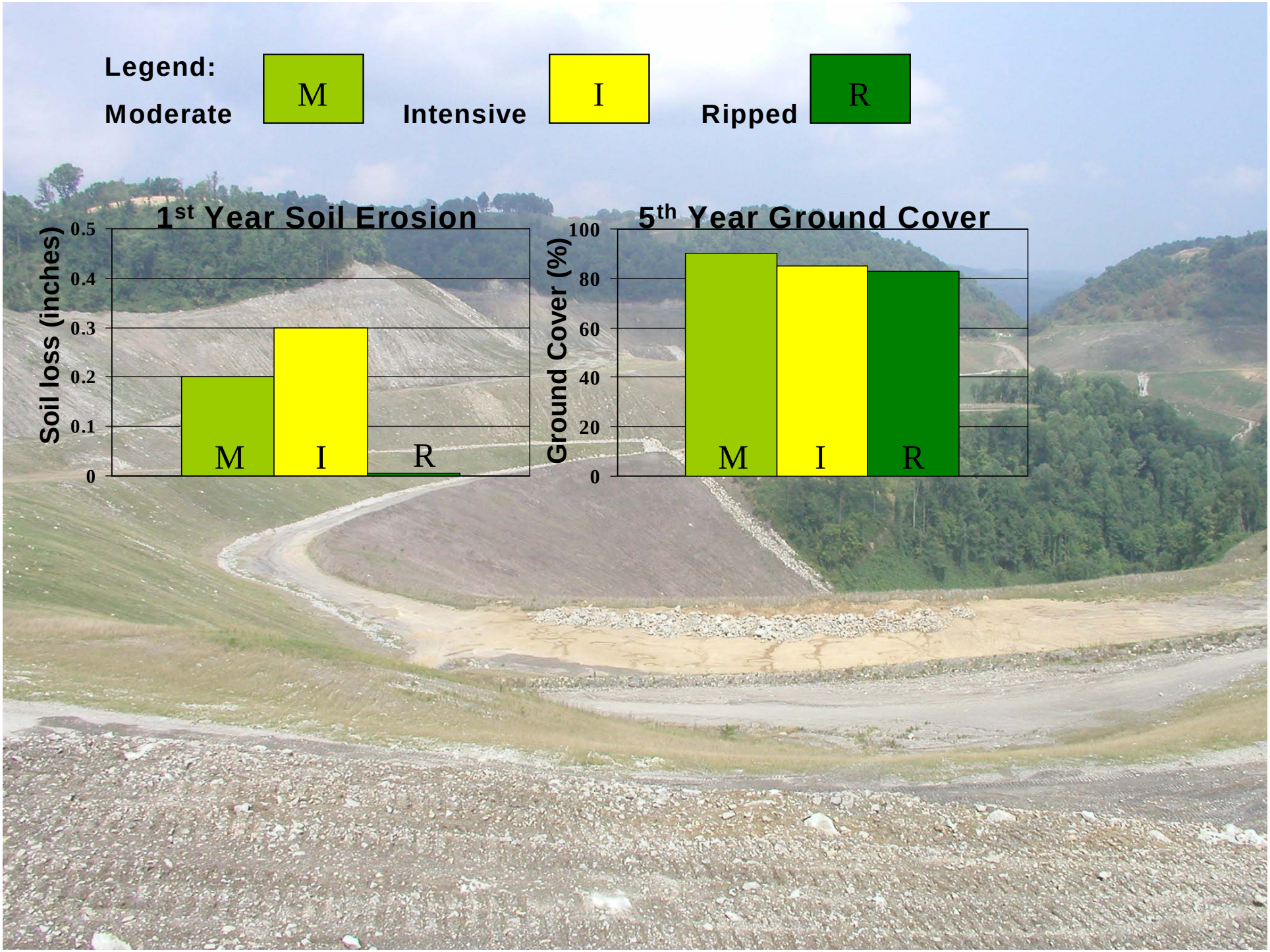
Treatments (all with D-9):

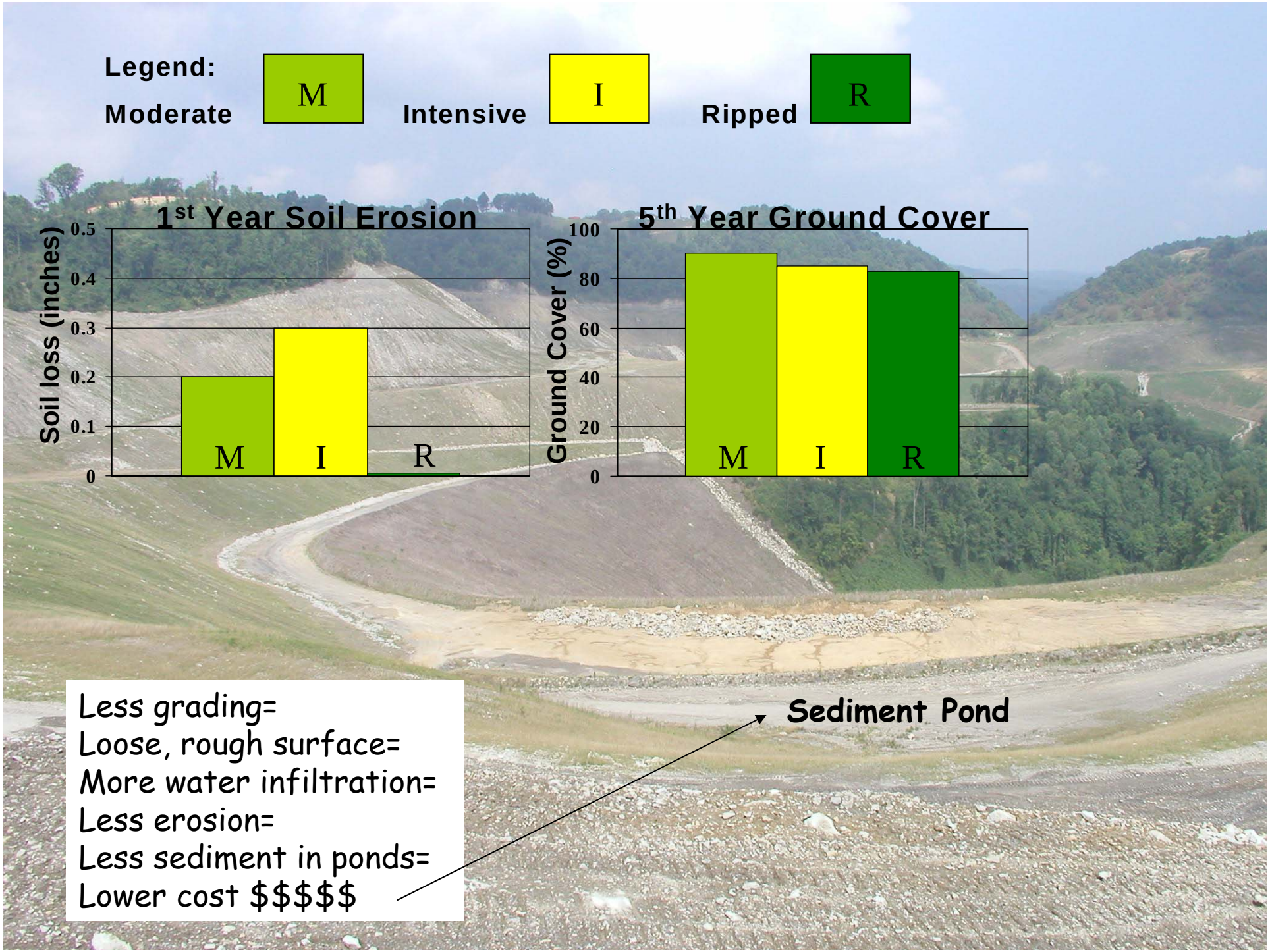
Intensive Grading - front- and backbladed, 1-3 three passes, + tracking in

Ripping - After standard grading: rip 3 ft deep and 10 ft apart running up- and down-slope with a subsoiling shank

Moderate Grading - backbladed downslope, 1-2 passes

Torbert, J.L., and J.A. Burger. 1994. Influence of grading intensity on ground cover establishment, erosion, and tree establishment on steep slopes. p. 226-231, in: *Proceedings, 1994 ASMR*


Legend:
Moderate
M
Intensive
I
Ripped
R
1st Year Soil Erosion
Soil loss (inches)
0.5
0.4
0.3
0.2
0.1
0
M
I
R
5th Year Ground Cover
Ground Cover (%)
100
80
60
40
20
0
M
I
R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M
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R
5th Year Ground Cover
Ground Cover (%)
100
80
60
40
20
0
M
I
R
Less grading=
Loose, rough surface=
More water infiltration=
Less erosion=
Less sediment in ponds=
Lower cost $$$$$
Sediment Pond

3. Use non-competitive herbaceous species for erosion control.
4. Plant valuable native hardwoods and wildlife species.

Tree-compatible Re-vegetation Mix for Native Hardwood Reforestation

(examples of useful species)

- Grasses
  - Ryegrass
  - Foxtail millet
  - Timothy

No fescue or grains

- Legumes
  - Birdsfoot trefoil
  - White clover

No tall clovers

- Fertilizer
  - High phosphorus
  - Low nitrogen

- Wildlife Trees (100/ac)
  - Shagbark hickory
  - Redbud
  - Dogwood
  - Crab apple

N fixing & wildlife food

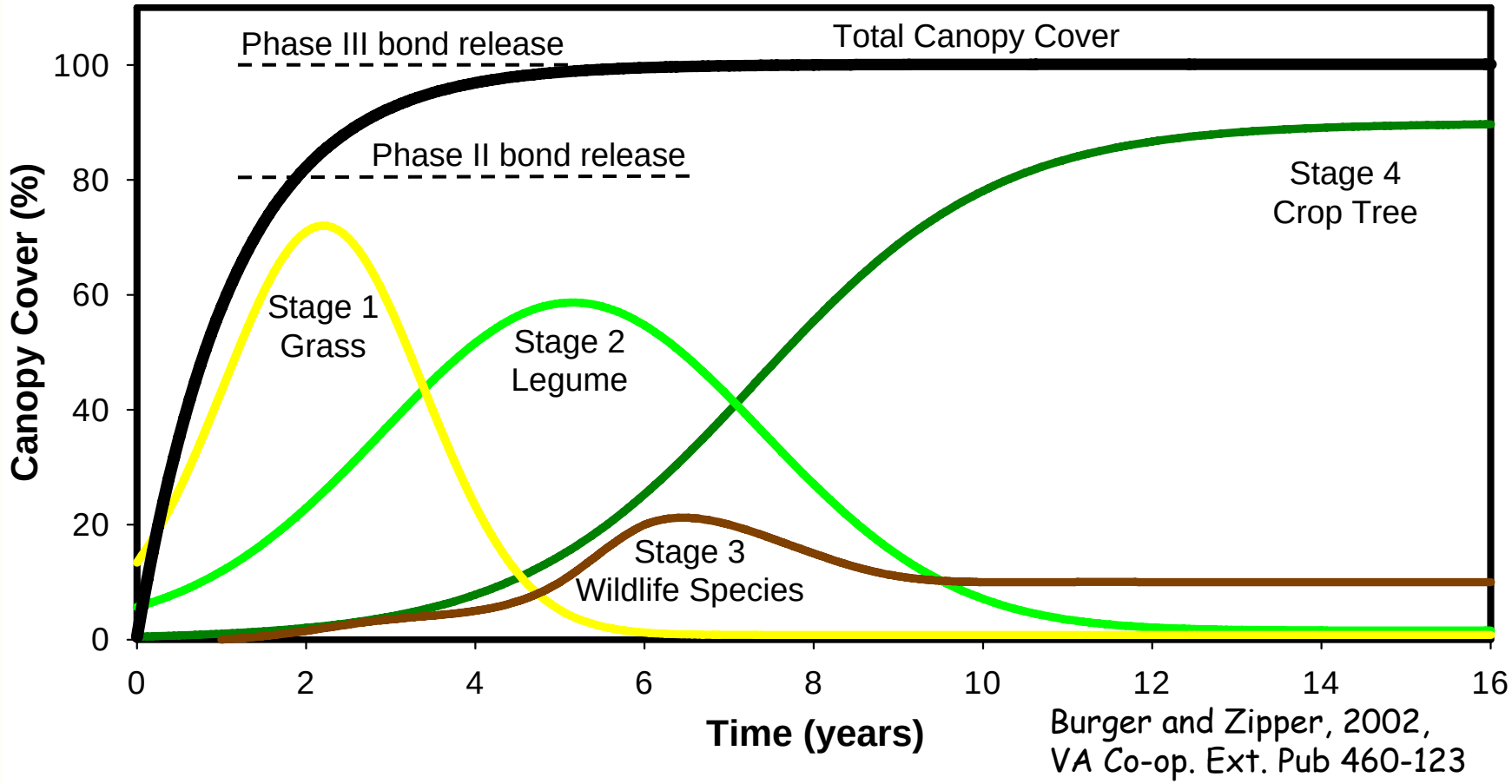
- Crop Trees (600/ac)
  - Red & white oaks
  - White ash
  - Sugar maple
  - Tulip poplar
  - Black cherry

Plant mid & late-successional species.

Early-successional species will volunteer.

Torbert and Burger. 1998. ASA Mongraph; Burger and Zipper, 2002 VCE 420-123

Ground cover development in Stages using the FRA re-vegetation mix for reforesting mined land



Burger and Zipper, 2002,
VA Co-op. Ext. Pub 460-123

Step 5. Use experienced, reputable planters who guarantee their work.

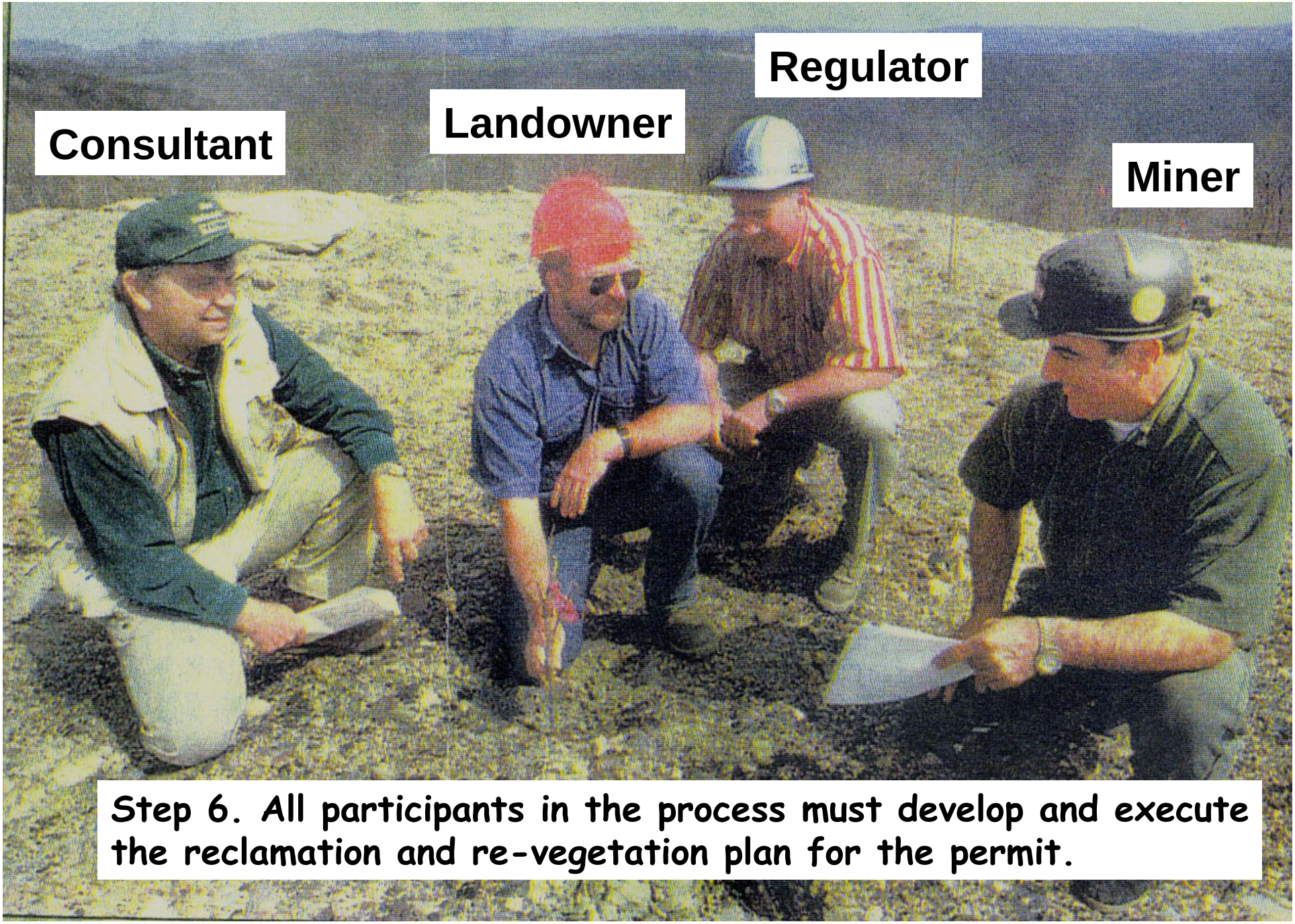
Using high quality seedling stock and good handling and planting procedures are critical.

Refrigerated transport and storage

Proper seedling handling and treatment

Proper planting

These 5 FRA steps produce:
Diverse, high-value, reclaimed forestland
ready for bond release after 5 seasons.



Step 6. All participants in the process must develop and execute the reclamation and re-vegetation plan for the permit.

Research Milestones:

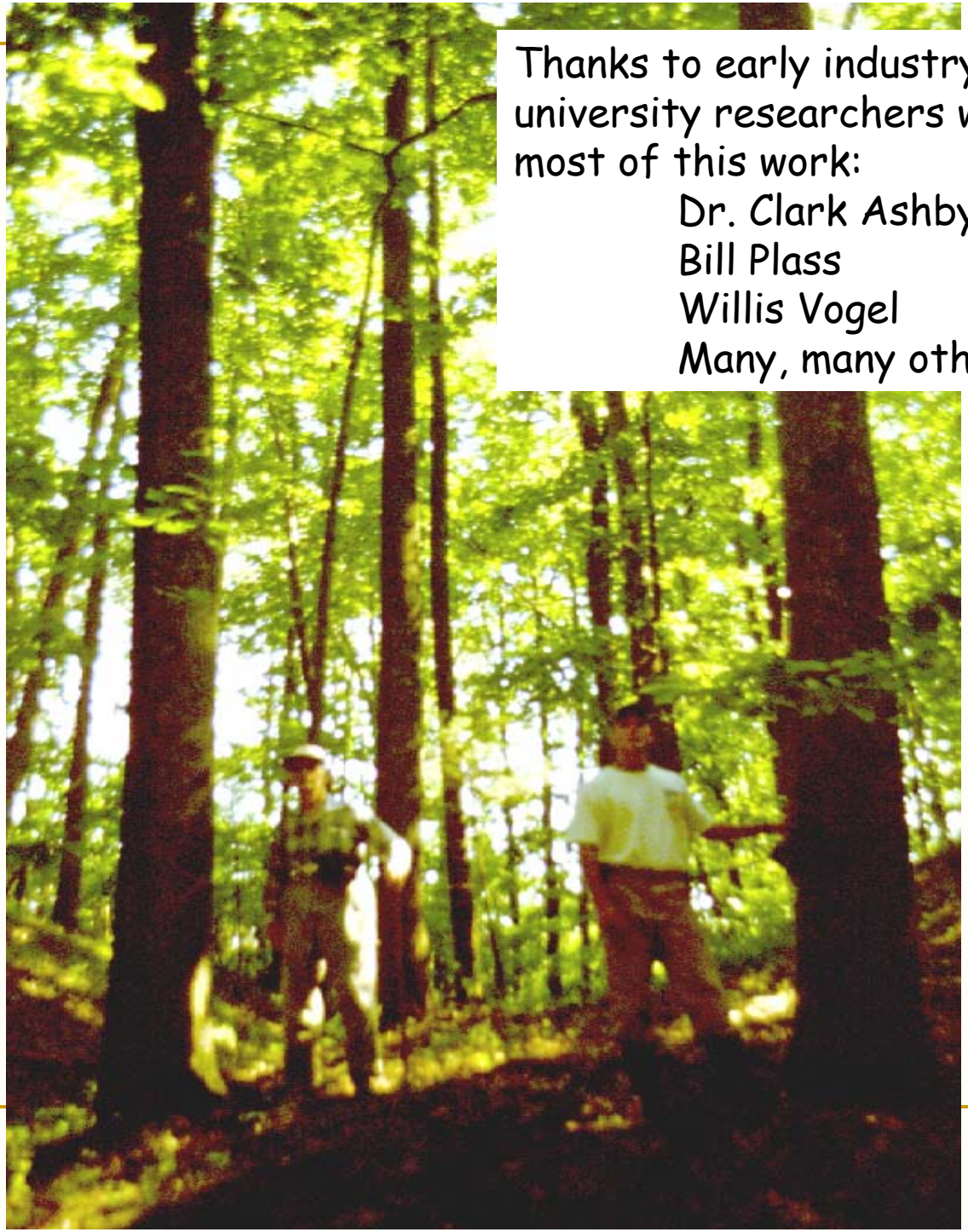
- **Reclaimed forest land is very valuable for both wood products and landscape services.**

- **On average, forest land capability has not been restored on post-SMCRA mined land, but research clearly shows that it can be restored at no extra cost.**

- **Research shows that two reclamation approaches must be recognized:**
  - **A grassland reclamation approach for Grassland**
  - **A forestland reclamation approach Forestland**

- **Research shows that Forestland capability and forests can be restored by:**
  - **Using topsoil substitutes suitable for trees**
  - **Light grading of deep, loose mine soil; ripping compacted soils**
  - **Using tree-compatible ground cover at reduced rates**
  - **Planting a mix of native hardwoods**
  - **Using reputable tree planters**

- **Forest land is less costly for operators to establish: less grading and less sediment pond cleanout.**



Thanks to early industry, agency, and university researchers who pioneered most of this work:

Dr. Clark Ashby
Bill Plass
Willis Vogel
Many, many others