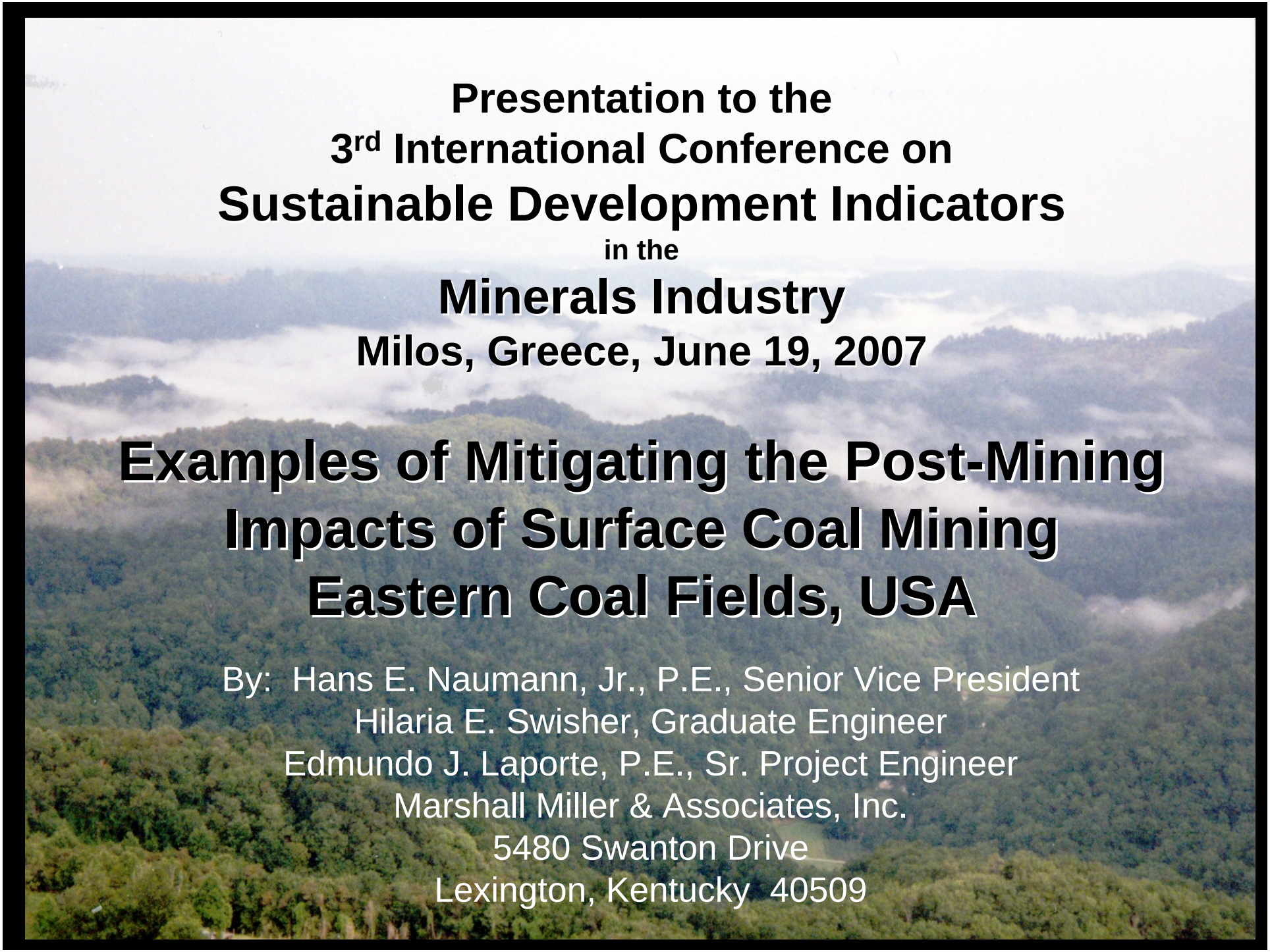

Presentation to the
3rd International Conference on
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Milos, Greece, June 19, 2007

Examples of Mitigating the Post-Mining Impacts of Surface Coal Mining Eastern Coal Fields, USA

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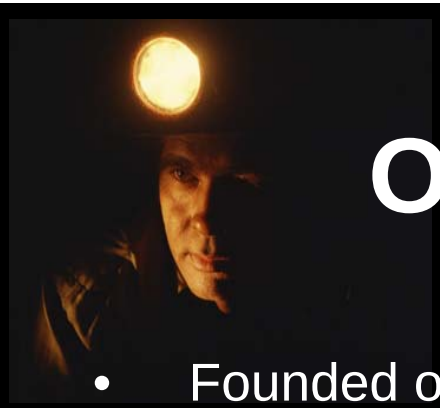


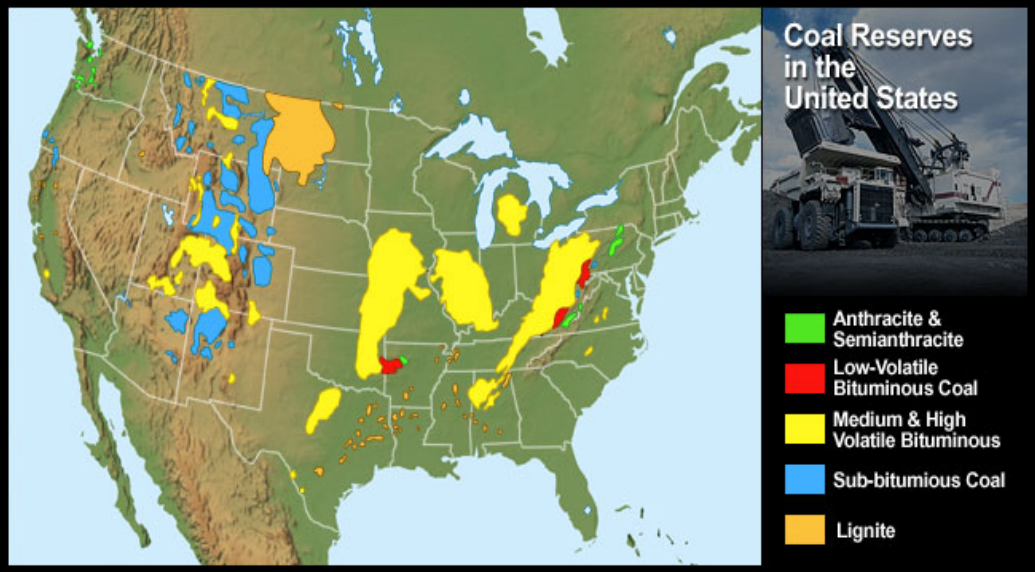
Our Company

Energy • Environmental • Engineering

- Founded over 30 years ago in the Appalachian town of Bluefield, Virginia.
- The company roots were laid in coal exploration and mining engineering under the founding name Geological Consulting Services, Inc. The original founders remain active in upper management today.
- In the mid-80's, the company began diversification efforts and changed the name to Marshall Miller & Associates, Inc. (MM&A)
- MM&A's three primary service sectors include:
  - ✓Environmental Science
  - ✓Energy & Mineral Resources
  - ✓Civil Engineering
- MM&A employs nearly 200 people and operates from 12 offices in 10 states

Coal's Strategic Importance in the U.S. Energy Picture

- North America holds an abundance of coal



- The coal resources are predominantly held (unitized) by the major coal producers
- The coal production process is safe, productive, and time-proven
- The delivery systems are in place
- The coal mining industry has taken significant steps to achieve sustainability.

Mitigation of the Post-Mining Impacts of Surface Coal Mining

Current High-Profile Methods
High-value Post-mining Land Uses

Restored & Created Wet Lands

Restored Prime Farmlands

Restored Rangelands

Golf Courses

Airports

Housing

Correctional Facilities

Pasture/hayland Plateaus

Reforestation

A Mitigation Option for Mining-related Surface Disturbance

- Surface mines produce approximately 50% of the coal mined within the member states of the Southern States Energy Board

- The re-establishment of a natural forest system on formerly mined lands or other deforested sites is:
  - One of several desired Post-Mining Land Uses
  - Supported by Federal and State mining regulations

Environmental Benefits of Reforestation

- Preservation of habitats for diverse species of plants & animals

- Removal of large amounts of carbon dioxide from the air

- Conservation of water resources

- Minimization of soil erosion

Recreational Value

- Hiking, biking, skiing
- Seasonal hunting
- Outdoor activities which
  - support regional tourism
  - benefit area residents

Other Economic and Social Benefits

- Job Creation
- Local Tax Revenue
- Tax incentives for landowners to choose forestry land use

The Challenge: Making Valuable Tree Species Grow on Reclaimed Mine Lands

Without extraordinary effort:

- Only 20 -22% of tree seedlings planted for reforestation purposes survive
- Those that survive are often small and weak

Most coal mine reclamation plans have thus migrated away from this post-mining land use option.

Problems with Current Reclamation Practices

- Excessive compaction of the rooting (growth) medium (soil or approved soil substitute)
- Selection of inappropriate rooting medium
- Excessive competition from the herbaceous ground-cover species established to control erosion

Underlying Causes for Poor Reforestation Experiences

- Strong desire to establish a tightly compacted mine spoil to prevent slope stability issues
- Machine operators and regulators concerned about the immediate “look” of the reclaimed land above long-term outlook
- Compelling desire to establish a dense herbaceous cover (grasses and legumes) very early into the final phases of the reclamation portion of the life cycle of a mine

Uniformity of the Reforestation Problem

- Primarily in non-prime farmland coal mining regions
- Overwhelming influence of regulations promulgated pursuant to SMCRA (PL 95-87)
- General conformity of State reclamation regulations with SMCRA

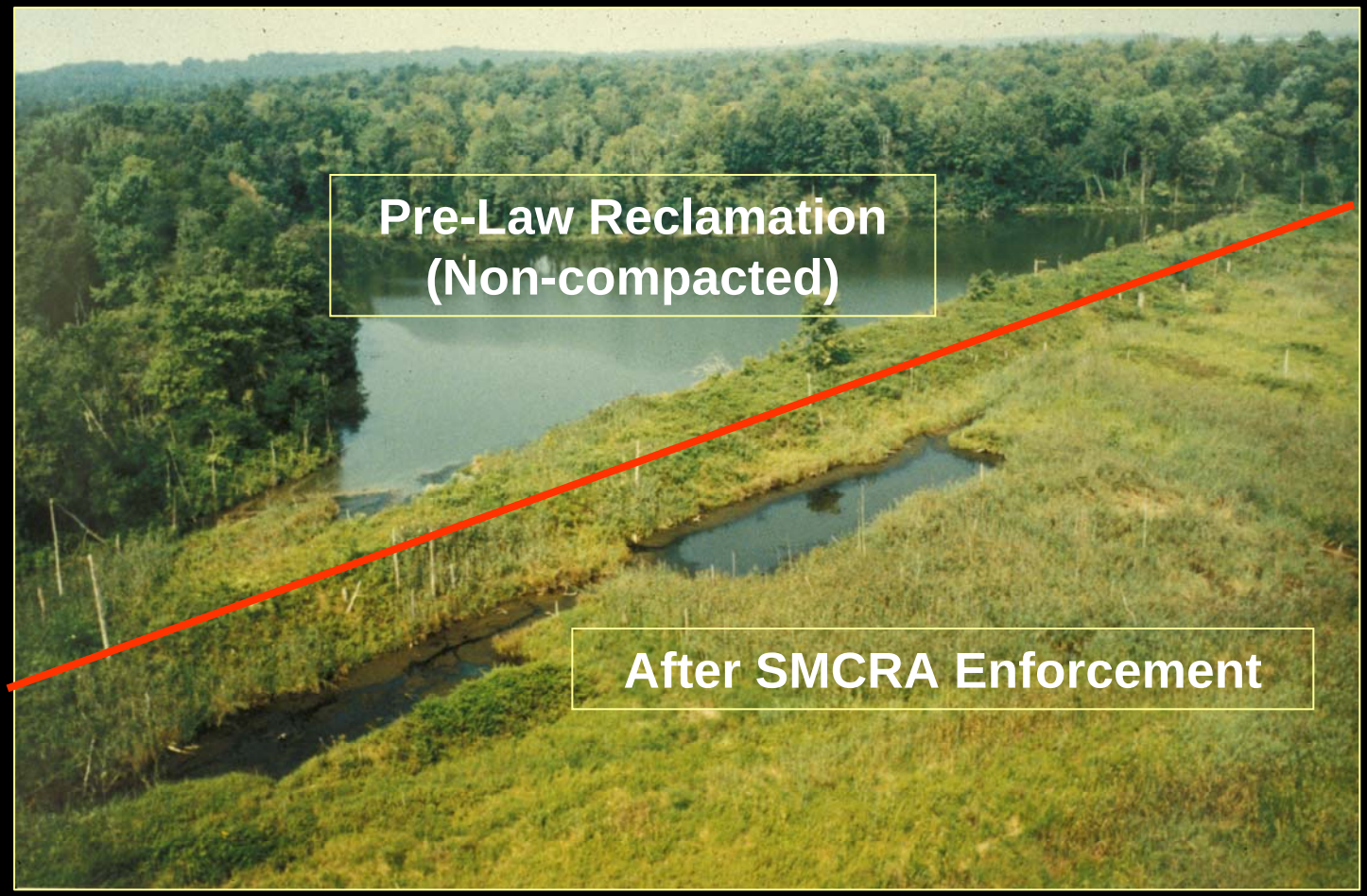
Surface Mine Control and Reclamation Act (SMCRA) 1977

- Establishes a nationwide program to protect society and the environment from the adverse effects of mining
- Prohibits mining activities in areas where reclamation is not feasible
- Requires reclamation activities to occur as contemporaneously as possible with mining operations
- Provides for balance between environmental protection/agricultural production and national coal production requirements
- Assists development of similar state programs

SMCRA Title V – Active Surface Mining

- Return lands affected by mining to a condition equal to or better than before mining
- Must return mine land to its approximate original contour (AOC)
- Must place reclamation bonds on the areas impacted by surface mining
- Must include the designation of post-mining land use and reclamation plan
- Each state has its own requirements. All place high importance on the final surface grading, ground cover, and number of trees

The Result?
Reforestation
Compacted vs. Non-Compacted
Regraded Mined Lands



Typical Surface Coal Mine Life Cycle

Pre-mining

Mining

Contemporaneous Reclamation

Dense herbaceous cover

Reforestation Research Projects

- University of Kentucky
  - Starfire
  - Bent Mountain
- West Virginia University
  - Ohio Mine Study
  - Mountain Top Mined Areas
  - AML Sites
- Virginia Tech
  - Powell River

Kentucky

Virginia

West Virginia

Commonwealth of Kentucky, USA
Reclamation Advisory Memorandum (RAM) No. 124 – March 1997

- The Commonwealth of Kentucky Issued Forestry Reclamation Practices RAM 124 based on the advice of a panel of experts and administrators
- RAM 124 comprised the following items
    1. Selection of a growth medium
    2. Grading
        1. Area/Mountaintop
        2. Dragline
        3. Steep Slope
        4. Final Surface

Commonwealth of Kentucky, USA

Reclamation Advisory Memorandum (RAM) No. 124 (cont'd)

3. Tree-compatible ground cover
4. Fertilizer requirements*
5. Tree species selection
6. Tree planting

Commonwealth of Kentucky, USA

Reclamation Advisory Memorandum (RAM) No. 124 (cont'd)

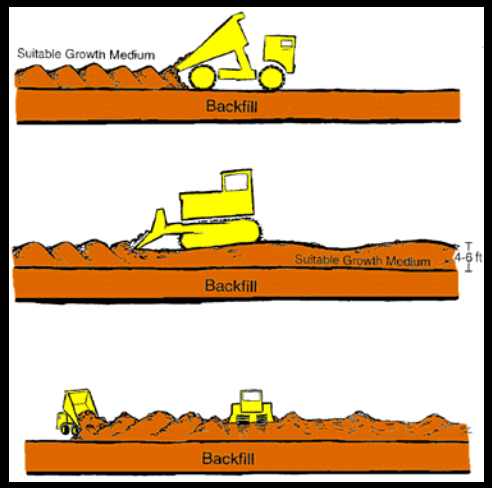


Diagram 1. Area Mining or Mountaintop Mining Methods

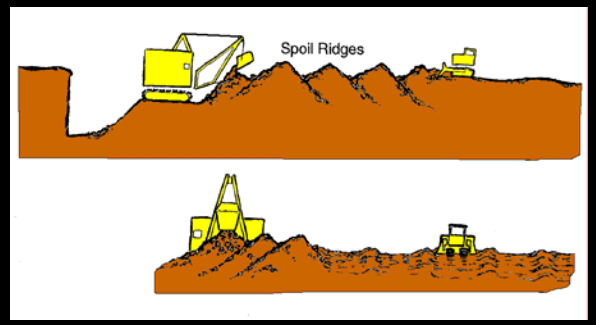


Diagram 2. Area Mining or Mountaintop Mining by Dragline Method

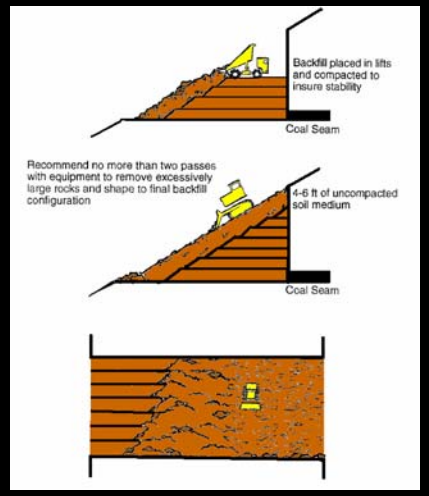
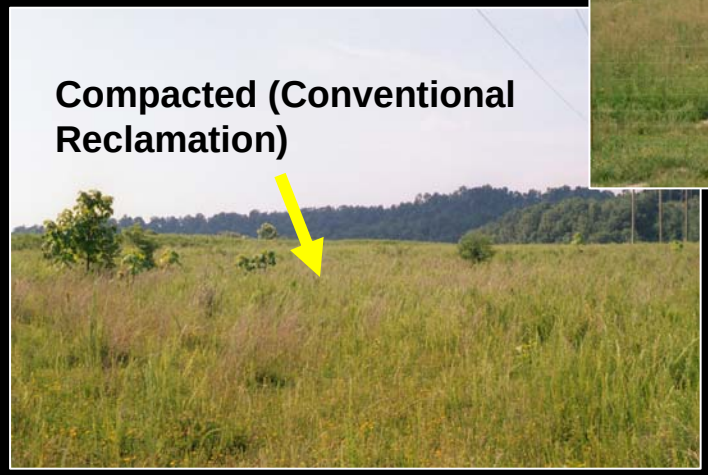
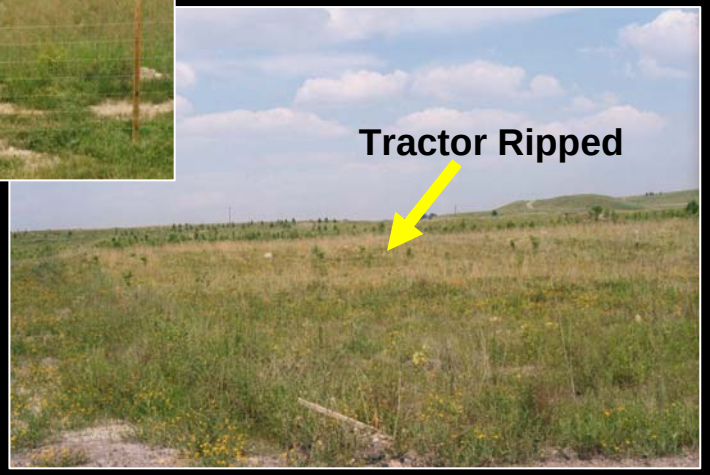


Diagram 3. Contour Mining or Other Sloped Areas

Starfire Mine:
Testbed for RAM 124 Reforestation Concepts

Starfire Mine: Loose vs. Compacted Final Ground Cover





7-Year Starfire Testbed Program Validates RAM 124

Seedling plots on compacted site (control) after seven years of growth.

Seedling plots on uncompacted site (loose dump) after seven years of growth.

Starfire Mine Test Bed

Tree Growth on Uncompacted Soil

(2 year growth)

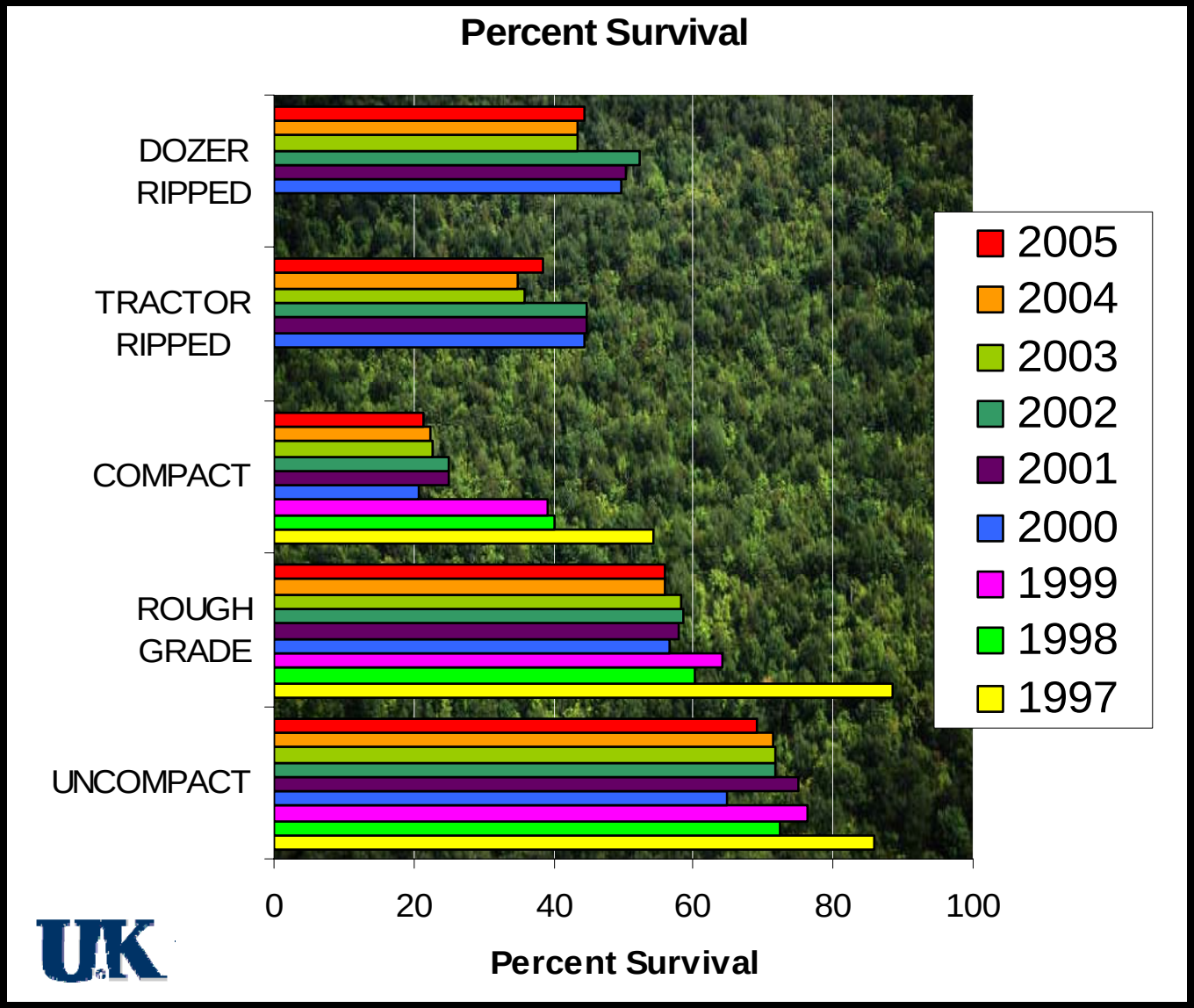
Starfire Mine Test Bed

Tree Growth on Uncompacted Soil (7 year growth)

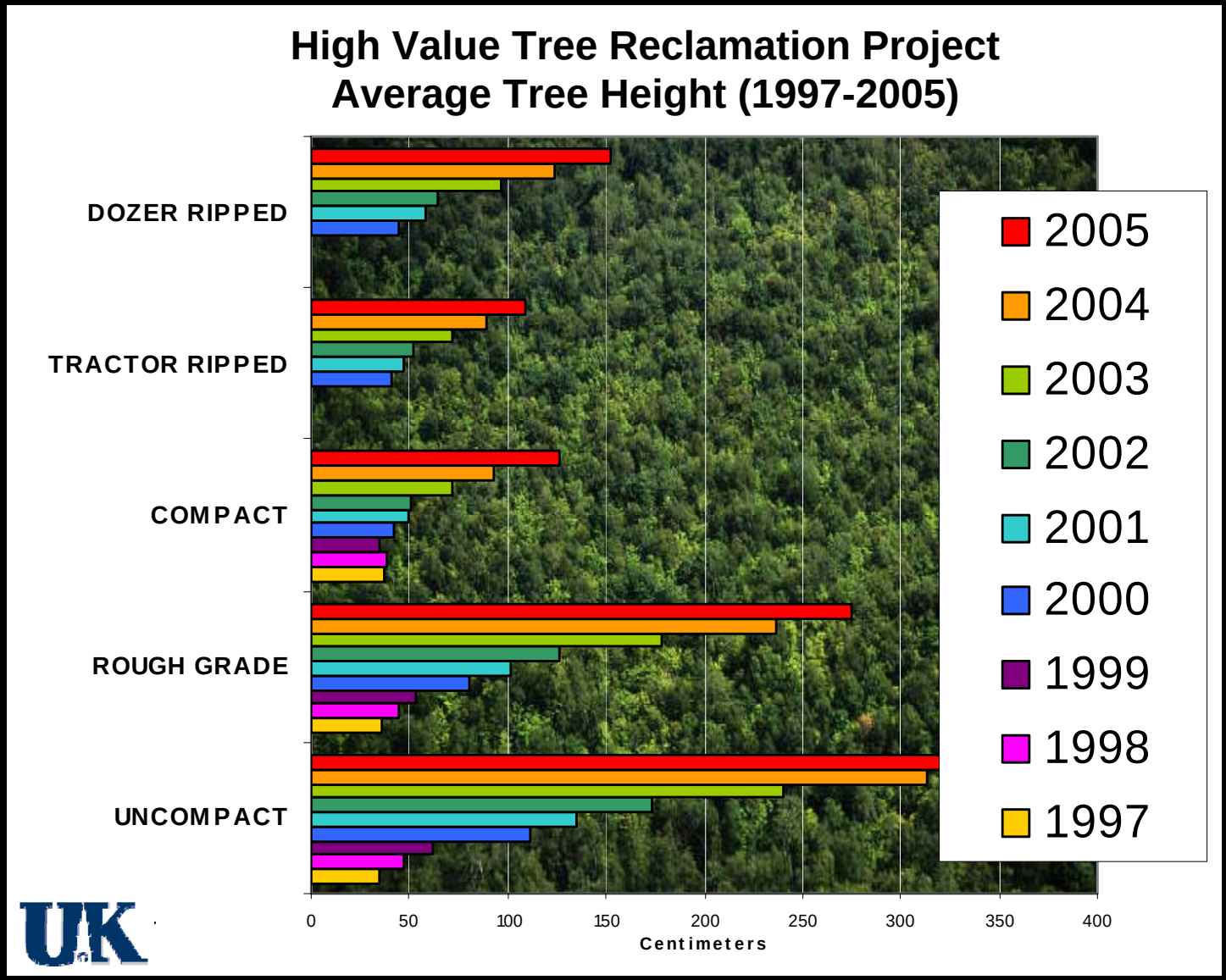
Starfire Mine Test Bed

Tree Growth on Uncompacted Mine Spoil (10 year growth)

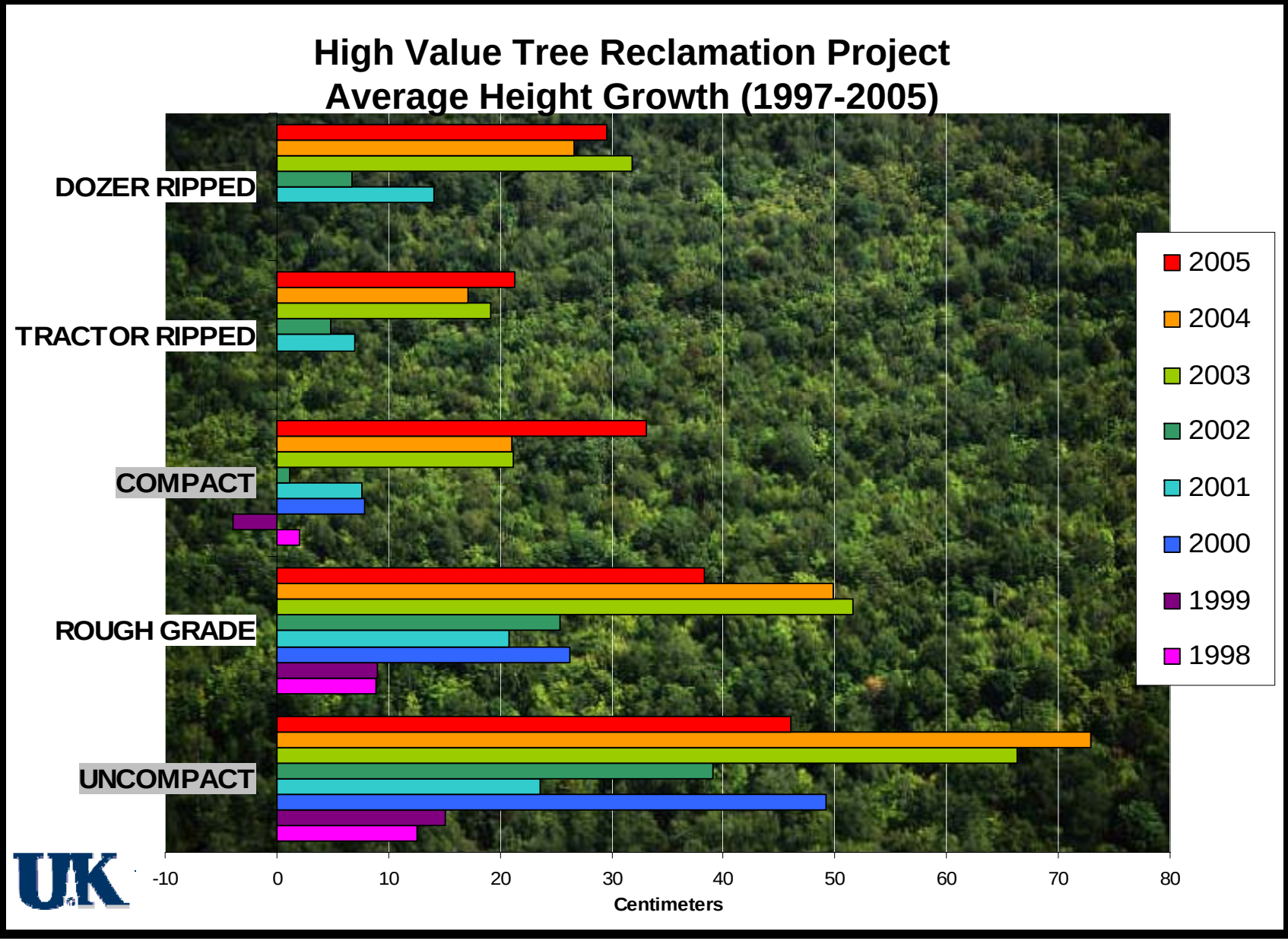
Starfire Mine Testbed Statistics



Starfire Mine Testbed Statistics



Starfire Mine Testbed Statistics



RAM 124 Practice Results
Bent Mtn Mine, Kentucky, USA

From this

To this

Reforestation of Previously Reclaimed Sites

- Challenge: Preparation of a loose rooting zone
  - Excavator “Pockets”
  - Deep ripping

Excavator Pocket Results

Two excavators preparing previously reclaimed mine site for tree planting.

Trees planted utilizing excavator pocketing, Bent Mountain, Kentucky.

Ripping Previously Reclaimed Mined Lands for Reforestation Purposes

Reclaimed mine site (compacted)

Preparing reclaimed mine site for reforestation

Tractor ripping compacted ground on reclaimed mine site

Reclaimed mine site prepared for reforestation

Large-Scale Ripping of Previously Reclaimed Lands

Dozer ripping on contour cut
Bent Mtn Surface Mine
Pike County, Kentucky, USA

3–Year Tree Growth on Deeply Ripped Previously Reclaimed Lands

Bent Mtn Surface Mine

Revised Best Practice for Reforesting Mine Lands

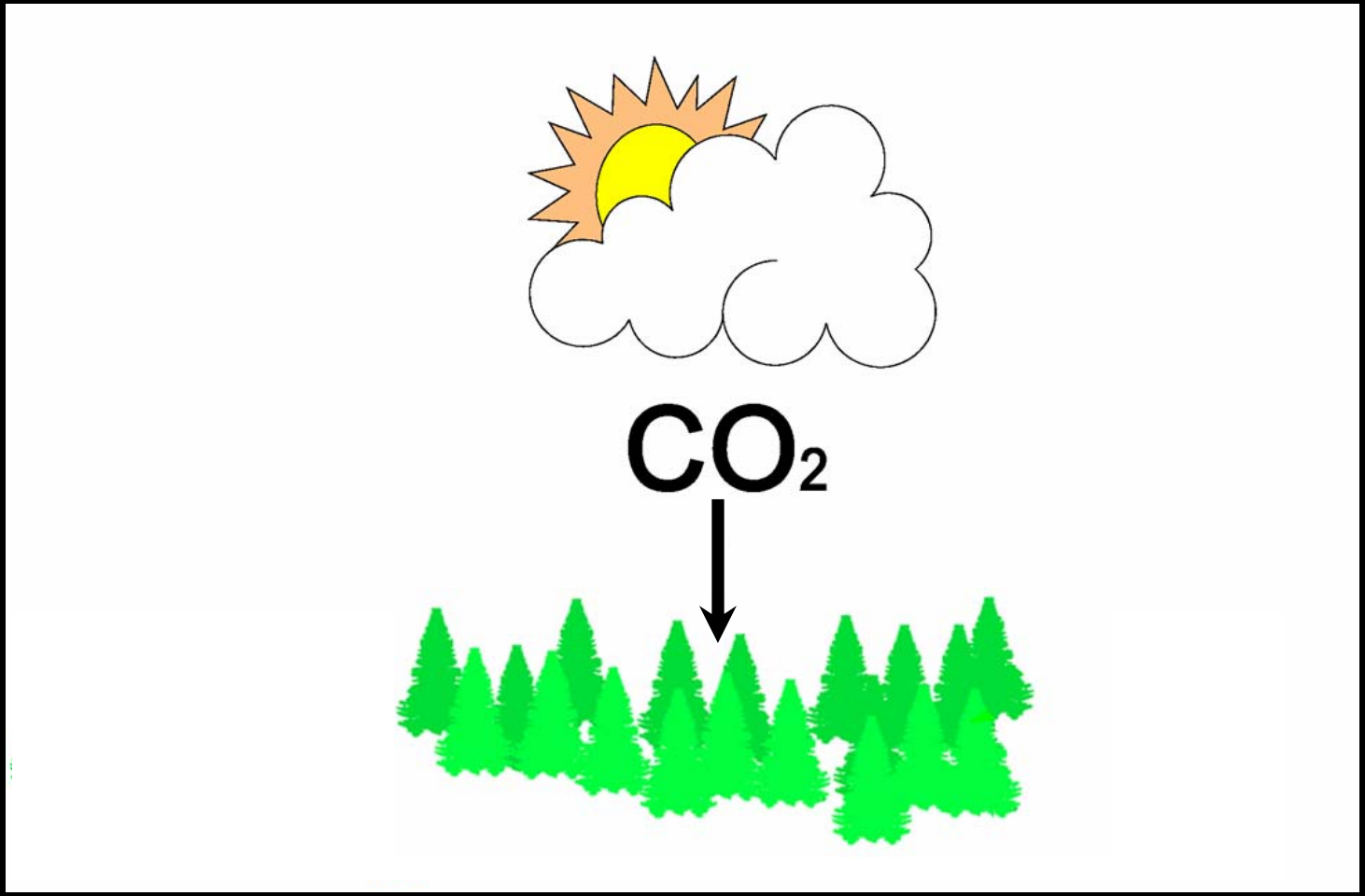
Five-step approach adopted by Appalachian Regional Reforestation Initiative (ARRI) based on two decades of research:

1. Create a new soil medium
2. Loosely grade the topsoil or topsoil substitutes
3. Use native and noncompetitive ground covers
4. Plant two types of trees
5. Use proper tree planting techniques

State Regulatory Agencies that have Adopted New Mined Land Reforestation Guidelines

- The Virginia Department of Mines, Minerals, and Energy (DMME) – 1996
- The Kentucky Department of Surface Mining and Reclamation Enforcement (DSMRE) – 1997
- The West Virginia Department of Environmental Quality – 1998
- The Missouri Department of Natural Resources – 1998
- The Tennessee Federal Program – 1999
- The Indiana Division of Reclamation – 1999

Reforestation and Carbon Capture & Storage



Carbon Storage Potential of Trees

- The benefits of reclamation with trees include reducing the negative effects of global warming by storing carbon in trees.

A tree can store up to one ton of carbon dioxide over its lifetime.

Harvesting and using the wood for permanent/semi-permanent uses (furniture, buildings, etc., extend the storage period.

Storing Carbon in Forests Planted on Abandoned Mine Land

- 367,000 acres (148,500 hectares) of abandoned (unreclaimed) mine land (AML) in the Appalachian coal region of the USA
- Provide little or no economic value
- Afforestation and forest management can provide two major benefits
  - Financial
  - Environmental

Abandoned Mine Land (AML) Reclamation Project

Abandoned Mine Land (AML) Reclamation Project (cont'd)

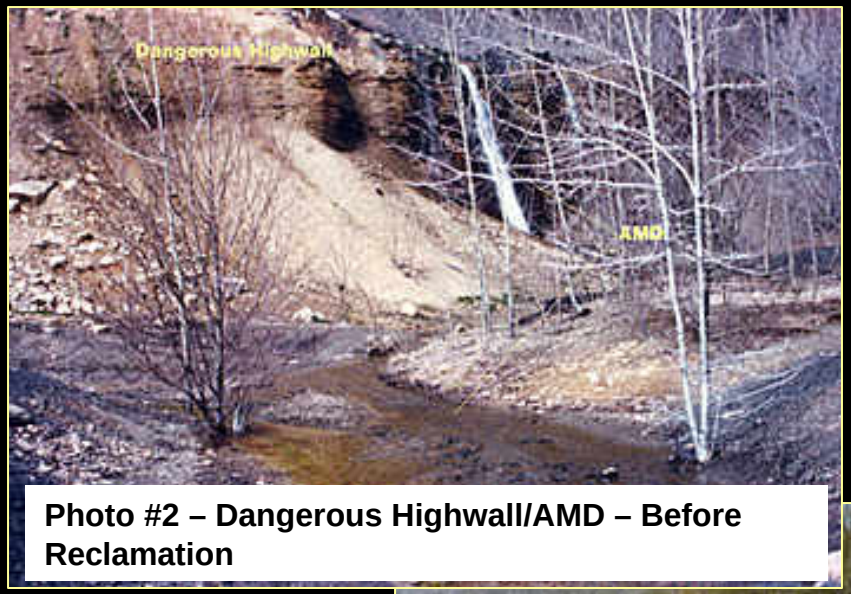


Photo #2 – Dangerous Highwall/AMD – Before Reclamation

Photo #3 – Dangerous Embankment/Clogged Stream

Photo #4 – Industrial/Residential Waste – Before Reclamation

Abandoned Mine Land (AML) Reclamation Project (cont'd)

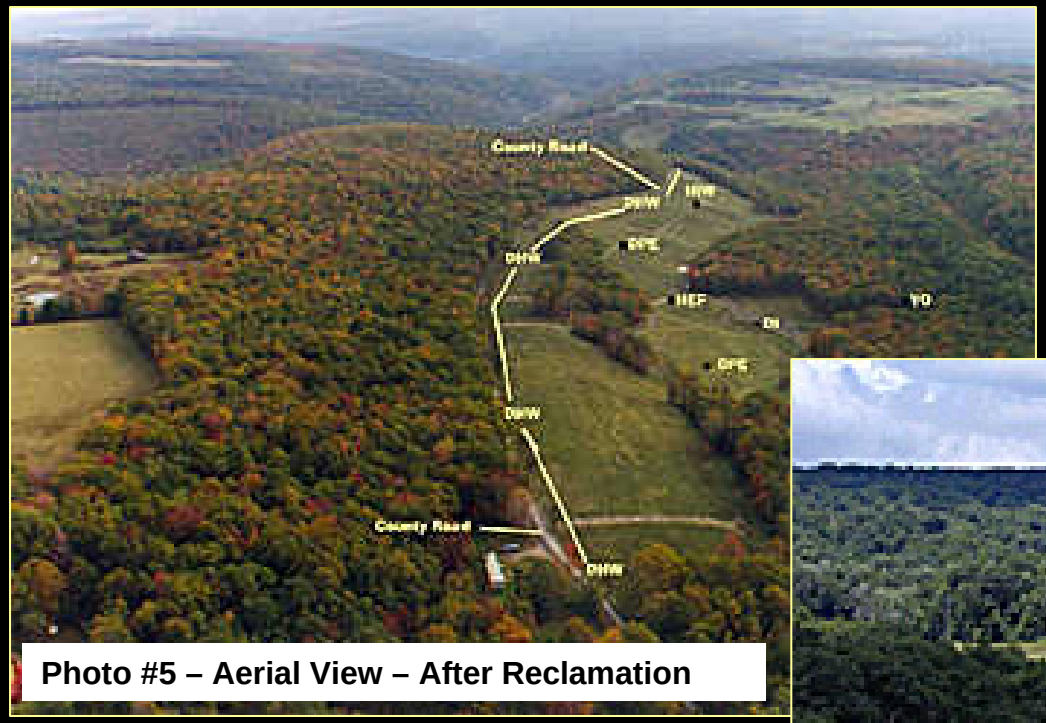


Photo #5 – Aerial View – After Reclamation

Photo #6 – After Reclamation

Remining – A Reforestation Opportunity

- Both surface and underground mines are increasingly “reworking” previously mined over areas
- Remining by surface mines provides an opportunity to restore/reclaim/and reforest

Remining: Surface/Underground Mines

Fairfax site located in West Virginia.

Fairfax site during remining.

Regraded to approximate original contour.

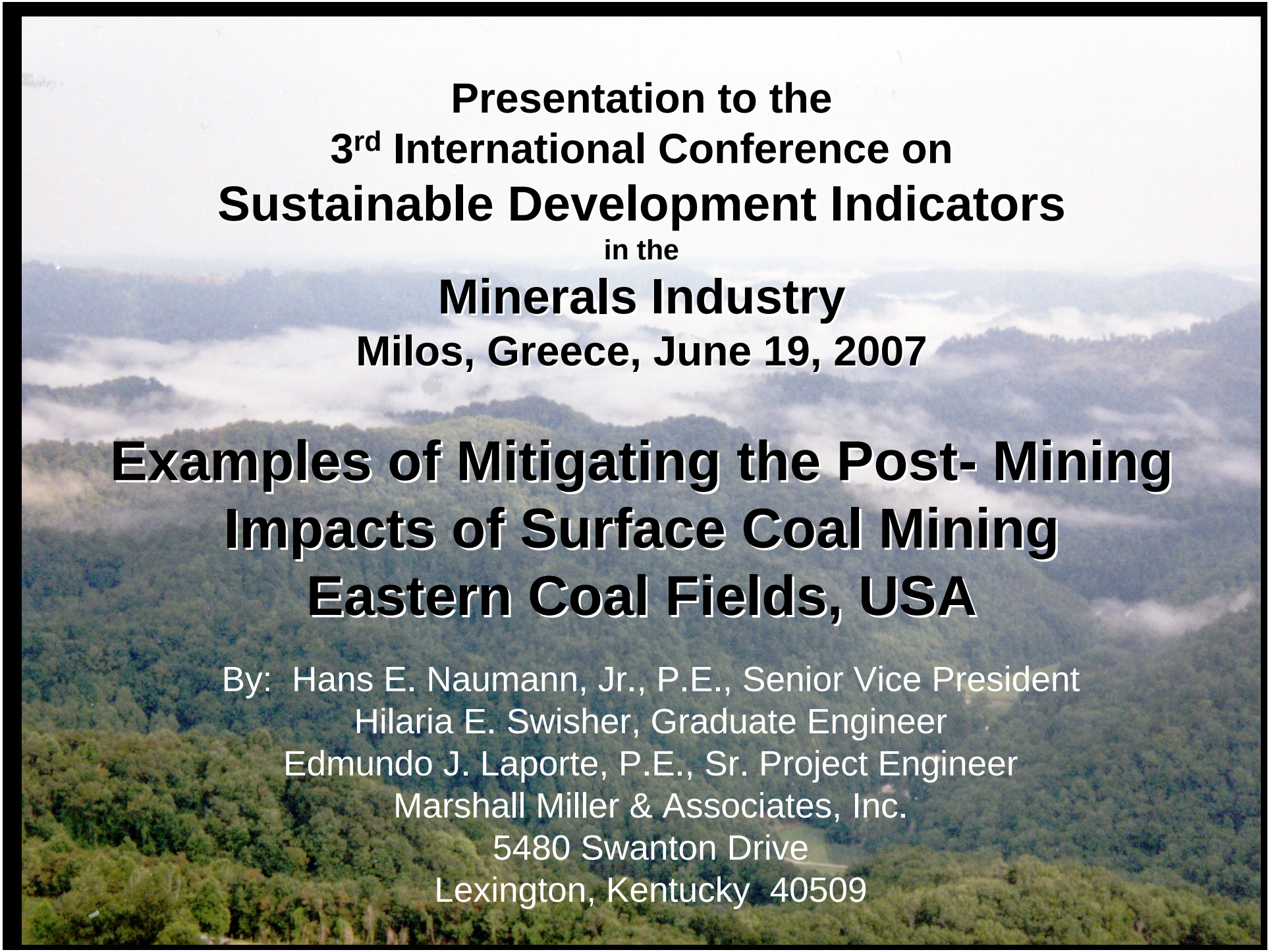
Fairfax site after revegetation.

Re-Cap
Coal's Strategic Importance in the U.S. Energy Picture

- North America holds an abundance of coal
- The coal resources are predominantly held (unitized) by the major coal producers
- The coal production process is safe, productive, and time-proven
- The delivery systems are in place
- The industry has a proven commitment to environmental and regulatory compliance
  - ✓ The industry has taken major steps in:
    - ➢ maximizing resource recovery
    - ➢ mitigating the impacts of mining
    - ➢ developing alternative land uses and,
      - ➢ providing an attractive carbon capture and storage option

Partial List of Resources

- **Virginia Tech**, Sustainable Development of Mineral and Energy Resources, Lecture #13, Rehabilitation and Post-Mining Land Use
- **Office of Surface Mining/U.S. Department of Energy/National Energy Technology Laboratory**, www.mcrcc.osmre.gov
- Robert Addington, Chairman/CEO, **EnviRes, LLC/DTX Technologies, LLC**
- Dr. Don Graves, Ph.D, Extension Professor, Surface Mine Reclamation and Forest Economics, **University of Kentucky**
- Dr. Jeffrey G. Skousen, Ph.D, Extension Specialist and Professor of Soil Science, College of Agriculture, Forestry and Consumer Sciences, **West Virginia University**
- David Maynard, General Superintendent, **Bent Mtn Surface Mine, Appalachian Fuels, LLC**
- William Marshall, Facility Director, Robinson Forest, College of Agriculture, Department of Forestry, **University of Kentucky**
- J. Steven Gardner, P.E, President/CEO, **Engineering Consulting Services, Inc.**
- **Appalachian Regional Reforestation Initiative**, Statement of Mutual Intent, November 3, 2006, Hazard, Kentucky
- Reforestation and Mine Reclamation, **U.S. DOI, OSM**, 2006
- Reclamation Advisory Memorandum, **KDSMRE**, March 10, 1997
- Mined Land Technical Reforestation Guidance & Recommendations, Memorandum 99-3, **Indiana Division of Reclamation**, July 17, 1999



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