

ARRI Conference

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Forestry Reclamation Approach: Low Compaction Grading

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Purpose

Overview of the benefits of **low compaction grading** for mined land reforestation.

Traditional site preparation



Forestry site preparation



West Virginia Forestry Statistics

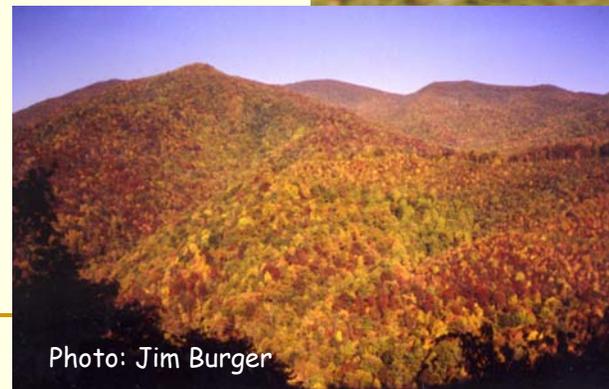
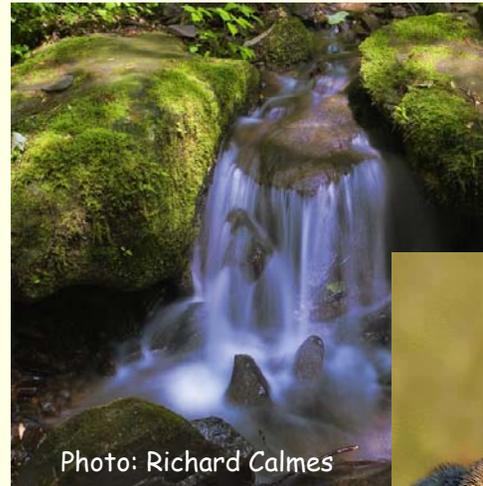
American Forest and Paper Asso. (2002) (<http://www.afandpa.org/>)

- 79% forested
- 271 manufacturing facilities
- Wood products is 3rd in manufacturing after metals and chemicals
- Annual payroll \$430 Million
- Value of industry shipments: \$2 Billion
- Value of coal production: \$5 Billion (WVCA 2007)



Forest Products and Services

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



All increase as quantity and quality of forests in the landscape increase.

Native forest

- Mixed mesophytic
- Appalachian oak



Land Use Change in the Midwestern and Appalachian Coalfields

Surface Mining Control and Reclamation Act

“ All disturbed areas shall be restored to their original use and capability or to a higher or better use.”

1.3 Million acres



Scrub Land

Black locust
Autumn olive
Fescue/lespedeza

Post-mining condition

- abandoned hayland/pasture
- abandoned wildlife habitat
- unmanaged forest land

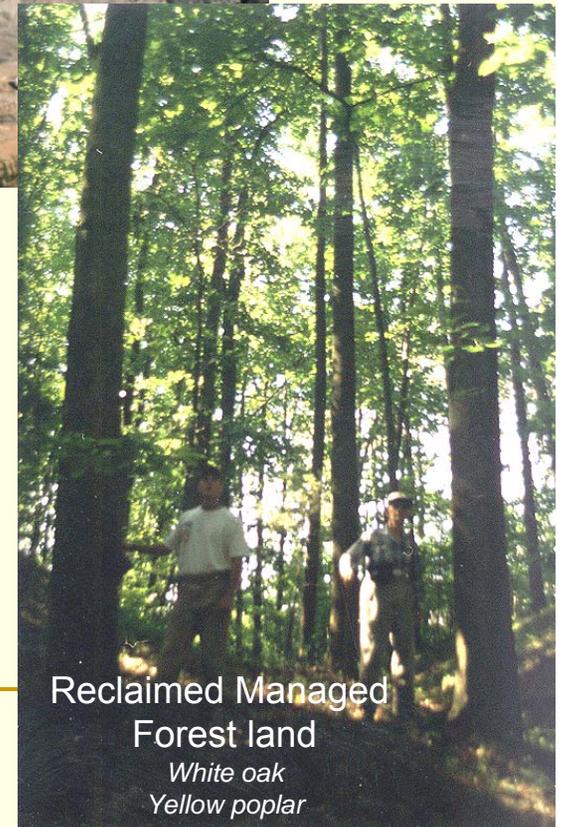


Our Reclamation Legacy

Which will it be
←----?---->

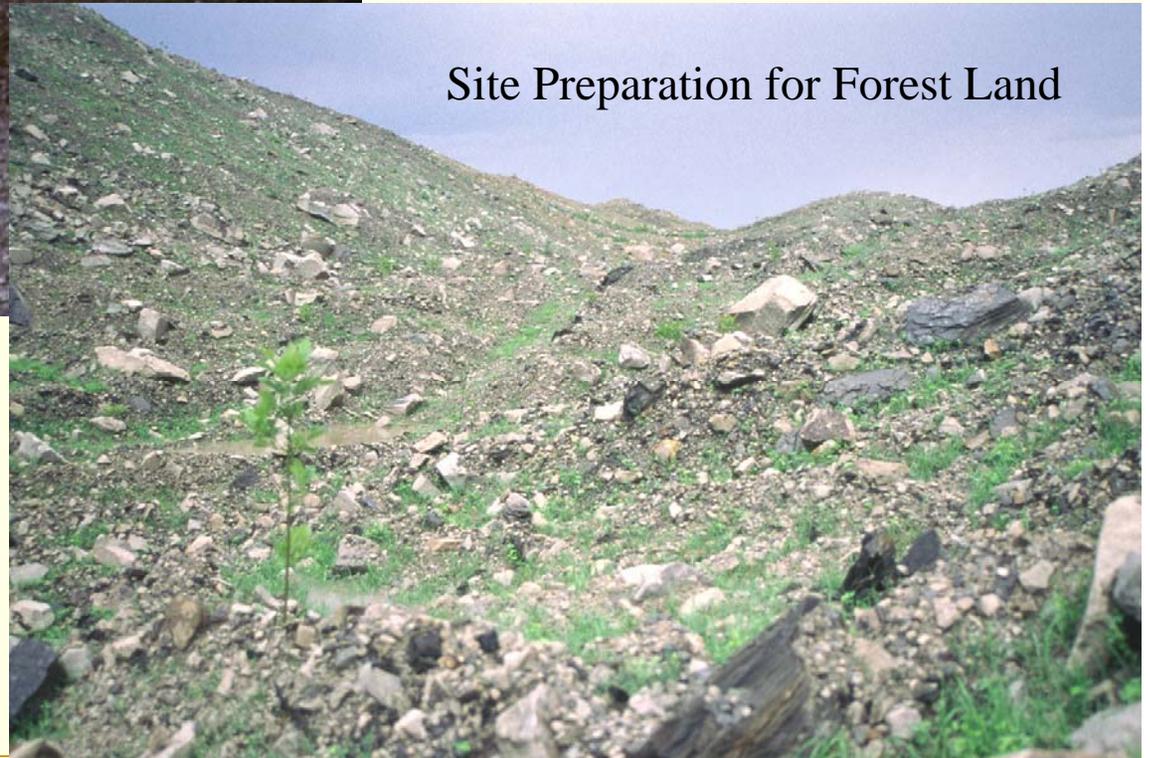
Reclaimed Managed Forest land

White oak
Yellow poplar





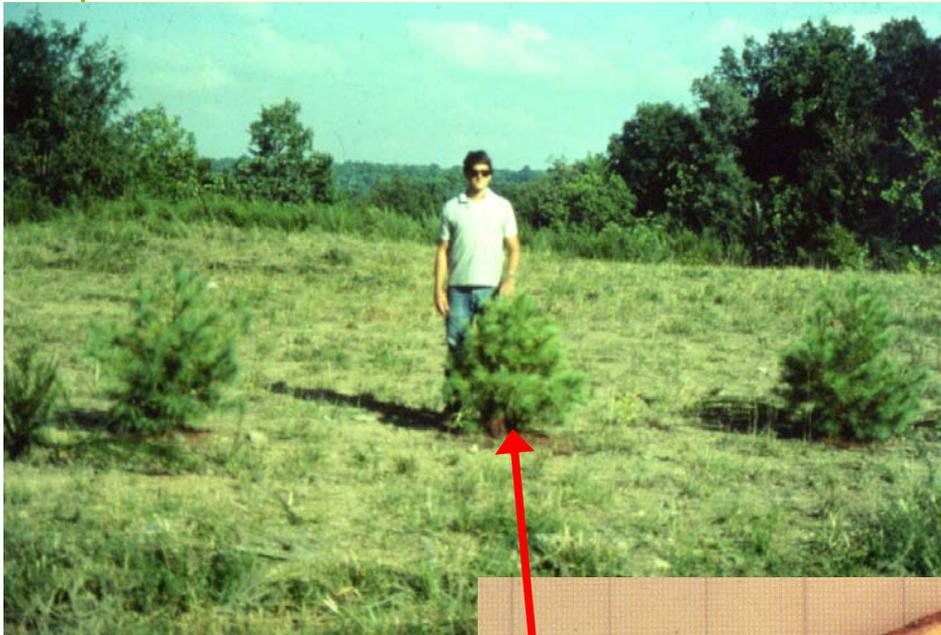
Traditional Site Preparation



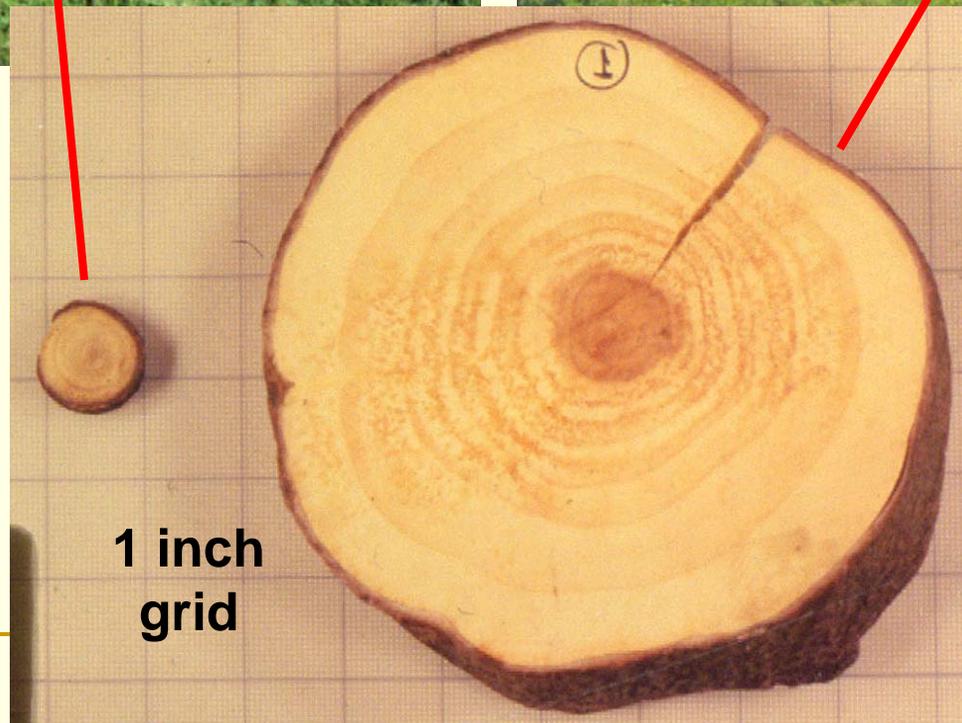
Site Preparation for Forest Land

FRA Step 2. Leave surfaces loose and un-compacted.

8-yr-old white pine; site class V



8-yr-old white pine; site class I



1 inch
grid

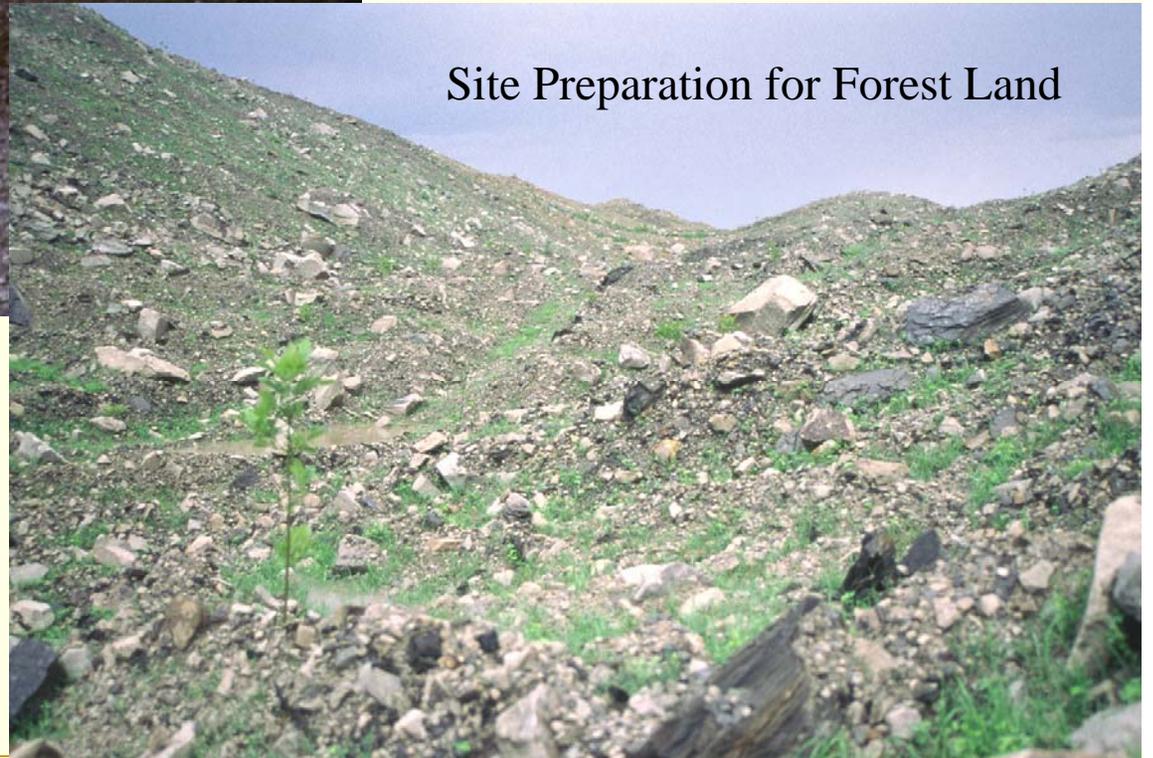
Forbert et al., 1988,
J. Environ. Qual.

Influence of mine site quality on commercial forest value

Mine Soil Quality	Very Dense	Heavily compacted	Moderately compacted	Slightly compacted	Loose
Oak Site Index (ft ₅₀)	45	55	65	75	85
Volume Board feet (MBF)	1	2	4	7	12
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
Average % Return on Investment	-2	1	2	4	8



Traditional Site Preparation

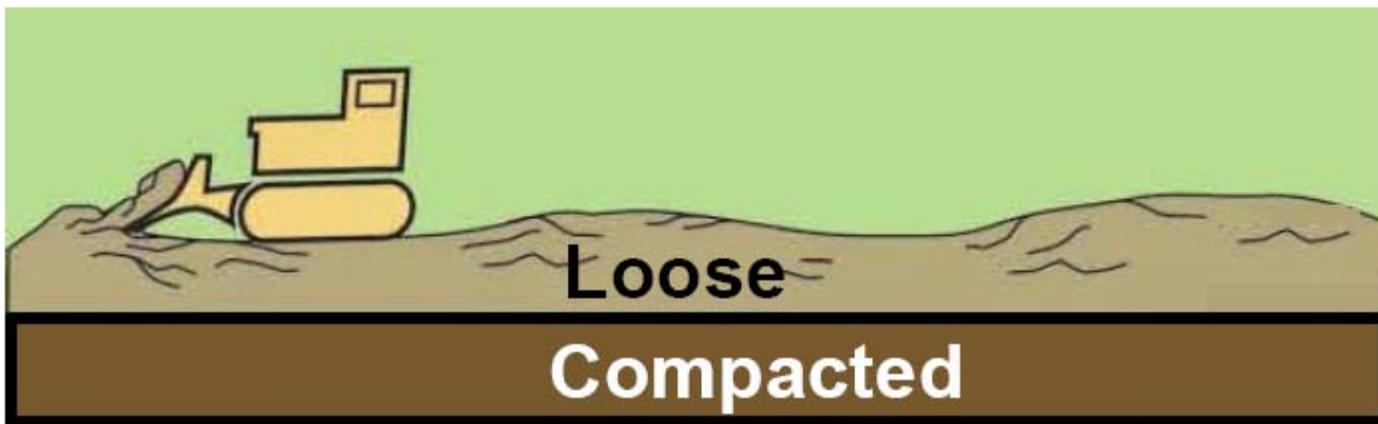


Site Preparation for Forest Land

FRA Step 2. Leave surfaces loose and un-compacted.

Flat to moderate slopes

- End-dump topsoil in tight piles 4 to 6 feet deep
- One pass strike off with light dozer, dry conditions
- Keep traffic off final surface

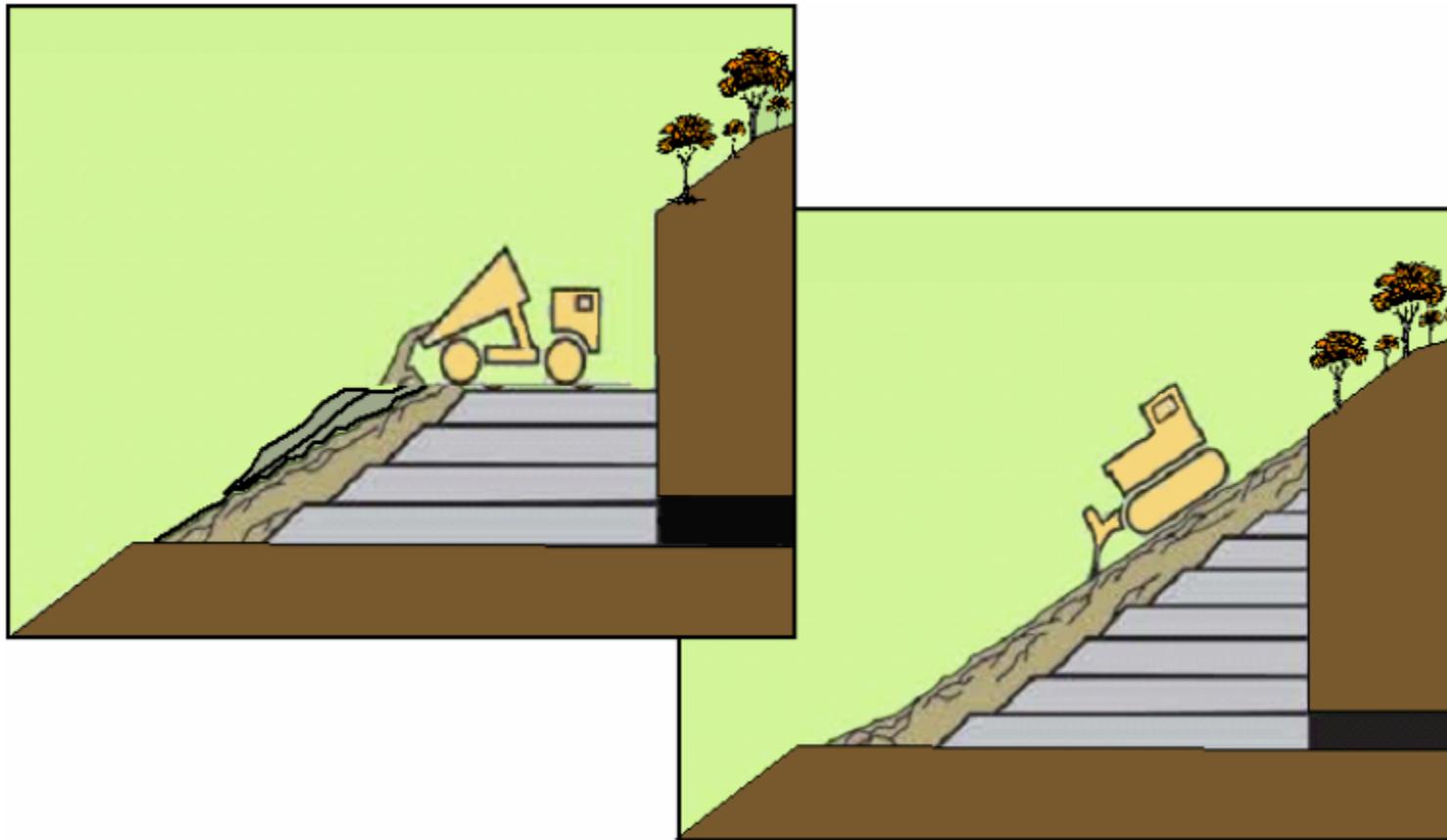






Steep slopes

- backfill compacted for stability
- topsoil applied after each lift or after complete backfill
- leave surface rough-one pass





University of Kentucky Starfire Project: Loose grading project established 1997

Photos 2004



Conventional

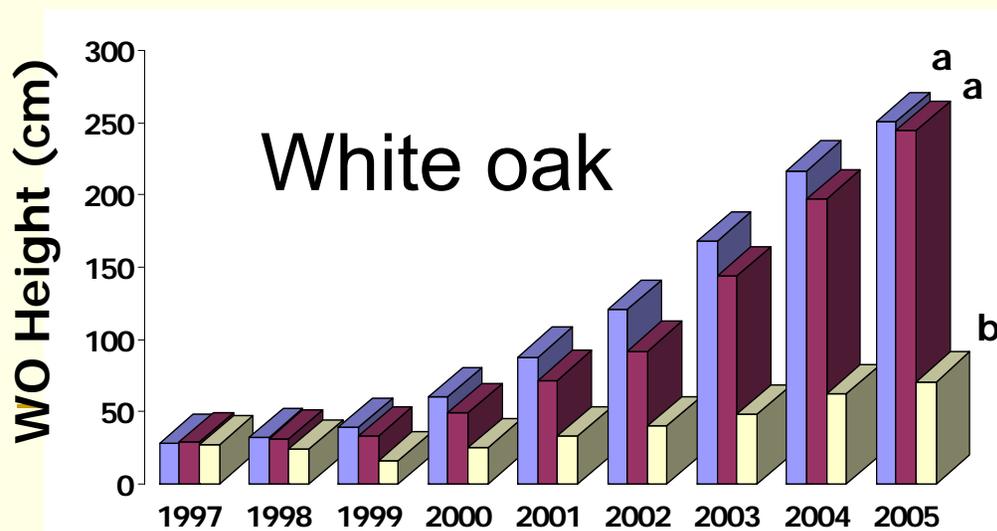
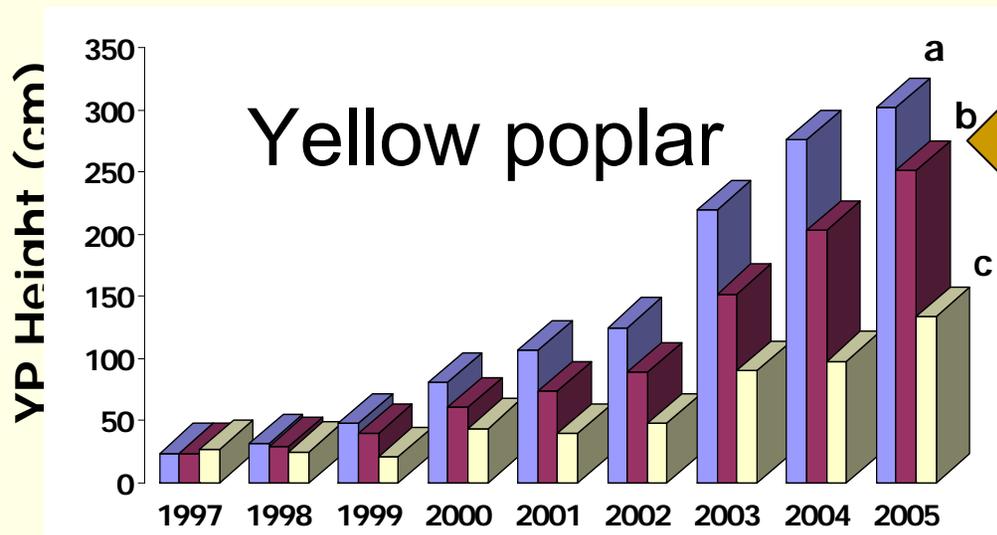


Loose-dump

UK Starfire Project: Compaction study

■ Uncompacted ■ Strike-Off ■ Conventional

Strike-Off 2007



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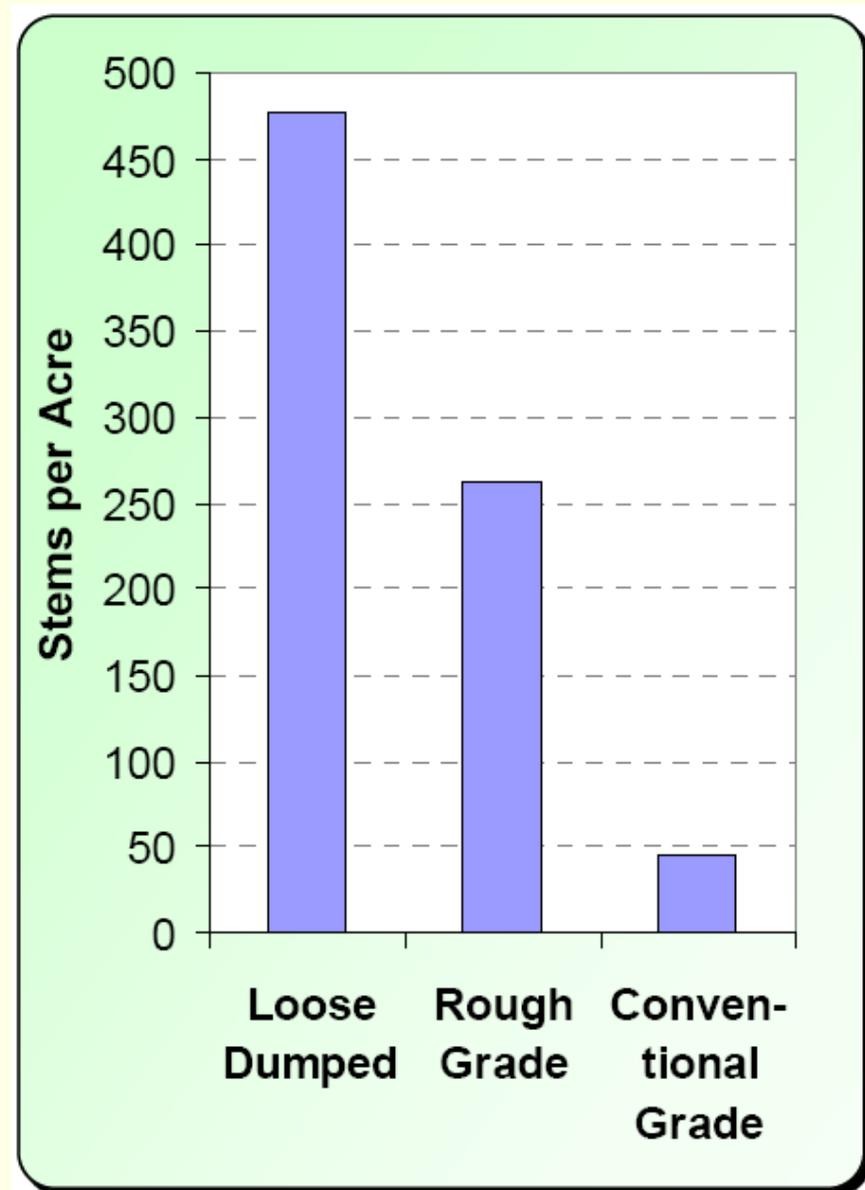
Biodiversity

Grading effect on Natural Seeding of forest species after 8 years (Perry Co., KY)

Loose Dumped: the woody canopy occupied more than half the area.

Conventional Grade: woody canopy cover was only 5% percent.

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



Mine soil density, compaction, grading

Martiki Mine, Eastern KY



Treatment 1
Backblade 2 passes



Treatment 2
Bladed 3 passes
Tracked in



Treatment 3
Intensive grading
Ripped 3 feet deep
10 feet apart

Torbert, J.L., and J.A. Burger. 1994. *ASMR Proceedings*

Soil Erosion and Sediment Control

Legend:

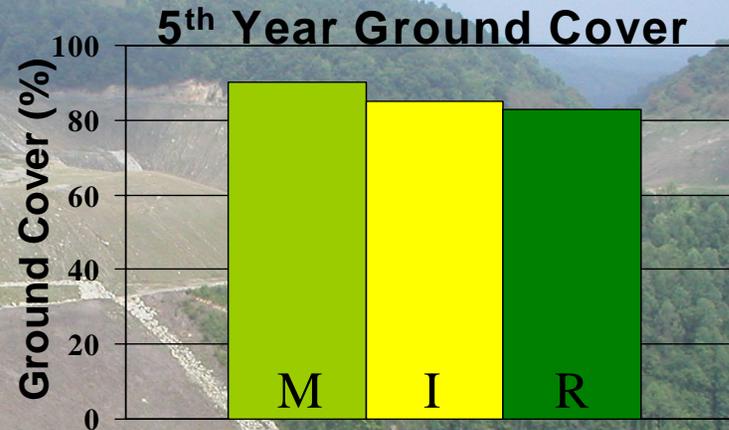
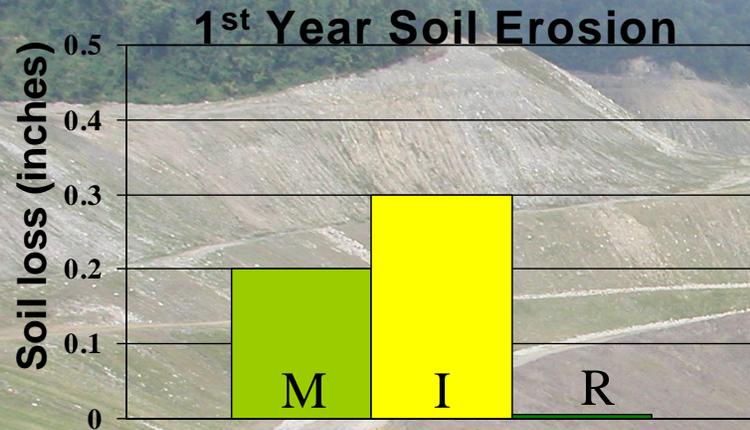
Moderate



Intensive



Ripped



Torbert, J.L., and J.A. Burger. 1994. *Proceedings ASMR*

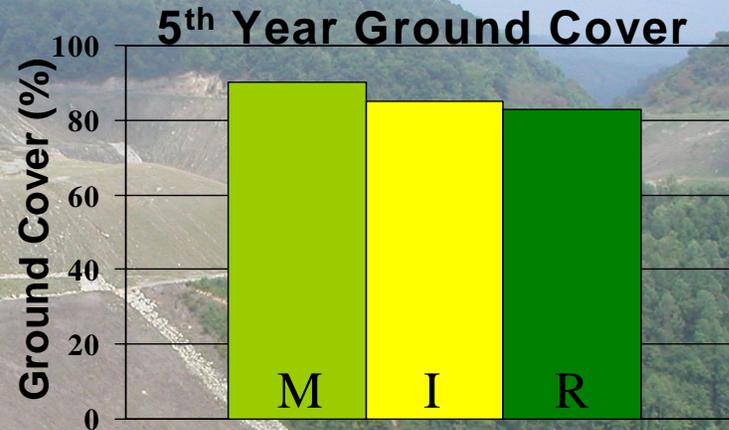
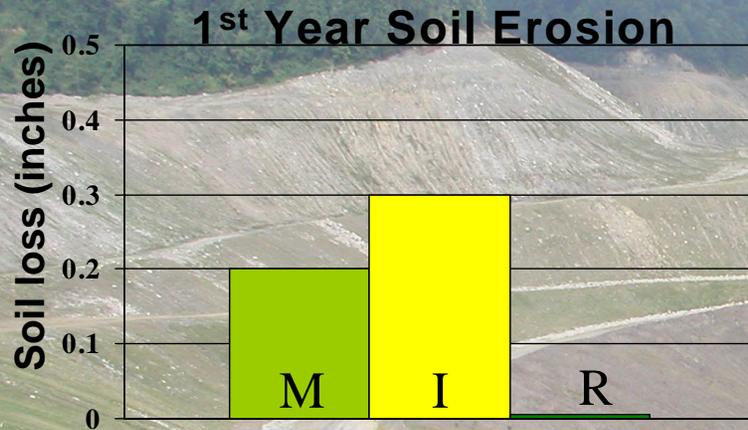
Legend:
Moderate



Intensive



Ripped



- Less grading
- Loose, rough surface
- More water infiltration
- Less water runoff
- Less erosion
- Less sediment in ponds
- Lower cost to maintain

Sediment Pond

Torbert, J.L., and J.A. Burger. 1994. *Proceedings, 1994 ASMR*

Grading costs (\$/acre)

(Baker et al., 2008)

	Hayland/Pasture		Forest	
	D9	D11	D9	D11
KY	481	589	120	147
MD	360	441	90	110
OH	395	484	99	121
PA	469	574	117	144
TN	403	493	101	123
VA	396	485	99	121
WV	773	947	193	237

- state differences based on machine operating conditions
- reclamation type difference based on number of bulldozer passes

Total costs (\$/acre)

(Baker et al., 2008)

	Hayland/Pasture	Forest
KY	1798	1574
MD	1711	1543
OH	1841	1899
PA	1993	1679
TN	1611	1460
VA	1655	1515
WV	2210	1860

- forestry less expensive in grading & seeding, but mitigated partially by tree planting
- Ohio difference due to tree seedling costs

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Sediment pond clean out? \$\$\$\$\$\$

Gully repair work? \$\$

Low compaction grading is smart reclamation

- It costs less money
 - Smooth surfaces are counter productive to forestry reclamation and are not required by SMCRA
 - Tracking-in compacts surface soil and is not needed
-

Loose, un-compacted soils helps trees survive and grow because:

- Planters get trees planted correctly
 - Rain water soaks in the soil instead of running off
 - Soil is more porous so it holds more water and air
 - Roots can grow more freely
-

Triple Shank Ripper

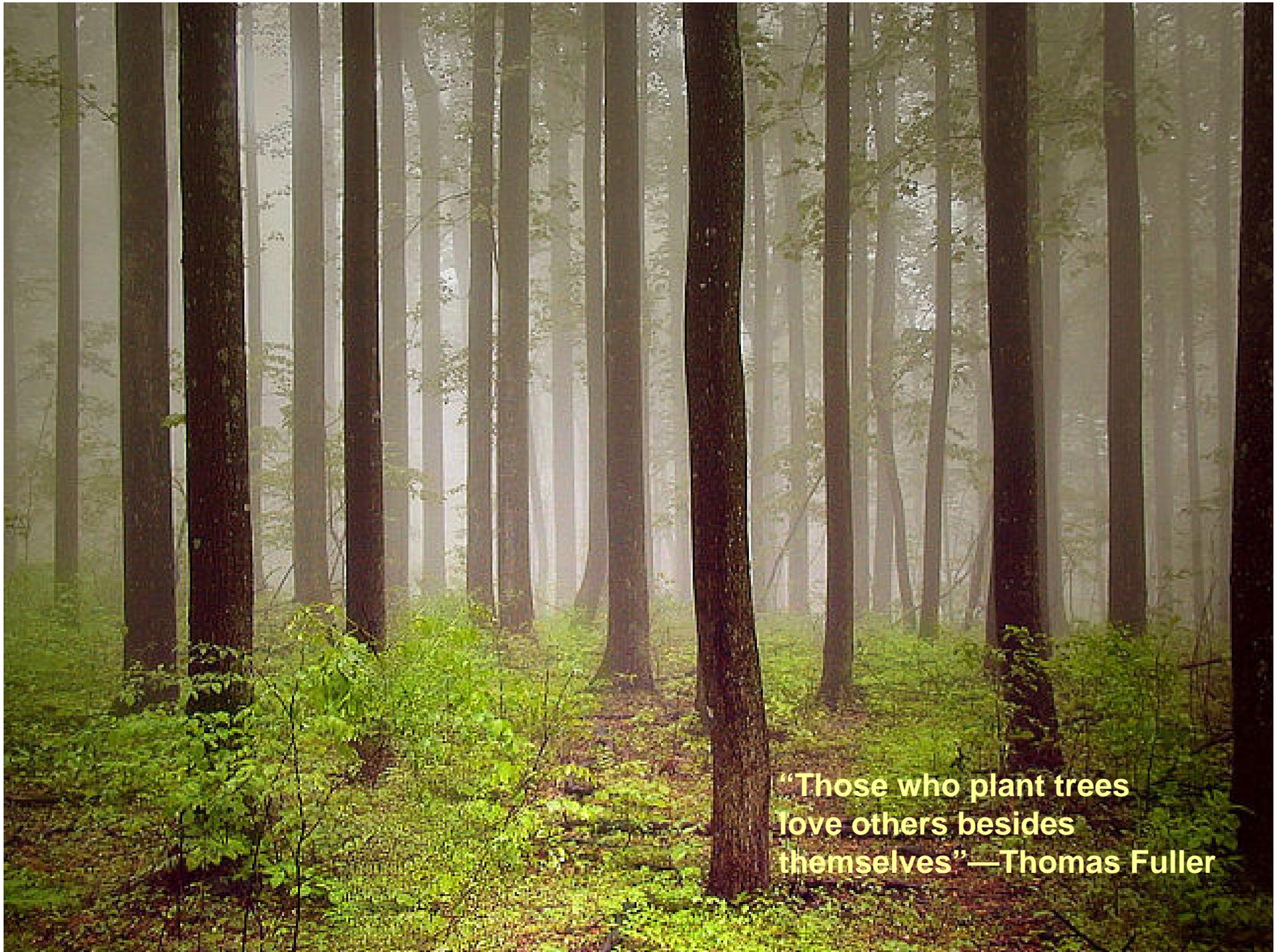


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Frequently asked questions

- What about site stability?
 - What about backfill settlement?
 - If left loose and rough, is it too “ugly”?
 - If the surface is not compacted, will it erode faster?
 - If gullies develop, should they be regraded?
 - Will the mine inspector like it?
-



**“Those who plant trees
love others besides
themselves”—Thomas Fuller**

Is Ripping Needed?



Soil Density Condition	Very Dense	Dense	Moderately Compacted	Slightly Compacted	Loose
Spade penetration	0-1 inches	1-3 inches	3-6 inches	6-9 inches	9-12 inches
Site Quality Class	V (poor)	IV (fair)	III (medium)	II (good)	I (excellent)
Oak site index ^a	40	50	60	70	80
Use for wood products	None	Firewood	Railroad ties	Saw timber	Veneer
\$/1000 board ft stumpage value ^b	-	Less than \$100	\$200	\$500	\$2000
Relative return on investment	-2%	0%	2%	4%	8%