



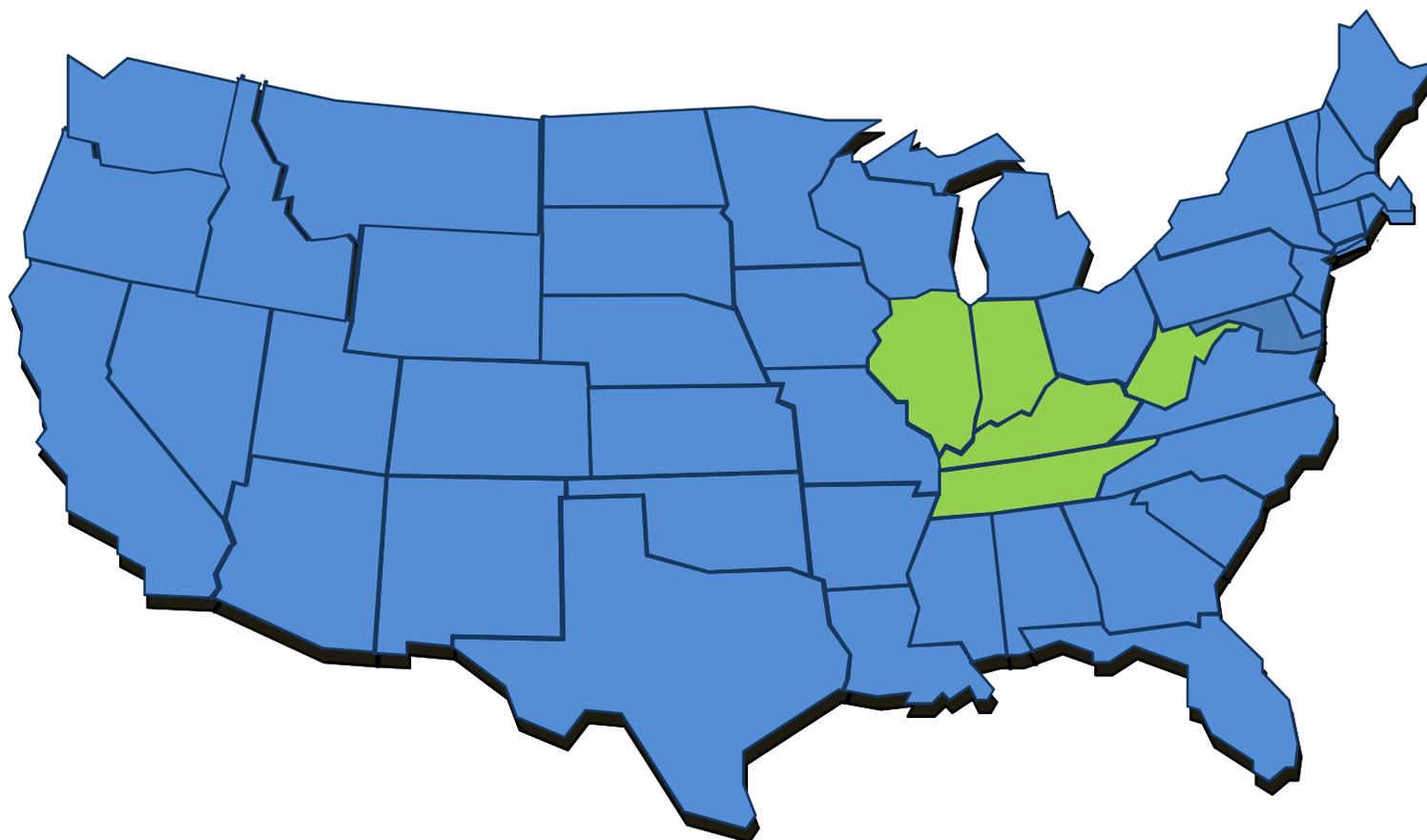
Applying the FRA

Big Brush Creek Mine No. 2

Sequatchie County, Tennessee

2010 Joint Mining Reclamation Conference
June 8, 2010

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Lexington Coal's Beginnings...

- Founded in 2004 to reclaim 305 coal permits in 5 states orphaned in the Horizon Natural Resources bankruptcy.
- Cooperative agreement: LCC, the regulatory agencies, and the sureties.

Lexington Coal 5 1/2 years later...



- Number of SMCRA permits reduced from 305 to 79.
- Liabilities reduced from \$234 million to \$28 million.
- Bonds released from \$218 million to \$40 million.
- 98% of the original permits have achieved at least a Phase I bond release.
- **Planted 3.3 million tree seedlings – many using the FRA.**
- Expanded into coal mining and contract recl.

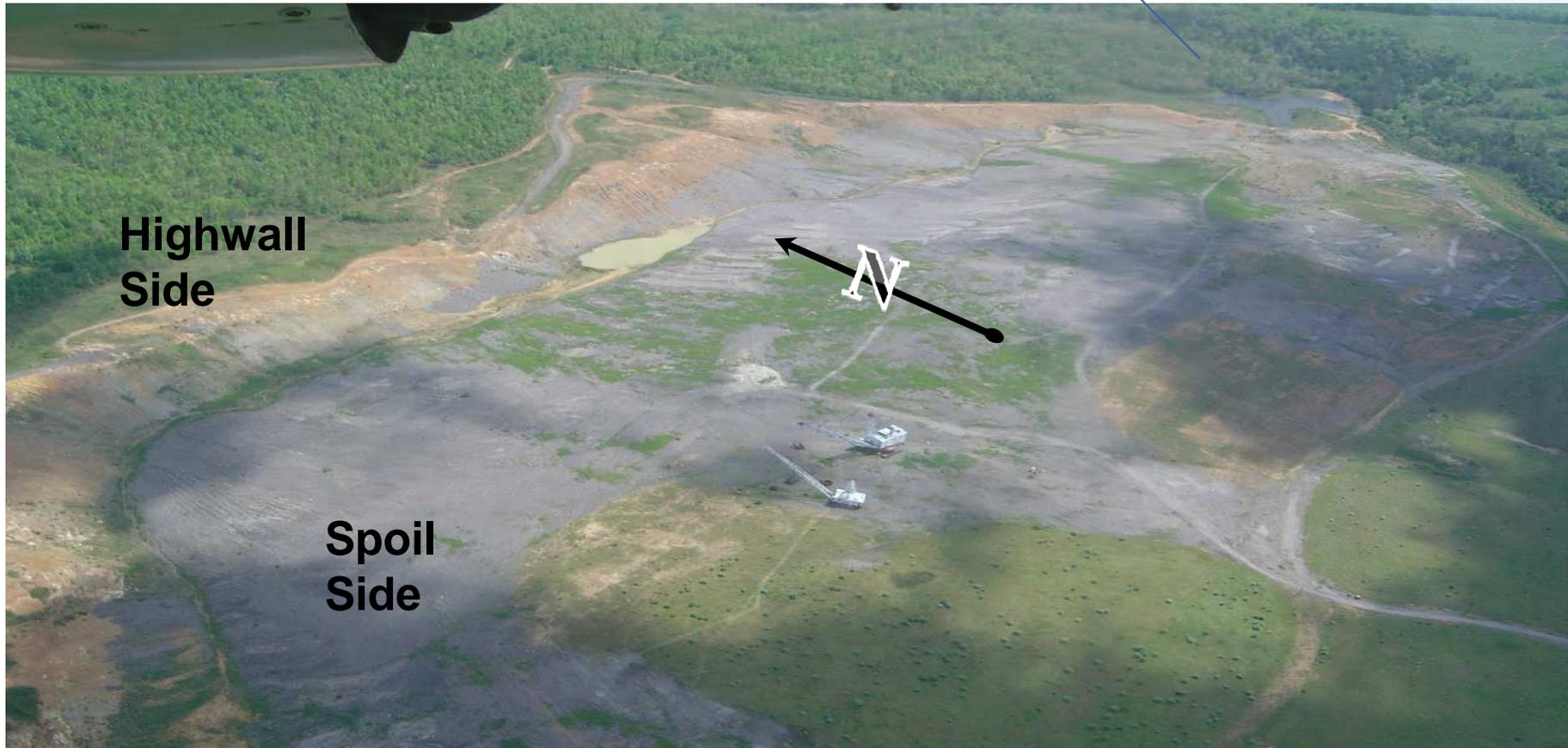


Big Brush Creek Creek No. 2 - *Mining*



- 650 acre Skyline Big Brush Creek Mine No. 2 (Permit No. 3186), located on the Sequatchie Valley plateau near Chattanooga, Tennessee.
- Cyprus Amax and Addington Enterprises, among others mined this coal in the '80's and '90s. Lexington Coal did no mining here.
- The 42 yd³ BE 1300 and 12 yd³ Marion 7400 draglines removed 17 million yd³ of overburden annually, uncovering 550,000 tons of coal.

Mining Suspended



- Coal removal ceased in 1999, leaving behind:
 - 2 million tons of coal reserves.
 - 280 acres of disturbance to be reclaimed.
 - An open dragline pit 100 feet deep, 120 feet wide and 3,500 feet long.
 - Two large draglines that we didn't own in the way.



Reclamation Liability

- Exposed highwall had been shot down and the spoils were rough graded into the dragline pit, consistent with a Fish & Wildlife PMLU.
- Reclamation efforts stopped until 2008...



Water Treatment

- 1,600 gpm of groundwater works its way through the mine spoils carrying with it Manganese that slightly exceeds effluent limits.
- Constructed wetlands with a limestone Manganese removal bed provides effective passive water treatment.



Fish & Wildlife PMLU

- Previous reclamation efforts involved multiple dozer grading passes, resulting in tight compaction of the soils.
- The Toxic Material Handling Plan required heavy top dressing of lime.
- Promoted excellent grass growth, but not conducive to trees/shrubs.

Fish & Wildlife PMLU



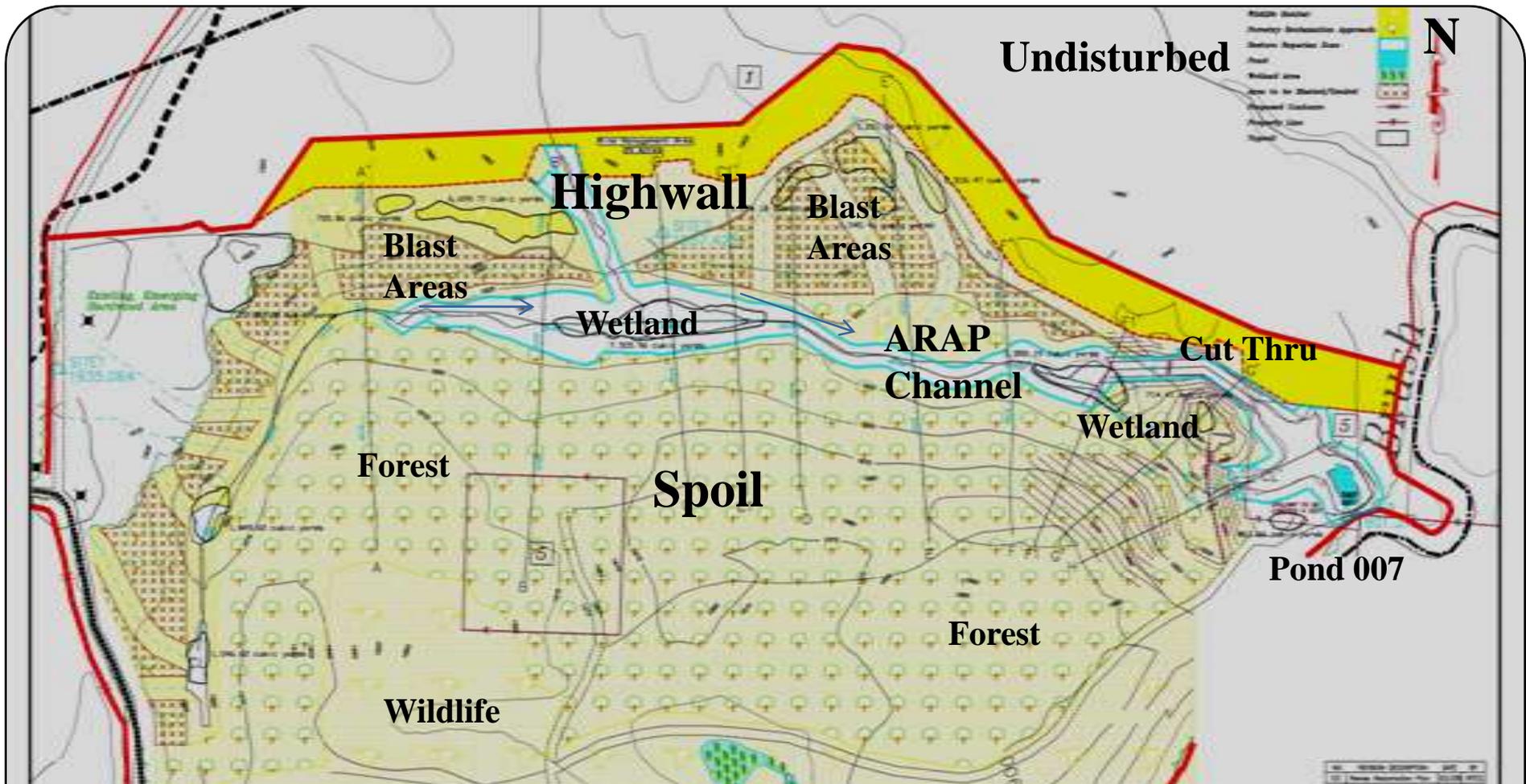
- Promoted excellent grass growth -- good for birds, wildlife and grazing, but not conducive to tree survival and growth.
- Commercial forestry is prevalent in the area for the paper industry.

Reclaimed Grasslands



Native Forestlands





Revised Reclamation Plan

➤ In 2008, Lexington Coal, OSM-KFO, TDEC and the landowner agreed on a contemporary reclamation plan for BBC2. Components:

- Eliminated north coal reserves.
- Grading plan that met Approximate Original Contour standard.
- Commercial Forestry PMLU using the FRA techniques.
- Aquatic Resource Alteration Permit (ARAP) stream restoration as mitigation.



Challenges: Compacted Spoils

- Soil Condition:
 - Well compacted, due to multiple dozer passes during grading of slopes and the site laid idle over 10 years.
 - History of AMD limited ability to disturb the backfill material.
- FRA Prep: Scarified by ripping on the contour, 4 feet deep on 8 foot centers using Cat D-10 dozer – avoiding volunteer trees. Limited traffic across the area.
- Results: Reduced compaction, minimized erosion, and provided for ease in planting seedlings.

Challenges: Limited Topsoil



- Stockpiled topsoil limited to 62,000 yd³
- Must use the “best available material”
- Topsoil distribution on ~120 of the 200 FRA acres:
 - Spoil side dark shale areas (6”) - 28,000 yd³
 - HW side mixed with sandstone (4”) - 8,500 yd³
 - Drainways - 3,500 yd³
 - ARAP covering liner – 22,000 yd³



Drilling & Blasting

- ➔ Purpose 1) Eliminate exposed highwall; 2) Reduce slopes; 3) create at least 4' of uncompacted seedbed material; 4) reroute stream channel; and 5) create stone for rip-rap channels and structures.
- ➔ 200,000 yd³ shot
- ➔ IR DM45 drill with 7-7/8" dia bore hole
- ➔ Pattern 16' x 16' x 20' deep



1. Ready...



2. Aim...



3. FIRE in the hole!!!

Highwall Preparation

Grading

- Loosely graded using single or double pass dozing with D9, D10 and D11 dozers.
- Reduced slopes to 4H:1V or flatter.



Topsoil

- Spread topsoil using an excavator, loader and articulated trucks.
- Ripped 4' deep on the contour to break up the seedbed and mix the topsoil.



Final Grading to AOC



➔ Local contractor, Walker Construction, performed the dirt work with 6 employees using LCC's heavy equipment .



Highwall Preparation



➔ Stable, loose, rough and rocky red sandstone/topsoil ripped and ready for grass and trees....



Soil Sampling



Purpose

- Amendment and nutrient requirements.
- Appropriate ground cover and tree species .

Sampling Program

- 91 individual samples were taken from 4' deep x 3' wide x 6' long soil pits.
- 10 composite samples weighing ~ 75 pounds each were tested (7 spoil side and 3 HW side, representing ~ 20 acres per composite).
- 5 topsoil stockpiles tested.

Soil Analysis



➤ Growth Medium

- Topsoil and subsoil (sand/silt/clay 80%- 90%)
- Weathered and fragmented sandstone & shale (>2mm - 10%-20%)

➤ Analysis & Amendments (for trees, shrubs and grasses)

<u>Parameter</u>	<u>Spoil Side</u>	<u>Highwall Side</u>
Analysis		
Soil pH	7.2 – 8.0	4.8 – 5.7
Organic Matter (%)	0.1 - 0.8	0.1 – 0.5
Application Rate		
Lime to a 6.0 pH (tons/ac)	0	1
Nitrogen (lbs/ac N)	60	60
Phosphate (lbs/ac P ₂ O ₅)	120	120
Potash (lbs/ac K ₂ O)	0	30
Mulch (lbs/ac Cellulose)	1,500	1,500

Ground Cover



➤ Hydroseeding used to broadcast the required amounts of seed, fertilizer, lime and mulch.

➤ 33 lb/acre of native, non-competitive species.

- Perennial Ryegrass (10 lbs)
- Orchard Grass (5 lbs)
- Sorghum Sudan Grass (5 lbs)
- Birdsfoot Trefoil (5 lbs)
- Timothy (5 lbs)
- Ladino Clover (3 lbs)





Ground Cover

- Spoil side was sown in the late-Fall '08, coincidental with tree planting.
- Highwall side was sown in the Spring '09, as was the tree planting.



Tree Species



<u>FRA Areas¹</u>		<u>Riparian Zone</u>		<u>Channel Bank²</u>	
<u>Species</u>	<u>Rate/Ac</u>	<u>Species</u>	<u>Rate/Ac</u>	<u>Species</u>	<u>Rate/3 yd²</u>
White Oak	125	White Oak	65	Sandbar Willow	1
White Ash	125	Black Oak	65	Silky Dogwood	1
Red Maple	125	Northern Red Oak	65	Elderberry	1
Loblolly Pine	125	Southern Red Oak	65		
Tulip Poplar	120	White Ash	65		
Crab Apple	20	Black Walnut	65		
Redbud	20	Redbud	65		
Silky Dogwood	20	Hawthorn	75		
		Persimmon	75		
		Callera Pear	75		
Total	680		680		3

¹Permit calls for 3+ crop tree species and 2+ wildlife tree/shrub species at a combined planting rate of 680 stems per acre intermixed on an 8' x 8' spacing.

²Live stakes placed every 3' on both sides of the channel and around the structures.



Tree Planting

- Professional crews planted 30,000 to 50,000 tree seedlings per day, 171,000 hardwoods all total, using the proper procedures for handling and planting the trees.
- Spoil side planting – Fall '08; HW side planting – Spring '09; Riparian & stream side planting – Spring '10; Spoil side re-planting – Spring '10.

Tree Planting



- The American Chestnut Foundation provided about 50 pure American Chestnut seedlings.
- The seedlings were planted on the highwall side in the spring '09 and are all doing well.



Tree Survival

- Most highwall and riparian areas are looking good at ~80% survival with generally fast, healthy growth.
- Spoil side ~50% survival with some areas showing stunted growth, possibly due to dark shale and high pH. Replanted 350 seedlings/acre in the poorest areas during the Spring '10.



ARAP Features - *Liner*



Purpose

- ➔ Limit infiltration of surface water into the backfill spoils, and thereby reduce the volume of groundwater requiring treatment
- ➔ Maintain a moist environment in “bowls” within the stream substrate to support aquatic life and insects during dry periods.

Design

- ➔ 3' to 6' beneath the surface of the wetlands and thalweg, including under the flood zone.
- ➔ Overlap and seal to form an impenetrable layer.

Product

- ➔ *Centomat Claymax* by CETCO, Manufactured in Georgia
- ➔ Bentonite clay sandwiched between two impervious geosynthetic layers.

ARAP Features - *Liner*



Dimensions

- 16' long
- 3' diameter
- 2,200 sq ft/roll
- 1.5 tons

Project Needs

- 128 rolls
- 283,000 sq ft
- \$117,000





1. Avoid flood waters

ARAP Features *Liner Installation*



2. ~1' of fine gravel liner base



3. Provide a smooth base for liner



ARAP Features *Liner Installation*



4. Roll out geosynthetic liner



5. Cover with ~1' of topsoil



6. Cover with 2'-5' of ovb

ARAP Features – *Wetlands*

...that don't leak!



ARAP Features – *Thalweg*



1. Rough dig the thalweg



3. Fine grade to exacting elev



2. Install root wads/log vanes



4. Install coir fiber matting

ARAP Features – *Meanders*



- Thalweg winds down through the swale, replicating the natural stream channels in this area.





ARAP Features - *Step Pools*

- ➔ 30' waterfall over the mine highwall replaced with a series of step pools, significantly dissipating the energy.



ARAP Features - *Rip-Rap Drainways*



- ➔ Sandstone armored ditches minimize erosion and suspended solids.



Riparian Zone - *Live Stakes*



- Sandbar Willows, Silky Dogwoods and Elderberry
- 0.5"-2" Dia; ~2' Long
- Dormant at time of planting in Mar '10
- Maintained moist and cool
- Planted in random mix
- Spaced ~3' on centers
- Drilled holes 18" deep along the stream banks
- Compact area around stake with foot



Riparian Zone - *Live Stakes*



- The live stakes somehow know which end should grow roots and which end should grow leaves...



Before...



After...



➔ The trees and grass are growing, water is running, bees are buzzing, birds are singing ...and the draglines have been cut-up and hauled away.





Concluding Remarks

2 years and \$3 million later...

- Commercial forest is in its infancy, supported by sound FRA techniques that offer the greatest likelihood of success.
- The wetlands, permanent impoundments, streams, tree plantings, open areas, and bordering woodlands create diversified habitats conducive to wildlife, water fowl, aquatic life and insects.
- The engineered ARAP was built to withstand what Mother Nature has to offer with minimal maintenance.
- Success owed to the cooperative effort and flexible thinking of OSM-KFO, TDEC and LCC. Thanks to all involved!

Questions?

