

# Geomorphic Reclamation of Abandoned Coal Mines near Raton, NM

## The Swastika Mine and Dutchman Canyon Reclamation Project

- Design and Construction Oversight
- Reclamation and Revegetation

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# The Swastika Mine and Dutchman Canyon Reclamation Project

- Design and Construction Oversight
- Reclamation and Revegetation



Completed  
Geomorphic  
Reclamation of  
Dillon Canyon  
at the Swastika  
Abandoned  
Coal Mine Site

Sept. 18, 2012

# Environmental Permitting & Reclamation Planning

- EA & FONSI
- Wetland Delineation and Jurisdictional Determination
- ACOE 404 NW-27 Permit
- ACOE Mitigation and Monitoring Plan Approval
- Archaeology Survey and SHPO Mitigation Plan Approval
- Wetlands Preservation & Reclamation Planning

# Wetlands Preservation



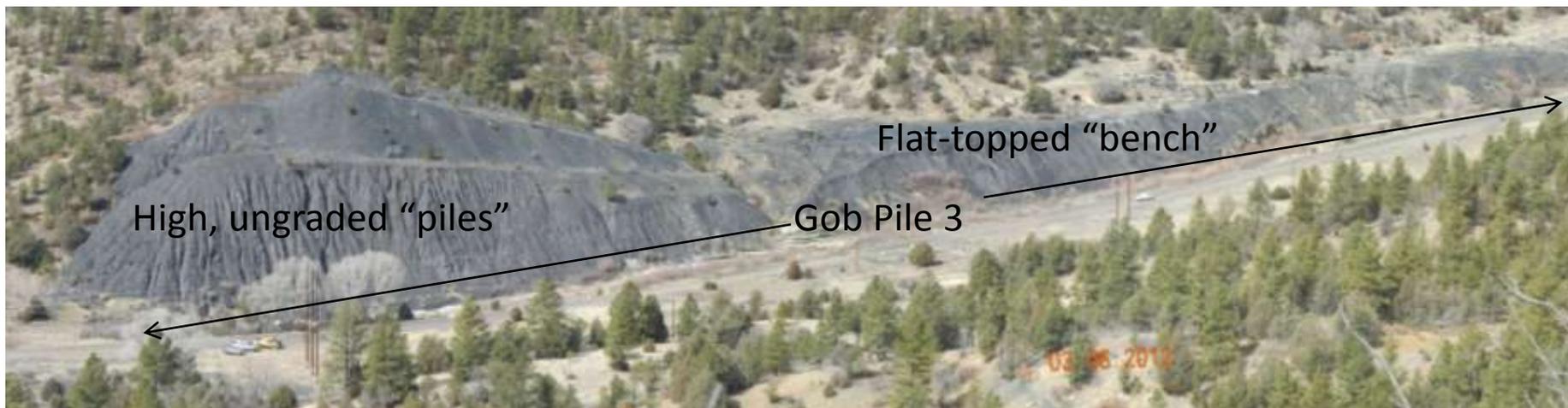
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# Wetlands Preservation



# Abandoned Coal Waste at Swastika Mine



## Site Characterization



- Gob Chemistry
- Borrow Soil Chemistry

## Site Characterization



- Wetland Delineation
- Vegetation Survey
- T&E Species Survey

# Reclamation Planning



- Borrow Soil Suitability
- Gob Mitigation

## Gob Mitigation

Gob Pile	Depth (inches)	pH	EC ( $\mu\text{S}$ )	SAR	Potential Acidity (t/kt)
GP-5 Pre	0-6	4.4	0.39	0.73	2.2
GP-5 Pre	6-12	4.2	0.77	0.66	2.8
GP-5 Post	0-12	6.6	4.6	8.2	4.1
GP-3b Pre	0-12	7.4	2.0	15	1.4
GP-3b Post	0-12	7.8	2.7	11.5	6

## Borrow Soils

Site	Borrow Soil Horizon	Depth (inches)	pH	EC $\mu$ S	SAR	Texture	OM (%)
Swastika Borrow	A	0-35	7.4	0.44	0.71	L	1.87
	Bt	35-54	7.4	0.77	0.79	SCL	1.63
	Bk	54-85	7.5	.73	0.79	SCL	1.13
Swastika Channel	A	0-19	7.5	0.6	0.5	SCL	2.32
	Bt	19-64	7.0	2.4	0.6	SCL	2.62
	Bk	64-105	7.5	1.2	0.5	SCL	2.71

## Reclamation Planning: Seed Mixes

Seed Mix	Composition (# of species, %, PLS/SF)			
	Grasses	Forbs	Shrubs	Total PLS/SF
Upland	10, 75, 37.5	6, 22, 11	3, 3, 1.5	50
Wetland Swastika	10, 85, 42.5	4, 15, 7.5	0, 0, 0	50
Wetland Dutchman	8, 90, 45	1, 10, 5	0, 0, 0	50

## Construction:



- Channel Realignment
- Soil Borrow & Gob Repository

# Construction:

- Installation of BMPS
- Gob removal and reshaping
- Geomorphic grading



# Reclamation: Amendments

- Lime, Gypsum and Fertilizer were amended at rates determined by the soil test results



- Lime: neutralize potential acidity and SAR
- Gypsum: neutralize SAR
- Fertilizer: Nitrogen to modify C:N ratio of compost

## Reclamation: Compost



- Local source of composted sawmill waste
- C:N ration of 110:1
- Treated with N to 30:1
- Applied at 400 cy per acre

## Reclamation: Compost



- Applied at 400 cy per acre over gob and poor cap soils

## Reclamation: Ripping

- Ripping to incorporate amendments and alleviate compaction
- Two perpendicular passes
- Rip to 12" depth
- Final pass on the contour



# Reclamation: Seeding & Mulching



- Broadcast seeding at 50 PLS/sf
- Seed size variability required hand seeding



## Woodstraw™ Application Rates:

- 0-5%: 4,000 lbs/acre (40% cover)
- <33%: 7,500 lbs/acre (50% cover)
- >33%: 13,800 lbs/acre (70% cover)

## Reclamation: Turf Reinforcement Mat (TRM)



EXCEL CC4  
LandLok TRM 450

## Reclamation: TRM



Duckbill anchors used to secure TRM at edges

## Reclamation: TRM



- Duckbills inserted 3 feet into the ground with an impact hammer
- Friction disk hold fabric in place up to 300 psi

# Reclamation: TRM

- TRM EXCEL CC-4 transitions between lower velocity point bars and straight reaches
- Landlok 450 is placed at approaches to cut banks



## Reclamation: Wetland Transplant Plugs



- Wetland plugs dug from channel before backfilling
- Held in 1 gallon pots until new channel was constructed



# Reclamation: Wetland Transplant Plugs

- Local provenance of wetland plugs
- Many species are not commercially available



- Wetland plugs established and spread quickly

# Reclamation: Riparian Transplants

- Willows and Cottonwoods harvested with 32" tree spade from channel before backfilling
- Placed in wire baskets for storage



- Cottonwoods were fenced for protection from grazing by elk

## Reclamation: Riparian Transplants



- Willows planted next to channel in wet soils
- Cottonwoods planted up gradient into mesic soils



# Reclamation: Riparian Transplants

- Transplants moved from digging areas to nursery holding yard



## Reclamation: Riparian Willow Staking



- Willow stakes cut in Spring 2013
- Planted by Raton area student volunteers



# Reclamation: Riparian Cottonwood Pole Planting



- Cottonwood poles were cut, limbed and planted
- Hole depth to ground water table

## Reclamation: Upland Transplants



- Upland species including oak, chokecherry, rabbitbrush and currant were transplanted



## Reclamation: Dutchman Compensatory Wetlands



- ACOE 0.6 acre mitigation wetland
- Further finish saline/sodic historic mine adit drainage

# Reclamation: Dutchman Compensatory Wetlands

- Flood irrigation onto compensatory wetland site
- Seeded with wetland mix
- Willow staking



## Project Constraints:



Unidentified Cultural Resources

## Project Constraints:



- Steep Slopes
- Groundwater



# Project Constraints



- In-stream Construction
- Sediment Control

## Project Constraints



- Wildlife

# Project Constraints



Detailed  
Geomorphic  
Grading Plan

# Project Constraints



- Steep and short transition from up gradient project boundary and channel
- Narrow work area due to cultural resources
- 2012-2013 drought

# Geomorphic Channel Realignment and Restoration



- Transplanting native vegetation resulted in a quick establishment
- Rapid channel stabilization

- TRM will stabilize channel banks until vegetation is established



## **THE NEW MEXICO MINING AND MINERALS DIVISION PRESENTED A 2012 EXCELLENCE IN RECLAMATION AWARD TO THE PROJECT TEAM**

Water and Earth Technologies Inc., and Habitat Management Inc., Kiewit New Mexico Company and 814 Solutions LLC, were honored for their work at the Swastika Mine and Dutchman Canyon Reclamation Project at the Vermejo Park Ranch where the focus was innovative abandoned coal mine reclamation and geomorphic landforming.



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## The Swastika Mine and Dutchman Canyon Reclamation Project

**Habitat Management**, and **Water & Earth Technologies** express our appreciation for the assistance and dedication of the following individuals and companies in making this award winning project a success:

Zoe Isaacson, Mike Thompson and John Kretzmann-New Mexico EMNRD AML Program; Gus Holm-Vermejo Park Ranch; Peter Kiewit New Mexico and 814 Solutions

**ANY QUESTIONS?**

