Geomorphic Reclamation of Abandoned Coal Mines near Raton, NM

Water & Earth TECHNOLOGIES
Water Resources and Environmental Consulting

The Swastika Mine and Dutchman Canyon Reclamation Project

- Design and Construction Oversight

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

Sept. 18, 2012

Kate Malers, P.E., Water & Earth Technologies, Inc. (WET)

Geomorphic Reclamation of Abandoned Coal Mines near Raton, NM

Water & Earth TECHNOLOGIES
Water Resources and Environmental Consulting

The Swastika Mine and Dutchman Canyon Reclamation Project

- Design and Construction Oversight
- Reclamation and Revegetation

Habitat Management, Inc.

New Mexico Abandoned Mine Land Program
EMNRD - MMD

Geomorphic Reclamation of Abandoned Coal Mines near Raton, NM

Presented By: Kate Malers, P.E.: Water & Earth Technologies (WET)

Additional Preparers:

Richard Spotts, P.E. (WET)
Melissa Brennan, P.E. (WET)
Ryan Wade, P.E. (WET)

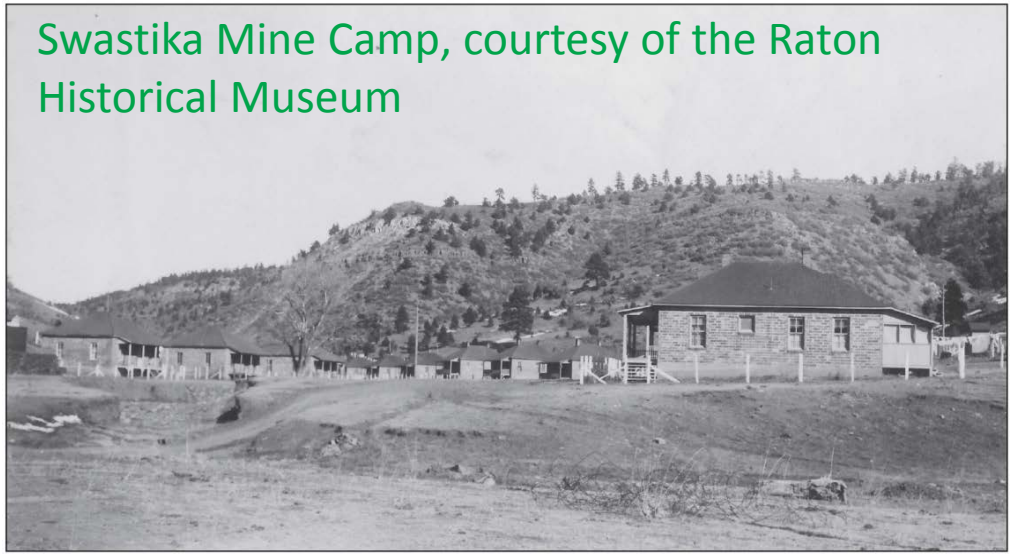
Ken Carlson: Habitat Management, Inc. (HMI)

Zoe Isaacson: New Mexico Abandoned Mine Land Program (NM AMLP)

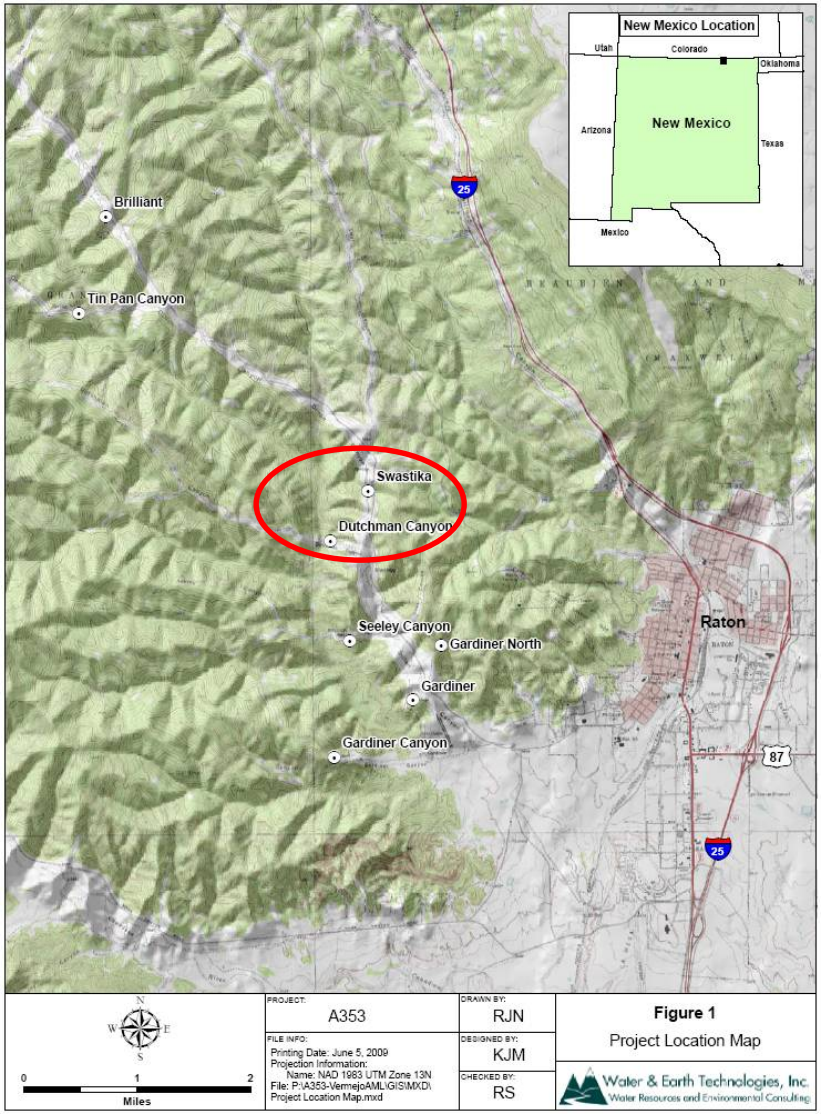
Historic Mining in the Raton Coal Field near Raton, NM

Swastika Mine, 1917-1953

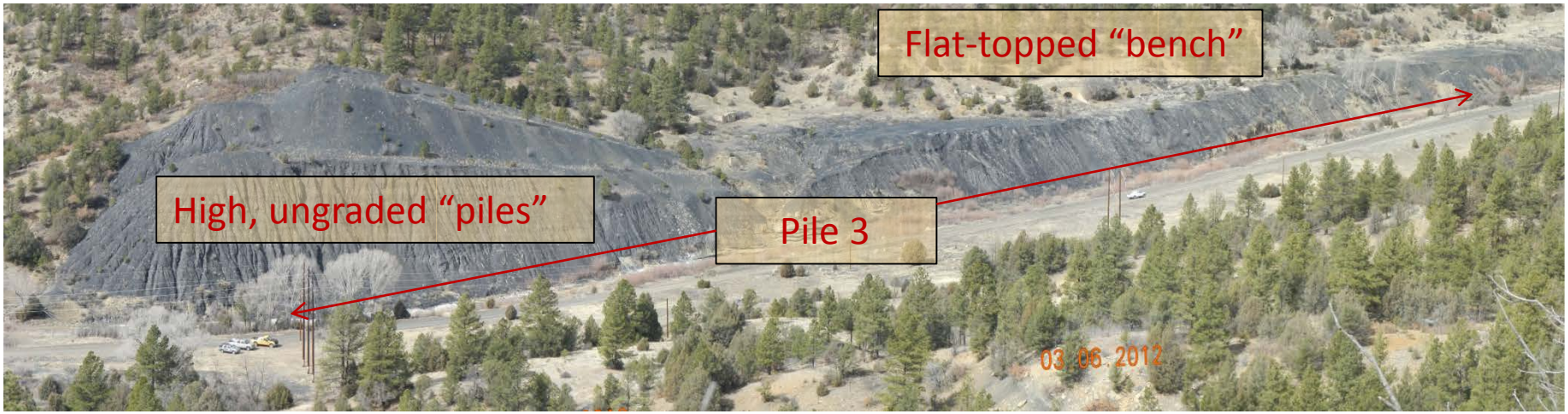
Swastika Mine Camp, courtesy of the Raton Historical Museum

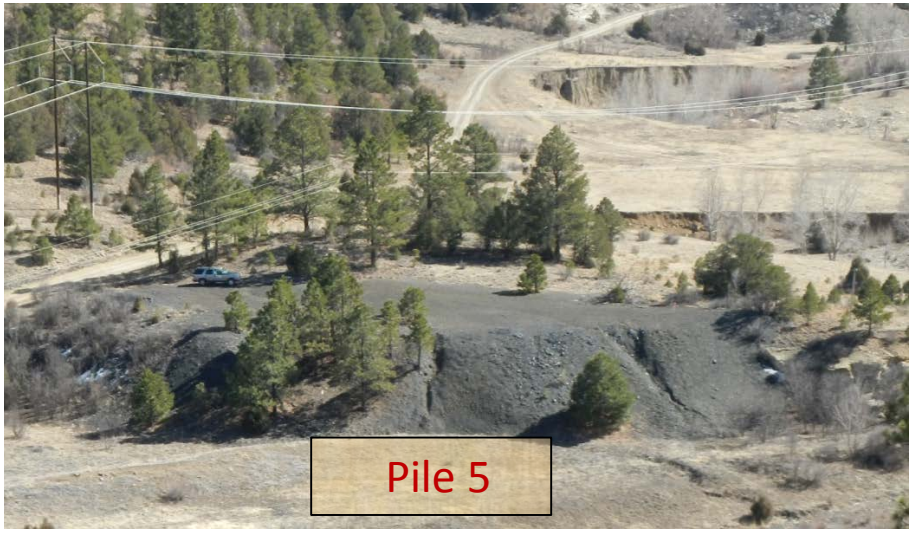


Abandoned Mines in Dillon Canyon



Abandoned Coal Waste at Swastika Mine





Environmental Detriments Associated with Abandoned Coal Waste

- Unstable coal waste slopes collapsing into the stream
- Infiltration leaching contaminants from the coal waste pile and conveying them to the stream channel
- Coal waste eroding into the stream during runoff events

Environmental Detriments Associated with Abandoned Coal Waste

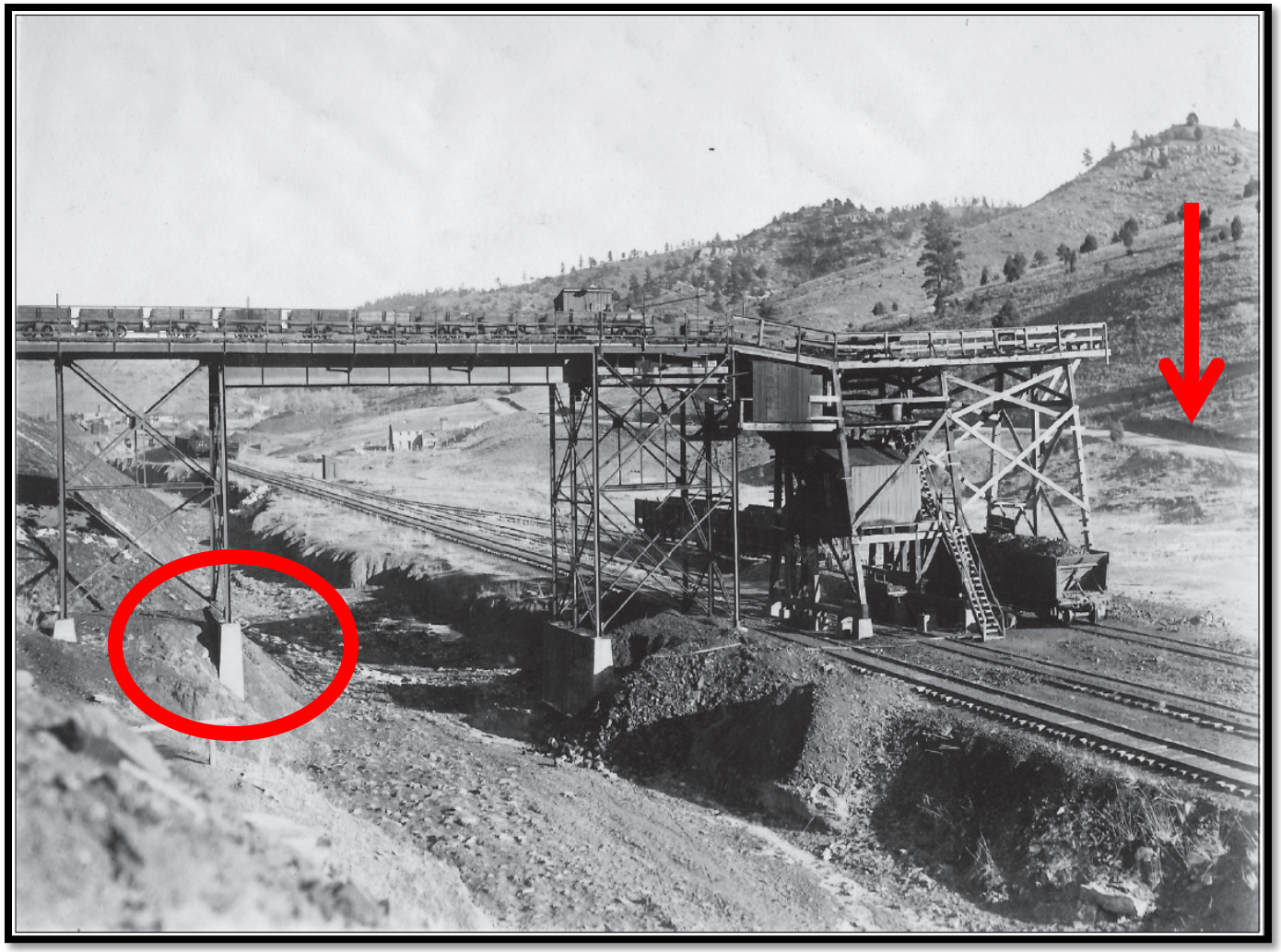
In those locations where runoff from the mountainside above the waste pile crossed the pile, very deep gullies eroded through the coal waste.

Environmental Detriments Associated with Abandoned Coal Waste

The “Dillon Canyon Stream” is an emphemeral tributary, with scattered perennial pools.

Environmental Detriments Associated with Stream Channelization

- The stream was straightened to accommodate coal handling facilities
- Channelization reduces stream gradient and increases flow velocities
- High flow velocities erode the channel bed and banks, de-stabilizing the stream

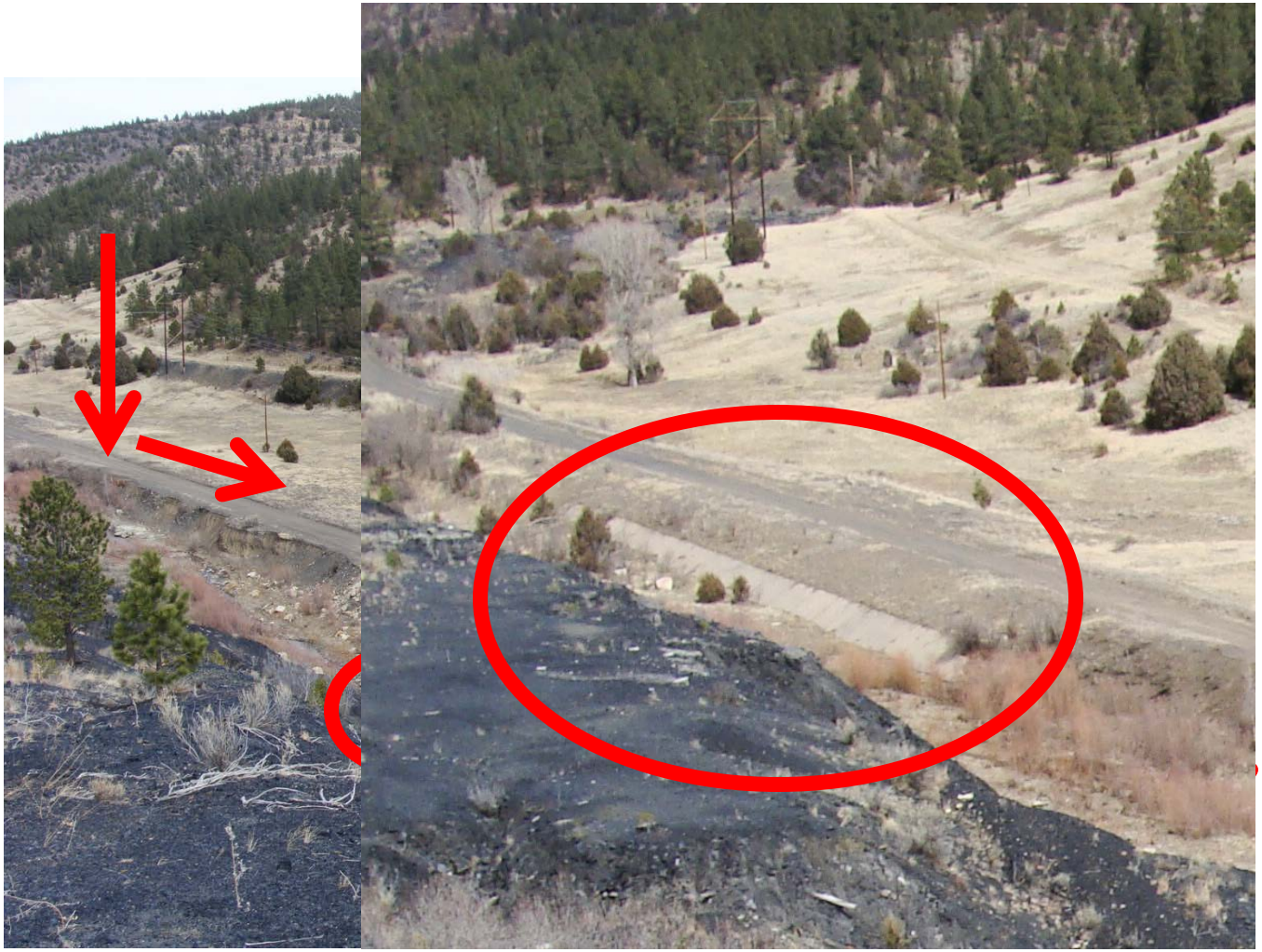


Environmental Detriments Associated with Stream Channelization

- Channel bed degradation propagates from the disturbed reach

- Bank erosion works towards the return to a meandering stream alignment

- However, bank erosion is undesirable because it undercuts the coal waste pile and the road



Environmental Detriments Associated with Stream Channelization

The large capacity channel conveys flood flows in-channel, without the benefits of floodplain inundation:

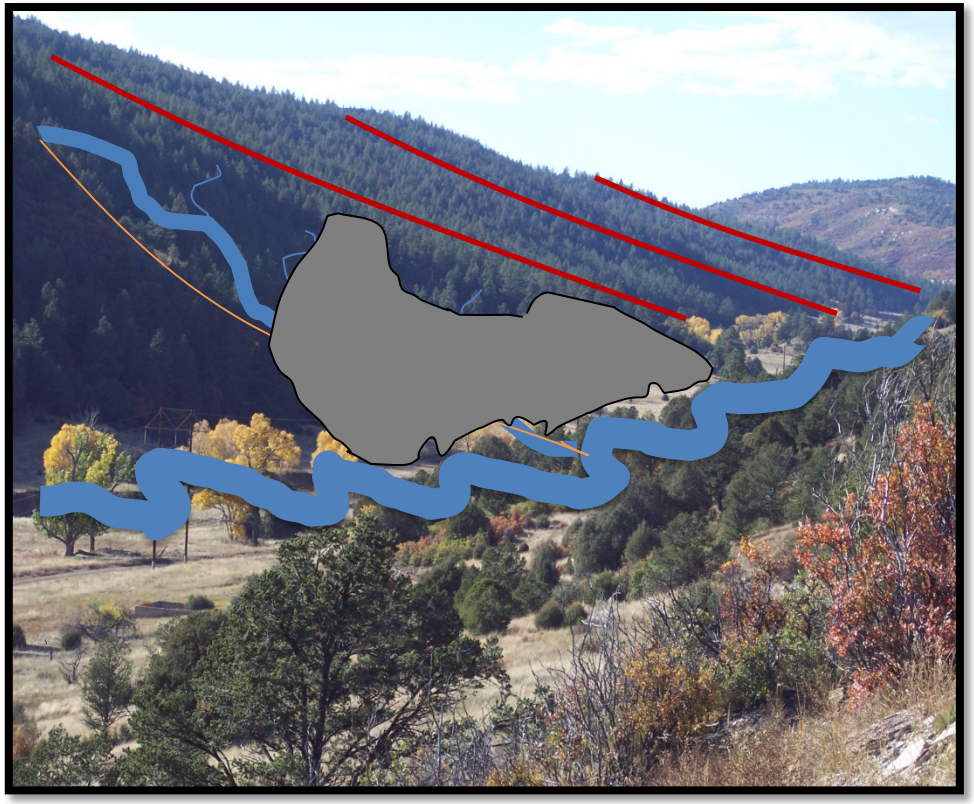
- Zones of shallow, slow overbank flood flow and deposition
- Bank storage
- Flood peak attentuation
- Riparian habitat benefits

Traditional Reclamation on Vermejo Park Ranch

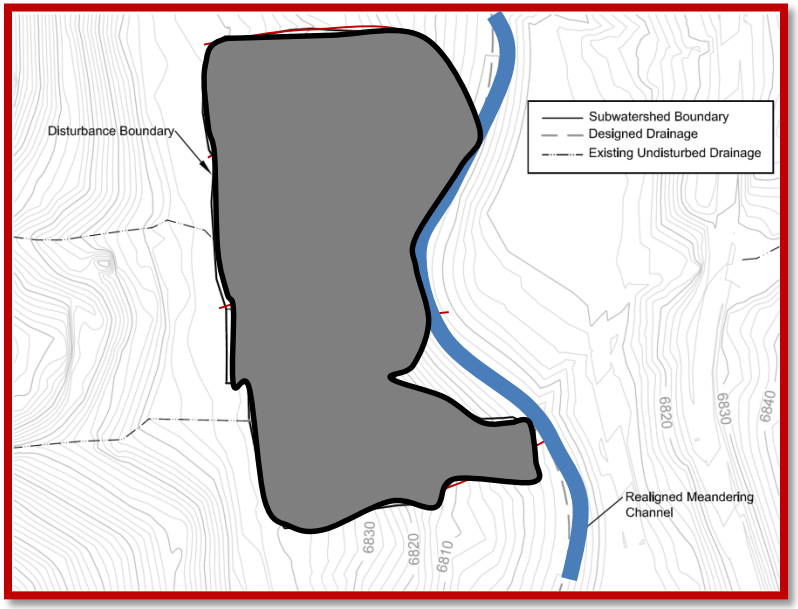
Koehler Mine near Raton, NM

- Terraced Landforms with Downdrains
- Channels Armored with Rip Rap

Geomorphic Design: Mimic Stable Natural Stream and Landform Characteristics Created by Natural Processes



- Reduce Maintenance
- Improve Aesthetic and Habitat Values



Undisturbed Reach of Dillon Canyon

Geomorphic Design

Design Challenges

- Determining the design volume of coal waste to be reclaimed, given uncertainties about the underlying "native" landform obscured by the pile

- Determining appropriate slopes and slope lengths for reclaimed landforms that will have no underlying geologic structure

Design Challenges

- Conveying runoff from the undisturbed hillside across the reclaimed landform and into the channel

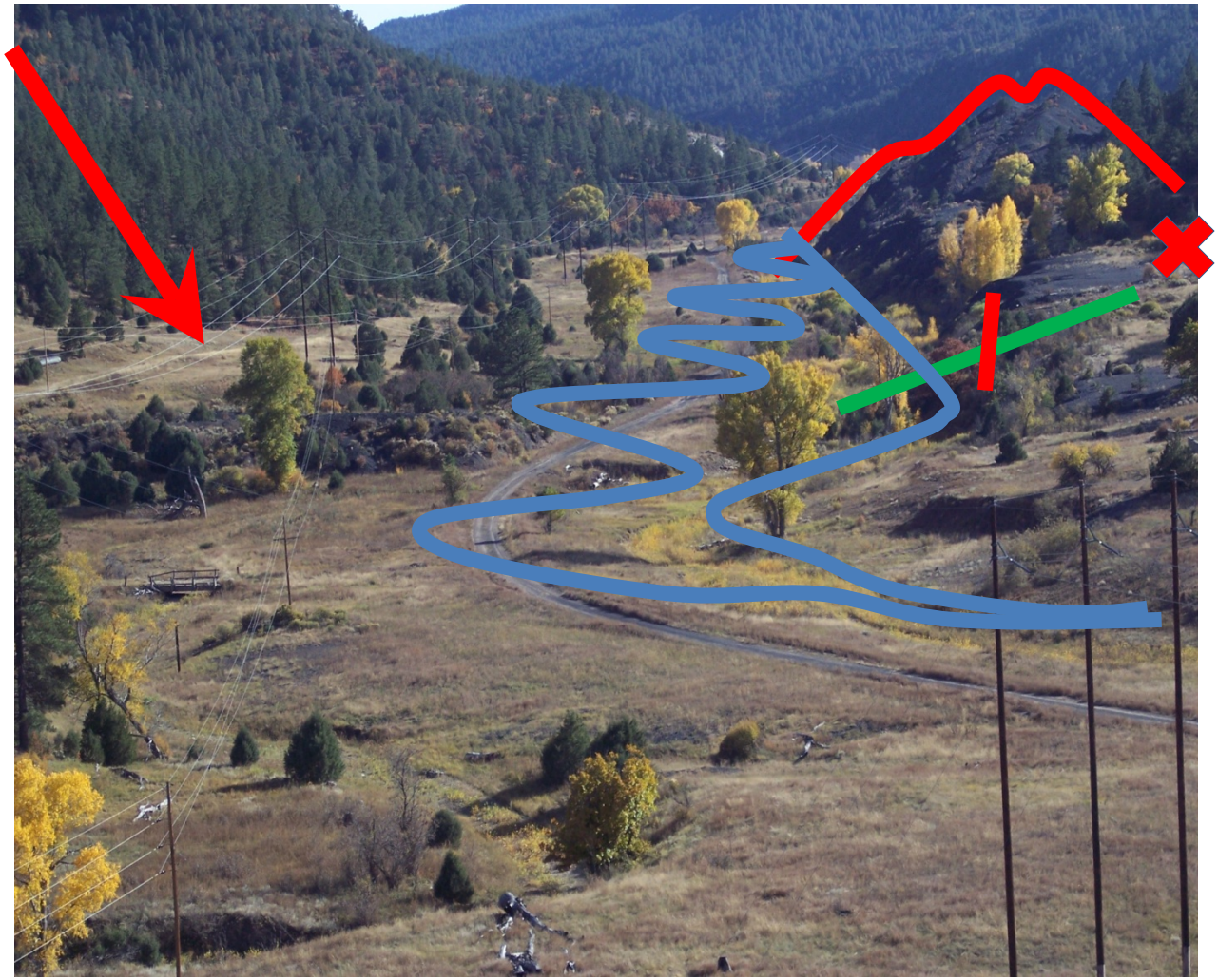
- Preserving a row of archaeological features lying at the base of the hillside behind the bench of coal waste.

Design Challenges

- Scattered archaeological features
- Power poles (during the design phase), and power lines (during construction)
- Scattered resources including mature trees and wetlands

Project Approach: Stream and Road Realignment

- Reshape the coal waste “bench” into a landform with stable slopes
- Return the channel to a restored, meandering alignment in the center of the valley
- Return the road to the abandoned road alignment on the east side of the valley, with road and drainage improvements



Project Approach: Partial Removal of Coal Waste

Remove enough material to accommodate the remaining coal waste volume in geomorphic landforms with stable slopes

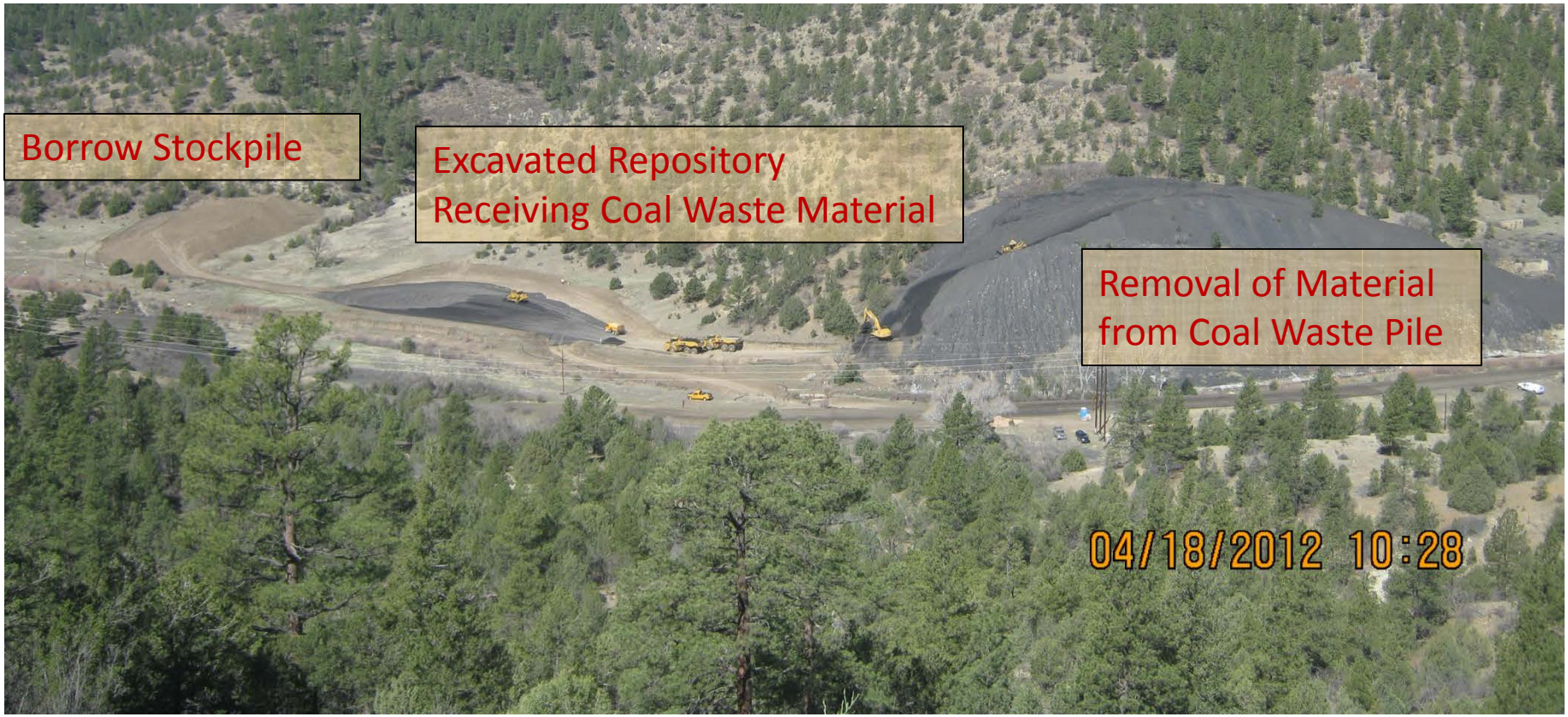
Project Approach: Combination Soil Borrow/Coal Waste Repository Landforms

- Provide borrow soil for capping coal waste landforms

- Provide excavated volume and additional volume above the natural ground surface for backfill by coal waste

- Minimize disturbance area

Combination Soil Borrow/Coal Waste Repository Landforms



Combination Soil Borrow/Coal Waste Repository Landforms

South Combination Soil Borrow/Coal Waste Repository with wood straw mulch

May 3, 2013

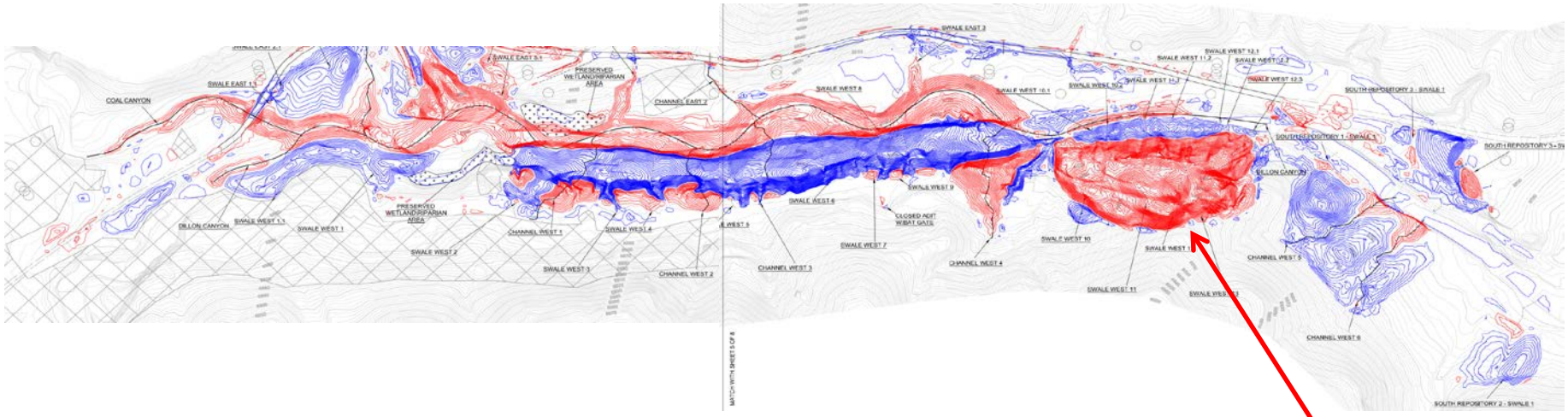
Completed Geomorphic Landform at Pile 3

Geomorphic Landform and Integrated Drainage Channel

March 7, 2013

GPS Machine-Control Landform Construction

Plan View of Project Cut/Fill Balance



- Preventing Disturbance to Archaeological and other Avoidance Zones
- Cut/Fill Balance for Coal Waste, Clean Fill and Capping Soil
- Minimizing Double- and Triple-Handling of Materials while Minimizing Disturbance Area

Dillon Canyon Coal Waste Landforms Before, During, After Geomorphic Reshaping

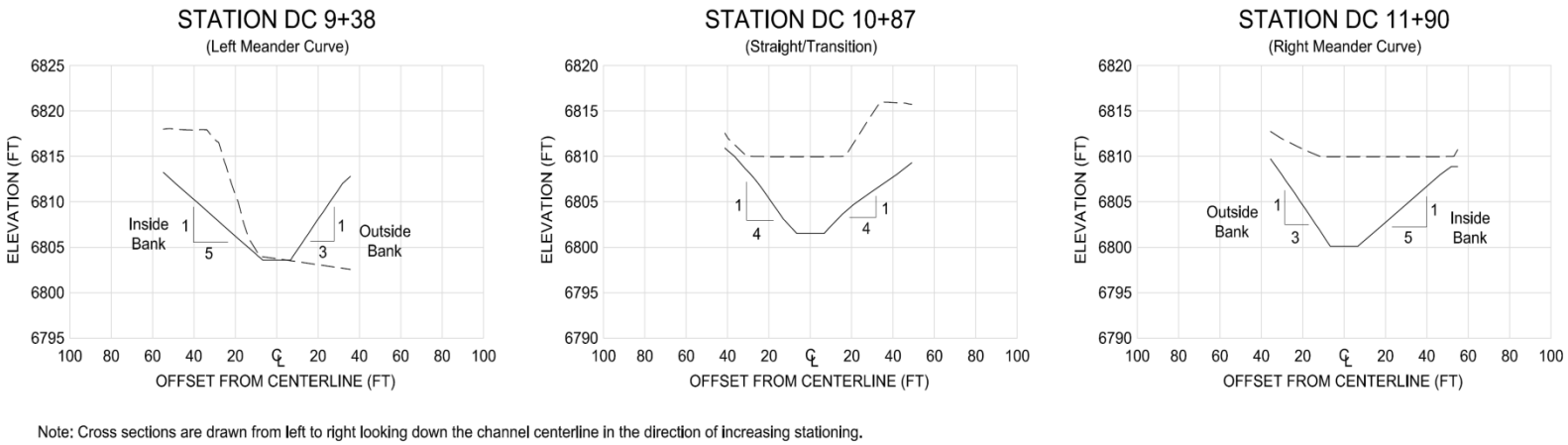
Dillon Canyon Stream Channel Before, During, and After Geomorphic Realignment and Restoration

Template Stream Reaches

Template Reach of Dillon Canyon

- Low gradient, sinuous channel
- Low flow channel armored with small rocks
- Wide, shallow channel cross section with moderate, vegetated banks
- High flows inundate a functional, vegetated floodplain with shallow, low velocity flow

Geomorphic Channel Realignment and Restoration



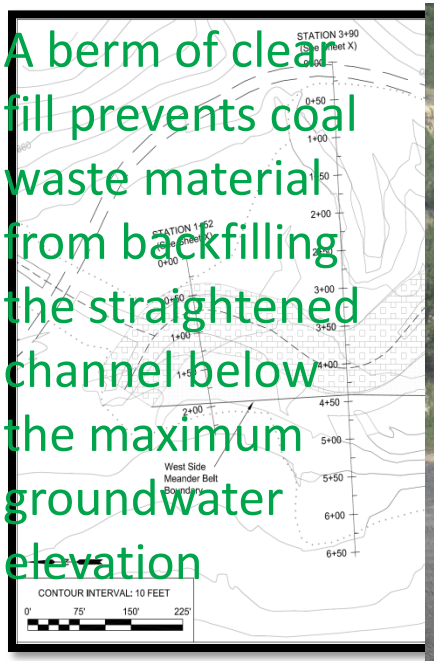
Note: Cross sections are drawn from left to right looking down the channel centerline in the direction of increasing stationing.

Typical channel cross section geometry, transitioning from steeper to flatter side slopes depending upon the location in the meander pattern

Steeper slopes on the outside of meanders are protected with a heavier TRM product (green) in the completed restoration

Geomorphic Channel Realignment and Restoration

A berm of clean fill prevents coal waste material from backfilling the straightened channel below the maximum groundwater elevation



Coal waste was exc
within the "Meand
channel as a preca
exposure as the ch
time

Geomorphic Channel Realignment and Restoration

Reclaimed Valley

Compatibility with Undisturbed Features of the Valley