Geomorphic Reclamation at BHP Billiton’s New Mexico Coal - Successes, Challenges & Future

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Nearly half a century ago, the Navajo Mine, and later San Juan and La Plata mines, were constructed to supply energy to a growing and developing population in the Southwest. Three generations of our coal miners have since created value for our workforce, our shareholders, our customers, and to the community in which we operate.

**We have Pride in our Heritage**

We have an overriding commitment to health, safety, the environment and the community. We strive for Zero Harm.

We supply a vital fuel source to meet the energy needs of millions of homes and workplaces in the Southwest of the United States. Our wages, royalties, taxes, donations, and the things that we buy personally and for our business creates wealth for the community in which we live.

**We are energizing the future.**
Regional Location of New Mexico Coal Operations
Regional Topography

Photographs showing undisturbed natural topography adjacent to the mine sites.

Photographs by EQ Dept. Personnel
Unless otherwise noted
### Operational Details
- Operations began in 1986
- Truck/shovel operations
- Reclamation activities completed Spring 2009
- Over 1,650 acres reclaimed
  - 1,400 acres reclaimed using fluvial geomorphic approach
Orthophotograph of La Plata Mine showing permit boundary and final surface configuration.
Buckeye and Elk Point (Panel 5 Highwall)

- Deepest final pit at LPM

Photographs showing final pit (upper right) and final construction (lower left).

Arrow indicates the same landmark pinion/juniper area.
Younger Bluffs
- Final highwall area
  - Adjacent to natural sandstone outcrop

Photographs showing final pit (upper right) and final construction (lower left).

Arrow indicates the same landmark notch area.
SJCC – San Juan Mine

Operational Details
- Mining began 1974
  - Surface dragline operation
- Transitioned to underground operation in 2002
- Reclamation activities ongoing
- Approximately 2,700 acres reclaimed
  - 400 acres reclaimed using fluvial geomorphic approach

Photographs of San Juan underground mine portal area (lower left) and plant and stack out area (upper right).
Orthophotograph of Cottonwood Area showing permit and lease boundaries and final surface configuration.
Cottonwood Mining Area – During mining

Photograph of Cottonwood Area during mining operations.
Arrow shows landmark reference.
Cottonwood Mining Area – During Landform Construction

Photograph of Cottonwood Area during landform construction.
Arrow shows landmark reference.
North Pinon Mining Area

Photographs showing final construction (lower left) and after topdressing and seeding (upper right).

Arrow indicates the same channel meander.
BNCC – Navajo Mine

Operational Details

- Multi-dragline surface mine
- Located entirely on the Navajo Reservation
- Mining began in 1963
- Produces 8.5M tons of coal annually
- Reclaimed 7,600 acres to date
  - 44 acres using fluvial geomorphic approach

Photograph by Ken Logan, Mine Engineer
Barber Ramp 3 Project
- Haulage ramp to final dragline pit (44 ac.)
- Goals of project
  - Apply fluvial geomorphic approach
  - Optimize material handling
- Total construction time was 22 days over a span of 2 months
- To be seeded spring 2009

Photograph by Cary Cooper, Mine Engineer
BNCC – Navajo Mine

Channel Construction
- A-channels keyed into regrade
- A-channel excavation to build ridges

Photographs showing construction process. Dozer used to key in channels to build ridges (upper right) and smoothing out channel and sub-ridge (lower left).

Photographs by Cary Cooper, Mine Engineer
Navajo Mine Slides

Topdressing Activities
- Scrapers delivered topdressing
- Dozers spread topdressing
- Seeding and mulching this spring

Photographs showing final construction after topdress lay-down.

Photographs by Cary Cooper, Mine Engineer
Operational Details

- Proposed surface operation
  - 50 year mine life
  - Multi-dragline operation
  - 13,000 acre permit area
  - SMCRA permit to be completed in 2009
**Area 4 South**

- Relatively flat terrain
- Area divided by Pinabete Arroyo
  - 44 square mile upstream watershed
  - Temporarily diverted during mining
- Arroyo to be reconstructed for watershed
- Used fluvial geomorphic approach
Fluvial Geomorphic Setting

- Wide flat sandy arroyo
- Smaller areas of steeper topography with A-channels
- Bedrock control in channels
Conceptual AOC for Area 4 South

- **Goals of AOC**
  - Create a stable landform supporting vegetation that is compatible, diverse, effective and permanent
  - Incorporate applicable fluvial geomorphic reclamation principles
  - Meet material handling goals
  - Provide for stable and permanent placement of CCBs
  - Compatible with contemporaneous construction requirements

- **Milestones of AOC**
  - First fully integrated fluvial geomorphic reclamation design
  - Reconstruction of major arroyo
General Reclamation Photos

Landform Construction Activities

- Engineer designs can be communicated:
  - To the dozer fleet
  - To the shift foreman
- Foreman and dozer can track progress
General Reclamation Photos

Landform Construction Activities

- Primary grading
  - Truck/shovel or truck/loader
  - Dragline
- Final grading and drainage construction by dozer

Photographs showing benches cut into spoil before primary regrade (upper right) and dozer using stakes as reference to construct channels (lower left) at LPM.
General Reclamation Photos

Topdressing Activities
- Delivered by truck or scraper
- Spread by dozer
General Reclamation Photos

**Seeding and Mulching Activities**
- Seed bed may be prepared by deep chiseling
- Seed is broadcast or drilled
- Mulch is then spread and crimped
General Reclamation Photos

Irrigation Treatments

- San Juan Mine and Navajo Mine provide irrigation treatments
  - Germination
  - Support cycle
  - Second growing year

Photographs showing irrigation treatments: SJM Cottonwood Area with irrigation network on steeper slopes (upper right) and Navajo Mine with irrigation network on flatter slopes after initial treatments.
2004 Excellence in Surface Coal Mining & Reclamation National Award

L to R: Collette Brown (EQ/SJCC)
Tim Ramsey (EQ/SJCC)
Gary Lansdale (Manger/SJCC)
Steve Funk (Production/SJM)
Larry Tsosie (Operator/SJM)
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2004 The Best of the Best Award
Acknowledgements

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