

INTEGRATING GEOMORPHIC RECLAMATION WITH UNDISTURBED AND PREVIOUSLY RECLAIMED AREAS USING A MULTI-PROGRAM COMPUTERIZED DESIGN APPROACH AT MCKINLEY MINE

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Project Team:



Chevron Mining Inc.
McKINLEY MINE



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HISTORY:

- McKinley Mine Opened In 1962
- 1st Large Scale Surface Coal Mine in New Mexico
- Employed 600 people in its peak
- 175,000,000 tons over 50 years



Overview of the McKinley Coal Mine

The project area is located due North of Gallup NM

- PROJECT STATS:
- FINAL PIT HIGHWALLS - 11,850 LF
- UNGRADED SPOIL – 793 AC
- CONVENTIONAL RECLAMATION AREA – 211 AC
- CONTRIBUTING UNDISTURBED WATERSHED – 891 AC

SPECIFIC PROJECT CHALLENGES:

- Handle the interface between existing conventional reclamation & proposed geomorphic reclamation
- Incorporate run on from large upgradient watersheds
- Achieve an earth balance
- Evaluate constructability



Conventionally
Reclaimed Areas

INTEGRATED GEOMORPHIC APPROACH

Hydrology

- Rainfall Parameters
- Runoff Characteristics

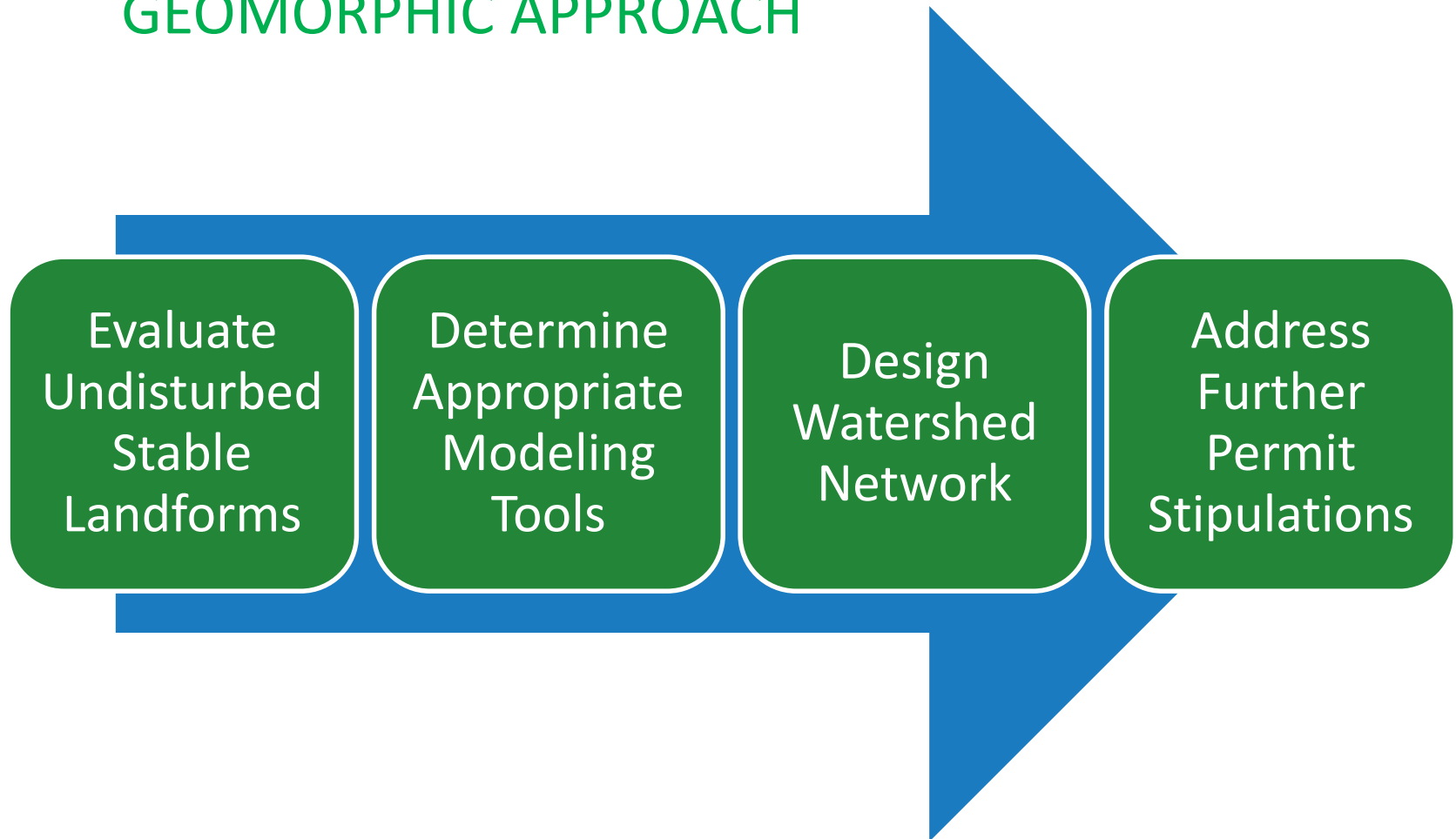
Geomorphic Characteristics

- Drainage Density
- Ridge to Head Of Channel
- Concave Slopes
- Slope Lengths
- Channel Sinuosity

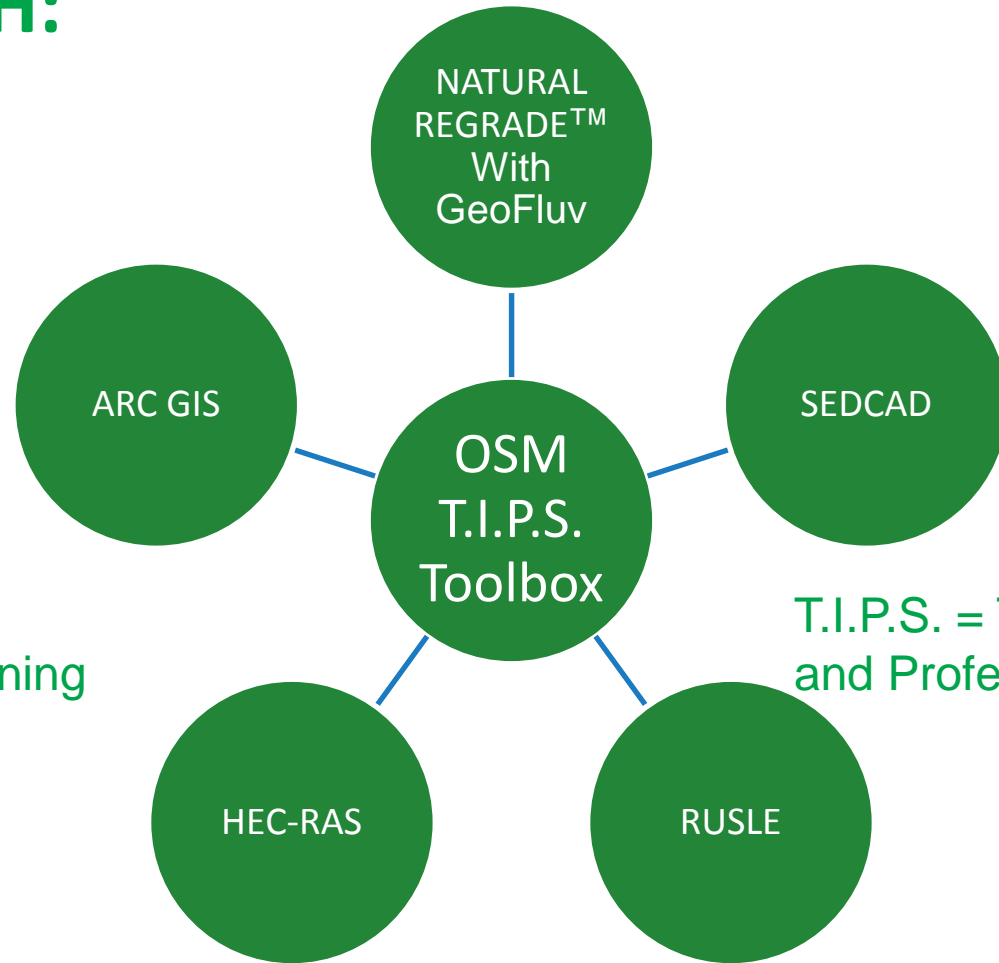
Hydraulics

- Channel Capacity
- Velocities
- Shear Stress
- Channel Protection

GEOMORPHIC APPROACH



MULTI-TOOL APPROACH:



OSM = Office of
Surface Mining

T.I.P.S. = Technical Innovation
and Professional Services

Rainfall/Runoff Parameters

New NOAA Atlas 14 for New Mexico

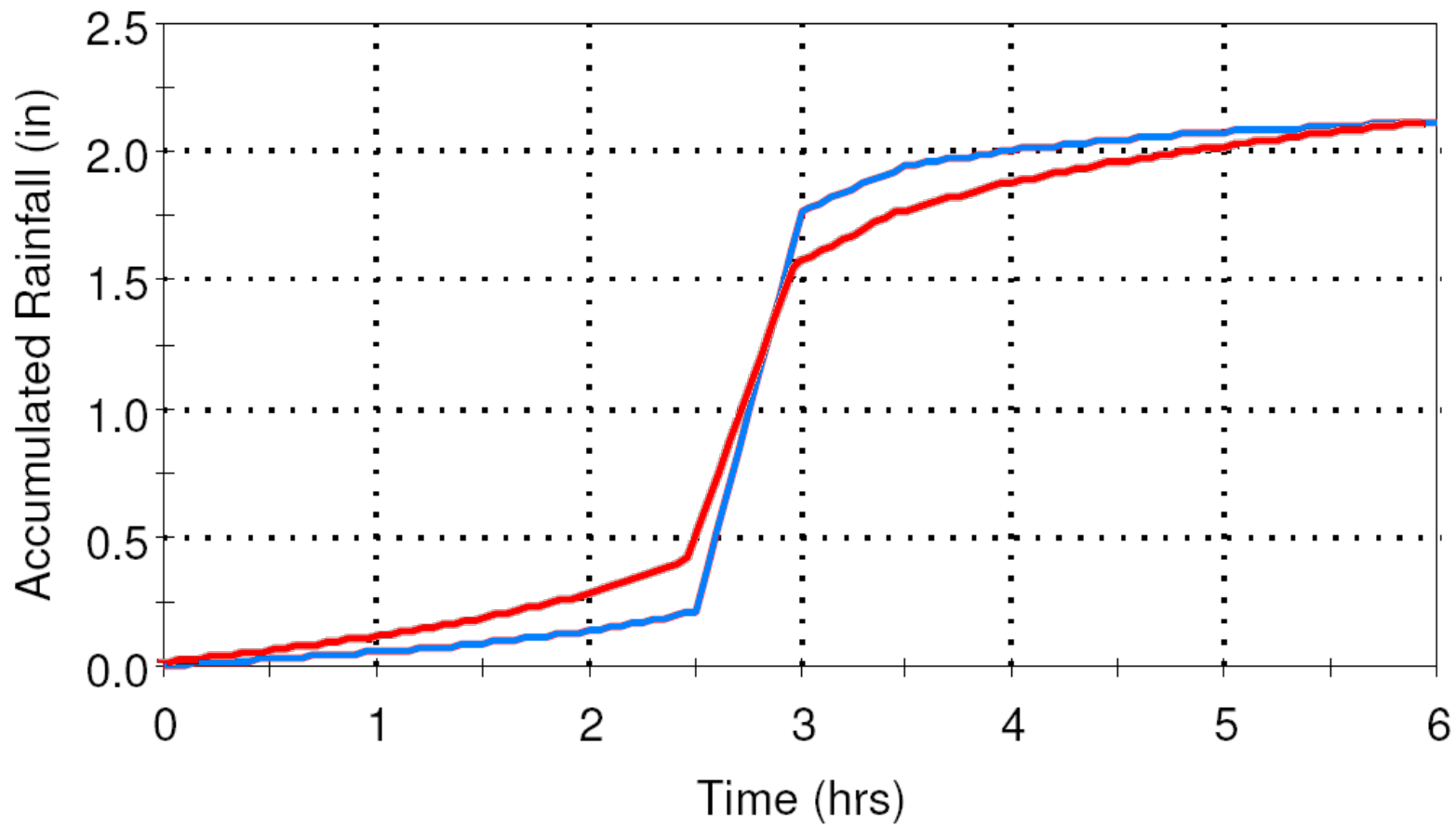
- 2-yr, 1-hr (bankfull)
- 50-yr, 6-hr (floodprone)
- 100-yr, 24-hr (if required by permit)

Rainfall Distribution Curves

- Type II 70 distribution
- United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)

Runoff Characteristics

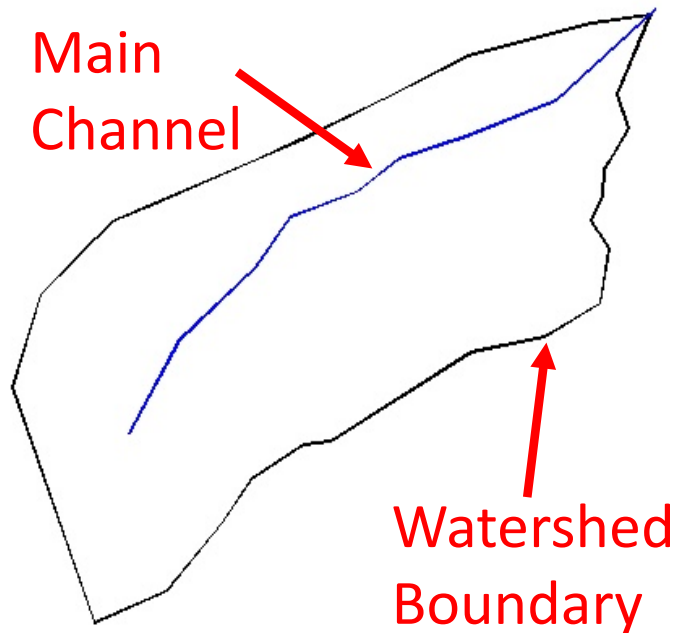
- NRCS Curve Numbers (Disturbed/Undisturbed)



Drainage Density =

$$\frac{\text{Length_Of_Channel}}{\text{Watershed_Area}}$$

Target Drainage Density = 154 ft/acre



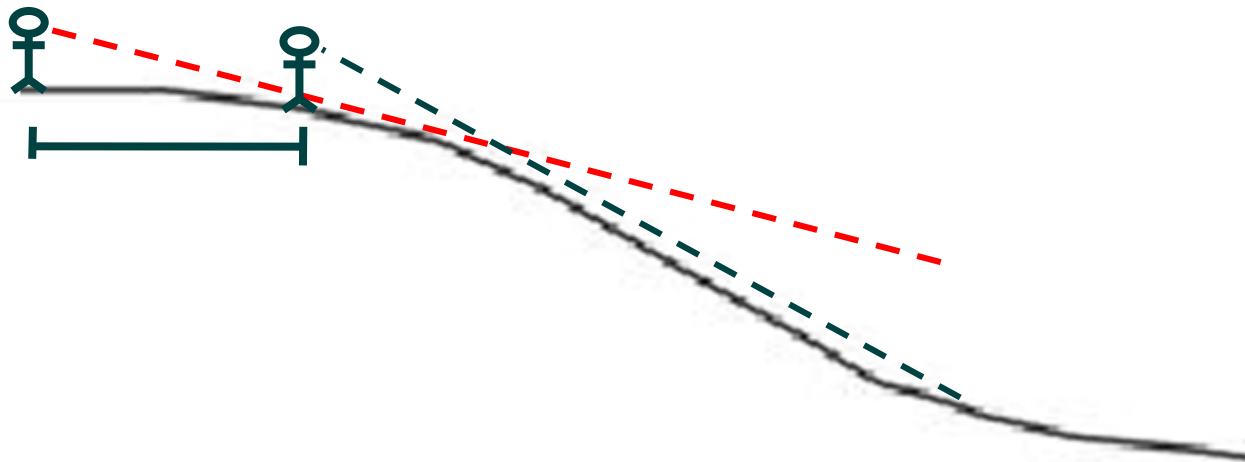
Length = 420 ft

Watershed Area = 2.9 ac

Drainage Density = 145 ft/ac

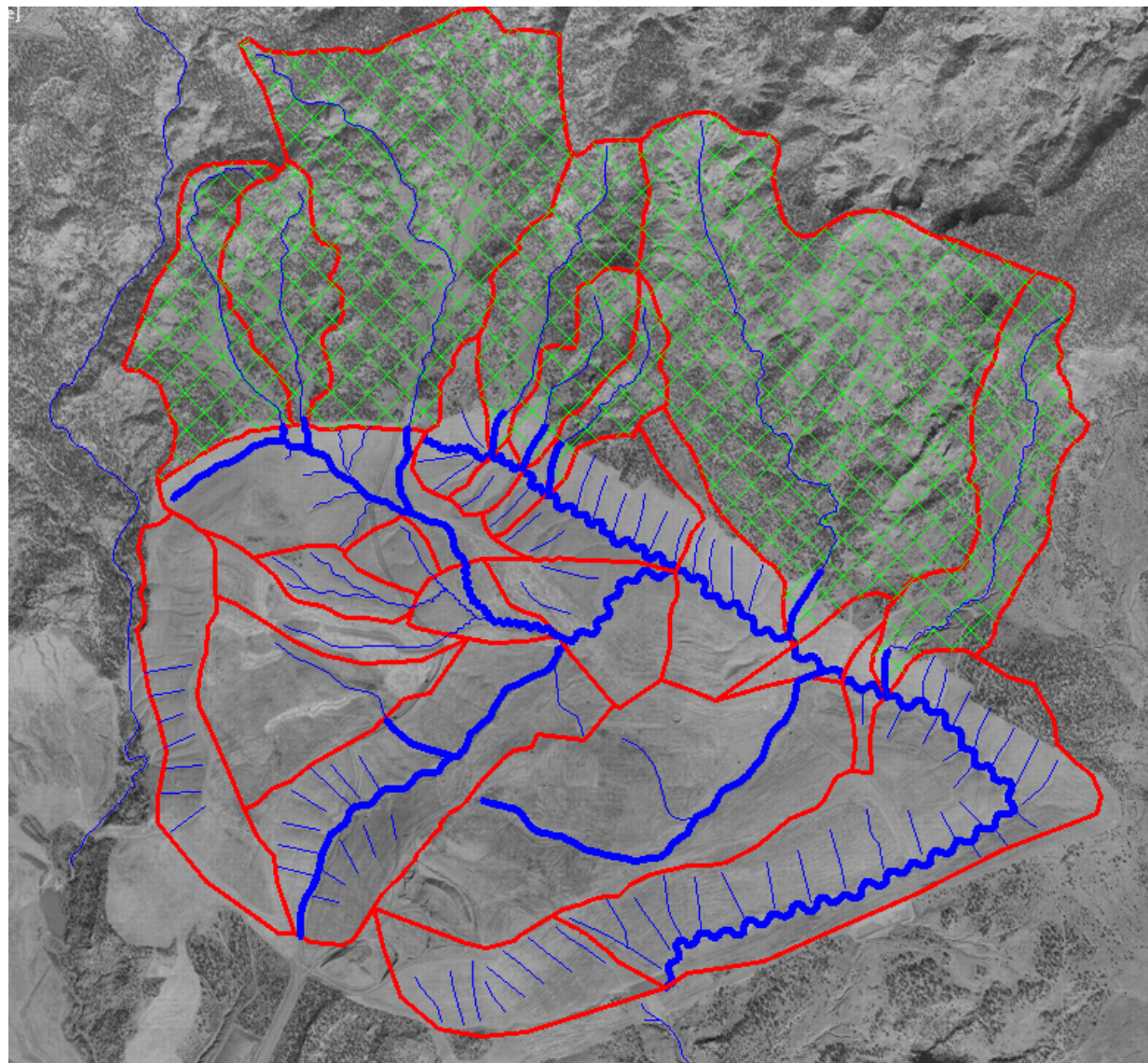
Ridge to Head of Channel Distance

Ridge Head of Channel



Determine Watershed Configuration

- Sub-Watershed Boundary
- Drainage
- ▨ Undisturbed Area



Complete a Geomorphic Design for Stable Landforms using Natural Regrade™

File... Settings...

Setup Channels Output DWG

Preview

Draw Design Surface...

Data for GeoFluv work area:

Valleys (ft.)	692.95
Area (ac.)	2.84
Drainage Density(ft/ac):	244

Comparison Surface

P:\...al2c_existing11-7-08.tin

1 inclusion polyline was used.

No exclusion polylines were used.

Update Cut / Fill

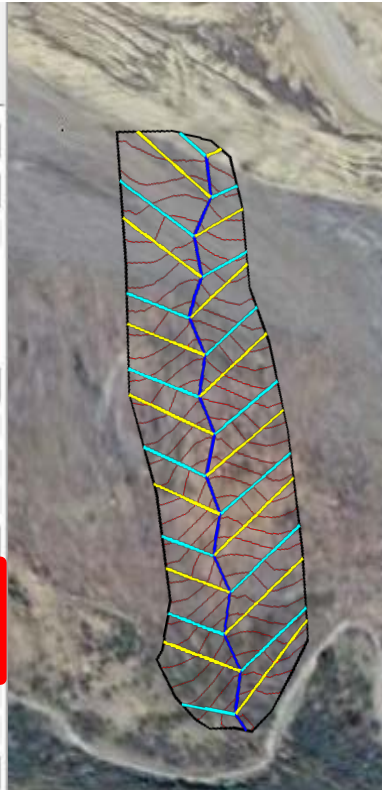
Cut (c.y.):	5888
Fill (c.y.):	5848
Cut / Fill (%):	100.69






Summary Report...

Reread Valley Bottoms

Exit Help

Cut-Fill balance is achieved



-  Subwatershed Boundary
-  Channel
-  Ridge
-  Valley
-  5' Contour

Importance of Sub-Ridges and Sub-Valleys



As part of the comprehensive approach, additional analysis on the geomorphic design surface was completed to show that erosion rates and specified design flows would meet permit criteria

Additional Analysis Completed

- A 100-yr, 6-hr peak flow analysis was completed for designed watersheds with contributing area greater than 1 mile.
- A 50-yr, 6-hr peak flow analysis was completed for designed watersheds with contributing area less than 1 square mile.
- A soil loss analysis was completed on the worst case slope in each watershed. The condition needed to be better than or equal to soil loss for pre-mining conditions.
- A channel stability analysis was completed to determine if additional channel protection would be necessary.

Channel Protection

- Riprap Lining
- Loose Rock Check Dams







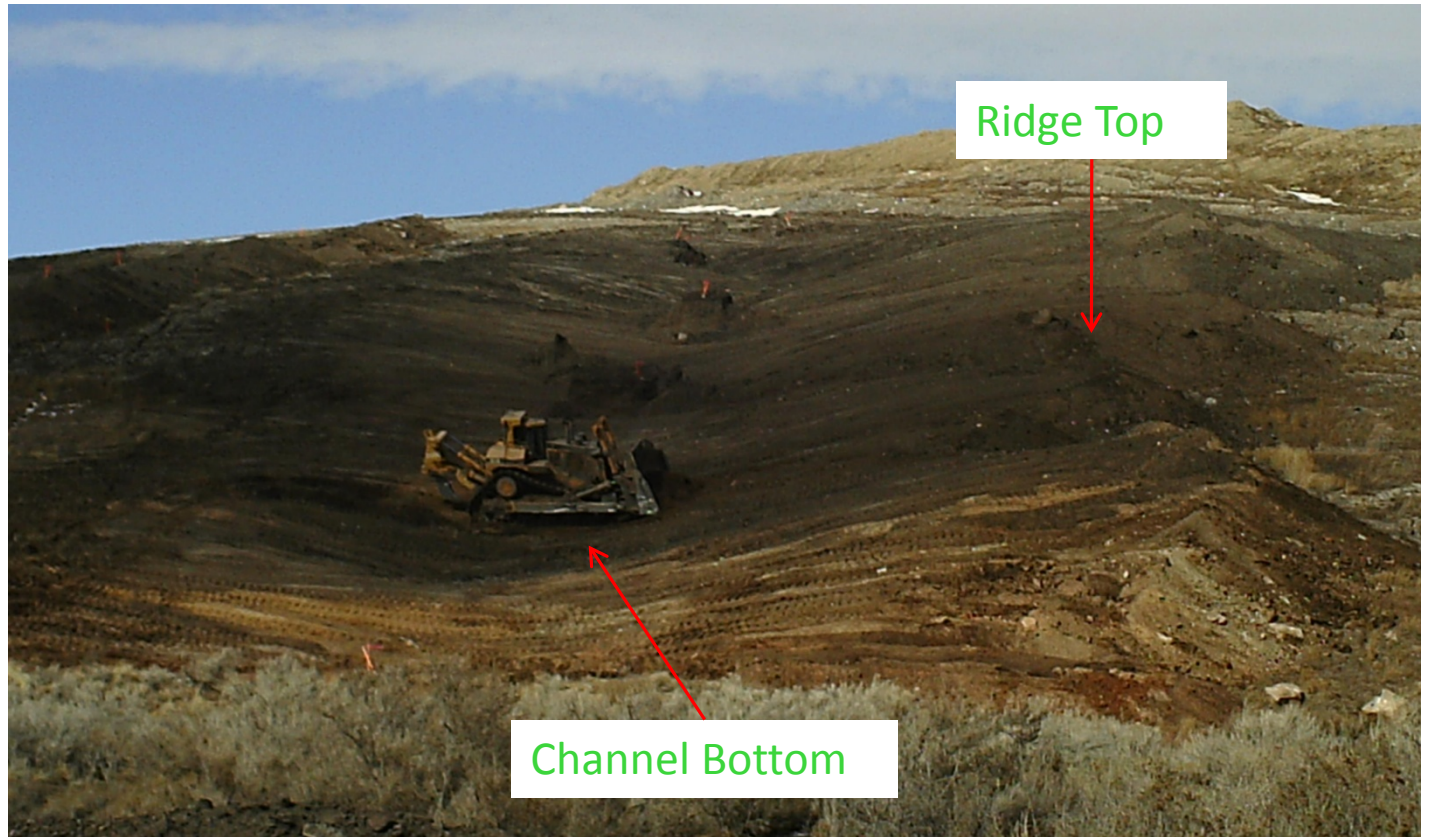
Time Lapse – 2005 - 2011



Construction



Bulldozer rough grades watershed geometry by pushing horizontally from the channel bottom to the ridge tops



Ridge Top

Channel Bottom

Final Product







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Benefits of Integrated Geomorphic Reclamation

- Stable Landform
- Flexibility for integrating with existing reclamation
- Ability to handle large flows
- Topographic Diversity
- Low Maintenance
- Aesthetically pleasing

Questions

