

**Comparative Evaluation of
Sediment Yield from Native and
Fluvial Geomorphic-
Rehabilitation Watersheds**

Mine Rehabilitation Conference 2017

What is Fluvial Geomorphic Rehabilitation?

- The essence of the approach is to identify the type of drainage network that forms over time, given: the site's earth materials, relief, climate, and slope stability to achieve a stable landform, and to design and build that landform.

10 July 2003



1 August 2003



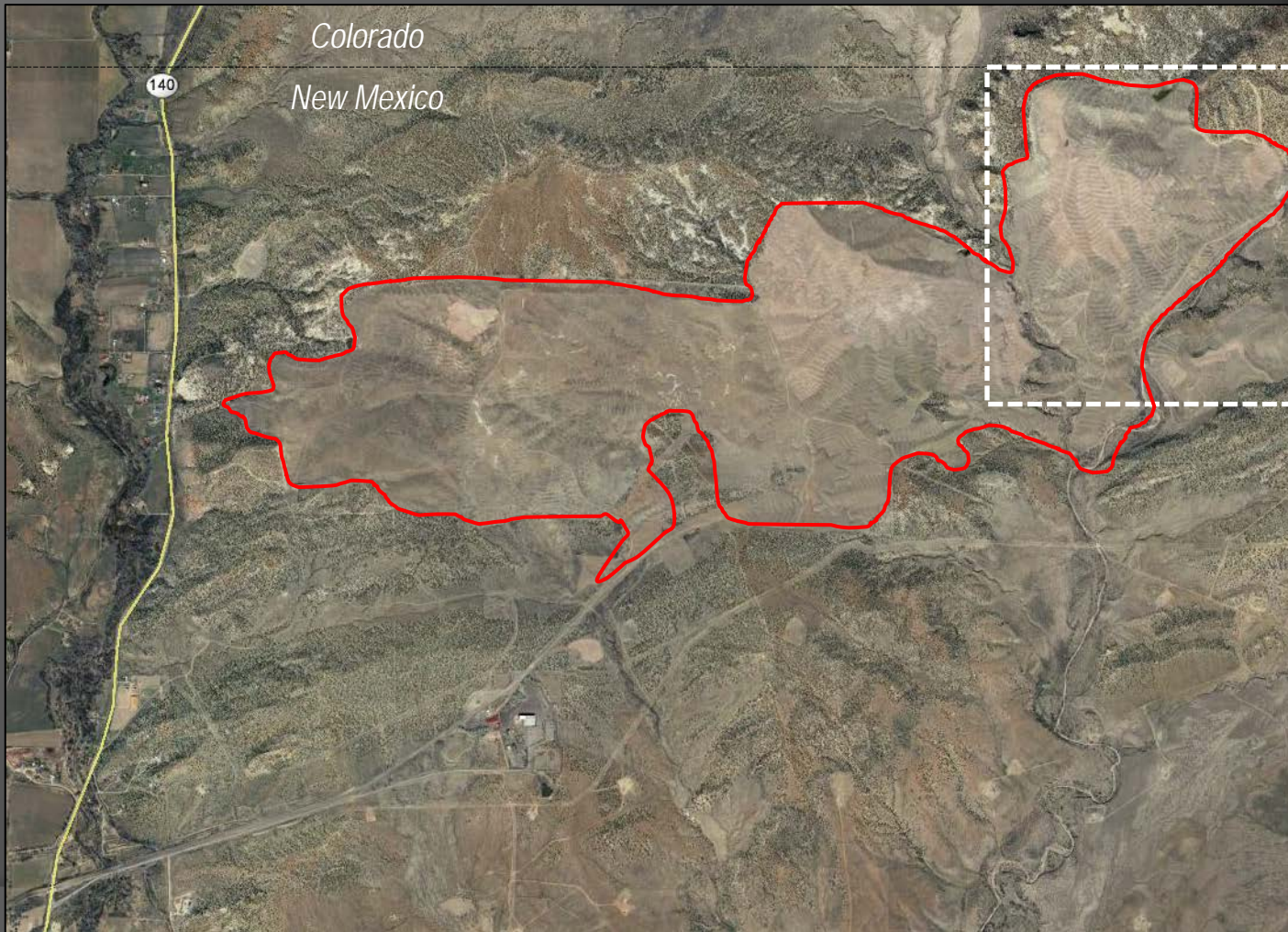
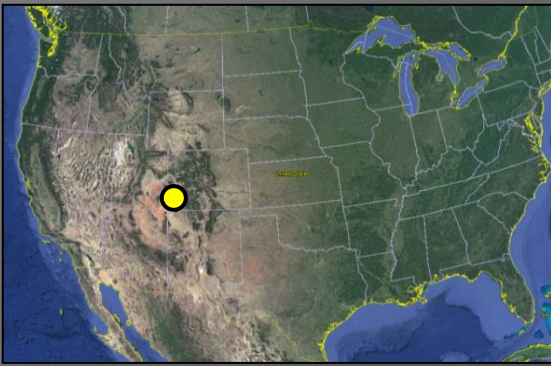
30 August 2010



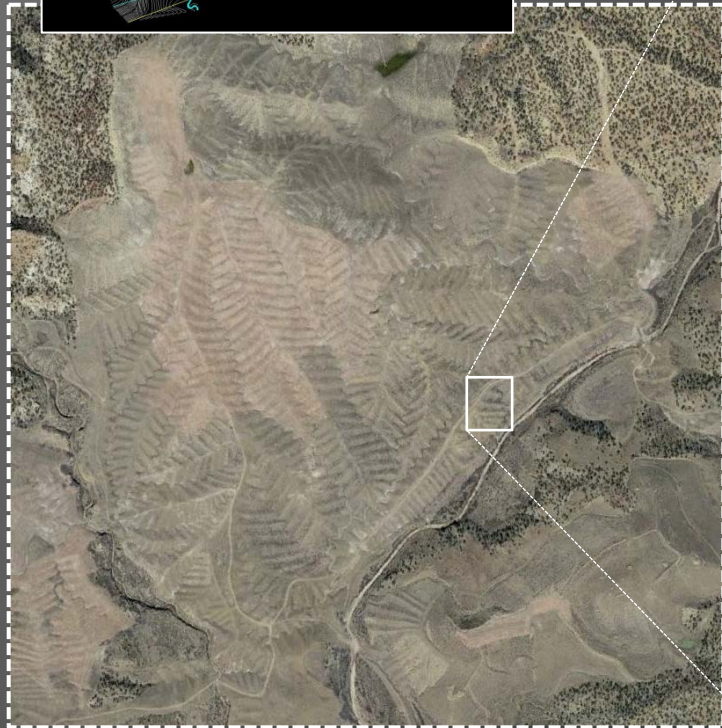
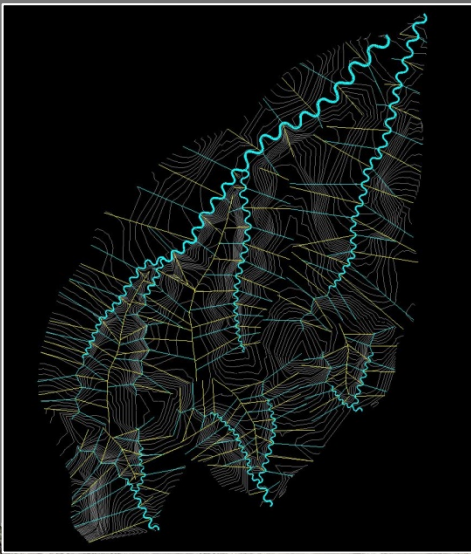
Study Background

- From 1999-2008 the San Juan Coal Company (SJCC) reclaimed 743 ha at the *La Plata Mine* using fluvial geomorphic rehabilitation design methods
- Qualitative evaluations support fluvial geomorphic rehabilitation methods at minimising erosion and sedimentation rates, in comparison to natural sites
- In 2011 SJCC began research to quantify sediment yield (t/ha/yr) from geomorphic landforms and surrounding undisturbed lands
- Three selected sub-watersheds,
 - N - Native, undisturbed by mining
 - MV - Moderately vegetated, top-dressed geomorphic design
 - WV - Well vegetated, top-dressed geomorphic design

La Plata Mine, New Mexico



La Plata Mine, New Mexico



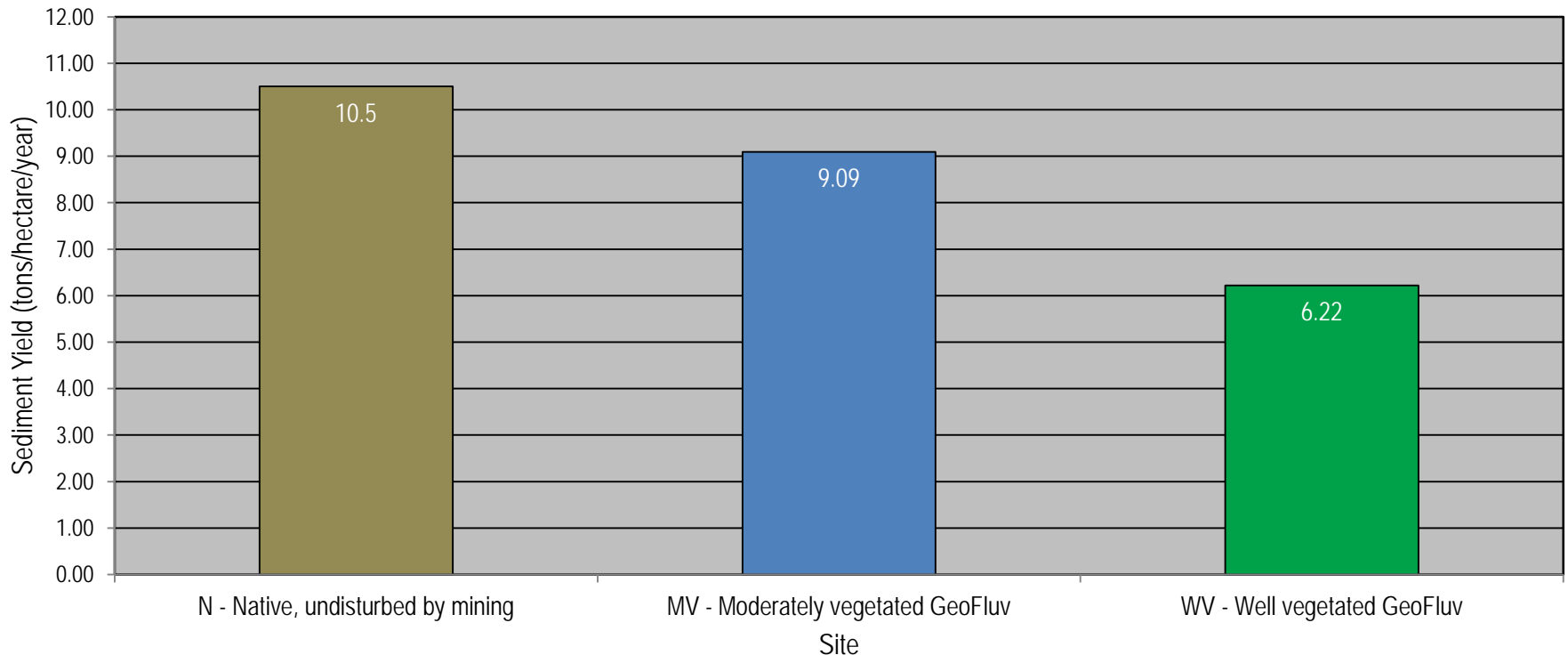
Study Methodology Overview

- Temporary dams designed to impound runoff from a 2-yr, 1-hr storm
- Erosion pins used to measure sediment deposition
- Precipitation recorded by the La Plata Mine meteorological station and supplemental site-specific gauges
- Data included multiple precipitation events sufficient to cause sediment transport

Sediment Yield Results

- N - Native, undisturbed site: 10.5 t/ha/yr
- MV - Moderately vegetated, top-dressed geomorphic design: 9.09 t/ha/yr
- WV - Well vegetated, top-dressed geomorphic design: 6.22 t/ha/yr

Measured Study Period Sediment Yield
12 May 2012 - 25 Oct 2013, 525 days



Installation of Sample Sites



← Native site during survey with sediment pins installed

WV site after construction of temporary sediment dam →



Sample Sites

N - Site after first sediment event



MV - Site with moderate vegetation



WV - Site with significant vegetation



Factors to Consider

- **Watershed size** - Research shows sediment yields are lower as watershed area increases due to internal sediment storage – smaller watersheds minimise this effect
- **Watershed type** - Semi-arid regions with relatively high sediment yields versus grassed and forested watersheds with expected lower sediment yield rates
- **Watershed precipitation** - Differing climatic conditions and site-specific rainfall characteristics and relationships could affect sediment yield rates. This semi-arid site is in the highest sediment-producing precipitation range
- **Landform maturity** - Designs based on geomorphically *immature* landforms will generate greater rates of sediment; Designs based on geomorphically *mature* reference landforms are expected to generate less sediment

Recommendations for Future Study

- **Contribute to the knowledge base for best practice rehabilitation methods**
- **Study done in an extremely erosive environment - results are supported by other qualitative and quantitative monitoring, i.e. Mojave desert**
- **Increase number of sites and study other site types**
- **Conduct studies in other regions - internationally**

Rehabilitation Landform Performance

- Using the GeoFluv method at La Plata,

“The proposed drainage density design exceeded the pre-mine drainage density (because of loss of bedrock control in channels), helping MMD to recognise that we were negotiating with people who “get it”. The more conservative design then experienced a 200-yr, 2-hr storm event, on freshly soiled reclamation, and did not result in more erosion than would be expected on undisturbed land.”

(Clarke, D., Mining and Minerals Division, 2008).

- Qualitative observation of San Juan Mine geomorphic rehabilitation,

“The most remarkable result was that the impounded water resulting from the rain event was clear. This is the first time I have witnessed clear water coming off reclaim in 18 years of inspecting.”

(Mine inspector, San Juan Inspection Report, New Mexico Mining and Minerals Division, 2002).

Inspection after 200-yr, 2-hr storm



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