Evaluating Sediment Production from Reclamation Designed Using the GeoFluv Fluvial Geomorphic Method

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Abstract: Natural landforms are often observed to withstand storm runoffs that cause undesirable erosion on adjacent reclamation sites. The GeoFluv™ reclamation landform design method designs landforms using fluvial geomorphic principles so that reclaimed lands can function similar to undisturbed natural lands. The GeoFluv method is patented and is the heart of the Natural Regrade computer software that was released in 2005 and now has licensed users on six continents. Thousands of acres of disturbed lands have been successfully reclaimed using the GeoFluv method.

The success of the method has been documented by subjective observation of the lack of need for maintenance repairs after severe storms, by storm water runoff sampling that provides some quantification of sediment discharge, and most recently by quantification of sediment discharge as tons per acre per year.

The largest GeoFluv-designed reclamation project to date is a 1,835 acre of coal mine reclamation that began in 2001. The final fluvial geomorphic reclamation grading, topdressing, and seeding at this site was completed in 2008. In the fall of 2011, GeoFluv partnered with the San Juan Coal Company to make a research study to test the effectiveness of its geomorphic reclamation to reduce sediment loading from reclamation areas.

Data were acquired from three types of sub-watersheds differentiated as native (undisturbed by mining), geomorphic design with topdressing and poorly established vegetation, and geomorphic design with topdressing and significant vegetation establishment. The three sub-watersheds were selected to ensure similar size, aspect, and slope and were located as close as possible together to minimize storm intensity variation effects. The three sites were each instrumented with a temporary check-dam-type sediment control structure at the outlet of each sub-watershed. These were designed to impound runoff from a 2-year, 1-hour storm. Erosion pins facilitated measurement of sediment deposition in the impounded area. Lastly, site-specific precipitation gauges were placed at each site to understand storm effects. The La Plata Meteorological Station helped study storm event precipitation in relation to longer-term precipitation records.

Monitoring of the study sites included a pre-project survey of the study sub-watershed uplands, receiving channels, and sediment control structures to provide an accurate base-level measurement of the landform surface. Data collection included note taking and photo-documenting the condition of each sub-watershed, and measuring sediment accumulation at sediment pins, following potential runoff-producing storm events.

The study results provided quantification of sediment production as tons/acre related to individual storm events that produced runoff spanning the 2012 to 2014 water years. The 2013 water year data, from several runoff-generating storms, facilitate a sediment production estimate as tons/acre/year. The analysis also provides quantification of the difference in sediment production among the three sub-watershed types.

Additional Key Words: geomorphic reclamation, erosion rates, sediment production.

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