Hydrology-Based Design of Geomorphic Evapotranspiration Covers for Reclamation of Mine Land[1]

Z. Fred Zhang[2], Nicholas Bugosh, Teklu Tesfa, Meghan McDonald, and John Kretzmann

Abstract: Currently there are about half a million abandoned mine sites in the U.S. and New Mexico has an estimated 15,000. Surface mining imposes severe ecological effects on the land because it not only alters the vegetation, soils, bedrock, and landforms, but also changes the surface hydrology, groundwater, and flow paths that ultimately result in degraded ecology and water quality. Two relatively new methodologies, fluvial geomorphic landform design and evapotranspiration (ET) waste covers, offer solutions to reclaim these sites for long term. GeoFluv™ is a specific geomorphic grading design method that uses natural analogues for post-mining landscapes and uses design input values taken from stable natural landscapes to make a reclamation design that provides hydrological function, supports ecosystem integrity, and is cost-effective, sustainable, and more visually attractive. It has documented the ability to produce surface runoff water quality equal to or better than adjacent undisturbed lands and has been used for disturbed lands, including active and abandoned mine sites, in Africa, Australia, Canada, Europe, South America, and the USA. To manage the subsurface hydrology, surface ET covers have been used above landfills, waste sites, and mine lands. ET covers protect the underlying materials against erosion, provide a medium for vegetation growth, store precipitation within the cover, and release the stored water into atmosphere so that the infiltration of precipitation is minimized. The storage capacity of an ET cover can be further enhanced by including a capillary break beneath the storage layer. The ET covers with a design life of centuries to a millennium have been successfully demonstrated in the field for over two decades. A conceptual design study is carried out based on an actual, typical abandoned mine site near Raton, New Mexico, to which common problem conditions at abandoned mine sites are assumed. The purpose of this study is to demonstrate that superior covers can be designed by integrating these two remediation technologies (geomorphic grading and ET cover) as a geomorphic ET (GET) cover. The overall shape of the GET cover can mimic the natural topography of the surrounding area, while the thickness and layering of the cover can be optimized for best vegetation growth and infiltration control. Watershed groundwater flow is considered during GET cover design so that the post-reclamation groundwater flow is managed to meet the water quality standards. The application of GET cover technology on mine land is expected to substantially improve the reclamation effects by coupling the benefits of the geomorphic cover (drainage reduction, runoff management) with the benefits of ET covers (vegetation growth and sustainability, percolation reduction, protection of surface and groundwater).

Additional Key Words: Tailings; Geotechnical; Water Management; Vegetation

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[2] Z. Fred Zhang, Environment Engineer; Teklu Tesfa, Scientist; Energy and Environment Directorate, Pacific Northwest National Laboratory, Richland, WA 99352. Nicholas Bugosh, GeoFluv, Inc., Parma, Ohio 44134. Meghan McDonald, John Kretzmann, New Mexico Abandoned Mine Land Program, Energy Minerals & Natural Resources Department, Mining & Minerals Division 1220 South St. Francis Dr., Santa Fe, NM 87505.