OSMRE National Technology Transfer Team (NTTT), **Applied Science Fact Sheet***
U.S. Department of the Interior, OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT

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

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Project Description and Objectives:

The goal of this project was to demonstrate that geomorphic reclamation can be improved with the design of mine land covers that will reduce infiltration of precipitation and, consequently, minimize hazardous mine drainage and prevent degradation of water quality in the discharge area. This work was to provide evidence that future performance of geomorphic reclamation can be enhanced by proper configuration of the vertical structure or layering of the surface soil.

Applicability to Mining and Reclamation:

The geomorphic grading (GG) technology is relatively new and its design generally has little or limited consideration of infiltration into the subsurface. The evapotranspiration (ET) cover technology is relatively mature and multiple designs are available for different purposes; e.g., for landfills, nonhazardous or hazardous solid waste, and radioactive waste. The use of proper ET cover designs can considerably reduce the infiltration of precipitation. A geomorphic evapotranspiration (GET) cover is a technology that integrates the ET cover and GG technologies The GET cover is expected to minimize soil erosion and improve control of surface runoff and infiltration through the underlying mine zone.

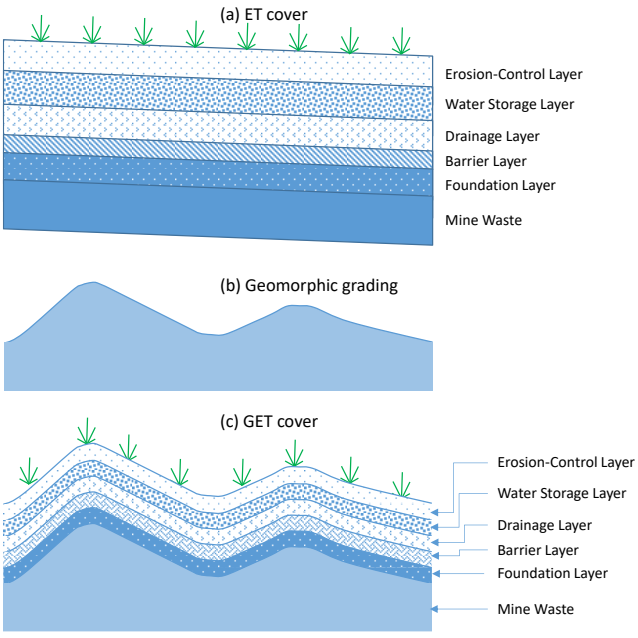
In the arid and semi-arid regions, simple GET cover designs without a drainage layer may be sufficient to reduce percolation. However, in more humid region, ET generally is insufficient to release all the precipitation to the atmosphere. For such cases, a drainage layer is needed to guide the clean water from precipitation out of the footprint of the waste area so the water will not be a driving force to mobilize contaminants.

Methodology:

1) Evaluate the surface water/groundwater hydrology of the watershed where the site is located and potential impacts of the site to the environment.

2) Make GG design of waste area with the fluvial geomorphic approach for stable landform against erosion and promoting sustainable land development.

3) Design the GET cover over the regraded landforms for optimized management of runoff and percolation.



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Highlights:

- A GET cover by integrating the ET cover and GG technologies was introduced.
- The GET cover concept was demonstrated at the Tin Pan mine site near Raton, New Mexico, by conducting computer simulations of hydrology at both the watershed scale and site scale.
- Three alternative GG designs were made based on the characteristics of stable topography of surrounding area.
- The watershed simulation indicated that the stream discharge at the outlet of Tin Pan watershed was mainly driven by intense precipitation events.
- The site-scale simulations showed that a smaller precipitation or a deeper roots or larger leave area index led to smaller percolation and vegetation coverage played a very important role in limiting percolation.

Results and Findings:

The goals of the design were to reclaim the gob piles with a drainage network with natural form and function, convey the on- and off-site runoff water through the project without accelerated erosion, reduce steep slope areas for minimal slope erosion, and improve re-vegetation success. The site waste material slopes are predominately in the steepest slope category (averaging 58.1 percent steepness) and only 43.2% of the slopes are in the target range of ≤33 percent steepness.

The slope zone analysis of the GG design Alternative #2, which held promise for fully satisfying all the site design criteria. Alternative #2 increases the fraction of slopes that are in the target range from only 0.43 in the existing topography to 0.71. The site material movement can occur to facilitate the GET cover waste construction.

The groundwater generally flowed from hill (with higher hydraulic head) to the stream (with lower hydraulic head). At the Tin Pan site, water table was approximately 2 to 30 m below land surface. The depth of groundwater became smaller when it was closer to the steam channel. The highest horizontal groundwater flow was near and below stream networks.

The Soil and Water Assessment Tools (SWAT) model estimated the potential evapotranspiration (PET) at the Tin Pan Watershed. The annual PET has the mean and standard deviation of 1355±45 mm, which is roughly 3 times the average annual precipitation (P) of 453 mm. The large PET/P ratio indicates that a GET cover is suitable for the area and can be used to minimize runoff and percolation.

The percolation from the gob piles with different vegetation coverage or precipitation was estimated with computer simulation. The percolation rate varied temporally, with higher values in the periods with rainfall than those without rainfall. However, the percolation rate was affected by the amount of precipitation, root depth, and leaf area index (LAI). A larger precipitation or a shallower roots or smaller LAI led to larger percolation.

During the year of investigation, the annual total percolation ranged from 2.1 to 44.8 mm, which were 0.5% and 10.2% of the corresponding P. The results indicate that vegetation coverage played a very important role in limiting percolation.

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