



APPLYING WEPP TECHNOLOGIES TO WESTERN ALKALINE SURFACE COAL MINES

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ABSTRACT

One aspect of planning surface mining operations, regulated by the National Pollutant Discharge Elimination System (NPDES), is estimating potential environmental impacts during mining operations and the reclamation period that follows. Practical computer simulation tools are effective for evaluating site-specific sediment control and reclamation plans for the NPDES. The purpose of this study was to apply the USDA's WEPP (Water Erosion Prediction Project) model to evaluate cumulative watershed hydrological responses and the spatial variation of soil detachment and deposition as affected by complex topography and spatial distribution of Best Management Practices (BMPs) for erosion control at Western Alkaline Surface Coal Mines. Our specific objectives were (1) to acquire and compile WEPP inputs for climate, topography, soil, and land management to describe mining conditions, and (2) to develop templates for erosion control BMPs (revegetation, sediment basin, and silt fence).

The WEPP model was applied to Watershed III in Area A, Big Sky Mine, a major surface coal mine in southeast Montana. Mining of the area was completed in 1989, and most reclamation activities, including regrading, topsoil replacement, and revegetation of the mined areas above the sediment ponds, were completed in 1992. Watershed III has been gauged for channel flow since 2000. Four sets of WEPP simulations were carried out to examine model performance in simulating the effect of three typical mine area sediment control BMPs: revegetation, sediment basin, and silt fence. The simulation scenarios were: (1) pre-mining condition as a baseline against which other scenarios can be compared, (2) post-mining condition with revegetation 1, 10, or 30 years since seeding, (3) same as (2) with an additional sediment basin, and (4) same as (2) with an additional silt fence.

As topographic, vegetation, landuse, and management conditions vary from the mining to post-mining period and differ from the natural, pre-mining conditions, the USGS National Elevation Data and land cover maps typically cannot be used for the mining areas. To prepare required inputs for the WEPP watershed simulations, we used current WEPP technologies, including the core model and its geo-spatial interfaces, and GIS techniques. In simulating the pre-mining conditions, we acquired soil and management data using the online WEPP GIS interface and the oldest DEM data available for the study area. In simulating the post-mining scenarios, we developed topographic, soil, and land management inputs based on information and data included in the reclamation plans submitted by the Big Sky Mine to the Montana Department of Environmental Quality.

Return period analyses were performed on field-observed channel flows and WEPP simulation results. Runoff volume and sediment yield of WEPP-simulated events with a return period of 2, 5, 10, or 20 years were compared with the field observations. The study results show that revegetation, sediment basin, and silt fence are effective measures in erosion and sediment control, and WEPP is a useful tool for assessing the hydrologic and erosion impacts of different BMPs for the Western alkaline surface coal mines. Future efforts should be devoted to developing functions for using user-specified DEM, land cover, management, and soil maps to aid in preparation of inputs for WEPP applications to mining areas.

KEYWORDS. Surface coal mine, Water erosion, Hydrologic modeling, WEPP.

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