APPLICATION OF A SATURATED-UNSATURATED GROUNDWATER FLOW MODEL TO SIMULATING THE PROBABLE HYDROLOGIC CONSEQUENCES OF MINING AT THE NAVAJO MINE EXTENSION PROJECT, NEW MEXICO[1]

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Abstract: This presentation describes the numerical groundwater flow model developed in support of the baseline hydrogeologic characterization and the probable hydrologic consequences assessment of the BHP Billiton Navajo Coal Company (BNCC) proposed Navajo Mine Extension Project (NMEP) near Farmington, New Mexico. Groundwater models are conceptual descriptions or approximations that describe physical systems using mathematical equations. Although the hydraulic conductivities of the coal beds at the NMEP are relatively low, they are still considerably higher than the interbedded shales, resulting in large vertical potentiometric gradients and perched groundwater zones. One of the primary hydrogeologic changes to occur as a result of mining is the removal of the coal and the interbedded shales and sandstone strata resulting in more homogeneous and isotropic conditions within the mine backfill. In order to meet the modeling objectives, a multi-layer numerical groundwater flow model of the NMEP mine area and adjacent area has been developed using FEFLOW, a finite element analysis technique that simulates groundwater flow and chemical transport for both saturated and unsaturated conditions.

The set-up and calibration of the model is briefly described followed by a summary of the application of the model to simulate the results for the proposed mining and reclamation plans. Re-saturation of spoil backfill results from recharge from precipitation, lateral inflow from the coals and interburden of the Fruitland Formation, and upward flow from the Pictured Cliffs Sandstone. Recharge from precipitation will be higher during active mining due to surface depressions and lack of vegetation in the mine spoils prior to reclamation. The results show that the rate of groundwater recovery in the mine backfill and the rate of groundwater flow once post-mine steady state conditions are reached are both extremely slow. FEFLOW has also been applied to simulate the spatial and temporal distribution of TDS and selected trace constituents from mine spoils and Coal Combustion Byproduct (CCB) materials that are planned for selective placement in mine backfill.

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