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Development of a catchment/landscape erosion prediction model (MINErosion 4) for post-mining landscapes in Central Queensland, Australia.

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Open-cut coal mining in Central Queensland involves the breaking up of overburden that overlies the coal seams using explosives, followed by removal with draglines which results in the formation of extensive overburden spoil-piles with steep slopes at the angle of repose (approximately 75 % or 37o). These spoil-piles are found in long multiple rows, with heights of up to 60 or 70 m above the original landscapes. They are generally highly saline and dispersive and hence highly erosive. Legislation requires that these spoil-piles be rehabilitated into a stable self sustaining ecosystem with no off-site pollution.

The first stage in the rehabilitation of these landscapes is the lowering of slopes to create a landscape that is stable against geotechnical failure and erosion. This is followed by revegetation generally with grasses as pioneer vegetation to further reduce erosion and a mixture of native shrubs and trees. Minimizing erosion and excessive on-site discharges of sediment into the working areas may result in the temporary cessation of mining operation with significant financial consequences, while off site discharges may breach the mining lease conditions. The average cost of rehabilitation is approximately $ 22,000 per ha. With more than 50,000 ha of such spoil-piles in Queensland at present, the total cost of rehabilitation facing the industry is very high. Most of this comprised the cost of reshaping the landscape, largely associated with the amount of material movement necessary to achieve the desired landscape. Since soil and spoil-piles vary greatly in their erodibilities, a hillslope erosion model MINErosion 3 (this conference) was developed to determine a cost effective combination of slope length, slope gradient and vegetation that will result in acceptable rates of erosion. This model was useful to determine the design parameters for the construction of a suitable post-mining landscape that meets the required erosion criteria. However, the mining industry further require a tool that enables them to predict and manage the impact of on-site and offsite discharges from storm events and to identify the areas of high erosion risk.

Work is in progress to develop a user friendly package MINErosion 4 by combining the hillslope model MINErosion 3 with ARC-GIS 9, which allows the prediction of sediment losses and deposition from proposed post-mining landscapes (designed based on criteria derived from MINErosion3) subjected to rainstorms with known recurrence intervals for selected locations. An option is provided to derive mean annual soil loss from these catchments and landscapes. Soil samples were collected from various locations on 6 minesites to provide a measure of variability in erodibilities across a minesite. The model was validated against 9 years of catchment data collected from previous projects and the agreement between predicted (Y) and measured (X) soil losses are good with regression equations of Y = 0.919 X (R2 = 0.81) for individual rainstorms, and Y= 1.473 X (R2 = 0.726) for average annual soil loss.