Mine Closure 2006 — Andy Fourie and Mark Tibbett (eds)
 ISBN 0-9756756-6-4

Towards a Climate Based Risk Assessment of Land Rehabilitation

C. Hinz *Centre for Land Rehabilitation, The University of Western Australia, Australia*

G.S. McGrath *Centre for Land Rehabilitation, The University of Western Australia, Australia*

A.J. Hearman *Centre for Land Rehabilitation, The University of Western Australia, Australia*

1 INTRODUCTION

Successful rehabilitation of mined land is one of the key concerns for mine closures. Disturbance through mining is often so severe that rehabilitation must be viewed as the first step towards a long term evolution of the landscape and the ecosystem to a stable state that is in harmony with the surrounding land. To ensure that the rehabilitation measures will create a stable and sustainable landform, risk assessment needs to be carried out for the initial phase of rehabilitation, which may cover a time span of the first two decades depending on climate, soil and vegetation. This initial, short term assessment should also be complemented by long term risk assessment extending beyond decades.

The first years after rehabilitation are the most vulnerable to extreme weather events, especially for rock dumps and tailing storage facilities that involve the design of a new landform along with placement of soil material on the surfaces. It is often a single infrequent event such as a cyclone that causes excessive erosion and potentially significant leaching events contributing to acid mine drainage. This high risk period during these first years of rehabilitation is due to immature vegetation establishment and soil development. Understanding and quantifying water redistribution on mined landforms and rehabilitated dumps and tailing dams is therefore the key to risk assessment of rehabilitation success.

One of the first order controls of water redistribution is climate and in particular rainfall. While great effort has been placed on the use of detailed mechanistic understanding of small scale processes to predict and model surface runoff, infiltration, erosion and water movement in soils and rock dumps, little attention has been placed on climate forcing. In this paper we will outline a generic analysis on how the stochastic and episodic nature of rainfall contributes to the triggering of significant hydrological events that may cause damage to land rehabilitation and hence will provide us with a risk assessment tool. The analysis will focus on short term (years to decades) risk assessment aspects, as long term stability can only be realistically assessed when rehabilitation has been shown to be successful in the short term. We therefore promote a probabilistic event based approach that uses a minimalist description of hydrological processes and accurate and detailed information on rainfall as this is the most important first-order control of triggering relevant hydrological processes. We will use surface runoff as an example of our approach. This analysis will be further complemented by an analysis of the rainfall resolution required to predict surface runoff.

2 APPROACH

2.1 Background

In this section we will briefly outline the limitations of conventional methods used to predict hydrological processes at the plot and hillslope scale. Current trends in hydrological research have led us to question the use of large complex models for predicting hydrological processes at the catchment and hillslope scale for various reasons. These reasons include the uncertainties associated with large parameter sets and our inability to determine unique values for them and the assumption that by simply using small scale process description at each node on a spatial grid we realistically predict hydrologic responses at the next larger scale such as hillslope and first-order catchment. These problems are further exacerbated by the heterogeneities of surface and subsurface properties that are present at all scales and which are often poorly characterized.