Inquiry into the rehabilitation of mining and resources projects as it relates to Commonwealth responsibilities

Dear Committee,

Please find below our submission to address issues raised in (b), (d) and (j) below.

Who we are:

Greg Hancock

Hancock is currently an Associate Professor in the School of Environmental and Life Sciences at The University of Newcastle. Hancock's research activity is concerned with the flow of fluids and transport of both suspended and dissolved materials and how these processes shape or modify the landscape surface. This is conducted in two separate but related streams, firstly, theoretical geomorphology/hydrology, and secondly degraded site rehabilitation. Theoretical geomorphology is a rapidly growing area as a result of new technology and increased computer power. This research uses mathematical representations of earth surface processes and couples these into a computer model that links these processes together on the hillslope and catchment scale. From this technology computer models have been developed which predict the evolution of landforms. This is achieved by using high-powered computer simulations, field studies and also using laboratory scale (accelerated time scale) experimental model landscapes.

An example of these theoretical studies is the use of computer modelling techniques to quantify natural erosion rates in catchments. If validated and calibrated, theoretical models give the ability to predict the impact of human disturbance and also climate change on soil erosion and water quality. This theoretical research is then applied in both natural (field catchments) and also on degraded sites such as post-mining landscapes. This has resulted in very strong relationships with the mining industry. Hancock has developed a particularly strong research relationship with Federal Government agencies (The Environmental Research Institute of the Supervising Scientist (eriss), Department of Environment, Water, Heritage and Arts) investigating the impact of uranium mining in the Kakadu and Arnhem Land areas of the Northern Territory where landscapes are extremely sensitive to disturbance and release of Radionuclides is of extreme environmental concern. Evidence of these relationships can be seen in the publication record. In 2012 he commenced working with the NSW Forestry Corporation investigating the use of LiDAR in forest practices and harvesting. He is also investigating the impacts of harvesting on stream water quality.

Hancock is currently an Associate Editor for European Geophysical Union (EGU) Journal - Earth Surface Dynamics and an OzReader for ARC Discovery and Linkage Grants. He is a former Associate Editor for Geophysical Research-Earth Surface and Hydrological and Earth System Science and Geoderma. He is a regular reviewer for Earth Surface Processes and Landforms, Hydrological Processes, Catena, Geomorphology, Geoderma, Soils and Tillage Research, Water Resources Research and Journal of Hydrology.

Hancock has published over 100 research and conference papers as well as numerous industry research reports. He has obtained over $2 million in competitive external grants as well as numerous internal and non-competitive funding.

Garry Willgoose

Willgoose is currently Professor of Environmental Engineering in the Discipline of Civil, Surveying and Environmental Engineering at The University of Newcastle. Willgoose's research interests are in the long term evolution of the environment, specifically landforms, soils and vegetative ecosystems, with the specific aims of better understanding the spatial and temporal dynamics of soil moisture, hydrology and long term stability of man-made landforms.

Willgoose is the developer of EAMS-SIBERIA the main tool used worldwide to assess the long term stability on post-mining landforms, encapsulation structures for mine tailings and repositories for low-level nuclear waste. SIBERIA was developed in the late 1980's while Willgoose was at the Massachusetts Institute of Technology (MIT) in Boston. Subsequent to that time SIBERIA has been tailored to the needs of the mining and nuclear waste industry with the support of funding from Australian Research Council (ARC), Australian Coal Association Research Program (ACARP), Australian and state government regulatory and research agencies, the US Department of Energy and the US Nuclear Regulatory Commission, and the mining sector both in Australia and overseas. Current research activities are focussed on developing tools for predicting the long-term sustainability of constructed soil profiles.

The Sustainable Mine Rehabilitation program at Newcastle, led by Willgoose and Hancock, carries out a range of activities including (i) mine rehabilitation research, (ii) direct consulting to industry on mine design and assessment of mine rehabilitation design, (iii) peer review of mine rehabilitation proposals developed by the industry and its rehabilitation consultants, (iv) technical support to consultants in the use of EAMS-SIBERIA and other associated tools we have developed, and (v) short courses in mine rehabilitation design. EAMS-SIBERIA is distributed for free as a public-good service and use of EAMS-SIBERIA, or one of the (loosely) equivalent long term sustainability packages developed internationally, is a defacto standard for state government environmental agencies for assessing satisfactory rehabilitation design. Of the packages used for this purpose by industry, EAMS-SIBERIA is the only one developed and maintained in Australia.

Willgoose is a founding member of the NSW Mining and Petroleum Gateway Panel which provides pre-EIS science and regulatory advice to the NSW government (primarily the Ministers for Planning, Primary Industries, and Mineral Resources) on mining and CSG projects which may potentially have an impact on agricultural activities. Gateway interacts strongly with the federal Independent Expert Science Committee (IESC) which has a more narrow remit of water and biodiversity impacts.

Willgoose has published over 200 refereed journal and conference papers as well as numerous commercial in confidence reports for industry and government. He is the author of 7 books including “Modelling Soilscape and Landscape Evolution”, which presents the theory underpinning the next generation of mine rehabilitation tools (currently in press at Cambridge Press).

Submission

Below we address issues raised in points (b), (d) and (j)

The community well-recognises the need for mining to support our economy and generate export income. However, in the act of mining significant disturbance of the landscape occurs. Cost-effective and environmentally sustainable rehabilitation design is crucial for the long-term stability of any engineered post-mining landform. Underlying any mine closure strategy is the need to engineer a rehabilitation program that allows for a “walk away” at the end of operations. To achieve a “walk away” result it is expected that a significant research effort will be required as waste rock dumps and Tailings facilities are considered one of the greatest long-term post-mining liabilities. In many cases, the research effort at each mine site is inadequate (**Point b**) to develop an understanding of the new materials that the post-mining landscape will be constructed from.

A key issue is that once mining waste has been placed or a landscape has been constructed, it is relatively costly to make any significant changes. It is even more difficult post-closure if any unforeseen erosion issues emerges. Any constructed landform will be different to the prior undisturbed or natural surface and have some environmental impact. This reconstructed landform will be present forever post-mine closure. It is therefore of critical importance that we as a community get the design right. Any failure will ultimately rest with the community and be a long-term legacy community issue **(Point d)**.

In particular, post-mining landscapes need to be designed using an understanding of geomorphic landscape processes together with best practice technology. In the rehabilitation of land systems affected by mining, the final result is largely controlled by topographic reconstruction. Understanding the geomorphology of the post-mining system is vital to successful rehabilitation as geomorphology influences soil and soil development down the slope (i.e. the soil catena), landscape hydrology, establishment and maintenance of vegetation as well as erosion.

However, many post-mining rehabilitation projects do and will fail because the landscape is unable to sustain functional ecosystems and/or because the export of sediments has and can affect ecosystems downslope and downstream. For any mine, a reconstructed landscape must be designed to achieve a long-term viable ecosystem while releasing sediment at a minimal rate and geochemically compatible with the surrounding undisturbed landscape. Consequently, landform stability over the long-term is essential for a sustainable functioning ecosystem. Assessing the long-term behaviour of any rehabilitated site is difficult, as visual inspection after a few years may not reveal any longer-term issues (**Point g**).

Our expertise is in the use of computer-based landscape evolution models for the assessment of post-mining landforms. These models offer the ability to evaluate landscape stability over the short (annual), medium (hundreds of years) and long-term (thousands of years). Modeling has advantages in that design ideas can be tested, different surface material properties and treatments can be evaluated, and risk analysis carried out. Landscape evolution models allow the landscape surface to change through time (in contrast to other more general soil erosion models). These models also offer the advantage that the landscape can be evaluated visually as it develops through time which is not possible with other models. Landscape evolution models can be used for not only soil loss assessment (i.e. tonnes/hectare/year) but also to evaluate the method of soil loss (i.e. rill or interrill erosion) and the design life of erosion protection treatments. At many sites both here in Australia and internationally these models are used, however the field data available from the site for use as model inputs are often barely adequate for reliable outcomes to be determined.

To address this we believe that each mine site requires long-term field plots and test sites to understand both the natural and disturbed landscape system. Questions regarding how the material and erodibility properties of the landscape temporally change (i.e. armouring and weathering) leading to pedogenesis and how this affects the long-term erosional stability of the landform are very difficult questions to answer and each landform will be different due to its differences in material properties. Long-term field plots (decadal time scale) are needed to assess such important questions. Many mines operate for many decades so at these site such field sites and test plots are not constrained by time.

A further important question is - what is an acceptable erosion rate. No reconstructed landscape will be geomorphically the same as that pre-mining. Nor should it be expected to be, since in many cases the hydrology and erosion properties are different from the pre-mining condition. There is also the increasingly important issue of how landscapes will perform under different climate scenarios and enhanced climate variability. There is an increasing realisation that any climate understanding that we have is based on relatively short term data and that any constructed landform has to be stable for geomorphic time. From an engineering design perspective, a conservative approach should always be taken. In the majority of rehabilitation design cases, it is likely that the newly disturbed and exposed surface material is more erodible than the long-term weathered and armoured surface. Field assessment of materials is required to fully establish any long-term erosion behaviour.

We attach a recent publication which outlines the data needs and modelling assessment that can greatly aid mine site rehabilitation.