Submission No 26

INQUIRY INTO BENEFICIAL AND PRODUCTIVE POST-MINING LAND USE

Organisation: Hunter Innovation and Science Hub

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Standing Committee on State Development

Parliament of New South Wales

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Beneficial and productive post-mining land use

To whom it may concern,

Thank you for the opportunity to provide a submission into the *Inquiry into beneficial and productive post-mining land use* and taking the time to consider my submission.

Hunter Innovation and Science Hub (HISH) unites organisations in the Hunter Region and beyond to collaboratively deliver world-leading events, activities and competitions engaging school students and the community with Science and STEAM (Science, Technology, Engineering, Arts, Mathematics).

Productive post-mining land use (PMLU) holds significant promise for benefiting communities and improving the environment in traditional mining regions, as well as the broader population of New South Wales. To fully realize these advantages, it is essential that the NSW Government makes substantial and sustained policy and funding commitments. In light of this, I propose the following recommendations.

Landform Design

The effective implementation of PMLU requires a stable and permanent landform.

The New South Wales resources regulator requires stable and permanent final landforms that are suitable for the agreed end land use, that will not adversely affect surrounding land, and with maintenance needs no greater than the surrounding land. Landform design must address:

- potential geotechnical/geochemical and erosional issues;
- incorporating characteristics of surrounding landforms into the final landform design (e.g. macro and micro-relief) and general considerations for the visual amenity of the final landform; and
- surface water management to optimise landform stability and integration with surrounding catchments (NSW Resources Regulator, 2024).

This requirement should be expanded to include "blending into and complementing the drainage pattern of the surrounding terrain" (SMCRA, 1977).

SMCRA (1977), Stiller et al. (1980), and Hannan (1984) claimed the need of replicating the patterns and complexity that stable landforms have in natural catchments.

Traditional landform design approaches are limited in their ability to manage drainage and erosion. Terraces, berm, contour banks, steep drainage lines (downdrains), and sediment ponds by design will fail. Overtopping is inevitable in the long term, and as such this solution requires ongoing maintenance and associated costs. (Hancock et al., 2019).

An alternative approach is geomorphic rehabilitation utilising progressive rehabilitation.

Geomorphic rehabilitation provides the path for restoring hydrologic and ecologic function of the land, resulting in increased land use and a visually appealing landscape. This is relatively new practice which works best with progressive rehabilitation of the mine site but is popular with both the public and regulators.

Progressive rehabilitation has been recognized by the mining industry as key to minimising environmental risk and mine closure costs. Geomorphic rehabilitation of land degraded by mining through progressive rehabilitation involves the progressive rebuilding of structured and functional landscapes as the earth movement works advance (Martín Duque, et al., 2021).

Geomorphic rehabilitation is a catchment approach to mine rehabilitation, utilising drainage basins as fundamental basic planning units for mine rehabilitation, with the goal to replicate the patterns and complexity that landforms have in natural catchments (Hancock et al., 2019). The use of geomorphic software combined with automatic GPS-guidance machine control have enabled the design and implementation of such 3D landforms and drainage networks that mimic natural ones (Hancock et al., 2019).

An example geomorphic rehabilitation method is GeoFluv, which can reproduce the complexity of natural landforms and drainage networks within catchments, and designs mature and stable stages of catchments like those which would naturally form by erosional processes for the materials, climate and physiographic conditions at the target site. This method has proven geomorphic stability in the most erosive environments. Studies have found that fluvial geomorphic rehabilitation methods such as GeoFluv achieved long-term stability against erosion (no major slope blowouts and rill and gully formation), reduced maintenance, and increased biodiversity as compared to traditional landform design approaches (Bugosh & Epp, 2019).

Furthermore, sedimentation rates are significantly lower with geomorphic rehabilitation than landform design approaches traditional landform design approaches and lower than even undisturbed native sites (Bugosh & Epp, 2019).

The landform diversity resulting from geomorphic rehabilitation provides variation in gradient and shading from differing slope aspects which in turn varies moisture retention across the landscape and promotes biodiversity.

The resulting landform blends with the surrounding terrain complementing the visual amenity of the final landform. Moreover, it is just not visual integration. Geomorphic Rehabilitation is the key factor for truly (functional) ecological integration and for increasing the potential for post-mining land uses.

New mines and extensions to mines should utilise best practice through the use of geomorphic rehabilitation to enable ecological integration and the increased potential for PMLU.

Landform Evolution Models

Landform Evolution Models (LEM) simulates erosion and deposition across a landscape showing how a landscape will evolve over time. LEM can utilise changes rainfall amount and intensity due to changes in climate and are particularly useful for assessing post-mine landscape designs such as geomorphic landform designs or traditional landform designs (Hancock et al., 2019).

Real life examples of failures in landform design such as gullying are difficult to find in low rainfall areas such as inland areas, as erosion is often connected to high intensity rainfall events which are rarer there than in higher rainfall areas such as coastal areas. In visiting mine sites in the Hunter Valley, failures in downdrains were personally observed in coastal areas but not apparent in mines further up the valley. This is not to say that they are immune from this problem but that it is less frequent and would probably be observed over a longer time period.

LEM allow simulation of these long time periods allowing to observe whether the structure would fail and potentially when.

LEM must be utilised for new mines and extensions to mines to ensure landscape designs negate any potential erosional issues. This would allow any landform designs that fail LEM to be redesigned and retested to resolve potential failures prior to commencement of the mine development / extension.

LEM should also be used for current mine landscape designs to determine potential for failure and expected ongoing maintenance costs. This would be useful information to the government on any significant ongoing maintenance costs prior to mine site relinquishment.

Further research and collaboration between Universities, Government, environmental practitioners, and mining companies is needed for both Landform design and Landform evolution modelling to ensure best practice is implemented and enhanced over time.

Incorporation of new land use

New novel uses for mined lands have recently been suggested. To utilise the reclaimed lands for such uses (not thought of at the start of mine planning), the final land use may need to be modified as part of the mining operations plan (if it is old enough) or the rehabilitation management plan for the mine. To enable these changes, government regulations may need to be amended and a process developed for the modifying the final post-mining landform and approval mechanism. This may include:

- Retention of certain infrastructure
- Retention of certain landform; and
- Proposed modification of the landform design.

Such land use changes may include:

- New industry such as pumped hydro, intensive agriculture, bioenergy precinct, chicken processing plants.
- Biodiversity / climate corridors
- Changed land use

'Fit for purpose' Built Infrastructure that may need to be retained (as needed for the proposed new land use) (NSW Resources Regulator, 2024) could include:

- High voltage electricity lines
- Access roads
- Rail loops
- Water Infrastructure
- Built infrastructure (buildings, etc)
- Flat areas

It should be noted that environmental standards must be maintained (or improved) by any changes to post-mining land use.

Most mining areas consist of multiple mines. An integrated landscape rehabilitation plan must be developed and maintained for each of these areas as this is not covered by individual mine rehabilitation plans.

Thank you for your consideration of my submission.

Sincerely,

Alec Roberts

Hunter Innovation and Science Hub

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