

Identifying a post-mining land use for residual mine voids

Implications for leading practice
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- Leading practice approaches support a thorough assessment of options for post-mining land uses for residual mine voids unless they are approved to remain a non-use management area.
- It is necessary to demonstrate the proposed final landform, whether voids are filled or unfilled, does not pose an unacceptable risk (i.e. is stable and non-polluting).
- It is necessary to demonstrate that any proposed post-mining land use for a residual mine void will provide a positive benefit to stakeholders.
- Strategic mine planning approaches should be used to explore the costs and benefits associated with post-mining land use scenarios.
- Financial evaluation techniques used to assess residual mine void rehabilitation should go beyond Net Present Value and consider both the environmental and social risks and benefits to multiple stakeholders.
- A Multi Criteria Analysis should be used to assess and compare the social, economic and environmental impacts and the potential benefits from post-mining land use options for a residual mine void.
- Early incorporation of closure outcomes into mine planning processes is considered leading practice and is expected to provide a greater range of options for post mining land uses.

Background

The Queensland Mine Rehabilitation Commissioner engaged a multi-disciplinary team to develop leading practice approaches to select post-mining land uses (PMLUs) for residual mine voids. This document should be read in conjunction with the technical paper that describes the approaches (Côte et al, 2023). The team included experts from the Centre for Water in the Minerals Industry (CWIMI), in the Sustainable Minerals Institute at the University of Queensland and Quantified Strategies, a company specialising in strategic mine planning. This document briefly describes the implications for leading practice derived from the study.

The rehabilitation of mine voids following open cut mining presents significant challenges. Mine voids left open usually accumulate water and continue to accumulate contaminants over the life of a mine. In most instances, this can make the water unsuitable for use in the long term. In Queensland, residual mine voids must be progressively rehabilitated to be safe, stable and non-polluting, although there are exceptions to this. An example is where a historic approval exists that allows a residual mine void to remain as a non-use management area. However, for all new mine proposals and for some existing mines where a non-use management area has not previously been approved, there is a need to identify a viable PMLU for residual mine voids unless approvals are sought for a non-use management area. A proposal for a residual void post-mining land use should be properly justified and based on a thorough assessment of a range of PMLUs.

The Progressive Rehabilitation and Closure Plan guideline (DES, 2021) requires “*evidence-based comparison and justification for each proposed PMLU against alternative options*”. There are currently no standard approaches to identify and compare options for residual mine void uses. The Technical paper describes a process to achieve this. The approach recommends using strategic mine planning to explore the



feasibility of a range of residual mine void configurations and assess the costs and benefits associated with closure scenarios for residual mine voids. The report also recommends the use of a Multi Criteria Analysis to weigh up the social, economic and environmental impacts and potential benefits from the perspective of multiple stakeholders.

The approach can be used at any stage of mine life, but the range of options for rehabilitation are likely to diminish over time with much greater constraints towards the end of mine life. For many existing mines, the accumulation of contaminants in residual mine void water means that uses such as crop irrigation, aquaculture, recreation or other uses may not be possible. Where the potential PMLUs are likely to be constrained by water quality, options for water treatment to improve water quality are to be integrated into the assessment.

Applying the approach to new mines and incorporating closure outcomes into mine planning processes early is more likely to result in a broader range of feasible outcomes and lower the cost and risk of implementation. Accordingly, incorporating closure outcomes into mine planning processes early is considered to represent leading practice. The approach will be iterative, but the number of iterations will depend on the scenarios that are analysed and on the number of potential uses that are identified. However, once a Progressive Rehabilitation and Closure Plan and associated rehabilitation schedule are approved, the PMLUs are effectively locked in. A formal amendment would be required to make changes to the PRC plan and schedule. A scenario that considers a water-filled residual mine void is the most complex and will require detailed understanding of all connections between residual mine void design and water assessments.

This process to compare post-mining use options is separate from a public interest evaluation (PIE). Where an analysis of post-mining options does not identify a viable use, then a proposal for a PIE may need to be considered as a subsequent process.

Approach to identify and compare residual mine void uses

Choosing the appropriate PMLU for a residual mine void is best done with an assessment of the feasibility of all options at the mine planning stage. Table 5 of the report by Côte et al, (2023) includes a list of potential post-mining land uses for material filled and open mine voids. Selecting a post-mining use for a void requires integrating PMLUs into mine planning to assess the feasibility of options. This process is undertaken in an iterative way as information becomes available. It requires analysis of strategic mine planning scenarios, including backfilling the void and where the void is left open (where it may accumulate water). Results from these scenarios can be used to:

Assess the feasibility of backfilling a residual mine void

The first stage is to assess the feasibility of backfilling a residual mine void with spoil by considering a range of strategic mine planning options that define its final location, shape and size. The feasibility of backfilling can be influenced by a range of factors including the cost of earthmoving, the geochemical characteristics of materials and the techniques used to manage and dispose of mine waste. There is also a need to properly consider the benefits arising from any nominated use.

Assess residual mine void hydrology and potential interactions with the surrounding environment

If a void is not backfilled or is only partially backfilled, modelling is required to predict whether the void will sustain a permanent water body. Long-term closure risks include, poor water quality, uncertainty related to water levels, potential for seepage to groundwater and the potential for releases to surface water. This option might require strategies to manage water level and quality.

Assess the feasibility of post-mining land uses for residual mine void water

If a residual mine void is water-filled, prediction of long-term water quality is required to assess its suitability for a wide range of PMLUs. The technical paper document provides suitability criteria for each PMLU and they can be used to assess their potential suitability at the relevant stage of mine life.

Assess the long-term closure risks from the structure

The closure risk profile of each planning scenario should be determined through time. The risk profile should consider the costs of establishing and maintaining the selected PMLU, geotechnical and geochemical risks, any water quantity and quality management requirements and need for ongoing monitoring.

Assess the risks and benefits of residual mine void uses to stakeholders

When weighing up the value of a closure option, both the PMLU value and the closure risk profile should be considered, for instance using a multi-criteria analysis that incorporates the views of multiple stakeholders. Cost and risks should be presented using financial metrics not restricted to standard Net Present Value (NPV) to give broader consideration of future risks and benefits.

References

Côte C, Holloway E, Dunlop J and Chrystal R. (2023). *Leading practice approaches to select post-mining land uses for residual mine voids*. Brisbane: Office of the Queensland Mine Rehabilitation Commissioner, Queensland Government.

Department of Environment and Science (2021) *Guideline - Progressive rehabilitation and closure plans (PRC plans)*. Version 2. Queensland Government.